Cottonwood Creek Watershed

Strategic Fuels Reduction and Management Plan

Cottonwood Creek Watershed Group

Western Shasta Resource Conservation District

Forest Service U S Department of Agriculture

COTTONWOOD CREEK WATERSHED
STRATEGIC FUELS REDUCTION AND MANAGEMENT PLAN

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Acronyms

Acronym	Definition
ACID	Anderson-Cottonwood Irrigation District
BLM	Bureau of Land Management
BWA	Beegum Watershed Assessment
CCW	Cottonwood Creek Watershed
CCWG	Cottonwood Creek Watershed Group
CDF	California Department of Forestry and Fire Protection
CNDDB	California Natural Diversity Data Base
CRMP Group	Coordinated Resource Management Planning Group
DFG	California Department of Fish & Game
EHR	Erosion Hazard Rating
FB	Fuel break
FEMA	Federal Emergency Management Agency
FMP	Fire Management Plan (Federal)
FRAP	Forest & Rangeland Resources Assessment Program
FSA	Farm Service Agency (USDA)
FSC	Fire Safe Council
LCPOA	Lake California Property Owners Association
LRMP	Land & Resource Management Plan
NRCS	Natural Resources Conservation Service
RCD	Resource Conservation District
RPF	Registered Professional Forester
STFMP	Shasta-Trinity Fire Management Plan
STNF	Shasta-Trinity National Forest
UC	University of California
USDA	United States Department of Agriculture
VMP	Vegetation Management Plan (California)
WNRA	Whiskeytown National Recreation Area
WRCC	Western Regional Climate Center
WSRCD	Western Shasta Resource Conservation District

STRATEGIC FUELS REDUCTION AND MANAGEMENT PLAN FOR THE COTTONWOOD CREEK WATERSHED

I. EXECUTIVE SUMMARY

Wildfire plays a natural part in the evolution of vegetation in the 603,854-acre Cottonwood Creek Watershed, located between Redding and Red Bluff, California. Vegetation in the watershed is characterized by grass and understory vegetation, forest and hardwood litter, dormant brush and slash, and chaparral brush. Much of the vegetation has evolved and co-existed with fire for many years and is either dependent on fire or has adapted to the fire regime associated with the area.

Successful fire suppression activities for the past eighty years have significantly increased the volume of vegetation across the landscape, resulting in High to Very High Fire Hazard Ratings by the California Department of Forestry & Fire Protection (CDF). The number and size of devastating wildfires impacting the western United States over the past ten years resulted in the creation of a National Fire Plan for the U. S. Departments of Interior and Agriculture. Funding was made available through the National Fire Plan, California Fire Plan and other agencies to assist local communities and watershed groups in identifying/planning and implementing fuel reduction projects.

The S*trategic Fuels Reduction and Management Plan for the Cottonwood Creek Watershed* was prepared by the Western Shasta Resource Conservation District under a contract with the Cottonwood Creek Watershed Group through a grant from the United States Department of Agriculture (USDA) Forest Service – National Fire Plan Community and Private Land Fire Assistance Program. The purpose of the plan is to identify those areas where the construction of shaded fuelbreaks and ridgetop fuelbreaks can increase protection for those living in the watershed, protect values at risk, provide firefighters safety when containing a blaze, allow residents safe transportation routes away from a wildfire, and encourage a maintenance plan to protect and continue this fuelbreak network.

The Plan includes an inventory and location of the various fuel types throughout the watershed, the results of running the BEHAVE computer modeling program to predict fire behavior in various vegetation types, a discussion of values at risk, landowner objectives, fuel treatments, the road system, potential funding sources, proposed fuel reduction projects, and previous fuelbreak locations used as links to develop the fuelbreak system.

Based on location, vegetation, typical wind direction, access, and values at risk, a list of shaded fuelbreaks, ridgetop fuelbreaks, dozer track fuelbreaks, brush abatement and maintenance projects were developed. Some are roadside and/or ridgetop fuelbreaks in east-west or north-south directions specifically to minimize the size of a wildfire and give firefighters a safer area to contain a fire, while others are more focused on giving residents a safe transportation corridor and protecting values at risk in case of a wildfire. The Cottonwood Creek Watershed Group is encouraged to pursue funding for these projects on a priority basis whenever possible.

II. INTRODUCTION

In 2001 the USDA Forest Service-National Fire Plan Community and Private Land Fire Assistance Program awarded funding to the Cottonwood Creek Watershed Group (CCWG) to prepare a Fuels Management and Reduction Plan for the watershed. This plan supports the goals and objectives of the recently completed Cottonwood Creek Watershed Assessment (Cottonwood Creek Watershed Group, 2001). CCWG subcontracted the plan to the Western Shasta Resource Conservation District, which has experience in preparing fuels reduction plans, implementing projects in several watersheds in western Shasta County, and conducting fuelbreak maintenance.

The Strategic Fuels Reduction and Management Plan for the Cottonwood Creek Watershed identifies actions needed to reduce the severity of wildfire hazards in the watershed. The plan provides important information about the watershed regarding existing fuel conditions, fire history, road systems, resources at risk, and recommendations for projects designed to reduce fire hazards and assist fire suppression activities. The work includes conducting a fuel inventory, simulating fire behavior in different areas of the watershed through the use of computer modeling, developing a list of priority projects to reduce the volume of fuels in strategic areas to assist in fire suppression, planning key areas of ingress and egress for landowners and firefighters, analyzing opportunities to make use of vegetation removed during project implementation for beneficial uses, and developing a strategy for maintaining fire safe conditions.

The goals and objectives of the Strategic Fuels Reduction and Management Plan are to:

- Conduct a fuel inventory and develop a fuel map.
- Run the Fire Behavior Predictions and Fuel Model System (BEHAVE) and interpret the results.
- Develop maps illustrating population centers, roads, vegetation types, and fire history.
- Develop a strategic fuels reduction plan.
- Analyze biomass processing opportunities.
- Identify long-term maintenance opportunities for fuelbreaks.
- Develop a priority list of recommendations for fuel reduction or fire-safe projects.
- Encourage ongoing maintenance of all projects to protect the network.

Page Break

III. BACKGROUND

A. PURPOSE AND NEED

The loss of homes and life from wildfire has become an all too common event in California. As people continue moving from urban areas into wildlands, the cost of suppressing wildfires, cleanup and loss of structures, has reached catastrophic proportions. In the hot, dry Mediterranean summers of the north Central Valley, the influx of people into the wildlands amplifies the rate of human-caused wildfire, which is the primary cause of wildfires.

In general, wildfire is less prevalent on today's landscape than in prehistoric times due to effective fire control policies and the subsequent alteration of the natural fire regime and vegetation types. Fire suppression has allowed for increased fuel loading across the landscape, escalating the fire severity ratings from Low to Moderate in historic times to High and Very High danger today. Within the Cottonwood Creek Watershed, 80 years of successful fire suppression has resulted in excessive accumulations of dead and down fuels and a significant accumulation of biomass, especially within the Chaparral plant community.

In 1999, the federal government General Accounting Office reported "The most extensive and serious problem related to the health of national forests in the interior West is the over-accumulation of vegetation." (U. S. Department of Interior and U.S. Department of Agriculture, 2000) The rate and intensity of wildfires continues to increase annually and in the 2000 fire season, more than 6.8 million acres of public and private lands burned, more than twice the 10-year national average. The magnitude of the fires was the result of two primary factors: 1) a severe drought accompanied by a series of storms that produced thousands of lightning strikes followed by windy conditions; and 2) the long-term effects of almost a century of aggressively suppressing all wildfires leading to an unnatural buildup of brush and small trees in forests and on rangelands.

B. LOCATION

The Cottonwood Creek Watershed is located approximately 13 miles south of Redding, California on the west side of the Sacramento River. The watershed is located within both Shasta and Tehama Counties and covers approximately 603,854 acres or 938 square miles. It is bordered on the north by the Anderson Creek and Lower Clear Creek watersheds, on the south by Red Bank Creek and Thomes Creek watersheds, on the east by the Sacramento River, and on the west by the USDA Forest Service Yolla Bolly-Middle Eel Wilderness and Shasta-Trinity National Forest, and the Trinity County line. The main watercourses within the Cottonwood Creek Watershed are Beegum Creek and the North Fork, Middle Fork (flowing along the Shasta/Tehama County line) and South Fork of Cottonwood Creek, which flow in an easterly direction to the Sacramento River.

C. CLIMATE

Generally, the climate of the Cottonwood Creek Watershed is characterized by warm, dry summers and cool, wet winters. The average temperature and precipitation vary greatly within the watershed due to elevation ranges from 350-7,000 feet. The average temperature range in July is from a low of 65 °F to 98 °F. The average temperature in December ranges from a low of 35 °F to 55 °F. Snowfall is not common in the lower elevations; however, moderate to heavy amounts of snowfall is common above 3,000 feet. Relative humidity during the summer months is usually less than 30% during the day and rises to about 50% at night. Winter humidity usually exceeds 50%.

D. VEGETATION

A majority (53%) of the Cottonwood Creek Watershed is composed of Blue Oak/Gray Pine stands with frequently occurring meadows throughout. This vegetation type characterizes the lowest elevation points of the watershed. The mid-elevation areas are characterized by California mixed chaparral species, which make up approximately 16% of the watershed. The higher elevations are composed of mixed conifer, Douglas-fir and true fir stands, which make up approximately 25% of the watershed. The remaining portions of the watershed (4%) are composed of Serpentine species, riparian species, agricultural and urban development, and barren rock. (Cottonwood Creek Watershed Group, 2002) (See General Vegetation, Map 1)

E. POPULATION

The majority of the population in both Shasta (total 2000 population: 147,036) and Tehama (total 2000 population: 49,625) Counties is located outside the Cottonwood Creek Watershed. Within the watershed, however, the population is concentrated in the far eastern portion of the watershed, east of the dividing line between Range 05W and 06W (Refer to Map 4). This is evident in the higher concentration of roads (Map 4) and agricultural production and urban areas (Map 1). Although rural in nature, the population centers in the watershed are:

Shasta County

- Cottonwood - The largest unincorporated town of approximately 2,960 people (US Census Bureau, 2000). A fire station serves the central area. The West Valley Volunteer Fire Company serves more rural areas to the west.
- Igo – A small rural community with a volunteer fire company, store and P.O.
- Ono – A small rural community with a volunteer fire company and restaurant.
- Platina – A small rural community with a volunteer fire company, store and P.O.

Tehama County

- Beegum – A small rural community consisting of a few homes.
- Bowman – A rural area with rapid growth. Tehama County/CDF Fire Station with two engines, squad and watertender for fire protection. Store nearby.
- R-Wildhorse Ranch - A privately owned community that operates on a time-share basis. It contains a variety of large community structures and many small cabins spread throughout. It has its own year round volunteer fire department made up of ranch staff that live on site. It has a fire engine and squad for fire protection.
- Lake California, a gated planned community with 580 homes, a few duplexes, a store, restaurant, and realty office. It has a Volunteer Fire Department which is part of the Tehama County Fire Department, with a fire engine at this location for fire protection.

F. FIRE HISTORY

Wildfire has had a major influence on many of the species and plant communities that occur in the Cottonwood Creek Watershed. Many of these species that evolved and co-existed with fire for many years and are either dependent on fire or have adapted to the fire regime associated with the watershed. But historical vegetation communities in the watershed were likely very different from today's flammable environment.

Historically fire was used to reduce brush cover to favor a park-like area of grasses, trees, and intermittent stands of brush within the woodland-grass belt of the state. Following fires, mature chaparral may have been “softened” by a dramatic growth of early successional species of grasses and forbs, along with the rapid re-growth of sprouts from many species of chaparral. Frequent surface fires were caused by lightning strikes or were set by Native Americans. With more open forest, these fires were more like low intensity burns, with rare catastrophic results. These frequent, low-intensity wildfires were common in the watershed and actually reduced the severity of the fire hazard by keeping the accumulation of fuels at low levels (Lewis, 1973).

The California Department of Forestry and Fire Protection (CDF) has maintained a fire history data base for the Cottonwood Creek Watershed and has provided this information back to the turn of the century (See Fire History, Map 2).

The fire history of the area indicates that lightning is the greatest single cause of fires. In spite of the higher number, lightning fires tend to be smaller in size and are normally associated with some precipitation. A few lightning fires, which have grown to larger than 300 acres in size, had relatively little precipitation and grew in size during the night and during periods of limited firefighting resources. Next to lightning, equipment operations, including chainsaws, welding, and mowing, caused the most fires. (CDF Tehama-Glenn Unit Fire Plan, 2002). Although details were not available for this report, fires may start along railroad tracks, as indicated as a cause in Table 1 to follow. A major freight and passenger railroad line runs north-south through the eastern portion of the watershed parallel to Interstate 5. Charts of all fire causes from 1990-2001 for Tehama-Glenn Zone 1 and 2 are shown in Figure 1A and 1B, and fire causes for Shasta County are indicated in Figure 2 and Table 1.

The significant issues noted in the CDF Tehama-Glenn Unit Fire Plan are protection of the homes around the populated areas of Bowman Road, Paskenta, Red Bank, R-Wildhorse Ranch, and in Lake California, as well as scattered ranches and country homes; protection of agricultural investments, watershed and rangeland; problems with moderate access and water supply; hardwood harvesting operations (equipment caused fires); and fast moving wind-blown fires in grass with some brush caused primarily by lightning and equipment use.

The CDF Tehama-Glenn Unit Fire Plan shows that during the 1999 Fire Season, there were five major fires blazed in Shasta and Tehama Counties:

AREA	ACRES	STRUCTURES DESTROYED
Shasta County		
Jones Fire	26,202	954
Canyon Fire	2,580	230
Lowden	2,000	23

AREA	ACRES	STRUCTURES DESTROYED
Tehama County		
Gunn II Fire	60,390	0
DeHaven Fire	17,000	0

During the 2000 Fire Season, two fires blazed in Shasta and Tehama Counties:

AREA	ACRES	STRUCTURES DESTROYED
Shasta County		
Union Fire	350	4
Tehama County		
Weinstein Fire	8,284	3

IV. SUPPORTING PLANS, ORGANIZATIONS AND AGENCIES

A. NATIONAL FIRE PLAN

In 2001 the Chief of the USDA Forest Service published a National Fire Plan (U.S. Department of Interior and U.S. Department of Agriculture, 2001), which is a cohesive strategy for improving the resilience and sustainability of forests and grasslands at risk; conserving priority watersheds, species and biodiversity; reducing wildland fire costs, losses and damages; and to better ensure public and firefighter safety. To achieve these goals, work began to improve firefighting readiness, prevention through education, rehabilitation of watershed functions, hazardous fuel reduction, restoration, collaborative stewardship, monitoring jobs, and applied research and technology transfer.

The objective of the plan is to describe actions that could restore healthy, diverse, and resilient ecological systems to minimize the potential for uncharacteristically intense fires on a priority basis. Methods include removal of excessive vegetation and dead fuels through thinning, prescribed fire and other treatment methods. The focus of the strategy is on restoring ecosystems that evolved with frequently occurring, low intensity fires. These fires typically occurred at intervals of between 1-35 years and served to reduce the growth of brush and other understory vegetation while generally leaving larger, older trees intact. The report is based on the premise that sustainable resources depend on healthy, properly functioning, resilient ecosystems. The first priority for restoration is the millions of acres of already roaded and managed landscapes that are in close proximity to communities. More information about the National Fire Plan is available on the Internet at www.fireplan.gov.

B. CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION

The California Department of Forestry and Fire Protection (CDF) is responsible for fire suppression on privately-owned wildlands and provides emergency services under cooperative agreements with the counties. CDF has two seasonal fire stations in the Tehama watershed side, Paskenta Station and Baker Station, as well as a cooperative station with Tehama County located in central Bowman.

The State Board of Forestry and CDF the have recently completed a comprehensive update of the state fire plan for wildland fire protection in California (CDF 2000). The overall goal of the plan is to reduce total costs and losses from wildland fire by protecting assets at risk through focused prefire management prescriptions and increasing initial attack success. CDF's statewide Initial Attack Fire Policy is to aggressively attack all wildfires, with the goal of containing 95% of all fire starts to 10 acres or less.

The California Fire Plan has five strategic objectives:

- To create wildfire protection zones that reduces risks to citizens and firefighters.
- To assess all wildlands (not just the state responsibility areas) to identify high risk, high-value areas and develop information and determine who is responsible, who is responding, and who is paying for wildland fire emergencies.
- To identify and analyze key policy issues and develop recommendations for changes in public policy.
- To have a strong fiscal policy focus and monitor wildland fire protection in fiscal terms.
- To translate the analyses into public policies.

A key product of the Fire Plan is the identification and development of wildfire safety zones to reduce citizen and firefighter risks from future large wildfires. Initial attack success is measured by the percentage of fires that are successfully controlled before unacceptable costs are incurred. Assets at risk are identified and include citizen and firefighter safety, watersheds, water, timber, wildlife, habitat, unique areas, recreation, range structures, and air quality. Based on the annual average acres burned by wildfires from 1985-1994, CDF calculates wildfires emit almost 600,000 tons of air pollutants each year.

The safety and asset assessments in the plan enable fire service managers and stakeholders to set priorities for prefire management project work. Prefire management includes a combination of fuels reduction, ignition management, fire-safe engineering activities and improvements to forest health to protect public and private assets. CDF finds there is a direct relationship between reduced expenditures for prefire management and suppression and increased emergency fund expenditures, disaster funding, and private taxpayers' expenditures and losses.

In the Cottonwood Creek Watershed, CDF is responsible for wildland fire protection on all ownerships, except those managed by the Whiskeytown National Recreation Area (WNRA) in the northwest section of the watershed. CDF and the WNRA have entered into a cooperative agreement for dispatching and resource sharing on all wildland fires occurring in the "mutual threat zone" near WNRA. The cooperative agreement, in conjunction with the California Cooperative Fire Agreement on Wildland Fire Suppression between CDF, USDA Forest Service, National Park Service, and Bureau of Land Management, outlines the cooperative sharing of resources for wildland fire suppression, since wildfires do not recognize political or ownership boundaries.

In summary, CDF believes that cooperative fire protection, fuels reduction, and fire prevention must be linked and an extensive network of collaboration in order to have future success in dealing with the wildfire problems within the Cottonwood Creek Watershed.

C. COTTONWOOD CREEK WATERSHED FIRE SAFE COUNCIL

The Cottonwood Creek Watershed Fire Safe Council also formed under guidelines of the statewide Fire Safe Council and has adopted as its mission to preserve the natural and man-made resources in Cottonwood Creek Watershed by mobilizing watershed residents to make their homes and communities fire safe through education and participation. The Cottonwood Creek Fire Safe Council developed a priority list of activities that can help in creating a fire safe watershed. These include:

1. Develop strategic locations for cisterns throughout the watershed.
2. Install cisterns in strategic areas previously identified.
3. Illustrate all large ranches, and subdivisions, etc. within the Cottonwood Creek Watershed on a map.
4. Locate and illustrate all existing water sources such as ponds, pools and streams and access routes for fire engines.
5. Install signs at major road intersections to indicate the location of existing water sources within the watershed.
6. Install reflective road signs on private and county roads to help firefighters and other emergency response teams locate and communicate target destinations.
7. Develop and disseminate educational information about fire prevention and emergency planning to all residents in the watershed.
8. Develop an evacuation plan for the watershed to provide residents with information regarding evacuation procedures, emergency shelters, and safe escape routes.
9. Continue CDF's VMP program within the watershed, concentrating on larger ownerships with an emphasis on noxious weed eradication and converting chaparral to annual grasslands.
10. Build or improve road access to existing and developed water sources.
11. Identify and map the location of landowners with water hookups for fire engines.
12. Provide property owners with the means to develop defensible space around homes.

The Cottonwood Creek Watershed Fire Safe Council posts minutes of their meetings on the California Fire Safe Council website at **www.firesafecouncil.org**.

D. SHASTA COUNTY FIRE SAFE COUNCIL

The Shasta County Fire Safe Council was formed in May 2002. It is part of a statewide effort which began in 1993 to form area Fire Safe Councils to educate and encourage Californians to prepare for wildfires before they occur. (See www.firesafecouncil.org for more information.)

Mission Statement
The mission of the Shasta County Fire Safe Council is to be a framework for coordination, communication and support to decrease catastrophic wildfire throughout Shasta County.

E. TEHAMA FIRE COUNCIL

The Tehama Fire Council formed in the spring of 2000 to be an advisory group and work with established fiscal agents, such as Resource Conservation Districts and watershed groups on funding for specific projects relating to fire management, fuel reduction and fire prevention. A steering committee provides general guidance for the council by prioritizing discussion issues, coordinating meetings and leading collaborative projects. The priority issues shown on their web page (see **www.firesafecouncil.org**) identified by participants include:

- smoke management and self regulation
- coordination on prescribed burning
- coordination on wildfire incidents
- public education
- fire prevention education
- fire training for land managers
- prescribed and emergency response fire capacity
- rehabilitation after wildfire incidents
- fuelbreak and vegetation treatment projects
- monitoring of regulatory and institutional environment
- alternative funding for traditional and innovative fire-safe projects

As of December 2001, the Steering Committee members represented The Bureau of Land Management, California Department of Fish & Game, CDF, CCWG, Sierra Pacific Industries, The Nature Conservancy and USDA Forest Service. Other participants include representatives of the Tehama County Air Pollution Control, Tehama County RCD, Denny Land & Cattle Company, Rosewood Ranch, Board of Forestry, Battle Creek Watershed Conservancy, Quincy Library Group and the National Park Service.

F. CDF's TEHAMA-GLENN UNIT FIRE PLAN

Out of the ten zones identified in the CDF Tehama-Glenn Unit Fire Plan, Zones 1 and 2 included the area of the Cottonwood Creek Watershed that includes (Zone 1) Paskenta, Red Bank, and R-Wildhorse Ranch, and (Zone 2) Cottonwood and Lake California. CDF's Tehama-Glenn Unit is made up of four field Battalions: Manton, Sacramento River, Red Bank and Paskenta. Only part of the Cottonwood Creek Watershed is in the Red Bank Battalion. Each Battalion consists of a distinct mix of geography, fuels, access issues, values at risk, and fire causes.

KEY SEGMENTS OF THE UNIT FIRE PLAN FOR ZONE 1

Many species of brush grow throughout Zone 1. In the eastern portions closer to development, the dominant chaparral species is Manzanita. This brush plant grows in patches that vary greatly in size and density. Manzanita can be a minor component in Blue-Oak woodland or grow in dense patches. Annual grasses usually surround brush patches and these grasses can carry flames into the brush canopy if the leaves are close to the ground. The same is true for Live Oak trees and Live Oak scrub. Both Manzanita and Live Oak have thick evergreen leaves that tend to burn slowly when ignited. If leaves are lofted into the air by rising convection columns during a fire, it can blow across a fireline or natural barrier and start spot fires hundreds of feet away. Other species of brush present in Zone 1, such as Poison Oak, Yerba Santa, Ceanothus and Redbud are not usually major problems during firefighting.

In the western portions of Zone 1, the Oak Woodland gives way to dense Chaparral brushland. The foothill areas near R-Wildhorse Ranch, Canyon Loop, Colyear Springs Road and lands west of Paskenta consist of mixed chaparral with large amounts of Chamise. Mature Chamise patches can burn with ferocious fire intensity during the late fire season.

In Zone 1, grass is usually the major carrier of fire. Annual grasses grow through the late winter and early spring months reaching maturity by June. Once cured, it becomes flashy fuel for vegetation fires. After curing the annual grasses are strongly influenced by daily changes in humidity. Flammability in grasses adjusts hourly as humidity in the air rises or falls due to changes in sunlight, temperature and wind. Grasses that will not burn during the morning high humidity can be susceptible to fires in the afternoon due to higher temperatures and lower humidity. Grass fires in this type are characterized as fast moving, strongly influenced by local wind, humidity and terrain.

The fire problem from Manzanita and Live Oak is cyclic and is concentrated in the latter part of the summer. By August, the brush becomes dormant due to drying soil conditions. Live fuel moisture drops to critical levels and the vegetation can allow severe fire intensity with spotting.

Fires in Zone 1 that involve both grass and brush greatly increase the danger and severity of a wildland fire. Late summer fires in chaparral often involve thousands of acres, a major ground and air firefighting force and large losses to improvements and natural resources.

Brush species remain dormant and relatively flammable from August through February. For this reason, landowners can sometimes conduct controlled burns during the winter. Since grasses are usually too green to burn during this period, the brush treatment projects can be conducted with lower risk of fire escape.

Regarding access, the general area of Zone 1 is accessible by substandard ranch roads or cross-country travel and adversely affects access for fire equipment. The many gullies in the area can severely hinder fire equipment access while allowing fire to spread. Fires that are not extinguished immediately require bulldozers and 4-wheel drive engines to provide access to fire perimeter. Aircraft are required on these fires to hold the fire perimeter until ground units can gain access. Man-made and natural ponds are found on ranches throughout Zone 1, but the majority are located in remote areas with little or no access.

During the past 11 years (1990-2001) this zone has experienced 115 vegetation fires.
The source of ignitions were (see FIGURE 1A):

TYPE	IGNITIONS
Equipment use	20
Smoking along roadside	8
Vehicle exhaust/roadside	10

Children playing w/fire	5
Control burn escapes	2
Debris burning escapes	4
Lawn mowers	4
Arson	5
Power lines	0
Lightning	23
Campfire escape	4
Welding	1
Chainsaw	1
Other	11
Undetermined	17

The priority rating for Zone 1 is Moderate. The CDF Action Plan includes the following:

- Utilize vegetation management practices to reduce and modify fuel loading.
- Enforce annual burn ban.
- Continue fuelbreak construction and maintenance in Pellows area.
- Continue fire prevention school programs at area schools.
- Promote additional fire prevention education among the general public.
- Focus fire prevention programs on hardwood harvesting operations.
- Focus law enforcement activities on equipment violations and arson.
- Conduct an agricultural equipment inspection program.
- Conduct Red Flag patrols and public contacts.
- Review effectiveness of initial attack capabilities at Baker Station.
- Review effectiveness of detection capabilities including loss of Pattymocus Lookout.
- Review Risk Rating Area for special treatment zones.

KEY SEGMENTS OF THE UNIT FIRE PLAN FOR ZONE 2

Zone 2 is bordered by Cottonwood Creek to the north, Luce and Griswold Road, Highway 36 West, and Bowman Road to the west and the Sacramento River to the east. This zone contains the communities of Bowman, Lake California, Wilcox and Dibble Creek, all rural type residential communities with few businesses.

Zone 2 vegetation consists of a mixture of grass rangeland, oak woodland, and brush. Blue and live oaks are the dominant tree species in the area along with lesser amounts of valley oak and foothill pine. The trees provide cooler temperatures and reduced wind under the canopy, thus affecting the rate of fire spread.

Although other species of brush grow in Zone 2, the dominant chaparral here is Manzanita, which grows in patches that vary greatly in size and density. As described in Zone 1, the Zone 2 Manzanita can be a minor or major component of an area. The fire problem from Manzanita and live oak is cyclic and concentrated in the latter part of the summer when live moisture in the plants is reduced. By August the plants become dormant due to drying soil conditions. The live fuel moisture drops to critical levels and the vegetation can allow severe fire intensity with spotting. These conditions continue until rainfall occurs in the fall.

Like Zone 1, Zone 2, annual grasses grow through the late winter and early spring months reaching maturity by June. Once cured, grasses become flashy fuel for vegetation fires. After curing, the annual grasses are strongly influenced by daily changes in humidity. Flammability in grasses adjusts hourly as humidity in the air rises or falls due to changes in sunlight, temperature and wind. Grasses that will not burn during the morning high humidity can be susceptible to fires in the afternoon due to higher temperatures and lower humidity. Grass fires in this type are characterized as fast moving, strongly influenced by local wind, humidity and terrain.

The topography of Zone 2 consists mainly of rolling to steep hills covered with grass and trees. Narrow drainages throughout the zone feed into seasonal streams, ponds and year round waterways. Much of the zone is accessible by county roads, such as Bowman, Hooker Creek and Jellys Ferry Roads. The zone also has many dirt and paved private roads leading into residential neighborhoods, such as Lake California Drive.

The terrain features of Zone 2 affect access into many portions of this zone. Most areas can be accessed with 2-wheel drive fire equipment through the road systems of the area. Some areas are too rugged for these units. The gullies in the area can severely hinder fire equipment access while allowing fire to spread. Fires in Zone 2 that are not extinguished immediately before they spread into inaccessible areas usually require hand crews, bulldozers and 4-wheel drive engines to provide access to the fire perimeter. These types of fires require the use of large and costly aircraft to hold the fire perimeter until ground units can made access.

The community of Lake California maintains a municipal fire hydrant system with flows typically at or above 1,500 GPM and hydrants spaced along the paved roadways about every 750 feet.

The assets at risk from fire in Zone 2 consist primarily of the many homes that are located throughout this area. The residences in Zone 2 are primarily houses located on large lots, ranchette style homes with small acreage, and ranches with houses and outbuildings located on the property. The exception to this rule is the community of Lake California.

Lake California is a designed community located in the northeast corner of this zone. Approximately 50% of this community has been developed and includes moderately- sized residential structures, a club house complex, a small business complex and a scattering of duplexes and apartments, typically situated in grass and oak woodland fuels on ridgelines and hilltops.

During the past 11 years (1990-2001) this zone has experienced 482 vegetation fires. The sources were (see FIGURE 1B):

TYPE	IGNITIONS
Equipment use	98

Smoking along roadside	39
Vehicle exhaust/roadside	47
Children playing w/fire	39
Debris burning escapes	26
Lawn mowers	18
Arson	36
Power lines	18
Lightning	12
Campfire escape	7
Welding	5
Other	66
Undetermined	71

The Priority Rating for this zone is High. The CDF Action Plan for this zone includes:

- Utilize vegetation management practices to reduce and modify fuel loading.
- Enforce annual debris burn ban.
- Identify and construct and maintain fuelbreak locations.
- Work with CalTrans and Public Works on roadside fuel modification.
- Develop fire protection water supply infrastructure.
- Continue fire prevention school programs at area schools.
- Promote additional fire prevention education among general public.
- Focus Law enforcement activities on debris burning and arson.
- Conduct equipment inspections.
- Conduct Red Flag patrols and public contacts.
- Conduct power line inspections.
- Review effectiveness of initial attack capabilities at the Bowman station.
- Review special treatment zones.

The primary current project in Zone 2 is with the Lake California Property Owner's Association. Since 1993 CDF has had a contract with the Lake California Property Owner's Association (LCPOA) to do fuel reduction projects in the area. The total project area is 1,900 acres with 500 acres of that being treated already. This is the fourth 3-year contract between CDF and the LCPOA. The project consists of cutting, stacking, chipping and burning the fuel removed using inmate crews, volunteers in prevention and chippers.

FIGURE 1A

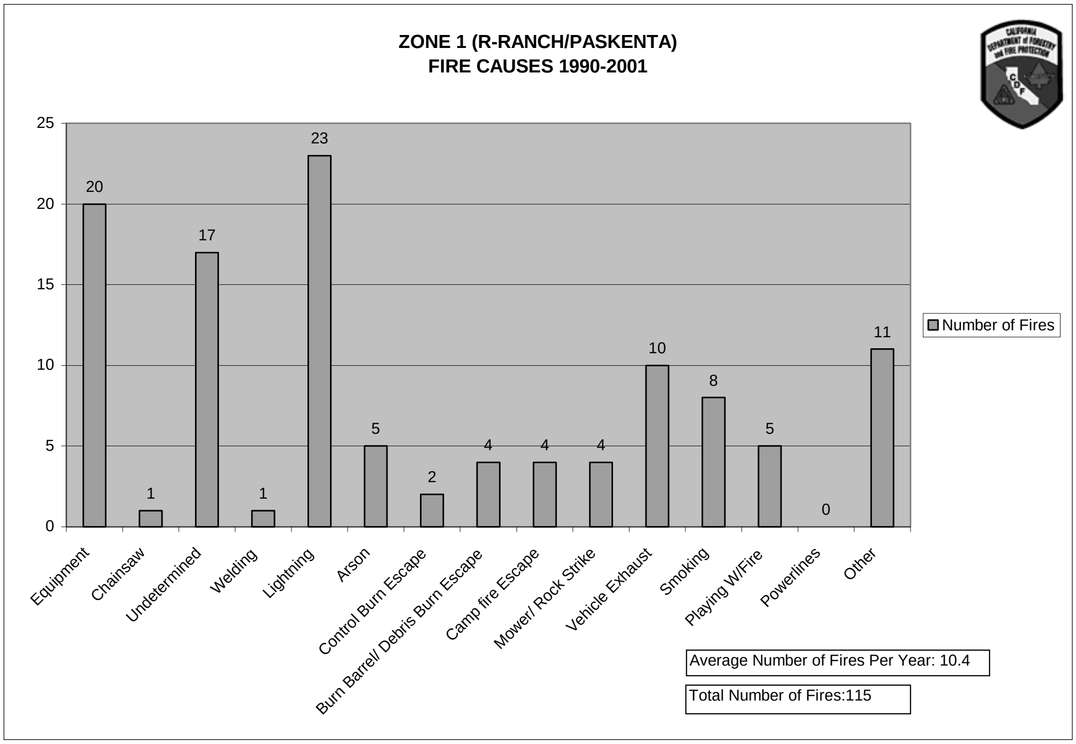
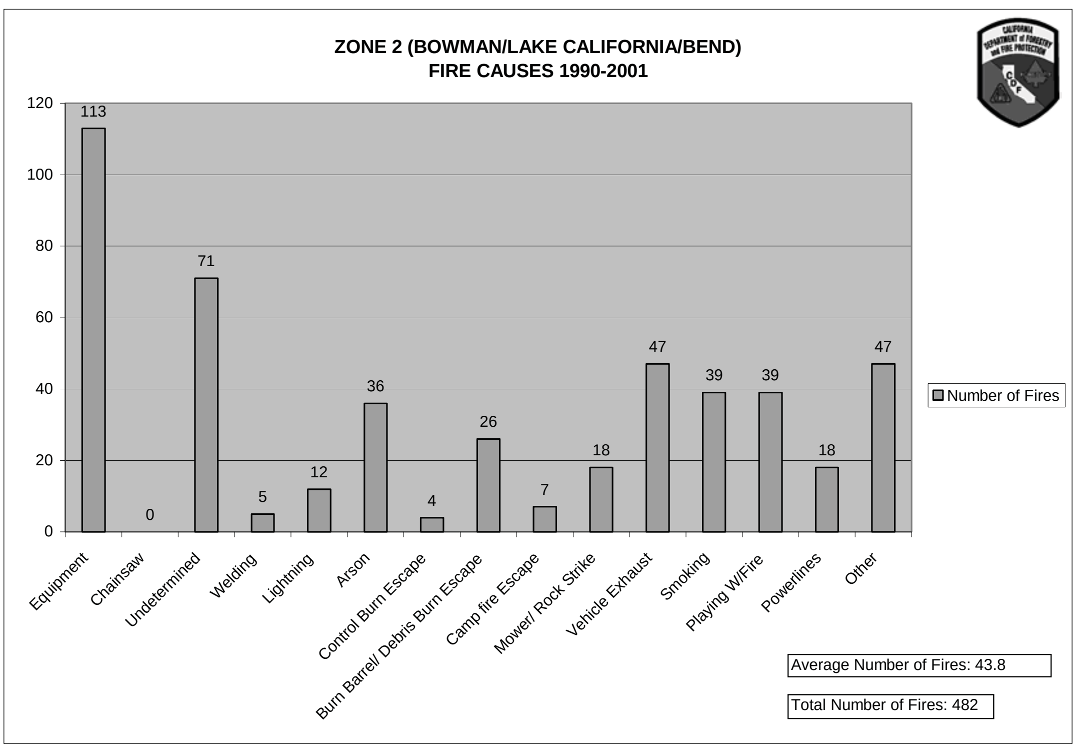


FIGURE 1B



G. CDF SHASTA COUNTY UNIT FIRE PLAN

The following details are for Shasta County Fire Activity in the Cottonwood Creek Watershed. Unwanted vegetation fires damaged 2385.5 acres of land during the last twelve years (1990 – 2001 inclusive), causing an estimated $172,459.00 loss of property. The leading cause during this time period was fires started by the use of equipment. The average leading equipment cause is from the use of mowers. 53% of mower caused fires result from sparks when a mower blade strikes a rock. The remainder is caused by mower engine exhaust; both faulty exhaust systems and exhaust contact with vegetation. The remainder of the equipment types varies from small-motorized tools to heavy equipment. See Figure 2 and Table 1 below:

FIGURE 2

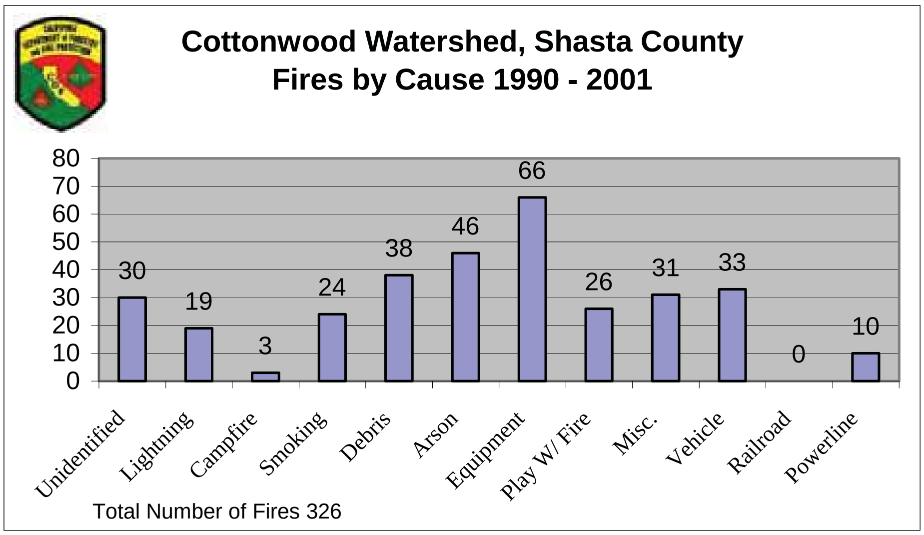


TABLE 1

	Unidentified	Lightning	Campfire	Smoking	Debris	Arson	Equipment	Play W/ Fire	Misc.	Vehicle	Railroad	Powerline	Total
1990	1	3	0	2	7	0	5	4	6	8	0	1	**37**
1991	0	2	0	0	1	2	4	2	2	9	0	0	**22**
1992	5	2	0	2	4	1	8	1	3	3	0	1	**30**
1993	5	0	0	3	1	0	9	2	0	0	0	2	**22**
1994	3	3	0	3	6	6	8	4	6	4	0	2	**45**
1995	3	0	0	1	2	5	4	1	5	2	0	1	**24**
1996	2	1	0	1	4	5	6	6	2	2	0	1	**30**
1997	2	3	1	1	1	2	2	1	0	0	0	0	**13**
1998	2	0	0	5	2	8	10	0	3	1	0	0	**31**
1999	3	4	0	2	6	8	5	4	2	2	0	1	**37**
2000	3	0	1	2	0	7	1	0	2	1	0	0	**17**
2001	1	1	1	2	4	2	4	1	0	1	0	1	**18**
Totals	**30**	**19**	**3**	**24**	**38**	**46**	**66**	**26**	**31**	**33**	**0**	**10**	**326**

The watershed fire causes mirror those of Shasta County where use of equipment is the leading cause. Debris burning and arson are the next two leading causes.

Equipment use continues to be a major cause of fires in Shasta County and the Cottonwood Creek Watershed; mowing dry grass the leading cause. Efforts are under way to educate persons to not mow on hot dry afternoons when fire start conditions are highest. These education efforts should continue as well as efforts to ensure equipment exhaust systems are properly maintained and compliant with Public Resources Code 4442.

Arson caused fires receive a considerable amount of investigation time. Historically one or two years may experience a high number of arson caused fires and the following few to none due to prevention efforts.

Debris burning caused fires have decreased due to a burn ban below 1000' feet in Shasta County that is in effect each year between May 1^{st} and October 31^{st} and a state wide debris burn ban during the active fire season. Fires caused by debris burn escapes typically occur in the early spring and fall and result from inadequate clearance and/or lack of attendance. Current fire prevention methods to control this cause are homeowner education and strict enforcement of the burn ban laws.

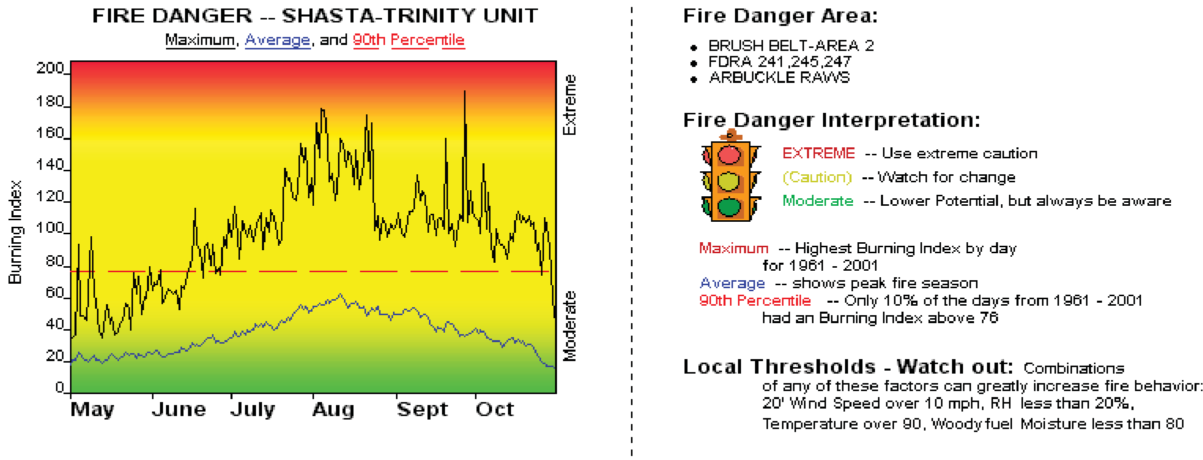
Vehicle caused fires are the result of the vehicle burning and spreading to the wildland or fires caused by the operation of vehicles. These fires usually start along the road edge. Miscellaneous fire causes are those fires started by events or activities that cannot be logically placed in any of the other cause classes. Playing with fire is a fire caused by children or persons with diminished mental capacity that do not understand the consequences of their actions. Involved children are counseled following FEMA's (Federal Emergency Management Agency) Juvenile Fire Setters /Arson Prevention Program guidelines. Smoking caused fires generally are located along the roadside. Education and awareness programs should continue and possibly target specific areas. Power line fires may be started by vegetation touching the powerline, fallen wires, animals or other objects coming in contact with the wires. Powerlines are cleared of vegetation following Public Resources Code 4293 – 4296. Fires caused by campfires are minimal in the watershed however education and prevention efforts must be maintained as the population changes.

Lightning within the watershed has caused few fires recently, however, historically the number has been higher. In addition many of these fires area located in inaccessible areas and are difficult to control. The unidentified fires are those where no specific causal factor was discovered after investigation.

A majority of the fires started within the Cottonwood Creek Watershed and Shasta County originate near a road edge. Fuel treatments along the roads serve several purposes. First, limiting fuels along the roadway slow the fires spread. Secondly, a cleared roadside will act as a fuel break. Thirdly, roadside clearance creates a safe egress allowing the smooth flow of traffic. Past fuel management programs have concentrated on the brush fields. CDF has assisted landowners in controlling brush with controlled burns under the CDF Vegetation Management Program. Property owners have also cleared some private ranchlands.

Fire danger ratings for the Cottonwood Watershed based on the Arbuckle Flat Remote Automated Weather Station. Figure 3 demonstrates the level of seasonal fire danger:

FIGURE 3



H. SHASTA TRINITY NATIONAL FOREST

The Shasta Trinity National Forest completed a Fuels Analysis and Strategy to provide a basis for managers to make decisions concerning placement and priorities of fuels management projects. It is a Forest level analysis meant for Forest level considerations. The report states it may also be used as a tool for project level planning.

The analysis characterizes the Shasta Trinity National Forest in terms of hazard, risk and value. Hazard is defined as fire behavior potential, which has implications for resource damage as well as suppression capability. Risk is the probability of a fire occurring based on local fire history. Value refers to the monetary, ecological or political worth of a definable area. All three areas (hazard, risk and value) are quantified by a measure of low, moderate, or high through a combined use of scientific data and technical expertise, and displayed in a GIS map. The three are then combined in an overall rating.

The final step of this analysis prioritizes the Forest in terms of critical fire danger areas based on the hazard, risk and value ratings and management needs. These priorities align with the National Fire Plan and the Cohesive Strategy and will guide resource management considerations on the Forest, such as natural fuels project priorities and identification of essential road access for protection purposes. The National priorities are wildland-urban interface, readily accessible municipal watersheds, threatened and endangered species habitat, and maintenance of existing low risk Condition Class I areas.

I. BEEGUM WATERSHED ANALYSIS

In March 1997 the Yolla Bolla Ranger District, South Fork Management Unit of the Shasta-Trinity National Forest published the Beegum Watershed Analysis (BWA) (USDA Forest

Service, 1997). The BWA was based on a six-step process and identified seven core topics representing the major ecological elements in the watershed. One of the core topics was Fire and Fuels.

The BWA covered only the 2/3 of the Beegum Watershed that lies within the National Forest boundary. The 1/3 outside the national forest in either BLM or private ownership was not addressed. The primary objectives for the land covered by this report were timber production, wildlife (deer habitat) management, and fuels management.

The report states that fire has been an important natural disturbance agent in the watershed, with lightning the primary ignition source. Ecosystems within the watershed, specifically those at lower and mid-elevations, have evolved under a frequent low-intensity fire regime. Higher elevation true-fir forest ecosystems, developed under a fire regime of infrequent high-intensity fires. Fire suppression efforts for over 80 years have set the stage for large catastrophic wildfires in both the decadent brushfields and the overstocked, moisture-stressed timber stands. The Yolla Bolly Middle Eel Wilderness, of which a small portion lies in the Beegum Watershed, has one of the few Class 1 Airsheds in the state. A Class 1 Airshed has the most stringent air quality constraints, which may severely impact opportunities for prescribed fire use within and adjacent to it.

Within the Yolla Bolla District fuelbreaks have been constructed and maintained in an effective fuelbreak system dating back to the 1970's. At the time of the BWA, there were approximately 26 miles of ridgetop fuelbreaks within the Beegum Watershed. Of these, 22 miles were in need of maintenance to remain effective. These were:

Ecological Unit	**~ Miles of Fuelbreak**
Dutchman	4
Little Red/Tedoc	2
North Yolla Bolla	2
Round/N. Star	3
Round/N. Star	2
Snake Lake	9

These fuelbreaks enabled fire suppression personnel to safely and effectively catch the previous two large fires on the district outside of wilderness areas, when it would have burned many additional areas, per reports from fire district personnel.

At the time of the BWA, lower elevations of the watershed were occupied with pure brush fields and chaparral communities. Chamise, a fire dependent shrub, dominated the shrub cover on the hottest and driest sites. Most of the brush was decadent. Approximately 20 years after burning, chaparral brush and associates are fully mature and approaching decadence (i.e. more dead material is produced each year than new growth). At approximately 25 years, about 30% of the biomass is dead, increasing to 50% around 50 years old.

According to Baumhoff, 1978 in BWA (1997), the Wintu Indian tribe utilized fire to control brush, promote growth of seed producing plants, mushrooms, herbs, bulbs and to enhance forage for deer and other game. Grassy areas were burnt regularly to prevent encroachment by surrounding vegetation and for grasshopper harvesting. Burning also provided new tender young shoots for a desirable basket material, which was easier to work and weave.

The Shasta-Trinity National Forest Hazard/Risk Analysis rates the overall watershed as having low-to-moderate hazard/risk rating. A more site-specific analysis incorporating values at risk and vegetation levels and conditions, rates the highest fire risk areas as Snake Lake, Round/N. Star (Central & South), and North Yolla Bolla.

One of the limiting factors in improving the deer herd on the forest is improving foraging conditions. Marrying deer forage needs with fuelbreaks was seen as one way to improve upon the forage found with chaparral habitat. Fuel reduction of the stands and then allowing fire within oak stands was seen as more cost effective vs. burning south facing chaparral habitat. Before burning could be implemented, migration corridors would need to be identified.

Priority recommendations in the BWA include dealing with the overstocking conditions and altered plant communities due to fire suppression and unnatural fire regime and decadent shrub communities and its impact on fire, fuels and deer habitat management.

The western portion of the Cottonwood Creek Watershed, including some isolated areas near Igo and Ono, contain fuel types, fuel loading and topography that are similar in nature to the area consumed by the Jones and Canyon fires in 1999 and the Skinner Mill fire in 1976. The Jones Fire was human-caused that started north of Jones Valley in the foothills. It consumed 26,202 acres of chaparral, timber and grassland in approximately 18 hours. The Canyon/Happy Valley fire was also a human-caused fire that consumed 2,542 acres of chaparral and grassland in the foot hills near Happy Valley. The Skinner Mill fire started near the South Fork Cottonwood Creek. It was also a human-caused fire that consumed 89,133 acres of chaparral within the upper reaches of the watershed.

J. USDA FOREST SERVICE SHASTA-TRINITY NATIONAL FOREST, FOREST WIDE LSR ASSESSMENT

Shasta-Trinity National Forest has prepared a Forest-wide Late Successional Reserve Assessment to allow development and implementation of projects within Late Successional Reserves (LSRs) and Managed Late Successional Areas (MLSAs). LSRs and MLSAs are key components of the Shasta-Trinity Forest Plan in providing for old forest ecosystems including habitat for the northern spotted owl. However, as the assessment reveals, there are critical issues that need attention within these areas, including unacceptable fuel hazards and over stocked stand conditions.

Two LSRs lie along the western boundary of Cottonwood Creek Watershed. The first is LSR RC-330 South Fork, which is located along South Fork Mountain, primarily in the South Fork of the Trinity River. The eastern boundary spills over into the Cottonwood Creek drainage around Rat Trap Gap. Primary vegetative cover is Late Successional: Dense, with minor amounts of Mid Successional: Dense.

The second is LSR RC-331 Chanchellula, which is located at the upper end of Chanchellula Creek, Browns Creek, and Hayfork Creek. The eastern boundary extends into the Cottonwood Creek Watershed from the ridge line down to the “front” country which consists of oak and/or grey pine stands. Stand densities Range from 50 percent Early Successional: Seedlings and Saplings, 31 percent Mid Successional: Dense, 13 percent Late Successional: Dense, and 6 percent Mid Successional: Open.

Fire History in the LSRs has been typical of the area. South Fork has had a significant influence on the LSR and the surrounding area during the early 20th century. Potential for large, high intensity fire is a primary concern. The relatively extensive amount of Mid-Successional natural stands is indicative of past conflagrations in this area. The vegetative cover reflects 78 percent of the land base is in fuel models 9 and 10 (See Page 21 for an explanation of fuel models).

The Chanchellula LSR has a large percentage of Mid-Successional vegetative cover also. This indicates a history of fire in the early 20th century. Fuel loading puts 37 percent of the area in fuel model 9 and 20 percent in fuel model 10.

Federally listed endangered, threatened, or proposed species in the South Fork LSR comprise five Federally listed species; five Forest Service sensitive animal species, and ten Forest Service sensitive plant species. The Chanchellula LSR has only one Federally listed species (the northern spotted owl), and Forest Service sensitive species consist of six animal species and 16 plant species.

The USDA Forest Service favors the introduction of prescribed fire to the LSRs and MLSAs to help encourage the processes and attributes that define Late Successional and old growth ecosystems. They feel it is desirable to have low to moderate intensity fires burn in LSRs/MLSAs. Low intensity fires can reduce fine fuels and ladder fuels, create a seedbed for a diversity of herbaceous plants, and create a patchy understory open enough for spotted owl movements. Moderate intensity fires are desirable if they create small openings in the canopy ranging from one to five acres.

The introduction of a fire cycle more similar to that which occurred in pre-suppression times, will reduce the risk of catastrophic fires. Large stand replacing, high intensity fires are not desirable within Late Successional Reserves/Managed Late Successional Areas (LSRs/ MLSAs).

Wildfire hazard reduction treatments within the LSRs/MLSAs have the objective to develop, restore, or maintain Late Successional conditions or to reduce the likelihood of stand replacing fires that would result in the loss of key Late Successional structure. Hazard reduction can take on the form of fuel reduction, firewood cutting, prescribed burning, and manual and mechanical fuel reduction.

V. ANALYSIS OF FUEL INVENTORY AND CONDITIONS

A. FUEL, WEATHER AND TOPOGRAPHY

The three major components of the Wildland Fire Environment are fuels, weather, and topography (National Wildland Coordination Group, 1994). Weather is a major factor and local weather conditions are important in predicting how a fire will behave.

Within the lower elevations of the Cottonwood Creek Watershed the wind blows from the north during the early part of the summer and from the south during the latter part of the summer, and in the western foothills, the wind trends up the canyons on the hillsides east to west. In the valley the wind patterns push wildfire in a northerly or southerly direction and westerly direction in the foothills. From a strategic standpoint, fire spread in lower elevations can most likely be decreased by an east-west fuelbreak or area to set up control lines. To hold valley fires from being pulled up through 'chimneys' in the foothills, strategically placed fuelbreaks near the foothills in a northerly/southerly direction can help.

During the fire season (June-October), daily temperature within the Cottonwood Creek Watershed are usually in excess of 90° Fahrenheit and relative humidity is typically less than 30%. When combined, these conditions create an extreme fire danger during the summer months; therefore, fuels management activities should only be conducted during late fall, winter and early spring.

Topography can affect the direction and the rate of fire spread. Topographic factors important to fire behavior are elevation, aspect, steepness and shape of the slope. When fire crews are considering fire suppression methods, the topography is always critical in determining the safest and most effective plan of attack. When accessible, ridge lines are very important features from which to conduct fire suppression activities and can be a strategic area to conduct fuels management activities.

Fuel factors that influence fire behavior are: fuel moisture, fuel loading, size, compactness, horizontal continuity, vertical continuity, and chemical content. (National Wildfire Coordinating Group 1994)

- Fuel moisture is the amount of water in a fuel, expressed as a percentage of the ovendry weight of that fuel. For example, a fuel sample can be found to have 20-60% moisture content.
- Fuel loading is defined as the ovendry weight of fuels in a given area, usually expressed in bone dry tons. For example, an area can be calculated to have 20 bone dry tons per acre of fuel. A bone dry ton is 2000 pounds of vegetation when rated at 0% moisture content.
- Size refers to the dimension of fuels, and compactness refers to the spacing between fuel particles.
- Continuity is defined as the proximity of fuels to each other, vertically or horizontally, that governs of the fire's capability to sustain itself.
- Chemical content in fuels can either retard or increase the rate of combustion.

All of these factors will influence the quantity of heat delivered, the duration, flame length and the rate of spread of any given fire, and should be considered prior to considering fire prevention projects or initiating fire suppression activities.

B. FUEL INVENTORY

The goal of the fuel inventory is to identify high fuel-loading areas and collect data that could be used as a tool to plan fire protection activities.

<u>Fuels Defined</u>
Fuels are made up of the various components of vegetation, live and dead, that occur on a given site. Fuels have been classified into four groups – grasses, brush, timber, and slash. The differences in fire behavior among these groups are basically related to the fuel load and its distribution among the fuel diameter-size class. In 1972, 13 mathematical fire behavior models or Fuel Models were developed by Rothermel (1972) to be utilized in fire behavior predictions and applications for every vegetation type. These Fuel Models represent the types of fuel most likely to support a wildfire.

TABLE 2 – FUEL MODEL TYPES

Fuel Model	Fuel Complex
	Grass and Grass-Dominated
1	Short Grass (1 foot)
2	Timber (grass and understory)
3	Tall Grass (2.5 feet)
	Chaparral and shrub fields
4	Chaparral (6 feet)
5	Brush (2 feet)
6	Dormant brush, hardwood slash
7	Southern rough
	Timber litter
8	Closed timber litter
9	Hardwood litter
10	Timber (litter and understory)
	Slash
11	Light logging slash
12	Medium logging slash
13	Heavy logging slash

The fuel models were designed to estimate fire behavior during severe fire hazard conditions when wildfires pose greater control problems and severely impact natural resources. Fuel models are simply tools to help the user realistically estimate fire behavior. The criteria for choosing a fuel model includes the assumption that fire burns in the fuel stratum best conditioned to support the fire. This means that situations will occur where one fuel model will represent the rate of spread most accurately, while another best depicts fire intensity. In other situations, two different fuel conditions may exist, so the spread of fire across the area must be weighed by the fraction of the area occupied by each fuel type.

Results of the Fuel Inventory

The Cottonwood Creek fuel inventory found 5 of the 13 fuel model types present, as described by Anderson (1982), in the watershed.

- Fuel model 2 is grass and understory and is the largest fuel type, comprising 32% of the watershed or 192,609 acres, predominately found in the lower elevations of the watershed.
- Fuel model 10 is forest litter and understory and is the second largest fuel type, comprising 27% of the watershed or 163,112 acres, found in the higher elevations of the watershed.
- Fuel model 9 is hardwood litter, the third largest fuel type, comprising 22% or 132,292 acres, found in the higher elevations of the watershed.
- Fuel model 6 is dormant brush and slash, the fourth largest fuel type, comprising 12% or 75,396 acres, found in mid elevations of the watershed.
- Fuel model 5 is chaparral brush, the fifth largest fuel type, comprising 4% or 23,730 acres, found in mid elevations in the watershed.

Combined, the five fuel types make-up 97% of the vegetation within the watershed. The remaining balance of the vegetation types or land types is comprised of riparian vegetation, serpentine vegetation, barren rock, water bodies, and urban development (Refer to Fuel Models, Map 3).

The following table illustrates the fuel models, vegetation types or land types in the watershed, and the acreage (vegetation acreages, CCWG, 2002):

Page Break

TABLE 3 – FUEL INVENTORY RESULTS

Fuel Model/ Vegetation Type	**Total Acres**
2 – grass and understory	192,609
5 – chaparral brush ~2’	23,730
6 – dormant brush, slash	75,396
9 – hardwood litter	132,292
10 – forest litter, understory	163,112
OTHER: Agriculture	6,456
Riparian Vegetation	333
Serpentine Vegetation	6,090
Barren Rock	578
Water Bodies	503
Urban Development	2,755
TOTAL	**603,854**

To understand the current fuel loading conditions, it is important to understand past fuel loading conditions. Due to the historical fire regime, overall plant densities were most likely lower than those of today. Frequent fires would have drastically reduced vegetation densities and accumulated fuels. Furthermore, it is also very likely that the species composition is much different today due to fire suppression. Fire-adapted species, which thrived in reoccurring fire environments, have probably declined due to competition from non-fire dependent species.

C. BEHAVE - FIRE BEHAVIOR

1. Background

With the inventory of the fuel models for the watershed, the type of fire behavior that may be expected in the Cottonwood Creek watershed can be predicted. The BEHAVE system is a computer program used for predicting fire behavior (Andrews, 1984). The program requires five inputs:

Fuel model
Fuel moisture
Wind direction
Windspeed
Slope

The fuel model inventory map (Map 3 in the Appendix) provided the fuel model identification. In this case, the fuel moisture, defined as the amount of water in a fuel, was provided by the California Department of Forestry and Fire Protection. Inputs in reference to windspeed and wind direction were developed by the Cottonwood Creek Fuels Team. Numerous scenarios were run using the BEHAVE system (see Appendix B). The fuel models used in each run represent the major fuel models in the Cottonwood Creek watershed. These are:

Grass model #2
Brush models #5 and #6
Timber models #8 and #10

The input data was obtained from the California Department of Forestry and Fire Protection offices in both Tehama and Shasta Counties for their responsible areas. The input data includes fuel moisture, live herbaceous moisture, wind speed and percent slope. Fuel moisture and live herbaceous moisture can be defined as the amount of water in fuel or a live stem, expressed as a percent of the ovendry weight of any given fuel or live stem. Rick Hartley, Pre-fire Engineer, with the California Department of Forestry and Fire Protection (Shasta Trinity Unit), believes fuel moistures are lower within the Shasta County portions of the watershed due to the increased southern exposure, which receives more radiant heat and reduces fuel moisture.

In the following analysis, the input data was based on both Shasta County and Tehama County average and extreme summer weather conditions. Reports from the Western Regional Climate Center (WRCC) show from 1962 through 1974 the average daily high temperature during the month of July was 92.7 degrees Fahrenheit. The highest recorded temperature in July was 109 degrees Fahrenheit (although at the time this plan is being prepared, the high temperature in July has been 116 degrees Fahrenheit.). The temperature data was collected from a weather station near Platina, CA. Wind speed data was not available through the WRCC, but according to the California Department of

Forestry and Fire Protection (Shasta Trinity Unit and Tehama-Glenn Unit) the average wind speed during the month of July is 7 miles per hour, with an extreme wind speed of 15 miles per hour. Both wind speed and temperature directly impact fuel moisture. As wind speeds and temperatures increase, fuel moistures decrease. In addition, two slope classes were used to determine the effect of ground steepness (slope) on wildfire behavior.

2. Fuel Moisture

The amount of moisture in fuel is the major element that will determine how much of the fuel will burn (the available fuel). According to how much moisture is in the fuel, either all of it will burn, only part will burn or, if wet enough, little will burn.

The fuel moisture is described based on the diameter of the vegetation. Dead fuels contribute most to fire spread, therefore the dead fuel moisture is used for the purpose of predicting fire spread. Dead fuels are grouped into four size classes, based on the time lag, which is the rate at which the fuel gains or loses moisture due to changes in its environment. The four size classes of fuel are 1-hour, 10-hour, 100-hour and 1,000-hour fuels. (Thousand hour fuels are used as indicators of drought, but not for making fire behavior predictions.)

As an example of how the groupings are made, the 1-hour category includes fuels from 0 to ¼" in diameter (e.g., twigs, pine needles, grass). A 1-hour rated fuel are those fuels that in the presence of fire have a moisture content that reaches equilibrium with the surrounding atmosphere within one hour. The 100-hour fuel (1 to 3" in diameter), are those fuels when in the presence of fire have a moisture content that reaches equilibrium with the surrounding atmosphere after approximately 4 days, or 96 hours.

Dead forest fuels absorb and expend moisture continuously according to dryness of the air (relative humidity), wind, temperature and precipitation. One-hour fuels, such as small twigs and grass, lose moisture rapidly and will have the greatest day-to-day variation. The longer a fuel is exposed to dryer conditions, the dryer it will get. As fuel size increases, such as logs and large limbs, fuel moisture fluctuates at a slower rate. For this reason heavy fuels do not become very dry until exposed to very long periods of dry weather.

As mentioned earlier, the Cottonwood Creek watershed has an increased southern exposure in the northern portion of the watershed. For this reason two separate fuel moistures were used in each BEHAVE run to determine the variation. The northern portion of the watershed, which is located in Shasta County, will be referred to as the <u>Shasta Run</u>, and the southern portion the <u>Tehama Run</u>.

The four size classes are based on diameter of the vegetation:

1-hour fuel	0 to ¼- inch in diameter
10-hour fuel	¼ to 1-inch in diameter
100-hour fuel	1 to 3-inches in diameter
1000-hour fuel	3 to 8-inches in diameter

The following fuel moistures were used to differentiate the north from the south:

Fuel Moisture (Estimates for moisture content based on vegetation diameter)	**Shasta Run**	**Tehama Run**
0 – ¼" diameter	4	4
¼" – 1" diameter	5	8
1" – 3" diameter	6	10

As you will note, slightly lower fuel moistures were used for the ¼" to 3" diameter vegetation. The reason again, the northern portion receives more southern exposure when compared with the southern portion, the Tehama Run. Table 4 describes the Tehama Run for "average" summer conditions. Table 5 describes the Shasta Run for "average" summer conditions, zero wind and zero percent slope. This represents surface fuel fire only and does not predict crown fire. Site specific issues can change these results.

Table 4 – BEHAVE - Tehama Run

Fuel Model	Flame Length (Feet)	Rate of Spread (Feet/Hour)	Area burned after 1 hour with no suppression (Acres)
2 – Grass	9.1	4,884	167
5 – Brush	8.5	3,036	64
6 – Dormant Brush	8.4	4,026	115
8 – Closed Timber Litter	1.5	264	0.4
10 – Timber (Litter and Understory)	7.1	1,056	7.5

Table 5 – BEHAVE Shasta Run

Fuel Model	Flame Length (Feet)	Rate of Spread (Feet/Hour)	Area burned after 1 hour with no suppression (Acres)
2 – Grass	9.2	4,884	168
5 – Brush	8.6	3,036	65
6 – Dormant Brush	8.6	4,158	121
8 – Closed Timber Litter	1.6	264	0.5
10 – Timber (Litter and Understory)	7.1	1,056	7.6

RESULTS –
BEHAVE displays fire behavior with three outputs:

OUTPUT	MEASURE	RESULTS
Flame length	measured in feet	average height of the flames
Rate of spread	feet per hour	forward rate of spread

Area burned	acres	area burned if no suppression during the first hour

The results show Fuel Model #2, the **grass** model, has the most intense fire behavior. Fire behavior outputs were very similar for both Shasta and Tehama on this run, based on average summer conditions. Flame length for both Shasta and Tehama are just over 9 feet, rate of spread for both runs are 4,884 feet per hour, and the area burned after 1 hour from ignition was 167 acres in the Tehama run and 168 acres in the Shasta run.

The **brush** models, #5 and #6 had similar flame lengths; however the rate of spread for Fuel Model #6 was much higher, which increased the area burned. For example, in the Tehama run, the flame length for both brush models, #5 and #6 was 8.6 feet, the rate of spread for model #5 was 3,036 feet per hour, for model #6 it was 4,158 feet per hour, an increase of approximately 1,122 feet per hour, and the area burned for model #6 was 121 acres after a 1 hour time lapse, 56 acres more than the area calculated for model #5. Fuel model #6 represents brush where the foliage is more flammable than fuel model #5. Fuel model #5 generally represents smaller, younger brush with little dead material.

Fuel Models #8 and #10, the **timber** models display very different fire behavior. Fuel model #8 represents closed canopy stands, where there is a very compact litter layer. Fuel model #10 represents a timber setting where there is a large quantity of 3-inch or larger limbwood resulting from overmaturity, natural events, insect- or disease-ridden stands, windthrown stands, partial-cut slash, etc. Fires burn in model #10 with a greater intensity than the other timber models. In the Shasta run, model #8 shows a flame length of 1.6 feet, and model #10's flame length under the same conditions is 7.1 feet. The rate of spread in model #8 calculated to be 264 feet per hour, in model #10, again same conditions, rate of spread was 1,056 feet per hour. The area burned after 1 hour was 0.5 acre for model #8 and 7.6 acres for model #10. Fuel Model #10 has a higher density of dead and down vegetation, providing more fuel to burn which would result in a more intense fire than Fuel Model #8.

The predictions made by the BEHAVE system using the two different fuel moistures, Shasta run and Tehama run, did not display a significant difference using average summer conditions, zero percent slope and zero percent wind factor.

Another simulation was done using an increased windspeed of 15 mph and adding a slope of 30%. Table 6 describes the results for Tehama County and Table 7 the results for Shasta County.

Table 6 – BEHAVE - Tehama: Increased Windspeed and Slope

Fuel Model	Flame Length (Feet)	Rate of Spread (Feet/Hour)	Area burned after 1 hour with no suppression (Acres)
2 – Grass	16.2	15,774	1,147
5 – Brush	14.4	8,778	351
6 – Dormant Brush	13.1	9,702	426
8 – Closed Timber Litter	2.3	528	1.5
10 – Timber (Litter and Understory)	11.6	2,970	39

Table 7 – BEHAVE - Shasta: Increased Windspeed and Slope

Fuel Model	Flame Length (Feet)	Rate of Spread (Feet/Hour)	Area burned after 1 hour with no suppression (Acres)
2 – Grass	19.3	22,836	2,044
5 – Brush	16.1	11,220	482
6 – Dormant Brush	15.0	13,002	647
8 – Closed Timber Litter	2.3	528	1.5
10 – Timber (Litter and Understory)	13.4	3,828	56

Predictions using a 30% slope factor and increased windspeed of 15 mph, showed a significant increase in all fire behavior outputs, flame length, rate of spread and acres burned. As the windspeed and slope increased, the fire behavior also increased. When comparing the Shasta Run to the Tehama Run, it is apparent that the lower the fuel moisture the higher the outputs for flame length, rate of spread and acres burned.

There are two reasons why slope affects fire behavior:

1. Preheating of fuels
2. Up-slope winds

Because of the local, up-slope winds, wildfires usually burn up-slope. The steeper the slope, the more rapidly and more intensely the fire will burn up-slope. The flames are closer to the fuel on the uphill side and receive more radiant heat. This result is more preheating and faster fuel ignition. A printout of all fire runs can be found in Apdx. B.

VI. VALUES AT RISK

A. RESIDENCES AND MAJOR STRUCTURES

According to the 2000 Census, urban development within the Cottonwood Creek Watershed has significantly increased over the past several years, specifically in the Cottonwood and Bowman areas. As more people build homes in these rural areas with severe fire hazard potential, more lives are at risk from increased fire starts. As a result, many homes within the Cottonwood Creek Watershed are surrounded by dense fuels and severe fire hazard. Building design, maintenance around homes, and wildfire defense planning can significantly influence the impacts of wildfires. The values at risk in the Cottonwood Creek Watershed are included in the CDF Tehama-Glenn Unit Fire Plan, a summary of which is found in Section IV (F) of this report.

In Zone I, the western portion of the watershed, the communities most at risk are those surrounded by dense chaparral. Both the communities of Platina and Beegum are surrounded by large, contiguous areas of dense brush species, which pose a serious fire danger. The communities of Igo and Ono are also located in close proximity to chaparral and are also at risk, however, the fire hazard associated with Igo and Ono does not appear to be as severe. A majority of the area associated with Igo and Ono is characterized by annual grasses with oak/gray pine forest throughout. This vegetation type encompasses most of the residential development within the watershed, and although grasses intermixed with oak/gray pine forest do pose a fire hazard, this type of vegetation is much less hazardous in comparison to the chaparral landscapes.

In Zone 2 of the CDF Tehama-Glenn Unit Plan, on the eastern side of the watershed, the assets or values at risk from fire are primarily the many homes located throughout this area, which includes the Bowman Road area, Cottonwood, and the gated community of Lake California. Anderson-Cottonwood Irrigation District (ACID) canals supply irrigation water to numerous ranches in this eastern portion of the watershed and are accordingly emergency water sources for these residential areas. Typically residences in this area are homes on large lots, ranchette style homes with small acreage, and ranches with houses and outbuildings. Lake California is a designed community located in the northeast corner of the watershed. Approximately 50% of this community has been developed and includes moderately-sized structures, a club house complex, small business complex, and a scattering of duplexes and apartments. The structures are typically in grass and oak woodland fuels on ridgelines and hilltops. For more information on residence and major structures, refer to the Community Fire Safe Fuel Reduction Guidelines (Appendix D).

B. FOREST LAND

The upper reaches of the Cottonwood Creek Watershed contain several thousand acres of federal forestland. Given the high economical and ecological value of wood products, it is considered a valuable asset. Unfortunately, most of these forests are located adjacent to dense, contiguous thickets of chaparral, which creates an extreme fire hazard risk. When wildfires start in the brushy foothills of the watershed, the fire quickly climbs the foothills into the forests and tree canopies, creating a very hazardous condition.

The majority of forestland within the Cottonwood Creek Watershed is publicly owned and managed by the USDA Forest Service. The remaining forestland is owned and managed by the Roseburg Resources Company, Sierra Pacific Industries, Crane Mills, and several other non-industrial forest landowners. The fire and fuels management objectives established by these landowners will be discussed in the following section.

C. FISH AND WILDLIFE

1. Fish

Approximately 130 miles of Cottonwood Creek and its tributaries are accessible to anadromous fish (USFWS, 1980). Populations of fall-run, late-fall run, and spring run Chinook salmon and steelhead use various reaches depending on life history needs.

Adult fall-run chinook salmon ascend Cottonwood Creek and spawn in late October through November (Cottonwood Creek Watershed Assessment, 2001). Juvenile salmon begin migrating following emergence as early as December, and smolts continue to leave the stream through May (CDFG, 1978) It is estimated that on average, approximately 1,000 to 1,500 adult fall-run Chinook salmon return to spawn in Cottonwood Creek each year. The California Department of Fish & Game estimate fewer than 500 late-fall run and fewer than 500 spring-run Chinook salmon return to spawn in Cottonwood Creek each year (CDFG, 1993). *The Final Restoration Plan for the Anadromous Fish Restoration Program* (USFWS, USBR, 2001) established a population target of 5,900 Chinook salmon for the Cottonwood Creek watershed.

Cottonwood Creek is an important source of spawning gravel for the upper Sacramento River, contributing 33% of gravel bedload movement into the Sacramento River. (Cottonwood Creek Watershed Assessment, 2001).

2. Wildlife

The Cottonwood Creek watershed provides an array of wildlife resources and habitat types that reflect the diversity of landscapes and disturbance mechanisms. A systematic review of wildlife in the Cottonwood Creek Watershed Assessment identified at least ten specific habitat types in the watershed. The California Wildlife Habitat Relationships Model identifies almost 150 species of wildlife may exist within the watershed.

Riparian habitats in the watershed were found to support a significant diverse assemblage of wildlife species over a wide array of geographic settings. Approximately 75% of the potential species identified rely on riparian habitat for some component of their life stage. The riparian areas provide primary residential and breeding habitat for a number of species, while riparian corridors serve as transition habitat or migratory corridors and provide for population dispersal over time.

Research by the Audubon Society found that wildfire is harmful to vegetation and wildlife in riparian woodlands. Most mammals move out of the way as a fire approaches, however species living or nesting in trees may be directly impacted. Indicators are populations of small mammals are reduced for at least two years following wildfires and large mammals enter a burned area to forage when vegetation resprouts. Audubon found bird numbers may dramatically increase on burned plots in native grasslands for two years following wildfire, probably in response to increased seed production and availability.

D. WATER QUALITY

The Cottonwood Creek watershed has an annual runoff of 586,000 acre feet. With its relative low elevations, there is a limited amount of snowpack that can accumulate in any given year, which reduces seasonal storage and produces a hydrology with abrupt swings closely correlated to storm events. Watershed runoff is flashy; high in the rainy season and low in the dry season.

The water quality of Cottonwood Creek is generally considered good from a drinking water standard perspective. There is some concern regarding the South Fork's regular contribution of suspended sediments and turbidity to the mainstem.

Surface water flowing from burned areas may carry increased levels of sediment, organic debris and chemicals that may contribute to significant degradation of water quality and habitat.

VII. LANDOWNER MANAGEMENT OBJECTIVES

A. INTRODUCTION

This section describes the fire suppression goals and objectives of various state and federal agencies that own or are responsible for land in the watershed, along with the basic fire suppression objectives of private industrial timberland owners in the watershed.

The Bureau of Land Management, USDA Forest Service, and National Park Service are responsible for managing approximately 28% of the Cottonwood Creek Watershed. Roseburg Resources Company, Sierra Pacific Industries, and Crane Mills also own and manage several thousand acres of timberland in the watershed. It is important to view this plan in context with the management goals developed by each agency and major landowner in the watershed.

B. WHISKEYTOWN NATIONAL RECREATION AREA (NRA)

A very small portion (627 acres) of the 42,500-acre Whiskeytown National Recreation Area (WNRA) is located in the northern portion of the watershed at the head of the North Fork of Cottonwood Creek. To achieve the objectives of the WNRA fire management program, the Cottonwood Creek portion has been declared a fire suppression zone. All lightning and human-caused wildfires originating from or threatening the area will be suppressed (confined, contained, controlled, or a combination). Mechanical fuel manipulation and management-ignited prescribed fires may be used to reduce fuels and maintain vegetative mosaics and wildlife habitats that approximate natural conditions and ecosystem processes within the area.

Decades of fire suppression have led to a volatile increase in fuels. Excessive amounts of flammable vegetation and dead and downed debris are found throughout Whiskeytown NRA. The fuels buildup problem is getting attention in several ways. The ability of a fuelbreak to slow the spread of a high intensity fire also gives the ability to halt the spread of a low intensity fire.

Whiskeytown's fuelbreaks are part of a growing network of interconnected fuelbreaks. The California Department of Forestry and Fire Protection, Bureau of Land Management, Western Shasta Resource Conservation District, California Department of Corrections, National Park Service and local residents, are working together to design and implement a system based on interagency partnership and cooperation. The partnerships enable fuelbreaks to stretch across boundaries and, in effect, reduce the chance of significant losses over a greater area.

Before work on a fuelbreak can begin, firefighters and park mangers sit down to pinpoint where the use of a fuelbreak would be the most effective. The main factor taken into consideration is location. Ridge tops and roadways are typically the primary location for a fuelbreak, since these areas are known to slow the spread of an approaching wildfire. By installing fuelbreaks along ridges and roads, it can lessen the intensity of a wildfire and perhaps even halt its spread.

Once the location of a fuelbreak is designated, a supervised crew begins construction. Brush is first cut and then piled in the middle of the fuelbreak. Shading from trees left in the fuelbreak help reduce the intensity of a fire by lowering the temperature at the fuelbreak site. The use of prescribed fires can help introduce low intensity fires back into the landscape. Using fuelbreaks in conjunction with prescribed fires can help firefighters' ability to slow or stop a fire from spreading across boundaries into undesirable areas or conditions.

In November 2001, Whiskeytown completed the 720-acre Sunshine Prescribed Burn, the first significant burn completed in the NRA in three years. The burn was an interagency project to help reduce the threat of wildfire to the community of Old Shasta and west Redding and enhance the effectiveness of fuelbreaks already in place outside the NRA boundary.

In 2002, the 1993 Whiskeytown Fire Management Plan is being updated and will outline the NRA fire goals for the next 10 years. A broad range of new issues, improved information and technology, and unforeseeable limitations have emerged which have the potential to affect the future direction of the fire management program within the park. Some of these issues include a continued decline in ecosystem health due to fire suppression; increased hazardous fuels buildup; expanding use and development in the wildland-urban interface; increased risk and cost associated with fire suppression; increased interest in mechanical manipulation, especially in accessible area; and more stringent air quality regulations. To update the fire plan, an Environmental Impact Statement is being completed. The new Fire Management Plan should be published in the late-summer or fall of 2002.

C. BUREAU OF LAND MANAGEMENT (BLM)

The BLM manages approximately 29,621 acres in the Cottonwood Creek Watershed. The Redding BLM office has entered into a Cooperative Fire Protective Agreement with the California Department of Forestry and Fire Protection (CDF), where CDF is responsible for wildland fire protection on BLM lands.

A majority of the BLM parcels within the watershed have been designated as ‘transfer parcels,’ which means the parcels are eligible for exchange with other federal or private landowners as a means to consolidate BLM’s ownership in other areas (Herzog, 2002). The remaining BLM parcels, which are located directly adjacent to the North Fork, Middle Fork and South Fork of Cottonwood Creek and Beegum Creek, will be maintained as part of BLM’s ownership and be managed as sensitive areas. Sensitive areas have been established by BLM in response to the potential Wild and Scenic Rivers designation that may be imposed on the North Fork, Middle Fork and South Fork of Cottonwood Creek and Beegum Creek. To protect the potential for designation, no mechanized equipment is allowed within the sensitive areas illustrated on Land Ownership, Map 4.

All BLM lands with burnable vegetation must have an approved Fire Management Plan (FMP), a strategic plan that defines a program to manage the wildland and prescribed fires based on the area’s approved land management plan (U. S. Department of Interior, U.S. Department of Agriculture, 2002). The FMP provides for firefighter and public safety; includes fire management strategies, tactics and alternatives; addresses values to be protected and public health issues; and is consistent with resource management objectives, activities of the area and environmental laws and regulations. Until an FMP is approved, BLM units must take an aggressive suppression action on all wildland fires consistent with firefighter safety and public safety and resources to be protected.

The BLM Fire Management Officer is responsible and accountable for providing leadership for the BLM fire and aviation management program at the local level. The BLM Fire Management Officer in the Cottonwood Creek Watershed is Walter Herzog.

The BLM strategically focuses fuel treatment activities by placing priority on areas where actions will mitigate threats to the safety of employees and the public; areas were actions will protect, enhance, restore and/or maintain plant communities and habitats that are critical for endangered, threatened or sensitive plant and animal species; and areas where actions will reduce risks and damage from a wildfire.

Although structural fire suppression is the responsibility of tribal, state or local governments, BLM may assist with exterior structural protection activities under a formal agreement with CDF. There are three categories of structures: those not threatened; those threatened; those lost or too dangerous to protect. In the wildland-urban interface, BLM lists several “Watch Outs” that assist personnel in sizing up a wildfire situation. These watch outs may be beneficial to readers of this report in assessing the fire-safe condition of personal property. Watch out for:

- Wooden construction and wood shake roofs
- Poor access and narrow one-way canyons
- Bridge weight and size limits when using heavy equipment
- Inadequate water supply
- Natural fuels 30’ or closer to structure
- Evacuations of public, livestock, pets, animals (planned or occurring)
- Power lines and poles overhead and fallen lines
- Propane and above-ground fuel tanks with nearby vegetation or wooden improvements
- Local citizens attempting suppression actions
- Level of coordination with multiple agencies.

D. USDA FOREST SERVICE (USFS)

The USDA Forest Service is responsible for managing approximately 122,830 acres in the Cottonwood Creek Watershed, of which a portion is designated the Yolla Bally-Middle Eel Wilderness Area (See Land Ownership, Map 4).

The goals related to fire management within the Shasta Trinity National Forest (STNF), pursuant to the Shasta Trinity Fire Management Plan (STNF 2001), are as follows:

- Restore fire to its natural role in the ecosystem when establishing the desired future condition of the landscape.

- Achieve a balance of fire suppression capability and fuels management investments that are cost effective and able to meet ecosystem objectives and protection capabilities.

To meet those goals, fire management direction in the Shasta Trinity Land & Resource Management Plan states:

- Wildland fires will receive an appropriate suppression response that may range from confinement to control. Unless a different response is authorized in this plan or subsequent approved plans, all suppression response will have an objective of control.

- All wildland fires, on or threatening private land protected by agreement with the State of California, will receive a control suppression response.

- Activity fuels that remain after meeting wildlife, riparian, soil, and other environmental needs, will be considered surplus and a potential fire hazard. The amount and method of disposal will be determined in the ecosystem analysis, a project level decision.

- Plan and implement fuels treatments emphasizing those treatments that will replicate fire's natural role in the ecosystem.

- Natural fuels will be treated in the following order of priority: 1) public safety; 2) high investment situations (structural improvements, power lines, plantations, etc.); 3) known high fire occurrence areas; 4) coordinated resource benefits, i.e., ecosystem maintenance for natural fire regimes.

- Consider fuelbreak construction investments when they compliment forest health/biomass reduction needs, when very high and extensive resource values are at risk, and to protect forest communities.

- Design fire prevention efforts to minimize human-caused wildfires commensurate with the resource values-at-risk.

- Assess brushfields (chaparral) for multi-resource management opportunities, and develop project plans for treatment. Selection of the treatment methods used will be guided by the following criteria:

    1) The effectiveness of producing multi-resource benefits through modification of the specific vegetation associations;
    2) The cost effectiveness of the project;
    3) The degree of fire protection provided by conversion;
    4) The risk in watersheds; and
    5) The natural fire regime.

The goals related to fire management within the Shasta Trinity National Forest wilderness areas, pursuant to the Shasta Trinity National Forest Land and Resource Management Plan (LRMP), are as follows:

- Restore fire to its natural role when not in conflict with public safety. Permit fire management activities that are compatible with wilderness objectives.

- Prepare Fire Management Action Plans (now referred to as Fire Management Plans) that will consider and define the circumstances to use in confine, contain, and control suppression strategies.

- Wildfire suppression tactics will favor the use of natural barriers, topography or watercourse, and low impact techniques. After fires are declared out, take appropriate actions to rehabilitate and/or restore the site.

- Locate incident bases and staging areas outside of wilderness. When necessary, within a wilderness, use small (50-60 people) suppression camps in areas where degradation of water quality can be avoided. Return sites to a pre-use condition.

- Permit helispots when approved by the Forest Supervisor. Use natural openings to the extent possible.

E. INDUSTRIAL FORESTLAND OWNERS

There are three major private forest landowners in the Cottonwood Creek Watershed: Roseburg Resources, Sierra Pacific Industries, and Crane Mills. The land management objectives for these property owners may vary due to the need for different species and sizes of wood for their manufacturing facilities. The facilities owned by these companies produce a wide variety of products, such as plywood, windows, doors, framing material, decking, fencing, and much more. When it comes to protecting the forest land, their most valuable asset, from wildfire, their goals are very much the same. There are stiff requirements for all contractors and employees working in the forest during fire season.

Typically, all contractors and employees permitted on private forest land are required to make every effort and take all precautions necessary to prevent fires. A sufficient supply of hand tools are maintained on a job site at all times for fire fighting purposes only. Tools include shovels, axes, saws, backpack pumps, and scraping tools. Each forest worker, employee, or person permitted on private forest land is required to take immediate action to suppress and report any fire on or near the property.

On all fires, a sufficient number of people stay on a fire until it is known that adequate action has been taken by CDF or the agency taking primary responsibility for putting out the fire. All people and equipment remain until released by the agency in charge, or for a longer period, if considered necessary by the land manager.

During fire season, most companies conduct daily aerial patrols covering their forest operations and pay special attention to those areas where work is being conducted, even hours after workers have left the area.

Typically there are specific treatments detailed for care of limbs and other woody debris (often called slash) created by harvest operations in order to minimize fire hazards. It can include piling and burning slash no later than April 1 of the year following its creation, or within a specified period of time after fire season, or as justified in the associated Timber Harvest Plan. Within 100 feet of the edge of the traveled surface of public roads, and within 50 feet of the edge of the traveled surface of permanent private roads open for public use where permission to pass is not required, the slash and any trees knocked down by road construction or timber operations are typically lopped for fire hazard reduction, then piled and burned, chipped, buried or removed from the area. Lopping is defined as severing and spreading slash so that no part of it remains more than 30” above the ground. All woody debris created by harvest operations greater than one inch (1”) and less than eight inches (8”) in diameter within 100 feet or permanently located structures maintained for human habitation are removed or piled and burned. All slash created between 100-200 feet of permanently located structures maintained for human habitation are usually lopped (cut) for fire hazard reduction, removed, chipped or piled and burned. Lopping may be required between 200-500 feet from a structure if an unusual fire risk or hazard exist has been determined.

F. OTHER PRIVATE

Due to the size of the watershed, the exact portion of the watershed owned by private interests or the amount of acreage used for agriculture, has not been formally determined, according to the Cottonwood Creek Watershed Assessment (pg 12-10). Driving through the watershed one notices the predominant valley ownership, except in specific population areas, is grassy open space typically used for grazing. In the timbered foothills and mountains, private homes are scattered about. Land management objectives other than for grazing activities are difficult to discern.

VII. FUEL TREATMENTS

A. INTRODUCTION

Reducing fuel loads is one of the most effective elements of any fire prevention and protection program. Although fire is an integral component of the Cottonwood Creek Watershed ecosystem, managing fire by managing fuel loading is critical to maintaining communities, ranches, grazing lands, riparian areas, and the overall health and function of the watershed. The ability to implement fuels reduction projects typically comes down to the source of funds available, the cost of labor, and the ability to implement the project.

B. FIRE AS A MANAGEMANT TOOL

Prescribed fire is used to approximate the natural vegetative disturbance of periodic wildfire occurrence. This vegetative management tool is used to maintain fire dependent ecosystems and restore those outside their natural balance. Generally, low intensity prescribed fire is applied by trained experts to clear ground of dangerous fuels like dead wood and brush. This low-intensity fire is vital to the life cycles of fire-dependent range and forest lands.

Most prescribed fires are lit by crews using a drip torch, a hand-carried device that pours out a small stream of burning fuel. Other fires or burns are ignited by helicopters carrying a gelled fuel torch (helitorch) or a sphere dispenser machine that drops material to ignite the surface fuels in forest and range types. Exactly how each unit is ignited depends on weather, the lay of the land, and the intensity of the fire needed to meet the goal of the burn (USDA Forest Service 2002). The technique can be used to burn piles of cut brush or grass over a designated prepared area (broadcast burn).

Prescribed fire is useful in restoring and maintaining natural fire regimes in wildland areas, but logistic, economic, and social attributes are constraints on widespread deployment. Because of such conflicts, resource managers often employ mechanical fuel reduction, such as thinning, in conjunction with prescribed fire to reduce fuels and the fire hazard (Regents of the University of California 1996) (CDF 2002).

Prescribed fire is not without controversy and risk. A prescribed fire can get out of control and cause damage to watersheds, wildlife habitat, and structures, and can even result in loss of life. It is only an option when this risk can be reduced to manageable levels. Factors closely monitored to mitigate risk include:

- Fuel moisture content
- Ratio of dead-to-live fuel
- Fuel volume
- Size and arrangement of fuel
- Percentage of volatile extractives in the fuel
- Wind speed and direction
- Relative humidity
- Air temperature
- Topography

A successful prescribed burn must account for all these factors to prevent the fire from going out of control. Guidelines for measuring the data and selecting the levels necessary to manage the prescribed fire are available from a variety of sources. One excellent reference for wildland-urban zones is the USDA Forest Service publication, "Burning by Prescription in Chaparral" (USDA Forest Service 1981).

Air quality is another consideration when considering the use of prescribed burning. Communities in the Urban-Wildland Interface are very sensitive to the presence of smoke. Burn days approved by state and local authorities take into consideration the meteorological effects on both fire severity and smoke dispersion. In the case of chaparral, prescribed burning for range improvement has been practiced by California landowners under permit from the California Department of Forestry and Fire Protection (CDF) since 1945 (Green 1981). Currently, procedures for prescribed burning require a written plan for each burn. A plan includes such items as an objective, an area map, a description of the burn unit and surrounding areas, a smoke management plan, and the burn prescription (USDA Forest Service 1981).

Prescribed fire is the primary treatment method for all public lands, ranging from USDA Forest Service land to state parks. According to FRAP, the *Forest and Rangeland Resources Assessment Program* (Regents of the University of California 1996), most prescribed burns were to control brush, especially chaparral. Public agencies feel prescribed burns offer the lowest cost solution when considering the scale of the area requiring treatment. However, prescribed fires can be quite expensive when the true cost of planning, data gathering, reporting, and control and suppression are considered. Other major constraints are the reduction in allowable burn days because of increasing air quality concerns, high fuel load levels found in many forested and urban-wildland areas, and the increased production of pollutants, such as carbon monoxide, nitrous oxide, and particulates. In these situations, a combination of mechanical methods of fuel reduction combined with prescribed fire may provide the best solution.

C. SHADED FUELBREAKS

Shaded fuelbreaks are constructed as a means to create a defensible space in which firefighters can conduct relatively safe fire suppression activities. Fuelbreaks may also slow a wildfire's progress enough to allow supplemental attack by firefighters. The main idea behind fuelbreak construction is to break up fuel continuity to prevent a fire from reaching the treetops, thus forcing the fire to stay on the ground where it can be more easily and safely extinguished. Fuelbreaks may also be utilized to replace flammable vegetation with less flammable vegetation that burns less intensely. A well-designed shaded fuelbreak also provides an aesthetic setting for people and a desirable habitat for wildlife, in addition to fuels reduction. The California Board of Forestry has addressed the needs to strengthen community fire defense systems, improve forest health and provide environmental protection. The California Board of Forestry rules allow a Registered Professional Forester (RPF) to use a special silviculture prescription when constructing or maintaining a community fuelbreak, exempts community fuelbreaks from an assessment of maximum sustained production requirements and allows defensible space prescriptions to be used around structures.

The WSRCD has developed the following Fuelbreak Standards:

- The typical minimum width of a shaded fuelbreak is 100 feet, but can be up to 300' wide. The appropriate width is highly dependent on the slope, fuel density, fuel type, fuel arrangement, and landowner cooperation.
- Fuelbreaks should be easily accessible by fire crews and equipment at several points. Rapid response and the ability to staff a fire line is very important for quick containment of a wildfire.
- The edges of a fuelbreak are varied to creating a mosaic or natural look. Where possible, fuelbreaks should compliment natural or man-made barriers such as meadows, rock outcroppings, and roadways.
- A maintenance plan should be developed before construction of a fuelbreak. Although a fuelbreak can be constructed in a matter of a few weeks, maintenance must be conducted periodically to keep the fuelbreak functioning.
- The establishment of a shaded fuelbreak can lead to erosion if not properly constructed. Short ground cover, such as grass, should be maintained throughout the fuelbreak to protect the soil from erosion.

A properly treated area should consist of well-spaced vegetation with little or no ground fuels and no understory brush. Tree crowns should be approximately 10-15' apart. The area should be characterized by an abundance of open space and have a 'park like look' after treatment.

The Pile and Burn method is most commonly utilized when constructing fuel breaks. Material is cut and piled in open areas to be burned. Burning takes place under permit on appropriate burn days. Burn rings can be raked out after cooling as a means to decrease their visual effect.

In dealing with chaparral, a relatively new technique is called “crush and burn” which combines mechanical fuels treatment with burning. It is more effective at eliminating chaparral then a low-intensity prescribed burn, which has difficulty competing with the high moisture content of live chaparral. In this method, the chaparral is mechanically crushed, then piled and burned. It is a good technique for areas adjacent to communities and to encourage chaparral regeneration in riparian zones.

D. MECHANICAL TREATMENT

Using mechanized equipment for reducing fuels loads on suitable topography and with certain fuel types can be very effective. Depending on the use of the equipment, it may require environmental review and documentation. Using equipment to remove excess vegetation may enable the landowner to process the debris to a level where it can be marketed as a product for use in power generation. The debris then becomes labeled as “biomass” or “biofuels” and is further explained in Section XII of this report.

Mechanical methods to remove fuels include, but are not limited to, the utilization of bulldozers with or without brush rakes, excavators, chainsaws or mechanized falling machines, masticators, chippers, and grinders. Mechanical treatments are typically conducted on chaparral landscapes with some type of masticator, which grinds standing brush and reduces it chips which are typically left on the ground. Brush may also be mechanically removed and fed into a grinder for biomass production. Mechanical treatments are also utilized on industrial and non-industrial timberlands in which trees are thinned by mechanized tree cutting or falling machines. In most cases, stands of trees are thinned from below as a means to eliminate fuels that can take a fire higher in the forest into the tree canopy (ladder fuels). However, stands of trees may also be thinned from above to eliminate crown continuity.

Mechanical treatments can be used successfully on stable ground up to 50% slope, but should only be conducted during dry periods when soils are not saturated, as a means to minimize erosion and compaction. The drastic visual impacts should be considered when planning projects so that all parties are aware of how the area will look when the project is completed. Initial planning should address mitigation for erosion potential, using measures such as waterbars, ditching, and mulching in critical areas. Furthermore, the impacts on wildlife and archaeological resources must be addressed.

Due to air quality concerns, the mechanical treatment method is fast becoming the acceptable method of fuel reduction in urban interface areas. Compared to prescribed fire, mechanical treatment involves less risk, produces less air pollutants, is more aesthetically pleasing, and allows landowners to leave desirable vegetation.

E. MAINTENANCE TREATMENT

Periodic maintenance of a fuelbreak sustains its effectiveness. Seeding the fuelbreak with annual grass cover immediately following its construction will help reduce brush and conifer invasion, but only depending on grass cover will not eliminate invading plants for an extended period of time. There are several methods to maintain fuelbreaks.

1. Herbicides

The use of herbicides is a very effective method of eliminating unwanted vegetation, but there are many restrictions. Some herbicides are species specific, which means they can be used to eliminate brush species and will not harm grass species. Manual treatment is also a very effective means to eliminate invading vegetation, but is very labor intensive. The cost of fuelbreak maintenance must be balanced with its degree of effectiveness. The recommended rotation time to control sprouting regrowth and encourage the maintenance of ground cover by prescribed burning is 4 to 7 years (Schimke and Green, 1970).

2. Dozer Lines

The use of dozer lines parallel to roadways is a common method to create a firebreak for ranchers in the north state. The firebreak is normally scraped, dug or bladed to mineral soil and provides a control point from which firefighters can work.

3. Herbivores

Herbivore (goat) grazing may be used as a means of maintaining fuelbreaks, since goats would rather eat brush and weeds than grass. Browse makes up about 60% of a goat's diet, but only about 10-15% of a cow's diet.

Goats used for fuel load reduction are managed to remove dense understory, including brush, shrubs, forbs, and lower branches to remove ladder fuels. It may require giving goats supplements of protein or energy, depending on the class of goats used and the time of year. The choice must be balanced on the type of soil, vegetation and livestock analysis. Eliminating the ladder fuels helps prevent soil erosion and enhances rainfall infiltration. Monitoring of the herbivore grazing is critical since over-grazing can lead to erosion.

As goats work through an area they are also working on the understory, old pine needles and leaves, breaking lower branches, and splitting apart old downed branch material. Once an area has been "brushed" by goats, it can be maintained as a living green belt.

Fire control or containment with goats takes coordination of the stock owner, land steward, local fire patrol, professional fire abatement teams, CDF, DFG, and others.

According to a report published by the North Carolina Cooperative Extension Service, grazing goats have been observed to select grass over clover, prefer browsing over grazing pastures, prefer foraging on rough and steep land than over flat, smooth land, graze along fence lines before grazing the center of a pasture, and graze the top of the pasture canopy fairly uniformly before grazing close to the soil level.

Herbivore grazing has been done in the Sierra Foothills by Goats Unlimited, Rickerby, CA. They report the vegetation in the Sierra Foothills grazing area consists of woody plants, shrubs, forbs and grasses. Before entering a new area, they develop a landscape goal, complete a vegetative survey and identify toxic plants. They identify the growth habit and adaptation of each plant specie, especially those that are toxic. The objective is to control the invasion of unwanted species and encourage perennial grasses to return. In a report published by Langston University, goats improve the cycling of plant nutrients sequestered in brush and weeds, enabling the reestablishment of grassy species. Portable electric fencing with solar energizers is used to control the goats' foraging area.

No published cost analysis could be located at this time on rate/acre, rate/head, rate/project or rate/site for using goats to control vegetation.

FIGURE 4 – Herbivores Used In Fuel Reduction

4. Converting Brush Land to Oak Woodland

Brush land usually occurs on soils that are best suited for growing brush. Soils are sloping to very steep loams and are stony or rocky. These soils are usually shallow to bedrock, and available water capacity is low or very low. Vegetation is generally chaparral, but can include such species as chamise, Lemon's ceanothus, buckbrush, toyon, poison-oak, whiteleaf manzanita, and western mountainmahogany. There are few trees occurring on the sites, such as interior live oak and gray pine. At least 80 percent of the surface cover is woody vegetation.

Conversion from brushland to oak woodland will entail a thorough investigation of the site. Soil depth, type, aspect, and exposure will all determine the success or failure of an attempted conversion. With few exceptions, most of the brushy sites are naturally occurring, and represent the native vegetative community.

Natural regeneration of oak species is very difficult to accomplish. A conversion from brush to oak woodland should begin with a thorough investigation of the capability of the site to support oak trees. The second, or next step, should be to secure a reliable source of oak seedlings; and the third step should be to develop a planting plan. A realistic cost estimate should be the fourth step. All this should be accomplished before the existing brush cover is removed.

IX. SOILS

The Soil/Vegetation Survey of California, conducted by the Pacific Southwest Forest and Range Experimental Station, describes soil types including those with a moderate-to-high Erosion Hazard Rating (EHR). Information in the Watershed Assessment confirms 98% of the soil types within the Cottonwood Creek Watershed meet the criteria for a moderate-to-high EHR. The remaining soil types were characterized by either a slight EHR or a very high EHR.

Fuels management activities located on unstable soils or on slopes in excess of 40% can stimulate erosion processes or exacerbate existing erosion problems; therefore, prior to any fuels management activities, all soil types within any future project area should be identified and evaluated to determine the erosion hazard. Projects should be designed to prevent or minimize erosion by reducing soil disturbance, maintaining vegetation where appropriate, avoiding steep and unstable slopes if possible, incorporating the use of grass seed or other fire resistant vegetation as a means to provide soil stabilization. The locations of major soil types have been illustrated on the Soils, Map 5; however, more detailed soils mapping information should be examined once project boundaries have been established.

High intensity wild fire also damages soil by incinerating roots and the humus layer (organic portion of soils) that hold soils together and provide energy dissipation. In addition, the loss of large areas of vegetation can reduce evapotranspiration and increase peak flow, which can result in augmented erosion potential, adversely affecting watershed resources. Many life forms as well, including invertebrates of phylum Arthropoda that are essential for cycling plant material and fixing atmospheric gases, are unknowingly destroyed. These invertebrates eventually re-establish their populations, but this time is lost time in maintaining and building up the soils. Overtime, continual burning will result in soil depletion, much the same as continual plowing and crop harvesting will deplete the soil of mineral nutrients and negatively affect the soil structure. Fortunately in this area of California, there exist relatively young volcanic soils in the mountains and recent alluvial soils in the valleys that can tolerate fire without immediately showing the negative effects. Continued burning though can have long-term negative effects (Richards, 2002).

Low intensity prescribed fires in light to medium fuels seldom produce enough heat to significantly damage soil or increase the erosion potential within a given watershed. The chemical and physical properties of soil change dramatically after a high intensity fire. Loss of organic matter causes the soil structure to deteriorate, and both the water-storing and transmitting properties of soils are reduced. The living tissues of microorganisms and plants can be damaged by fire if the temperatures are above 120 -degrees F (DeBano 1970).

X. FISH AND WILDLIFE

In general, the watershed provides suitable habitat for a wide variety of wildlife species. The main stem of Cottonwood Creek, in addition to the north, middle and south forks, provide suitable habitat for anadromous fish species as well as resident coldwater and warm water fish species (Cottonwood Creek Watershed Group 2002). The oak woodland, meadows and chaparral vegetation types appear to provide quality habitat for foraging species and a healthy prey base for predators. The conifer stands, located within the upper reaches of the watershed, also provide foraging opportunities as well as habitat for species that require a dense overstory and an abundance of horizontal structure.

Pursuant to the California Natural Diversity Data Base (CNDDB) (U.C. Davis 2002), the Cottonwood Creek Watershed contains several plant and wildlife species, which have been categorized as federally endangered, state endangered, sensitive, species of concern, or rare (See Table 8 below).

The following table lists the species indicated on Plant & Wildlife, Map 6.

TABLE 8 - WILDLIFE AND PLANTS

Wildlife Species		
Common Name	Scientific Name	Special Status
Winter-Run Chinook Salmon	*Oncorhynchus tshawtscha*	FE, SE
Spring-Run Chinook Salmon	*Oncorhynchus tshawtscha*	FT, ST
Foothill Yellow-Legged Frog	*Runa boylii*	SOC
Northern Pond Turtle	*Clemmys marmorata*	SOC
Bald Eagle	*Haliaeetus leucocephalus*	SE, FT
Bank Swallow	*Riparia riparia*	ST
Northern Spotted Owl	*Strix occidentalis*	FT
Yellow Warbler	*Dendroica petechia*	SOC
Pacific Fisher	*Martes pennanti*	SOC
Pale Big-Eared Bat	*Corynorhinus townsendii*	SOC
San Joaquin Pocket Mouse	*Perognathus inornatus*	SOC
Plant Species		
Common Name	Scientific Name	Special Status
Mt. Tedoc linanthus	*Linanthus nuttallii* ssp. *Howellii*	List 1B
Jepsons's milk-vetch	*Astragalus rattanii* var. *jepsonianus*	List 1B
Brandegee's eriastrum	*Eriastrum brandegeae*	List 1B
Niles's harmonia	*Harmonia doris-nilesiae*	List 1B
Oregon fireweed	*Epilobium oreganum*	List 1B
Pointed broom sedge	*Carex scoparia*	List 2
Red Bluff dwarf rush	*Juncus leiospermus* var. *leiospermus*	List 1B
Silky cryptantha	*Cryptantha crinita*	List 1B
Stebbins's harmonia	*Harmonia stebbinsii*	List 1B

Special-status Species Legend:

Federal	FT = Federally Threatened	
	Article I.	FE = Federally Endangered
State of California	ST = State Threatened	
	Article II.	SE = State Endangered
	SOC=Species of Concern	

CNPS = California Native Plant Society

List 1B=Rare, Threatened or Endangered in CA and elsewhere
List 2=Rare, Threatened or Endangered in CA, common elsewhere

XI. ROADS FOR ACCESS

Roads are an essential part of any fire and fuels management plan, providing the principal access to the communities, homes and wild places in the watershed. Additionally, roads may offer a defensible space from which firefighters can conduct direct attack on wildfires and also provide strategic locations for roadside fuelbreaks. Roadside fuelbreaks not only provide defensible space for firefighters, but also a safe escape route for residents in the event of a wildfire.

For this plan, the roads in the Cottonwood Creek Watershed have been classified into two groups: main roads, which are state routes or major county arterial roads, and secondary roads, which access neighborhoods, rural areas, forest zones, and ranch areas. The secondary roads have also been grouped by compass location within the watershed.

All roads are important for providing fire protection access. This plan will not attempt to identify and map all paved or improved roads. Roads that are vital to future projects will be included in treatment options.

In the eastern section of the Cottonwood Creek Watershed, road concentrations are in the developing areas near Bowman Road, Gas Point Road and Happy Valley Road. In the western portion of the watershed, there are many forest access roads onto public and private forest land. Ranch roads dominate the central and foothill portions of the watershed. Many of the private ranch roads are gated and locked.

The existing road map, split between the eastern and western portions of the watershed are shown on Maps 7 and 8. Roads names with main road vs. secondary road, compass groupings and county are as follows:

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COTTONWOOD CREEK WATERSHED
ROADS

MAIN

Interstate 5	N/S	Shasta (S)/ Tehama (T)
State Hwy 36	E/W	S/T
Platina Road	SW/NE	S
Bowman Road	E/W	T

SECONDARY - NORTH

Bland Road	SW/NE	S
Bully Choop Road	N/S	S
Duncan Creek Road	SE/NW	S
Fiddler's Rd	SE/NW	S
McAuliffe Road	E/W	S
Rainbow Lake Road	E/W	S
Roaring Creek Rd	E/W	S
South Fork Rd	E/W	S
Sunny Hill Road	Loop	S

SECONDARY - WEST

Beegum Gorge Rd	SW/NE	S
Cow Gulch Rd	SW/NE	S
Deer Lick Knob Rd	N/S	S
Deer Lick Springs Rd	N/S	S
Forest Route (F.R.) 41	SE/NW	T
F.R. 45	E/W	T
Harrison Gulch Rd	N/S	S
Pattymocus Rd	E/W	T
Tedoc (Gap) Rd	N/S	T
White Rock Rd	SW/NE	S

SECONDARY - SOUTH

Ball Rd	N/S	T
F.R. 26N01	N/S	T
F.R. 35	E/W	T
Hammer Loop Rd	Loop	T
Pettyjohn Rd	E/W	T
Vestal Rd	E/W and N/S	T
Weemasoul Rd	N/S	T

SECONDARY - EAST

Balls Ferry Rd	SW/NE	S
Basler Rd	SW/NE	T
Benson Rd	SW/NE	T
Cannon Rd	SW/NE	T
Evergreen Rd	E/W	T

SECONDARY – EAST cont.

Farquhar Rd	N/S	T
Gas Point Dr.	SE/NW	S
Happy Valley Rd	N/S	S
Hooker Creek Rd	E/W and N/S	T
Kingsland Way	E/W	S
Lake California Drive	E/W	T
Lower Gas Point Dr.	N/S	S
Luce B Griswold Rd	N/S	T

Matlock Loop	Loop	T
Quail Ridge Rd	SW/NE	T
Squiss Dr	SE/NW	S
W. Anderson Dr	N/S	S

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XII. BIOMASS ANALYSIS

For thousands of years, people have been taking advantage of the earth's vegetation, also called biomass, to meet their energy needs (www.epa.gov, 2002). Technologies for using biomass continue to improve and today biomass fuels can be converted into alternative fuels (biofuels), such as ethanol, methanol, biodiesel, and as boiler fuel for use in industrial heating and power generation.

When used for generating electricity, biomass is typically burned to transform water into steam, which is used to a drive a turbine and attached generator (www.epa.gov, 2002). Although a majority of the biomass market is associated with energy production, biomass offers a wide verity of uses such as fiber-reinforced composites, fiber-filled thermoplastics, high performance fiberboard, cement board, mulch for landscaping and soil amenities, smoke chips for curing and flavoring meat and bio-oils which are used as asphalt additives or adhesives. Potential markets continue to be explored and developed by the private sector, and the federal government has also demonstrated interested in the biomass industry by the release of Executive Order 13134. On August 12, 1999, President Clinton released Executive Order 13134, designed to stimulate the creation and early adoption of technologies needed to make biobased products and bioenergy cost-competitive in the large national and international markets (www.bioproducts-bioenergy.gov, 1999).

The utilization and development of biomass technology offers many economic and socioeconomic benefits. However, one of the most widely acknowledged benefits is the development and utilization of biofuels as a means to reduce the world's dependency on non-renewable fossil fuels. Presently, a majority of the electricity in the U.S. is generated by burning fossil fuels such as coal, natural gas, and oil. On the local level, the development of biotechnology also offers both economic and socioeconomic benefits. The Cottonwood Creek Watershed contains thousands of acres of forestland, which produce a substantial amount of renewable biomass each year. The biomass market associated with wood products production has been long developed, and biomass harvesting for fuel reduction is a common practice within managed forestlands in Northern California. Biomass production not only provides economic support at the local, state, and federal levels but also reduces the nation's dependency of fossil fuels. The watershed also contains thousands of acres of chaparral, which produce a significant amount of renewable biomass, and although only a small portion of the biomass produced from chaparral landscapes is utilized for biofuels.

The potential for biomass production within the Cottonwood Creek Watershed is good given that the watershed contains a substantial amount of raw material (chaparral and forestland species). In addition, the watershed is located within close proximity to a 50-megawatt wood-fired power plant, Wheelabrator Shasta Energy, in Anderson, which utilizes one hundred semi truckloads (~1,400 bone dry tons) of biomass each day, seven days/week, to produce electricity (Jolley 2002). There are other wood-fired power plants in Shasta County, but this facility is the closest to the Cottonwood Creek Watershed.

The feasibility of any biomass operation depends on the market price of biomass, also commonly called hogged fuel or hog fuel if it is processed through a hammer hog, the density or amount of fuel on the ground, and transportation costs. Processing can include harvesting and chipping or hogging and costs are directly correlated with the species, age, size and density of the vegetation being processed as well as the topography of the area. The transportation cost from the project area to the nearest wood fired power plant is directly related to the size of the vehicle, time needed for loading biomass, the road bed system and distance to the plant.

The price a power plant is willing to pay for a ton of biomass vs. the processing and transportation determines the economic feasibility of an operation. However, the value of fuel reduction to the landowner should be included in this calculation to determine the true feasibility of a biomass operation.

Harvesting is usually accomplished with an excavator and/or a bulldozer tractor which is utilized to remove and pile the brush. Processing can be accomplished with a hammer hog, tub grinder, drum chipper or some other type of industrial type chipper fed by the excavator or other mechanical means.

Figure 5: Biomass Collection in Action. Tub grinder on right, conveyor takes biomass into the van.

Pursuant to the California Forest Practice Rules, if biomass operations involve the harvest of commercial species, the project requires a permit issued by the California Department of Forestry and Fire Protection. Biomass operations which do not involve the harvest of commercial species are not subject to the California Forest Practice Rules, but may require county permits or other agency review depending on the physical characteristics of the project area. A Registered Professional Forester should be involved prior to commencement of any biomass operation in order to determine what permits might be required and to estimate the cost and timing of obtaining the permits.

Although the biofuels industry is the most developed biomass market in northern California, other markets are currently in the developmental stage and may become a commercially viable option for biomass products in the future. These markets are far from becoming a significant force in the market place but may provide alternative utilization methods and future marketing opportunities.

XIII. POTENTIAL FUNDING SOURCES

The following table (Table 9) of cost share programs was provided by the University of California, Cooperative Extension Service (UCCE).

TABLE 9 – FUNDING SOURCES AND COST SHARE PROGRAMS

Program	Goals	Services	Will Fund	Agency	Who	Limitations
Emergency Watershed Protection	Helps safeguard people and property following natural disasters.	Technical and financial assistance	Up to 75%	NRCS	Public agencies, non-profits, community groups	25% cost share. Must obtain necessary permits
Environmental Quality Incentives Program	To address significant natural resource needs and objectives	Cost sharing, technical and educational assistance	Up to 75% set by local working group	NRCS, FSA	Agricultural producers having significant natural resource needs	Approved practices up to $10,000 per producer per year. Must have Conservation Plan approved by RCD.
Forest Stewardship Program	Assist California communities to more actively manage their watershed resources, to keep forests and associated resources productive and healthy	Technical, educational and financial assistance	Cost share up to $50,000. 100% match is required.	CDF	RCDs, RC&Ds, special districts, Indian tribes, and community non-profit organizations.	Projects that involves activities that may lead to changes in the environment are required to comply with CEQA. Projects must be on NIPF land & address one of the major categories: pre-fire fuels mgmt, forest &woodland health, water quality, or wildlife & fisheries habitat.
Hazard Mitigation Grant Program	Hazard mitigation to reduce risk from future disasters	Cost share	Up to 75%	FEMA	Agencies, governments, non-profits, tribes	Federal Disaster Areas
Vegetation Management Program	To provide incentives for using fire as a tool to control unwanted brush, and other vegetation, which creates wildfire hazards.	Covers liability, conducts prescribed burn	Up to 90% cost share	CDF	Landowners, individual or group	Agreement to sign, plan required
California Forest Improvement Program	Forestry, watershed and riparian protection and enhancement	Reforestation, site prep, land conservation, and fish & wildlife habitat improvements	75% up to $30,000 per contract, rehab after natural disaster up to 90%	CDF	Landowners	Plan (can be cost shared) required, 20-50,000 acres of forestland

Additional funding sources include:

- **California Department of Conservation**, RCD Grant Assistance Program
- **U. S. Forest Service,** Forest Service Community and Private Land Fire Assistance Grant Program
- **Tehama County Regional Advisory Committee**, Title II Funds, Secure Rural Schools and Community Self-Determination Act of 2000
- **Sacramento Regional Foundation** (for the Bureau of Land Management), Community-Based Wildfire Prevention Program

XIV. FUELBREAK MAINTENANCE FUNDING

Since grant funds are often obtained just to construct the fuelbreak, maintenance efforts are often left to the landowner. Unfortunately, some landowners do not have the physical or financial means to do maintenance. If a fuel break is not properly maintained in its entirety, it will not provide adequate fire protection in the long run. Therefore, in some situations it is often best for watershed groups and other conservation organizations to seek funding for maintenance as a means to better ensure fire protection for a given area. The Community Protection Plan was developed as a result of the USDA Forest Service' National Fire Plan. This plan provides grant funding for fuel reduction projects on private lands. In addition, many of the programs listed in Table 4 above also provide funding opportunities for fuels reduction and maintenance. Future legislation, such as AB 1983, may also provide funding for fuels reduction projects.

California Assembly Bill AB 1983 was introduced by Assembly Member Dickerson on February 14, 2002. The bill would enact the **California Fuel Hazard Reduction Act** to be administered by the California Department of Forestry and Fire Protection (CDF), in consultation with the Department of Food and Agriculture, to encourage the development of wildland fuel reduction practices. The bill would establish the Fuel Hazard Reduction Fund in the State Treasury to fund the program. CDF would be authorized to spend up to 5% of the fund balance for program administration and wildfire cost collection. The bill would authorize the allocation of up to 10% of the fund balance to agencies and institutions each fiscal year for fuel management research purposes. In addition, the bill would establish a cost-share assistance program and would permit the director to fund up to 90% of the cost to complete an eligible wildland fuel reduction project. This bill would establish both the procedure by which applicants may apply for assistance and the process used by the director to grant funds. The full text of the bill can be found at www.leginfo.ca.gov. As of this writing, the bill will likely be reintroduced at the next legislative session.

In addition, many private sector programs are available. Information on private sector funding can be found at the following Internet sites:

www.fdncenter.org	**www.ceres.ca.gov/foreststeward/funding.html**
www.ice.ucdavis.edu/	**www.teleport.com/~rivernet/general.htm**
www.tpl.org/tpl/about/	**www.ufei.calpoly.edu/data/news/grants.html**

Funding programs can assist in the development of shaded fuelbreaks, defensible space around structures, roadside fuel reduction, and community fire safe projects.

XV. VEGETATION EXAMPLES IN THE WATERSHED:

All Photos taken between April 24 and July 5, 2002

Cottonwood Creek: Foothill Areas

State Hwy 36 @ Cannon Rd; main SE entrance of CC Watershed

Typical Cannon Rd

Pettyjohn Rd: ~2 mi W of Cannon/Reeds Creek Rds (PROPOSED PROJECT AREA I)

Weemasoul Valley to Vestal Rd; some chaparral on SE slopes (Similar to PROPOSED PROJECT Q)

Vestal Rd, E/W section

State Hwy 36 @ Platina Rd facing East.
(PROPOSED PROJECT AREA M)

Gas Point Rd, ~ 1 mi S of Clear Creek Rd (PROPOSED PROJECT AREA E)

Clear Creek Rd, btwn Gas Point & CCW NE boundary. (PROPOSED PROJECT AREA F)

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Cottonwood Creek: *Platina Area*

Platina from Beegum Gorge Rd, looking north. The Platina Store is to the left. (PROJECT AREA O)

Beegum Gorge Rd, ~1 mile from Platina. Dense chaparral. Monastery is to the north. (PROPOSED PROJECT AREA L)

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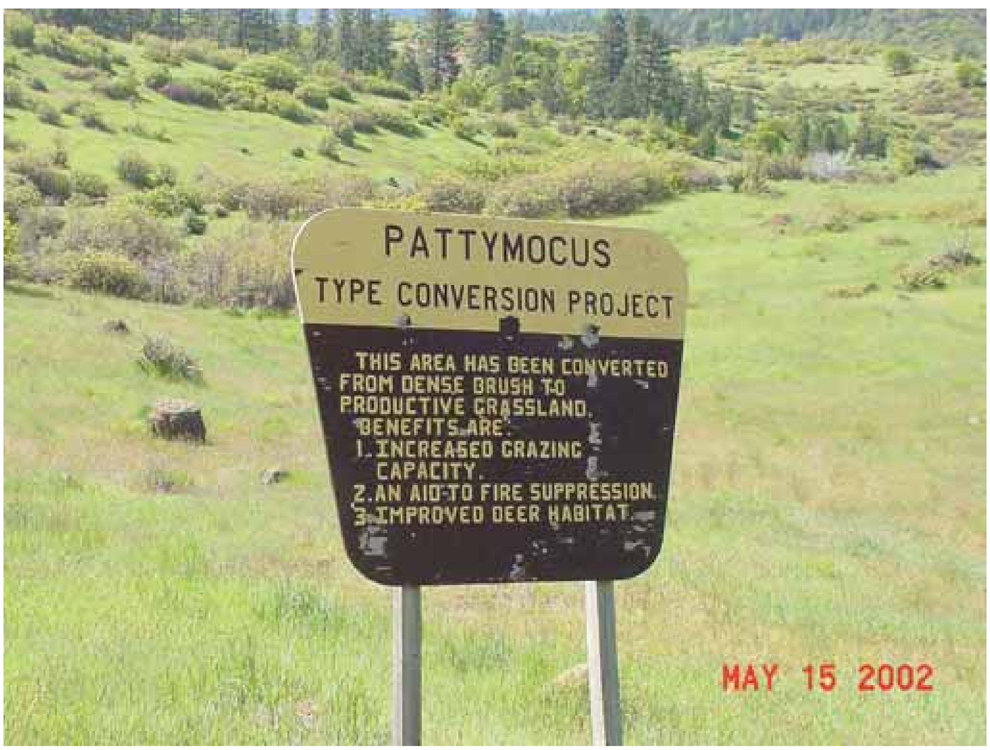
Smith Ranch, viewed from Platina Rd, approximately 4 miles NE of Platina. (PROPOSED PROJECT AREA X)



Pattymocus Type Conversion Project, Tedoc Gap Rd. Project took place in the 1970s. (MODEL for PROJECT A1)

Cottonwood Wilds, private parcels in four Sections, N of Platina. High need for fuel suppression. (PROPOSED PROJECT AREA K)

Cottonwood Wilds Overgrown fuel-break. (PROPOSED MAINTENANCE AREAS J)

Cottonwood Wilds cabin, indicating typical overgrowth.

Cottonwood Wilds. Old Deer Lick Springs Rd heading west in to USFS land.

Cottonwood Creek: *Mountainous & Central Area*

Pasture land, Platina Rd

Hammer Loop Rd. Dense chaparral, but no structures.

Yolla Bolly Rd, SE of Platina Rd.

Timber Harvest Plan, FR 35.

Ball Rd, typical of central "foothill" areas. Parallel & similar to Vestal & Bland Rds, PROJECT AREA S, & representative of AREA R

Harrison Gulch Rd: ~ 2 mi N of SR 36. Maximum of 6 houses in canyon type area.
(PROPOSED PROJECT AREA N)

Cottonwood Creek: *East side of Watershed (Bowman)*

Pine Creek, along Benson Rd (PROPOSED PROJECT AREA A)

Basler Rd, PROPOSED PROJECT AREA B, similar to Quail Ridge Rd, PROJECT AREAS C & D.

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XVI. RECOMMENDATIONS

A priority list of fuel reduction and maintenance projects were developed by the Project Team. Factors considered in developing this list include:

- Fire history for the area, both lightning caused and human caused fires.
- Heavy fuel loading conditions with closed canopies.
- Assets at risk.
- Common wind directions and speed.
- Roadsides overgrown with vegetation.
- Major topographical features important to fire control and weather patterns which influence fire behavior
- Road access for fire crews.

The following table (Table 10) is a list of recommendations for projects in the Cottonwood Creek Watershed.

TABLE 10: Proposed Project Areas

Project #	***Area of Water-shed***	***Project Location***	***Length***	***Type***	***Other Information***
A	Bowman	Benson Rd	3 mi	Ridge-top Shaded FB	5.5 mile road
B	Bowman	Basler Rd	2 mi	Ridge-top Shaded FB	8.3 mile road
C	Bowman	Quail Ridge Rd	5 mi	Ridge-top Shaded FB	
D	Bowman	Quail Ridge Rd		Man-made cistern for H2O storage	Multiple willing landowners
E	Igo	Gas Point Rd, just S of Placer Rd	2-3 mi	Ridge-top Shaded FB	19 mile road
F	Igo	Clear Creek Rd, Gas Point Rd to CCW boundary	2 mi	Shaded FB	Majority of road east of CCW boundary

Project #	***Area of Water-shed***	***Project Location***	***Length***	***Type***	***Other Information***
G	Igo	Cloverdale Rd, S – tie in with existing FB N of Clear Creek Rd	2.2 mi	Shaded FB	Ridge road, along CCW NE boundary
H	Ono	Rainbow Lake Rd	5 mi	Shaded FB for foothill protection	Road is ~5 miles from Ono to Rainbow Lake
I	Pettyjohn Rd	Pettyjohn Rd, ~2 mi W of Reeds Creek Rd	1.8 mi	Shaded FB	Remote area
J	Platina	Cottonwood Wilds – tie in with BLM & USFS	Multiple FB lines	Maint. of ~11 existing FBs	Range of existing FBs: 0.2 – 1.4 mi; BLM sections interspersed
K	Platina	Cottonwood Wilds		Controlled burn	Conversion of Brush/ Chaparral to Grass/Oak Savannah
L	Platina	Beegum Gorge Rd – tie in with USFS	1 mi	Shaded FB	Roadside, some ridge top
M	Platina	SR 36, section of road east of Platina Rd	0.8 mi	Shaded FB	Roadside
N	Platina	Harrison Gulch Rd	3 mi	Shaded FB	SR 36 to USFS line
O	Platina	Surrounding hillsides, Platina		Controlled burn	Fuel reduction of dense chaparral areas
P	Platina	Between Platina & Beegum		Water source	Year-round availability needed

Project #	***Area of Water-shed***	***Project Location***	***Length***	***Type***	***Other Information***
Q	Central Watershed	Vestal Rd	~6.5 mi mostly grazing land	Education	SR 36 south to Weemasoul Rd
R	Central Watershed	Bland Rd	~8 mi ranch areas	Education	MF Cottonwood Creek to SR 36
S	Central Watershed	Ball Rd	~2.5 mi	Dozer track	SR 36 to end, combating E-W wind
T	Central Watershed	R Wild Horse Ranch on SR 36	Area around ranch	Shaded FB	Protection of rural, seasonal community
U	State Route 36	SR 36	~35 mi	Dozer track or Shaded FB as needed	Length of Hwy through CCW
V	Platina Rd	Platina Rd	~23 mi	Dozer track or Shaded FB as needed	Length of road from Gas Point Rd to SR 36
W	Platina Rd	MF Cottonwood Creek	~2 mi	Fuel break -to protect riparian habitat	~ 1 mi upstream & ~1 mi downstream of Platina Rd
X	Platina Rd	Smith Ranch		Brush abatement	Around Smith Ranch & Trinity Wilderness
Y	Lake California	Lake Calif. Dr	~3 mi	Maint.	I-5 to Lake CA gate
Z	All Areas			Maint. of burned areas	Eliminates decadent brush fields to benefit wildlife
A1	All Areas			Regenerate from chaparral to grass/ oak areas	Eliminates decadent brush fields to benefit wildlife

Refer to Proposed Project Areas, Map 9 and Strategic Fuels Reduction Network, Map 10 for map reference.

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APPENDIX & MAPS

APPENDIX

A. **GLOSSARY**

B. **FIRE BEHAVIOR FUEL MODEL DESCRIPTIONS**

C. **BEHAVE INPUT-OUTPUT DATA DEFINITIONS**

D. **BEHAVE RUNS**

E. **PROJECT TEAM**

F. **COMMUNITY FIRE SAFE FUEL REDUCTION GUIDELINES**

MAPS

1. **GENERAL VEGETATION**

2. **FIRE HISTORY**

3. **FUEL MODEL (Acreages, see Table 2)**

4. **LAND OWNERSHIP**

5. **SOILS**

6. **PLANT & WILDLIFE**

7. **EXISTING ROADS MAP, EAST**

8. **EXISTING ROADS MAP, WEST**

9. **PROPOSED PROJECT AREAS**

10. **STRATEGIC FUELS REDUCTION NETWORK**

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A. GLOSSARY

BEHAVE – A computer program used for predicting fire behavior.

Chain – A unit of measurement equal to 66 feet.

Fuel Characteristics – Factors that make up fuels such as compactness, loading, horizontal continuity, vertical arrangement, chemical content, size and shape, and moisture content.

Fuel Chemical Content – Substances in the fuels which can either retard or increase the rate of combustion, such as mineral content, resins, oils, wax or pitch.

Fuel Ladder – Fuels which provide vertical continuity between strata. Fire is able to carry from ground, to surface, to crown.

Fuel Moisture Content – The amount of water in a fuel, expressed as a percentage of the ovendry weight of that fuel.

Fuels – Any organic material, living or dead, in the ground, on the ground, or in the air, that will ignite and burn. General fuel groups are grass, brush, timber and slash.

Mechanical Treatment – Using mechanized equipment including but not limited to bulldozers with or without brush rakes, rubber tired skidders, mechanized falling machines, chippers and grinders.

Pile and Burn – Material is cut and piled in open areas to be burned. Burning takes place under permitting environmental conditions.

Prescribed Burning – The burning of forest or range fuels on a specific area under predetermined conditions so that the fire is confined to that area to fulfill silvicultural, wildlife management, sanitary or hazard reduction requirements, or otherwise achieve forestry or range objectives.

Rate of Speed – It is expressed as rate of forward spread of the fire front, usually is expressed as chains per hour.

Shaded Fuelbreak – A wide strip or block of land on which the vegetation has been modified by reducing the amount of fuel available, rearranging fuels so that they do not carry fire easily, and replacing particularly flammable fuels with others that ignite less easily and burn less intensely.

Surface Fire – A fire that burns surface litter, debris and small vegetation.

Topography – The configuration of the earth's surface, including its relief and the position of its natural and manmade features.

B. FIRE BEHAVIOR FUEL MODEL DESCRIPTIONS

Fuel Model 1 is a short (generally below knee level or about 1-foot tall), fine-textured pure grass model which best represents typical grasslands and savannas. Less than one-third of the area has other vegetation like shrubs or trees.

Fuel Model 2 is dominated by grass about 1 to 2-feet tall, usually under an open wooded or timber overstory. Shrubs like sage and thistle are often intermixed and may be taller than two feet. The larger particle size in these shrubs and the litter from the tree overstory increases intensity, but reduces spread. Oak or pine stands with grass understory, or grass with scattered sage or thistle are examples.

Fuel Model 3 is a tall (above knee height or about 3-feet); coarse, difficult to walk through grass model which represents the tall, dense grasses like meadow grass or sawgrass. Cured grains (oats, barley, etc.) are also in this group. Since homes are seldom built in this fuel model, it is not shown.

Fuel Model 4 is brush; head high (6 feet or more) with continuous, interlinking crowns. Best represented by California mixed chaparral and the high pocosins and pine barrens along the east coast. Closed jack pine stands of the north central states, the "roughs" of the south, and plantations and dense second growth pine stands and young plantations of the west are also in this model. Spot fires at long distances down wind can be expected.

Fuel Model 5 may be composed of the same mixes of vegetation as Fuel Model 4 but are shorter; usually sparser, and less mature with little or no dead component. It occurs on poor sites, on recent burns and may occur under tree overstories. Immature stands of California chaparral, young stands of chamise, sagebrush and western coastal scrub are examples.

Fuel Model 6 is taller and more flammable than Fuel Model 5, but not as tall or as dense as Fuel Model 4. The spacing between shrubs is such that it takes an eye level wind greater than 8 miles per hour for the fire to spread. Model 6 sometimes occurs under sparse tree overstories where ground fuels provide some spread at lower wind speeds. Intermediate stands of chamise, oak brush, sparse chaparral, low pocosins and light slash with shrubs can be considered. Decadent brush with needle drape under pines is included. The pinyon-juniper type is included.

Fuel Model 7 is a surface and low shrub vegetation type with volatile live fuels usually occurring under a pine overstory. The Palmetto-gallberry, low pocosins and gallberry "rough" of the south are representative. Scotch Broom, live brush with needle drape, and dense pine reproduction are included.

Fuel Model 8 has no shrub layer and the few fine fuels (about 1 to 2 tons-per-acre) are largely compacted leaf and short needle conifer litter. Larger fuels less than 3-inches in diameter (fallen limbs) average 3-4 tons-per-acre.

Fuel Model 9 typically has little or no shrub layer but has more fine fuels (about 2-4 tons-per-acre) which are deeper and "fluffier" like oak leaves and long conifer needles. Larger fuels average only about 1-2 tons-per-acre. Fall leaf litter in hardwoods can result in severe fire behavior under windy conditions until it rains.

Fuel Model 10 almost always has a shrub or immature tree understory with loadings of fine fuels of about 2 to 4 tons-per-acre and heavy loadings (12+ tons-per-acre) of large fuels. These stands are typical of overstocked, unmanaged natural conifer stands. Fire behavior, while typically slow spreading, is intense with frequent torching of the overstory, generation of large amounts of embers and long range spotting.

Fuel Model 11 is either the felled boles of a thinned stand or the limbs and tops from a logging operation. Recently deposited slash ("red slash") may be 3+ feet deep and will have about the same burning characteristics as Fuel Model 4. Aged slash will likely burn more like Fuel Model 10. Loading is about 12 tons-per-acre and the fuel bed depth is about 1-foot.

Fuel Models 12 and 13 are both 2 to 4-feet deep, exceed 35 tons-per-acre of fuel and are difficult to walk through. Homes are sometimes built adjacent to such fuel beds, and great care should be given to access, evacuation and defenses against radiant energy. Large numbers of firebrands will be generated and long range spot fire activity can be expected.

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C. BEHAVE INPUT-OUTPUT DATA DEFINITIONS

The following information is a list of the input data utilized and the resulting output data (predicted fire behavior):

DEFINITIONS:

- FUEL MOISTURE – The amount of water in a fuel, expressed as a percent of the ovendry weight of that fuel
- MPH – Miles per hour
- CHAIN – A unit of measure, equal to 66 ft.
- BTU – British Thermal Unit
- DIRECTION OF WIND VECTOR – Direction the wind is blowing from
- SQ. FT. – Square feet
- FT – A unit of measure, 12"
- S – Seconds
- M - Minutes

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D. BEHAVE RUNS

INPUT AND OUTPUT

FIRE 1 RUNS
TEHAMA COUNTY
AVERAGE SUMMER WEATHER CONDITIONS
0% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-4.0
10-HOUR FUEL MOISTURE-8.0
100-HOUR FUEL MOISTURE- 10.0
LIVE HERBACEOUS MOISTURE- 90.0
MIDFLAME WINDSPEED- 7.0 MPH
TERRAIN, SLOPE- 0%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME 1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 74 CHAINS/HOUR
HEAT PER UNIT AREA- 512 BTU/SQFT
FIRELINE INTENSITY- 692 BTU/FT/S
FLAME LENGTH-9.1 FEET
REACTION INTENSITY- 3712 BTU/SQFT/M
EFFECTIVE WINDSPEED-7 MPH
ACRES BURNED-167

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 46 CHAINS PER HOUR
HEAT PER UNIT AREA – 711 BTU/SQFT
FIRELINE INTENSITY – 597 BTU/FT/S
FLAME LENGTH – 8.5 FT
REACTION INTENSITY – 3117 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.0 MPH
ACRES BURNED - 64

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 61 CHAINS PER HOUR
HEAT PER UNIT AREA – 515 BTU/SQFT
FIRELINE INTENSITY – 578 BTU/FT/S
FLAME LENGTH – 8.4 FT
REACTION INTENSITY – 2097 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.0 MPH
ACRES BURNED - 115

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 4 CHAINS/HOUR
HEAT PER UNIT AREA- 208 BTU/SQFT
FIRELINE INTENSITY- 14 BTU/FT/S
FLAME LENGTH-1.5 FEET
REACTION INTENSITY- 1024 BTU/SQFT/M
EFFECTIVE WINDSPEED-7 MPH
ACRES BURNED-.4

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 16 CHAINS/HOUR
HEAT PER UNIT AREA- 1385 BTU/SQFT
FIRELINE INTENSITY- 396 BTU/FT/S
FLAME LENGTH-7.1 FEET
REACTION INTENSITY- 6364 BTU/SQFT/M
EFFECTIVE WINDSPEED-7 MPH
ACRES BURNED-7.5

FIRE 1 RUNS
TEHAMA COUNTY
AVERAGE SUMMER WEATHER CONDITIONS
30% SLOPE

DIRECT (INPUTS)
FUEL MODEL-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-4.0
10-HOUR FUEL MOISTURE-8.0
100-HOUR FUEL MOISTURE- 10.0
LIVE HERBACEOUS MOISTURE- 90.0
MIDFLAME WINDSPEED- 7.0 MPH
TERRAIN, SLOPE- 30%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL -2 (Grass)
RATE OF SPREAD- 80 CHAINS/HOUR
HEAT PER UNIT AREA- 512 BTU/SQFT
FIRELINE INTENSITY- 747 BTU/FT/S
FLAME LENGTH-9.4 FEET
REACTION INTENSITY- 3712 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.3 MPH
ACRES BURNED-188

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 50 CHAINS PER HOUR
HEAT PER UNIT AREA – 711 BTU/SQFT
FIRELINE INTENSITY – 647 BTU/FT/S
FLAME LENGTH – 8.8 FT
REACTION INTENSITY – 3117 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.4 MPH
ACRES BURNED - 72

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 67 CHAINS PER HOUR
HEAT PER UNIT AREA – 515 BTU/SQFT
FIRELINE INTENSITY – 628 BTU/FT/S
FLAME LENGTH – 8.7 FT
REACTION INTENSITY – 2097 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.5 MPH
ACRES BURNED - 129

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 4 CHAINS/HOUR
HEAT PER UNIT AREA- 208 BTU/SQFT
FIRELINE INTENSITY- 16 BTU/FT/S
FLAME LENGTH-1.6 FEET
REACTION INTENSITY- 1024 BTU/SQFT/M

EFFECTIVE WINDSPEED-7.5 MPH
ACRES BURNED- .5

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 17 CHAINS/HOUR
HEAT PER UNIT AREA- 1385 BTU/SQFT
FIRELINE INTENSITY- 434 BTU/FT/S
FLAME LENGTH-7.4 FEET
REACTION INTENSITY- 6364 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.5 MPH
ACRES BURNED-8.5

FIRE 1 RUNS
TEHAMA COUNTY
EXTREAM SUMMER WEATHER CONDITIONS
0% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-3.0
10-HOUR FUEL MOISTURE-5.0
100-HOUR FUEL MOISTURE- 7.0
LIVE HERBACEOUS MOISTURE- 65.0
MIDFLAME WINDSPEED- 12.0 MPH
TERRAIN, SLOPE- 30%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 232 CHAINS/HOUR
HEAT PER UNIT AREA- 554 BTU/SQFT
FIRELINE INTENSITY- 2359 BTU/FT/S
FLAME LENGTH-16 FEET
REACTION INTENSITY- 4015 BTU/SQFT/M
EFFECTIVE WINDSPEED-12 MPH
ACRES BURNED-1095

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 128 CHAINS PER HOUR
HEAT PER UNIT AREA – 765 BTU/SQFT
FIRELINE INTENSITY – 1792 BTU/FT/S
FLAME LENGTH – 14.1 FT
REACTION INTENSITY – 3351 BTU/SQFT/M
EFFECTIVE WINDSPEED – 12.0 MPH
ACRES BURNED - 331

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 141 CHAINS PER HOUR
HEAT PER UNIT AREA – 562 BTU/SQFT
FIRELINE INTENSITY – 1451 BTU/FT/S
FLAME LENGTH – 12.8 FT
REACTION INTENSITY – 2288 BTU/SQFT/M
EFFECTIVE WINDSPEED – 12.0 MPH
ACRES BURNED - 402

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 8 CHAINS/HOUR
HEAT PER UNIT AREA- 224 BTU/SQFT
FIRELINE INTENSITY- 34 BTU/FT/S
FLAME LENGTH-2.3 FEET
REACTION INTENSITY- 1102 BTU/SQFT/M

EFFECTIVE WINDSPEED-11.3 MPH
ACRES BURNED-1.5

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 43 CHAINS/HOUR
HEAT PER UNIT AREA- 1515 BTU/SQFT
FIRELINE INTENSITY- 1184 BTU/FT/S
FLAME LENGTH-11.7 FEET
REACTION INTENSITY- 6960 BTU/SQFT/M
EFFECTIVE WINDSPEED-12 MPH
ACRES BURNED-37

FIRE 1 RUNS
TEHAMA COUNTY
EXTREME SUMMER WEATHER CONDITIONS
30% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-3.0
10-HOUR FUEL MOISTURE-5.0
100-HOUR FUEL MOISTURE- 7.0
LIVE HERBACEOUS MOISTURE- 65.0
MIDFLAME WINDSPEED- 12.0 MPH
TERRAIN, SLOPE- 30%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 239 CHAINS/HOUR
HEAT PER UNIT AREA- 554 BTU/SQFT
FIRELINE INTENSITY- 2431 BTU/FT/S
FLAME LENGTH-16.2 FEET
REACTION INTENSITY- 4015 BTU/SQFT/M
EFFECTIVE WINDSPEED-12.2 MPH
ACRES BURNED-1147

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 133 CHAINS PER HOUR
HEAT PER UNIT AREA – 765 BTU/SQFT
FIRELINE INTENSITY – 1865 BTU/FT/S
FLAME LENGTH – 14.4 FT
REACTION INTENSITY – 3351 BTU/SQFT/M
EFFECTIVE WINDSPEED – 12.4 MPH
ACRES BURNED - 351

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 147 CHAINS PER HOUR
HEAT PER UNIT AREA – 562 BTU/SQFT
FIRELINE INTENSITY – 1513 BTU/FT/S
FLAME LENGTH – 13.1 FT
REACTION INTENSITY – 2288 BTU/SQFT/M
EFFECTIVE WINDSPEED – 12.4 MPH
ACRES BURNED - 426

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 8 CHAINS/HOUR
HEAT PER UNIT AREA- 224 BTU/SQFT
FIRELINE INTENSITY- 34 BTU/FT/S
FLAME LENGTH-2.3 FEET
REACTION INTENSITY- 1102 BTU/SQFT/M

EFFECTIVE WINDSPEED-11.3 MPH
ACRES BURNED-1.5

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 45 CHAINS/HOUR
HEAT PER UNIT AREA- 1515 BTU/SQFT
FIRELINE INTENSITY- 1238 BTU/FT/S
FLAME LENGTH-11.9 FEET
REACTION INTENSITY- 6960 BTU/SQFT/M
EFFECTIVE WINDSPEED-12.4 MPH
ACRES BURNED-39

FIRE 1 RUNS
SHASTA COUNTY
AVERAGE SUMMER WEATHER CONDITIONS
0% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-4.0
10-HOUR FUEL MOISTURE-5.0
100-HOUR FUEL MOISTURE- 6.0
LIVE HERBACEOUS MOISTURE- 90.0
MIDFLAME WINDSPEED- 7.0 MPH
TERRAIN, SLOPE- 0%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 74 CHAINS/HOUR
HEAT PER UNIT AREA- 514 BTU/SQFT
FIRELINE INTENSITY- 699 BTU/FT/S
FLAME LENGTH-9.2 FEET
REACTION INTENSITY- 3730 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.0 MPH
ACRES BURNED-168

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 46 CHAINS PER HOUR
HEAT PER UNIT AREA – 717 BTU/SQFT
FIRELINE INTENSITY – 606 BTU/FT/S
FLAME LENGTH – 8.6 FT
REACTION INTENSITY – 3142 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.0 MPH
ACRES BURNED - 65

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 63 CHAINS PER HOUR
HEAT PER UNIT AREA – 527 BTU/SQFT
FIRELINE INTENSITY – 608 BTU/FT/S
FLAME LENGTH – 8.6 FT
REACTION INTENSITY – 2148 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.0 MPH
ACRES BURNED - 121

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 4 CHAINS/HOUR
HEAT PER UNIT AREA- 211 BTU/SQFT
FIRELINE INTENSITY- 15 BTU/FT/S
FLAME LENGTH-1.6 FEET

REACTION INTENSITY- 1037 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.0 MPH
ACRES BURNED-.5

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 16 CHAINS/HOUR
HEAT PER UNIT AREA- 1401 BTU/SQFT
FIRELINE INTENSITY- 405 BTU/FT/S
FLAME LENGTH-7.1 FEET
REACTION INTENSITY- 6436 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.0 MPH
ACRES BURNED-7.6

FIRE 1 RUNS
SHASTA COUNTY
AVERAGE SUMMER WEATHER CONDITIONS
30% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-4.0
10-HOUR FUEL MOISTURE-5.0
100-HOUR FUEL MOISTURE- 6.0
LIVE HERBACEOUS MOISTURE- 90.0
MIDFLAME WINDSPEED- 7.0 MPH
TERRAIN, SLOPE- 30%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 80 CHAINS/HOUR
HEAT PER UNIT AREA- 514 BTU/SQFT
FIRELINE INTENSITY- 755 BTU/FT/S
FLAME LENGTH-9.5 FEET
REACTION INTENSITY- 3730 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.3 MPH
ACRES BURNED-190

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 50 CHAINS PER HOUR
HEAT PER UNIT AREA – 717 BTU/SQFT
FIRELINE INTENSITY – 658 BTU/FT/S
FLAME LENGTH – 8.9 FT
REACTION INTENSITY – 3142 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.4 MPH
ACRES BURNED - 73

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 68 CHAINS PER HOUR
HEAT PER UNIT AREA – 527 BTU/SQFT
FIRELINE INTENSITY – 661 BTU/FT/S
FLAME LENGTH – 8.9 FT
REACTION INTENSITY – 2148 BTU/SQFT/M
EFFECTIVE WINDSPEED – 7.5 MPH
ACRES BURNED - 136

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 4 CHAINS/HOUR
HEAT PER UNIT AREA- 211 BTU/SQFT
FIRELINE INTENSITY- 16 BTU/FT/S
FLAME LENGTH-1.6 FEET

REACTION INTENSITY- 1037 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.5 MPH
ACRES BURNED-.5

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 17 CHAINS/HOUR
HEAT PER UNIT AREA- 1401 BTU/SQFT
FIRELINE INTENSITY- 444 BTU/FT/S
FLAME LENGTH-7.4 FEET
REACTION INTENSITY- 6436 BTU/SQFT/M
EFFECTIVE WINDSPEED-7.5 MPH
ACRES BURNED-8.7

FIRE 1 RUNS
SHASTA COUNTY
EXTREME SUMMER WEATHER CONDITIONS
0% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-3.0
10-HOUR FUEL MOISTURE-4.0
100-HOUR FUEL MOISTURE- 5.0
LIVE HERBACEOUS MOISTURE- 70.0
MIDFLAME WINDSPEED- 15.0 MPH
TERRAIN, SLOPE- 0%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 342 CHAINS/HOUR
HEAT PER UNIT AREA- 554 BTU/SQFT
FIRELINE INTENSITY- 3475 BTU/FT/S
FLAME LENGTH-19.1 FEET
REACTION INTENSITY- 4014 BTU/SQFT/M
EFFECTIVE WINDSPEED-15.0 MPH
ACRES BURNED-1982

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 165 CHAINS PER HOUR
HEAT PER UNIT AREA – 762 BTU/SQFT
FIRELINE INTENSITY – 2309 BTU/FT/S
FLAME LENGTH – 15.9 FT
REACTION INTENSITY – 3338 BTU/SQFT/M
EFFECTIVE WINDSPEED – 15.0 MPH
ACRES BURNED - 462

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 191 CHAINS PER HOUR
HEAT PER UNIT AREA – 568 BTU/SQFT
FIRELINE INTENSITY – 1992 BTU/FT/S
FLAME LENGTH – 14.8 FT
REACTION INTENSITY – 2312 BTU/SQFT/M
EFFECTIVE WINDSPEED – 15.0 MPH
ACRES BURNED - 620

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 8 CHAINS/HOUR
HEAT PER UNIT AREA- 225 BTU/SQFT
FIRELINE INTENSITY- 35 BTU/FT/S
FLAME LENGTH-2.3 FEET

REACTION INTENSITY- 1109 BTU/SQFT/M
EFFECTIVE WINDSPEED-11.3 MPH
ACRES BURNED-1.5
FUEL MODEL 10 (Timber)
RATE OF SPREAD- 56 CHAINS/HOUR
HEAT PER UNIT AREA- 1511 BTU/SQFT
FIRELINE INTENSITY- 1554 BTU/FT/S
FLAME LENGTH-13.2 FEET
REACTION INTENSITY- 6944 BTU/SQFT/M
EFFECTIVE WINDSPEED-15.0 MPH
ACRES BURNED-53

FIRE 1 RUNS
SHASTA COUNTY
EXTREME SUMMER WEATHER CONDITIONS
30% SLOPE

DIRECT (INPUTS)
FUEL MODELS-2, 5, 6, 8, 10
1 HOUR FUEL MOISTURE-3.0
10-HOUR FUEL MOISTURE-4.0
100-HOUR FUEL MOISTURE- 5.0
LIVE HERBACEOUS MOISTURE- 70.0
MIDFLAME WINDSPEED- 15.0 MPH
TERRAIN, SLOPE- 30%
DIRECTION OF WIND VECTOR-0
ELAPSED TIME-1 HOUR

PREDICTED FIRE BEHAVIOR

FUEL MODEL 2 (Grass)
RATE OF SPREAD- 349 CHAINS/HOUR
HEAT PER UNIT AREA- 554 BTU/SQFT
FIRELINE INTENSITY- 3545 BTU/FT/S
FLAME LENGTH-19.3 FEET
REACTION INTENSITY- 4014 BTU/SQFT/M
EFFECTIVE WINDSPEED-15.2 MPH
ACRES BURNED-2044

FUEL MODEL 5 (Brush)
RATE OF SPREAD – 170 CHAINS PER HOUR
HEAT PER UNIT AREA – 762 BTU/SQFT
FIRELINE INTENSITY – 2377 BTU/FT/S
FLAME LENGTH – 16.1 FT
REACTION INTENSITY – 3338 BTU/SQFT/M
EFFECTIVE WINDSPEED – 15.3 MPH
ACRES BURNED - 482

FUEL MODEL 6 (Brush)
RATE OF SPREAD – 197 CHAINS PER HOUR
HEAT PER UNIT AREA – 568 BTU/SQFT
FIRELINE INTENSITY – 2055 BTU/FT/S
FLAME LENGTH – 15.0 FT
REACTION INTENSITY – 2312 BTU/SQFT/M
EFFECTIVE WINDSPEED – 15.4 MPH
ACRES BURNED - 647

FUEL MODEL 8 (Timber)
RATE OF SPREAD- 8 CHAINS/HOUR
HEAT PER UNIT AREA- 225 BTU/SQFT
FIRELINE INTENSITY- 35 BTU/FT/S
FLAME LENGTH-2.3 FEET
REACTION INTENSITY- 1109 BTU/SQFT/M

EFFECTIVE WINDSPEED-11.3 MPH
ACRES BURNED-1.5

FUEL MODEL 10 (Timber)
RATE OF SPREAD- 58 CHAINS/HOUR
HEAT PER UNIT AREA- 1511 BTU/SQFT
FIRELINE INTENSITY- 1606 BTU/FT/S
FLAME LENGTH-13.4 FEET
REACTION INTENSITY- 6944 BTU/SQFT/M
EFFECTIVE WINDSPEED-15.4 MPH
ACRES BURNED-56

E. PROJECT TEAM

Name/Title	Agency	Address
Dave O. Smith Assistant Wildlife Biologist	CA Dept of Fish & Game	601 Locust Ave Redding, CA 96001
Vieva Swearingen Watershed Coordinator	Cottonwood Creek Watershed Group	P.O. Box 1198 Cottonwood, CA 96022
Tom Harrington Professional Forester	Sierra Pacific Industries	P.O. Box 496014 Redding, CA 96001
Rick Hartley Pre-fire Engineer	CDF (Shasta-Trinity Unit)	875 Cypress Ave. Redding, CA 96001
Doug Wenham Battalion Chief	CDF (Shasta-Trinity Unit)	875 Cypress Ave. Redding, CA 96001
Chuck Dethero Professional Forester	Roseburg Forest Products	P.O. Box 680 Weed, CA 96094
Richard Pound Prefire Engineer	CDF (Tehama-Glenn Unit)	604 Antelope Blvd. Red Bluff, CA 96080
Eda Eggeman Environmental Specialist	CA Dept of Fish & Game	601 Locust Ave Redding, CA 96001
Arlene Kallis Forest Planner/Annalist	US Forest Service	2400 Washington Ave. Redding, CA 96001
Dave Loeffler Fire Management	US Forest Service	P.O. Box 159 Hayfork, CA 96041
Kathleen Schori Vegetation Management Specialist	CDF (Shasta-Trinity Unit)	875 Cypress Ave. Redding, CA 96001
Hide Wenham Projects Manager	Western Shasta RCD	6270 Parallel Rd Anderson, CA 96007
Dave Soho WSRCD Board of Directors	Western Shasta RCD	6270 Parallel Rd Anderson, CA 96007
Gerry Hubatka Civil Engineer Tech.	USDA Natural Resources Conservation Service	3179 Bechelli Lane Redding, CA 96002

F. COMMUNITY FIRE SAFE FUEL REDUCTION GUIDELINES

COMMUNITY FIRE SAFE

FUEL REDUCTION GUIDELINES

A CRITICAL ELEMENT OF THE COMMUNITY FIRE SAFE PROGRAM IS TO REDUCE THE AMOUNT OF FUEL AVAILABLE TO AN UNCONTROLLED VEGETATION FIRE. YOU CAN REDUCE UNWANTED VEGETATION BY APPLYING THESE GUIDELINES TO YOUR PROPERTY AND WORKING TO ACHIEVE FUEL REDUCTION.

RALPH MINNICH
BATTALION CHIEF
FEBRUARY, 1996

ARTWORK BY PATRICK WESTRIP

RHM:Fuel Reduction Guidelines

Page Break

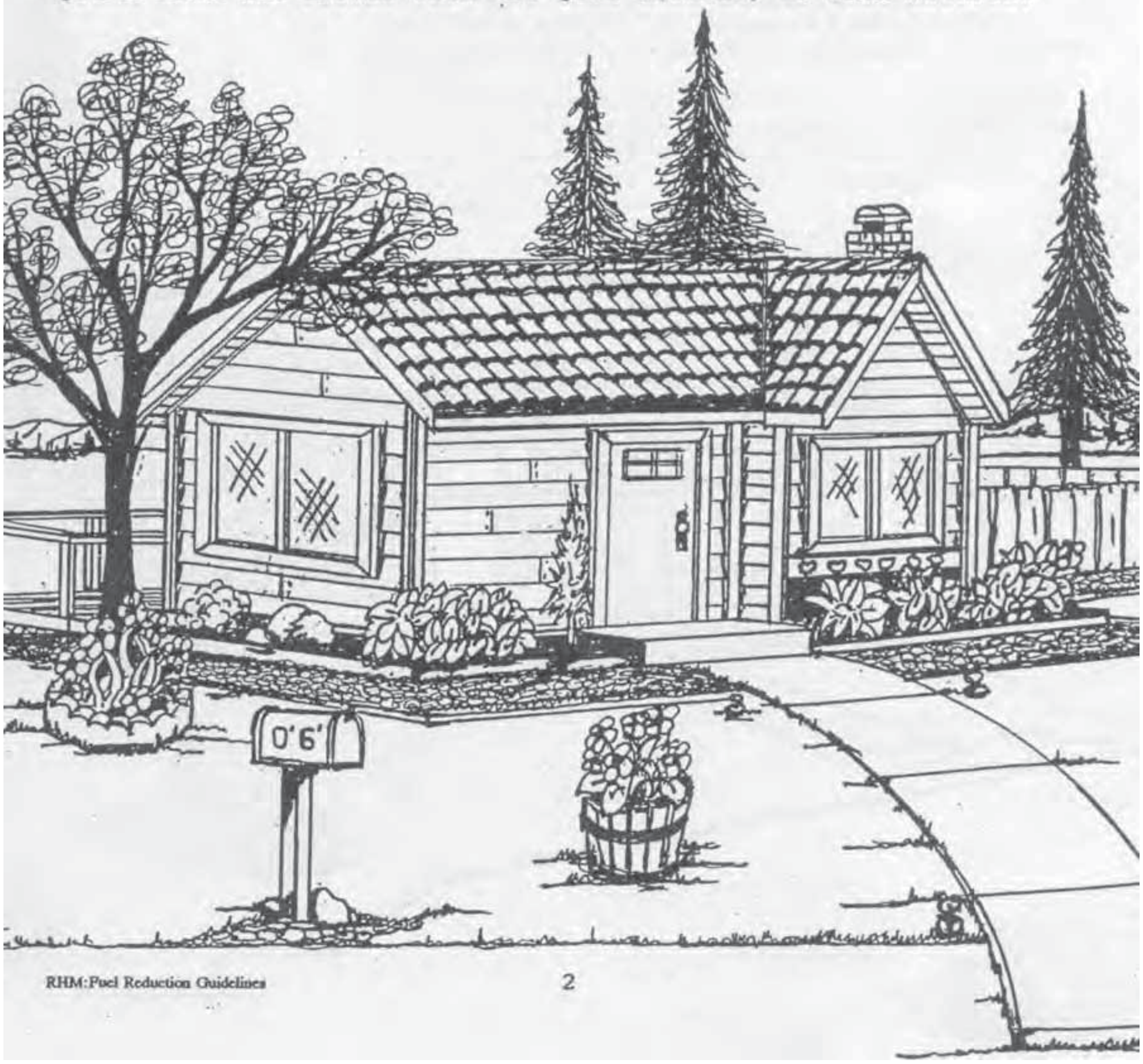
1. The Home Zone 0' to 6'

GOAL: To prevent the spread of fire from the structure to vegetation <u>or</u> from vegetation to the structure.

OBJECTIVE: Remove all fuel sources from this zone. Conifer trees, brush, dry grass, leaves, needles, woodpiles and flammable ornamentals are examples.

Remember to clean leaves and needles from roofs and gutters.

This zone can be landscaped with gravel, concrete or left bare to mineral soil. Replacing vegetation with less-flammable plants, green lawn and flower beds are good choices, if well-watered.



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2. The Yard Zone 6' to 30'

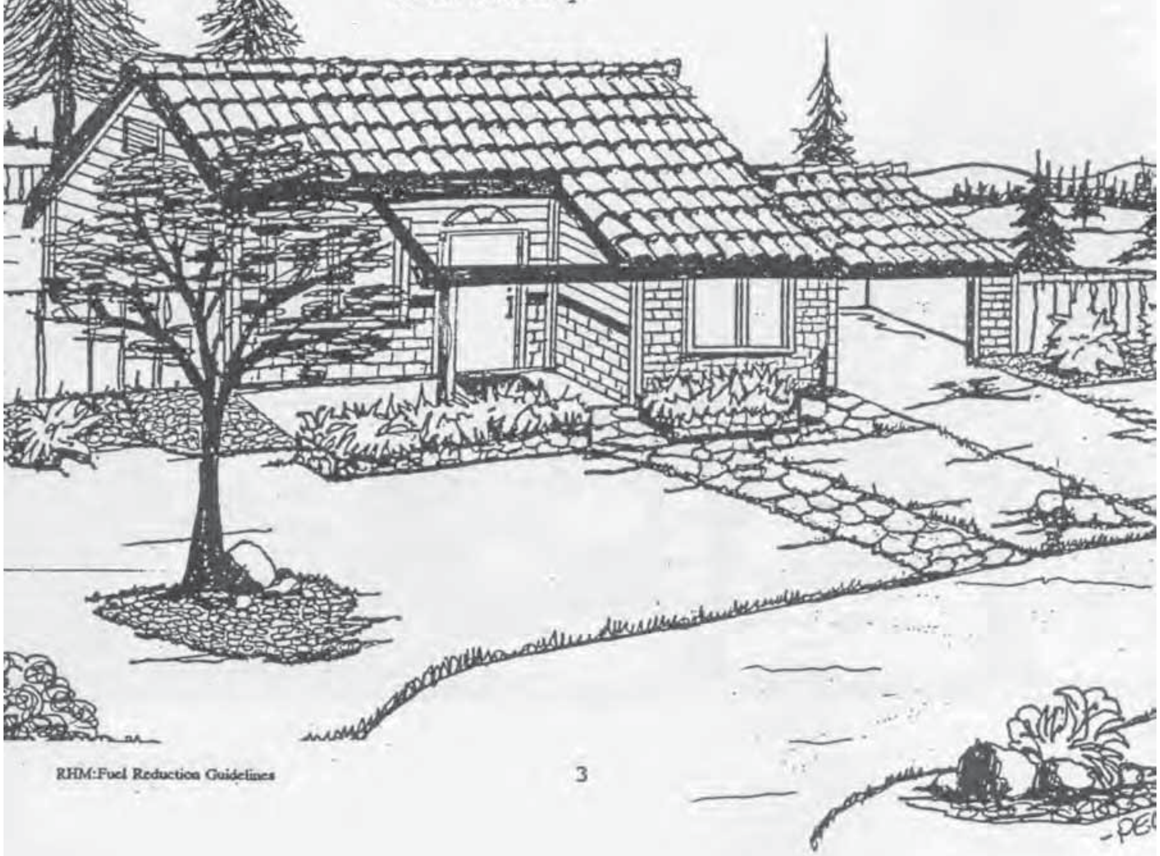
GOAL: To prevent a fire from moving from ground fuels to brush or tree crowns and to slow the rate of fire spread.

> reduced fuels means reduced fire intensity
> reduces potential exposure problems
> preserves overstory vegetation

[This zone should be sufficient for grasslands and is integrated into fuel reduction for brush and timberlands.]

OBJECTIVE:

1. Eliminate fuel ladders (continuous fuel from ground to tree crowns)
2. Limit litter layer to less than 3".
3. Remove fine, dead, standing material.
4. Clip dead twigs and branches from brush.
5. Prune branches of trees to at least 10' above ground.
6. Separate tree crowns by 15'.
7. Break up horizontal continuity of fuels by use of low-flammability plants, flower beds, green lawns, gravel or concrete. Watering reduces flammability.



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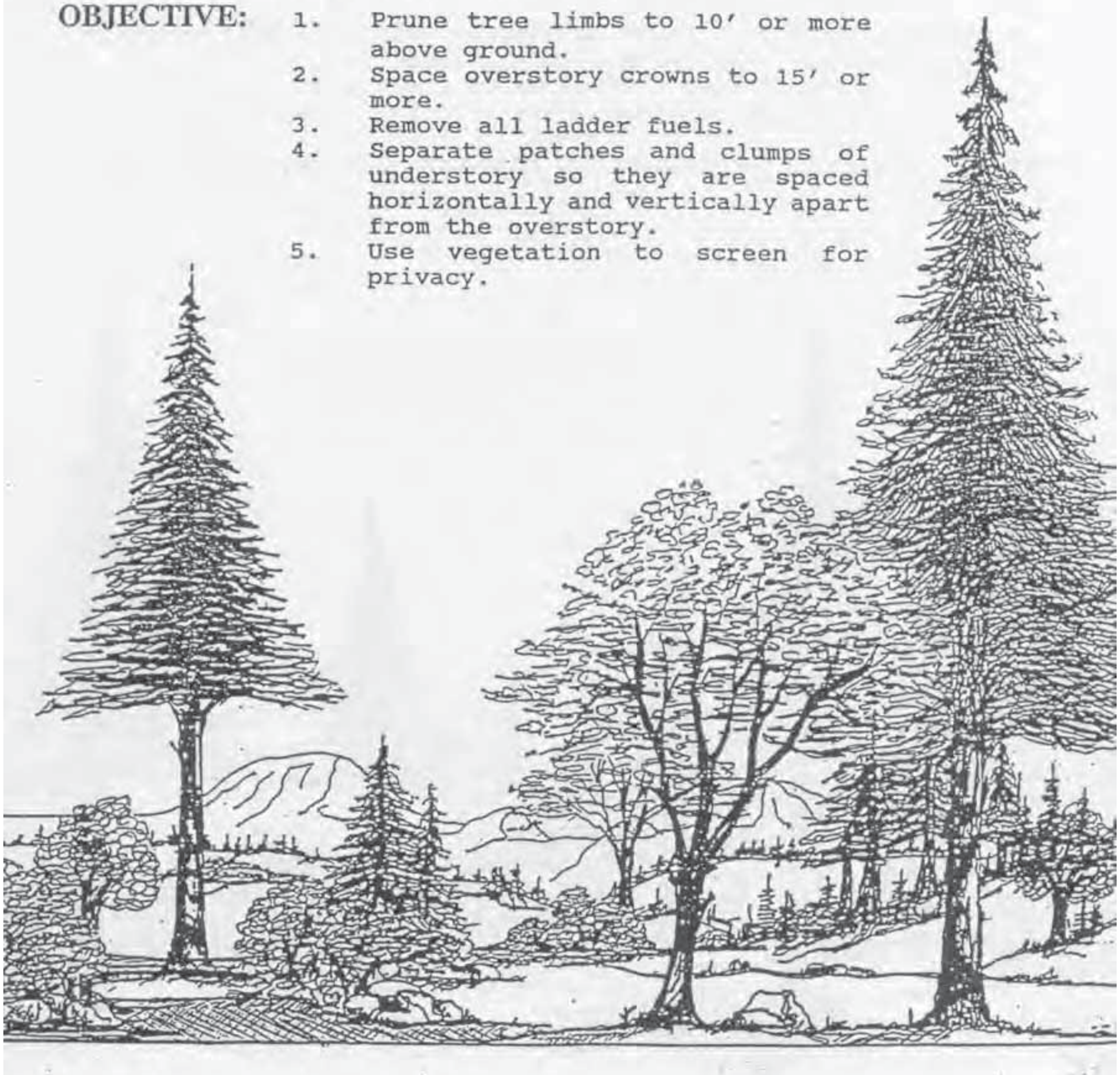
3. The Brush / Screen Zone 30' to 75'

GOAL: To keep a wildland fire on the ground thereby minimizing intense burning and damage to overstory vegetation.

[This is the primary zone for fire suppression. Although 75' of fuel reduction appears adequate for brushcovered lands, further effort is necessary in timberlands.]

OBJECTIVE:

1. Prune tree limbs to 10' or more above ground.
2. Space overstory crowns to 15' or more.
3. Remove all ladder fuels.
4. Separate patches and clumps of understory so they are spaced horizontally and vertically apart from the overstory.
5. Use vegetation to screen for privacy.



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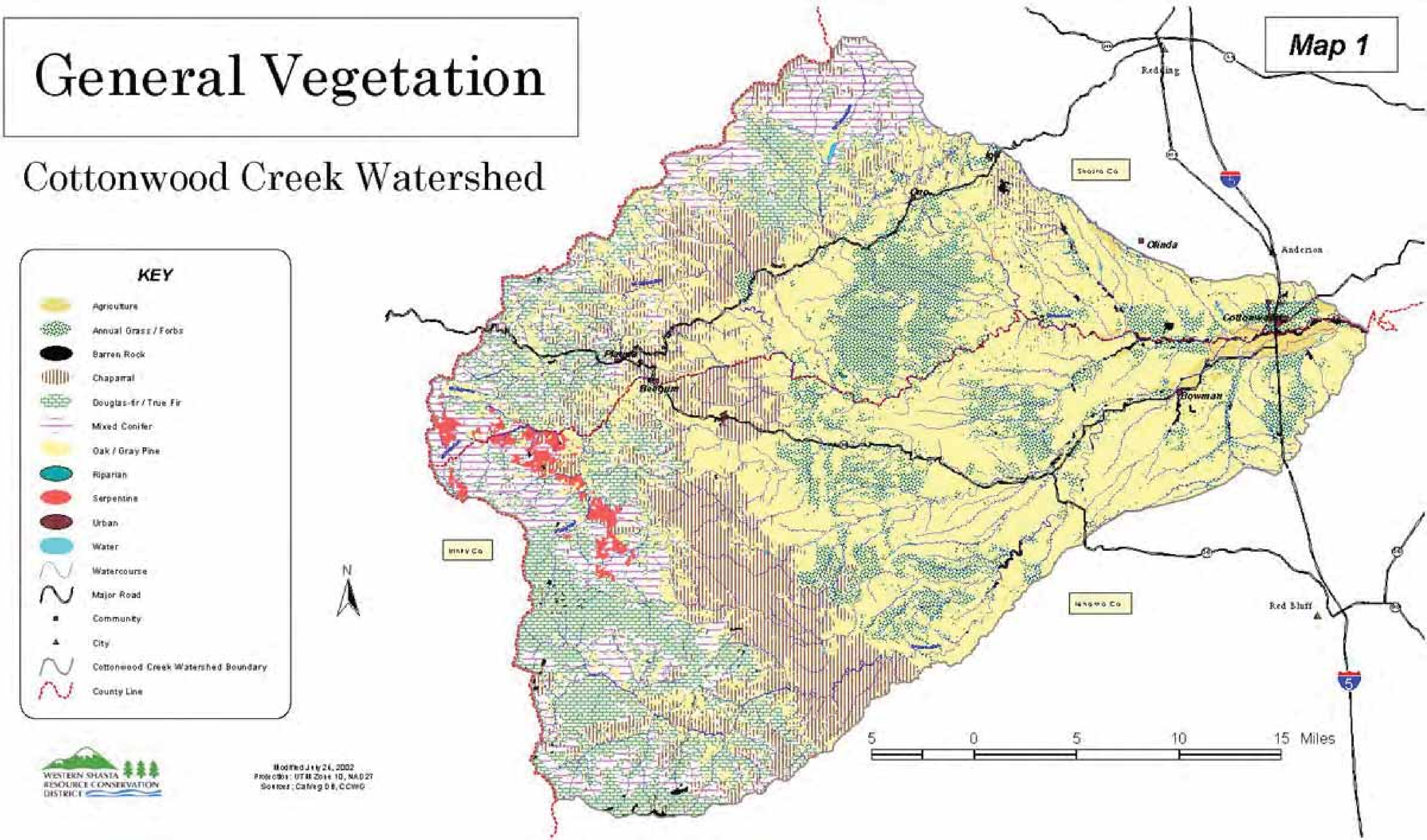
4. Woodland / Forest Zone 75' to 150'*

GOAL: To provide a space in which a fire will "cool down, slow down and stay on the ground" thereby maintaining fire safety in forest communities.

[This zone can provide cover for wildlife. Views within this zone can be enhanced to be more aesthetically pleasing.]

OBJECTIVES:
1. Remove dead material from brush and trees.
2. Prune limbs in trees to 10' above ground.
3. Thin trees to 20' trunk spacing.
4. Create patchy landscaping.

*Fuel reduction zones increase for properties on ridges or slopes.

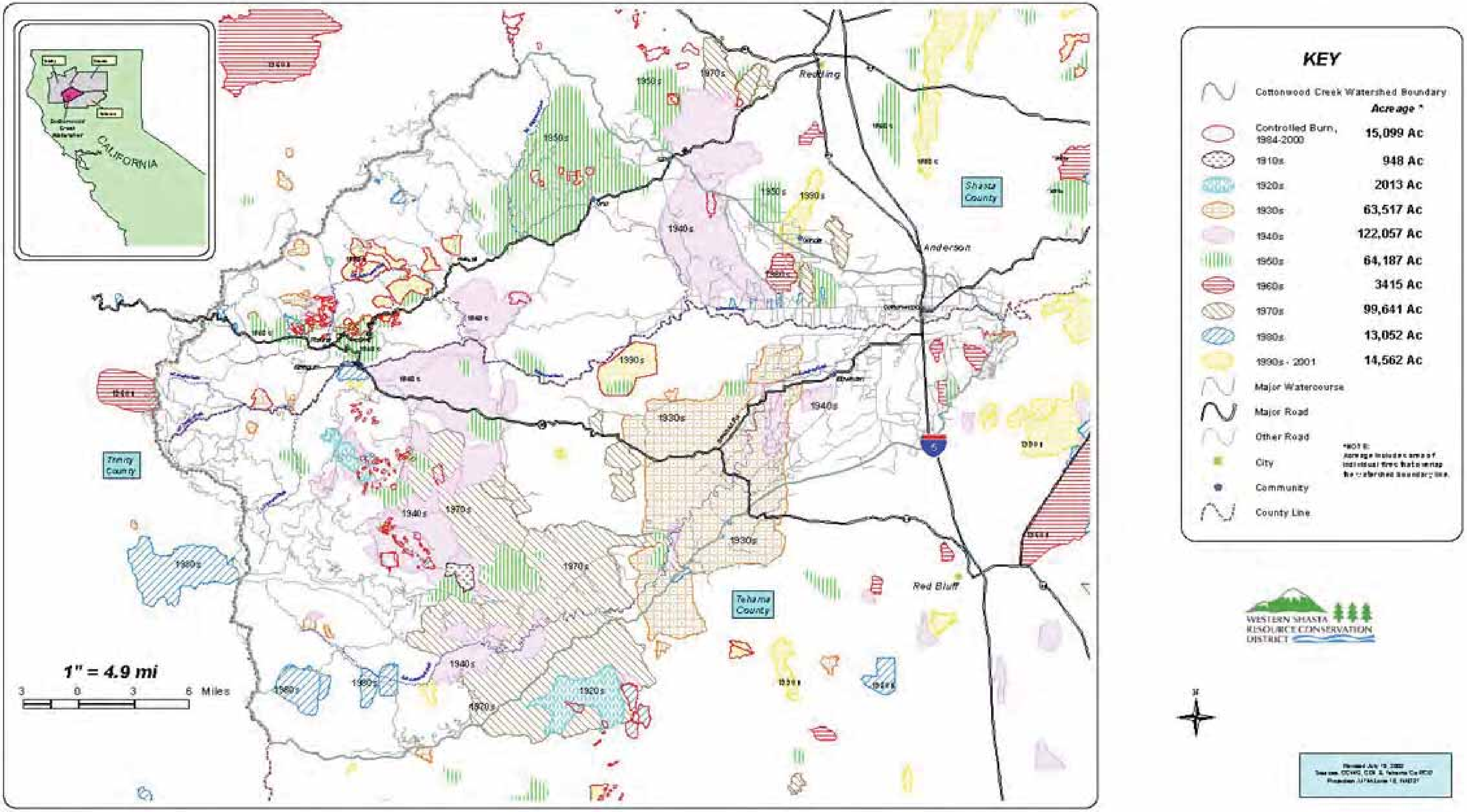


General Vegetation
Cottonwood Creek Watershed
Map 1
KEY
Agriculture
Annual Grass / Forbs
Barren Rock
Chaparral
Douglas-fir / True Fir
Mixed Conifer
Oak / Gray Pine
Riparian
Serpentine
Urban
Water
Watercourse
Major Road
Community
City
Cottonwood Creek Watershed Boundary
County Line
Redding
Anderson
Olinda
Cottonwood
Bowman
Beegum
Red Bluff
Shasta Co
Tehama Co
Trinity Co
N
5 0 5 10 15 Miles
Modified July 24, 2002
Projection: UTM Zone 10, NAD27
Sources: Calveg DB, CCWG
WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

FIRE HISTORY

COTTONWOOD CREEK WATERSHED

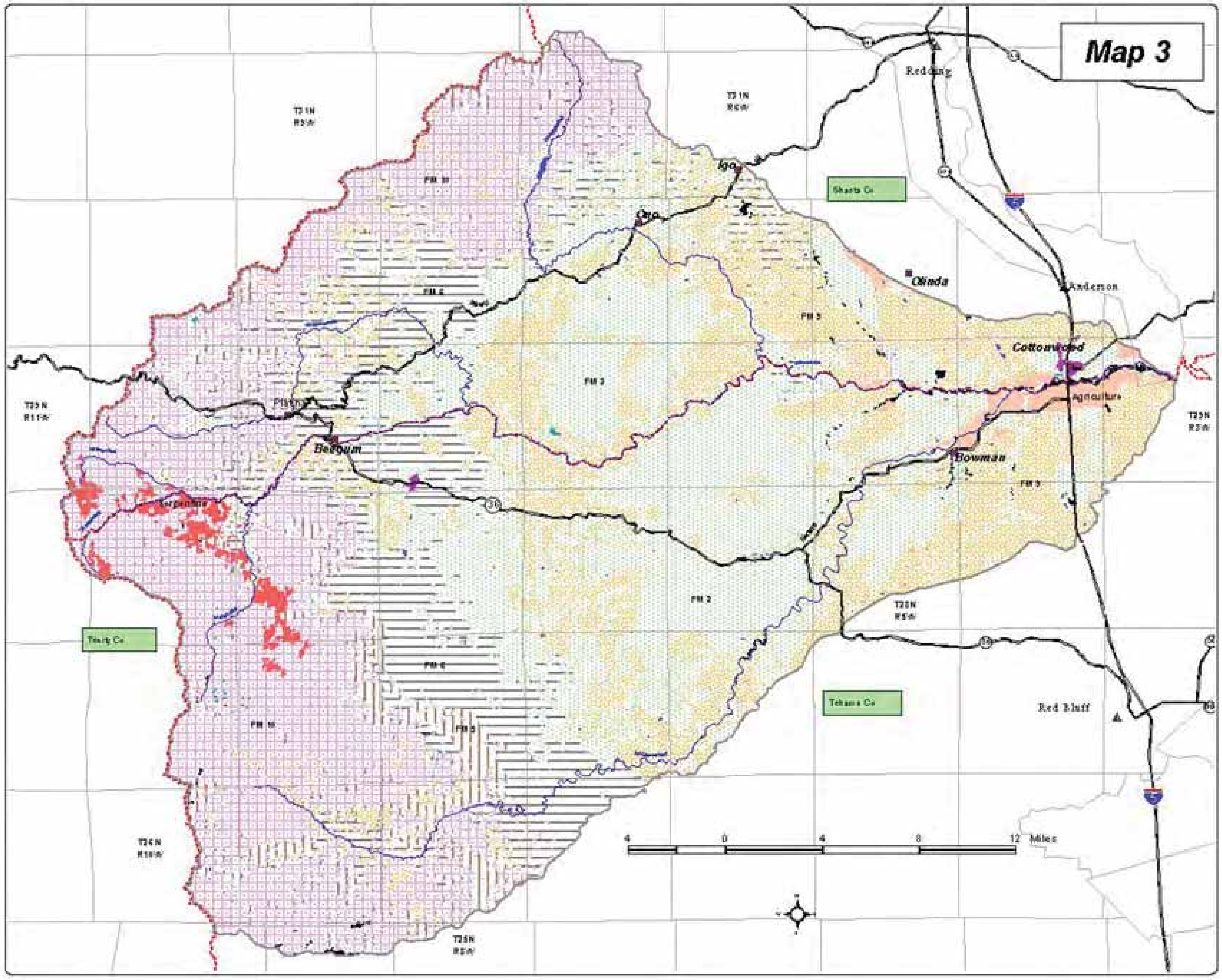
Map 2

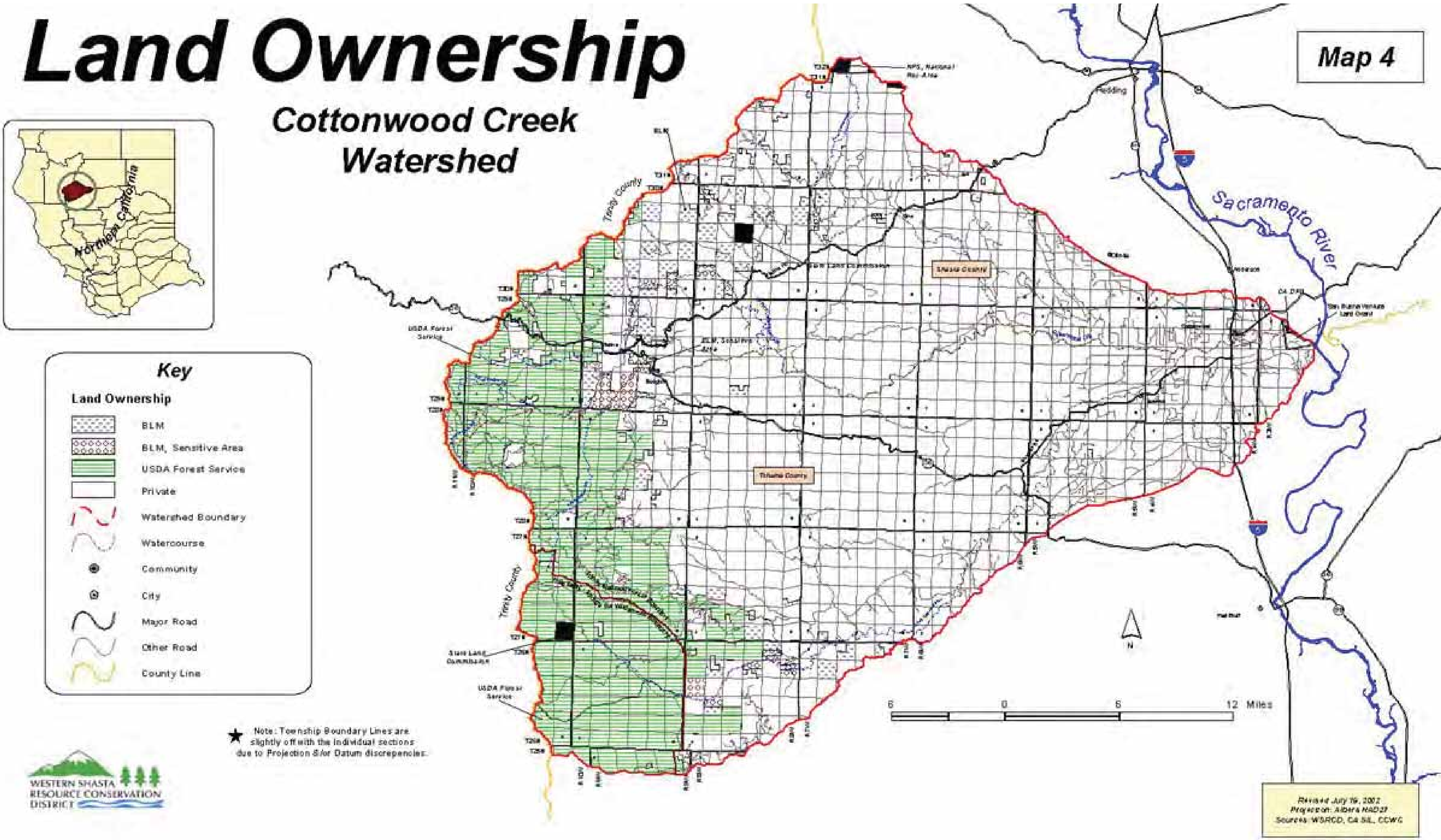


Fuel Models
Cottonwood Creek Watershed

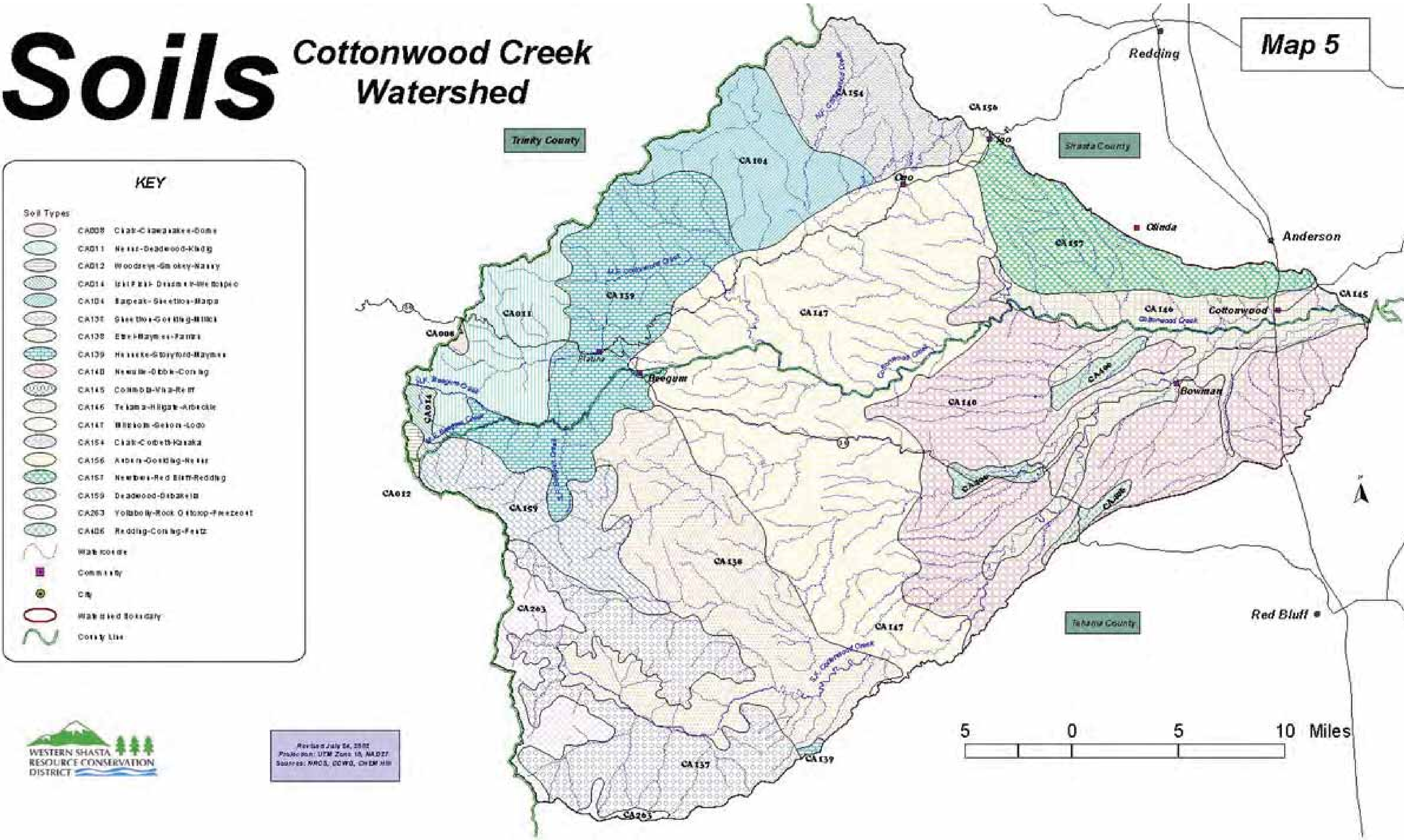
Legend

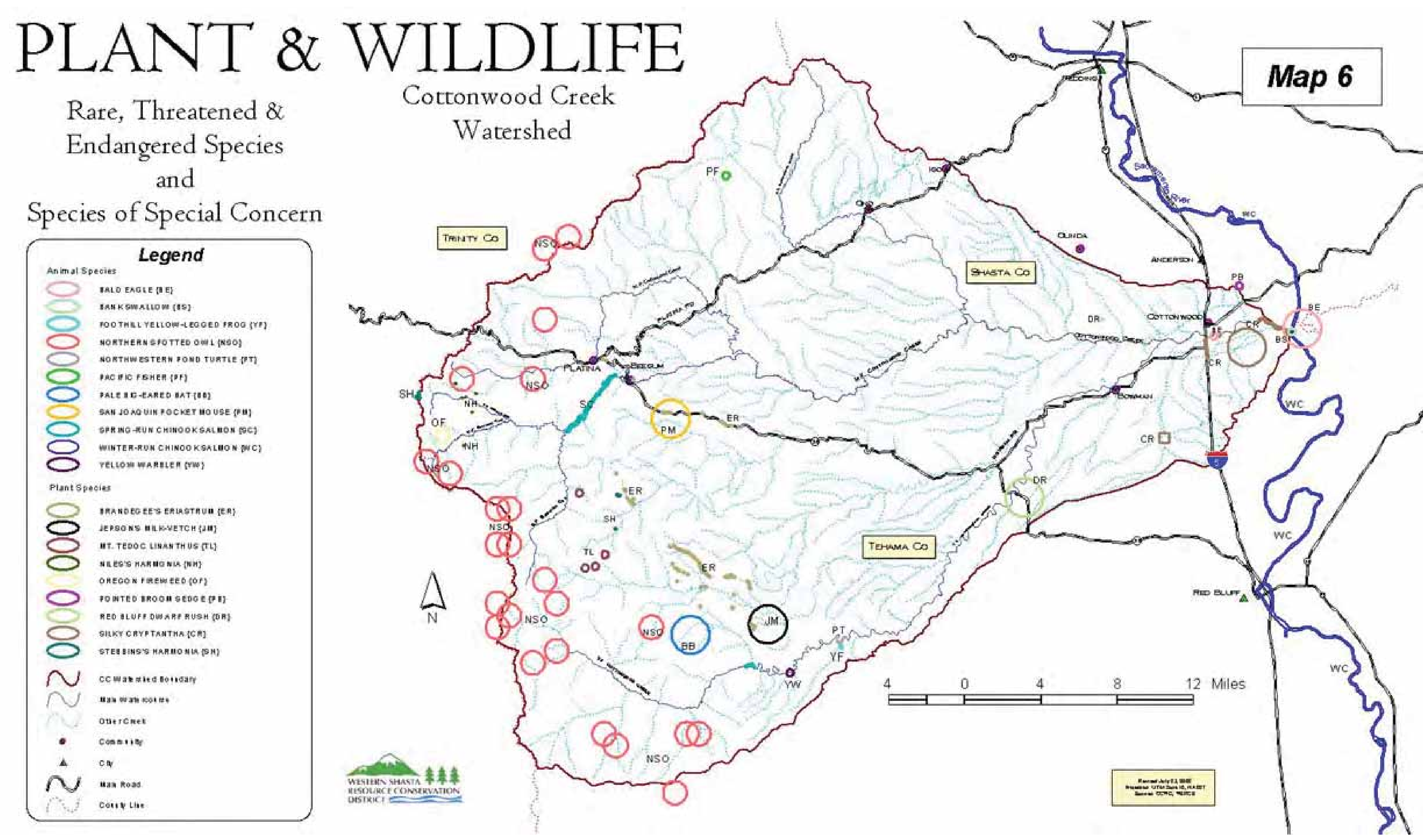
Fuel Model
- Fuel Model 2
- Fuel Model 5
- Fuel Model 6
- Fuel Model 9
- Fuel Model 10
- Major Road
- Community
- City
- Watercourse
- Agriculture
- Barren Rock
- Riparian
- Serpentine
- Urban
- Water
- Cottonwood Creek Watershed Boundary
- County Line




Land Ownership
Cottonwood Creek
Watershed
Map 4
Northern California
Key
Land Ownership
BLM
BLM, Sensitive Area
USDA Forest Service
Private
Watershed Boundary
Watercourse
Community
City
Major Road
Other Road
County Line
Note: Township Boundary Lines are slightly off with the individual sections due to Projection &/or Datum discrepencies.
Sacramento River
Redding
Shasta County
Tehama County
Trinity County
Trinity County
BLM
USDA Forest Service
USDA Forest Service
State Lands Commission
NPS, National Rec Area
BLM, Sensitive Area
6 0 6 12 Miles
N
Revised July 19, 2002
Projection: Albers NAD27
Sources: WSRCD, CA SIL, CCWG
WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

Soils Cottonwood Creek Watershed

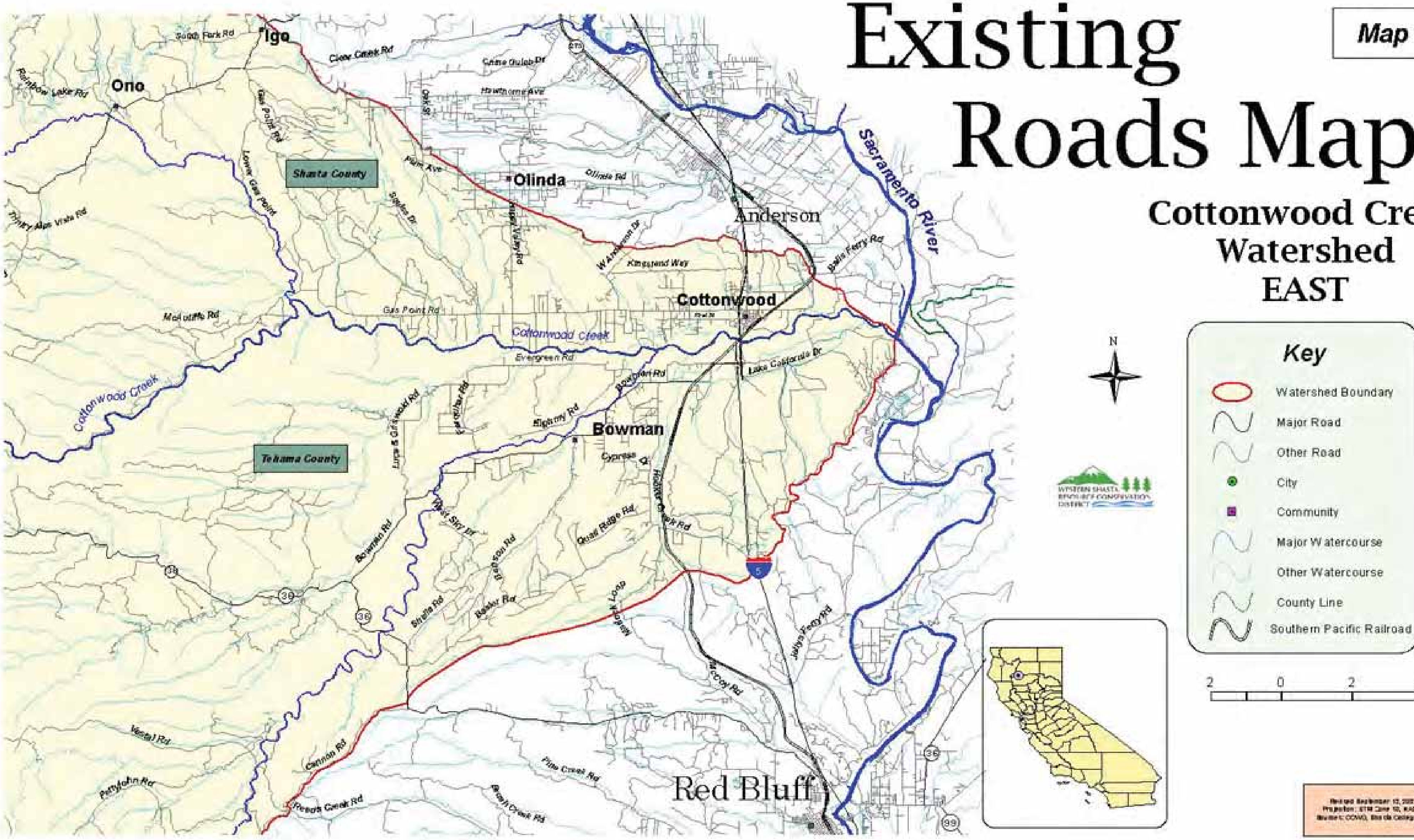



PLANT & WILDLIFE
Rare, Threatened & Endangered Species and Species of Special Concern
Cottonwood Creek Watershed
Map 6
Legend
Animal Species
BALD EAGLE (BE)
BANK SWALLOW (BS)
FOOTHILL YELLOW-LEGGED FROG (YF)
NORTHERN SPOTTED OWL (NSO)
NORTHWESTERN POND TURTLE (PT)
PACIFIC FISHER (PF)
PALE BIG-EARED BAT (BB)
SAN JOAQUIN POCKET MOUSE (PM)
SPRING-RUN CHINOOK SALMON (SC)
WINTER-RUN CHINOOK SALMON (WC)
YELLOW WARBLER (YW)
Plant Species
BRANDEGEE'S ERIASTRUM (ER)
JEPSON'S MILK-VETCH (JM)
MT. TEDOC LINANTHUS (TL)
NILES'S HARMONIA (NH)
OREGON FIREWEED (OF)
POINTED BROOM SEDGE (PB)
RED BLUFF DWARF RUSH (DR)
SILKY CRYPTANTHA (CR)
STEBBINS'S HARMONIA (SH)
CC Watershed Boundary
Main Watercourse
Other Creek
Community
City
Main Road
County Line
Trinity Co
Shasta Co
Tehama Co
Platina
Cottonwood
Anderson
Olinda
Bowman
Red Bluff
4 0 4 8 12 Miles
N
WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

Map 7

Existing Roads Map

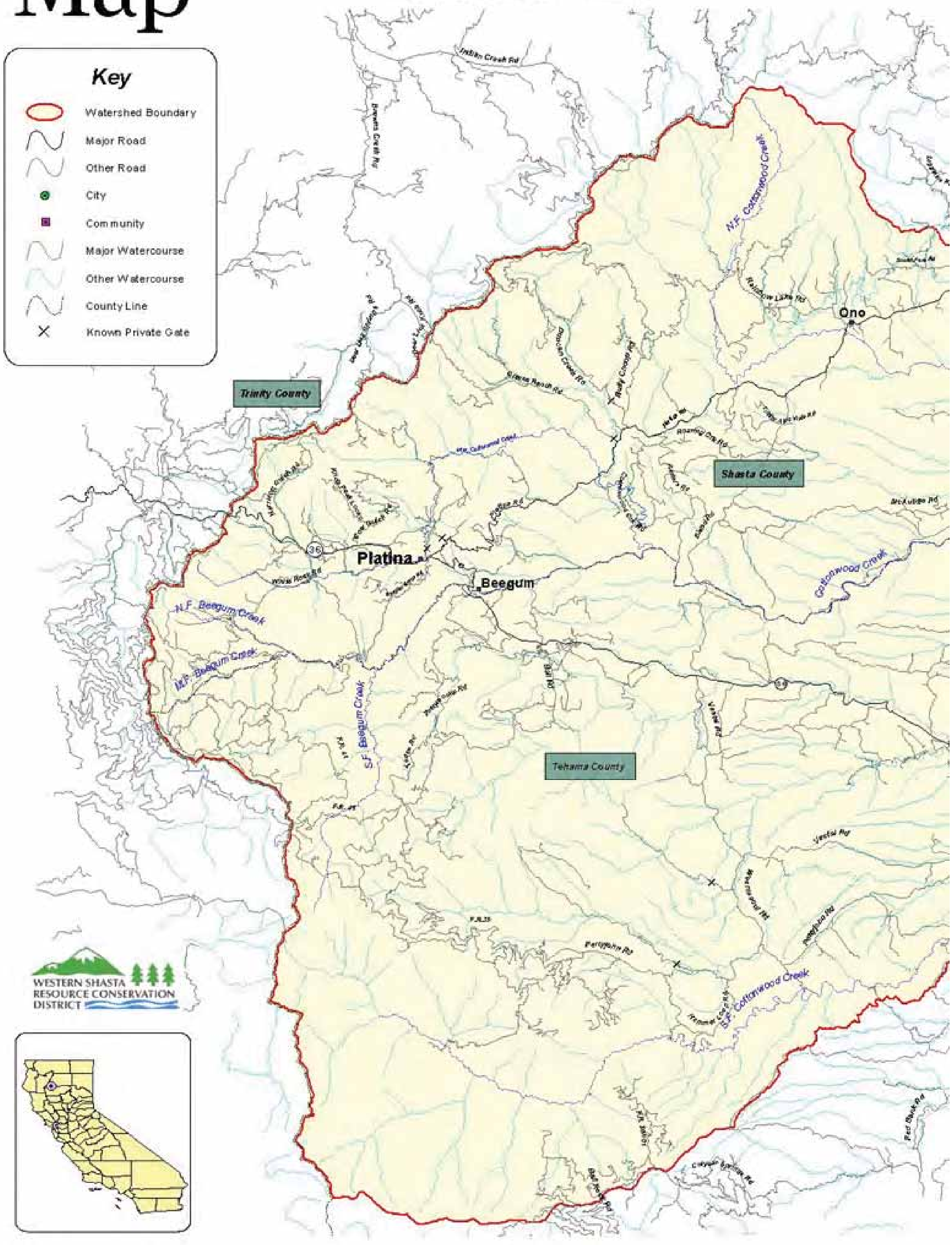
Cottonwood Creek Watershed EAST



Existing Roads Map

Map 8

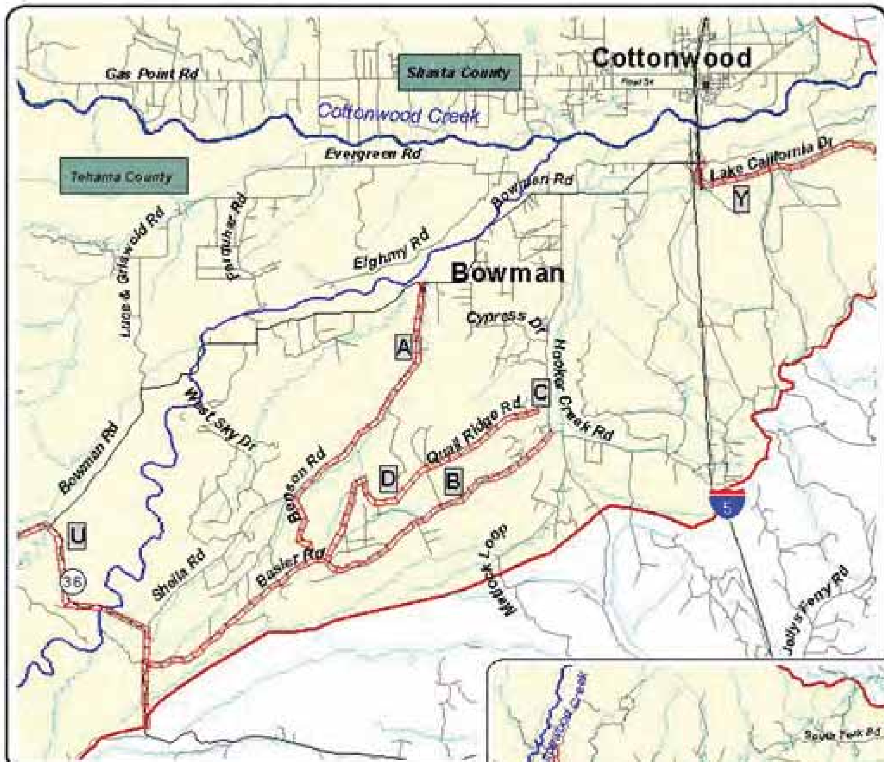
Cottonwood Creek Watershed WEST



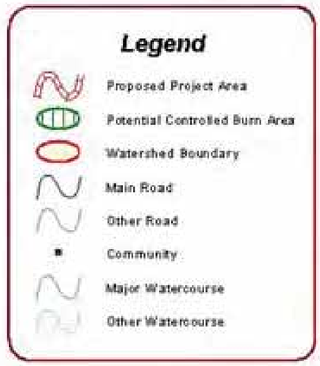
PROPOSED PROJECT AREAS, DETAILED

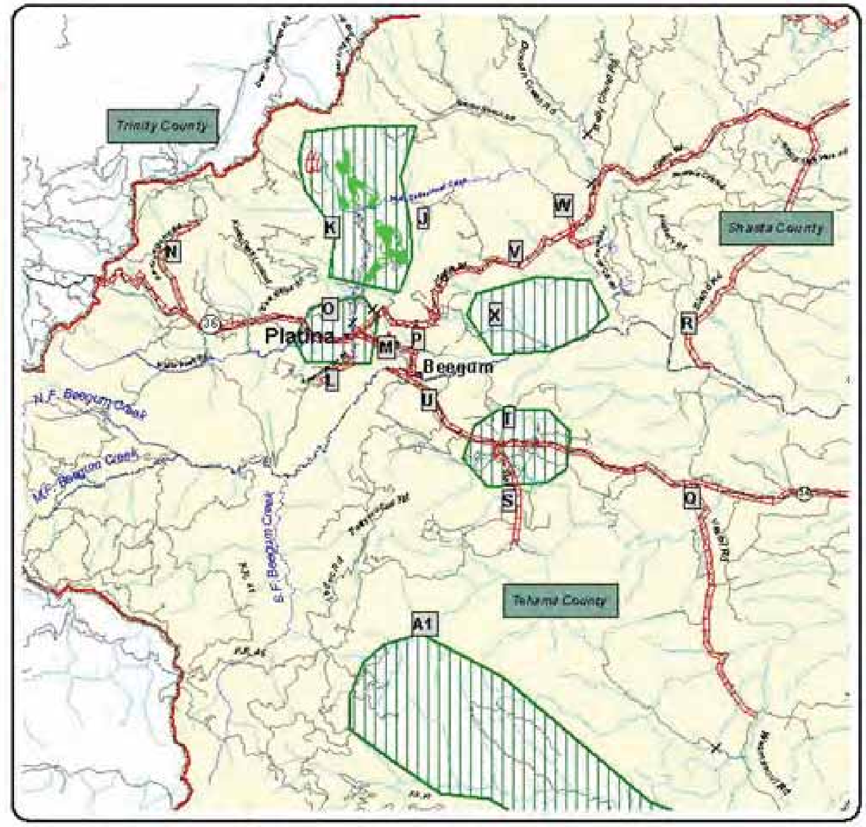
COTTONWOOD CREEK WATERSHED

MAP 9

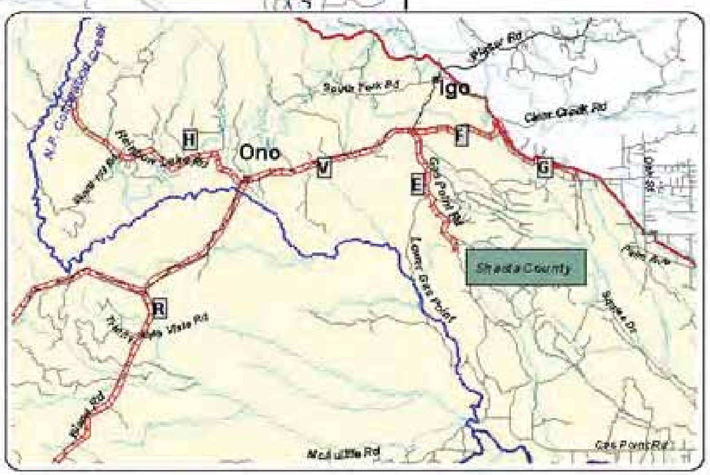


Bowman Area





Platina/Beegum Area



Igo/Ono Area

Revised August 26, 2002
UTM, NAD27

WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

STRATEGIC FUELS REDUCTION NETWORK