University of California, San Francisco

Draft Vegetation Management Plan (TAC Draft)

Mount Sutro Open Space Reserve

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HORT SCIENCE

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Mount Sutro Open Space Reserve
University of California
San Francisco CA

Executive Summary

The University of California, San Francisco (UCSF) owns and manages the Mount Sutro Open Space Reserve ("Reserve"), located south of its Parnassus Heights campus. In 1976, the Regents of the University of California (the Regents) designated the Reserve as "permanent open space to be kept free of any permanent structures or facilities except footpaths and appropriate landscape construction intended to enhance its use as a natural area," which was reaffirmed in UCSF's 2014 Long Range Development Plan (LRDP).

The last several years of drought, forest pathogens infestation, and the age of the stand have led to a decline in the overall health of the forest. Overall, there are too many trees in the Reserve to support a healthy canopy. Under ideal conditions, the forest should have many more small-diameter trees than large-diameter. At present, this is true in only a third of the Reserve, but a large proportion of those trees are either dead or in poor health.

There is abundant evidence to suggest that the existing forest will not recover on its own. The data show a continuing trend of declining tree health. Recent years have seen below-average rain, which may continue into the future. For these reasons, we believe the only path to healthy diverse vegetation involves active management and silvicultural treatment.

The purpose of this Mount Sutro Open Space Vegetation Management Plan (the Plan) is to provide a management framework for protecting, enhancing, and restoring vegetation in the 61-acre Reserve. In developing this Plan, University staff worked with consultants and a panel of technical advisors. This Plan has been prepared to guide short-term and long-term management towards four goals:

1. Protect the safety of Reserve users and adjacent campus and residential properties
2. Improve and enhance the health and stability of the ecosystem;
3. Enhance the visual design and aesthetic experience;
4. Maintain and ensure public access to the Reserve.

Following a comprehensive inventory of the Reserve, the property was divided into four forest types. These forest types were determined based on similar characteristics with respect to tree species composition, health, and density. The Reserve contains approximately 10,000 live and 3,400 dead trees, based on the size of each forest type and the density of trees per acre. Live tree density per acre ranged from 45 to 270. Blue gum eucalyptus is the dominant tree species, but was not found to be regenerating in sufficient numbers to provide for canopy replacement. This Plan will outline a strategy for regenerating the eucalyptus canopy.

Executive Summary, continued

In accordance with UCSF's already established risk-reduction program, the Plan outlines the goal of protecting the safety of Reserve users and adjacent structures with vegetation management to reduce the risk of both tree failure and fire. Along trails, vegetation management shall clear sight lines.

To achieve a healthy and stable ecosystem, the Plan outlines strategies for increasing the biodiversity of vegetation, conserving existing native vegetation, improving the regeneration and recruitment of tall tree species, managing insect and disease pressure on blue gum eucalyptus, and improving structural diversity.

The plan seeks to enhance the visual design and aesthetics of the Reserve by establishing a mosaic of trees, shrubs and ground cover of different types, with gaps in the canopy that create patterns of sun and shade and offer views of the ocean and Golden Gate Park, and also protect users from the wind. The desired outcome is to maintain a "forest" experience.

UCSF provides for public access into the Reserve through a system of multi-use trails, built and maintained in partnership with the non-profit Sutro Stewards.

The Plan identifies a series of treatments to meet its goals. Desired future conditions and required treatments have been described for the four Forest Types. The Plan continues the University's programs of tree risk assessment and hazard tree removal, creation and management of defensible space, maintaining trail access, and conservation and stewardship of native plants.

In addition, the Plan identifies three phases of forest treatment. During the first few years, forest treatments will focus on Forest Type 1, the area in greatest need of treatment. Management activities include: 1) removing dead, dying, unhealthy and structurally unsound trees, 2) controlling low-growing vines and shrubs that would compete with desired vegetation, 3) preventing sprouts from decayed stumps (these sprouts would also contain decay), and 4) planting new trees. Approximately four acres of Forest Type 1 will be treated and replanted with blue gum eucalyptus.

In the second phase, the density of Forest Types 1, 3 and 4 will be reduced in order to meet the desired number of trees per acre by clearing dead, dying, unhealthy and structurally unsound trees. Remaining areas of Forest Type 1 will be treated and replanted. In this phase, the Plan recommends apportioning replanting equally between blue gum eucalyptus and non-blue gum eucalyptus species. Additionally, Forest Types 2, 3, and 4 will be treated.

The third phase will extend the treatments to remaining areas of the Reserve and will include an evaluation of the results of the first two phases. The Plan also recommends establishing systems for monitoring the status of vegetation and wildlife in the Reserve to evaluate the results of the treatments.

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Introduction and Overview

UCSF owns and manages the Reserve, located south of its Parnassus Heights campus. The Parnassus campus is the oldest and largest of the UCSF campus sites. In 1976, the Regents designated the Reserve as "permanent open space to be kept free of any permanent structures or facilities except footpaths and appropriate landscape construction intended to enhance its use as a natural area," which was reaffirmed in UCSF's 2014 Long Range Development Plan (LRDP).

The Reserve is 61 acres in size, located on the south side of the Parnassus campus. UCSF's hospital, research, educational and support structures are located north of the Reserve. The Reserve is bounded on the east by the City of San Francisco's Interior Greenbelt. The University's Aldea Housing and Clarendon Avenue, Christopher Drive and Crestmont Drive form the Reserve's southern and western boundaries.

The purpose of this Mount Sutro Open Space Vegetation Management Plan (the Plan) is to provide a management framework for protecting, enhancing, and restoring vegetation in the Reserve. The Regents designated the Reserve as permanent open space in 1976 and provided specific goals in the 1996 LRDP. The 2001 Mount Sutro Open Space Reserve Management Plan has provided the framework for current operations. Therefore, this Plan has been prepared to guide short-term and long-term management towards four goals:

1. Protect the safety of Reserve users and adjacent campus and residential properties;
2. Improve and enhance the health and stability of the ecosystem;
3. Enhance the visual design and aesthetic experience;
4. Maintain and ensure public access to the Reserve.

Site and Management History

Mount Sutro is named after Adolph Sutro, a successful mining engineer. After he retired, Sutro moved to San Francisco and invested successfully in real estate. One of his holdings was Mount Parnassus, which was re-named Mount Sutro in his honor after his death.

In the 1800s, prior to Adolph Sutro, Mount Parnassus was covered predominantly with coastal scrub chaparral, consisting of native grasses, wildflowers, and shrubs that provided habitat for a wide variety of wildlife. Trees likely included willow and bay along streams. It is possible that coast live oak and coast redwood were also present.

In 1886, Sutro planted the hill with blue gum eucalyptus, Monterey pine, Monterey cypress, and possibly fruit trees and other species. In the 1930s, trees were harvested on some portion of what is now the Open Space Reserve (Photo 1).

The eucalyptus trees were the most successful trees in adapting to the site conditions, and they soon shaded out smaller trees of other species. Over time, blue gum became the dominant tree species. Vine and shrubs species arose naturally or were planted. Over time, the native vegetation disappeared. By the turn of the 20th century, the entire mountain was covered with trees, and it became commonly known as Sutro Forest.

Photo 1. 1935 photo of the Reserve. Note the open areas on the south side of the Reserve. Source: Craig Dawson, Sutro Stewards.

In 1895, Sutro donated 13 acres on Parnassus Avenue to the Regents. This property was developed for the UCSF Parnassus Heights campus. In 1953, UCSF purchased a 90-acre parcel to the south, which included Mount Sutro. The Aldea Housing (11 acres), the Woods parcel (5 acres), and University House (the Chancellor's Residence) were constructed within the Reserve boundaries.

In the 1950's, the U.S. government constructed a radar control facility for the Nike missile defense installations present in the Bay Area. Located at the summit of Mount Sutro, the facility was accessed by the existing Nike Road. It was abandoned in the 1970's, and the site was cleared. In 2003, the Rotary Club funded a vegetation restoration project. Now known as "Rotary Meadow" this area is excluded from this Plan.

In 1973, in response to community concerns about campus expansion, the Regents designated 50 acres of Mount Sutro as an open space reserve for at least 25 years. The University's 1975 LRDP incorporated this designation. In May 1976, the Regents amended the LRDP to expand the Reserve to 58 acres and to make permanent the designation of open space. The 1996 LRDP resurveyed the area and determined that it was 61 acres.

The University's 1996 LRDP, which was approved by the Regents, contained several recommendations related to the Reserve:

1. Maintain the Reserve as permanent open space and investigate an appropriate maintenance and restoration program for trees and vegetation.

2. Propose improvement to encourage recreational use of appropriate areas of the Reserve while maintaining the open space character of the area.

3. Improve the hiking trails on Mount Sutro.

At present, the University employs a small staff to oversee and perform vegetation maintenance operations within the Parnassus campus, including the Reserve. Within the Reserve, maintenance activities are provided to: 1) protect the campus and adjacent residential structures, 2) reduce the risk of tree failure, 3) create defensible space between tree canopy and structures, 4) maintain accessibility to trails, and 5) restore areas of remnant native vegetation (in conjunction with the Sutro Stewards).

Maintenance of trails and restoration of native vegetation are performed in cooperation with the Sutro Stewards (http://sutrostewards.org/). Formed in 2006, the Sutro Stewards is a non-profit, volunteer organization. Its mission is "to create urban recreational opportunities while practicing sustainable habitat conservation through stewardship." The Sutro Stewards provides trail maintenance and improvement, manages a native plant nursery, provides habitat conservation, and offers public education programs.

Plan Process and Development
Development of this Plan for the Mount Sutro Open Space Reserve was initiated in late 2015. The University brought together staff from its Community and Government Relations, Campus Planning and Campus Life Service, Facilities Services t program (Table 1). They also identified key leaders in the fields of forest management and ecology to participate on the plan's Technical Advisory Committee (Table 1). Primary project consultants were: Jim Clark and Matt Greene, who prepared this Plan, and Daniel Iacofano, who facilitated the Technical Advisory Committee process.

Table 1. Project team. Mount Sutro Open Space Reserve Vegetation Management Plan. University of San Francisco.

University staff	
Kevin Beauchamp	Director, Physical Planning, Campus Planning
Barbara French	Vice Chancellor, University Relations
Christine Gasparac	Interim Director, Community Relations
Julie Sutton	Facilities Program Manager, Campus Life Services, Facilities Services
Paul Takayama	Assistant Vice Chancellor, Community and Government Relations
Diane Wong	Principal Planner, Physical Planning, Campus Planning
Lori Yamauchi	Assistant Vice Chancellor, Campus Planning
Technical Advisory Committee	
Peter Brastow	Biodiversity Coordinator, San Francisco Department of the Environment
Peter Ehrlich	Forester, The Presidio Trust
Joe McBride	Professor emeritus, University of California Berkeley
Richard Sampson	Forester/Division Chief, CAL FIRE
Lew Stringer	Restoration Ecologist, The Presidio Trust
Consultants	
Jim Clark	HortScience, Inc.
Matt Greene	Matt Greene Biological and Forestry Consulting
Daniel Iacofano	MIG Architecture & Planning
Nicole Yelich	Nicole Yelich Strategies

Table 2. Plan goals, objectives and organizing principles. Mount Sutro Open Space Reserve Vegetation Management Plan. University of San Francisco.

Plan Goals and Objectives: Defining Success

1. Reserve and ecosystem health
2. Visual design and aesthetics
3. Public safety
4. Public access

Key assumptions of the plan include:

1. Improves safety of the Reserve and protects lives and structures
2. Addresses hazard reduction and promotes a sustainable ecosystem
3. Includes a replanting strategy to promote biodiversity
4. Utilizes a phased-in approach

Relevant University policies regarding vegetation management:

1. The safety of people and structures is the University's top priority.
2. Use of herbicides in the Reserve is prohibited.
3. Unnecessary tree work during bird-nesting season (March to August) will be avoided.
4. Commitment to transparency and community planning principles.
5. Public access to the Reserve's trail network will be maintained and enhanced.
6. The beauty of the Reserve, its character as a novel ecosystem, and its value as a public resource will be preserved.

The process of developing this Plan was based on several elements (Table 2). The first element was defining Plan success in four areas: 1) Reserve and ecosystem health, 2) visual design and aesthetics, 3) public safety, and 4) public access. From the University's perspective, a successful Plan would provide short-term and long-term management strategies and actions that would improve safety, reduce hazards, promote a sustainable ecosystem, include a replanting strategy, and employ a phased-in approach.

Finally, key University policies were articulated. First, the safety of people and structures is the University's top priority. Second, use of herbicides in the Reserve is prohibited. Third, unnecessary tree work during bird-nesting season (March to August) should be avoided. Fourth, a commitment to transparency and community planning principles. Fifth, public access to the Reserve's trail network should be maintained and enhanced. Sixth, the beauty of the Reserve, its character as a novel ecosystem, and its value as a public resource will be preserved.

Key points in the planning process were meetings of the Technical Advisory Committee and the project team (Tables 3 and 4). Public comment was heard during these meetings. In addition, the Technical Advisory Committee toured the Reserve.

Much of the discussion at the first TAC meeting focused on the definitions of terms. More specifically, there was a discussion of how terms such as sustainable, biodiversity and forest applied to the Open Space Reserve (see Appendix A for list of terms and definitions).

At the second TAC meeting, the project team presented the TAC with the definitions of terms that were agreed on by the University and the TAC. The project team then presented strategies for achieving the management goals and a framework for developing this Plan. The TAC also received data gathered from fieldwork in the Reserve to better understand the current conditions in the Reserve.

Table 3. Technical Advisory Committee Meeting #1. Summary.
Mount Sutro Open Space Reserve. Vegetation Management Plan.
January 14, 2016

The meeting introduced the project, project team, and the Technical Advisory Committee (TAC). Members of the public were also present. The following topics were discussed:

1. **Mount Sutro Open Space Reserve Management Planning Process**
   - Project and site overview. UCSF committed to maintain the Reserve as open space.
   - Process Timeline. Winter 2016 through fall 2017.
   - TAC Organizing Framework

2. **Review and Discussion of Management Plan Goals and Objectives: Defining Success**
   - Reserve and Ecosystem Health. Overview of current conditions. Concern over declining tree health and lack of regeneration.
   - Visual Design and Aesthetics. What is the forest experience?
   - Public Safety. Tree risk management and creation of defensible space.
   - Public Access. Increase usage as a recreational area.
   - Other

3. **Public Comment**

4. **Summary and Next Steps**

Questions from the TAC focused on defining what the project means by terms such as forest, sustainability, forest health, hazard, ecosystem health, and biodiversity. These terms form a number of the University's assumptions about the Reserve. The TAC identified the need to clarify use of terms with respect to vegetation in the Reserve.

Public comment was heard.

Table 4. Technical Advisory Committee Meeting #2. Summary.
Mount Sutro Open Space Reserve. Vegetation Management Plan.
April 28, 2016

Attendees included the project team and the Technical Advisory Committee (TAC). Members of the public were also present. The following topics were discussed:

1. **Process overview.** Review of the project, project team, and process.

2. **Recap of TAC meeting #1.**

3. **Defining success.**
   Review of definitions developed following TAC #1.

4. **Vegetation management plan overview. Goals & objectives.**
   - Reserve and Ecosystem Health
     a. Increase biodiversity
     b. Promote native vegetation
     c. Improve plant regeneration / recruitment
     d. Manage insect and disease pressure
     e. Improve structural diversity

   - Visual Design and Aesthetics. Describing the forest experience.

   - Public Safety. Tree and fire management. Vegetation and crime.

   - Public Access. Review of existing and planned trails.

5. **Preliminary plan framework**
   - Review of forest inventory. 4 forest types identified. All dominated by blue gum, varying in basal area, number of stems per acre, management history, and associated vegetation.

   - Proposed treatments: single tree selection, group selection, sanitation thinning.

   - Review of needs of young trees: light, growing space, irrigation, removal of competing vegetation.

6. **Public comment**

7. **Summary and next steps**

Questions from the TAC focused on the findings from the forest inventory, their significance to short- and long-term management, and how they inform any plan for regeneration.

Public comment was heard.

Existing Conditions

A vegetation management plan does not start with a blank slate, but must work from the site's existing conditions. In this section, we review site conditions and current vegetation. In so doing, we rely on previously published information, as well as current field studies.

General Setting

The Mount Sutro Open Space Reserve is located near the geographic center of the City and County of San Francisco. With an elevation of over 900', it is one of the highest points in the City.

The Reserve is bounded on the east by the City of San Francisco's Interior Greenbelt. The University's Aldea Housing and Clarendon Avenue, Christopher Drive and Crestmont Drive form the Reserve's southern and western boundaries.

At 61 acres, the Open Space Reserve is smaller in size than The Presidio and Golden Gate Park, both of which have large assemblages of eucalyptus cover. The Reserve is, however, unique in that the eucalyptus cover is largely continuous.

Climate

With its proximity to the Pacific Ocean, Mount Sutro's climate features "mild, wet, almost frostless winters and cool summers with frequent fog or wind" (Brenzel, 2007). Temperatures below freezing rarely occur. Summer high temperatures are normally 60° to 75° F.

Rainfall is concentrated in the October - May period with the heaviest rainfall in December, January and February (Figure 1). Although snow has fallen in San Francisco, it is a very rare occurrence. Fog is of far more significance, occurring during both summer and winter months. In winter, fog originates in the Central Valley. Summer fog originates off-shore. Summer fog is common at Mount Sutro and is an additional source of moisture for its vegetation.

The significance of fog to the water balance on Mount Sutro is difficult to quantify. In summer months, trails on the west side of the Reserve are often muddy while those on the east may be dry and dusty.

Annual rainfall in San Francisco has historically averaged about 23" (Figure 2). In general, the west and northwest sections of the City receive slightly more rain than the east. Over the period 2006 to 2015, the average rainfall in San Francisco was 19" with below-average rainfall in 7 of the last 10 years (Golden Gate Weather Services).

Wind is an important climate feature in the Reserve. Winds in San Francisco are typically from the west most of the year with some north winds during the winter months. The range in wind speed is 6.3 mph in December to 11.2 mph in July (Golden Gate Weather Services). Strongest winds are in the winter months with winds gusting to 50 mph in November and December.

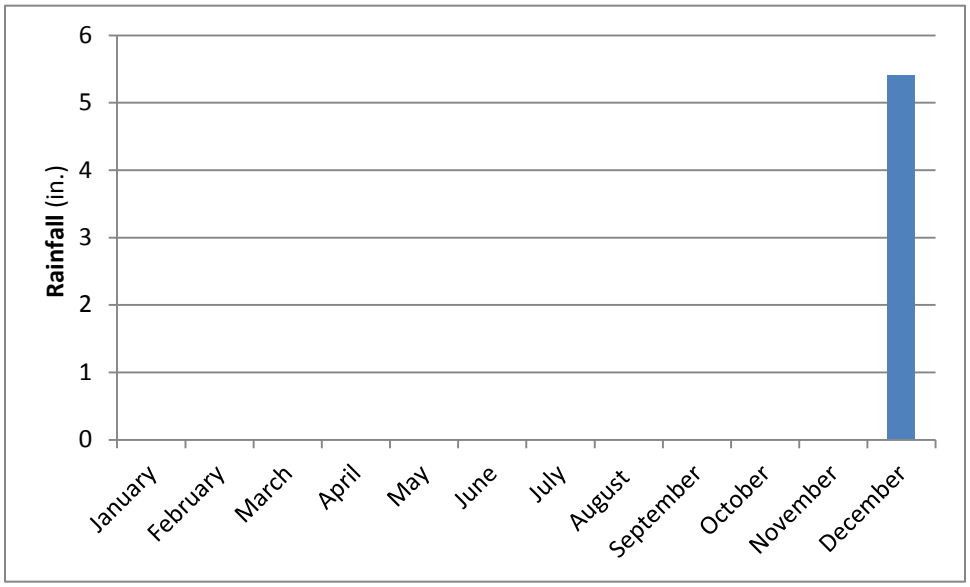


Figure 1. Distribution of rainfall in San Francisco by month for the period 1994 to 2015. Source: Golden Gate Weather Services. http://ggweather.com/sf/

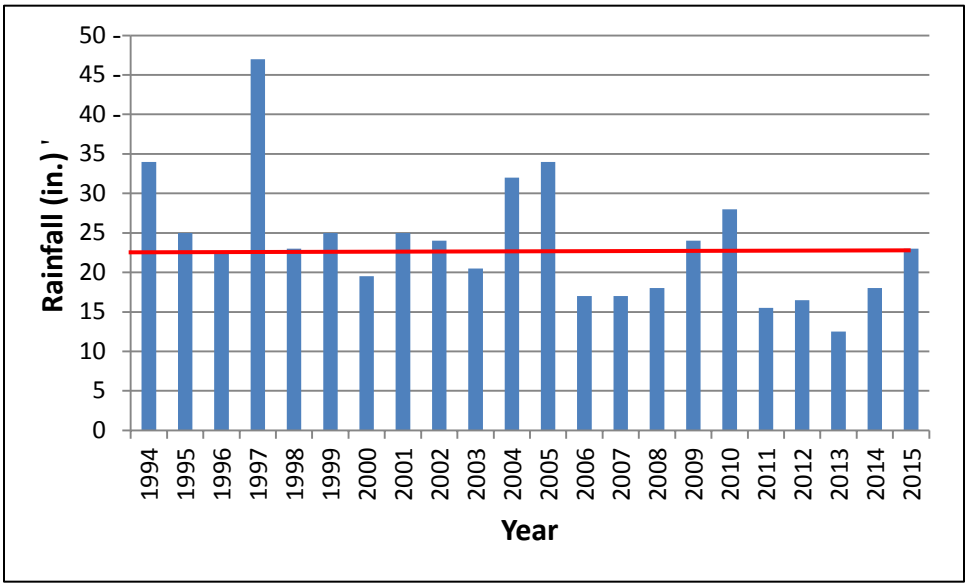


Figure 2. Annual precipitation in San Francisco for the period 1994 - 2015. Average rainfall for that period is 23.7 in. (red line). Source: Golden Gate Weather Services. http://ggweather.com/sf/

Given the topography of the site, the west-facing side of the Reserve is more exposed to wind than the east. In addition, there are some locations in the Reserve that are protected from the direct wind.

Occasionally, in September through early November, there are hot, dry, high-intensity winds that blow in from the northeast. This occurs when the semi-permanent low-pressure system of the southwestern United States weakens, and the Pacific high-pressure system shifts inland. These winds often occur in combination with high air temperatures and low humidity, and may serve to increase the vulnerability of the forest to wildfire during these periods.

Vegetation at Mount Sutro is dependent on rainfall and fog for moisture. There are no permanent streams within the Reserve. The Woodland Creek on the east side of the Reserve is seasonal, peaking in flow during the rainy season and drying out in the summer.

Geology, Soils, and Slope
Hikers on Mount Sutro's trails will observe exposed outcrops of the Franciscan formation chert. Chert is hard, dense sedimentary rock. Franciscan chert is characterized by thin-bed layers. Its red color results from oxidation of iron.

Soils on Mount Sutro are generally thin and composed of sandy material. The soil complex is mapped as Candlestick fine sandy loam - Kron sandy loam - Buriburi gravelly loam, on 30 to 75% slopes (SCS 1991). The constituent soil types of this complex are likely to occupy different areas. The Candlestick fine sandy loams are usually from 20 to 40 inches thick over bedrock, whereas the Buriburi gravelly loam and the Kron sandy loam are usually from 10 to 40 inches thick over bedrock. Because of Mount Sutro's steep slopes, the soil depth is shallower and less continuous.

The combination of relatively shallow soil, a period of seasonal drought, and absence of natural sources of water means that vegetation in the Reserve should have some tolerance to drought. Although mitigated by tree canopy cover and summer fog, newly installed landscape plants require irrigation to establish. For example, even though the Rotary Meadow was restored with drought-tolerant species, a temporary irrigation system was used during the first few years after installation.

Mount Sutro's topography is characterized by sloping terrain. Areas of flat ground are rare. Over 60% of the Reserve has slopes in excess of 30%. In general, shallower soils are present on steeper slopes. Exposed soils on steeper slopes are more vulnerable to slope failure and surface erosion. The Plan will incorporate treatments such as leaving wood chips and logs on-site to minimize soil erosion during any revegetation treatments.

Wildlife
In 2010, the University commissioned a report on wildlife and habitat resources in the Reserve (Nature in the City, 2010). The report surveyed existing natural resources with recommendations for improving habitat for wildlife and native plant conservation. The report provided detailed information about the wildlife present in the Reserve, including birds, bats, mammals, amphibians, reptiles, and butterflies. At that time, more than 100 species of birds, 15 mammals, four reptiles, 2 snakes, and three amphibian species were recorded on Mount Sutro (Appendix D).

In addition, the presence of birds has been documented by volunteers reporting their observations to ebird, a program of the Cornell Lab of Ornithology (http://ebird.org). Birders submit bird sightings, and the information is then compiled for public use. As of July 2016, 89 species had been reported for Mount Sutro (Appendix A). Included on the list is the olive-sided flycatcher, a California Species of Special Concern.

Vegetation

In its 2010 report to UCSF, Nature in the City, identified more than 120 plant species as present in the Reserve. The Sutro Stewards and this project team added to that list. Approximately 140 species of plants have been observed (Appendix C). Approximately 84 species are native (or believed to be native) to the Reserve while 57 are non-native.

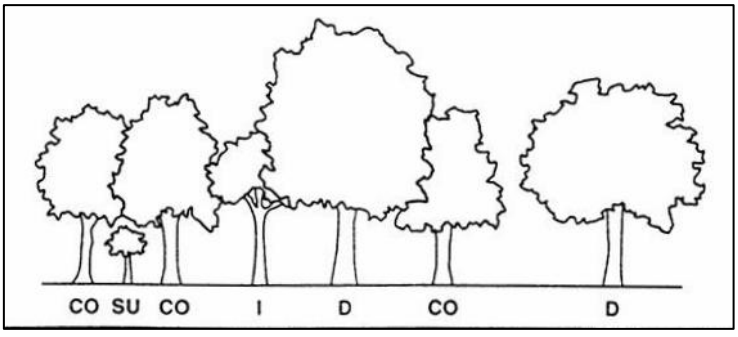
The California Invasive Plant Council publishes an inventory of plants known to be invasive (www.calipc.org). Plants on the list are noted as having high, moderate or limited invasive potential. Of the 57 non-native species, 28 have been identified as invasive (five high, 18 moderate, five limited). In addition, UCSF staff have identified nine other plant species as particularly problematic in the Reserve.

In April of 2016, a forest inventory was conducted, focusing on trees and forest composition. Eleven 1/5 acre ***fixed radius plots*** were established on a ***stratified grid***. This sample represents a sampling of 3.5% of the entire Reserve. In all, 566 trees (alive and dead) 2" in dbh and greater were measured in this sampling.

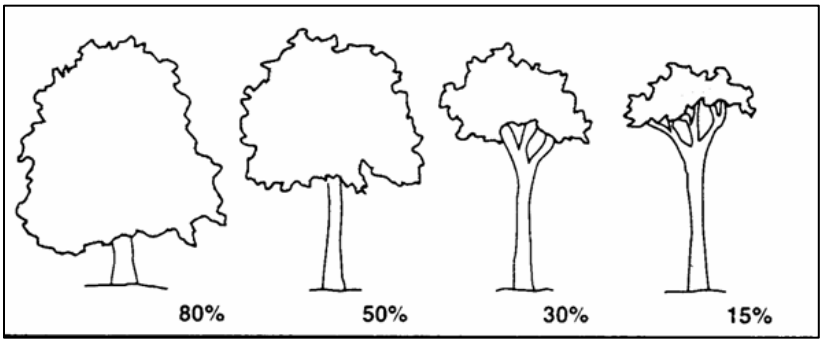
The following measurements were taken:

Tree

- Species sampled were: blue gum eucalyptus (*Eucalyptus globulus*), blackwood acacia (*Acacia melanoxylon*), Monterey pine (*Pinus radiata*), Monterey cypress (*Hesperocyparis macrocarpa*), redwood (*Sequoia sempervirens*), plum (*Prunus domestica*), cherry (*Prunus* sp.), Bailey's acacia (*Acacia baileyana*), willows (*Salix sp*.), California bay laurel (*Umbellularia californica*), and coast live oak (*Quercus agrifolia*).
- Diameter at breast height (dbh) measured at 4.5 feet from the ground on the uphill side of the tree.
- A determination if the tree was alive or dead based on canopy and bark moisture.
- The crown class noted as:
  a. dominant (stands above the canopy of neighboring trees)
  b. codominant (general level of the main canopy, receiving light from above but not the sides)
  c. intermediate (shorter in height than codominant and receiving light only from directly above)
  d. suppressed (beneath the general level of the main canopy).



- The live crown ratio (percent of canopy which has live green vegetation versus the total height of the tree).



- Specific notes on each tree (such as, if the top of the tree is dead or has live canopy, if the tree is stem or basal sprouting, if the tree has some other damage like a broken top, or how the canopy looks in terms of foliage density).

Plot

- Basal area
- Site index if a conifer tree were available
- Notes about the dead fuel load
- Understory species composition
- Any notes about the history of the area if something is visible.

Results were synthesized into four Forest Types based on tree species composition, tree health, location history, and aspect (Figure 3, Table 5). All four Types were dominated by blue gum eucalyptus but varied by number of trees per acre, diameter distribution, tree health and other factors.

Forest Type 1

This forest type occupies 24 acres of the Reserve. It is primarily located between the main ridge on the Reserve, which runs north/south and down to Medical Center Way. The slopes run between flat ground (on the ridge top) to over 60%. This forest type primarily has an eastern and northern aspect.

Within this forest type, the dominant species include blue gum eucalyptus and blackwood acacia, with Monterey cypress, Monterey pine, redwood, plum, cherry, bay, coast live oak, and willows making up a minor component.

This forest type has a range in size of trees from 2” dbh (diameter at breast height) to over 36” dbh (Figure 4). There are currently 279 trees per acre within this type. Most of these are blue gum eucalyptus (164 trees) and blackwood acacia (68 trees). This forest type also has 110 dead standing trees per acre. Most of these trees are eucalyptus between 2” and 10” dbh. Larger diameter trees, however, were also dying.

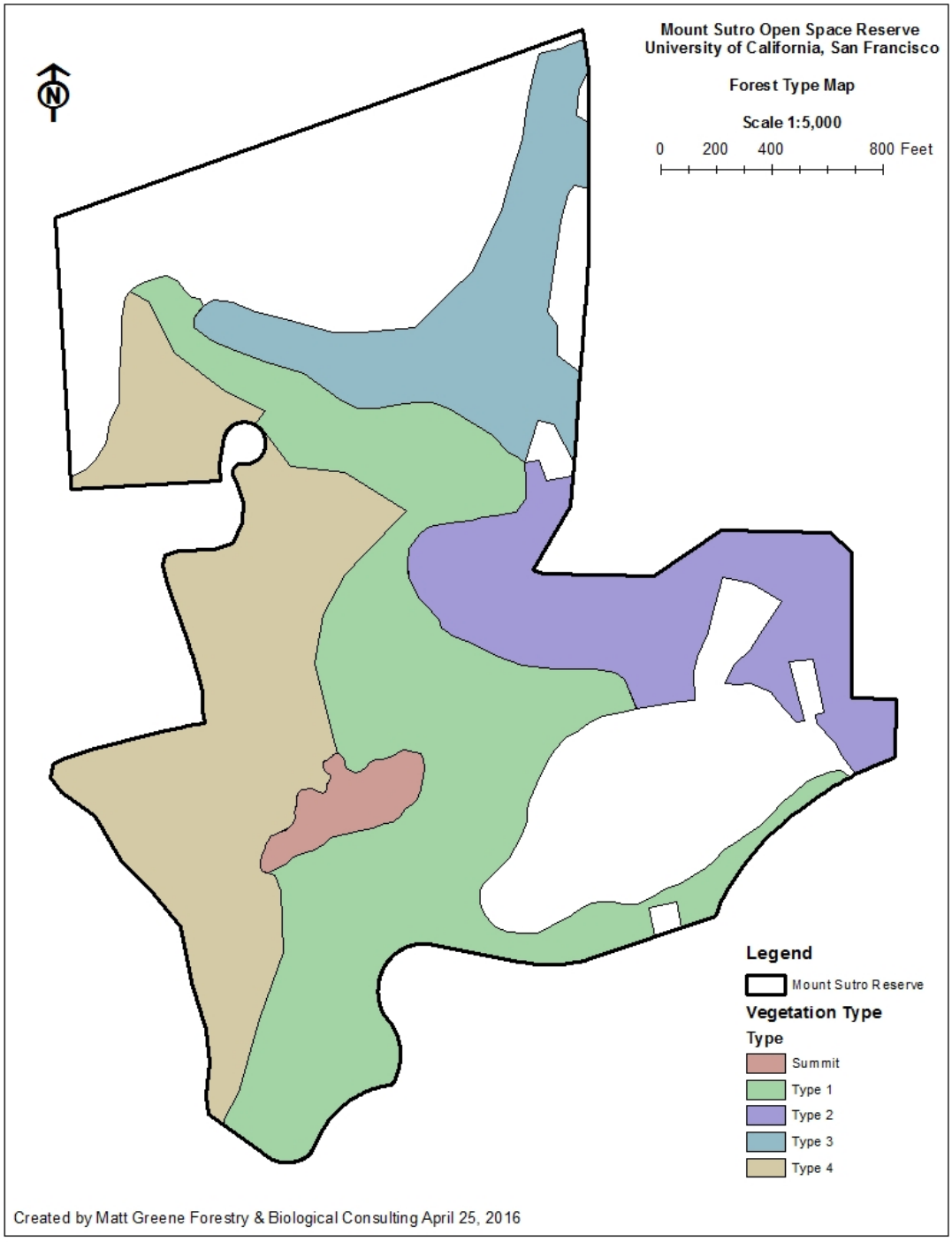


Figure 3. Forest Type map created from 2016 forest inventory. See text for descriptions of each type.

Photo 2. Typical view of Forest Type 1 in April 2016. Death of the upper crown is visible in most of the trees.

The upper crown of a vast majority of the live eucalyptus trees in this forest type have died (Photo 2). In April 2016, no stem sprouting was observed. These plots were visited again in June, and a few of the trees developed stem sprouts (Photo 3). University staff noted that similar sprouting had occurred in March 2016, but did not survive through April.

Photo 3. Sprouting in blue gum eucalyptus. Forest Type 1. June 2016.

This type has 158 square feet of ***basal area*** and a ***site index*** of 100 (measured on 3 redwood trees within the type). Within this type, there is a heavy amount of ***windfall***. A greater number of downed trees were located near the summit than downhill.

The understory of Forest Type 1 is dominated by Himalayan blackberry (*Rubus discolor*) and poison oak (*Toxicodendon diversilobum*). This vegetative layer is likely prohibiting new trees from becoming established. Also present are red elderberry (*Sambucus racemosa*), ivy, and other species.

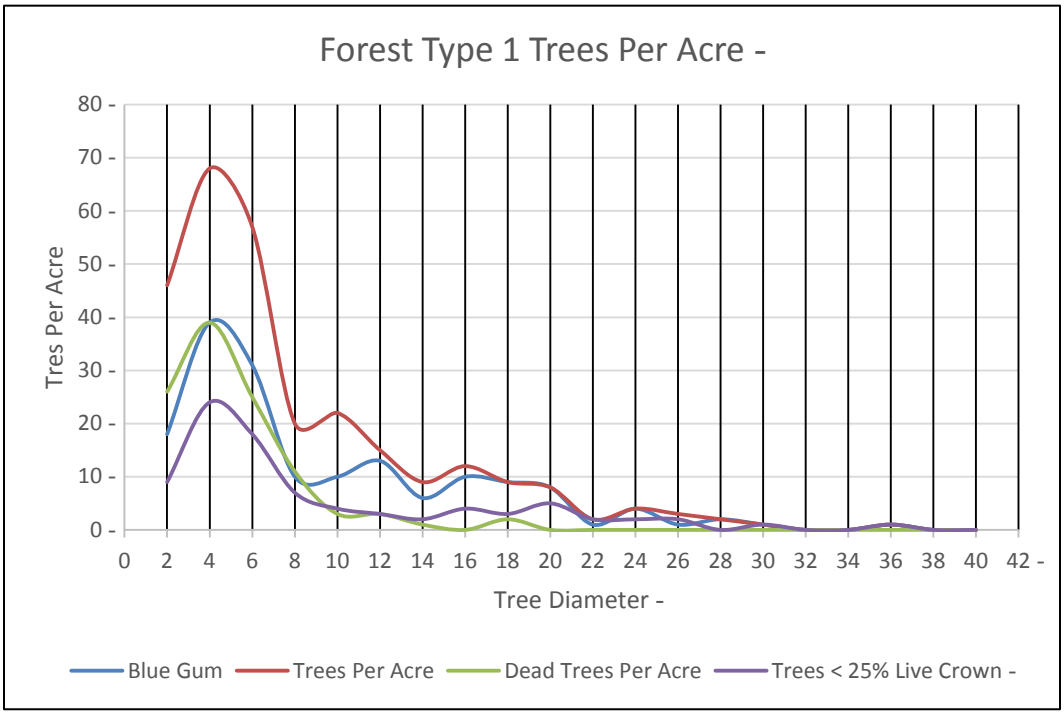


Figure 4. Stand density by tree condition. Forest Type 1.

Forest Type 2
Forest Type 2 is approximately nine acres in size, located on the east side of the Reserve below Medical Center Way and along Woodland Canyon. The slopes within this forest type range from 20% to over 70%. It abuts the Interior Greenbelt on the east. A seasonal watercourse is present in Woodland Canyon.

Species within the vegetation type include primarily blue gum eucalyptus (88%) and Monterey cypress (12%) (Photo 4). Coast redwood, blackwood acacia, Monterey pine, and willows were observed outside of individual sample plots. Few small diameter trees were present (Figure 4). No trees below 14" dbh were present in any of the sample.

Understory of Forest Type 2 is dense English (*Hedera helix*), German (*Senecio mikanioides*) and cape ivy (*Delairea odorata)*, poison oak and blackberry.

Tree density is 45 trees per acre, largely blue gum. The vast majority of trees have live crown ratio of less than 20%. In April 2016, no basal sprouting was observed. In June, there was very limited stem sprouting. Little or no regeneration has occurred in the last 10 to 20 years (Photo 5).

Basal area is approximately 163 square feet, predominantly in blue gum.

Photo 4. Typical view of Forest Type 2. Dominated by eucalyptus, the understory has self-thinned and is almost completely void of small diameter trees. Most trees in this photo are >20" diameter.

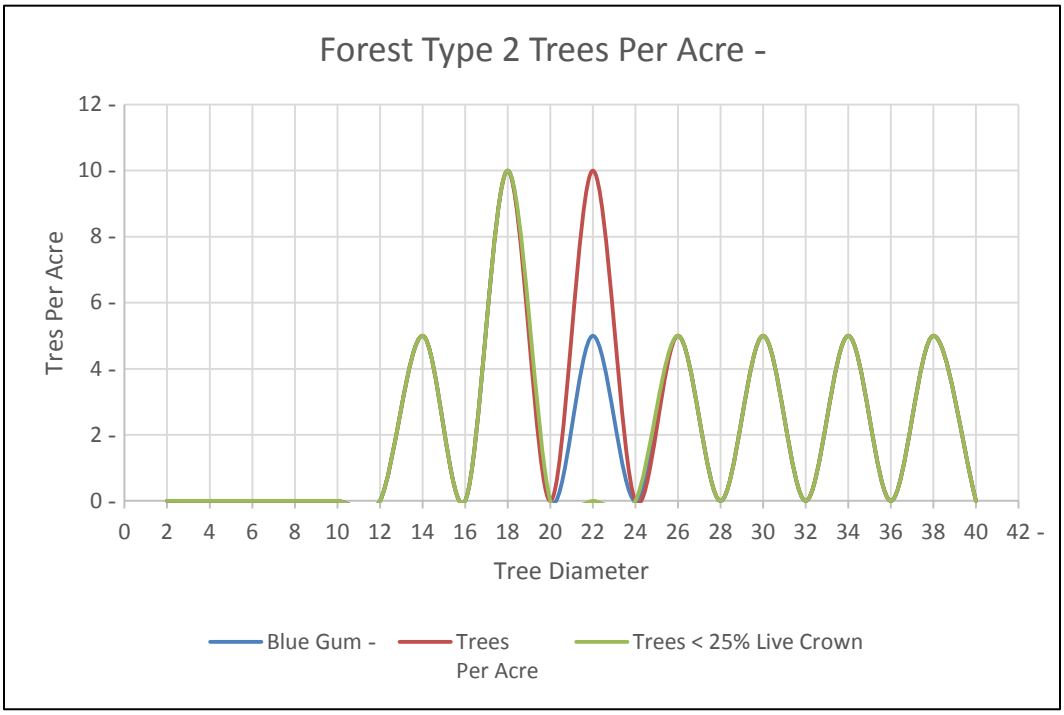


Figure 4. Stand density by diameter class and tree condition. Forest Type 2.

Photo 5. Forest Type 2. Note lack of trees in the understory.

Forest Type 3
Forest Type 3 is approximately eight acres, located on the north side of the Reserve between Medical Center Way and the main campus. Species include blue gum, blackwood acacia, plum, cherry, bay, and coast live oak. Trees range in size from 2" dbh (diameter at breast height) to over 40" dbh (Figure 5).

Density is 110 trees per acre with approximately 10 dead trees per acre. Eucalyptus is the dominant overstory vegetation (45%) with acacia (25%) willow (10%) and plum (20%) in the understory. The upper crowns of most blue gums were dead. In both April and June 2016, no basal sprouting was observed.

All eucalyptus trees within the measured plots were larger than 12" dbh. Smaller diameter trees were dead. The majority of the trees within this type had 20 to 30% live crowns.

A heavy ground cover of cape ivy, German ivy, and English ivy as well as blackberry was present. This heavy layer of growth is prohibiting any new trees from becoming established.

Basal area is 196 square feet. A vast majority of the live eucalyptus trees have experienced top mortality. In both April and June 2016, no stem sprouting was observed.

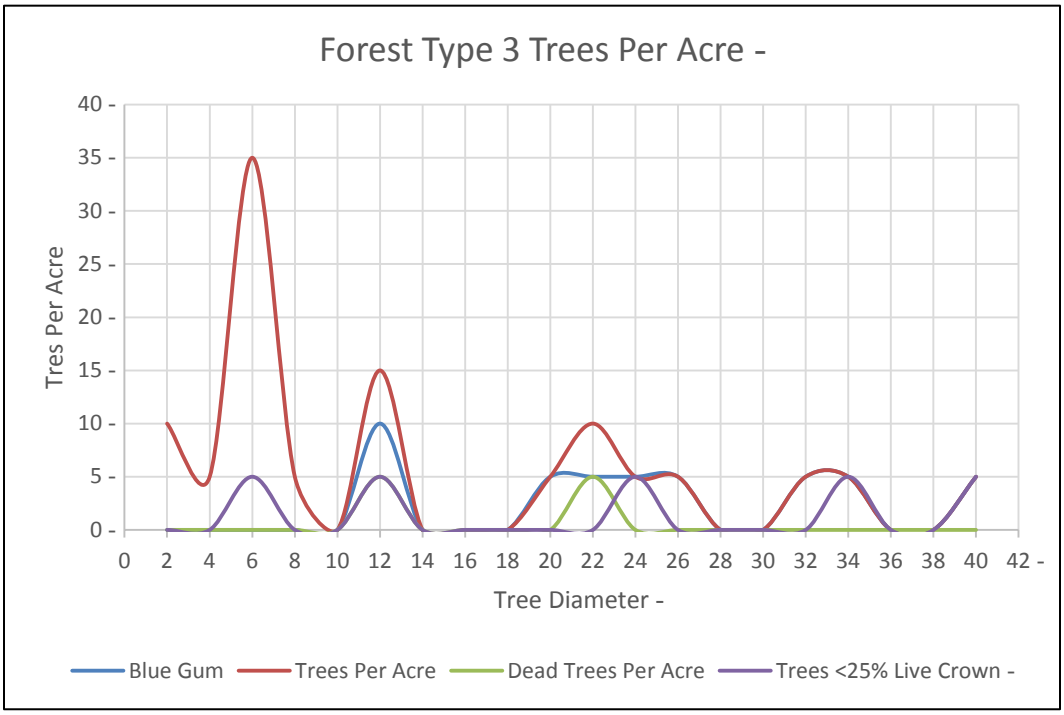


Figure 5. Stand density diameter class and tree condition. Forest Type 3.

Forest Type 4
This forest type is 18 acres and located on the west side of the Reserve. Tree cover is dominated by blue gum eucalyptus. This forest type has the healthiest trees in the Reserve. Most trees have foliage in the upper canopy and live crown ratios of 40% or greater. Monterey cypress, cherry, coast live oak and willows were observed to a lesser degree.

Trunk diameter ranges 2" to 34" (Figure 6). There are 128 trees per acre. Some live, small diameter blue gums are present in the understory. There are approximately 50 dead trees per acre, mostly between 2" and 12" dbh.

Basal area is 152 square feet. Coast redwood trees are present and the area has a site index of 140 (based on four redwood trees).

The understory is dominated by elderberry, blackberry, and poison oak with bracken ferns, vetch and other species present to a lesser degree (Photo 6). Elderberry was 6' to 8' tall and fairly significant.

There were a large number of wind-thrown eucalyptus trees.

Photo 6. Forest Type 4. Note variation in understory. **Left**: dense small blue gum, acacia and blackberry. **Right**: area lacking understory.

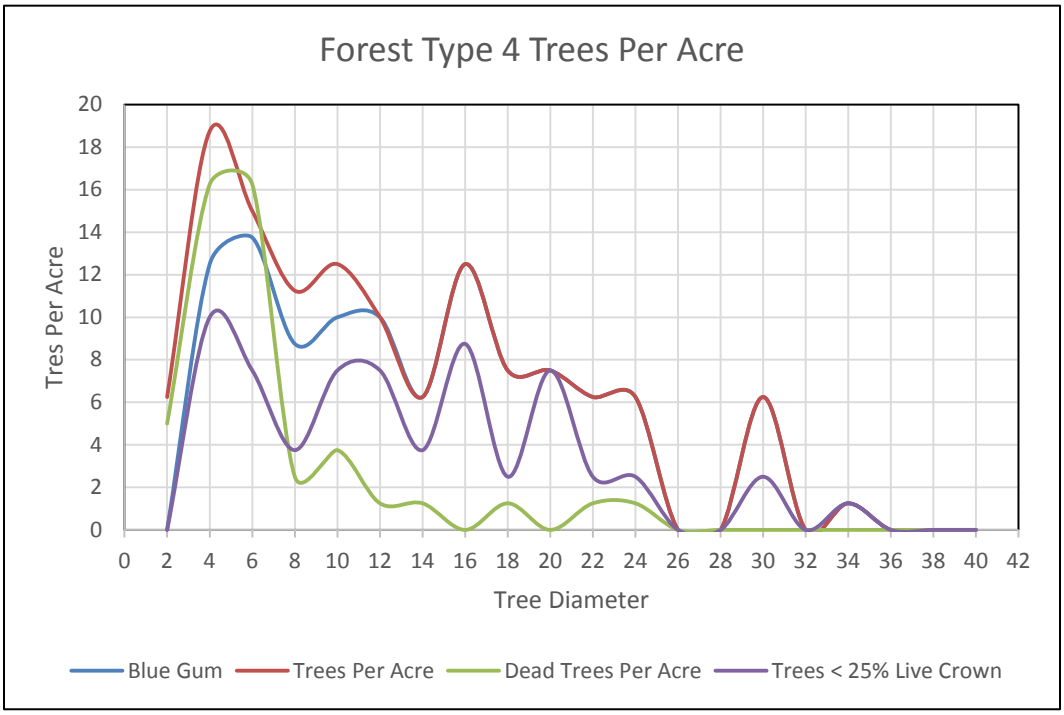


Figure 6. Diameter distribution by diameter class and tree condition. Forest Type 4.

Inventory Summary
The Reserve's four Forest Types vary by density, and ***stand structure*** (Table 5). In each forest type, blue gum eucalyptus is the dominant tree species. On the west side of the Reserve, (Type 4) blue gum is largely the only canopy species. In other areas, species such as blackwood acacia and Monterey cypress may be found in the canopy.

Table 5. Summary. 2016 forest inventory. Mount Sutro Open Space Reserve.

Forest Type	Size (acres)	Trees per acre		Basal Area (sq. ft.)	DBH Range (in.)	Tree Species		Location
		Live	Standing dead			Dominant	Secondary	
1	24	270	100	158	2 to >36	Blue gum, blackwood acacia	Monterey cypress, Monterey pine, coast redwood, plum, cherry, Calif. bay, coast live oak, willow	East side of Mount Sutro to Medical Center Way
2	9	45	10	163	14 to 20	Blue gum, Monterey cypress	Monterey pine, blackwood acacia, coast redwood, willow	E. of Medical Center Way
3	8	110	10	196	2 to >40	Blue gum, blackwood acacia	Willow, plum	NE. corner of the Reserve
4	18	128	50	152	2 to 34	Blue gum	Monterey cypress, cherry coast live oak , willow	West side of the Reserve

The history of management varies among the four Forest Types. Forest Types 1 and 4 were harvested in the early 1930s with retention of approximately 60 trees per acre. In addition, prolific stump sprouting followed any harvest. Forest Types 2 and 3 do not appear to have been harvested.

With respect to forest health, Forest Types 1, 2, and 3 are in fair condition. There are numerous standing dead trees, and live trees that have been stressed by drought. The upper crowns of a large majority of the mature trees have died back, resulting in live crown ratios of 20 to 30%. Forest Type 4 was in better overall condition. Trees retain a fair proportion of the live crown with less death of the upper canopy. The most likely explanation for the better condition is that the trees received a greater amount of moisture from rain and fog.

The Mount Sutro Open Space Reserve contains approximately 10,000 live and 3,400 dead trees, based on the size of each forest type and the density of trees per acre. Total tree density per acre (dead and living trees) ranged from 55 to 370.

The density of trees per acre in 2016 was much lower than was observed in HortScience's 1999 inventory. At that time, HortScience estimated that Reserve-wide tree density was 740 trees per acre (HortScience, 1999). Several factors may explain the difference between the 1999 and 2016 results. First, the 2016 inventory was designed to be statistically valid where the 1999 inventory was not. For this reason, the results from the 2016 inventory are more reliable. Second, the 2016 inventory had a minimum tree diameter of 2" where HortScience's minimum was 1".

In 2016, most dead blue gums were in the 2" to 12" diameter range, but larger trees have died as well. Dead trees of other species were more variable in size and often larger than 12". There were also a considerable number of large diameter dead trees on the ground. The fact that most dead blue gums were small in diameter would suggest that the forest is moving through a ***stem exclusion phase*** in response to drought stress and insect pressure. Young, small diameter trees are suppressed and die rather than becoming part of the canopy. Forest Types 2 and 3 have transitioned out of a stem exclusion phase and have very few trees under 12". Little to no regeneration is occurring within Forest Types 2 and 3, and what regeneration is occurring is not enough to offset canopy loss.

Approximately 20% of all of the inventoried trees have experienced some level of top kill. This is heavily weighted to Forest Types 1, 2 and 3. Few of these trees are expected to survive. In addition, 21% of the trees had less than 25% live crown ratio. Survival of these trees is problematic under the current conditions.

Based on the inventory results, Forest Type 1 and the southern section of Type 4 are in the most need of restoration and regeneration. Based on our observations, Types 2 and 3 are self-regulating, but will require treatment in the future, as there are no trees to replace the current and future loss of dominant trees.

Additional Observations: Decay
While the data suggests that most tree mortality is associated with drought stress and insect pressure, heart rot of woody stem was frequently observed (Photo 7).

Photo 7. Base of 45 year-old tree with decay in the center.

Most blue gum eucalyptus trees currently in the Reserve arose as stump sprouts that developed around the margin of a cut stump. As such, the attachment of the stem to the stump can be compromised by the decay. Over time, as sprouts die and are replaced, decay continues to develop. For this reason, future tree generations are going to be susceptible to issues like breakage (Photo 8) and blow-down.

Photo 8. Blue gum broke 5' above the ground due to internal decay that moved up the trunk from the root system.

Because of the presence of decay in old stumps, future regeneration must rely on planting rather than sprouting.

Additional Observations: Forest Openings

There are a few natural and created openings that are currently found within the forest canopy, on the south and west sides of the Reserve (Photo 9). Three of them are associated with the water tank on the south side of the Reserve and the pipeline that runs down the hill from it.

Photo 9. Openings in the forest canopy associated with the waterlines that lead to the water tank on the south side of the Reserve. In April 2016, these openings lacked sprouts of any kind, either from recently cut vegetation or regeneration. In addition, blackberry plants were absent.

The openings below the water tank are narrow and long. The area around the water tank is larger, mostly due to the water tank itself. Several 1 or 2 year-old seedlings were present. This is one of only two areas on the Reserve that had any signs of blue gum sprouts in April. The two lower openings are between a tenth of an acre and one quarter of an acre in size. The upper area around the tank is approximately one third of an acre in size.

If regeneration is going to be successful, then openings will need to be strategically planned and be at least 0.25 to 0.50 acre in size. The shape of these openings will likely be decided by the number and patterns of dead and dying trees to be removed. The shape of each opening and aspect with regard to the sun are additional considerations.

Additional Observations: Regeneration

Essentially no sprouting or natural regeneration is taking place. The only sprouting that was observed was in areas that had just been cut in early 2016 (Photo 10). Sprouting was only observed in locations that were in full sun.

Photo 10. New sprouts from a cut stump.

No other young trees were seen growing in the Reserve. It is unlikely that many seedlings of blue gum eucalyptus are present. The species requires bare ground to germinate. Accumulations of leaf litter and organic debris on the ground are likely to prevent successful germination and establishment (McBride and Froehlich, 1984).

Additional Observations: Groundcover plants

The ground plane of the Reserve is a mosaic of woody and herbaceous vines including, but not limited to: Himalayan blackberry, poison oak, English ivy, German ivy, Cape ivy, wild geranium and nightshade. English and German ivy will climb tree trunks and branches. These species develop in significant densities and severely limit access to the site. They are highly successful in occupying large areas of ground. Nature in the City (2010) described their importance as follows “On Mount Sutro, invasive plants are indeed the #1 problem for natural resource management and the conservation of biodiversity.”

These plants are also very difficult to control. Because most are perennial, mechanical control is rarely effective in removing underground reproductive structures. University staff and Sutro Stewards note that management of this vegetation requires hand-pulling/cutting three or four times per year.

Native Vegetation
Eighty-four (84) native species have been identified as present in the Reserve (Appendix C). There is no clear record of what plant species were present on Mount Sutro prior to Adolph Sutro's planting in 1886. Sources such as Howell *et al*. (1958) can only speculate. Examples of woody plants that were likely present on Mount Sutro prior to Sutro's planting include willow, toyon, elderberry, snowberry, coyote bush, coffee berry, ocean spray, coast live oak and Calif. bay.

Photo 11. One of the Sutro Stewards' oldest project areas, it has been restored numerous times over the last 5 years.

In 2010, Nature in the City observed that up to a dozen native plant communities once existed on Mount Sutro. Communities present in 2010 included:

- North-facing coastal scrub along the Historic Trail.
- Coastal prairie and herb understory along the road-cut of lower Medical Center Way.
  Nootka reed grass and fern community directly below the summit and on the north slope between the Historic and North Ridge Trails.
- Coastal scrub on the east ridge and above upper Medical Center Way.
- Snowberry scrub along the Mystery Trail.
- Mixed coastal scrub and grassland along the Fairy Gates Trail.
- Mixed coastal scrub /evergreen woodland understory along the trails.

The Sutro Stewards have identified approximately 11 restoration sites, 9 remnant sites, and 4 proposed restoration sites to preserve and propagate native plants (Figure 7). These are concentrated in Forest Types 1 and 4, and occur in both full-sun and shaded (below tree canopy) situations. Total acreage for restoration areas is approximately 2 acres.

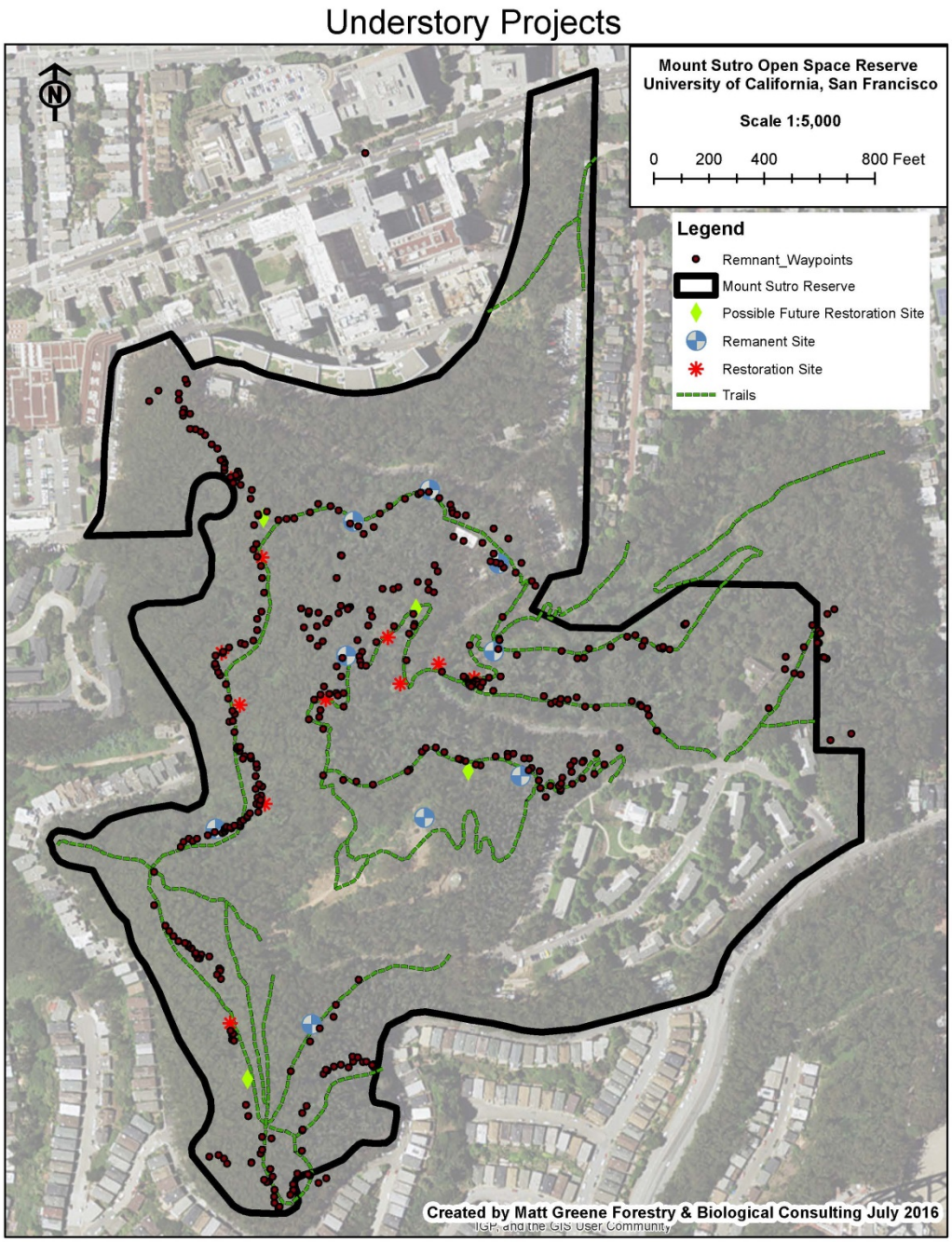


Figure 7. Location of areas of remnant native vegetation and restoration sites.

Vegetation: Summary of Existing Conditions

Vegetation in the Open Space Reserve is dominated by a canopy of blue gum eucalyptus. Other tree species, whether large, medium or small in size, are present in much numbers. The ground plane is dominated by invasive, highly competitive herbaceous and woody vegetation including Himalayan blackberry, poison oak, English ivy, German ivy, Cape ivy, wild geranium and nightshade. Small patches of native plants are present but comprise at most 2 acres of the 59 acres reviewed in this Plan.

We estimate that approximately 140 plant species are present in the Reserve (Appendix C) including approximately 84 native species and 57 non-native. Of non-native species, over 50% have been identified as invasive in the San Francisco region or problematic within the Reserve. Some of these invasive species are most vigorous plants in the Reserve and yet are the least desirable. Not only do they outcompete native plants, they compete with small blue gum seedlings and saplings.

Condition of blue gum trees has declined over the past decade, due to the effects of high stand density, prolonged drought and insect pressure. In HortScience's 1999 assessment, of 170 trees, 21 (12%) were dead. In 2016, Matt Greene observed 566 trees, of which 156 (23%) were dead. Most dead trees are in the small diameter classes. In some parts of the Reserve, small diameter trees completely absent. Of large diameter trees that form the upper canopy, approximately one-quarter have live crown ratio of <25%. Another 20% have dead tops. In short, small trees have died and large trees have declined in health.

Little or no regeneration of blue gum is occurring. The dense forest floor prevents seed from germinating and seedlings from developing. Stump sprouts are subject to decay and increased potential for failure.

In summary, the dominance of blue gum in the Reserve is unsustainable in the moderate-term. Tree health has declined over the last decade. The canopy is much thinner and more open than in the recent past. Young trees have died. Large canopy trees are not being replaced as they die or fail because little regeneration is occurring. No other tree species is poised to replace blue gum.

Analysis and Management Options

The University needs to create a vegetation management plan that can identify specific goals and develop tactics and practices to meet them. The University has four goals for the Reserve and this plan:

1. Protect the safety of Reserve users and adjoining campus and residential properties;
2. Improve and enhance the health and stability of the ecosystem;
3. Enhance the visual design and aesthetic experience;
4. Maintain and ensure public access to the Reserve.

This section describes specific aspects of each goal and how success will be determined. The management activities to achieve these goals will be presented in the next section.

Public Safety

The University regards the safety of its faculty, staff, students, and visitors as its primary concern for the Reserve. Vegetation management in the Reserve should reduce the risk of both tree failure and fire, as well as provide accessible trails (see next section). To this end, the University will continue to manage the risk that trees may fall and injure someone or damage property. The focus on tree risk management will be use areas such as housing, roads, and trails. Vegetation management will be in accordance with guidelines established by the San Francisco Fire Department and Cal Fire to create and maintain defensible space between vegetation and buildings. Along trails, vegetation management shall clear sight lines.

Reserve and Ecosystem Health

The basic premise of this goal is that healthy, diverse vegetation is the cornerstone of the University's commitment to maintaining the Reserve as open space and enhancing its use as a natural area. In addition, healthy, diverse vegetation is more stable over time.

At this time, the vegetation in the Reserve is neither particularly diverse nor healthy. Approximately 140 plant species are present. Blue gum eucalyptus is by far the dominant tree. Health of blue gums in the Reserve has declined over time. Small blue gum trees are not being recruited into the canopy. For wildlife, the best documentation of diversity is for birds with 90 - 100 species having been observed within the Reserve.

In order to improve the health of vegetation and improve the habitat for wildlife in the Reserve, we recommend the following actions:

A. Increase biodiversity of vegetation

There is a clear need to diversify forest composition and structure through planting, particularly for the tallest tree species. In addition to blue gum eucalyptus, we recommend that species such as Monterey cypress, Monterey pine, coast live oak, Calif. bay, coast redwood and other eucalyptus be planted. Creating canopy of different tree species will also create new environments for understory and ground cover vegetation.

We recommend that species diversity, both plant and wildlife, be monitored. The University should partner with groups such as the Sutro Stewards and Audubon Society for assistance in monitoring vegetation and wildlife

B. Promote native vegetation

At this time, the localized areas of native vegetation have greater diversity of species than does most of the Reserve. This diversity should be conserved and enhanced through continued planting and cultivation. This Plan recommends building on the recommendations contained in the Nature in the City (2010) report. Specifically, a long-term goal of native plant stewardship is to have viable assemblages of the seven communities observed by Nature in the City. Achieving such diversity will have the added benefits of conserving natural resources and enhancing wildlife habitat.

We assume that the University will continue to work with the Sutro Stewards to establish specific goals for native vegetation, including existing and potential species, environmental requirements, and management of competing vegetation.

C. Improve plant regeneration/recruitment

Tree species such as blue gum require growing conditions of full sun and adequate space without competition from vines and other groundcover plants. Most tree seed requires bare ground to germinate and establish. Seedlings require full sun to grow and develop. These conditions do not presently exist in the Reserve.

In order to establish good growing condition, or these reasons, successful regeneration of blue gums and other tree species into the canopy will require planting and more intensive site management. Management of competing vegetation will also be required. Because the University does not permit use of herbicides in the Reserve, other control methods will be required.

D. Manage insect and disease pressure

Blue gum eucalyptus in the Reserve has been attacked by pests such as the long-horned borer (*Phoracantha* spp.), snout beetle (*Gonipterus scutellatus*), and tortoise beetle (*Trachymela sloanei*). Under normal conditions, these insects are not a significant problem for blue gum. But under conditions of monoculture and extended drought, they will attach to stressed trees in large numbers. Reductions in canopy density of blue gums over the past several years have been extensive.

Methods to reduce insect pressure on blue gums include thinning existing stands and removing competing vegetation to reduce water stress, and performing tree work in the winter months when the insects are not active.

In addition, converting the tree canopy from a monoculture of blue gum to include species that are not susceptible to these insects will reduce the overall pressure.

E. Improve structural diversity

We describe forest structure at Mount Sutro as a mosaic of age classes, species, patch or stand sizes, canopy gaps, overstory/understory/groundcover plants, standing dead, and downed woody plants. In order to enhance structural diversity within the Reserve, the diversity of species must be increased, and the age and patch structure must be increased. Because dead trees, either standing dead or downed, represent a potential fire hazard, their retention much be balanced against goals for fire fuels management.

Visual Design and Aesthetics
Regarding the characteristics of a visual design and aesthetic that the University wants the Reserve to possess, there are at least two perspectives. One is a distant view of the Reserve from outside locations. The second is the experience of being within the Reserve. When viewed from afar, the Reserve should have continuous vegetation that screens existing structures.

The experience within the Reserve, along its trails and roads, should have a mosaic of trees, shrubs and ground cover of different types. There should be gaps in the canopy that create patterns of sun and shade, and protect users from the wind. Tree trunks should be visible. There should be gaps that allow far views out of the Reserve towards the ocean and Golden Gate Park. Wildlife should be encouraged.

We believe the qualities that create a healthy forest also result in a visually stimulating experience of the Reserve.

Public Access
The primary public access into the Reserve is a system of multi-use trails. This system was identified in the 1996 LRDP (Figure 6). The existing trail system will be supplemented by two new trails. At this time, the Clarendon Trail is under construction, and the Sunset Trail is being designed.

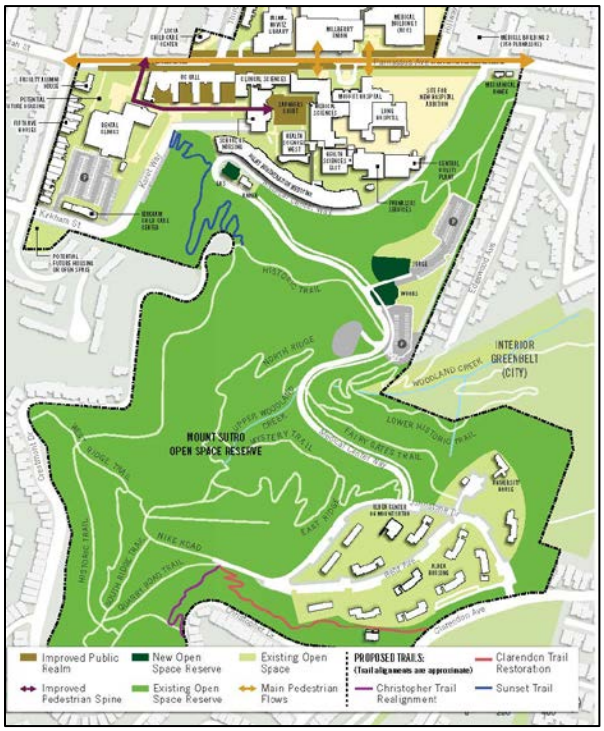


Figure 8. Existing and proposed trail system for the Mount Sutro Open Space Reserve. Source: Long Range Development Plan. 1996.

Maintaining and improving access to the Reserve's trail system is a cooperative effort between the University and the Sutro Stewards. Trails are maintained to prevent encroachment by vegetation and to improve/maintain walkability.

Desired Future Conditions
If healthy, diverse vegetation is the cornerstone of the University's commitment to maintaining the Reserve as open space and enhancing its use as a natural area, then what actions should the University take to attain that goal?

First, growing conditions appropriate for species such as blue gum need to be created. This will require thinning existing stands and removing trees to create full-sun gaps in the canopy as well as clearing and maintaining competing vines and vegetation. Only under these conditions can successful growth and regeneration of tall trees take place.

Second, under ideal conditions, the forest should have many more trees in the small diameter classes than in the large diameter class (Figure 9). Based on our observations, we do not believe that the existing forest will ever attain this distribution on its own. For these reasons, we believe the only path to healthy diverse vegetation involves active management and silvicultural treatment.

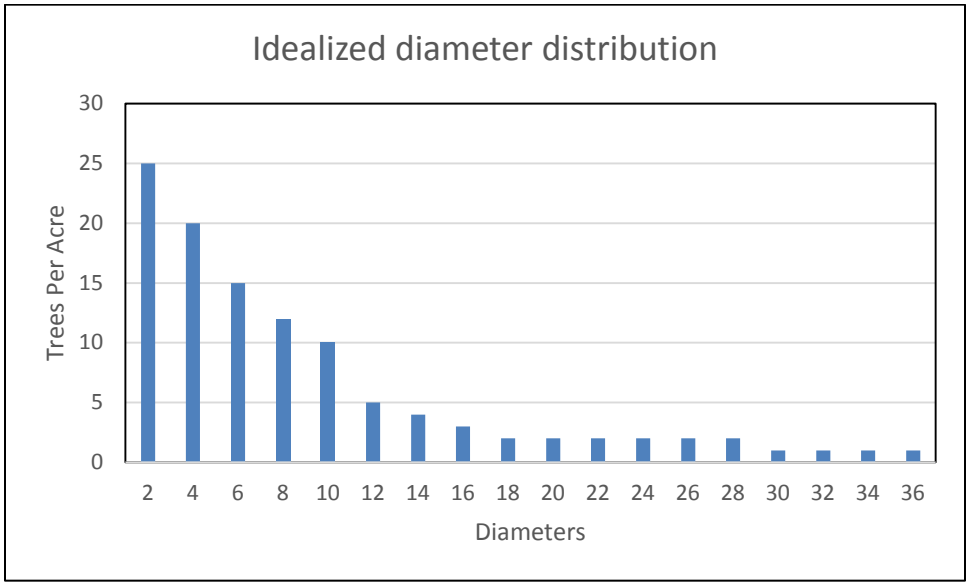


Figure 9. An inverse J-shaped pattern of trunk diameters is the desired condition in uneven-aged forest stands. In the Reserve, trunk diameter distribution in Forest Type 1 adheres to this pattern. Forest Type 4 approaches this distribution. Forest Types 2 and 3 do not.

Because the vegetation and existing conditions vary with the four Forest Types, recommended treatments are specific to each Forest Type:

- Forest Type 1 is currently over-stocked and should be thinned of its dead, dying, unhealthy and structurally unsound trees to between 75 and 100 trees per acre.

- Forest Type 2 has no small diameter trees. Insufficient regeneration is occurring to sustain (and if necessary replace) the existing overstory trees. We recommend it be managed to 50 to 75 trees per acre. A second age class should be established. A long-term goal within this type will be to establish new age classes every 10 to 15 years as needed to maintain 50 to 75 healthy trees per acre.

- Forest Type 3 may be able to sustain 75 to 100 trees per acre. A high percentage of trees have low live crown ratios, but without dieback of the upper crown. A second age class should be established. A long-term goal within this type will be to establish new age classes every 10 to 15 years as needed to maintain at least 50 to 75 healthy trees per acre.

- Forest Type 4 is in the best overall condition. Drought stress is mitigated by summer fog. It is likely that this type can sustain 80 to 100 trees per acre moving forward.

Finally, a desired future condition for the Reserve includes healthy, diverse patches of native vegetation. These are unique assemblages of plants that represent the pre-settlement vegetation of the Reserve. The existing native plant assemblages are resources that need to be managed just as other resources in the Reserve. The 2010 report prepared by Nature in the City serves as an excellent starting point for a formal plan as does the map (Figure 7) created by the Sutro Stewards.

In some locations, native vegetation benefits from the presence of an overhead tree canopy. In other situations, plants that require full sun would benefit from areas that lack canopy. UCSF and the Sutro Stewards have worked together to locate areas of native plants and provide stewardship for their care.

Forest Treatments
Silviculture is the art and science of growing trees, including establishment, growth, composition, health, and quality of forests. The following are treatments appropriate for the Open Space Reserve.

1. **Individual Tree Selection Method**
   Individual trees are removed to: 1) promote growth of remaining trees, 2) reduce the number of dead trees, 3) provide space for new regeneration, 4) to provide defensible space, 5) reduce fuel loads, 6) enhance or establish views, and 7) reduce risk of tree failure and injury or damage.

2. **Group Selection Method**
   Small openings of 2.5 acres or less are created by removing dead, dying, unhealthy and structurally unsound trees to: 1) promote the growth of remaining trees, 2) reduce the number of dead trees, 3) provide space for new regeneration, 4) reduce risk of tree failure and 5) reduce fuel loads. The shape of openings varies in order to maximize openings and orientation to the sun.

3. **Seed Tree Method**
   Dead, dying, unhealthy and structurally unsound trees, are removed in areas between 0.5 and 5 acres. Healthy trees are retained to restock the forest.

In each of the above treatments, trees may be felled, bucked into smaller pieces, moved off site, or left to lay on the ground floor (Photo 12). Small diameter trees may be chipped, masticated, or ground with the remains spread across the forest floor. Individual trees may be pruned. Standing dead trees should be removed near use areas, but can be retained elsewhere.

Various pieces of equipment may be utilized in the process of removing trees and include the following and likely more: hand saws, chainsaw, harvesters, masticators, chippers, grinders, skidding equipment, loaders, and other commonly employed equipment. The least invasive equipment should be used, but this will be determined on a site by site basis. No herbicides should be used to facilitate the maintenance of vegetation.

Photo 12. Downed trees in contact with the forest floor will decompose faster. Removing branches from downed trees should occur in high use areas to reduce safety hazards, reduce fuel loads, aid in decomposition and increase forest aesthetics.

4. Understory Removal

Removing competing vegetation (e.g. non-native blackberry, ivy, and other vine species) will permit natural and planted trees to become established (Photo 13). This treatment may be done as a stand alone or in combination with other treatments (see Habitat City 2012).

Understory removal will not use herbicides. Removal will occur by hand or by equipment. Treatment should focus on removing as much of the root system as possible so that brushing and trimming is kept to a minimum.

Photo 13. Two areas where the non-native ivy, blackberry and other vines have successfully been removed.

Management Plan Recommendations

This section provides recommendations and implementation to achieve the Plan goals.

Phase 1 (Initial 5 years)

1. **Continue to manage tree risk**

   UCSF currently manages tree risk by a) routine inspections by staff as part of daily operations and 2) bi-annual assessment of trees within and adjacent to use areas of the Reserve by an outside contractor. Within the Reserve, the contractor examines trees adjacent to streets, driveways, buildings, parking and trails.

   Assessment of trees along designated trails focuses on trees with a high potential for failure that could strike the trail. In the recent past, such trees have been 18" or less in diameter, and either dead, dying or leaning towards the trail. Because of the density of low shrubs and vines, access to trees located off-trail is problematic. Assessment has generally been limited to less than 25' on either side of a trail.

   We recommend:

   a) The inspection area along trails should be enlarged to 50' on either side of the trail. This will treat approximately 18 acres of the Reserve.

   b) Drive-by and walk-by inspections of use areas should occur following storm events.

   c) Where appropriate, combine tree risk assessment and abatement with other forest management activities.

2. **Initiate forest treatments**

   UCSF does not currently have a program of forest treatment to establish a new generation of trees in the Reserve. It is clear that such a program is necessary for the long-term health of trees in the Reserve. To this end, we believe the University must treat areas of the Reserve to 1) remove dead, dying, unhealthy and structurally unsound trees, 2) control low-growing vines and shrubs that would compete with desired vegetation, 3) prevent sprouts from decayed stumps, and 4) plant new trees.

   We recommend:

   a) Establish two seed tree treatments in Forest Type 1 (Figure 10). Approximately 1.5 acres in total. Plant blue gum eucalyptus. Planting of trees will likely be on a 20' X 20' spacing for forest types 1, 2 and 3. This would produce a future stand of approximately 100 trees per acre with 100% survival. Supplemental replanting may be required to maintain a minimum of 75 trees per acre.

b) Establish 8 group selection treatments in Forest Type 1 (Figure 10). Approximately 2.5 acres in total. Plant blue gum eucalyptus or other eucalyptus species. Planting of trees will likely be on a 20' X 20' spacing for forest types 1, 2 and 3. This would produce a future stand of approximately 100 trees per acre with 100% survival. Supplemental replanting may be required to maintain a minimum of 75 trees per acre. Retain 2 to 3 snags per acre in areas where safety isn't a high concern.

None of the above will be successful if competing understory vines and vegetation are not controlled.

3. **Continue to enhance restoration and stewardship of native plants.**
UCSF cooperates with the Sutro Stewards to conserve and enhance areas of native plants. The Plan supports this effort to diversify plant species and habitats within the Reserve.

We recommend:

a) The University and Sutro Stewards should continue to build on the 2010 Nature in the City recommendations in both the short- and long-term.

b) The University should expand native plant conservation from the existing 2 acres to 5 acres.

4. **Continue to enhance defensible space between buildings and Reserve vegetation.**
USCF has set a goal of defensible space of 30' to 100' between buildings and Reserve vegetation. Within 30', all flammable vegetation is removed and lower tree branches are removed to provide 10' clearance to the ground. Between 30' and 100' low branches (ladder fuels) are removed.

We support this goal. Open areas created by tree removal may be suitable for restoration with native plant species. Removing tall trees within 30' of buildings, roads and neighboring properties would encompass approximately 14 acres.

5. **Continue to manage and maintain trails and public access.**
In cooperation with the Sutro Stewards, the University maintains a system of trails throughout the Reserve. We support this goal and recommend:

a) Continue to maintain vegetation within 5' to 10' on either side of trails (where appropriate).

b) Restrict non-woody vegetation to a height of 3' in order to maintain sight lines into the forest.

c) Design trails to be at least 5' wide, which would allow passage of a bike and a person at the same point.

d) Use downed logs to define and support trails, placing logs on the downhill side.

Figure 10. Proposed treatment areas. Forest Type 1. Phase 1.

Phase 2 (Years 6 to 10)
This phase of the project is going to focus on forest restoration and regeneration. It is critical to begin establishing a new forest to prepare for future generations to enjoy the experience of the property. During this period, tree species other than blue gum will be used in order to diversity the canopy.

1. **Forest treatments**
   Continue the initial program of forest treatment to establish a new generation of trees in the Reserve. Continue to treat areas of the Reserve to 1) remove dead, dying, unhealthy and structurally unsound trees, 2) control low-growing vines and shrubs that would compete with desired vegetation, 3) prevent sprouts from decayed stumps. and 4) install new trees.

   We recommend:
   a) Begin removing dead, dying, unhealthy and structurally unsound trees in Forest Types 1, 3 and 4 to achieve desirable stand densities. Start in locations that are ***least likely*** to undergo reforestation. Remove 50 to 65 trees per acre in Forest Type 1; 20 to 25 in Forest Type 3 and 10 to 15 in Forest Type 4. Focus removal on dying, structurally unsound, and unhealthy trees, particularly when less 18" diameter. In all three Forest Types, focus removal on species other than blue gum.

   b) Treat rest of Forest Type 1 with either group selection or seed tree treatments. Initially focus on areas where there is a low tree density. Such locations encompass several critical elements tied to planting success: slope, aspect, and thin overhead canopy. Plant blue gum and possibly other eucalyptus species in 50% of locations; non-eucalyptus in the other 50%. Plant on a 20' X 20' spacing for forest types 1, 2 and 3, with eucalyptus on the more exposed (to sunlight) sides of the openings. This would produce a future stand of approximately 100 trees per acre with 100% survival. Supplemental replanting may be required to maintain a minimum of 75 trees per acre.

   c) Treat Forest Types 2 and 3, and 4 with either group selection or seed tree treatments. Initially focus on areas where there is a low tree density. Such locations encompass several critical elements tied to planting success: slope, aspect, and thin overhead canopy. Plant eucalyptus in 50% of locations; non-eucalyptus in the other 50%. Plant on a 20' X 20' spacing for forest types 1, 2 and 3, with eucalyptus on the more exposed (to sunlight) sides of the openings. This would produce a future stand of approximately 100 trees per acre with 100% survival. Supplemental replanting may be required to maintain a minimum of 75 trees per acre.

2. **Continue to manage tree risk.**

3. **Continue to conserve and nurture native plant restoration.**

4. **Continue to manage defensible space between buildings and Reserve vegetation.**

5. **Continue to manage and maintain trails and public access.**

At the end of year 10, we hope to accomplish the following:

- Reduce the risk of tree failure and injury/damage.
- Reduce competition within Forest Types for water and growing space.
- Restoration of at least five acres of native vegetation.
- Establish at least 10 acres of young healthy new forests.
- Move Forest Types 1 and 4 towards an uneven-aged condition and Types 2 & 3 towards a two-age class forest.
- Better understand the climate issues which affect the forest.
- Provide improved access and enhanced visitor experience.

Phase 3 (Years 11 to 20)
This phase of the project will treat the remaining acres that have not been treated in the first two phases. During this period, a mixture of tree species will be used in order to diversity the canopy.

Before starting on any treatments, however, we recommend that the forest inventory be updated. Such an update will provide feedback on the effectiveness of the treatments over the first 10 years, make new recommendations (or reinforce the existing treatments) about how to manage the Reserve, document shortcomings in existing knowledge and data, and fill answers in any unanswered questions.

1. **Forest treatments**
   Continue the initial program of forest treatment to establish a new generation of trees in the Reserve. Continue to treat areas of the Reserve to 1) remove dead, dying, unhealthy and structurally unsound trees, 2) control low-growing vines and shrubs that would compete with desired vegetation, 3) prevent sprouts from decayed stumps, and 4) install new trees.

   We recommend:
   a. Continue removing dead, dying, unhealthy and structurally unsound trees in Forest Types 1, 2, 3 and 4 to achieve desirable stand densities. Start in locations that are ***least likely*** to undergo reforestation. Focus removal on dying, structurally unsound, and unhealthy trees, In all four Forest Types, focus removal on species other than blue gum.

   b. Treat the Forest Types with a mix of single tree selection, group selection, or seed tree treatments. Plant blue gum and possibly other eucalyptus species in 50% of locations; non-eucalyptus in the other 50%. Plant on a 20' X 20' spacing for forest types 1, 2 and 3, with eucalyptus on the more exposed (to sunlight) sides of the openings. This would produce a future stand of approximately 100 trees per acre with 100% survival. Supplemental replanting may be required to maintain a minimum of 75 trees per acre.

2. **Continue to manage tree risk.**

3. **Continue to conserve and nurture native plant restoration.**

4. **Continue to manage defensible space between buildings and Reserve vegetation.**

5. **Continue to manage and maintain trails and public access.**

Monitoring

Monitoring is an integral part of this Plan. The effectiveness of specific treatments can only be assessed over time, by comparing the initial conditions with those that develop as trees mature. Monitoring should consist of:

A. Re-visiting the forest inventory plots established in spring 2016. Locations were marked with GPS. These sites could be revisited every 10 years to assess forest health and structure.

B. Monitoring of each individual treatment should occur upon completion of the project and in years 1, 3 and 5 after establishment. This is a fairly common time response for plant species projects. At each project site, the following should be noted:

    1. Number and rough location of each planted tree.
    2. Overall plant survival.
    3. Effectiveness of vegetation management treatments such as mulching and black fabric.
    4. Tree height and diameter growth.
    5. Need for supplemental irrigation.
    6. Resprouting of stumps whether treated or not.

C. In conjunction with the Sutro Stewards, the University should maintain an inventory of plants growing within the Reserve.

D. In conjunction with the local Audubon Chapter and/or interested birders, the University should maintain an inventory of birds both observed and nesting in the Reserve.

E. The University should reach out to other non-profit groups to establish monitoring programs for wildlife, reptiles and amphibians, insects such as butterflies, etc.

F. The University should consider establishing a feedback system where visitors and others could comment on their enjoyment of the Reserve. Being able to report hazards, people camping, new wildlife, or other things which one might observe could be a valuable resource.

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APPENDICES

A. Definitions discussed by the Technical Advisory Committee.

B. Bird species observed in the Mount Sutro Open Space Reserve.

C. Plant species observed in the Mount Sutro Open Space Reserve.

D. Wildlife species observed in the Mount Sutro Open Space Reserve.

E. Glossary

APPENDIX A. Definitions discussed by the project team and Technical Advisory Committee and their application to vegetation management. Mount Sutro Open Space Reserve.

Term	Definition	Definition in relation to the Mount Sutro Open Space Reserve
Biodiversity	The variety of life forms within a system.	As a novel ecosystem, biodiversity at Mount Sutro is a construct, resulting from the conversion of the native scrub and chaparral community to a blue gum plantation. Among woody plants,16 species native to Mount Sutro and 16 non-native species have been identified. Among birds, 75 species have been observed on or near the site. Little or no data is available for other indicators of diversity.
Cultural landscape	Sites associated with a significant event, activity, person or group of people. Also used to describe historic landscapes. http://tclf.org/landscapes/what-are-cultural-landscapes	Mount Sutro is one of areas in San Francisco that became forested as a result of tree planting. Examples include sections of The Presidio, Mount Davidson, and McLaren Park. These locations have cultural significance in their origin, unique vegetation and presence in the dense urban environment.
Defensible space	The natural and landscaped area around a structure that has been maintained and designed to reduce fire danger. In January 2005. California law extended the defensible space clearance around homes and structures from 30 feet to 100 feet.	In the context of Mount Sutro, the University relies on the advice and direction of the San Francisco Fire Department and CalFire in establishing guidelines for defensible space. Near structures and use areas, the University has a goal of 100' of defensible space.
Ecosystem health	The condition of an ecosystem.	As a novel ecosystem, ecosystem health of the Mount Sutro Open Space Reserve has to reflect its unique character. Indicators could include 1) healthy forest and understory canopy, and 2) diversity (including forest and open areas, structural diversity in forest). Maintenance of ecosystem health will require human intervention.

APPENDIX A, continued. Definitions discussed by the project team and Technical Advisory Committee and their application to vegetation management. Mount Sutro Open Space Reserve.

Term	Definition	Definition in relation to the Mount Sutro Open Space Reserve
Forest	An area of land covered chiefly with naturally occurring trees and undergrowth.	Mount Sutro is covered by trees planted by Adolph Sutro. In that sense, it is not a forest and might be more appropriately described as a plantation. UCSF designated 61 acres as the Open Space Reserve rather than forest. That said, the Open Space Reserve has a long history of being referred to, and viewed, as a forest.
Forest health	The perceived condition of a forest may be derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stand that comprises the forest, and the appearance of the forest at a point in time. Society of American Foresters *Dictionary of Forestry.*	Improving the health of trees in the Mount Sutro Open Space Reserve would involve: 1) improving the vigor of individual trees by reducing insect pressure. reducing water stress by thinning & managing competing vegetation, and 2) increasing age and species diversity.

APPENDIX A, continued. Definitions discussed by the project team and Technical Advisory Committee and their application to vegetation management. Mount Sutro Open Space Reserve.

Term	Definition	Definition in relation to the Mount Sutro Open Space Reserve
Invasive species	California Invasive Plant Council (www.cal-ipc.org/ip/definitions/index.php) . When plants that evolved in one region of the globe are moved by humans to another region, a few of them flourish, crowding out native vegetation and the wildlife that feeds on it. These invasive plants have a competitive advantage because they are no longer controlled by their natural predators. Invasive non-native plants that threaten wildlands are plants that 1) are not native to, yet can spread into, wildland ecosystems, and that also 2) displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.	For the Mount Sutro Open Space Reserve, invasive plants to be addressed are those identified by the California Invasive Plant Council as having either moderate or high invasive potential, including but not limited to: English and German ivies, Himalayan blackberry, panic veldtgrass, Bermuda buttercup, and French and Scotch brooms. Blue gum eucalyptus is designated "limited" invasive potential.
Novel ecosystem	Human-built, modified, or engineered niches of the recent past; existing in places that have been altered in structure and function by human agency and lacking natural analogs. A defining characteristic of a novel ecosystem is a change in species composition relative to ecosystems present in the same biome prior to crossing a threshold." Morse *et al.* 2014. *Ecology & Society* 19(2): 12.	Mount Sutro Open Space Reserve is a classic novel ecosystem. Prior to Adolph Sutro's tree planting, the Reserve was likely covered with coastal sage scrub and chapparal vegetation with oak, bay and willow. The Reserve did not support a continuous canopy of trees. Some remnants of the native vegetation remain but the site is dominated by non-native tree species. The Reserve exists within a completely urban environment. Maintaining tree canopy requires human intervention.

APPENDIX A continued. Definitions discussed by the project team and Technical Advisory Committee and their application to vegetation management. Mount Sutro Open Space Reserve.

Term	Definition	Definition in relation to the Mount Sutro Open Space Reserve
Stewardship	The responsible planning & management of resources.	As the owner of Mount Sutro, the University of California takes the leadership role in planning and managing resources. It does so within the context of the proposed management plan and EIR. A key partner in this effort is the Sutro Stewards, a non-profit group. UCSF may interact with other organizations with a focus on the stewardship of public lands (e.g., Audubon Society, California Native Plant Society, Xerces Society).
Sustainability	The capacity to remain productive and diverse. To create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations. http://www.epa.gov/sustainability/learn-about-sustainability#what	For Mount Sutro, sustainability involves balancing the needs of humans and nature so that both benefit, now and into the future. The needs of humans are primarily access, safety and an experience with nature. For the vegetation, the needs are to foster healthy plants of all types, remove highly invasive species, and create diversity. Because it a planted forest, trees and other vegetation at Mount Sutro will require on-going stewardship.
Sustainable ecosystem	A biological environment and series of habitats that is able to thrive and support itself without outside influence or assistance. http://www.ehow.com/facts_7398138_sustainable-ecosystem_.html	Maintaining a tree canopy at the Open Space Reserve requires stewardship by the University and its partners. Regeneration of remnant native areas may occur naturally, if growing conditions are met. As such, sustainable ecosystem means creating and nurturing, a diverse series of habitats and species that are stable over decades, so long as human intervention is present.

APPENDIX B. Bird species seen in the Mount Sutro Open Space Reserve as reported at http://ebird.org, a program of Cornell Lab of Orinthology. Data accessed July 21, 2016.

Acorn Woodpecker
Allen's Hummingbird
American Crow
American Goldfinch
American Robin
Anna's Hummingbird
Ash-throated Flycatcher
Band-tailed Pigeon
Black Phoebe
Blackbird sp.
Black-headed Grosbeak
Brown Creeper
Brown-headed Cowbird
Bullock's Oriole
Bushtit
Buteo sp.
California Towhee
Caspian Tern
Cassin's Vireo
Cedar Waxwing
Chestnut-backed Chickadee
Common Raven
Cooper's Hawk
Dark-eyed Junco
Downy Woodpecker
Downy/Hairy Woodpecker
Eurasian Collared-Dove
European Starling
Fox Sparrow
Golden-crowned Sparrow
Great Horned Owl
Greater White-fronted Goose
Gull sp.
Hairy Woodpecker
Hermit Thrush
Hermit Warbler
Hooded Oriole
House Finch
House Sparrow

APPENDIX B continued. Bird species seen in the Mount Sutro Open Space Reserve as reported at http://ebird.org, a program of Cornell Lab of Orinthology. Data accessed July 21, 2016.

House Wren
Hummingbird sp.
Hutton's Vireo
Lazuli Bunting
Lesser Goldfinch
Mourning Dove
Nashville Warbler
Northern Flicker
Nuttall's Woodpecker
Olive-sided Flycatcher
Orange-crowned Warbler
Osprey
Pacific Wren
Pacific-slope Flycatcher
Pacific-slope/Cordilleran Flycatcher (Western Flycatcher)
Peregrine Falcon
Pigeon/dove sp.
Pine Siskin
Purple Finch
Pygmy Nuthatch
Red-breasted Nuthatch
Red-breasted Sapsucker
Red-masked Parakeet
Red-shouldered Hawk
Red-tailed Hawk
Rock Pigeon
Rose-breasted Grosbeak
Ruby-crowned Kinglet
Rufous/Allen's Hummingbird
Sharp-shinned Hawk
Song Sparrow
Spizella sp.
Spotted Towhee
Steller's Jay
Swainson's Thrush
Townsend's Warbler
Turkey Vulture
Varied Thrush

APPENDIX B continued. Bird species seen in the Mount Sutro Open Space Reserve as reported at http://ebird.org, a program of Cornell Lab of Orinthology. Data accessed July 21, 2016.

Violet-green Swallow
Warbling Vireo
Western Gull
Western Scrub-Jay
Western Tanager
Western Wood-Pewee
White-crowned Sparrow
White-throated Sparrow
White-throated Swift
Wilson's Warbler
Yellow Warbler
Yellow-rumped Warbler

http://ebird.org/ebird/hotspot/L1011743?yr=all&m=&rank=mrec&hs_sortBy=taxon_order&hs_o=desc

APPENDIX C. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Silver wattle	*Acacia dealbata*	Non-native; moderate	Large shrub/small tree
Ncn	*Acacia decurrens*	Non-native	Tree
Blackwood acacia	*Acacia melanoxylon*	Non-native; limited	Medium tree
Yarrow	*Achillea millefolium*	Native	Herbaceous perennial
Calif. buckeye	*Aesculus californica*	Native	Tree
Wild onion	*Allium* sp.	Non-native; problematic	Herbaceous perennial
Pearly everylasting	*Anaphalis margaritacea*	Native	Herbaceous perennial
Angelica	*Angelica hendersonii*	Native	Herbaceous perennial
Columbine	*Aquilegia Formosa*	Native	Herbaceous perennial
Elk clover	*Aralia californica*	Native	Herbaceous perennial
Madrone	*Arbutus menziesii*	Native	Tree
Pipevine	*Aristolochia californica*	Native	Herbaceous vine
Calif. sagebrush	*Artemesia californica*	Native	Shrub
Mugwort	*Artemisia douglasiana*	Native	Shrub
Wild oats	*Avena barbata, A fatua*	Non-native; moderate	Grass
Coyote bush	*Baccharis pilularis consanguinea*	Native	Shrub
Barberry	*Berberis pinnata*	Native	Shrub
Calif. brome	*Bromus carinatus*	Native	Grass
Ripgut brome	*Bromus diandrus*	Non-native; moderate	Grass
Brome	*Bromus stamineus*	Non-native	Grass

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Nootka reedgrass	*Calamagrostis nutkaensis*	Native	Perennial grass
Morning glory	*Calystegia purpurata*	Native	Herbaceous vine
Milk maids	*Cardamine californica* var. *integrifolia*	Native	Herbaceous perennial
Bitter cress	*Cardamine oligosperma*	Native	Herbaceous perennial
Italian thistle	*Carduus pycnocephalus*	Non-native; moderate	Herbaceous perennial
Sedge	*Carex barbarae*	Native	Perennial sedge
Rock sedge	*Carex brevicaulis*	Native	Sedge
She-oak	*Casuarina stricta* (planted)	Non-native	Tree
Carmel ceanothus	*Ceanothus griseus*	Non-native	Shrub
Blue blossom	*Ceanothus thyrsiflorus*	Native	Shrub
Valerian	*Centranthus ruber*	Non-native	Herbaceous perennial
Soap plant	*Chlorogalum pomeridianum divaricatum*	Native	Herbaceous perennial
Soaproot	*Chlorogalum pomridianum*	Native	Herbaceous perennial
Cineraria	*Cineraria cruentus*	Non-native	Herbaceous perennial
Indian thistle	*Cirsium brevistylum*	Native	Herbaceous perennial
Miner's lettuce	*Claytonia perfoliata*	Native	Herbaceous annual
Poison hemlock	*Conium maculatum*	Non-native; moderate; probelmatic	Herbaceous shrub
Mirror plant	*Coprosma repens*	Non-native	Shrub

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Cotoneaster	*Cotoneaster franchetii*	Non-native; moderate	Shrub
Parney's cotoneaster	*Cotoneaster lacteus*	Non-native; moderate	Shrub
Nutsedge	*Cyperus* ssp.	Non-native; problematic	Annual or perennial
Scotch broom, English broom	*Cytisus scoparius*	Non-native; high	Shrub
Portugese broom, hairy-fruited broom	*Cytisus striatus*	Non-native; moderate	Shrub
Cape-ivy	*Delairea odorata*	Non-native; moderate; probelmatic	Herbaceous vine
Bleeding heart	*Dicentra formosa*	Native	Herbaceous perennial
Blue dicks	*Dichelostemma capitatum*	Native	Herbaceous perennial
Wood fern	*Dryopteris arguta*	Native	Fern
Panic veldtgrass	*Ehrharta erecta*	Non-native; moderate; probelmatic	Perennial grass
Blue wildrye	*Elymus glaucus*	Native	Perennial grass
Willow herb	*Epilobium brachycarpum*	Native	Herbaceous perennial
Willow herb	*Epilobium ciliatum*	Native	Herbaceous perennial
Australian fireweed	*Erechtites glomerata*	Non-native; moderate	Herbaceous perennial
Seaside daisy	*Erigeron glaucus*	Native	Herbaceous perennial
Lizard tail	*Eriophyllum staechadifolium*	Native	

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Calif. poppy	*Eschscholzia californica*	Native	Herbaceous annual
Blue gum, Tasmanian blue gum	*Eucalyptus globulus*	Non-native; limited	Large tree
Red fescue	*Festuca rubra*	Native	Grass
Woodland strawberry	*Fragaria vesca*	Native	Perennial
Coffeeberry	*Frangula californica*	Native	Shrub
Mission bells	*Fritillaria affinis*	Native	Herbaceous perennial
Fumaria	*Fumaria officinalis*	Non-native; problematic	Herbaceous
Bedstraw	*Galium aparine*	Native	Herbaceous perennial
Bedstraw	*Galium aparine*	Non-native	Herbaceous perennial
French broom	*Genista monspessulana*	Non-native; high	Shrub
Wild geranium	*Geranium maculatum*	Non-native; problematic	Herbaceous perennial
Red Robert	*Geranium robertianum*	Non-native	Herbaceous perennial
San Francisco gumplant	*Grindelia hirsutula maritime*	Native	Herbaceous perennial
Algerian ivy	*Hedera canariensis*	Non-native; high; problematic	Woody vine
English ivy	*Hedera helix*	Non-native; high; problematic	Woody vine
Cow parsnip	*Heracleum maximum (lantaum)*	Native	Herbaceous shrub
Monterey cypress	*Hesperocypraris macrocarpa*	Non-native	Tree

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Toyon	*Heteromeles arbutifolia*	Native	Shrub
Hawkweed	*Hieracium albiflorum*	Native	Herbaceous perennial
Oceanspray	*Holodiscus discolor*	Native	Shrub
Foxtail, Italian wild rye	*Hordeum murinum leporinum*	Non-native; moderate	Grass
English holly	*Ilex aquifolium*	Non-native; moderate; probelmatic	Shrub
Douglas iris	*Iris douglasiana*	Native	Herbaceous perennial
Toad rush	*Juncus bufonius*	Native	Herbaceous perennial
Blue rush	*Juncus patens*	Native	Herbaceous perennial
Hillside pea	*Lathyrus vestitus vestitus*	Native	Herbaceous perennial
Italian rye	*Lolium multiflorum*	Non-native; moderate	Grass
Honeysuckle	*Lonicera hispidula* var. *vacillans*	Native	Woody vine
Twinberry	*Lonicera involucrate ledebourii*	Native	Vine
Wood rush	*Luzula comosa*	Native	Herbaceous perennial
Slim solomon	*Maianthemum racemosum*	Native	Herbaceous perennial
Manroot	*Marah fabaceus*	Native	Herbaceous perennial
Melic grass	*Melica torreyana*	Native	Herbaceous perennial
Sticky monkey flower	*Mimulus aurantiacus*	Native	Woody perennial

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Myoporum	*Myoporum laetum*	Non-native; moderate	Shrub
Forget-me-not	*Myosotis sylvatica*	Non-native; limited; problematic	Herbaceous perennial
Osoberry	*Oemleria cerasiformis*	Native	Shrub
Sweet ciceley	*Osmorhiza chilensis*	Native	Herbaceous perennial
Oxalis	*Oxalis incarnatum*	Non-native	Herbaceous perennial
Bermuda buttercup	*Oxalis pes-caprae*	Non-native; moderate; probelmatic	Herbaceous perennial
Goldback fern	*Pentagramma triangularis*	Native	Fern
Stinging phacelia	*Phacelia malvifolia*	Native	Herbaceous annual
Monterey pine	*Pinus radiata*	Non-native	Tree
Victorian box	*Pittosporum undulatum*	Non-native	Shrub
English plantain	*Plantago lanceolata*	Non-native; limited	Herbaceous perennial
Polpody fern	*Polypodium (glycchiriza)*	Native	Fern
Calif. polypody	*Polypodium californica*	Native	Fern
Leather fern	*Polypodium scouleri*	Native	Fern
Sword fern	*Polystichum munitum*	Native	Fern
Fern	*Polystichum* sp.	Native	Fern
Fairy bells	*Prosartes hookeri (Disporum hookeri)*	Native	Herbaceous perennial
Cherry plum	*Prunus cerasifera*	Non-native; limited; problematic	Small tree
Bracken fern	*Pteridium aquilinum*	Native	Fern
Coast live oak	*Quercus agrifolia*	Native	Tree

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Pink currant	*Ribes sanguineum glutinosum*	Native	Shrub
Wood rose	*Rosa gymnocarpa*	Native	Shrub
Himalayan blackberry	*Rubus armeniacus (discolor)*	Non-native; high; problematic	Trailing shrub
Thimbleberry	*Rubus parviflorus*	Native	Trailing shrub
Calif. blackberry	*Rubus ursinus*	Native	Woody vine
Willow	*Salix* sp.	Native	Tree
Lily of the valley vine	*Salpichroa rhomboidea* (at granite pile MCW)	Non-native	Herbaceous vine
Hummingbird sage	*Salvia spathacea*	Native	Herbaceous perennial
Red elderberry	*Sambucus racemosa*	Native	Shrub
Woodland sanicle	*Sanicula crassicaulis*	Native	Herbaceous perennial
Bee plant	*Scrophularia californica*	Native	Herbaceous perennial
German ivy	*Senecio mikanioides*	Non-native; problematic	Herbaceous vine
Coast redwood	*Sequoia sempervirens*	Non-native	Tree
Blue-eyed grass	*Sisyrinchium bellum*	Native	Herbaceous perennial
Slim Solomon	*Smilacina stellata*	Native	Herbaceous perennial
New Zealand nightshade	*Solanum aviculare*	Non-native; problematic	Herbaceous vine
Nightshade	*Solanum dulcamara*	Non-native; problematic	Herbaceous vine
Nightshade	*Solanum furcatum*	Non-native	Herbaceous perennial

APPENDIX C, continued. Plants observed in the Mount Sutro Open Space Reserve. See notes at end of Appendix.

Common name	Scientific name	Native or Invasive Category	Plant type
Poroporo/kangaroo apple	*Solanum laciniatum*	Non-native	Herbaceous perennial
Black nightshade	*Solanum nigrum*	Non-native; problematic	Herbaceous vine
Sow thistle	*Sonchus oleraceus/asper*	Non-native	Herbaceous perennial
Wood mint	*Stachys ajugoides*	Native	Herbaceous perennial
Chickweed	*Stellaria media*	Non-native	Herbaceous perennial
Snowberry	*Symphoricarpos albus*	Native	Shrub
Fringe cups	*Tellima grandiflora*	Native	Herbaceous perennial
Torilis	*Torilis arvensis*	Non-native; moderate	Herbaceous perennial
Poison oak	*Toxicodendron diversilobum*	Native; problematic	Trailing shrub
Trillium	*Trillium chloropetalum*	Native	Herbaceous perennial
Triteleia	*Triteleia* sp.	Native	Herbaceous perennial
Nasturtium	*Tropaeolum majus*	Non-native	Herbaceous perennial
Calif. bay	*Umbellularia californica*	Native	Tree
Stinging nettle	*Urtica dioica holosericea*	Non-native	Herbaceous perennial
Periwinkle	*Vinca major*	Non-native; moderate	Herbaceous vine

Source: Nature in the City (2010), Sutro Stewards (2016). Invasive categories from Calif. Invasive Plant Council.

APPENDIX D. Wildlife observed in the Mount Sutro Open Space Reserve (Nature in the City 2010)

Mammals

Insectivora
California Mole
Vagrant Shrew
Ornate Shrew

Bats
Hoary Bat
Mexican free-tailed bat
California Myotis
Pallid Bat

Carnivora
Coyote
Grey Fox
Red fox

Procyonids
Raccoon

Rodents
California Vole
Deer Mouse
Eastern Grey Squirrel
Black Rat
Norway Rat

Reptiles

Lizards
San Francisco N. Alligator Lizard
Southern Alligator Lizar
Western Fence Lizard
Western Skink

Snakes
Terrestrial Garter Snake
Ringneck Snake

Amphibians

Salamanders
California Slender Salamander
Oregon Ensatina Salamander
Arboreal Salamander

Butterflies

Anise swallowtail
West coast painted lady
American painted lady
Red admiral
Green hairstreak

APPENDIX E. Glossary

Basal area	Is a measure of forest density and usually expressed on a per acre basis. It is generally considered the cross-sectional area of trees measured at DBH.
DBH	Diameter at breast height (or 4.5 feet above the ground).
Fixed radius plot	A inventory plot with a fixed circular area (of 52.7 feet) which is sampled as opposed to a variable radius plot or a transect.
Lopping	Severing and spreading of limbs and stems so that no part of it remains more than 15 to 30 in. (76.2 cm) above the ground.
Over-stocked	An acre's productivity controls what an acre is able to grow. If an area has too many trees for its given productivity (which is based on soils, availability to water, nutrients, and light), it is considered over-stocked.
Site index	Describes the relative productivity of a particular site or location. The capacity of an area to produce forest crops related to climate and soil factors; expressed by a value based on the height of trees at a certain age in an area.
Stand	Is a contiguous group of trees which are of a uniform age, composition, and structure. This can also be considered a Forest Type.
Stand structure	The special and temporal distribution of plants, shrubs and trees within a forest or stand. This can include components of tree heights, diameters, and canopies.
Stem exclusion phase	A period in forest succession where new trees are prevented from successfully becoming established and at the same time existing trees die from overcrowding and are preventing from maturing.
Stratified grid	A sampling system which allows for consistent sampling and improved precision on estimates.
Windfall	Trees which are uprooted or broken off by wind. This can be a single tree or in extreme circumstances many trees.