PROJECT F.U.E.L
Fuel Utilization Energy Logging

Prepared by the Western Shasta Resource Conservation District
For the USDA Forest Service
Community and Private Land Fire
Assistance Grant Program
Grant #01-DG-11051400-017

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WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

COOPERATORS

Project F.U.E.L would not have been possible without the help and cooperation of the following landowners and government agencies (in alphabetical order):

Bear Creek Watershed - Shingletown:

Bear Creek Watershed Group
California Department of Forestry & Fire Protection
Central Valley Regional Water Quality Control Board
Good News Rescue Mission Ranch
Klassen Ranch
Shingletown Fire Safe Council
USDA Forest Service: Shasta-Trinity National Forest

Shasta West Watershed – Old Shasta:

Bureau of Land Management
Central Valley Regional Water Quality Control Board
Redwood Development Group
Shasta West Fire Safe Council.
Shasta West Watershed Group
USDA Forest Service: Shasta-Trinity National Forest

Lower Clear Creek Watershed - Igo:

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Lower Clear Creek CRMP
Parrott Ranch
William Rich
USDA Forest Service: Shasta-Trinity National Forest

Upper Clear Creek Watershed - French Gulch:

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French Gulch-Upper Clear Creek Resource Management Group.
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Wesley and Phyllis Williams

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ABSTRACT

In Project F.U.E.L., the Western Shasta Resource Conservation District created four shaded fuelbreaks using different methods of cutting, processing, removing and/or distributing excess woody debris (the fuel loading) that acts as a catalyst for catastrophic wildfires. The Project F.U.E.L. (**F**uels **U**tilization for **E**nergy **L**ogging) report identifies the costs and challenges associated with these processes, including the use of the woody debris as fuel for a wood-fired power plant where it was used to create electricity.

I. EXECUTIVE SUMMARY

Strategically located fuelbreaks help reduce the threat of catastrophic wildfire, increase access to an area for firefighters, and improve the safety along escape routes for residents when a wildfire occurs. The plan in Project F.U.E.L. was to create shaded fuelbreaks in four communities near USDA Forest Service land in Shasta County, California. The communities of Shingletown, French Gulch, Igo, and Old Shasta were chosen for this project due to their location near the Shasta-Trinity National Forest in areas designated Very High Fire Severity by the California Department of Forestry and Fire Protection (CDF). These areas are classified as Wildland Urban Interface Zone, which is defined as the line or area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels (SAF, July 1990).

After a series of major wildfires devastated large areas of western Shasta County, the Western Shasta Resource Conservation District (RCD) developed the project idea to explore several methods to cut, process, remove and/or distribute excess woody debris that acts as a catalyst for catastrophic wildfire, including the use of the debris as fuel for a wood-fired power plant for conversion into electricity. In 2001, the RCD was awarded a grant by the USDA Forest Service through the Forest Service Community and Private Land Fire Assistance Grant Program to fund Project F.U.E.L. This project had three primary goals:

1. Build wildfire defense improvements that create defensible space (fuelbreaks) in the Wildland Urban Interface Zone.

2. Process the woody debris into biomass fuel where possible for use in wood-fired power plants that produce energy (electricity).

3. Reduce air pollution by converting the woody debris into biomass fuel that would be burned under controlled conditions at a power plant instead of just being open burning at the project site.

In addition, there were three secondary goals:

1. Develop community support for expanding fuelbreak construction.
2. Serve as a catalyst for independent fuels treatment by private landowners in the area of the fuelbreak.
3. Spawn ideas for using the woody debris as wood products.

These projects were completed in three general stages: location of the ideal site for a project and finding willing landowners to host the project on their land; developing a Scope of Work, completing environmental documentation including CEQA and NEPA, developing and distributing the bid packet; construction, including flagging, contracting, supervision, data gathering, post construction erosion control measures, and report writing.

The results of the project show the cost to reduce fuel loads varies dramatically per acre depending on the volume of vegetation that needs to be removed to effectively create a shaded fuelbreak, the areas within the footprint that have lesser vegetation to be removed (also called open space), the ability to access to the fuelbreak site with heavy equipment and trucks/vans, the topography, soil type, presence of cultural resources and the need to hand clear or avoid the area, landowner participation, and the methodology used to remove the fuel.

Variables along the way include inflation, the cost of gasoline, the price a wood-fired power plant is willing to pay for biomass fuel, the time of year, and who is available to do the work when all of the pre-construction preparation and environmental documentation has been completed.

Table 1 summarizes the work completed and costs associated with the four project locations.

BIOMASS PROJECTS IN SHINGLETOWN AND OLD SHASTA

Factor	Shingletown (30 days)	Old Shasta (35 days)	Total
Fuelbreak Footprint in Acres	58.0	33.9	91.9
Acres Treated	34.0	25.0	59.0
Truckloads of Biomass	46	27	73
Green Tons of Biomass Delivered	1,084.88	643.83	1,728.71
Bone Dry Tons Biomass Delivered	842.61	558.03	1,400.64
Average Green Tons Per Truckload	23.58	23.85	23.68
Average Bone Dry Tons Per Truckload	18.31	20.67	19.19
Green Tons Per Acre Treated	31.9	25.75	29.3
Bone Dry Tons Per Acre Treated	24.78	22.32	23.73
Average % Moisture Content	22.4%	13.3%	-
Hauling Distance -- One Way	18	16.4	-
Price per Bone Dry Ton Received by Contractor	$32.50	$32.50	-
Biomass Revenue	$27,385	$18,136	-
Handling Fee Paid to Contractor	$15,000	$15,000	$30,000
Cost per Acre Treatment Only	$441	$600	-
Total Cost Per Project	$31,816	$27,487	$59,303
Total Cost Per Fuelbreak Acre	$549	$811	$645
Total Cost Treated Areas Only/Acre ++	$936	$1,099	$1,005

MASTICATION COSTS – IGO

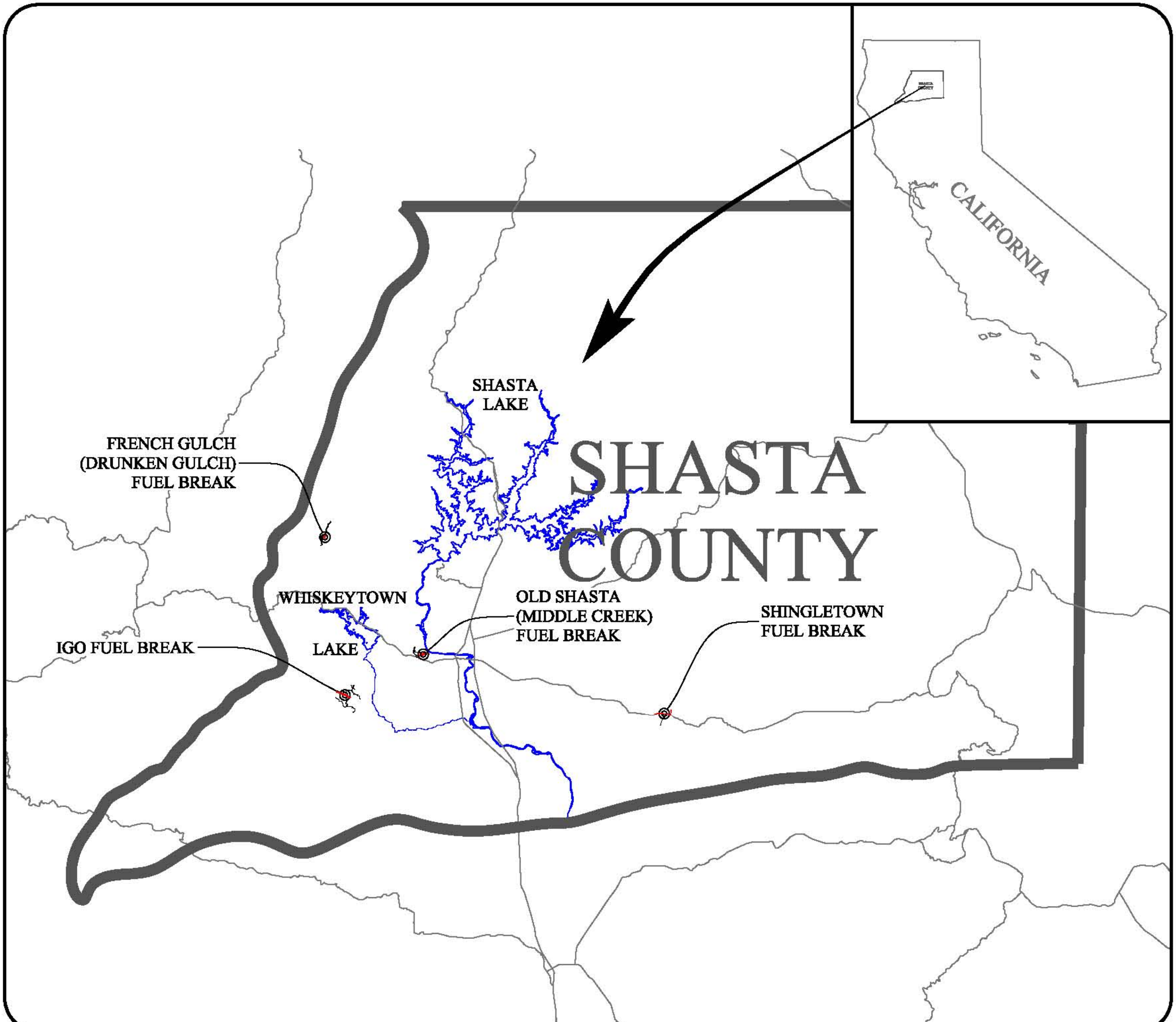
Factor	Total
Footprint of the Project in Acres	18.25
Acres Treated	14.25
Cost of Treatment Contract	$11,800
Cost of Treatment Per Acre	$828
Estimated Green Tons of Fuel per Acre *	45.6
Total Cost Per Project	$23,642
Total Cost Per Fuelbreak Acre	$1,295
Total Cost Treated Areas Only/Acre ++	$1,659

FUELBREAK COSTS – FRENCH GULCH (DRUNKEN GULCH)

Factor	Total
Footprint of the Project in Acres	18.12
Acres Treated	12.12
Cost of Contract (CDF Inmates)	$1,920
CDF Expenses Per Acre	$160
RCD Personnel Per Acre	$563
Total labor Per Acre	$723
Estimated Green Tons Per Acre *	22.4
Total Cost Per Project	$12,834
Total Cost Per Fuelbreak Acre	$708
Total Cost Treated Area Only/Acre ++	$1,058

* Based on <u>Photo Series for Quantifying Forest Residues in the Sierra Mixed Conifer Type, Sierra True Fir Type</u> (Pacific Northwest Forest and Range Experiment Station, Maxwell and Ward, October 1979). (See Appendix C)

++ This cost includes pre-project planning, site selection, landowner agreements, environmental documentation, permits, contract supervision, contract preparation, construction oversight, post-project erosion control, indirect costs, quarterly and final reports.



WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

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PROJECT F.U.E.L.

LOCATION MAP

DATE: 2005

FILE: PROJECT FUELS 03.21.05.PBG.2

SCALE: NOT TO SCALE

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.

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IF NOT ONE INCH ON THIS SHEET , ADJUST SCALE ACCORDINGLY.

SHEET TITLE:

LOCATION

DSGN: Phil Garbutt

DR: Phil Garbutt

CHK:

II. INTRODUCTION

Wildfire has historically been a natural influence on the landscape in western Shasta County. Before the influence of humans, wildfires started from lightning strikes fanned by hot dry winds and spread across large tracts of land before burning out. Such frequent, low-intensity fires burned quickly through underbrush, preserving large trees and maintaining diverse multi-story forests. Due to the influx of people into wildland areas, fires that once burned as a part of a natural process now threaten lives, property, and valuable resources in what is now called the Wildland Urban Interface Zone. Additionally, fire suppression actions over the past decades have further added to fuel buildup, increasing the risk and intensity of wildfire.

Wildfires not only destroy valuable assets and resources, but the scorched earth left behind creates a high potential for erosion that can impact water quality and stream health. The reduction of excessive fuel loads can greatly reduce the risk and spread of catastrophic wildfire. Fuel reduction projects provide protection for communities and natural resources and increase firefighter access to more effectively suppress wildfires.

Three components are needed to sustain a wildfire: fuel, an ignition source, and air. The fuel that feeds a catastrophic wildfire is made up of various components of vegetation, living and dead, which occur on a given site. Fuel loading is the total amount of fuel or excess vegetation in an area (typically calculated on a per acre basis) that is available for ignition. In most areas of western Shasta County, the fuel loading is excessively high with ladder fuel conditions. The debris removed or masticated in Project F.U.E.L. had 26-32 green tons/acre. Definitions of fuel loading are presented in Table 2.

Table 2: Fuel Loading Definitions Based on Tons Per Acre.

Low Fuel Loading	less than 10 tons/acre
Medium Fuel Loading	10 to 15 tons/acre
High Fuel Loading	over 15 tons/acre

Ladder fuel conditions occur when vegetation grows at such a variety of heights in an area that when it begins to burn, a ladder effect is created that carries the fire into the canopy of trees where it can become explosive, difficult to control, and carry fire from tree to tree.

Figure 1. Typical fuel ladder conditions that can lead to a crown fire (courtesy of CDF).

Several methods exist for removing excess fuel: cut/pile/burn; mastication; cut/chip/disperse; and biomass for energy. Each of these methods has different benefits, drawbacks, and costs. This report explains the methods and associated costs on four demonstration sites. Each area presented unique challenges during planning and implementation, which are discussed in an effort to expand public knowledge and understanding of the treatments and the potential use of the woody debris created during a fuels reduction project.

III. BACKGROUND

Shasta County lies at the northern end of the Great Central Valley in California, an area with a Mediterranean climate of long hot days from late spring to mid-fall with intermittent rain and snow during the cooler season. Summer daytime humidity can reach 15% and lower. The area experiences extreme fire weather conditions, especially from July until late September when high temperatures range between 95-115 degrees F. Frequent strong north winds and dry lightning storms occur throughout the summer in most years.

The county has experienced devastating wildfires in recent history. The fuel loading on all of these fires had reached a critical level due to years of fire exclusion and a prolific growth of vegetation. In most areas of the county the landscape has been accumulating vegetation without interruption for 50-80 years. Table 3 lists the major fires in Shasta County.

Table 3: Major Fires in Shasta County, California

Year	Wildfire	Consumed	Cost of Suppression
1992	Fountain Fire	63,960 acres, 636 structures	$21 million
1999	High Complex Fire	39,000 acres (on Forest Service Land)	
2001	Canyon Fire	2,580 acres, 230 structures	
2001	Jones Fire	26, 202 acres, 176 homes, 63 barns, 2 churches, 115 garages, 90 RVs and boats, 422 outbuildings, 123 vehicles	$ 6 million
2004	Bear Fire	10,484 acres, 2 cabins, 28 houses, 46 mobile homes, 1 other, 9 RV's, 130 outbuildings, 155 vehicles (~1/3 of this fire was a re-burn of the 2001Jones Fire)	$9.2 million
2004	French Fire	13,323 acres, 17 houses, 8 mobile homes, 1 other, 1 IOOF Hall, 76 outbuildings, 58 vehicles	$14.9 million

The fire triangle has three components: air, fuel, and ignition source. Project F.U.E.L. addressed the ‘fuel’ component of the triangle by reducing or modifying the quantity and arrangement of excess vegetation, which in this report is called ‘fuel’. Experience has shown that this type of modification, when made at strategic locations where topography (elevation, aspect, steepness and shape) can affect the direction of a wildfire, acts as a break in the continuity of fuels where the fire slows down, drops back to the ground from the tree tops, gives firefighters a greater opportunity to contain the fire, gives residents a chance to leave the area of the fire, and allows greater access to firefighters coming into the fire area.

A goal of all firefighting agencies and local government has been to find economical methods of lowering the threat of catastrophic fire by reducing the volume of excess woody material. The construction of a network of shaded fuelbreaks is one way to reduce fuel loading in strategic locations, yet the biggest concern in planning a fuel modification project is what to do with the excess woody material once it is cut.

As the largest landowner in Shasta County, the Shasta-Trinity National Forest (STNF) supports the creation of strategically located shaded fuelbreaks as one way of increasing the protection of USDA Forest Service land and the Shasta Lake National Recreation Area. Larger healthy trees are selected to remain based on a desired crown spacing of 15 to 30 feet. The fuelbreak is designed so that brush is almost completely removed in the strip. The number of shrubs can be increased towards the outside boundaries, so the fuelbreak blends in with the surrounding landscape more naturally. Fuelbreaks are generally placed along ridgelines and roads to allow maximum firefighting effectiveness and to simplify construction and maintenance. Fuelbreaks are expected to reduce wildfire severity by limiting the size of the area affected by wildfire, creating zones where fire suppression efforts can be conducted more safely and effectively, breaking up the continuity of fuels over a landscape, and working as anchor lines for further area-wide fuel treatments and can include prescribed burning. The fuelbreak line is created by 150-300’ wide shaded fuelbreaks positioned along strategic ridgelines and the sides of roads along key travel corridors. To maximize the effectiveness of a network, individual landowners in the area should create 100’ of defensible space around homes and structures in areas with High and Very High Fire Severity Ratings. This is referred to as the Wildland - Urban Interface Zone.

Since 1999, Western Shasta Resource Conservation District (RCD) has actively sought funding to accelerate the construction of shaded fuelbreaks in high risk areas of the 1.7 million acre district. The RCD applied for a grant from the USDA Forest Service through their National Fire Plan Community and Private Land Fire Assistance Program, requesting funds for Project F.U.E.L. to explore the costs and challenges of several methods of treating the excess vegetation during the construction of shaded fuelbreaks.

Project F.U.E.L. was designed to explore the feasibility of various methods to cut, process, load, ship and haul woody material to wood-fired power plants for conversion to electrical energy. The four areas selected for projects are representative of the variety of fuel, topography, and population density found in western Shasta County. The four sites specified in the grant were Shingletown, Igo, Old Shasta, and French Gulch. RCD was aware at the outset there would be challenges associated with the various sites of the project. Varying fuel types, access, topography, and population densities presented unique challenges in each of the four project areas. These considerations were balanced with finding projects that were economically viable, while also contributing to the creation of fuelbreak in a strategic location. The combination of all these factors influenced the RCD's approach to utilization of the woody material at each site.

IV. GOALS AND OBJECTIVES

Project F.U.E.L. had three primary goals:

1. Build wildfire defense improvements that create defensible space (fuelbreaks) in the Wildland Urban Interface Zone.

2. Process the woody debris into biomass fuel where possible for use in wood-fired power plants that produce energy (electricity).

3. Reduce air pollution by converting the woody debris into biomass fuel that would be burned under controlled conditions at a power plant instead of being open burned at the project site.

In addition, there were three secondary goals:

1. Develop community support for expanding fuelbreak construction.

2. Serve as a catalyst for independent fuels treatment by private landowners in the area of the fuelbreak.

3. Spawn ideas for using the woody debris as wood products.

The grant requirements included: communicating the results of the project to the grant sponsor, media, professionals and the general public; conduct a workshop on the utilization of woody debris; compile the findings in a final report.

V. FUEL TREATMENTS

There are several ways to remove or distribute fuel or excess vegetation while creating a shaded fuelbreak. The cost and the ability to apply each method differs in labor source, intensity, time, season of the year, and specifically the way the fuel is treated at the site. The methods analyzed in Project F.U.E.L. include: cut/pile/burn; cut/chip/disperse; cut and biomass (process into pieces 3” or less in diameter for use as fuel in a wood-fired power plant); and mastication. Mechanical methods to remove fuels include, but are not limited to, the utilization of bulldozers with or without brush rakes, excavators, chainsaws or mechanized falling machines, masticators, chippers, and grinders.

CUT/PILE/BURN

Hand cutting brush and small trees is done using chainsaws, pole saws and brush trimmers. This labor-intensive method requires the understory brush and small trees to be cleared by hand with the material lopped or cut near the base of the plant. Larger woody debris is cut into smaller manageable pieces. The vegetation is piled and burned on site. An archaeological assessment is conducted on the area where the burn pile will be located to insure no cultural resources are impacted. For liability reasons RCD crews do not conduct pile burning, so when this method is used, the RCD crews do the cutting and then contract with CDF inmate crews (Figure 2) or professional fire crews to pile and burn. Burning is typically limited to winter and early spring when conditions allow safe ignition (Figure 3).

Figure 2. CDF Crews clearing vegetation by hand.

Figure 3. Piles of woody debris that will be burned.

CUT/CHIP/DISPERSE

This method is used when open burning is not possible due to high fire danger or when air quality conditions or the time of year limit the number of available burn days, and/or the site is not accessible to vans that could haul the processed wood to a power plant. In many areas burning may not be an option due to regulatory constraints or it may not be acceptable to the landowner. Hand cutting brush and small trees is done using chainsaws, pole saws and brush trimmers. The understory and small trees are cleared by hand with the material lopped or cut near the base of the plant. Large woody debris is cut into smaller manageable pieces. Once cut, the residue is dragged to a chipper where it is chipped into pieces about 3" or less in size and dispersed or blown back onto the ground where it remains as mulch. It is important in dispersing the chips that the mulch is not piled more than 4" thick to eliminate the threat of spontaneous combustion from the heat released by the wood as it degenerates. This method is slower than piling and burning due to the to extra time needed to move the cut material to the chipper (Figure 4) and may not be feasible in remote areas where a chipper cannot be brought to the site (Figure 5).

Figure 4. Dragging brush to chipper is labor intensive.

Figure 5. Chippers require road access to the project.

CUT AND BIOMASS

Shasta County is home to several wood-fired power plants that use processed 3" minus woody debris or biomass as their fuel source (Figure 6). The feasibility of fuels projects for power generation is highly dependant on the market price of biomass at the power plant. The "cut and biomass" method uses large heavy equipment to remove the brush and small trees before processing the debris with a tub grinder or wood chipper. A loader puts the debris into the grinder or chipper (Figure 7) where it is processed into the preferred size, which is 3" minus. The grinder or chipper then conveys or blows the fuel into a 40-45' van (Figure 8). When the van is full or at legal capacity (25 green tons) a tractor hooks up to the van and hauls it to a wood-fired power plant. At the power plant, a truck dump lifts the van and tractor into the air and the biomass empties out of the back of the van into a bin where it is metered onto a conveyor that carries it to the fuel pile.

Figure 6. Wheelbrator Shasta Energy Company.

Figure 7. Loader placing material into chipper.

Figure 8. Chip van being loaded.

MASTICATION

Mastication is a form of mechanical fuels treatment that modifies the fuel loading within an area by chopping, grinding and mowing. This form of fuels treatment does not reduce the amount of woody material within a site, but rearranges it. The vertical height of the fuels is lowered as it is ground into smaller pieces left on site. Mastication can be very beneficial as it creates its own erosion control practices by how it moves and grinds the debris, which can reduce or eliminate the cost of erosion control typically associated with the use of heavy equipment.

Many different types of mastication equipment exist including tracked and wheeled machinery. The wheeled machinery can cover more acreage per day, but is limited to gentler slopes in comparison to the tracked vehicle. The cutting tool or head can either operate like a flail mover (Figure 9) or like a lawnmower (Figure 10). Some machines have self-leveling cabs that can be used on steeper terrain. Additionally, the head can either be mounted directly on the machine or placed at the end of an arm that allows the head to reach out or down into areas not accessible to the machine.

Figure 9. Vertical Shaft Masticator with wheels.

Figure 10. Horizontal Shaft Masticator with treads.

Mastication can be a fast and effective way to create shaded fuelbreaks. It can also be used before controlled burns to minimize risk to existing stands of desirable species. Mastication is limited by access, slope, and terrain, including rocky and unstable soil conditions. Additionally, there is a risk of accidental ignition from the machinery and from sparks when the metal head hits hard objects. This increased risk of fire limits the time of the year mastication can be used. Masticators also can impact soil conditions and may not be suitable for areas with sensitive or granitic soils.

V. CONSTRUCTION PREPARATION

SITE SELECTION

When a Strategic Fuels Reduction Plan is completed for a watershed or large area, it identifies the location for a network of shaded fuelbreaks to ultimately be constructed and maintained. A Site Selection Committee made up of foresters and biomass experts prioritized the fuelbreak segments and assisted in locating funding for the projects. The RCD typically uses the prioritized list from the Strategic Fuels Reduction Plan when applying for grant funding to implement a project.

Since all areas included in Project F.U.E.L. did not have completed strategic fuels reduction plans the specific sites for implementation were not identified up front, but were developed with the assistance of a Site Selection Committee once funding was secured. Visual impacts are considered when planning shaded fuelbreaks so that all parties are aware of how the area will look when the project is completed. Initial planning addresses mitigation for erosion potential and the use of measures such as waterbars, ditching, and mulching. Furthermore, the impacts on wildlife and archaeological resources are addressed.

Whether a project can be implemented using either the biomass method or mastication or the more expensive cut-pile-burn or chip and disperse depends on several factors:

1. Fuel Loading. The volume of vegetation in a given acre is the ‘fuel loading.’ Vegetation varies greatly from location to location and the suitability for bringing in heavy equipment to create biomass depends on the amount of tonnage available to be cut and processed. Fuel loading is typically described as either green tons per acre or bone dry tons per acre. A green ton is 2,000 pounds, while a bone dry ton is 2,000 pounds of wood when all moisture has been deducted. The moisture content is calculated by drying a green wood sample in a wood-drying oven using industry standard procedures.

2. Road Access. One of the key components to a biomass operation is the ability to move equipment into and out of a location. The general minimum requirements needed for the feasible use of chip vans (trailers used to haul biomass) was provided by Sierra Pacific Industries, Anderson, California, and are:

- Rolling dips should be at least 75' long, and a maximum of 2' deep. The turning radius needs to be at least 100' for curves on roads. A road will need either a large turn around spot, "loop" road or a spot where drivers can "nose" into and back up and make a 3-point turn. The van must be able to back into the chipper or be accessible to the chipper depending on chipper location. Road grades should not exceed 15 percent favorable grade, and turns should be minimal in the steep parts, and the road should be kept watered, but not slick. Chip van trailer lengths are 42', 46', 48', or 53' without the tractor, as tractor lengths will vary. Overall length of tractor and trailer cannot legally exceed 70 feet.

- The creation of new roads or improving existing ones to allow the use of chip vans will increase the costs associated with using the biomass process and increase the potential for erosion after project completion, which must be mitigated.
- Hand crew operations utilizing hand-fed chippers must also have access that minimizes dragging distances in order to keep costs within reason. Dragging vegetation uphill, even for minimal distances, or distances over 100 feet on fairly flat terrain will increase costs and may eliminate the feasibility of chipping with hand crews.

3. Topography. The machinery used for biomass processing is capable of working on slopes less than 40%; however, slopes exceeding 20% are usually avoided to prevent accelerated erosion or the need for extensive erosion control measures. The material must also be accessed by a grinder or chipper that will require flat ground in close proximity to the cut piles. The working area for the grinder or chipper must have turnaround space for the vans and tractors as specified above.

4. Site Conditions. Soils such as decomposed granite can be more susceptible to erosion after a biomass operation due to its unstable and easily eroding nature. This can be mitigated by erosion control practices, which also increases the cost. Extremely rocky areas may eliminate the use of masticators or increase the cost of biomass clearing due to the time associated with the rocks damaging the machinery and the threat of sparks causing a fire. This has a similar effect to hand crews using chainsaws and inadvertently striking rocks.

5. Impact to Resources. During the planning and permitting phases of a project additional impacts may dictate the methodology used, including wildlife protection and cultural resources.

6. Willing Landowners. Participating landowners may prefer low impact hand clearing methods instead of the large equipment associated with mechanical treatment. Additionally, some locations may not be suitable for mechanical treatments if it is near schools and communities sensitive to high noise levels.

PERMITS AND LEGAL CONSIDERATIONS

Before permitting begins, a complete scope of work for the project must be created including an accurate map of the project footprint and a detailed description of the actions to be taken during implementation within that footprint.

ENVIRONMENTAL DOCUMENTATION

The California Environmental Quality Act (CEQA) requires the evaluation of all planned actions taken during a project to determine whether there might be a significant impact to the environment. The CEQA documentation process must be completed before the project is started. If the project was funded through federal grants or is conducted on federal property, the National Environmental Policy Act or NEPA documentation must also be completed. The RCD was required to complete both CEQA and NEPA on these projects.

For all four Project F.U.E.L locations the RCD evaluated the project impacts on wildlife, including habitat assessments, and evaluated state and federal lists of threatened, endangered or sensitive species, cultural resources including record searches and field surveys, land use and ownership, and soils and geology. “Scoping” was also completed for the projects and included the publication of notices in the Redding Record Searchlight (the largest circulation newspaper in Shasta County), sending letters to all landowners within and adjacent to the project locations, sending letters to all tribal entities and agencies responsible for the oversight of cultural resources in California. Scoping allowed the public to comment on the project prior to implementation. No comments were received regarding this project. One letter was received from a landowner that has led to a project on their property through another grant.

AGENCY PERMITS

The size of the fuelbreak, its topography, location, and method of construction determine the specific agency permits needed before construction. The agency permitting process is designed not only to ensure that the implementer is following all applicable rules and regulations, but that the effects of the project will not have a negative impact on the environment or the existing natural and cultural resources. The typical agency permits required for fuels reduction projects include:

- California Department of Fish and Game Stream Bed Alteration Agreement if fuel break construction occurs near waterways and riparian areas;
- Regional Water Quality Control Board Storm Water Pollution Prevention Plan (SWPP);
- City, County, or State Encroachment Permit; City, County, or State Grading Permit;
- Air Quality Management District Burn Permit; and
- City, County, or State Fire Department burn permit.

For projects that impact federally listed wildlife under the Endangered Species Act of 1973, the United States Fish and Wildlife Agency must be consulted. California also requires notification for impacts to wildlife through consultation of the Department of Fish and Game under the California Endangered Species Act.

Local ordinances vary by county and even location within the counties. Checking with public works agencies is the best way to identify the need for further permitting. Additionally, at all four locations a USA search was completed to ensure that no utility lines were impacted during project implementation.

LANDOWNER PERMITS

In most cases a shaded fuelbreak will cross multiple land ownerships. Typically, the RCD invites landowners in and around the project area to a community meeting early in the process to find out about the project, its importance, the process, timeframe, requirements, and expected results. RCD staff met with each landowner to answer questions and visit their segment of the project. Usually most landowners are happy to sign a Temporary Entry Permit that allows the RCD crews on their property to do the work. Quite often landowners that initially choose not to participate change their mind when we refer them to other shaded fuelbreak work that was done in the area.

STATE FOREST PRACTICE RULES

California has the strictest forest practice rules in the nation, which include rules on the construction of shaded fuelbreaks in areas designated as commercial forestland. Prior to June 2004, fuel reduction projects were covered under Paragraph 1038(c), which exempted biomass harvesting within 150 feet of a permitted and legally approved residence. In June 2004, the California Board of Forestry voted to accept an emergency rule package for biomass fuel reduction in the State Forest Practice Rules. The emergency rules (an amendment to Paragraph 1052) formalized the archaeology requirements, set the waiting period at 15 days for the installation of vegetative treatments, required all trees harvested or all trees retained to be marked, and required a Registered Professional Forester to approve the prescription, all of which adds to the cost.

Water Quality Protection – In early 2004, the Regional Water Quality Control Board (RWQCB) notified the RCD that they would cease the requirement that Project F.U.E.L. fuelbreaks file a Notice of Intent and the preparation of a Storm Water Pollution Prevention Plan (SWPPP). The RWQCB stated that the RCD must exercise prudence in protecting the waters of the State and the formal documents would not be needed. The cost of filing a Notice of Intent and developing and filing a SWPPP for the Middle Creek Project alone would have been well over $1200.

IV. THE PROJECTS

BEAR CREEK WATERSHED - SHINGLETOWN

BACKGROUND

Shingletown is a community of 10,200 residents located on a ridge at 3,200 foot elevation in Shasta County. A *Shingletown Wildfire Defense Plan* was written in 1995 to address the issue of high fuel buildup and the potential for catastrophic wildfires. The plan was updated in 2003.

The topography on the ridge itself is fairly flat, with steep country to the south, west, and north, increasing the potential for intense fast moving wildfires to burn into the ridge from those directions. Prevailing south winds supported by upslope winds on hot days and the concentrating influences of canyons add to the threat. Temperatures in Shingletown reach over 90 degrees when temperatures in the valley exceed 100 degrees most of the summer months. In the fall, north winds that blow for days are common. CDF has rated the fire danger for the Shingletown Ridge area as Very High. There were 32 recorded wildfires in the Shingletown/Inwood area between 1900 and 2000, which burned 45,455 acres. In the 1960's 19,512 acres burned and in the 1970's 8,986 acres burned.

The communities in and around Shingletown have been actively involved in holding Community Clean-up Days since 1992, where residents cut excess vegetation and it is processed for them at a nominal fee. CDF and the local volunteer fire department have spearheaded this effort. CDF has also supported the clean-up with their staff time, funding for equipment, and operators.

CHOOSING THE PROJECT SITE

When planning a biomass project in the Shingletown area, one of the considerations was the volume to be removed on land classified as Commercial Timberland. The fuel reduction must fall below the "10 percent average volume per acre removal rule". (See California Forest Practice Rules, Paragraph #1038 and 1052 for details, Appendix B.) The decision to remove more than the 10 percent rule triggers the preparation of a Notice of Emergency Timber Operations or a Timber Harvest Plan (THP), a lengthy procedure with costs ranging from $12,000 to $20,000 for a completed THP. The density of the tree canopy in the forest around Shingletown is such that frequent removal of less than 10 percent of the volume is not sufficient to create a viable fuelbreak. By moving the fuelbreak location away from Shingletown proper, and to the west in communities surrounding Shingletown, we changed forest type from a commercial ponderosa pine forest to an oak/gray pine/manzanita savannah, which is classified by the state as a non-commercial forest type. The large amount of fairly flat topography is conducive to moving large equipment in and out and for staging 42-53' vans and tractors to haul the biomass. The closest wood-fired power plant was Wheelabrator Shasta Energy, a 50 megawatt plant in Anderson, California, about 18 miles southwest by paved road.

The RCD, CDF, and a biomass expert evaluated five potential project sites. Four of the sites were rejected because of unfavorable site conditions and uneven density of fuels made it uneconomical for biomass harvest. In order for a site to be considered suitable for biomass harvest, several criteria must be met:

1. The terrain must be suitable for operating the mechanical harvesting equipment, so the topography must be favorable, and the surface must be free of rocks and boulders.

2. The access road system must be suitable for chip vans.

3. The densities of the fuel to be harvested must be high enough to be economically feasible.

Two of the four project areas were eliminated because of low fuel density available for biomass harvest. A third site was eliminated because houses were too close to the site to safely operate the grinder. The fourth site was eliminated due to a lack of access for the chip vans.

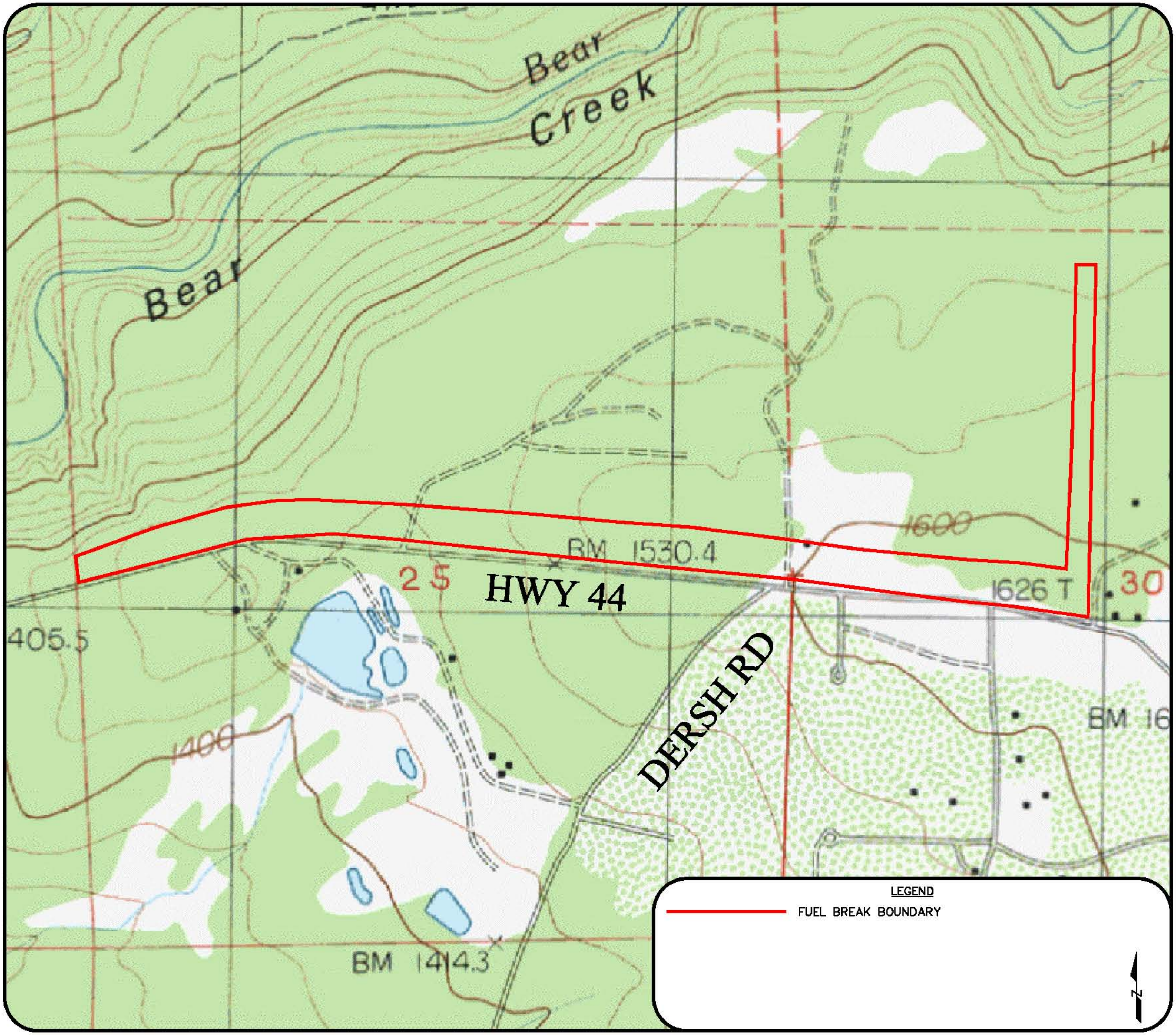
The selected site along Highway 44 was owned by the Good News Rescue Mission and Klassen Ranch. The decision took into consideration residents in the communities of Inwood and Midway on the ridge to the east. Developments on the south side of Highway 44 along Camino Oro, Camino Vista, and Camino Real would also benefit. The fuelbreak would provide needed protection to these communities in the case of catastrophic wildfire and help prevent a fire from spreading uphill into the community of Shingletown. Additional considerations were: the configuration of the site approximated the acreage specified in the grant; adequate vegetation and uniformly thick brush to support a biomass operation; easy access for chip vans with good road frontage; a highly visible site so the public would see what a fuelbreak looked like during and after construction; and only two landowners would be involved and both were very willing to participate.

CONSTRUCTION PREPARATION

Once the site was selected, the RCD determined how the fuelbreak would be positioned on the landscape to provide the maximum benefit from a strategic fuels reduction standpoint. Since the prevailing winds in the area during the fire season are typically from either the north or south, an east-west orientation was essential. The proximity to a nearby creek canyon was also taken into consideration as this canyon has the potential to carry a large fire upstream and uphill into the more densely populated areas of Shingletown. It was decided that the fuelbreak would be situated along a 1.5 mile stretch of Highway #44 (East/West) and average 300' wide (see Map 1. Shingletown Fuelbreak).

The fuelbreak would be constructed close to the canyon rim on the west end of the fuelbreak and incorporate open areas to increase the overall size of the fuelbreak. The project footprint totaled 58 acres, which included 34 acres treated after deducting lesser vegetated areas. After obtaining signed landowner agreements for temporary entry to do the work, the RCD began CEQA and NEPA documentation. The archaeology survey investigation revealed the property was part of the historic Nobles Trail and a portion of the historic Hill Ditch water ditch. Field surveys further revealed artifacts indicating a large prehistoric site. To protect these sites, a 4-acre area was flagged for hand crews only. Once the project was designed and had gone through the evaluation and permitting process, a bid document was prepared, and bids were solicited from contractors capable of performing the work.

The RCD maintains a Contractor's List on an annual basis that has contact information for contractors performing various types of work in the district. Eight contractors who indicated that interest in bidding on fuels reduction projects were chosen from the list, faxed a scope of work, and invited to a required job showing to go over the project. Three contractors attended the pre-bid job showing on July 21, 2003 at the job site. The RCD received two bids for the project which were $15,000.00 and $42,907.57. The high bidder was located in Chico and set up to process prunings in orchards; this was not a cost effective project for them.



WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

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PROJECT F.U.E.L.

MAP 1

BEAR CREEK (SHINGLETOWN) FUELBREAK

DATE: 2005

FILE: PROJECT FUELS 03.21.05.PBG.2

SCALE: 1" = 1,000'

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.

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IF NOT ONE INCH ON THIS SHEET , ADJUST SCALE ACCORDINGLY.

SHEET TITLE:

SHINGLETOWN

DSGN: Phil Garbutt

DR: Phil Garbutt

CHK:

FUELBREAK CONSTRUCTION

Justis Waste Recycling (JWR) of Redding, California was the successful qualified low bidder. A contract was signed, a Notice to Proceed was issued on August 19, 2003 and construction began September 3, 2003. The highway encroachment was constructed on September 12, 2003.

The equipment utilized by the contractor consisted of a Caterpillar 325 Excavator with a thumb on the bucket (Figure 11), a D4-C Caterpillar bulldozer with a brush rake on the blade, a Caterpillar 966 loader (Figure 12), a Morbark Tub Grinder (Figure 13), and three chip vans. The tub grinder and chip vans were on site for five days (Figure 14).

Figure 11. A Caterpillar 325 excavator with thumb.

Figure 12. A Caterpillar 996 loader moves woody debris to grinder.

Figure 13. A Morbark tub grinder processing debris.

Figure14. A chip van being loaded.

The contract allowed 25 working days in the 58-acre footprint of the fuelbreak. A change order was issued on September 19th allowing five more working days in exchange for clearing an additional six acres, which was originally intended to be masticated. When the six acres was put out to bid only one bid was received and it was so prohibitively high. As a result JWR agreed to do the work in exchange for the additional working days. The final loads of biomass were removed from the site on October 6, 2003. A Notice of Completion was filed October 16, 2003.

The shaded fuelbreak on the four-acre archaeological site was constructed using CDF inmate crews to cut brush, carry it out of the archaeological site, then pile and burn it. This took the crew ten days to complete and the work was finished on November 21, 2003.

On September 30, 2003, RCD was notified by Central Valley Regional Water Quality Control Board (CVRWQCB) staff that our CEQA Programmatic Exclusion through CDF, with whom we collaborated on CEQA, was not sufficient to cover the amount of cleared area from the biomass project, and we would need to prepare a Storm Water Pollution Prevention Plan (SWPPP). We filed the Notice of Intent with the Water Quality Control Board, and prepared a SWPPP for the project site. The Best Management Practices (BMP) put into the plan were mulching with either weed-free straw or biomass generated on site, and the construction of water bars at critical locations within the fuelbreak. The BMP's were installed by RCD personnel, and their cost is reflected in the cost of the project. The fuelbreak was monitored after the first rains of the season, and the site stabilized satisfactorily, the BMP's held up as designed, and the Notice of Termination was filed in December 2003. CVRWQCB sent a release for the Notice of Termination on March 9, 2004.

RESULTS

A total of 1,084.88 green tons of fuel (842.61 bone dry tons) were delivered in 46 van loads to Wheelabrator Shasta Energy Company in Anderson, California. The power plant purchases biomass on a bone dry ton basis. Each van load of biomass is weighed in and out. A gallon-size sample was taken from the load and a 1000 gram sample dried according to standard industry practices. The moisture content was applied to the green weight of the biomass and bone dry tons calculated. The result was an average of 31.9 green tons, or 24.78 bone dry tons per acre. The contractor received $32.50 per bone dry ton or $27,384.83 for the biomass. The JWR cost to mechanically clear the area was $15,000 (total costs were offset by revenue from sales of the biomass to Wheelabrator Shasta Energy). CDF cleared the 4-acre archeological avoidance area by hand at a cost of $750 dollars.

This project met with the goals of Project F.U.E.L. by creating a fuel reduction project near the community of Shingletown and utilizing the woody debris to compensate for the cost of the fuel reduction effort. Additionally, the woody biomass was used to create clean energy at a wood-fired power plant. The following before and after photos illustrate the project.

Figure 15. Before (note grey pine)

Figure 16. After

Figure 17. Before (note sign)

Figure 18. After

Figure 19. Before

Figure 20. After

SHASTA WEST WATERSHED – OLD SHASTA

BACKGROUND

Old Shasta is a community of 1,000 residents located at 825 feet elevation, 5 miles west of Redding. The community includes a 19-acre historic state park with many old buildings that date back to the 1850's. Increased development in this Wildlife Urban Interface Zone has put residents at an increased risk of property loss due to wildfire. Historical records from CDF and the USDA Forest Service indicate that between 1940 and 1970 the Shasta West Watershed experienced many large-acreage fires.

The *Shasta West Watershed Strategic Fuel Management Plan* (RCD, November 2003) was completed to address the issue of high fuel buildup and the potential for wildfires by designing a strategic fuels reduction network that, when completed, would help reduce the threat of catastrophic wildfire, give firefighters additional protection and locations to stop or contain a wildfire and give residents more protected ingress and egress. In the lower elevations of the Shasta West Watershed the wind blows from the north during early summer and from the south during latter summer. In the western foothills, the wind trends up the canyons on the hillsides both east and west. In the valley the wind patterns push wildfire in a northerly or southerly direction and in a westerly direction in the foothills. The strategic plan showed that fire spread in the lower elevations can most likely be decreased by an east-west fuelbreak where control lines would be set up.

CHOODING THE PROJECT SITE

Three potential sites in the Old Shasta area were reviewed. All sites were covered in heavy brush and small oak trees. One site had a segment of land in the middle owned by the Bureau of Land Management (BLM), but efforts to coordinate the project to dovetail with BLM efforts within the allotted timeframe were unsuccessful. A second site involved multiple absentee landowners and after several successive attempts, it was not possible to get the level of response needed from the owners to complete the project in the timeframe allowed. One landowner, Redwood Development Group, familiar with the RCD past projects agreed to cooperate on this project. Their property was on the ridge between Middle Creek and Salt Creek, which was ideal.

RCD personnel visited the Middle Creek project site with the landowner, and a Temporary Entry Permit was signed on March 12, 2003. The site had adequate dense vegetation on sufficiently gentle slopes with few rocks on the surface. The parcel was large enough for the 25-acre shaded fuelbreak footprint on the ridge top. Road access was suitable for the grinder and there was ample room for staging the vans to haul out the biomass. The vegetation was a mixture of Blue oak (*Quercus douglasii*), Scrub oak (*Quercus dumosa*), Buckbrush (*Ceanothus Cuneatus*), Manzanita (*Arctostaphylos spp*.) and Gray pine (*Pinus sabiniana*). Heavier fuel loading was on the northern slopes of the project area and consistent with typical mixed chaparral (disturbed blue oak-foothill pine) with a heavy closed canopy and height ranging 1 to 4 meters. There was evidence of past vegetation clearing throughout the fuelbreak location. In many of these areas, scrub oak, manzanita, and buckbrush had taken over, creating dense stands with little or no herbaceous vegetation and deep litter.

CONSTRUCTION PREPARATION

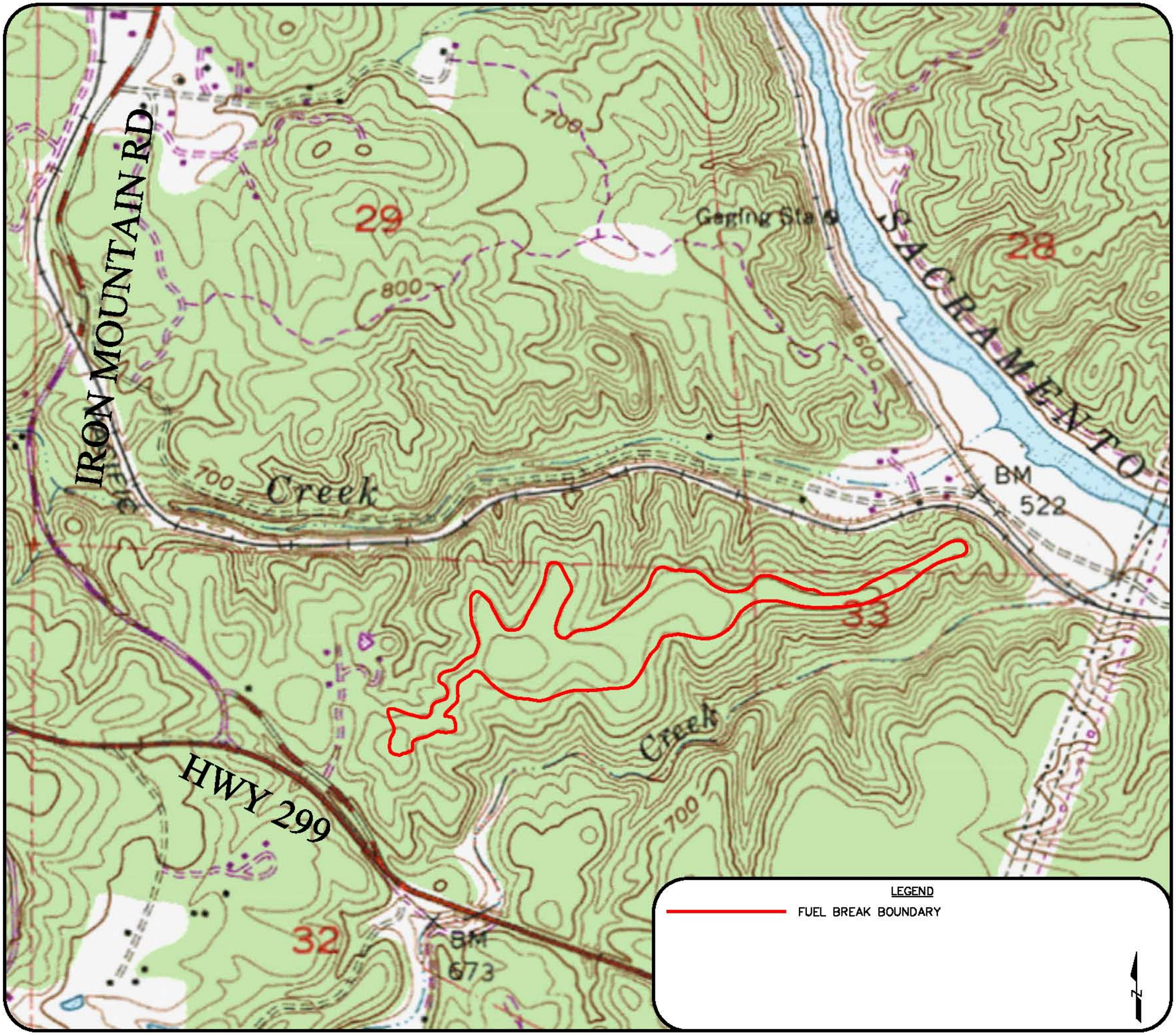
Once the site was selected, the RCD determined how the fuelbreak would be positioned on the landscape to provide the maximum benefit from a strategic fuels reduction standpoint. Since the prevailing winds in the area during the fire season are typically from either the north or south, an east-west orientation was again essential. The proximity of two nearby creek canyons and the popular Sacramento River Trail system was also taken into consideration for the potential of a fire starting from public use of the trail system, burning into either of the creek canyons and continuing north or south to the surrounding landscape (see Map 2. Shasta West – Old Shasta). It was decided that the fuelbreak would be situated along a 1-mile stretch of the ridge between the two creeks and average over 200' in width. The project footprint would be constructed entirely using the biomass method. After obtaining a signed landowner agreement for temporary entry to do the work, the RCD then consulted with the Bureau of Land Management who owned the land adjacent to the project to confirm that the landowners' encroachment was valid. Once all access concerns were addressed, the RCD began CEQA and NEPA documentation. During the archaeology survey investigation revealed the property was contained several small historic mining sites that would be excluded from the project and left as isolated patches of vegetation within the fuelbreak.

Once the project was designed and had gone through the evaluation and permitting process, a bid document was prepared and attempts were made to solicit bids from contractors capable of performing the work. All but one of the contractors who were contacted to perform the work was not available to create the fuelbreak during the 2004 construction season. The contractor who could complete the project during the 2004 construction season was shown the project site and provided the RCD with a proposal to construct the fuelbreak for $15,000.

FUELBREAK CONSTRUCTION

Justis Waste Recycling (JWR) of Redding, California was the successful qualified bidder. A contract was signed, a Notice to Proceed was issued on May 5, 2004 and construction began the same day. The equipment utilized by the contractor consisted of a Caterpillar 325 Excavator with a thumb on the bucket, a D4-C Caterpillar bulldozer with a brush rake on the blade, a Caterpillar 966 loader, a Morbark Tub Grinder, and three chip vans, similar to the equipment used at Shingletown. Clearing and grubbing on this project took 110 hours and was completed on May 21st. Grinding the cleared material commenced on June 14th and was finished by June 19, 2004. The final footprint of the fuelbreak was mapped with a handheld GPS unit. The contractor was required to install waterbars on haul roads in excess of 10% at 150 foot intervals.

The Regional Water Quality Control Board (RWQCB) did not require a SWPP, but stipulated that all disturbed areas with potential erosion hazard be mulched. The timing of implementing the erosion control measures was important in order to have preventative measures in place before the first winter rains, but not so early that the straw might blow away or act as a fire hazard during the rest of the fire season. On September 17, 2004, RCD crews spread straw and installed rice straw wattles in the swales and on the outlets of the waterbars.



WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

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PROJECT F.U.E.L.

MAP 2

SHASTA WEST (MIDDLE CREEK) FUELBREAK

DATE: 2005

FILE: PROJECT FUELS 03.21.05.PBG.2

SCALE: 1" = 1,000'

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.

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IF NOT ONE INCH ON THIS SHEET , ADJUST SCALE ACCORDINGLY.

SHEET TITLE:

MIDDLE CREEK

DSGN: Phil Garbutt

DR: Phil Garbutt

CHK:

RESULTS

A total of 643.83 green tons of fuel (558.03 bone dry tons) were delivered in 27 van loads to Wheelabrator Shasta Energy Company, Inc. in Anderson, a haul distance of 16.4 miles. Wheelabrator paid the contractor $32.50 per bone dry ton for the biomass or $18,135.98.

This project met with the goals of Project F.U.E.L. by strategically creating a fuel break to protect Forest Service land, the community of Old Shasta and surrounding residences, creating usable biomass from the material, and the use of that material for production of power at a wood-fired plant. The following photos illustrate the work completed at Middle Creek.

Figure 20. Heavy fuel loading prior to project.

Figure 22. Looking at figure from other direction after clearing.

Figure 23. Fuelbreak with manzanita removed.

Figure 24. Erosion control measures after biomass.

LOWER CLEAR CREEK WATERSHED – IGO

BACKGROUND

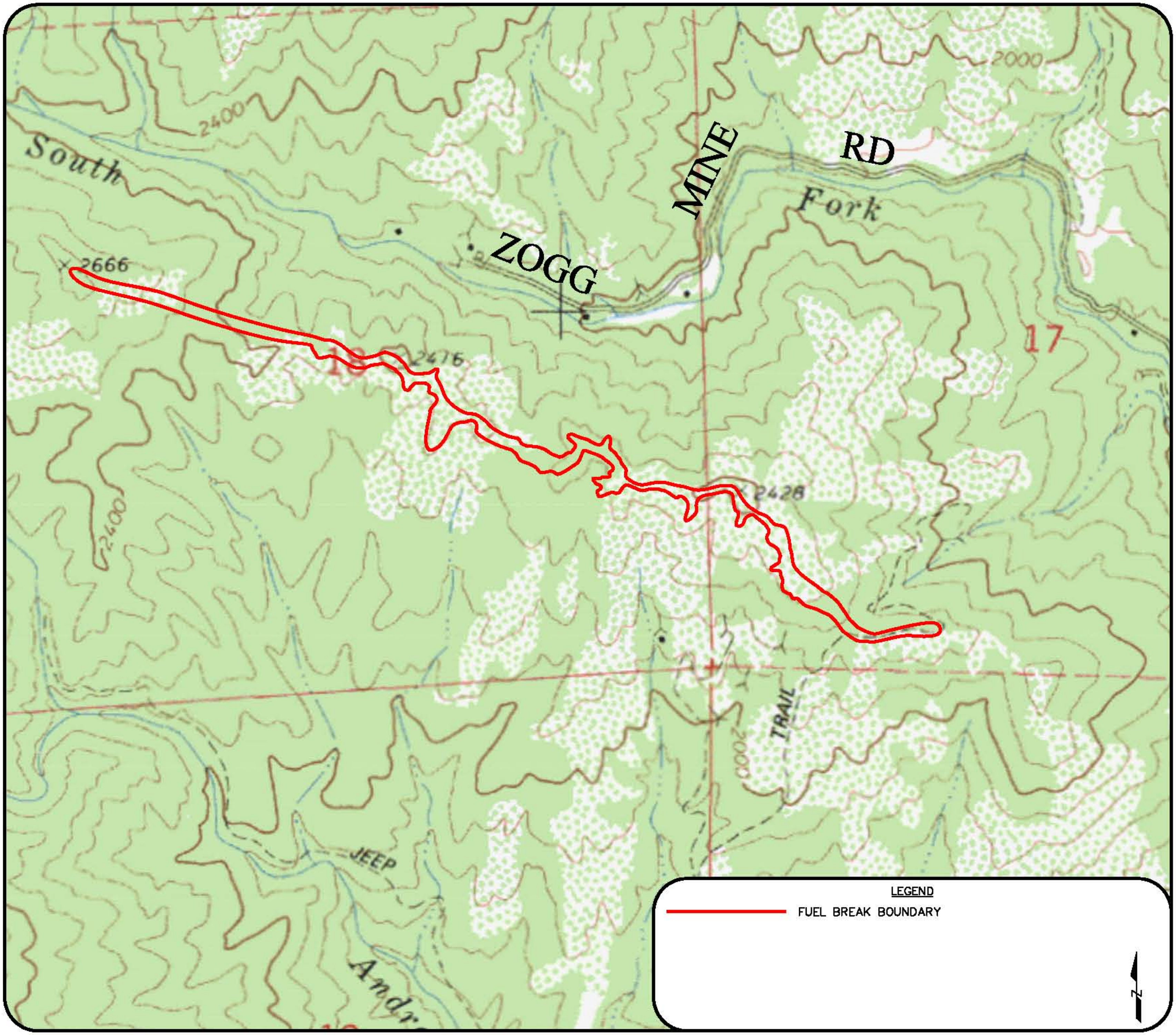
The Igo area was selected as part of Project F.U.E.L., because it represents a distinctive portion of Shasta County and is different from the other areas. The soils are primarily made up of decomposed granite, representative of the western part of the Lower Clear Creek Watershed. Igo is a small community with many residences tucked among ravines in areas of high fuel loading. The project area lies to the east of the Whiskeytown National Recreation Area boundary, a major recreational area in Shasta County.

The topography consists mainly of steep narrow ridges. Much of the area has been logged or burned in the past, which caused the vegetation to return in brush and second-to-third growth forest. In constructing fuelbreaks with machinery in this area the concern is the granitic soils. Grantic soils are composed of minerals including feldspar and quartz. Over time weather transforms this fairly tough rock into extremely erodible decomposed granite, which creates problems when heavy machinery exposes soil during construction. The cost of covering an entire fuelbreak with mulch after construction reduces the cost effectiveness. Mastication, however, leaves the woody material on the ground, effectively creating its own erosion control measures as it moves through the area.

CHOOSING THE PROJECT SITE

RCD personnel looked at several potential sites. At one site along Archer Road near Igo, the vegetation along the road was oak woodland, with minimal brush. Several of the landowners were thinning the oak for firewood and were unwilling to cooperate. A second possibility was along Rainbow Lake Road, but this site did not have sufficient volume to justify a biomass project, and the number of houses within the proposed project corridor made mechanical treatment with a masticator too risky due to the potential for flying debris.

The project site selected was a ridge top between Andrews Creek and the South Fork of Clear Creek (See Map 3). Once the site was selected, the RCD determined how the fuelbreak would be positioned in the landscape to provide the maximum benefit from a strategic fuels reduction standpoint. Since the prevailing winds in the area during the fire season are typically from either the north or south, an east-west orientation was again used. It was decided that the fuelbreak would be situated along a 6,200 feet long stretch of the ridge between two populated rural roads and up to 120 feet in width. The project footprint totaled 18.25 acres and would be constructed entirely using mastication. After obtaining signed landowner agreements from the four landowners involved for temporary entry to do the work, the RCD then began CEQA and NEPA documentation. The upper reaches of the project area form steep canyons with narrow canyon bottoms growing upland brush and trees. The southern portion of the project area was composed of a hardwood tree layer of ponderosa pine, live oak and black oak, typical of montane hardwood environments in the Clear Creek Watershed. There was evidence of past clearing adjacent to both sides of the road for most of the length of the fuelbreak. Typical shrub vegetation consists of manzanita,



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PROJECT F.U.E.L.

MAP 3

LOWER CLEAR CREEK (IGO) FUELBREAK

DATE: 2005

FILE: PROJECT FUELS 03.21.05.PBG.2

SCALE: 1" = 1,000'

VERIFY SCALE
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IF NOT ONE INCH ON THIS SHEET , ADJUST SCALE ACCORDINGLY.

SHEET TITLE:

IGO

DSGN: Phil Garbutt

DR: Phil Garbutt

CHK:

buck brush and poison oak and was consistent for the first portion of the proposed fuelbreak. In some areas large dense stands of manzanita have developed. The northwestern portion of the fuelbreak consisted of typical montane hardwood habitat with knobcone pine and Douglas fir interspersed. Decadent stands of manzanita were present throughout the project.

CONSTRUCTION PREPARATION

The combination of highly erosive granitic soils, steep topography, and minimal access roads meant biomass processing could not be used. Fuels reduction using hand crews would be expensive due to the steep ground and substantial travel time to the project site, which included a 45-minute drive each way from the property entrance, as well as a 30-minute hike each way to the furthest reaches of the project due to the roughness of the road. The substantial cost to construct adequate access for fire crews and their suppression vehicles also made hand piling and burning an expensive proposition. The obvious method for creating the fuelbreak was mastication. The steep narrow ridges limited the types of equipment to tracked, excavator-type masticators.

The soils in the project area are underlain by granitic bedrock, which is well to somewhat excessively drained, but the erosion hazard is high so it was important that the mastication operation disturb a minimal amount of soil and distribute the masticated material across the landscape to act as mulch for erosion control. The small size of the project was not very cost effective for a contractor considering move-in move-out costs to get the equipment to the site. The highly flammable brush in the project area made it impossible to do the project during fire season.

Four vendors were located that had tracked masticating equipment and a bid packet was prepared and distributed. Three vendors attended the required job showing on November 9, 2004. The mastication contract was awarded to the lowest qualified bidder, which was OPR, Inc. The contract was signed November 24, 2004.

FUELBREAK CONSTRUCTION

Construction began December 1, 2004, and was completed on December 14, 2004. Actual working time was six days. A Timbco Tree Harvester with a MacMurray masticating head was used to construct the fuelbreak (Figure 25). The tracks on the machine enabled it to maneuver easily on the steep ridge terrain and the self–leveling cab enabled the machine to work slopes steeper than would be accessible with excavator-type machines without the self-leveling feature. A pilot road had been constructed on the ridge top in the project area, and the operator worked off both sides of the road in the manzanita (Figure 26).

IGO PROJECT PHOTOS

Figure 25. Timbco harvester at Igo.

Figure 26. Typical wall of manazanita at Igo.

RESULTS

Fourteen and a quarter acres were masticated to create this shaded fuelbreak, which offers protection to the four landowners involved, the residents along Zogg Mine Road, Archer Road and the Whiskeytown National Recreation Area.

The volume of the brush that was masticated was not measured since the material was not removed from the site. However, this was by far the most densely vegetated project area of the four and volumes would easily have had 32-36 green tons/acre surpassing both the Shingletown and the Old Shasta biomass sites had the material been removed using the biomass method.

The Timbco machine and the operator were well suited to the task. The density of the vegetation was high enough to cover the ground with an adequate layer of woody mulch. The mulch cover was necessary to protect the exposed decomposed granitic soil. After the project was completed, rolling dips and additional erosion control material was used where necessary.

This project met with the goals of Project F.U.E.L by creating a fuelbreak near the community of Igo. While the material was not used as biomass for co-generation it was utilized to help stabilize the soils in the project location, reducing the cost of post-implementation erosion control. Masticators are very effective at changing the position of fuel within an area. There is concern that it is just rearranging the fuels within an area and not removing it. A fire can still travel across the woody debris in the event of a catastrophic wildfire. However, fuelbreaks are intended to not only break up the continuity of fuel and remove the ladder fuel condition, but also to slow the progress of the fire and create an area for fire suppression activities. This fuel reduction project meets those needs by reducing crown fires through ladder fuel removal, proper crown spacing, and creating access for safer firefighting. If there is a concern about the material on the footprint of the project, a bulldozer can very quickly rearrange the fuels, creating large exposed soil areas to halt the fires progress.

UPPER CLEAR CREEK WATERSHED - FRENCH GULCH

BACKGROUND

French Gulch is a community in the Upper Clear Creek watershed that has approximately 650 residents at 1,355 feet of elevation just north of Whiskeytown Dam. The town itself has multiple historic mining sites in the area, including some in close proximity to the fuelbreak location. The topography is characterized by sharp ridges and steep slopes that limit access for fire suppression crews, reducing the ability to fight fires. Much of the area has been impacted by mining, logging to support the mining efforts, modern logging, rural development, and wildfire. Private land is interspersed with federal land, managed by BLM, USFS, and NPS. The majority of the wildfires in the Upper Clear Creek Watershed follow the same pattern, with fires beginning at the bottom of the hill and running to the top. This is a direct result of the upslope winds common during the day. Current logging practices on the private land are highly regulated by the California Forest Practice Rules, which put limits on the amount of timber harvested from a site, location of access roads and skid trails, and specifies the amount of timber remaining on the land after harvest.

CHOOSING THE PROJECT SITE

RCD staff looked at several potential project sites in the French Gulch area. The land ownership was a challenge because much of the brushland suitable for biomass is in federal ownership and not eligible for these grant funds. RCD staff located three willing landowners/neighbors that had combined acreage sufficient to accommodate the size of fuelbreak required in the grant.
None of the candidate locations proved capable of biomass harvest due to the mixture of vegetative species, steep terrain, and lack of a road system suitable for chip vans. The terrain was too steep to use the mastication method. In keeping with the goals of Project F.U.E.L., the RCD staff chose to construct a fuelbreak with a footprint of 18.2 acres along two ridges of Drunken Gulch using hand crews (see Map 4). The estimated fuel load that would have potential as biomass was 269 tons @ 22.4 tons/acre.

The vegetation in the Drunken Gulch fuelbreak consisted of Black oak, Oregon white oak, Douglas-fir-Tanoak-madrone and Canyon live oak series. The fuel loading was high with dense areas of manzanita, buckbrush, and scrub oak that created canopies of dense vegetation and a hazardous fuel ladder condition. The dry slopes supported Douglas-fir (*Pseudotsuga menziesii*), Ponderosa pine (*Pinus ponderosa),* Black oak (*Quercus kelloggii*) and Canyon live oaks (*Quercus chrysolepis*), with gray pine and knobcone (*Pinus attenuata*) interspersed in the lower portions of the fuelbreak. The western portion of the fuelbreak was more consistent with montane hardwood, including more broad-leaved species in dense mosaics on the gentler slopes of the ridge. Past efforts of logging, brush cutting and fire suppression most likely created the dense shrub cover in the area that was not consistent with typical montane hardwood vegetation structure. The area of the Drunken Gulch Fuelbreak is described in the *Upper Clear Creek Wildfire Defense Plan/ Fuels Management* (RCD, 2001) as having fires that quickly run through the surface litter where there are concentrations of dead-down woody material that contribute to spotting and crowning activity. The fuel ladder was widespread and over 75% of the area had no break in the vegetation from the ground to the tree crowns.

LEGEND

FUEL BREAK BOUNDARY

WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

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PROJECT F.U.E.L.

MAP 4

UPPER CLEAR CREEK (FRENCH GULCH) FUELBREAK

DATE: 2005

FILE: PROJECT FUELS 03.21.05.PBG.2

SCALE: 1" = 500'

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SHEET TITLE:

DRUNKEN GULCH

DSGN: Phil Garbutt

DR: Phil Garbutt

CHK:

The fuelbreak would help firefighter access and reduce the ability of a wildfire from spreading into the community around French Gulch and into the vast holdings of both private and public timber. Ladder fuels would be removed where canopy cover was thin compared to surrounding areas where the higher horizontal continuity in the crown may allow a fire to advance from top to top of trees independent of the surface fire.

The fuelbreak area was along both the north and the south ridges of Drunken Gulch, which is north of French Gulch and east of Trinity Mountain Road. This drainage lies south of the East Fork of Clear Creek, and drains the northwest side of Shirttail Peak. The fuelbreak would create defensible space from a wildfire coming out of the East Fork drainage or from a fire burning out of the south.

CONSTRUCTION PREPARATION

The entire project area was walked by RCD personnel and the landowners prior to signing the Temporary Entry Permits. The project was walked again by RCD personnel to ground truth, locate, and flag the archaeological features named in the archaeological report, for the wildlife evaluation, and flag the project boundaries. A burn permit was obtained by the Shasta County Air Quality Management District.

FUELBREAK CONSTRUCTION

For this project CDF inmate crews were used to cut, pile, and burn the vegetation. An RCD Lead Technician inspected the job. Vegetation less than eight inches in diameter was targeted for removal unless there was a merchantable species smaller than eight inches in diameter that could remain and still have adequate crown spacing of 15 to 30 feet. Remaining trees were limbed so that no part of the branches were less than six feet off the ground, with the exception of small diameter conifer trees that were limbed in proportion with their height. Crews were instructed what to cut, what not to cut, how to treat the archeologically important areas, and where burning would be permissible. Burn fuel was provided to the CDF crews on a daily basis. The inmates started on the project November 18, 2004, and finished on December 6, 2004.

RESULTS

Construction of the 18.12 acres of fuelbreak in Drunken Gulch created wildfire defensible space usable in defense of structures within Drunken Gulch, as well as structures on Log Cabin Road, East Fork Road, and Trinity Mountain Road north of Cline Gulch and the community of French Gulch. Drunken Gulch is a perennial stream that feeds directly into Clear Creek. Fuelbreaks on both ridges will decrease the chance of wildfire coming into Drunken Gulch and leaving behind bare soil to erode and fill both the stream and Clear Creek with sediment.

The terrain of this project and the French Gulch area presented challenges that prevented the use of biomass processing but illustrated an important concept: fuel reduction projects should first be chosen on their merit to aid in the prevention and spread of catastrophic wildfire. The proper location is selected first followed by the method used to reduce the fuel loading. The following photos illustrate the work completed at Drunken Gulch.


Figure 27. Before.


Figure 28. After.


Figure 29. Before.


Figure 30. After.


Figure 31. Before.


Figure 32. After.

VIII. WORKSHOP ON WOODY RESIDUE UTILIZATION FOR FUELBREAK CONSTRUCTION

WORKSHOP ORGANIZATION

The workshop was organized to visit the two biomassed areas in the field and discuss the similarities and differences in the two. Because of limited access, the masticated fuelbreak and the fuelbreak constructed by hand were presented on posters by RCD personnel. Publicity for the workshop consisted of a news release, and personal e-mail or postal notification to all landowners and others involved all four projects.

WORKSHOP MATERIALS

Workshop materials were a combination of posters and individual handouts. The information presented to attendees was a combination of photos, facts and figures describing the construction of all four projects.

WORKSHOP FORMAT

The basic format of the workshop was a field tour of the two biomass projects and a poster session presenting the findings from the other two projects.

WORKSHOP RESULTS

Attendees met at RCD offices at 8:00 A.M., December 6, 2004, and traveled to the Shingletown site for the first leg of the tour. After completing the tour of the Shingletown site, the group moved on to the site in Old Shasta, and toured the fuelbreak there. At the end of the tour of the Old Shasta project, RCD staff presented the findings from both the Igo and the French Gulch projects using poster boards and handouts.

IX. SUMMARY

These projects were completed in three general stages:

- locating the right site for a project and finding willing landowners to host the project on their land;
- completing the Scope of Work with the landowner, environmental documentation including CEQA and NEPA, developing and distributing the bid packet and showing the project to contractors; and
- constructing the project, which includes flagging, contracting, supervising, data gathering, post construction erosion control measures, and report writing.

The results of the project show the cost of fuels reduction varies dramatically per acre depending on several factors:

- the willingness of landowners to participate, since the effectiveness of a fuelbreak across several landownerships can be diminished if key property owners will not participate;
- the willingness of landowners to allow the appropriate and lowest cost fuels reduction method on their property, since some landowners do not want heavy equipment disturbing their land;
- the volume of vegetation that needs to be removed to effectively create a shaded fuelbreak; a greater volume that can be removed using biomass equipment and sold to a power plant helps lower the cost;
- the variable market price for biomass and the transportation costs to the closest power plant willing to purchase the biomass;
- the density of the fuel loading within the footprint, including those areas with lesser vegetation, which in total creates the fuelbreak;
- the ability to access the fuelbreak site, moving in and out with heavy equipment and trucks/vans or mastication equipment;
- the topography, which often dictates the fuels reduction method(s) that can be effectively used;
- the soil type, which dictates erosion control or the sensitive practices required for protection;
- the presence of cultural resources and whether the area of cultural resources must be hand cleared or must be avoided;
- the presence of threatened, endangered, or species of special concern may dictate the method used and limit the operational hours and time of year;
- the availability of low cost CDF crews to assist in piling and burning, which is difficult to predict due to their shifting and changing priorities;
- the cost of gasoline for crews traveling to and from the site and for equipment use;
- the time of year, since the number of hours available for work during fire season is limited by the posted fire danger rating or the amount of rainfall and snowfall can limit working hours;
- the availability of heavy equipment crews after the project documents have been prepared and the project is ready to bid out and begin;
- the depth of review and timing required for proper CEQA and/or NEPA environmental documentation;

- the larger the acreage the cheaper the cost for biomass projects since more volume covers the high move in-move out equipment costs; and
- if the project is on soil capable of growing commercial timber and a product is sold, the project must comply with the California Forest Practice Rules, which can significantly increase the cost.

BIOMASS PROJECTS IN SHINGLETOWN AND OLD SHASTA

Factor	Shingletown (30 days)	Old Shasta (35 days)	Total
Fuelbreak Footprint in Acres	58.0	33.9	91.9
Acres Treated	34.0	25.0	59.0
Truckloads of Biomass	46	27	73
Green Tons of Biomass Delivered	1,084.88	643.83	1,728.71
Bone Dry Tons Biomass Delivered	842.61	558.03	1,400.64
Average Green Tons Per Truckload	23.58	23.85	23.68
Average Bone Dry Tons Per Truckload	18.31	20.67	19.19
Green Tons Per Acre Treated	31.9	25.75	29.3
Bone Dry Tons Per Acre Treated	24.78	22.32	23.73
Average % Moisture Content	22.4%	13.3%	-
Hauling Distance -- One Way	18	16.4	-
Price per Bone Dry Ton Received by Contractor	$32.50	$32.50	-
Biomass Revenue to Contractor	$27,385	$18,136	-
Handling Fee Paid to Contractor	$15,000	$15,000	$30,000
Cost per Acre Treatment Only	$441	$600	-
Total Cost Per Project	$31,816	$27,487	$59,303
Total Cost Per Fuelbreak Acre	$549	$811	$645
Total Cost Treated Areas Only/Acre ++	$936	$1,099	$1,005

MASTICATION COSTS – IGO

Factor	Total
Footprint of the Project in Acres	18.25
Acres Treated	14.25
Cost of Treatment Contract	$11,800
Cost of Treatment Per Acre	$828
Estimated Green Tons of Fuel per Acre *	45.6
Total Cost Per Project	$23,642
Total Cost Per Fuelbreak Acre	$1,295
Total Cost Treated Areas Only/Acre ++	$1,659

FUELBREAK COSTS – FRENCH GULCH (DRUNKEN GULCH)

Factor	Total
Footprint of the Project in Acres	18.12
Acres Treated	12.12
Cost of Contract (CDF Inmates)	$1,920
CDF Expenses Per Acre	$160
RCD Personnel Per Acre	$563
Total Labor Per Acre	$723
Estimated Green Tons Per Acre *	22.4
Total Cost Per Project	$12,834
Total Cost Per Fuelbreak Acre	$708
Total Cost Treated Areas Only/Acre ++	$1,058

* Based on Photo Series for Quantifying Forest Residues in the Sierra Mixed Conifer Type, Sierra True Fir Type (Pacific Northwest Forest and Range Experiment Station, Maxwell and Ward, October 1979). (See Appendix C)

++ This cost includes pre-project planning, site selection, landowner agreements, environmental documentation, permits, contract supervision, contract preparation, construction oversight, post-project erosion control, indirect costs, quarterly and final reports.

Without the CDF inmate crews, the cost per acre using a professional hand crew is $1,500-$2,000/acre due to the labor rate, the cost of liability insurance, the ability to conduct open burning with the proper suppression equipment on site.

The total costs of Project F.U.E.L.

	Actual Expense	Match Actual	Budget Expense	Match Expected
RCD Personnel	33,658	763	36,958	-
w/CDF	2,523	13,400		12,600
	36,181	14,163	36,958	12,600
Supplies, tools, field equip.	4,353		6,598	
Professional Services	41,440	45,521	37,000	42,000
JWR $30,000				
OPR $11,440				
Transportation	1,312		1,190	
Other	-		1,540	
Subtotal	83,286	59,684	83,286	54,600
Indirect	12,492		12,492	
TOTAL	95,779	59,684	95,779	54,600

Expenses by Task

Site identification, site selection, landowner agreements	$ 10,838
Scope of Work developed with landowner, CEQA/NEPA document preparation	$ 13,530
Construction, professional services, Pre and post-site work, flagging, Erosion control, supervision, data Gathering, report writing, CDF crews	$ 71,411
Total	$ 95,780

PUBLICITY

An important part of the overall project was education and information for the public and other agencies. The following outreach was conducted:

- A bullet-proof sign announcing each of the fuelbreak projects was located along the roadside to educate passersby about the project.
- Press releases issued on the Shingletown Project were published in the Shingletown Ridge Rider Newspaper on March 21, 2003.
- A newspaper article on the project and Firesafe Plan for Shingletown were published in the Shingletown Ridge Rider on April 21, 2003.
- A "Speak Your Piece" editorial written by RCD District Manager, Mary Schroeder, about fuelbreaks and the Middle Creek Project was published in the Redding Record Searchlight on December 6, 2003.
- The project was highlighted in the Spring 2004 WSRCD newsletter.
- The visibility of the Shingletown project was excellent since it occurred along Highway #44, a heavily traveled highway. A 4'x 8' sign explaining the project was placed roadside in the center section of the project across from where Dersch Road intersects with Highway 44 and was visible from both highways.
- Two notable field tours were done for the Shingletown Project: On March 17, 2004 the Shingletown Project was part of a fuel reduction field tour for the Forestry Committee of the California Association of Resource Conservation Districts. The tour included representatives of conservation districts across the state. RCD and CDF staff and the landowners led the discussion and answered questions. On May 17, 2004 the Shingletown Project was included on a tour of biomass operations for members of the Wildland Fire Leadership Council who are employees of the Departments of the Interior and Energy in Washington, D.C. The mission of their tour was to present the impacts of a fuelbreak on wildlife habitat and fire hazards and its effectiveness on wildfire behavior. RCD personnel explained the objective of the project, and answered questions about the permitting process, volume of material removed, value of the material removed, the cost of the field operations, and the total cost of the project including staff preparation time.
- The RCD hosted a tour of fuel projects on the west side of Redding for two staff members of the National Association of Conservation Districts, Bill Berry and Bill Horvath, and two members of the USDA Forest Service's Washington Office of State and Private Forestry, Fred Deneke, and Steve Yaddof. The tour included a stop at the Middle Creek Project where the biomass operation was in progress. RCD staff explained the project and answered questions about the funding source and the permitting process.

Roadside Sign at Shingletown Fuelbreak Site.

FINAL RECOMMENDATIONS

The biomass process should be used wherever it is cost effective and feasible to implement. It reduces the fuel loading in an environmentally friendly way. It eliminates building burn piles and the air pollution from open burning, while moving the material into the controlled environment of a wood-fired power plant.

When strategic fuels management plans are being developed they should identify areas or locations where biomass can be utilized, not only for linear fuel reduction projects, but landscape level projects. The conventional pile and burn method is a much slower process, creates air pollution, and may not be acceptable to all landowners. In addition, the loss of biomass revenue significantly impacts the cost.

While cut/pile/burn is effective, very few fuel reduction programs have the use of CDF crews at such a reduced cost. Private sector costs to cut/pile/burn can easily be $1,500 to $2,000/acre plus all of the other costs of implementing a fuel reduction project.

Mastication is cost effective, efficient and fast, but some landowners may be uncomfortable leaving the fuel on the ground as a mulch. It is not appropriate near homes or structures because of the flying debris cast out by the mastication head.

APPENDIX A. Wheelabrator Shasta Energy Company

Wheelabrator Shasta Energy Company is one of northern California's most modern, independent wood-fired power plants. The 49 MW (net) plant processes 750,000 tons of mill waste and forest residues from Shasta County and surrounding areas. Un-merchantable waste wood from Shasta-Trinity and Lassen National Forests, as well as from private lands, are selectively removed and processed in the plant to improve remaining standing timber.

The plant produces over 375 million kwh of electricity per year for sale to a local utility. The plant design includes three independent wood-burning units, comprised of state-of-the-art wood-fired traveling grate furnaces with utility-type high pressure boilers. The highly automated woodyard design includes capabilities to accept mill wastes, chips, and un-merchantable whole logs (culls) up to six feet in diameter that are chipped on site for fuel. The plant design also includes modern air quality control units, condensing turbines, and multi-cell wet cooling towers. The facility incorporates some of the latest emissions control features, including staged overfire air in specially shaped furnaces, a selective non-catalytic reduction system for control of ozone-forming nitrogen oxides, and a zero water discharge system by use of staged cooling towers.

GENERAL
Location: Anderson, CA
Project Owner/Operator: Wheelabrator Technologies Inc.
Start-up: December 1987

PROJECT CHARACTERISTICS
Net Capacity: 49,500 kilowatts
Fuel Consumption: Approx. 100 tons/hour mill waste/forest residues at 50% moisture
Furnaces/Boilers: Three, Zurn traveling grate, staged combustion furnaces; membrane waterwall boilers producing 170,000 lbs/hr steam
Turbine Generators: Three Elliott condensing turbine generators
Heat Rejection: Surface condensers with multi-cell evaporative cooling towers
Fuel Handling: Two truck scales, three platform truck dumpers, one hydraulic log loader; one 52-inch V drum, one 72-inch drum chipper and infeed/offloader conveyors

AIR QUALITY CONTROL
Type of Equipment: Three-field, high efficiency electrostatic precipitators

PROJECT ECONOMIC BENEFITS
* Full-time employment of approximately 52 operating personnel
* Operating payroll of approximately $3.0 million/year
* Related local employment of over 125 people for supply, transport, and handling of wood fuel
* Over $10 million per year in fuel purchases