THE RISKS AND COSTS
OF GROWING BLUE GUM EUCALYPTUS AND MONTEREY PINE

Jerry Kent- December 7, 2013

INTRODUCTION

The Park District's decision in 2010 to continue growing large blue gum eucalyptus trees will be more risky and costly than Frank Havens' Mahogany Eucalyptus enterprise in the early 1900's when his 3,000 acres of eucalyptus trees failed to become a "gold mine" for usable hardwood lumber. One hundred years later, the Park District and other agencies are stuck spending untold millions trying to deal with Havens' troublesome eucalyptus forests now identified as wildfire hazards. Trees don't last forever, so agencies growing blue gums and Monterey pine will be responsible for each tree until the end.

The Park District has an adopted Wildfire Hazard Mitigation Plan/EIR (Plan) that was specific about how 1,293 acres of dense eucalyptus forests would be handled. The Park Plan recommends thinning mature forests to a 20' to 25' spacing (100 trees per acre) for medium sized trees, and 30' spacing (50 trees per acre) for larger trees. Thinned groves then require ongoing pruning and removal of sprouts, ribbon bark, ground fuel, and understory trees, shrubs and seedlings every 3 to 5 years to create a heavily maintained forest with a rather bare understory. The Plan also recommends conversion of 1972 freeze suckers on high ridges and above homes to a native understory plant community. However, the Plan did not inform the public or the Park Board about the potential costs required to implement the Plan.

Mature Eucalyptus Forest costs are now becoming more apparent with District staff using a $8,000 average cost estimate per acre for the initial entry thinning, and $1,000 average per acre cost for ongoing annual maintenance. Staff does not currently project eventual removal costs for 1,293 acres of large trees when they become unsafe or terminal. The Park District has recently awarded a contract in Tilden for $377,000 to thin 34 acres and remove 29 hazardous blue gums at $3,000 per tree. The overall cost of eventually removing 50,000 to 60,000 large blue gums at the end of their useful and safe lifetime will dramatically skyrocket on just 1,293 acres, if the cost for tree removal rises to $3,000 per tree. Moreover, the District actually owns 2,400 acres of blue gum eucalyptus and pine that will require thinning, management, and hazard tree removal.

A total contract cost could easily reach $180,000 for each mature eucalyptus/pine acre when all costs are included over the next 25 to 40 years plus contract management, stewardship costs, and monitoring for adaptive management. Overall costs for mature stands would include the first entry thinning, and 25 years of regular management and understory fuel removal. A follow-up second thinning would be required to get 30' spacing for large trees with the eventual removal of 50 large blue gums per acre when trees are a hazard or reach the end of their normal life cycle. The timing for each stage of management is complex, but the math is relatively simple. $180,000 times 1,293 acres equals $232 million dollars.

1972 Freeze Sucker area costs are less apparent but significantly lower by converting eucalyptus sucker dominated areas to native vegetation that would survive the next freeze and exhibit less risky fire behavior. The Park District and the University of California have completed several 1972 freeze blue gum sucker-to-native projects with initial project costs ranging from $4,000 to $12,000 per acre eliminating future expensive blue gum thinning, understory maintenance, and hazard tree removal. Maintenance of converted areas will be minimal after five to seven years of controlling invasive weeds, eucalyptus sprouts, and seedlings.

As agencies set out to make their eucalyptus and pine forests fire safe they will need adequate funding, a clear political/legal strategy, and a reasoned environmental program. Otherwise, they will be sending their employees on a fool's errand. They must also understand the 140-year history of Bay Area eucalyptus and Monterey pine forests.

THE TASMANIAN BLUE GUMS ARRIVAL WELCOMED AROUND 1870

Large-scale tree planting projects took place in the Bay Area over a forty-year period between 1870 and 1910. The Bay Area native landscape was too barren for the early settlers from the East Coast. They praised the weather and location but missed their tall-hardwood forests. Early tree projects always included the new and fast growing Tasmanian blue gum eucalyptus in combination with a few other large trees to create a new urban landscape. Planters used quick growing trees that would buffer winds, provide ready firewood, landscape new parks and universities, provide mountain home sites for sale, create timberland to reduce property taxes, collect fog drip for increased water supply, and provide trees to be harvested for hardwood lumber.

There were many projects, but the following timeline is representative of the beginning, mid-point, and the end of large-scale tree planting for the San Francisco Bay Area. California coastal Monterey pine and Monterey cypress were used extensively in early tree projects, but Bay Area planters were amazed and encouraged by the glowing report's from Australia about eucalyptus trees that were 400 feet tall, lived for 300 years, and quickly produced magnificent lumber.

- **In 1858**, Captain Joseph Aram planted a blue gum at his nursery north of San Jose. The Aram eucalyptus is now 170 feet tall with a trunk circumference of 34 feet and a diameter of 10.8 feet. The crown diameter is 85 feet. His tree is listed as San Jose Heritage Tree HT-04-005.

- **In 1869**, General James T. Stratton, California's Surveyor-General, was the first to plant a large-scale blue gum plantation on forty-five acres of hill land behind Hayward. He became one of California's largest producers and distributors of eucalyptus seeds during the 1870s, but in 1880 cut down 20 acres of his plantation to make way for an orchard.

- **In 1870**, the State Board of Agriculture spoke of the need for "artificial forests" in California to cover the barren terrain. To quote, "it was the duty of the board to stop any further destruction of the state's forest and to encourage the planting of new vegetation. It is a matter of no less importance to encourage and foster the growth and cultivation of artificial forests." California had no natural hardwoods required for the manufacture of wagons, carriages, and agriculture implements, and the State Board hoped the new trees from Australia would supply the needed lumber.

- **In 1871**, eucalyptus trees were planted at Mills College by Founder Cyrus Mills to landscape his new campus. Later, Aurelia Reinhardt, college president, Howard Gilkey, landscape architect, and Howard McMinn, professor of botany collaborated to add mostly native species to the college landscape. Several aging blue gum and other varieties of eucalyptus trees still remain today on the campus. Recently more than 100 blue gum trees (120 years old and 120 feet high) were removed along Bryant's path, and replaced with a different eucalypt species. A multi-age blue gum forest continues to provide visual screening to separate the campus from Oakland urban areas.

- **In 1871**, William Hammond Hall planted close to 60,000 trees, including Tasmanian blue gum eucalyptus, Monterey pine, and Monterey cypress in Golden Gate Park. Four years later, 155,000 trees covered over 1,000 acres of sand dunes and bare hillsides on San Francisco's "outside lands". Today, there are 33,342 trees of all sizes in the park's 624 acres of natural forest woodland with an average of 54 trees per acre. Blue gum trees in the Park and Panhandle now have trunk diameters that range between 4 and 8 feet. As aging trees are

removed, it's doubtful that new blue gum eucalyptus trees will be used by San Francisco to replace old or unsafe blue gums.

- **In 1873**, John McLaren, planted elms and blue gum and manna gum eucalyptus along Burlingame's El Camino Real, as a windbreak along the barren roadside. Eucalyptus trees were planted next to the elms for shelter. 247 mature blue and manna gums from the original planting reach well over 100 feet with 5 feet diameters. The 2.2-mile section of the Howard-Ralston El Camino Real State Highway, with 557 contributing trees, is now listed in the National Park Service's National Register of Historic Places.

- **In 1876**, Presidio post trader Angelo Beretta planted a blue gum eucalyptus near the parade ground. His tree is now named the Centennial Tree, and is 190 feet tall with a trunk circumference of 22 feet and a diameter of 7 feet. The crown diameter is 100 feet spreading over the center of the main parking lot.

- **In 1877**, the University of California planted Tasmanian blue gums near the Berkeley Campus West Gate as a windbreak for the old cinder running track. The "Founders Grove" trees now have 2 to 5-foot diameters with 63 survivors of varying size in the two-acre grove. Tree heights are above 200 feet with several leaners appearing unstable around the edge of the grove. Three leaners were recently removed at a cost of $4,000 each. The University is closely monitoring tree health in order to take appropriate action before tree failure. A solitary blue gum of the same vintage stands at the end of the west gate entry road. This tree is one of the larger trees on campus with a 27-foot circumference and 8.5-foot diameter, and with massive limbs hanging over the entry road turnaround.

- **In 1878**, 700 blue gums were planted along a farm road that was later named The Governor's Avenue on Stanford Campus. Approximately 50 huge survivors are now scattered along the "road" with live oaks and smaller trees now being used as replacement trees.

- **In 1886**, San Francisco Mayor Adolf Sutro led Arbor Day plantings on Mount Davidson, the highest hill in San Francisco.

- **In 1886**, the first mass tree planting at the Presidio included eucalyptus, pine, and cypress on the first celebration of Arbor Day in California. The Army would boast six years later that 329,975 trees had been planted by 1892. Recently, 300 acres of the Park's eucalyptus forest were designated a Federal Historic site. The Presidio's Forester is currently conducting experiments to find replacement eucalypts that will fulfill historic grove criteria, but not have the negative characteristics of blue gums.

- **In 1886**, Mayor Sutro planted a eucalyptus forest on the top of his Mt. Parnassus property to celebrate Arbor Day. The current 61-acre UCSF preserve has not been thinned or managed with 45,000 trees, suckers, and seedlings totaling 740 stems per acre. Keeping 45,000 trees on 61 acres is preposterous, but a few tree advocates are demanding that the University retain all eucalyptus "trees" regardless of size and spacing. The University has prepared a Draft Forest Management Plan/EIR that is currently under review.

- **In 1888**, Stanford University planted several varieties of eucalyptus and other trees at the new campus. Soon the eucalyptus trees became the focal point of the campus, arboretum, and botanic garden. Stanford's largest eucalyptus trees today range to 200 feet tall with trunk diameters of 4 to 12 feet. Crown diameters are

generally 90 feet or more. Hundreds of Stanford blue gums were lost to the freeze in 1972, and to Australian long-horned beetles in the 1990s. Landscape trees of modest size and native species are being used today in newly developed areas of the campus, and to replace the original, aging blue gum eucalyptus.

- **By 1914**, large scale planting of the miracle eucalyptus tree in the Bay Area was over. No new grand parks needed pioneer trees, homes were heated with oil instead of wood, hardwood lumber was imported by rail, and mayors turned their interests to WWI instead of Arbor Day.

SUCCESSIVE DESCRIPTIONS OF THE BLUE GUM EUCALYPTUS TREE

During the 1850s, returning sea captains bragged about the new miracle trees from Australia. But, we now know that only a few of the 700 uniquely specialized varieties of eucalypts from Australia were able to achieve the glowing descriptions and tree dimensions that braggers seemed to apply to all eucalypts. It was soon clear that eucalyptus trees would thrive in this new land. Many different species of eucalyptus tree seeds made it to the Bay Area, but the ease of propagation, the ease of cultivation, and the extremely rapid growth made the blue gum the tree of choice by early tree planters. The following quotes document the changes in descriptions, and sometime imprudent advocacy for eucalyptus trees over the past 137 years.

(1876) Ellwood Cooper, quoting Baron Ferdinand Von Mueller

"Eucalyptus globulus- the blue gum of Victoria and Tasmania. This tree is of extremely rapid growth, and attains a height of four hundred feet, furnishing a first-class wood. Ship builders get keels of this timber one hundred and twenty feet long; besides this, they use it extensively for planking and many other parts of the ship, and it is considered to be generally superior to American Rock Elm."

(1910) C. H. Sellers, formerly Assistant Forester of California

"It has already been shown that the woods of the various eucalypts form satisfactory substitutes for the Eastern hardwoods, in the manufacture of agricultural implements, vehicle stock, boat ribs, paving house blocks, street curbing, naves and felloes of wheels, piles, posts, poles, railway ties, and for other similar purposes where strength and durability are desired. Owing to the great value of the Eucalyptus for so many uses, no mistake will be made in planting it wherever it will thrive."

"Eucalyptus has gained the reputation of possessing a phenomenal rate of growth. Under favorable conditions, trees in seedling plantations have reached a maximum development of six inches in diameter and sixty-seven feet in height in four years. This represents an average growth of seventeen feet in height per year, though a growth of ten to fifteen feet in height yearly is the general average under favorable conditions."

"The cutover redwood lands of the coast region will some day become the most valuable hardwood producing area of the United States. Growth of Eucalyptus on redwood cutover lands has been demonstrated by several lumber companies. The redwood belt is a natural forest plantation; the second growth redwood will be stimulated by the planting of Eucalyptus."

(1911) The Havens Mahogany Eucalyptus & Land Company Prospectus

"The forests concerned in these pages were planted with a clear understanding of the situation. The company now sees plainly that it possess a source of emolument (profit) higher than the average gold mine- the idea so long associated with California wealth."

"Thereupon, immediately the forests were begun. Grown timber tracts are already in existence; planting has never ceased and last year alone over 500,000 young

eucalypts were planted in furtherance of the projects. All the trees are thriving and vigorous."

"Timber actually arrives at its maturity in the incredibly short period of a decade or two."

"No teak, mahogany, ebony, hickory, or oak was ever tougher, denser, stronger or of more glorious hardness than this swift growing eucalyptus of California."

"A ten years supply would be the total from which the huge building operations of the world could draw were no other trees planted."

(1956) August issue of Sunset Magazine

"The Trees that captured California- Here is the fantastic story of how the giant eucalyptus trees changed the landscape of California. At first, groves were planted for badly needed firewood. A eucalyptus grows fast, and regrows from the stump. Its wood burns hot. Later, ranchers began to plant the big trees in rows to protect crops from winds. And, 50 years ago, California went through its eucalyptus timber boom, spurred by the false notion that these fast-growing trees could supply a new timber industry. No one talks of the eucalyptus as a get-rich tree today, but it has left its enduring mark on the lands. Here are the highlights of its conquest of California…."

(2007) Jared Farmer, California's love-hate relationship with eucalyptus trees

"In retrospect, introducing gums to the Golden State was a beautiful mistake. In certain nature preserves and in certain fire-prone neighborhoods it is worth the effort to remove them or to thin their numbers. But in other places--especially highways, parks, and campuses--the non-native trees have become vital elements of the California scene. This is the only place outside of Australia where eucalypts--like them or not--remind people of home. Their loss would be our loss."

(2013) Cal-IPC California Invasive Plant Council

"Within groves, biological diversity is lost due to displacement of native plant communities and corresponding wildlife habitat. Abundance and diversity of understory vegetation is dependent on stand density. Understory establishment is inhibited by the production of allopathic chemicals and by the physical barrier formed by high volumes of forest debris consisting of bark strips, limbs, and branches. The fuel complex formed by this debris is extremely flammable, and under severe weather conditions could produce drifting burning material with the potential to ignite numerous spot fires. Because ribbon bark is carried away while burning, eucalyptus forests are considered the worst in the world for spreading spot fires. The Oakland hills firestorm was both intense and difficult to control because of the many stands of eucalyptus. Individual trees growing near structures or in public use areas are hazardous because of the potential for branch failure. Stature and growth form are distinctive and unlike native tree species, compromise the visual quality of natural landscapes."

FRANK HAVENS 110 YEAR OLD EUCALYPTUS AND PINE PLANTATIONS

The eucalyptus forests currently owned by East Bay agencies (Park District, UC, EBMUD, Oakland, etc.) can be traced back to Frank Havens and his Mahogany Eucalyptus & Land Company or to the Havens/Smith Realty Syndicate. Havens funded tree projects in the Oakland/Berkeley hills that were significantly different than other Bay Area planting projects. He was a businessman and developer who planted pine, cypress, and eucalyptus plantations for future residential development and for hardwood lumber.

In 1962, Joe Furtado, Havens tree planting foreman in his oral history for the Oakland Garden Club, said "eucalyptus trees were planted to conserve fog drip, to beautify the hills, and for timber." Over an 18-year period beginning in 1895, Furtado and his workers turned 13,000 acres of Realty Syndicate land in the Oakland and Berkeley hills

into pine, cypress, and eucalyptus plantations for future residential development along with 3,000-acres of eucalyptus lumber plantations on Havens private water company land. According to Furtado, Havens thoroughly enjoyed the process of planting his trees, and did not regret financing the largest tree-planting program in the Bay Area. He passed away in 1917, providing little time to enjoy his investment.

Havens timber venture was a complete failure. Havens hope that eucalyptus trees would catch fog drip to increase water supply for his water company accomplished the opposite. Blue gum eucalyptus trees are aggressive summer water users leaving no summer fog drip to replenish the underground water table or provide surplus summer water to reach a storage reservoir. His mountain residential forests were successful in accelerating development of the hills after WWII. New hill residents enjoyed their new mountain homes with views of the Bay. Unfortunately, tall trees soon blocked most Bay views, and eucalypts and pines contributed to significant home loss in the 1923, 1970, 1980, and 1991 fires.

Dense East Bay Hill residential areas with aging pine, cypress, and eucalyptus canopies remain a serious fire hazard, and have currently been placed in the Very High Fire Severity Zone of Cal Fire's statewide fire hazard mapping program. The 1995 Hills Emergency Forum Fire Mitigation Plan, the 2010 Park District Fire Mitigation Plan EIR, and the 2013 FEMA East Bay Hills hazardous Fire Risk Reduction EIS recommended costly treatment or conversion of dense eucalyptus and pine forests. There should be absolutely no confusion or argument about the serious nature of wildfire risks in the East Bay Hills, because the above reports clearly document the problem and offer potential solutions. This paper will therefore not attempt to repeat or summarize the fire hazard mitigation information that has been developed for the East Bay Hills, one of the most studied areas in the state and nation following the 1991 Oakland/Berkeley fire.

THE PARK DISTRICT'S EUCALYPTUS AND MONTEREY PINE TIMELINE

Most of Frank Havens planted eucalyptus trees in today's regional parks have grown into thickets that are recognized fire hazards. The original intent in the Havens plantations was to harvest trees in a decade or two for lumber. His plantations were not harvested or maintained resulting in today's dense, flammable, and unsustainable eucalyptus "jungles" located on parkland or other public lands intermixed with expanding residential areas. WPA and CCC crews planted Monterey pine in Tilden Park before WWII with Park District plantings continuing between 1945 and 1962.

Even though the eucalyptus and pine trees in park forests were planted around the same time, there is a wide range in the current condition and tree details for each grove. Some groves are blue gum and some are red gum. Most groves have dense tree spacing, but a few were thinned in Tilden by WPA crews and have more open spacing. Some groves have heavy ground fuel loading above 50 tons per acre, and some groves have less than 13 tons per acre. Some high ridge groves were killed or seriously damaged by the freeze of 1972, but lower groves were unaffected by the freeze. Some groves have dense thickets of seedlings, and some are primarily large trees with fewer seedlings. Some groves have an understory of grass, brush, and native trees, and some groves are so dense that there is little understory vegetation.

The following timeline describes several of the key events related to eucalyptus and pine plantings in the current chain of Regional Parks between Lake Chabot and Wildcat Canyon.

- **In 1895,** Frank Havens and Borax Smith began planting Realty Syndicate land with pine, cypress, and eucalyptus. By 1910, 13,000 acres of future residential land and 3,000 acres of Peoples Water Company eucalyptus plantations were scattered around the Oakland/Berkeley Hills. In 1916, Havens eucalyptus timber

plantations on watershed lands were sold to the East Bay Water Company, and then in 1928 sold to the East Bay Municipal Water District.

- **In 1923**, the Berkeley Fire started on East Bay Water Company land near todays Inspiration Point in Tilden Park. The fire spread westward across valley grasslands and eucalyptus groves eventually reaching the ridgeline where the wildfire was blown downhill by blustery foehn winds into residential areas, some landscaped with blue gums, where 580 homes were destroyed in two hours.

- **In 1934**, The East Bay Regional Park District was formed to purchase 10,000 acres of surplus EBMUD land for a grand regional park. In 1936, eucalyptus forests at Tilden, Sibley, and Temescal were acquired with 30-year old eucalyptus trees that had never been thinned or maintained. Redwood Park with several eucalyptus and ridgetop Monterey pine groves was added in 1939.

- **In 1937**, The Oakland Tribune reported that the first shipment of redwood seedlings from Ft. Bragg arrived at the Port of Oakland for the first part of a Park District program to remove 200,000 eucalyptus trees and reforest Tilden with redwoods. The District planned to use CCC and WPA workers to clear park eucalyptus and then plant redwood seedlings under the direction of John McLaren, superintendent of Golden Gate Park. McLaren was a volunteer consultant for the Park District until his untimely death in 1943. A few redwoods were planted, but did not survive without summer water, but the eucalyptus trees continued to flourish on the parks dry hillsides.

- **In 1940,** Park District planting programs over the next 25-years added groves of Monterey pine to Tilden's eucalyptus forests and grassy hillsides under the direction of James Roof, District Forester and Botanic Garden Director. In later years, Roof deeply regretted having overseen the planting of Monterey pine and other introduced species in park grasslands replacing the amazing displays of spring wildflowers that are now gone. Trees planted in the '40s are now looking very tired, and should be removed as they decline to release native understory.

- **In 1953** the Park District acquired Chabot Park with its 800-acre 53-year old - eucalyptus forest that had never been thinned or maintained. However, fire and freezing weather impacted several areas of the forest between 1920 and 1950.

- **In 1964**, the Park District leased Lake Chabot from EBMUD with its 100-acre 64-year old eucalyptus forest that had been thinned by the CCC but not maintained.

- **In 1960s,** the Park District developed Kennedy Grove and the Chabot Family Campground under 60-year old eucalyptus trees. Both areas were thinned during development, but trees are now 110 years old with most large trees tagged as hazard trees. These two facilities are used daily by large numbers of park visitors.

- **In 1967**, William Penn Mott Jr., District General Manager, returns from a three-month consultancy in Canberra Australia. Mott reports that the blue gum tree is not favored as a landscape tree in urban Australia, and should be considered a weed tree in East Bay Parks. He also proposed that the Park District import the organism's found under Australian eucalypts to help decompose the high levels of fuel loading found under regional park eucalyptus.

- **In 1970**, 37 homes were lost and 37 damaged when flames starting on Fish Ranch Road spread through brush and over the ridge into pine and eucalyptus

trees and expensive homes in upper Tunnel Canyon and upper Claremont Canyon. The Oakland Tribune reported, "The wind was swirling in every direction. The heat was so great that some houses were exploding before the fire actually reached them."

- **In 1972**, an eleven-day freeze killed or damaged eucalyptus in the high ridge lands of the East Bay Hills. A ridgetop fuelbreak was quickly installed between Chabot and Tilden Parks. The Park District, Water District, University, and the City of Oakland cleared several hundred acres of dead or damaged eucalyptus trees to remove fuel that could contribute to a major wildfire. Unfortunately, stumps were not treatable at this scale, and multiple fast growing sprouts coppiced on each stump. The only registered stump control herbicide at that time was 24D/245T, the discredited Agent Orange chemical of Vietnam era infamy.

- **In 1975**, Roger Fenwick, Australian Fire Consultant, was hired by the District to make recommendations for reducing the significant fire hazard represented by the 800-acre Chabot eucalyptus forest. He recommended use of regular prescribed fire, but for a number of sound reasons, prescribed fire in dense hill eucalyptus forests at the urban intermix remains an idea that has never been tried by cautious fire chiefs and agency administrators. Local experience with fire in eucalyptus groves also indicates that very dense sprouting and new seed germination will follow a fire making the grove even more flammable than before.

- **In 1978**, Proposition #13 resulted in the layoff of two eucalyptus crews (15 park employees) working on fuelbreak and eucalyptus stump control.

- **In 1980**, five homes under a canopy of eucalyptus trees were lost in a fire above Wildcat Canyon Road near the Tilden Merry Go Round. Five area mayors demanded that the District take the lead in developing a new fire hazard reduction plan for the East Bay Hills.

- **In 1982**, the Blue Ribbon Fire Hazard Reduction Report, developed by a committee of experts and chaired by William Penn Mott was completed. It focused on completing the hills ridgetop fuelbreak, and setting fire safety goals for urban I-zone residential areas. A joint agency was recommended in the Report to implement the new fire hazard reduction program, but all agencies decided to proceed on their own. As a result, very few of the Reports recommendations were implemented.

- **In 1983**, work began again on the District's fuelbreak between Chabot and Tilden with a small crew working on stump and sprout control. A year later, the Park District Board, at the unions urging, adopted its first Integrated Pest Management (IPM) policy and program to regulate and reduce the use of pesticides on District lands, and to stem the growing debates about the proper use of chemicals for stump sucker control, weed control, and other pest control efforts.

- **In 1989**, The Park District's Fuel Break Plan, by Ed Leong and Carol Rice was adopted by the Board of Directors to clarify policy and implementation details for the District's 25-mile long fuelbreak along the ridgetop and residential edge of Wildcat Canyon, Tilden, Sibley, Redwood, and Anthony Chabot Parks. The fuelbreak was designed and maintained to assist in ridgetop firefighting during any park fire that could be driven by Northeast winds into residential areas.

- **In 1991**, the Oakland/Berkeley wildfire began at an Oakland wildland urban interface residential area in Tunnel Canyon above Buckingham Road. The 1991

fire to this day remains the most costly single urban wildfire fire in U.S. history. Of the 11,055 people living in the fire area, 25 were killed, 150 injured, and at least 5,000 left homeless. 3,000 homes and 2,000 automobiles were destroyed. 10,000 people were evacuated from the area, the Red Cross answered 3,000 inquiries from concerned family members, and non-profit groups served 100,000 meals. 4,407 families registered for assistance, 1,221 temporary housing grants were issued, 842 individual family grants were issued, and 3,921 Small Business Administration loan applications were filed. The total estimated cost of the fire in 1991 was more than 1.5 billion dollars.

- **In 1992**, the Hills Emergency Forum (HEF) was formed. In 1995 the HEF released the second comprehensive fire mitigation plan for the East Bay Hills with a focus on residential edge fuelbreaks, eucalyptus and pine ember control, and defendable residential areas. Several environmental groups opposed the 1995 Fire Hazard Mitigation Plan because it did not include a CEQA process. The HEF has served as the voluntary entity for agency fire hazard reduction planning and project coordination for the past 21-years.

- **In 1994,** the District retained a contractor (at no cost) for fuelbreak expansion in Chabot along Skyline Boulevard, and to clear six internal fuelbreaks to compartmentalize the grove for use of prescribed fire under the Fenwick Plan. Two areas of the large Chabot grove were also thinned, all in accordance with the Parks 1980 Land Use Plan/EIR, but stump sucker control was erratic.

- **In 1996**, The Australian long-horned beetle made its way into park eucalyptus forests at Pt. Pinole and Ardenwood. Thousands of trees were lost before the District funded $75,000 to introduce a South African stingless wasp under the direction of UC Riverside entomologists that would effectively parasitize long-horned beetle eggs to prevent further loss of park trees.

- **In 2003**, Federal Emergency Management Agency (FEMA) after five years of work approved an Environmental Assessment for Regional Park fire hazard reduction projects that included removal of eucalyptus suckers and conversion to native understory. Funding was provided by a $500,000 FEMA grant and a $500,000 Park District match.

- **In 2004**, Park District Measure CC passed by Zone One voters provided $1,000,000 for a comprehensive District Fire Hazard Mitigation Plan and CEQA process for Parks from Lake Chabot to Wildcat Canyon. $9,000,000 was also included for fire hazard reduction projects. The environmental community supported both Measure CC and the 2010 Park District Fire Hazard Reduction Plan EIR.

- **In 2010**, the Park District approved its first multi-park fire hazard mitigation plan that identified 144 polygons requiring treatment and ongoing management. The new Plan/EIR covered 1,500 acres of shrubland thinning or conversion, 1,500 acres of eucalyptus and pine thinning or conversion, and 600 acres of strategic fire roadside vegetation management between Lake Chabot Park and Wildcat Canyon Park. The Hills Conservation Network sued, but eventually settled.

- **In 2013**, after nine years of hard work and at considerable cost, FEMA completed a Draft Hazardous Fire Risk Reduction Environmental Impact Statement (EIS) for the East Bay Hills with public hearings completed in May. Work on projects can begin only after adoption of the EIS, and release of several million dollars in grants.

THE BAY AREA MEDITERRANEAN CLIMATE

The East Bay Hills, San Francisco Peninsula, and the Marin Headlands surround the Bay and are all exposed to coastal winds from the West and to periodic strong interior winds from the East. This area's native plant communities were repeatedly subjected to cool winter rain, dry summers, variable winds, regular "cool" Indian burning, and periodic wind driven wildfire. As a result, the Bay Area's Franciscan flora was remarkably grassy, floristically diverse, and spectacular. Trees were modest with riparian vegetation along streams, and with native shrubs, oak, and bay woodlands grouped in ravines and along the North and East side of the hills. A few redwood forests were scattered around the perimeter of the region in protected locations.

The native vegetation of the East Bay Hills in 1740 was amazingly beautiful, especially the native grasslands and the diversity of wildflower displays depicted in the above painting at Inspiration Point by Laura Cunningham in consultation with Steve Edwards, Tilden Botanic Garden Director.

Very little of today's East Bay Hill wildland vegetation is pristine because of the dramatic landscape changes that have occurred over the past 270 years. Returning to the vegetation of 1740 on a large scale is not realistic or even remotely possible with today's East Bay population of 2.5 million resident's, the extensive changes in hill development and land use, the introduced "exotic" grasslands that have replaced pristine flora in the hills, and the ongoing native plant succession that is moving grasslands and shrublands toward bay/oak woodland. But, efforts to re-establish sustainable relic grasslands should be part of ongoing park vegetation management efforts instead of creating fields of exotic weeds that require annual maintenance and annual goat grazing.

Existing native plant communities are the result of the unique and complex history of plant species and habitat evolution in this geographical area. Most of today's East Bay Hill public land vegetation (by counting numbers of species represented in that vegetation) is composed of "truly native" species. However, most of the plant communities, in their current locations and size, are relatively young, growing more densely, and will continue to change. As change occurs, today's natively-evolved local species and their tendencies to aggregate into recognized "native habitats" can persist very well if allowed and assisted by dedicated land managers. Invasive weeds like French Broom, oblong spurge, and other exotics have increased fire risks, and invaded

areas that should be occupied by native flora along trails and other disturbed areas and will require more active control than has occurred in the past.

The above native plant communities will indeed not remain static. During the next 200 years, many grass and shrub areas that are not grazed or affected by repeated fires will go through stages of succession with increased density and flammability, and reach their climax stage as a relatively fire safe bay/oak woodland. California bay will likely be the dominant tree species at climax.

The 2006 survey of vegetation for Hill Regional Parks between Lake Chabot and Wildcat Canyon tell us what general categories of vegetation exist today in Regional Parks, and by example for other wildland areas in the hills that have not been recently surveyed.

A. Species native to the East Bay Hills, in self-sufficient ecological communities.

Plant community	acres	percent
Oak/Bay Woodland	3,675	27%
Woodland Succession	2,440	18%
Grassland (Mostly grazed introduced grasses)	1,688	12%
Shrubland	1,505	11%
Shrub Succession	1,023	8%
Redwood Forest	474	3%
Willow	110	1%
Bay Woodland	91	1%
Riparian/Wetland	30	.2%
Native Subtotal	11,036	82%

B. Planted or introduced species (dominated by a single species- a monoculture).

Plant community	acres	percent
Eucalyptus Forests	1,862	14%
Pine Forests	341	3%
Mixed Eucalyptus and Conifer Forests	185	1%
Acacia	5	.03%
Non-native Subtotal	2,393	18%

All of the East Bay Hill fire hazard reduction reports have found that native flora (group A plant communities above) do not require active management except when flame lengths are above 8 feet within 200 feet of homes at the wildland urban interface where expanded defensible space is required to aid firefighting forces protect structures. The 1995 HEF and the 2010 EBRPD fire hazard mitigation plans also document the fact that almost all vegetation will burn, often with flames above 8 feet, but that residential interface fuel management in designed and maintained fuelbreaks will be most effective on ridgelines and at the wildland/residential interface where access is possible and where fire fighting is most likely to occur.

PLANTED NON-NATIVE VS. NATURAL NATIVE VEGETATION

All of this areas recent fire hazard reduction reports have found that dense eucalyptus and pine forests (group B plant communities above) are potential fire hazards requiring active and costly management or conversion to less risky native species.

The 1995 East Bay Hills Emergency Forum Fire Hazard Reduction Plan recommended thinning or removal of East Bay Hill agency eucalyptus forests and removal of all 1972-freeze stump sprouts (mistakenly called 20-year old trees) and new seedlings. The 2010 Park District's adopted Fire Hazard Mitigation Plan and EIR recommended 20 to 25-foot spacing (100 trees per acre) for eucalyptus and pine trees, and 30-foot spacing for mature eucalyptus trees (50 trees per acre), and conversion of ridge top and residential edge eucalyptus trees (mostly 1972 freeze suckers) to native vegetation. Well-planned

conversion projects should remove introduced monocultures, and then assist the understory native plant community to expand and blend into adjacent natural areas.

In this context both exotic and non-native are the appropriate descriptions for Havens eucalyptus trees from the Island of Tasmania Australia, and for pines and cypress from the coastal regions of central California. They carry broadly significant meaning in terms of fire hazard as well as the impacts these species have created and continue to present to the locally evolved native biodiversity. It is not sufficient to consider these species as isolated occupants of the land. They each have negative impacts that must be factored into any equation regarding fire hazard reduction, and protection and preservation of native resources in areas of locally diminished open space acreage.

The 2013 Park District's Master Plan includes the following carefully worded policies:

> "Management of exotic eucalyptus and pine plantations to reduce fire risks is necessary and appropriate. While conversion from eucalyptus or pine to native habitat will not be accomplished easily, transition to a grassland/brush mix, oak/bay woodland or other appropriate native, plant community is a long-term goal".
>
> "The District will evaluate eucalyptus, pine and cypress plantations, and shrubland or woodland areas occurring along the wildland/urban interface on a case-by-case basis for thinning, removal, and/or conversion to a less fire-prone condition".

EUCALYPTUS TREE SIZE AND DENSITY

During the pioneer era, experienced gardeners thinned tall trees that were planted in parks or on university campus's to achieve a romantic landscape that would result in well-spaced trees of 25 to 50 trees per acre and cleared competition around a solitary tree. However, eucalypts that were planted for lumber on watershed lands or at Arbor Day projects on lands without a maintenance staff grew into dense thickets of old trees surrounded by seedlings and sprouts that could range from 400 to 900 stems per acre.

The original intent in lumber plantations was to plant on nine to twelve-foot centers, and then to harvest trees in a decade or two for lumber. Unfortunately, the plantations were not harvested or thinned resulting in today's dense and unsustainable eucalyptus "jungles". Density is a measurable attribute of a stand. Stand density is a measure for how much of a site is being used, and the intensity of competition between trees for the site's resources (i.e., water, light, nutrients, space).

At higher densities with larger trees, the growth rates of individual trees slow down because there are more trees competing for the site's limited resources. Tree density is not a matter for a public vote, and should be left to the individuals responsible for the health and safety of a woodland or forest. Thinning is also required at several stages in a forest or woodland as trees age and need to occupy larger spaces.

As an example, the Vegetation Management Plan for the Presidio includes the following statement on tree density.

> "In the experience of managers of Golden Gate Park, tree vigor is highest where mature tree density is between 30 and 50 trees per acre. When density is above 100 trees per acre, stand vigor decreases (State of California 1980). While site conditions and tree species planted differ somewhat between the forests of Golden Gate Park and the Presidio, it can be assumed that a much lower mature tree density (100 trees per acre or fewer) would be beneficial to the health and vigor of the Presidio forest of the future. "

Unfortunately, there are no published standards for sequential spacing of California eucalypts as trees are initially thinned and then grow to larger trees. However, the Queensland Forest Association Inc. recommends the following eucalyptus tree spacing for healthy hardwood forests.

Diameter of tree in inches	Spacing between trees	Number of trees/acre
4-8 inches	24' x 24'	72
8-16 inches	32' x 32'	40
16-24 inches	39' x 39'	28
24-32 inches	49' x 49'	18

THE BLUE GUM EUCALYPTUS AND MONTEREY PINE FIRE HAZARD

The blue gum eucalyptus tree and forest evolved in Tasmania and South East Australia to survive fire and spread fire. Blue gums are large trees with shredding bark and leaves susceptible to lofting and ember spotting that evolved in Australia to survive fire and also spread fire as a means of encroachment and invasion into adjacent areas. Tree height is often above 150 feet making crown fires extremely dangerous. The ever-present Monterey pine is also a flammable tree that is resinous, sheds needles, has low-hanging branches and dense foliage, and can retain dried needles. In a wind driven fire, flames in both species can reach 100 feet above forest treetops, and throw burning embers a half-mile or more in our steep and windy hills. Significant reduction of blue gum and pine forest fuel, and making homes ember resistant and defendable is absolutely mandatory to reduce fall wildfire risks in the hills.

In Australia, where eucalyptus occurs naturally, the most widely used fire hazard reduction program involves the application of prescribed fire on a five or ten year cycle. This is a controversial program in suburban areas and even more so in relatively remote parks. Australia has been burning its forests for the past 80 years, but major fires still occur with devastating results.

In the East Bay, blue gum eucalyptus and Monterey pine trees typically reach 100 feet or more in height and are characteristically found in the hills as un-maintained, debris-filled, highly flammable groves. Diablo winds are likely to fan ground fires into the tree crowns thereby creating the type of wildfire that can be impossible to control and that throws burning fire brands and embers into vegetation on lower slopes and into unprepared residential areas, igniting homes and significantly reducing evacuation time for residents.

Crown fire is the most severe version of fire in eucalyptus, yet local fire fighters cannot be expected to control even a ground fire during a wind-driven fire on steep terrain and ridge tops where most eucalyptus and pine trees have been planted. In most locations along hillsides, there will be few locations where fire fighters will have safe access to attempt to control a wind driven fire under tall trees. In the autumn, when hot dry conditions tend to prevail throughout the hill area, a 30 to 50-mile-an-hour Diablo wind can easily enable a wildfire to enter a dense eucalyptus or pine grove where it would be likely to spread, involve many acres, and continue to burn for a long time. Such a situation is apt to create a monster convection column that has the ability to elevate leaves, twigs, ribbon bark, and even whole branches into the fire column. Under such conditions, flame length can reach 60 to 100 feet above the treetops. Long ribbons of eucalyptus bark ignite and continue to burn as they soar high up in the convection column. Shaped like a box kite in cross section, these ribbons of eucalyptus bark can travel long distances and continue to burn until they fall to earth and cause new ignitions.

During the past 70-years, the Park District, several area agencies, and private land owners have acquired property from Havens successors, and have not had to worry about the increasing cost and liability of growing flammable trees in parks, wildlands, or within residential areas. However, there is now agreement that unmanaged eucalyptus and pine forests with high fuel loads are fire-prone, and require ongoing management, or that they should be converted to other less costly and less dangerous native species. Making 3,000 acres of dense blue gum eucalyptus and pine forests fire-safe in the East Bay's steep and windy hills is not feasible or sustainable given current agency budgets. Agencies will need significant new grant and tax funding to support this work with funds earmarked solely for this purpose.

EUCALYPTUS FLAMMABILITY BASED ON FUEL, LEAF OIL, AND BARK

The following selected quotes are from Carol Rice's excellent article *The Science Behind Eucalyptus Fire Hazards*, in the Claremont Canyon Conservancy Spring 2013 Newsletter. See the Conservancy website for the complete article.

"Eucalypts are big plants. They produce a lot of fuel load. Ignoring the trunks and larger branches, there is still a lot of volume in the tree's foliage, bark and debris. Fuel loads measured in Sibley Preserve, Angel Island and Golden Gate National Recreation Area range from 29-50 tons/acre. By comparison, grasslands range from 1-5 tons/acre; north coastal scrub rarely exceeds 5 tons/acre, eucalyptus stands have a quantum level more volume of fuel to burn."

"Eucalyptus branches, leaves, and bark slough off in long pieces that end up draped on one another, creating a near optimum mixture of oxygen and fuel. This fluffy arrangement provides a "goldilocks situation:" not too dense and not too airy, but one that provides close enough contact for the fire to burn and transfer heat easily to the next particle. The stringy bark of Eucalyptus globulus is an unusual aspect of trees in the East Bay because bark provides yet another way for fire to climb into the tree canopy."
"Eucalyptus leaves contain enough oils to be sold as a product. Oils have approximately three times the energy as cellulose, so it burns hotter. The leaves of blue gum eucalyptus also release a number of terpenes and phenolic acids. The volatiles are important because they are released as flammable gases at lower temperatures, and ignite more easily. Keep in mind that combustion is the burning of gases just outside the solid material—volatiles act as catalysts, and eucalyptus has more of them. Studies of eucalyptus's crude fat content find that it ranges from about 10-20% of its dry weight (whereas tropical leaves typically have about 3%); this was the highest percentage found of all plant sources measured, even higher than chamise (also called "greasewood")."

“When eucalyptus trees ignite, they can distribute embers long distances. Embers were a major source of structure ignition, as determined by evaluations of losses in recent fires. The distance embers can spread to start new fires is affected by the height of the tree, its position on the slope, and roughly, the shape and size of the particle. Eucalyptus is a tall tree and is often located high on the slope, promoting long ember cast. The leaves, bark or other particles are thin enough to be lifted but large or long enough to be still burning when they land.”

“Australia’s new fuel assessment features a prediction of spotting distance, based on bark type, and routinely predicts a distance of three miles or more when the trees have ribbon bark like Eucalyptus globulus.”

THE FREEZE OF 1972- LOGGING, CURRENT SUCKERS, AND NATIVES

James Roof, Director of the Tilden Botanic Garden described the 1972 freeze in this way.

> “In the period December 5-15, 1972 an almost unprecedented weather front moved upon the Bay Area. The front was caused by unusual weather conditions to the east of California. In normal years there is a winter high-pressure ridge that holds over the mid-continental Rocky Mountains. That ridge channels arctic air down through Montana, Idaho, Nevada, and Utah. The cold air is warded off from most of California by the Sierra Nevada. In December of 1972 the Rocky Mountain high shifted to the westward, creating a wall that channeled cold, dry air from the arctic down west of the Sierra and along this state’s Pacific coastline. That flow of air in turn shoved the coast’s usual low -pressure trough out into the ocean, blocking out the Pacific storm system that generally warms the California seaboard through the worst of winter. The arctic airflow maintained its grip on coastal areas for eleven days. It began moving over the Bay Area on December fifth, reached its lowest temperatures from December ninth to December eleventh, and did not relax its hold until the early morning of December seventeenth.”
>
> “The sub-freezing temperatures of December 1972 bit and then held their grip on the sub-tropical tree species for eleven days, allowing them little chance for recuperation. For many of the smaller trees the bite appears to have been fatal. No local native plant species were even slightly damaged by the low temperatures.”

Aerial photographs using color and color-infrared techniques were taken on February 15, 1973. The total acreage with severely affected crown canopy was determined to be 2,745 acres within the following jurisdictional boundaries: 1,500 EBRPD, 600 City of Oakland, 260 UC Berkeley, 255 EBMUD, 80 City of El Cerrito, and 50 City of Berkeley. Flammable ground fuel in affected areas averaged 42.6 tons per acre (117,000 tons total for 2,745 acres).

Cold snaps featuring persistent sub-freezing temperatures occurred in 1922, 1932, 1949, 1972, and 1991. After the 1972 freeze and eleven straight days of night temperatures below 30 degrees, thousands of high elevation eucalyptus trees were dead and standing, yet some trees began sprouting new leaves from epicormic buds.

Local agencies and forestry experts felt they were dealing with a major increase in eucalyptus tree fire hazard, and appealed to State and Federal agencies for funding to remove the hazard. In response, Governor Ronald Reagan declared a State of Emergency to make federal funds available for fire hazard reduction work. Expenditures by local public agencies dealing with this emergency exceeded $7 million.

A federal grant provided $1.3 million to create a 25-mile-long fuel break on public land between Anthony Chabot Regional Park and Tilden Regional Park, and the new fuelbreak was quickly installed. The Park District, EBMUD, and University used no-cost logging contractors to remove dead or damaged trees along with branches, bark, leaves, and other flammable debris that fell to the ground. The University cleared 400 acres of freeze-damaged trees in Strawberry and Claremont Canyons. The Park District cleared 400 acres of freeze-damaged trees in Tilden, Sibley, and Chabot Regional Parks. EBMUD cleared eucalyptus trees in Siesta Valley and Claremont Canyon. Usable tree material was transported to Crown Zellerback Corporation in Antioch where it was chipped and used in paper production.

The above photo was taken at the Tilden Golf Course from the 17th Tee around 1975. It shows large eucalyptus trees that were eventually removed because of the freeze, and cleared hillside eucalyptus that froze and were removed with coppiced suckers growing from stumps.

Unfortunately stumps were not treatable after the no-cost contracts, and suckers began to sprout vigorously sending up new fast-growing multiple stems. Within a few years the new stems, typically four to ten per stump grew into very tall, dense canopies. Coppiced groves were also full of leaves, branches, and long strands of bark, and are a more dangerous fire hazard than ever before. Fast-growing eucalyptus suckers served as a "nurse species" for the slower growing understory of native shrubs and oak, bay, buckeye, elderberry and big-leaf maple that would provide a more diverse and fire-safe environment if allowed to mature without being overtopped by the eucalyptus. After 1972 freeze suckers (mistakenly called 20-year old trees in the 1995 HEF Plan, and thinned eucalyptus in the Park District 2006 vegetation survey) are removed, the well-developed understory native trees and shrubs will flourish requiring only invasive weed control. After five to ten years of conversion, maintenance costs will be minimal.

FUEL LOADS. HAND REMOVAL OR PRESCRIBED FIRE?

In recent years there has been growing agreement that unmanaged eucalyptus groves with high fuel loads are fire-prone and either need costly, ongoing management or

conversion to natives to reduce flammability. Excessive eucalyptus fuel loads on the forest floor and fuel ladders to their high crown mean that eucalyptus groves on steep hillsides will be extremely flammable under any summer or fall Diablo Wind condition making control of a moving flame front impossible until the winds stop, with serious ember spotting into adjacent neighborhoods.

Based on the Australian system of burning to keep fuel loads below 6 tons per acre in wildland areas and 2 tons per acre near homes, one might conclude that use of prescribed fire is the only feasible means for keeping large-scale eucalyptus groves safe. Yet the practicality, cost, smoke and other environmental impacts of removing several tons of fuel every five years under hill eucalyptus groves using prescribed fire, mechanical means, or other method remains rather mind-boggling, especially on steep hillsides.

Reluctance to use prescribed fire in the Oakland/Berkeley Hills is not only about the risk of a fire escape near an urban area, the risks of impacting air quality, the significant costs and the lack of fire crews trained and experienced in the use of this technique in groves near residential areas, and the narrow climate window for use of prescribed fire on steep hillsides. Reluctance is based on all of the above in combination with the unique characteristics of local eucalyptus groves. Blue gum groves in the Oakland/Berkeley Hills are apparently more flammable than groves of the same or similar varieties of eucalyptus near Victoria, Sydney, or Tasmania Australia where prescribed fire is often used, but remains controversial. East Bay fuel loads exhibit a range of 13 to 50 tons of flammable fuel under studied eucalyptus groves in the Bay Area while fuel loads range between 2 to 14 tons for eucalyptus forest species in Australia.

American fire behavior models (developed for softwood forests and extrapolated for use in local eucalyptus groves) use 12 tons per acre for East Bay eucalyptus to predict flame lengths of 8 to 20 feet. Australian fire behavior models developed for eucalyptus hard wood forests use 12 tons per acre to predict flame lengths of 60 to 100 feet. Roger Fenwick, Australian Forester and Bushfire Consultant with 39 years of experience says: “If your fuel model predicts 8’ to 20’ flame lengths in a eucalyptus grove? I’d like to see that! It’d do those numbers in meters on an average day. On a bad fire day, flames would be way over that. Like, 20m (60 feet) over the tops of the trees, not above ground.”

It may be a fact of life that if prescribed fire can’t be used in the East Bay to keep eucalyptus forests fire-safe because of risk, costs, environmental impacts, and smoke; then blue gum forests will always be unsafe near residential areas.

DIABLO WINDS

Under normal conditions, fires that start in the hills are efficiently controlled by firefighters, and do not usually reach residential areas. During most of the year, temperatures are moderate and vegetation is relatively moist and fire-safe. Summers bring overnight and morning fog along the hills until noon, with moist mid-day winds blowing westerly in from the coast. Westerly winds can fan flames in a fire almost anytime during the summer or fall, but embers from a park fire would be carried in an easterly direction away from most residential areas.

However, there are a few days each year when all of the conditions are in place for extreme wildfire behavior. These red-flag periods usually occur for a few days each year during the months of August through November. During these periodic extreme weather episodes, park vegetation will experience a “perfect fire storm condition” with unusually hot temperatures above 90 degrees, humidity below 12 percent, and strong Diablo Winds blowing from the Northeast. Diablo winds then race over high ridge tops and

down leeward, west facing, slopes into densely populated residential areas. Any fire involving a eucalyptus forest under these conditions could produce millions of burning embers and firebrands that could blow over fuelbreaks and other cleared areas and then drop to ignite unprepared homes and landscapes, and reduce evacuation time for fleeing residents.

The science and capability for fighting large-scale wildland forest fires is advancing at the national level, but forest fires are growing larger, more costly to control, and are beginning to involve more and more residences that have moved into forested wildlands. The science and capability for fighting Diablo wind urban wildfire continues to be questionable. Local fire departments are not equipped to quickly stop a wind driven fire in our steep and often inaccessible hills. Experienced fire fighters will not attempt a head-on attack a 40-mile per hour urban wildfire until the winds slow. Yet, there is total confusion and controversy at the local level about how to reduce fire hazards created by dense residential areas and dense forests of eucalyptus and pine groves. Unfortunately, the ongoing controversy feeds the confusion and impedes political action.

TRENDS IN BLUE GUM PESTS AND DISEASES

Blue gum pests and pathogens did not arrive along with the eucalyptus seeds brought to California in the 1800s. However, the Eucalyptus long-horned borer in the 1990s, and now other pests have begun to arrive and to cause significant and increasing damage. Almost every blue gum tree in East Bay Hills is currently experiencing leaf damage by the Australian tortoise beetle that may possibly weaken trees enough for the next beetle, weevil, freeze, or drought to do more serious damage. The following quoted paragraphs are from a peer-reviewed research article UC scientists apply IPM techniques to new eucalyptus pests.

"Eucalyptus had virtually no insect pests or diseases for almost a century and a half in California. When the first pests were detected, it was possible to develop pest management strategies directed toward individual pest species, and often with a single effective tactic. However, California now has accumulated a community of at least three feeding guilds of insects, including borers, defoliators and sap-feeding insects. Individual pest species can no longer be managed in isolation. Instead, integrated pest management strategies must take into consideration the entire complex of insect herbivores."

"For example, when there were no leaf or sap-feeding pests, management of tree stress to reduce risk of infestation by a single borer species was relatively simple. Now, there are at least two important defoliators and two damaging fluid feeders that apply additional stress to trees, and this stress cannot be mitigated simply by proper irrigation. Furthermore, management options, particularly pesticide applications or cultural practices, aimed at one pest species may exacerbate problems with another species."

OPINION'S ABOUT EUCALYPTUS TREES ARE "ALL OVER THE PLACE"

The public during each controversial tree project has been inundated with conflicting information about eucalyptus trees by blogs, tweets, short media articles, TV broadcasts using 'sound bites", background material for public meetings, and by 3,000 page Draft Plans and Environmental documents. To be clear, the eucalyptus dilemma today is about giant blue gums, and not about the large and impressive catalog of eucalypts native to Australia. There are more than 700 species of beautiful eucalypts with many used successfully for urban landscaping purposes in the Bay Area. One should not allow the debates about the very large and expensive blue gum eucalyptus tree to influence how other smaller eucalypt varieties might be used to enrich the urban landscape.

Testimony favors everything but a clear direction

The testimony at UCSF's public hearing for its 61-acre Mt. Parnassus Draft Forest Management Plan and Environmental Impact Report is typical for meetings of this type. People love the forest, and the unexpected wildness in the heart of the city. People spoke to the sense of wonder and magic, even a sense of emotional and spiritual connection. They recalled childhood games in the forest, decades ago. Some spoke of the wildlife in the forest habitat.

Some were concerned about the extent of the planned tree cutting, though they wouldn't have objected to removing a few selected trees as part of a management plan. People objected to UCSF changing its no-pesticides policy on Mount Sutro. They were unconvinced by the DEIR's promise to use herbicides in small quantities; once it started, usage might expand. Some strongly preferred the zero-pesticide solution.

There were mixed views on the reality of the fire hazard. Others felt that there was indeed a fire hazard. Some addressed potential adverse effects of the planned felling, including the likelihood of rockslides as the root systems died, and the increased wind on all sides of the mountain. Some noted the effect that cutting down thousands of trees would have on pollution and on carbon sequestration, especially in the context of global warming. "Every tree counts," said several speakers. Opinions were divided on whether management is needed, and if so, how much. Some consider the forest self-regulating, and want it left alone. Others believe it needs aggressive management, and they support UCSF's plan

Many noted that it's not right to dismiss eucalyptus trees for being non-native; we are all non-native, as are the buildings. The DEIR doesn't consider the cumulative actions of cutting down thousands of trees, when SF Recreation and Parks Dept. is also felling thousands of trees, both as part of the Native Areas Program and tree-removal for other reasons, as is the Golden Gate National Recreation Area.

Letting Nature Take Its Course" favors invasive species

I am always amazed when people urge the Park District to "let nature take its own course" after 150 years of human impacts have already changed natural areas with further invasions of exotic weeds sure to come. Another version is "we should accept new plant immigrants, and the effort to remove exotics is a form of gardening that just doesn't work." Both positions favor invasive and often very flammable species that threaten the survival and integrity of park native wildlands as well as the safety of adjacent residential neighborhoods.

Agencies, like the Park District, are created to manage parkland using appropriate science-based resource management policies and environmental principles, and at the same time to provide for public use. The Park District Board, each decade, updates its Master Plan to adopt policies that include how the agency will balance resources values, recreational opportunities, and neighborhood safety, in the context of economic reality for the agency. Appropriately, Park District policies continue to favor native species, recognizing that significant restoration work is ahead and that it will not be easy.

The San Francisco Bay Chapter of the Sierra Club, the East Bay Chapter of the California Native Plant Society, and the Golden Gate Audubon Society, urged East Bay agencies to base their fire hazard reduction plans on "the twin goals of reducing the risk of catastrophic fire and maintaining the fragile native habitat found in the wildland/urban interface". They agreed that 'there is a frightening wildfire potential each fall for some residents living in the East Bay Hills, and that "plans should integrate natural resource sciences and fire science." Their 29-page Green Paper also emphasized the differences between self-sufficient native plant communities and monocultures that are dominated by planted or invasive species.

THINNING AND STUMP CONTROL

Thinning a mature forest is a relatively inexpensive first step on the long road of owning and being responsible for large numbers of high-risk flammable trees near residential areas. Thinning trees, removal of understory brush, control of poison oak, and routine removal of ground fuel will be required to make the grove maintainable and theoretically safe while attempting to keep fires on the ground. However, groves managed in this way will become dead-end monocultures with little chance of introducing other long-term tree species to become the replacement woodland. For areas where a blue gum forest is the desired long-term tree, hazardous trees would need to be individually removed, at $2,000 to $4,000 each, with small and medium eucalyptus trees selectively retained to achieve a multi-aged eucalyptus forest.

Thinning blue gum eucalyptus is just the first step in creating a realistic tree density, and achieving a reasonable level of fire hazard reduction in a dense eucalyptus forest. Unless stumps are treated within minutes of being cut, multiple stems will eventually sprout producing several sucker "trees" where only one existed previously.

For many years sucker control was an exercise in futility. The District used a variety of herbicides with mixed results. However, results improved significantly when Triclopyr (Garlon) was registered by the State for stump control and included as an approved chemical at the Park District. Garlon is now used successfully for treating stumps. All applications are carefully applied to each stump's cambium layer by licensed park staff or licensed contractors.

A REALITY CHECK ABOUT BLUE GUMS, MONTEREY PINE, AND THE URBAN MIX

It is clear that Park District officials understood from the very beginning that Tilden Park's eucalyptus timber plantations were going to be a problem. It would be a mistake to think that the public was aware of a problem, or that every generation of park managers and board members were aware of a eucalyptus or pine tree problem that they needed to solve. Eucalyptus and pine forests provided welcomed trees, habit for wildlife, shade, and enjoyment for park visitors.

However, the 1991 Oakland/Berkeley fire caused a paradigm shift in our understanding of extreme wildfire behavior in the hills, along with a re-discovery of the role that dense residential areas, eucalyptus, pine, and native wildlands would play again in future fires. Fire records for the East Bay Hills are sketchy, yet newspaper clips and old fire planning studies document an active and dangerous fire history that was topped by the **1**,520 acres and 3,000 homes that burned during the 1991 fire. It was called the fire of the future, a classic urban/wildland mix fire with 653 acres (43%) involving residential areas on steep hillsides often landscaped with pine, eucalyptus, and other tall trees, 465 acres (31%) involving eucalyptus and pine trees, and 402 acres (26%) involving scattered mosaics of grass, shrubs, and native woodland trees.

When it comes to eucalyptus and pine trees, it has not been easy for the public to view trees as either a wildfire or liability problem because of the beauty of a park or forest. However, pioneer blue gum eucalyptus and other trees that were selected in the 1800s are rarely used today in developed urban areas or in areas with mature landscapes. As a general rule, agencies are moving toward native species, more "friendly" eucalypts, or smaller landscape scale trees as replacements for aging pioneer trees that have become too large, are facing growing pest problems, are costly to remove, and are often viewed as increasing liabilities.

The Park District and other agencies growing large numbers of aging blue gum trees will soon find that meager funding for tree care and maintenance will be insufficient as trees reach "the age of unacceptable risk" and " the age of failure." Blue gum eucalypts, because of their size, create a special dilemma for agencies. Very large blue gum trees

have no economic value to help in covering removal costs, and very large trees are beloved by the public who will lobby to save every tree possible.

Retaining large high-risk trees that exhibit failure tendencies forces a public agency or landowner to hope that no one will ever be injured or killed by the retained tree if it fails. It's commonly called "betting not to lose". The "bet" can be safeguarded to some extent by following the advice of science-based arborists or other tree experts, but the agency, landowner, or individual involved in the "bet" will remain responsible and should expect a lawsuit if they are negligent or have deep pockets.

Many pioneer blue gums have already been removed, presumably for cause, but a few 140-year old blue gum trees remain on campuses and parks to be monitored for performance during their final years. I recently visited several Bay Area pioneer-planting projects, but observed not a single blue gum that will reach 400 feet tall and 300 years of age. There will obviously be a few giants, but California blue gum descriptions should be for trees that are 150 to 200 feet tall, and 130 to 150 +/- years of safe/viable age. Maximum tree diameters should be for 3 to 5 feet for trees in groves, and 5 to 12 feet for solitary trees. Of course, individual tree, forest age, and tree size will vary based on overall health, actual site conditions, resistance to increasing pests and pathogens, and the potential for an entire forest to be classified as a fire hazard and thinned or converted to another type of vegetation.

HILL RESIDENTS AND CITIES MUST DO THEIR PART

Mitigating and living with fire in the East Bay Hills involves more than reducing eucalyptus and pine fire hazards. Hill fire-safety begins with a clear strategy for protecting people and homes.

- Wildfires during extreme Diablo wind weather can move quickly and may not be totally controlled by firefighters until the winds slow. Incident commanders with experience in suppressing large fires at the Wildland Urban Interface should lead firefighting efforts using tactics based on pre-attack plans and not free-lance firefighting.

- Since extreme wind fires move fast, evacuations and strategic firefighting must not be unplanned or uncoordinated events. Police Departments should preplan and execute evacuations as firefighters minimize fire spread and eventually achieve full control at the earliest feasible time.

- Homes and hill residential areas must meet fire and ember resistant standards. This is the essential missing homeowner and regulatory action needed to reduce future home losses in the hills, and to give firefighters a reasonable chance to control and eventually stop wildfires that originate in or reach residential areas. Densely placed homes are the most flammable fuel in the East Bay hills, far exceeding the fuel load and flammability of wildland areas.

- An estimate of the heat release rate during a house fire in the 1991 Oakland and Berkeley Hill fire was made by Trelles (1995) and by Trelles and Pagni (1997). According to these estimates, "a house burns at a peak rate of 45 MW (45 million watts) for 1 hour yielding about 160 GJ (1 gigajoule equals 947,817 BTU), and then dies down over another 6-hour period. The die-down of the fire is approximated as two steps, one 10 MW for 3 hours and the last as 5 MW for 3 more hours. The total burn time is 7 hours, and the total energy released by the house is 324 GJ. If, as assumed also, there is brush around each house that releases another 5 MW for one hour, then an additional 18 GJ of energy will be released."

- It is an illusion to believe that home safety can ever be achieved in the hills by dealing only with wildland fuels. The following quote is from *Home survival in*

Wildfire-Prone Areas: Building Materials and Design Considerations-UC Publication 8393, May 2010.

"A wildfire-safe home must be an ember-ignition-resistant home, so that even if the flames do not reach the home, it will be able to with-stand the exposure to embers that may have been blown a mile or more in front of a wildfire. To provide maximum wildfire protection for a home, a combination of near-home vegetation management, appropriate building materials, and related design features must be used. Preparing and maintaining adequate defensible space will guard against flame contact and radiant exposures from nearby vegetation, but because of the likely ember exposure to a home during a wildfire, homeowners cannot ignore building material and design considerations. Similarly, if a homeowner ignores defensible space (i.e., does not have it or does not maintain it), the wildfire will produce maximum ember, flame, and radiant exposures to a home. It is very unlikely that even hardened buildings can survive such exposure, as a weak link will likely exist somewhere in the building enclosure"

The high-density residential fuel issue is the crucial unaddressed fire mitigation step that would have lasting benefit for homeowners and agency firefighters. Allowing homeowners to feel their homes might survive or be protected without making the appropriate investments for retrofitting homes to eliminate ember, flame, and radiant exposure would be indefensible if another 3,000 unprepared $600,000 to $3,000,000 homes are lost in the next major wildfire. Adopting standards for just new construction will not solve the home fire loss problem in high-risk areas dominated by 50 to 70-year old homes.

Wind driven wildfire in the hills will automatically result in the evacuation of residents leaving most homes unguarded. There are no guarantees offered by making a home fire resistant. However, if a home is vulnerable to radiant heat, flames, burning firebrands, and has no defensible space, it means that a crew of firefighters and the home would be totally defenseless in a wildfire. Then random luck will provide the only chance for home survival.

Cities must find a way to require effective defensible space and enforce home retrofitting standards that will give homes a reasonable chance to survive, and to give firefighting a reasonable chance in the East Bay Hills during Diablo Wind fire.

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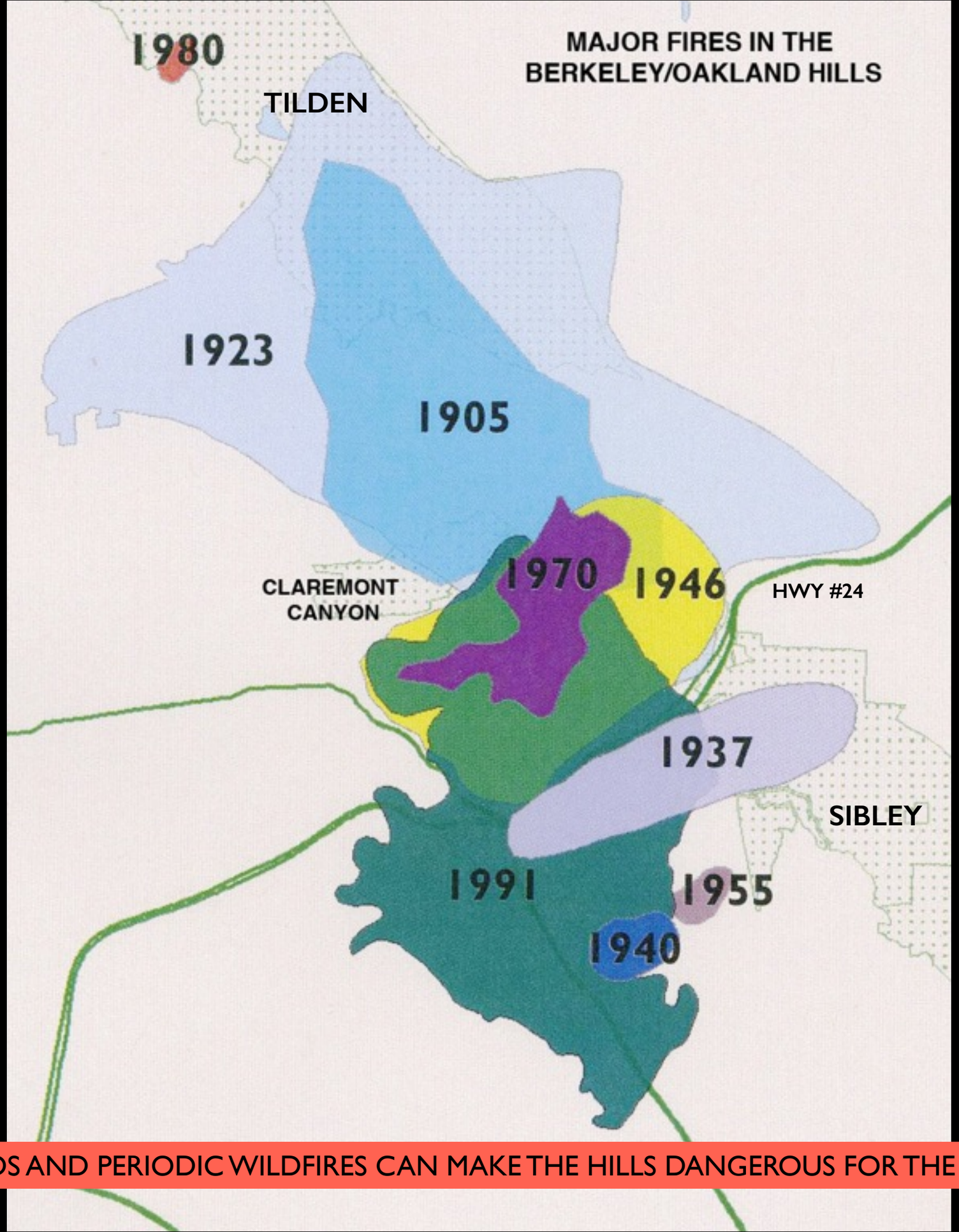
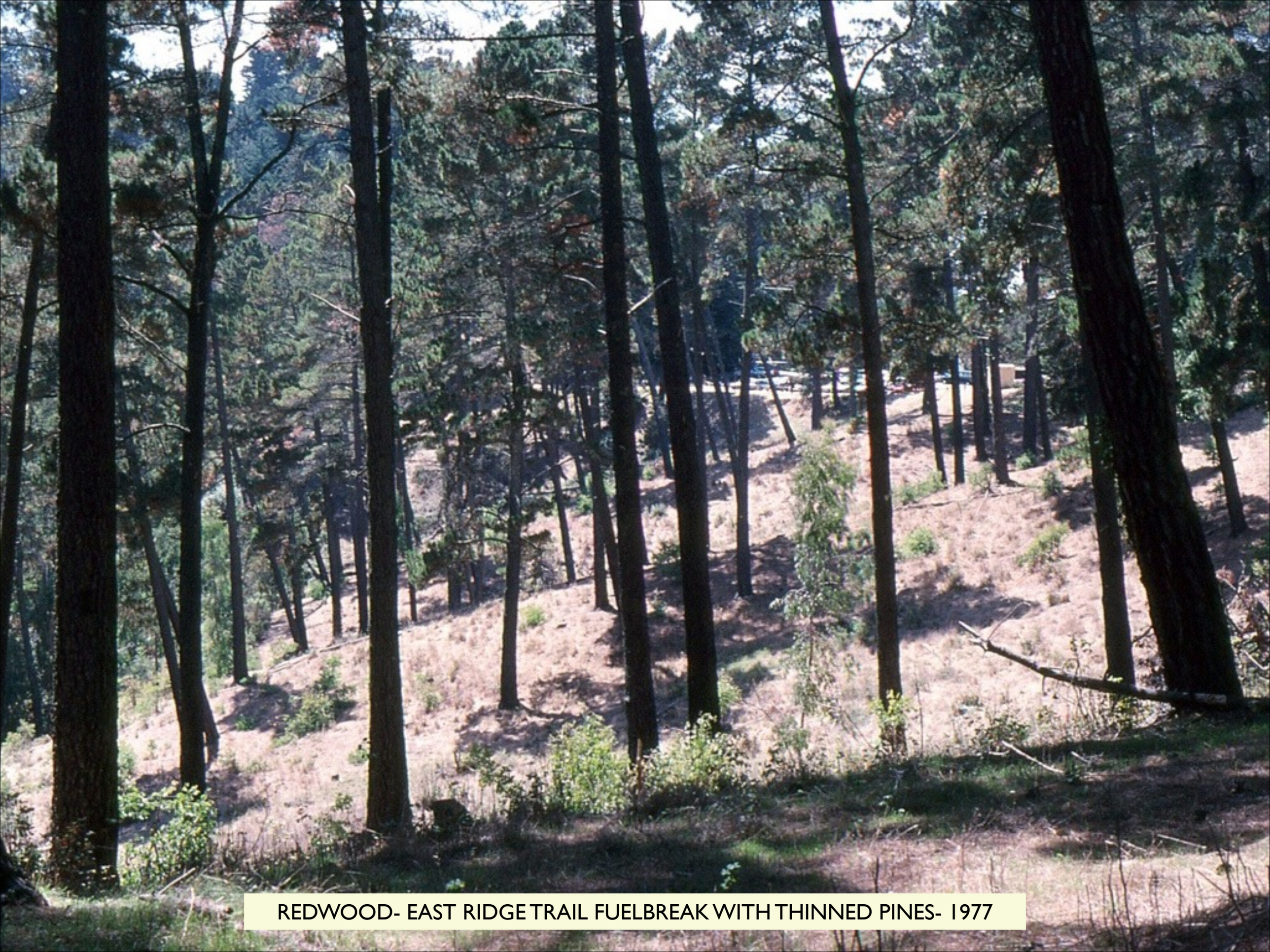


DIABLO WINDS AND PERIODIC WILDFIRES CAN MAKE THE HILLS DANGEROUS FOR THE UNPREPARED

PINE, EUCALYPTUS, AND HOMES IN TUNNEL CANYON- AFTER 1991 FIRE

PINE AND EUCALYPTUS IN TUNNEL CANYON- AFTER 1991 FIRE



REDWOOD- EAST RIDGE TRAIL FUELBREAK WITH THINNED PINES- 1977

REDWOOD- EAST RIDGE FUELBREAK AFTER 31 YEARS- 2008

FIRE HAZARD REDUCTION IN 30-YEAR OLD PINE FOR JOINT FIRE SCIENCE PROGRAM- 2005

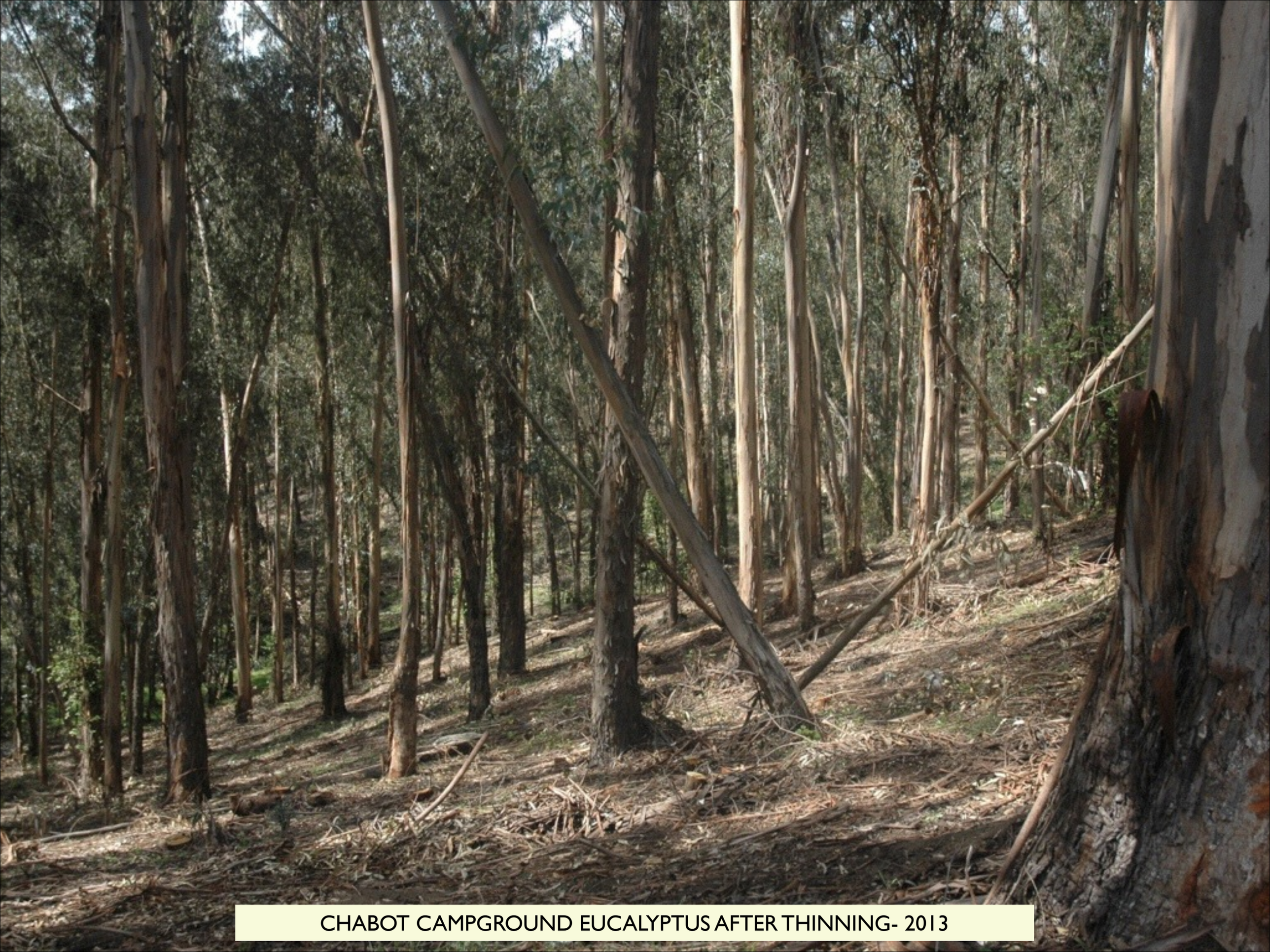
BEFORE

PRINCIPLE INVESTIGATORS
John Swanson USFS,
Dr.Scott Stephens UCB
Dr. Kevin O'hara UCB
Ken Blonski EBRPD
Dr. John Shelly UCB

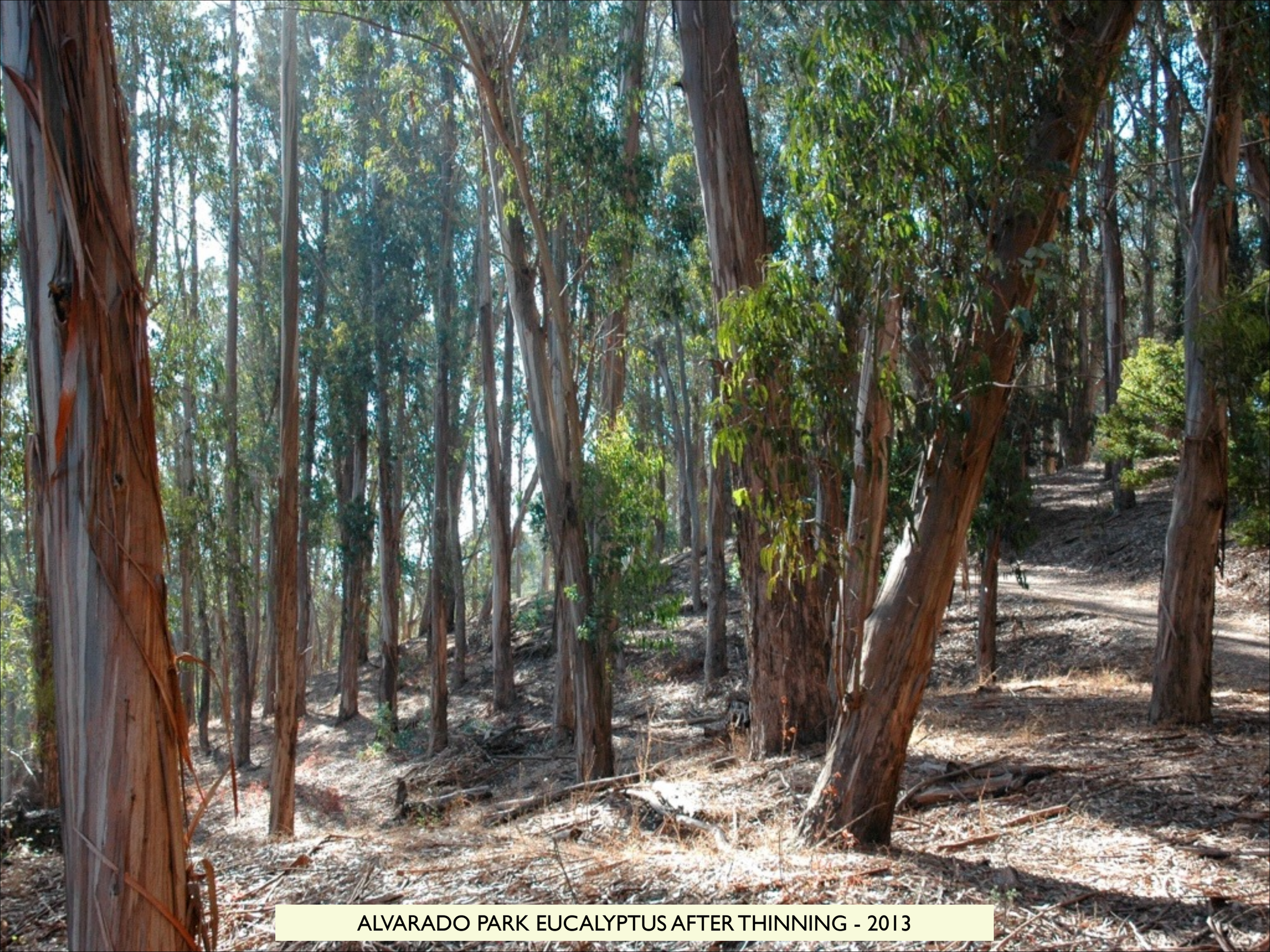
AFTER

TYPICAL SIERRA PINE THINNING WITH OPEN CANOPY AND NO UNDERSTORY

TYPICAL SIERRA PINE THINNING WITH NO UNDERSTORY AND PRESCRIBED FIRE



CHABOT CAMPGROUND EUCALYPTUS AFTER THINNING- 2013



ALVARADO PARK EUCALYPTUS AFTER THINNING - 2013

SIBLEY TRIANGLE- 50' ROADSIDE 1972 EUCALYPTUS SUCKER REMOVAL- 2004

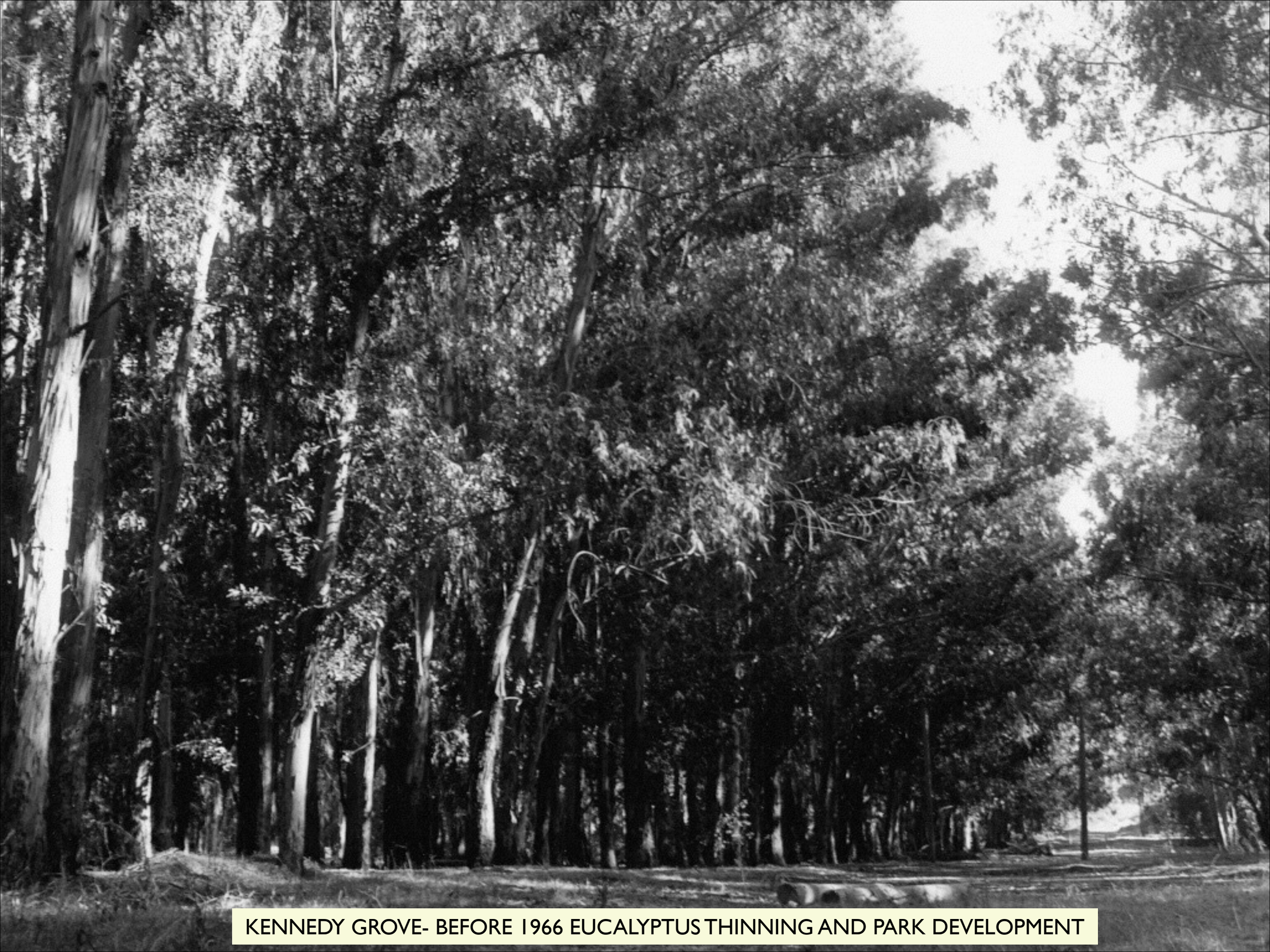
SIBLEY TRIANGLE- ROADSIDE SECTION OF FINAL EUCALYPTUS SUCKER THINNING- 2013

UC CLAREMONT CANYON- DURING 1972 FREEZE SUCKER REMOVAL- SOUTH OF ROAD- 2006

UC CLAREMONT CANYON- AFTER 1972 FREEZE SUCKER REMOVAL- SOUTH OF ROAD- 2007

UC CLAREMONT CANYON- KEEP SUCKERS OR KEEP OAKS/BAYS ? - NORTH OF ROAD- 2012

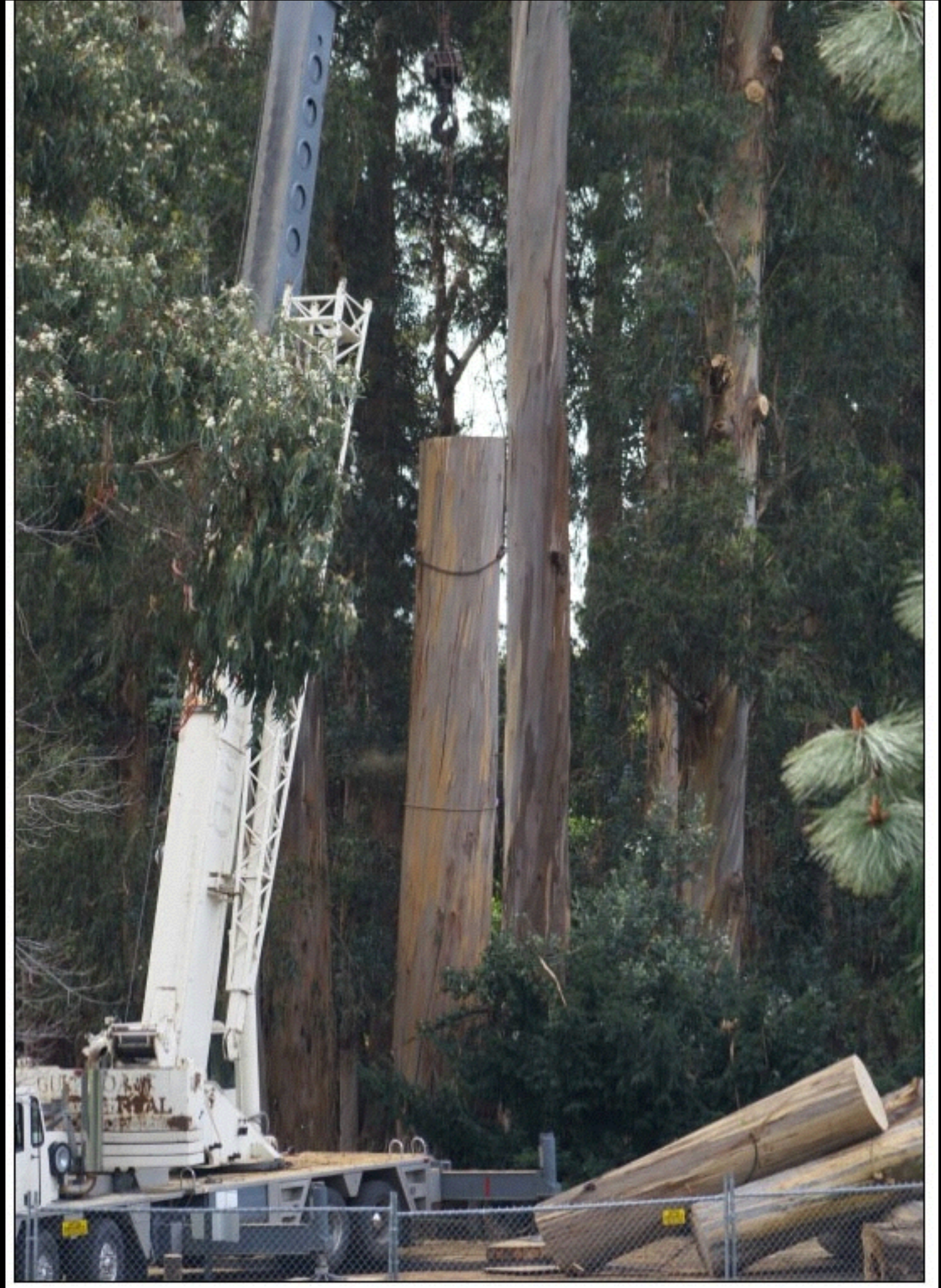
UC CLAREMONT CANYON- POTENTIAL NORTH OF ROAD REMOVAL OF SUCKERS TO SAFER OAK/BAY WOODLAND - 2012



KENNEDY GROVE- BEFORE 1966 EUCALYPTUS THINNING AND PARK DEVELOPMENT

KENNEDY GROVE- 110 YEAR-OLD EUCALYPTUS TREES. ANNUAL ARBORIST REVIEW REQUIRED WITH $3,000 PER TREE COST TO REMOVE A HAZARDOUS TREE

40 TON U.C. LEANER
REMOVED AT $4,000
COST



136 YEAR OLD BLUE GUM LEANER. 40 TON TREES REQUIRE SPECIAL EQUIPMENT