Boggs Mountain Demonstration State Forest Management Plan

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California Department of Forestry and Fire Protection
The Resources Agency
State of California

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1. Introduction

The California Department of Forestry and Fire Protection (Department or CAL FIRE) manages approximately 71,000 acres of Demonstration State Forests, on behalf of the public. Boggs Mountain Demonstration State Forest (BMDSF) is a 3,493-acre mixed conifer forest located in Lake County between Clear Lake and Calistoga (Figure 1).

Forests provide great value to the citizens of California. They supply many outputs that we use and enjoy, including clean water, fish, wildlife, and forest products. They are also increasing in importance as a destination for recreational activity.

The majority of public wildlands in California are set aside as reserves and parks to preserve rare ecosystems and wild areas. Demonstration State Forests, by contrast, are public lands that by legislative mandate have a unique and distinctly different purpose from parks and wilderness areas. Demonstration State Forests are working landscapes that are mandated to conduct research, demonstration, and education on sustainable forestry practices using active forest management, including periodic timber harvests. Management of the Demonstration State Forests is required to protect values relating to recreation, watershed, wildlife, range and forage, fisheries, and aesthetic enjoyment.

While still the number three timber-producing state in the nation, California is also home to a very large population with strong interests in environmental protection. Given the often controversial role of logging and timber production in California, the Demonstration State Forests fill a unique niche to advance research, demonstration, and education on sustainable forestry practices. The Demonstration State Forests fill an important role in helping maintain California's leading role as an innovator in solutions to difficult resource management challenges.

The concept of forest sustainability includes the sustainability of forest ecosystems, both terrestrial and aquatic. Important issues include stewardship of managed forest lands to maintain biodiversity and ecosystem functions. Maintaining biodiversity and ecosystem functions on private timberlands however, is not likely to succeed if it is not financially viable to implement them. Incentives for continued investment in forest land are needed to relieve economic pressures to convert to other land uses such as residential, with a higher and more immediate payoff. While these issues are in some ways beyond the scope of State Forest management, they also create an important area of research and demonstration for the Demonstration State Forests, including BMDSF: testing a range of timber/ecosystem outputs for their economic and financial viability, as well as their environmental sustainability.

Boggs Mountain Demonstration State Forest is managed as a working forest which facilitates research and demonstrates diverse timber management practices to private timberland owners and the public at large. The State Forest provides for healthy and sustainable ecosystems as well as a financially viable timber management program. The forest is managed over the long term for a dynamic mosaic of diverse habitats and a high standing inventory. It produces a sustainable harvest of high quality timber products, supports biological diversity, and ensures opportunities for future forestry research. The knowledge gained from research and demonstration is shared with forest landowners and the public through a variety of outlets. Public use of the State Forest is encouraged so that visitors may experience a variety of outdoor recreational activities as well as educational opportunities. Having achieved a significant expansion of recreational facilities over the past 15 years, this plan proposes to maintain a rustic outdoor recreational experience within a working forest environment.

The BMDSF management plan describes present conditions on the forest and outlines the direction that management will take in the future by establishing a desired future condition or target for management. This plan must be considered as a flexible guide and subject to modification because of the uncertainties of environmental, economical, and political changes.

Revisions of the plan will be made periodically as needed and operating procedures will be modified to accommodate the changes.

Management Objectives

The primary State Forest management objective is two-fold: 1) achieve an active research and demonstration program and 2) achieve maximum sustained production of high quality timber products, while developing an all-aged forest with the widest possible diversity of forest structures. Specifically, detailed objectives are as follows:

- Maintain and strive to improve the research and demonstration program to provide valuable information regarding timber production, wildlife habitat requirements for various species that inhabit BMDSF, and road management practices that result in reduced sediment.

- Cooperate with other research agencies on forest resource studies. Emphasize an ongoing experimental and demonstration program to improve timber production and management methods. Highest priorities will be given to forest regeneration, vegetation management, hazard reduction, and urban interface management. Encourage other research agencies to conduct forest resource studies.

- Maintain a continued timber sale program, which achieves sustained yield of all forest resources, including recreation, wildlife, timber, and water through the use of uneven-aged and intermediate silvicultural methods. Harvest timber under sustained yield management (PRC 4513). The methods and levels of harvest will permit continuous production of timber and achieve maximum sustained production of high quality timber products (PRC 4513) without degrading the productivity and health of the forest and while contributing to local employment and tax revenue.

- Investigate and conduct timber stand improvement practices and young growth management to produce the best quality of forest products on a sustained basis. Explore the production and utilization of hardwoods and small “unmerchantable” biomass material from thinning operations.

- Work toward maintaining the widest possible diversity of managed forest stands in different successional stages, in order to foster ecosystem resiliency and adaptability to climate change, and develop a laboratory of representative forest conditions for research. Seek opportunities to maintain or increase functional wildlife habitat within the planning watersheds.

- Improve and maintain the forest road system through implementation of the Road Plan.

- Maintain a forest resources inventory for decision making and research support.

- Provide a multiple-use recreation experience through maintenance and improvement of existing recreational facilities. Provide for expansion of these facilities as resources permit and use justifies.

- Maintain safe conditions for employees, visitors, and neighbors by identifying hazardous situations and eliminating the hazards where possible.

- Maintain a law enforcement presence on the forest to preserve the peace and prevent ongoing vandalism of roads and facilities.

- Continue fire prevention and hazard reduction programs, including a prescribed burn program to reduce the fire hazard and maintain fuel breaks in critical areas to keep potential damage from wildfires to a minimum.

- Continue an aggressive pest management program to prevent the spread of insects and disease in order to keep mortality at a minimum level. Harvest salvage material where feasible.

History of Boggs

BMDSF was within the territory of one or more of the following Native American groups: the Eastern Pomo, Southeastern Pomo, Lake Miwok, Clear Lake Wappo, and Patwin. Since the crest of Boggs Mountain divides the Putah and Kelsey Creek watersheds and since California Native Americans often used watershed divides as territory boundaries, it is likely that more than one group controlled the area. Evidence shows that Boggs Mountain enjoyed some prehistoric use year-round with populations rising during the summer and fall months.

Artifacts collected on BMDSF support the theory that the primary pre-historic activity on Boggs Mountain was hunting. No known milling equipment has been found within the forest boundary. Archaeological research in the State Forest has revealed temporary camps, collecting stations, lithic workshops, and chipping stations. Also, a high projectile point to debitage ratio is found throughout the forest. Neither informal flaked stone tools nor any nonflaked expedient tools are present in the BMDSF collection.

The majority of prehistoric archaeological sites and artifacts discovered on BMDSF belong to the Late Prehistoric Period (A.D. 500-1579) which appears to be the largest population density of indigenous people. This large population continued through the Proto-historic period, until the time of initial contact between the California Native Americans and the Europeans.

During the Mexican period, trappers including Jedediah Smith and Ewing Young explored Clear Lake or its tributaries in the early 1830's. These visits were of little consequence on the Clear Lake Basin until Mariano Vallejo was granted 44,280 acres in June 1834. The first Mexican military penetration into Clear Lake country and what is now Boggs Mountain Demonstration State Forest occurred during fights with the Wappo in 1835. When the Californios Cavalry killed over 200 attackers, Governor Figueroa forced a peace. The following April, in 1836, a second attack by 20 Californios and 100 Suisun Indians against the Wappo resulted in a peace treaty where 7 local chiefs agreed to live in peace. As a result of this treaty, Mariano's brother, Salvador Vallejo received a 71,000 acre land grant including Boggs Mountain Demonstration State Forest area.

With statehood in 1850, California became the 31st state in the Union and Napa became one of the original 27 California counties. Lilburn W. Boggs, ex-Governor of Missouri, and a successful merchant in Sonoma farmed the Napa Valley. Sometime before 1860 he purchased land in what is now Lake County. Boggs' son Henry C. bought a steam-powered sawmill in 1866 and later combined sawmill, gristmill, and planer. Located on the eastern margin of what is now Boggs Mountain Demonstration State Forest, Boggs' Mill and Boggs' Lake operated until 1880. In 1878 Henry C. Boggs bought a small lot near the head of Malo Creek, moving his sawmill there two years later. By 1884 Henry Boggs bought almost all the timberland within the present State Forest boundaries. His son Lilburn H. Boggs served as manager in addition to his duties as Lake County Sheriff. The major road between Middletown and Clear Lake, now Highway 175, was called Boggs' Road in the early 1880's. Logging took place on most of what is now the State Forest, with the heaviest cutting between 1882 and 1887. By 1898, the year of Henry C. Boggs death, the Farmers Savings Bank under its president James W. Boggs, had acquired just about all the acreage presently incorporated by the State Forest.

The property was subsequently owned by Hugh Davey then Jim McCauley. McCauley established a resort near the head of Kelsey Creek renaming it Camp Calso. Jim McCauley died in 1941 and his heirs sold the timber rights to Setzer Forest Products. Most of the land use after Boggs was for cattle-grazing until 1947 when the then present owner, Calso Company, sold the timber rights on 2700 acres to the Setzer Forest Products Company.

The funds to purchase lands for State Forests were made available by the 1947 legislature to implement the State Forest Purchase Act (PRC 4631). In December 1949, after Setzer had clearcut 2800+ acres, the State of California bought the timberland for $38,700 with the intention of creating a demonstration forest. The research concern at Boggs Mountain Demonstration State Forest was the study of forest recovery from a completely cut over area. 3,432 acres of land and timber were acquired from the Calso Company for $20,600. The remaining $18,100 went to Setzer Forest Products Company. Setzer owned the merchantable timber on 2,731 acres of the tract. Setzer sold all the timber between 16 and 23 inches in diameter at breast height (DBH) (an estimated 6,100,000 board feet of timber) and one million board feet of thrifty seed trees between 23 and 29 inches DBH to the State for under terms of a precutting agreement. All other commercial timber was harvested in 1949 and 1950.

Setzer completed logging their timber holdings in 1950. In 1954, Glenco Forest Products Company, successor in interest to Setzer Forest Products, quitclaimed its rights, title, and interest in the property to the State in accordance with the terms of the cutting agreement

The status of the Forest at the time of purchase by the State was that of a recently cut-over forest from which all merchantable timber had been harvested except for scattered seed trees and patches of old-growth trees considered inaccessible at the time of purchase. Early State occupancy of the Forest property was mainly for protective and custodial purposes. The Service Forester assigned to the Region I Office in Santa Rosa did inventory and mapping, to a limited extent, during this period.

In 1965, Cliff Fago, became the first permanent forest manager assigned to Boggs Mountain State Forest. He completed the forest inventory, began experimental and demonstrational activity, and conducted the first timber sale in 1966. The timber harvesting was directed toward removal of the remaining old growth. The residual old growth was essentially removed from the Forest by 1976, and since then, cutting methods have been used that will result in a regulated, all-age forest. An active experimental and demonstrational program has developed during this period involving growth determination, disease control, better utilization methods, fertilization studies, and reforestation.

Geothermal activity, particularly in the Cobb Mountain area, a few miles west of Boggs Mountain, caused an increase in the surrounding population in the 1980's. Exploratory drilling occurred in the surrounding areas, including Boggs Mountain Demonstration State Forest, where Geothermal Kinetics, Inc. made an exploratory drilling to a depth of approximately 4,400 feet in July 1981. The drilling was abandoned, however, when geologic conditions indicated that a geothermal source would not be found at a depth that would make utilization feasible.

No timber was cut on the Forest from the completion of logging in 1950 until 1967 when 3,085,000 board feet of old growth was cut. A Forest-wide inventory was completed the same year which estimated the total gross timber volume after the 1967 cut at 31,465,000 board feet on 3433 acres, 6,000,000 or more of which was old growth. The acquisition estimate apparently considerably under estimated the merchantable volume on the Forest. Most of the residual old growth was harvested from the Forest by 1976.

Total area of the Forest at present is 3493 acres. Two land purchases have added to the forest land base. Thirty-one (31) acres were added to the Forest in 1972, when the Division of Forestry acquired Lot 3, Sec. 6, T11N, R7W from the State Lands Commission for $5600. A 40+-acre

parcel in the NW1/2SE 1/4, Sec. 35, T11N, R8W was purchased from the Voss family by the State of California in 1991. A portion of the Forest was sold in 1981, as a result of Assembly Bill 476. 9.8 acres in SE1/, SE1/4 Sec. 3, T11N, R8W were sold to the Middletown Unified School District for $41,160.

Purpose and Statutory Authority

Purpose of the Management Plan

The State Forests have as their top priority the conducting of demonstrations, experiments, and public education; to disseminate the results of demonstrations and experiments and to manage timber for the maximum sustained yield of high quality forest products. Therefore, the State Forest landbase is to be retained in timber production for research and demonstration purposes. Demonstrating useful timber management practices within the context of a working forest is the legislated charge for the State Forest system. This “working forest” concept enables State Forests to facilitate research needed to answer relevant questions concerning the maintenance of biodiversity on private timberlands. Research conducted within this context helps guide private landowners on how best to allocate funds to restoration efforts that will have the greatest likelihood of success.

The Forest Management Plan directs the management of BMDSF for the next 10 to 15 years or until a subsequent plan or major revision is approved. The Plan and the projects undertaken also will be evaluated by the Board of Forestry and Fire Protection every five years (Board Policy 0351.10; see Appendix I). The Plan’s purposes are to guide the integrated use and protection of the Forest’s resources, to meet requirements of legislation and Board of Forestry and Fire Protection (Board) policy, and to address local, regional, and statewide issues.

The Public Resources Code (PRC) specifically addresses the management of State Forests. PRC Section 4645 provides that the Department, in accordance with plans approved by the Board of Forestry, shall manage State Forests. PRC Section 4646 provides that the Director of the Department shall administer all the statutory requirements relating to State Forests in accordance with policies adopted by the Board of Forestry. Thus, management of the State Forests is a cooperative effort between the Department and the Board of Forestry. Management which is inconsistent with policies of the Board of Forestry violates these statutory provisions.

The Legislature’s stated purpose in acquiring land for State Forest designation is multifaceted: to hold and reforest cutover timber lands, both young and old-growth timber, to demonstrate management of small areas (2000 acres or less) in timber counties where management of small areas needs investigation, demonstration and education, and for larger areas (up to 40,000 acres) to demonstrate economical forest management (PRC Section 4631). PRC Section 4631.5 states that it is in the public interest to retain the land base of State Forests in timber production for research and demonstration purposes.

The State Forest system was established to demonstrate how to make private timberlands “fully productive” (PRC 4631). BMDSF was acquired for the purpose of demonstration of economical forest management. Management is further defined by the Legislature as “...the handling of forest crop and forest soil so as to achieve maximum sustained production of high quality forest products while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, and aesthetic enjoyment” (PRC 4639).

Read as a whole, the statutory direction indicates that the management of BMDSF is primarily for sustainable timber production with the primary purpose of education and research relating to economical timber management. Specifically, the management plan for BMDSF must adhere to

these goals. BMDSF must demonstrate sustainable timber production, and that timber production must be managed primarily to provide research and educational values. Within that broad statutory mandate, the management plan must adhere to policies and regulations developed by the Board of Forestry.

The State Board of Forestry and Fire Protection sets policy for management of the State Forests. This policy builds upon legislation, directing CAL FIRE to prepare detailed management plans and to conduct programs in timber management, recreation, demonstration, and research. Echoing the Legislature, the Board cites a large acreage of potentially productive timberland in California not producing satisfactory growth of young timber. To attain proper management, the Board states that there is a need to investigate, develop, and demonstrate new and improved forest management methods to timberland owners and the public. The State Forests serve this purpose while contributing to the economic stability of local communities by providing high yields of forest products that help sustain local employment and create tax revenues.

The Board of Forestry forest management policies are defined in Chapter 0350 (0350-0351.10); these policies outline and guide management actions (see Appendix I). Board policy 0351.3 establishes the primary purpose of the State Forest program to conduct innovative demonstrations, experiments, and education in forest management. Additionally, this article establishes timber production as the primary land use on BMDSF, while recognizing that recreation is a secondary but compatible land use.

Statutory Authority

BMDSF's management direction derives directly from statutes, regulations, and policies set by the State Board of Forestry and Fire Protection (see Appendix I for details). Board policy describes Boggs Mountain and three of the other Demonstration State Forests as "commercial timberland areas managed by professional foresters who conduct programs in timber management, recreation, demonstration, and investigation in conformance with detailed management plans," (Board Policy 0351.1). More specifically, Board policy states that the primary purpose of BMDSF is to conduct innovative demonstrations, experiments, and education in forest management; that timber production will be the primary land use on BMDSF, and that recreation is recognized as a secondary but compatible land use on BMDSF (Board Policy 0351.2). Further noteworthy policy directions that guide BMDSF management include:

- Research and demonstration projects will include silviculture, mensuration, logging methods, economics, hydrology, protection, and recreation. Research and demonstration projects will be directed to the needs of the general public, small forest landowners, timber operators, and the timber industry.

- Conduct periodic field tours to exhibit State Forest activities and accomplishments to forest industry, small forest landowners, relevant public agencies and the general public, and disseminate information to these audiences.

- Consult with and solicit the cooperation of the State universities and colleges, the USDA Forest Service, and other public and private agencies in conducting studies requiring special knowledge.

The Boggs Mountain Demonstration State Forest was acquired under the authority of the State Forest Purchase Act (PRC Section 4631) and from funds made available to implement this act provided by the 1947 Legislature. The legislative authority for the State Forest system is contained in Sections 4631-4664 of the PRC. Division 4, Part 2, Chapter 9 of the PRC sets forth the purposes and statutory conditions governing the acquisition and management of State Forests.

Article I, Section 4631 of this chapter declares it "to be in the interest of the welfare of the people of the State of California and their industries and other activities involving the use of forest products, that desirable cut-over forest lands, including those having young and old timber growth, be made fully productive and that the holding and reforestation of such lands is a necessary measure predicated on waning supplies of original old-growth timber." The law declares it to be the policy of the State to acquire limited cut-over lands, to reforest them, and to demonstrate economical forest management.

Management is defined in Article 2, Section 4639 as "the handling of forest crops and forest soils so as to achieve maximum sustained production of high quality forest products while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, and aesthetic enjoyment.

Article 3 of the same chapter authorizes the Department to manage, protect, and reforest State Forests. The Director of the Department is authorized to administer State Forest land, sell forest products, and deposit receipts with the State Treasurer. This article also authorizes the Board of Forestry to establish rules and regulations in accordance with provisions of Chapter 4.5, Part I, Division 3, Title 2 of the Government Code for preservation, protection, and use of State Forests.

Part 2.5, Chapter 3, Section 4799.13 creates the Forest Resources Improvement Fund (FRIF) in the State Treasury. Receipts from State Forest sales are deposited into the Forest Resources Improvement Fund.

Policy

The Board of Forestry and Fire Protection sets policy for management of the State Forests. To attain proper management, the Board states that there is a need to investigate, develop, and demonstrate new and improved forest management methods to timberland owners and the public.

Regulations and policies set by the Board and CDF guide management of all State Forests. According to law and State Board of Forestry policy, the primary purpose of the State Forest program is to conduct innovative demonstrations, experiments, and education in forest management. Such projects are integrated into the production and harvesting of forest products whenever possible with due regard to conservation of soil, watershed, scenic, wildlife, and recreational values. Reasonable use of State Forests for hunting, fishing, recreation, and camping is also permitted.

Local Ordinances and Zoning

In addition to compliance with the Forest Practice Rules applicable to the Northern Forest District, timber harvesting operations on BMDSF are subject to Lake County rules within areas designated as “Scenic Combining District” pursuant to Title 14 of the California Code of Regulations, Sections 945 through 945.5. Single-tree selection is required by the Lake County Rules in the Scenic Combining District. Where the general rules conflict with the Lake County Rules, the Lake County Rules shall apply.

With the exception of the 40 acres of property acquired from Voss, BMDSF is zoned by Lake County as Timber Production Zone (TPZ), devoted to and used for growing and harvesting timber and compatible uses. Since its inclusion in 1991, the Voss addition has not been classified as TPZ.

“Compatible use” is defined in the Timber Yield Tax law as any use which does not significantly detract from the use of the property for, or inhibit, growing and harvesting timber and shall include, but not be limited to the following, unless in a specific instance such use would be contrary to the preceding definition of compatible use:

- Management for watershed.
- Management for fish and wildlife habitat or hunting and fishing.
- A use integrally related to the growing, harvesting, and processing of forest products, including but not limited to roads, log landings, and log storage areas.
- The erection, construction, alteration, or maintenance of gas, electric, water, or communication transmission facilities.
- Grazing.
- A residence or other structure necessary for the management of land zones as timberland production.

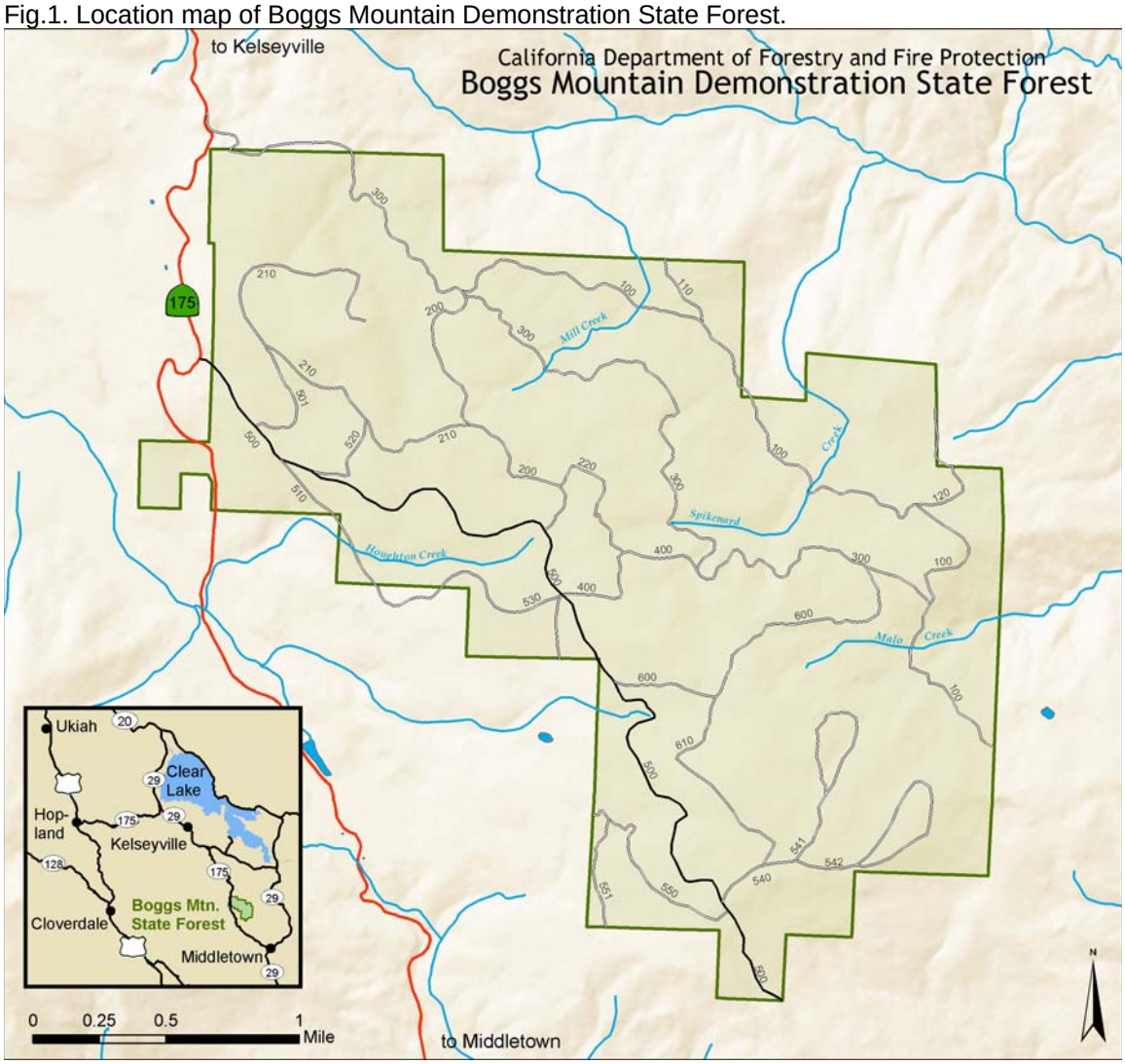
2. Current Management Situation

General Features

Location

Boggs Mountain lies approximately 50 miles inland from the Pacific shoreline and 75 air miles north of San Francisco, on the summit separating the Clear Lake drainage to the north from Putah Creek drainage to the east. The community of Cobb is adjacent to BMDSF. It is six miles south of the southeast end of Clear Lake. Lakeport, the county seat of Lake County, is 30 miles to the northwest and Middletown is eight miles to the southeast.

Fig.1. Location map of Boggs Mountain Demonstration State Forest.



Boundaries

BMDSF is a contiguous ownership located in southern Lake County within Townships 11 and 12 North, Ranges 7 and 8 West on the Mount Diablo Base and Meridian. Legal subdivision lines form the boundaries. On the south and east sides of the Forest, the boundary generally follows the edges of the natural occurrence of timber. All boundaries of the Forest have been surveyed and established by licensed surveyors. The surveys are recorded and on file at the Lake County Courthouse. The property line has been established in the field with the posting of signs and tree marking.

Topography

The State Forest is a lava cap area about one mile wide by 3-1/2 miles long, forming a gently rolling summit with the sides breaking down into moderate to steep slopes. Practically the entire area is ideal for tractor logging. There are a few small areas of steep slopes and rock outcrops. Boggs Mountain lies at elevations from 2,360 feet to 3,750 feet above sea level. At 3,000 feet elevation the topography flattens out so that the top of the mountain resembles a plateau, dissected by several gulches. To the east and northeast, the mountaintop breaks very sharply to Big Canyon Creek, resulting in rather steep terrain in Section 6 and the northeast parts of Sections 1 and 7.

On the west, the country slopes gently into the valley drained by the headwaters of Kelsey Creek at an elevation of about 2,500 feet. To the northeast, the Forest extends almost into the pass through which State Highway 175 crosses the Boggs Mountain range at an elevation of 3,000 feet. Generally, the ground is smooth with little or no rock outcrops except on the steep slopes. There are four main creeks, which originate near the mountaintop. Mill Creek and Spikenard Creek flow down the north side, Houghton Creek flows down the west side, and Malo Creek flows down the east side.

Climate

The climate in the area of Boggs Mountain is typical of areas where pure ponderosa pine stands occur in California and particularly that of the ponderosa pine belt at the lower elevations along the western slope of the Sierra. Rainfall follows a Mediterranean climate pattern, with long, dry summers and heavy rainfall during the winters. Annual precipitation ranges from 22 inches to 130 inches with an average of just over 65 inches (±20 inches). Some light snowfall occurs every winter but usually melts within a few days. Occasionally a 2 to 3 foot snowfall is experienced which remains on the ground for a month or more.

Annual temperature ranges are considerably greater than those within the immediate areas of coastal influence. Temperature extremes are from a minimum of 15° F in winter to a maximum of 105° F in summer.

Area, Ownership Pattern, and Adjacent Ownerships

Recorded acreage of the Forest is 3,493 acres. There are no private ownerships included within the Forest boundaries. The Forest has common boundaries with eight subdivisions and some 70 private landowners. Most of the adjacent ownerships on the west side of the Forest have been developed for residential subdivisions. Because of the large numbers and the frequent turnover of owners, current ownership information will be periodically updated from the Lake County Assessor's records. Larger less developed parcels are found adjacent to the northern and eastern boundaries of the forest. The undeveloped parcels are brushland or very extensively managed timberlands.

Forest Description

Forest Structure

The current average age of BMDSF timber stands is 60 years, however the age classes are not evenly distributed. The predominant age of the younger trees is 50 years, as a result of the 1949-50 harvesting. The majority the older trees is 85-90 years, these trees were considered not merchantable during the 1949-50 harvest, and thus escaped harvest.

The management direction on BMDSF is to emphasize uneven-aged management in order to create an all-aged forest structure, with stands containing a variety of age and size classes. The concept of stand age therefore becomes less relevant. Management of Boggs is directed at creating desired forest structures rather than a distribution of even-aged stands.

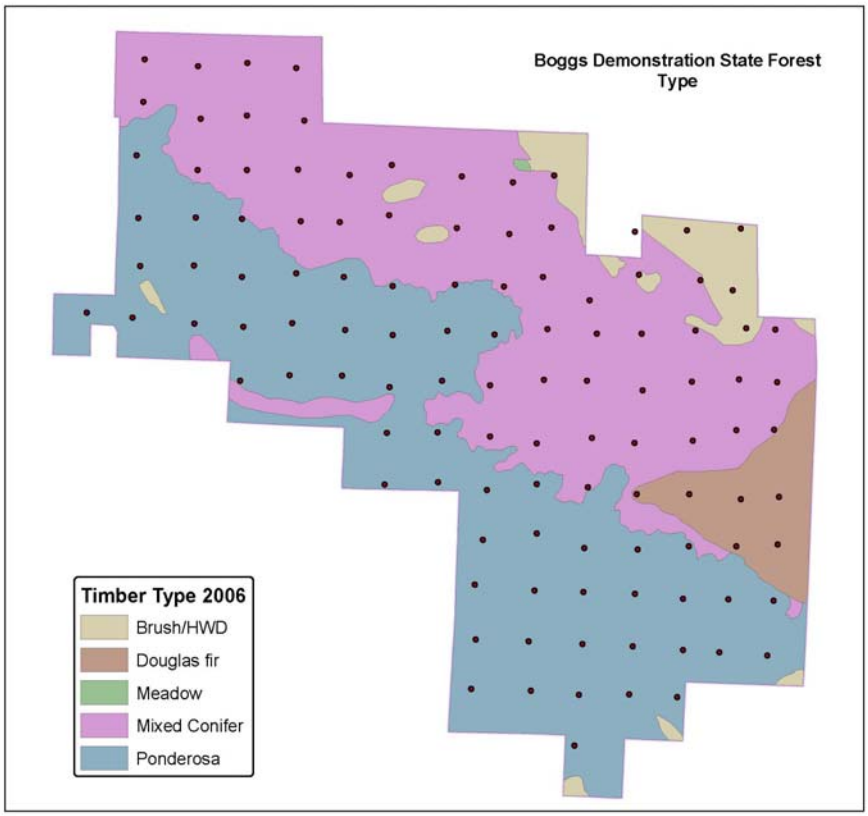
Forest Types

The Forest contains 3,313 acres of commercial timber type land and 180 acres of non-timberland. Nearly all of the forest land is well-stocked with predominantly conifer species. Conditions for natural regeneration after Setzer's 1947-1950 logging were very favorable and practically all of the areas left unstocked immediately after logging have since become stocked and support excellent stands of reproduction with ponderosa pine (*Pinus ponderosa*) as the predominant species.

Three forest types are recognized on the Forest: ponderosa pine; ponderosa pine/Douglas-fir (*Pseudotsuga menziesii*) and Douglas-fir. Ponderosa pine dominates on the west slope and top of the mountain with about five percent sugar pine (*Pinus lambertiana*) included. The northeast slope of the mountain supports a ponderosa pine/Douglas-fir stand with various densities of ponderosa pine, sugar pine and Douglas-fir. A few small pockets of pure Douglas-fir occur on the lower slopes on the northeast side of the mountain. A very small patch of incense-cedar (*Libocedrus decurrens*) is located near the northeast corner of Section 12.

In addition to conifers, hardwood species comprise 15 percent of the total basal area. The hardwood species present are black oak, white oak, canyon live oak, bay laurel, and madrone. Several patches of native brush species, MacNab cypress (*Cupressus macnabiana*), and hardwoods are located at lower elevations along the northeast boundary of the Forest.

Figure 2. Forest vegetation types at Boggs Mountain DSF.



Site Quality

The average 50-year site index for the Forest is about 80 feet using Krumland and Eng (2005) site index equations. BMDSF will use Dunning's classification system for planning and Forest Practice Rule compliance (stocking and leave standards). Beyond Forest Practice Rule compliance, the site classifications exist primarily to quantify the actual site index values into classes for evaluation and growth projection purposes. Growth projections for the Forest are based on the actual site index measurements in table 1 below.

Table 1. Site Classes for BMDSF.

Dunning Site Class	50-year Breast High Age Average Site Index (Krumland and Eng, 2005)	Percent of Forest
IA	91	5
I	83	84
II	72	8
III	46	3

Forest Inventory and Growth

Measurements of vegetation resources on Boggs Mountain, including timber volume and growth, are derived primarily from a system of plots referred to as the BMDSF Continuous Forest Inventory (CFI). The CFI consists of a 17 chains by 17 chains grid of 114 permanent plots, 108 of the plots are on areas that support growth of commercial conifer species. Plots are measured every five years. The permanent CFI plots consist of a fixed 1/100-acre plot nestled in a 20 basal area factor variable plot. Trees over 4.5 feet tall and under 5 inches in diameter at breast height (DBH) are tallied by species in the 1/100 acre plots. All "In" trees in the variable plots are measured at breast height.

The 1976 timber inventory measured the gross timber volume as 34,599,286 board feet on 3,464 acres (9,988 bf/ac). The 2001 timber inventory measured the gross timber volume as 47,105,623 board feet on 3,493 acres (13,485 bf/ac). Total current forest volume is measured at 51,911,602 bf (14,862 bf/ac). Hardwood volume is 1,757,356 cubic feet. Volumes were calculated using volume equations developed for BMDSF by Pillsbury and Pryor (1991).

Following the 1976 inventory, the annual board foot volume growth on the Forest was measured at 1,101,418 board feet, or 334 board feet per acre per year. Based on 1996 through 2006 CFI measurements, current forest growth is measured at 347 board feet per acre per year. These figures are considered to be highly accurate, as they are based on actual measurements and not a projection from yield tables.

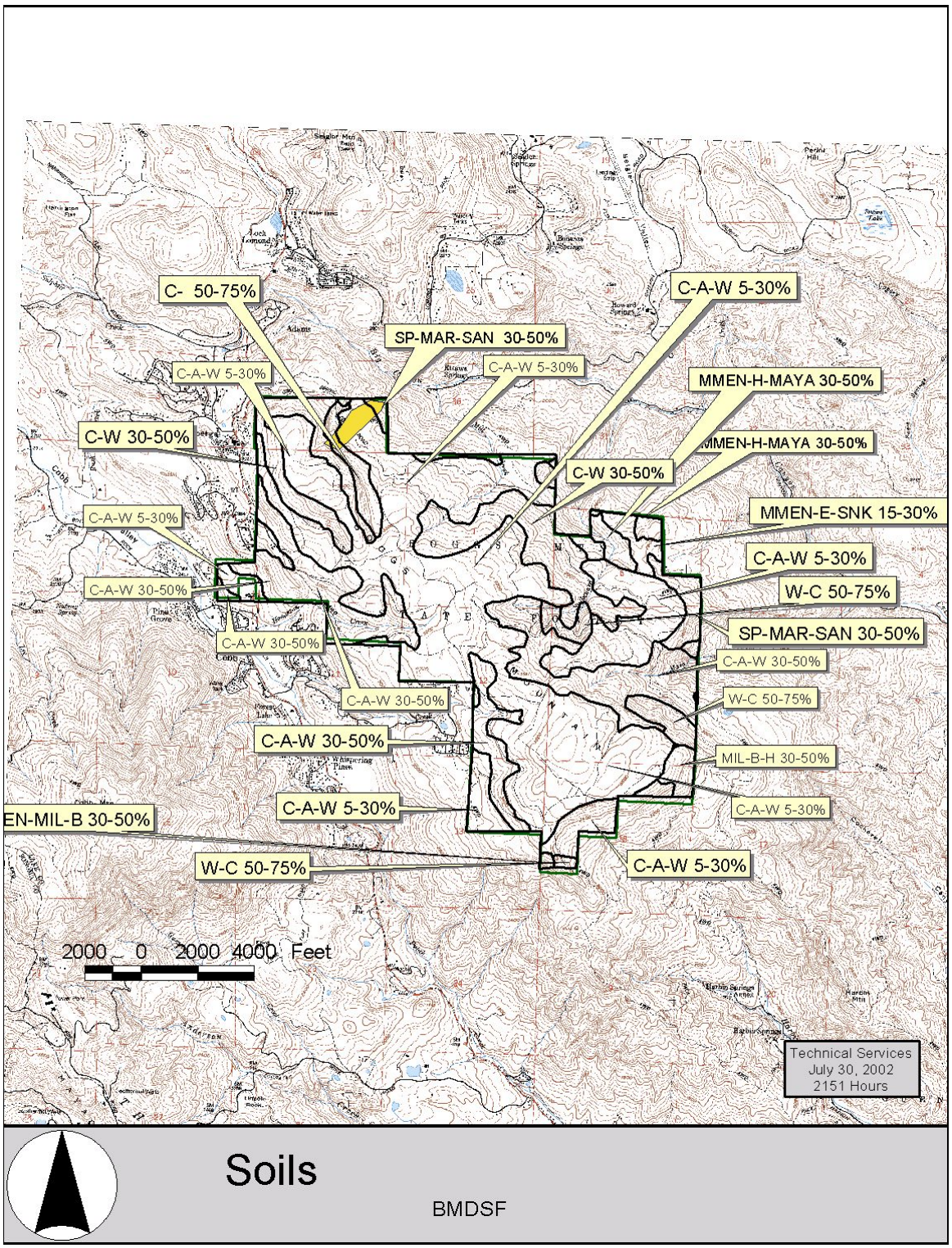
Soils

The USDA Soil Conservation Service surveyed and mapped the soils on Boggs Mountain in the early 1980's. Soil maps and descriptions are found in the 1989 publication "Soils Survey of Lake County." The soils on Boggs Mountain are moderately deep to very deep, well-drained very gravelly loam and loam derived mainly from the Mountain's lava cap of andesite, basalt, and dacite. Igneous rock derived Aiken and Collayomi soils are the Forest's most productive soils. A limited amount of timber soils and most of the non-timber soils are derived from Great Valley formation sandstone or shale parent materials. Sanhedrin, Whispering, Speaker, and Marpa are lower site timber soils. Maymen, Estel, Snook, Hopland, Mayacoma, Millsholm, and Bressa soils are non-timber soils.

Table 2. Soil Series on BMDSF.

Soil Series No.	Name	Parent Material	Slope Range (percent)	Acres	Dominant Vegetation
126	Collayomi Complex	Andesite, Basalt, Dacite	50-75	71	Ponderosa pine, Black oak, Douglas-fir, Sugar pine
127.	Collayomi-Aiken-Whispering Complex		5-30	1917	Ponderosa pine, Black oak, Sugar pine, Douglas-fir
128.	Collayomi-Aiken-Whispering Complex	"	30-50	712	Ponderosa pine, Black oak, Sugar pine, Douglas-fir
129.	Collayomi-Whispering Complex	"	30-50	437	Ponderosa pine, Black oak, Sugar pine, Douglas-fir
224.	Speaker-Marpa-Sanhedrin Complex	Sandstone	30-50	106	Ponderosa pine, Douglas-fir, Black oak, Live oak
245.	Whispering-Collayomi Complex	Andesite, Basalt, Dacite	50-75	78	Ponderosa pine, Black oak, Sugar pine
Timber Soil Totals				3321	
168.	Maymen-Estel-Snook Complex	Sandstone , Shale	15-30	56	Chamise, Manzanita, Buckbrush
169.	Maymen-Estel-Snook Complex	"	30-75	21	Chamise, Manzanita, Buckbrush
173.	Maymen-Hopland-Mayacama Association	"	30-50	52	Chamise, Manzanita, Buckbrush, Black oak, Madrone, Live oak. Scattered Douglas-fir and Laurel
174.	Maymen-Hopland-Mayacama Association	"	50-75	5	Chamise, Manzanita, Buckbrush, Black oak, Madrone, Live oak. Scattered Douglas-fir and Laurel
175.	Maymen-Millsholm-Bressa Complex	"	30-50	6	Chamise, Manzanita, Buckbrush, sometimes Blue oak
177.	Millsholm-Bressa Loams	"	30-50	5	Blue oak, Grass
178.	Millsholm-Bressa-Hopland Association	"	30-50	27	Blue oak, Grass
NONTIMBER SOILS TOTAL				172	

Figure 3. Soils map of Boggs Mountain.



Geology

Geologically, BMDSF is complex. The State Forest is on a lava cap area about one mile wide by 3.5 miles long, forming a gently rolling summit with the sides breaking down into moderate to steep slopes. There are a few small areas of steep slopes and rock outcrops. Volcanic rocks are exposed over much of the forest. Andesites and basalts are visible as outcrops and along roads over most of the upper elevation, with the lower slopes of the northwest portion having volcanic rocks cap sandstones and mudstones.

Water Resources

BMDSF is a part of the top of Boggs Ridge, which is mostly a dry ridge top that runs northwest/southeast separating Putah Creek and Kelsey Creek watersheds. Boggs Mountain is part of the headwaters for the Kelsey Creek and Putah Creek drainages. Kelsey Creek is in the Clear Lake watershed; Putah Creek is in the Lake Berryessa watershed. Drainages on the forest are first and second order with no fisheries resources. Several landowners use water that comes directly from BMDSF. Most of these are in the east side of the forest including Ettawa Springs and Harbin Hot Springs. BMDSF has at least one easement for BMDSF water.

Surface water is uncommon on the forest. There are 3.8 miles of perennial streams; portions of Grouse Spring, Houghton, Malo and Spikenard Creeks. Three springs exist on the forest: Big Springs, Bluff Springs and Houghton Springs have been developed to fill fire suppression storage tanks.

Table 3. Perennial streams on BMDSF.

Big Springs Creek	.50 mi.
Grouse Spring Creek	.25 mi.
Houghton Creek	.76 mi.
Malo Creek	.76 mi.
Mill Creek	.76 mi
Spikenard Creek	1.14 mi.
TOTAL	3.8 mi.

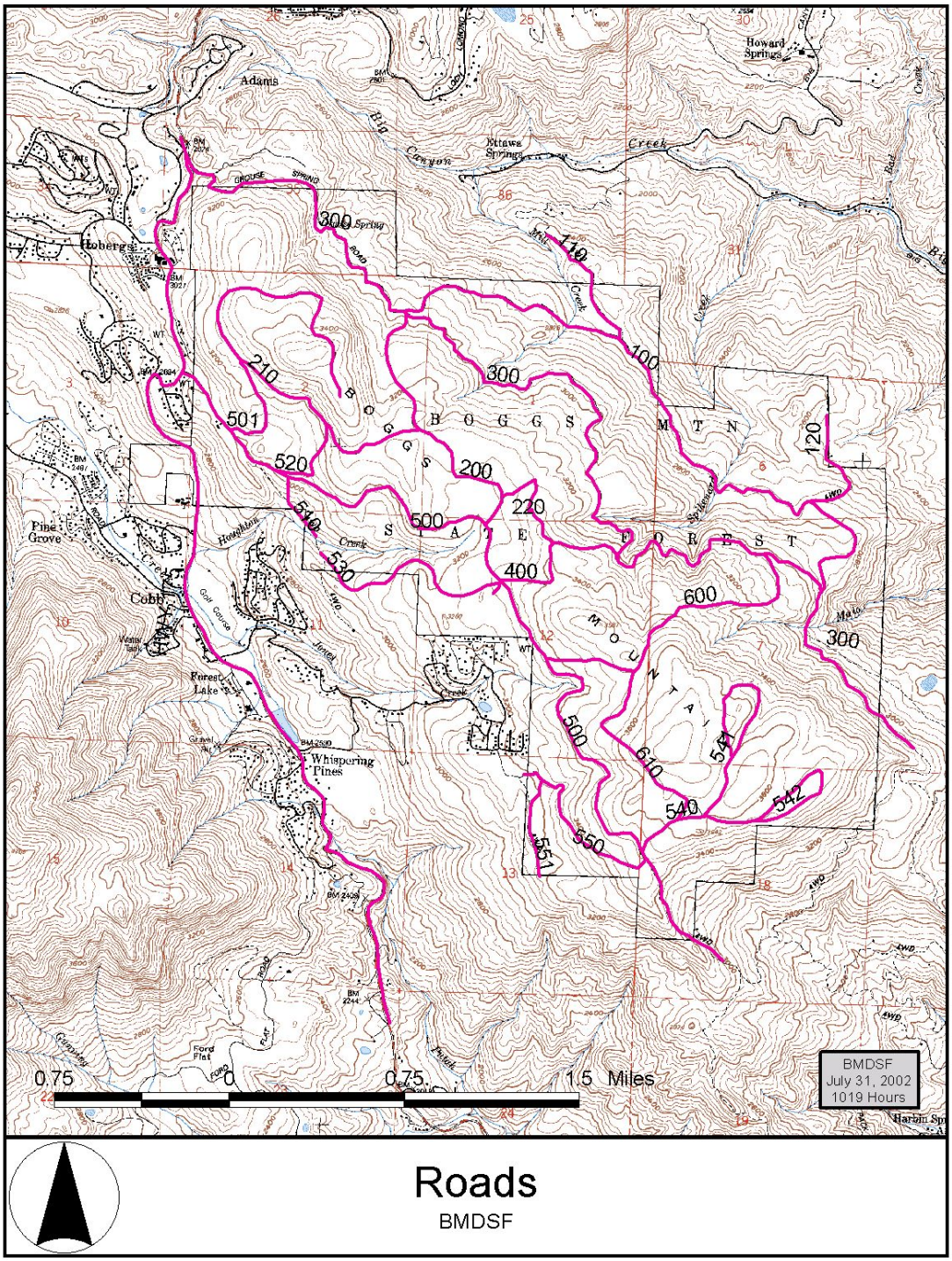
Roads

An access road system based on the original logging road network was established shortly after the Forest was acquired. Starting in 1965, major portions of the original road system were rebuilt improving grades, alignment, and drainage. Some short sections of new roads were constructed to avoid adverse grade problems. The 22 mile road system consists of 12 miles of primary, all-weather roads and 10 miles of secondary seasonal roads. No further additions to the road system are planned. Existing roads will be improved or decommissioned as funds and opportunities arise.

All roads on BMDSF that are no longer required for management and recreational purposes will be considered for abandonment. Roads to be abandoned will include user-generated roads, temporary roads, and roads to be permanently closed. User-generated roads are those that vehicles have made by not following a recognized BMDSF road and creating tracks for others to follow. Temporary roads can be defined as roads that are used for one or two years for timber sale activity and then abandoned. They may be reopened and reused in the next timber sale entry.

Upgrading of the road network is essential for long term resource management, administrative access, fire control, and recreational purposes. Erosion control, watershed restoration, and road rehabilitation work will be accomplished by implementing the road management plan. A major goal of the plan is to establish a road system that is largely self-maintaining and/or requiring low levels of maintenance. A systematic approach to road management problems will be employed in order to identify, prioritize and cost-effectively treat current and future sediment sources on the Forest.

Figure 4. Road system on Boggs Mountain.



Ground Cover

Within the forested areas, ground cover varies from pine needle litter to patches of shrubs typical of central and northern inland California foothill areas. Under the denser stands of timber, the ground is park-like and open with no undergrowth, then grades into sparse grass and dense brush in the more open stands.

Areas that were unstocked following logging have since become a thick cover of predominantly ponderosa pine reproduction and/or brush. The brush patches are composed principally of Konocti manzanita (*Arctostaphylos manzanita ssp. elegans*), and Sonoma manzanita (*Arctostaphylos canescens ssp. sonomensis*). Ponderosa pine reproduction has forced its way up through the brush canopy in many of the brush patches.

Konocti Manzanita (*Arctostaphylos manzanita* ssp. *Elegans)* and Sonoma Manzanita (*Arctostaphylos canescens* ssp. *Sonomensis)* are two rare species of manzanita identified during recent botanical surveys. These species are listed as CNPS 1B, but are considered locally common on Boggs Mountain. Considering the large population of these two Manzanita species found throughout the state forest, the proposed silvicultural methods, the use of existing landings, skid trails, and roads, and the lack of herbicide use it appears that no significant adverse impact to the population will occur.

Economic Situation

Towns and communities

The Forest is located in the community of Cobb, which is about equidistant from Middletown, Kelseyville, and Lower Lake. These three towns are about 30 minutes driving time from the Forest over paved state highways. In recent years Middletown has become an affordable alternative to the high housing prices of Sonoma County. The urban areas of Santa Rosa and Ukiah are becoming too expensive causing people to move into the area because of the lower housing costs. Many of the residents of Middletown join the commuter traffic to Santa Rosa each morning.

In the past and up until the early 1970's the Cobb area was a major resort area. Since the early 1970's, Cobb's resort industry has decreased to a small part of its past glory. Today most of the old resorts are owned by groups as conference centers or retreats and are not open to the general public. The Forest is surrounded by areas of intensive recreational use and though most summer resorts have declined in the vicinity, summer and year-round home construction and subdivision development in the area immediately surrounding BMDSF is continuing. This growth has translated into increased visitors to the forest.

The demand for energy greatly accelerated the exploration for and development of the geothermal resource in Lake County in the 1980's. The greatest development was in the Cobb Mountain area within a few miles of Boggs Mountain. Calpine operates 19 plants on Cobb Mountain, known as "The Geysers," with a generating capacity of 850 megawatts. The Forest is within a few miles of the Geyser's geothermal field, which has been developed extensively since 1976. The geothermal industry brought new economic prosperity to the Cobb area during the late 1970's and early 1980's. During the 1980's, as geothermal development leveled off, community growth continued because of relatively inexpensive land and housing.

The population of Lake County has increased by almost 50 percent since 1986. Much of the increase is occurring in the southern county where Boggs Mountain is located. Subdivision

development and home construction have increased the population pressures on commercial development, schools, demand for recreation, and increased demand for services. The population growth increased the demand for fuel wood from the State Forest. This demand is heightened by the relatively high heating fuel costs in Lake County which is not served by natural gas. Population growth and increased pressure for more services make the addition of staff at BMDSF desirable.

Markets for forest products

The Department currently offers the public and private commercial interests the opportunity to purchase minor forest products, subject to specific rules and constraints. At present, permits can be purchased for collection of products including salvage sawlogs, poles, split products, greenery (e.g. boughs, shrubs, and ferns), rocks, and firewood. Class I sale permits are issued for the collection of these minor forest products.

The market for the sawlog timber was very limited when the first BMDSF timber sales were offered in 1967. Only one mill in Ukiah showed interest in the first sale and two mills, one in Ukiah and one in Marysville, bid on the second sale. With improving market conditions, sawlog timber has become very marketable with more mills and loggers showing interest in State Forest timber sales. In addition to the sale of sawlogs, BMDSF staff is exploring the opportunities within the pole timber and biomass markets.

Table 4. Forest products mills in California.

Mill	Location	Distance in miles from BMDSF
Unity Forest Products	Yuba City	90
Marysville Forest Products	Marysville	92
Harwood Products	Branscomb	95
Sierra Pacific Industries	Richfield	115
Sierra Pacific Industries	Anderson	145
Sierra Pacific Industries	Camino	160
Sierra Pacific Industries	Shasta Lake City	165
Sierra Pacific Industries	Quincy	195
Collins Pine Company	Chester	205
Shasta Green, Inc	Burney	210
Sierra Pacific Industries	Burney	210
Sierra Pacific Industries	Chinese Camp	225
Sierra Pacific Industries	Standard	235
Sierra Pacific Industries	Susanville	235
Sierra Forest Products	Terra Bella	370

Transportation Facilities

All markets are accessible by state highways. Highway 175 is adjacent to the northwestern boundary of the forest and within four miles of all of the State Forest roads. Major highway improvements have been made between 1965 and 2004 on State Highways 20 and 29, cutting the time and cost of hauling logs to the mills.

3. Desired Future Conditions and Planned Management

This section describes the planned management on Boggs Mountain over the next five to ten years. The goals for management of the Forest are described in terms of desired forest structural conditions. The management of Boggs is intended to balance sustained productivity with long-term biological productivity of the timberland and protection of public trust resources. The timber management program under this plan is expected to produce a moderately low but perpetually sustainable harvest level. Harvest levels will support a financially viable timber management program in order to remain relevant as a research laboratory for sustainable forestry on private timberlands. Planned harvest rates are somewhat lower than that of many private owners due to additional landscape and wildlife habitat constraints imposed on Boggs Mountain as a public forest and the need to maintain the widest possible range of forest conditions in order to accommodate potential future research studies.

Desired Future Conditions

The overall goal is to maintain Boggs Mountain as a mid-seral forest type. Early and late seral stands will be represented but overall the Forest will maintain the characteristics of a mid-seral forest. This goal is not discretionary, but rather follows directly from the research and demonstration mandate for Boggs Mountain. Rather than a park or reserve, the legislated mandate for the Forest is that of a working forest for demonstration and research purposes, serving a clientele of small to medium size land owners.

In order to remain relevant as a research forest, Boggs Mountain aims to create and maintain a wide range of forest types, ages, size classes, successional stages, and structural characteristics. It is going to be very difficult to maintain pure stands of each of these characteristics on a Forest the size of BMDSF. As a result, the approach will be to incorporate a continuum of types, age classes, successional stages, and structures mixed within stands across the Forest as far as possible.

The concept of the fully regulated forest, with an approximately equal representation of all age and structure classes, averaging out to an overall mid-seral forest, lends itself well to the goal of maintaining as wide a range of forest conditions as possible to accommodate future research. This concept will be used as a guide in maintaining and cultivating the aggregate of individual stands on BMDSF.

Stands will typically remain a mixture of conifer and hardwood species typical of the Ponderosa pine and Kalmath mixed conifer type. The prevalent age class structure will be that of uneven-aged stands, in which individual trees of a range of ages and size classes are present in the stands. Once the desired long-term forest structure conditions have been accomplished, it is anticipated that the oldest trees on the Forest will be about 100 years old.

Based on field work and forest inventory data, stands were assessed for meeting the Board of Forestry late-successional forest definition. Due to the fact that the Forest was largely clearcut at the the time of transfer to State ownership, the oldest trees on the Forest are currently 50-60 years old, and no late-successional stands currently exist on BMDSF. Some of the functional characteristics of late-successional stands, such as large down logs, large decadent trees, and snags exist in scattered stands throughout the Forest. These attributes will be retained and recruited wherever feasible. Such stands provide a valuable starting point for the recruitment of additional adjacent acreage to late successional conditions through management.

Structural characteristics such as snags, downed woody debris, decadent trees, and irregular tree characteristics (large branches, irregular form, hollows) will be retained to a density where they do not pose a safety hazard, fire hazard, impede the establishment and growth of new trees on the site, or provide a source of pest and disease to infect nearby healthy trees. Recruitment of large diameter snags will be accomplished by leaving, where feasible, dead trees, large trees that show signs of poor vigor, stress, or disease. No treatments are planned to actively create snags by girdling or topping live trees, unless prescribed on individual research installations. A key component of late-successional forest stands are the decadent components, snags, and down large logs. Snags from the dominant and predominant members of the stand are preferred to later become down logs.

Silvicultural Methods

Silvicultural methods will be used that promote growth and regeneration in order to develop and maintain an all-aged forest composed of a mosaic of age and size classes consistent with the desired future forest structure conditions. Specific research projects may occasionally utilize unconventional methods that do not follow the general direction for silvicultural methods described below.

Uneven-aged management will be the dominant forest management method at BMDSF. Currently the ponderosa pine, Douglas-fir and mixed conifer stands are made up of groups and aggregates of even-aged size classes resulting from the 1949 and 1950 harvesting just prior to transfer of ownership to the State. Special and Alternative silvicultural prescriptions will be used to a lesser extent, as required to develop a fully regulated all aged forest. Even-aged methods will be used in a minority of cases, where warranted by fire prevention concerns, pest and disease or regeneration difficulties. Specific research projects may also use even-aged methods. In most cases, even-aged harvests will be a green tree retention method, i.e. a significant amount of mature trees from the previous stand will be left on site to provide structural and habitat diversity, and to enhance regeneration of new trees. Although timber harvesting will focus on the removal of conifers, some hardwoods may also be removed to maintain natural relative site occupancy of hardwood to conifer species for this area. The majority of the timber harvesting will be conducted under the following regeneration methods:

Selection (unevenaged): Under the selection method, trees are harvested individually or in small groups sized from .25 acres to a maximum of 2.5 acres. Single tree selection will be the primary prescription for the Douglas-fir and mixed conifer stands. Group selection will be used within the pine stands to avoid species conversion and to maintain species diversity. Openings will be created to obtain more pine regeneration rather than the more shade tolerant Douglas-fir which is favored by single tree selection. For purposes of natural regeneration, group openings shall retain at least one seed tree per acre greater than 18 inches DBH, with full crown and superior phenotype. Artificial regeneration may be used to supplement natural regeneration.

Transition (unevenaged): The transition method will be used to develop an unevenaged stand from a stand that currently has an unbalanced irregular or evenaged structure. The transition method involves the removal of trees individually or in small groups from irregular or evenaged stands to create a balanced stand structure and to obtain natural reproduction. This method will be used no more than twice in order to increase stocking and improve the balance of age classes. The residual stand will be managed by the single-tree selection or group selection methods during future harvests.

Commercial thinning (Intermediate): Commercial thinning is the removal of trees in a young-growth stand to maintain or increase average stand diameter of the residual crop trees, promote timber growth, and/or improve forest health. The residual stand will consist primarily of dominant

and codominant trees from the preharvest stand. The residual stand will be managed by the single-tree selection or group selection methods during future harvest.

Sanitation-Salvage (Intermediate): Sanitation is the removal of insect attacked or diseased trees in order to maintain or improve the health of the stand. Salvage is the removal of only those trees which are dead, dying, or deteriorating due to damage from fire, wind, insects, disease, flood, or other injurious agents. Salvage provides for the economic recovery of trees prior to a total loss of their wood product value. Sanitation and salvage may be combined into a single operation.

Rehabilitation of Understocked Areas (Special): The rehabilitation prescription will be used for the purposes of restoring and enhancing the productivity of commercial timberlands which do not meet the stocking standards defined in the Forest Practice Rules.

Fuelbreak/Defensible Space (Special): Trees and other vegetation and fuels will be removed to create a shaded fuel break or defensible space in an area to reduce the potential for wildfires and the damage they might cause.

Alternative Prescriptions: An alternative prescription will be included in a Timber Harvesting Plan (THP) when, in the judgment of the Forest Manager, an alternative regeneration method or intermediate treatment offers a more effective or more feasible way of achieving the objectives of the management plan than any of the standard silvicultural methods provided in the Forest Practice Rules.

Shelterwood (evenaged): The shelterwood regeneration method reproduces a stand via a series of harvests (preparatory, seed, and removal). The preparatory step is utilized to improve the crown development, seed production capacity, and wind firmness of designated seed trees. The seed step is utilized to promote natural reproduction from seed. The removal step is utilized when a fully stocked stand of reproduction has become established and this step includes the removal of the protective overstory trees. The shelterwood regeneration method is normally utilized when some shade canopy is considered desirable for the establishment of regeneration.

Reforestation

The viable sources of natural seed available on BMDSF provide for the successful establishment of seedlings from natural regeneration in most cases. A dense stand of reproduction has been established in nearly every opening since the property was purchased by the State. Planting for purposes of restocking or to supplement natural regeneration will be done when necessary. Planting for experimental and demonstrational purposes will be continued.

Thinning

Precommercial thinning guidelines are developed to accomplish the desired spacing of young growth stands on the forest for maximum diameter growth of future crop trees. The annual thinning goal is at least 15 acres per year with the conservation camp crews. Thinning operations are laid out and supervised by the forest staff. Priority thinning areas are on the most densely stocked areas of the Forest. Material developed from the precommercial thinning operations will be sold for firewood under a Class I timber sale permit, chipped, or piled and burned. Commercial thinning operations will be used under the THP process as an intermediate silvicultural treatment to promote growth and vigor of the residual stand. Material developed from commercial thinning operations will be sold for sawlogs, poles, and biomass as a Class III timber sale and sold as firewood under a Class I timber sale permit. The residual stand will be managed under the Selection or Group Selection silvicultural methods during subsequent harvests.

Pruning

Natural pruning occurs throughout the Forest due to the dense stocking of the timber stands. Mechanical pruning will only be used for purposes of research and demonstration.

Hardwood Management

Hardwoods on BMDSF are scattered and only occasionally occur in dense stands. Hardwoods on the Forest that are mixed with young conifers will be managed for their wildlife habitat and forest structure values. Hardwood management is directed toward wildlife habitat and the benefits derived from species diversification. The management goal for hardwoods is to maintain an evenly distributed basal area component in the ponderosa pine/Douglas-fir timber type at 15-20 percent and increase it to approximately 5-10 percent in the ponderosa pine forest type.

Brush Management

Brush, primarily in the form of manzanita, coffeeberry and oak, cover several hundred acres of the Forest with and without intermingled conifers of varying sizes. Approximately 155 acres of brush type are on soils that are incapable of growing commercial timber. These lands are valuable for watershed protection and wildlife habitat, therefore conversion to grass or rangeland is not planned.

On areas where brush occupies conifer soils in conjunction with or exclusive of conifers, various methods of brush management aimed at increasing regeneration and growth of conifer species will be initiated and will continue to be a major component of the Forest's management and demonstration program. Consistent with protecting the native vegetation of BMDSF, herbicides shall only be used on BMDSF for the periodic control of invasive or noxious weeds.

Fertilization

The various aspects of forest fertilization to increase timber growth and yield have been investigated in the past. Investigations will be continued in the future as the opportunity arises.

Forest Management

The area of BMDSF stocked with coniferous trees (the timber land base) on BMDSF is 3,313 acres. One hundred eighty acres is occupied by non-coniferous forest types, primarily early seral brush and hardwood species. These acres will be maintained over time to provide a continuous habitat for species that rely on early seral forest conditions and to provide research opportunities in early seral forest conditions.

The current growth rate for all conifer stand types on BMDSF average between 300 and 350 board feet per acre per year, or roughly one million board feet annually. Due to the large area covered by young trees, site specific growth rates in individual stands can vary significantly around the average. As stands grow to maturity over time, the growth rate is expected to increase significantly.

In addition to conifers, hardwood species comprise 15 percent of the Forests' basal total area. The hardwood species present are black oak, white oak, canyon live oak, bay laurel, and madrone. The average forest-wide volume of black oak, the major hardwood species, is estimated to be 1,023 cubic feet per acre. The relative site occupancy of hardwood species to conifers will not be reduced by timber management activities.

Sustainable Harvest Levels

The allowable cut is based upon the long term sustainability analysis in the BDSF Option A plan (California Department of Forestry and Fire Protection 2008). The long-term sustained yield (LTSY) is 1.66 million board feet per year (475 board feet per acre per year). Current annual growth is 357 board feet per acre per year. The corresponding near term sustainable annual harvest level in the first decade is 770 thousand board feet per year (220 board feet per acre per year). This constitutes a harvest intensity of 1.5 percent of inventory.

The annual harvest is less than the LTSY due to the constraints on forest management activities imposed by other forest values on BMDSF, and the fact that most of the stands on the Forest are still young and will accumulate significantly more growth as they mature. In addition to the constraints placed on the calculation of the long term sustained yield in the harvest schedule, there are also discretionary commitments to planned management practices for non-timber resources. These commitments are in large part discretionary management practices which are necessary to maintain a healthy managed forest ecosystem. They are also necessary to avoid foreclosing on future management options. A goal of BMDSF is to have an active research program, which in turn depends on a diverse mix of forest structures, from early to late seral.

In 1978, management compartments were established for the Forest. So that timber harvesting will not be concentrated in any single large area, an effort will be made to conduct cutting in a systematic manner in these compartments, based on silvicultural and economic factors. The harvests will normally occur in one of the State Forest's nine management units on an 18 year cutting cycle. Adjustments to the cutting cycle in specific units would occur if disease, insects, fire, or inventory results indicate adjustments are needed.

The harvest limit includes salvage as well as green tree sales. Biomass harvesting will be conducted within the Highpoint and Starview Management Units approximately 10 years prior to standard commercial harvesting operations. Table five shows the planned near-term harvest schedule. It presents a current best estimate of upcoming timber sales, but it is likely to change due to currently unknowable future circumstances. The schedule is subject to change due to changes in factors such as budgets, staff, management priorities and natural events such as fire.

Table 5. Planned near term harvest schedule.

Harvest Year	Management Unit	Acres
2008-09	Bluff Springs Mill Creek	181
2009-10	High Point Calupowee	320
2011-12	Spikenard	250
2013-14	Big Springs	220
2015-16	Giffords	270
2017-18	High Point	250
2019-20	Starview	357
2021-22	Pine Summit	371

Harvest Cycles

An 18-year cutting cycle is planned. Generally, the largest tree grown will be 32" DBH. Exceptions will be sugar pine, which will be grown to 36" DBH. Larger sugar pine will be retained since the species is still rapidly growing up to that size in this area and because cone crops are

generally significantly heavier for larger trees. Trees larger than 40" DBH (currently 0.2 per acre on average) will be retained for aesthetic, wildlife, and genetic values if feasible.

Timber Sales

The State Forest plans for and schedules regular timber sales as directed by Board policy and existing management plans. Forest product sale transactions are broken into two categories based on size and/or value. These are Class I sales and Class III sales (an intermediate Class II category was discontinued in 1976). Class I sales are limited to no more than 100 thousand board feet in volume, and cannot exceed $10,000 in value. These sales tend to consist of salvage operations, power line right-of-way clearance, and other small lots of timber. Class I sales of other forest products have a limit of $10,000, and typically include firewood, split products, poles, greenery, and mushrooms. The Department of General Services exempts CAL FIRE from the requirements for competitive bidding for Class I sales, although these sales can be bid when it is appropriate. (For example, it may be desirable to use a bidding process to select a purchaser of a small sale when there are many people interested.)

Class III Timber Sales:

Class III sales cover the major timber sale program and are awarded through a competitive bidding process. Following Forest staff review of the management plan, a THP and sale contract are prepared. The sale is appraised and advertised. A prospectus for each sale is sent to potential purchasers, local logging contractors, and other interested parties. The sale is also listed on the California State Contracts Register website.

An advertising period of four to five weeks is typically provided to allow purchasers and contractors ample time to evaluate the sale and the contract provisions. Sales usually have bid dates in late winter or early spring, which allows the contract to be awarded, approved, and operations to begin shortly after the end of the winter period. Sale contracts are valid for one to two operating seasons, depending on the complexity of the operation and how early in the year the sale is awarded.

Administrative inspections work to ensure compliance with the timber sale contract. Inspections of the sale area are made at least bi-weekly and more often during critical or sensitive phases of operation. Additional administrative duties include monitoring harvesting progress and the request of stumpage payments on a timely basis.

State Forest sale administrators do not double as CAL FIRE Forest Practice inspectors on the sales that they administer. Although sale administrators, as Registered Professional Foresters and as CAL FIRE employees, have a duty to enforce the Forest Practice Act and Rules, there is potential of a perception of conflict of interest. It is important that there be oversight of Act, Rule and THP compliance by CAL FIRE inspectors that are not State Forest staff.

The contract administrator's responsibilities extend beyond the completion of timber harvesting, to include inspection and arrangement of maintenance of erosion control facilities during the maintenance period and ensuring that harvest units meet stocking requirements.

Class I Timber Sales:

Class I sales are limited to no more than 100 MBF in volume and cannot exceed $10,000 in value. They may or may not be awarded through a competitive bidding process. Following Forest staff review of the management plan, a timber harvest document is prepared. In order to keep the small number of local loggers in business (and available for salvage sales) it may be in the State's interest to award a Class I sale without a competitive bid.

Logs may be purchased from the State Forest, subject to permit constraints and applicable state regulations. Payments are generally made on the basis of log volume removed from the State

Forest. The purchaser is responsible for paying all applicable yield and sales taxes. The removal of timber requires the purchaser to be in possession of a valid timber operator's license. Prices for logs to be removed are subject to negotiation between the purchaser and the State Forest manager. All timber operations are limited by the Forest Practice Rules and constraints established by the State Forest manager. Logging requires a THP approved by CAL FIRE. Typical State Forest constraints include provisions for protection zones for watercourses, slope limitations, wet weather restrictions, and pre-location of yarding and hauling facilities. Trees must not exhibit signs of active nests.

Minor Forest Products:

BMDSF offers the public and private commercial interests the opportunity to purchase minor forest products, subject to specific rules and constraints. Permits can be purchased for collection of products including salvage sawlogs, poles, split products, greenery (e.g. boughs, shrubs, and ferns), rocks, and firewood. Class I sale permits are issued for the collection of these minor forest products. Payment is made on an item or volume basis and the purchaser is responsible for payment of all applicable taxes.

Harvesting Methods

Tractor yarding is appropriate for BMDSF since over 95 percent of the timberland on the forest is under 50 percent slope and has an existing tractor road network in place from past harvesting operations. Rubber tired skidders, forwarders, and track laying equipment may be utilized over most of the forest. Areas with slopes over 65 percent are small and reachable with a tractor long line; however cable and/or helicopter yarding systems may be used when economically feasible. Horse logging has been done primarily for research and demonstration purposes and may be used again in the future.

Carbon Sequestration and Greenhouse Gas Emissions

In 2007 the State of California passed the Global Warming Solutions Act (AB 32), which set targets to reduce greenhouse gas emissions to 1990 levels by 2020 and 80 percent below 1990 levels by 2050. The California Air Resources Board was tasked with obtaining compliance with the cap through regulatory and market approaches. Planning is currently underway and definitive decisions by the Board have not yet been taken, however, it appears that forests will play a significant role in non-regulated strategies to meet targets. This is anticipated to occur both as offsets within a cap and trade system and through voluntary measures.

Recognized strategies to mitigate Greenhouse Gas Emissions (GHG emissions) and enhance terrestrial sequestration include reforestation, forest management, and fuels treatments to avoid catastrophic losses. BMDSF will contribute to the targets of AB 32 by increasing the resiliency of the Forest to catastrophic mortality by improving the general health of stands, pre-fire implementation of a shaded fuel break, and maintenance of firefighting infrastructure such as roads, signage, and water sources. The long-term carbon stocks of the Forest are projected to increase over time. For example, the Option A Plan projects that the timber inventory on the Forest will increase from 14,500 board feet per acre in 2008 to about 25,000 board feet per acre in 2108.

Forest products produced from BMDSF will sequester carbon during their life cycle. Biomass fuels produced on the Forest also provide an opportunity to replace fossil fuels with an alternative energy source that is close to carbon neutral.

Fish, Wildlife and Plants

Due regard will be given to the preservation of wildlife values. BMDSF has two California Wildlife Habitat Relationship (WHR) System habitat types; ponderosa pine and Douglas-fir. Brush or meadows cover approximately 2 percent of the total landbase. The ponderosa pine habitat type is mainly on the south and west slopes and the Douglas-fir habitat type is mainly on the north and east slopes.

Hunting, urbanization, and resource extraction are obvious impacts to wildlife on the State Forest. Because of its easy access and its proximity to large urban areas, BMDSF is heavily used for hunting and target shooting. In addition to the hunting pressures, the Forest is bounded by high density subdivisions on its south and west sides, with the Loch Lomond rural residential area located across Big Canyon to the north.

The Forest is open to hunting in accordance with State Fish and Game laws and Section 4656 of the PRC. Although the management of BMDSF has little control over hunting and urbanization pressures placed on wildlife and their habitat, it does have a responsibility to consider the maintenance and enhancement of biological diversity when proposing forest management projects. Biological diversity can be defined as the variety and variability of living organisms and the ecological complexes in which they occur. Biological diversity is an important ecosystem characteristic for a variety of ecological, economic, and aesthetic reasons. Retaining the diversity of components, structure, and processes of ecosystems appears to dovetail with future forest productivity.

The development of BMDSF as true all-aged forest will provide for a more biologically diverse habitat than is found in the current predominantly young forest. The single tree selection, group selection, commercial thinning, and sanitation-salvage harvesting will improve the forest habitat by developing and maintaining a variety of crown levels, stand densities, and small openings in the Forest. Group selection openings will provide habitat for wildlife species that prefer and need edge cover. The openings themselves will provide feeding habitat for rodents and the predators that feed on the rodents. The multilevel forest canopy will provide habitat for the wildlife that lives in the various levels of the forest canopy. The variable crown canopy density will allow varying amounts of light to reach the forest floor which will determine the amount and types of vegetation which may grow on the forest floor and provide cover, food, and shelter for wildlife that utilizes the forest floor.

Rare, Threatened or Endangered Species

The BMDSF is type C spotted owl habitat (14 CCR 895.1). Spotted owls do not nest within BMDSF at this time, however a single transient owl has been located in the vicinity of Malo Creek on numerous occasions. Periodic owl surveys will be conducted by Forest staff in accordance with the US Fish and Wildlife Service (USFWS) approved protocol as described in “Guidelines for Surveying Proposed Management Activities that may Impact Northern Spotted Owls”.

In order to satisfy the disclosure requirements of the Forest Practice Rules and CEQA, CAL FIRE has sought from USFWS technical assistance to the Northern Spotted Owl Guidelines. The purpose of the Guidelines is to ensure that THPs submitted within the range of the northern spotted owl will not likely result in take of this federally listed species.

The Natural Diversity Data Base indicates that Rincon Ridge ceanothus (*Ceanothus confuses*) was identified and last seen in 1940, one+ mile northwest of the Forest along what is now State Highway 175. Botanists working on the BMDSF fauna and flora assessment in 1991-92 (Baad, 1992) have identified squaw carpet (*Ceanothus prostratus*) on the Forest but have not found Rincon Ridge ceanothus. If this species is present on BMDSF, the ground disturbance and openings in the forest canopy created by the timber harvest will improve its habitat by reducing competition and allowing more light to reach the forest floor.

Two sensitive plant taxa were identified during the recent (2006) botanical surveys. Konocti manzanita *(Arctostaphylos manzanita* ssp. *Elegans)* and Sonoma manzanita (*Arctostaphylos canescens* ssp. *sonomensis*) are listed as CNPS 1B species that could potentially be impacted by timber harvesting operations. Impacts to this species would primarily occur from construction of new skid trails. The established network of skid trails within the state forest shall be used wherever possible, in order to minimize potential impacts. Considering the large population of these two Manzanita species found throughout the state forest, the proposed silvicultural methods, the use of existing landings, skid trails, and roads, and the lack of herbicide use it appears that no significant adverse impact to the population will occur.

Watershed and Fisheries

BMDSF lies within four Calwater Planning Watersheds: Big Canyon Creek (5512.300105), Upper Kelsey Creek (5512.300103), Anderson Creek (5512.300101), and Hoodoo Creek (5512.300102). Protection of watershed values will be an integral part of the overall management of the Forest and will be directly correlated with silvicultural practices and logging standards pursuant to Section 4651 of the PRC and the Forest Practice Act.

Upper Kelsey Creek, Anderson Creek, and Hoodoo Creek planning watersheds have been designated as within the Evolutionary Significant Unit (ESU) for Chinook salmon, Coho salmon, and steelhead trout within the FRAP Calwater mapping system. However, consultations with DFG personnel indicate that Timber Harvest Plans submitted within these watersheds may operate under the standard rules because of downstream barriers to anadromous species.

Table 6. Planning watersheds at Boggs.

Planning Watershed/sub-watersheds	Acres	Percent of Forest
Upper Kelsey Creek Watershed	913	26
Houghton Creek	506	
Jones Creek	241	
Kelsey Creek	166	
Anderson Creek Watershed	197	6
Putah Creek	197	
Hoodoo Creek Watershed	213	6
Harbin Creek	196	
Cockerell Creek	23	
Big Canyon Creek Watershed	2170	62
Grouse Spring	197	
Malo Creek	459	
Mill Creek	449	
Big Canyon Creek	238	
Spikenard Creek	797	
Unnamed Tributaries	30	

There are no anadromous fisheries or fish-bearing watercourses within the Forest boundary, however the management of BMDSF recognizes that watercourses and associated riparian zones form a critical link between the terrestrial and aquatic environments, exerting a strong influence on the biological and physical processes that create and maintain aquatic habitats. In addition to providing important habitat elements for a variety of plants and animals, riparian vegetation provides shade that moderates stream water temperatures and contributes large woody debris (LWD) which influences the aquatic and terrestrial food web.

Recreation

Recreational opportunities found on BMDSF are informal, unsupervised, and diverse. Primary recreational activities include camping, picnicking, hiking, single-track mountain biking, driving, equestrian activities, target shooting, and hunting. Boggs does not collect any fees for recreational uses but does provide considerable public value to the visitors.

BMDSF is open to the public all year, except for temporary area closures for public safety and the periodic closure of roads to motorized vehicles during wet weather. Although public use on the Forest has not diminished over time, priorities for implementing a recreation program have fluctuated with political goals and their resultant budgets. The management of BMDSF is directed toward the goal of integrating recreation management, forestry education, resource protection, and timber harvesting to demonstrate compatible use.

The popularity of the trail system for walking, mountain biking, and horseback riding is a major factor in recreational use. BMDSF is used very much like a local park. The road system and easy access from Cobb, Whispering Pines, Hobergs, and Loch Lomond allows for extensive day use. It is estimated that day use comprises at least four times as many visitor-days as overnight camping. Day use is heaviest evenings and weekends. Peak visitor use periods tend to be two to three hours before the start and two to three hours after the end of the workday with another peak in usage occurring around 10 pm to 2 am. The typical recreational uses are walking dogs, horseback riding, walking, jogging, mountain biking, hunting, and camping. Trail use and firewood cutting appear to be the predominant public use of the forest.

Camping is not the primary draw for recreationists on BMDSF since the campgrounds are generally not full even Labor Day weekend. In a survey conducted by Community Development by Design "camp overnight" was the third most frequent response in the case of Jackson Demonstration State Forest (60 percent) and Mountain Home Demonstration State Forest (71 percent); it was 20th in the BMDSF results (only 28 percent). The number one reason for visiting BMDSF is the peaceful forest environment.

Table 7. Recreational Carrying Capacities.

Recreation Use	Maximum Physical	Current Sustainable
Campgrounds (camper-days)	58,400	23,000
Trails (hiker-days)	163,520	65,400

In accordance with Board of Forestry and Fire Protection policy, recreational facilities will generally be maintained to provide a rustic and informal experience. An estimate of recreational carrying capacity was developed as part of the management plan to guide the development of new campgrounds, picnic areas, and trails. There are several approaches to defining “carrying capacity.” Most approaches focus either on the maximum physical capability of the facilities or on the level of use that can be sustained without an unacceptable impact on the facilities and other resources. Both are shown in table 7. Future expansion of recreational facilities will depend on the level of staffing and funding available.

Archaeological Resources

BMDSF has had eleven separate archaeological field surveys including an extensive overview (Gerike and Stewart 1988) and a reconnaissance study and report by Dillon (consulting archaeologist, 1991). The entire forest has been covered during these studies.

BMDSF's cultural resources management procedures are based on CAL FIRE's statewide Management Plan for Historic Buildings and Archaeological Sites (plan) (Foster and Thornton, 2001) and its accompanying Environmental Impact Report (Foster and Sosa, 2001) which prescribe general measures for identifying, evaluating, and managing heritage resources on CAL FIRE lands statewide, including BMDSF.

If any unrecorded sites are discovered during surveys or management activities, a CAL FIRE Archaeologist will be contacted to determine the appropriate protection measures. Archaeological surveys will be conducted by professional archaeologists or BMDSF staff who are trained to conduct archaeological surveys (Foster, 2006):

1. The CAL FIRE Archaeologist will be contacted to evaluate any new activities within or immediately adjacent to recorded archaeological sites.

2. On recorded sites that have been used as roads and landings and that will be used again as roads or landings, a surface survey will be made prior to, during, and after the area is used. If cultural materials are found on the site, a collection of the materials will be made. The collected material, if any, will be recorded and mapped, defining where it was collected, by whom, and when. The artifact(s) will be returned to this site after use or maintenance at the site is completed or the collected artifacts may be retained at the Forest Headquarters for protection and/or further study. Sites that have been heavily damaged in the past will be managed in this manner.

3. Sites that have had minimal or no disturbance will be avoided. If use is necessary, the recommendations of the CAL FIRE Archaeologist will be followed.

Forest Protection

Sanitation Cutting and Hazard Reduction

Each year since acquisition of the Forest by the State, some sanitation cutting and hazard reduction has been done on the property. This has consisted of cutting, bunching, and burning windfalls, felling snags, burning concentrations of bark and limbs at log landings, and insect control work.

This type of work diminished somewhat after 1953, but increased again in 1976-77 due to increased mortality caused by bark beetles. Windfall in pole stands has materially decreased, old slash has either been reduced by weather or burning, and insect attacks in pole stands have tapered off and have been reduced by control work.

BMDSF will continue to harvest dead, dying, and diseased trees through the exemption permitting process.

Fire Protection

The Sonoma-Lake-Napa (LNU) Unit Chief is responsible for fire protection in the State Forest. The South Lake County Fire Protection District and CAL FIRE provide local fire protection on and adjacent to the Forest. Initial attack can be provided by the CAL FIRE Boggs Mountain Helitack Base, which is located on the Forest property. Detection strategies include patrol, searching for evidence of fires, and patrol flights during extreme fire danger periods or after lightning storms. The Unit's Emergency Command Center personnel routinely check the Automatic Lightning Detection System for possible strikes in the Forest. The period of high fire danger generally occurs between July and November, though this period may be extended by severe weather conditions.

During periods of high fire danger, BMDSF will follow LNU's Red Flag Alert Plan. The Forest Manager coordinates with the Unit Duty Chief to determine necessary actions to be employed. The steps may include increasing patrols of the Forest, posting alert signs, providing more fire prevention information and awareness of current conditions to Forest visitors, and reducing activity in the Forest by closing specific areas.

Pre-suppression fire protection activities will be conducted to ensure successful fire prevention and suppression. Shaded fuel breaks are being constructed along the entire 22 mile Forest road system by conservation camp crews. Forest fuels reduction through brush and slash control will be an ongoing program which will supplement and eventually replace the fuel break system as the Forest's main defense against wildfire. Prescribed fire will continue to be used on the Forest. Fire is a natural ecosystem process within the Forest. Fire exclusion over the long run is not possible and is generally not desirable in maintaining natural ecosystem processes. The use of prescribed fire can facilitate fire hazard reduction, silvicultural and habitat research, and ecosystem management research.

The existing road system developed from the original logging road network provides adequate access for fire protection purposes. The major roads and trails in the Forest are maintained to provide access for fire protection purposes. Seven spring-fed water storage tanks with a total capacity of 54,000 gallons have been constructed on the Forest for fire protection and recreational use. Both the road system and the water storage tanks will require periodic maintenance for continued effective fire suppression.

Potential ignition sources such as campfires and smoking are controlled on the Forest. Campfires are restricted to developed fire pits within campgrounds. Smoking is only allowed in areas sufficiently cleared of light fuels.

Insects and Disease

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 stocking, windthrow, fire, and other site disturbances. The effects of pests may reduce tree growth, affect species composition, or impact forest stocking. At the same time, other forest resources, such as wildlife habitat, may be impacted by the change in forest structure brought upon by excessive tree mortality.

Various species of bark beetles, Ips sp. and Dendroctonus sp. in pine and Scolytus sp. in Douglas-fir are endemic pests on the Forest. Periodic short dry periods and longer droughts cause varying mortality increases. Disease is found throughout the Forest. Black Stain (*Verticicladiella wagenerii*) is found on Douglas-fir. Fomes root and butt rot (*Fomes annosus*) is common in Douglas-fir and pine. Dwarf mistletoe (*Arceutholiurn campylopodum*) is found on ponderosa pine in localized areas. State Forest staff monitor for early signs of forest pests or conditions that may lead to pest infestations. Forest pest management specialists will be used to train employees in forest pest recognition and management. BMDSF remains available for forest pest research opportunities to interested agencies, institutions, or organizations

Measures taken to protect against infestations of insects and diseases on BMDSF will include the following:

- Maintain a diverse species composition and favor resistant species during harvest operations, e.g. establish ponderosa pine in Douglas-fir Black Stain areas.
- Promptly treat bark beetle brood material during timber sales. Treat all conifer stumps with borax to reduce the chance of new fomes root and butt rot infections.
- Minimize injuries to residual trees during timber sales.
- Harvest ponderosa pine with heavy mistletoe infection or with any mistletoe if it overtops smaller trees.

- Promote vigorous growth through commercial and pre-commercial thinning.
- Release stands from brush and hardwood competition.

Sudden Oak Death:

The Boggs Mountain Demonstration State Forest is located within Lake County, which has been declared a zone of infestation for Sudden Oak Death (SOD). Currently there is no indication that this pest is present on the Forest. The BMDSF General Management Practices for controlling the spread of SOD will be followed during THP preparation and prior to movement of merchantable material off site (see Appendix III).

Table 8. Pests common to commercial species on BMDSF.

Scientific Name	Common Name	Host
Arceuthobuim campylopodum	(dwarf mistletoe)	PP
Armillaria mellea	(armillaria root disease)	DF, PP, SP
Dendroctonus brevicomis	(western pine beetle)	PP
Dendroctonus ponderosae	(mountain pine beetle)	PP
Dendroctonus pseudotsugae	(Douglas-fir bark beetle)	DF
Dendroctonus valens	(red turpentine beetle)	PP, SP
Endocronartium (Peridermium) harknessii.	(western gall rust)	PP
Gymnosporangium libocedri.	(incense-cedar rust)	IC
Heterobasidion annosum	(annosus root disease)	SP, PP
Ips spp.	(pine engraver beetle)	PP
Leptographium wageneri var. pseudotsugae	(black stain root disease)	DF
Melanophila drummondi	(flatheaded fir borer)	DF
Pseudohylesinus nebulosus	(Douglas-fir pole beetle)	DF
Scolytus unispinosus	(Douglas-fir engraver beetle)	DF
Phellinus pini	(white pocket rot or red ring rot)	PP, DF
Phaeolus schweinitzii	(schweinitzii root disease)	SP, DF

Other Management Factors

Law Enforcement

State law requires CAL FIRE to protect the State Forest “from damage and to preserve the peace therein.” The Forest Manager, Fire Prevention Battalion Chief, local CAL FIRE Battalion Chief, and Fire Prevention Captain work together to ensure that all relevant state laws are enforced. There are a number of laws that are specific to the State Forest system that address camping, campfire permits, noise, firearms use, firewood, rubbish dumping, smoking, and the protection of archeological features. Forest regulations and policies are posted on signs. The Department of Fish and Game wardens enforce fishing, hunting, and trapping laws.

Off-road use by four-wheel drive vehicles and motorcycles has been on the increase for several years and has resulted in soil erosion in some areas and the destruction of native and planted seedlings. This use also poses a definite fire hazard by vehicles without spark arrestors, and in some cases without mufflers, being driven over forest litter in areas remote from access from the Forest roads. Efforts to block known off-road trails have met with only limited success.

The cutting of green trees, the destruction of Forest roads and informational signs, and the dumping of garbage is a continuing problem that increased patrol and vigilance have not eliminated. The Lake County Sheriff's office has made many arrests on BMDSF in the past ten years. CAL FIRE employs a Forest Manager and Assistant Manager who enforce state laws on the State Forest as part of his/her duties. Unit Prevention Officers also assist with law enforcement issues.

Acquisition and Exchange

There are timberland parcels adjacent to the Forest, which may be available for purchase in the future, prior to subdivision or rural residential development. The pressure to pass through BMDSF to home or cabin sites that are landlocked could be greatly reduced and future problems avoided if the state were to purchase these sites.

PRC 4648 governs acquisition of forestland. Acquisition is made only upon the approval of the Director. Approval by the Director is based on satisfactory evidence presented to him by the Board of Forestry and Fire Protection as to the suitability and desirability of lands under consideration for purchase for State Forest purposes. This suitability and desirability is predicated on, but not limited to, the land being:

(a) Suited primarily to timber growing.
(b) Representative of growing capacities not below the average for the timber region.
(c) Favorably situated for multiple use and economical administration, management, and utilization.

The Director cannot approve the acquisition of any lands unless the Board of Supervisors, following a public hearing, adopts a resolution recommending State acquisition. Notice of the hearing will be published pursuant to Section 6066 of the Government Code. The holding of a hearing is optional to the Board of Supervisors for areas of 2,000 acres or less. Upon approval of a purchase by the Director, the Department may negotiate for and consummate the purchase of the lands.

Chapter 4. Research and Demonstration

The primary purpose of State Forests is to research and demonstrate economical silvicultural practices and timber harvesting procedures that protect environmental values. Long-term studies are crucial to understanding the effects of forest management actions as well as the effects of broader changes in forest influences, such as global climate change. As a publicly-owned forest dedicated to research and demonstration, BMDSF provides an ideal venue for long-term research. Some research projects on BMDSF have been periodically monitored for decades.

Ecologists used to focus on seral stages: pioneer through climax conditions. Once reaching a climax condition it was thought that stands of trees would always proceed in a steady-state small scale disturbance regime. This concept is now considered the exception for most ecosystems, with disturbance being the rule rather than the exception (Botkin 2006). The challenge now is to understand the disturbance regimes of the past and future to provide a productive outdoor laboratory for researchers. BMDSF's management plan, with its mix of older and young forest structure goals, and utilization of various unevenaged and evenaged silviculture techniques, allows for such studies.

Climate change, along with geological processes, has been shaping the range and genetic configuration of forests for millions of years. Scientists have modeled what may be near term alterations in climate, but there is a large degree of uncertainty. There is no significant environmental climate change impact related to management of BMDSF that can be predicted given the current state of scientific knowledge.

Three strategies will be employed on BMDSF to address the uncertainty regarding climate change:

- Keep the Forest healthy to maximize resilience to perturbations in moisture, temperature, pests, and storm events.
- Monitor species abundance and health as part of a long-term monitoring strategy.
- Develop partnerships, undertake and fund research.

Research Program Objectives

1. All ongoing studies should be carried out to completion. Final reports will be written on these studies. Reports should be in the form of a California Forestry Note whenever possible. Technical reports should be published in other journals when significant results are found. Follow up with researchers to ensure publication of results.

2. Encourage the permanent staff to be alert for potential studies and initiate studies whenever possible. Seek advice from research institutions and forest managers on potential studies that could be conducted.

3. Continue to utilize research funds and leverage professional contacts, Forest data, infrastructure (housing) and assistance with labor to encourage researchers to conduct their research on BMDSF.

4. Give tours to groups or individuals to show projects being conducted.

Five-Year Strategic Plan for Research and Demonstration

The goal of this plan is to build upon the current demonstration program by emphasizing research infrastructure, applied demonstration targeted towards small forest landowners and outreach. This plan identifies specific objectives to be accomplished within the next five years and resource requirements.

Research Planning

Research and demonstration on BMDSF typically takes two forms: a) projects initiated by CAL FIRE staff, either with or without outside researchers' involvement, and b) research undertaken by outside researchers, typically universities. This latter type of research project usually arises when the Forest staff is approached by researchers looking for a place to locate their research installations, and is difficult to anticipate. Planning future research projects therefore involves both creating the necessary diverse forest structure conditions necessary to make the Forest an attractive location to do research, and planning research and demonstration projects initiated by CAL FIRE staff.

The purpose of conducting demonstrational and experimental programs, either independently or in cooperation with other public agencies and educational institutions, is to gather and disseminate the information to forest landowners and the general public. To implement these programs has been the responsibility of the Forest Manager using the operating funds generally available for forest operations. To date, there has been one cooperative agreement with an outside agency to conduct a study. The advantages of a cooperative demonstration are the influx of additional expertise and a broader funding base.

CAL FIRE funded research comes from revenues created by timber harvest or through external grants. The periodic timber sales on the forest can also incorporate demonstration and experiment projects by including research project tasks or costs in timber sale agreements to be charged against stumpage.

Research Infrastructure

A demonstration forest is also a research forest. Some projects are accomplished by simply observing the process and the outcome (strictly demonstration). Many others, however, require the rigors of the scientific process to further the state of knowledge about forest resources (research or experimental).

Infrastructure is defined as the basic elements necessary to facilitate further activity. For this plan, research infrastructure includes researcher facilities, baseline data and information systems.

Objective: Maintain the available barracks, including bunks and kitchen facilities, at BMDSF headquarters.

This will be an ongoing function of BMDSF staff that will include routine maintenance, materials for minor building repairs, necessary supplies including propane, diesel, and cleaning supplies. Estimated cost is $5,000 annually.

Objective: Collect, organize, and store data on tree and plant inventories; wildlife and fish inventories; and soil, geologic, meteorological, and watershed data so that it is available to researchers.

An ongoing multi-resource terrestrial inventory is conducted on BMDSF, the Continuous Forest Inventory (CFI). The CFI inventory was established in 1976 providing important long-term data on forest growth. It will be updated every five years. Significant BMDSF staff time is allocated to

collecting and managing this data. The CFI inventory will be periodically reviewed for appropriateness and efficiency by BMDSF staff and State Forests Biometrician and Research Coordinator. The possibility exists to expand both the intensity (number of plots) and the range of parameters being measured.

At least one weather station will be installed on the Forest. Installation is dependent upon adequate research budget and staffing. Ongoing maintenance and data collection will be the responsibility of BMDSF. Estimated annual costs are $3,000 and the staff time of the BMDSF Research Forester.

Applied Demonstration

Objective: Demonstrate various means of applying group and single tree selection so that practical implementation issues and multi-resource implications may be examined.

Demonstration areas that may also be used for research will be installed on BMDSF. As funding permits, two or more levels of residual stocking, for each silvicultural method, will be demonstrated. Records will be kept, by unit, pertaining to costs and other relevant parameters.

Research targeted at regeneration units within group selection areas, or even-aged management areas where they occur, will be encouraged. This research will look at regeneration and herbaceous vegetation growth, methods of controlling competing vegetation, and possibly the use of fire and other mechanical means for site preparation.

Objective: Demonstrate methods to inventory and update roads to reduce erosion.

Continue to implement a road inventory and improvement program on BMDSF. Document projects to show before and after conditions, particularly regarding inside ditches and watercourse crossings. Records on costs will be retained, as will estimates of sediment savings derived from improvements.

Applied Demonstration Costs: The selection silviculture demonstration project will require both BMDSF and Sacramento staff's time to initiate and track. It is not anticipated that any additional forest inventory plot work over and above the current CFI will be necessary. Depending on the applicability, costs for multi-disciplinary investigations could cost the Sacramento research fund up to $10,000 per year.

The road improvement demonstration is part of an ongoing operational program started in 1998. BMDSF staff time requirements will increase due to information tracking requirements. Road improvement funds from Sacramento must be fully funded.

These projects will result in BMDSF staff time requirements for outreach projects such as report writing, presentations, and tours.

Outreach

A strong outreach program to convey information and display results complements the investment in research and demonstration. Outreach is accomplished through papers, articles, presentations, tours, and the web.

Objective: Research results from BMDSF are provided to customers.

Each project will be evaluated as to the most appropriate outlet for dissemination. The following table provides some guidance.

Table 9. Guidelines for publications.

Type	Outlet	Criteria for Use	Responsible Persons
Peer Reviewed Scientific Journal	Forest Science, Canadian J. of Forestry, J. of Forestry, discipline specific journals such as the J. of Wildlife Mgmt.	Strongly encouraged for rigorous scientific studies, enforces objectivity and thorough review of methods	Authors are responsible for writing and editing; some assistance from Sac. Pubs. Coordinator
Peer Reviewed Applied Journal	Western J. of Applied Forestry	Strongly encouraged for studies with direct field applicability	Same as above
Institution Specific Pub. (non-CAL FIRE)	Hilgardia (UC), General Technical Report (USDA For. Serv.)	Lengthy publications, publication not appropriate for other journals, but of high value	Same as above
CAL FIRE Publication	California Forestry Note	Applied articles of six pages or less; may be a shorter summary of journal paper	May be written either by author or Sac. Pubs. Coordinator; edited and published in Sac.
CAL FIRE Publication	California Forestry Report	Applied articles of greater than six pages; may be a longer more detailed version of a journal paper	Authors are responsible for writing; Sac. Pubs. Coordinator responsible for editing and publishing
CAL FIRE Publication	California Demonstration State Forests Newsletter	Quarterly publication that includes research, demonstration, recreation, and other news	All state forests staff contribute articles, Sac. Pubs. Coordinator responsible for editing and publishing
Presentations	Poster Presentations	Appropriate at any stage of development for a project	Author has primary responsibility with assistance from Sac.
Presentations	Oral Presentations	May be conference or meeting presentation, strongly encouraged for critical research results	Author has primary responsibility with assistance from Sac.
Tour	Educational	May be conducted for any interest group including professionals, politicians, or students.	BMDSF staff has primary responsibility
Tour	Workshop	Usually directed towards natural resource professionals	BMDSF staff has primary responsibility with assistance from author(s) if required
Web Site	California Demonstration State Forests Web Site	Part of the CAL FIRE web site, this will contain electronic copies or links to all relevant publications, posters, etc.	Sac. Pubs. Coordinator has primary responsibility with assistance from BMDSF staff

Objective: The public has access to information about the State Forest mission as well as past and current projects at BMDSF.

This will be facilitated by the California Demonstration State Forests web site, which will be housed at the CAL FIRE web site. The CAL FIRE publications will be posted to the web site and distributed to appropriate libraries in the State, as funding and staffing allows. The State Forests Newsletter will report on projects and results.

Outreach Costs: BMDSF staff time requirements for outreach will vary with the number of publications produced in-house and the number of tours and workshops put on. Editing of contracted publications by BMDSF staff also consumes staff time and will vary with the number and complexity of projects.

Many of the outreach costs are borne over the entire Demonstration State Forests system, such as the web site or newsletter. This assumes that the biometrician, research coordinator, and publications coordinator positions in Sacramento are fully staffed and that operating funds are available. At least $10,000 per year will be needed in Sacramento to fund publishing costs.

Conclusion

This five-year research and demonstration plan for BMDSF provides a direction for the continued success of BMDSF. Growth in demonstrations and experiments will result from the attention to research infrastructure and outreach. The specific demonstration projects outlined above will add significant value to current operational practices by using them as models for sustainable forest management.

Research Projects

Planned Projects

A high priority for research is regenerating, increasing growth, and harvesting timber species in second growth ponderosa pine and ponderosa pine/Douglas-fir forests in the interior coastal range of California. The demonstration and experiment goals will be attained by management of timber and non-timber species of vegetation through traditional and new harvesting, thinning, and release practices.

There is an abundance of biomass material available for harvest within BMDSF in the form of small, overcrowded, suppressed, dead and dying trees. The smaller trees are expensive to harvest and the markets for pulp and fuel for wood-burning energy facilities have steadily declined in California over the past decade. BMDSF will take an active role in exploring the economic feasibility of harvesting these low-value resources for stand improvement and fire hazard reduction.

Climate change and carbon sequestration is an emerging fertile research area. Relatively little is known about the potential for sequestering carbon in forests and how different management regimes can result in different amounts of carbon sequestered over long periods of time. BMDSF plans to install at least one such study to evaluate the carbon storage benefits of converting current brush dominated land to conifer forests, given sufficient budget and staffing.

Ongoing Projects

Growth and Mortality Plots - 1952/53 – CDF: Ten, 2 1/2-acre plots distributed throughout the Forest are measured every five growing seasons. Originally these plots were established on cutover areas to determine growth and mortality, especially to determine losses from insect attack following extensive logging in 1950/51. The distribution and the small number of the plots render them unsuitable for inventory purposes. The results given are for the plots only and cannot be projected to other areas of the forest with any degree of accuracy. The plots have been maintained in recent years because they offer a relatively long periodic growth record of several individual and groups of trees and because individual and groups of plots allow for useful learning settings for measuring exercises.

Completed Projects

Dogwood Control project -Terminated 1974.
Fomes Annosus Stump Protection Studies (State Forest Note #39 1969).
Pine Fertilization Test #1 (Final Report submitted 1973) .
Demonstration Planting Project 1971 -Terminated 1974. Possible plantation release study site.
Manzanita Control in a Ponderosa Pine Regeneration Area -Completed 1971.
Competing Vegetation Study -Completed (Forest Note #49 -1972) .
Yield Study, Even-aged Ponderosa Pine -Completed 1970.
Chemical Control of Dwarf Mistletoe -Completed 1970.
Cut Surface Hardwood Treatment "Herbicide Injection of Cull Hardwoods With a Tree Marking Paint Gun." -Completed 1971.
Commercial Firewood Harvesting Study -Completed (Forest Note #70 -1979)
1972 Commercial Thinning Plot -Terminated 1982.
Biomass Cutting Study -Completed 1982.
1983 Horse Logging Demonstration -Completed 1983.
Evaluation of Fire Management Decisions on the Urban-Wildland Interface -
Boggs Mountain Nature Trail - 1987 - Cooperative CDF/Middletown Unified School District - Cobb Mountain School.
CDF Funded: U.C. Berkeley - Researcher: Robert Martin. Completed -1988.
Plant Succession, Planted Pine Seedlings, and Competing Vegetation in a Group Selection Cutting - 1989 - CDF Funding: Cooperative CDF/USFS Study - Researchers: Philip McDonald and Gary Fiddler, USDA Pacific Southwest Forest and Range Experiment Station. Completed-1993
Prescribed Fire Effects in Douglas-fir and Extended Decision Analysis - CDF Funded: U.C. Berkeley - Researcher: Robert Martin. Completed-1991.
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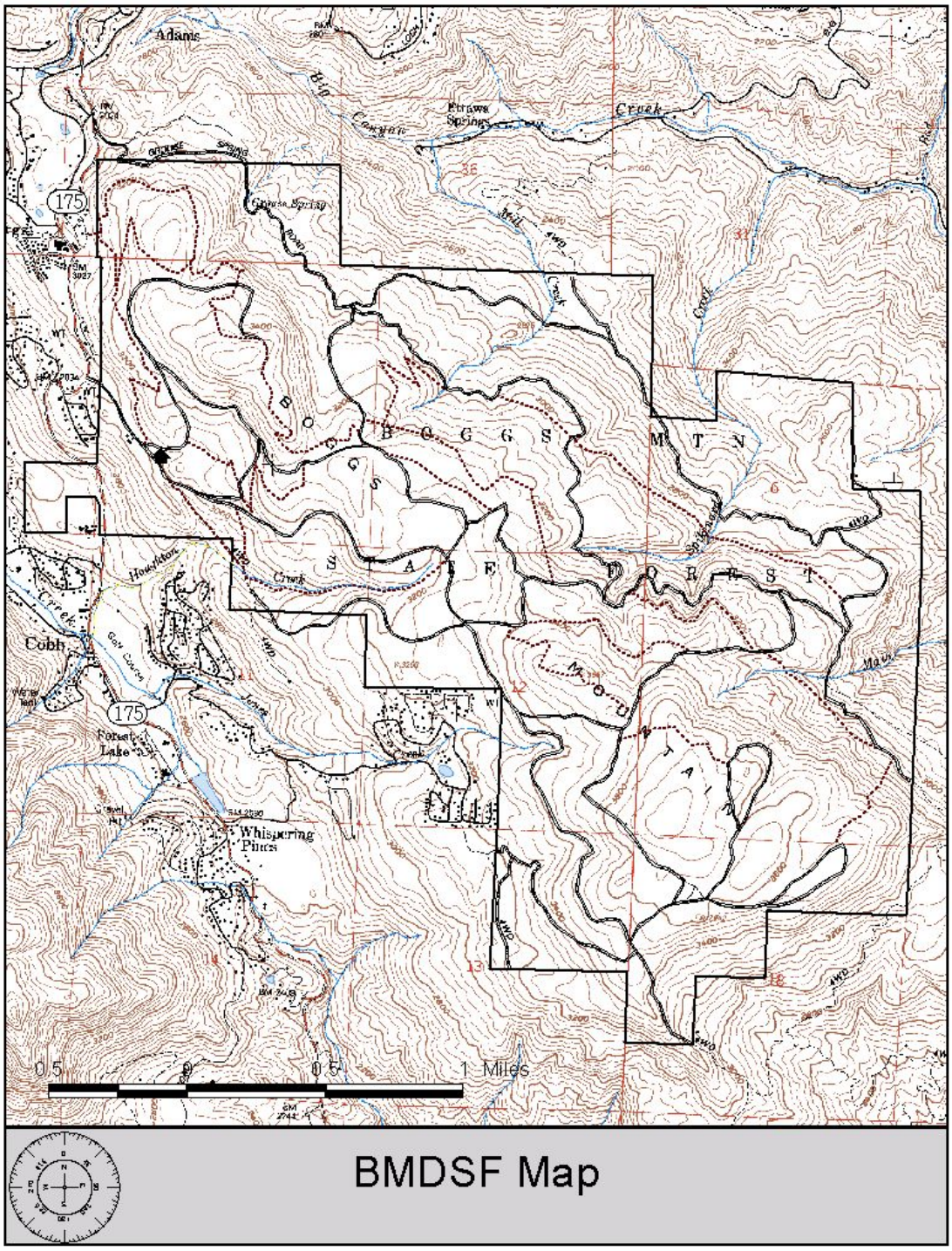
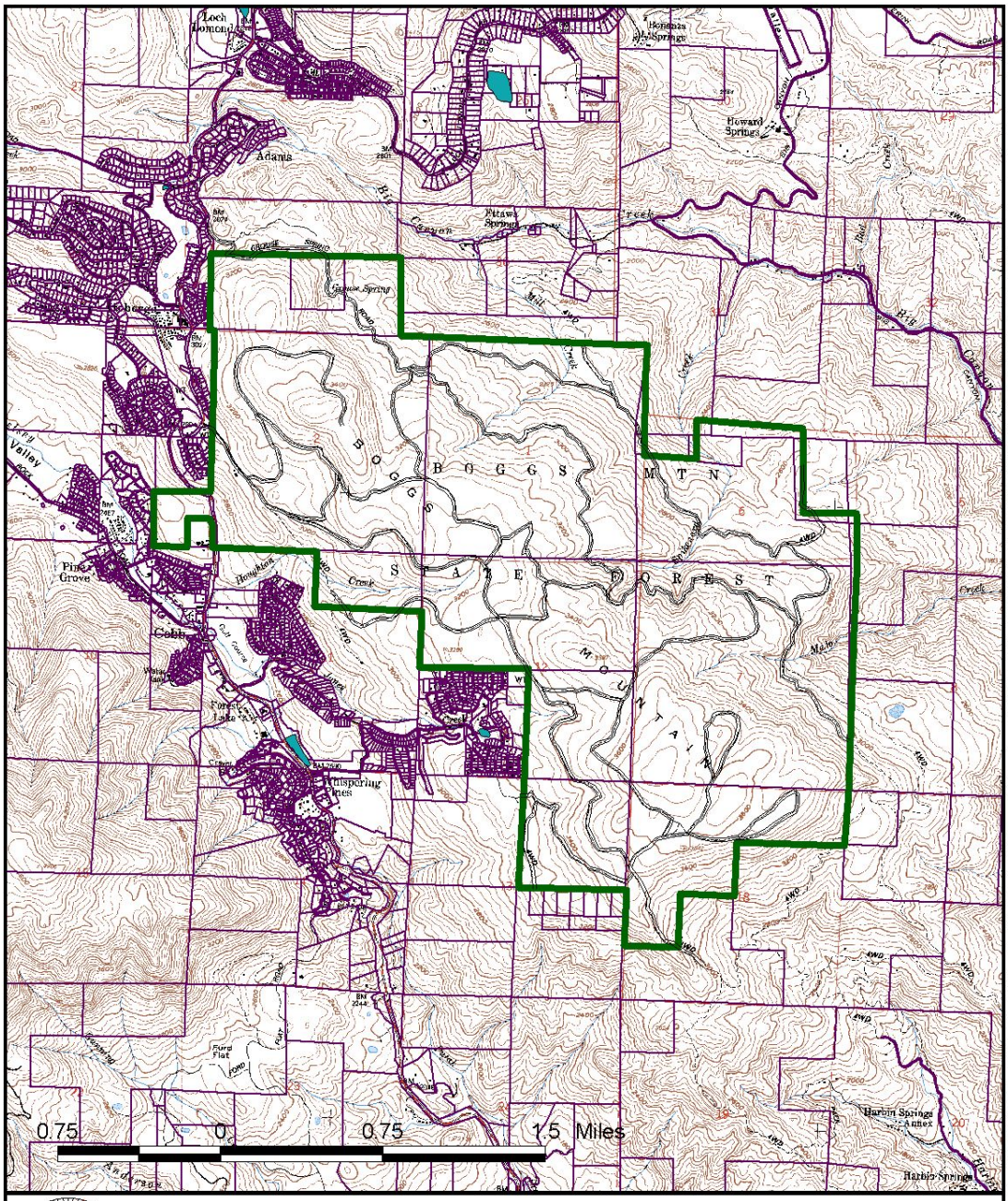
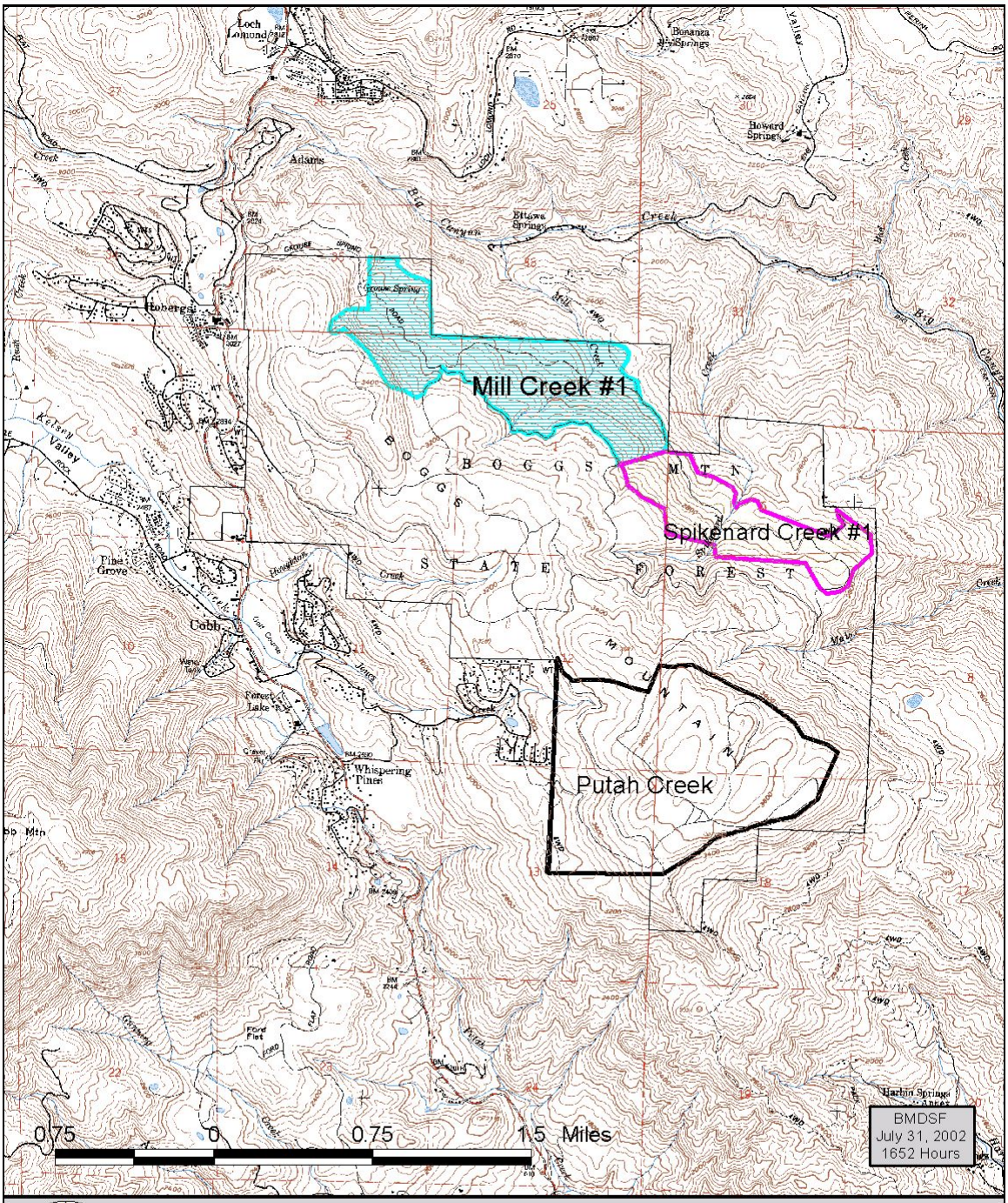
Appendix I. Maps





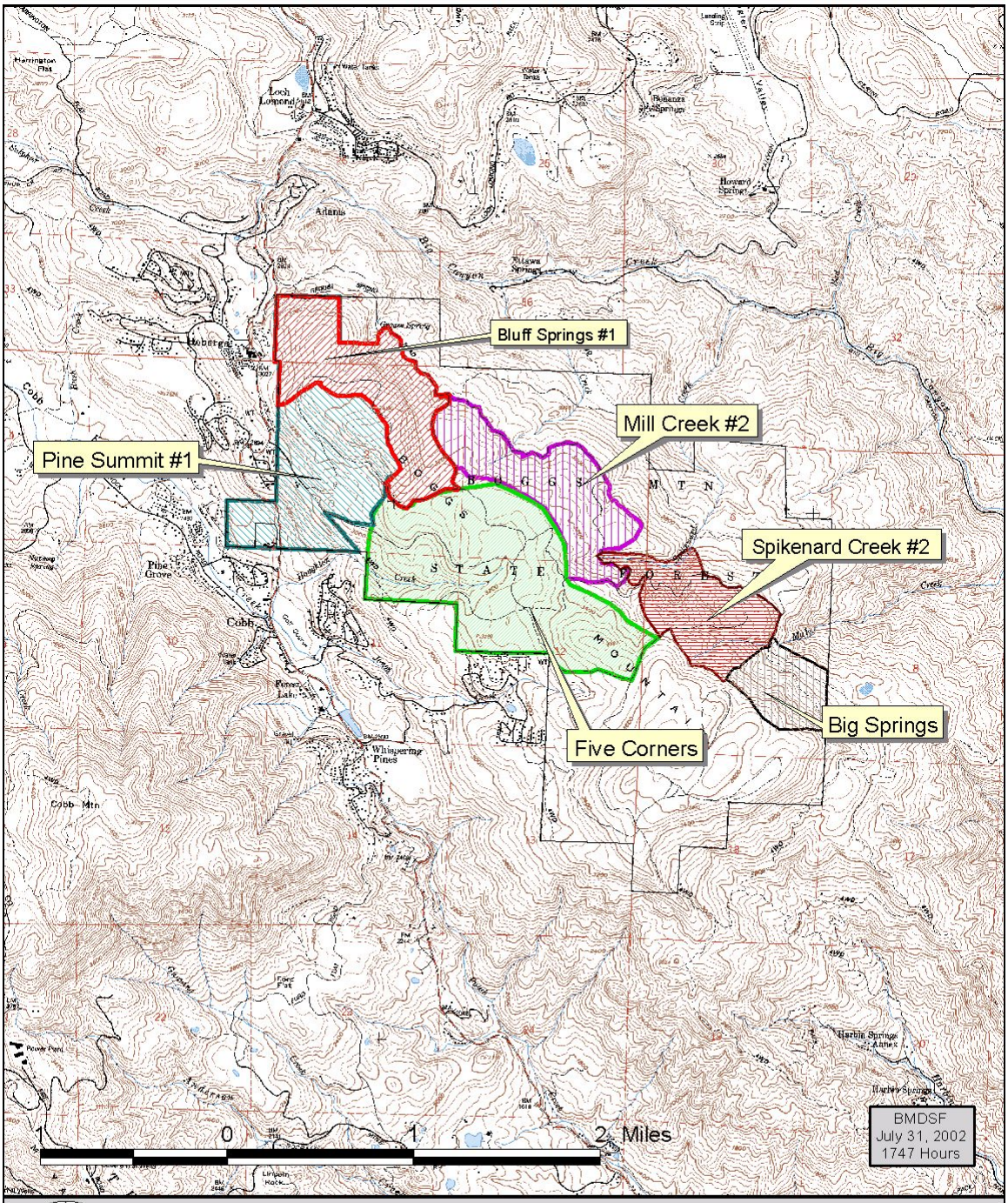
Adjacent Parcels

Boggs Mtn DSF



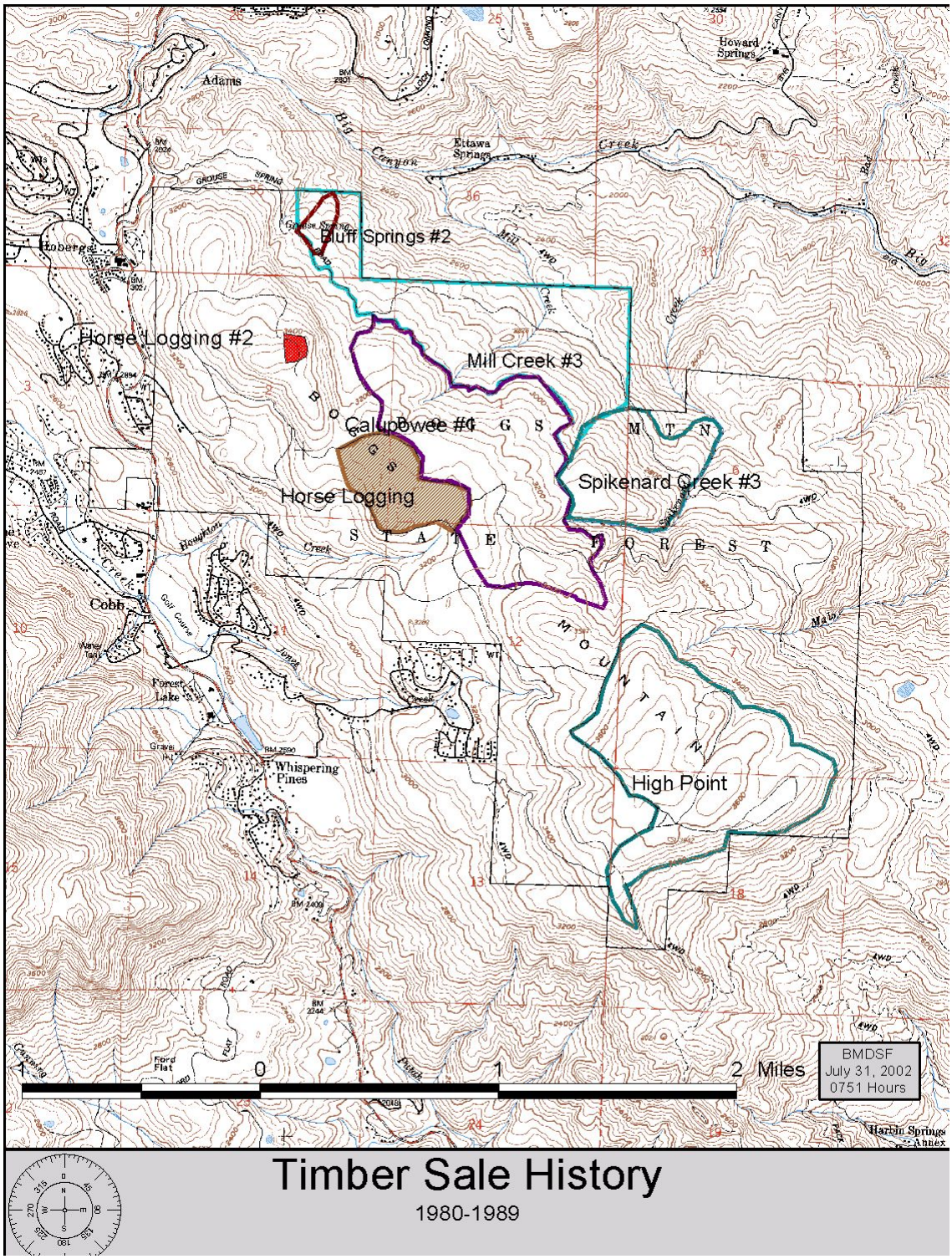
Timber Sale History

1949-1969



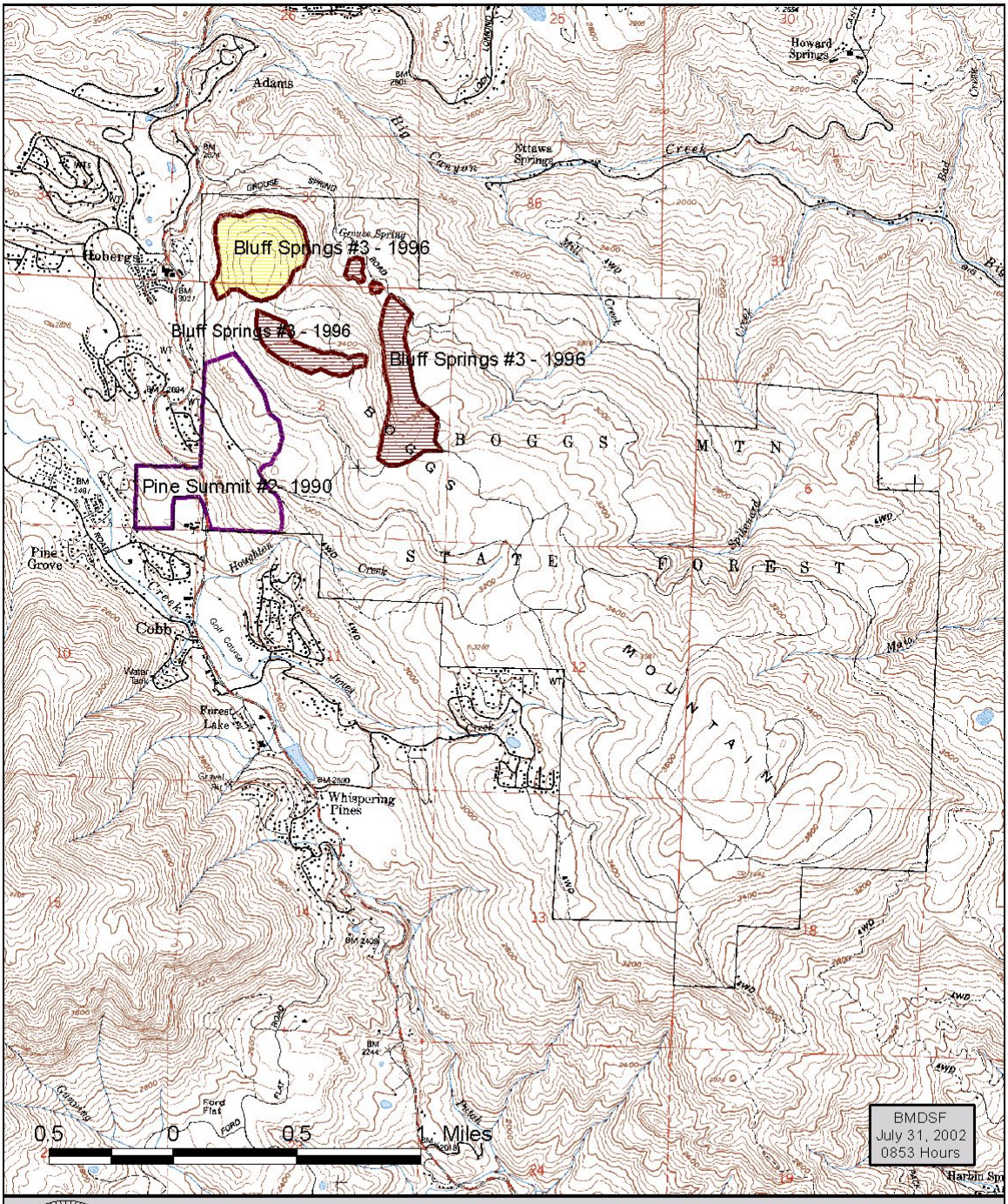
Timber Sale History

1970-1979



Timber Sale History

1980-1989

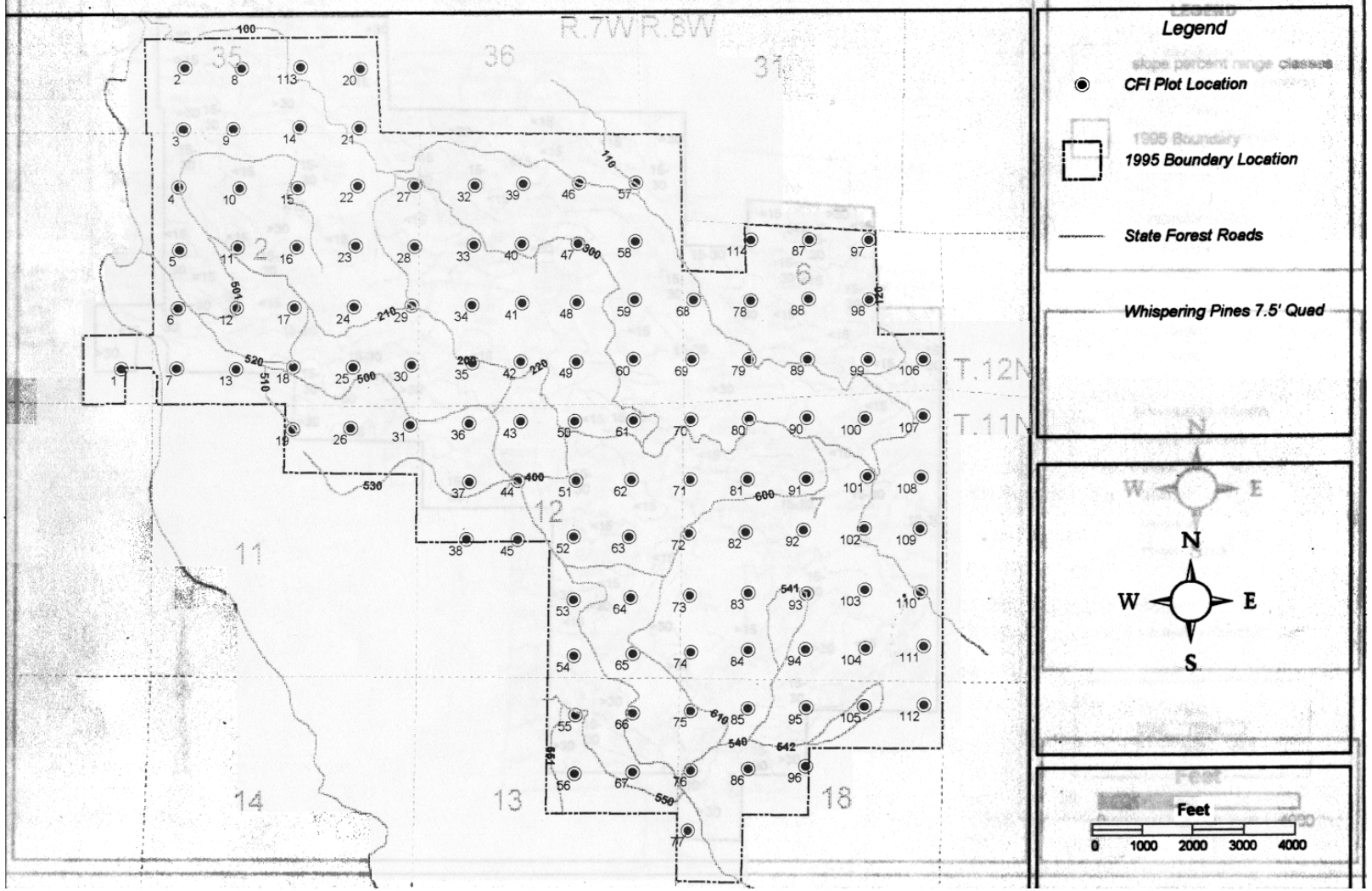


Timber Sale History

1990-1999

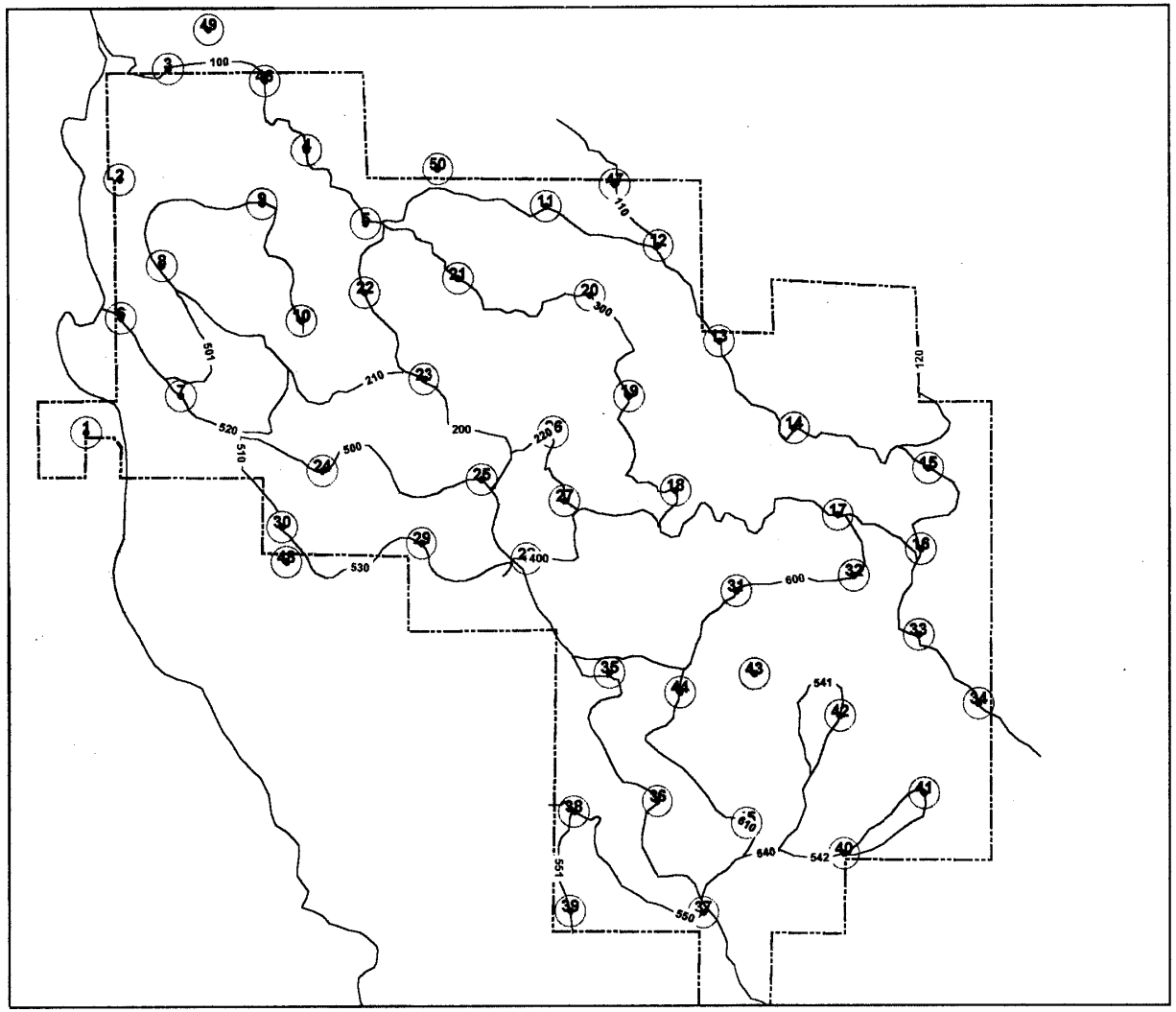
BOGGS MOUNTAIN DEMONSTRATION STATE FOREST

Continuous Forest Inventory Plot Locations



BOGGS MOUNTAIN DEMONSTRATION STATE FOREST

Spotted Owl Calling Points



Legend

NSO Calling Points

1995 Boundary

Roads

N
W E
S

Feet

0 1000 2000 3000 4000

Appendix II. Road Management Plan

Introduction

This road management plan involves erosion control, watershed restoration and road rehabilitation work on Boggs Mountain Demonstration State Forest (BMDSF) in Lake County, Ca. Upgrading of the road network is essential for long term resource management, administrative access, fire control and recreational purposes. A major goal of this plan is to establish a road system that is largely self-maintaining and/or requiring low levels of maintenance. Road upgrading will minimize fine sediment contributions to stream channels and reduce the risk of serious erosion and sediment yield when large magnitude storms occur. A variety of upgrade techniques such as culvert upsizing, converting ditched insloped roads to outsloped alignments and installing rolling dips as well as other treatments will be utilized throughout the road network. A systematic approach to road management problems was employed in order to identify, prioritize and cost-effectively treat current and future sediment sources on the forest.

Road Survey

To meet the objectives of the road management plan, an assessment of the road system was conducted. The assessment process included:

1. Field inventories of potential sediment sources:
   - roads and landings
   - landslides and cut/fill failures
   - gullies and stream channels

2. Development of site-specific treatment prescriptions

3. Prioritization of sites for treatment

The road survey was accomplished by identifying work sites beginning from the west end of all the roads with the exception of Roads 400 and 600. These were surveyed from the south end (Jct. Road 500) and proceeding north to the junction of Road 300. Sites (i.e. road sections) were located by noting the mileage (from west to east) on the road inventory data forms. All roadwork can be laid out using the standard engineering “station” method. A station is a 100-foot interval, measured along the centerline of the road. A station lath, or colorful flagging, will be installed on the cutbank along the road every 100 feet starting at the beginning of the road. An alternative to this method is to label colorful flagging at the beginning and end of a work site. This method can be accomplished using the mileage locators from the work site descriptions. It is recommended that work should proceed from the end of the road and work out (i.e., west to east). There are approx. 9 miles of inboard ditch on the road system. Of this, approx. 7.5 miles can be eliminated in the upgrade process.

Techniques for Mechanical Erosion Control

1. Road and Landing Ripping (RIP)

Ripping is employed to thoroughly decompact and disaggregate a road or landing surface in order to improve infiltration and speed revegetation. On a road, it is employed from the outboard edge to and including the inboard ditch. Typical equipment used for ripping compacted road and landing surfaces include D-7 and D-8 size tractors with two or three hydraulically operated ripping or chisel shanks mounted on the rear. On roads, which are less well-compacted and not heavily surfaced with rock, graders or smaller tractors with chisel teeth mounted on their scraping blades can also be used for decompacting.

Ripping is performed at all fill sites (including where outsloping occurs) prior to the application of fill, and to all road and landing surfaces whether they are to be cross road drained or outsloped. Road and landing surfaces should be ripped before any other treatment is applied. The ripping depth and the maximum spacing between adjacent ripper shank passes shall average 1.5 feet and spacing shall not exceed 2.0 feet.

Inboard ditches are not to be ripped where cross road drains are prescribed, nor are the remaining benches ripped along reaches where Exported Outsloping (EOS) is to be performed. In addition, the surface of stream crossing fills and other road fills, which are to be completely excavated, need not be ripped if the fill is to be removed as a part of the rehabilitation treatment. In some cases, decompaction of these surfaces may make later excavations easier to accomplish.

2. Cross Road Drains (XRD)

A cross-road drain is a deeply cut ditch, excavated across a road surface, which drains the road bed and inboard ditch. Cross road drains are more substantial and deeper than conventional waterbars used to drain forest and ranch roads. Well constructed cross-road drains will often be deep enough to prevent vehicular access to an area. Cross-road drains are typically constructed (excavated) using a tractor, an hydraulic excavator or a backhoe.

Spacing of cross-road drains is highly dependent on the permeability and erodibility of the soil, which is exposed on the road surface. Drains in stable, forested areas may be spaced approximately 200 feet apart when road grades are less than 6%, and roughly 100 feet apart when road grades exceed 6%. In areas of erodible, decomposed granitic soils, road surfaces shall be drained at intervals not exceeding 50 feet and more frequently if local soil conditions and road gradients dictate.

Each cross-road drain shall be free draining for its entire length, and have a uniform grade approximately equivalent to the gradient of the ditch or adjacent road surface, which flows into the cross-road drain. The depth of the drain at its inlet side should equal the existing inboard ditch level, but shall never be less than 18 inches. In all cases, cross-road drains on ditched roads shall be deep enough to intercept all ditch flow.

Spoil is placed, compacted and smoothed on the downhill side of the excavated drain as a berm. Compacted fill and spoil is also used to completely fill the ditch at the drain inlet (where the drain intercepts the inboard ditch) to prevent ditch flow from bypassing the structure's inlet. Side-bank steepness along the drain should not exceed 50%. Existing inboard ditches are left undisturbed and free flowing to each drain.

No more than 15% of the total excavated volume of each cross-road drain may be sidecast at the drain outlet (there is a tendency to sidecast more material when the drain is built by a tractor). In areas underlain by decomposed granitic soils or other highly erodible soil, or where the drain is to discharge in close proximity to a stream channel, sidecasting shall be avoided. This largely dictates the use excavators and backhoes.

Cross-road drains shall not discharge onto the sideslopes of freshly excavated stream crossings, or onto long reaches of bare, unprotected slopes. On a site-specific basis, energy dissipation (rock armor, secured slash or other suitable materials) will be required to control erosion at the outlet of the cross-road drain.

3. Waterbars

A waterbar is a shallow ditch excavated at an angle across a road or trail to drain surface runoff. They are usually built on seasonal or temporary roads, which are to receive little or no traffic

during the winter period. The waterbar should be extended to the cutbank to intercept all ditch flow and extend beyond the shoulder of the road. A berm must block and prevent ditch flow from continuing down the road during flood flows. The excavated waterbar should be skewed 30 degrees to the ditch-line with the excavated material bermed on the downhill grade of the road. Water should always be discharged onto the downhill side on a stable slope protected by rip-rap or vegetation. The cross ditch depth and width must allow vehicle cross-over without destroying the function of the drain.

4. Critical Dip (CD)

Critical dips are broad swales excavated into the bed of the maintained road in order to eliminate the potential for stream diversion if the culvert plugs during a storm or flood. At stream crossings with a high diversion potential, floodwaters back up behind a plugged culvert, flow onto the road surface (or into the ditch) and flow down the road. In a crossing with no diversion potential, floodwaters emerging onto the road surface travel across the road prism and back into the channel on the lower side of the crossing potentially washing out the fill.

Critical dips may be excavated over the top of the crossing, provided the culvert is deeper than the proposed excavation. If the culvert is located shallow in the crossing fill, the excavation for the critical dip may be made immediately down-road from the crossing site. The excavation work can typically be performed with a crawler tractor in 1 to 1.5 hours.

5. Rolling Dip (RD)

Rolling Dips are simply breaks in the grade of a road. They are sloped either into the ditch or to the outside of the road edge to drain and disperse road surface runoff. Rolling dips are installed in the roadbed as needed to drain the road surface and prevent rilling and surface erosion. They are most frequently used on outsloped roads.

Excavation for a rolling dip typically begins 50 to 100 feet up-road from where the axis of the dip is planned. Material is progressively excavated from the roadbed, slightly steepening the grade until the axis is reached. This is the deepest part of the excavation, with the overall depth being determined by the slope of the road. The steeper the road, the deeper the dip will have to be in order to reverse grade. To effectively direct runoff to the side of the road, the axis of a rolling dip should be angled about 30 degrees to the road alignment. On the down-road side of the rolling dip axis, the road bed slope should actually rise slightly to ensure that runoff cannot continue down the road surface. This is called a “grade change”.

The rise in grade is carried for about 10 to 20 feet before the road surface begins to fall again at its original slope. This transition from axis bottom, through rising grade, to original falling grade is achieved in a road distance of 15 to 30 feet. The rolling dip should be broad and shallow enough to permit low-boys, log trucks and other equipment to pass without slowing traffic excessively or causing them to scrape bottom.

Figure 1.

Table of Rolling Dip Dimensions				
Road grade (%)	Upslope approach (distance from up-road start of rolling dip to trough)(ft)	Reverse grade (distance from trough to crest)(ft)	Depth below average road grade at discharge end of trough (ft)	Depth below average road grade at upslope end of trough (ft)
<6	55	15-20	0.9	0.3
8	65	15-20	1.0	0.2
10	75	15-20	1.1	0.1
12	85	20-25	1.2	0.1
>12	100	20-25	1.3	0.1

6. Outsloping (OS)

This treatment calls for the removal of unstable or excess sidecast material from the outer edge of a road prism and replacing this spoil locally on the adjacent, remaining road bench, or at another stable storage site. In road upgrading, excavated material can be used to build up the roadbed and convert an insloped, ditched road to an outsloped road.

Conditions that might limit road outsloping include: steep road grades, winter use of an unsurfaced road and upslope runoff or excessive spring-flow from the cutbank or roadbed. However, roads, which are outsloped for much of their length, can be insloped to deal with local conditions. Outsloping is most frequently performed using a combination of crawler tractors and excavating machinery. Roads crossing moderate or gentle terrain can be outsloped with tractors alone. On steeper sites or where there are numerous trees along the alignment, hydraulic excavators are often the best tools for performing the outsloping work.

Figure 2.

Outsloping "pitch" for roads up to 8% grade		
Road grade	Outslope "pitch" for unsurfaced roads	Outslope "pitch" for surfaced roads
<4	3/8" per foot	1/2" per foot
5	1/2" per foot	5/8" per foot
6	5/8" per foot	3/4" per foot
7	3/4" per foot	7/8" per foot
>8	1" per foot	1 1/4" per foot

7. Storage Areas and FillsiteTreatment (FS)

In most cases, stable fillsites with adequate capacity are within a bulldozer's push distance from a worksite. Rock pits, wide, stable sections of road, ridges and landings are typical locations where fill can be stored.

All fillsites shall be thoroughly ripped prior to importing and placing spoil material. The fill shall be placed first along the inside area (against the cutbank) and then extended outward from the

cutbank to approximately 8 feet from the outboard edge of the road or landing. Fill thickness should grade down to not more than 3 feet along the outboard edge of the road to minimize the potential for mass movement. The fill shall be shaped conformably into the existing cutbank, not to exceed the height of the cutbank. The steepness of any finished fillsite shall not exceed 50%. The finished surface shall not trap or pond surface water and must encourage surface flow in the same direction as adjacent lands.

8. Straw Mulching

Straw from bales shall be spread evenly over a predesignated area at an application rate of 3000 to 6000 lbs./acre, as specified in the field. At these application rates, the ground surface will be visible in no more than 5% of the mulched area. Covered areas should be 3 to 4 inches deep.

- Straw shall be spread evenly at the designated rate and within the designated bare and/or disturbed areas.
- Bailing wire shall be removed from the site and disposed of properly.
- Straw shall be as free as possible from exotic seeds. Hay shall not be used unless otherwise specified.
- Mulching shall be the last task performed on the work area, following any heavy equipment operations, seeding and fertilizer application.

Heavy Equipment

1. Bulldozers

Bulldozers are best for moving large quantities of fill quickly, preliminary stream crossing excavations, rolling dips, recontouring rock pits and for final shaping of outsloped roads, landings and fillsites.

2. Excavators

Excavators are best for lifting fill on steep slopes, final shaping of stream channel bottoms and working in tight locations, such as between trees. Excavators have a 360-degree swing, enabling them to put the fill directly behind them, where another piece of equipment can get to it.

3. Backhoes

Backhoes are seldom used for excavating work, except for road maintenance activities such as replacing culverts. Their limited swing and reach, and low bucket capacity make them inefficient for large excavation sites. The major advantage of a backhoe is mobility and low-cost on small work sites.

4. Dump Trucks

Dump trucks are a costly but essential method to move fill longer distances. If fill needs to be moved further than 800 feet, trucks are usually more cost-effective than bulldozers. The use of 10 cubic-yard trucks is very common.

Work Site Descriptions

ROAD 100

Mileage begins at the junction of Road 300(west) and proceeds eastward

Site1: Mile 0.0 to 0.5 (2640 ft.)
Priority: High

This section of road is insloped with an outside berm and an inboard ditch. The most significant problems are the serious erosion that is occurring with the inboard ditch and surface erosion of the roadbed. Drainage structures from Road 300, which is upslope approximately 100-200 feet, are having a significant impact on the amount of concentrated runoff accumulating on this section of Road 100. As a result, the ditch relief culverts are overwhelmed and are highly susceptible to plugging. In some places the inboard ditch has eroded to 5 feet wide and 6 feet deep, while in other downslope locations, the inboard ditch has filled with fine sediment and is non-existent. The headwall for the culverts, in some cases, is non-existent or is badly degraded. The berm on the outside road edge channels surface runoff back onto the roadbed. Even where the road surface is level, crowned or slightly outsloped, the outside berm prevents free-flow drainage of the road surface. There are several waterbars that drain surface runoff, but the main problem is with the inboard ditch. Most of the sediment yield is dissipated on the downhill slopes, but a fair percentage is delivered to Mill Creek. Parent rock exposed first .05 miles of road and then at .15, .5-.7 miles. Inboard ditch is filled in and the berm deteriorating in some spots. Runoff flows downhill from culvert #4.

Remedial treatments include:
1. Outslope road surface
2. Remove ditch relief culverts and replace with rolling dips or rocked fords
3. Excavate outside berm and use spoil to fill inboard ditch
4. Upgrade culvert #2 to 18” diameter or install rocked ford and armor outfall
5. Retain inboard ditch, mile 0.7 to 0.75

Site 2: Mile 0.75
Priority: High
Mill Creek Stream Crossing

There are currently two 30” diameter culverts at this stream crossing with a headwall of approx. 5 feet. A waterbar drains the overflow but does not direct the runoff back into the watercourse (High Diversion potential). Slope erosion into inboard ditch just past Mill Creek.

Remedial treatments include:
1. Replace and install larger culvert (diameter 72”, length 40 feet)
2. Install Pipe Arch culvert (72” diam.)
3. Increase headwall height
4. Maintain vegetation control at inlet
5. Install Trash Rack to prevent debris from plugging culverts
6. Install Critical dip

Site 3: Mile 0.75 to 1.2 (2376 ft.)

This section of road is insloped with an outside berm and an inboard ditch. The berm on the outside road edge channels surface runoff back onto the roadbed. There are several waterbars that drain surface runoff, but the main problem is with the inboard ditch. The inboard ditch has

failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to some surface erosion. Ditch relief culverts and waterbars have been functioning properly in this section of road. Exposed rock at .9 and 1.1 miles. Inboard ditch non-existent in some places. Tree growing over road at 1.15.

Remedial treatments include:
1. Outslope road surface
2. Remove ditch relief culverts and replace with rolling dips or rocked fords
3. Excavate outside berm and use spoil to fill inboard ditch

Site 4: Mile 1.2 to 1.7 (2640 ft.)

This section of road is insloped with an outside berm and an inboard ditch. Due to high rock content of roadway, there is minimal surface erosion occurring. Most of the ditch relief culverts in this reach of road were plugged or partially plugged. The waterbars in this section of road have been functioning properly. Exposed rock at 1.45-1.5, and 1.7 miles.

Remedial treatments include:
1. Outslope road surface
2. Remove ditch relief culverts and replace with rolling dips or rocked fords
3. Excavate outside berm and use spoil to fill inboard ditch

Site 5: Mile 1.75 to 2.2 (2376 ft.)

This section of road is insloped with an outside berm and an inboard ditch. Due to high rock content of roadway, there is minimal surface erosion occurring. Most of the ditch relief culverts in this reach of road were plugged or partially plugged. Exposed rock at 1.75-1.8, 1.9, 2.0, and 2.2 miles.

Remedial treatments include:
1. Outslope road surface
2. Remove ditch relief culverts and replace with rolling dips or rocked fords
3. Excavate outside berm and use spoil to fill inboard ditch

Site 6: Mile 2.3 to 2.7 (Jct. Rd. 300) East (2112 ft.)

This section of road is insloped with an outside berm. There is minimal or no inboard ditch in this section. Existing waterbars are responsible for road surface drainage. There are no ditch relief culverts until the junction of Road 300. Berm on right side of road. Exposed rock most of the way, but especially around mile 2.4. Bad erosion near junction. Vegetation grown over road.

Remedial treatments include:
1. Outslope road surface
2. Install rolling dips
3. Excavate outside berm and smooth over road surface

Site 7: Mile 2.7 to 3.15 (Big Spring) (2376 ft.)

This section of road is currently outsloped, level or crowned with an outside berm. There is no inboard ditch and consequently no ditch relief culverts. Even though the road surface is level, crowned or slightly outsloped, the outside berm prevents free-flow drainage of the road surface. Existing waterbars are responsible for road surface drainage. Exposed rock at 2.8 miles.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over road surface
3. Install rolling dips

Site 8: Mile 3.2 to 3.3 (End) (528 ft.)

This section of road is insloped or crowned with an outside berm. There is moderate to heavy erosion occurring just past Big Spring due to an old road that delivers concentrated runoff directly onto the road surface of Road 100 (mile 3.2). A deep gully has formed in the old road due to the failure or lack of drainage structures. A waterbar on Road 100 partially drains this excess runoff, but the waterbar itself is heavily eroded. Drainage structures need to be installed on the old road to prevent the current erosion problem. There is no inboard ditch nor ditch relief culverts in this stretch of road. The outside berm prevents free-flow drainage of the road surface. Existing waterbars are responsible for road surface drainage. Major mud bogs in this section.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over road surface
3. Install rolling dips or rocked fords
4. Install drainage structures on old road (i.e. waterbars, cross-road drains)

ROAD 200

Mileage begins at the junction of Road 300.

Site1: Mile 0.0 to 0.15 (792 ft.)
Priority: Medium

This section of road is insloped with an outside berm and an inboard ditch. Ditch relief culverts have not been functioning properly in this section of road. These culverts are prone to plugging from rocks and debris carried by the inboard ditch. The road grade on this section of road is approximately 8%. Drainage structures such as waterbars will need to be maintained. Water bars seem to be working in this section of road.

Remedial treatments include:
1. Outslope road surface
2. Remove ditch relief culverts and replace with rolling dips or rocked fords
3. Excavate outside berm and use spoil to fill inboard ditch
4. Rock surface
5. Armor drainage outlets

Site 2: Mile 0.15 to 0.3 (792 ft.)
Priority: Medium

This section of road is insloped with an outside berm and an inboard ditch. Fine sediment is being delivered to an adjacent watercourse, which parallels the road. Ditch relief culverts are prone to plugging from rocks and debris carried by the inboard ditch. The road grade on this section of road is approximately 4%. Exposed rock at .15 miles.

Remedial treatments include:
1. Retain insloped road prism
2. Improve and armor inboard ditch

3. Install rolling dips between ditch relief culverts
4. Maintain CMP culverts
5. Armor outfalls from culverts and rolling dips
6. Rock surface

Site 3: Mile 0.35 to 0.55 (1056 ft.)
Priority: Medium

This section of road is insloped with an outside berm and an inboard ditch. The berm on the outside road edge channels surface runoff back onto the roadbed. There are several waterbars that drain surface runoff. Ditch relief culverts and waterbars have not been functioning properly in this section of road. The road grade on this section is 9-10%. The road prism can be outsloped but waterbars will still need to be retained and improved. Exposed rock throughout.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and use spoil to fill inboard ditch
3. Rock surface
4. Armor drainage outlets Maintain CMP culverts
5. Armor outfalls from culverts and rolling dips

Site 4: Mile 0.55 (Jct. Rd. 210) to 1.05 (2112 ft.)
Priority: Medium

This section of road is insloped with an outside berm. There is minimal or no inboard ditch in this section. Existing drainage structures are spaced too far apart to be effective. Roadbed has developed rills and ruts from surface erosion. Exposed rock at .75, .95 miles.

Remedial treatments include:
1. Outslope road surface
2. Install rocked rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor drainage outlets

Site 5: Mile 1.05 to 1.25 (Jct. Rd. 500) (1056 ft.)
Priority: High

This section of road is insloped with an outside berm. The Inboard ditch is practically non-existent. Existing drainage structures are spaced too far apart to be effective. Roadbed has developed rills and ruts from surface erosion. Rolling dip at the junction of Road 200-500 needs to be recontoured in order to accommodate large vehicles such as log trucks, transports and fire engines. Junction Road 220 at 1.0 miles. Lots of exposed rock.

1. Remedial treatments include:
2. Outslope road surface
3. Install rolling dips or rocked fords
4. Excavate outside berm and smooth over roadway
5. Armor drainage outlets
6. Recontour and rock existing rolling dip

Road 210

Mileage begins at top of ridge and proceeds south and east to junction of Road 200.

Site 1: Mile 0.0 to 0.3 (1584 ft.)

This section of road is insloped with an outside berm. There is no inboard ditch nor ditch relief culverts in this section. Existing drainage structures (waterbars) have failed due to winter use. Roadbed has developed rills and ruts from surface erosion. Some waterbars will need to be retained and repaired to adequately drain this stretch of road.

Remedial treatments include:
1. Outslope road surface
2. Install rocked rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor drainage outlets

Site 2: Mile 0.3 to 0.5 (1056 ft.)

This section of road is insloped with an outside berm with no inboard ditch. Existing waterbars are responsible for all road surface drainage. The road grade on this section is relatively flat, @ 0% slope. Exposed rock at .3 miles, major rill erosion at .5 miles, below landing. Ruts from vehicle tracks. Waterbars need to be installed and/or maintained.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Armor drainage outlets
4. Retain and improve existing drainage structures

Site 3: Mile 0.55 to 0.8 (1320 ft.)

This section of road is insloped with an outside berm with no inboard ditch. Existing waterbars are responsible for all road surface drainage. Road grade on this section is –17% going downhill from landing, and –10% below the rocky section. Major mud bog at mile .85 where road grade is flat. Numerous rocky sections and areas of exposed parent material at 0.7 mi. Waterbars need to be installed and/or maintained to provide adequate drainage.

Remedial treatments include:
1. Outslope road surface
2. Replace existing waterbars with rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor drainage outlets

Site 4: Mile 0.9 to 1.0 (528 ft.)
Priority: High
This section of road is insloped with an outside berm with no inboard ditch. Existing waterbars are responsible for all road surface drainage. The road grade on this section is approximately 9%. No drainage outlets present.

Remedial treatments include:
1. Outslope road surface

2. Excavate outside berm and smooth over roadway
3. Armor drainage outlets
4. Retain and improve existing drainage structures
5. Rock surface
6. Re-route road around this section

Site 5: Mile 1.1 to 1.35 (Jct. Rd. 520) (3168 ft.)

This section of road is insloped with an outside berm with no inboard ditch. Existing waterbars are responsible for all road surface drainage. Water is allowed to pool in low spots of road. From mile 1.1 to 1.3, road may need to be built up to achieve adequate drainage. From mile 1.3 to 1.7, road can be outsloped. Tire ruts at 1.1 miles, exposed rock at 1.15. Waterbars need to be installed and/or maintained to provide adequate drainage.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Install rolling dips
4. Retain and improve existing drainage structures
5. Rock surface

Site 6: Mile 1.7 to 2.1 (End-Jct. Rd. 200) (2112 ft.)

This section of road is insloped with an outside berm with no inboard ditch. Water is allowed to pool in low spots of road. Some ruts and rills have formed in several places along this stretch of road. Existing drainage structures are badly degraded or non-functioning. Road grades are 1-2% in this section of road.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Install rolling dips
4. Improve existing drainage structures
5. Rock surface

Road 220

Mileage begins at Jct. of Road 200 (in campground) and proceeds east to Jct. Rd. 400.

Site 1: Mile 0.0 to 0.5 (Jct. 200 to Jct. 400) (2640 ft.)
Priority: Low

This section of road is insloped with an outside berm with no inboard ditch. Some ruts and rills have formed in several places along this stretch of road. There are few drainage structures along most of this road. In some places, boulders are exposed from excessive surface erosion. One rill extends from mile 0.2 to 0.4. Road grades are 2-3% in this section of road. Entire road can be outsloped. Exposed rock, potholes throughout.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Install rolling dips
4. Improve existing drainage structures

5. Rock surface

ROAD 300

Mileage begins from gate just past Bluff Spring and proceeds south and east to junction of Road 100 at east end of forest.

Site1: Mile 0.0 (gate) to 0.6 (Bluff Sp.) (3168 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion. The road grade in this section is approx. 3%. At mile 0.6, a natural dip in the road has pooled runoff due to lack of a drainage structure. A rolling dip should be installed here.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Install rolling dips
4. Improve existing drainage structures
5. Rock surface

Site 2: Mile 0.65 (Bluff Spring)
Priority: High

This is an active spring site that flows all year. The main problems occurring at this location is the plugging of the ditch relief culvert and the undermining of the roadbed. Just up-road from the culvert, the spring flows under the road creating an unstable sub-grade. The ditch relief culvert (12” diam.) is undersized and is prone to plugging from sediment and vegetation. At the outfall of the culvert, significant erosion has taken place to the fill surrounding the outlet. There is little or no armor here. The inboard ditch associated with this site is plugged with vegetation and commonly overflows onto the roadway during winter storms.

Remedial treatments include:
1. Clean and improve inboard ditch
2. Upgrade culvert to 18” diam.
3. Armor outfall of culvert
4. Rock road surface

Site 3: Mile 0.65 to 0.9 (1320 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. Drainage structures (waterbars) have failed in this section and rills and gullies have formed in the roadway. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Install rolling dips

4. Improve existing drainage structures
5. Rock surface

Site 4: Mile 0.9 to 1.0 (Jct. Rd. 200) (528 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. Concentrated runoff from this section of road has severely impacted Road 100, which is down slope approx. 100 feet. Outfalls from all drainage structures need to be armored and outflows need to be dissipated before reaching Road 100.

Remedial treatments include:
1. Outslope road surface
2. Excavate outside berm and smooth over roadway
3. Install rolling dips
4. Improve existing drainage structures
5. Armor outfalls
6. Rock surface

Site 5: Mile 0.0 (Jct. Rd. 200) to 0.4 (2112 ft.)
*note: restart mileage from junction Rd. 200 heading east.

This section of road is insloped with an outside berm and inboard ditch. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion. Drainage structures (waterbars) have failed in this section and rills have formed in the roadway. Ditch relief culverts are prone to plugging and overflowing onto the roadway. There are numerous seeps (springs) emanating from the cutbank. Local “Mud boggers” have taken advantage of the extensively saturated conditions to further damage the road surface.

Remedial treatments include:
1. Outslope road surface
2. Clean and improve inboard ditch
3. Clean and maintain ditch relief culverts
4. Excavate outside berm and smooth over roadway
5. Install rolling dips
6. Armor outfalls
7. Rock surface
8. Fill “Mud Bog” areas with 6-inch minus compacted shale rock.

Site 6: Mile 0.42
Upper Mill Creek
Priority: High

Problems here are very similar to the conditions at Bluff Spring. The inboard ditch associated with this site is plugged with vegetation and commonly overflows onto the roadway during winter storms. Leaks from a water tank just above the road have saturated the soil and moved into the roadbed. Additional runoff is concentrated from a hiking/biking trail (Jethro’s) which intersects the road where the spring activity occurs. Sediment is being delivered to the watercourse from the eroded recreational use trail and from the roadway.

Remedial treatments include:
1. Clean and improve inboard ditch

2. Inslope road surface
3. Clean and maintain ditch relief culverts
4. Excavate outside berm and smooth over roadway
5. Armor outfalls
6. Rock surface
7. Install drainage structures between road and water tank on recreational trail

Site 7: Mile 1.2 to 1.85 (Jct. Rd. 400) (3432 ft.)
Priority: High

There has been significant erosion to the roadway in this section of road. The inboard ditch has failed or is non-existent. Runoff accumulates and flows down the roadway unimpeded. Drainage structures (waterbars) have failed in this section and rills and gullies have formed in the roadway. The road prism is incised and has the effect of a through-cut. Exposed large rocks and boulders are prevalent throughout this section of road. From mile 1.4 to 1.85, the inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion. Exposed rock. No ditch or working waterbars.

Remedial treatments include:
1. Outslope or Crown road
2. Install rolling dips or sharp-angled waterbars
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Import fill to build up roadbed
6. Rock surface

Site 8: Mile 0.0 (Jct. Rd. 400) to 0.35 (1848 ft.)
*note: restart mileage from junction of Road 400 and proceed eastward.

This section of road is insloped with an outside berm and inboard ditch. The berm on the outside road edge channels surface runoff back onto the roadbed. Even where the road surface is level, crowned or slightly outsloped, the outside berm prevents free-flow drainage of the road surface. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion. Where culverts for watercourses cross the road, the inboard ditch should be maintained adjacent to the stream crossing. Exposed rock.

Remedial treatments include:
1. Outslope or Crown road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Rock surface

Site 9: Mile 0.4 to 0.55 (792 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. At mile 0.45, there is a cutbank failure approximately 15 feet wide, 40 feet long and 4-6 feet deep. The surface of the slide has vegetation approx. 5-10 years old covering a portion of the surface. There is no indication of recent activity, but adjacent cutbank soil may be unstable.

Remedial treatments include:

1. Outslope or Crown road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Rock surface

Site 10: Mile 0.55 to 0.7 (792 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. Drainage structures (waterbars) have failed in this section and rills and gullies have formed in the roadway. Extensive gullies characterize this site. The soil type (Hugo) in this section of road appears to be Serpentine (Blue Goo). Winter use has exasperated the problem. Sediment is delivered to watercourses, which flow into Spikenard Creek. Exposed roots at .6 miles.

Remedial treatments include:
1. Outslope or Crown road
2. Retain and improve inboard ditch (mile 0.6-0.7)
3. Install rolling dips and waterbars
4. Excavate outside berm and smooth over roadway
5. Armor outfalls
6. Rock surface

Site 11: Mile 0.7 to 1.1 (End- Jct. Rd. 100) (2112 ft.)

This section of road is insloped with an outside berm and inboard ditch. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion. Exposed roots and bedrock at Junction of Road 600.

Remedial treatments include:
1. Outslope road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Rock surface

ROAD 400

Mileage begins at the junction of Road 500 and proceeds north to junction of Road 300.

Site 1: Mile 0.0 to 0.1 (528 ft.)
Priority: Medium

Roadway was constructed on a flat hill-slope and cannot be outsloped. Drainage structures (waterbars) have failed in this section and rills have formed in the roadway. The grade of this road is approx. 6-7%, which would make rolling dip installation difficult. Some exposed rock.

Remedial treatments include:
1. Slope or Crown roadbed
2. Install rolling waterbars
3. Install inboard ditch if necessary
4. Excavate outside berm and smooth over roadway as much as possible
5. Armor outfalls
6. Rock surface

Site 2: Mile 0.1 to 0.35 (1320 ft.)
Priority: Medium

This section of road is insloped with an outside berm and inboard ditch. There is little or no inboard ditch. Mud bog .2-.3 miles. Exposed rock at .2 miles. No waterbars or culverts.

Remedial treatments include:
1. Outslope or Crown road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Fill "Mud Bog" areas with 6-inch minus compacted shale rock.

Site 3: Mile 0.35 to 0.65 (Jct. Rd. 300) (1584 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. Small landslide into ditch at .4 miles. Ditch plugged at .55 miles.

Remedial treatments include:
1. Outslope road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor outfalls

ROAD 500 *High Priority Main Line Road*

Mileage begins at the end of the pavement (Forest Office) and proceeds southeast to the junction of Road 540.

Site 1: Mile 0.0 to 0.25 (Jct. Rd. 520) (1320 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. Although originally designed as an all-weather permanent rocked road, the running surface has eroded to native material or bedrock in many places with numerous potholes. At mile 0.1, there is an active spring on the cutbank and in the inboard ditch. The ditch and culvert at this location should be maintained. Outside berm is largely non-existent.

Remedial treatments include:
1. Outslope road
2. Apply a 3 inch layer of 2 inch – minus crushed rock to the running surface.
3. Install rocked rolling dips
4. Excavate outside berm and smooth over roadway
5. Armor outfalls
6. Retain and improve inboard ditch at mile 0.1

Site 2: Mile 0.25 (Jct. Rd. 520) to 0.9 (3432 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. The inboard ditch in this section of road is heavily eroded due to excessive flow, insloped road and widely-spaced ditch relief culverts. Exposed rock at .3, .45-.5, .7, and .8 miles. Inboard ditch filled in at .45, non-existent at .8-.9 miles.

Remedial treatments include:
1. Outslope road
2. Apply a 3 inch layer of ¾ inch crushed rock to the running surface.
3. Install rolling dips
4. Excavate outside berm and smooth over roadway
5. Armor outfalls

Site 3: Mile 0.9 to Jct. Rd. 400 (1.25) (2640 ft.)
Priority: High
(section runs next to campground)

Roadway was constructed on a flat hill-slope and cannot be outsloped. The berm on the outside road edge channels surface runoff back onto the roadbed. The inboard is heavily eroded due to excessive flow. There are no ditch relief culverts in this section and existing waterbars have failed or drain only surface runoff. The waterbars in this section need to extend into the inboard ditch. Some erosion by campground, exposed rock.

Remedial treatments include:
1. Crown or slope road surface
2. Install rocked rolling dips and /or sharp-angled waterbars
3. Extend waterbars to inboard ditch
4. Armor inside ditch with rock
5. Excavate outside berm and smooth over roadway
6. Spot rock the running surface with 2 inch-minus crushed rock.

Site 4: Mile 0.25 (Jct. Rd. 400) to 0.65 (Jct. Rd. 600) (2112 ft.)

This section of road is insloped with an outside berm and inboard ditch. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion.

Remedial treatments include:
1. Outslope road
2. Spot rock the running surface with ¾ inch crushed rock.
3. Install rolling dips
4. Excavate outside berm and smooth over roadway
5. Armor outfalls

Site 5: Mile 0.65 (Jct. Rd. 600) to 1.7 (Jct. Rd. 540) (5544 ft.)

This section of road is insloped with an outside berm and inboard ditch. Rills and numerous potholes exist in this section of road. Exposed rock at 2.7 miles.

Remedial treatments include:
1. Outslope road
2. Spot rock the running surface with ¾ inch crushed rock.
3. Install rolling dips
4. Excavate outside berm and smooth over roadway
5. Armor outfalls

ROAD 501

Mileage begins at the junction of Road 210 and proceeds south to junction of Road 500.

Site 1: Mile 0.0 to 0.2 (1056 ft.)
Priority: High

This section of road is insloped with an outside berm. Drainage structures are mainly waterbars, which are degraded and only partially functional. Some rilling is occuring on road surface resulting in exposed rocks and roots. Water bars need to be maintained, especially at the .2 mile mark.

Remedial treatments include:
1. Outslope road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor outfalls

Site 2: Mile 0.2 to 0.3 (528 ft.)
Priority: High

This section of road was constructed on a flat hillslope with no cross-grade. Waterbars are the drainage structures in place and are functioning properly; however, winter use has degraded the road bed. The road surface has low rock content, so erosion potential is high. The road grade in this section is approx. 1-2%. Road grade is nearly flat, some exposed rocks.

Remedial treatments include:
1. Crown or slope road surface
2. Install sharp-angled rolling waterbars
3. Armor waterbar outfalls with rock
4. Excavate outside berm and smooth over roadway
5. Rock surface
6. Re-route road

Site 3: 0.3 to 0.4 (528 ft.)
Priority: High

This section of road is insloped with an outside berm. There is no inboard ditch in this section. Existing waterbars are responsible for all road surface drainage. Road grade on this section is approx. 12%

Remedial treatments include:
1. Outslope road surface
2. Replace existing waterbars with rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor drainage outlets

ROAD 520

Mileage begins at the junction of Road 500 and proceeds north to junction of Road 200.

Site 1: Mile 0.0 to 0.1 (528 ft.)
Priority: High

This section of road is insloped with an outside berm and inboard ditch. There has been significant erosion to the roadway in this section of road. The inboard ditch has failed in several locations due to sediment deposition and dense vegetation within the ditch. This has directed runoff onto the roadway and has led to surface erosion. Runoff accumulates and flows down the roadway unimpeded. Drainage structures (waterbars) have failed and rills and gullies have formed in the roadway. Exposed large rocks and boulders are prevalent throughout this section of road. Waterbars have been improved, but need to be maintained.

Remedial treatments include:
1. Outslope road surface
2. Replace existing waterbars with rolling dips
3. Excavate outside berm and smooth over roadway
4. Armor drainage outlets
5. Import fill to build up roadbed
6. Rock surface

Site 2: Mile 0.1 to 0.2 (Jct. Rd. 200) (528 ft.)
Priority: High

This section of road is insloped with an outside berm and no inboard ditch. The outside berm contains an excessive amount of material that could be re-incorporated back into the road running surface. Drainage structures are mainly waterbars, which are degraded and only partially functional. Exposed rock, and rilling on the road surface. Waterbars need to be regularly maintained.

Remedial treatments include:
1. Outslope road
2. Install rolling dips and/or improve waterbars
3. Excavate outside berm and smooth over roadway.
4. Armor outfalls
5. Rock surface

ROAD 530

Mileage begins at the junction of Road 500 and proceeds south to property boundary.

Site 1: Mile 0.0 to 0.3 (1584 ft.)
Priority: Low

Roadway was constructed on a flat hill-slope and cannot be outsloped. Drainage structures (waterbars) are inadequate and runoff is allowed to pool on the roadbed.

Remedial treatments include:
1. Crown or slope road surface
2. Install rolling dips or improve existing waterbars
3. Excavate outside berm and smooth over roadway as much as possible

4. Rock surface

Site 2: Mile 0.3 to 0.45 (792 ft.)
Priority: Low

This section of road is insloped with an outside berm. Existing waterbars are not functioning and surface erosion is occurring. Rills and gullies have formed in the roadbed. Tree bent over road at .4 miles. Exposed rock and channels prevalent.

Remedial treatments include:
1. Outslope road
2. Install rolling dips or improve existing waterbars
3. Excavate outside berm and smooth over roadway as much as possible
4. Armor outfalls and rock surface

ROAD 540

Mileage begins at junction of Road 500 and proceeds north to junction of Road 541.

Site 1: Mile 0.0 to 0.25 (Jct. Rd. 541) (1320 ft.)
Priority: Medium

This section of road is insloped with an outside berm. The berm on the outside road edge channels surface runoff back onto the roadbed. There is no inboard ditch in this section. Existing waterbars are responsible for all road surface drainage. Rill and gully erosion down roadway, potholes at 0-.2 miles.

Remedial treatments include:
1. Outslope road from 0.0 to 0.1
2. Crown road from 0.1 to 0.25
3. Install rolling dips and/or improve waterbars
4. Excavate outside berm and smooth over roadway
5. Armor outfalls
6. Rock surface

ROAD 542

Mileage begins at junction of Road 540 and proceeds along right fork looping to end at Road 540.

Site1: Mile 0.0 to 1.0 (1.3) (5280 ft.)
Priority: Low

This section of road is insloped with an outside berm. Existing waterbars are responsible for all road surface drainage. Erosion, potholes, gullies and exposed rock throughout.

Remedial treatments include:
1. Outslope road
2. Install rolling dips and/or improve waterbars
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Rock surface

ROAD 600

Mileage begins at junction of Road 500 and proceeds north to junction of Road 300.

Site 1: Mile 0.0 (Jct. Rd. 500) to 0.3 (1584 ft.)
Priority: Medium

Roadway was constructed on a flat hill-slope and cannot be outsloped. The inboard ditch is largely non-existent on this stretch of road. Drainage structures are mainly waterbars, which are degraded and only partially work. Therefore runoff onto the roadway has led to rill formation and potential gullies. The grade of this road is approx. 5-8%, which would make rolling dip installation difficult.

Remedial treatments include:
1. Slope or Crown roadbed
2. Install rolling dips
3. Install inboard ditch if necessary
4. Excavate outside berm and smooth over roadway as much as possible
5. Armor outfalls
6. Rock surface

Site 2: Mile 0.3 to 0.9 (3168 ft.)
Priority: Medium

This section of road is insloped with an outside berm with no inboard ditch. Existing waterbars are responsible for all road surface drainage. Very rocky. Waterbars should be up-graded.

Remedial treatments include:
1. Outslope road
2. Install rolling dips and/or improve waterbars
3. Excavate outside berm and smooth over roadway
4. Armor outfalls
5. Rock surface

Site 3: Mile 0.9 to 1.2 (1056 ft.)
Priority: Medium

This section of road is insloped with an outside berm and no inboard ditch. Drainage structures (waterbars) have partially failed in this section and rills and gullies have formed in the roadway. There has been significant erosion to the roadway with extensive gullies characterizing this site. The soil type (Hugo) in this section of road appears to be decomposed granitic soils (Blue Goo). Winter use has exasperated the problem. Sediment delivery to a watercourse, which feeds Malo Creek, is a major problem in this section of road. Major mud bog at 1.2 miles. Some exposed rock, lots of loose rock. Waterbars should be up-graded.

Remedial treatments include:
1. Outslope or Crown roadbed
2. Install rolling waterbars
3. Install inboard ditch from mile 0.95 to 1.0 (approx. 250 feet)
4. Excavate outside berm and smooth over roadway as much as possible
5. Armor outfalls
6. Rock surface
7. Fill “Mud Bog” area with 6-inch minus compacted shale rock.

Site 4: Mile 1.2 to 1.4 (Jct. Rd. 300) (1056 ft.)

This section of road is insloped with an outside berm with no inboard ditch. Existing waterbars are responsible for all road surface drainage. Gully erosion at junction of Road 300 and considerable amounts of exposed bedrock throughout.

Remedial treatments include:
1. Outslope road
2. Install rolling dips
3. Excavate outside berm and smooth over roadway as much as possible
4. Armor outfalls
5. Rock surface

ROAD 610

Mileage begins at junction of Road 600 and proceeds east to junction of Road 540.

Site 1: Mile 0.0 to 0.55 (2904 ft.)
Priority: Low

This section of road is insloped with an outside berm and no inboard ditch. Drainage structures (waterbars) have partially failed in this section and rills and gullies have formed in the roadway. There has been significant erosion to the roadway in this section of road evidenced by exposed bedrock and tree roots.

Remedial treatments include:
1. Outslope road
2. Install rolling dips and/or waterbars
3. Excavate outside berm and smooth over roadway as much as possible
4. Armor outfalls
5. Rock surface

Site 2: Mile 0.55 to 0.75(Jct. Rd. 540) (1056 ft.)

Roadway was constructed on a flat hill-slope and cannot be outsloped. Drainage structures (waterbars) are inadequate and runoff is allowed to pool on the roadbed. Major mud boggs at end.

Remedial treatments include:
1. Crown or slope road surface
2. Install rolling dips or improve existing waterbars
3. Excavate outside berm and smooth over roadway as much as possible
4. Rock surface
5. Fill “Mud Bog” areas with 6-inch minus compacted shale rock.

BMDSF Road Inventory Project

Culvert Inventory and Status

Road	Mileage	Culvert #	Diameter (inches)	Status	Notes
100	.05	1	18	OK	
	.1	2	12	FIX	culvert ok, heavy erosion to inboard ditch
	?	3	12	FIX	excess runoff has created gully from outfall
	.4	4	24	FIX	check culvert size, 1000' inside ditch
	.5	5	18	FIX	vegetation at inlet may cause plugging, erosion downhill from culvert
	?	6	18	FIX	plugged at outlet
	.75	7	30/30	FIX	Mill Cr., check CMP size, overflow onto road, left culvert slightly plugged, clear veg at inlet
	.85	8	12	FIX	outlet plugged (100%), inlet 65%
	.9	9	12	FIX	outlet needs rock armor, plugged 20%
	1.0	10	36(12?)	OK	maintain vegetation control at inlet and outlet, outlet needs rock armor
	1.45	11	12	FIX	not plugged, headwall built
	?	12	12	FIX	culvert is plugged
	1.65	13	48	OK	Spikenard Cr. headwall 8'
		14	12	FIX	not plugged, inlet damaged (bent rim)
		15	12	OK	clean inlet area-OK
		16	12	OK	clean inlet area-OK, overflow washes over road, gully downhill
		17	12	FIX	culvert is plugged 50% in +out
	2.5	18	12	FIX	partially plugged (50% inlet) (75% outlet)
	2.55	19	18	FIX	partially plugged (10%), erosion at outlet, major gullies
	2.65	20	36	OK	Malo Cr., boulders at inlet may obstruct CMP
		21	24	FIX	culvert is rusted through, erosion at outlet, Big Spring

		22	14	FIX	Starting to rust, outlet damaged,
200	.1	1	12	FIX	outlet needs armor, 500' of inside ditch
	.15	2	12	FIX	Overflow, ditch filled b4 inlet, inlet plugged 25%
	.2	3	12	OK	high plugging potential, check periodically
	.3	4	12	FIX	culvert exposed at outlet .
300	3.45	1	18	OK	high plugging potential, check periodically
	?	2	12	OK	Bluff Sp., high plugging potential, erosion at outlet
	3.2	3	18	FIX	outlet plugged w/sediment, no cmp slope
	3.0	4	36	FIX	inlet partially plugged, culvert functioning ok
	?	5	18	FIX	culvert partially plugged, inlet damaged (bent rim)
	?	6	12	FIX	outlet plugged w/sediment, inlet ok
	?	7	12	FIX	inlet damaged, outlet plugged w/sediment
	2.7	8	12	OK	inlet damaged, erosion at outlet occurring, needs bigger culvert, water over road
	2.6	9	12	OK	erosion to roadbed, exposed springs in cutbank
		10	30	OK	inlet damaged, culvert functioning ok, upper mill creek.
	2.5	11	12	OK	400' of inside ditch and spring activity
		12	12	OK	spring-fed area, needs headwall, CMP dented
	1.4	13	24	FIX	inlet is partially plugged w/debris (slash)
		14	12	FIX	inlet damaged, overflow onto roadbed
	1.4	15	12	FIX	runoff is diverted across roadbed, stream crossing, needs headwall, inlet bent
	1.3	16	24	OK	high plugging potential, check periodically
	1.1	17	24	FIX	High plugging potential, check CMP size, needs h.w
	.675	18	14	FIX	culvert rusted through, no headwall, overflow
	.45	19	18	FIX	inlet is plugged, no armor at outlet, forming gully, inlet completely buried near road to rock quary
	.15	20	12	FIX	culvert is plugged, inlet and outlet
	.1	21	12	OK	overflow, check periodically for

					plugging
400	.35	1	12	FIX	culvert is plugged 75%in 95%out, runoff diverted onto roadbed, ditch filled, need headwall
	.375	2	12	FIX	culvert is 50% plugged at outlet, needs armor, inlet needs h.w, ditch drains into road
	.4	3	12	FIX	inlet is 10% plugged, needs h.w
		4	12	FIX	Erosion above outlet, culvert is exposed, needs armor/h.w
500	.1	1	18	FIX	outlet partially plugged, inlet damaged, needs armor
	.15	2	12	FIX	outlet plugged, inlet damaged, spring activity
	.25	3	12	FIX	inlet damaged, outlet ok, some erosion
	.3	4	12	OK	check periodically, inlet part plugged, damaged
	.35	5	18	FIX	inlet needs h.w, out completely plugged
	.4	6	12	OK	no armor at outlet, gully formed, needs h.w
	.5	7	12	OK	no armor at outlet, gully formed, out damaged, part clogged
	.6	8	12	OK	same as previous, in needs h.w
	.7	9	18	OK	Erosion @inlet, out part plugged
	.8	10	18	OK	Out 50% plug, needs armor
	1.05	11	12	FIX	inlet damaged, part plugged, needs armor
		12	12	FIX	culvert plugged w/sediment
	1.2	13	24	OK	campground
	1.55	14	12	FIX	culvert plugged w/sediment, damaged, needs armor
	1.85	15	12	FIX	Out part plugged, damaged
	1.9	16	12	OK	inlet damaged (rim bent down)
	2	17	12	OK	inlet and outlet damaged (bent rims), needs armor
		18	12	FIX	outlet is plugged
		19	12	OK	functioning properly
	2.1	20	24	OK	excessive vegetation at inlet and outlet
	2.35	21	18	OK	functioning properly
	2.6	22	18	OK	no armor at outlet, gully formed, shallow inboard ditch
	2.8	23	18	FIX	Looks fine
	2.9	24	12	FIX	Completely covered

Total # of culverts:
76

Culvert Sizing Procedure for the 100-Year Storm

The Rational Method of estimating flood discharge from small watersheds was used to determine the proper size diameter culvert for the drainages on Boggs Mountain Demonstration State Forest. To calculate the size of culvert which would handle the 100-year storm flood flow, the volume of runoff which would occur at each stream crossing must first be estimated. The Rational Method is based on the equation: **Q=CIA**

Where: Q= peak runoff at crossing (in cfs)
C= runoff coefficient (percent runoff)
I= uniform rate of rainfall intensity (inches/hour)
A= drainage area (in acres)

Information needed:
A= area of watershed (acres)
H= elevation difference between highest point in watershed and the crossing point (ft)
L= length of channel in miles from the head of the watershed to the crossing point
I= uniform rate of rainfall intensity. Obtained from precipitation frequency-duration data for local rain gages .
C= runoff coefficient from table created by Rantz (1971)

When selecting an "I" value, one must consider the travel time for the runoff to reach the crossing (Tc), and the precipitation conditions for the particular watershed. Time of concentration can be calculated using the formula: $\mathbf{Tc=[11.9L^3/H]^{0.385}}$

Where: Tc= time of concentration (in hours)

Once the time of concentration has been determined, then that value is used to determine which rainfall duration to use. For all of the calculations, a 10 minute duration was used. The runoff value for a 10-minute duration of a 100-year flood flow was obtained from rainfall depth duration frequency table for Clear Lake Highlands (.31), and then multiplied by six to get the hourly value (1.86). The runoff coefficient (C) used for all of the drainages at Boggs was 0.4. This is representative of woodland with a shallow impeding horizon.

Once the volume of runoff was estimated for each of the crossings, the Culvert Capacity Nomograph was used to determine the needed culvert size that will accommodate the 100-year flood flow. The culvert entrance type for all of the crossings is Type 1, with a headwall. The headwater depth in diameters was calculated by dividing the distance from the road grade to the bottom of the culvert by the culvert size in feet. By drawing a line from the headwater depth (in diameters) through the discharge values (in cfs), one will be able to determine the needed culvert size (in inches).

<u>Lower Mill Creek:</u>

The crossing at Lower Mill Creek has two 30-inch "shotgun" culverts mounted in concrete measuring 4' from the base of the culvert to the headwall, and 7' to the road grade. The headwater depth is 2.8 culvert-diameters.

A=152 acres L=3200 feet (.67 miles) H=680 feet

$Tc= [11.9(.67)^3/680]^{.385}= .133$ hours (7.96 minutes)

Q= .4(1.86)152 = 113.1 cfs

The suggested culvert size for Lower Mill Creek was determined to be 40”.

Upper Mill Creek:

The crossing at Upper Mill Creek has a 30” culvert, measures 2.5’ from the base of the culvert to the headwall, and 3.5’ to the road grade. The headwater depth is 1.4 culvert-diameters.

A=114 acres L= 832 feet (.2 miles) H= 320 feet

Tc= $[11.9(.2)^3/320]^{.385}$= .044 hours (2.6 minutes)

Q= .4(1.86)114
= 84.8 cfs

The suggested culvert size for Upper Mill Creek was determined to be 44”.

Lower Spikenard Creek:

The crossing at Lower Spikenard Creek has a 48” (4’) culvert, and measures 8’ from the base of the culvert to the headwall as well as to the road grade. The headwater depth is 2 culvert-diameters.

A=248 acres L= 3980 feet (.75 miles) H=840 feet

Tc= $[11.9(.75)^3/840]^{.385}$= .139 hours (8.4 minutes)

Q= .4(1.86)248
= 184.5 cfs

The suggested culvert size for Lower Spikenard Creek was determined to be 52”.

Upper Spikenard Creek:

The crossing at Upper Spikenard Creek has a 36" (3') culvert, and measures 4' from the base of the culvert to the headwall, and 5' to the road grade. The headwater depth is 1.7 culvert-diameters.

A=96 acres L= 1100 feet (.2 miles) H= 500 feet

$Tc= [11.9(.2)^3/500]^{.385}= .037$ hours (2.2 minutes)

Q= .4(1.86)96
= 71.4 cfs

The suggested culvert size for Upper Spikenard Creek was determined to be 38".

Malo Creek:

The crossing at Malo Creek has a 36" (3') culvert, and measures 14' from the base of the culvert to the headwall as well as to the road grade. The headwater depth is 4.7 culvert-diameters.

A= 96 acres L=2484 feet (.47 miles) H= 460 feet

$Tc= [11.9(.47)^3/460]^{.385}= .102$ hours (6.1 minutes)

Q= .4(1.86)96
= 71.4 cfs

The suggested culvert size for Malo Creek was determined to be 29". Since the present culvert size is 36", and there is a very high headwall, the crossing at Malo Creek is probably adequate to withstand the 100-year flood flow.

Houghton Creek:

The crossing at Houghton Creek has a 24" culvert (2').

A= 134 acres L= 1000 feet (.2 miles) H= 80 feet

$Tc= [11.9(.2)^3/80]^{.385}= .07$ hours (4.5 minutes)

Q= .4(1.86)134
= 99.7 cfs

Designing Watercourse Crossings for Passage of the 100-Year Flood

(Supplemental Information)

Prepared by Pete Cafferata, CDF, and Dr. Michael Wopat, CGS
April 11, 2006

For small watersheds (less than 200 acres), one of the most common methods for sizing a culvert is to use the Rational Method (see Cafferata and others 2004 for a detailed description of this method). The Rational Method requires the following information:

- Basin drainage area (acres)
- Runoff coefficient
- Rainfall Intensity (inches per hour) for the 100-year storm

To obtain rainfall intensity data for a 100-year recurrence interval event for a short time period (typically 10 or 15 minutes), we recommend using the updated rainfall depth-duration-frequency data that is available on the Department of Water Resources "Climate" webpage at:

http://www.climate.water.ca.gov/climate_data/

To successfully use the information on this website, complete the following:

- Prior to opening the website, open your Microsoft Excel program.
- From the menu tool bar, click on Tools, then Macros, then Security.
- Change the Security level (if necessary) from High to Moderate or Low.
- Open the DWR website page (http://www.climate.water.ca.gov/climate_data/).
- Scroll down on the page to the bottom; find the major heading labeled "Depth-Duration-Frequency."
- Click on "Rainfall Depth-Duration-Frequency Data (preliminary)."
- Open the "CA Hydro Basins Map" pdf file and determine the zone where you are interested in finding data. For example, for the Mendocino County coast, the zone is F80. [note: you may have to "zoom in" to 125% to read the zone number]
- Open the Station Index file for a complete list of stations.
- At the "FTP Log On" screen, select "Anonymous" (ignore password request) and select "OK." Station names are listed alphabetically. The table provides data on elevation, station latitude and longitude, county, and hydrologic zone (e.g., F80 is displayed in column F for the Fort Bragg station). While this can be helpful, the data will more useful when sorted by county, etc. [A short description of how to accomplish this is presented on the following page].
- Open the folder labeled "Rain H DDF Hourly."
- Open the folder with the hourly rainfall data that corresponds to the zone where the crossing being designed is located (e.g., folder labeled "DDF HF for the F80 zone for the Mendocino coast).
- Observe the Excel files for the stations with hourly data in this zone (e.g., DDF HF). Select the station closest to the crossing being designed.
- For example, for the Mendocino coast, this might be Fort Bragg. Select the file labeled "F80H Fort Bragg 5N."
- Select "open."
- Enable macros if necessary (will be required if in step 3 above, you selected "moderate" for the security level in Excel).
- Observe that the 10-minute duration, 100-year return-period rainfall for the Fort Bragg station is 0.53 inches. This equates to 3.18 inches per hour, which is the value required for the Rational Method.

Detailed Information on How to Sort the Station Index File

A Registered Professional Forester working on a company ownership will likely be interested in rainfall data from one to several counties in California. We suggest the following procedure for quickly locating available stations within a given county:

- Open the Station Index Excel file on the DWR Climate webpage, located under "Rainfall Depth-Duration-Frequency Data (preliminary)."
- Save the Station Index file to your personal computer (must save it to be able to sort).
- From the menu tool bar, select "Data" and click on "Sort."
- Highlight the entire spreadsheet, except the initial row displaying header information (4906 rows).
- Sort by columns I (county [sort ascending]), L (latitude [sort descending]), and K (longitude [sort descending]) [or other desired attributes].
- Save the revised file to your hard drive.

The result of this sorting is a file in which the stations are sorted by county, and under each county, they are listed from north to south, and for any given latitude, from east to west. If you get the approximate latitude and longitude for the crossing site, then you can easily go to the correct county and identify the station(s) in that county that are closest to the crossing site. Note that not all of the stations in the index will have **hourly** depth-duration-frequency data. Then one can open the correct folder under Rain H DDF Hourly on the website and compare the available stations with hourly data in the county of interest to the list of stations from the Station Index file.

Once the Station Index file is downloaded, saved, and sorted as above, the RPF can remove all of the stations that will not be needed. Also, if the RPF works in a specific area, the list of stations for that area (e.g., Trinity County) can be printed out for future reference so that one does not always have to open up the file – one can just look at the printed list and then go to the database on the web and get the data.

Appendix III. Forest Resources Inventory

Forest stand descriptors of BMDSF from 1991-2006 (trees 5 inches DBH and larger).

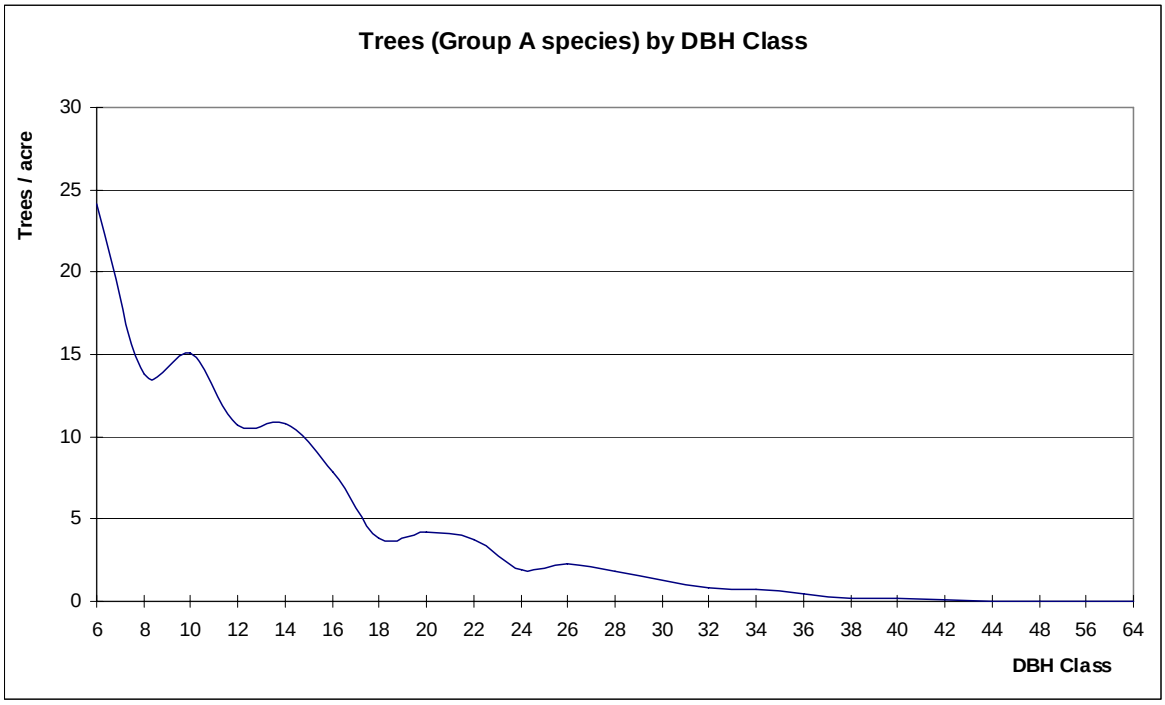
Year	Basal Area, Sq. ft. / acre	Trees per Acre	Dq	SDI	% of Max SDI (750)
1991	90	93	20.8	302	40
1996	102	100	21.3	338	45
2001	112	106	21.9	375	50
2006	117	103	22.5	380	51

Stock Table:

BMDSF gross per acre inventory volume by species, 2006.

DBH	DF	PP	SP	IC	Total
12	264	318	36	0	618
14	417	543	68	0	1,028
16	469	617	48	0	1,133
18	233	477	75	0	785
20	403	684	80	0	1,167
22	349	969	90	19	1,427
24	231	734	48	0	1,013
26	458	848	131	0	1,437
28	358	963	117	0	1,438
30	516	528	120	0	1,163
32	114	731	130	0	975
34	321	593	73	0	987
36	283	297	114	0	694
38	67	153	153	0	373
40	171	0	79	0	250
42	132	0	41	0	173
44	35	0	0	0	35
48	38	0	0	0	38
56	83	0	0	0	83
64	46	0	0	0	46
Total	4,985	8,456	1,402	19	14,862

Stand Table:



Growth Data:

Annual Growth of Merchantable Timber on BMDSF in Board-Feet.

Year	Gross Volume per Acre	Growth per Acre/Year
1991	10,163	
1996	11,822	332
2001	13,486	333
2006	14,500	357

Appendix IV. BMDSF General Management Practices for Controlling the Spread of Sudden Oak Disease

Boggs Mountain Demonstration State Forest is located within Lake County, which has been declared a zone of infestation for Sudden Oak Death (SOD). Currently there is no provision that allows moving any host material out-of-state under the federal regulations without removing all bark prior to shipment out-of-state. General Management Practices for operations where products do not move from the state are as follows:

1. A "free-from" survey can be conducted and, if no infected hosts are found, no additional mitigations are required. If the survey is conducted it must be conducted by an RPF or other approved person that has attended training for survey and sampling, and is certified as an official sampler, and the plan must explain how the survey was conducted as explained in the training. The "free-from" certification and the approved harvest document explaining the survey process acts as the compliance agreement and the SOD mitigation measures.

2. If a "free-from" survey is not conducted, all hosts are assumed to be infected and SOD mitigations as discussed below should be included in approved harvest documents and will be discussed during the on-site RPF-LTO meeting prior to commencement of timber operations (14 CCR 1035.2). When a free-from survey has not been conducted, the following Management Practices will be incorporated into THPs prepared on BMDSF lands to prevent the spread or introduction of SOD:

a. Commercial Harvest on a Regulated Site Where Infected Trees Are Not Being Harvested:

i Regulations for movement of host material still apply even though logs are not removed from the site. Infected host material (especially foliage) could be picked-up on logging equipment and transferred to other sites. Mitigation measures to minimize the unintended movement of host material are required. Forest Staff or contractors will complete inspection of loads of logs and equipment leaving the site to ensure that no host material is being transported without a permit. This may require cleaning dirt or mud from the vehicle to remove host plant material embedded in the dirt or mud, depending on conditions when the timber harvest is conducted.

ii If firewood from host material is being removed from the site for commercial or private use, a compliance agreement must be in place. The information as to where and what is being removed, how it will be transported, specifically where it will be moved to, and during what time period should be included in the harvest plan if the plan will act as the compliance agreement. If this information is not included in the plan, a separate compliance agreement will be necessary prior to movement of host material. In addition to the compliance agreement, contractors removing firewood on the Forest must still have the required firewood permit.

b. Commercial Harvest On An Infested Site Where Infected Trees Will Be Harvested:

i State and Federal regulations apply. Host material cannot leave the site except as authorized by the County Agricultural Commissioner and/or mitigation measures specified in the approved harvest document. Infected host material (especially foliage) and contaminated soil could be picked-up on logging equipment and transferred to other sites. Mitigation measures to minimize the unintended movement of host material are required. Forest staff or contractors will do inspection of loads of logs and equipment leaving the site to ensure that no host material is being transported without a permit. This may require cleaning dirt and
mud from the vehicle to remove host plant material contained in the dirt or mud, depending on conditions when the timber harvest is conducted.

ii If firewood from host material is being removed from the site for commercial or private use, a compliance agreement must be in place in addition to the required firewood permit. The information as to where and what is being removed, how it will be transported, specifically where it will be moved to, and during what time period, should be included in the harvest plan if the plan will act as the compliance agreement. If this information is not included in the plan, a separate compliance agreement will be necessary prior to movement of host material.

iii In the regulated area, the collection of minor special forest products that are known host plants will be restricted to areas where the "free-from" protocol has been implemented, or where a compliance agreement is in place.

3. Should SOD be identified on BMDSF lands, Management Practices to minimize the unintended movement of host material from infested areas include:

a. The RPF will inform personnel that they are working in an SOD-infested area, unauthorized movement of plant material is prohibited, and the intent of the mitigation measures is to prevent disease spread (914 CCR 1035.2).

b. If some sites in the general operating area are found to be disease-free of have a low incidence of disease, initiate and complete operations on these sites before moving to more heavily infested sites.

c. To the extent practical, locate landings, log decks, logging roads, tractor roads, and other sites of equipment activity away from host plants, especially areas with disease symptoms.

d. Route equipment away from host plants and trees, especially areas with disease symptoms.

e. The equipment or vehicles must be inspected for host plant debris (leaves, twigs, and branches each time equipment or vehicles leave the site. Host plant debris must be removed from the equipment and vehicles prior to their departure. This applies to all equipment and vehicles associated with the operation, including logging equipment, log-hauling trucks, pick-up trucks, employee's personal vehicles, etc. An exception will be granted for equipment or vehicles that leave the site temporarily and will not be traveling to uninfested areas prior to their return.

f. In addition to following California Department of Fish and Game (CDFG) drafting guidelines (intake mesh size, etc.), water should not be drafted from a watercourse in a SOD-infected drainage and used in an uninfested area. This is because sporangia from infected leaves (or minute parts of infected leaves), themselves in the watercourse, could be suctioned in the draft and transported to new areas. Infection could be possible if abatement over-spraying landed on susceptible hosts.

4. Management Practices to minimize the unintended movement of soil and host material from infested areas (these practices are not specifically required for operations on infested sites, but the RPF must state and justify what practices will be used to minimize the unintended movement of infested host material):

a. The SOD fungus resides in soil and duff in infested areas and soil/duff is therefore a potential carrier of the disease. The greatest threat of disease spread occurs when wet soil is present. Soil movement should be addressed.

b. Because wet soil and mud will readily adhere to vehicles, equipment, and boots: conduct operations during the dry season; utilize paved and rocked roads and landings to the extent possible.

c. After working in an infested area, remove or wash off accumulations of soil, mud, and organic debris from shoes, boots, vehicles and heavy equipment, etc. before traveling to an area that is

not infested with SOD. Consider establishing an equipment power wash station. The station should be:

Located within the generally infested area.
Paved or rocked.
Well-drained so that vehicles exiting the station do not become recontaminated by the wash water.
Located where wash water and displaced soil does not have the potential to carry fines to a watercourse (see "Saturated Soil Conditions" in 14 CCR 895.1).

d. Pay particular attention to sites where soil and organic debris may accumulate.