Coastal Development Permit Application
Attachment F

Ellwood Mesa/Sperling Preserve Open Space
2018 Implementation Plan

(Submitted as a requirement of Emergency Permit No. G-4-17-0048)

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EXECUTIVE SUMMARY

In 2017, arborists' studies commissioned by the City of Goleta (City) revealed the presence of more than one thousand standing dead and dying eucalyptus trees in the groves on Ellwood Mesa/Sperling Preserve Open Space (Ellwood Mesa). Ellwood Mesa is a publicly accessible and popular open space in the western portion of the City's Coastal Zone that is well known for its seasonal monarch butterfly aggregations. Because these trees pose a hazard to the public due to risks of falling, the City took immediate action and closed all public trails in the eucalyptus groves in July 2017 pending abatement of the safety hazard. On September 7, 2017, the City Council directed that a limited number of dead tree removals be undertaken to restore safe public access to a small number of trails used for coastal access through Ellwood Mesa, and that the remaining trails stay closed until a habitat management plan is prepared and implemented.

On September 22, 2017, City staff submitted an emergency permit application to the California Coastal Commission (Coastal Commission). In response, the Coastal Commission issued Emergency Permit G-4-17-0048 authorizing the one-time removal of 29 eucalyptus trees on Ellwood Mesa adjacent to four essential public trails that were dead and/or at high risk of failure in order to protect life and property from imminent danger. In addition, the Emergency Permit authorized the temporary closure of several public trail segments within the eucalyptus tree groves on Ellwood Mesa. Consistent with the requirements of the Emergency Permit, in September through December of 2017, 27 dead/dying eucalyptus trees were removed and two trees were pruned to remove dead material in order to protect the public from the risk of the hazardous trees.

The Emergency Permit required that the City submit a Coastal Development Permit (CDP) Application to the Coastal Commission within 12 months following the completion of the tree work. As stated in the Emergency Permit, the CDP must address tree removal mitigation, restoration of the aggregation sites within the grove, and a strategy for re-opening public trail segments in coordination with habitat management strategies and requirements. As such, the objective of this 2018 Implementation Plan (IP) is to satisfy these Emergency Permit requirements as part of the CDP application to the Coastal Commission. In summary, the following actions are included in this 2018 IP:

- Continue monitoring the monarch population with monthly counts,
- Remove trail closure signs, replace with cautionary signage about tree fall risks,
- Install trail markers, educational signs, and trail safety signs,
- Plant approximately 63 eucalyptus trees to replace the 27 trees removed and 2 trees pruned under the Emergency Permit and to restore a butterfly aggregation site within the grove,
- Plant native understory species in conjunction with the eucalyptus tree plantings,
- Irrigate the new plantings and control weeds and,
- Monitor the newly planted trees to ensure success.

No trees (dead, dying, or living) are proposed for removal as part of this 2018 IP.

1.0 INTRODUCTION

1.1 BACKGROUND

This Ellwood Mesa 2018 Implementation Plan (IP) outlines activities to comply with the Emergency Permit (G-4-17-0048) issued by the California Coastal Commission on September 26, 2017. The Emergency Permit was issued at the City's request to (1) address dead and dying trees at high risk of failure that constitute a risk to public health and safety, (2) protect life and property from imminent danger, and (3) restore butterfly aggregation sites within the eucalyptus grove. More specifically, to address the immediate hazard concerns, the Emergency Permit authorized:

- The temporary closure of nine public trail segments within the eucalyptus tree groves on Ellwood Mesa (marked with signs and symbolic fencing),
- The one-time removal of 29 eucalyptus trees on Ellwood Mesa that are dead and/or at high risk of failure adjacent to four essential public trails,
- The re-opening of four trail segments (portions of trail #6, 16, 18, and 25) following the tree removal work,
- Trail closures at the remaining five trails segments (portions of trail #16, 19, 23, 24, and 25) until a follow-up Coastal Development Permit (CDP) is issued by the Coastal Commission.

Consistent with the Emergency Permit, the City closed (with signs and symbolic fencing) nine public trails, removed twenty-seven trees and pruned two trees on September 30 and between November 29 – December 1, 2017, and re-opened four trail segments (portions of trail #6, 16, 18, and 25) following the tree work. Trail closures are currently in place at the remaining five trail segments (portions of trail #16, 19, 23, 24, and 25). For references purposes, tree removals/pruning and trail closures are depicted on Figure 1.

1.2 PURPOSE

The 2018 IP presents work tasks to satisfy the Coastal Commission's Emergency Permit requirements and is an attachment to a CDP application for Commission's review. The purpose of the 2018 IP is to address tree removals with restoration of the aggregation sites within the groves and to reopen trails. Input from the public and City Council informed this IP, as described in Section 1.6, and is summarized in the CDP Application transmittal letter, Attachment E.

Proposed restoration is intended to protect and enhance habitat for monarch butterflies, sustain naturalized habitat on Ellwood Mesa, support other wildlife species, and benefit public use and enjoyment of this open space area. Actions delineated are directed toward protection and improvement of individual trees, as well as enhancement of areas where trees have died.

1.2.1 Coastal Commission Emergency Permit Compliance

This 2018 IP is intended to comply with requirements specified in the California Coastal Commission's 2017 Emergency Permit (Case No. G-4-17-0048) authorizing hazard tree removals

and trail closures. The City's compliance with the conditions in the Emergency Permit is summarized in Table 1 below.

Table 1. Emergency Coastal Development Permit Compliance

Condition Number	Condition Text	Compliance Actions
1	The enclosed form must be signed by the applicant and returned to our office within fifteen (15) days.	The form was signed and returned to the Coastal Commission on October 6, 2017.
2	Only that work specifically described above and as more specifically described in the Commission's file for this Emergency Coastal Development Permit (CDP) Application, is authorized for the specific property listed above, subject to the conditions set forth below. Any additional work requires separate authorization from the Executive Director.	All activities were performed as described in the Emergency Permit application, and no unauthorized work was conducted.
3	The work authorized by this permit must be completed within 120 days of the date of this permit, or as extended by the Executive Director through correspondence, and shall take place in a manner to minimize any potential damages to any resources, including Devereux Creek, and to minimize impacts to public access. Public access shall be maintained with the use of signs directing the public around the construction and tree fall hazard areas. The applicant shall also avoid adverse impacts to aggregating monarch butterflies and to live eucalyptus trees near the project site to the maximum extent feasible.	The work was performed as described in the application, and environmental protections including pre-activity bird and butterfly surveys, and monitoring, were in place. All requirements were adhered to, and work was completed within 120 days of the permit's issuance.
4	The work authorized by this emergency permit is temporary and limited to the one-time removal of 29 eucalyptus trees and the temporary closure of several trails segments. Within twelve (12) months following completion of the proposed work, the permittee shall submit a complete regular Coastal Development Permit Application to the California Coastal Commission for a Ellwood Mesa Habitat Management Plan to address tree removal mitigation and restoration of the aggregation sites within the groves and a strategy for re-opening public trail segments in coordination with habitat management strategies and requirements. This deadline may be extended by the Executive Director for good cause through correspondence.	Compliance with this condition will be effectuated through implementation of the 2018 IP. A Coastal Development Permit application was submitted in October 2018.
5	In exercising this permit, the applicant agrees to indemnify and hold harmless the California Coastal Commission, and its agents and employees, from any liabilities or claims for damage to public or private properties or personal injury that may result to any party from the project authorized herein.	Agreed.
6	This permit does not obviate the need to obtain necessary authorizations and/or permits from other local, state and federal agencies.	Understood.

1.3 PROBLEM OF IMMEDIATE CONCERN

The eucalyptus forest on Ellwood Mesa suffered during an historic and ongoing drought starting in 2011, as evidenced by damaged and dead trees. The loss of living trees and the reduction in canopy and cover has degraded the habitat value for monarch butterflies, birds, and other wildlife (Figure 2). In 2017, to assess the extent of this decline, the City retained a qualified arborist to conduct a tree inventory at the site. Each tree within the monarch butterfly aggregation sites on Ellwood Mesa (East, Main, West, North, and Sandpiper [eastern portion on City property]) was evaluated for health by Certified Arborist Cory Meyer, and for use by monarch butterflies by Daniel E. Meade, Ph.D. Individual trees were tagged with metal tree tags, their measures and condition were documented, and their locations were recorded using sub-meter accuracy Trimble GeoXT global positioning system (GPS) and plotted using ArcGIS. The inventory determined that 1,260 trees within the assessed area on City property were dead. This included 59 dead trees in monarch butterfly aggregation sites, 247 within falling distance of public designated trails, and the 27 that were removed later in 2017. As of January 2018, within the aggregation sites, two trees have fallen and one has been removed, reducing the number to 56. At least three other trees have fallen, and others have died along trails.

Drought and disease from insect pests and pathogens continues to affect the health of the forest. Insect pests absent from California prior to 1985 contributed significantly to the death of trees. Dead trees reduce opportunities for recruitment and regrowth of young trees. These dead trees may also present an imminent hazard to adjacent residences and to members of the public who extensively use the Ellwood Mesa trails and open space. Protecting and enhancing monarch butterfly overwintering habitat while informing forest users about tree hazards is a primary driver of this 2018 IP.

1.4 ENVIRONMENTAL SETTING

Ellwood Mesa contains approximately 78 acres of eucalyptus forest and windrow habitat. Three species of eucalyptus are present: blue gum (*Eucalyptus globulus*), river red gum (*E. camaldulensis*), and red ironbark (*E. sideroxylon*). Blue gum eucalyptus is the dominant species on Ellwood Mesa. Within the eucalyptus forest, there are six known aggregation locations for monarch butterflies—Ellwood Main, Ellwood West, Ellwood North, Ellwood East, Sandpiper, and Ocean Meadows (Figure 3). All of these sites, except Ocean Meadows, are known to regularly harbor monarch butterfly aggregations through the overwintering period from October 1 through March 31. The Ocean Meadows site supports a limited number of monarch butterflies on rare occasions. Five of the aggregation sites — Ellwood Main, Ellwood West, Ellwood North, Sandpiper, and Ocean Meadows — are on City property. A portion of the Sandpiper aggregation site and the Ellwood East aggregation site are on adjacent private property. The Ellwood Mesa monarch butterfly groves, especially the Ellwood Main aggregation site, are well-known and visited by thousands of people each year, including local residents and out of town visitors. Ellwood Main has been specifically designated as the "Goleta Butterfly Grove" and is a location for visitors to view the butterflies as it has been configured with rope barriers, trails, and viewing areas for the public.

As described in Section 1.3 above, the eucalyptus groves on Ellwood Mesa have experienced significant declines in recent years. The area near the Ellwood North aggregation site has been

most severely affected, and the catastrophic die-off of eucalyptus in this area between 2010 and the present has actually resulted in the relocation of the aggregation site southward to an area with greater remaining tree canopy. Figure 2 illustrates the difference between canopy conditions in the vicinity of Ellwood North in 2010 and 2018, and shows that the eucalyptus canopy, once dense and full, has become minimal and that dead trees now dominate the habitat at this location. If the monarch butterfly overwintering habitat on Ellwood Mesa is to be maintained, it is critical that the eucalyptus canopy be restored to pre-drought conditions, which offered sufficient protection and structure to support this species.

1.5 PUBLIC OUTREACH

A draft 2018 IP was developed based on the professional opinions and expertise of City staff and consultants, and was informed by input received during a significant public outreach process. The draft 2018 IP was released to the public in draft form on July 26, 2018. After the release of the draft 2018 IP, staff hosted a stakeholder meeting on August 2, 2018 with the purpose of soliciting early feedback from agencies and organizations who had expressed interest. Stakeholder feedback was used to inform a public workshop hosted at City Hall on August 16, 2018 and a presentation before the Public Tree Advisory Commission on August 22, 2018. An update to the City Council was provided at a public meeting on September 4, 2018. All of these opportunities for public participation were well attended, and the City received meaningful comments on the content of the draft 2018 IP, which helped to inform the revisions made to this final 2018 IP.

The comments received were overwhelmingly supportive of the management of the Ellwood Mesa butterfly habitats as a biological and recreational resource. Among substantive issues raised, the importance of maintaining the area open to the public, including and especially the historic eucalyptus groves hosting butterflies, was voiced by many public speakers. The City also received comments calling for removal of the existing trail closure signage, and for trails to be kept open for use with cautionary signage warning users of tree hazards. Additionally, members of the public asked that the extent of signage within the groves be limited, and replaced by signage at access points to Ellwood Mesa (parking lot, entries off adjacent streets). These suggestions have been incorporated into this 2018 IP where appropriate.

Enhancement of monarch butterfly habitat within the eucalyptus groves on Ellwood Mesa was also a major theme in the public comments received. Members of the public were concerned about the ongoing decline of the groves due to drought and pests, and called for replenishment of the habitat by planting additional eucalyptus trees to increase canopy cover for overwintering monarchs. Because optimal overwintering habitat can be transient, commenters urged management of the eucalyptus groves as a whole, rather than focusing on the locations where aggregations currently occur. The use of red ironbark, a drought-tolerant eucalyptus species with a smaller stature than the blue gums that currently comprise the majority of the groves, was raised as both a positive and negative value. Some speakers advocated maximizing the amount of new eucalyptus canopy to be established, and advocated replacement of the dead/dying trees at a ratio rather than simply pursuing a "no net loss" approach. Many of the speakers emphasized that a "less is more" approach to the groves is best, and warned against excessive removal of dead trees or downed material for fire protection or other purposes. Overall, the public was overwhelmingly

supportive of actions that will maintain and enhance the overwintering habitat in the eucalyptus groves, and this 2018 IP reflects this input.

A few comments were received advocating native plant habitat restoration. While native plantings have been incorporated in areas paralleling and in the understory of Ellwood North, replacement of eucalyptus trees with natives is not proposed in this 2018 IP because it would not maintain the desired abundance and quality of monarch butterfly overwintering habitat. Some non-substantive and minor suggestions on the draft 2018 IP were received, including requests for the final 2018 IP to include more citations and an executive summary, expand the signage program and related sign information/contact detail, and clarify other details and add specificity wherever possible. Many of these additional suggestions have also been incorporated into this 2018 IP where appropriate.

1.6 OTHER MANAGEMENT PLANS

This 2018 IP references a number of other management plans that offer valuable input and guidance. The Xerces Society management guidance document, *Protecting California's Butterfly Groves, Management Guidelines for Monarch Butterfly Overwintering Habitat,* was published November 7, 2017 (Jepsen *et al.* 2017). This Implementation Plan incorporates The Xerces Society guidance and is consistent with its recommendations. The 2018 IP also consulted the University of California San Francisco Mount Sutro Open Space Reserve Vegetation Management Plan (UCSF 2018) and the Monarch Butterfly Overwintering Site Management Plan for Lighthouse Field State Beach (Pelton *et al.* 2017) and incorporates applicable management and restoration recommendations from these plans where feasible and appropriate.

1.7 RESPONSIBLE PARTIES

Table 2 provides contact information for the responsible parties with permit and oversight authority.

Table 2. Responsible Parties

Lead Agency
City of Goleta Planning and Environmental Review 130 Cremona Drive, Suite B Goleta, CA 93117 805-961-7543 Contact: Anne Wells, Planning and Environmental Review Department awells@cityofgoleta.org

Property Owner Representative/Manager	Responsible Agency
City of Goleta Public Works 130 Cremona Drive, Suite B Goleta, CA 93117 805-961-7543 Contact: Charlie Ebeling Public Works Director cebeling@cityofgoleta.org	**California Coastal Commission** Ventura Field Office 89 S. California Street, Suite 200 Ventura, CA 93001-2801 (805) 585-1800 Contact: Jonna Engel Jonna.Engel@coastal.ca.gov

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2.0 MONARCH BUTTERFLIES AND SIGNAGE IMPLEMENTATION

Monarch butterfly habitat enhancement, educational, and monitoring activities will commence in 2018 and continue through 2019. These activities will include the replacement and installation of new signage and the continued monitoring and counting of the overwintering monarch butterfly population, as described below.

2.1 MONARCH POPULATION COUNTS

For almost three decades, the population of overwintering monarch butterflies has been tracked at Ellwood Mesa during the monarch butterfly overwintering season. This monitoring will continue by counting and documenting the monarch butterfly population number and cluster locations within the six Ellwood Mesa aggregation sites every year. The counts will be conducted every 2 weeks through the overwintering season (October 1 through March 15) using the counting protocol established by the *Step-by-Step Western Monarch Thanksgiving Count Monitoring Guide* (The Xerces Society for Invertebrate Conservation 2017). Where possible, the tag numbers of trees will be recorded with clustering monarch butterflies to establish habitat use patterns (Althouse and Meade 2017, or as updated).

2.2 SIGNAGE

Replacement signage and installation of new signage will occur at various locations throughout Ellwood Mesa. Several types of signs will be installed, including cautionary signs, educational signs, two varieties of safety signs, and site enhancement signs. In addition, trail markers indicating the routes to Ellwood Main will be replaced. Installation and maintenance of signage will be conducted in such a way as to not disturb overwintering monarchs or nesting birds. Signs will be posted in English and Spanish.

2.2.1 Replacement Trail Markers

Replacement markers will mark the trails toward Ellwood Main, provided safety concerns have been addressed (Section 3.0). These markers will be placed at various locations between the Ellwood Mesa parking lot and the Coronado Preserve entrance and the Ellwood Main. The City and sign designers will create and install trail markers to guide visitors between the Coronado Preserve and Ellwood Mesa.

2.2.2 Educational Signs

Informational signs will educate visitors on the biology, migration, and behavior of monarch butterflies. These signs will be placed near the viewing area for the Ellwood Main aggregation site, and will likely follow the information and format of the temporary poster board sign made by the Ellwood Mesa Monarch Docents in 2016. The City and sign designers will collaborate with the Santa Barbara Land Trust to create educational signs for visitors along the routes between the Coronado Preserve and Ellwood Mesa.

2.2.3 Cautionary and Safety Signs

Cautionary signs will inform the public about trail closures while also alerting them to be aware of falling limbs and branches overhead. The existing trail closure signs will be removed and replaced with signage educating users about the risks associated with using trails near dead/dying trees that may fall or shed limbs. "Enter at your own risk", or similar cautionary language, will be posted. Safety signs reading "Fire Lane – No Parking" will be posted at the entrance to Ellwood Mesa at the end of Santa Barbara Shores Drive to keep the access road clear and accessible for fire and other emergency access. In addition, safety signs reminding the public of site restrictions such as No Fires/No Camping/No Smoking will be posted at all major trail entrances to Ellwood Mesa.

2.2.4 Site Enhancement Signs

Public information signs will be placed near the enhancement areas. At a minimum, signs will include the phrase, "Monarch Butterfly Habitat Enhancement in Progress" and will have the City of Goleta's logo and contact phone number for the responsible City staff. Additionally, the signage will direct visitors to the City's website for additional information and updates about the status of ongoing Ellwood Mesa habitat enhancement and trail access projects.

2.2.5 Sign Summary

Cautionary, educational, habitat enhancement, and safety signs (two varieties) to be installed at Ellwood Mesa are summarized in Table 3 below. The locations of the signs are illustrated on Figure 3, Placement of Signs. Existing trail closure signs will be removed.

Table 3. Sign Installation Summary

Sign	Location
Cautionary Signs ("Enter at Your Own Risk" or Similar)	Along 6, 16, 18, 19, 23, 24, and 25 trail segments at the entrance to the eucalyptus forest canopy
Educational Signs	At the viewing area for Ellwood Main
Monarch Butterfly Habitat Enhancement Area signs	On the western edge of the enhancement area, facing towards the public's viewpoint
Fire Lane/No Parking Safety Signs	At the end of Santa Barbara Shores Drive
No Fires/No Camping/No Smoking Safety Signs	At every major trail entrance to Ellwood Mesa

3.0 TREE AND HABITAT IMPLEMENTATION

Work prescribed within this 2018 IP consists of three overall implementation strategies: 1) Tree removal mitigation, 2) Restoration of aggregation sites within the eucalyptus grove, and 3) Development of a strategy for reopening public trails segments. Plantings will be installed in an area where the density of the eucalyptus canopy has been significantly reduced by mortality, as illustrated in the Enhancement Plan on Figure 4. Work will be managed by the City. A licensed landscape contractor and/or vegetation management specialist will be contracted by the City to conduct habitat enhancement actions such as tree planting.

3.1 PRIORITIES AND TIMING OF WORK

During the enhancement of the eucalyptus forest at Ellwood Mesa the priority will be the protection of habitat and limiting any impacts to the overwintering monarch butterflies and other wildlife. Therefore, timing for work activities within the eucalyptus forest and especially the monarch overwintering site locations will take the necessary precautions to avoid the monarch butterfly overwintering season (October 1 through March 31) and the nesting bird season (March 15 to August 15). In addition, areas with open water in Devereux Creek and tributaries will be avoided to protected water quality.

Each year between August and October, a limited window of opportunity exists for working in areas where monarch butterflies aggregate and birds nest. Habitat enhancement activities may be conducted throughout the year if precautions are taken so as to not affect wildlife, including butterflies and nesting birds, or water quality. Work may be conducted within the seasons for nesting birds and overwintering monarchs, only after a biological monitor has surveyed the work area and 300 ft. around the work area and determined that no wildlife will be impacted by the work. A biological monitor will also be required to be present during the work activity during these seasons and have the authority to stop work if an impact to wildlife is observed.

3.2 HABITAT ENHANCEMENT

Habitat enhancement actions to be taken include replacement of dead or hazardous trees removed and maintenance of restored habitat. The enhancement area where removed eucalyptus trees will be mitigated and where additional habitat enhancing trees will be planted is shown on Figure 4, and is consistent with that presented to the public and the City Council during the September 4, 2018 meeting. The final planting and temporary irrigation plans must be consistent with the conceptual plan and approved by the City of Goleta, Planning & Environmental Review and Public Works Departments.

3.2.1 Site Selection

When seeking a suitable site for monarch butterfly habitat enhancement, City staff and consultants sought to identify a location where the plantings would have maximal benefit to the monarch butterfly habitat while also affording relatively convenient access for installation and maintenance. In 2016, The Xerces Society published a paper evaluating the overwintering sites in

California and created a list of the top 50 priority sites (Pelton *et al.* 2016). This list prioritizes sites for protection and active management, with the highest ranks representing sites with the greatest declines that still host the largest proportion of the remaining western overwintering population. These sites have suffered population declines but still hold potential for recovery to support the monarch population. Two of the aggregation sites on Ellwood Mesa are included on the Top 50 list, including Ellwood Main at #4 and Ellwood North at #45. The paper states that Ellwood Main has suffered a decline of 58% from the 1997-2001 average, and that Ellwood North has seen a decline of 98.3% during the same period. The extreme decline in overwintering monarch populations at Ellwood North is consistent with the catastrophic die-off of eucalyptus groves that has been observed in this area between 2010 and the present, and has actually resulted in the relocation of the aggregation site southward to an area with greater remaining tree canopy. Figure 2 illustrates the difference between canopy conditions in the vicinity of Ellwood North in 2010 and 2018, and shows that the eucalyptus canopy, once dense and full, has become minimal and that dead trees now dominate the habitat at this location.

In addition to a demonstrated need for habitat enhancement, the eucalyptus grove near Ellwood North is an advantageous enhancement site from a practical standpoint because it is near the main parking lot and offers excellent vehicle access for tree installation and maintenance. Additionally this area is highly visible, which will raise public awareness regarding the habitat enhancement effort while also helping to deter vandalism. Considering these factors, the western edge of the eucalyptus grove near the Ellwood North aggregation site has been selected as the planting location (see Figure 4). Using the overall size of the enhancement site and incorporating 20-foot trunk spacing to emulate recommended grove density for monarch butterfly aggregation habitat, the resulting number of trees to be planted is 63 eucalyptus trees. The proposed habitat restoration and enhancement activities are described in detail in Sections 3.2.2 through 3.2.8 below.

Planting eucalyptus trees to enhance habitat at Ellwood Main is not proposed due to the challenging topography of that site, combined with significantly greater difficulties in access and irrigation compared to the Ellwood North location. By installing enhancement plantings in this location, the 2018 IP will initiate the long-term process of returning the canopy in one of Ellwood Mesa's most significant monarch habitat areas to pre-drought conditions.

3.2.2 Access Routes and Staging Areas

Vehicles expected to be used during habitat enhancement activities include rubber-tired flatbed trucks, pickup trucks, and water trucks. The enhancement area will largely be accessed by these vehicles from the parking lot and the existing 7.5-foot-wide dirt trail at the southern end of the parking lot (see Figure 4). However, the truck needed for the delivery of the water storage tank may access the site from the north by driving along the foot access route or from the south through the enhancement area prior to enhancement activities. The water storage tank will be refilled periodically by a water truck, which will be operated from the parking lot and connected to the tank with a hose; the water truck will be confined to the parking lot and will not be driven off-pavement.

Workers will access the enhancement on foot from the southern terminus of the vehicle access route as well as from the north through an existing opening in the parking lot fence (see Figure 4). Foot access routes will be approximately 2 feet wide and have been located along existing trails as feasible.

An approximate 870 square foot (0.02 acre) staging has been established at the southern end of the enhancement area at the terminus of the vehicle access route (see Figure 4). This location will provide easy access for implementation and maintenance activities, and will facilitate the temporary storage of container plants, tools, and up to two trucks. No materials will be stored overnight within the staging area; only the number of plants needed for the day's activities will be brought on-site at any given time. The staging area is currently occupied by non-native grassland, and will not be cleared or graded to accommodate staging activities. An access route from the parking lot to the staging area is illustrated on Figure 4; this is the least impactful route and does not require vehicles to traverse native habitats. The access route will not be improved or marked with signage, to avoid unnecessary biological or visual impacts.

Water will be stored at the site in a temporary aboveground water tank, located adjacent to and north of the enhancement area as illustrated on Figure 4. The water tank area will be sufficient to accommodate a 5,000 gallon water tank at approximately 111 square feet (0.003 acre). The water tank storage area has been positioned so that it is at the highest elevation, although change in elevation is limited, to facilitate a gravity-fed irrigation system. See Section 3.2.7 for design details.

3.2.3 Replacement Trees to be Planted

Replacement eucalyptus trees will be installed to reestablish the eucalyptus grove's aggregation habitat along with additional plantings to enhance the native understory. The enhancement area encompasses approximately 0.58 acre and is located within the existing distressed eucalyptus grove as shown in Figure 4. To maximize benefits for the monarch butterfly, the trees will be installed in rows oriented north to south using approximately 20-foot spacing. This configuration will mimic groves commonly utilized by monarchs for overwintering. The red ironbark eucalyptus will be placed closer to the outer edge of the existing grove, and the blue gum eucalyptus will be placed closer to the interior of the existing grove. This configuration will mean that the heartier tree species will be located on the outside of the grove, thereby offering protection for the tree species on the interior, to help ensure that the enhanced habitat will be healthier and therefore be more suitable for monarch butterflies. Precise trunk locations for the plantings will be determined in the field by a City-approved biologist, taking into consideration factors such as optimal spacing, locations of standing trunks of existing eucalyptus trees in the area, and localized topography. The locations will be flagged for easy identification during tree installation.

Replacement trees will be installed as 5-gallon container stock as available. Trees will be obtained from local commercial nurseries, and will be installed by a City staff or a contractor. Final planting and temporary irrigation plans must be consistent with this Implementation Plan.

The twenty-seven trees removed and two trees that were trimmed in 2017 were all eucalyptus. Replacement and habitat enhancement trees are also eucalyptus, and will be primarily red ironbark eucalyptus due to drought tolerance of this species. The following eucalyptus tree species will be planted:

- 52 red ironbark eucalyptus (5-gallon)
- 11 blue gum eucalyptus (5-gallon)

3.2.4 Native Species to be Planted

In addition to the eucalyptus trees described above, the City will also plant appropriate native species within and adjacent to the eucalyptus enhancement site. Within the eucalyptus grove, these native plants will be limited to understory species, including shrubs, grasses, and forbs that are seen co-occurring with the eucalyptus overstory in other locations on Ellwood Mesa. The planting palettes for both enhancement areas are included in Table 4. Native species quantities are general guidelines and are subject to change with availability.

Table 4. Planting Palettes

		Number of Plants per Enhancement Area		
		Eucalyptus Grove	Toyon and Lemonade Berry Scrub	
Common Name	**Scientific Name**	**0.58 acre 20-ft spacing for eucalyptus, 10-ft spacing for native shrub species**	**0.11 acre 5-ft spacing for native shrub species**	**TOTAL**
Trees				
Blue gum eucalyptus	*Eucalyptus globulus*	52	-	52
Red iron bark eucalyptus	*Eucalyptus sideroxylon*	11	-	11
Shrubs				
coyote bush	*Baccharis pilularis*	12	25	37
lemonade berry	*Rhus integrifolia*	12	25	37
toyon	*Heteromeles arbutifolia*	12	25	37
Groundcovers				
California brome	*Bromus carinatus*	22	16	38
California goldenrod	*Solidago veluntina* ssp. *californica*	22	16	38
blue-eyed grass	*Sisrinchium bellum*	22	16	38
giant ryegrass	*Elymus condensatus*	22	21	43
mugwort	*Artemisia douglasiana*	22	16	38
purple needlegrass	*Nassella pulchra*	22	16	38
verbena	*Verbena lasiostachys*	22	16	38
TOTAL		**253**	**192**	**445**

Native trees will not be planted as part of this plan, to avoid interference with the desired enhancement of the eucalyptus canopy. Native species will be installed in the understory of the 0.58 acre replacement eucalyptus grove as shown in Figure 4. Additionally, toyon and lemonade berry scrub species will be installed adjacent to and west of the eucalyptus grove in an approximate 0.11 acre area as shown in Figure 4.

3.2.5 Planting Methods – Replacement Trees

Replacement and habitat enhancement eucalyptus trees will be planted in the eucalyptus grove enhancement area illustrated on Figure 4. Locations of replacement eucalyptus will be marked in the field by a City-approved biologist with pin flags or wooden stakes designating tree species to be planted, and verified by a City-approved monarch butterfly expert and a certified arborist. Planting locations will be in openings with approximately 15 feet or greater radius between live eucalyptus trunks. Planting will be conducted under the supervision of a certified arborist or City-approved biologist. Planting activities may be supported by volunteers through the City's volunteer program or by City staff or contractors.

Trees will be planted as described below in accordance with the CalFire's Guideline Specifications for Selecting, Planting, and Early Care of Young Trees (Exhibit A). Browsing by deer or damage by wildlife is not expected.

- Holes will be dug at least twice the diameter, but not more than 2 inches deeper, than the root ball.
- Excavated soil will be mixed with wetting agents and organic material to increase plant growth. One example is a unique, all-purpose soil surfactant containing 5 percent kelp concentrate (Kelpro® or equivalent) to stimulate plant root growth. Hydrolink Advance® (or equivalent) is a year-round wetting agent that assists with penetration and retention of moisture, particularly in heavier soils or mulched surfaces. In addition to the concentrated kelp extract, Hydrolink Advance contains 45 percent blended surfactant, including a strong surface tension agent for rapid soil and mulch penetration.
- The root crown will be planted even with the soil surface. Fill material will be backfilled and tamped around the root ball to eliminate air pockets.
- Vinyl stem protection will be wrapped at least 8 inches up each stem.
- A 6-foot-diameter ring of loose soil will be formed to create a basin. Loose soil will be covered with 3 to 4 inches of mulch and/or compost, slightly thinner on top of the root ball, keeping mulch 2 to 3 inches from the stem. Mulch refers to a layer of organic material over soil, such as naturally deposited leaves or thatch. Compost will also be used with mulch. Compost is a mixture of decaying organic matter. Both mulch and compost are spread directly over soil. They protect soil from raindrop erosion, retain soil moisture, and enhance nutrient release to the young tree roots. Wood chips will be placed over the mulch and between sapling planting locations to protect soil from erosion, and to reduce evaporative loss of soil moisture.

Installed species will be watered immediately after installation is complete.

If warranted due to wind exposure, trees will be braced with two to three tree stakes, with flexible straps placed below the canopy where practicable.

Each tree will be outfitted with a numbered stake. The number will be recorded with GPS coordinates and identified on maps prepared to report planting results. After installation, replacement tree number, species, height, sapling caliper, and/or diameter at breast height (DBH) (as applicable) will be recorded. Notes regarding microsite condition and nearest neighbor trees/shrubs will also be recorded (e.g., thin soil, north-facing slope, *E. globulus* within 20 feet).

Downed debris from the surrounding eucalyptus trees may need to be moved aside in order to dig holes for the plantings, but will not be removed from the site.

3.2.6 Planting Methods – Native Species

Native species will be planted in the eucalyptus grove and toyon and lemonade berry scrub enhancement areas as illustrated on Figure 4. Locations will be marked in the field by a licensed landscape contractor or qualified restoration biologist with pin flags designating species to be planted. Planting will be conducted under the supervision of a licensed landscape contractor or qualified restoration biologist. Planting activities will be conducted by volunteers through the City's volunteer program or by City staff or contractors. Native species will be planted as described below.

- Holes will be dug at least twice the diameter, but not more than 2 inches deeper, than the root ball.
- The root crown will be planted even with the soil surface. Fill material will be backfilled and tamped around the root ball to eliminate air pockets.
- An approximate 2-foot-diameter ring of loose soil will be formed to create a basin. Loose soil will be covered with 3 to 4 inches of mulch and/or compost, slightly thinner on top of the root ball.

Installed species will be watered immediately after installation is complete.

3.2.7 Irrigation

The 2018 IP includes irrigation for 63 planted eucalyptus trees, as well as the native shrubs and understory species, in the areas specified. Irrigation water will be supplied to supplement natural rainfall through the establishment period. Replacement trees must be watered until established, which may require several years depending on rainfall patterns. Native scrub species will be watered until established.

The *Guideline Specifications for Selecting, Planting, and Early Care of Young Trees* (Kempf and Gilman 2011) specify that newly planted trees need about 3 gallons of water per inch of trunk diameter to the root ball 2 or 3 times per week for the first growing season. Irrigation should increase in volume and decrease to once per week in the second year and decrease to bimonthly in the third year and continue until established. Irrigation will be scheduled for twice a week to deliver

approximately 6 gallons per tree for all replacement trees (assuming tree trunk diameter is 2 inches) or a generous soaking for the first growing season. This watering schedule will be confirmed by the restoration biologist and may be adjusted based on the condition of the replacement trees and annual rainfall.

The restoration biologist will establish an irrigation schedule to maximize growth of the eucalyptus plantings and native scrub species, while accounting for natural rainfall and minimizing growth of invasive non-native plants. Generally, if irrigation is needed, more irrigation will be provided during the growing season (winter and spring) to mimic seasonal weather patterns, and minimal irrigation will be provided during the summer and fall as needed to keep plants alive. Irrigation of the native scrub will be coordinated with irrigation of the replacement trees as applicable. Saplings may be outfitted with Tree Gators (or equivalent) that may be periodically filled.

The water tank storage area has been positioned so that it is at the highest elevation, although change in elevation is limited, to facilitate a gravity-fed irrigation system. Hand crews will temporarily connect hoses to the tank and will water the plantings by hand. Should a gravity-driven irrigation system not be sufficient, then a solar or battery powered pump may also be employed. The pump will be connected between the tank and hose temporarily during watering events, and will not be left on the site overnight. The water tank will be refilled periodically by a water truck, which will be operated from the parking lot and connected to the tank with a hose via the northern foot access route. Alternatively, as feasible, plantings may be watered by a hose connected to the water truck directly. In all cases the water truck will be confined to the parking lot, and will not be driven off-pavement. Figure 4 shows the access route for the water truck visits to the enhancement area.

3.2.8 Weed Control

Table 5 lists weed species in and near the enhancement area that are on the California Department of Food and Agriculture (CDFA) Noxious Weeds List, the California Invasive Plant Council (Cal-IPC) Invasive Plant Inventory, or both lists. Current extent at the site and recommendations regarding the need to eradicate or control each species are also provided. Those species that require management are listed in Table 5 as "target weeds," and are discussed in more detail below. Species that are naturalized and widespread in the region and that do not present habitat or management concerns, i.e. "non-target weeds," will not be removed during weed control efforts, unless they pose a direct detrimental effect on installed species within the enhancement area (see Table 5). Any removal of non-native plants will be conducted by City staff or contractors with oversight by the restoration biologist. Any actions proposed will also be reviewed and approved by the monarch butterfly expert.

Mock orange (*Pittosporum undulatum*) and myoporum (*Myoporum laetum*), two non-native plant species, have become established in some areas of the forest. Mock orange is not in the Cal-IPC plant inventory, and myoporum is rated a moderate invasive plant species by Cal-IPC. The spread of these two species will be monitored and included in annual assessments of the condition of the enhancement area.

English ivy (*Hedera helix*) and Algerian ivy (*Hedera canariensis*) are rated as high in the inventory of invasive plants. Both species are lumped together in California invasive weed lists. Cal-IPC (2012) provides the following description of ivy infestation:

> English ivy can alter natural succession patterns in forests. It forms ivy deserts of vigorous vines in forests where nothing else seems able to compete. It inhibits regeneration of understory plants, including forest wildflowers and new trees and shrubs (Thomas 1980). By blocking regeneration in forests, it jeopardizes their long-term persistence. English ivy also kills trees in the understory and overstory by shading them out (Thomas 1980). It tends to grow up tree trunks into branches, especially those of deciduous trees. (Cal-IPC 2012)

Herbicide application on English or Algerian ivy has poor success due to the waxy nature of the leaves, and is not recommended. No effective biological control for these species has been found, and because of the wide use of both species for ornamental plantings, introduction of a biological control is not appropriate. Cal-IPC (2012) recommends:

> "The best method for controlling English ivy may be hand removal of vines using pruners to cut the vines and then pulling the plants up from the forest floor and down from the trees. Removing and killing vines that spread up into trees is especially important because the fertile branches grow primarily on upright portions of the vine. If vines are cut at the base of the tree the upper portions will die quickly but may persist on the tree for some time; vines on the ground around the tree should also be removed to prevent re-growth up the tree. Care should be taken to minimize disturbance during removal. If the forest floor becomes disrupted, appropriate native species should be planted on the site to inhibit re-infestation by English ivy or another invader (Humphries *et al.* 1991)."

In general, non-native plants will be removed primarily using hand removal methods, e.g., hand-held weed whips, loppers, and hoes. If hand removal is not feasible due to the characteristics of the species, such as resistance to hand removal methods, the size of the plants, or the number of plants, perennial invasive non-native species may be treated with herbicides. Herbicide application will be limited to the smallest extent possible while maintaining effectiveness. Only individual plants will be treated; no blanket spraying efforts will be utilized. If herbicide is applied, it will be applied during dry and low wind conditions in order to prevent drift into drainages or other non-targeted areas. Herbicide application must be performed by a licensed applicator that can identify the species to be treated and is experienced in the handling and application of herbicides. Only herbicides approved for use near or in water, such as AquaMaster™ or equivalent, will be used near Devereux Creek and other drainage channels.

Table 5. Weedy Species

Scientific Name Common Name Plant Family	**Weed Rating**	**Pre-Action Distribution and Discussion**	**Level of Management**

Scientific Name Common Name Plant Family	**Weed Rating**	**Pre-Action Distribution and Discussion**	**Level of Management**
Bromus diandrus Rip-gut brome Poaceae	Cal-IPC Moderate	Recruits easily to disturbed sandy soil.	Control where it adversely affects saplings.
Centaurea melitensis Tocalote Asteraceae	CDFA C Cal-IPC Moderate	Common in disturbed areas on mesa. Can invade disturbed areas such as trail borders.	Control
Convolvulus arvensis Field bindweed Convolvulaceae	CDFA C (Cal-IPC Evaluated and Not Listed)	Widely distributed, common in open grassland areas.	Control as needed only if adversely affecting saplings.
Ehrharta calycina Perennial veldt grass Poaceae	Cal-IPC High	Recruits easily to disturbed sandy soil.	Eradicate where it adversely affects saplings.
Foeniculum vulgare Fennel Apiaceae	Cal-IPC High	Recruits to disturbed areas in the coastal zone.	Eradicate; target species
Hedera canariensis Algerian ivy Araliaceae	Cal-IPC High	Competes with trees for water and sunlight.	Eradicate; target species
Hedera helix English ivy Araliaceae	Cal-IPC High	Competes with trees for water and sunlight.	Eradicate; target species
Hirschfeldia incana Perennial mustard Brassicaceae	Cal-IPC Moderate	Occasional throughout site. Fire hazard when dense. Recruits easily to disturbed sandy soil.	Control where it adversely affects saplings.
Myoporum laetum Myoporum Scrophulariaceae	Cal-IPC Moderate	Occasional recruit from residential gardens.	Eradicate; target species
Pittosporum undulatum Mock orange Pittosporaceae	Cal-IPC Watch List	Uncommon recruit from residential gardens.	Eradicate; target species
Salsola tragus Russian thistle Chenopodiaceae	CDFA C Cal-IPC Limited	Occasional in disturbed areas.	Control

Note: Scientific name, common name, plant family, weed rating from CDFA, Cal-IPC, and level of management concern for the success of the Implementation Plan are presented in order of scientific name.

3.3 PERFORMANCE CRITERIA

The success of this 2018 IP will be based on enhancement efforts meeting performance criteria that include attainment of quantitative benchmarks (count, height, aerial extent, distribution) for replacement eucalyptus; establishment of replacement eucalyptus plantings (healthy plants without irrigation in non-drought conditions); and effective habitat maintenance actions, such as weed control, as outlined in Table 6. Performance criteria will apply to the replacement eucalyptus trees planted within the eucalyptus grove enhancement area.

Occasionally, planted trees fail to establish for various reasons, and a limited number of planted trees are expected to die from the stress of replanting in the habitat enhancement process. When planted eucalyptus trees die, they will be replaced in-kind as part of the monitoring program. In order to successfully meet the performance criteria and be completed, 100% of the planted eucalyptus trees will be healthy and established by the end of the 10 year monitoring period.

Individual replacement eucalyptus trees will be evaluated yearly for a minimum of 10 years following installation, or until successful establishment of the tree is determined.

Table 6. Performance Criteria and Data Collection Requirements

Criterion	Notes	Metric	Target
Number of live trees	Total eucalyptus trees planted by year and as a total	Count planted	All planted trees are alive, or have been replaced
	Total eucalyptus trees alive each year	Count alive	
Aerial extent	Average canopy diameter per individual eucalyptus tree	Square foot average for individuals	Increase each year
	Aerial extent of the entire planted eucalyptus canopy	Square footage/ acreage of total sapling canopy	
Canopy health	Health of planted eucalyptus trees	1 to 10 arborist rank (range and average)	7 to 10 average arborist rank
Weeds	Weeds eradicated and controlled	Aerial extent of treatment by species.	Reduce aerial extent and/or occurrence of target weeds.
Pests	Note damage by pests	Location, extent (percentage)	Reduce damage by pests

Note: Individual replacement eucalyptus trees will be evaluated yearly for a minimum of 10 years following installation, or until establishment of the tree is determined.

3.4 MONITORING PROGRAM

3.4.1 Replacement Tree Monitoring

Replacement eucalyptus trees will be monitored by a certified arborist or biologist contracted with the City to ensure trees are healthy and receiving appropriate care to obtain establishment. Any trees that die will be assessed and replaced. The arborist/biologist will establish cause of any replacement trees that die, will make recommendations appropriate to support replacement trees, and will correct any deficiencies in care. Monitoring of the eucalyptus grove enhancement area will occur weekly during installation. After installation is complete, monitoring will occur monthly for the first year, every 2 months for years 2 through 5, and every 4 months for years 6 through 10, or until establishment of trees is determined.

The eucalyptus grove enhancement area will be photographed from at least three representative locations each year. Observations will be recorded regarding habitat use by monarch butterflies, birds, mammals, reptiles, amphibians, and pests such as rats and invasive insects. Human impacts will be documented. Performance criteria will be evaluated for each of three sites and summarized in an annual report. Raw data will be made available to City staff for their records and possible further analysis.

Reporting will include a habitat enhancement installation completion report and annual reports for the balance of the 10-year monitoring period. Annual reports will include monitoring dates and weather/site conditions present on those days, restoration planting data related to performance criteria, and monarch butterfly use data from site visits during monarch butterfly aggregation season (e.g., October, December, January/February). Reports will also include appendices with detailed records of herbicide application (if used), irrigation maintenance, plant replacement dates, and other maintenance actions by City staff or approved volunteer activities. As needed, recommendations for adaptive management strategies will be provided in the annual report. Annual reports will be completed by May 15 each year.

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4.0 SCHEDULE

The project is expected to commence in 2019; a schedule of the major tasks associated with the project are summarized in Table 7.

Table 7. Schedule of Tasks

Task	Responsible Party	Timing
Selection of plant nursery to source plantings	City of Goleta	Jan – Feb 2019
Nesting bird surveys	City biologist	Within 1 week of work (only during nesting bird season between March 15 to August 15, 2019)
Monarch Butterfly surveys	City biologist	Within 1 week of work (only during monarch overwintering season between October 1 to August 15, 2019)
Installation of enhancement plantings	City of Goleta	March 2019
Installation of signage, removal of existing closure signs	City of Goleta	March – May 2019
Long-term replacement tree monitoring and annual reporting	City of Goleta	2019 - 2029

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5.0 FIGURES

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Figure 1 Tree Removals/Pruning and Trail Closures

Figure 2 Canopy Comparison

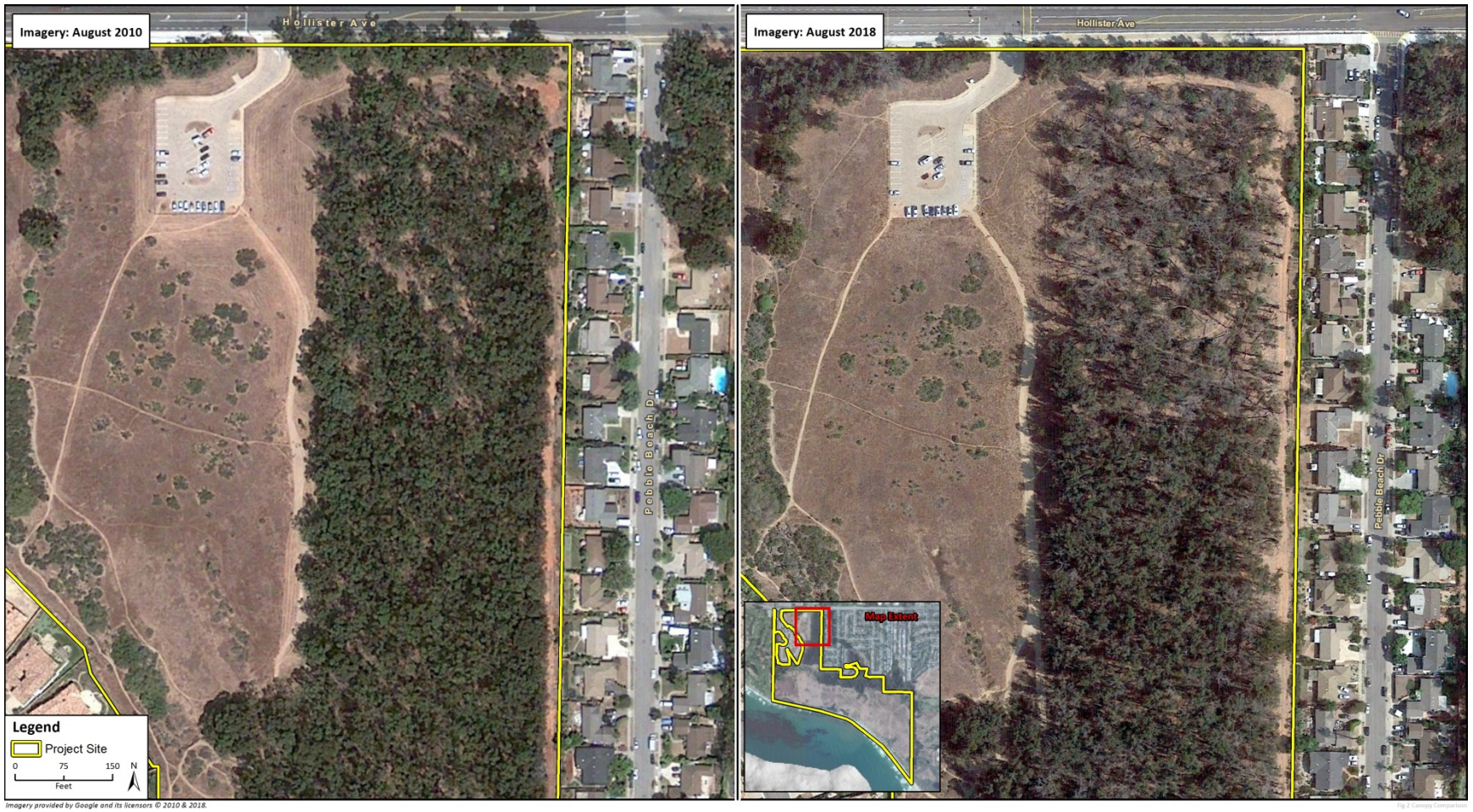

Figure 3 Placement of Signs

Figure 4 Enhancement Plan

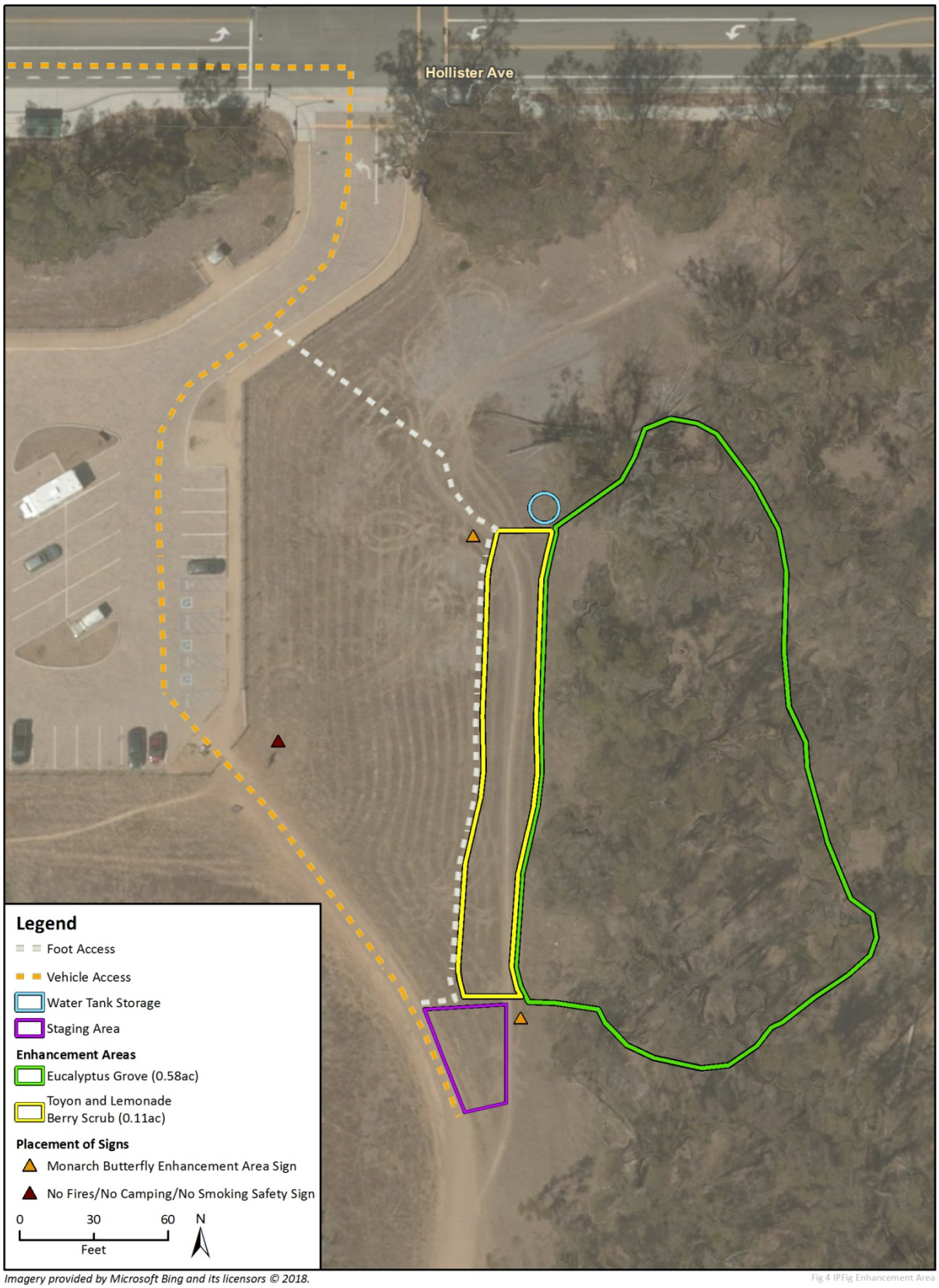

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Fig 4 IPFig Enhancement Area

6.0 REFERENCES

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7.0 EXHIBIT

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Exhibit A – Tree Planting Guidelines

Guideline Specifications for Selecting, Planting, and Early Care of Young Trees

This document is a compilation of the *Guideline Specification for Nursery Tree Quality: Strategies for Growing a High-Quality Root System, Trunk, and Crown in a Container Nursery,* and the *Tree Care Cue Cards*. It has been prepared to help green industry professionals in the efforts to select, plant, and care for young trees.

Illustrations by Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida; adaptions from *Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines*, 4th ed., by R. W. Harris, J. R. Clark, and N. P. Matheny (Prentice Hall, 2003).

Urban Tree Foundation

CAL FIRE SINCE 1885

CALIFORNIA ReLEAF

WESTERN CHAPTER INTERNATIONAL SOCIETY OF ARBORICULTURE

Nursery Tree Quality

I. GENERAL SPECIFICATIONS

Proper Identification: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by species and cultivar (as appropriate).

Compliance: All trees shall comply with federal and state laws and regulations requiring inspection for plant disease, pests, and weeds. Inspection certificates required by law shall accompany each shipment of plants. Clearance from the local county agricultural commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted. Even though trees may conform to county, state, and federal laws, the buyer may impose additional requirements.

Inspection: The buyer reserves the right to reject trees that do not meet specifications as set forth in these guidelines or as adopted by the buyer. If a particular defect or substandard element can be corrected easily, appropriate remedies shall be applied. If destructive inspection of a root ball is to be done, the buyer and seller shall have a prior agreement as to the time and place of inspection, number of trees to be inspected, and financial responsibility for the inspected trees.

Delivery: The buyer shall stipulate how many days prior to delivery that delivery notification is needed. Buyer shall stipulate any special considerations to the nursery prior to shipment.

II. HEALTH AND STRUCTURE SPECIFICATIONS

These specifications apply to deciduous, broadleaf evergreen, and coniferous species. They do not apply to palms. Note that leaf characteristics will not be evident on deciduous trees during the dormant season.

Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar. The leader shall be intact to the very top of the tree.

Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of moisture stress as indicated by wilted, shriveled, or dead leaves.

Branches: Shoot growth (length and diameter) throughout the crown shall be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.

Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds (except properly made pruning cuts), sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, cankers, girdling ties, or lesions (mechanical injury). The terminal bud on the leader shall be intact to the very top of the tree, and it shall be the highest point on the tree.

Roots: The root system shall be substantially free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Root distribution shall be uniform throughout the container substrate, and shall be appropriate for the species or cultivar. At time of inspection and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

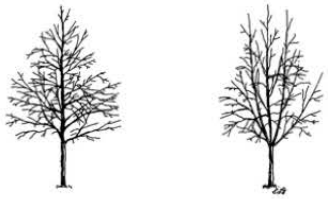
Shade trees that grow to be large shall have one relatively straight central leader (Figure 1). Heading the tree is acceptable provided the central leader is reestablished in the nursery.

Figure 1.

Desirable Desirable Not desirable

Main branches (Figure 2) shall be well distributed along the central leader, not clustered together. They shall form a balanced crown appropriate for the cultivar or species.

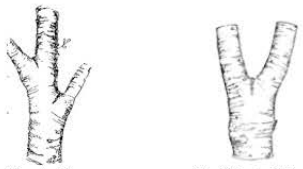
Figure 2.



Desirable Not desirable

The diameter of branches (Figure 3) that grow from the central leader, or trunk, shall be no larger than two-thirds (one-half is preferred) the diameter of the trunk measured just above the branch.

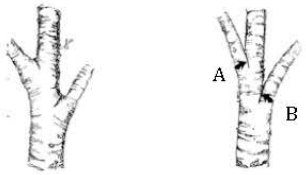
Figure 3.



Desirable Not desirable

The largest branches shall be free of bark inclusions that extend into the branch union (Figure 4 A and B).

Figure 4.



Desirable Not desirable

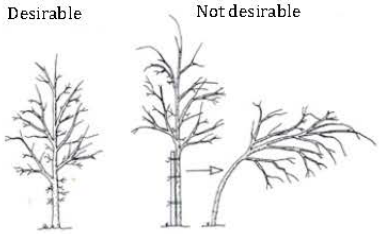
Small-diameter branches (Figure 5, left), particularly on trees less than 1 inch caliper, should be present along the lower trunk below the lowest main branch. These branches shall be no larger than 3/8 inch in diameter.

Figure 5.

Desirable Not desirable

The trunk shall be free of wounds, sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, cankers, or lesions. Properly made recent or closed pruning cuts are acceptable.

Figure 6.

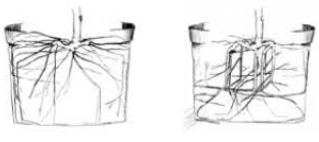


Desirable Not desirable

The trunk caliper (diameter) and taper (Figure 6) shall be sufficient so that the tree remains vertical without a stake.

The root collar (the uppermost roots) (Figure 7) shall be within the upper 2 inches of the soil media (substrate). The root collar and the inside portion of the root ball shall be free of defects, including circling, kinked, and stem-girdling roots. Roots at the surface should grow mostly straight to the side of the container. You may need to remove soil near the root collar to inspect for root defects.

Figure 7.



Desirable Not desirable

The tree shall be well rooted in the soil media. Roots shall be uniformly distributed throughout the container, meaning that roots should not be concentrated at the bottom of the root ball. Some roots should contact the container wall in the top half of the root ball (Figure 7, left). When the container is removed, the root ball shall remain intact. When the trunk is lifted, both the trunk and root system shall move as one. The imprint of the liner or smaller container shall not be visible (Figure 7, left).

The root ball shall be moist throughout at the time of inspection and delivery. The roots shall show no signs of excess soil moisture as indicated by poor root growth, root discoloration, distortion, death, or foul odor. The crown shall show no signs of moisture stress as indicated by wilted, shriveled, or dead leaves or branch dieback.

Tree Planting

Selecting quality trees: Planting quality trees begins by selecting the right tree for the right location and choosing vigorous, structurally sound trees from the nursery.

Digging the hole: A firm, flat-bottomed hole will prevent trees from sinking. Dig the hole only deep enough to position the root collar even with the landscape soil surface (Figure 8). Use a rototiller or shovel to loosen soil in an area three times the size of the root ball. This loose soil promotes rapid root growth and quick establishment.

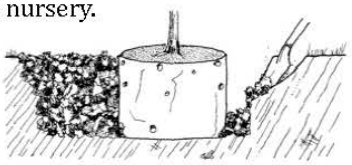


Figure 8. Loosening soil in a large area around the root ball allows for rapid root growth and quick establishment.

Installing the tree: Remove soil and roots from the top of the root ball to expose the root collar; cut away any roots that grow over the collar (Figure 9). Also cut any roots that circle or mat along the sides and bottom of the root ball (Figure 10). The root collar shall be even with the landscape soil after planting (see Figure 9). Backfill with soil removed from the hole. Minimize air pockets by packing gently and applying water. Build a berm 4 inches tall around the rootball to help force water through the root ball. Enlarge the berm as the tree establishes.

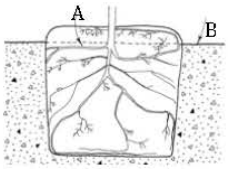


Figure 9. Remove soil and roots growing over the root collar (A) and place collar level with soil surface (B).

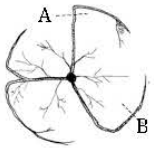


Figure 10. Cut roots at (A) to form new roots that grow away from the trunk. Do not cut roots at (B), since the root defects will regrow.

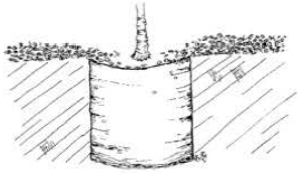


Figure 11. Mulch shall taper to a slightly thinner layer on top of the rootball.

Mulching: A layer of organic mulch, such as leaf litter, shredded bark, or wood chips, helps protect tree roots from temperature extremes and conserves soil moisture. Mulch also helps prevent grass from competing with the tree for water and nutrients. The mulched area makes it easier to operate mowers and weed eaters without hitting the trunk and compacting soil. Apply mulch to a depth of 3 to 4 inches (slightly thinner on top of the root ball) (Figure 11).

Staking: The method of staking is dependent on a tree's ability to stand on its own and the location of the planting site. Staking is used to hold trees erect, allow the root ball to anchor, and protect the trunk from damage by equipment. Stakes should be removed when the tree can stand on its own and the root ball is anchored. Stakes should be positioned away from the tree and secured to the trunk at the point where the tree stands straight. Do not use wire or any strap that will girdle the tree or damage the bark. If a tree cannot stand straight on its own after staking, a splint stake tied directly to the trunk made of bamboo, spring steel, or a fiberglass rod may be used to straighten the upper trunk and/or leader. Avoid using square wood secondary stakes.

Figure 12. Double staked

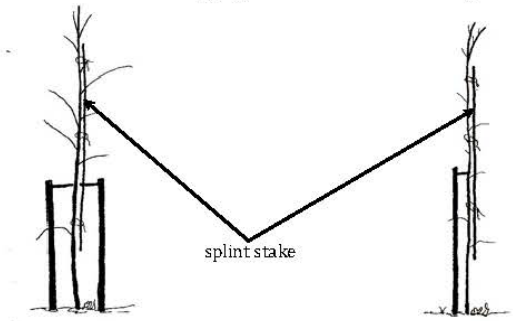


Figure 13. Double staked with splint stake.

Figure 14. Single staked with splint stake.

Tree Training at Planting and in the Early Years

Trees that grow to be large are more structurally sound and cost-effective to maintain when trained with a central dominant leader that extends 30 feet or more into the crown (Figure 15, left). Vigorous, upright branches and stems that compete with the central leader can become weakly attached (Figure 15, right).

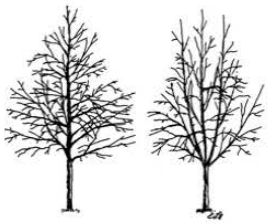


Figure 15. Good tree structure (left); poor structure (right).

Trees with branches spaced along the central leader, or trunk (Figure 15, left) are stronger than trees with branches clustered together (Figure 15, right). Prune trees at planting to one central leader by removing or shortening (shown) competing stems (Figure 16). All branches and stems shall be considerably shorter than the central leader after pruning is completed (Figure 16, right).

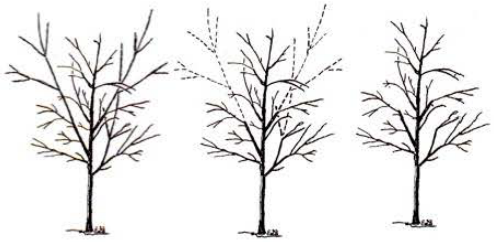


Figure 16. Shorten competing stems to improve structure.

Remove or shorten branches that are larger than half the trunk diameter at planting and every few years thereafter. Shorten them by cutting back to a live lateral branch (Figure 17, right). This lateral branch shall be pointed away from the trunk and it should not be growing upright. The central leader shall be more visible in the crown center after pruning. Only large-diameter branches need to be pruned because they compete with the leader and could be weakly attached (Figure 17, L). Small branches (Figure 17, S) do not need pruning because they will not compete with the leader.

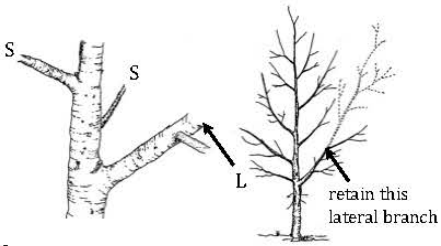


Figure 17. Only large branches need pruning (L). Small branches (S) do not need to be pruned.

Shorten or remove the largest low branches when the tree is young to keep them small (Figure 18). This ensures that only a small wound is created when they are eventually removed from the trunk.

The best way to shorten large or long stems and branches is to cut them back to a live lateral branch (Figure 19). This slows growth on the pruned parts and encourages growth in the dominant leader creating sound structure.

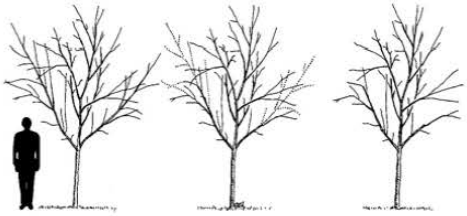


Figure 18. Shortening larger low branches concentrates growth in the leader and improves tree structure.

Remove larger branches by making three cuts. This prevents the bark from peeling or splitting off the trunk below the cut. Make the final cut back to the branch collar (enlarged area around union of branch where it joins the trunk).

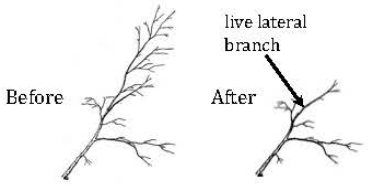


Figure 19. Reduce a stem back to a live lateral branch to slow its growth.

Structural Pruning Checklist

1. Develop and maintain a central leader.
2. Identify the lowest branch in what will become the permanent crown.
3. Prevent branches below the permanent crown from growing larger than half the trunk diameter.
4. Space main branches along the central leader.
5. Reduce vigorous upright stems back to lateral branches or remove entirely (Figure 20).

Reduction cuts can be used on trees at planting to subordinate branches that are codominant (Figure 20). Some upright stems and branches can be removed entirely back to the trunk. Heading cuts may have to be used occasionally.

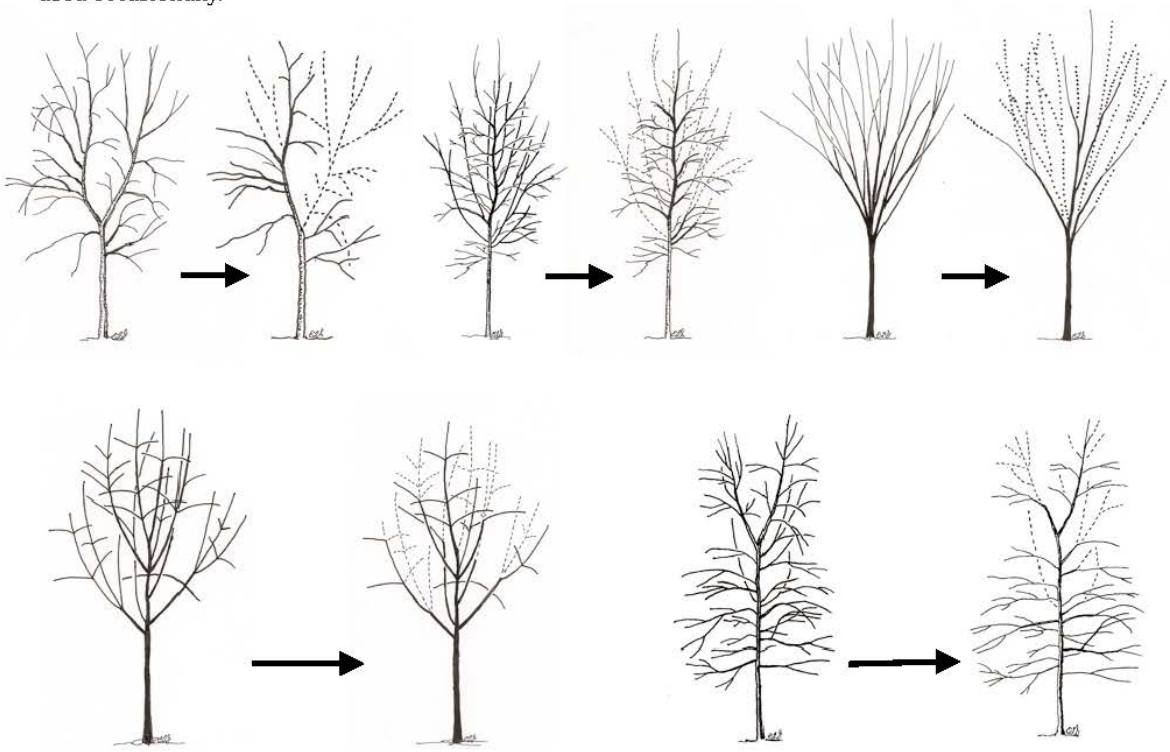


Figure 20. Before and after pruning at planting for structure

Irrigation

Consistent irrigation is critical for establishment.

1. Apply about 3 gallons 0f water per inch of trunk diameter to the root ball 2 or 3 times per week for the first growing season.
2. Increase volume and decrease frequency as the tree becomes established.
3. Weekly irrigation the second year and bimonthly irrigation the third year should be sufficient for establishment.
4. Once established, irrigation requirements depend on species, planting site, climate, and soil conditions.
5. Irrigation devices should be regularly checked for breaks and leaks.