

Chris Detwiller

Subject: Wicklow Fuels Management Project

Date: Wednesday, April 9, 2008 8:45 AM

From: Chris Detwiller <cdetwiller@openspacetrust.org>

To: cjolley@hmbfire.org

Priority: High

Dear Mr. Jolley,

The Peninsula Open Space Trust has recently submitted our permit application to the County for the implementation of a fuels management plan for POST's Wicklow property, a property in El Granada that is composed primarily of eucalyptus forest. Through the development of the fuels management plan we consulted with CDF and Gareth Harris of the Half Moon Bay Fire Department, who I understand is no longer with the department. After extensive consultation with CDF and San Mateo County Planning, it was determined that a County Coastal Development Permit would be the proper permitting route for the fuels reduction project. We have recently submitted our permit applications to the County, and will soon be having a public workshop to present the plan.

In advance of this workshop, I wanted to get in touch with you to offer to meet with you to present and discuss the plan, either on the property itself or at the fire department. I would also like to ask for your support and for your attendance at the public workshop, which is scheduled for Thursday, April 17 from 7 to 9 pm at the El Granada Elementary School.

I spoke with Michele Ortiz this morning, and she said that you will be out until April 16, so it appears unlikely that we could meet in advance of the public meeting. I will, however, keep my schedule open on the 16th and 17th in the event that you may be able to meet.

Attached is the fuels management plan, developed by Buena Vista Services and Wildland Resource Management. I will also send you the project description and assessment for the County permitting process. This is a large file, so I will send it via file transfer. I have also attached the public meeting notice.

I look forward to sharing the details of this important project with you, and hope that you will be able to offer the fire district's support for the project at the meeting on the 17th. Please let me know if you have any questions, and I look forward to hearing from you. Thank you very much.

Regards,

Chris Detwiller

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The Wicklow Fuels Management Plan

**Prepared for the
Peninsula Open Space Trust**



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EXECUTIVE SUMMARY

This fuel management plan is Phase I of the efforts to address the fire hazard on Peninsula Open Space Trust's Wicklow property. There are two primary reasons for taking actions on the Wicklow Property. The most pressing reason is to reduce the fire hazard to the residents of El Granada Hills. The other is to reduce the potential damage to the values in the POST landholding (including the natural values such as vegetation, wildlife, soil stability and water quality).

A fire management assessment for the POST landholdings identified Wicklow as the highest priority among their properties. Wicklow is a 445-acre parcel that extends eastward from nearly sea level up to a prominent ridge reaching 932 feet in elevation. Wicklow is covered with a dense eucalyptus forest of mostly pole-sized trees (265 acres), and with northern coastal scrub (163 acres). Generally, the eucalyptus forest covers the lower west-facing slopes, and the northern coastal scrub covers the upper west- and east-facing slopes. The fuels produced by the eucalyptus forest are quite hazardous in terms of potential fire behavior, and pose such a risk of damage to nearby residences that Wicklow has been ranked as the highest priority of POST landholdings to treat for fire hazard.

Although an old network of roads and trails is extensive, vehicular access within the parcel has been degraded by slides and surface erosion.

Treatments are recommended to provide safe emergency access, limit fire size, reduce fire intensity on the parcel of the perimeter, and protect and enhance on-site natural resources. This is done by reducing fuel loads and changing the forest structure in two key locations: on the perimeter of the parcel and along designated fire roads.

Wicklow was divided into 10 management units. Within each management unit, Treatment Areas were designated and actions specified. Recommendations are to thin the eucalyptus forest within 100 feet of identified fire roads to a spacing of 35 feet, and to foster native tree species within the treatment zone. In some locations along the perimeter, all eucalyptus trees are to be removed. Northern coastal scrub should be mowed for a distance of 50 feet from identified roads.

Numerous landslides have rendered several critical internal access roads unusable or at risk of becoming unusable for fire suppression. Stream crossings (culverts) have plugged and contributed to these failures. In addition to misdirected overflow an earthen dam has caused a slide on an adjoining road. General recommendations are made for repair, while specific actions will be developed as part of the permitting process in Phase II.

A review of potential permitting options was made, and the Emergency Notice (CAC 1052) option was considered the most appropriate in terms of costs and support from reviewing agencies. During the permitting process a higher level of specificity will be provided including delineation of treatment boundaries on maps and on the ground.

Project implementation is greatly facilitated by funding, which is available either through grants or by recouping value from products derived by the treatments. Unfortunately, the market does not support any cost-recovery from the products, so obtaining grants is the most likely form of funding. Grants stemming from the National Fire Plan, Federal Emergency Agency, and through Fire Safe Councils are all potential sources of funds.

Implementation can be split into two phases. The first phase would be to treat perimeter locations, both along adjacent values at risk and along the perimeter fire road. The second phase would be to treat the interior portions of the Wicklow property, generally along the mid-slope fire road.

Due the absence of value in the cut material, costs to perform all recommended treatments are significant. Implementation of both phases as presented in Section G could cost as high as \$350,000. An initial phase to treat the highest risk area adjacent to Dolphine, and the associated roads is estimated at around \$240,000. Significantly, this area contains several critical road failures, which increases the per acre treatment costs. The phasing of treatments will help spread the costs over time, and cost data from the initial phase will help refine subsequent budgets.

The results of the recommended treatments will greatly improve the fire safety of the site. Fuel types will be changed, with resulting lower flame lengths. Fire intensity in treated areas and the related potential damage resulting from a fire on Wicklow will both dramatically decline. Fire suppression organizations will more safely be able to respond to such a fire, and are likely to be more willing to commit resources to a fire on the Wicklow property. While the probability of a damaging fire will be much lower after the recommendations are implemented, there is still a chance a fire could still produce significant damage.

I. INTRODUCTION

A. PURPOSE OF FUEL MANAGEMENT PLAN

There are two primary reasons for taking actions on the Wicklow Property. The most pressing reason is to reduce the fire hazard to the residents of El Granada Hills. The other is to reduce the potential damage to the values in the POST landholding (including the natural values such as vegetation, wildlife, soil stability and water quality).

A fire management assessment for the POST landholdings by ECORP Consulting, Inc. (2004) identified preparation of a fire management plan (FMP) for Wicklow to be the highest priority among their properties. This parcel has several attributes that combine to justify its high priority. The fire hazard stemming from dense eucalyptus forest-based fuels, and steep terrain adjoining numerous residences create a high level of concern about potential fire damage stemming from a fire on Wicklow property. Gareth Harris, Fire Marshal of the Half Moon Bay Fire Department, predicted at an on-site meeting March 23rd 2005 that a wildfire on the interface like this could create "flash-over" conditions where the forest and homes all reached combustion temperature at the same time, as a block of flames. Suppression efforts in these conditions are often extremely limited.

In general, the actions proposed to reduce fire hazards on Wicklow are to treat the vegetation and repair strategic roads. The specific goals of such a program are presented below.

1. Provide Safe Emergency Vehicle Access Routes and Safety Zones

The highest priority is to provide safe routes for emergency vehicles (including firefighting equipment) in order to access the scene of the fire. This would entail making strategic roads drivable, reducing potential fire intensity near roads, and creating safety zones of suitable size and vegetative conditions to afford a place for firefighters to retreat to during extreme emergency conditions. All these actions enhance the chance that fire departments will commit firefighters to an incident on Wicklow, and thus have a reasonable chance to minimize losses from a wildfire.

2. Limit Fire Size

Because of limited firefighting resources available on the central coast, any fire on Wicklow would be of high concern. The concern is that under severe weather conditions a fire can ignite and spread too quickly to be suppressed by local firefighting staff and equipment. Such a fire can quickly spread through untreated lots or burn structures causing unacceptable damage before additional firefighting resources can arrive to contain the larger fire. Many homes and mature trees could be lost. The goal is to compartmentalize fires and limit spread of any fire within the Wicklow property. One must assume that on a high danger fire day, other fires may take resources away from one on Wicklow, and any actions that enhance the ability to limit fire size is highly recommended.

3. Reduce Fire Intensity Next to Structures

When the fire intensity is high next to structures, damage is more likely. Reducing fire intensity near structures is the most important action POST can take to reduce the chance of structure damage. Fire intensity is most often reduced by vegetation management, such as thinning eucalyptus, pruning lower limbs of trees, removing understory shrubs, and mowing grasses.

4. Minimize the Number of Fire Ignitions

Reduce the chance of fire ignitions thereby reducing the chance that a wildfire would escape the initial control efforts by local firefighting staff.

5. Protect Valuable Natural Resources

Higher fire intensity increases the damage to natural resources. While most natural resources on POST have adapted to fires, catastrophic wildfires that burn in fuels that have not been burned in many decades can result in loss of sensitive plant and wildlife species, changes in soil composition, and severe soil erosion.

6. Fire Behavior

The goal to reduce fire hazard includes actions to change specific types of fire behavior: reduce flame length, spotting potential from the eucalyptus stands, fire spread rates (both from spotting as well as from surface fire spread) and the ability of a surface fire to spread to tree crowns. This is accomplished by reducing fuel volumes, separating canopies both vertically and horizontally, and removing understory and shrubby live fuels.

7. Fire Safety on Adjacent Properties

An ongoing goal regarding fire hazard reduction is to inform the residents of El Granada and users of the Quarry Park and Wicklow trails of the need for fire safety, and to engage citizens in following fire-safe practices. This includes vegetation management, vigilance, education to help minimize potential ignitions, and methods to make their homes more ignition-resistant.

8. Non-Fire Goals

An ancillary goal that can be achieved through vegetation management is the enhancement of ecosystem diversity. Inherent in this goal is the desire to retain species, provide a greater proportion of native species in a diverse set of age classes, and to promote sustainability of the range of ecosystems on the site over time. One element of ecosystem enhancement is to improve growing conditions for young cypress and pine trees, and other native tree species that are already present in the understory of the eucalyptus stand or shrub areas by providing more light and growing space. Eucalyptus is considered invasive because it tends to spread and chokes out native trees, shrubs and herbs. The dense eucalyptus forest also reduces water available to streams because they transpire large quantities of water. Because it displaces valuable riparian vegetation, its spread is significant.

Another benefit will result from repairing existing road problems. These roads will then provide reliable access for future maintenance of the property, and by repairing slides and failed crossings, sedimentation will be reduced dramatically and water quality improved. Because soils on Wicklow are inherently erosive, there may be temporary increases in sedimentation from soil disturbance and vegetation removal, but the long-term benefits of fuel reduction far outweigh the risks. Specific mitigations will be developed as part of the Erosion Control Plan that will ensure sedimentation levels remain insignificant following fuel treatments. Significantly, a wildfire would result in much greater sedimentation losses.

An important goal that was considered (but is not the reason for performing the work) is to incorporate visual aspects - to retain screening of buildings especially at the top of the slope, to enhance the visitor's ability to view into eucalyptus groves, to create an "open and park-like" scene in eucalyptus groves, and to retain visual diversity of heights and scenes in the shrublands/woodlands.

Similarly, the vegetation management prescriptions include a goal to provide for visitor enjoyment of the area, recognizing the high usage the area receives from hikers, joggers, bicyclists, and informal recreation from neighbors.

B. HISTORY OF MANAGEMENT

The Wicklow property is located in what was the southeastern corner of an 1839 Mexican land grant named Rancho Corral de Tierra Palomares (see Location Map). From the early 1800's to around 1900, the rancho was used primarily for cattle grazing. It is reasonable to assume that, as a result of this sustained management, most of the subject property was coastal grassland over this period. Prior to the Mission era, it is unclear what the vegetation cover type was, but in the absence of intensive grazing it was most likely some type of mixture of grassland and coastal scrub communities that experienced periodic fires that either occurred naturally or were set by Native Americans.

Originally planned by the Ocean Shore Railroad as a resort, the town of Balboa (now El Granada) was designed by noted Chicago architect and city planner Daniel Burnham (1846-1912) and included radial semicircular streets and elaborate landscaping. Significantly, the landscape design included an approximately 500 acre "pleasure park," which was planted with blue gum eucalyptus around 1905.

By 1908, the railway followed the shoreline from San Francisco to Tunitas Glen, but due to financial problems and improved automobile access, the coastal railroad ceased operations in 1920. The failure of the railroad effectively ended the project. The residential roads and eucalyptus forest are the clearest evidence of this early failed development.

The property was later purchased by the Johnston family, who planned to manage the eucalyptus forest for fuelwood production. In 1982, a Forest Management Plan was developed by local forester Ralph Osterling. Soon thereafter, Osterling developed a Timber Harvest Plan, and the forest was heavily logged. As a part of this harvest, an extensive network of forest roads and trails was constructed. Many of these roads were not maintained, and are currently impassible in several places due to erosion and landslides.

Rock was quarried from the property to build an airport at nearby Pillar Point for the Army in 1941. After World War II, this airport was turned over to the Navy, and the county then acquired it in 1947. The 40-acre portion of the rancho that was quarried was purchased by the county in 1995. Now called Quarry Park, this Wicklow inholding is managed by the nonprofit group Midcoast Park Lands (MPL).

In 1994, the O'Neill family of San Francisco bought the property and did not alter the property in any discernable way. Following a lot line adjustment that retained a ridgetop home (built earlier by the Johnston family) and parcel for the family, the O'Neills donated the 462 acre remainder to POST in 2002.

C. WILDFIRE HISTORY AND FIRE PROTECTION RESPONSIBILITY

The Wicklow property is mapped as 96% state responsibility area (SRA), meaning that fire protection is provided by the California Department of Forestry and Fire Protection (CDF), with 4% of the land protected by the Half Moon Bay Fire Department (HMBFD). It is more likely HMBFD will be the first to respond and make an initial attack on the fire. If the fire is not contained in this first effort, CDF will be called in.

Several sources have reported the story of a fire on the property in the mid 1920's that killed 30 people. More recently, a 5-acre fire spread from the southern portion of the property to the coast in 1997. Several small fires have been started near the structure on the valley floor in the last few years due to juvenile activity.

D. SITE CONDITIONS



Image 1. View of Wicklow from west.

1. Values at Risk

The most obvious risk of a wildfire is to the residents of nearby neighborhoods, and the values that accompany those dwellings. These accompanying values may include the equipment and materials inside the structure, and secondary structures (such as landscape construction, garden features, and fences). Additionally, landscaping (which is sometimes a significant investment totaling as much as 20% of the value of the lot) is at risk from wildfires. Specific values such as the water tank and on-site barn are also at risk. Last but not least, the trauma of the event has been shown to have a lasting detrimental impact on the well-being of those individuals involved in a loss. Surprisingly, this also holds true for individuals where the structure was saved but the surrounding environment was destroyed.

The values at risk in the open space of the Wicklow property consist, in part, of the natural vegetation that covers the property. A fire may cause much damage to some of the values at this point in time because the scorch heights and heat output can be high enough to cause damage to many of the trees. While a wildfire would create wildlife habitat from dead trees and new growth the following year, the visual impact would be significant, and the process would not be in the control of land managers.

Adjacent values at risk include residences to the west and north in El Granada Hills, particularly the properties on El Granada Road and Dolphine Road that are located above and abut the property. Two elementary schools at the base of the hill will be impacted during a fire, either directly through potential damage and evacuation, or as a likely staging area during the fire. New development is proposed to the southern edge of Wicklow, with another public ownership serving as a buffer between the residential use and Wicklow.

While the roadway is not expected to incur severe damage from a wildfire, extended closures to Highway 1 would have a noticeable impact. Fences delineating property boundaries and serving as enclosures would likely be damaged from a wildfire; and the potential release of livestock in stables near Highway 1 or in small pastures is another value at risk from wildfire.

Open space is situated to the east; these lands are used primarily for agriculture, recreational activities and to serve as an ecological preserve. A fire in these lands would not cause long-lasting damage because this vegetation type is adapted to repeated fires.

Surface erosion from early, heavy rains the following year may be of concern should a fire burn the Wicklow property in both the shrub and eucalyptus areas. The soils on Wicklow are extremely sandy and known to be erosive. Erosion after a fire could cause sediment to fill the ponds, and degrade habitat in riparian areas.

A major fire will result in the death of certain animals. While most birds and larger mammals can escape, many reptiles and amphibians, as well as many invertebrates, might not be able to escape a fast-moving wildfire. Generally, wildlife populations will increase or decrease immediately after a fire, and will return to pre-fire numbers within a short time.

2. Weather

Weather on the Wicklow property is surprisingly hot and dry, considering how close it is to the coast. Nonetheless, the project site's location in proximity to the coast influences its weather conditions. It has the warm, dry summers and cool, moist winters characteristic of coastal mountain ranges.

The area averages about 20 inches of precipitation a year, primarily between November and March (ECORP Consulting, Inc. 2004). Thus, the fire season (the time of highest fire danger) comprises the dry months of May to October.

Summertime temperatures are usually quite warm, often well over 100 ° F. Sometimes the property is blanketed by fog. However, westerly winds that precede the fog may fan flames of a fire if ignition were to occur during this common windy period.

Occasional episodes consisting of several still, stagnant days formed by stationary highs occur during summer months. During these periods—characterized by continuous high temperatures and low relative humidities—fuels dry to a National Fire Danger Rating System rating of over 81 for the Burning Index, indicating extreme resistance to fire-control. This overall weather pattern creates extremely low humidities and enhances the possibilities of ignition and extreme fire behavior.

Northeasterly winds (typical fire weather conditions) are especially conducive for transport of embers. This will be a particularly acute problem with roadside ignitions, possibly from the road that abuts the eastern property boundary. Canyons trending in a northeasterly direction will be aligned with these winds, thereby forming the same funnel effect on a smaller scale.

Although the wind normally blows from the west, the most severe fire weather occurs in conjunction with strong north or northeast winds. Under these conditions (which are common in the fall), humidities drop to 20% and temperatures soar to over 100 ° F. Northerly or northeasterly winds would be particularly troublesome, because they would be aligned with all the canyons in the property. This overall weather pattern of extremely low humidities enhances the possibilities of ignition and extreme fire behavior.

The steep topography of Wicklow creates its own wind so that up-canyon drafts in the morning and down-canyon drafts in the afternoon can be expected. Additionally, the many canyons can divert the wind so that, for example, a prevailing westerly wind is oriented more to the south. Again, all of the canyons within Wicklow run northeast-southwest, which is aligned with northeast winds. As a consequence, dry, hot subsiding winds from the northeast will funnel fire through these canyons to the residences below.

3. Soils

The Wicklow property is located on the southern foothills of Montara Mountain that is underlain with Cretaceous granite called Montara granodiarite, which is layered with Slope Wash and Colluvium deposits. Streambeds, flow channels and flat areas are composed of coarsely grained alluvium deposits and marine terrace deposits. Weathered granitic soils and colluvium are prone to small landslides, and several have been located on the property, mainly associated with roads.

Soil Conservation Service (SCS) maps indicate that the predominant soil type present on Wicklow is the highly erodable Miramar sandy loam series (MmD2, MmE2 and MmF2). Flat drainage bottoms also contain Farallone coarse sandy loam (FcC2) and Denison coarse sandy loam (DeA) – both considered high quality agricultural soils. Refer to Soils Map.

4. Risk of Ignition

Risk of ignition is fairly low. Typically ignition is caused by mechanical devices, i.e. welding equipment, mowers, vehicles. Research shows that one quarter of all fires on the coast are accidentally ignited by mechanical devices. The overall ignitability of the fuels is high, so if the cause were in place, the fuels would be conducive to burn.

5. Expected Fire Behavior of Specific Fuel Types



Image 2. Example of fuel conditions in eucalyptus stand

a. Eucalyptus Stands

Eucalyptus stands cover 255 acres, or a little more than 55 percent of the property. Refer to Vegetation Map. Generally, they are located on the western portion of the Wicklow property. The eucalyptus forest extends from the valley to the top of the ridgeline in a uniform density and structure. Pole-sized boles ranging from 3 to 8 inches in diameter comprise the vast majority of the eucalyptus trees. Occasionally (one per 100-foot spacing) specimen eucalyptus trees with diameters larger than 30 inches are found among the poles.



Image 3. Example of fuel conditions in eucalyptus stand

Should a fire ignite on the steep slopes in Wicklow, fire will spread rapidly and run uphill (or downhill in subsiding winds) toward the structures. Without fuels modification and/or management, eucalyptus litter, shrubs and unmowed grass would generate enough heat to cause the shrub and eucalyptus canopies to ignite, distributing embers widely, and produce enough heat to potentially involve the nearby structures.

Unmowed grass and eucalyptus litter comprise the flashiest (most ignitable) fuel on the site. Trees with low branches, and shrubs--particularly pampas grass and poison oak--are most likely to serve as a "ladder fuel" to enable fires beneath to be spread into the tree canopy or crown. Should the fire involve the tree crowns, embers can be expected to be cast throughout the neighborhood, and potentially cause countless more fires.

The eucalyptus stands contain the highest fuel volume in the project. The forest floor is covered with leaves, strips of bark, tree branches, and decomposed forest litter and exceeds two feet in depth in some locations and averages 6-12 inches depth. The total volume of dead material that would be involved in a fire (dead material smaller than 3 inches in diameter) is likely to exceed 30 tons/acre. The eucalyptus litter is famous for its ignitability, and for the ferocity with which it burns. Further, if a fire were to ascend to the trees crowns, the burning leaves and bark would be distributed widely.

Summary

The combination of a build-up of dead material, and the highly ignitable nature of the litter creates the potential for fire behavior which could exceed the ability of the finest fire department

to control. Eucalyptus is very aggressive in its ability to spread, and without containment, more of the open space will fall into this explosive type of fire behavior.

b. Shrubland/grasslands

Shrubs

Shrubs generally occupy the eastern, east-facing slopes of Wicklow. Shrubs cover 163 acres, or 36 percent of the lands. Shrubs also comprise a significant portion of understory of the eucalyptus, however, the species composition and structure is quite different from the north coastal scrub that is grown without an overstory.



Image 4. Northern coastal scrub under eucalyptus stand

The understory of the eucalyptus forest is comprised of species that require more moisture availability and can withstand more shade (e.g. coffeeberry, elderberry). They are less dense and generally do not contain as much volume as the open-grown scrub community. The species composition of the north coastal scrub community on the eastern portion of Wicklow is more typical of undisturbed grasslands which have been more recently occupied by coyote bush, then a rich assembly of more xeric species (e.g. ceanothus, camas, poison oak).



Image 5. Northern coastal scrub in eastern portion of Wicklow

Both types of shrubs will burn with similar characteristics. The shrubs under the eucalyptus may be expected to be higher in moisture (in both foliage and dead material), but they also serve as a vehicle for the fire to reach eucalyptus crowns.

Total fuel loads of both types of shrub fuel types are approximately 5 tons/acre, with most of the fuels occurring in the smaller diameter fuels. A preponderance of dead fuels can be found in the smallest size class, those smaller than 1/4 inch in diameter. The dead to live ratio of mature stands is usually quite high - an equal proportion of living and dead material is often found. Live foliage on the plants comprises approximately half of the total fuel load.

Fire behavior is not normally explosive, however, it was this fuel type that fueled the Oakland Fire of 1991 on Saturday, October 19, and the morning of October 20th. Rates of spread are quite fast, and predicted flame lengths are over 15 feet - hot enough to confound suppression efforts.

Grass

Grasslands currently cover only 17 acres of the Wicklow property, however, if the north coastal scrub is reduced to minimize roadside fire intensity, grasslands may constitute a higher proportion of the parcel. Grassland fuels (both annual and perennial) are fairly uniform and homogeneous compared to other fuel types. Grasslands are generally characterized as having a light total fuel load made entirely of fine herbaceous material that cures in the summer. This material responds rapidly to changes in humidity and is easily ignited in dry periods.

Grass fuels produce relatively little heat but produce a fire that travels quickly. Containment is the greatest challenge in these fuel types. Grass also serves as a wick to more hazardous fuels, e.g. ones apt to cause more damage. Thus grass provides an avenue for fire to move into densely vegetated areas. Grass fires may build up enough "head of steam" to burn into landscaped areas, or into other types of fuels under conditions that would not sustain a fire there by itself.

Because of a lack of disturbance, coyote bush has occupied the vast majority of previous grasslands, particularly on the main ridge-top and spurs. With management, such as mowing, grasslands will occupy the managed sites; more benign fire behavior in terms of lower flame lengths and total heat output will result, providing areas more safe for passage and access. Ignitability would continue to be a problem because grass would still be prevalent.

c. Comparison of Fire Behavior in Eucalyptus, Grass and Scrub

Several characteristics of eucalyptus groves which have not been maintained and/or were damaged by previous logging combine to create a fire hazard that is infamous the world over. A commonly held ecological principle is that species that are favored by fire have adapted to have characteristics that provide the species a propensity to burn. In presenting this hypothesis, Mutch (1969) used eucalyptus as a quintessential example of a species designed to burn. By burning, eucalyptus is favored over native species because the soil surface is prepared for the numerous seedlings to germinate and grow, and because the trees sprout vigorously from the root collar when the stem is killed.

Availability to burn

Eucalyptus litter can burn all year long, given a short period of dry weather. In contrast, grass generally will not burn from November to May, and shrubs (north coastal scrub) generally will not burn from November to June as their foliar moisture declines slowly during the summer season. Fire in both grass and brush is inhibited by high foliar moisture in both life forms. However, the dead material in eucalyptus is what burns and has a much shorter time lag between being non-combustible and burnable. The Wildcat Canyon Fire in 1980 in the Berkeley hills burned five homes in a eucalyptus grove in mid-December, long after the grass was green and would not carry a fire.

Amount of fuel available to burn

Fuel loading is an industry standard for an indicator of hazard. The fuel load of dry litter (leaves, bark and twigs) is extremely high in eucalyptus. In the 1980's Roger Fenwick (a Fire Chief from Australia) reported 40 tons per acre of fuel that was smaller than 1/4 inch in diameter in Chabot Park in the East Bay Regional Park District. Normally, larger material comprises the greatest weight, or load, so one might expect a much greater total fuel loading. Martin et al (1988) measured 50 tons of litter and duff on Angel Island in undisturbed eucalyptus stands.

The litter and duff release an enormous amount of heat when burned, at 12,000 btu's per pound, or 24 million btu's per ton. When 50 tons per acre are present, 1,200,000,000 (1.2 billion btu per acre) is available to burn on the ground, not including leaves and bark still attached to the trees. If leaves and branches are burned, that's additional heat produced.

Fuel loadings of grass rarely exceed 5 tons per acre, and the btu's per pound normally average 8500. Northern coastal scrub also rarely exceeds 5 tons per acre (differing from eucalyptus stands by a factor of 10). So the difference in the amount of heat released between eucalyptus and native fuels is dramatic.

Fuel accumulation rate

Martin et al (1988) measured 44 tons per acre of litter and duff on Angel Island in stands which were burned five years prior. Most of the accumulation occurred in the two years, but on the average, the accumulation rate is nine tons/acre per year.

Maintenance for a one-third lot would require almost a ton of eucalyptus debris removal each year (accounting for the area the building occupies and other spaces). Removal of litter in wildland settings would need to be performed on a five-year interval or more frequently in order to maintain acceptable levels of fire safety.

In contrast, brush and grass rarely exceed five tons per acre even without management. In times of budget limitations, lack of maintenance would not produce as large an accumulation in brush as grass as in eucalyptus. Thus the worst-case scenario is less damaging in native fuels.

Ease of control

Fires in grass are difficult to contain because of their fast-moving nature. However, hand lines and bulldozer work can be done quickly in this fuel type. The tree trunks, logs, stumps and other barriers in eucalyptus forests hamper line building rates, and thus ultimate containment.

Spotting ahead of fire front

As was the case in the Oakland Fire, most urban-wildland interface fires are spread by spot embers ahead of the flaming front. Several factors come into play in this phenomenon.

First, the ease of crowning in the forest is a factor. The first relationships developed on crowning potential determined the ease of crowning in eucalyptus is among the highest rating possible (Fahenstock 1970). The height of the fuel is an important factor in determining the spotting distance and eucalyptus are quite tall compared to brush or grass.

The presence of ladder fuels (where branches or limbs of trees vertically continuous) enhance the potential for fire to travel upward into the tree crowns. Once fire has reached the tree crowns, spotting is almost certain. Unfortunately, many eucalyptus stands - particularly the ones cut in the 1980's - have branches which are quite low to the ground and have shrubs intermixed, creating a greater vertical and horizontal continuity.

Lastly, the amount of heat produced under the canopy determines whether crowning and spotting will occur: the greater the heat, the more likely spotting and crowning will happen (because the heat produced is directly related to the amount of fuel).

Spotting distances have been reported by the media. Both eucalyptus leaves and bark flew several thousands of feet ahead of the fire (easily from the Wicklow site to the ocean). In contrast, the material from grass and brush is too small to still be burning when it lands.

Foliar characteristics

Eucalyptus has oils in the leaves -- enough to be used for cough medicine. The oils have a higher caloric content, and volatilize (release flammable gasses allowing ignition to start) at a lower temperature than cellulose. The higher the percentage of volatiles, oils, terpenes, and fats, the more flammable it becomes. Moisture tends to dilute the oils, etc. Eucalyptus has the highest heat values of foliage and leaf litter of ANY plant sampled, including chamise (also known as greasewood). The logs are not particularly high in heat value, but this part of the tree is not normally consumed in a wildfire.

Roger Fenwick reported fire behavior is likely to be more extreme in coastal California because the litter layer is more loosely compacted and thus optimally aerated.

Summary

Unmanaged eucalyptus stands in California pose an extremely hazardous situation compared with native vegetation. Eucalyptus trees have numerous attributes that promote explosive fire behavior. While fire behavior of local grasslands and north coastal scrub can also be dramatic under the worst conditions, the fire intensity, spotting potential are not comparable to eucalyptus stands. Treatments to reduce the eucalyptus fuel volume and to convert to native vegetation are rational approaches to minimizing potential damage from wildfire.

6. Non-Eucalyptus Invasive Plants

Unfortunately, Wicklow has a plethora of non-eucalyptus invasive plants in the understory. The cover of non-native understory plants is especially uniform on the western, lower slopes of Wicklow. Sourgrass, German ivy, Cape ivy, pampas grass, and French broom are common invasive species that cover the hillsides. French broom and pampas grass constitute significant fire hazards, due to the increased volume of fuels in the understory, and in the case of pampas grass, a high proportion of fine, ignitable fuels. In contrast, German and Cape ivy and sour grass do not cure and become dry and thus do not form an ignitable fuelbed. However ivy grows over other dry fuels and provides a facade that may mask a hazard beneath it.

II. TREATMENT PRESCRIPTIONS FOR FIRE HAZARD REDUCTION

A. OVERVIEW/SUMMARY

Management objectives guide the actions to be taken - each action should help achieve a management objective.

<i>Management Objectives</i>	<i>Actions</i>
1. <i>Access for fire response</i>	Make strategic roads drivable, reduce fire intensity near roads by thinning eucalyptus and mowing scrub within 100 feet, and create safety zones (widely-spaced trees in an area of 1 acre minimum).
2. <i>Limit Fire Size</i>	Compartmentalize fires and limit spread of any fire within Wicklow House. Enhance fire response, Create areas of lower fire intensity within the property.
3. <i>Reduce Fire Intensity Next to Structures</i>	Manage vegetation by thinning eucalyptus, pruning lower limbs of trees, removing understory shrubs, and mowing shrubs and grasses. This is most effective along the perimeter, by El Granada and Dolphine Road.
4. <i>Minimize the Number of Fire Ignitions</i>	Work with local fire departments, homeowners and property owners to help enforce fire safe behavior and treat fuels to reduce flammability.
5. <i>Protect Natural Resources (added benefit)</i>	Constrict eucalyptus stand edge at valley bottom and upper edge of eucalyptus forest, provide more growing space for native trees and shrubs. Create openings on canyon floors. Overall reduction of fire intensity in treated areas could reduce damage to natural species.

B. OVERVIEW OF VEGETATION TREATMENTS TO REDUCE FIRE HAZARD AND INCREASE FIREFIGHTER SAFETY

There are four categories of vegetation treatments, each with their own set of prescriptions. The categories and prescriptions will be presented, then management units with treatment areas will describe the locations of where the prescriptions will be applied.

1. Roadside Treatments

a. Eucalyptus Areas



Image 6. Roadside treatment zone in eucalyptus stand

i. Initial Treatment

1. Thin eucalyptus along strategic fire roads, both inside the boundaries of Wicklow and in adjacent landholdings, such as Quarry Park or Mirada Surf. The responsibility of treatments outside Wicklow cannot lie with POST, however the prescriptions for treatments are equally appropriate on lands outside Wicklow. Refer to Road Treatment Zones Map.

Generally, a spacing of 35 feet would be established, with some exceptions. Trees to be removed are those of smaller diameter and those trees which are unhealthy or structurally unsound. Large trees would be retained. In locations where cypress, pines, and oaks are growing under scattered eucalyptus trees, remove the eucalyptus trees in order to expand the cover of these other species.

Ensure remaining trees are healthy and structurally sound. Dead trees may remain only when isolated from tree canopies by 50 feet on all sides, and when pruned of branches smaller than 3 inches up to 20 feet in height.

ii. Follow-up Treatments - Eucalyptus Areas

After the selected eucalyptus trees have been removed, prune lower branches which are less than 3 inches in diameter up to a height of 10 feet from remaining eucalyptus and 8 feet from oaks. (See Figure 1, Tree Pruning Guidelines). Pruning must be done by hand with power saws.

For at least two to three years, the trunks of the cut eucalyptus should be treated with an herbicide to prevent sprouting and ensure mortality. Refer to the section that addresses herbicide application and use regarding details of this treatment. While each eucalyptus tree cut will need to be treated with an herbicide in the initial treatment, the number of stumps to which herbicide will be applied during the follow-up treatment is dramatically less, on the order of 10 to 25%.

iii. Summary of Sequence of Treatments-Eucalyptus Areas

The sequence of treatment first will be to remove selected eucalyptus trees. The debris generated from tree removal (or slash) will be reduced and the trees can be limbed up, with removal facilitated via a firewood removal operation. In this operation the dead wood in the tree canopy will be removed, and the loose bark will be pulled off the eucalyptus trees.

The understory shrubs then will be removed, but can also concurrently be done with the limbing operation. An application of an herbicide to control eucalyptus sprouts is most likely done in conjunction with the understory shrub removal operation. Follow-up maintenance entails revegetation and pruning on a 5-7-year interval.

b. Mow shrubs as a Roadside Treatment

Mow shrubs along strategic fire roads, again both inside the boundaries of Wicklow and on adjacent landholdings, such as O'Neill property and on POST Rancho Corral de Tierra. As with thinning eucalyptus along roads, responsibility for treatments off of POST property cannot lie with POST, however the prescriptions for treatments are equally appropriate on lands outside Wicklow.

2. Perimeter Treatments

a. Eucalyptus Area - Thin

Thin eucalyptus by El Granada Boulevard up to Dolphine Road to the same specifications (both initial and follow-up) as roadside treatments.

b. Eucalyptus Area - Thin then manage Northern Coastal Scrub

i. Initial Treatment

Remove eucalyptus above Dolphine Road to create an area of northern coastal scrub. This scrub area will need to be managed in future years to maintain a fire safe condition in this vegetation type.

The treatment entails creating islands of shrubs with grass or forbs between the shrubs. Create islands of less than 12 feet in diameter or twice the height of tallest shrub (whichever is smaller). Create clumps that are natural in appearance including specimens of variable age classes. Within 100 feet of improvements, grass between shrub islands should be mowed when cured. The distance between islands should be greater than twice the height of tallest shrub, or a minimum of 8 feet, whichever is greater. Retain between 30 to 40 % of brush areas in brush crown cover.

The removal of brush should be based on criteria which are listed in approximate order of importance to fuel management objectives:

- Relative flammability - Remove the most flammable species first.
- Plant vigor - Remove shrubs of low vigor, dying or dead shrubs.
- Sprouting capability - Remove species with sprouting capability first.
- Effects of plant species on soils - Retain shrubs with slope-holding capacity, or that increase soil nutrients.
- Value for wildlife food and cover
- Aesthetic values

These fuel management objectives for the site on Wicklow can be translated into the following priority for removal:

- a) coyote bush
- b) poison oak
- c) blackberry
- d) northern sticky monkey flower
- e) coastal sage brush

Remove only if necessary

- f) coffeeberry
- g) thimbleberry, salmonberry
- h) ceanothus
- i) bush lupine
- j) wild currant
- k) madrone
- l) toyon
- m) coast live oak

The order of priority will change according to local conditions such as the relative abundance of each species. For example, where coffeeberry is not abundant, it may be placed high in priority to retain. Attempts should be made to maintain diversity of species. Training and oversight of crews will assist in species identification and selection of material to be removed.

Tree specimens should be protected, and canopy closure of adjacent trees should be encouraged. Where native trees are over 8 feet tall, cut out shrubs below driplines and within 6 feet from edge of tree canopy. Prune up to a maximum of 1/3 height of trees that are not taller than 24 feet tall

ii. Follow-up Treatment

The initial treatment will be the most significant operation, with a treatment cycle of 5 to 7 years to maintain shrub islands in treeless areas, and 3 to 5 years to maintain spaces surrounding emerging trees.

Mowing of grass that is expected to grow instead of northern coastal scrub will be a routine follow-up treatment. Grass should be mowed annually shortly after it cures, and no later than June 1.

c. Remove eucalyptus on eastern side of perimeter road (different from roadside treatment).

i. Initial Treatment

On the eastern side of the perimeter ridge road, all eucalyptus should be removed to enhance safety for fire responders and to limit the spread of eucalyptus into native vegetation. Where

native tree species are present, these can be retained. Scrub and grass ecosystems similarly are to be preserved, even though some damage to individual plants can be expected during the eucalyptus removal operation.



Image 7. Remove eucalyptus east of trail, prune cypress

ii. Follow-up Treatment

The follow-up treatments will be same as with roadside treatments.

3. Safety Zones

Safety zones offer refuge to firefighters when their preferred position may become untenable. Widely spaced trees can remain in safety zones at a spacing no closer than 50 feet. Understory vegetation will need to produce little heat should it burn (e.g. low, moist shrubs or grass or mowed grass). The safety zones would be at least one acre in size, generally with a 100-foot radius.

a. Install three safety zones along the mid-slope fire road in the eucalyptus forest and at the border between Quarry Park and Wicklow, at Culvert #13. In all cases the most appropriate locations identified in the field were at the intersection of two roads or in an old landing site, dating from the time the stand was logged in the 1980's. The follow-up treatments will be same as with roadside treatments.

b. Install one safety zone on the tractor trail to the southeast of the O'Neill property. This ridgeline location in the north coastal scrub also needs to be at least one-acre in size, with generally a 100-foot radius. This safety zone can also serve as a potential helispot after the brush is cleared. The follow-up treatments will be same as with roadside treatments.



Image 8. Recommended site of safety zone

c. Remove eucalyptus on the lower edge of the road that rings an old agricultural field and contains the only structure on Wicklow. The valley floor can then serve as a safety zone, and potentially serve as a staging area for fire response equipment for fires up the slopes. The follow-up treatments will be same as with roadside treatments.

d. Install a safety zone mid-slope on the fire road that leads up from the water tank, located between Units #6 and #7. The follow-up treatments will be same as with roadside treatments.

4. Opportunities to Enhance Diversity



Image 9. Remove eucalyptus around native trees

a. Initial Treatment

In pockets throughout or near the roadside treatment zones, treatments to reduce fire hazard can also enhance plant diversity and structural diversity of the ecosystem. Where either Monterey pine or Monterey cypress are found, remove eucalyptus for a distance of 50 feet from the native trees. Prune pines and cypress of lower limbs to a height of 8 feet from the ground, and remove understory litter and shrubs. Cypress stands may remain dense; no thinning is necessary, however, pine stands will need to be thinned to a 20-foot spacing.

In places of canyon bottoms where the eucalyptus cover is already sparse, or where eucalyptus trees are all less than 6 inches in diameter, complete removal of the eucalyptus for an area of approximately one acre will offer opportunities for an assembly of native plants that require more water.

b. Follow-up Treatments

The follow-up treatments will be same as with roadside treatments.

5. Site-wide Revegetation

Revegetation to minimize surface soil erosion should take place on disturbed areas where over 1,000 square feet of surface soil is exposed. Generally, these locations would be side cast associated with road repair, skidding operations, and movement of cut material. Revegetation should be comprised of native perennial grasses of local origin, and will be covered in an erosion control plan as part of the permitting process.

The erosion control plan should consider that in order to maintain a relatively fire-safe condition, a vertical separation between the ground and tree canopy will need to be maintained. This precludes the presence of a tall understory, and limits the type of revegetation possible. In locations where conversion of tree canopy is desired (such as on the pockets of riparian vegetation or where the eucalyptus trees are sparsely distributed and can thus be individually removed in the future), revegetation with oaks has potential. These are expected to thrive under the more open growing conditions if they are protected from the effects of prescribed burning. Many of the shrubs on-site will resprout and will form an understory in time.

6. Maintenance with Prescribed Burning

Prescribed burning may be used as a means of periodically removing litter build-up in the understory of the eucalyptus, particularly where fire roads or distinct trails bound the treatment area and can be used as containment locations. This maintenance method would be used with extreme care and only under appropriate weather conditions and with ample equipment and personnel.

C. TREATMENTS BY MANAGEMENT UNITS

A total of 151 acres are encompassed by the treatments recommended in the 10 Management Units delineated on Wicklow. Refer to the Management Unit Map. Appendix 5 displays a table of the acreage of treatments by treatment, segregated by three treat types: thinning eucalyptus along the fire roads, mowing scrub along fire roads, and removing eucalyptus along the perimeter. Refer to Road Treatment Zones Map.

Unit 1

Location: Bordering structures and vacant unmanaged lots on western boundary of park, down to road that rings canyon bottom.

Site Condition: Pole-sized eucalyptus overstory. Understory in southern one-half of unit is primarily poison oak and exotic species: German ivy, oxalis, broom. Understory in northern one-half is increasingly more native coastal scrub species: coffee berry, baccharis, poison oak, elderberry. The understory in the northern aspect of this drainage is comprised of ferns, snowberry.

Fire Management Goal: Create a condition where flames will be shorter than 8 feet when it crosses park boundary.

Vegetation goal: Restore growing conditions for northern coastal scrub, preserve fern understory of eucalyptus, reduce alien invasive species.

Actions to Achieve Goal:

Treatment Area #1 - Remove all eucalyptus to bottom of drainage, retain scrub wherever possible.

Treatment Area #2 - Remove all eucalyptus of poor health or structure, and those smaller than 18 inches in diameter, with spacing of 35 feet, retain ferns and grasslands.

Access concerns: Decommission mid-slope road below Dolphine Road because it is riddled with landslides and would require an engineering solution to enable full access. Replace culvert at crossing #1 with rolling dip.

Unit 2

Location: North-eastern corner of parcel, diamond adjacent to and northeast of O'Neill property (including roadway).

Site Condition: The entire unit is covered with northern coastal scrub, with north-facing slopes characterized by a more fully developed scrub, and ridgelines and south-facing slopes by scrub that has invaded grasslands more recently.

Fire Management Goal: Provide for emergency response.

Vegetation goal: Maintain growing conditions for northern coastal scrub, create openings of native grasslands.

Actions to Achieve Goal:

Treatment Area #1 - Create safety zone due east of Culvert #15. At this safety zone, mow northern coastal scrub generally within a radius of 100 feet to encompass no less than 1 acre. Remove all pines in the safety zone.

Treatment Area #2 - Remove all eucalyptus east of the perimeter ridge road between the highest point on the road and roughly 200 feet south of Culvert #18.

Treatment Area #3 - Remove all eucalyptus east of the perimeter ridge road from approximately 800 feet north of Culvert #21 to Culvert #23. Where a major trail trends east from the perimeter fire road northeast of Culvert #21, remove northern coastal scrub for 100 feet east of the trail, prune Monterey cypress trees, and removal all eucalyptus and understory shrubs under cypress.

Access concerns: There is access to the uppermost (western) portion of this management unit. This road originates from the POST mid-slope road. Access to the top of the management unit is also possible from the valley bottom of Arroyo de en Medio; this trail forms the northeastern boundary of the management unit.

Unit 3

Location: North-eastern corner of parcel, diamond adjacent to and northeast of O'Neill property (including roadway).

Site Condition: Northeast-facing slope is covered with northern coastal scrub, the southwestern-facing slope is covered with annual grass.

Fire Management Goal: Provide for emergency response on perimeter road. Create a place where flames will be shorter than 8 feet when they cross the Wicklow property boundary within 500 feet of the O'Neill property.

Vegetation goal: Maintain growing conditions for northern coastal scrub.

Actions to Achieve Goal:

Treatment Area #1 - Mow coastal scrub for a combined distance of 50 feet from the access road to the O'Neill property.

Access concerns: There is access only to the southwestern portion of this management unit. This road originates from the POST mid-slope road.

Unit 4

Location: North-western corner of parcel, adjacent to open space.

Site Condition: The management unit is covered with northern coastal scrub.

Fire Management Goal: Provide for emergency response.

Vegetation goal: Maintain growing conditions for northern coastal scrub.

Actions to Achieve Goal:

Treatment Area #1 - Mow coastal scrub for a combined distance of 50 feet from the access road to the O'Neill property.

Access concerns: There is access only to the eastern portion of this management unit. This road is a public road.

Unit 5

Location: Canyon bottom, encircling pond and old house/barn/farm site.

Site Condition: Pole-sized eucalyptus on fringe of unit, valley bottom with grasslands, coyote bush, broom, and pampas grass.

Fire Management Goal: Create a safety zone on the valley bottom, and a place suitable for staging fire-response equipment.

Vegetation goal: Prepare site for agriculture, reduce alien invasive species, enhance growing conditions for Monterey pine and Monterey cypress.

Actions to Achieve Goal:

Treatment Area #1 - Remove almost all eucalyptus, coyote bush, broom to fire road that bounds management unit. Retain only eucalyptus around pond that provides wildlife habitat. The eucalyptus on the dam face should be considered as part of the evaluation of actions regarding the dam.

Access concerns: Repair slide on northern loop of road, regrade. Evaluate actions to drain or repair dam.

Unit 6

Location: Below the mid-slope fire road between ridgeline fire road leading up from water tank and bottom of canyon directly below Dolphine Road.

Site Condition: Eucalyptus stand of pole-sized trees with few large-sized specimens, occasional Monterey pine and cypress.

Fire Management Goal: Provide for emergency response, create safety zones, reduce fire intensity in borders.

Vegetation goal: Create thinned forest of eucalyptus, enhance growing conditions for pine and cypress and other native species, retain understory ferns on north-facing slope nearest Dolphine Road, create openings in riparian habitat.

Actions to Achieve Goal:

Treatment Area #1 - Create safety zone mid-way between Slide 2 and Culvert #4. At this safety zone, remove eucalyptus to retain only specimen trees, at no closer spacing than 50 feet. The area to be treated will be generally a radius of 100 feet to encompass no less than 1 acre.

Treatment Area #2 - Create safety zone mid-way between Slide 2 and Culvert #4. At this safety zone, remove eucalyptus to retain only specimen trees, at no closer spacing than 50 feet. The area to be treated will be generally a radius of 100 feet to encompass no less than 1 acre.

Treatment Area #3 - Remove all eucalyptus of poor health or structure, and those smaller than 18 inches in diameter, with spacing of 35 feet, retain ferns and grasslands.

Access concerns: There is access to this management unit from the mid-slope road, the tank ridge road and the dam road.

Unit 7

Location: Middle of property below mid-slope fire road and northeast of Quarry Park, between the fire road leading up from the water tank and the fire road with Culvert #8 and 9.

Site Condition: Eucalyptus stand of pole-sized trees with few large-sized specimens, occasional Monterey pine and Monterey cypress, especially lower on slope near water tank.

Fire Management Goal: Provide for emergency response, create safety zones.

Vegetation goal: Reduce fire intensity in borders, increase growing space for Monterey cypress and Monterey pines throughout unit.

Treatment Area #1 - Within 100 feet of the encircling fire road remove all eucalyptus of poor health or structure, and those smaller than 18 inches in diameter, with spacing of 35 feet, retain ferns and grasslands.

Treatment Area #2 - Create safety zone mid-way along the fire road that forms the northern border of the unit (midway between the water tank and the mid-slope fire road). At this safety zone, remove eucalyptus to retain only specimen trees, at no closer spacing than 50 feet. The area to be treated will be generally a radius of 100 feet to encompass no less than 1 acre.

Access concerns: There is access to this unit via the tank ridge road, the mid-slope road and the park road to the overlook.

Unit 8

Location: North-center of parcel, adjacent to the access road to the O'Neill property, Rancho Corral de Tierra, and the O'Neill property.

Site Condition: The upper half is comprised of short northern coastal scrub, the bottom half of pole-sized eucalyptus with occasional specimen trees of large (greater than 30 inches) diameter.

Fire Management Goal: Provide for emergency response.

Vegetation goal: Maintain growing conditions for northern coastal scrub, minimize outer edge of eucalyptus.

Actions to Achieve Goal:

Treatment Unit #1 - Remove all eucalyptus above mid-slope fire road from end of Dolphine Road south to the ephemeral stream (Culvert #1) to allow enhanced growing conditions for northern coastal scrub. Manage northern coastal scrub as shrub islands.

Treatment Area #2 - Within 100 feet of the mid-slope fire road remove all eucalyptus of poor health or structure, and those smaller than 18 inches in diameter, with spacing of 35 feet, retain ferns and grasslands.

Treat Area #3 - Mow coastal scrub for a combined distance of 50 feet from the access road to the O'Neill property.

Access concerns: There is access to the eastern portion of this unit via the O'Neill road, and the southwestern portion via the mid-slope road which currently impassible due to numerous landslides.

Unit 9

Location: South-western corner of parcel, adjacent to the Mirada Surf property.

Site Condition: Pole-sized eucalyptus with occasional specimens of large diameter, Monterey pine and Monterey cypress. Broom forms a dense understory on the southwestern corner, Monterey pine regeneration is found in patches in the southeastern sections.

Fire Management Goal: Provide for emergency response.

Vegetation goal: Reduce fire intensity in borders, increase growing space for Monterey cypress and Monterey pines throughout unit.

Actions to Achieve Goal:

Treatment Zone #1 - Remove all eucalyptus for a distance of 100 feet west of perimeter ridge fire road from Culvert #8 to a length approximately 800 feet south of Culvert #8. Remove the large Monterey pine trees, leaving pine trees smaller than 10 inches in diameter at a spacing of 35 feet. Prune remaining Monterey pine and Monterey cypress trees and remove understory shrubs.

Treatment Area #2 - Create a safety zone at Culvert #13. At this safety zone, remove eucalyptus to retain only specimen trees, at no closer spacing than 50 feet. The area to be treated will be generally a radius of 100 feet to encompass no less than 1 acre.

Treatment Area #3 - Within 100 feet of all fire roads remove all eucalyptus of poor health or structure, and those smaller than 18 inches in diameter, with spacing of 35 feet, retain ferns and grasslands. Remove all broom within the unit.

Access concerns: Access is provided by a road that leads from Mirada Surf property.

Unit 10

Location: Center of property, above the fire road that leaves up from the water tank and below the perimeter fire road.

Site Condition: Pole-sized eucalyptus with occasional specimens of large diameter. Occasional Monterey pine and Monterey cypress.

Fire Management Goal: Provide for emergency response.

Vegetation goal: Reduce fire intensity in borders, increase growing space for Monterey cypress and Monterey pines throughout unit.

Actions to Achieve Goal:

Treatment Area #1 - Within 100 feet of all fire roads remove all eucalyptus of poor health or structure, and those smaller than 18 inches in diameter, with spacing of 35 feet, retain ferns and grasslands.

Treatment Area #2 - Create a safety zone at the intersection of the mid-slope fire road and the road that leads up from the water tank. At this safety zone, remove eucalyptus to retain only specimen trees, at no closer spacing than 50 feet. The area to be treated generally will be a radius of 100 feet to encompass no less than 1 acre.

Access concerns: This unit has very limited access, mainly via tractor trails.

D. PRESCRIPTIONS FOR NON-EUCALYPTUS INVASIVE PLANTS

Several invasive species take advantage of bare soil than may result from the treatments. While several mitigations will be in place to minimize the amount of surface soil exposure, invasive plants may be common after treatment, but may comprise a smaller proportion of the forest floor than present. Of the four most common non-eucalyptus invasive plants, (French broom, pampas grass, sour grass and German ivy) French broom and pampas grass constitute fire hazards as they become abundant. Prescriptions are offered for broom and pampas grass when these two species are found after treatments.

1. French Broom

French broom is an invasive weed that both poses a fire hazard due to its abundant biomass and poses a threat to native plants because of its aggressive nature and successful reproduction strategies. French broom sprouts and produces seeds that stay viable in the soil for years, and are distributed by animals. Successful broom management plans generally use a combination of pulling, cutting, and spot spraying, and always plan for several years of management actions. In addition, yearly maintenance is necessary to remove new plants before they set seed.

a. Initial Treatment

In areas which have an abundant population of broom, the first step should be to cut all French broom plants (and possibly chip them) and haul the material in a covered truck or container to an offsite disposal site. The chipped material cannot be used on the site because of the abundance of seeds in the chipped material that will generate more seedlings. This first step can be done at any time of year, and should be done as soon as possible. The cutting can be done with hand labor or machinery. If hand labor is being used, a crew that consists of at least one worker with a chain saw and several others to cut plants with machetes and to haul plants. Hauling must be conducted over sites which are already infested with French broom. In no circumstances should the cut material be hauled over uninfested sites.

b. Follow-up Treatment

The second step should be to monitor the site for re-sprouts and new germinations in subsequent springs. Actions should begin as early as February and be completed before seeds set (possibly by April).

- Hand pull scattered re-sprouts (this can be done any time the soil is moist).
- Cut broom plants six inches or taller with no seeds. The cut plant may remain on the property.
- Spray with Garlon4 dense (100 plants per square meter or greater) patches of broom seedlings.

Outlying plants should be treated immediately to prevent establishment in new areas. Larger broom stands should be removed from the perimeter of the area moving toward the center.

Pulling broom plants by hand while the soil is moist (winter or early spring) is the most effective method of removal. Hand cutting is preferred to hand pulling where broom infestations are large or located on steep slopes where erosion is a concern. Cutting minimizes soil disturbance and allows the intact roots to help stabilize the slope. Stems should be cut as close to the ground as possible. Application of herbicide needs to occur after growth provides enough surface area for the herbicide to be effective. Thus seedlings and sprouts need to be at least four inches in height. Where desirable native plants are intermixed with broom, a hood wand that helps direct the spray will minimize damage to desirable plants.

2. Pampas Grass

Pampas Grass is another invasive weed that both poses a fire hazard due to its abundant biomass and poses a threat to native plants because of its aggressive nature and successful reproduction strategies. Pampas grass produces prodigious amounts of seeds, and reacts to cutting by spreading through rhizomes. Successful pampas grass eradication plans generally entail a combination of pulling and spot spraying, and always plan for several years of management actions. In addition, yearly maintenance is necessary to remove new plants before they set seed.

a. Initial Treatment

In areas with pampas grass, a combination of cutting with immediate application of a specific herbicide has achieved some control.

b. Follow-up Treatment

The follow-up treatment should be to monitor the site for sprouts and seedlings in subsequent springs. Actions should begin as early as February and be completed before seeds set (possibly by April)

- Hand pull scattered seedlings (this can be done any time the soil is moist)
- Cut re-growth and immediately spray with a specific herbicide

E. ROAD IMPROVEMENT FOR FIRE CONTROL

Road access for fire suppression forces on the Wicklow property is an essential element of this fuel treatment plan. Without safe access to incident locations, fire suppression agencies must limit their initial attack forces, which are critical in preventing increases in fire size and flame length. The consequences of limited access can result in higher suppression costs and potentially greater losses in life and property. Incident Commanders will simply not allow their crews to be trapped in wildfires, and the current eucalyptus overgrowth and road deterioration on the Wicklow property have been specifically identified as obstacles to early suppression efforts by CDF and HMBFD.

A fairly extensive road network has been developed over the years on the property, primarily a result of the logging operation completed in the early 1980's (refer to Crossings, Slides and Road Map). Following consultations with CDF and HMBFD, existing roads were classified in terms of critical value for fire access. Other roads, that provide less value for this purpose and lack other significant access value, have been designated for decommissioning, which will still allow for foot traffic, but not vehicle use. Decommissioning is a process by which roads are "put to bed", and allowed to re-vegetate. This practice also dramatically reduces erosion from these old roads by reducing the concentration of surface water flow. Other roads will be retained as critical fire trails that can handle bulldozer use, and also provide access for hikers and other recreational users. Important secondary uses for these fire roads will be for follow-up fuel treatments and erosion maintenance. The resulting road network is depicted on the Crossings, Slides and Road Map.

1. Main Fire Roads

Two basic treatments are recommended to ensure the viability of the main fire roads: tree clearing and slide/erosion repair.

Unless limited by other factors, eucalyptus trees will be removed on a 35-foot spacing to a distance of 100 feet from the road shoulder. Stumps will be treated immediately with glyphosate to suppress sprouting.

Numerous landslides and road failures have been located on the main fire roads that require repair in order to maintain access and minimize future failures. The most significant slides are located on the main mid-slope road (slides 1, 2 and 3). These slides are likely the result of poor maintenance and/or poor design. Another significant slide is located near the existing earthen dam, and appeared associated with improper dam overflow. In general, treatment of these slides will require a dropping of the road grade, and a conversion of existing failing culverts to rocked fords.



Image 10. Slide #2 on mid-slope road

2. CGS Pre-consultation

A pre-consultation regarding slide repairs was performed on April 15, 2005 with Michael Huyette of the California Geological Survey (CGS). This meeting was arranged at the suggestion of CDF in order to determine what they would expect to be analyzed in any permits that they might review. Another purpose of the meeting was to help identify the potential costs associated with essential road restoration work. On April 18, 2005, Mr. Huyette provided a report titled: *Preliminary Review of Engineering Geological Concerns, Proposed Equipment Access Routes for Possible Fuel Hazard Reduction Project, Peninsula Open Space Trust (POST) Wicklow House Property, San Mateo County, California*. A primary recommendation of the report is the development of an Erosion Control Plan (ECP), which would provide specific repair and maintenance practices to be applied on the Wicklow road network. The report also discusses the

earthen dam, and the potential risks to public safety. Because a road failure (slide #5) has been caused by improper dam overflow, repair of this slide may trigger the need for a specific evaluation of the dam by a Certified Engineering Geologist (CEG). Depending on the objectives of the landowner regarding the pond, the costs of a CEG consultation should range from \$2,000-\$3,000.

Forded crossings require virtually no maintenance, thus avoiding the risks of road failures when future maintenance is not certain. Where culverts and associated road segments appear stable, culverts will be retained, and the road surfaced reshaped to ensure an overflow point if the culvert should fail in the future. This "critical dip" system, greatly reduces the probability of a road failure following a winter plugging of the culvert. These culverts will still require yearly inspections and maintenance. Refer to Tables 1 and 2 for detailed recommendations.

3. Tractor Trails

Existing tractor trails are generally steep (greater than 20%) and are typically located on ridges. These trails can provide critical access for firebreak construction and back burning during the early stages of fire suppression. In some areas, eucalyptus should be cleared to ensure safe escape routes, while in other areas where trails follow existing vegetation types, the benefits of clearing are not as critical. Because they are so steep, these trails currently show moderate amounts of erosion damage, and require erosion control treatments. These treatments should consist of constructed "water bars," spaced 50 to 100 feet apart, and built at an angle to direct water off the trail surface and into well-vegetated areas as quickly as possible.

4. Secondary Access

Improvements to the road may tempt homeowners to consider this a secondary access in times of fire. **This should not be used as a secondary access.** Because the road leads into an area of heavy fuels, and is located mid-slope, it is possible homeowners will experience areas of rather high fire intensity for which they are unprepared. It is a long road with safety zones, but few opportunities to exit the forest. Instead, homeowners should follow the end of Dolpine Road up and follow the northernmost road away from the eucalyptus grove. Discussions of appropriate secondary egress routes could be part of communications with neighbors regarding the repair of fire roads and fire hazard reduction treatments on Wicklow

5. Repair Cost Estimates

Recommended slide repairs would require the use of a bulldozer, backhoe, and possibly an excavator. Because this type of work is very common performed on timber harvest projects in the Santa Cruz Mountains, a Licensed Timber Operator (LTO) would be capable of doing the work. Repair of all ten mapped slides would be ideal, but repair costs for the highest priority slides (S1, 2, 3 and 5) could range in cost from \$4,000 to \$6,000. Refer to Appendix 2 and 3. High priority crossing repairs should costs in the range of \$1,000 to \$3,000. All recommended crossing work could range as high as \$4,000. The development of an ECP in the next phase of this project will allow for a more detailed cost estimate suitable for planning.

III. FUELS MANAGEMENT PLAN IMPLEMENTATION

POST has taken a commendable step in considering implementation of a Fuels Management Plan. Treatments to reduce the fire hazard, facilitate fire response, and generally to reduce overall potential damage from a wildfire on Wicklow are justified based on site conditions presented in the previous chapter. Implementation is especially important to pursue, for once a hazard has been identified, undue delay in taking action can be construed as less than prudent. Should damage occur before action is taken, the landowner is often forced to show they were doing "what a reasonable person was doing" and not being negligent.

A. DISCUSSION OF PERMITTING AND FUNDING ALTERNATIVES

The development, submission and agency review of appropriate permits for this project would occur in next phase of this project. However, we have analyzed the permitting options and offer recommendations below. A significant element to any subsequent permit application, and associated grant applications, will be the development of a comprehensive Erosion Control Plan (ECP). The ECP will contain specific treatments and a sharper focus on the estimated costs to perform recommended treatments.

1. THP vs. NTMP vs. Emergency Notice (CAC 1052)

Because the subject property is a private ownership and also a State Responsibility Area (SRA) for California Department of Forestry and Fire Protection (CDF) fire suppression, a suitable permitting process must be identified in order to proceed with any plan implementation. During initial discussions between POST and CDF, several permit options were reviewed, including a Timber Harvest Plan (THP), a Non-industrial Timber Management Plan (NTMP) and an Emergency Notice (CAC 1052). Under the California Environmental Quality Act (CEQA), CDF is the lead agency in permitting any land disturbing projects. Other agencies involved in project review include California Department of Fish and Game (CDFG) and possibly Regional Water Quality Control Board (RWQCB). The degree of involvement of RWQCB is not entirely clear at this point due to changes in their mission and staffing issues.

A THP is a detailed plan developed by a Registered Professional Forester (RPF) that includes an exhaustive discussion of existing resources (e.g., archaeological, biological, visual, traffic, water quality, noise, etc.) that might be affected by timber harvesting, and what mitigations will be implemented to keep any potential impacts insignificant. Harvest practices and post-harvest timber stocking are described, and roads and stream crossings analyzed for stability and improvements that will reduce long-term erosion. Often, this is the minimum requirement for obtaining an approved THP since site-specific resources and mitigations can vary considerably between properties. A THP is nearly always used to allow for the commercial harvesting of timber. In other words, if the timber has value as logs, CDF requires that a THP be prepared to ensure adequate environmental review and scoping. All practices proposed in a THP must comply with the California Forest Practice Rules (Title 14, CCR, Chapter 4). Costs to obtain a THP in the area can range from \$15,000-\$30,000 depending on what environmental and political issues arise.

An NTMP is very similar to a THP, but unlike a THP, which is valid for 3 three years, an NTMP remains valid indefinitely. The primary benefit of the NTMP is that it ensures long-term sustainable harvests while allowing for a much smoother process for re-entering a property for harvesting over time. The primary limitations to an NTMP are that it limits the landowner to uneven-aged silviculture (e.g. no clear-cutting), and the costs can be 10-20% higher than a THP

due to the requirement to inventory the timber and model future growth and yield. On the San Mateo coast, clear-cutting is not permitted under the Forest Practice Rules.

The third permitting option available to POST for fuel treatment operations is an Emergency Notice (EN) under CAC 1052. An emergency in this context is a hazardous fuel condition. Unlike the THP and NTMP, larger areas would be permitted to be cleared and/or thinned to achieve the objectives of a Fuel Management Plan (FMP). Depending on the presence of archaeological and biotic resources, preparation costs for an EN can range from less than \$1,000 to \$3,000. The EN was identified by CDF as the preferred permit for this property. Although scoping is not as extensive when using an EN, we recommend notifying neighbors prior to any operations, and maintaining contact with interested parties throughout the process.

2. Need for Scoping and Environmental Review (CEQA)

Besides the SRA status of Wicklow, the CEQA process can include significant levels of scoping and notification, which allows for public comments and concerns to be aired. This process can significantly increase project costs, but can also provide valuable input from neighbors that can improve the effectiveness of the project. Due to the significant number of neighbors and the adjoining County Park, any activities on Wicklow would be highly visible, and scoping, whether required or not, was deemed essential by POST from the beginning.

3. Funding/Grant Possibilities

There are two major ways to pay for the recommended operations. The products derived from the site (chips for cogeneration, firewood), may offset some of the costs of the operation, which is a form of funding the work. Another funding possibility is to obtain grants to implement the project, or to participate in cost sharing with the State's Vegetation Management Program or the program to utilize Sheriff Inmate Crews

a. Grants as a Form of Funding

There is an unprecedented level of grant funds available at this time, but this situation is not expected to last. Federal funding is distributed through many avenues. For the most current federal grants that can be accessed electronically contact www.grants.gov to research information on the over 900 grant programs offered by the 26 Federal grant-making agencies. Three programs that fund fire mitigation are: 1) the National Fire Plan, 2) the Healthy Forest Restoration Act, and 3) the Department of Homeland Security through the Federal Emergency Management Agency (FEMA) and US Fire Administration. The National Fire Plan and Healthy Forest Restoration Act are often linked.

The FireSafe Council of San Mateo County is an important ally in funding. Through the FireSafe Council the Sheriff Inmate Crews are available at subsidized rates for work on projects. These crews can be used where hand labor is required, e.g. to cut trees smaller than 12 inches in diameter where slopes preclude the use of machinery, or prune trees and stack firewood.

The FireSafe Council can also be an avenue to obtain funding from outside sources. California grant information is available on line at www.firesafecouncil.org, and www.cafirealliance.org/grant.asp. POST can apply directly for grants or partner with the FireSafe Council. The state-wide Fire Safe Council website hosts an e-grant concept paper process. In collaboration with the California Fire Alliance, the intent is to provide one-stop

shopping for grants at the California Clearinghouse¹. However, it does not cover all programs.² Many grants are extremely competitive with requests for funding far exceeding the available funding.

Most funding for projects that mitigate potential wildfire damage comes from the National Fire Plan (NFP), available at www.fireplan.gov. Funds originate from five federal agencies, and grants are awarded to projects on private or local areas that are near federal lands. In the case of Wicklow, the nearby Golden Gate National Recreation Area provides a nexus that could justify funding.

The California Fire Safe Council Clearinghouse offers an efficient on-line grant application process. Applicants submit one concept paper that gets routed to as many applicable grant programs as possible. The concept paper is followed by an application and, upon funding, by progress reports. This process exposes many projects to funding sources the applicants may not know about and vice versa. While most grants spring from the National Fire Plan, in 2005 the Clearinghouse also includes state funds for watershed protection. If funding is not immediately approved the Clearinghouse "banks" projects to enable quick obligation of extra funds if they become available. In 2004-2005 the Clearinghouse logged 366 concept papers requesting \$29 million. Approximately \$8.6 million was available to fund projects (Bisch, in press).

Projects developed in collaboration with federal, state and local partners at the community level typically place high in priority. Other funding sources actually require that funded projects be developed through collaborative planning process (e.g. the Healthy Forest Initiative requirement for a Community Wildfire Protection Plan).

The State Fire Assistance (SFA) program is a supplemental appropriation allocation through the National Fire Plan, in addition to a regular appropriation distributed by formula to state foresters through the USDA Forest Service. These funds can be used for planning and implementation of hazard mitigation projects, including fuel reduction, prevention and mitigation education and community hazard reduction. These funds are competitive and available nationwide. Thirty-five percent of the funds are distributed among the states to meet firefighting preparedness and safety needs.

The Community and Private Lands Fire Assistance (CPLFA) is a relatively new program authorized in the 2002 Farm Bill. The program authorized \$35 million per year for use the US Forest Service, but this has not been funded. The purpose is similar to the SFA program, but emphasizes assisting landscape-scale planning for hazard reduction. This program was not yet funded even though the bill appeared promising the details are not yet known.

The National Academy of Public Administration identified regional and state grant websites in each of the states that offer grant programs. www.napa.org.³

¹ The California Fire Alliance is a nonprofit organization composed of federal, state and local fire and land management agencies in California, along with the State-wide Fire Safe Council. The Alliance's mission is to promote the accomplishment of pre-fire projects by reducing bureaucratic barriers.

² California grant information is available on line at www.firesafecouncil.org, and www.cafirealliance.org/grant.asp.

The US Forest Service also offers funding through the State and Private Forestry (S&PF) Programs. Programs administered through Cooperative Forestry are the Stewardship Incentives Program (SIP); Watershed Forestry Initiative; Forest Legacy; and the Urban & Community Forestry;

Private funds and volunteerism usually play a large role in implementation of community fire plans. Local and national business often offer grants, local nurseries, contractors and other business are often key partners. A private public partnership can be created formally, happen unwittingly, or be regulated around a specific issue or problem. Formal partnerships may take the form of FireSafe Councils, or Homeowner Associations that agree to work on fire safety in a community in conjunction with local government, citizens and businesses. They may fund their work through dues, gifts, in-kind contributions or seek funding from outside sources.

FEMA has recently established the Pre-Disaster Mitigation Program (PDM). The PDM is established to facilitate cooperation between state and local authorities with funds being awarded competitively for both planning and project implementation activities at the state and local level (as a sub grantee). Traditionally, FEMA has not addressed wildfire as compared with hurricanes, floods and earthquakes, so funding levels are unknown at this time. The website www.fema.gov/fima/hmgrp/statedir.shtm lists state level connections for various grants and assistance related to natural hazard preparedness and planning as well as some post-disaster activities.

CDF administers several sources of funds suitable for this operation. The California Forest Stewardship Program provides technical and financial assistance to communities and private landowners and includes a number of programs that can be related to fire safety. The California Forest Improvement Program (CFIP) is a cost share for forestry, watershed and riparian protection and enhancement.

There is inherent uncertainty when estimating the costs of fire hazard reduction operations because there are few potential bidders for the work, and on-site conditions may change, or new conditions be exposed. If costs change after a grant is obtained, project scope can be adjusted as appropriate, and modifications to the grant negotiated with the granting entity.

b. Cost-Sharing to Facilitate Implementation

The CDF Vegetation Management Program (VMP) is a cost-sharing program targeting areas that are suitable for prescribed burning, (and potentially, other treatments to reduce hazard and possible damage from wildfire). Up to 90 percent of the costs can be borne by the State, and the liability associated with this treatment lies with CDF. There is a long lead-time required for preparation of planning and environmental review documentation; this may be acceptable because the recommended role for prescribed burning is as a maintenance tool.

c) Marketability of Material

Consultations with local firewood sellers and tree removal contractors confirm the lack of a viable market for cut eucalyptus. There has been speculation among contractors that a biomass or diesel conversion plant may be established at Montara, but we were unable to confirm definite plans for such a facility. Firewood cutters have traditionally fought the perception among consumers that eucalyptus is somehow unsafe, or otherwise unsuitable for firewood. The but

³ Appendix E: Wildfire Mitigation Assistance: Regional and State Grant Websites. National Academy of Public Assistance. Enhancing Hazard Mitigation Capacity. January 2004. pp 49-50.

rating for this species is higher than oak or madrone, and when mixed with these species, is an excellent and low ash heat source. Nonetheless, local buyers have an ample supply from private landowners and trees removed from public right of ways.

Based on current projects operating on the central coast, because of the lack of market demand and high hauling costs, the most cost effective way to dispose of cut material is to grind it onsite and spread it for erosion control. Excessive amounts of eucalyptus chips are either hauled offsite, or piled on landings or roads and burnt on onsite. Typically 10 to 15% of the cut material can be used onsite as poles or rounds to build fences, stairs, retaining walls, and other erosion control structures.

It is essential that when a request for proposals (RFP) is developed for this type of project, that prospective contractors would take title to the cut material, and that it would be their responsibility to either remove it from the property at their cost, or chip and distribute it onsite pursuant to the recommendations of POST's forestry consultant.

Bids should include itemized cost schedules for cutting trees, chipping material, treating residue, treating stumps, mowing roadsides, and performing road repairs. This detail will provide valuable information that can help choose a contractor(s), develop the contract(s), and provide the highest value for the landowner.

d. Summary of Funding Options

Because the current market does not hold much value for the products to be produced from the treatments, funding the implementation through grants or cost-sharing programs appears to be the most viable approach. Obtaining funds through grants is promising because of the high hazard and potential damage posed by the situation at Wicklow.

B. TREE REMOVAL METHODS

Most eucalyptus trees to be removed as part of this project are fairly small – between 8 and 14" in diameter at breast height. These trees will be cut using chainsaws by professional falling crews, working ahead of a tractor. Trees near watercourses will be felled away from the stream zones wherever possible, and any branches or slash generated in the process will be immediately removed from stream courses. This is a critical practice to avoid the redirection of winter flows out of stream channels where they might cause bank erosion and sediment movement.

1. Indicated Yarding System

The property was logged in the early 1980's using tractors, which required the construction of a network of still existing "skid trails" which are suitable for tractor use, but are generally too steep for two-wheel drive vehicles and log trucks. These trails are a significant legacy of this past operation in terms of the associated erosion and slope instabilities. After logging operations, skid trails must be "water-barred," which entails the construction of earthen berms along the trail surfaces, designed to redirect surface water flow into stable areas. These water bars also serve to prevent vehicle access, which can create rutting and increase surface erosion significantly. In several locations, these water bars were not properly constructed or maintained, and significant erosion has resulted.

The proposed fuel removal operation should take advantage of the existing trail network, reuse existing trails where needed, repair existing trails as needed, and properly water-bar trails after operations are completed.

Alternative yarding options briefly explored include cable yarding and horse logging.

Cable yarding would increase operation costs significantly, with only marginal increases to resource protection. There are also many portions of the proposed operating area that lack the topographic elements necessary to operate a cable system. The smaller the acreage to yard by cable, the higher the unit costs will be due to fixed costs. In addition, cable machines require openings on ridge tops that may not be consistent with the other goals of the landowner.

Horse logging has been successfully used on several East Bay MUD fuel removal projects in recent years. Although generally considered an environmentally sensitive method by the public, there are some shortcomings to this system worth mentioning. Costs can be high compared to traditional tractor and rubber tired skidder (RTS) methods (approximately \$5,000 per acre for horses compared to around \$1,000 per acre for a typical timber project). Draught horses require specialized operators, and production rates are much lower. Typically, horse logging can treat one to three acres per day, while a tractor can treat twice that. Power limitations of horses also limit the size of logs that can be skidded, requiring several trips across the same trails to move the same material a tractor might skid in one pass. This repeated and concentrated impact can result in both soil compaction and erosion. Further, tractors are equipped with cable winches that facilitate much safer falling of trees that are leaning or hang up on adjacent trees after being cut.

2. Landing/Loading/Hauling Locations

Cut material will be skidded to landing locations as mapped. These landings are either existing, or will be constructed at the time of operations. Landings will be less than ¼ acre in size, and graded to facilitate drainage and reduce erosion potential. Several landings will be designed to also serve as safe zones. Log trucks will be loaded at these landings using log loaders, and access Highway 1 at El Granada. Depending on the scheduling and extent of tree cutting, one to three truckloads per day could be expected for one to two weeks. Roads would be posted with "Caution Trucks" signs at prominent locations, and hauling schedules set to avoid conflict with school bus and commuter periods.

3. Operations Timing

The timing of any proposed tree removal operations will be dependent on several factors. Public use of the adjoining Quarry Park and playground, especially any scheduled events will limit both cutting and hauling times. Coordination with Midcoast Parklands and posting of operation times and warning notices will help assure minimal contact with park users. Hauling will need to be scheduled to limit conflict with school buses and commuters.

Operations should be performed in the spring and summer months to avoid rain and erosion to opened roads and trails. Operations during especially hot "red flag" periods in the late summer and fall will be limited to avoid the possibility of fire ignition. All work crews will be required to have fire suppression equipment stationed on-site.

C. RESIDUE TREATMENT ALTERNATIVES

1. Post Tree Removal Treatments

Once the tree thinning, understory removal, and pruning operations have been completed, controlled burns, herbicide applications, and erosion control treatments would be conducted.

2. Debris Treatments

A significant amount of small wood, prunings, shrub branches, and slash would remain on site after the tree removal operations are complete. Clean-up crews reduce this amount of debris. High volumes of debris would still remain, which can cause an extreme fire hazard. If all material

cannot be utilized, treatments of the debris can reduce the volume of biomass, through crushing on site or multi-cutting to avoid transport. Typically the height of slash will be reduced to lower than 30 inches, especially in native fuels. While the remaining debris would create a temporary elevated level of fire hazard, the greater surface area and greater contact with the soil promotes decomposition so that within a few years the surface fuels would be negligible. Eucalyptus fuels may take longer to decay, and more elaborate residue treatments (e.g. lower slash heights, or smaller lengths of materials, or more complete removal) will be called for during the permitting process. Controlled burns can be conducted to reduce this large volume of woody material in the future.

a. Potential uses⁴:

- Fiber products such as paper and cardboard. This market is especially sensitive to the low demand for finished product, specific biomass quality requirements, harvest and transport costs, in addition to facility operation costs, financing and environmental issues that can diminish potential viability.
- Conventional lumber. Production faces high cost for small diameter trees or low quality lumber, but products do not achieve comparable returns.
- Fire wood - Small to large branches and logs cut for firewood, however this market may be close to saturation.
- Pellets or briquettes (densified solid fuels). These are currently made from manufacturing wood waste and could be made from UWI removal related biomass. However, there is an over-capacity in this industry and uncertain future.
- Compost and mulch. Market may be close to saturation in many areas. The Deschutes Soil and Water Conservation District in Oregon received a National Fire Plan Community Assistance grant in 2001 to turn woody biomass into compost. The fuel reduction efforts in the lodgepole and ponderosa pine forests produced woody biomass from ladder fuels. The material was composted and sold or spread on Sun River golf courses making it a valued soil additive in the volcanic soils that lack organic materials.⁵
- Shavings Used for animal bedding for horses as well as small pets. Because Wicklow is close to several stables, shavings may be marketable. The marketability would be greatly enhanced if the specialized equipment to produce shavings were nearby in order to reduce transportation costs.
- Specialty markets For post and rail, rustic furniture, cabins and customized outhouses.
- Grazing The only technique that can both remove and dispose in a single operation. Goats are commonly used to reduce the overall volume and height of shrubs, particularly poison oak. These herds are contained by movable electric fences; depending on the size of the herd and intensity of grazing desired, can graze one acre per day. This debris removal is one appropriate initial treatment as well as maintenance technique in the coastal scrub of Wicklow. Because fencing is the greatest cost, linear arrangements of treatment areas, such as roadside treatments are typically more costly per acre than area-wide treatments.

b. Debris Burning

⁴ Shelly, John R. PhD. Biomass in California "Is it a Valuable Resource?" Forestland Steward. Summer 1998.

⁵ Drew, Jason. District Manager Nevada Tahoe Conservation District. Statement presented to Subcommittee on Forests and Forest Health Committee on Resources at Oversight Hearing on *Developing Biomass Potential: Turning Hazardous Fuels into Valuable Products* June 23, 2004.

While concerns surrounding burning debris typically focus on the environmental impact from smoke, the Monterey Fire Safe Council chipped 150 tons of piles and burned 50 tons in piles at the Indian Springs neighborhood in Monterey, CA. The Monterey Air Quality Control District is writing a letter saying they would have preferred to burn 150 tons and chip 50 tons, because of the diesel toxics the spume from the chipper, and that chipping that much volume would create more air pollution than the pile burning.

c. Debris Chipping

- Chipped and used for mulch.
- Chipped and used for co-generation, although there is no nearby co-generation plant.
- Refined through manufacturing processes into usable materials (products such as rayon, paper, chipboard, plastics and composite building materials and chemicals).

D. HERBICIDE USE AND APPLICATION

Eucalyptus is an extremely hardy tree that is fast growing, drought tolerant, frost tolerant, resistant to most insects and diseases, and with an extensive and persistent root system that promotes vigorous sprouting. Very few methods can easily control the re-sprouts of this tree. Herbicide application to the stump is the most effective means of eliminating regrowth. It is imperative to follow the label and the recommendation provided by the licensed Pest Control Advisor. The greatest threat of damage from herbicide use comes from spills associated with mixing and transfer of the chemicals. The herbicide applicator will need to develop a plan to minimize spillage.

1. Suggested Sprout Control Method

The recommended method of control outside standing or slowing water is to apply Garlon IV in a solution of approved fine oil using basal bark, direct cambium injection or a variation of the cambium injection method as described below. The fine oil will act as a penetrant to speed delivery to the cuticle and bark. The herbicide should be applied within one week of the cut, with the desired goal as soon as possible after the cut.

The following methods can be used to deliver herbicide to the stump:

a. Direct Basal Bark Application

The stump is sprayed to wet but not run off using a low pressure applicator to reduce drift potential. Drift to an area within 4 feet of the stump is possible on a breezy day, however, usual drift is less than 2 feet from the stump. The herbicide penetrates the bark, enters the cambium through which it is delivered to the roots. Nearby trees and vegetation have not been affected in similar applications elsewhere. The greater surface area sprayed allows more herbicide to enter the plants' transport system with greater speed. The effect is an overnight knockdown of foliage and a kill within 30 days.

The method is not as labor intensive as direct cambium injection, and delivers the active ingredient quickly and in large volume. This method usually takes 15 minutes per stump to apply. This time estimate also includes the time to clear debris from around the stump. The spray is concentrated on the target (actually a spot spray) and provides the quickest kill. However, there is a possibility of drift to the immediate area and/or vaporization, and people nearby (within 50 feet) may be able to smell fumes for a short period of time (the time it takes for the oil to evaporate, which is usually less than 1/2 hour).

b. Direct Cambium Injection

An injection or lance is used to deposit herbicide into a cut in the bark, which is made by the tool being used. Cuts can also be made with an ax, into which herbicide is injected via a syringe injector. The pool of herbicide is absorbed into the cambium and delivery is much the same as with the spray method.

With this method there is less exposed herbicide, with a lesser chance of drift and fewer fumes therefore less potential that people would smell such fumes. However, more labor is required (usually 25 minutes per stump), with a requirement of more expensive equipment. This method also does not provide as quick a mortality of the stump.

Suggested mix of methods: Garlon is not known to be a residual herbicide. However, some precautions may be advised in areas that are considered to be more sensitive. The suggestion is to use the basal bark treatment in non-sensitive areas (upper slopes and non-drainage areas) and use direct cambium injection in more sensitive areas (i.e. close to buildings, workplaces, and drainages).

c. Application of Herbicide in Areas of Standing or Flowing Water

Concern for effects on amphibians requires an additional level of caution when applying herbicide near areas of standing or flowing water. Where water is standing or flowing, a glyphosate-based herbicide, Rodeo, is suggested as an alternate for Garlon IV. Round-up is not labeled for use in this environment. This herbicide will need to be applied to the cambium within minutes from cutting. The herbicide is delivered with a spray bottle, so drift is minimized. Because it is likely that Rodeo would not be diluted (other than the addition of a dye), there would be no side effects from the herbicide carrier. Similar to basal bark application, the estimated time for herbicide application is 15 minutes.

2. Equipment

The following equipment will be necessary to conduct the suggested application of herbicide for the control of eucalyptus sprouts:

- tank sprayer
- backpack sprayer
- herbicide syringe
- chain saw
- injection ax or lance

3. License Requirements

The formal recommendation for the herbicide application will need to be written by a Pest Control Advisor (PCA) who is licensed in San Mateo County.

To assure the treatment will be applied responsibly, and per the formal recommendation provided by the PCA, the applicator should hold a Qualified Applicators License Class E (forestry), Pest Control Business License, and be registered with the San Mateo County Agricultural Commission.

E. FIRE PREVENTION MEASURES

Signage informing visitors of fire hazard and danger could be posted near the property entrances. This is a program that could be established jointly with the MidCoast Parklands. Additional signs could be posted prohibiting smoking if this rule were instituted.

Users of Quarry Park should be encouraged to contact the HMBFD if unsafe behavior were observed; signage relating this information could similarly be posted.

Usage should continue to be restricted so that no camping and no barbeques are allowed on Wicklow. Similar restrictions are advised for the Quarry Park.

POST could help foster understanding of the fire hazards outside the POST property, and help educate the homeowners and owners of vacant lots of actions they can take to reduce the chance of ignition and potential damage from fire. Partnering with the HMBFD and participation in a FireSafe Council meeting, or event/program may further this understanding.

POST should require that equipment used on the property - for fuel reduction, or transportation, for example, is in good working order with spark arrestors and operating catalytic converters. Approximately one-quarter of all ignitions on the coastal counties of California are started by equipment. Personnel who perform vegetation management should be trained in fire safe practices regarding the use of mechanical equipment. Shovels and water for fire suppression must be on hand when performing vegetation management during fire season. Mowing and cutting of vegetation should be stopped when fire danger is high. POST should establish levels of danger when such operation should cease, and the method for contractors to find out levels prior to working each day. For example, when the Burning Index in the National Fire Danger Rating System exceeds 81 (indicating a potential flame length greater than 8 feet), special precautions against ignitions should be in place. Under these conditions, all gas-powered cutters would be banned.

F. RECOMMENDATIONS FOR ACTIONS ON ADJOINING PROPERTIES

Adjacent properties can greatly influence the effectiveness of treatments on Wicklow. Neighbors can compound the effectiveness by leveraging treatments on Wicklow with treatments on their own land. Or, if nothing is done, treatment effectiveness is minimized, since hazards will remain outside of Wicklow that could jeopardize the same values the treatments are intended to protect.

These neighbors, along with local agencies such as the HMBFD can also be effective collaborators, lending support to projects. These collaborators can be important factors in grant applications, greatly increasing the chances of obtaining funds. The collaborators also are particularly powerful communication avenues regarding the project and benefits thereof.

Several residential areas as well as vacant lots between Wicklow property and occupied lots are untreated and present a considerable hazard. Mirada Surf, a community park owned by San Mateo County, abuts Wicklow to the southwest and sits between Wicklow property and lands that will soon be developed for residential use. To the east, there are agricultural parcels.

1. Residential Areas



Image 11. Adjacent yards of residential lots

The area within 100 feet from any structure will be considered a defensible space zone, and have a more stringent definition of actions that need to take place annually. HMBFD will be an important partner in communicating the need for defensible space and enforcing maintenance on residential properties. The initial treatment may consist of either the tree removal or goat grazing operations, followed up by hand labor to achieve the more stringent standards that appear in Defensible Space Standards that follow.

The prescription for vegetation management in this unit is to mow grasses annually, to remove hazardous tall trees, and to create spaces between large groupings of shrubs, between shrubs and trees, and from under trees. All cut material should be removed from the site, or chipped, provided the mulch layer is less than 2 inches in depth.

The standards which must be met each year follow:

- a. Remove all dead plants and dry vegetation to establish and maintain a defensible space. The following actions will provide the same level of fire safety as removing all combustible material.
 - i. Cut grass and weeds yearly to less than 4 inches in height when 30% of the grasses have cured. Beginning May 15, inspect the grass on a weekly basis to determine the state of grass curing. Re-mow if late-season rains promote grass growth after the first cutting.

Cutting native grass and wildflowers can be delayed until after seed set if they will not rapidly spread fire to any structure.

- ii. Keep the ground, roofs, decking, and balconies free of dead leaves or other plant debris.
 - iii. Clear leaves, bark, and humus under trees and shrubs (including vines and semi-woody species) every year. At no time should a buildup of leaves and humus exceed 1 inch in depth anywhere in a landscaped area. However, do not expose bare earth in over 50% of the site, and no one patch larger than 15 square feet.
 - iv. Remove dead material that drapes over ground cover (including leaves, bark, and branches) annually, before June 1.
 - v. From mature trees, remove all vines, loose papery bark, dead branches, and live branches smaller than 3 inches in diameter to a height of 8 feet above the ground.
 - vi. Remove all dead branches from within live ground covers, vines, shrubs (including semi-woody species), and immature and landscape trees.
- b. Prune trees and large tree-form shrubs (e.g. oaks, toyon) that are being retained to provide clearance of three times the height of the understory plant material, or 8 feet, whichever is higher. Prune limbs that are smaller than 3 inches in diameter up to 8 feet above the ground; in young trees, prune these branches the lower one-third of the height of the tree. Thus, if a tree is 10 feet tall, prune the lower 3 to 4 feet and keep the understory plant material to less than 1 foot in height. Then as it grows to 24 feet in height, it can achieve the 8-foot distance from the ground, and the understory plant material can reach 2.5 feet in height. Do not disturb or thin the tree canopy, because these actions promote growth of more flammable vegetation (see Figure 1). Remove all branches within 10 feet of any chimney, flue, or stovepipe. Maintain 5 feet of vertical clearance between roof surfaces and overhanging portions of trees.

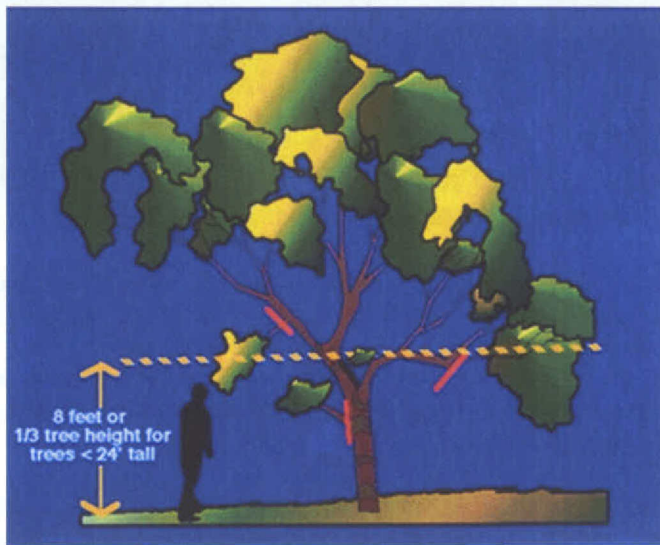


Figure 1. In young trees, prune branches on the lower one-third of the height of the tree. From mature trees, prune branches to a height of 8 feet above the ground. Do not disturb or thin the tree canopy. This promotes growth in the understory, which is more easily ignited.

- c. Do not locate plants that are replacing ones that die, or oaks planted as a mitigation measure, under trees. To avoid creating "ladder fuel situations" (in which a fire can climb from one

vegetation layer to the next higher one), do not plant shrubs (including vines, semi-woody species, and all chaparral species) under trees.

d. Make sure that all landscaping and replacement plants are fire-resistant in nature. Prohibit planting of plants that are highly ignitable and burn with intensity. The website www.ucfpl.ucop.edu provides a searchable database of fire-resistant and flammable plants.

e. Manage individual plants or shrub masses to maintain adequate horizontal spacing. Design distinct groupings of shrubs (including vines, semi-woody species, all types of brush, and all chaparral species) to dampen the spread of fire. Make sure that the plant groupings are small enough to provide adequate horizontal separation between groupings and to allow proper maintenance; groupings should measure no wider than two times the grouping height, or 120 square feet. However, one row of shrubs in a linear band with a maximum width of 7 feet, located at least 10 feet from the structure, need not comply with the 120 square feet area limit. The space between islands should be greater than two times the height of the shrubs, or 12 feet at a minimum. On emerging trees, clear a spacing of 12 feet from the edge of the canopy (see Figure 2).

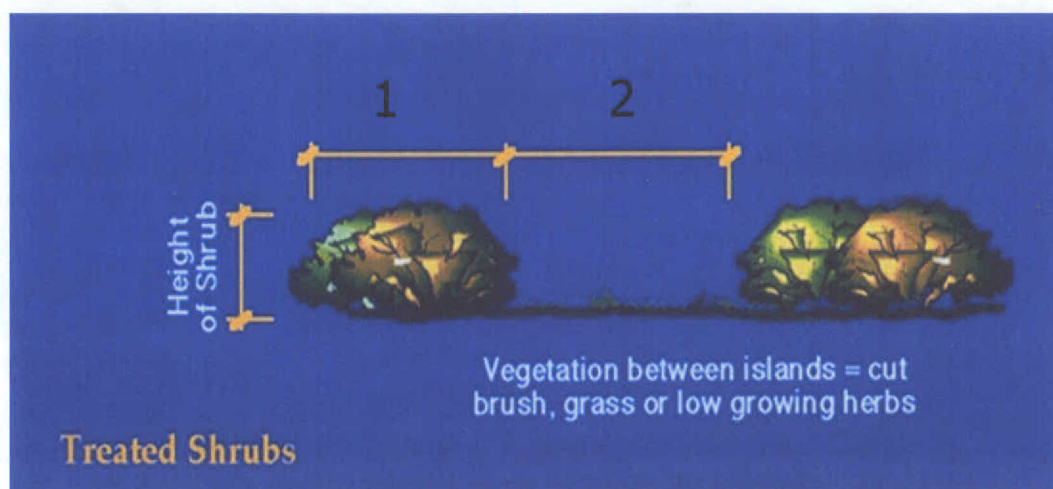


Figure 2. Shrub island spacing. Design groups of plants small enough to provide horizontal separation between groups. This allows proper maintenance and helps slow the spread of fire. Each shrub or group of plants should measure no wider than two times its height, or less than 120 square feet (or 6 feet x 20 feet). The space between groups should be greater than three times the height of the shrubs, or at least a 12 feet distance. A row of plants with a maximum width of 7 feet located at least 10 feet from any structure can be greater than 120 square feet (or 3 feet x 40 feet).

f. Remove and safely dispose of all cut vegetation and hazardous refuse.

g. Allow chipped materials to remain on the site, provided the mulch layer is no greater than 2 inches in depth.

2. Adjoining Vacant Lots

Adjoining vacant lots constitute a major fire hazard irrespective of the condition on Wicklow. Local fuel management requirements for these vacant lots are enforced by the Half Moon Bay Fire Department. Because they are located above and adjacent to Wicklow, fire could easily spread from Wicklow onto these lots. They will not be treated under the current plan, however, they could participate, if POST approves, and appropriate agreements are made. Location of lot lines could present a significant problem during implementation of the fuel management plan.



Image 12. Adjoining vacant lot between Dolphine Road and Wicklow

3. Quarry Park and Mirada Surf Park

Because the conditions on Wicklow are duplicated on Quarry Park, whenever possible, the same roadside treatments should be applied as on Wicklow. This would greatly enhance the effectiveness of treatments on Wicklow. Conversely, if treatments are not performed on Quarry Park, fire response using roads that travel through the park may be in jeopardy.

As a buffer between Wicklow and future residential lots, it is incumbent on Mirada Surf Park to reduce fire hazards on their property, particularly because the land extends to Highway 1. Because roadsides are the most common location for ignitions, this park can serve as a means of fire spread from the highway to Wicklow.



Image 13. Boundary of Wicklow and Quarry Park



Image 14. Mirada Surf Community Park with adjoining structures at risk

4. Rancho Corral de Tierra

4,262 acres of Rancho Corral de Tierra, also owned by POST, encompass a nearly intact 1839 Mexican land grant, named Rancho Corral de Tierra-Palomares. It is adjacent on the north and east sides to other GGNRA lands, most notably the 23,000-acre San Francisco Watershed lands over which the National Park Service holds a protective and recreational easement, and to the north McNee Ranch State Park (780 acres) and San Pedro Valley County Park (978 acres), with further linkages to the GGNRA.

In order to create a continuous route of safe passage for fire responders, POST should establish a mechanism to allow fuel management (mowing of northern coastal scrub, and subsequently grasslands) on Rancho Corral de Tierra on the first 50 feet on both sides of its southernmost access road (on the perimeter ridgeline fire road on Wicklow). The length of this treatment is estimated as less than 600 feet.

5. O'Neill Property

As an in-holding within Wicklow, the O'Neill property is vulnerable from fires crossing out of Wicklow. As with the Quarry Park, roadside treatments for fire roads that pass through this property should be consistent with those on Wicklow. Defensible space creation and maintenance around the residence should be consistent with the guidelines recommended on residential lots.

Because the perimeter ridgeline fire road travels through and adjacent to the O'Neill property for over 1600 feet, POST should establish a cooperative agreement with the landowner to allow roadside treatment (mowing of coastal scrub and subsequently, grassland) on their property. The intent of roadside treatment is to achieve a combined width of 50 feet of clearance on both sides of the road.

6. Agricultural Lands/Wildlands to East

Treatments to reduce hazard on Wicklow will not directly involve the agricultural lands to the east. As neighbors, they should be informed of anticipated actions and offered an opportunity to support the project.

G. PRIORITIZED SCHEDULE OF ACTIVITIES FOR FUEL REDUCTION AND ACCESS IMPROVEMENT

First Phase

- Treat perimeter to reduce hazard to adjacent landowners
 - Unit 1, Treatment Areas #1 and #2
 - Unit 2, Treatment Areas #1 and #2 and #3
 - Unit 3, Treatment Areas #1
 - Unit 4, Treatment Areas #1
 - Unit 5, Treatment Areas #1
 - Unit 8, Treatment Areas #1 and #3
 - Unit 9, Treatment Areas #1, #2 and #3
- Regain access for perimeter road
- Thin eucalyptus with roadside treatments along the ridgeline perimeter road
- Install safety zones - done in conjunction with roadside treatment on the ridgeline perimeter road

Second Phase

- Regain access for mid-slope fire roads, other interior fire roads
- Thin eucalyptus along mid-slope fire road, in other Treatment Areas
- Interior treatment to increase biodiversity

Maintenance

- Manage to remove invasive flammable plants
- Consider use of prescribed fire under the CDF Vegetation Management Program

H. GENERAL DISCUSSION OF COSTS AND VARIANCE IN COSTS

There is a wide variation in treatment costs, between agencies/landowners, and between treatment types. Even when detailed cost estimates for the treatments are gathered, they must remain approximate because of the varying conditions within the treatment areas and the range of production rates of work crews and machinery. While ranges are provided in a table that follows, estimates may vary by 50%. Some examples of treatment costs follow:

A central coast fuel management contractor reports costs of \$350 - \$500/acre for a combination of mechanical operations and hand labor on a variety of vegetation types (spanning grasslands, Douglas fir forests, chaparral, north coastal scrub and oak woodlands). Mechanical operations primarily depend on a Bobcat mini-tractor and a hand crew of two laborers.

Other mastication operations using Tyco-based equipment generally costs \$400/acre to cut chaparral. If multi-year contracts are provided, and "shoulder" season work is allowed, costs may be reduced to \$200/acre.

Contractors with large road-side mowers can mow grass on two miles of roadside in a day, depending on traffic; with equipment costs of \$40 per hour and operator costs of \$35 per hour, this equates to \$250 per acre for this type of treatment. Grassland mowing will be possible on the northern perimeter road once the property is in a maintenance mode.

Use of grazing animals also has a wide range of costs. A herd of goats can cost as low as \$125 per acre (including fencing, insurance and oversight), but other areas with a dense undergrowth can cost over \$300 per acre.

The USDA Forest Service reports that the cost of prescribed burning is approximately \$100 per acre on the Los Padres National Forest, with approximately \$7 per acre dedicated to operations and \$93 for environmental documentation and mitigation. In contrast, the prescribed burn in Fort Ord is reported to have cost approximately \$6,000 per acre because of extensive and detailed planning requirements. As with mowing, prescribed burning is a potential only as a maintenance technique.

Herbicide application generally ranges from \$34 per acre (as seen by the University of California Hill Area project in 2002 to 2004) to \$100 per acre. Sue Gardner of the Golden Gate Conservancy reported that post-eucalyptus-removal (including stumps) costs for 8 acres were \$10,000 to \$15,000 per year for five years, or a cost of \$1,250 to \$1,875 per acre for five years.

In 1990, Leonard Charles Associates (LCA) provided detailed cost estimates for 16 types of fuel treatments, spanning hand cutting, mechanical treatments and prescribed burning. Cost estimates were specific to grass, chaparral, woodlands with heavy or sparse understories because of the differences in production rates between these different vegetation types and densities.

LCA further compared different costs for contract labor and sheriff inmate labor, but are not included in the following table. This type of 20-man crews has a travel time of 1 to 2 hours every day, resulting in useable time of approximately six hours every day. The USDA Forest Service recorded productivity of crews in Monterey County as treating one acre per day when hand cutting chaparral. Crews are paid \$100 per day on a per-day basis. Inmate crews are often available at highly subsidized rates, and potentially available through grants.

In order to implement the first phase of treatments described above, the cost to repair associated roads and crossings should be anticipated to be between \$1,000 and \$3,000, although it could be lower if an LTO is hired. Costs to prepare permits and pay an engineering consultant should be between \$5,000 and \$8,000. Costs to treat the vegetation could go as high as \$230,000 on 75 acres. So to implement the first phase of this FMP, a budget of around \$240,000 would be appropriate, not including POST staff time. The second phase should cost around \$110,000. As mentioned earlier, as more detail is developed in the permitting phase, the scope of the first phase can be adjusted to match available funding. Although identified as significant problems, this phase would not include repair of slides on the mid-slope road. This work and the remaining road

treatments would be done in the following phase, and require a similar cost minus the permit and ECP preparation. The CDF permit and ECP developed for the first phase would be applicable to the second phase.

I. POST-TREATMENT FIRE HAZARD

The results of these treatments will greatly improve the fire safety of the site. Fuel types will be changed, with resulting lower flame lengths. Fire intensity in treated areas, the related potential damage resulting from a fire on Wicklow will both dramatically decline. Fire suppression organizations will more safely be able to respond to such a fire, and are likely to be more willing to commit resources to a fire on the Wicklow property. While the probability of a damaging fire will be much lower after the recommendations are implemented, there is still a chance a fire could still produce significant damage.

J. REFERENCES AND CONSULTATIONS

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K. FIGURES AND MAPS

Location Map

Management Units

Vegetation

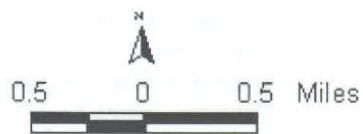
Crossings, Slides and Roads

Road Treatment Zones

Soils Map



Wicklow Property - POST Location Map



Buena Vista Services LLC 2005

Wicklow Property - POST Management Units



Burns Vista Services LLC 2005



