FUELS, WEATHER, LEVEL OF SERVICE & ASSETS AT RISK

As part of the fire plan process, the fuels, assets at risk, past fire weather history and the level of service that CDF has provided to the public will be analyzed. Data for these four components has been compiled by staff in CDF's Fire and Resource Assessment Program (FRAP) in Sacramento. The initial fire plan analysis will only be performed on CDF DPA lands. From this point on in this document, the acronym DPA will refer to CDF DPA, unless otherwise noted. Through a cooperative planning effort with other agencies that are responsible for wildland fire protection on non DPA land, CDF would like to include all lands in the Unit in future data analysis.

To arrive at a common land area unit to assemble and analyze this data, US Geological Survey 7.5 minute quadrangle maps were divided by a 9x9 grid, forming 81 equal area blocks of land. Each block contains approximately 450 acres and has been named a quad 81st. The data for the entire Unit has been aggregated down to the quad 81st.

Fuels are the burnable vegetation that exist within the Unit. Assets at risk refer to anything of value as determined by the local stakeholders that has the potential to be burned or damaged when a wildfire burns in an area. Seventeen assets have been identified by CDF's Fire and Resource Assessment Program (FRAP) and will be ranked as to their risk from wildfire. The past fire weather history will be analyzed and the percentage of days, during the fire season, that severe fire weather is experienced by each quad 81st will be calculated. The level of service is a measure of how successful CDF is at controlling fires during the initial attack stages of a fire. Initial attack is defined as the wildfire control efforts taken by firefighters that are first to arrive at a wildfire. The number of fires that are controlled during the initial attack stage of a fire (successful initial attacks) divided by the total number of initial attacks will equal the level of service provided by CDF for the time period analyzed.

Fuels

Wildland fuels or vegetation are the basic catalyst that support the combustion process of wildfires. The various fuels found in California have specific characteristics, which allow fire behavior analysts to categorize them based upon how they burn. The Fire Behavior Prediction System (FBPS) was the method chosen for categorizing fuels for the fire plan process. This method classifies fuels into 13 basic fuel models, each of which has specific physical and burning characteristics. The models include 3 grass, 4 brush, 3 timber and 3 slash fuel types. The fire plan has labeled fuel model #2, a grass model, as a woodland fuel. The woodland fuel model is primarily an area covered with annual grass with scattered trees that provide some shading to the grass. The overall fuel modeling system also allows the creation of custom fuel models when none of the 13 models adequately represent the fuels that are found in an area. Custom fuel models were developed for plantation/burned areas, water, rock/barren and urban areas.

The fuels models will be used to label the current and historic fuels in the Unit. The current fuels are those fuels that presently exist in TCU. The historic fuels are the climax fuel models or those that existed prior to fire occurrence or other activities in the area. Past wildfires, land management activities, Vegetation Management Program (VMP) burns and other occurrences have modified these fuels to their current condition. The Unit was assessed to determine the historic fuels that existed prior to the activities noted above.

The historic fuel models will be used to label the four CDF planning belts found in the Tuolumne-Calaveras Unit. Planning belts are the general fuel categories of grass, brush, woodland or conifer that are used to group the basic fuel models into similar fuel types. These general types are then used to classify lands throughout the state based on their vegetative cover, which is used in the CDF Level of Service analysis discussed later in this document.

The fuel hazard rank is used to define the wildland fire hazard presented by the current fuels when other factors are taken into consideration. The current fuel model, slope class, a ladder fuel and crown closure component, and a difficulty of control rating will be used to derive the fuel hazard rank for each quad 81st. CDF staff in Sacramento determined that there are realistically no low hazard fuels in California, thus the fuels will be ranked medium, high or very high. FRAP has assigned a medium ranking to fuel model #1 (grass) on slopes of 10% or less and high on slopes greater than 10%. Fuel model #2 (woodland) is ranked high on slopes of 40% or less and very high on slopes greater than 40%. Fuel model #6 (brush/hardwood) is ranked high on slopes of 75% or less and very high on slopes greater than 75%. Fuel models #4 (brush) and #10 (timber) are ranked very high regardless of the slope.

TCU Pre-Fire Management staff completed the Unit fuels validation in 1997. Since then, there have been several major wildfires and enough manmade disturbances to local vegetation that a reassessment is necessary. It is anticipated that the reassessment will occur over the next 2 years as time and personnel are available to work on the project. In 2002, CDF was a member of an interagency group that contracted with a vendor to collect new color digital orthophoto data for Calaveras County. The 2 foot resolution digital imagery will be very useful when the fuels are re-evaluated.

TCU Current Fuels

Referring to the current fuel model map; 45% of the quad 81st's in the DPA were labeled as grass, 19% woodland, 8% brush, 7% brush/hardwood, and 21% timber. The majority of the grass model exists west of State Highway 49 in the lower foothills, and to the east of the highway, the grass model is limited above 2,500 feet in elevation. The woodland areas are scattered from 800 to 4000 feet in elevation, some of which are in large blocks.

The brush model (#4) exists in larger blocks in the 800 to 4000 foot elevation. The blocks are in some of the less inhabited areas of Tuolumne and Calaveras Counties. The Pardee Reservoir, New Hogan Lake, Bear Mountain, Red Hills, Lake Don Pedro,

Moccasin and New Melones Lake areas have the largest concentrations of brush. There are also large blocks of brush north of San Andreas, south and east of Railroad Flat, south of Mountain Ranch, the Tuolumne River canyon south of Tuolumne City, and Highway 49 south of Moccasin.

Fuel model #6, the brush/hardwood model, was used to label those areas that have a mixture of live oak, black oak, manzanita, and chamise. This fuel type has a closed overstory (tree canopy) with light grass or leaf litter on the ground. Manzanita and chamise make up less than 15% of the fuel cover. The majority of this fuel type is between 1000 to 4000 feet in elevation. In Calaveras County, there are large blocks of this fuel model located east of Highway 49. A large block extends from New Melones Reservoir near Parrots Ferry, up the South Fork of the Stanislaus River approximately 5 miles, and then over Big Hill to the Cedar Ridge area. South of this area, there are scattered areas consisting of 2 to 4 Quad 81st cells.

Except for scattered blocks between Mountain Ranch and West Point, and a large block east of Groveland, the timber fuel model (#10) is primarily above 3500 feet in elevation. In the DPA, approximately 140,000 acres of this model are Sierra Pacific Industries (SPI) timberland. The remaining areas are made up of USFS, BLM, CDPR and other government and private ownership. Timber fuel models #8 and #9 are scattered throughout the unit. These models are less hazardous than fuel model #10, which consists of larger, denser dead fuels on the ground.

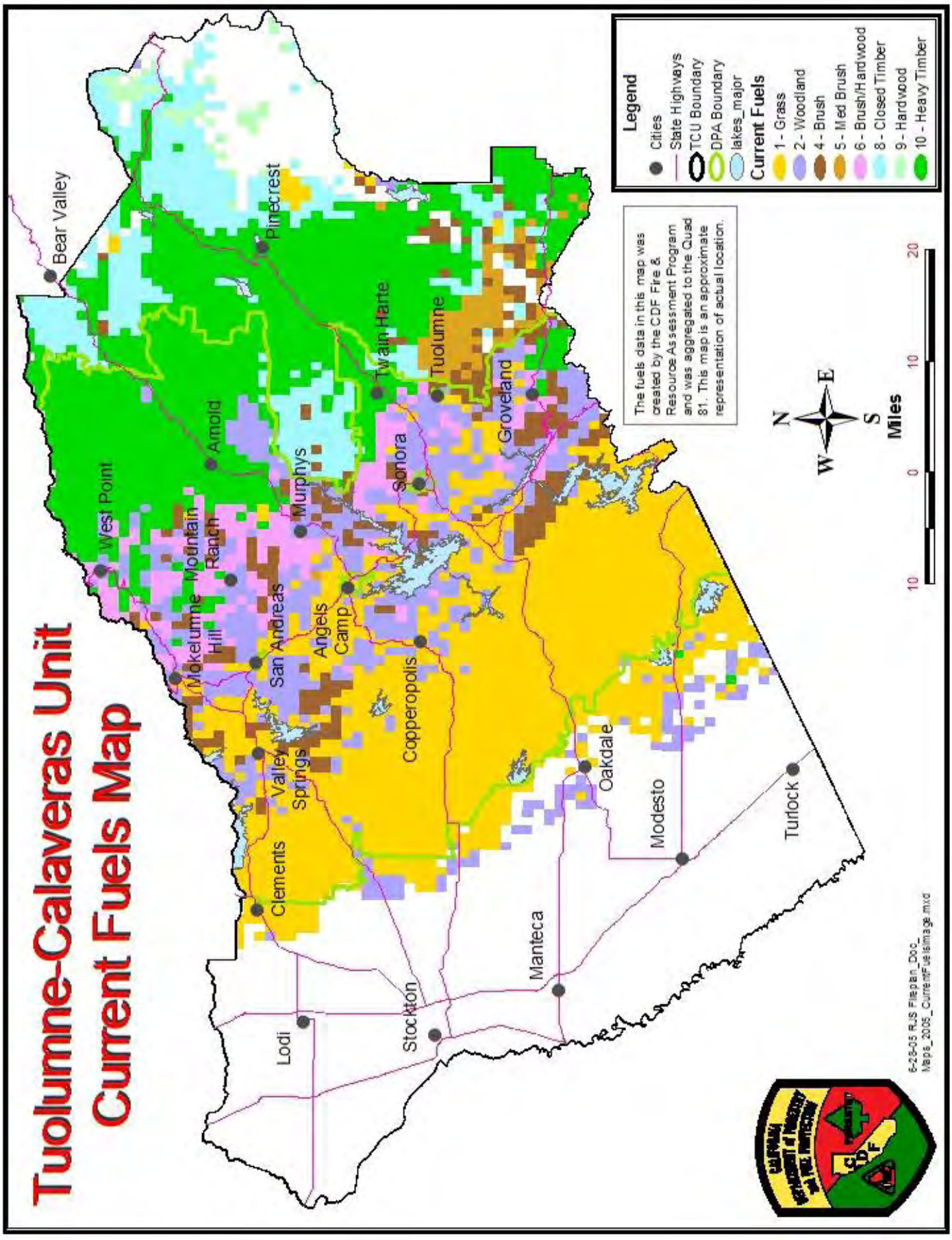

Figure 3: Current Fuels Map

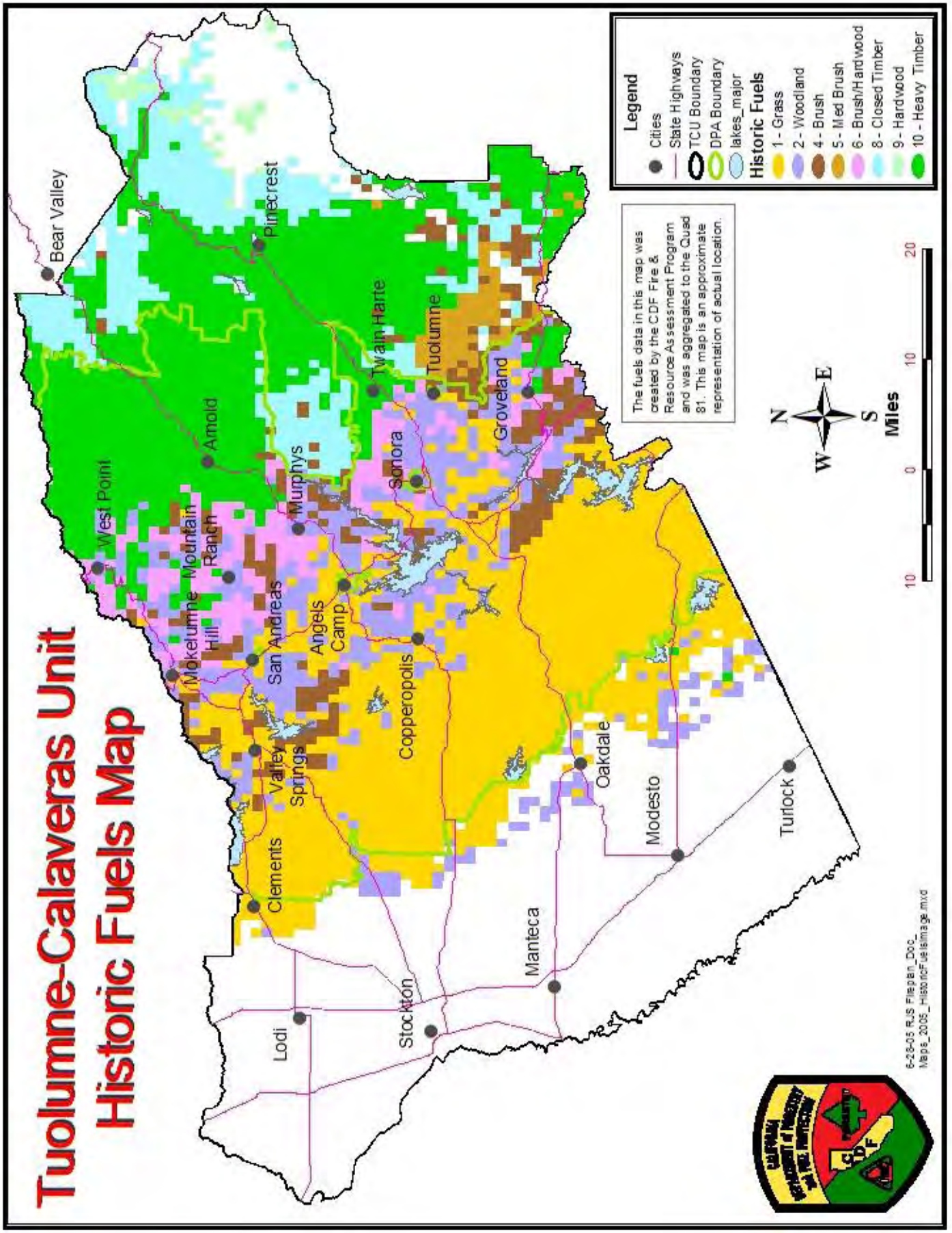

Figure 4: Historic Fuels Map

Historic Fuels and Planning Belts

In the DPA, with the exception of several areas, the current fuels are very similar to the historic fuels. Most of the fuels in burn areas have reverted to their historic state or close enough to classify them as such. Some quad 81st's within the Railroad Flat Complex (July 1988), the Gulch Fire and the Moccasin Fire (August 1992) areas have not reverted back to their historic fuel models.

The historic fuels were the basis for assigning planning belts to each quad 81st. The table below shows the fuel models assigned to and the percentage of the DPA covered by each planning belt.

Planning Belt	Historic Fuel Model(s)	% of DPA
Grass	1 and 3	44
Woodland	2	18
Brush	4, 5, 6 and 7	17
Conifer	8, 9 and 10	21

Table 1: TCU Fuels by Planning Belt

Except for the woodland planning belt, all of the others include two or more fuel models. In the DPA, there are more areas shaded in brown on the planning belt map compared to that of the historic fuels map because fuel models #4 and #6 are combined to form the brush planning belt. Fuel model #10 was used to classify all the conifer type areas in the DPA, so the conifer planning belt in the DPA is exactly the same as the area covered by fuel model #10 in the historic fuel map.

Fuel Hazard Rank

In the DPA, 25% of the quad 81st's were ranked medium, 45% high and 30% very high. This shows that over three-quarters of the CDF direct protection area contains high hazard fuels.

The fuel rank for each quad 81st is directly related to its assigned current fuel model. All cells labeled with fuel models #4 and # 10 were ranked very high and represent a total of 29% of the DPA. Those consisting of fuel model #6 (8%) were all ranked high. Because higher slopes can increase their fuel rank, it was necessary to take the slope into consideration in Quad 81st's with fuel models #1 and #2. The grass model (#1) covered 44% of the DPA, of which the number of cells were divided equally between medium and high ranks. Fuel model #2 (18%) was divided into 90% high and 10% very high ranks.

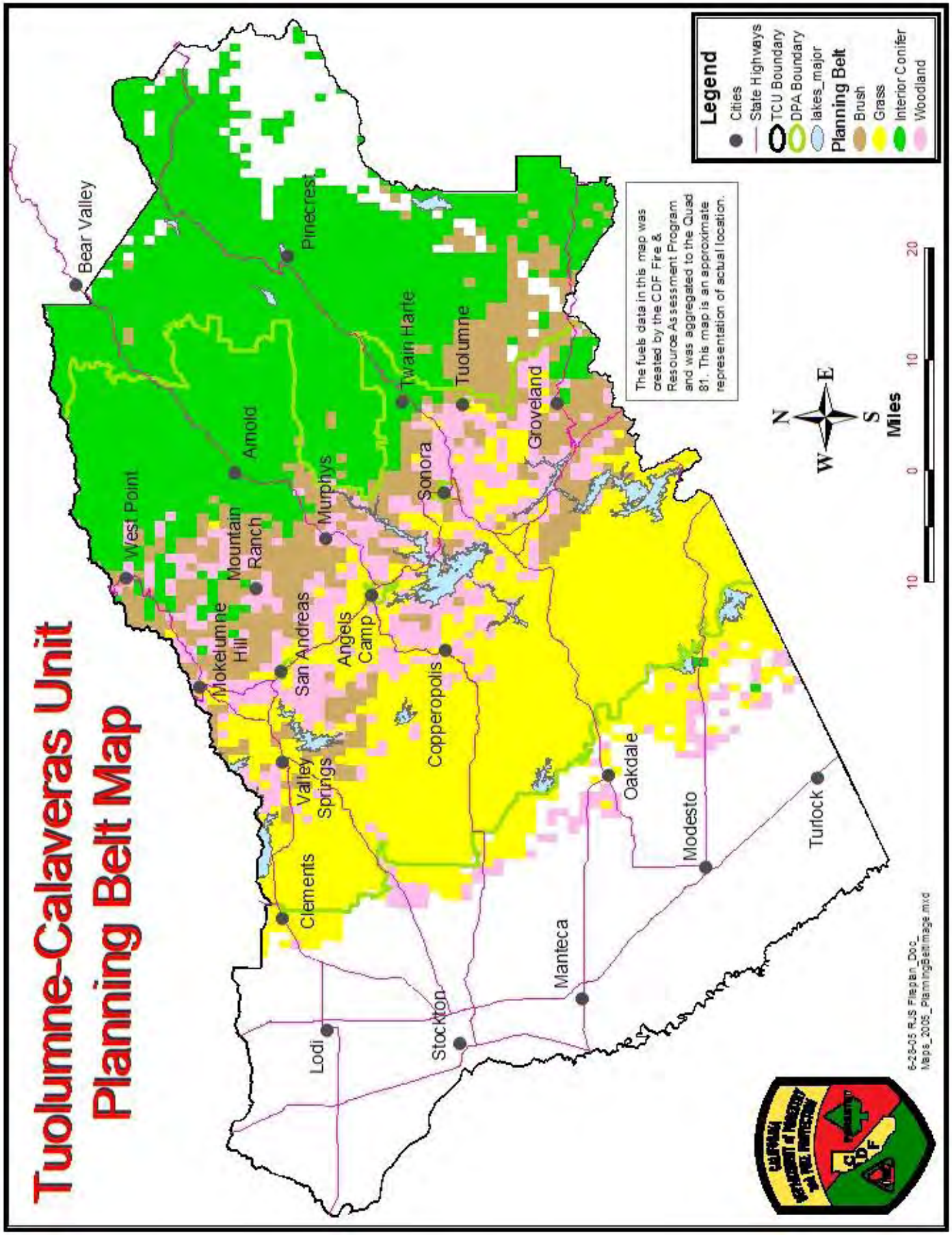

Figure 5: Planning Belt Map

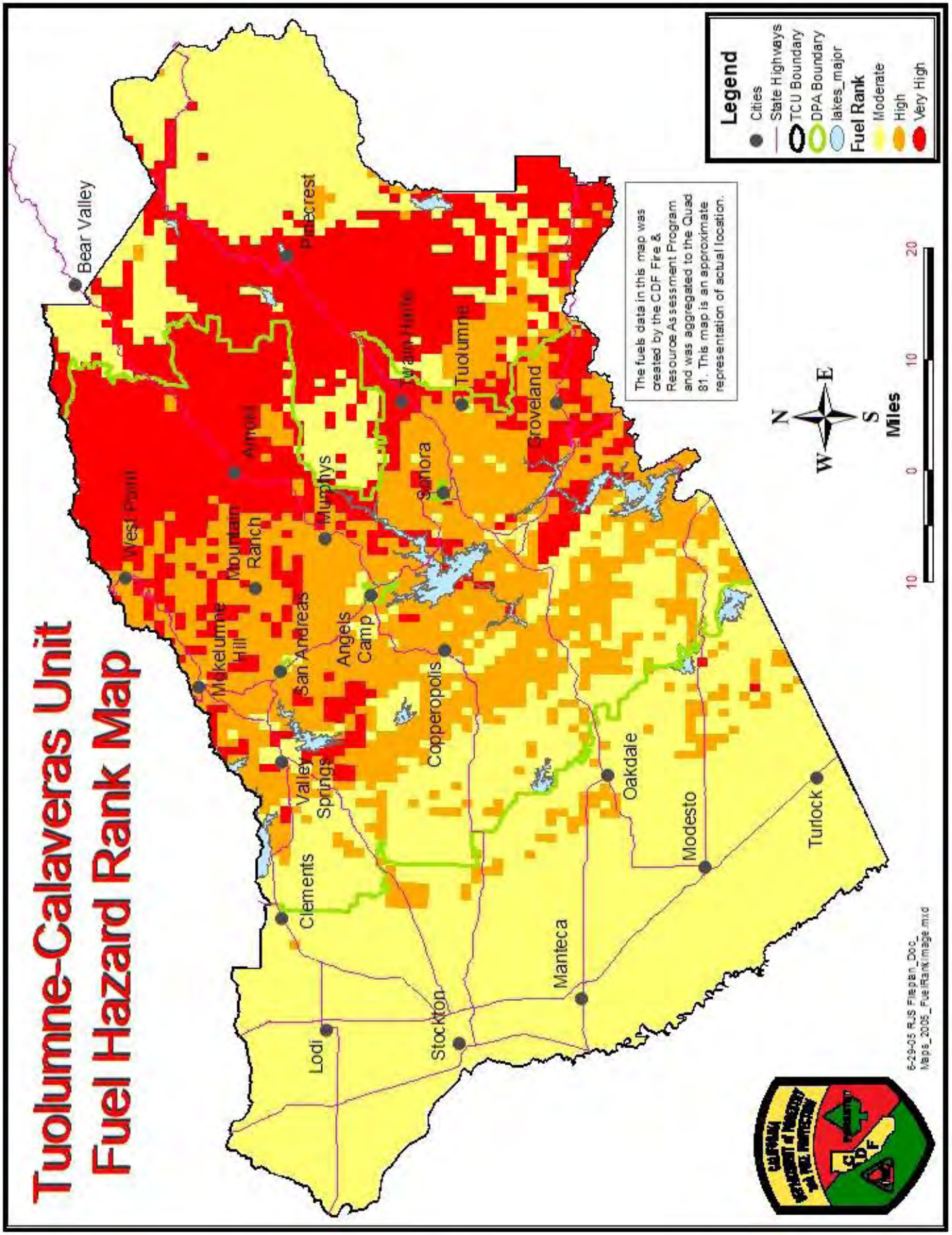

Figure 6: Fuel Hazard Rank Map

Weather

Fire weather is one of the most important factors to consider in a study of wildland fire history and potential for a given area. In the fire plan, past weather data will be used to calculate the Level of Service (LOS), assign a severe fire weather ranking to each quad 81st, and run the California Fire Economics Simulator, Version 2 (CFES2). In order to perform these operations, it will be necessary to gather past weather records from local weather stations that cover different areas within the Unit. Each quad 81st will be assigned a weather station from which data will be collected. Prior to 1991, the CDF Remote Automated Weather Stations (RAWS) maintained incomplete data due to malfunctions and other equipment problems. During this period and any other time that data is not available, the weather data will come from other weather stations that cover similar areas outside the Unit.

The weather data will be used in several ways in the fire plan analysis. In the LOS analysis, it is used to calculate the Burn Index (BI) and Energy Release Component (ERC) to determine the fire intensity for each fire ignition that occurred during the analysis period. From these components and other ignition information, the fire will be categorized as a successful or unsuccessful initial attack. This software will also calculate the severe fire weather rank (high, medium or low), for each quad 81st, based on the weather data, slope and other quad 81st attributes. In CFES2, the historic weather data will be used to project fire indices (BI, ERC, Rate of Spread (ROS)) to be used in simulating wildland fires in the future. This information will then be used to analyze how changes in fire suppression forces will affect the Unit's level of service.

Weather Station Coverage

Ten weather stations were used to provide weather coverage in the Tuolumne-Calaveras Unit. The Green Springs weather station covers the low elevation areas below 1000 feet. The Esperanza station covers from 1000 to 3500 feet in the north and central portions of the Unit. It also covers southern Tuolumne County between 1000 and 2000 feet in elevation. The Buck Meadows (USFS) station covers 2000 to 4800 feet in southern Tuolumne County. The West Point and Railroad Flat areas are covered by the Mount Zion station. Most of the Unit between the elevations of 3500 to 6000 feet is represented by weather data from Beaver (USFS) on the north end of the Unit and Mount Elizabeth (USFS) on the south. The Pinecrest station (USFS) covers areas between 5,000 to 6,000 feet in the east-central area of the Unit. The 6,000 to 7,200 foot elevation areas are covered by the Crane Flat (YNP) weather station. The White Wolf (YNP) services the elevations between 7,200 and 8,600 feet. The Tuolumne Meadows (USFS) weather station covers from 8,600 feet to just east of the Sierra crest.

Weather Rank

The process for deriving the weather rank is currently being reassessed and modified. This section will be added to the fire plan once a new method is developed and implemented.

Level of Service

A primary California Board of Forestry responsibility is set forth in Public Resources Code Section 4130, which dictates the following:

1. Directs the Board to classify all wildland within State Responsibility Areas (SRA) based on cover, beneficial water uses, probable erosion damage and fire risks and hazards.
2. Determine the intensity of protection to be given to each type of wildland.
3. Prepare a fire plan to assure adequate statewide fire protection so that lands of each type are assigned the same intensity of protection.

The Level of Service (LOS) analysis will assess how successful CDF has been in providing equal fire protection to similar lands across the state. In addition, it will show where this goal is not being achieved and improvement is needed. For the purposes of the LOS analysis, CDF is using planning belts to classify similar wildland areas throughout the state. The brush, grass, woodland and interior conifer (timber) planning belts exist and will be used to analyze the LOS within the Tuolumne/Calaveras Unit.

Software to perform the LOS analysis was developed by staff at CDF's Information Technology and Fire and Resource Assessment Program offices in Sacramento. This software measures CDF's effectiveness in controlling wildfires during the initial attack (IA) stage of a wildland fire, before unacceptable costs and losses occur. GIS data containing the location of each wildland fire ignition for a given period is examined by the software and each ignition is classified as being either a successful or unsuccessful IA. The ignition data is derived from the Emergency Activity Reporting System (EARS) database where all fire ignitions for CDF are collected and stored. Ignitions are assigned to a wildland area type based upon the planning belt in which they occurred.

The initial attack success or failure determination is made based on the fire size and intensity characteristics of each ignition. Fire size class cutoffs (based on acreage) for each planning belt were set so that if the fire size meets or exceeds the cutoff it would be classified as an unsuccessful initial attack. The fire intensity is calculated through an analysis of the fire weather which was present on the date of each ignition and planning belt existing at each ignition location. Two standard fire weather indices (energy release component or burn index) are determined based on this analysis. The fire size class and fire weather index are coupled for each planning belt and cutoff points are set to classify whether the initial attack forces were successful or not (see figure below). Fire weather data is obtained from archived weather report data files. For ignitions in which no

weather records are found (unmatched), only the size parameter is used to determine if the fire was an initial attack success or failure. The number of successful IA's is then divided by the total number of ignitions in each planning belt to determine the IA success rate for each planning belt.

Ignitions Workload Analysis Matrix

Unit: TCU

Planning Belt: G (grass)

FIRE SIZE

FWI

	Spot	Small	Medium	Large	Escape
LOW	455	138	37	7	3
MEDIUM	182	96	38	17	4
HIGH	27	7	2	0	0
UNMATCHED	45	20	2	2	2

Planning Belt ID: G (grass) Unit ID: TCU Refresh Matrix

Success:97 %

Fire Sizeclass Cutoffs for grass planning belt	FWI Index Intensity Cutoffs
Spot: Less than 1 acre(s)	Low: less than 15
Small: 1 - 10 acres	Medium: 15 - 30
Medium: 10 - 100 acres	High: greater than 30
Large: 100 - 500 acres	Unmatched: no weather observation available
Escape: greater than 500 acres	

Figure 7: LOS (Ignition Workload) analysis for the grass planning belt in TCU.

During the 1994-2004 period, TCU had 3,825 ignitions, of which 3,657 (95%) were contained within the initial attack stage of the fire as determined by the fire plan analysis. The 168 initial attack failures that were experienced during this period occurred within 157 quad 81st's. That means that some quad 81st's experienced more than one failure.

The ignition and LOS analysis were performed on ignition data for the 1994 to 2004 period. The number of ignitions, unsuccessful initial attacks, successful initial attacks and LOS score for each planning belt in TCU for this period are listed in the table below.

Table 2: TCU LOS by Planning Belt

Planning Belt	# of Ignitions	# of Unsuccessful Initial Attacks	# of Successful Initial Attacks	LOS %
Brush	258	13	245	95
Grass	1084	32	1052	97
Interior Conifer	1991	100	1891	95
Woodland	406	15	391	96
Non-Classified	86	8	78	91
Total	3825	168	3657	95

Table 2 shows the Level of Service for each planning belt, as a whole, in TCU. The TCU Level of Service Map (Figure 8) is color-coded based on the LOS score that each quad 81st received. This map shows the percentage of initial attacks that were successful based on the total number of ignitions that occurred in each quad 81st. The Ignition Density Map (Figure 9) shows the number of wildland fire ignitions occurring in each quad 81st for the 1994-2004 period. The Ignition Failure Map (Figure 10) shows where the unsuccessful initial attacks occurred in the Unit.

An analysis of the Ignition Density Map shows that the Highway 108 corridor and the Valley Springs area had the most ignitions. Areas in the Unit where there are recreation areas or a higher population density also experienced more ignitions. The remainder of the Unit is scattered with ignitions that occurred less often than the areas noted above.

During the 1994-2004 period, the largest number of unsuccessful initial attacks occurred in the San Andreas vicinity. Other areas where unsuccessful initial attacks occurred are scattered throughout the Unit.

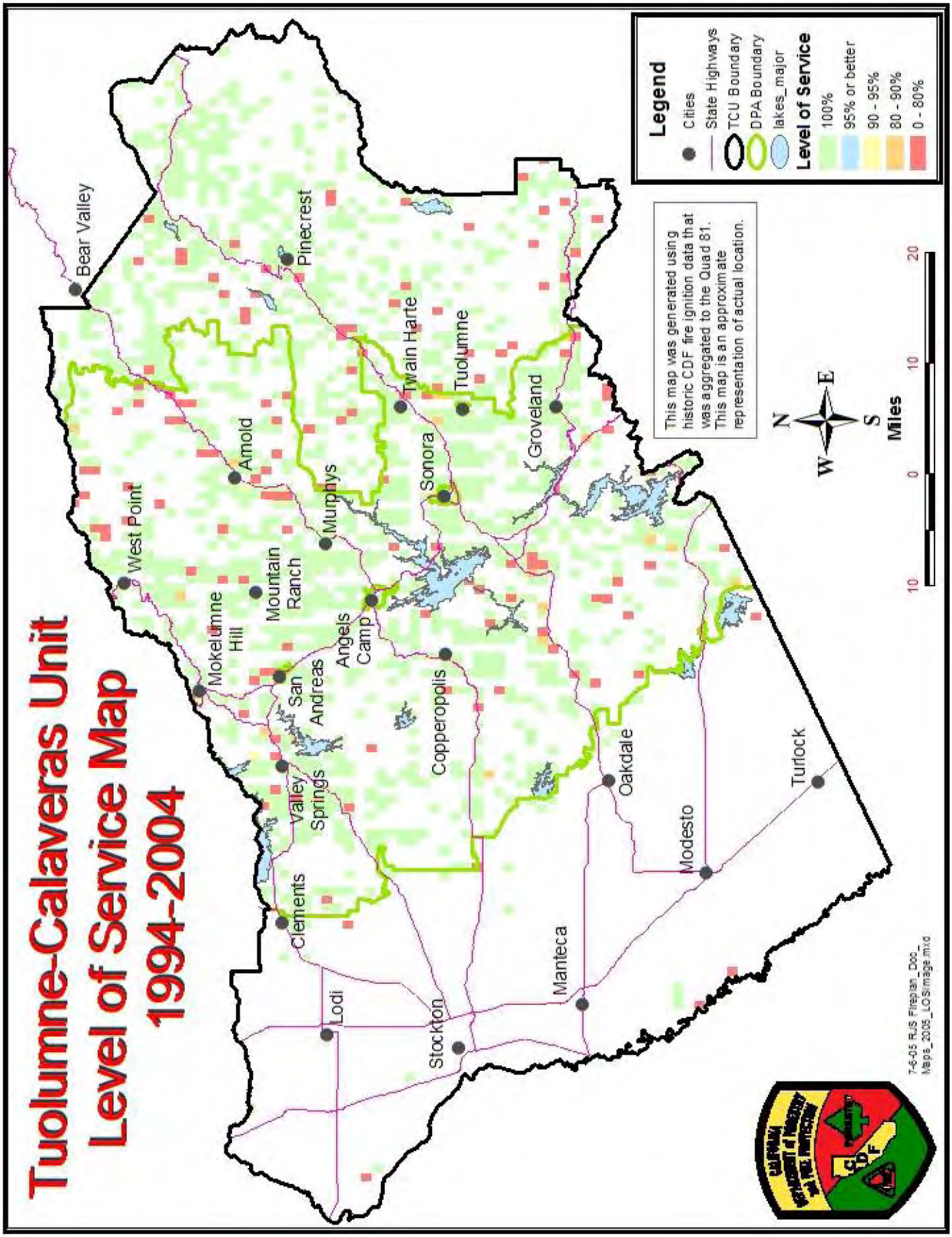

Figure 8: TCU Level of Service Map

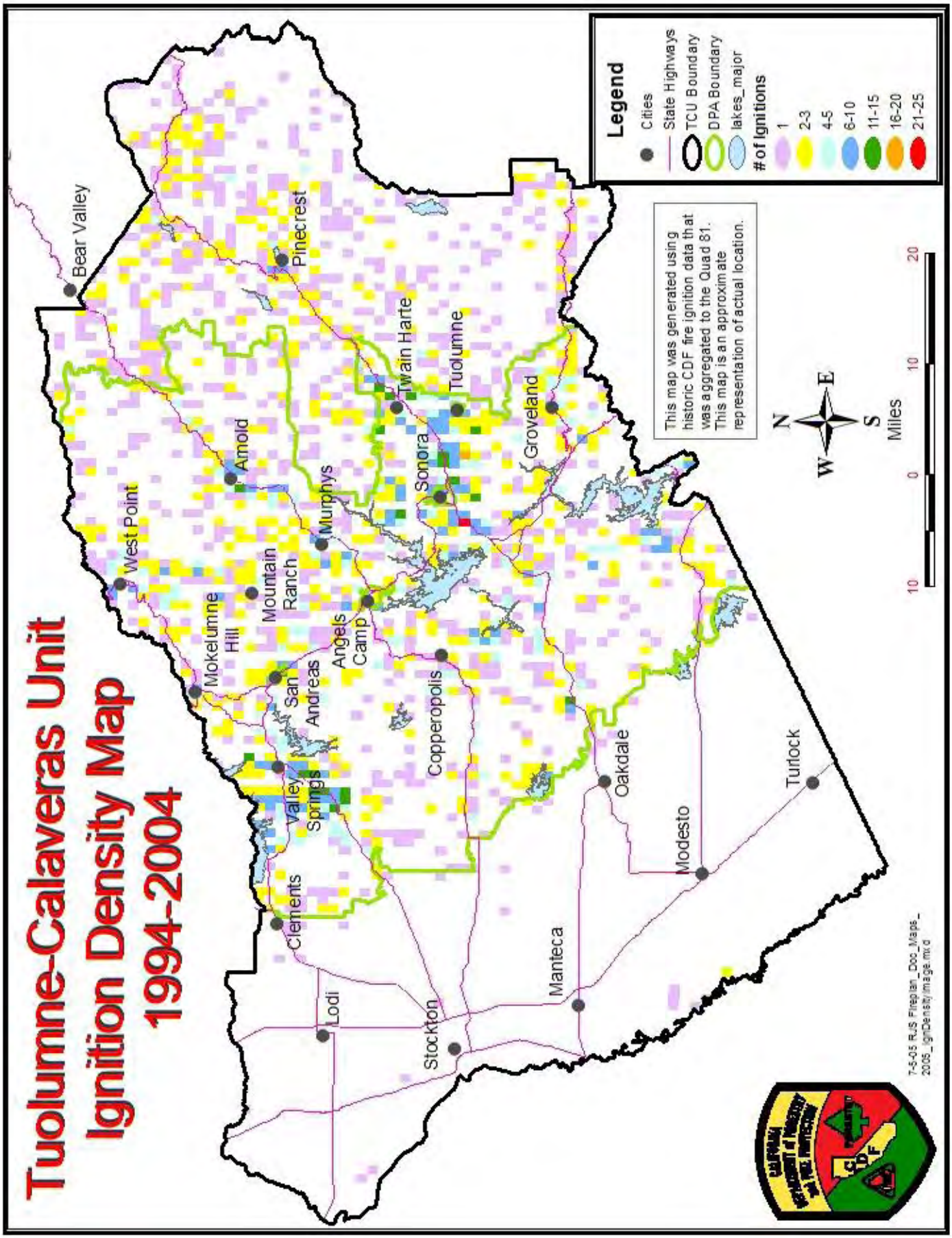

Figure 9: TCU Ignition Density Map

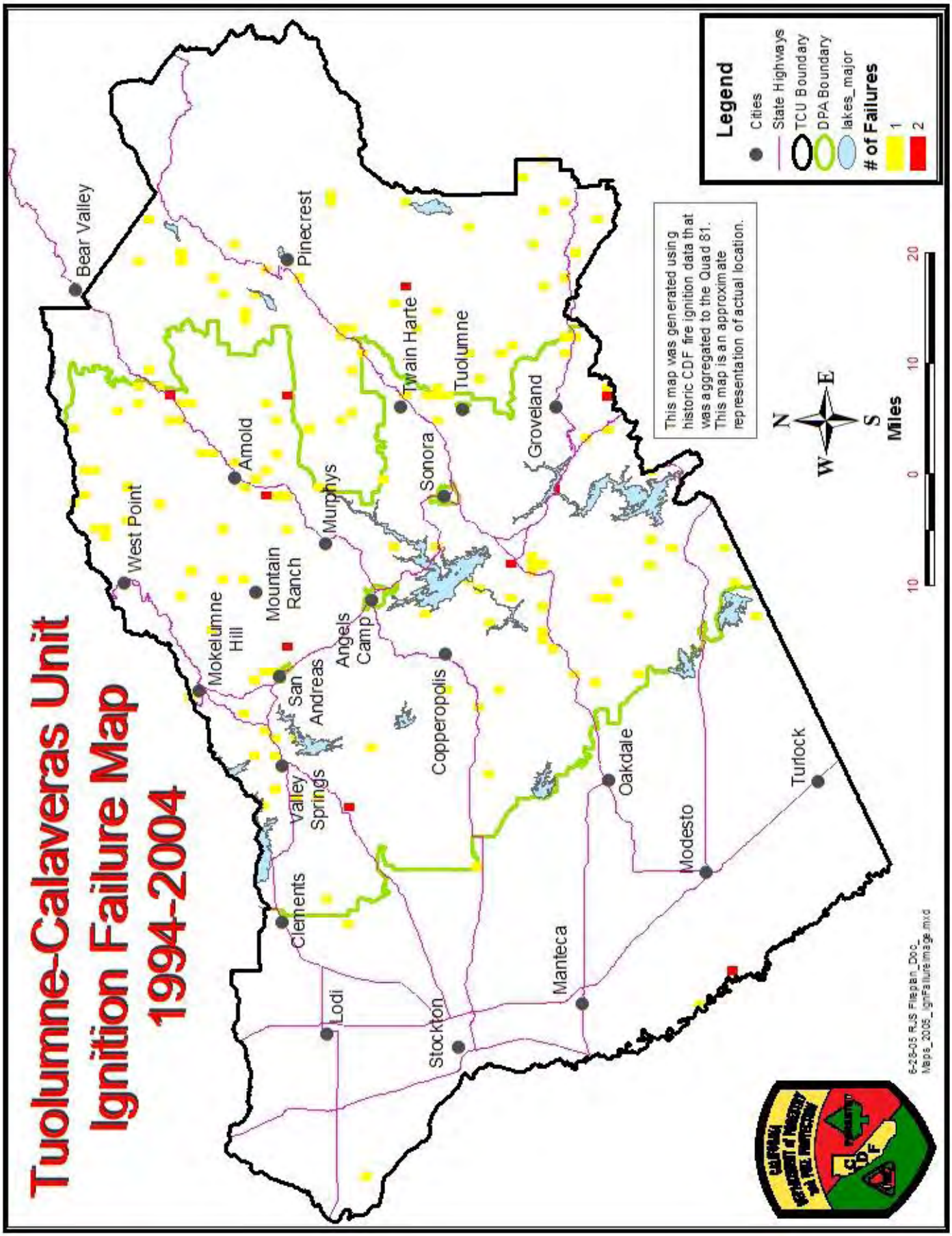

Figure 10: TCU Ignition Failure Map

Assets at Risk

The Tuolumne-Calaveras Unit has a multitude of natural and manmade values (assets) that are at risk when major wildfires occur. Fires can wreak havoc not only on commercial values, but also on nature in general by destroying fragile habitat and threatening rare and endangered species. Commercial and residential property is destroyed by wildfires within the Unit each year. Water, telephone and power utility companies have lost millions of dollars through both the direct and indirect effects of forest fires. Wildfires also cause damage to scenic and aesthetic values in rural areas.

Water and Power

The watershed areas are of particular concern since they affect so many other assets. Water, power, recreation and fisheries are just a few of the values associated with the Unit's watershed areas. Soil erosion is a major contributor to damage and degradation of our watersheds and their associated water storage and power generating facilities.

Over 48 water providers and users divert, store or transport water from the watersheds that lie within the Tuolumne-Calaveras Unit. This water is used for domestic, commercial and agricultural purposes in the Unit, Central Valley, and greater San Francisco Bay Area. Millions of people benefit from this great resource.

Many of the local water utility companies still depend on ditches and flumes to transport water to their treatment facilities. Some of the flumes have been damaged directly by past fires or indirectly by erosion of the steep slopes where they exist. Redwood water tanks are still in use in some areas of the Unit. One of these wooden tanks was so severely damaged during the 2004 Pattison Fire that it was necessary to replace the tank.

There are nine utility companies that generate hydroelectric power in the Unit. Over 5.1 million megawatts of electricity are produced each year by the 30 power plants owned by these companies. In the past, wildland fires have caused major damage to both the watersheds where power plants exist and the power line system used to distribute the electricity.

Structures

The most sacred of all possessions is a person's home or business. These are threatened almost every time a wildfire burns. Within the Unit, high concentrations of residential and commercial structures exist primarily in the communities along the Highway 4, 12, 26, 49 and 108 corridors. Outside of these areas, there are several other communities and subdivisions that have a high structure density including: Groveland, Tuolumne City and Lake Don Pedro in Tuolumne County; and West Point, Mountain Ranch and Railroad

Flat in Calaveras County. The remainder of the structures outside of these concentrated areas are primarily scattered on large acreage parcels.

Through the National Fire Plan, the Communities at Risk list was developed to identify communities that were at risk from the threat of wildfires. The official California Communities at Risk list includes 34 communities in Calaveras County and 28 in Tuolumne (Tables 1 & 2). The lists do not include the name of every small community or subdivision. Some of the communities listed cover general areas that encompass what the general public would assume to be several separate communities. Others were named based on their old town site name, not the current subdivision or commonly known name. The federal and state wildland fire control agencies are currently developing a process to add new communities to the official list. Once this is established, communities will be added if they meet the specified criteria.

Table 3: Calaveras County Communities at Risk list

Altaville	Cottage Springs	Paloma
Angels Camp	Dorrington	Rail Road Flat
Arnold	Douglas Flat	San Andreas
Avery	Forest Meadows	Sandy Gulch
Big Meadow	Ganns	Sheep Ranch
Big Trees	Glencoe	Sky High
Burson	Hathaway Pines	Vallecito
Calaveritas	Jenny Lind	Valley Springs
Camp Connell	Milton	West Point
Campo Seco	Mokelumne Hill	Wilseyville
Clements	Mountain Ranch	
Copperopolis	Murphys	

Table 4: Tuolumne County Communities at Risk list

Arastraville	Harden Flat	Sierra Village No.1
Bumblebee	Jamestown	Sonora
Chinese Camp	Jupiter	Soulsbyville
Cold Springs	Kennedy Meadow	Standard
Columbia	Long Barn	Stent
Confidence	Mather	Tuolumne City
Cow Creek	Mi-Wuk Village	Tuttletown
Dardanelle	Moccasin	Twain Harte
East Sonora	Mono Vista	
Groveland-Big Oak Flat	Phoenix Lake-Cedar Ridge	

Timber

Approximately 920,000 acres of commercial timberland exist within the Unit. It is estimated that 58% of these timberlands have a high site index, which leads to increased timber stand productivity. The largest private commercial timberland owner is Sierra

Pacific Industries (~140,000 acres). In addition to the SPI timberland, many small landowners own commercial timberland. The USFS is the largest government owner of timberland in the Unit (over 600,000 acres).

Recreation and Scenic

Recreation is a major industry in the Unit. Camping, hunting, fishing, boating, wine tasting and many other leisure activities account for a large percentage of the revenue generated in this area. Wildfires may influence these activities in several ways. First, they may destroy the recreational facilities and the surrounding forest vegetation. Second, these facilities may be temporarily closed while fires are actively burning in and around these areas. Third, once a fire burns in an area, the public's once positive perception of the area may be slighted.

The four major east-west highways, especially Highways 4, 108 and 120, are the gateways to recreational areas in the upper elevations in the Unit. The area east of West Point in the Highway 26 corridor is primarily used for hunting and fishing. The Highway 4 corridor provides access to numerous communities with summer homes, Big Trees State Park, Bear Valley, Spicer Meadow Reservoir, Lake Alpine and many other frequently visited sites in the Ebbetts Pass area. Although Bear Valley is home of the Bear Valley Mountain Resort, a winter recreation area, many summer events occur in the area including the Bear Valley Music Festival. The Highway 108 corridor contains numerous summer home areas and a variety of both summer and winter recreational opportunities. Highway 120 is one of the major access points to Yosemite National Park. Wildfires that burn anywhere on these highway corridors result in both short and long term effects to the recreational industry for the same three reasons noted above.

The Sierra Nevada foothills offer the public unsurpassed scenic landscapes that people from all over the world come to visit. Portions of State Highways 4 and 89 are designated as scenic highways. A large area of Calaveras County is in the viewshed of State Highway 88, which is a scenic highway in Amador County. Highway 120 leads to the north entrance of Yosemite National Park and provides a substantial viewshed east of Groveland.

Air Quality

The Tuolumne-Calaveras Unit has portions of the San Joaquin Valley and Mountain Counties Air Basins within its boundaries. The Mountain Counties Air Basin makes up 81% of the CDF DPA area.

During fire season, prevailing southwest, west and northwest winds tend to blow the smog generated in the valley into the Mountain Counties Air Basin. Smoke generated from wildfires that occur in the Unit adds to the already stagnant air conditions. Low inversion layers reduce the air quality further by trapping the smoke closer to the ground.

Prescribed burn projects minimize the negative effects that wildfires have on the air quality. Prescribed burning is performed when the weather conditions will allow quick dispersal of the smoke generated by the burn. These burns are aimed at reducing the amount of heavy brush and dense forest fuels. The lighter fuels that exist after a prescribed burn produce considerably less smoke when burned by a wildfire.

Historic Buildings

Since the Tuolumne-Calaveras Unit lies within the Gold Country, many historic structures exist in all areas of the Unit. High concentrations of historic buildings exist in the communities of Sonora, Columbia, Jamestown, Angels Camp, Murphys, San Andreas and Mokelumne Hill. Outside of these communities, individual or small groups of historic structures are located throughout the Unit. A survey was performed to determine which of these structures might be threatened by wildfires.

Wildlife

Most of the Unit consists of forest, brush and grass covered lands, which provide excellent habitat for both game and non-game wildlife. Many wildfires burn at such a high intensity that they affect wildlife by damaging or destroying their fragile habitat. Wildlife habitat can benefit greatly and many of the harmful effects of wildfires can be mitigated through the use of prescribed fire.

The California Natural Diversity Database will be used to locate critical habitats in high fire hazard areas within the Unit. When projects are developed in these areas, consultations will occur with the Department of Fish and Game (DFG) and mitigation measures will be used to protect and enhance any critical habitats that are found.

Infrastructure

Infrastructure includes transportation and communications systems, water and power lines, and public institutions. Water, power and structures are addressed in other asset descriptions in this document. Most of the transportation systems in the Unit are not directly affected physically by wildfires. Indirect effects influence them more through the erosion that may occur on steeper slopes following a fire.

Communications systems in are the focus of the infrastructure assets at risk analysis. Communications vaults and various types of antennas exist in remote locations throughout the Unit, usually on mountaintops. Because of their location and the heavy forest fuels that may surround them, wildfires threaten many of these facilities on a regular basis. The locations of radio, television, microwave and cellular telephone antennas will be noted in this analysis.

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