D. Wildland Fuel-Hazard Reduction[1]

There are a myriad of fuel-reduction methods available to land managers. This document explains many of these methods, to allow land owners and managers to knowledgably choose the most appropriate practices for their particular site within Lake County. It is written inform and empower Lake County landowners (large or small) to cooperate on fuel management toward a fire-safe community, and a healthier wildland environment. This document differs from *Appendix C: Wildfire Safety at Home,* in that it focuses on the Wildland Fuel Reduction Zone, which is the area one hundred feet or more from structures. This zone is where innovative, ecologically savvy fuel-reduction treatments can be accomplished, in an effort to begin the restoration process for previously impacted and degraded landscapes.

The landscape seen today in Lake County is the result of past glacial periods ending nearly 10,000 years ago. Mud core samples taken from Clear Lake show that the vegetation now present has been in place and stable for a very long time. However, the current vegetation is also a result of plant succession, the progressive change of the plant and animal life in response to environmental conditions. The last century of human practices (fire suppression, road building, logging, the introduction of non-native plants, and vegetation conversion for agriculture and livestock) has created the "natural" landscape today.

These human practices have left an ecological legacy on the landscape. In some cases, forests and woodlands are choked due to tightly growing trees. This leads to low-level growth or vigor. This comes with an increased susceptibility to *pathogens*, as well as increases in *fuel load conditions*, and changed *species composition* and *habitat conditions* of all vegetation types (forestlands, woodlands, shrublands, and grasslands). Some of these changes have increased local fire hazards by 1) increasing fuels, 2) increasing acreages of susceptible fire-prone plant communities, and 3) increasing overall risk of catastrophic fire given that today a larger area of the county is wildland-rural-urban interface.

To remedy this landscape imbalance, *modify fire behavior,* and reduce the potential for crown fire, local land management agencies and private landowners are taking a proactive approach to reducing fuels.

When guided by conservation-based principles, fuel-hazard reduction will facilitate long-term positive environmental outcomes, and assist in the process of restoring health to the forestlands, woodlands, shrublands, and grasslands of Lake County. Incorporating ecological considerations into planning and implementing these fuel-reduction treatments can be an innovative and exciting task for landowners and land managers, with positive improvements for neighborhoods, and the surrounding ecosystem.

In this document, you will find explanations of the concepts of fuel management, and pros-and-cons on each of the techniques available, all presented in what is intended to be a clear and user-friendly manner. Some of the most common fuel-reduction methods include controlled burning, thinning, brush clearing, mastication, and grazing; all are intended to restore and maintain vegetative communities to a more fire-resilient condition. Although vegetation types vary greatly in Lake County, and site-specific treatments will need to be developed to take into account this variation, certain silvicultural and other land management practices are applicable throughout all the different vegetation types. *See Reference I: Glossary for definitions of terms found here.*

For examples of treatment prescriptions for the wildland zone, see the Fuel Modification descriptions for each vegetation type in Chapter 4.

D.1. Ecologically Based Fuel Reduction

Ecological fuel reduction seeks to reduce surface fuels, ladder fuels, and *crown density* while implementing treatments that work to enhance plant community health and biodiversity. Ecologically based fuel-reduction techniques assist degraded ecosystems in becoming more stable, resilient, and *productive.*

Treatments are designed to be site-specific; they take into consideration vegetation, soil types, slope, aspect, ecosystem health needs, and individual landowner objectives. Fuel-reduction objectives are most successfully accomplished when combined with an emphasis on ecological treatments. In the forest, these include *forest stand*

[1] Parts of this document were written by Marko Bey of Lomakatsi Ecological Services: www.lomakatsi.org.

enhancement and restoration techniques such as thinning and controlled burning. The implementation of ecologically restorative fuel-reduction treatments is guided by the Conservation Principles in Chapter 1.

Methods for ecological fuel reduction seek to strike a balance among the following:

Goals

- To make all vegetative communities less susceptible to crown fire.
- To reduce wildfire intensity through activities that separate surface and ladder fuel continuity and volume.
- To manage and modify fuels and configurations of trees and plants.
- To reintroduce low-intensity (cool-burning) fire.
- To positively contribute to the ecological processes and functions of local forest and plant communities.
- To improve the health of vegetation most suited to the site.
- To emulate a plant regime similar to what occurred with natural fire.
- To maintain and enhance native species diversity.
- To maintain and enhance wildlife habitat.
- To control problematic, invasive, non-native species.
- To provide erosion control where appropriate, in conjunction with fuel-reduction activities.
- To make fire-suppression efforts safer and more effective as a result of reduced fuel loads in the vicinity of roads, homes, and other important areas.
- To utilize byproducts of fuel-reduction activities where ecologically appropriate and economically feasible, to help offset costs.

Methods

This document proposes methods that emulate lightning and other *anthropogenic* low-intensity fires that have helped shape the landscape for thousands of years. These methods include:

- Selectively thinning portions of the forest or shrub understory.
- Selectively thinning or burning dense vegetative communities such as chaparral.
- Favoring and retaining the largest, most fire-resilient, and healthiest trees adapted to the location.
- Favoring and retaining native vegetation.
- Burning, chipping, and/or masticating the smaller fuel loads.
- Mowing or grazing grasses and small woody plants.

D.1.1. Introduction to Treatment Prescriptions

A treatment prescription as it relates to fuel-hazard reduction is a sequence of steps to bring a plant community to a more stable state. These efforts will ideally increase the area's resiliency to fire as a natural disturbance without resulting in catastrophic impacts.

Prior to beginning any fuel reduction work, the first step is an assessment of the property, including fuel hazards and health conditions. This is called an *initial site assessment,* where you walk the property and take a closer look to gather information about present conditions. Using the answers to a series of questions outlined below, you will gather the data that will enable you to plan your fuel-hazard reduction treatments.

When planning fuel-reduction prescriptions, remember that you are attempting to manage a natural, living system. Whatever you do, nature will respond either favorably (with lower intensity fires) or negatively (by increasing fire hazards). Three important concepts to consider and/or research in planning your prescription are *1) Present Condition, 2) Historic Natural Condition,* and *3) Future Desired Condition.* To reduce fuel hazards without creating additional environmental problems, use these three concepts when planning a treatment prescription.

Site Assessment—Present Condition

Present Condition describes what conditions occur on your property now. It will enable you to outline your activities based on today's starting condition. It will also facilitate gathering your initial assessment data for planning your treatments.

The following is a list of questions that will help you plan a prescription for an ecologically based fuel-hazard reduction project. *(Definitions that may help you prepare your plan are in Reference I: Glossary).* When answering each question be sure to collect and organize information into a written document (or "plan"). This document can be as simple or detailed as you want; what matters is that it meets your needs.

Site Evaluation Information and Questions

1) What is the elevation of the treatment area? List the variety of elevations from low to high.
2) What are the aspects of the treatment area? What direction does your property face? Explain in detail.
3) Give a brief synopsis of the topography of the site. Highlight *draws,* ravines, rock outcroppings, and special landscape features.
4) What are the vegetation types and plant associations of the site?
5) What are the dominant and *codominant* species on the property?
6) What are the estimated *age classes* of the plant communities on the site? What is the variability (and range) of sizes of the trees? What are the trees' diameters at breast height (DBH)?
7) Explain the fuel load conditions on the site. Describe the density of vegetation and the variety of fuel types *(see Chapter 3 for an introduction to fuel models).* Assess the *ground fuels,* surface fuels, ladder fuels, snags, widow-makers (large trees with lots of dead limbs), etc.
8) Give an estimate of the number of snags per acre on the site. What species of snags are present? What is the DBH of these snags? Which snag classes are present? Snags are categorized into three structural classes[2]—characterized by the amount of bark and branches, condition of the treetop, and condition of the wood—these features determine wildlife use. Document snag height. What may be causing tree mortality? Is there beetle activity present?

8) Describe fuel loads in relationship to home-site, driveway, and other access/exit routes on the property.

9) List and explain any details about this site that should be considered for fuel mitigation and vegetation-enhancement treatments. Include information about sensitive zones for plants, wildlife, *slope stability,* etc.

Historic Natural Condition

The Historic Natural Condition will give you the baseline data regarding how the ecosystem functioned prior to previous activities such as fire suppression, or industrial activities that may have occurred. Questions include:

- What trees and plants were dominant on the property and historically present?
- How frequently did fire occur?
- What plant communities were present prior to European settlement that are now gone?

Some of these questions can be answered from the vegetation type descriptions in Chapter 4. You can also acquire this information from old or historic photos of your property, old settler's journals, the traditional oral descriptions of Native American elders who may be living in your area, or by visiting neighboring lands in your watershed that have not been greatly altered. You can also talk to an ecosystem restoration professional.

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[2] Structural Class 1 represents those trees that have died recently and retain most of their bark and most of their branches; the top is intact. Very little decay has occurred in the wood, unless the tree had "heart-rot" decay when living. Heart-rot refers to fungus-caused decay of a tree's interior wood. Class 1 snags are typically used primarily for foraging by woodpeckers on bark beetles in and under the bark. Once the bark loosens, bats can roost under the bark.

Structural Class 2 represents those snags that have been dead for several years and have lost some branches and bark; tops are often broken; there is some evidence of decay. Woodpeckers use these for nesting, foraging in the bark, and foraging in the interior for carpenter ants.

Structural Class 3 represents those snags that have been dead a long time and lack branches and bark. Tops are broken off and the sapwood and heartwood are extensively decayed. The primary use of these trees is by woodpeckers foraging on carpenter ants and wood-boring beetle larvae. Most of these trees are too decayed for woodpeckers to excavate a cavity in them, although secondary nesters may use existing cavities.

The site-specific information for your property will create a closer-to-home level that will help in planning your treatment prescription. "Site-specific" is a key concept that means tailoring your treatment prescription to your property, using general guidelines as a basis, while taking into consideration detailed site conditions. It describes the unique place and its conditions, and should be considered in the overall plan.

Future Desired Condition

Future Desired Condition outlines both the short-term and long-term goals you wish to accomplish. The Future Desired Condition for fuel-mitigation efforts along a driveway might be described as follows:

"Will be an area with little-to-no surface fuels, no ladder fuels, and fire-resistant, shade-casting trees without low-hanging branches. There will be larger, well-spaced trees with wide spreading crowns. Any shrub or brush patches will be small and isolated. The grasses on the site will be converted over time, from tall, annual grasses that carry longer flame lengths to shorter, native grasses with shorter, flashier flame spread."

You can create your future desired condition concepts with help from the Conservation Principles *(see Chapter 1)* and other information in this CWPP.

D.1.2. Know Your Vegetation

Lake County includes diverse vegetation types that can be categorized generally as forest, woodlands, shrubland, or grassland. Within each of these general categories are many distinct vegetation communities. *These are each described in more detail in Chapter 4.*

Forests within the county consist of trees such as ponderosa pine (*Pinus ponderosa)*, knobcone pine (*P. attenuate)*, incense cedar (*Calocedrus decurrens)*, Douglas fir (*Pseudotsuga menziesii)*, California black oak (*Quercus kelloggii*), and canyon live oak (*Q. chrysolepis),* intermixed with a variety of shrub species such as manzanita (*Arctostaphylus spp.)*, buck brush (*Ceanothus cuneatus*), and poison oak (*Toxicodenron diversilobum)*. Forest communities can vary greatly throughout the county from pure stands of knobcone pine to stands of ponderosa pine intermixed with Douglas fir, incense cedar, and a variety of understory shrub species. Crown fires can occur in forested areas that have very dense canopies and are characteristic of species such as knobcone pine.

Woodlands can vary from pure stands of valley oaks (*Q. lobata*) in deep, fertile soils to pure stands of blue oaks (*Q. douglassii*) on drier sites. In most cases these deciduous species can be intermixed with interior live oak (*Q.wislizenii*), gray pine (*P. sabiniana*), or at upper elevations canyon live oak (*Q. chrysolepis*). On upper elevation sites, pure stands of scrub oak (*Q. berberidfolia*) can dominate an area with associates of knobcone pine, chaparral pea (*Pickeringia montana*), toyon (*Heteromeles arbutifolia*), manzanita, coyote bush (*Baccharis pilularis)*, and *Ceanothus spp.*

Shrublands within the county consist of species such as chamise *(Adenostoma fasciculatum*), manzanita*, Baccharis spp*., and *Ceanothus spp.* It can be very diverse or dominated by a single species. These vegetation types can be composed of pure stands of chamise that can cover thousands of acres or dense stands of manzanita with a scattered gray pine overstory and/or a variety of oak trees. Fires in these shrub-dominated communities can be very intense.

Grasslands are important vegetation type within Lake County, sometimes associated with vernal pool habitats. Grasslands within the county are dominated by non-native invasive annual grasses and plants such as yellow star thistle (*Centaurea solstitialis*). Grasslands can be intermixed with both forest and scrubland vegetation types, forming mosaic landscapes. Grasslands fires tend to burn very rapidly, although with relatively low intensity due to their highly volatile fuels.

See Chapter 4 for a more specific description of the vegetation types found in Lake County.

D.1.3. Fuel-Reduction Treatment Methods

Fuelbreaks—where fuel volumes have been intentionally reduced to slow down a fire and reduce its flame length and intensity—are one of the most well known types of fuel-reduction methods. Firebreaks on the other hand, are where all fuels are removed to bare mineral soil for fire suppression. Fuelbreaks can be created in several different ecologically sound ways that mimic naturally occurring fires, and will vary within each vegetation type found in the county.

Shrubland Fuelbreak

Historically, the preferred method to managing fuels in shrublands was to use controlled fire on a 5-10 year cycle, limiting the amount of accumulating fuel by repeatedly burning the "brush." Today, it is common to observe large, cleared pathways meandering through these communities serving as a fuelbreak, such as in the Cow Mountain area. Removal of surface and ladder fuels, and reduction of horizontal continuity of fuels, are the major objectives in reducing fire intensity and rate of spread within shrublands.

On residential properties vegetation can be removed in clumps or thinned throughout a selected area. When creating clumps be sure to separate them by a distance of approximately three times the height of the plant. For example a clump that is three feet tall should be separated by at least nine feet from the next clump. Identify clumps throughout the area that will be left as wildlife habitat. When thinning in clumps or over entire areas, focus on removing dead plants, trees, and branches before cutting live vegetation. Where present, identify hardwood and/or conifer snags that will be retained as wildlife habitat. If trees are present they should be pruned to reduce the ladder fuels that could carry fire into their canopy. *For more information on pruning, see below: Pruning Individual Trees and* Figure D-1. Proper Pruning Techniques.

When thinning in shrubland areas that are far away from roads, it may be best to deal with slash created during thinning operations by either "lopping and scattering" (see below) or by creating burn piles. Burn piles should be created in small openings and gaps created during thinning operations in order to reduce the risk of escaped fires during burning. Both the Air Quality Management District and the local Fire Protection Districts have jurisdiction over burning for both fire safety and air quality. All burning must comply with all rules and regulations, and a permit or Smoke Management Plan is always required. *(See Burning section D.2.1 below for an explanation on how to properly burn piles).*

When thinning next to a road much of the thinned material can either be chipped back onto the site or loaded into a chip truck for removal. When chipping material back onto a site, be sure the chips do not exceed more than several inches in depth *(see D.2.3 Chipping below).* Some of the thinned material can also be lopped and scattered back onto the site for soil stabilization and wildlife habitat *(see D.2.4 Lop and Scatter below).*

Grassland Fuelbreak

The purpose of treating grassland fuels is to lower the flame length and fire intensity in desired locations as well as to restore damaged landscapes. A grassland fuelbreak consists of mowing, burning, or grazing a desired area. Areas adjacent to roads or ecotone edges are treated to lower grass height. Grasses can be treated approximately 50-100 feet on each side of roads to create a sufficient fuelbreak. Prior to initiating any fuel reduction within grassland areas it is important to identify native grasses to be retained as future seed sources. Grazing and fire are two potential approaches to treating grassland areas *(see D.2.1 Burning and D.2.2 Grazing sections below).* When using fire as a management tool within grasslands, trees and shrubs should be protected by first reducing the amount of vegetative fuels around their base. This helps protect the tree from damage caused by direct flame contact.

Upon completion of grassland fuel treatments it is highly recommended to begin the process of sowing native perennial grasses. Work with local resource and restoration professionals, and/or rangeland managers to create a restoration plan that will convert non-native grasslands into native grasslands over time.

Forest and Woodland Shaded Fuelbreak

When you remove fuel ladders around your property and leave the top layer of the trees (canopy) in place, you are creating a shaded fuelbreak. This break in fuel continuity—a result of treating both surface and ladder fuels—gives firefighters a chance to slow down and perhaps even stop a fire. Shaded fuelbreaks are effective because they 1) reduce amounts of fuel, 2) modify types of fuel, and 3) improve fuel arrangement. It is called "shaded" because most of the forest canopy is left intact. In some cases, some of the canopy may need to be removed if local conditions are high for a crown fire.

A shaded fuelbreak differs from a firebreak where a bulldozer or other equipment is used to create a bare-ground break with no vegetation. Firebreaks tend to regenerate quickly with flashy fuel and require a lot of maintenance, adding to future costs and fire hazards. By contrast, the shade cast by the canopy helps to reduce

regeneration, thus keeping the amount of fuel low in these fuelbreaks and requiring less maintenance. Shaded fuelbreaks also improve evacuation routes, as they provide a place where a fire might slow down or decrease in intensity, making it safer for you to get out (and firefighters to get in) if and when the time comes.

Shaded fuelbreaks should be strategically located. These include ridges and *benches,* along roads, around communities, and some other areas of flatter terrain. It is important that these efforts be coordinated with multiple landowners to achieve increased community wildfire-safety objectives. Shaded fuelbreaks located mid-way on a slope can be dangerous because fire can preheat an area from below, and burning materials from above can roll downhill and ignite fires.

The exact prescription for a shaded fuelbreak depends on your objectives and local conditions. Some landowners want to create as much cleared space as possible, under their perception of fire safety. Others want to maintain as much privacy as possible, sometimes compromising but almost always still improving fire safety. Many comment after implementing shaded fuelbreaks and other fuel-reduction treatments that the end results are aesthetically pleasing. Treatment prescriptions will vary according to the vegetation type and the aspect in which you are working. Determine your vegetation type and reference its Fuel Modification Prescription in Chapter 4 for site-specific treatments to incorporate into your design.

Within shaded fuelbreaks trees are typically spaced so their crowns no longer touch. Lower branches are pruned. Shrubs and dead and downed material are removed to reduce surface and ladder fuels. Not all small trees need to be removed; care should be taken to create horizontal space between small trees and nearby larger trees. Heavy underbrush and fallen limbs are generally removed, leaving mature trees that are more fire resistant. In ponderosa pine and mixed conifer areas, between sixty and eighty-five percent of the overstory canopy can be left intact, depending on the forest type.[3] Act cautiously within the project area by retaining enough canopy to prevent adverse effects from opening it up too much, too fast. Moving any forest stand toward historic conditions can be achieved in repeated intervals of five- to ten-years. The method of *sequential entries* can be an effective, cautious way both to reduce fire hazard and restore the stand and associated ecological conditions. Monitoring the response of the forest and ecological community will be the guiding influence on what time intervals to use for further thinning entries. Ecological monitoring can be accomplished by a visual assessment of the stand's response, *photo point monitoring,* or by establishing permanent monitoring plots to closely measure ecological benefits or impacts. *See Chapter 9 for more information on monitoring.*

In chaparral, shaded fuel breaks can be created by leaving shrub groupings in well-spaced patches while leaving sufficient shade to prevent the ground from drying out and exotic species from invading.

Varying levels of light on the forest floor will generate different re-sprouting responses; therefore creating shaded fuelbreaks requires the commitment to maintain them. As in all fuel-reduction treatments, regular annual or bi-annual maintenance is often necessary as stump-sprouting plants, invasive species, and/or shrubs begin to colonize the understory (although this is theoretically minimized with the shade provided by the intact canopy). Maintenance can be accomplished either by pruning and cutting back re-growth, or through use of prescribed-burning techniques. Shaded fuelbreaks in appropriate locations provide a good opportunity for the use of fire.

Following thinning and controlled-burning applications, restoring and establishing native grasses and forbs along shaded fuelbreaks is a long-term objective for the prevention of invasive species. In situations where private lands border federal lands or wilderness areas, invasive species can travel into these neighboring public lands and "spread like wildfire;" hence it is critical that long-term stewardship be a priority for maintaining these sites.

Shaded Fuel Break Basic Prescription for First Entry[4]

- For the first entry, cut as much of the *1-hour* (0–0.24 inches in diameter) and *10-hour fuel* (0.25–1.0 inch in diameter) as possible, i.e. the finer fuel.

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[3] Salmon River Fire Safe Council. *Fire Planning & Fuels Reduction Program.* www.srrc.org/programs/firefuels.php. And, Dennis Martinez. *Canopy Retention for Fuel Modification Treatment in Douglas Fir Stands.* 2003. Boulder Dumont Late Successional Reserve (LSR) Vegetation Management Project. Tiller Ranger District, Umpqua National Forest.

[4] This prescription is also based on the work of Dave Kahan, Full Circle Forestry, Redway, CA.

- Remove trees that look brushy (versus a more tree-like form), or unhealthy, are lacking in vigor, or are overtopped by larger and/or more vigorous trees that block access to open spaces in the canopy.
- Eliminate dead vegetation of all sizes.
- Shade will inhibit regrowth of sprouting species, so it will not be a major maintenance problem. Prune up all trees left behind as high as you can safely reach, with a chainsaw or pole saw.
- Start low in the area and work gradually uphill. Prioritize the lowest-growing plants and then work up the fuel ladder. This will help keep you from burying your work, and the result will be cleaner and more thorough.
- When implementing shaded fuelbreaks, work in teams with a sawyer and a brush hauler. This can result in a more thorough job with less effort, once safety and logistical issues have been established. The sawyer can make a small to moderate mess in one spot and then move to the next spot while the brush hauler cleans up the mess in the first spot. They then flip-flop and the sawyer returns to the first spot to expand upon what's been done, while the brush hauler cleans up the mess in the second spot. This method requires teamwork and awareness, and it will enable the sawyer to cut with more ease. Meanwhile the brush hauler is cleaning things up but is not in danger from falling trees and limbs because the cutting occurs in a separate area.

Second Entry, or Advanced First Entry

- Go to those trees and shrubs that you weren't sure about on the first pass.
- Think about vegetation health and species composition. You will generally want to favor rarer species. The type of vegetation you have on your property will determine what species to leave, and the appropriate percentage of canopy and understory density *(see Chapter 4)*.
- Look at the leader (the new growth at the top of the tree) and the overall health and vigor of the tree in relation to other trees of the same species. The leader reveals the annual growth. How is the tree growing in relation to other trees? Is the leader longer or shorter? Does it look healthy? Leave the healthiest trees. Is there space for them to grow in the upper canopy? If not, can you create that space by removing the less healthy or suppressed trees? If not, the tree is a good candidate for removal regardless of health and vigor. Imagine the same place in ten or twenty years. Will there be room for all the trees you have left? If not, remove some of the unhealthiest and smallest ones, or those in the way of your largest and most dominant trees. Keep in mind that the denser the canopy, the less regeneration (maintenance) you will have to address next year.

How to Decide which Trees to Leave or Take

- First look for the vigorous, healthy trees. These are the trees to leave, and to favor in your treatments.
- One way to decide which trees to cut is to look at how much crown is on a tree. Trees with less than twenty-five percent live crown are candidates for removal because they will have a hard time being released.
- Choose trees with healthy crowns to leave. Create space around them by removing less vigorous trees.
- Look for existing space in the canopy. Is there space for the tree to grow into the upper canopy? If so, leave it. If not, consider removing it.
- There may be trees that you will eventually want to remove—often intermediate trees—that are not cost-effective on the initial entry, but could be on a subsequent entry, especially with the addition of a value-added wood products market in the county. *See section D.2.5 Small-Diameter Wood Products below*.

After you've created your shaded fuelbreak, take a final pass through the area. How does it look? Do you need to remove any branches or small fuels that were left behind? Did you miss some trees or shrubs that obviously can be taken out now? Remember, you don't need to remove everything. You can leave clumps of vegetation for wildlife habitat.

Pruning Individual Trees

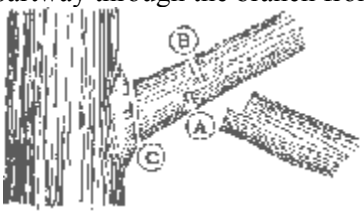
- Prune as high as you safely can with a chainsaw or a pole saw, given your available time and financial resources. Remember, the more you prune, the more slash you will have to remove.
- Leave at least one-half of the tree height in live crown. Only remove one-third of the total foliage at one time.

- Don't bother pruning anything that is shorter than you (unless it's in your defensible space zone, then it should probably be removed).
- Be sure to follow proper pruning techniques (see below) so you don't create health problems in your trees.
- Pruning is one of the most difficult skills to master but it is also one of the most important. For tips on proper pruning techniques, see the following table, and the website: "Prune trees for better health and higher value," by the California Forest Stewardship Program.[5]

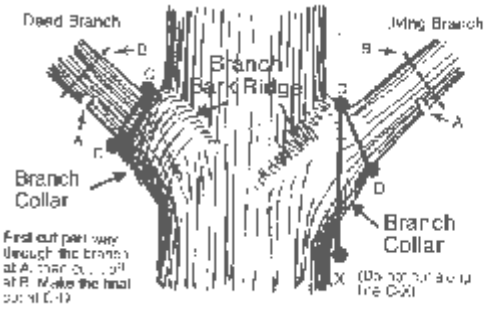
Figure D-1. Proper Pruning Techniques[6]

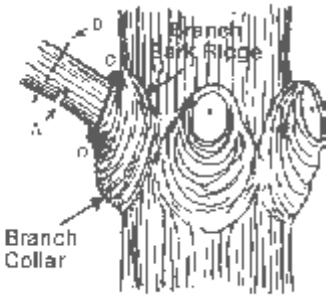
Prune correctly. The object of the operation is to remove the branches as close to the tree stem as possible without leaving any stubs.

A. Cut partway through the branch from beneath at a point one or two inches from the trunk.



B. Make a second cut on the top of the branch, at a distance of 1/3 to 1/2 the diameter of the limb from the first cut. This should allow the length of the limb to fall from its own weight and be safely removed.
C. Complete the job by making a final cut next to the trunk, just outside the branch collar, with the lower edge farther away from the trunk than at the top.





Using the illustrations above, final cuts should be made from points C to D. Do not cut along C–X, which is an imaginary vertical line to help you locate C–D. First cut partway through the branch at A, then cut it off at B. Make the final cut at C–D.

Drip-Line Thinning

The technique of drip-line thinning can be used to reduce ladder fuels and release desired leave trees from competition for nutrients, sunlight, and water by removing the nearby small trees and shrubs.

The drip line is the area at the end of the longest branches of a tree or shrub where water drips vertically to the forest floor. Drip-line thinning is accomplished by clearing away the ladder fuels within the drip-line circumference around the desired leave tree. The best place to begin is by picking out your healthiest, largest, desired leave trees and drip-line thinning around them. You can then reevaluate what vegetation is left and plan how to shape the remaining plants and stands of trees. Trees may be left individually, or standing in groups.

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[5] California Forest Stewardship Program. "Prune Trees for Better Health and Higher Value." *Forestland Steward* Newsletter. Winter 2002. http://ceres.ca.gov/foreststeward/html/prune2.html.

[6] California Forest Stewardship Program. 2002.

Mosaic Thinning and Adaptive Management

Mosaic thinning is a style of vegetative thinning that creates openings and patches of vegetation to increase the potential variety of habitat types. It can be used to accomplish fuel-reduction objectives and provide ecologically sound treatment results such as enhancing site biodiversity. Mosaic-thinning regimes work to emulate the structural composition created by wildfire. Although thinning will not achieve the same ecological results as a natural fire, the openings and patches of vegetation that are created can increase the potential for a variety of habitat types. For example, in certain portions of a treatment area, thicker vegetation and tree cover may be left to provide *thermal cover* for deer, elk, and other wildlife, while in other locations canopy cover may be reduced to provide sunlight to the forest floor in order to favor struggling native grasses and associated herbaceous understory vegetation. Mosaic thinning includes treatments that reduce the abundance of dense vegetation, thus encouraging herbaceous understory and overstory growth. Such thinning results in a diversity of habitat types beneficial to wildlife by creating islands, corridors, thickets, open understory forest stands, and small grassy openings of random shape, size, and occurrence.

Variable-Density Thinning

A variable-density treatment means thinning or selectively cutting trees in a manner to restore repeating variability or redundancy in a forest. *Variable-density thinning* regimes are an integrated approach to the management of forest stands and vegetative communities of different sizes and densities. This silvicultural practice can be applied to the diversity of vegetation types throughout the county, with site-specific adjustments made to accommodate the favored species historically suited for each plant community location.

The main goal of variable-density thinning is to restore maximum repeating variability or redundancy to a forested landscape.[7] Since we do not know exactly how much of what kind of habitat to restore or maintain, it is good to vary the treatments and apply them in small areas. This is in line with the Precautionary Principle.

This kind of thinning will help reduce crown fire hazard and can be combined with biomass utilization, surface fuel treatments, and controlled-burning activities. Low- to moderate-severity fire (the kind experienced historically in parts of the county) will then tend to naturally select for fire-resistant species.

> "Variable-density thinning regimes in which thinning intensity and tree marking rules are varied within the stand of interest (Carey and Johnson 1995; Carey and Curtis 1996) are a useful approach to increasing heterogeneity in stand density and canopy cover. Variable-density thinning is sometimes referred to as a 'skips and gaps' approach. In such a prescription, some portions of a stand are left lightly or completely unthinned ('skips'), providing areas with high stem density, heavy shade and freedom from disturbance, while other parts of the stand are heavily harvested ('gaps'), including removal of some dominant trees, providing more light for subdominant trees and understory plants (Carey et al. 1996). Intermediate levels of thinning are also applied in a typical variable-density prescription."[8]

These goals can be accomplished by the following practices:

- Creating and maintaining variable or uneven spacing, with clumps of trees and canopy gaps;
- Maintaining the largest trees of the stand;
- Maintaining "early-seral species" on the landscape, those species which begin growing in natural succession following a disturbance like fire or logging;
- Reducing the density of "ingrowth," trees that grow large enough in a season to be considered a sapling or pole timber; and
- Reducing the fuel loading by removing ladder fuels.

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[7] Lindenmayer, David B.; Franklin, Jerry F. *Conserving Forest Biodiversity: A Comprehensive Multi-Scaled Approach.* 2002. Island Press. Washington, D.C. See in particular the "Risk Spreading" chapter.

[8] Lindenmayer and Franklin. 2002. p. 184.

In addition to providing fire safety, ecological fuel reduction provides many other benefits. Some of these are:

- Improved forest health and productivity. There will be less stress and mortality from reduced competition, and this translates into lower fire intensity. By removing the lower branches of your trees, you will have higher-quality lumber (less knots) should you ever choose to harvest those trees for wood products.
- Improved wildlife habitat. Opening up the lower canopy and forest floor provides habitat for some of the species that prefer to dwell in larger trees or older forests.
- Improved aesthetics. Many landowners comment on how much nicer their view is after doing fire hazard reduction, as they can see out into the forest again.
- Creation of firewood.

For additional information on fuel-hazard reduction, please see Appendix F: Fire Safety Information.

D.2. What to Do with Thinned Materials

As a result of your fire safety efforts, you will likely accumulate a lot of branches and other materials. There are several options for dealing with thinned materials, including: burning, chipping, lop and scatter, grazing, some combination of these, and small-diameter wood products, and/or biomass.

Be aware when working on forested properties. You can only use commercial wood products from forestry operations on your own property. To sell most commercial wood products from a forest operation requires a Timber Harvest Plan (THP) approved by the California Department of Forestry and Fire Protection (CAL FIRE). THPs are generally too cost-prohibitive for fuel-hazard reduction in most young forests nor would they be appropriate or applicable to much of Lake County. However, the Forest Fire Prevention Exemption provides an alternative: *see section C.1.2 on the Board of Forestry in Appendix C, for more information.* The Mattole Restoration Council (MRC) has a great summary and comparison of fire-hazard reduction exemptions you can use for your fire-hazard related forestry operations. Find their "Forest Practice Rules for Thinning Exemptions," at mattole.org/pdf/Exemption_thinning_requirements.pdf, and "Comparison of Thinning Exemptions," at mattole.org/pdf/fire_hzrd_exemption_comparisons.pdf *(also in Appendix F)*.

In addition to MRC's summary and explanation of fuel-hazard exemptions, the State Board of Forestry has developed a table of permit options for fuel-hazard reduction on private and state owned lands.[9] *This document is also available in Appendix F.*

Firewood is also a great by-product of fuel-hazard reduction. To sell firewood, you need a firewood exemption permit from CAL FIRE. Additional permits may also be required by the county.

D.2.1. Burning

Controlled burning (or prescribed fire) is the controlled application of fire to forest, woodland, shrubland, or grassland in either their natural or modified state. All methods of controlled burning need to be undertaken with great care, with a well thought-out plan in place, and must follow all legal requirements. Fire can be an important tool to help restore fire-adapted ecosystems such as those found in Lake County. However, it can be a dangerous tool, and must only be used with the utmost respect, care, and skill. Before initiating any burning with your fuel-reduction efforts, consult with both the Lake County Air Quality Management District (LCAQMD)[10] and your local Fire Protection District (FPD). *See Broadcast Underburning below for more on necessary precautions.*

Controlled burning must be done within site-specific environmental conditions to confine the fire to a predetermined area. The objective is to produce the fire behavior and characteristics required to attain fuel treatment, ecological restoration, and resource-management objectives. (*For more information on how some other communities are using fire, see El Dorado County Fire Safe Council, Prescribed Burning,*

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[9] Board of Forestry (BOF). *Table of Current Fuel Hazard Reduction Permit Options.* September 17, 2008. www.bof.fire.ca.gov/other_board_actions/permit_options_for_fuel_hazard_reduction_on_private_and_state_owned_lands/finaldraftfhrtable.pdf.

[10] Lake County Air Quality Management District: www.lcaqmd.net. General E-mail: lcaqmd@lcaqmd.net. Voice: 707-263-7000. Fax: 707-263-0421. Address: 885 Lakeport Blvd., Lakeport, California 95453.

www.edcfiresafe.org/prescribed_burning.htm, and Orleans Somes Bar Fire Safe Council Prescribed Burning Program, http://www.mkwc.org/programs/firefuels/prescribedburn.html.)

Burning, like all slash disposal options, has both advantages and disadvantages.

Advantages for burning are:

- Fairly quick to dispose of large amounts of thinned materials.
- Access is generally not a limiting factor.
- May be the most inexpensive ways to remove thinned material.
- Recycling of nutrients into the ecosystem.

Disadvantages to burning are:

- Emitted smoke can cause adverse health impacts
- Risk of escaped fires.
- Limited number of burn days.
- Usually requires experienced fire professionals and fire suppression resources.
- Can be significant liability issues, especially with fire escapes.

The following is a list of suggestions for safe burning based on those developed by the California Forest Stewardship Program[11] and adapted for Lake County:

- Only clean, dry vegetation should be burned.
- Arrange the material to be burned to burn hot, fast, and free of dirt, to minimize smoke emissions. Place material of various sizes in the pile for adequate airflow, guarding against excessive smoke when burning.
- Only ignite outdoor fires with ignition devices approved by LCAQMD and CAL FIRE.
- Ignite material to be burned as rapidly as practical within applicable fire control restrictions.
- Curtail, mitigate, or extinguish burning when smoke is drifting into a nearby-populated area or creating a public nuisance. Smoke Management Plans (obtained from LCAQMD) can be utilized to minimize smoke problems and nuisance.
- Don't burn material unless it is free of tires, rubbish, tarpaper, plastic, and construction debris; is reasonably free of dirt, soil, and moisture; and is loosely stacked in such a manner as to promote drying and ensure combustion with a minimum amount of smoke.

In Lake County, the "Burn Ban" goes into affect on May 1st every year. Only "economic exemptions for agricultural operations" may be granted during the fire season; contact your local Fire Protection District or the Air Quality Management District (707-263-7000) for details.[12]

Residential burn piles must be no larger than 4x4 feet, at least 100 feet from the nearest neighbor, at least 30 feet from the nearest structure, and the ground scraped clean for at least 10 feet around the pile. A responsible adult must be present during burning at all times. Keep children far away from all fires and smoke. Residential burning hours in Lake County are 9am–3pm on permissive burn days. Burn permits last from the end of fire season (CAL FIRE determines when fire season is over) to the end of April.

Agriculture burn permits (issued for routine agricultural burning) are also required within the county. Burning hours for this permit are 11am–3pm for leaves, grass, and field crops and 9am–3pm for other material. LCAQMD also offers a parcel or land-development burning permit. This permit is issued for land development and clearing only and typically requires a pre-burn inspection by the local FPD. These permits are not for the use of year-to-year vegetation management.

LCAQMD may require a Smoke Management Plan for burning if:

- Smoke impact potential is high.
- There is a history of burn complaints.

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[11] California Forest Stewardship Program. *How to Burn Piles Properly.* www.ceres.ca.gov/foreststeward/html/burnpiles.html.

[12] Juntunen, Linda. Personal Communication. August 6, 2009.

- There is a high danger that the fire might escape.
- The fire will burn for more than one day, or
- The property includes more than one acre of standing brush, understory, removed whole vines, or trees.

These permits are only issued by the LCAQMD. Note: that there is NO burning within commercial areas in Lake County. Commercial properties include golf courses, apartment complexes, motels, and trailer parks. For more information regarding burning and burn permits please visit www.lcaqmd.net.

Controlled-Burning Methods and Treatments

Controlled burning (AKA prescribed burning or prescribed fire) methods vary and include swamper burning, *hand pile burning, broadcast underburning,* and *patch burning.* All burning methods can be used to reduce fuel hazards and improve the ecological health of Lake County wildlands. When choosing the right controlled burning activity for your property it is very important to consult fuel management and forestry professionals, especially when considering broadcast underburning. Controlled burning methods are very site-specific, and generally only applicable for larger ownerships. Not all methods are appropriate for every location. Burning prescriptions must be determined on a unit-by-unit or section-by-section basis. The details you will need for burning will develop as on-the-ground work progresses along with your knowledge of site conditions. Whenever burning, dry material properly (this can take several weeks or more). Minimum drying times are available through LCAQMD.

Swamper Burning

Swamper burning is a controlled burning method in which fuels are gradually and continually added (usually over the course of a day) to a hand or machine pile. Near homes, swamper burning may be a good option. This method is highly recommended within denser vegetation zones, following an initial *first-entry thinning treatment,* where high concentrations of slash will be generated. Swamper burning is a first preparation step prior to broadcast underburning.

This method can be beneficial for the following reasons:

- There is less smoke at any one time when dragging and burning downed slash, rather than lighting many hand piles at once.
- More fuels are consumed as a result of this method. There is little opportunity for piles that are lit to extinguish in the center.
- Swamper burning minimizes scorching of leave trees and sensitive vegetation zones. Slash can be dragged away from leave trees and transported to burning piles in more open locations.
- The danger for crown scorching and the potential for runaway fire is lessened because piles are more manageable in a swamper burn situation than in a larger *touch-off* hand-pile burn.
- The visual appearance of hundreds of hand piles burning at one time can be frightening. In contrast, swamper burning is a good tool to educate landowners about fire, and the fire-adapted landscape in which they live.
- Swamper burning methods are safer and more manageable in both appearance and execution. In light of the prescribed-fire disasters in the Southwest, this is important in terms of developing and maintaining community trust for landowners, contractors, and agencies involved in the application of controlled burning.
- In a swamper-burning situation, materials for special forest products and small-diameter utilization can be sorted by hand crews.

The swamper burn method is site-specific. For controlled burning activities in chaparral, chemise-chaparral, and foothill woodland *(see Chapter 4)* where fuels burn hotter than conifer forests, the swamper burning approach will achieve positive end results, provide a safer burn, and prepare site conditions for the future reintroduction of low-intensity fire.

Swamper Burning Prescription

- Place burn-pile locations at a minimum of ten feet outside the drip zones of the largest overstory leave trees, where they exist.
- Place burn piles in the most open areas to avoid damage to surrounding trees and other vegetation.

- Construct small piles (comprised of mainly smaller fine fuels such as live and dead branches) approximately every 15-25 feet to serve as *pilot ignition piles.* These piles can be constructed roughly three feet high and covered with slash paper. (Check with LCAQMD for approved slash paper materials.) After stacking enough material for the base of the pile, place a sheet over the material then stack about 1/3 more on top to hold down the paper—this will keep things dry for later lighting.
- Leave the remainder of slash on the ground until you burn.
- Swamper burning must be conducted prior to fire season; check with your local FPD, LCAQMD, or CAL FIRE for permitting details.
- Desired sub-merchantable materials can be sorted for special forest products, small-diameter poles, and firewood. *(See section D.2.5 below for more information*.) Yard these products to roadside locations.
- When the burning, ignite pilot piles in smaller sections (ten piles at a time), with the remaining slash dragged to the burning piles in a rotational fashion. Add slash to the piles while keeping reasonable flame lengths. When these piles have become manageable, crew members with hand-carried *drip torches* can move ahead to ignite other piles. At the same time, a mop-up crew will stay behind and clean up the remaining slash and burn out the surrounding slash in the piles.
- Depending on the time of year, a *scratch line* or *scalping* down to *bare mineral soil* may need to be placed around the piles to prevent the fire from burning outside the pile ring.
- After visible flames have burned down, hot embers will remain in the burn ring. Depending on what fuel type you are burning, these hot embers may remain for several days. It is important to inspect the area where you were burning several times throughout the following days until the fires are completely out, more often if there is <u>any</u> wind. Throughout Lake County, fuels on the ground can dry out rapidly even after several days of rain. Pay close attention to this to prevent fire from escaping.

Following burning, a good restoration practice is to sow native grass seed into the mineral-rich ashes of some of the burn locations to help restore native grasses. Native grass can establish itself well in disturbed locations such as burn spots. Check with your local nursery to acquire native grass seed for your specific location. Sow these seeds by hand; experiment with how much seed to sow. Seeding rates will vary; check where you buy seed as to how much to use per location, trying to obtain the freshest seed stock. The best time to sow native grass seeds is November through March, during their dormant time which depends on elevation. Sowing native grasses not only restores herbaceous plant communities to your site, it is a good preventative measure for noxious weeds.

Remember: don't strip the ground of all woody material in your burning operations. Be sure to leave some coarse woody debris (the larger the pieces the better). Don't burn every stick. Decide what to leave on the site based on slope percentage, aspect, and location, (e.g. leave more large materials on steeper slopes).

Hand Pile and Burn

Following thinning operations you may consider the method of *hand pile burning*, where slash is gathered into piles in open areas and burned. Slash is piled soon after it is cut, then covered with slash paper to allow the piles to dry out so they can be properly (and legally) burned. Slash piles are usually burned in the fall and winter during moist days. At this time, the piles will be relatively dry while surrounding vegetation will be damp, minimizing the spread of fire beyond the pile. This method differs from swamper burning in that materials are not continually added to the piles once they are ignited.

<u>Hand Piling Specifications</u>

- Pile debris ranging from two to eight inches in diameter, at least two feet or more in length. On slopes greater than 55%, small-diameter (greater than eight inches) coarse woody debris may be left for soil stability. Favorable small-diameter materials may be yarded for special forest product utilization. *See D.2.5 below.*
- Piles should be placed away from old stumps and fallen logs to minimize their ignition. To prevent holdover fire potential (i.e., a fire not burning out completely), make sure piles aren't located on top of old stump holes or decomposing logs. Place piles a sufficient distance from the drip lines of trees to prevent scorch.
- Construct piles up and down slopes; create a secure base to prevent the rolling of materials.
- Use smaller fuels as the initial core for later ignition, with larger fuels placed on tops and sides.

- Size piles in a range from a minimum of three feet high by five feet in diameter to a maximum of five feet by seven feet, except when insufficient slash is available in the area.
- Residential burn piles must be no larger than four by four feet.
- Make piles as compact as possible. Limbing, aligning the material, and placing heavier material on top of the pile will obtain compaction. Do not exceed three inches in cross dimension air space between logs and limbs after piling.
- Cover piles with slash paper so the covering does not go beyond half the length of each side of the piles, as measured from the top (or center/mid-point). The goal is to have the center core of the pile covered (not the entire pile) for successful ignition when lighting the pile later.
- Placing heavy materials on top of slash paper to provide the best protection from rain and snow.

For piles that may cause unavoidable scorch to residual trees upon combustion, burn them during periods of rain or snow to minimize damage. Each pile should be *chunked* at least once during burning operations. Include any creep in the chunk to keep the fire confined to the piled area. Chunk piles after they have had sufficient time to burn down. Check piles daily, and frequently throughout the day in windy conditions. Use extreme caution: escaped burn piles are responsible for numerous wildfires.

Broadcast Underburning

Broadcast underburning allows a controlled fire to burn in the understory throughout a designated area within well-defined boundaries. It is done to reduce fuel hazards and/or as a silvicultural restoration treatment. It is generally used only on very large properties, or public lands. Prior to considering broadcast burning, be sure to contact local fire agencies, CAL FIRE, and LCQAMD to obtain all the necessary permits and to conform to all legal requirements. Before burning in forested stands, obtain a Smoke Management Plan from the LCAQMD and approval for specific burning times from LCAQMD and your local FPD.

To effectively and responsibly reintroduce fire—to ensure it will burn on the ground and not in crowns—first thin and brush the site. This reduces stand densities, ladder fuels, and excessive brush and surface fuels.

Preventative measures should be taken to ensure the survival of overstory trees. Often a thick duff or thatch layer will accumulate beneath mature trees. Feeder roots will often grow into the duff layer close to the surface of the ground. The loss of these roots due to extreme heat and/or fire can cause tree mortality. Thus duff should be raked back several feet with a McLeod or other raking device to prevent unwanted impacts. This is important beneath large pines and oaks, which often accumulate thick mounds of debris, colonized by sensitive roots.

Favorable conditions for igniting fires include low winds, moderate humidity, fairly moderate temperatures, and a small amount of soil moisture to protect soils from baking. Aboveground fine fuels should be dry enough to ignite and carry fires. The idea is to reduce fine fuels in the form of duff or grasses without compromising or impacting soils, fungal associates, sensitive tree roots, etc. Burn intensities will vary depending on the vegetation type, the amount of ground and surface fuels, and the restoration objectives on the site.

Flashy underburns are the desired outcome where there are less surface fuels, and grass persists in the understory (e.g. oak woodlands and grasslands). Flashy underburns are best accomplished in the fall, usually on the second dry day following a rain, and enable safer broadcast burning of larger areas. The top several inches of the surface fuels should be dry, with the moisture content sufficiently low to safely carry the fire quickly (flashy), consuming the top layer of the surface fuels while leaving some organic material to protect the soil.

Where surface fuels consist of deep, heavier leaf litter mixed with duff (e.g. ponderosa pine and mixed conifer forests), a slower creeping fire may be more appropriate. During mid-winter periods, an annual window of an extended dry period often occurs following heavier periods of earlier winter rain. This is a good time to accomplish this type of underburning to consume more of the abundant surface fuels. The slow creeping fire will consume more depth of surface and ground fuels. The native people in the region referred to this type of burning as 'cool burning'; fire creeps along and consumes fuels without getting hot and out of control.[13]

[13] Pilgrim, Agnes Baker. Confederated Tribe of Siletz, Takelma Tribe of the Rogue Valley, Southern Oregon. Personal communication.

Broadcast Burn Fire Preparation Example

- Thin and remove ladder fuels and jackpots (pockets of dense fuels where fire could flare up and burn more intensely); prune to head height. Separate ground-to-crown and crown-to-crown live and dead fuels.
- Lop and scatter tree branches and tops; cut to twelve- to eighteen-inch lengths on the ground.
- Pile all other slash three to four feet high, five to six feet at base.
- Use flagging to mark desired leave species like seedlings and native shrubs. Create a *blackline* around these. Slowly burn out from desired leave species to protect them during the main broadcast burn).
- Blackline (backburn) all retained doghair thickets and gulches before broadcast burning.
- Use a McLeod tool to pull back heavy duff from leave trees to prevent root steaming and possible mortality,.
- Leave slash less than two to three inches in diameter on the forest floor.
- Put medium-sized slash in piles or near roads for firewood.
- Leave slash greater than eight inches diameter on the forest floor.

Patch Burning

Following initial thinning and slash treatment, patch burning may be used in site-specific locations. Patch burning is done by defining and isolating a small area of fuels that you want to burn, and applying fire only to that area. This method is sometimes used in the management of invasive blackberries where the area around the patch is thinned, a scratch line is created around the thinned area, then the inside patch is ignited.

This method can also be used to burn surface fuels within a variable-density treatment where unthinned areas are retained but you want to achieve the diversity of mosaic burn conditions.

If performed properly, patch burning can be a very effective method for reducing fuels and costs. In the proper conditions it works well in chaparral and chemise-chaparral, as these plant types often have lots of dead fuel, and patches can be isolated and burned.

As with other controlled-burning methods, only perform the activities with the proper permits and by consulting and hiring skilled fire or forestry professionals.

Considerations for Burning Activities within Riparian Corridors

Some variation may occur during burning operations due to changes in vegetation, slope, and aspect.

- Burning should be carried out with extreme caution along slopes above riparian draws, especially in *headwalls,* or where loose boulders may be found. Lop and scatter coarse woody debris in these locations to protect the soil and enhance slope stability.
- Burn on stable benches within upland riparian areas. Transport thinned slash by hand crews to these locations.
- Take extra care while burning is being conducted to protect vegetative diversity. Burn slash away from "mesic" (normally moist) vegetation.
- Underburn in a patch-burn fashion.

D.2.2. Grazing

As explained in Chapter 4, grazing is an option to reduce grassland fuels using livestock (e.g. cows, sheep, goats, and horses). One of the long-term objectives of using grazing as a restoration tool is to convert an area from exotic annuals back to native grasses, as native plants are generally adapted to the local wildfire ecology. This can be done in the fall or spring, and followed by the sowing of native grass seed. Conversion from annuals back to perennials is a very time-consuming task requiring meticulously scheduled seasonal activities, and is more appropriate for highly focused areas due to the intensity of the work.

If grass conversion is not the focus, a very temporary and selective rotation of livestock grazing on an area can mitigate annual grass heights and also clear brush. Goats, sheep, or cows are all options for livestock grazing. Whereas cows and sheep are good for grasslands, goats are a great option for heavily brushed areas, including dense stands of poison oak or Himalayan blackberry. There are several local goatherds available for fuel

reduction. Goats are a good option for areas that are steep, or for smaller tracts. Only one or two goats can effectively clear smaller areas.

With any grazing treatment for fuel reduction, areas that you do not want to be grazed will need to be fenced, or some other method will need to be used to control the animals. Where grazing is desired in a strip pattern, use proper fencing to contain animals in the proper location. Grazing animals can quickly denude an area of all plant life if left unmonitored.

Advantages to grazing are:

- Can be inexpensive.
- Only fuel costs are in transport.
- Can quickly clear an area.
- Provides nitrogen-rich fertilizer.

Disadvantages to grazing are:

- Can quickly denude an area.
- Can spread exotic species through manure.
- Need to be controlled by fencing or other means to protect areas not to be treated.
- Need access to water.
- May need protection from wildlife.

D.2.3. Chipping

Chipping is the use of machinery to reduce branches and other small materials to small chips, or wood chips. It is another method for treating thinned materials, and like all options it has both advantages and disadvantages.

Advantages to chipping are:

- You can work on most days when other options may not be feasible.
- The chips created can be used for landscaping, such as on paths around your homesite (but not within your five-foot fire-free zone).
- Chips spread along roadsides will suppress the growth of vegetation, thereby keeping down fire hazards.
- There is a no chance for escaped fires or smoke.
- Free or reduced-cost chipping is available for smaller projects through the local Fire Safe Councils.

Disadvantages to chipping are:

- Chipping can be expensive if you are doing it on your own.
- Chippers break down and need to be serviced.
- Production levels for slash disposal can be slow, especially with large materials and a small chipper.
- Chippers are limited to where they can be staged; they generally need to be close to roads.
- Chippers are noisy.

If you don't have access to a chipper, the Lake County Fire Safe Council (707-263-4180, ext. 16) and the South Lake Fire Safe Council (Bruce Anderson 707-928-5232 or Allen Clay at 707-987-0243) are part of a community-chipping program in cooperation with the Resource Conservation Districts (RCD, Dave Mostin 707-279-2968). Contact any of them for more information. They can likely help you chip your residential slash.

The Lake County community chipping program began in 2002 with a chipper purchased by Lake County Air Quality Management District (LCAQMD) and leased to the Lake County Fire Safe Council (LCFSC). The LCFSC helped develop the program; the foreman and crew work for West Lake RCD.

The program is supported by minimal fees, private donations, and the County of Lake and LCAQMD. Once the program was established, the chipper was donated to the program by the LCAQMD, with an MOU that the chipper would be available for public benefit projects upon request. Lake County Special Districts also donated a used dump truck. LCAQMD provided funding to convert the truck from diesel to propane for emissions reductions. The chipper is now owned and maintained by West Lake RCD It continues to be a successful method of fuel reduction for the county's residents.

The South Lake Fire Safe Council began its own chipping program in 2002. It utilized grants to hire a chipping contractor at no charge to residents. This program today however utilizes the chipper managed by the West Lake RCD. It is still offered at no cost by the SLFCS to the communities that they serve.

The Hidden Valley Lakes Association purchased a chipper in 2002 to service their residents. Dues provides by association members pay for this chipping program.

For specific instructions regarding how to prepare your materials for use with the community chipping programs, please visit: http://southlakefiresafecouncil.org/chipping.htm, and www.recycling.co.lake.ca.us/news/ChippingProgram.pdf.

If one of these programs is not available to you, you can hire a forestry contractor who has a chipper, or rent one. If you rent one, it should be able to process material up to ten inches in diameter. Even if the material you are chipping is six inches, having a ten-inch chipper will make things go faster because sometimes you will want to put three branches (each three inches in diameter) in the chipper simultaneously. With a chipper that takes larger-diameter material you will prevent the potential problem of jamming the machine. It is very important that you get a good chipper, since it can be frustrating to rent a chipper that does not serve your needs.

Chippers are best suited for use close to roads, landings, or where access to your thinning slash is convenient, although tracked chippers are available that can drive through the forest on minimal slopes. The best materials to chip are softwood conifer species. Chippers can be used on hardwood and chaparral, but you will need to pre-process these materials before putting them into the chipper. Broad, branchy fuels like chaparral (e.g. manzanita or buck brush) can cause a chipper to jam if you do not first limb the branches with a chainsaw. These fuel types are time-consuming but workable. Limit dirt from getting into the chipper, as this will quickly dull the blades. Remember to stack all your branches in the same direction so you can easily feed the chipper.

Use extreme caution when operating a chipper; always wear safety glasses and ear protection. Pay special attention to the feed control; watch that your clothes (especially shirtsleeves) are not caught on branches as they are pulled into the chipper. Keep children far away from all chipping operations.

Finally, another form of chipped or processed materials can be achieved in conjunction with the county green waste program. There is free curbside pickup for green waste for county residents with refuse pickup. The local composting facility uses wood processing equipment to produce landscape materials and compost for residential and commercial use, from materials from the green waste and chipping programs. More facilities such as this, and/or composting facilities could be developed in Lake County for processing of removed fuels, benefitting the local economy and creating local jobs.

D.2.4. Lop and Scatter

Lop and scatter is a method whereby thinned materials are spread about to rot on the forest floor—taking care not to form large piles of slash (jackpots). Lop and scatter can be very cost-effective; it is definitely a site-specific treatment.[14] This is the best method for improving site soil fertility and hence the ecosystem's long-term productivity. By removing the ladder fuels and scattering them low to the ground, you are improving the chances of your forest or wildland surviving a wildfire. However, because of short-term increased hazard this is not a method to do near structures within the Defensible Space Zone.I It is more appropriate in the Wildland Fuel Reduction Zone *(see Appendix C for more information on the various zones).*

Advantages to lop and scatter are:

- Do not have to pay for additional disposal treatment such as burning or chipping.
- Material is left on site and produces wildlife habitat and future soil.
- Access is generally not a limiting factor.

Disadvantages to lop and scatter are:

- It is very time consuming to cut material into short lengths.
- Fuels are not removed, so there is still a surface fire hazard for up to three years or more.

[14] Jones, Tim. Fire Management Officer, Bureau of Land Management. Arcata, CA. Personal Communication. July 12, 2004.

Material should be cut down to an ideal height of one foot above the ground. However, lopping to less than or equal to twelve inches above ground is likely beyond the skills of most, so eighteen inches is sufficient goal. Remove all large pieces of wood; use this for firewood). Dedicate some larger, heavier pieces to sit on top of the slash and weigh it down. Conifer slash "lies down" much easier with much less lopping than most hardwood slash due to its growth habit. Green slash of all species lies down easier than dry slash (if you're thinking of coming back later to lop). Make sure none of your material on the ground is touching the base of any trees or shrubs you have left standing (your leave trees). Think about this in terms of creating defensible space around leave trees just as you would around structures.

The biggest risk with the lop and scatter method is that fire may occur within your treated area before the fine fuel falls to the ground and decomposes. Even so, lop and scatter does reduce your fuel hazard because the fuel is no longer part of the fuel ladder, and there is vertical clearance between the surface fuel and the bottom branches of the trees (ideally a minimum of eight feet of space). Nevertheless, your surface fuel hazard may increase in the short term—from three to ten years—depending on your forest types and decomposition times.

D.2.5. Small-Diameter Wood Products

Much effort has been made in California and throughout the Pacific Northwest to develop markets for small-diameter, or value-added wood products, especially for hardwoods. Small-diameter wood products are furniture and other materials developed from generally small, suppressed trees, or large limbs.[15] (Not to be confused with smaller branches and other materials from fuel-reduction projects that can be used as mulch or for landscaping.)

Advantages to small-diameter wood products are:

- Creation of local jobs.
- Creation of valuable wood products to sell.
- Helps to offset the cost of fuel-reduction projects.

Disadvantages to small-diameter wood products are:

- Can be expensive to remove these materials.
- Limited availability of infrastructure currently to can handle this material.

It is possible to use these materials commercially. They often produce beautiful lumber. Small, suppressed Douglas fir—a softwood—often has a tight grain that makes for attractive trim and tongue-and-groove flooring. Local hardwoods such as tanoak and madrone can be used by local woodworkers to create stunning furniture, cabinets, and floors. To be merchantable, the logs need to be straight and between six to ten inches in diameter. Two great Northern California sources for more information are the Institute for Sustainable Forestry (www.sustainablehardwoods.net) and the Watershed Center (www.thewatershedcenter.com).

There are many issues limiting the use of small-diameter and non-conventional forest products in Lake County. The main issues are the lack of both infrastructure and a constant supply of small-diameter wood products. There are portable sawmills in Mendocino County. However, hauling costs could limit the feasibility of adding value to small-diameter materials generated during fuel-reduction projects. Lake County could be a central location for a small-diameter log mill that could service areas of eastern Mendocino County, Napa County, and Colusa County. A small-diameter log mill can create local jobs as well as add value to material cut during fuel-reduction projects. The added value of these wood products can help offset the cost of fuel-reduction efforts.

In addition to milling small-diameter material for conventional wood products, vegetation cut during fuel-reduction projects can also be used for a variety of other purposes. Manzanita, for example, is very beautiful and can be used for decorative purposes in its round form. Small-diameter conifer and hardwood material removed during fuel-reduction projects can be used to create rustic furniture. The ability to sort this type of material at a scale that is economically feasible (wood sort yard) will be the major limiting factor in creating a value-added facility in Lake County. A local sort yard could help supply the public with specialty wood products that have been cut during fuel-reduction activities. The Watershed Center in Trinity County has a functioning sort yard that

[15] For more information on small diameter wood products and biomass, see: Rural Voices for Conservation Coalition. *Woody Biomass Terms.* April 2008. www.forestguild.org/biomass/resources/definitions_rvcc.pdf.

could be a model for a similar project in Lake County. These projects can help reduce fire danger, limit the amount of burning, and create local jobs.

D.2.6. Biomass

As stated throughout this CWPP, the vegetative communities of Lake County have accumulated high amounts of biomass over the past decades.

> "Biomass refers to organic material from living things such as trees, shrubs, grasses and other plants. The temperate forests of the Pacific Northwest contain the highest amounts of biomass per acre of any forests in the world, far exceeding tropical forests. Biomass is commonly used as lumber, firewood, and paper. Biomass can also be used for energy production."[16]

California's biomass resource is large and diverse. The statewide gross annual resource in 2005 was estimated at over 86 million *bone dry tons* (BDT). Of this, 34 million BDT/yr are potentially available for sustainable use. This is a preliminary estimate based on technical and ecosystem limitations in resource acquisition and does not strictly define the fraction of biomass that is economically feasible to use. Of the gross annual statewide resource, 25% is from agriculture, 31% from forestry, and 44% from municipal solid wastes.[17]

Within Lake County the amount of estimated[18] biomass in 2005 varied within these categories (agriculture, forestry and municipal solid waste). Estimated agricultural biomass—orchard and vineyard clippings—was approximately 14,548 BDT/yr. Estimated forest biomass was 429,018 BDT/yr. Of this figure, logging slash comprised 119,806 BDT/yr, forest thinning 118,929 BDT/yr, mill residue 64,392 BDT/yr, and shrublands 125,891 BDT/yr.[19] This biomass has the ability to create energy or be used for a variety of other uses.

In its simplest form, biomass is used as firewood to create heat. One of the most efficient ways is through a process called gasification. This technology is being used in schools in rural areas *(see www.fuelsforschools.org)*. Gasification uses woody materials as a source of energy to produce methane and hydrogen gases. These gases are then used to create heat or as fuel to power an engine for electricity. Biomass can even be used to replace our dependence on fossil fuel. It can be better for the environment, assuming the production and collection of the original biomass is done in an ecologically appropriate and sustainable manner.

One of the noteworthy challenges associated with biomass as a source of energy is transportation cost. In order for biomass utilization to be economically feasible, the distance for the biomass to travel should not exceed 25-50 miles. However, alternatives are being developed as biomass is being emphasized as a federal mandate for public land management agencies. One alternative is to bring the biomass plant to the woods. Portable biomass facilities are being developed but are not yet commercially viable. Community-scale biomass alternatives that distribute the benefits and the risks (such as over-exploitation of forests and air pollution), while reducing transportation costs and limiting large-scale impacts are most desirable and advantageous for Lake County.

Finally, a resource for developing biomass in Lake County is the California Forest Biomass Working Group (CFBWG). This group includes numerous agencies, consultants, and conservation organizations, and has developed the following mission statement:

> "Every forest community in California has the capacity to address and utilize the excess biomass in their area that is appropriately scaled to be economically and ecologically sustainable so that local jobs are created that help restore the environment and reduce fire risk."

Learn more about CFBWG by contacting Bruce Goines of US Forest Service Region 5: 707-562-8910.

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[16] Institute for Sustainable Forestry. *Safeguarding Rural Communities: Fire Hazard Reduction and Fuels Utilization, Final Report.* September 2001 to December 2002. p. 23.

[17] Department of Biological and Agricultural Engineering, University of California Davis. California Biomass Collaborative. *Biomass Resource Assessment in California.* 2005. p.54.

[18] Department of Biological and Agricultural Engineering. 2005.

[19] Department of Biological and Agricultural Engineering. 2005. Pp. 5–16.