A STRATEGY TO UTILIZE BIOMASS GENERATED FROM FOREST TREATMENTS IN THE LAKE TAHOE BASIN

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF TABLES

APPENDIX A

LIST OF ABBREVIATIONS

ARRA	American Recovery and Reinvestment Act
BCAP	Biomass Crop Assistance Program
CWPP	Community Wildfire Protection Plan
GIS	Geographic Information System
GT	Green Ton(s)
LTB	Lake Tahoe Basin
LTBMU	Lake Tahoe Basin Management Unit
MACC	Multiple Agency Coordinating Committee
RPS	Renewable Portfolio Standard
SEZ	Stream Environment Zone
SNPLM A	Southern Nevada Public Land Management Act
TFFT	Tahoe Fire and Fuels Team
USDA	United States Department of Agriculture
WUI	Wildland Urban Interface

EXECUTIVE SUMMARY

Forested landscapes in the Lake Tahoe Basin are at serious risk of catastrophic wildfire events. To address this risk, the Tahoe Fire and Fuels Team (TFFT) formed in February of 2008. The TFFT is a partnership between local fire protection agencies, state and federal land management agencies, and private land owners to facilitate forest treatments throughout the Lake Tahoe Basin (LTB). The TFFT primarily focuses on fuels treatment conducted by the fire protection agencies, which are coordinated with forest treatments conducted by state and federal agencies, who are also members of the TFFT. Significant progress has been made over the past ten years to treat unnaturally high accumulations of hazardous forest fuels. A Biomass Working Group composed of members from the TFFT was formed to inform the development of a biomass strategy for optimizing the collection and use of woody biomass generated as a byproduct of forest thinning and fuel reduction treatment activities in the LTB. This biomass strategy is intended to compliment the Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy (Fuels Strategy) that was completed in December of 2007.

Of the approximately 93,300 acres identified in the draft extended wildland-urban interface (WUI) map (recently revised by US Forest Service Lake Tahoe Basin Management Unit for the Fuels Strategy) and targeted for fuels treatments, approximately 26,400 acres are currently limited to pile burning due to a combination of slope and access constraints; approximately 17,400 acres are available for hand-thinning with the potential for biomass removal; and approximately 42,600 acres are available for mechanical treatment with the potential for biomass removal. The majority of acres available for hand thinning with the potential for biomass removal are privately owned, where as the majority of acres available for mechanical treatment are publicly owned.

Between the years 2000 through 2009, the TFFT treated an average of 4,000 acres per year for fuels reduction. The TFFT is planning to treat an average of approximately 6,600 acres per year between 2010 and 2014. Of this acreage, 60% are planned for hand thinning followed by pile burning, and 31% (approximately 2,100 acres per year) are planned for hand thinning followed by chipping or mechanical treatments. Between 29,000 and 53,000 green tons of potentially recoverable biomass material could be generated from these treatments annually.

Current value-added markets for biomass material include use in thermal and electrical energy generation facilities, use by facilities that generate landscape materials such as compost and mulch, use as firewood, creation of composite panels and use in soil restoration activities. While these markets have the capacity to utilize the 53,000 green tons potentially recoverable from the LTB fuels reduction efforts, these markets range from 30 to 135 miles away from the fuels treatment activities. Transporting the green biomass to these markets would add significant costs to the fuels reduction efforts. Emerging markets include a planned biomass to energy facility in or near the LTB, as well the use of forest products in construction of composite decking products.

The Biomass Working Group reviewed and discussed current barriers to the successful collection, processing and transport of biomass material to value-added markets. The top five barriers include:

- *High Transportation Costs to Value Added Markets:* Transportation costs are typically the most significant expense when conducting biomass collection and removal operations. Diesel fuel prices continue to fluctuate (typically upward) creating conditions that add uncertainty. Current transport costs average $70 to $90 per hour for a commercial truck and trailer. Transport costs can add an additional $8 to $10 per ton (assuming a 50 mile one way haul distance) or $200 to $350 per acre (assuming 25 tons per acre recovery) to the cost of fuels treatment.
- *Lack of a Sustained Budget to Support Biomass Removal Activities:* Very few agencies have developed options for sustained funding of biomass removal operations. Currently, these operations are subsidized by grants for conducting fuels treatment, the availability of which will be greatly reduced in the future.
- *Low Market Value for Biomass Material:* Market prices for biomass material are dependent upon externalities such as the value of renewable electrical power, housing starts, and the general state of the regional economy.
- *High Cost of Biomass Removal:* Current policies prohibit the use of equipment in many areas (steep slopes, near houses, in SEZs). The use of hand crews necessitated by these policies results in a high cost of biomass removal, due to high labor costs and the fact the biomass must be handled several times.
- *Negative Public Perception:* Some stakeholders believe that developing a commercial use of biomass will result in the industry dictating resource management decisions to ensure long term sustainability of the business.

A recommended strategy to address these barriers and thereby increase the biomass material removed from the site of forest treatment projects include:

- *Reducing Transportation Costs to Move Biomass Material to Value-Added Markets.* This includes:
  - Supporting market-based solutions for local value added biomass utilization that will reduce transportation costs including:
    - Finding private sector parties interested in the purchase and operation of the Northern Nevada Correctional Center biomass facility in Carson City, Nevada,
    - Encouraging innovative value-added uses for biomass material including expanding local markets for soil restoration/soil amendments within the LTB and the development of mobile processing technology including torrefaction-based technologies, and
    - Support construction of a biomass co-generation facility within or near the LTB.
  - Exploring the feasibility of locating facilities throughout the basin to dry and pre-process the biomass, thereby reducing the volume and weight of the material and thus reducing subsequent transportation costs.

- *Securing consistent funding to support biomass removal activities.* This includes:
  - Encouraging coordination between agencies removing the biomass and value-added utilization enterprises, including long-term contracts (e.g. stewardship contracts), and
  - Pursuing options for long term funding, including state and federal grants and/or local tax initiatives to support forest treatment activities.
- *Pursuing options to increase the market value for biomass material.* This includes:
  - Reflecting the actual costs of wholesale power rates for renewable energy associated with renewable energy generation, rather than tying the cost to externalities such as natural gas prices, and including the societal benefits of renewable energy, and
  - Supporting alternative uses for biomass material such as use in soil restoration activities and soil amendments.
- *Reducing the high cost of biomass removal.* This includes:
  - Changing policies which do not allow mechanized equipment on certain land types to reflect improvements in technology supported by field or pilot studies,
  - Changing fuel treatment operations to combine biomass removal with initial treatment to reduce the number of times the biomass material is handled,
  - Encouraging the creative use of mechanical methods by supporting pilot studies to demonstrate compatibility with environmental standards (such as exploring the use of mechanical treatment on smaller lots, on steeper slopes, and in SEZs) along with appropriate monitoring,
  - Assembling a technology assessment and review panel to monitor and assess effectiveness and practicality of emerging collection, processing and transport technologies, and
  - Expanding the use of long-term contracts (such as stewardship contracts) to provide stability to fuels treatment contractors and encourage the investment in innovative equipment.
- *Reducing Negative Public Perception.* This includes:
  - Sharing lessons learned and innovative fuels treatment techniques with all stakeholders.

INTRODUCTION

Forested landscapes in the Lake Tahoe Basin (LTB) are at serious risk to catastrophic wildfire events. Recent fire history (2007 Angora Fire) confirms how devastating a wildfire event can be within the LTB. To address this risk, the Tahoe Fire and Fuels Team (TFFT) formed in February of 2008. The TFFT is a partnership between local fire protection agencies, state and federal land management agencies, and private land owners to facilitate forest and fuels treatment throughout the Basin. The TFFT primarily focuses on fuels treatment conducted by the fire protection agencies, which are coordinated with forest treatments conducted by state and federal agencies, who are also members of the TFFT.

Significant progress has been made over the past ten years by the fire departments, fire protection districts, state and federal land management agencies, and private land owners to treat unnaturally high accumulations of hazardous forest fuels. Large quantities of woody biomass material (small trees, brush, limbs) are generated as a byproduct of forest thinning and fuels reduction treatment activities. A common and relatively cost effective method of biomass material disposal has been piling and burning of this material. Unfortunately there are consequences with the implementation of this technique, including air emissions in the form of particulate matter (PM), carbon monoxide (CO), volatile organic compounds (VOC), carbon dioxide (CO2), nitrogen oxides (NOx), and methane. Not only are these air pollution emissions having an impact on human health, but they also contribute to climate change, particularly methane, which is a potent greenhouse gas (GHG). Other methods of disposing of the biomass material include chipping and scattering the material onsite, chipping and removing the biomass for subsequent disposal or utilization, or the use mechanical treatment techniques which provide for simultaneous treatment and biomass removal. Each of these methods have associated advantages and disadvantages, which are discussed further in this document.

This biomass strategy was developed to assist agencies operating in the LTB in optimizing collection and utilization of woody biomass generated as a byproduct of forest thinning and fuels reduction treatment activities in the region. Issues regarding air quality and regional haze generated as a result of open burning of woody biomass material are a major concern to the residents of the LTB. Alternative collection and utilization options will help minimize the need to dispose of excess biomass material using open burn or chip and scatter techniques. Collection and utilization of woody biomass material for value-added products may also help to offset some of the treatment costs associated with hazardous fuels reduction projects.

BENEFITS OF BIOMASS UTILIZATION

Utilization of woody biomass material from fuels treatment activities presents a number of opportunities and benefits. Summarized below are societal benefits associated with biomass collection and utilization:

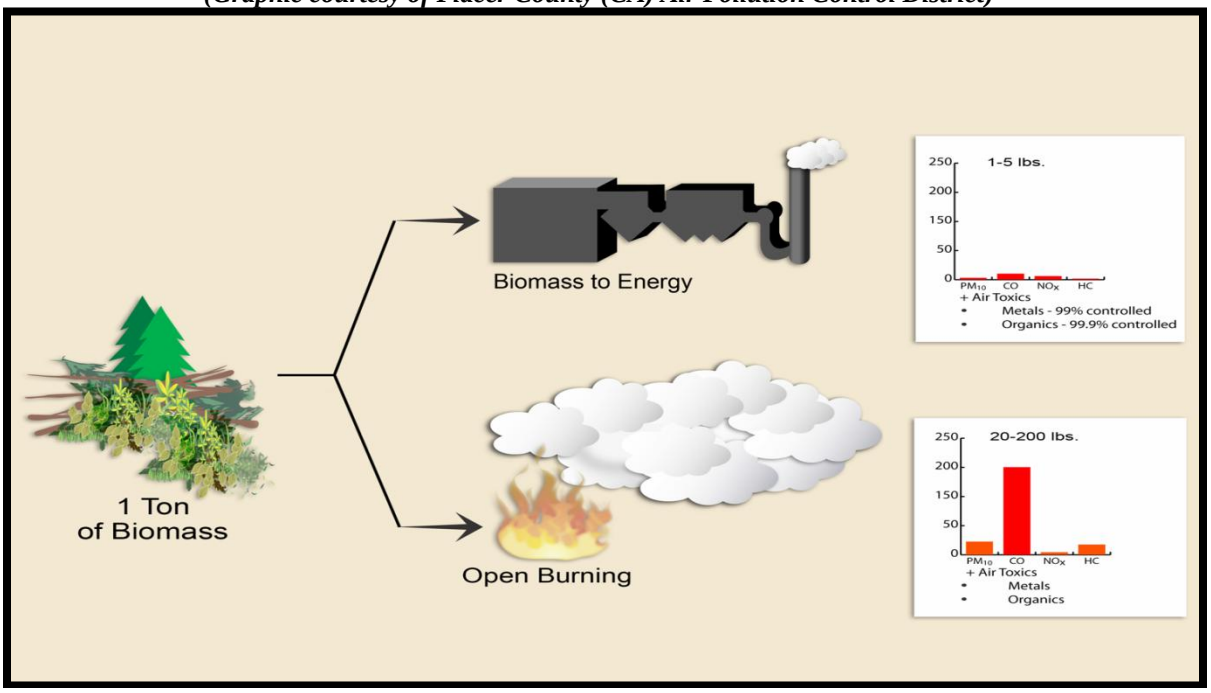
- **Improved Air Quality:** Diversion of woody biomass that would normally be burned in the open will have a net positive impact on local and regional air sheds. Reduction of regional haze will improve viewsheds and recreational experiences. Figure 1 compares controlled and uncontrolled emissions from the combustion of biomass at a biomass to energy facility and when open burned.

Note that uncontrolled combustion produces 20 to 200 pounds of air pollutants per ton of biomass combusted while controlled combustion produces 1 to 5 pounds of air pollutants per ton of biomass combusted.

- **Renewable Power Generation:** Diversion of biomass for use as fuel to generate renewable electrical power helps both Nevada and California meet their respective Renewable Portfolio Standards (RPS). The State of California's RPS mandates that investor owned utilities make up 20% of their retail power sales with renewable generation technologies by 2010. California's legislature is currently considering ramping up the RPS to 33% by 2020. The state of Nevada's RPS mandates 25% renewable generation by 2025.

Figure 1. Biomass Combustion Air Emissions – Biomass to Energy Utilization Compared to Open Burning.

(Graphic courtesy of Placer County (CA) Air Pollution Control District)



- **New Employment Opportunities:** Woody biomass material must be collected, processed and transported if recovered and removed for value-added uses. Each one of these steps requires staff and equipment. Full time employment opportunities in this sector are typically family wage jobs due to the relatively skilled staff required to operate specialized equipment. In the case of biomass utilization for renewable power generation, a 1999 study[1] conducted on behalf of the National Renewable Energy Laboratory found that 4.9 jobs were created for every MW of biomass power generation capacity.

- **Carbon Emissions Benefit:** As mentioned above, utilization of woody biomass that in many cases would have been burned in the open with no air emissions control will significantly reduce the production of air pollutants including PM,

[1] Morris, G. (1999). Value of the Benefits of U.S. Biomass Power. NREL Report No. SR-570-27541.

CO, VOCs, and NOx. Greenhouse gases will also be reduced through elimination of methane gas emissions associated with disposal through open burning, landfilling, or left in place to decay. If the woody biomass is utilized in an energy conversion facility, the biomass energy is considered "carbon neutral" when harvested in a sustainable manner, offsetting of fossil fuel use in a power plant by biomass use will result in additional reduction of GHGs. This offset would further California's effort in reducing GHG, as required under Assembly Bill 32. These GHG benefits far outweigh GHG emission increases from additional fossil fuel combustion needed for biomass processing and transport. Alternatively, biomass used for wood products provides significant GHG benefits through displacement of energy intensive materials such as cement and steel.

- **Reduced Landfill Diversions:** Keeping woody biomass material out of landfills helps to extend the useful service life of active landfills and serves to mitigate or delay the need for development of new landfills.
- **Potential Partial Offset of Treatment Cost:** Fuels treatment activities are expensive (ranging from $200 to $10,000 per acre) in the LTB and these costs could be partially offset with revenue generated from the sale of biomass material.

STRATEGY OBJECTIVES

This biomass strategy is designed to be iterative, documenting past treatment accomplishments as well as forecasting treatment initiatives for the next five years. Presented in executive summary format, this document provides policy makers, stakeholders and on-the-ground practitioners with a global view of the LTB treatment efforts. In addition, it serves to summarize estimated volumes of woody biomass material that are potentially available over time from treatment activities in the LTB region.

In recent years a number of studies and planning documents have been issued that address the need to treat and remove hazardous forest fuels in the LTB region. This biomass strategy provides projections for biomass collection and utilization goals with specific metrics (e.g., acres treated, tons removed) arrayed over a five year planning horizon. These goals were developed with significant input from the multiple agencies and related organizations that are active in the LTB.

KEY PARTICIPATING AGENCIES

A number of agencies are actively involved in the planning and implementation of fuels treatment activities within the LTB. Listed below in Table 1 are the key agencies that actively manage fuels treatment activities and participated as part of the Biomass Work Group in providing input to this strategic plan.

The Biomass Working Group met over the span of several months during the winter and spring of 2010. It was critical that key land management agencies and fire districts/departments provide direct input so that a realistic framework with accomplishments and projections could be crafted.

Table 1. Biomass Working Group.

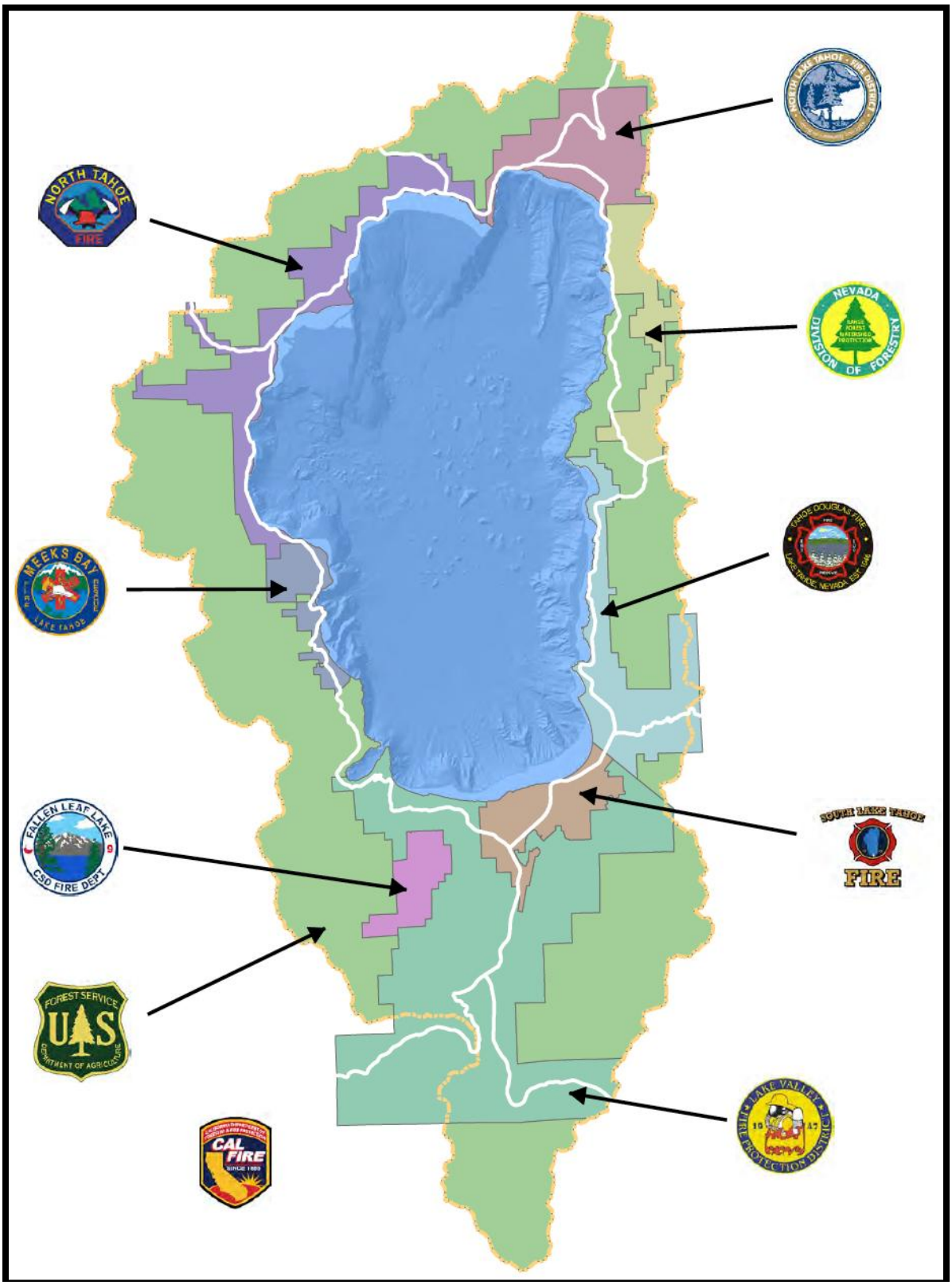
TFFT AGENCIES AND ORGANIZATIONS
Nevada Fire Safe Council
Tahoe Regional Planning Agency
California Department of Forestry and Fire Protection
USDA Forest Service – Lake Tahoe Basin Management Unit
California Tahoe Conservancy
Nevada Division of Forestry
California State Parks and Recreation
Nevada Division of Lands
Tahoe Douglas Fire Protection District
South Lake Tahoe Fire Department
Lake Valley Fire Protection District
Fallen Leaf Lake Fire Department
North Lake Tahoe Fire Protection District
North Tahoe Fire Protection District
Meeks Bay Fire Protection District
ADDITONAL WORKING GROUP MEMBERS
Nevada Tahoe Conservation District
El Dorado County
Placer County

The Biomass Work Group provided current information regarding fuels treatment activities underway in the LTB. Items covered over the span of two Biomass Work Group meetings included:

- Identify agencies that should weigh in on the biomass strategy.
- Review past fuels treatment accomplishments.
- Confirmation of the location and scale of planned fuels treatment activities.
- Review treatment/removal methodologies available.
- Confirm current utilization options and costs.
- Discuss lessons learned from past fuels treatment projects.
- Generate a decision matrix that addresses disposal/utilization options.
- Review and rank barriers to collection and utilization of biomass material.
- Generate five-year forecast of planned fuels treatment activities.

Most of the organizations that make up the Biomass Work Group are not only managing fuels treatment activities, but they are also providing fire response services. Figure 2 highlights the fire response agencies and their respective jurisdictions.

Figure 2. Lake Tahoe Basin Fire Response Agency Map.



RECENT LITERATURE

During the past decade a number of reports and papers have been issued that address fuels treatment activities in the LTB. These documents provide background and analysis of fuels treatment efforts in the region and were helpful in providing context for this planning effort.

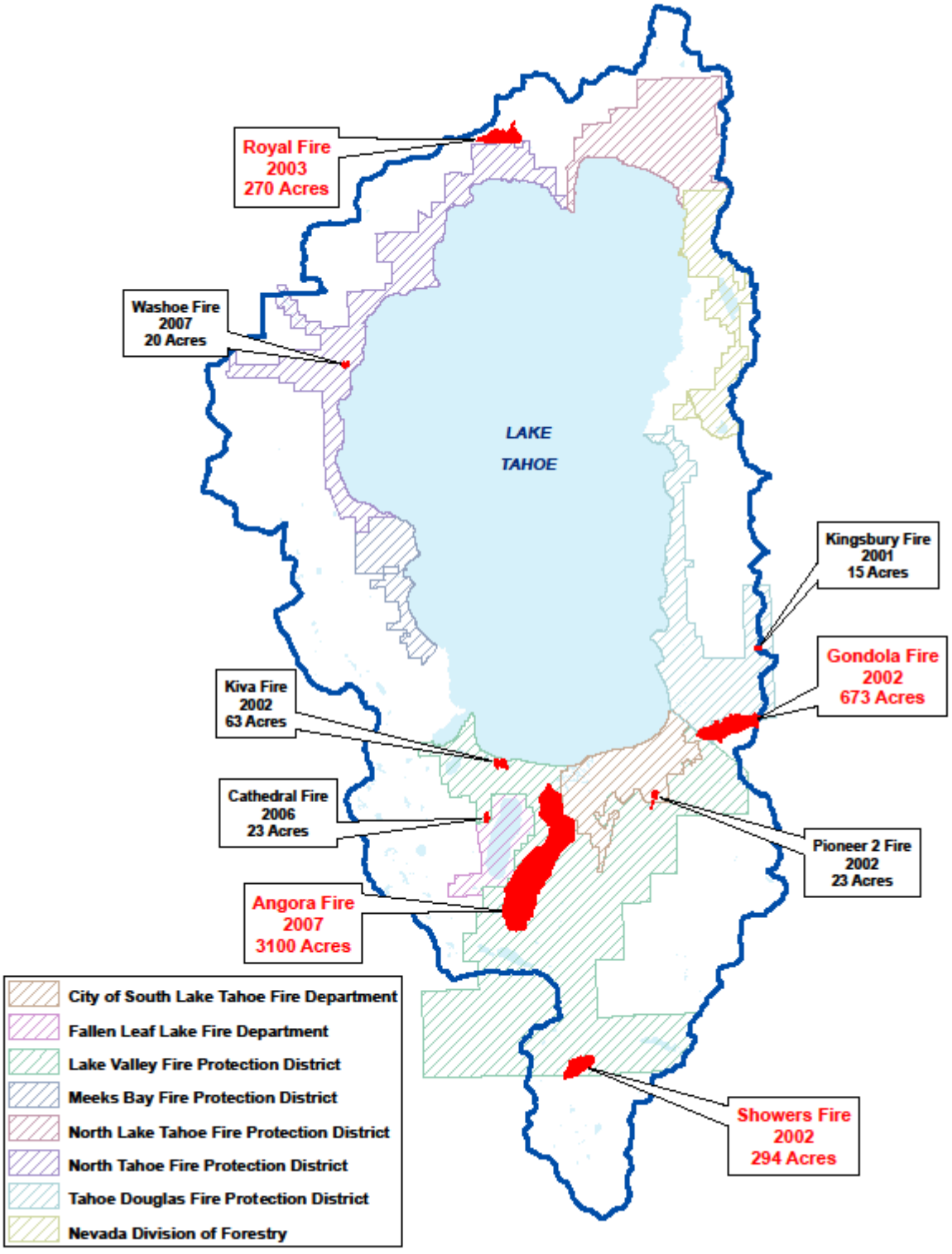
In particular, the following reports and papers proved helpful:

- Biomass Energy Opportunities in and Around the Lake Tahoe Basin; McNeil Technologies, August 2003
- Biomass Resource Assessment for Carson City and Surrounding Area: McNeil Technologies, 2004
- Community Wildfire Protection Plan for the California Portion of the Lake Tahoe Basin; C.G. Celio & Sons Company, November 2004
- Strategic Plan for the Wildfire Protection and Biomass Utilization Program; Placer County, October 2007
- Biomass Initiative for the Lake Tahoe Basin; Steve Holl Consulting, November 2007
- Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy – 10 Year Plan; Fire Districts, Organizations and Agencies operating in the Lake Tahoe Basin, December 2007
- Reno/Tahoe Biomass Supply and Demand Study; Sierra Economic Development Corporation, January 2008
- The Emergency California-Nevada Tahoe Basin Fire Commission Report; California-Tahoe Basin Fire Commission, May 2008
- Forest Biomass Removal on National Forest Lands; Placer County Executive Office and TSS Consultants, November 2008
- Cable Harvesting as an Option for Steep Slope Fuel Reduction in the Tahoe Basin; Forest Engineering Inc, October 2009
- Effects of Fire Management in the Tahoe Basin: A Scientific Literature Review; USDA Forest Service, Pacific Southwest Research Station and the Tahoe Science Consortium, November 2009

WILDFIRE IN THE BASIN

During the past 10 years the LTB has experienced wildfire events on approximately 4,500 acres. Due to the fact that much of the LTB is accessible by road and fire response infrastructure is well equipped and highly organized, most wildfires have not exceeded 1 acre in size. However, the Angora Fire of 2007 was the exception – consuming 3,100 acres and 254 homes over the span of 48 hours. Fortunately, no lives were lost. Figure 3 is a fire history map showing the location of wildfires (15 acres or more) in the LTB in the last decade.

Figure 3. Recent Wildfire History (2000 – 2009).



As a direct result of the Angora Fire, the California-Nevada Tahoe Basin Fire Commission was formed. This commission was tasked with assessing current land management policies and deliver recommendations to reduce the risk of wildfire. The Commission issued 48 findings and 90 recommendations – many of them in support of expanded fuels treatment activities and continued funding support for these efforts.

HAZARDOUS FUELS TREATMENT PRACTICES

Fuels treatment activities in the LTB have focused on forest thinning and reduction of hazardous fuels within the wildland urban interface (WUI). The WUI represents the zone of transition between unoccupied land and human development. In the LTB, the WUI also includes developed areas, as these areas are interspersed with undeveloped land. In addition, most residential and industrial parcels contain significant amounts of forested land. In the LTB the WUI has been delineated and targeted for treatment in various planning documents including the Community Wildfire Protection Plans and the Fuels Strategy. The USFS – LTBMU is currently revising the WUI map presented in the Fuels Strategy.

The primary objectives of WUI fuels treatment are to alter fire behavior from a crown fire to a low intensity surface fire, and to facilitate the placement of fire suppression assets (fire fighting staff and equipment). Treating fuels in the WUI also creates fire evacuation routes that facilitate safe evacuation procedures for local residents.

Wilderness areas are not being actively treated due to federal law. Figure 4 shows the location of the WUI and wilderness areas in the LTB. The WUI identified in Figure 4 is consistent with the draft revised extended WUI being developed by the USFS – LTBMU. Minor modifications in the boundary of the WUI may change as the draft WUI map undergoes review.

Fuels treatment techniques utilized in the LTB include:

- Hand thinning with resulting biomass piled and burned (pile and burn).
- Hand thinning with the resulting biomass chipped and removed.
- Hand thinning with the resulting biomass chipped and scattered on-site.
- Mechanical thinning (such as cut-to-length systems) and removal of biomass.
- Understory burn.
- Mastication (grinding) and scattering biomass on-site.

With the exception of understory burning, all techniques can be used for initial or maintenance treatments. Understory burning is limited to maintenance treatments, and its use as a maintenance treatment is increasing in the LTB. The cost to conduct these fuels treatment activities range from $200/acre (understory burn) to a high of $10,000/acre (hand thin, chip and remove). In addition to the expense of the treatment activity, agencies implementing treatments must also assess current fuel conditions, topography, best management practices and regulatory agency guidelines before deciding which treatment practice is optimal for a particular site.

The Biomass Work Group created a table that describes the fuels treatment technique, costs, geographic constraints and frequency of use. Table 2 summarizes the results.

Figure 4. Draft Extended Wildland Urban Interface (as revised by the LTMBU), Wilderness and Roadless Areas and General Forest.

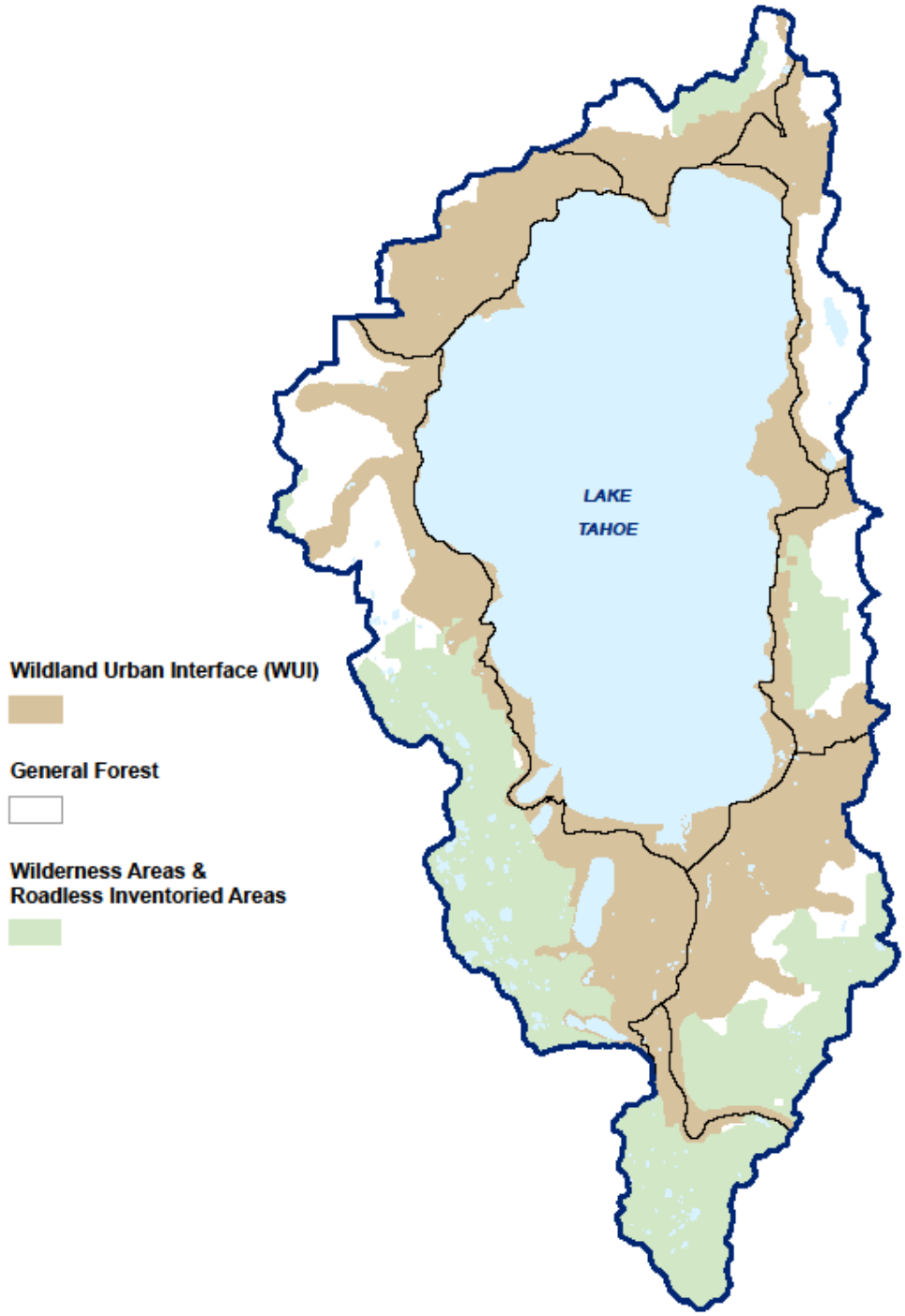


Table 2. Description of Current Fuels Treatment Practices.

TREATMENT TYPE	TREATMENT DESCRIPTION	COST PER ACRE	GEOGRAPHIC CONSTRAINTS	TYPICAL FREQUENCY OF USE
Hand thin, pile and burn	Crews using hand tools thin small trees (less than ~20 inches in diameter at breast height) to specific spacing criteria. Thinned material is then piled and burned. Utilized for both initial treatment and maintenance treatment.	$1,150 - $6,850	Traditional methodology on steep slopes (>30%). Used between 100 ft of a road and edge of the extended WUI, or along state and federal highways that cannot be closed to accommodate equipment. Piling and burning on steep slopes in SEZ currently not allowed, although ongoing research may change this.	55 to 60% of treated acres
Hand thin, chip and remove	Crews using hand tools thin small trees (less than ~20 inches in diameter at breast height) to specific spacing criteria. Thinned material is then chipped and removed for alternative uses. Utilized for both initial treatment and maintenance treatment.	$2,300 - $10,000	Used on steep slopes (>30%) or small parcels (less than ~0.5 acres regardless of slope), both within 100 ft of a road due to high cost to hand carry thinned material to roadside location for chipping. Not conducted along state and federal highways due to concerns regarding crew safety.	10 to 15% of treated acres (includes chip and remove and chip and scatter)
Hand thin, chip and scatter	Very similar to hand thin, chip and remove treatment except material is chipped and scattered on site. Utilized for both initial treatment and maintenance treatment.	$3,000 - $5,000	Similar to hand thin, chip and remove. Often used in place of hand thin, chip and remove to save transportation costs, or if no ready market available for chip.	10 to 15% of treated acres (includes chip and remove and chip and scatter)

Table 2 (continued). Description of Current Fuels Treatment Practices.

TREATMENT TYPE	TREATMENT DESCRIPTION	COST PER ACRE	GEOGRAPHIC CONSTRAINTS	TYPICAL FREQUENCY OF USE
Mechanical thin and remove	Contractors using specialized equipment thin pre-designated trees. Material is chipped roadside into chip vans for delivery to end markets. Occasionally, saw logs are removed in conjunction with this treatment. Utilized for both initial treatment and maintenance treatment. Treatment techniques are evolving as new equipment is being developed.	$1,000 - $5,000	Conducted on topography under 30% slope, within 1/2 mile of roads on parcels typically larger than ~0.5 acres. Use in SEZs can be constrained, although equipment exclusion zones do allow biomass removal (using reach-in techniques). Some leeway based on dry versus wet SEZ.	~25% of treated acres (includes mechanical removal and mastication).
Mastication	Mechanical treatment of vegetation that grinds and scatters material on site. Often used in conjunction with mechanical thin. Can be used for both initial treatment and maintenance treatment. Treatment techniques are evolving as new equipment is being developed.	$500 - $2,100	Conducted on topography under 30% slope. Can be used on smaller parcels. Use in SEZs can be constrained. Some leeway based on dry versus wet SEZ.	~25% of treated acres (includes mechanical removal and mastication).
Understory burn	Crews using drip torches set burns that target ladder fuels for treatment. Typically used as a maintenance treatment.	$200 - $2,000	Implemented on a wide variety of topography. Not typically used in close proximity to communities due to concerns regarding air quality impacts on local residents.	<10% of treated acres

Hand thinning followed by pile and burn (Figure 5) is currently the only feasible technique on slopes steeper than 30% in areas more than about 100 ft from a road. However, these techniques are currently not allowed in stream environment zones (SEZs). Hand thinning followed by chip and remove is not currently feasible in areas further than 100 ft from a road due to the labor required to move the biomass safely to the road for subsequent chipping (Figure 6).

Figure 5. Hand thinning followed by pile burning.

Figure 6. Hand carrying biomass to the road for chipping.

Hand thinning followed by chipping is also limited to areas with safe road access (Figure 7), and thus is not used on major highways. Hand thinning followed by chip and scatter (Figure 8) is often used in place of chip and remove treatments to save the cost of transporting the chip, or when no use for the chip is readily available.

Figure 7. a) Chipper and chip truck staged on a nearby road; b) Chipping into chip truck for removal.

a) **b)**

Figure 8. Chipping and scattering biomass on-site.

Mastication (Figure 9) is used to grind slash, smaller trees and brush. It can be used as a stand alone treatment (especially as a maintenance treatment), as well as following mechanical treatments such as cut to length systems (Figure 10). Mechanical treatments, such as cut to length systems (Figure 10) are currently limited to areas with less than 30% slope and within a ½ mile of a road. Understory burning (Figure 11) is typically used as a maintenance treatment following an initial treatment to reduce biomass to a level that allows safe, low intensity burning.

Figure 9. A masticator grinding brush.

Figure 10. Mechanical cut-to-length system. A harvester drops the trees, which are removed by the forwarder.

Figure 11. Low-intensity understory burns are effective in maintaining initial treatments.

The Working Group also generated a fuels treatment matrix that provides an overview of key factors to consider when selecting a fuels treatment activity that is optimized for a particular site. Table 3 summarizes the results.

Table 3. Criteria used to select Fuels Treatment Type.

TREATMENT TYPE	RELATIVE COSTS	POTENTIAL AIR QUALITY IMPACTS	PRIMARY GEOGRAPHIC CONSTRAINT	EFFECTIVENESS IN REDUCING WILDFIRE RISK AND OTHER CONSIDERATONS
Hand thin, pile and burn	High	Moderate to High	Pile burning currently not allowed in SEZs.	Moderate to high potential to mitigate fire risk, unburned piles may pose a continued fire hazard until burned. Labor intensive. Limited acreage can be completed within a season. Limited window of opportunity to conduct pile burning (cool season) to maintain adequate fire control.
Hand thin, chip and remove	High	Low	Requires road access for chipping equipment.	Moderate to high potential to mitigate fire risk. Labor intensive. Limited acreage can be completed within a season. Most cost effective within 100 feet of roads. Additional safeguards necessary when operating in hot/dry conditions to prevent accidental fire ignition.
Hand thin, chip and scatter	Moderate	Low	Requires road access for chipper or specialized chipping equipment.	Moderate potential to mitigate fire risk, remaining material has some associated fire risk. Labor intensive. Additional safeguards necessary when operating in hot/dry conditions to prevent accidental fire ignition.
Mechanical thin and remove	Moderate	Low to Moderate	Limited to slopes <30% and larger parcels. Use in SEZs can be constrained.	High potential to mitigate fire risk. Higher acreage can be treated as compared to hand treatment techniques. Additional safeguards necessary when operating in hot/dry conditions to prevent accidental fire ignition. Can generate significant dust.
Mastication	Low	Low to Moderate	Limited to slopes <30%. Use in SEZs can be constrained.	Moderate potential to mitigate fire risk, remaining material has some associated fire risk. Additional safeguards necessary when operating in hot/dry conditions to prevent accidental fire ignition. Can generate significant dust.
Understory burn	Low	Moderate to High	Not typically used in close proximity to communities.	Moderate to high potential to mitigate fire risk (varies based on pre-treatment activities). Limited window of opportunity to conduct burning (winds and relative humidity within prescription) to maintain adequate fire control.

Hand treatments tend to be expensive, but can be used across a variety of geographic areas. Depending on whether the resulting biomass is removed (either through burning or removal of chip) or chipped in place, these treatments are moderately to highly effective in reducing fire hazard. Piles waiting burning may pose a continued fire hazard until the piles have been burned, although this hazard is usually less than the original high-density standing biomass. Pile burning is typically conducted in the cooler months to allow for adequate fire control. Additional safeguards must also be taken when conducting chipping operations during hot/dry conditions to prevent accidental fire ignition. Hand treatments are very labor intensive, and thus only a limited number of acres can be treated each year. In addition, their impact on air quality can range from high (in the case of pile burning) to low (in the case of chipping).

Mechanical treatments that remove the biomass are moderately expensive, and can be highly effective in reducing fire hazard. A large number of acres can be treated each season. The impact to air quality is generally low, although significant dust can be generated during operations. Additional safeguards must be taken when operating machinery during hot/dry conditions to prevent accidental fire ignition. Mechanical treatments are also more geographically constrained than hand treatments.

Mastication is relatively inexpensive. Since the masticated material remains on site, it may be only moderately effective in reducing fire hazard. While the fire behavior of masticated fuel is not well characterized, most fire professionals assume that masticated material on the ground results in a reduced threat of a crown fire as compared to the presence of vertical ladder fuels. The impact to air quality is generally low, although significant dust can be generated during operations. Additional safeguards must be taken when operating machinery during hot/dry conditions to prevent accidental fire ignition. Mastication, like other mechanical treatments, is constrained to slopes less than 30%.

Understory burning is relatively inexpensive, and can be effective in maintaining the surface fuel loading obtained from initial treatments. While typically conducted in the late summer to early fall, the timing is limited to meteorological conditions (calm winds, adequate humidity) that allow for adequate fire control. The impact on air quality can be moderate to high.

Using the constraints described in Table 2, a geographic information system (GIS) analysis was conducted to characterize the potential location of fuels treatment practices within the basin. The GIS analysis used the approximately 93,330 acres comprising the draft extended WUI (Figure 4), the area targeted for fuels treatment, as the basis for the analysis. Due to their overall small size and limited representation within the LTB, no SEZ constraints were included in the analysis (i.e. SEZ areas were not excluded when otherwise these areas would not be treated).[2]

A series of maps (Figures 12 through 18) were generated showing where biomass collection techniques could be conducted to remove biomass material generated as a byproduct of fuels treatment activities. From these maps, the overall acreages of each general fuels treatment type were calculated. Table 4 summarizes the results of GIS

[2] All vegetated areas were considered to be forest. This may result in a slight overestimation of treatable acres, as some areas may consist of rocky outcrops or similar non-forested or non-vegetated land types.

analysis shown in Figures 12 through 18. These data are meant to provide a global view of the treatment types and land ownerships most likely to provide biomass collection opportunities in the LTB, and should be considered approximate. The acreages represent the total acreages available for treatment. Each year a subset of these acres are selected by the fire protection and land management agencies for treatment. Additionally, just because a given parcel has the potential for a given treatment (i.e. mechanical or hand thin with biomass removal), does not mean this is the treatment the parcel will ultimately receive. Fire protection and land management agencies will select the final treatment method based on constraints and considerations present at that time. For example, while a given parcel may have the potential for hand thin with biomass removal, if there are no facilities accepting the biomass at that time, pile burning may be selected. Or, if a single 0.5 acre parcel has the potential for mechanical treatment, this single parcel may be deemed to be too small to justify mobilization costs.

Figure 12 shows the areas with the potential to be treated by hand thinning followed by biomass removal. These areas would include areas that are currently treated by hand thinning followed by chip and scatter, as well as hand thinning followed by chip and remove. As described in Table 2, these are areas within 100 ft of a road in areas with slopes greater than 30%, as well as all parcels less than 0.5 acres (0.51 acres was used to facilitate the GIS analysis). Of the approximately 17,400 acres with the potential to be hand thinned followed by biomass removal, just over 13,000 acres (75%) are in private ownership (Figure 13, Table 4). However, most of these 13,000 acres are likely to have structures covering at least 30% of the parcel. Thus, at most only about two-thirds of the 13,000 acres (7,800 acres) could produce recoverable biomass.[3]

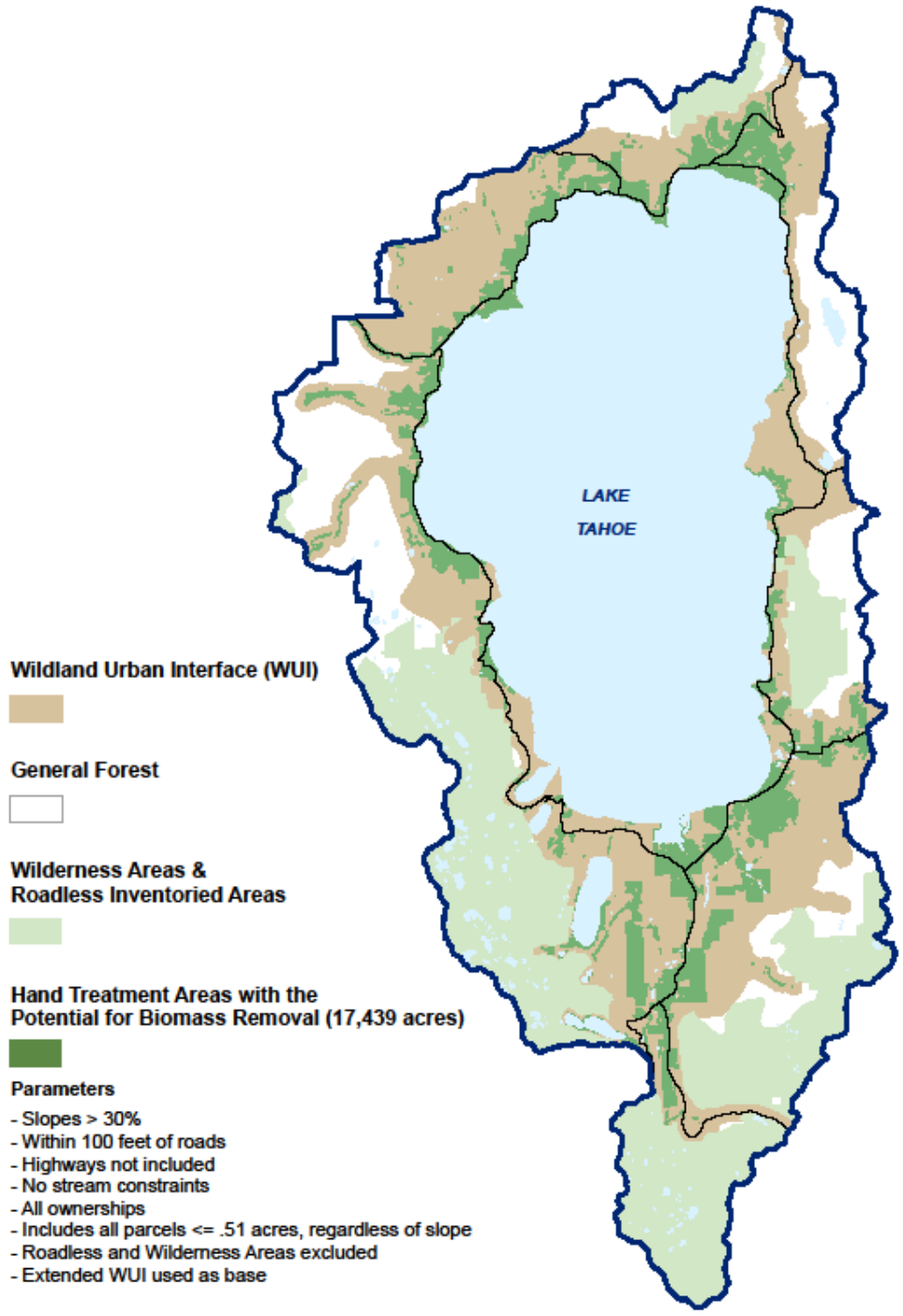
Approximately 42,600 acres can potentially be mechanically treated followed by biomass removal (Figure 14). These are areas within ½ mile of a road with slopes less than 30%. Almost 38,000 acres are in public ownership (Figure 15, Table 4), with the federal government owning over 28,000 acres (67%). Private ownership accounts for less than 5,000 acres (11%). For this analysis, if a parcel was greater than 0.5 acres, it was assumed that mechanical treatment could be conducted. However, for mechanical treatment to be cost effective, numerous parcels of this size located in close proximity to each other would be required. Single 0.5 acre parcels are unlikely to be treated mechanically.

Currently, approximately 26,400 acres are constrained to treatment by hand thinning followed by pile burning (Figure 16). This is due to both steep slope (greater than 30%) and distances greater than 100 ft from a road. Of these acres, approximately 19,400 (73%) are in federal ownership (Figure 17, Table 4).

Figure 18 shows the combined potential fuels treatment within the draft extended WUI. Of the approximately 93,300 acres within the extended WUI, approximately 6,700 acres (7%) were not captured in the analysis of potential treatments. These are primarily areas

[3] In addition, a limited number of small parcels are actually part of "paper developments" in which roads were not constructed, and the parcels not developed. Although considered small parcels for this analysis, they are actually part of a larger, continuous forested unit, and in some cases could be treated using mechanical methods.

Figure 12. Hand Treatment Areas with the Potential for Biomass Removal.[4]



[4] Figure 12: this figure shows hand treatment acreage with biomass removal potential, however other factors (ready access, biomass markets) may result in no biomass removal and the creation of burn piles.

Figure 13. Hand Treatment Areas with the Potential for Biomass Removal by Ownership.

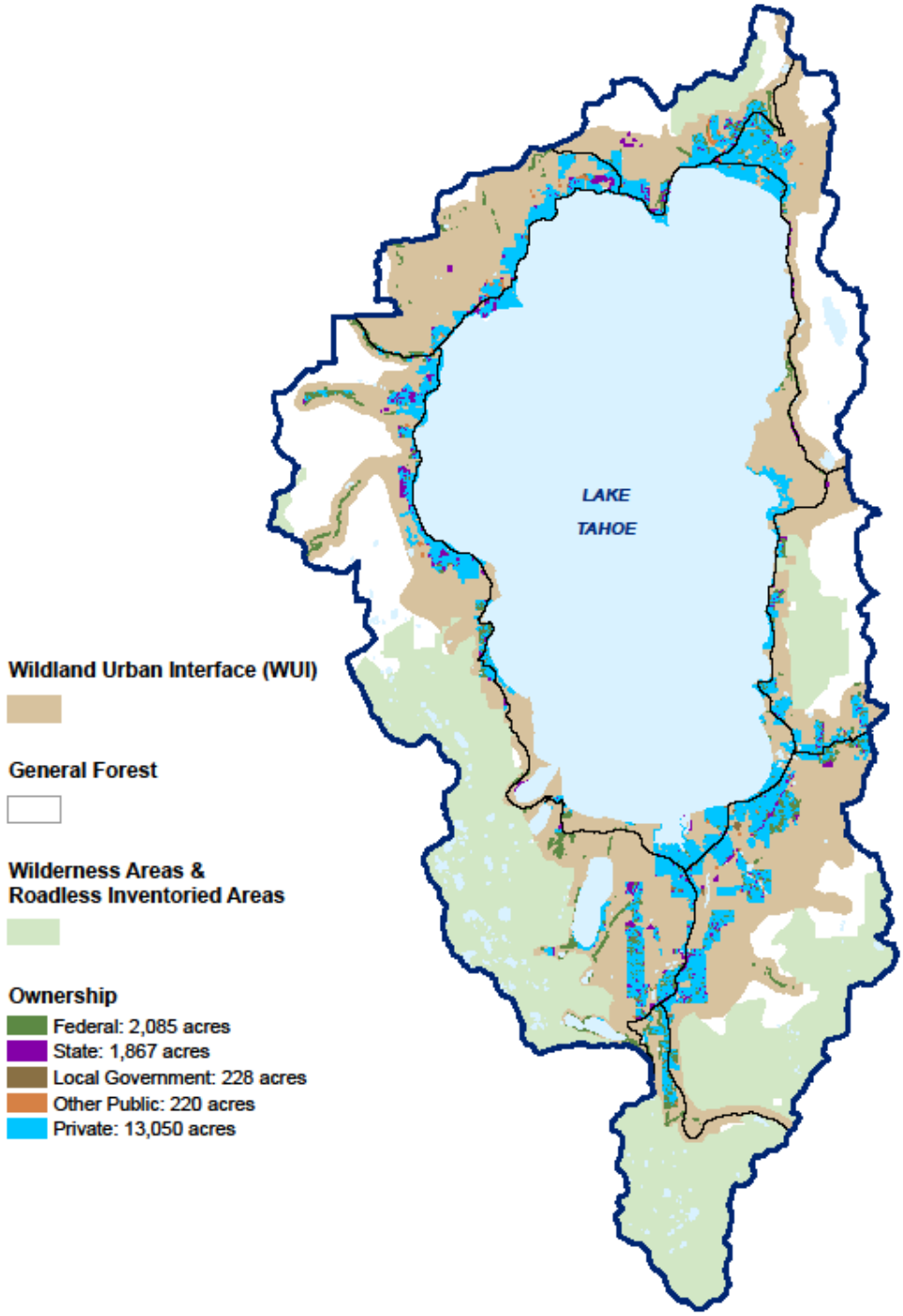
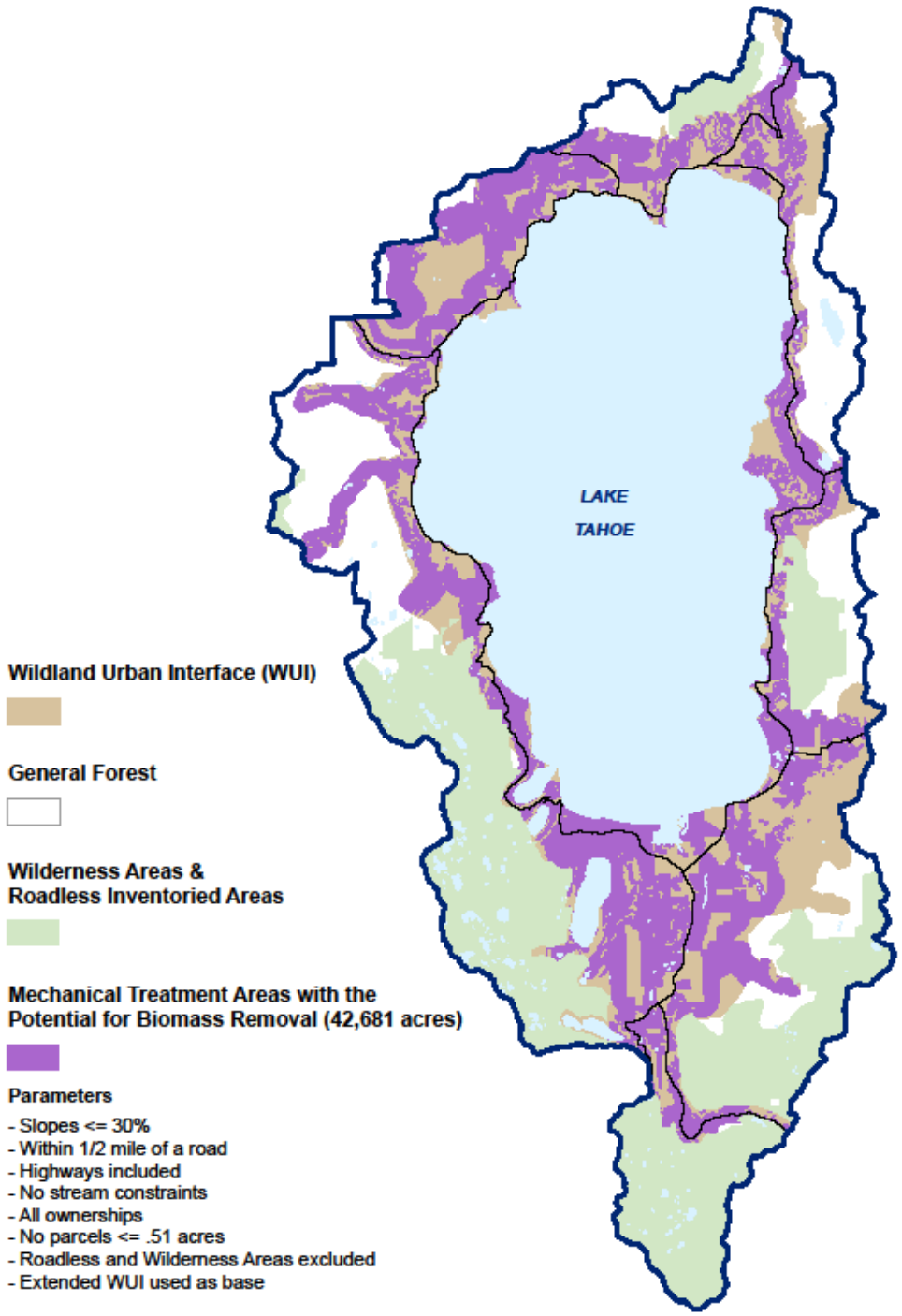


Figure 14. Mechanical Treatment Areas with the Potential for Biomass Removal.[5]



[5] Figure 14: shows acreage that could be treated mechanically. Most biomass removed as timber by logging operator.

Figure 15. Mechanical Treatment Areas with the Potential for Biomass Removal by Ownership.

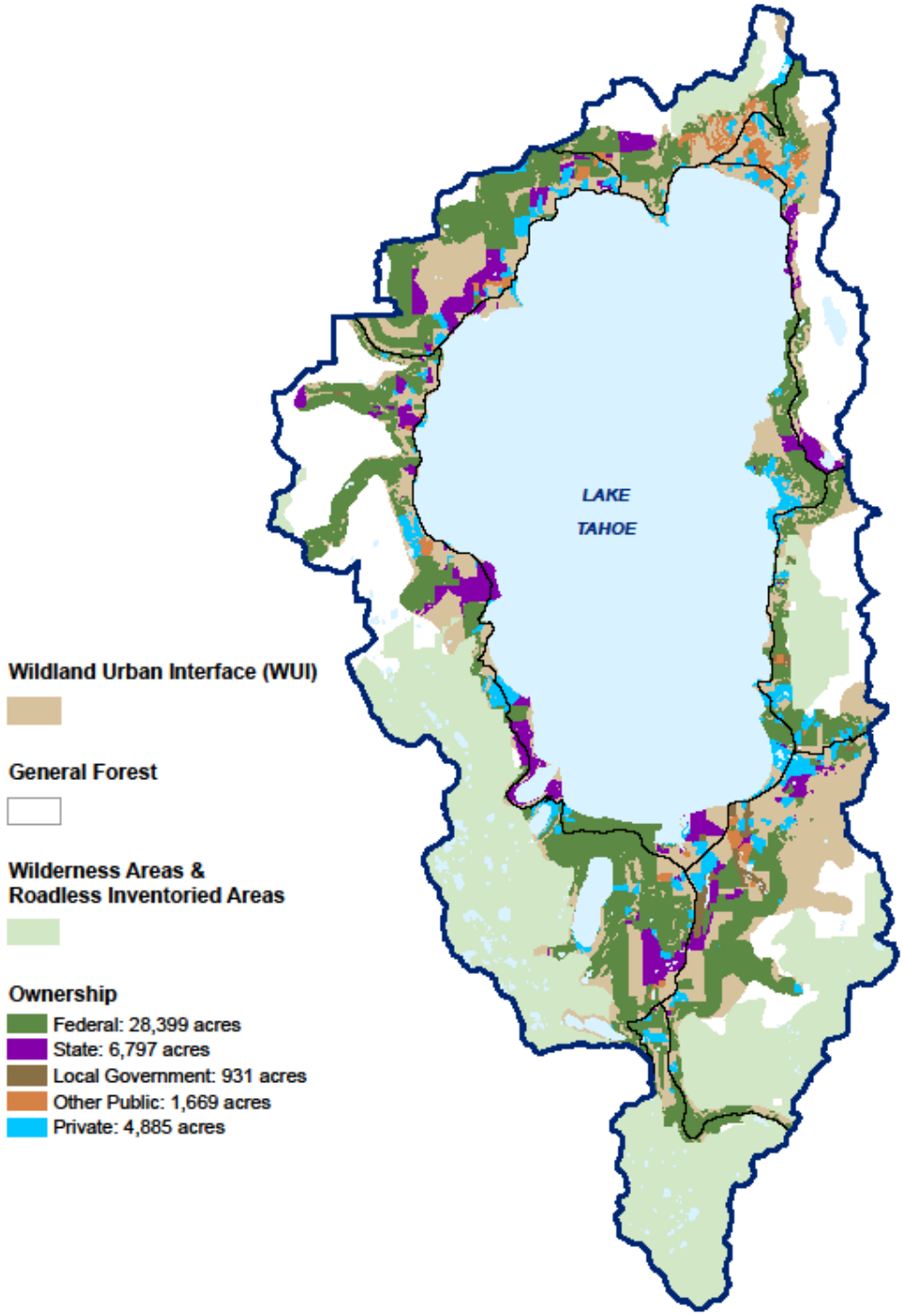
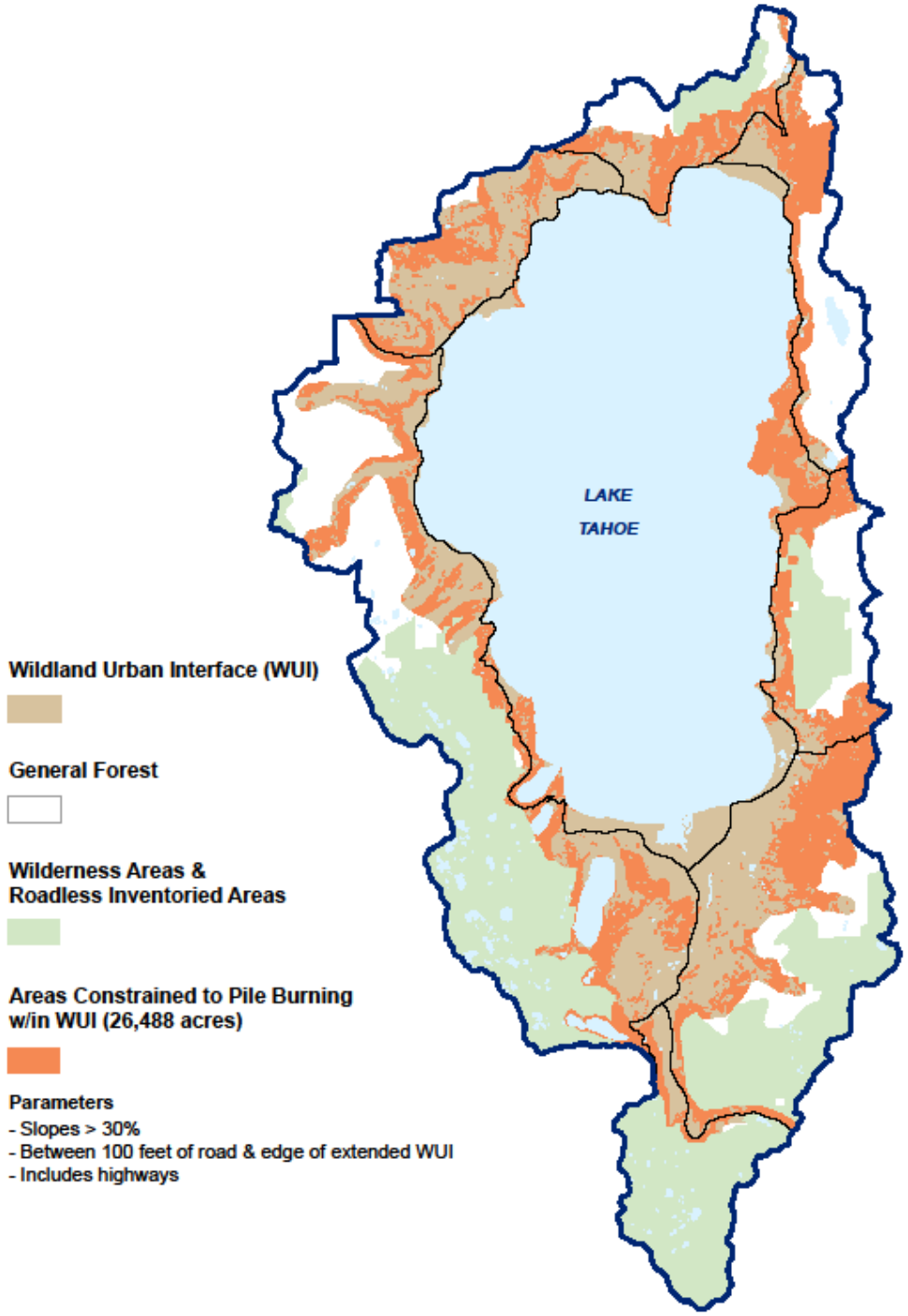


Figure 16. Areas Constrained to Pile Burn Treatments.[6]



[6] Figure 16: represents acreage that at this time is currently constrained to pile burning as a biomass removal treatment.

Figure 17. Areas Constrained to Pile Burn Treatments by Ownership.

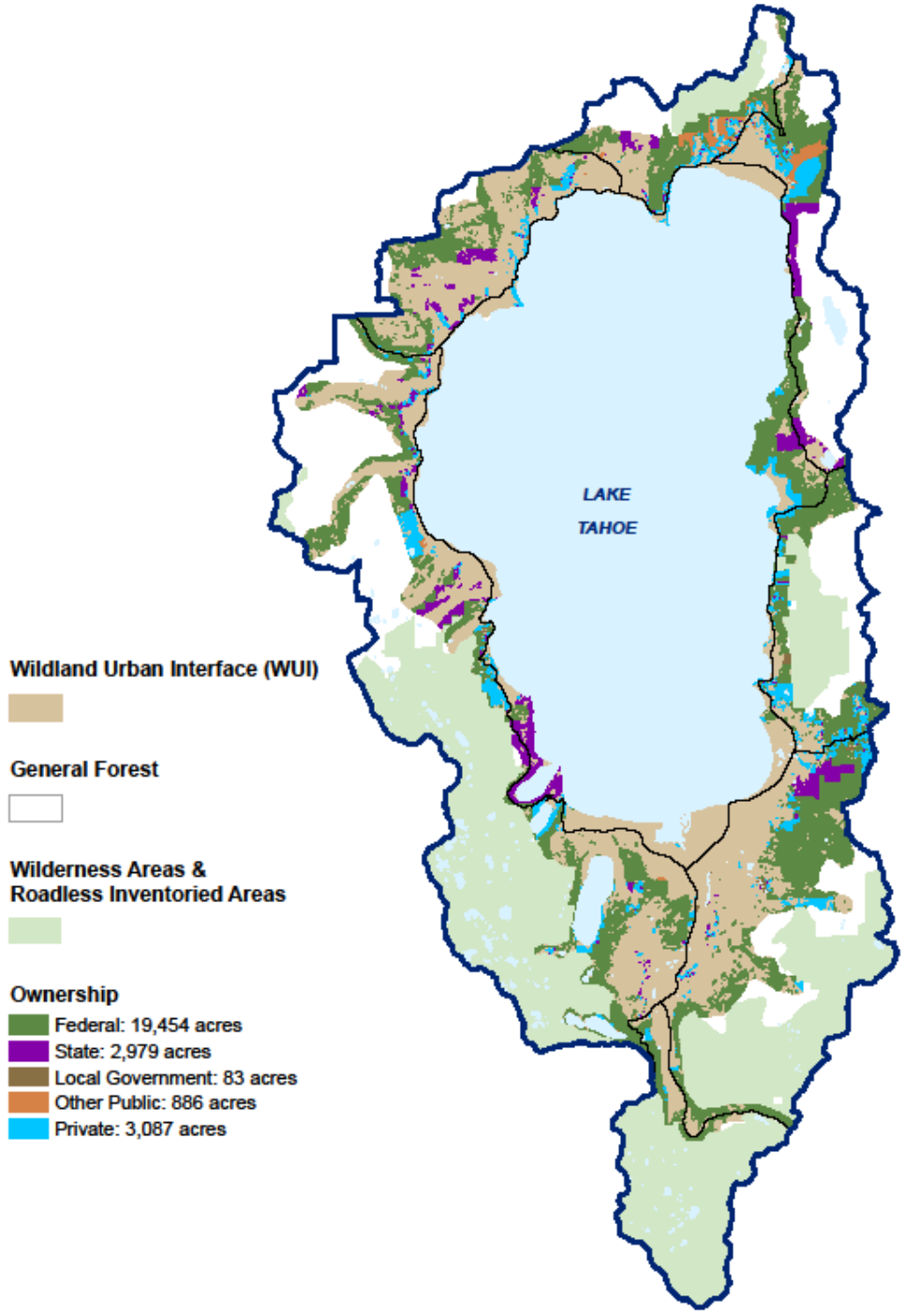


Figure 18. All Fuels Treatments.

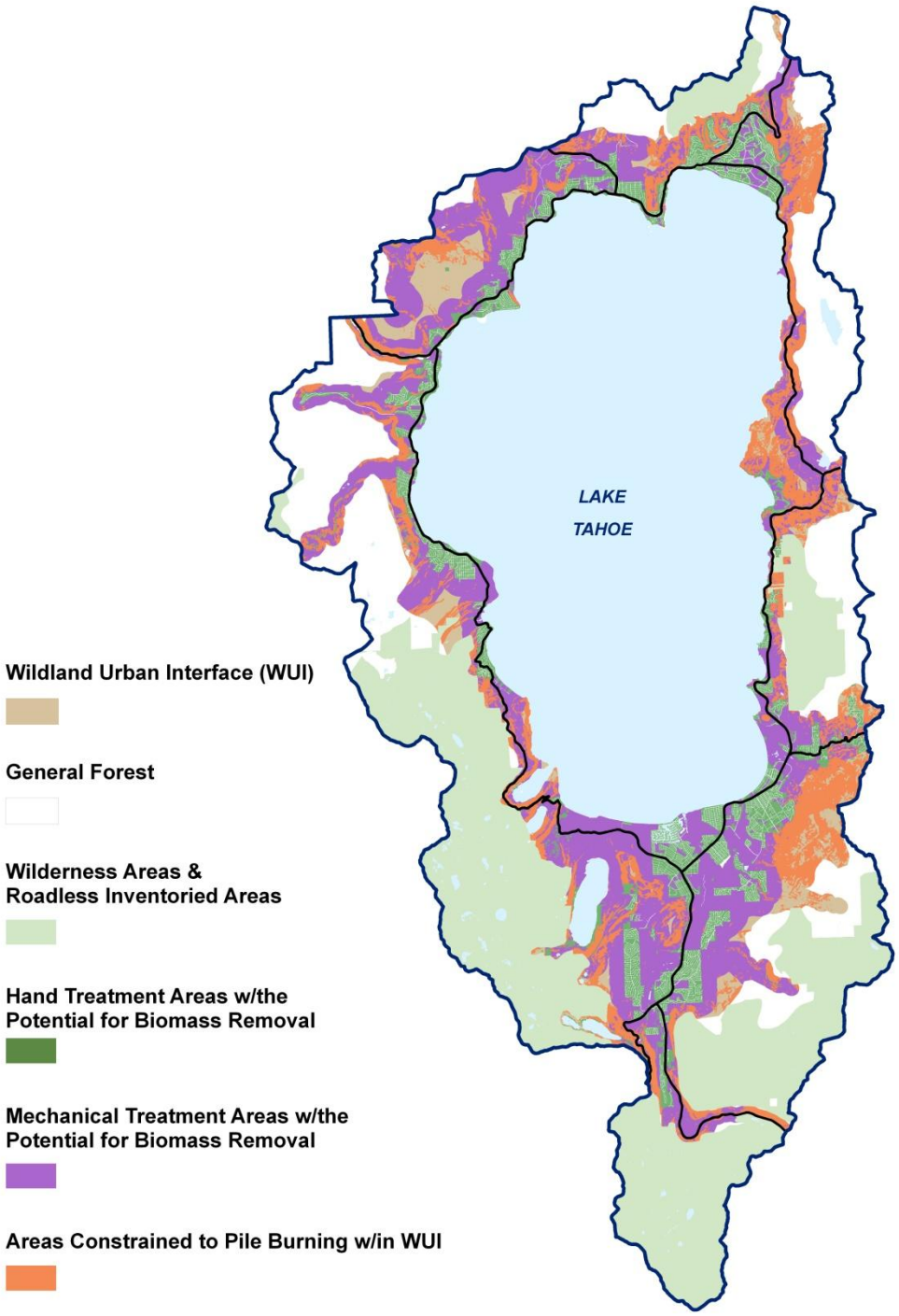


Table 4. Summary of Total Acres Potentially Accessible by Treatment Type and Ownership Within the Extended WUI (a subset of which are treated annually).[7]

OWNERSHIP	HAND TREATEMENT ACRES WITH THE POTENTIAL FOR BIOMASS REMOVAL	MECHANICAL TREATMENT ACRES WITH THE POTENTIAL FOR BIOMASS REMOVAL	ACRES CONSTRAINED TO HAND TREATMENT FOLLOWED BY PILE BURNING	TOTAL ACRES ACCESSIBLE FOR TREATMENT WITHIN THE EXTENDED WUI
Federal	2,085	28,399	19,454	49,938
State	1,867	6,797	2,979	11,643
Local Government	228	931	83	1,242
Other Public	220	1,669	886	2,775
Private	13,050	4,885	3,087	21,022
Total	**17,439**	**42,681**	**26,488**	**86,608**

[7] Columns and rows do not precisely sum due to compounding of estimation errors within the GIS analysis.

that are less than 30% slope but greater than ½ mile from a road. Due to their inaccessibility, these areas would most likely either be treated by hand thinning followed by pile burning, or not treated.

The fuels treatment activities that have the most potential to facilitate biomass collection and utilization include:

- Hand thin, chip and remove.
- Mechanical thin and remove.

As stated earlier, removal and utilization of biomass material is a targeted outcome of this analysis. Many factors (as outlined in Tables 2 and 3) are considered when land managers and fire district staff assess the most suitable fuels treatment technique for the target location. Analysis results provided here is in no way a substitute for on-the-ground decisions made by seasoned professionals, well versed in selecting the optimized treatment technique tailored for a particular site.

FUELS TREATMENT – ACCOMPLISHENTS BETWEEN 2000 AND 2009

Land management agencies and fire protection districts throughout the LTB have made significant progress treating hazardous fuels in the extended WUI using the techniques presented in Tables 2 and 3. Table 5 summarizes 2000 through 2009 fuels treatment accomplishments by the fire protection districts and land management agencies within the LTB. Of the approximately 93,300 acres representing the extended WUI in the LTB region the various agencies and fire districts have treated an average of 4,300 acres per year in the past 10 years (Table 5). The acreages described in Table 5 only include fuels treatments on primarily undeveloped land and do not include the residential chipping program operated by most fire districts. In this program, residents thin their property, and the resulting slash is chipped and removed by the fire protection districts. Most of the 13,000 privately owned acres within the WUI would be treated under this program, which represents a significant source of biomass.

The data summarized in Table 5 were gathered by the Biomass Working Group members and represent their best estimate of accomplishments by treatment type. Note that the hand thin and chip (whether scatter or remove), and mechanical thin and remove techniques are the treatment types that present the best opportunity for the collection and utilization of biomass material. Woody biomass material generated as a byproduct of fuels treatment activities is typically measured in green tons (GT) per acre. The amount of biomass material produced per acre will vary across the LTB depending location within the basin (for example, forests are more productive on the west side of the basin than the east), and whether the treatment represents initial or subsequent treatment. Biomass produced can range anywhere from a low of 4 to a high of 50 GT/acre. The range given in Table 5 is the average range of 14 to 26 GT/acre, with the results rounded to two significant figures.

Clearly significant progress on treating hazardous fuels has been made by the agencies and fire protection districts operating in the LTB. Key findings from the data presented in Table 5 include:

- Approximately 4,300 acres of treatment per year.
- 54% of treatment activities utilize hand thin, pile and burn practices.
- 40% of treatments (approximately 1,700 acres per year) generated biomass material (hand thin and chip and mechanical removal) that was potentially recoverable.
- An average of between 24,000 and 44,000 GT of biomass material has been removed or chipped and scattered annually.

The fuels treatment accomplishment data summarized in Table 5 are likely an under estimate, as many agencies have just recently begun to track this information. Also, the amount of treated acreage has increased greatly in the past three years.[8] It should be noted that accomplishments report on acreage treated. This acreage may again be treated in another five to ten years due to the dynamics of vegetation growth. As forests grow and add additional ladder fuels and brush (the target biomass material), follow up or maintenance treatments will be required.

FUELS TREATMENT – FIVE YEAR FORECAST

Utilizing past accomplishments as a guide, the Biomass Working Group generated a five-year forecast for fuels treatment activities planned (but not necessarily funded) for 2010 through 2014. Table 6 summarizes the five year forecast of fuels treatment activities planned by Biomass Working Group organizations. Key findings from this forecast include:

- Approximately 6,600 acres of treatment activities planned per year. This ramp up from an average of 4,300 acres (during 2000 through 2009 time period) is primarily due to the LTBMU increasing efforts to treat more acres.
- 60% of planned treatment activities utilize hand thin, pile and burn practices.
- 31% of planned treatments (approximately 2,100 acres per year) could generate recoverable biomass material (hand thin and chip and mechanical removal).
- Between 29,000 and 53,000 GT of biomass material to be removed or chipped and scattered annually.

While the 53,000 green tons of biomass material forecast represents an increase in the volume of biomass (over the volume generated during the 2000 through 2009 period) that could be available, it should be noted that this figure is an estimate of the potential volume that could be recovered and utilized. Additional analysis (outside the scope of this effort) would be needed to confirm what volume of biomass material is practically available (given equipment limitations, topographic and vegetative conditions). Once the practically available figures are available an additional level of analysis can review what fraction of the biomass material is economically recoverable given existing biomass markets.

[8] This is due to the increased availability of federal funding through the US Forest Service, the US Bureau of Land Management, and the American Recovery and Reinvestment Act.

Table 5. Historic Fuels Treatment Activities in the Lake Tahoe Basin from 2000 through 2009 (Average per Year).[9]

Fire District/Agency/ Organization	Total Acres Treated	Understory Burn (Acres)	Hand thin, Pile and Burn (Acres)	Hand Thin and Chip (Acres)	Mechanical Removal - CTL + Mastication (Acres)	Biomass Tonnage Removed or chipped in Place (GT)[10]
California State Parks	98	10	10	28	50	1,100-2,000
North Lake Tahoe FPD	313	54	253		6	84-160
USFS - LTBMU	1,876	200	1,148		528	7,400-14,000
North Tahoe FPD	653		300	200	153	4,900-9,200
CA Tahoe Conservancy	155		52	93	10	1,400-2,700
City of SLT FD	76		36		40	560-1,000
Fallen Leaf Lake FD	46		23		23	320-600
Tahoe Douglas FPD	234		136	5	93	1,400-2,500
Meeks Bay FPD	51		19	4	28	320-600
Lake Valley FPD	219		18	175	26	2,800-5,200
Nevada Division of Lands	210		183	12	15	380-702
Placer County Biomass Program	130			130		1,800-3,400
TOTALS	**4,061**	**264**	**2,178**	**647**	**972**	**23,000-42,000**
PERCENT OF TOTAL		**6%**	**54%**	**16%**	**24%**	

Numbers for North Tahoe FPD to be confirmed.

[9] Please note that figures for California State Parks and CA Tahoe Conservancy do not include acres treated by the fire agencies on behalf of these organizations on their land.

[10] Assumes a range of 14 to 26 GT/acre.

Table 6. 2010 - 2014 Forecast of Fuels Treatment Activities in the Lake Tahoe Basin (Average per Year).[11]

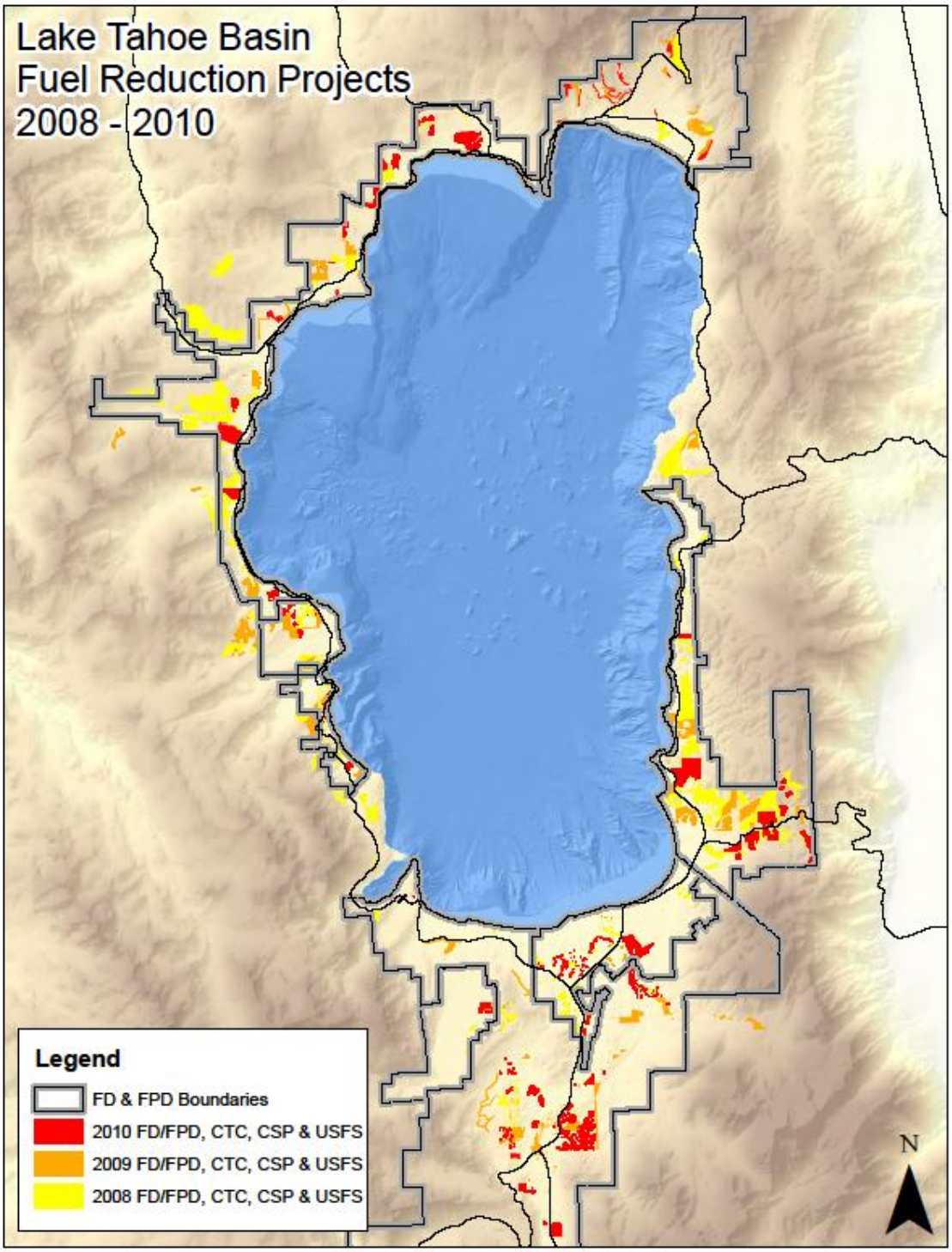
Fire District/Agency/ Organization	Total Acres Treated	Understory Burn (Acres)	Hand Thin, Pile and Burn (Acres)	Hand Thin and Chipped (Acres)	Mechanical Removal (CTL and Mastication) (Acres)	Biomass Tonnage from Mechanical Removal and Hand Thin/ Chipped (GT)[12]
California State Parks	150	30	10	30	80	1,500-2,900
North Lake Tahoe FPD	361	100	241		20	280-520
USFS - LTBMU	4,400	450	2,950		1,000	14,000-26,000
North Tahoe FPD	520		300	200	20	3,100-5,700
CA Tahoe Conservancy	100		40	60		840-1,600
City of SLT FD	139		53		86	1,200-2,200
Fallen Leaf Lake FD	58		29		29	400-750
Tahoe Douglas FPD	250		200		50	700-1,300
Meeks Bay FPD	45			30	15	630-1,200
Lake Valley FPD	319		34	165	120	4,000-7,400
Nevada Division of Lands	240		140		100	1,400-2,600
Placer County Biomass Program	50			50		700-1,300
TOTALS	**6,632**	**580**	**3,997**	**535**	**1,520**	**29,000-53,000**
PERCENT OF TOTAL		**9%**	**60%**	**8%**	**23%**	

[11] Please note that figures for California State Parks and CA Tahoe Conservancy do not include acres treated by the fire agencies on behalf of these organizations on their land.

[12] Assumes a range of 14 to 26 GT/acre.

Figure 19 map highlights 2008 and 2009 fuels treatment projects that have been implemented (some are still underway) and the 2010 planned projects.

Figure 19. 2008 and 2009 Fuels Treatment Projects Initiated and 2010 Fuels Treatment Projects Planned.



MARKETS FOR VALUE ADDED UTILIZATION OF BIOMASS MATERIAL

Currently there are several value added utilization markets for woody biomass material generated within the LTB. The primary markets include:

- Fuel for electrical and thermal energy production.
- Firewood for personal use.
- Raw material for landscape products and soil restoration (e.g., soil amendment, landscape cover).
- Raw material for composite panel production (e.g., particleboard).

Table 7 provides a list of the facilities that have in the recent past or are currently receiving biomass material generated in the LTB. Because transport costs (see Barriers section) are such a significant expense, a column has been added to note one way transport distance from Kings Beach (selected as a reference point for comparison purposes).

As Table 7 clearly shows, markets do exist for value added utilization of biomass material. Market capacity for utilization of biomass material is significant and is not a barrier in itself to biomass collection and removal in the LTB. However, due to the relatively dynamic nature and value of products produced by the facilities listed in Table 7, the delivered value (or willingness to pay) for biomass material is a variable that changes on a regular basis. Each of the four primary value added utilization markets for biomass generated within the LTB are facing challenging market dynamics that impact their ability to procure biomass:

- **Biomass Power:** Four of the nine facilities listed in Table 7 are biomass power generation plants that rely on wholesale power rates for their primary source of revenue. Currently the wholesale power markets are trending downward as fossil fuel prices (primarily natural gas) have fallen precipitously in the last several years. As wholesale power rates drop, so too does the ability of biomass power plants to procure fuel at prices that will compensate fuel treatment contractors for the full expenses associated with collection, processing and transport of biomass material generated within the LTB. The recent closures of the 1.2 MW biomass power generation facility at the Northern Nevada Correctional Center and the Sierra Pacific Industries (SPI) biomass power generation facility in Loyalton is indicative of the current financial challenges faced by biomass power generation facilities.
- **Firewood:** The US Forest Service, California Tahoe Conservancy, and the Nevada State Parks issue personal use and commercial firewood permits. Much of the firewood generated is for residential use within the LTB. This is a fairly consistent and predictable market.
- **Landscape Cover and Soil Amendment:** Three of the nine businesses listed in Table 7 are serving the landscape cover and soil amendment markets. Due to the recent downturn in the national economy and overall reduction in new housing starts the markets for this material are very depressed. All three of

Table 7. Current Markets for Woody Biomass Material Generated Within the Lake Tahoe Basin.

FACILITY AND LOCATION	DISTANCE FROM KINGS BEACH (MILES ONE WAY)	VALUE ADDED USE	BIOMASS MATERIAL USAGE (GT/YEAR)	COMMENTS
Northern Nevada Correctional Facility Carson City, NV	30	Thermal energy and electrical energy.	16,000 to 20,000	Closed in August 2010. Currently for sale.
Full Circle Compost Minden, NV	40	Landscape products – compost and mulch.	4,000 to 6,000	Primary customers for products produced are the general public and commercial agriculture operations.
Bently Agrowdynamics Minden, NV	40	Landscape products – compost and mulch.	9,000 to 10,000	Sourcing green waste as raw material. Currently charging a fee to accept raw wood.
Sierra Pacific Industries-Loyalton Loyalton, CA	50	Electrical energy.	170,000 to 190,000	Currently closed due to depressed whole-sale energy rates. Distance and transport costs from the LTB are a challenge.
Sierra Pacific Industries – Quincy Quincy, CA	82	Electrical energy.	170,000 to 190,000	Currently selling power to Pacific Gas and Electric. Distance and transport costs from LTB are a challenge.
Honey Lake Power Wendel, CA	135	Electrical energy.	300,000 to 360,000	Currently selling power to Pacific Gas and Electric. Distance and transport costs from LTB are a challenge.

Table 7 (continued). Current Markets for Woody Biomass Material Generated Within the Lake Tahoe Basin.

FACILITY AND LOCATION	DISTANCE FROM KINGS BEACH (MILES ONE WAY)	VALUE ADDED USE	BIOMASS MATERIAL USAGE (GT/YEAR)	COMMENTS
Firewood Lake Tahoe Basin	N/A	Thermal Energy. Typically for residential heating.	700 to 1,000	LTBMU, Nevada State Parks and CTC issue hundreds of personal use firewood permits.
Sierra Pine Rocklin, CA	94	Composite Panels.	150,000 to 200,000	Traditionally have utilized sawmill byproducts. Occasionally utilize forest sourced biomass.
Integrated Environmental Restoration Services, Tahoe City, CA	N/A	Soil restoration activities primarily in the LTB.	250 to 1,250	Primarily utilized on high disturbance sites such as residential developments and ski areas.

the soil amendment businesses are not paying for delivered material but will accept it for free or charge a nominal disposal fee.

- **Composite Panels:** The one composite panel manufacturer (Sierra Pine) is currently operating on a curtailed basis due to the depressed housing market and is not actively sourcing raw material from forest fuels treatment activities.

As a result of the relatively depressed market values for biomass (as noted above), fuels treatment contractors must charge a service fee (typically $ per acre) to agencies and fire protection districts for the removal, processing and transport of biomass material out of the LTB to markets such as biomass power plants, soil amendment operations or composite panel manufacturing facilities. Without a change in the biomass markets noted above, the fees for fuels treatment services will continue to be significant.

Potential markets that provide additional outlets for increased utilization of biomass material are being developed and show much promise. Table 8 summarizes the potential markets that show promise for increased use of woody biomass in the region.

Table 8. Emerging Markets for Woody Biomass Material Generated Within the Lake Tahoe Basin.

FACILITY AND LOCATION	DISTANCE FROM KINGS BEACH (MILES)	VALUE ADDED USE	ANNUAL USAGE OF BIOMASS MATERIAL (GT/YEAR)	COMMENTS
LTB Biopower Facility	N/A	Thermal energy and electrical energy.	32,000 to 40,000	Project will generate 1 – 3 MW of electrical energy. Targeting 2013 for commercial operations. Placer County is project proponent.
Trex Company, Inc Fernley, NV	77	Composite decking products.	40,000 to 50,000	Currently utilize wood waste residuals from greater Reno/Sparks area. With minor modification, may be able to utilize forest sourced biomass.

Summarized below is additional detail regarding the two projects that are likely to provide additional markets for biomass generated within the LTB:

- **LTB Biomass Power Facility:** The LTB biomass power facility is in phase I development and is focused on providing a ready market for biomass material generated as a byproduct of forest fuels treatment activities. The facility is planned for a location in Placer County in or near the LTB and several potential locations have been identified. A key biomass fuel procurement advantage for this project is the relative location of the facility to its primary fuel source – the LTB. Transportation costs are the most significant expense when recovering and removing processed biomass from the LTB region. By locating within the LTB this facility will mitigate transport costs for agencies and contractors treating fuels in the region. The project is currently undergoing environmental review, with the final location to be determined at the conclusion of the review process.
- **Trex Company Composite Decking:** The Trex Company facility at Fernley has traditionally utilized wood waste residuals generated within the greater Reno/Sparks region from commercial cabinet and wood working operations. However, as demand for Trex products increases (with improvements in the housing markets), there maybe an opportunity to modify the Trex manufacturing process to accept forest sourced biomass raw material.

In addition to these emerging markets for the use of biomass material, numerous innovative technologies are under development. These include mobile processing technologies that use torrefaction to reduce the biomass material down to energy dense "briquettes", as well as small boiler-based power plants that can use biomass material to power specific industries, such as waste water treatment plants.

Evolving value added technologies focused on the improved utilization of woody biomass material are receiving significant public and private sector support. Conversion of biomass into transportation fuels such as ethanol and synthetic diesel have been a major focus. Research and development focused on biomass to biofuels conversion technologies is ongoing and shows significant promise.

BARRIERS TO COLLECTION OF BIOMASS MATERIAL

Members of the Biomass Working Group agree that sustainable collection and removal of biomass material consistent with land management policies and objectives within the LTB is a laudable goal. Unfortunately there are a number of barriers that stand in the way of optimized collection and removal of biomass in the region. Working Group members listed and then ranked key barriers that impact successful biomass removal. Table 9 lists the top four.

Table 9. Barriers to Successful Biomass Collection and Removal in the Lake Tahoe Basin.

RANK	BARRIERS
1	Transportation costs to move biomass material to value-added markets.
2	Fiscal budgets to support biomass removal activities.
3	Low market value for biomass material.
4	High cost of biomass removal.

Barriers to biomass collection and removal in the LTB are discussed in more detail below:

- **Transportation Costs to Move Biomass Material to Value-Added Markets:** Markets for biomass material are located some distance from the LTB (see Table 7). The closure of the Northern Nevada Correctional Center and the SPI Loyalton biomass power generation facilities (see comments in Table 7) will reduce local biomass market opportunities and extend the haul distances required to move biomass material to alternative value-added markets. Transportation costs are typically the most significant expense when conducting biomass collection and removal operations. Diesel fuel prices continue to fluctuate (typically upward) creating conditions that add uncertainty. Currently transport costs average $70 to $90 per hour for a commercial truck and trailer. Transport costs can add an additional $8 to $10 per ton (assuming a 50 mile one way haul distance) or $200 to $350 per acre (assuming 25 tons per acre recovery) to the cost of fuels treatment. There is also a lack of mobile processing technology that produces a value added product at the point of harvest, which could substantially reduce or eliminate the high cost of transporting a low value resource to a fixed location processing facility.
- **Fiscal Budgets to Support Biomass Removal Activities:** Very few agencies or organizations have developed options for sustained funding of biomass removal operations. Currently these operations are subsidized by grants or funding for conducting fuels treatment from the American Recovery and Reinvestment Act (ARRA) which will not be available after 2010, and funding from the U.S. Bureau of Land Management through the Southern Nevada Public Land Management Act (SNPLMA) which will be greatly reduced. The USDA Forest Service operates on appropriated dollars set annually by congress. Some fire protection districts (e.g., Tahoe Douglas, North Tahoe and North Lake Tahoe) are located in communities that have passed local tax initiatives that support fuels treatment and biomass removal. Stable long term funding for each agency will be critical for successful implementation of this strategy.
- **Low Market Value:** Market prices for biomass material delivered to value added utilization facilities (see Table 7) are dependent upon externalities such as the value of renewable electrical power, housing starts and the general state of the regional economy. For example, California wholesale power rates are

currently very low because they are tied directly to natural gas prices. Natural gas pricing is forecast to remain low for the foreseeable future. This greatly reduces the price that can be paid by the biomass power generation facility for a ton of biomass fuel.

- **High Cost of Biomass Removal:** Current policies within the LTB often prohibit the use of equipment in many areas. Equipment may be restricted from flat land next to roads in some areas due to concern over obstructing major highways. Equipment often is restricted from use in SEZ's, or on topography with slopes exceeding 30%. Outside the LTB these factors are typically not barriers and the treatment costs per acre are substantially lower (reflecting the cost effectiveness of using mechanical equipment to collect and recover biomass material). When using hand crews necessitated by the current policies (steep slopes, near houses and in the SEZ) the cost of biomass material collection is very high. Utilization of hand crews is typically very costly (high labor costs) due to the fact that biomass material targeted for removal must be handled several times, and is very inefficient (see Figure 5 through 8).
- **Negative Public Perception:** An additional barrier is posed by those who hold the opinion that developing a commercial use of the biomass will result in the industry dictating resource management decisions to ensure long term sustainability of the business.

RECOMMENDED STRATEGY TO ADDRESS BIOMASS REMOVAL BARRIERS

The LTB is a unique and highly valued region that will require ongoing forest fuels treatment to address the high risk for wildfire in the basin. Recent wildfire events (such as the 2007 Angora Fire) demonstrate how quickly wildfire can impact landscape and assets (including homes) in the region. While significant progress has been made to treat hazardous forest fuels in the LTB, there are some barriers, that if addressed will result in a net increase of biomass collected and removed which will facilitate a net reduction in open burning (reducing air emissions) and a net reduction of fuels treatment costs (due to value-added utilization). Summarized below is a recommended strategy to address current barriers to collection and removal of biomass material in the LTB:

- **Reducing Transportation Costs to Move Biomass Material to Value-Added Markets:** Due primarily to the relatively distant value-added markets for biomass material, the costs to transport biomass material collected in the LTB are extraordinarily high. The ability to control transportation costs is to either 1) find/build local (within 30 mile radius) value-added uses for biomass material, or 2) subsidize the cost with grants or local taxes.
  - **Recommendation #1:** Support market based solutions for local value added biomass utilization that will significantly reduce transportation costs including:
    - Find private sector parties interested in the purchase and operation of the Northern Nevada Correctional Center biomass facility at Carson City,

Nevada. This facility represents one of the closest value-added market for biomass material generated in the region.

- Encourage innovative value-added uses for biomass material including expanded local markets for soil restoration/soil amendments (or other uses) within the LTB and the development of innovative mobile processing technology such as torrefaction-based technologies.
- Support construction of a biomass co-generation facility within or near the LTB.

- **Recommendation #2:** Explore the feasibility of locating facilities throughout the basin to dry and pre-process the biomass, thereby reducing the volume and weight of the material and thus reducing subsequent transportation costs to value-added markets.

- **Securing Consistent Funding to Support Biomass Removal Activities:** Currently very few agencies have developed budgets for biomass removal. ARRA and SNPLMA funding support have been used to support biomass removal operations but will soon run out. Some fire districts have implemented local tax ordinances to assist with fuel treatments (including biomass removal operations) but the long term solution is reducing the costs associated with fuels treatment while supporting value-added utilization. Options available to address sustained fuels treatment activities with limited and uncertain fiscal budgets include: 1) finding value-added markets that will cover (or partially cover) the cost of treatment, 2) passing local taxes, and 3) subsidizing the cost with grants.
  - **Recommendation #3:** Encourage coordination between agencies and value-added utilization enterprises. Both the agencies that desire to remove the biomass and the entities that will purchase the biomass need each other. If local markets exist then transportation costs can be minimized, which is in the best interest of the agencies and the biomass utilization enterprises.
  - **Recommendation #4:** Each agency should consider the possibility of passing a local tax initiative to support fuels treatment activities long term. Alternatively agencies should continue to pursue state and federal grants.
- **Pursuing Options to Increase the Low Market Value for Biomass Material:** The value of biomass material has historically been economically marginal in the LTB region. Current markets may improve with implementation of climate change policies at the state and federal level, but this is likely to take some time. The value of renewable power is relatively low (wholesale power rates are tied to externalities such as the value of natural gas) when compared to the cost of biomass power generation. To address the relatively low market value of biomass material several avenues should to be pursued:
  - **Recommendation #5:** Wholesale power rates for renewable energy should reflect actual costs associated with renewable energy generation and not be tied to externalities such as natural gas prices. Renewable power rates should be set based on the societal benefits delivered (e.g., wildfire mitigation, improved air quality) and not the relative value of fossil fuels.

- **Recommendation #6:** Support alternative uses for biomass material within the LTB region such as use in soil restoration/amendments. Innovative approaches should be encouraged.

- **Reducing the High Cost of Biomass Removal:** The relatively high cost of biomass removal activities can be addressed by 1) instituting policies which allow access for specialized collection and removal equipment, 2) subsidizing the cost with grants or local taxes, 3) reducing the creation of piles and instead conducting operations that remove the biomass at the same time the thinning operations take place and 4) developing or finding innovative equipment and operations.
  - **Recommendation #7:** Change policies which do not allow mechanized equipment on certain land types. Equipment utilized to collect, process and transport biomass material have evolved significantly over time. As the technology of biomass collection and removal has improved it is now less intrusive (fewer adverse impacts), and can effectively operate on a wider range of topography and soil types. Wherever possible, and in compliance with land management objectives and protection of critical resources (soils, habitat, SEZ) the use of cost effective collection equipment will help to mitigate biomass removal costs.
  - **Recommendation #8:** Change fuel treatment operations to combine biomass removal with initial treatment. Include biomass collection and removal (where appropriate) in fuels treatment plans to optimize efficiencies and maximize cost effectiveness.
  - **Recommendation #9:** Encourage innovation in the creative application of fuels treatment equipment that facilitates cost-effective collection, processing and transport of biomass material. New and updated equipment and techniques should be considered and field tested within the LTB. Monitor equipment impacts to critical resources (soils, habitat, SEZ) and effectiveness in treating fuels. Agencies jointly offering contracts could further enable a contractor to make the large investment necessary to purchase innovative equipment.
  - **Recommendation #10:** Assemble a technology assessment and review panel that can monitor and assess the effectiveness and practicality of emerging collection, processing and transport technologies.
  - **Recommendation #11:** Expanded use of long term contracts (e.g., stewardship contracts) for fuels treatment activities. Fuels treatment contractors need assurance that investment in expensive equipment can be amortized over several years of fuels treatment work. Long-term fuels treatment contracts will attract skilled and cost effective contractors.

- **Reducing Public Perception:** The perception that development of a commercial use for biomass will result in the industry dictating resource management decisions to ensure long term sustainability of the business should be countered by effective public outreach and education.
  - **Recommendation #12:** Share lessons learned and innovative fuels treatment techniques with all stakeholders. Outreach to stakeholders to provide

information related to current and emerging techniques to collect, process and remove biomass material generated as a byproduct of fuels treatment activities is important for community support of ongoing fuels treatment activities in the LTB.

APPENDIX A
Fuels Treatments within Fire Agency Boundaries

This appendix contains maps of the fuels treatment projects within the boundaries of the individual fire protection agency's jurisdiction initiated in 2008 and 2009, and planned for 2010. While in most cases the projects shown for 2008 and 2009 are complete, some projects are still underway, especially in the case of projects with burn piles that have not yet been burned.

Figure A-1. South Lake Tahoe Fire Department Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.

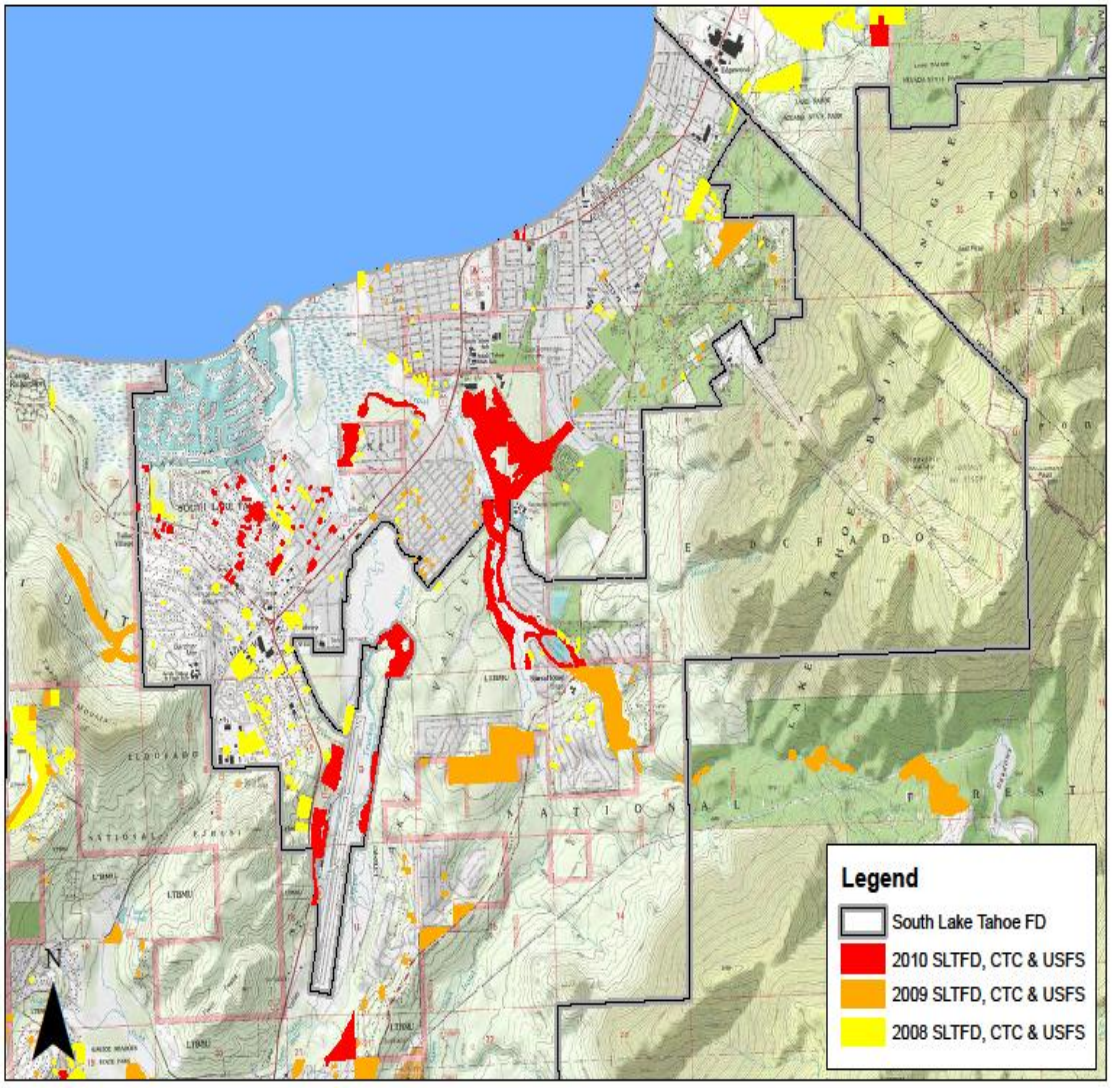


Figure A-2. Lake Valley Fire Protect District Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.

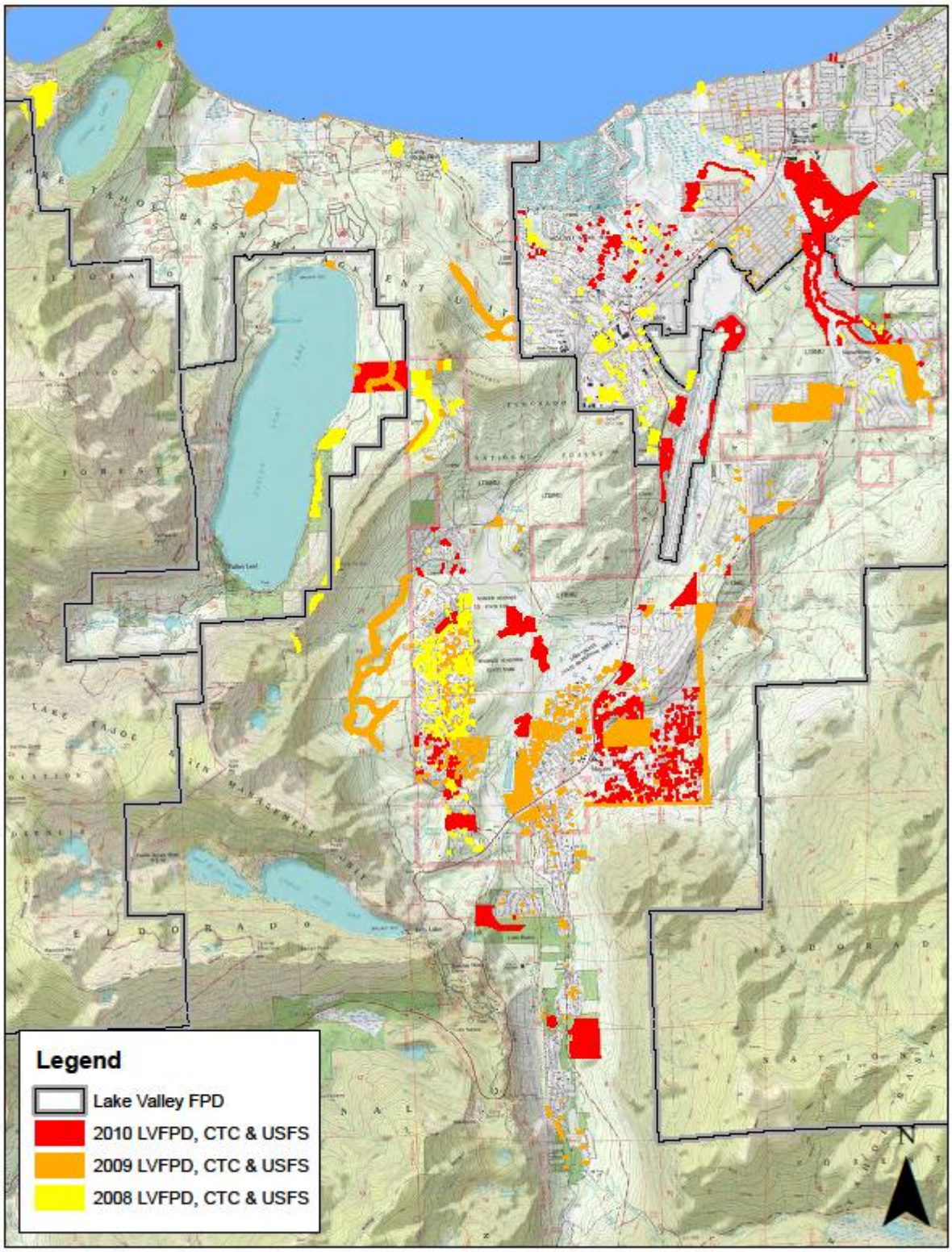


Figure A-3. Fallen Leaf Lake Fire Department Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.

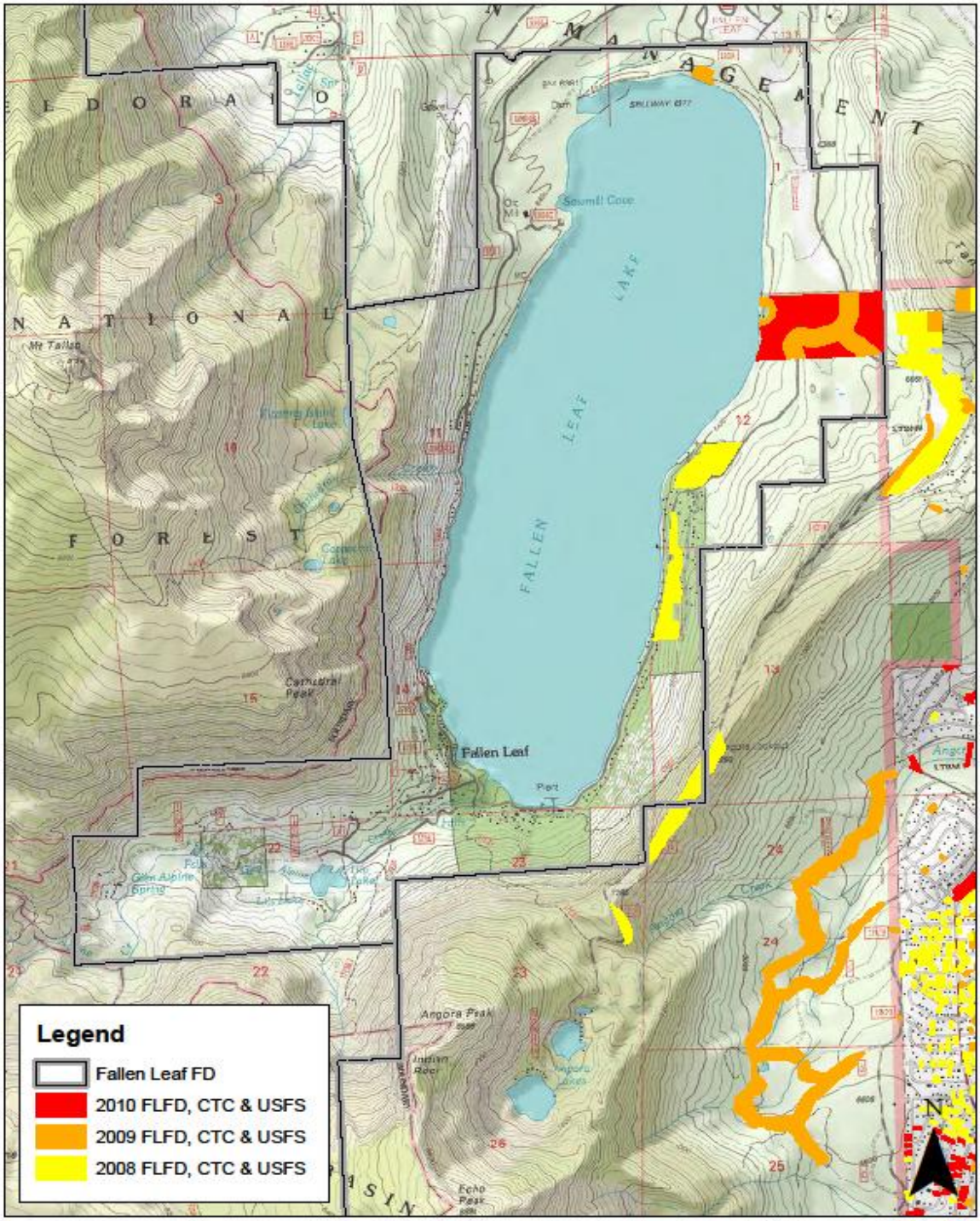


Figure A-4. Meeks Bay Fire Protect District Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.

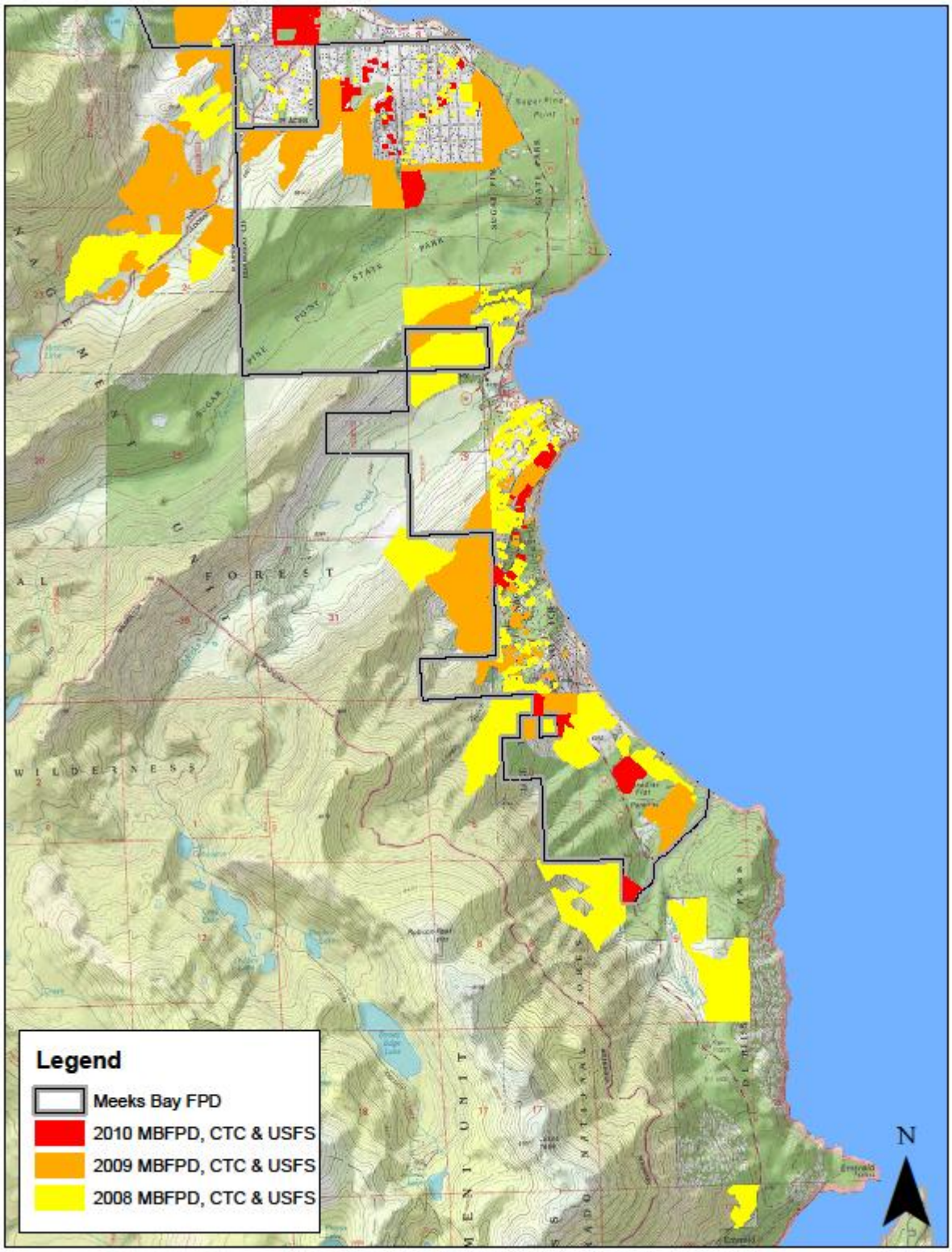


Figure A-5. North Tahoe Fire Protect District Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.

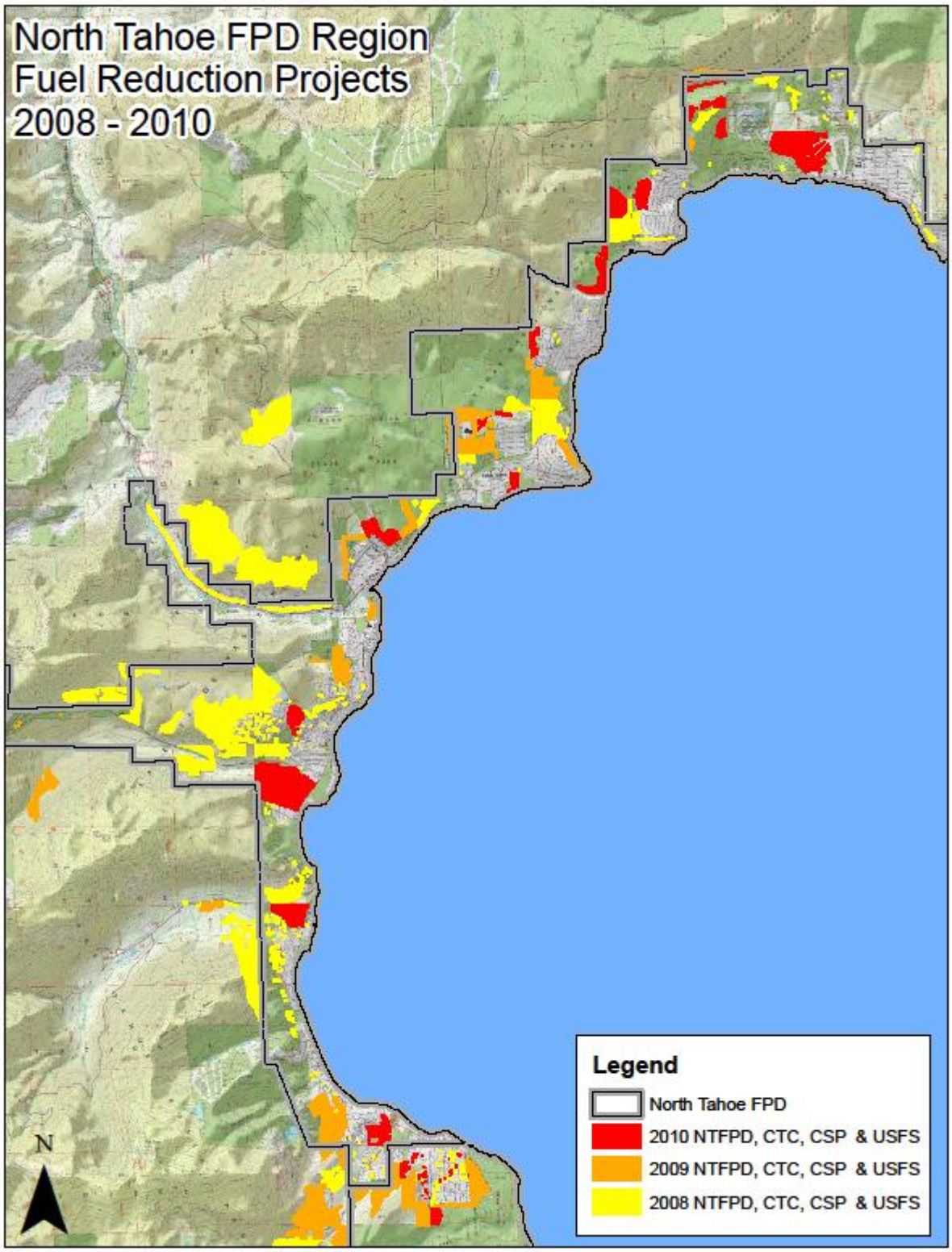


Figure A-6. North Lake Tahoe Fire Protect District Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.

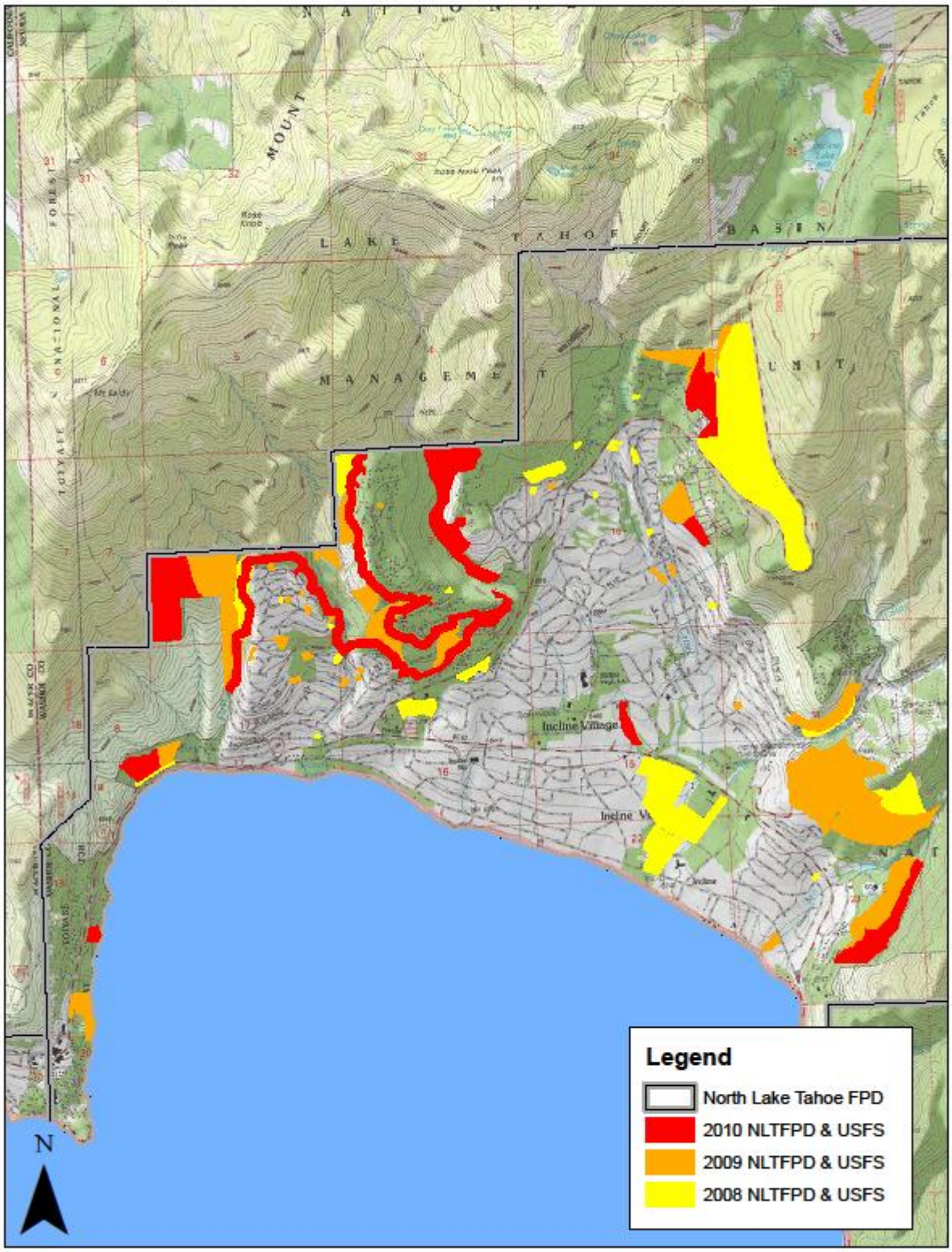


Figure A-7. Tahoe Douglas Fire Protect District Fuels Treatment Projects Initiated in 2008 and 2009 and Planned for 2010.