

# County of Santa Clara Ecology-Based Tree Management Guide



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Prepared by:

The Office of Sustainability Integrated Pest Management Program in collaboration with the:

Department of Parks and Recreation

Department of Roads and Airports

Department of Facilities and Fleet

Department of Health and Hospital Services

Cover photos courtesy Canopy.org

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## Chapter 1

### A. Purpose

To establish a cohesive vision for the County of Santa Clara’s tree management and to provide guidelines, standards/protocols and background information for each department to develop, review or update their own internal Tree Management Plans to implement the vision outlined below.

This *Ecology-Based Tree Management Guidance* is one of two distinct documents. This first document is a guide with summary, references, and appendices intended to institute planning consistency and provide information and resources. Using this document, departments are asked to review<sup>1</sup> and/or create a second document, an individualized departmental *Tree Management Plan* for trees in built environments and back-country forest.

Departmental plans should become “living documents,” continually improving during development and implementation.

### B. Vision

Through the collective ambitions, strengths and expertise of all, implement effective, sustainable, ecology-based tree management to:

- Achieve adequate support, visibility and continuity;
- Secure adequate funding to sustain an integrated maintenance structure;
- Implement planned management of trees across the entire County;
- Develop and advance goals to improve the size and/or health of green canopy; and,
- Mitigate the impacts of climate change through tree management.



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<sup>1</sup> For park trees (individual and stand level), this document’s guidance can be addressed in site specific and/or park-level forest health plans.

## C. Scope

The scope of this guidance document is limited to tree management on County-owned and/or managed lands.

## D. Roles and Responsibilities

Each department that manages County-owned lands and facilities has a responsibility to create or maintain a departmental Tree Management Plan (Plan), or similar type document, and implement that Plan to identify tree hazards, assess tree health, and manage County trees in a manner that supports the vision and achieves countywide tree management goals.

## E. Countywide Tree Management Goals

All departmental Tree Management Plans seek to:

- **Achieve adequate support, visibility and continuity:** Tree Management Plans developed under a collaborative vision aim to result in long-term, continuing, fully supported departmental policies and strategies.
- **Secure adequate funding to sustain an integrated maintenance structure:** Trees on County-owned and managed lands require stable, consistent, and appropriately expanded funding sources for management activities that take place throughout a tree's life-cycle.
- **Implement planned tree management across the entire County:** To conserve, protect, enhance and, when appropriate, restore to ensure the safety and survivability of trees on County-managed lands to protect this important asset for future generations.
- **Develop and advance goals to improve the size and/or health of green canopy:** A concentrated and coordinated effort to plant climate-appropriate trees or take other mitigation steps as defined in departmental Tree Management Plans will help stem canopy decline while bringing greening benefits to the County.
- **Mitigate the impacts of climate change through tree management:** Activities that maximize biomass production and forest health and minimize soil disturbance are effective at increasing forest carbon storage to minimize the effects of climate change.

## F. County Operational Benefits

Departmental Tree Management Plans help:

- county management by providing guidelines and goals for future decision-making;
- individual departments exercise more control in a situation, "proactively" establish goals, and consider contingencies;
- quantify goals and establish a means of measuring success;
- insure that a coherent set of actions are implemented, consistent with overall County vision, values, and priorities; and,
- leverage and allocate appropriate staff, materials, and time resources in an orderly and systematic manner.

## G. County Green Infrastructure Benefits

Tree ecosystems are vital County green infrastructure. They clean the air, save energy, combat climate change, increase property value, reduce stormwater runoff, and provide important resources including wildlife habitat, recreational opportunities, and biomass inputs ([see Appendix A](#)). However, threats to forest health from wildfire, insects, disease and development are increasing because of climate change and population growth. Ecology-based tree management can help mitigate the adverse impacts of climate change and improve local environmental conditions to gain the many benefits provided by trees.

These benefits are a byproduct of the ongoing health and fortitude of County trees, which are reliant on cohesive, comprehensive, long-term, and countywide sustained maintenance strategies. Critical tree ecosystems must be conserved, protected, enhanced and, when necessary, restored.

- **Conservation** includes active stewardship of tree ecosystems and the strengthening of their local environments.
- **Protection** includes reviewing, updating and/or adopting adaptive management strategies to safeguard trees against wildfire, pests, development and other threats.
- **Enhancement** includes, improvement of productivity, health, ecosystem services and economic vitality.

- **Restoration** includes targeting broken systems to return forests and trees to previous conditions.

## H. Tree Management Areas Categorized by Use and Relevant Guidance

Because of the varying nature of departmental operational goals and objectives, County-owned and managed tree and forest areas should be categorized. Four departments directly manage trees on County-owned lands: Department of Parks and Recreation (PRK); Department of Roads and Airports (RDA); Department of Facilities and Fleet (FAF); and Department of Health and Hospital Services (HHS). To provide a framework within which both system-wide and location-specific tree management strategies can be applied, these categories and their relevant guidance sections within this document are shown below:

| <b>Department</b> | <b>Tree Category</b>                          | <b>Document Sections</b> |
|-------------------|---|--------------------------|
| FAF               | Urban & Community Areas                       | Section A to G, H        |
| HHS               | Urban & Community Areas                       | Section A to G, H        |
| PRK               | Urban & Community Areas                       | Section A to G, H        |
| PRK               | Use Areas                                     | Section A to G, H        |
| PRK               | Infrastructure & Operational Facilities Areas | Section A to G, H        |
| PRK               | Backcountry Areas                             | Section A to G, I, J, K  |
| PRK               | Trails Areas                                  | Section A to G, I, J, K  |
| RDA               | Rural Roads Right-of-Way Areas                | Section A to G, I, K     |
| RDA               | Mountain Roads Right-of-Way Areas             | Section A to G, I, K     |
| RDA               | Expressways Right-of-Way Areas                | Section A to G, H        |
| Countywide        | Cultural Sites & Heritage Trees Areas         | Section A to G, H        |

Each of the above-mentioned categories will contain different ecosystem types and natural communities.<sup>2</sup> Because of this, even in areas categorized as the same, it is important to identify the natural communities contained therein and vary management accordingly.

## I. Relevant Ordinances, Guidelines, and Practices

- County of Santa Clara Tree Ordinance<sup>3</sup> and tree protection guidelines<sup>4</sup>
- International Society of Arboriculture best management practices<sup>5</sup>
- Other applicable backcountry cultural resource protection practices as developed by PRK
- County General Plan<sup>6</sup>
- County IPM Ordinance<sup>7</sup>
- County Stormwater Management Ordinance<sup>8</sup>
- County Sustainable Landscaping Ordinance (MWEL0)<sup>9</sup>
- County Sustainable Landscaping Policy<sup>10</sup>
- Departmental site plans, master plans, or natural resource plans.

## J. Advisory Group Members

- Office of Sustainability – IPM Program
- Department of Parks and Recreation
- Department of Roads and Airports
- Department of Facilities and Fleet
- Our City Forest
- Canopy
- Davey Resource Group
- Department of Planning
- Cal Fire

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<sup>2</sup> [https://www.wildlife.ca.gov/Data/VegCAMP/Natural-Communities#natural communities' lists](https://www.wildlife.ca.gov/Data/VegCAMP/Natural-Communities#natural%20communities%20lists)

<sup>3</sup> [https://www.sccgov.org/sites/dpd/DocsForms/Documents/Tree\\_Ordinance.pdf](https://www.sccgov.org/sites/dpd/DocsForms/Documents/Tree_Ordinance.pdf)

<sup>4</sup> [https://www.sccgov.org/sites/dpd/DocsForms/Documents/Brochure\\_TreePreservation.pdf](https://www.sccgov.org/sites/dpd/DocsForms/Documents/Brochure_TreePreservation.pdf)

<sup>5</sup> <https://www.isa-arbor.com/store/category/117/>

<sup>6</sup> <https://www.sccgov.org/sites/dpd/PlansOrdinances/GP/Pages/GP.aspx>

<sup>7</sup> [https://library.municode.com/ca/santa\\_clara\\_county/codes/code\\_of\\_ordinances?nodeId=TITBRE\\_DIVB28INPEM APEUS](https://library.municode.com/ca/santa_clara_county/codes/code_of_ordinances?nodeId=TITBRE_DIVB28INPEM_APEUS)

<sup>8</sup> <https://www.sccgov.org/sites/cwp/Documents/SC%20Co.%20Ordinance%20Code%20Section%20B,%20Title%20B%2011.5%20FINAL.pdf>

<sup>9</sup> <https://www.sccgov.org/sites/dpd/DocsForms/Documents/Landscape.pdf>

<sup>10</sup> <https://www.sccgov.org/sites/scc/gov/CountyPolicies/Board-Policy-8.5-Sustainable-Landscaping-Policy.pdf>

- County of Santa Clara Fire Department
- University of California Department of Forest Research and Outreach

## K. Outreach Tools and Resources

All outreach tools and resources created for the areas defined below will be developed in consultation with stakeholder departments. Outreach tools and resource areas are:

### 1. Training

Healthy forests and trees require an investment in the professionals providing the expertise and care to support them. The County supports the training of employees involved in tree management and care. Specific training to strengthen employee expertise and skills in tree management and care should be developed or offered, as appropriate.

### 2. Demonstrations and Field Trials

Demonstration projects within County forests for forest management experimentation, and research should be used to determine the economic feasibility of artificial reforestation, and to demonstrate the productive and economic possibilities of good forest practices toward maintaining forest land in a productive condition, while providing public recreation opportunities, fish and wildlife habitat, and watershed protection.

### 3. Public Education and Outreach

Public education and outreach should be designed to heighten the public's awareness of forest services, and the importance of forest resources.

### 4. Connect with Experts

A “registry” of internal and external experts for specific tree-related issues should be developed for departmental use.

### 5. Information Sharing Tools

Information on tree management best practices and tools to facilitate information sharing among departments should be developed.

### 6. Reporting Dashboard

A dashboard should be developed as appropriate to track tree management and forestry goals (see examples in Appendix G).

## Chapter 2: Background

### L. The Ecology of Forests and Trees

Ecology-based tree management is a holistic approach that focuses on trees as being more than just individual organisms, but rather as parts of a manifold habitat and complex biological zone. As such, the areas that need to be considered in ecology-based tree management are:

- (1) any area that interacts biologically with trees;
- (2) any area that interacts biologically with the plants and animals that live among trees; and
- (3) any area that interacts biologically with natural resources upon which trees rely.

Thus, a parking lot tree filtering stormwater and a Santa Cruz mountain redwood providing habitat can each contribute in many ways to meeting County operational goals and objectives.

A collection of trees forms a forest. A forest is made up of living and non-living components stratified into layers: the floor, the understory and the canopy. Depending upon the availability of sunlight, moisture and food, each layer will have a varying set of living organisms including: trees; shrubs; vines; grasses; mosses; algae; fungi; insects; mammals; birds; reptiles; amphibians; and, microorganisms. Effective management of the interaction and reciprocation between these various layers, organisms and the surrounding environment provides the framework for ecology-based tree management and the optimal fulfilment of all forest functions.



### M. Reasons for Tree Management Planning

#### Contents

1. [Deforestation and Degradation](#)
2. [The Shrinking Santa Clara Valley Tree Canopy](#)
3. [Minimizing the Impacts of Climate Change](#)
4. [Creating a Cohesive Countywide Vision](#)

Deforestation and forest degradation are the second leading human cause of Carbon Dioxide (CO<sub>2</sub>) emissions contributing to global warming, according to the Intergovernmental Panel on Climate Change (IPCC 2007).

## 1. Deforestation and Degradation

Deforestation occurs when forests are converted to non-forest uses, such as for agriculture and urban development.<sup>11</sup> In this sense, systematic deforestation is **not** a threat on County-owned lands; however, the impacts of past and future tree removals and, where appropriate, replacement should always be given due consideration.

Forest degradation occurs when tree area ecosystems lose their capacity to provide important goods and services such as cleaned air and water, wildlife habitat, landscape cooling, local economic support, and recreational, cultural and spiritual centers for communities across the County (see [Appendix A](#)). As such, the impacts of forest deforestation and degradation should be mitigated through active planning and holistic, ecology-based tree management.

One of the most dramatic impacts is the loss of habitat for millions of species. Eighty percent of Earth's land animals and plants live in forests, and many cannot survive the degradation that destroys their homes. In Santa Clara County forests, there are over 580 annual plants, one biennial, 645 perennial, 38 ferns, 232 shrubs, and 46 tree species found growing wild. Of these trees, many are native species<sup>12</sup> (See [Appendix C-5-b](#)). There are also native invertebrates, amphibians, reptiles, birds and mammals, including five endangered species.<sup>13</sup>

Another impact of deforestation and degradation is the loss of forest canopy, which blocks the sun's rays and holds in heat at night. Forest soils need to be moist, but without sun-blocking tree cover they quickly dry out. Many former forest lands in other areas around the world have become barren deserts as the result of deforestation.<sup>14</sup>

Trees also help perpetuate the earth's water cycle by returning water vapor to the atmosphere. Deforestation disrupts this process which can lead to drought and more extreme temperature swings that can be harmful to plants and animals.

Trees also play a critical role in absorbing the greenhouse gases that fuel global warming. Forested lands are the County's largest land-based carbon sink, drawing carbon from the atmosphere and storing it in wood and forest soils. Fewer forests means increased

Trees outside backcountry forest areas include: trees on agricultural lands; in rural landscapes and along roads, rivers and human settlements; as well as trees in and around cities.

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<sup>11</sup> <https://www.iucn.org/resources/issues-briefs/deforestation-and-forest-degradation>

<sup>12</sup> <sup>12</sup> Native Trees of San Mateo and Santa Clara Counties - <http://www.cnps-scv.org/index.php/education/33-school-gardens/93-native-trees-of-san-mateo-and-santa-clara-counties-93>

<sup>13</sup> Link to list of endangered species: <https://scv-habitatagency.org/DocumentCenter/View/123/Chapter-1-Introduction> p. 40

<sup>14</sup> <https://www.prb.org/whatsbehinddesertification/>

amounts of greenhouse gases entering the atmosphere, which contributes to global warming.

The most feasible solution to deforestation and degradation is to manage tree resources carefully and sustainably, to make sure that forest environments remain intact. Any tree loss or recession should be balanced by planting additional young, climate-appropriate trees, or by taking other appropriate mitigation steps.

## 2. The Shrinking Santa Clara Valley Tree Canopy

The City and County general plans in Santa Clara County, and other control mechanisms, have had a decidedly positive impact on curbing the destructive influences of urban growth. Even with these important control measures, the Santa Clara Valley is still currently losing more tree canopy than it is building or maintaining.<sup>15</sup> Additional coordination across County departments, and concerted efforts at all levels, will help to conserve, protect, enhance and, when necessary, restore valuable tree resources.

Before Silicon Valley emerged with its high-tech industries, before suburban development, before the landscape was covered in orchards, before 96 percent of the old-growth redwoods of the Santa Cruz mountains were logged – the area was the “Llano de los Robles” (Plain of the Valley Oaks), so named by the first Spanish explorers to reach the valley in the late 1700s.<sup>16</sup>

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<sup>15</sup> San Francisco Estuary Institute, Oak Savannas and Woodlands South Santa Clara Valley Historical Ecology Study, Chapter 6, available at [https://www.sfei.org/sites/default/files/6\\_oaks\\_SouthSantaClaraValleyHEStudy\\_HighResolution.pdf](https://www.sfei.org/sites/default/files/6_oaks_SouthSantaClaraValleyHEStudy_HighResolution.pdf)

<sup>16</sup> <http://www.scmbc.org/old-growth-forests-of-scmtns/>

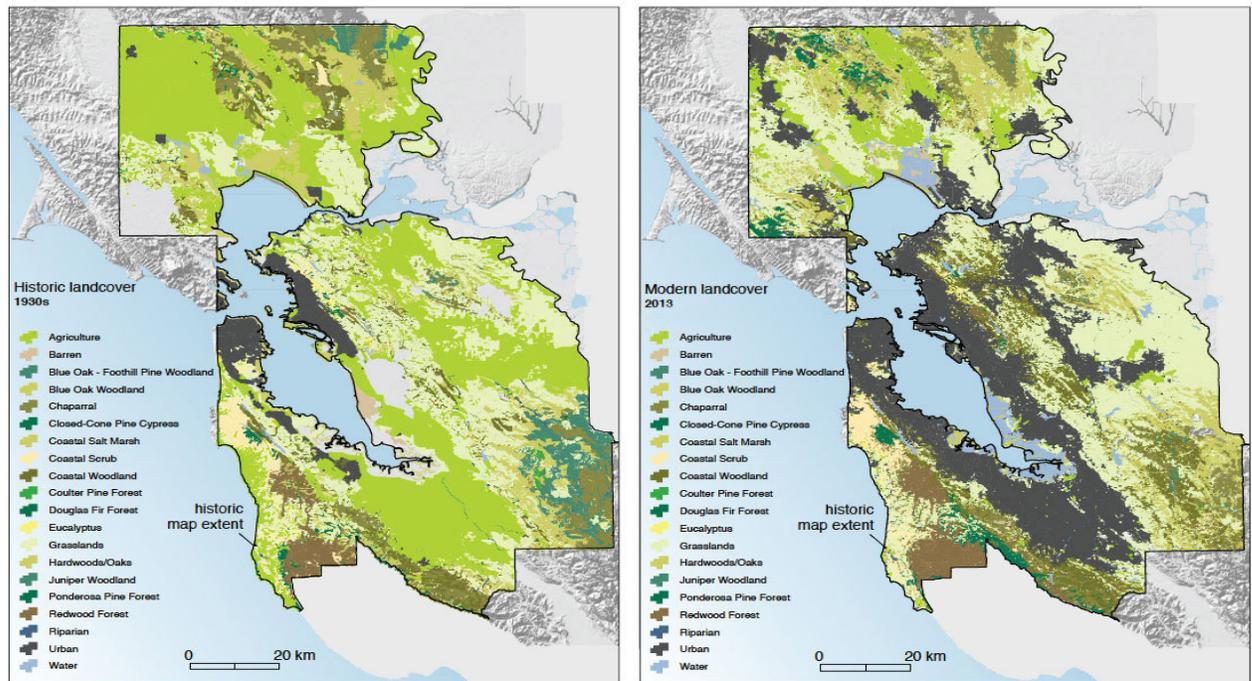


Figure 1 - Courtesy of the Spatial History Project

Then, the valley was a dryland habitat covered by varying degrees of oak density, from largely treeless grasslands, to oak woodland forests on well-drained soils.<sup>17</sup> These habitats along with chaparral, a type of shrub land, occupied the largest portions of the valley floor. There was a diverse array of wetland habitats characterized by varying degrees of inundation, from the seasonal meadows ringing the Bay (dry in the summer and muddy in the winter) to constantly flooded ponds and marshes that marked the lowest, flattest portions of the valley. Springs and seeps brought groundwater to the surface, impermeable clay soils impeded drainage, and creeks spread into broad, shallow sloughs. The Valley's creeks terminated within land, rather than connecting directly to the Bay or to other watercourses as they do today.<sup>18</sup>

Over the past 300 years many of the fundamental physical characteristics of the Santa Clara Valley – such as geology, soils, and topography in addition to shifting variables such as climate and land use have been dramatically changed by human activities. While not all areas of the

<sup>17</sup> San Francisco Estuary Institute, South Santa Clara Valley Historical Ecology Study, Chapter 6, Oak Savannas and Woodlands, pages 133-165, available at

[https://www.sfei.org/sites/default/files/6\\_oaks\\_SouthSantaClaraValleyHEStudy\\_HighResolution.pdf](https://www.sfei.org/sites/default/files/6_oaks_SouthSantaClaraValleyHEStudy_HighResolution.pdf)

<sup>18</sup> A Story Map - Watching Our Watersheds (WOW) Historic Santa Clara Valley available at

<https://www.arcgis.com/apps/MapJournal/index.html?appid=7ca58d914afe456fac2a1920a7c66149>

Valley were forested, urbanization has led to loss of native tree canopy; dirt roads have become highways; open spaces have become neighborhoods; trees have been cut down and non-native trees (some not suited to local climate) planted in their place; streams have been straightened and extended; and marshes have been drained, planted, and paved. As a result, The Valley's native forest lands have been severely reduced.

Fortunately, today's Santa Clara Valley – with many generations of modifications and stewardship – is still very much an ecological landscape that retains echoes of the earlier time. Despite changing land-use and climate, physical attributes such as geology, soils, and topography have remained largely stable.<sup>19</sup>

There is opportunity to rethink, reconnect, and rejuvenate our relationship with nature using a risk-management based approach including mitigation, adaptation, and restoration to maximize the benefits of the County forests. For example, “Re-Oaking,” as implemented by the San Francisco Estuary Institute, is one approach to reintegrate oaks and other native vegetation within the developed California landscape and restore this ecologically diverse and distinctive ecosystem to our cities and community. Native oaks are drought-tolerant, provide heat-tempering shade in the summer, and sequester more carbon than many other common urban trees. Drawing on the beauty of California oak woodlands, Re-Oaking could help bring a unique sense of “place” back to our cities. As we design ecologically healthy and resilient cities of the future, Re-Oaking could help integrate nature into our urban landscapes to benefit both ecosystems and people.<sup>20</sup>

Adoption and implementation of the practices and principles in this *Ecology-based Tree Management Guide* are expected to help stem the decline of the County's tree canopy.

### 3. [Minimizing the Impacts of Climate Change](#)

Climate change has not only a direct or reciprocal effect on trees and forest lands but also upon various other environmental influences, for example altered species habitats including vegetation, soil and hydrology, range shifts, food availability, and the predator-prey relationship.

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<sup>19</sup> A Story Map - Watching Our Watersheds (WOW) Historic Santa Clara Valley. Available at <https://www.arcgis.com/apps/MapJournal/index.html?appid=7ca58d914afe456fac2a1920a7c66149>

<sup>20</sup> SFEI: <https://www.sfei.org/projects/re-oaking#sthash.LSVXwYbd.mQfW8FOT.dpbs>

Growing evidence suggests forests will become a source of overall net carbon emissions if actions are not taken to enhance their health and resilience and to reduce the threats they face from human activities, wildfire, insects, disease, and risk from a changing climate.<sup>21</sup>

Carbon sequestration by trees is a widely recognized climate change mitigation approach,<sup>22</sup> as it is an immediate and relatively inexpensive means of addressing the issue. Tree management practices that will increase carbon sequestration include:

- Afforestation (establishing a forest where there was no previous tree cover), reforestation (replanting trees in a specific area<sup>23</sup>) and forest restoration (restoring a degraded forest to its original state);
- Increase tree cover through agroforestry, urban forestry, and tree planting in County landscapes;
- Enhancement of forest carbon stocks (both biomass and soils) and sequestration capacity through the modification of forestry management practices.

Managing trees properly can increase climate mitigation benefits more than leaving forests alone because management can increase forest growth and health as well as decrease the risk of wildfire.

Wildfires are responsible for over three percent of annual greenhouse gas emissions in the United States.<sup>24</sup> Therefore, reducing this threat can reduce carbon emissions. Management activities for wildfire mitigation include the careful selection of tree species, selective thinning, decreasing potential fuel for wildfires, and creating gaps in the forest to allow sunlight through, encouraging more trees to grow.

Protection of trees can be combined successfully with other site-specific uses for the County's urban facilities, roads, airports and regional park landscapes. The results of these actions will help to minimize the impacts of climate change on future generations.

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<sup>21</sup> Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p.

<sup>22</sup> Managing forests for climate change (FAO 2010: I1960E/1/11.10) available at <http://www.fao.org/docrep/013/i1960e/i1960e00.pdf>

<sup>23</sup> Increased absorption of carbon dioxide from the atmosphere. On average, a planted forest in a temperate zone can sequester about 3570 pounds of carbon per acre each year

<sup>24</sup> US EPA - Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, p.438 (available at [https://www.epa.gov/sites/production/files/2018-01/documents/2018\\_complete\\_report.pdf](https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf))

#### 4. Creating a Cohesive Countywide Vision

Realizing a cohesive vision for the County of Santa Clara's tree management depends on the collaborative actions of County employees, other public jurisdictions, the community and all organizations

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*County departments are committed to creating a shared cohesive vision and plan for the long-term care and management of the Countywide forest.*

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that create value and seek wealth and well-being from forests. Opportunities exist to improve the quality and quantity of benefits from these lands, but to realize these opportunities the entire tree management sector needs to share ideas, values, and actions. Reaching desired future conditions will require surmounting numerous political, social, and economic challenges.

Each department has a different mission, which will likely result in departmental Tree Management Plans with different specific goals and objectives.

- The mission of PRK is to provide, protect, and preserve regional parklands for the enjoyment, education and inspiration of this and future generations.
- The mission of RDA is to preserve, operate, and enhance the County's expressways, unincorporated roads, and two general aviation airports in a safe, timely and cost-effective manner to meet the needs of the traveling public.
- The mission of FAF is to improve the lives of the people of Santa Clara County by providing a sustainably planned and built environment for County services delivery.
- The mission of HHS is to provide high-quality, compassionate, and accessible healthcare for all persons in Santa Clara County regardless of their social-economic status and ability to pay.

Despite this wide variation, all departments can share a cohesive vision for countywide tree management goals.

This is a time of change and a new paradigm for trees on County-managed lands. These changes hold unprecedented challenges and great opportunities to ensure a sustainable future for one of the County's most prized natural resources. There is reason to be optimistic as current departmental programs are well-positioned and capable of advancing the County's sustainability commitments and climate-change goals on County-managed lands.

## Chapter 3: Departmental Plan Development

### A. Plan Groundwork and Goals

Planning decisions are influenced by policies, budgets, the current environment, and philosophies about land management. Departmental resources, skills, time constraints and applicable regulations in individual departments must be considered and supported. A professional arborist/forester can assist in creating a flexible plan that a department can follow to protect the environment and reach their tree management goals.

#### 1. Ordinance, Policies and Procedures

1. Review existing rules and regulations including the County's Tree Ordinance<sup>25</sup> and tree protection guidelines.<sup>26</sup>
2. Prepare a policy framework for: the constitution, management, and protection of trees and forest lands; the preservation and growing of trees and other vegetation recommended for climate change adaption; and other interconnected purposes.
3. Prepare departmental-specific tree management policies and operational procedures.

#### 2. Tree Inventory

Tree inventories at the individual tree-level and at stand-level in both built environments and in back-country forests (see Appendix C-7) allow for accurate planning and informed decision-making. Benchmarking allows departments to know where to allocate resources as well as how many and what type. Inventory requirements are based on the County tree and forest area category and natural community type/s in that location. Departments will allocate resources accordingly. Use of an individual tree-level inventory for developed areas versus a stand-level canopy inventory for backcountry forest is to be determined by each department depending on category and natural community type.

#### 3. Planning and Design Goals

Based on the vision, departments update, review or create a cohesive department-wide tree management action plan and prepare projects<sup>27</sup> with operational specificity, taking into consideration current ongoing tree management activities and the following goals:

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<sup>25</sup> [https://www.sccgov.org/sites/dpd/DocsForms/Documents/Tree\\_Ordinance.pdf](https://www.sccgov.org/sites/dpd/DocsForms/Documents/Tree_Ordinance.pdf)

<sup>26</sup> [https://www.sccgov.org/sites/dpd/DocsForms/Documents/Brochure\\_TreePreservation.pdf](https://www.sccgov.org/sites/dpd/DocsForms/Documents/Brochure_TreePreservation.pdf)

<sup>27</sup> A **management plan/project** is one of the most basic and important tools to improve the long-term health of County trees. Goals for the property are established, current resources are identified and described, and a timeline and set of strategies for achieving goals are developed.

a) Grow

- i. Arrest decline of County green canopy by significantly increasing the pace and scale of, or initiating, active management including; tree planting, pursuing and expanding equitable distribution of trees; natural encroachment; improved management of biomass and fuels; and protection of saplings/young trees.
- ii. Develop an associated funding and maintenance program to carry out this expanded management program and ensure long-term tree health.
- iii. Where possible, promote sustainable working forests and rangelands and accelerate agroforestry, and organic farming.
- iv. Prevent pathogen introduction and healthy gene pool management with sustainable nursery standards and procedures.
- v. Identify and promote a range of greening tools in the public rights-of-way and facilities.

b) Enhance

- i. Water quality and quantity protection.
- ii. Developed area tree management for energy conservation and improved air quality.
- iii. Planning and management for reduced wildfire risks to communities.
- iv. The full range of environmental, economic and social benefits provided to the community.
- v. Appropriate solutions for wood products (cradle to cradle) and biomass utilization to support ongoing sustainable tree management activities.
- vi. The biological diversity of tree and forest areas with plant, wildlife and fish habitat through conservation, protection, enhancement, and restoration.
- vii. Green infrastructure<sup>28</sup> for connecting people to the natural environment.

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<sup>28</sup> See: Green Infrastructure: <https://www.epa.gov/green-infrastructure/what-green-infrastructure>, and Green Infrastructure Forestry: [https://www.stateforesters.org/sites/default/files/publication-documents/2016\\_State\\_and\\_Private\\_Forestry\\_Report.pdf](https://www.stateforesters.org/sites/default/files/publication-documents/2016_State_and_Private_Forestry_Report.pdf).

- viii. Recreation as an important tree management consideration in all multiple-user categories of County forests.
- ix. Opportunities to identify climate change threats and solutions.
- x. The carbon sequestration potential and related benefits of tree and forest areas.

c) Protect

- i. Existing healthy trees and achieve a net-zero loss by combating biotic (disease and pests) and abiotic hazards through natural processes and healthy ecosystem management, to produce adaptive and resilient tree and forest areas.
- ii. Tree and forest land areas from wildfire threats.
- iii. Tree and forest areas from land conversions through land-use planning.

d) Manage

- i. Tree and forest areas' long-term health and sustainability through coordinated planning, design and maintenance.
- ii. Ecological processes within tree and forest areas, including the formation of soil, energy flows, and the cycles of carbon, water and nutrients.
- iii. Trees throughout their life-cycle by scheduling and employing cost-effective and efficient best management practices. By minimizing waste, reducing travel distances, and providing second-life opportunities for locally grown wood, the County can become a model of 21st century natural resource management. Components of the plan could include: provisions for natural expansion, developing a tree nursery to grow trees locally through a community partnership; determining a tree removal and succession plantings strategy; and creating a wood re-use program to encourage second-life products from trees removed from County land.
- iv. Collect and use data to manage and monitor trees.
- v. Improve coordination and communication between agencies, policy makers and the community.
- vi. Take into consideration, to the extent reasonably possible, climate change impacts such as:
  - a. the loss of biomass accompanying shifts in regional vegetation types (and resulting greenhouse gas emissions);

- b. the effects of vegetation, precipitation, wildfire and hydrologic changes on stream flooding and sedimentation/erosion/landslide rates within watersheds;
- c. contributions of landscape vegetation change and increased evapotranspiration on air quality and the urban heat island effect in the Santa Clara Valley; and
- d. expected increases in wildfire frequency and intensity and associated changes to planning, design, and tree management activities.

#### 4. [Funding](#)

- i. Secure funding for tree management projects, which can include: natural enhancement; tree inventories; planting; protection; encroachment; and maintenance, depending on County tree and forest area categories and natural communities therein.
- ii. Seek private and other funding sources.
- iii. Consider new and innovative funding sources.<sup>29</sup>

#### 5. [Implementation](#)

Implement sustainable forest/tree management practices.

#### 6. [Engage](#)

Community outreach should address the wide range of values that trees provide, and that people want - including economic benefits (commodities) (see [Appendix A-2](#)), social justice and equity (employment), and environmental benefits (e.g., fire safety, wildlife habitat, stormwater passive recharge, and carbon sequestration). Promote the role of trees in human health and wellness. Increase public awareness and environmental education to promote tree stewardship.

- i. Promote tree education and experimental opportunities.
- ii. Promote the benefits of trees to the public
- iii. Meet as the Countywide Ecology-based Tree Management Team at least bi-annually.

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<sup>29</sup> Possible funding tools include general obligation bonds, an assessment district, parcel tax, and General Fund revenue.

- iv. Provide ongoing outreach (awareness, training and resource information) to internal stakeholders (policy-makers, budget managers, land supervisors and workers).
  - a. Encourage participation in natural enhancement, planting, protection, encroachment prevention, and establishment and maintenance of trees through partnerships with private property owners and businesses in the County.
  - b. Recognize trees with special ecological, social or aesthetic contributions to the County's landscape (e.g., Heritage Trees).
  - c. Support federal, state and other local agency (cities, townships, water district, open space authority) goals and actions to improve forest and watershed health and resiliency.
  - d. Expand outreach to external stakeholders including all cities, townships, census designated places, and unincorporated communities of Santa Clara County, to private sector groups and adjoining public agencies, and to the public community with an aim to deepen their connection to nature and to create a model Countywide forest vision and plan inclusive of all jurisdictions at regional-scale.

## 7. Monitoring and Adaptive Management

- e. Support key research, data management (regular ongoing monitoring and data collection), and accountability needs.
- f. Measure and report progress in the OOS Semi-annual and Annual Sustainability and Climate Action Report Reports to the Housing, Land Use, Environment, and Transportation Committee (HLUET) and Finance and Government Operations Committee (FGOC) for the first three years and annually thereafter to HLUET as a separate report.

## B. Departmental Assessments

When needed, a department-specific tree management assessment (for individual and/or group of trees in built environments, and stand level trees in back country forests) can help develop or improve department plans and projects, leading to healthy, well-maintained and sustainable trees and greenery, improving County-owned lands' ecological functions and benefits.

## 1. Where to begin?

Departments shall develop a plan to evaluate tree or forest areas for physical attributes, current tree population, land management activities, and the necessity and actions needed to conserve, protect, enhance and, when necessary, restore trees and the ecology in that area. While planning, efforts and actions should not conflict with environmental health.

Departments (e.g., Parks) that have already completed benchmarking (individual tree health in built environments and stand-level trees in back country forests) and developed a strategy through a site plan, master plan, forest health or natural resource plan would implement those plans. Where plans do not exist, a department should analyze where planning is needed (i.e., gap analysis) and begin project planning.

The California Urban Forest Council's urban forest management plan toolkit<sup>30</sup> is one quality resource for developing the fundamentals of tree management planning and it is through that toolkit that the following questions were developed.

### i. Why develop a plan?

The reasoning will need to resonate with those who will approve and fund the development and implementation of the plan. Some justifications for the plan might include:

- Need to maintain tree and forest benefits.
- Benefit/cost relationships that show the positive contributions of a well-managed tree and forest area.
- Need to address county-specific challenges (e.g., damage from storms, fires, and pest/disease invasions).
- More efficient use of available funding and personnel.
- Improved ability to compete for future outside grant funding.

There might be administrative reasons why it would be especially advantageous to develop or revise a plan periodically. For example:

- Grant funding is available.
- Change in administration or personnel.

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<sup>30</sup> <https://ufmptoolkit.net/>

- A plan is needed to ensure tree management program continuity in the face of pending retirements.

ii. **Who will help with plan development?**

To gather the support and resources necessary to develop and implement a Tree Management Plan, departments will need to identify the key people and groups in their department who can make it happen. Seek input from a variety of stakeholders to:

- Develop a common vision.
- Assess values and awareness concerning tree management.
- Prepare a plan.
- Review the plan.

iii. **Stakeholder Analysis**

This is the process of identifying those affected by a project. Do some brainstorming with others to help identify the departmental stakeholders and their level of awareness.

- Who are the key people and groups that are impacted?
- Who are the people and groups whose support you will need?
- Who might be good at helping to develop or review the plan?
- Which stakeholder groups are likely to influence the success of the plan?
- Are these people aware of tree and forest management, community concerns, and the specific needs of the area to be planned? If not, how will you educate and engage them?

## 2. **Preliminary Assessment**

Tree management is the process of planning and implementing practices toward specific environmental, economic, social and cultural objectives. To develop a Tree Management Plan, it is important to determine objectives and circumstances in a specified area.

i. **Where?**

- Where will the geographical limits be?
- What areas will the plan cover?

ii. **What?**

- What do you want the urban forest to look like as a result of the plan?

- What is the department’s vision for their tree and forest areas?

Describe each tree or forest area and how it will be cared for and valued by the people who manage it. For example, if a department achieves its tree management goals, how will the area be different than it is now?

As departments proceed through the tree management planning process, they may decide to re-visit and change their initial plans and projects to include updated findings.

- What information is needed?
- What portions of the tree or forest area will be addressed (scope)?
- What is likely to be approved and funded.
- The scope of the plan should identify which trees will be managed.

Street trees are one of the most visible parts of the urban forest and have a great impact in terms of shading heat-absorbing surfaces and reducing urban heat island temperatures. Tree Management Plans developed for urban areas must understand the infrastructure conflicts, conditions, and special management needs of street trees.

Facility trees are trees located around built environments (buildings and other built facilities). Facility trees play an important role in shading structures and reducing energy use for cooling. Are there unique management or maintenance issues of facility trees that need to be addressed?

Trees in “park-like” settings, such as open areas of buildings, landscaped gardens, or picnic areas will have different site-specific needs.

The needs and management of trees in open spaces, such as in backcountry and trails areas (other than what is mentioned above for developed areas or built environments) will depend on the composition of the native plant community, what species are present, and land use goals.

### iii. When?

- Establish a timeline or schedule for developing the plan.

- Depending on the level of support, it might be necessary to take an incremental approach rather than going for the most comprehensive plan possible in the first attempt.
- What is the timeframe (horizon) that the plan will address? What planning, management and monitoring horizons will be addressed—5, 20, 50 years? Note if different short-term and long-term intervals apply to different plan components.

iv. How?

- How is the plan going to be developed?
- Personnel: In-house staff or consultants? How will the tasks be shared?
- Funding: Consider sources and availability.

### 3. Management

i. Responsibilities

When appropriate to departmental plans, County staff or contracted vendors should determine when any of the following actions are needed in the conservation, protection, enhancement and, when necessary, restoration of tree and forest areas:

- Planning and implementing of tree plantings.
- Maintaining existing trees.
- Management of hazards associated with declining trees.
- Removing trees that have reached the end of their useful life span.
- Recycling or disposing of green waste and wood from pruning and removals.

In some departments, tree care may be divided among several different programs. Determine where tree care responsibilities lie, and with whom. Review the roles of each person and department.

- How are activities of different entities coordinated and monitored?
- Are the various entities that affect trees working with the same vision and toward the same end?
- Are all units supporting the overall management goals through their activities?
- Which entities regulate or affect segments of the County tree management (e.g., tree committees, board of supervisors, planning commissions, or land use committees)?

- Who educates the public about the tree and forest care on public property?

Which entities perform activities that affect the tree and forest areas? Considerations are:

- Tree health monitoring.
- Planned growing space and rooting space.
- Utility line and structure clearance.
- Damage to sidewalks and other hardscape due to tree roots.
- Construction damage to tree roots.
- Non-native tree species invading natural areas.
- Fire hazards at the urban/wildland interface.

Which departments have direct tree care responsibilities and what areas do they manage?

Are the assigned roles and responsibilities providing for efficient and effective tree management? Evaluate the pros and cons of shifting responsibilities, and in-house versus contracted work.

In what ways, if any, could efficiency be improved (e.g., combining units, sharing equipment, or partnering with other departments)?

Assess for each unit that has direct tree care responsibilities:

- Are staff, training, and budget adequate to provide for tree care needs?
- Do staff retention rates affect program capabilities?
- What inventory and work scheduling system is used? How well does it work?

ii. **Issues**

Determine the specific issues that are relevant to each department plan and determine if awareness and education are needed regarding tree and forest benefits, management, and planning.

## C. Plan Synthesis and Execution

The strategic planning portion of the Tree Management Plan includes the development of goals, objectives, and actions that will lead to the achievement of the vision. The strategic planning process begins with the analysis of the data collected from tree inventories, departmental assessments and other sources.

### 1. Inventory, Analysis and Other Data

Obtaining the data needed for effective forest management planning is an important part of the process. Data includes tree information such as, location, species, size, and condition for individual trees in built environments, and stand-level tree information for back country forests. However, information on various economic, social and environmental parameters also needs to be considered. Such information may include: the existence and state of infrastructure; the availability of human resources; community attitudes about trees; sites of high conservation-value, including watersheds; heat-island effects; quantifiable eco-valuation benefits; and the presence of rare or endangered species.

If through analysis it is found that conservation, protection, enhancement, or restoration are needed, try to determine why. For example, if canopy cover is decreasing it could be due to a variety of reasons such as: more trees are being removed from an area than are being planted; an invasive pest is killing trees at an accelerated rate; or land use requirements such as breaks for wildfire protection or clearance of utility corridors have resulted in canopy decrease.

### 2. Issues and Trends

You can project what the tree or forest area is likely to look like in the future based on current conditions and practices. For example: If small-statured trees (e.g., crepe myrtles) have been planted to replace large trees (e.g., coast live oaks), tree canopy cover may not be restored even when new trees reach their mature size.

- What practices would need to be continued or changed to maintain or expand the existing green canopy?
- Is awareness and training needed regarding tree and forest benefits and management?

### 3. Goals

Goals are summative statements that spell out the overall general outcomes that departments seek to achieve (e.g., maximize benefits that trees provide to County structures). Develop broad goals that address the needs that have been identified. Achieving a general departmental consensus on the plan's goals can help ensure that necessary resources will be made available to implement the plan. If funding is limited, goals should be prioritized so that resources can be directed toward the most important or urgent goals first. Priority rankings are also used to phase activities over time so that high priority tasks are completed before low priority tasks.

- What do departments want?
- What would be the elements of a highly successful ecology-based Tree Management Plan?
- Review and revise department tree and forest management goals.

Remember, the health of the County forest often depends on active tree management. It is a misconception that a healthy tree is always an untouched tree. A plan is the road map to long-term success.

### 4. Objectives

Like goals, objectives are desired outcomes, but objectives are more specific and limited in scope (e.g., increase parking lot shade from 15 percent to 35 percent by the year 2030). Make objectives tangible, quantifiable and realistic. Departmental plans that are explicit in stating objectives will be easier to evaluate progress.

### 5. Projects

Based on each department's mission and resources, the combination of goals and objectives in their plan spell out the desired conditions of their tree and forest areas. Specific projects describe how you achieve, or maintain, those conditions.

A project is a step needed to realize an objective, (e.g., removing old trees, installing irrigation or planting new trees). Projects results should be monitored and evaluated against objectives and benchmarks. Subsequent projects or approaches to their implementation can be modified based on this evaluation.

The result of the planning process is a document containing all necessary information in the form of text, maps, tables and graphs indicating what is to be done, where, when, why and by whom to achieve the specified objectives.

Note: In many jurisdictions, including Santa Clara County, a designated government agency (for example Department of Fish and Wildlife, CA Department of Forestry, CalFire, etc.) may need to review and/or approve such plans before forest activities may commence. (e.g., a forest thinning and restoration project may require the preparation of a Timber Harvest Plan under State Forest Practice Rules).

## Chapter 4: Reference Material

### Best Management Practices Applicable to All Departmental Tree Categories defined under Chapter 1 Section H.

#### A. Best Management Practices

[See Appendix D for an example template.](#)

##### 1. Follow or Adopt Tree Management Best Management Practices

The International Society of Arboriculture [Best Management Practices \(BMPs\)](#) should be applied to all activities in County tree and forest areas, whether conducted by internal or external individuals or groups.

[See Appendix E for Tree Management Best Management Practices \(BMPs\) to be applied.](#)

##### 2. Relevant Best Management Practices Applicable to All

#### B. Tree Health Care

Healthy tree growth disruption can be divided into two main categories of causes: living (biotic) and non-living (abiotic) factors. More than one factor can affect the health of a tree at any time. A useful distinction can be made between primary pests, which first and principally affect the health of the tree, and secondary pests, which have a less important influence and usually affect trees already weakened by a predisposing factor.

The impact of insect pests is often increased by a previous weakening of the tree's vigor and a lowering of its natural resistance to infestation, for example through drought or waterlogging or nutrient deficiencies. One of the most common predisposing factors is poor nursery management. Saplings that become pot-bound do not develop a healthy root system and therefore grow poorly when planted.

Stress and off-site factors also play a major role in determining the health or condition of trees, as do poor soil and drainage. Therefore, an undue emphasis on poor site conditions or adverse climatic events such as drought and frosts as the primary causes of observed symptoms and damage to trees may hinder a more careful search for possible biotic influences.

### 1. Pest (biotic) influences

Some pest groups are better known than others simply because they are easier to see. Insects are frequently found on trees although many are casual feeders and not serious pests, and some are beneficial (natural enemies to tree damaging pests). Fungi are frequently seen on dead and decayed organic matter, but they may not necessarily be the primary cause of tree symptoms observed. Most fungi in nature are saprobic (living on dead or decaying tissue); only a very small proportion are pathogenic. Insects and fungi are relatively easy to distinguish by direct observation, while the remaining pest groups are not. Several other living agents occur on trees including mosses, lichens, and epiphytes such as bromeliads, but these have only a superficial impact on tree health.

[See Appendix F, Table 1, for major groups of pests that occur on trees.](#)

### 2. Non-living (abiotic) influences

The effects of poor soil and generally adverse growing conditions on the health of trees, and their causal association with observed symptoms, needs careful examination. Nutrient disorders produce symptoms like those of virus diseases and other pest infestations or infections, and a lack of information often makes it difficult to make even a preliminary diagnosis of a problem. Fire may also weaken trees and make them more susceptible to insect attack. When poor growing conditions have had long-term effects on the health of a tree, an examination of growth rings can help to reveal the history of factors, such as prolonged periods of drought. Other evidence may be more immediate and visible.

[See Appendix F, Table 2, for Non-living factors that impair the health of trees.](#)

### 3. Recognizing features of unhealthy trees

When is a tree unhealthy? The simple answer is when symptoms are observed in the crown, on the foliage, or on stems (shoots, branches, trunks). The difficulty in examining tree roots, and the failure to do so, may mask important evidence. However, for serious problems symptoms usually manifest in other parts of the tree.

The detection of ill tree health depends on the initial recognition of symptoms. Some symptoms are easy to identify, for example wilted leaves and stems with cankers, but others are not and may be difficult to distinguish from events that occur in the normal growth cycle. Many trees drop their leaves and stop growing during winter or dry seasons. It is important, therefore, to understand the tree's normal pattern of growth throughout the year, and from one year to the next, according to prevailing conditions at sites.

[See Appendix F, Table 3, for scheme for classifying symptoms.](#)

Similar features can have very different causes. A classification of tree health problems by symptoms may include more than one type of cause in some categories.

#### 4. Analyzing the cause of symptoms

##### a. Interpretation of symptoms

The fundamental challenge is to realize when a tree is unhealthy. The following stages are suggested for interpreting symptoms and making diagnoses from visual evidence only:

- 1) Learn the expected appearance of the tree where it is growing, the time of year, and the prevailing conditions. Seek advice from County extension agents or a professional arborist if necessary.
- 2) Observe the symptoms. Start with a close-up examination of plant parts, consider the distribution of symptoms in individual trees, and then examine the distribution of affected trees at the site. Last, find out the history of the problem. Make thorough notes because accurate information will be required if you request technical assistance.
- 3) Use the classification in [Appendix F, Table 3](#), to decide what types of symptoms are present. This will suggest possible causes.
- 4) If further investigations are required (for example, if many trees are dying), take samples. Look carefully for any evidence of pest activity; collect pest samples or plant samples showing early symptoms from the appropriate part of the tree.
- 5) Take samples to your County extension agent or a professional arborist for identification and recommendation.

##### b. Making a diagnosis

Many stages are involved between the first observations of symptoms and the conclusion about their cause. The first step is to eliminate factors that are unlikely to be the cause of the problem. For some symptoms the cause may be easily determined, as with the pustules on leaves produced by a rust fungus. Other symptoms may have several possible causes, such as dieback, which could be the result of a mammal feeding on a stem and stripping away the bark, a fungal root disease, or a phytoplasma infection to name a few. Resolving these problems may involve the identification of potential pest organisms. This can be a long and complicated procedure, hence the value of carrying out a preliminary diagnosis.

A good diagnosis considers wide knowledge of the host tree, the causal factors that impair its health and the interactions between the host, the causal factors, and the environment in which the tree grows. Identifying the precise cause of a problem is often difficult but can be achieved by following the simple procedures described above.

c. **Problems in linking symptoms to causes**

Some difficulties may be experienced in observing and interpreting the wide range of symptoms. Tree health problems are often assumed to be caused by insects because they are easy to find on trees and because alternative causes of ill health are often unknown ([see Appendix F, Table 2](#)). The supporting evidence should always be examined carefully in interpreting the significance and importance of insects and other external features such as bracket fungi on trunks. The role of atmospheric pollution in tree declines should also be examined carefully.

5. **Integrating different sources of knowledge**

Sources of knowledge on tree health range from the forester and the arborist to the extension officer and the researcher. Surveys are the traditional way of determining the incidence and severity of problems. The ability of local people to diagnose symptoms accurately may be limited, and different problems may be perceived as being the same one. However, careful interviews can be extremely helpful in explaining the history of a disease or disorder, when it first occurred, or where it is most damaging. See [Appendix F](#) for scientific literature sources for further information.

6. **Diagnostic and advisory services**

Always consult local support services (County extension agent) for initial advice if possible. If these sources are unavailable for tree health problems, then it is advisable to consult experts from the University of California in related disciplines and sectors such as plant pathology and entomology or certified arborist of county's tree-health care contractors. The next step may be to collect samples or to invite experts to examine the problem in the field.

If samples are required for laboratory investigation, always try to choose a laboratory or institute as close as possible to the site of the tree health problem (see Plant Pest Diagnostic Center – Plant Pathology Lab of California Department of Food and Agriculture).<sup>31</sup> A straightforward diagnostic investigation will involve examination of

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<sup>31</sup> Plant Pest Diagnostic Center – Plant Pathology Lab of California Department of Food and Agriculture available at <https://www.cdfa.ca.gov/plant/PPD/plantpath.html>

potential pest-infested material, either in the form of insect samples or perhaps plant tissues with fungal fruiting structures. A more detailed investigation will require isolation and identification of potential pest organisms or rearing of adult insects from larvae.

Always contact the laboratory before sending material to determine its policy for accepting samples or receiving cultures or samples of pest organisms, especially if the laboratory is out of county and quarantine legislation must be followed. Common services available include identification of insects for major orders. Fungi that produce spores on plant material are usually easier to identify than those that require isolation and culturing. Identifying bacteria is more difficult, while services for identifying viruses and phytoplasma are rare.

Diseased material can be sent by mail, but the ability to isolate pathogens decreases as the time increases between material collection and receipt by the diagnostic laboratory.

[See Appendix F for specific instructions on collecting and mailing plant and insect samples, and for suggested laboratory locations.](#)

#### 7. Soil Test

Soil samples tell us much about our County Forest's biological productivity, fire influences, changes due to global warming, and differences in nutrient contents from one area to another. Comparisons of soil samples could tell us, for example, how human activities have changed or not changed the landscape (for example trees in streetscapes, parking lots, around buildings, campgrounds), or how weather patterns or soil compaction influence water flow.

See Appendix F for instructions on collecting and mailing soil samples, and for suggested laboratory locations.

### C. Hazardous Tree Management Guidelines

Forests include trees with varying levels of health and vigor and structural integrity. In all forests because of drought, disease, and weather, the trees may shed limbs, lose their tops or completely fall over. Working around, walking in, or driving through forested areas may expose people to falling trees, tree tops and limbs. This section presents a framework for identifying risk of tree failure and making decisions in areas where dangerous trees pose a threat to individuals along forest roads or on work sites.

A tree's stability and structural integrity can be influenced by its location and the extent of structural defects, mechanical damage, insect attack, and disease, as well as work activities (e.g., physical ground activities around trees) and weather conditions. If a tree is unstable or its structural integrity compromised, total or partial failure may occur. During failure events, falling trees or parts may pose a danger to people or vehicles that may be struck by them.

Guidance for the identification and abatement of hazard from trees is provided by many sources including: the International Society of Arboriculture, California State Parks, and the U.S. Forest Service.<sup>32</sup> The County Parks and Recreation Department has also developed a tree safety program, based on the California State Parks.<sup>33</sup> All hazard tree guidelines are intended to provide consistent direction for hazard tree identification and abatement and their use is highly encouraged.

It must be recognized from the outset that even under the best of circumstances and with the highest standard of care, the ability to predict tree failure is not infallible. Simply put, there are limitations in the ability to reasonably foresee all tree failures all the time. However, by exercising good professional judgment and using a systematic approach, it is possible to significantly reduce (but not eliminate) the risk of injury to people and damage to property.

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*Continuously use dynamic risk assessment to identify trees that poses a clear and present danger*

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## D. Agroforestry<sup>34</sup>: Enhancing Resiliency in Landscapes Under Changing Conditions

Agroforestry is the collective term for land-use systems and technologies in which woody perennials (e.g., trees, shrubs) and agricultural crops or animals are intentionally integrated on the same parcel of land in some form of spatial and temporal arrangement.

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<sup>32</sup> For example see: U.S. Forest Service., Pacific Southwest Region (April 2012) titled "Hazard Tree Guidelines for Forest Service for Facilities and Roads in the Pacific Southwest Region," *available at* [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb5332560.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5332560.pdf)

<sup>33</sup> <https://www.sccgov.org/sites/parks/plansprojects/resource/documents/tree-safety-program.pdf>

<sup>34</sup> For more information see US Department of Agriculture, *Agroforestry: Enhancing Resiliency in U.S. Agricultural Landscapes Under Changing Conditions*, Gen. Tech. Report WO-96 (November 2017) *available at* [https://www.fs.fed.us/research/publications/gtr/gtr\\_wo96.pdf](https://www.fs.fed.us/research/publications/gtr/gtr_wo96.pdf)

Agroforestry can also be defined as a dynamic, ecologically based natural resource management system that, through the integration of trees on farms and in agricultural landscapes or through the production of agricultural products in forests, diversifies and sustains production for increased economic, social, and environmental benefits for land users.

Agroforestry has been practiced for a very long time in many parts of the world. The five widely recognized categories of agroforestry in the U.S. are:

1. Silvopastoral systems - combining woodland trees and the grazing of domesticated animals;
2. alley cropping, fodder banks, orchards and tree gardens, multipurpose trees and shrubs in farmlands;
3. forest farming (or multistory cropping), farm woodlots;
4. windbreaks, shelterbelts, conservation hedges, live fences, boundary planting;
5. riparian forest buffers.

Such practices can help to mitigate greenhouse gas (GHG) emissions and increase the resiliency of agricultural and forest lands to address impacts from climatic variability. They can also enhance agricultural production; protect soil, air, and water quality; provide wildlife habitat; and allow for diversified income. Agroforestry accomplishes these production and environmental benefits by:

- Modifying microclimates in ways that can improve crop yields from six to 56 percent depending on crop type.
- Reducing soil erosion from water and wind, and improving soil physical condition and fertility, thereby protecting future soil productivity.
- Modifying microclimates in ways that protect livestock productivity and well-being.
- Protecting streambanks and infrastructure, moderating water pollution, and ameliorating high stream temperatures, thereby protecting water quality and aquatic ecosystems.
- Creating habitat refuge and connectivity across highly fragmented agricultural and forest landscapes, protecting biodiversity including pollinators and beneficial insects.

- Generating innovative food-producing systems that diversify farm portfolios and increase economic stability.

Opportunities exist to manage forested rangelands as silvopasture systems that reduce fuel loads and severity of forest fires while enhancing forage and livestock production.

This subject should be explored to enhance resiliency in the County's agricultural/rangeland and forest landscapes under changing climate conditions.

## E. Land-Use Planning

Integrated "land-use planning," involves the allocation of land to different uses across a landscape in a way that balances economic, social and environmental values. Its purpose is to identify, in a given landscape, the combination of land uses that is best able to meet the needs of stakeholders while safeguarding resources for the future. Effective land-use planning provides direction on the way land-use activities should take place and encourages synergies between different uses. It requires the coordination of planning and management across the different sectors involved with County land use and land resources.

In forestry, land-use planning involves the systematic assessment of tree and forest areas and its potential for various land uses, a consideration of the desirability of those land uses, and an understanding of economic, social and environmental conditions to enable the identification and adoption of the best land-use options in tree and forest areas. Land-use planning is driven by the need for improved management and different land use patterns as dictated by changing circumstances. Key stakeholder groups should agree on the goals of a land-use planning exercise at its commencement. These agreed goals will provide reference points for future decisions on land allocations.

Activities that are common to tree and forest areas planning are:

1. assessing present and future stakeholder needs and systematically evaluating the capacity of the land to supply them;
2. identifying and resolving conflicts between competing uses, the needs of individuals and those of the community, and the needs of the present and future generations;
3. seeking sustainable options and choosing those that best meet identified needs and will contribute to agreed goals;

4. allocating land to a range of uses to bring about desired changes.

The process of land-use planning is iterative and continuous. Any land-use plan should be able to be renegotiated to consider new information and changing circumstances and goals.

## F. Wildlife Management

Although, this document will not provide guidance on operationally administering wildlife management, it should be noted that wildlife management is an integral component of tree and forest area management. See [Appendix H](#) for more information.

## G. Vegetation Fire Management (Prescribed Fire<sup>35</sup>) - Risk reduction: focusing resources on the underlying causes of fires

Prescribed fire is an important factor in the management of forests, woodlands and other vegetation types. The County has used prescribed fire to improve grassland habitat, reduce fuel loads and control the growth of brush for over 15 years. Prescribed fire plays an important ecological role by fostering renewed growth and controlling invasive plant species.<sup>36</sup>

Uncontrolled forest wildfires can have severe negative impacts on human health, livelihoods, assets, air and water quality, and biodiversity. Moreover, climate change with increasing temperatures and drought is expected to lead to increases in the incidence and intensity of, and the area affected by, vegetation fires. In turn, the greenhouse gas emissions that result from vegetation wildfires may exacerbate climate change. Prescribed fire, used as a forest management tool, can reduce the likelihood of uncontrolled wildfires.<sup>37</sup>

In regions like the County where fire is an important management tool, forest managers should continue to use it in a responsible manner. In general, all stakeholders should be actively involved in the planning and implementation of prescribed fire.

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<sup>35</sup> Prescribed Fire: Nor Cal Prescribed Fire Council, Central Coast prescribed Fire Council, and USDA  
<https://www.fs.fed.us/sites/default/files/toward-shared-stewardship.pdf>

<sup>36</sup> Fire (1) prepares a seedbed and favors germination and survival of seedlings; (2) recycles nutrients; (3) changes the successional pattern; (4) favors wildlife; (5) develops a mosaic of vegetation age classes and types (6) modifies impact of insects and disease; and (7) reduces hazardous fuels.

<sup>37</sup> <http://calfire.ca.gov/foreststeward/pdf/news-spring2013b.pdf>

## Best Management Practices Applicable to Specific Departmental Tree Categories defined under Chapter 1 Section H.

### H. Urban and Peri-Urban<sup>38</sup> Forestry: Tree Planting in Built Environments or Developed Areas

The total number of trees on Earth has decreased by nearly 46 percent since the start of human civilization. Changing land use patterns, and unsustainable management of forest resources are responsible for a total loss of over 15 billion trees each year.<sup>39</sup> Since 2000, the urban population of Santa Clara County has been growing at nearly one percent per year.<sup>40</sup> Planting urban and peri-urban trees today is essential to stabilize tree populations for future generations.

Urban and peri-urban trees are one of the most important elements of the street environment. If properly managed, trees can make an important contribution to the planning, design and management of sustainable resilient urban landscapes. They can help make the county more pleasant, attractive and a healthier place in which to live, as well as safer and wealthier. Trees should always be included in complete street designs. Appropriate tree species selection and planting sites ensure the healthy growth and longevity of trees, enhancement of the streetscape character, and maximization of the County and property owner's investment. There are many benefits trees provide, a few are described below.

Large urban trees are excellent filters for urban pollutants and fine particulates. By capturing, filtering and storing water, urban and peri-urban forests play an important role in regulating water flow and water quality. Because urban and peri-urban areas are major emitters of greenhouse gases and trees sequester carbon dioxide, urban forestry can contribute to climate change mitigation strategies. These green canopies can also help to adapt to climate change by providing shade, by decreasing the "heat island effect" and by cooling the urban environment.

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<sup>38</sup> Peri-Urban means denoting or located in an area immediately adjacent to a city or urban area, not back-country.

<sup>39</sup><https://www.nature.com/articles/nature14967>

<sup>40</sup><https://www.census.gov/population/www/censusdata/pop1790-1990.html>

Management of trees creates job opportunities that employ a diversified workforce. There are jobs in which little qualification is required and those requiring experts. The aesthetic benefits of green infrastructure increase surrounding land and property values and attracts tourists and businesses to the urban areas. This in turn adds to tax revenues. By providing shade, trees have a cooling effect on structures, yielding cooling energy savings and prolonging the life of streets and other grey infrastructure.

Green areas and parks also have a high recreational value that can improve neighborhoods and promotes physical activity. Children growing in an environment with adequate playgrounds and green areas are given equal development opportunities regardless of their social or economic classes, while green open spaces can promote a more active lifestyle for more senior adults. Green areas can be used for awareness raising and education about nature, climate change, arboriculture, etc.

See [Appendix A](#) for Social, Economic and Environmental Benefits of Forests and learn more about benefits of trees in “Guidelines on urban and peri-urban forestry (2016)” published by Food and Agriculture Organization of the United Nations.<sup>41</sup>

#### 1. Management Policy, Ordinances and Documents

The County of Santa Clara recognizes its trees as one of its most valuable resources. It is for this reason that the County has dedicated itself to the preservation, proper maintenance and continued enhancement of county forests. The following governing and procedure documents illustrate the County’s commitment to its trees:

- County of Santa Clara Tree Preservation and Removal Ordinance<sup>42</sup>
- County of Santa Clara – Department of Parks & Recreation’s Hazardous Tree Management Guidelines
- County of Santa Clara – Procurement Department’s contracting document for standards and scope of services related to conducting tree inventory, tree-health care and consulting arborist qualifications ([See Appendix G](#)).

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<sup>41</sup> Guidelines on urban and peri-urban forestry (2016). Food and Agriculture Organization of the United Nations available at <http://www.fao.org/3/a-i6210e.pdf>

<sup>42</sup> [https://www.sccgov.org/sites/dpd/DocsForms/Documents/Brochure\\_TreePreservation.pdf](https://www.sccgov.org/sites/dpd/DocsForms/Documents/Brochure_TreePreservation.pdf)

- Approved list of trees to be developed in consultation with Stakeholders Departments and University of California Forestry experts and CA Department of Forestry.

## 2. Tree Placement

Street types: All

Sidewalk zones: Expressways; Medians; Frontage; Furnishings; Extensions; Parking Lanes; Parking Lots; Building Perimeters; Facility Perimeters, Use Areas, Infrastructure and Operational Facilities Areas.

Urban and peri-urban trees are typically planted in tree basins (sidewalk cut-outs) in sidewalks. Where planting strips of enough width are located between sidewalks and streets, it is not necessary to create independent tree basins. Ground-cover landscaping should be included in planting basins larger than standard size.<sup>43</sup> In limited circumstances, trees may also be planted in above ground planters.

When adding trees to an existing urban and peri-urban scape, movable site furnishings should be relocated to allow for appropriate spacing. If unmovable sidewalk elements interfere with a planting sequence, place the tree a few feet in either direction to accommodate obstacles. When designing a new street, or renovating an existing one, locate or relocate utilities and other elements where feasible to attain regular tree spacing.

## 3. Tree Species Selection

Consistent plantings, flowering species, and accent trees add aesthetic value. Accent trees, distinguished by their contrasting color, texture, or size, may be used to alert motorists (in the case of streetscapes) to approaching intersections, or mark the entrances of facilities and parks.

On formal streets with sufficient width, a double row of trees should be used to create a distinctive design.

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<sup>43</sup> Street tree spacing is determined by the expected mature size of the tree. Therefore ground-cover landscaping should be in planting basins larger than the standard size to accommodate the crown diameter of the mature tree. For example, a small tree <20 feet crown diameter at maturity should be planted 15 to 20 feet on center; medium sized trees 20 to 35 feet crown diameter at maturity should be planted 20 to 25 feet on center; large trees >35 feet crown diameter at maturity, should be planted 35 feet on center.

Appropriate tree species selection should consider:

1. Form, mature size, color, and texture to reflect the urban design goals of a street;
2. The mature tree canopy with respect to how it may affect street and pedestrian lighting or views of signage and building fronts;
3. The potential for root systems to affect sidewalks, curbs, and utilities; and
4. Impacts and constraints created by local climate.

Departments can see references below<sup>44,45,46</sup> and work with University of California Forestry experts, California Department of Forestry, and/or contracted tree professionals for assistance in developing a department-wide or project-wide appropriate species tree list.

#### 4. Characteristics of Trees for Different Climatic Zones

Santa Clara County may be divided into three climatic zones:<sup>47</sup>

- Sunset Zone 15: Saratoga, southwestern Los Gatos, southwestern Cupertino and Mission San Jose.
- Sunset Zone 16: Campbell, most of San Jose, southern Sunnyvale, northeastern Cupertino, northeastern Los Gatos.
- Sunset Zone 17: Santa Clara, Alviso, Milpitas, northern Sunnyvale.

Because of the marine influence of San Francisco Bay, none of these zones are too severe. These zones support warm temperatures, skies that are dry, clear, and sunny, and generally light winds. Zone 17 is often relatively stable and less ideal for plants that have adapted to winter chill or summer warmth. Zone 16 is very similar to zone 15 but comprises hillside thermal belts where cold air drains away in winter and gets a bit warmer in summer. Above and below zone 16, zone 15 gets cool enough for plants that want winter chill but

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<sup>44</sup> Native Trees of the Santa Clara County. Available at <http://www.montesereno.org/DocumentCenter/View/645/Native-Tree-List>

<sup>45</sup> Native Riparian Plant of the Santa Clara Valley. Available at [https://www.valleywater.org/sites/default/files/D2/D2/D2-4\\_riparian\\_plants\\_2016%282%29.pdf](https://www.valleywater.org/sites/default/files/D2/D2/D2-4_riparian_plants_2016%282%29.pdf)

<sup>46</sup> Trees native to Santa Clara County. CalScape Database by California Native Plant Society. Available at <https://calscape.org/loc-santa%20clara/cat-Trees/ord-popular/vw-list?&poploc=1&srchr=sc5bad294891bd2>

<sup>47</sup> Sunset Climate Zones: Northern California. Available at <https://www.sunset.com/garden/climate-zones/sunset-climate-zone-northern-california>

may not get warm enough in summer for plants that need heat. The *Sunset Western Garden Book*<sup>48</sup> not only describes the climate zones in detail, but also specifies what zones every plant is adaptable to. Refer to the New Sunset Western Garden Book for information on general characteristics of trees best adapted to the Santa Clara County three climatic zones - Sunset Zone 15, 16 and 17.

#### Soil Survey Information for Santa Clara County<sup>49</sup>

### 5. Tree Size

Minimum size requirements for trees to be planted in tree basins in the sidewalk are as follows:

Trunk diameter of trees to be planted should be a minimum of two inches at eight feet of height (exceptions should be considered for desired species that may not attain this diameter size as a 24-inch box specimen).

Minimum tree size at planting is a 24-inch box; 15-inch box specimens and smaller diameter sizes could be allowed for volunteer planting efforts.

Tree branches that extend into the path of travel must maintain 80 inches of vertical clearance.

Tree spacing should create a continuous canopy and buffering effect between the roadway and the sidewalk. Closer spacing is desirable on heavily traveled streets to create a palisade view looking down the sidewalk.

Tree basins should be aligned so that the edges abutting the path of travel form a straight line along the block.

### 6. Trees in Medians

Trees may be planted in medians four feet or wider, including curbs. Trees planted in medians should have an arching canopy structures that provides visibility without excessive pruning or be upright and columnar in form. Tree species selected for planting on median strips that are four to six feet wide should be expected to grow to trunk diameters no greater than 12 inches. On median strips greater than six feet wide, trees obtaining larger diameters may be used.

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<sup>48</sup> The New Sunset Western Garden Book. Available at <https://www.sunset.com/garden/new-sunset-western-garden-book>

<sup>49</sup> [https://www.nrcs.usda.gov/Internet/FSE\\_MANUSCRIPTS/california/santaclaracawest2015/Santa-Clara-CA\\_West.pdf](https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/santaclaracawest2015/Santa-Clara-CA_West.pdf)

Coordination with street, building and parking lot lighting: Lighting should be coordinated with tree selection, placement, and pruning so that tree canopies do not sit directly below street lighting, per overall streetscape guidelines. Alternatively, pedestrian-scale lighting consistent with the approved street lighting that sits below the tree canopy could be used.

For new streets, buildings, and parking lots where lights and trees are being placed, lights should be generally placed halfway in-between trees. When trees are being added to an existing streetscape, the planting pattern should respond to the existing lighting locations. Similarly, when new lights are being added to an existing streetscape, lights should be placed as far away from existing tree canopies as possible.

#### 7. Trees and building projections

The width of any fire escape balcony, projected down to the sidewalk, should remain clear of any trees or landscaping. Awnings, canopies, signs, and marquees may also present conflicts with street trees. New building projections should not compromise tree health or potential tree planting locations.

#### 8. Size of Tree Basins

Trees need adequate surface area for root growth. Most tree species have the bulk of their roots in the first 18 inches of soil. An important variable in tree basin design is the amount of surface area. Greater surface area provides for increased entry of water and oxygen into the soil.

Tree basins should meet the minimum size as follows:

## Minimum Tree Basin Size

| Sidewalk Width      | Standard Basin Size |
|---------------------|---------------------|
| 6 1/2 to 7 1/2 feet | 2 x 4 feet*         |
| 7 1/2 to 12 feet    | 3 by 4 feet         |
| 12 to 13 feet       | 4 by 4 feet         |
| 13 feet and wider   | 5 by 5 feet         |

\*Note: In this basin size, only small (upright) tree species at maturity should be planted as approved by Department of Planning, County of Santa Clara.

Basins may be square, rectangular, or have other shapes to meet the minimum size requirements. Linear planters may enable a design to achieve optimal tree basin size on narrow sidewalks.

Permeable surfacing increases access of tree roots to water and oxygen when the optimal tree basin size is not possible. Continuous trenching between tree basins (which can be covered by paving) should be used wherever possible to maintain the capacity of oxygen and water to enter the soil in a tree basin, particularly where minimum sized tree basins must be employed.

Tree basin size should vary with the mature size of the tree species and soil conditions. Larger basins should be provided for larger trees where space permits.

### 9. Grade and Surfacing

For trees older than 5 years, landscaping with drought tolerant groundcovers, non-woody shrubs, or grasses is encouraged within the tree basin, if it is well maintained. Open soil in tree basins is discouraged. When landscaping or mulch is not used, the open basin area surrounding the tree's base should be filled with sand-set paving stones, cobbles or compacted decomposed granite to maintain a level surface.

- **Sand-set paving stones or cobbles:** Where sand-set paving stones or cobbles are used, they should generally be placed outside the root ball.
- **Decomposed granite (DG):** To account for settling of soil and DG, additional DG may need to be added during scheduled maintenance.

- **Permeable<sup>50</sup> paving materials:** not only create attractive streetscapes but can serve an important ecological role in improving the sustainability of streets. Permeable surfacing increases access of tree roots to water and oxygen when the optimal tree basin size is not possible. Continuous trenching between tree basins (which can be covered by paving) should be used wherever possible to maintain the capacity of oxygen and water to enter the soil in a tree basin, particularly where minimum sized tree basins must be employed.

In areas with a known high-water table and other subsoil issues, sites should be reviewed on a case-by-case basis as to their appropriateness for permeable landscaping. In such cases, an underdrain system should be used to drain the soil.

## 10. Rootable Soil Volume

Soils designed to properly function under streetscapes need to be highly compacted to ensure the integrity of street, sidewalk and utility infrastructure. These highly compacted soils can cause tree issues.

Rootable soil space is uncompacted soil volume that is accessible to tree roots. Without adequate rootable soil space, trees are more likely to cause damage, and are less likely to reach full mature height, ultimately reducing tree benefits. Whenever possible, solutions to provide adequate soil volume should be considered.

Recommended uncompacted soil volumes for optimal root growth:

- 400-600 cubic feet for small trees (0-29 feet in height and/or width)
- 600-800 cubic feet for medium trees (30-50 feet in height and/or width)
- 800-1200 cubic feet for large trees (50+ feet in height and/or width)

There are many options for increasing rooting space including: use of structural soils that allow rooting while resisting settling; curb bulbs that increase planting area; sidewalk alterations to increase planting area; enlarged or connected planting areas where trees

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<sup>50</sup> Permeable paving, also called pervious paving, is an alternative to standard paving and can help reduce stormwater runoff volumes by reducing impervious surface and providing temporary storage and or groundwater recharge through infiltration. Absorbed water is temporarily stored in the rock base before being discharged through subdrains or infiltrating into the soil. Permeable paving can thereby decrease the cost of required on-site detention systems and downstream stormwater infrastructure upgrades due to the potential for stormwater runoff delay and volume reduction.

can share soil; and engineered systems that support pavement from below to prevent compaction (soil cells).

It is also important to understand the location and nature of all utility infrastructure (power, water, communication) before excavating soil.

## 11. Tree Basin Furnishings

**Tree Grates:** Tree grates and other structural basin covers are generally discouraged because, over time, they can become an obstacle or tripping hazard and can interfere with the diameter growth of trees, resulting in tree girdling and damage. Maintenance of tree grates is costly, often requiring workers to expand the diameter of the opening as the girth of the trunk increases.

However, in limited locations, such as heavily traveled sidewalks where sidewalk width limits pedestrian movement at peak times or where a formal design treatment is desired (such as along ceremonial streets or in bus zones) it may be necessary or desired to install tree grates to provide an adequate walking surface or design treatment.

Grates should be designed with easily removable inner rings to allow for tree trunk growth. In limited circumstances, such as extremely narrow sidewalks, tree grates may be counted toward the minimum clear path of travel; however, as they are difficult to maintain to an accessible standard, this is not a preferred solution.

Grates should have less than 1/2 inch spacing between rings to provide a safer walking surface and to prevent material from being trapped or from falling into the basin.

Maintenance of grates used in high-pedestrian traffic areas should include the periodic cleaning of grates and adjustment to eliminate any tripping hazard.

**Tree guards:** Tree guards are generally discouraged but may be appropriate on heavily traveled sidewalks for the protection of newly planted trees. They are also appropriate adjacent to heavily used bus and light rail stops, around school buildings, and adjacent to other land uses with associated activities that may be considered detrimental to tree health and safety.

Tree guards should be of an attractive design, not possess any sharp edges, and be made of durable material. Tree guards should be a minimum of 18 inches wide to provide enough distance from the tree trunk at the time of planting.

Tree guards are an opportunity to provide a special design and to incorporate artistic elements.

**Edging and planting guards:** Tree basins may be edged with low planting guards, using appropriate clearances per sidewalk landscaping guidelines. Edging treatments are appropriate for residential and commercial neighborhoods with moderate to low pedestrian traffic. Where used, the base of the guards must be a solid four inches to allow for cane detection.

Edging should not prevent water from moving off the sidewalk and into the tree basin and should be designed to allow rainwater from the sidewalk (in all cases) and/or the street (if specifically designed to do so) to flow into the planted area. Openings in the edge treatment can allow for water to pass through.

Where the base of landscaping is not at grade with the surrounding sidewalk (such as on sloped streets where planting is terraced and in stormwater infiltration planting areas), a four to six inch raised edging treatment should be installed around the landscaped area to notify people with visual impairments about the presence of landscaping and grade change.

## 12. Maintenance Responsibilities

Responsibility to maintain street trees varies depending on the street. Most street trees in County owned and managed lands are maintained by the County Roads and Airports and the Parks and Recreation departments, and fronting property owners.

To sustain a healthy “Streetscape Forest,” it is preferred to standardize maintenance responsibility such that, in general, fronting property owners will be responsible for street tree maintenance in the public right-of-way. If not, the respective County department will be responsible for the maintenance of the trees.

## 13. Maintenance Practices

To ensure that a tree is properly established, careful attention to tree maintenance is especially important during at least the first three years after planting. Proper pruning of a young tree is a good investment, but it is important to note that pruning can either help or hurt trees. When appropriate practices are used, pruning can provide significant benefits and prevent problems, saving money, and creating a beautiful, healthy tree. When inappropriate practices are used, significant harm can result.

The County of Santa Clara has adopted pruning standards on public trees that must be followed. For the long-term health and structural stability of trees, it is critical that pruning practices conform to International Society of Arboriculture (ISA) standards. These standards recognize the American National Standards Institute (ANSI) safety standards, ISA tree pruning guidelines and ISA best management practices as benchmark standards for tree pruning and maintenance. County department arborists, managers, and related personnel and contractors are requested to retain and use copies of the above publications.

More information on reducing tree root sidewalk conflicts is at: <https://canopy.org/wp-content/uploads/Final-ReducingTreeRootSidewalkConflicts-10-5-16.pdf>.

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## I. Tree Planting Guidelines in a Forest (PRK Backcountry forest and Trails, RDA – Rural Roads Right-of-Way Areas, RDA – Mountain Roads Right-of-Way Areas)

Creating a forest or restoring a forest begins long before, and continues long after, tree planting and other reforestation activities. The ensuing comprehensive information on tree planting covers: planning and designing a forest; sapling care; pre-planting seedling care; planting methods; and post-planting care and maintenance of trees. Although these guidelines cover the main issues, it is important to consult with a local forester or arborist to assist with the details of a planting plan.

### 1. Planning and Design

#### a) Matching Uses and Goals to Tree Types

How and what to plant will depend, in part, on how the forest property will be used. Therefore, it is important to develop a vision for the land and to set goals to meet the scope (interests and needs). Define your goals and design considerations, for example: forest restoration; wildlife management; fire or erosion control; disease management; improving aesthetics; or a combination of one or many of these goals.

#### b) Site Evaluation

Once decisions on forest use and goals are completed, the next step in planning is to evaluate the site. Every location will be different, and the chosen plants, planting

methods, stand layout, and maintenance will all depend on a thorough assessment of the climate, soil type, existing vegetation, topography, location in the landscape, and conditions in surrounding forests. See [Appendix I](#) for more information.

c) [Selecting the Right Trees for Your Planting Plan](#)

Selecting the right species for a site will give the trees the best chance for growth and survival. Species characteristics can help narrow choices based on planting goals and site characteristics. Consult a local forester or arborist for specific information and recommendations about selection. See [Appendix J](#) for more information

d) [Choosing Nursery Stock](#)

It is critical to ensure that any planting materials brought to a site are free of plant pests and diseases. Phytophthora is a group of microscopic organisms that includes some of the most devastating plant pathogens. These pathogens have been detected in many California native plant nurseries. Ensure that any planting stock comes from a source that has taken precautions against spreading these pathogens. The guidelines<sup>51</sup> from the “Working Group for Phytophthoras in Native Plant Habitats” provide best practices for reducing the risk of phytophthoras and these or similar practices should be followed by any source providing planting stock. See [Appendix K](#) for additional information on stock selection.

## 2. [Planting](#)

a) [Site Preparation](#)

Preparing a site for planting is an often overlooked, yet important, part of successful planting. A few simple steps can make the difference between a healthy planting and one where trees struggle to survive. Two key considerations in site preparation are soil foundation and weed control. Native soil should be loosened to allow drainage and root growth. Controlling weeds allows trees to become established without competition for water, sunlight, and nutrients. To determine the most effective and cost-efficient site preparation method, consider soil type, existing vegetation type and density, and time and financial constraints.

For tree planting in natural resource areas (backcountry) there are two main site preparation methods used: mechanical and chemical. These methods can be used separately or together. Mechanical site preparation uses various types of machinery and tools to prepare the planting site. Chemical site preparation uses commercially

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<sup>51</sup> [http://www.suddenoakdeath.org/wp-content/uploads/2016/04/Restoration.Nsy\\_.Guidelines.final\\_.092216.pdf](http://www.suddenoakdeath.org/wp-content/uploads/2016/04/Restoration.Nsy_.Guidelines.final_.092216.pdf)

produced herbicides. A licensed arborist or forester can assist in any necessary site preparation techniques. See [Appendix L](#) for more information.

b) [Caring for Seedlings Before Planting](#)

Careful handling of tree seedlings from the nursery to the planting site is a critical component of a successful planting effort. Seedlings are living organisms and they require certain conditions to maintain good health and vigor. Proper care and handling can protect the investment and ensure that a seedling has the best start possible. See [Appendix M](#) for more information.

c) [The Planting Process](#)

Proper care and handling of seedlings before and during the planting process is essential for seedling survival. See [Appendix N](#) for more information.

d) [Maintaining a Forest Plantation](#)

More information on forest plantation management and maintenance can be found under [Appendix O](#).

e) [Controlling Competing Vegetation](#)

All vegetation growing in the same soil and air space competes for sunlight, water and nutrients. In plantings where weeds and tree seedlings grow together, the “losing competitor” will be the tree, because weeds and grasses grow faster. Good site preparation will get the seedlings off to a fast start, but weeds may need to be controlled for at least three growing seasons or until trees are well-established. Methods to control weeds include herbicides and mechanical means, with both often being used together. See [Appendix P](#) for more information.

f) [Limiting Animal Damage](#)

Anything that attracts wildlife to a site will increase the potential for wildlife damage to new seedlings. Most tree plantings will experience some animal damage such as browsing, rubbing, or bark feeding. To control damage, it may be necessary to keep wildlife at bay for the first few years while seedlings establish themselves. Many different techniques can be used to discourage wildlife to protect the trees from damage. See [Appendix Q](#) for more information.

g) [Fire Protection](#)

It is a good idea to maintain fire breaks and access roads in and around a natural resource tree planting site. A wildfire is unpredictable and may start anywhere and it is critical to help prevent its spread. The best fire breaks are 30 feet wide and disked

annually, mowed or grazed. Check with County policy to ensure that fire protection best practices are integrated into any tree management project.<sup>52</sup>

h) **Down the Road**

In five to ten years, a site will be well established or restored. Then the next phase in site management should be considered. Having a plan established will ensure the goals outlined for the site are met.

## J. **Silviculture in Natural Forests**

As the climate in the Santa Clara Valley changes from Mediterranean to semi-arid, adaptive management practices may prompt agroforestry and/or silviculture to sustain forest lands. At this time, the production of goods or services is not approved for County owned or managed tree and forest areas.

This subject may be explored as the need increases to enhance resiliency in the County's agricultural/rangeland and forest landscapes under changing climate conditions.

Natural forests are forests that have regenerated naturally and are composed of all the species (e.g., trees and other plants, fauna, and fungi) that occur naturally in them. Natural-forest silviculture can be defined as the practice of controlling the establishment, growth, composition, health and quality of natural forests to meet diverse needs and values. Silvicultural practice consists of the interventions applied to forests to maintain or enhance their utility for specific purposes, such as the production of wood and other forest products, biodiversity conservation, recreation, and the provision of environmental services.

Decisions on silviculture in natural forests can occur at three levels: silvicultural systems; silvicultural treatment regimens; and silvicultural operations.

A silvicultural system is the process by which the crops constituting a forest are tended, removed and replaced by new crops, resulting in the production of stands of distinctive form. The terms "stand" and "crop" are both used to denote silvicultural or management units that are homogeneous in one or several aspects.

A silvicultural treatment is a planned program of silvicultural operations that can be implemented during the entire or partial rotation of a stand. Within the context of silvicultural stand treatment, each stand is assigned a specific silvicultural objective and separately

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<sup>52</sup> <http://www.sccfd.org/>

assessed for the characteristics of its site (e.g., locality, slope, and soil type) and stocking (e.g., composition, age, diameter distribution, and regeneration). Based on this information, a silvicultural treatment regime is formulated.

Silvicultural operations are procedures that aim to achieve stand-specific objectives by using silvicultural techniques. Such techniques include, canopy alterations to induce natural regeneration, the harvesting of mature trees, planting, and thinning to improve timber quality and stand growth. Silvicultural operations involve decisions on machinery and other equipment, techniques, work organization and human resources, as well as considerations of operational cost and investment.

Silvicultural systems usually develop as a response to the practical need to balance market, socioeconomic, and ecological requirements in a technically feasible way. Silvicultural systems in natural forests can be categorized broadly as either monocyclic (“uniform”, “even-aged”) or polycyclic (“selective”, “uneven-aged”). Monocyclic systems involve harvesting all marketable timber in a single felling operation. The length of the cycle is equal to the rotation age of the species under exploitation. Clearcutting is the most obvious example of a monocyclic system. Polycyclic systems involve tree harvesting in a continual series of felling cycles. Selection cutting using a minimum diameter for harvesting is a common method. The length of these felling cycles is usually about half the time required for a species to reach marketable size.

There are many variations of these two systems, depending on biological, ecological, economic and administrative conditions and silvicultural goals. An important difference between them is that polycyclic systems rely on the existing stock of seedlings, saplings, and poles in the forest to produce the next harvestable crop, whereas monocyclic systems generally do not use existing stock, instead relying on seedlings recruited after felling to produce the next tree crop.

Silvicultural interventions should be planned in accordance with the management objectives of the forest and as specified in the Forest Management Plan. In forests managed for wood production, silvicultural interventions may be necessary to address the relative depletion of commercial tree species caused by past logging interventions, to increase the growth of commercial species, and to optimize the commercial value of the forest. The intensity of interventions will vary depending on, for example, accessibility, markets, site quality, management objectives, and ownership.

In planning silvicultural interventions, forest managers should ensure they have adequate biological and socioeconomic information on the forest (forest inventory), as well as sufficient knowledge of operational aspects such as weather, access, funding, and human resources.

Forest managers should also have a good understanding of the ecology of the forests in which interventions are planned, especially the structure of the existing stand and the requirements for ensuring the adequate regeneration of desirable species.

### 1. Silviculture and Management of Planted Forests

Planted forests are established by planting and/or deliberate seeding native or introduced species, either on land previously not classified as forest (afforestation, implies a transformation of land-use from non-forest to forest), or on previously forested land (reforestation). Planted forests are established for many reasons, such as conservation, production, and amenity.

Planted forests can provide a wide range of environmental services, many of which cannot be provided by other types of land use. Planted forests can help to restore and rehabilitate fragile ecosystems. They can help combat desertification, reduce erosion and absorb sewage water. They can help protect and improve soil and water resources, including when integrated with agriculture (see agroforestry above).

Planted forests can be effective in sequestering carbon and therefore in mitigating climate change. Globally, planted forests were estimated to have sequestered 1.5 gigatons of carbon in 2010, which was about 3.1 percent of global greenhouse gas emissions in that year.<sup>53</sup> The volume of carbon sequestered by planted forests is expected to increase as the area of such forests continues to expand.

Responsible management of planted forests can have additional benefits for climate-change mitigation and the provision of other environmental services. But the provision of such services is not an inevitable consequence of planting trees. Poorly designed and managed planted forests can result in diminished biodiversity, and soil and water quality, and increased greenhouse gas emissions.<sup>54</sup> To avoid such problems, the establishment of planted forests requires good planning and the use of participatory multi-stakeholder processes.

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<sup>53</sup> Silviculture and Management of Planted Forests by Food and Agriculture Organization of the World. Retrieved from <http://www.fao.org/sustainable-forest-management/toolbox/modules/silviculture-and-management-of-planted-forests/basic-knowledge/en/>

<sup>54</sup> Mature forests, having absorbed CO<sub>2</sub> from the atmosphere while growing, store carbon in wood, leaves, and soil. That carbon is released when forested land is poorly managed, degraded and destroyed.

## K. Forest Restoration and Rehabilitation

Forest restoration and forest rehabilitation are challenging long-term endeavors that require thoughtful planning, implementation and monitoring. While they are closely related, a conceptual distinction may be made between them.

The purpose of forest restoration is to restore a degraded forest to its original state – that is, to re-establish the presumed structure, productivity and species diversity of the forest originally present.

The purpose of forest rehabilitation is to restore the capacity of degraded forest land to deliver forest products and services. Forest rehabilitation re-establishes the original productivity of the forest and some, but not necessarily all, of the plant and animal species thought to be originally present at a site.

Both forest restoration and forest rehabilitation are implemented on sites or in landscapes where forest loss has caused a decline in the quality of environmental services. They aim to strengthen the resilience of forest sites and landscapes and thereby keep future land-use and management options open.

Forest restoration and rehabilitation may be carried out on unproductive or abandoned agricultural land, deforested grasslands, brushlands, scrublands or barren areas, and in understocked or degraded forests. Forests may be restored and rehabilitated by:

1. Reduction (thinning) of overly dense forests to reduce the effects of forest pathogens, reduce competition for water and nutrients and allow for the growth of fewer but higher quality and healthier trees with a goal to maintain or increase green canopy over time under challenging impacts of climate change;
2. protective measures (e.g., protection from fire or grazing and erosion control);
3. measures to accelerate natural recovery (e.g., through selective thinning, direct seeding or by planting seedlings in degraded primary or secondary forests);
4. measures to assist natural regeneration (e.g., through management of secessional species, weed control on degraded lands, and marginal agricultural sites); and
5. the planting of native or introduced trees in single-species or mixed-species plantations, in agroforestry production systems, and as trees outside forests.

Successful, ecologically sound, socially acceptable, and economically viable forest restoration and rehabilitation initiatives should consider the following key guiding principles:

1. Select a suitable site or landscape, including the analysis and evaluation of current land uses and land tenure/ownership, and identify involved stakeholders;
  2. Analyze and evaluate the drivers of deforestation or forest degradation;
  3. Engage stakeholders, discuss long-term goals of forest restoration considering the interests of all stakeholder groups, and draft a preliminary restoration/rehabilitation plan;
  4. Development of a restoration management plan, may include:
    - a) preparing a topographic land-use map, including a designation of forest functions, assessment of road accessibility, existence of natural regeneration and needs for planting;
    - b) inventorying existing conditions;
    - c) agreeing on restoration/rehabilitation objectives;
    - d) selecting the restoration/rehabilitation method;
    - e) choosing the species to be used, and establishing a nursery;
    - f) assessing possible positive and negative social and environmental impacts;
  5. Collect seeds, produce seedlings in nurseries and prepare for planting;
  6. Plant trees;
  7. Assess capacity-building needs and plan for the necessary training;
  8. Establish realistic time schedules and plan for financial requirements;
  9. Monitor restored/rehabilitated areas, and conduct maintenance activities as required;
  10. Consider possible climate-change impacts.
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## Appendices

### APPENDIX A: Social, Economic and Environmental Benefits of Forests

Tree planting provides many benefits, ranging from social and economic to environmental. Trees provide crucial services for human well-being and economic development. They filter water and air, provide food and fuel, and support soil formation. They regulate floods, climate and diseases, and can fill educational, medicinal, aesthetic and spiritual needs. They stabilize ecosystems, play an integral part in the carbon cycle, support livelihoods, and supply other goods and services that drive sustainable growth. This “green infrastructure” is essential to the County’s sustainability. A few benefits are described below:

#### 1. Social Benefits

- ✓ **Improve physical health** – The presence of trees makes people more likely to walk and participate in outdoor activities. Trees also filter airborne pollutants, reducing causes of asthma and other respiratory problems.
- ✓ **Heal** - Views of trees and greenery have been shown to speed healing time from injury and illness in hospital patients.<sup>55</sup> Children with ADHD show fewer symptoms when they have access to nature. Exposure to trees and nature aids concentration by reducing mental fatigue.
- ✓ **Strengthen communities** – Planting and caring for trees creates neighborhood pride, fosters social cohesion and promotes relationship building.
- ✓ **Bring diverse groups of people together** - Tree plantings provide an opportunity for community involvement and empowerment that improves the quality of life in neighborhoods. All cultures, ages, and genders have an important role to play at a tree planting or tree care event.
- ✓ **Add unity** - Trees as landmarks can give a neighborhood a new identity and encourage civic pride.

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<sup>55</sup> Ulrich, R. S. View through a Window May Influence Recovery from Surgery. *Science* 224.4647 (1984): 420-21. See also, Berger, Alan (ed.). *Health + Urbanism Report*. Massachusetts Institute of Technology Center for Advanced Urbanism (2013).

- ✓ **Teachers and playmates** - Whether as houses for children or creative and spiritual inspiration for adults, trees have provided the space for human retreat throughout the ages.
- ✓ **Connect people to nature (“biophilia”)** – Humans are hardwired for regular contact with nature. Trees provide opportunities to connect with the natural world in a dense urban environment. This can help reduce stress and support emotional and spiritual wellbeing.
- ✓ **Create memorable and beautiful places** – The visual characteristics of trees and landscaping (form, color, texture) add to the aesthetics of urban streets and can enhance the quality of the public realm.
- ✓ **Mark the seasons** - Is it winter, spring, summer or fall? Look at the trees.
- ✓ **Block things** - Trees can mask concrete walls or parking lots, and unsightly views. They muffle sound from nearby streets and freeways and create an eye-soothing canopy of green. Trees absorb dust and wind and reduce glare.
- ✓ **Calm traffic and promote pedestrian/bicyclist safety** – The presence of trees can reduce driving speeds by narrowing the visual width of the roadway and signaling to drivers that pedestrians and bicycles are present.
- ✓ **Reduce violence and crime** – Greenery around houses and apartments is associated with lower crime, graffiti, vandalism, littering, and domestic violence.<sup>56</sup> Neighborhoods and homes that are barren have shown to have a greater incidence of violence in and out of the home than their greener counterparts. Trees and landscaping help to reduce the level of fear.

## 2. Economic Benefits

- ✓ **Create economic opportunities** - Fruit harvested from community orchards can be sold, thus providing income. Small business opportunities in green-waste management and landscaping arise when cities value mulching and its water-saving qualities. Vocational training for youth interested in green jobs is also a great way to develop economic opportunities from trees.
- ✓ **Increase property values** – Trees provide a direct economic benefit to the value of real estate. Healthy, mature trees in front of buildings have been shown to increase property values. The American Nursery and Landscape Association reports that a large tree canopy adds 2 percent

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<sup>56</sup> Kuo, F.E. & Sullivan W.C. (2001). Aggression and violence in the inner city: Impacts of environment via mental fatigue. *Environment & Behavior*, 33(4), 543-571.

to 9 percent to the value of a home.<sup>57</sup> Furthermore, property values are greater in communities with neighborhood parks. A Texas A&M researcher found that in 20 out of 25 studies, for residences near parks and open space, trees contributed to higher property values.<sup>58</sup> Residential street trees escalate the worth of adjacent properties; street trees in front of homes added 3.4 percent to the market price in Portland, Oregon.<sup>59</sup> Homes with residential street trees also sold quicker, with the average time on the real estate market shortened by 1.7 days.

- ✓ **Increase property revenue** – The same study also calculated that street trees provided \$1.35 billion to home values in Portland, totaling \$15.3 million annually in tax revenue. Using the iTree software suite, the city of Minneapolis calculated that not only had they saved approximately \$6.8 million in energy expenditure by planting trees, but they had also increased property values by \$7.1 million.<sup>60</sup>
- ✓ **Boost commercial activity** – Trees create attractive environments that draw people and encourage them to linger. Trees are positively linked to shopping activity and a willingness to pay more for goods. Consumers often shop longer and are willing to pay more for parking in business districts that have large well-maintained trees.<sup>61</sup>
- ✓ **Increase business traffic** - Studies show that the more trees and landscaping a business district has, the more business will increase. A tree-lined street will also slow traffic – enough to allow the drivers to look at the store fronts instead of whizzing by.
- ✓ **Reduce building heating & cooling costs** – Trees conserve energy by shading buildings from the sun and by serving as windbreaks that slow the loss of heat from buildings.

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<sup>57</sup> Stigarll, A. & Elam, E. (2009). Impact of improved landscape quality and tree cover on the price of single-family homes. *Journal of Environmental Horticulture*, 27(1), 24-30.

<sup>58</sup> Crompton, J. L. (2000). The impact of parks and open space on property values and the property tax base. Division of Professional Services, National Recreation & Park Association. Retrieved from <http://catalog.hathitrust.org/Record/010024155>

<sup>59</sup> Donovan, G. H., & Butry, D. T. (2009). The value of shade: Estimating the effect of urban trees on summertime electricity use. *Energy and Buildings*, 41(6), 662-668.

<sup>60</sup> McPherson et.al. (2005). City of Minneapolis, Minnesota, Municipal Tree Resources. Center for Urban Forest Research, USDA Forest Service, Pacific Research Station. Retrieved from [https://www.fs.fed.us/psw/topics/urban\\_forestry/products/2/cufr645\\_MinneapolisMFRA.pdf](https://www.fs.fed.us/psw/topics/urban_forestry/products/2/cufr645_MinneapolisMFRA.pdf)

<sup>61</sup> Wolf, K. L. (2005). Business district streetscapes, trees, and consumer response. *Journal of Forestry*, 103(8), 396-400.

- ✓ **Reduce infrastructure costs** – Trees and other greenery can help reduce the need for expensive infrastructure systems to manage stormwater.
- ✓ **Increase worker productivity** – Employees whose offices have views of nature are often more productive, happier and healthier.
- ✓ **Provide food** - An apple tree can yield up to 15-20 bushels of fruit per year and can be planted on the tiniest urban lot. Aside from fruit for humans, trees provide food for birds and wildlife.
- ✓ **Provide wood** - In suburban, rural areas and forests, trees can be selectively harvested for fuel and craft wood.
- ✓ **Return on Investment:** The five-city study<sup>62</sup> found that, on a per-tree basis, the cities accrued benefits ranging from about \$1.50-\$3.00 for every dollar invested. These cities spent roughly \$15-\$65 annually per tree, with net annual benefits ranging from approximately \$30-\$90 per tree. The benefit-cost ratios are 3.61:1, indicating that \$3.61 is returned for every \$1.00 invested. Net benefits for a yard tree opposite a west wall and for a public tree are substantial when summed over a 40-year period:
  - \$1,640 (yard) and \$1,179 (public) for a small tree
  - \$2,392 (yard) and \$1,679 (public) for a medium tree
  - \$4,868 (yard) and \$4,034 (public) for a large tree
  - \$5,855 (yard) and \$5,685 (public) for a conifer
- ✓ **Value:** Nationally, urban forests in the U.S. are estimated to contain about 3.8 billion trees, with an estimated structural asset value of \$2.4 trillion.<sup>63</sup>

### 3. Environmental Benefits

- ✓ **Combat climate change** - Excess carbon dioxide (CO<sub>2</sub>) is building up in our atmosphere, contributing to climate change. Forests store carbon in biomass – that is, in tree trunks, branches, leaves, and roots, as well as in dead wood, leaf litter, and soil. This carbon storage is called sequestration. Through the photosynthesis process tree absorb CO<sub>2</sub>, removing and sequestering the

In one year, an acre of mature trees absorbs the same amount of CO<sub>2</sub> produced when you drive your car 26,000 miles.

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<sup>62</sup> McPherson, E.G., J. R. Simpson, P. J. Peper, S. E. Maco, and Q. Xiao. 2005. Municipal forest benefits and costs in five US cities (PDF) (6 pp, 267K). *Journal of Forestry* 103(8):411–416.

<sup>63</sup> Nowak, D. J. (2002). The effects of urban trees on air quality. Syracuse, NY: USDA Forest Service. Retrieved from [www.ncufc.org/uploads/nowak\\_trees.pdf](http://www.ncufc.org/uploads/nowak_trees.pdf)

carbon while releasing oxygen back into the air. Increased forest cover means increased carbon sequestration. Based on field data of ten U.S. cities in conjunction with national urban tree cover data, one study calculated that urban trees in the continental U.S. store 770 million tons of carbon valued at \$14.3 billion with a gross carbon sequestration rate of 22.8 million tC/year (\$460 million per year)<sup>64</sup>.

This carbon sequestration process continues even when forest products such as lumber are removed and used in construction – homes, buildings, furniture and flooring made with wood continue to store carbon. The benefits are even greater when forest products are used to replace more fossil-fuel intensive products, such as steel, concrete, or brick.<sup>65</sup>

- ✓ **Impact local weather:** Trees can have a dramatic effect on the weather systems in their area. Because of their size and the extent of their root structures, they often pump large amounts of water out of the ground. As they sit in the sunlight, much of this water evaporates through the leaves into the atmosphere. Through this process, a forest of trees can create a significant amount of the rainfall it needs for its own and the entire ecosystem's survival.
- ✓ **Clean the air** - Trees absorb odors and gaseous pollutants (carbon dioxide, nitrous oxides, ammonia, sulfur dioxide, and ozone) and filter airborne particulates by trapping them on leaves and bark.
- ✓ **Provide oxygen** - A U.S. Forest Service report found that a 30-foot tree could produce as much as 260 pounds of oxygen annually, and that a person typically consumes 386 pounds of oxygen in a year. Therefore, two-medium sized trees can supply all the oxygen one person needs annually (McPherson, 2007). In fact, one forested acre releases 2,140 pounds of oxygen. In one year that acre of mature trees can provide enough oxygen for 18 people.
- ✓ **Cool the streets and the county** - As tree coverage has declined and the number of heat-absorbing roads and buildings has increased, average temperatures in the last 58 years for Santa Clara County have risen by 7.9°F.<sup>66</sup> Trees and vegetation lower surface and air temperatures by providing shade and through evapotranspiration. Shaded surfaces, for

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<sup>64</sup> Nowak DJ1, Crane DE. Carbon storage and sequestration by urban trees in the USA. *Environ Pollut.* 2002;116(3):381-9. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/11822716>

<sup>65</sup> Carbon sequestration from processed wood: Malmshheimer, R. W. et al. 2008. *Forest Management Solutions for Mitigating Climate Change in the United States.* *Journal of Forestry*:115–173.

<sup>66</sup> Weather History for Santa Clara, CA - Average Mean Temperature: <https://www.almanac.com/weather/history/CA/Santa%20Clara/1960-07-02>

example, may be 20-45°F cooler than the peak temperatures of unshaded materials.<sup>67</sup> Evapotranspiration, alone or in combination with shading, can help reduce peak summer temperatures by 2-9°F.<sup>68 69</sup>

- ✓ **Conserve energy** - By shading homes in the summer, trees can help reduce energy demand up to 30 percent. They can reduce heating bills from two percent to eight percent when planted accurately to reduce wind exposure.<sup>70</sup>
- ✓ **Save water** - Shade from trees slows water evaporation from thirsty lawns. Most young trees need 10-15 gallons of water each week for the first year.<sup>71</sup> As trees transpire, they increase atmospheric moisture.
- ✓ **Prevent water pollution and Reduce stormwater runoff** – Trees capture rainwater that would otherwise flow into our combined storm-sewer system, replenishing the aquifer (recharging ground water supply), protecting the soil from erosion, soaking up pollutants and reducing the occasions on which polluted overflow floods our streets or runs into the Ocean and Bay. When mulched, trees act like a sponge that filters this water naturally and uses it to recharge groundwater supplies.
- ✓ **Prevent soil erosion** - On hillsides or stream slopes, trees slow runoff and hold soil in place.
- ✓ **Shield children from ultra-violet rays** - Skin cancer is the most common form of cancer in the U.S. Trees reduce UV-B exposure by about 50 percent,<sup>72</sup> thus providing protection to children on school campuses and playgrounds - where children spend hours outdoors.
- ✓ **Decrease noise pollution** – Trees absorb sound and muffle noise from freeways and other sources.

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<sup>67</sup> Akbari, H., D. Kurn, et al. 1997. Peak power and cooling energy savings of shade trees. *Energy and Buildings* 25:139–148.

<sup>68</sup> Huang, J., H. Akbari, and H. Taha. 1990. The Wind-Shielding and Shading Effects of Trees on Residential Heating and Cooling Requirements. ASHRAE Winter Meeting, American Society of Heating, Refrigerating and Air-Conditioning Engineers. Atlanta, Georgia.

<sup>69</sup> Kurn, D., S. Bretz, B. Huang, and H. Akbari. 1994. The Potential for Reducing Urban Air Temperatures and Energy Consumption through Vegetative Cooling (PDF) (31 pp, 1.76MB). ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy. Pacific Grove, California.

<sup>70</sup> Simpson, J. R., & McPherson, E. G. (1996). Potential of tree shade for reducing residential energy use in California. *Journal of Arboriculture*, 22, 10-18.

<sup>71</sup> <http://www.ourcityforest.org/blog/2015/2/26/the-ultimate-watering-guide> .

<sup>72</sup> Purdue News (April 2002): Researchers say trees could affect land use, reduce skin cancer <https://www.purdue.edu/uns/html4ever/020422.Grant.shade.html>.

- ✓ **Provide canopy and habitat for wildlife** – Flowers, fruits, leaves, buds and woody parts of trees are used by many different species. Trees provide shelter, food and nesting areas for birds, insects and small animals.
  - ✓ **Produce local food** – Fruiting trees and orchards increase food independence and reduce the distance that food must be transported to reach dwellers through local agriculture.
  - ✓ **Effects of Loss of Trees (Deforestation) on the Environment**
    - a) Deforestation can have a negative impact on the environment. The most dramatic impact is a loss of habitat for millions of species. Eighty percent of Earth’s land animals and plants live in forests, and many cannot survive deforestation that destroys their homes.
    - b) Deforestation also drives climate change. Forest soils are moist, but without protection from sun-blocking tree cover, they quickly dry out. Trees also help perpetuate the water cycle by returning water vapor to the atmosphere. Without trees to fill these roles, many former forest lands can quickly become barren deserts.
    - c) Removing trees deprives the forest of portions of its canopy, which block the sun’s rays during the day, and hold in heat at night. This disruption leads to more extreme temperature swings that can be harmful to plants and animals.
    - d) Trees also play a critical role in absorbing the greenhouse gases that fuel global warming. Fewer forests means larger amounts of greenhouse gases entering the atmosphere—and increased speed and severity of global warming.
    - e) The most feasible solution to deforestation is to carefully manage forest resources by eliminating clear-cutting to make sure forest environments remain intact. The cutting that does occur should be balanced by planting young trees to replace older trees felled. The number of new tree plantations is growing each year, but their total still equals a tiny fraction of the Earth’s forested land.
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## APPENDIX B: DEFINITIONS

**Forest** - is a term of common parlance, there is no universally recognized precise definition, with more than 800 definitions of forest used around the world. Under many definitions of forest, an area completely lacking trees may still be considered a forest if it grew trees in the past, will grow trees in the future, or was legally designated as a forest regardless of vegetation type. Landscapes without trees, for example rights-of-way on roads and airports, may also be part of a forest. Trees and bushes, fungi, and lichens all grow in the forest. The interaction and reciprocation between the various elements in the forest eco-system provide the framework for an optimal fulfilment of all forest functions.

## APPENDIX C: OTHER RESOURCES

### 1. Climate Change Adaptation and Mitigation

Adaptation and mitigation are the two main responses to climate change: mitigation addresses the causes of climate change; and adaptation addresses its impacts. In the forest sector, adaptation encompasses changes in management practices designed to decrease forest vulnerability to climate change and increase those interventions intended to reduce the impact on humans. Adaptation measures in forests to secure the continued delivery of forest goods and environmental services must begin today and will be required for many years to come.

Mitigation strategies in the forest sector can be grouped into four main categories: reducing emissions from deforestation; reducing emissions from forest degradation; enhancing forest carbon sinks; and product substitution.<sup>73</sup>

The future of sustainable forest management lies with product strategies that provide product substitution – cradle to cradle. This should be discussed with stakeholders so that this mitigation strategy is inclusive in addressing largest sustained mitigation benefits. It can be achieved by increasing off-site carbon stocks in wood products and enhancing product and fuel substitution using forest-derived biomass to substitute products with high fossil fuel requirements and increasing the use of biomass-derived energy to substitute fossil fuels. Most forest management activities aimed at enhancing sinks require up-front investments. The duration and magnitude of their carbon benefits differ by region, type of action, and initial condition of the forest. In the long term, sustainable forest management strategy aimed at maintaining or increasing forest carbon

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<sup>73</sup> Substitution comprises the use of wood instead of fossil fuels for energy and the use of wood fiber in place of materials such as cement, steel and aluminums, the production of which involve the emission of large quantities of greenhouse gases.

stocks, while producing an annual yield of timber, fiber, or energy from the forest, will generate the largest sustained mitigation benefit.

## 2. Climate change and Sustainable Forest Management (SFM)

As climatic conditions move beyond historical ranges, climate-change adaptation and mitigation will require the adjustment of management objectives, approaches, and monitoring systems. Fortunately, SFM is consistent with both adaptation and mitigation and provides a comprehensive framework that can be adapted to changing circumstances. Forest managers will need to factor climate change into their planning and to adjust their management practices accordingly to reduce vulnerability and to facilitate climate change adaptation. Forest managers (and other stakeholders) will need to consider the multiple goods and environmental services that forests provide to meet the diverse needs of a wide-range of stakeholders when weighing the risks, costs, and benefits of changes in forest management practices, keeping in mind that the costs of climate-change adaptation measures are likely to increase the longer there is delay. Forest managers should aim to take advantage of policy incentives and financial support mechanisms for climate-change adaptation and mitigation.



## 3. Santa Clara County Geography and Climate

- a) **Geography:** Santa Clara County is located at the southern end of the San Francisco Bay and encompasses 1,312 square miles. It is California's sixth most populous county and home to a population of 1.92 million.<sup>74</sup> The County is generally split into two geographic regions, the North Valley and the South Valley; the North Valley is extensively urbanized and is home to almost all the County's residents. The County consists of 13 cities, two townships, one census designated place and six unincorporated communities.<sup>75</sup> Thirteen of the County's fifteen cities are in the North Valley, while the remaining two cities, Gilroy and Morgan Hill, are in the South Valley. The South Valley remains predominantly rural, except

<sup>74</sup> Santa Clara County Population: census.gov;

<https://www.census.gov/quickfacts/fact/table/santaclaracountycalifornia/PST045216>

<sup>75</sup> **Cities, Townships, Census Designated Places and Unincorporated Communities of County of Santa Clara:** San Jose City, Sunnyvale City, Santa Clara City, Mountain View City, Milpitas City, Palo Alto City, Cupertino City, Gilroy City, Campbell City, Morgan Hill City, Saratoga City, Los Gatos Town, Los Altos City, Alum Rock CDP, Stanford CDP, East Foothills CDP, Los Altos Hills Town, San Martin CDP, Burbank CDP, Monte Sereno City, Cambrian Park CDP, Loyola CDP, Lexington Hills CDP, Fruitdale CDP, Bell Station, also known as Bell's Station and Hollenbeck's Station UC, Casa Loma UC, Chemeketa Park UC, Coyote UC, East San Jose UC, and Llagas-Uvas UC.

for Gilroy, Morgan Hill, the small unincorporated community of San Martin, and scattered residential areas generally having parcels of five acres or less. Low-density residential developments are also scattered along the Valley floor and foothill areas.

The fertile Santa Clara Valley runs the entire length of the County from north to south, ringed by the rolling hills of the Diablo Range on the east, and the Santa Cruz Mountains on the west. Salt marshes and wetlands lie in the northwestern part of the county, adjacent to the waters of San Francisco Bay.

Santa Clara Valley encompasses five major watersheds with more than 800 miles of creeks and rivers that catch rain and runoff from storm drains and carry the water north to San Francisco Bay or south to Monterey Bay.<sup>76</sup>

- b) **Climate:** Santa Clara Valley's climate is Mediterranean and generally remains temperate year-round due to the area's geography and its proximity to the Pacific Ocean. In general, the area is warm and dry much of the year. Rarely is the humidity uncomfortable, and the thermometer seldom drops below freezing. Rain generally occurs in the winter and there is rarely snow on the tops of the local mountains: the Mt. Hamilton Range lining the eastern border of the County, and the Santa Cruz Mountains to the west.<sup>77</sup> Mean daily temperatures in July range from 81 °F to 59 °F. January range from 60 °F to 42 °F. Most of the annual rainfall comes in the winter months; the summer months are generally rainless.<sup>78</sup>

By the end of the 21<sup>st</sup> century, the average annual temperature in California is predicted to increase by as much as 8.1° F.<sup>79</sup> The future hotter, and likely drier, climate may threaten the viability of many invertebrates, amphibians, reptiles, birds, mammals, and plant species that inhabit Santa Clara County forests. Also, by the end of the century sea level is predicted to rise by more than 4.5 feet.<sup>80</sup> The resulting inundation and attendant erosion and flooding could eliminate coastal and bay habitats.

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<sup>76</sup> Watersheds of Santa Clara Valley: Coyote Watershed, Guadalupe Watershed, Lower Peninsula Watershed, Uvas-Llagas Watershed, West Valley Watershed; <https://www.valleywater.org/learning-center/watersheds-of-santa-clara-valley>

<sup>77</sup> About Santa Clara County. County of Santa Clara. Retrieved from <https://www.sccgov.org/sites/scc/pages/about-the-county.aspx>

<sup>78</sup> Annual Weather Averages in Santa Clara. Retrieved from <https://www.timeanddate.com/weather/usa/santa-clara/climate>

<sup>79</sup> Cayan, D. R., A. L. Luers, G. Franco, M. Hanemann, B. Croes, and E. Vine. 2008. Overview of the California climate change scenarios project. *Climatic Change* 87 (S1) (January): 1-6. doi:10.1007/s10584-007-9352-2.

<sup>80</sup> Heberger, M., H. Cooley, P. Herrera, P. H. Gleick, and E. Moore. 2009. The Impacts of Sea Level Rise on the California Coast. California Climate Change Center. CEC-500-2009-024-F.

#### 4. Trees of Santa Clara County

For information about the trees of the County of Santa Clara see:

- a) Trees and Shrubs of California  
(<https://www.ucpress.edu/book.php?isbn=9780520221109>)
- b) Native Trees of Santa Clara County (<http://www.cnps-scv.org/index.php/education/33-school-gardens/93-native-trees-of-san-mateo-and-santa-clara-counties-93>)
- c) Native Riparian Plants of Santa Clara County  
([https://www.valleywater.org/sites/default/files/D2/D2/D2-4\\_riparian\\_plants\\_2016%282%29.pdf](https://www.valleywater.org/sites/default/files/D2/D2/D2-4_riparian_plants_2016%282%29.pdf))

#### 5. Forests of Santa Clara County

- a) **Biomass:** The County forests have 280,000 acres of forest land<sup>81</sup> (with a net volume of 447 million cubic feet<sup>82</sup> representing an estimated 80 million trees,<sup>83</sup> and a gross 36.6 volume of million cubic feet<sup>84</sup> representing approximately 1.5 million dead trees<sup>85</sup>) of which approximately 110 thousand acres is owned by State and local governments. This represents approximately 14 billion tons<sup>86</sup> of above ground biomass of live trees, 456 million tons<sup>87</sup> of above ground biomass of dead trees, 1.1 billion tons<sup>88</sup> of biomass of down wood, and 507 thousand megagrams<sup>89</sup> of carbon mass of down wood on Santa Clara

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<sup>81</sup> Total Forest Land – Santa Clara County: Table A2-3—Area of forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 83 and 85

<sup>82</sup> Net volume of live trees on Santa Clara County Forest land: Table A2-27—Net volume of live trees a on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 121

<sup>83</sup> Total number of live trees in Santa Clara County: Table A2-14—Number of live trees on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 97

<sup>84</sup> Gross volume of dead trees on Santa Clara County Forest land: Table A2-28—Gross volume of dead trees on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 123

<sup>85</sup> Total number of dead trees in Santa Clara County: Table A2-15—Number of dead trees on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 99

<sup>86</sup> Above ground biomass of dead trees on Santa Clara County forest land: Table A2-61—Aboveground biomass of live trees on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 173

<sup>87</sup> Above ground biomass of dead trees on Santa Clara County forest land: Table A2-62—Aboveground biomass of dead trees on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 175

<sup>88</sup> Biomass of down wood on Santa Clara County Forest: able A2-97—Biomass of down wood on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 228

<sup>89</sup> Carbon mass of down wood on Santa Clara county Forest: Table A2-98—Carbon mass of down wood on forest land, by county and land status, California, 2001–2010; [https://www.fs.fed.us/pnw/pubs/pnw\\_gtr913.pdf](https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf) Page 230

County forest land. (California's Forest Resources: Forest Inventory and Analysis (2001–2010))

- b) **Plant Species:** There are more than 580 annual plants, one biennial, 645 perennial, 38 fern, 232 shrubs, and 46 tree species found growing wild in Santa Clara County Forests. Of which, more than 29 trees in the Maple, Heath, Oak, Laurel, Olive, Pine, Sycamore, Buckeye, Willow, Bald Cypress, and Yew families are native trees.<sup>90</sup>
- c) **Rare Plant Species:** Plants that are rare, threatened or endangered in California are also found in these forests such as the:
- a. fragrant fritillary (*Fritillaria liliacea*) which grows in moist areas, often near serpentine grasslands;
  - b. Jewelflower (*Streptanthus glandulosus* ssp. *Peramoenus*) that blooms in both serpentine soils and Franciscan-complex soils;
  - c. Metcalf Canyon jewelflower (*Streptanthus albidus* ssp. *albidus*) found in a 20-mile habitat from San Jose south to Anderson Lake;
  - d. Hall's Bush Mallow, (*Malacthamnus hallii*), a tall shrub, often hidden among other chaparral shrubs;
  - e. Loma Prieta Hoita (*Hoita strobilina*), a serpentine lover found tucked beneath oaks;
  - f. Santa Cruz Manzanita (*Arctostaphylos andersonii*) found in open patches in the redwood forests of the Santa Cruz Mountains;
  - g. Mt. Hamilton fountain thistle (*Cirsium fontinale* var. *campylon*) which grows near serpentine seeps and streams, found on both the eastern and western slopes of the Mt. Hamilton Range;
  - h. Big-scale Balsamroot (*Balsamorhiza macrolepis* var. *macrolepis*) found in the grasslands of Coyote-Harvey Bear Ranch;
  - i. Tiburon Indian paintbrush (*Castilleja affinis* ssp. *neglecta*);
  - j. Coyote ceanothus (*Ceanothus ferrisiae*) found in Mt. Hamilton range;
  - k. Mt. Hamilton thistle (*Cirsium fontinale* var. *campylon*) found on serpentine soils in seeps and springs and along intermittent and perennial streams of Mt. Hamilton Ranges, and in the hills adjacent to the northern Santa Clara Valley; and
  - l. Santa Clara Valley dudleya (*Dudleya abramsii* ssp. *setchellii*) found in the vicinity of Coyote Valley from San Jose south and Smooth lessingia, (*Lessingia micradenia* var. *glabrata*) found on the eastern slopes of the Santa Cruz Mountains and the hills adjacent to the Santa Clara Valley.

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<sup>90</sup> Native Trees of San Mateo and Santa Clara Counties - <http://www.cnps-scv.org/index.php/education/33-school-gardens/93-native-trees-of-san-mateo-and-santa-clara-counties-93>

- d) **Endangered Species:** These forests also provide habitat to many invertebrates, amphibians, reptiles, birds and mammals, including five endangered species - the California Clapper Rail, the Salt Marsh Harvest Mouse, the California Tiger Salamander, the Bay Checkerspot Butterfly, and the San Joaquin Kit Fox.

## 6. Natural Community types found in Santa Clara County

A few natural community types within the County are as follows:

- a) **Central California Sycamore Alluvial Woodland, Willow Riparian Forest and Scrub, Mixed Riparian Forest and Woodland** – A large majority of pre-urbanization alluvial trees in Santa Clara Valley were sycamore. As higher-elevation riparian and alluvial areas moved down towards the bay and transitioned into perennial wetlands and streams, the willows, oaks, cottonwoods and a mix of other native trees became more prevalent.



The dominant features of alluvial areas were seasonally dry, un-vegetated gravel beds, bars and terraces. This terrain mainly consisted of broad gravel-dominated streams more than 200 feet wide, but there were also narrow channels as well. The broad terrain supported widely-spaced, open woodlands and savannahs. The narrow channels supported more densely wooded conditions. These areas provided an array of functions, including flood control, fine sediment storage, and habitat for a diverse array of plants and wildlife.

Earlier riparian corridors in Santa Clara Valley were wider. However, reservoir construction and operation as well as drainage control measures have constricted corridor widths. Historically, more than 70 percent of total corridor length was wider than 200 feet. Currently, 70 percent of total corridor length is narrower than 200 feet. As the width of the corridors has narrowed, the density of the woodlands has increased. A reduction of flow from dams and flood control measures have allowed trees to grow in what used to be active channels and un-vegetated

### Benefits of Riparian and Alluvial Forest and Woodlands

Streambank stability, sediment reduction and flood protection

Habitat for animals and plants, and vegetation as source of food

Regulation of water temperature, improved water quality and ground water recharge

Improved air quality

Enhanced scenic value, open space

gravel bars, this, along with increased urbanization, has led to the narrow, densely wooded banks of today.

These dense, closed-canopy riparian corridors offer the benefits of mature tree growth, but represent a significant habitat change from the sparse, open Sycamore woodlands of the pre-agricultural era. It remains to be seen what the long-term benefits and drawbacks of this growth will be.

Riparian plant communities are of conservation interest in Santa Clara Valley as they have high value for streambank stability, sediment reduction, flood protection, vegetation as source of energy, habitat for plants and animals, and regulating water temperature.

Riparian habitats in rural lands must be preserved through protection of native vegetation,<sup>91</sup> development setback, regulation of tree and vegetation removal, and control and design of grading, road construction, and bridges, and maintaining adequate buffers from natural and modified streams. Restoration of these areas could possibly also be achieved by considering manipulating reservoir discharge to more closely mimic natural hydrology.



- b) *Mixed Oak Woodlands and Forests, Valley Oak Woodland, Coast Live Oak Forest and Woodland, Blue Oak Woodland*: The oak woodland landscape is a mosaic of vegetation types, with sizes varying with the topography and other characteristics of the land. The

#### Value of Saving Oak Woodlands

Oak woodlands are critical component of healthy terrestrial and aquatic ecosystems, providing habitat, preventing erosion, moderating water quantity and supporting infiltration, sequestering carbon, filtering out air and water pollutants, moderating temperatures, and supporting watershed function. Replacement planting of a single Oak tree alone can take 30-100 years to be effective at sequestering carbon; the costs of such mitigation could be significant. Therefore, ~~preserving Oak Woodlands make sense.~~

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<sup>91</sup> Native Riparian Vegetation of the Santa Clara Valley: [https://www.valleywater.org/sites/default/files/D2/D2/D2-4\\_riparian\\_plants\\_2016%282%29.pdf](https://www.valleywater.org/sites/default/files/D2/D2/D2-4_riparian_plants_2016%282%29.pdf)

dominant trees of oak woodlands are several major species of oaks. Within and among this woodland tree canopy are numerous smaller trees, shrubs, grasses, and forbs.



These forests once dominated much of the south Santa Clara Valley, providing critical habitat for a diverse range of native plant and animal species. The acorn woodpecker (*Melanerpes formicivorus*), white-breasted nuthatch (*Sitta carolinensis*), oak titmouse (*Baeolophus inornatus*), and Pacific pallid bat (*Antrozous pallidus pacificus*), along with over 330 additional vertebrates, can be found living in these habitats<sup>92</sup>. Despite general appreciation and some preservation, local oak populations continue to decline. Many trees persist as relics of the past in agricultural fields, parking lots, or around manicured parks and homes, where natural recruitment of young trees is difficult, if not impossible.

Reintegrating valley oaks within present day south Santa Clara Valley could help support local populations in their resiliency to climate change and other environmental trends. The County's stewardship would be worthy of long-term conservation attention as part of a regional plan to restore, not just individual trees, but also valley oak and mixed oak ecosystems.

- c) *Mixed Serpentine Chaparral, Northern Mixed Chaparral / Chamise Chaparral*, a special plant community characterized by drought-hardy, woody shrubs, shaped by a Mediterranean-type climate (summer drought, winter rain). Santa Clara County has over 188,427 acres of Chaparral. It is within the chaparral where we will find the best and perhaps last chance to reclaim wildness, preserve our forest and realize the quality of life made possible by the region's natural, open spaces. The most characteristic shrubs of the chaparral are berry manzanita (*Arctostaphylos glauca*), Ceanothus (*Ceanothus tomentosus*), Scrub oak (*Quercus berberidifolia*), Chamise (*Adenostoma fasciculatum*), Silk-tassel bush (*Garrya flavescens*), and Mountain-mahogany (*Cercocarpus betuloides*).



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<sup>92</sup> SFEI South Santa Clara Valley Historical Ecology Study

[https://www.sfei.org/sites/default/files/biblio\\_files/6\\_oaks\\_SouthSantaClaraValleyHEStudy\\_HighResolution\\_0.pdf](https://www.sfei.org/sites/default/files/biblio_files/6_oaks_SouthSantaClaraValleyHEStudy_HighResolution_0.pdf)

Although many birds and mammal species travel over and through the chaparral, only a few call it home year-round. The basic chaparral birds, including year-round residents and those that make extended visits, are the Wrentit, Western Scrub-Jay, California Towhee, Spotted Towhee, and California Thrasher. Birds especially common in chaparral for several years after a fire are Costa's Hummingbird (especially spring and summer), Sage Sparrow (mostly winter), Rufous-crowned Sparrow, Lazuli Bunting (April through September), Lawrence's Goldfinch, Black-chinned sparrow (April through summer months). Other chaparral birds are Bushtit, Canyon Wren, Bewick's Wren, Greater Roadrunner, Anna's Hummingbird, Fox sparrow (winter), Hermit thrush (winter), and Golden-crowned sparrow (winter).

- d) **Redwood Forest, Mixed Evergreen Forest:** The Santa Cruz Mountains have historically been mixed evergreen forest. Redwood groves were patchily distributed among a variety of natural tree communities found within this area, including Douglas fir, tanoak, and California bay. Redwood distribution generally occurred from 1,000 to 2,000-foot elevations, where fog was prevalent. Drier slopes within this eco-region supported many other trees including, live oak, foothill pine, alder, buckeye and Pacific madrone. Late 19th and early 20th century logging operations removed about 96 percent of the original old-growth redwood forest.

At present, there are several mixed evergreen forest areas within the County that are currently preserved. These include Bear Creek Redwoods Open Space Preserve, Uvas Canyon County Park, Sanborn County Park, and Saratoga Gap Open Space Preserve. However, environmental change from human activities has also contributed to the loss of species. Many remaining forest areas, both protected and unprotected, may be threatened by climate change and development. Local conditions of drought are also threatening these woodlands.

- e) **Heritage Trees:** A heritage tree is typically a large, individual tree with unique value, which is considered irreplaceable. The major criteria for heritage tree designation are age, rarity, and size, as well as aesthetic, botanical, ecological, and historical value.



The County's Tree Preservation Ordinance (Division C16)<sup>93</sup> defines heritage tree as "any tree which, because of its history, girth, height, species, or other unique quality, has been recommended for inclusion on the heritage resource inventory by the Historical Heritage Commission and found by the Board of Supervisors to have special significance to the community, and which has therefore been included in the heritage resource inventory adopted by resolution of the Board of Supervisors." The ordinance orients towards a specific tree, not a woodland. The ordinance places limits upon the removal of these trees.

- f) *Streetscapes in; Urban-Suburban, Rural-Residential*: Streetscapes and public rights-of-way are valuable real estate, although people often forget they are not just about moving motor vehicles. They are also the front doors to homes, schools and businesses. As our County urbanizes and its spaces become more constrained, we need to re-consider how to create more value from our streetscapes. In addition to collecting drainage and wastewater, roadsides accommodate utilities, as well as provide space for pedestrians and off-road bicyclists, but trees and natural vegetation have often taken a back seat to other uses.



Figure 2 Courtesy of Google

The presence of trees in a streetscape, neighborhood, and community can decrease the amount of stormwater runoff and pollutants that reach local waters.

The County employs a variety of measures to manage stormwater runoff and can maximize the stormwater utility benefits that trees provide. Grey stormwater systems use curbs, gutters, drains, pipes, ponds, vaults, and outfalls to move water quickly to containment and/or treatment areas or to receiving waters. Alternatively, green stormwater systems manage stormwater on site with overflow ability, creating areas that mimic nature. Vegetation, swales, wetlands, buffer zones, and pervious surfaces capture, filter, and slow stormwater runoff. Volume is managed through evapotranspiration, infiltration, and soil moisture recharge. Planting trees in these rights-of-way can help.

1. reduce stormwater runoff by capturing and storing rainfall in tree canopies and releasing water into the atmosphere.

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<sup>93</sup>[https://library.municode.com/ca/santa\\_clara\\_county/codes/code\\_of\\_ordinances?nodeId=TITCCODELAUS\\_DIVC16TRPRE\\_SC16-12HETR](https://library.municode.com/ca/santa_clara_county/codes/code_of_ordinances?nodeId=TITCCODELAUS_DIVC16TRPRE_SC16-12HETR)

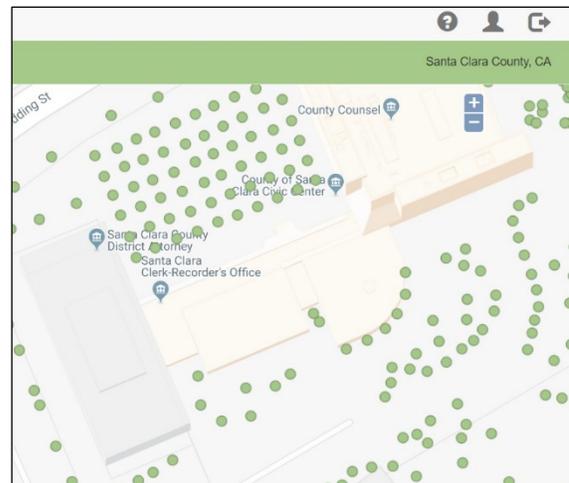
2. create soil conditions that promote the infiltration of rainwater into the soil.
3. slow down and temporarily store runoff and reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots.
4. transform pollutants into less harmful substances.

This can lead to plans for retrofitting County-managed road/expressway sections in mountain, rural, suburban and urban areas with planting more trees in and near trench drains, curb cuts, stormwater planters, planted cells, pervious concretes, vegetative, and bioretention swales to better handle stormwater and improve the environment for pedestrians, cyclists, and motorists.<sup>94</sup>

## 7. Tree Inventory

A tree inventory is a record of the attributes (location and characteristics) of trees within a defined geographic area. However, the scale and complexity of inventories varies with specific needs, goals and resources. The overarching benefit of a tree inventory is that it gives management the data needed to change operations from a predominantly reactive position of always “putting out a fire” to a proactive planning and execution position, leading to increased efficiency, improved pest response, better emergency preparedness, justified budgets, increased environmental benefits and documented actions.

A baseline individual and stand inventory, as applicable, of the entire County forest should be completed when a management plan/action plan is written. It is difficult to develop a plan without knowing what resources exist and how those resources affect long and short-term goals.



- A. **Individual Tree Inventory:** A complete tree inventory includes all trees, and often in urban forests, can even include empty planting sites as well. In Santa Clara County individual trees around facilities, parking lots, streetscapes, airports, recreational parklands, and expressways should be inventoried. An individual

<sup>94</sup> Environmental Site Design Implementation in Montgomery County, Maryland: Image Library:  
[http://www.montgomeryplanning.org/environment/documents/esd\\_implementation\\_graphics\\_201108.pdf](http://www.montgomeryplanning.org/environment/documents/esd_implementation_graphics_201108.pdf)

inventory will include all trees of a designated size within a defined geographic area. Attribute information for each tree is collected.

- B. **Stand-Level Inventory:** A stand-level inventory quantifies forest structure, volume, and growth over time. It is the backbone of any forest stand monitoring system. As it is impractical to measure every tree in a stand, a statistical sample of a stand is preferred. Inventory plots of a specific dimension are randomly located throughout a stand using a systematic sampling technique. Variables such as tree diameter, shrub cover, number of snags, etc., are then measured on each plot. Values from each plot are averaged together to generate an average value per acre for each variable measured (e.g., tree diameter). Values for each variable in the entire stand (e.g., total timber volume) can then be calculated by multiplying the average by the number of acres in the stand. Values from each stand are then added together to record and calculate results.



Once an initial baseline inventory of the County forest is completed, the inventory should then be updated every 10 years. For conducting a forest carbon inventory, permanent plots that can easily be re-measured should be established. Permanent inventory plots are often used on large land parcels, such as County forest land, and are the most precise method of monitoring forest change over time. To establish “permanent” plots, plot centers are marked with a stake or other marker and the variables of the forest stand within the plot are re-measured through time.

- C. **Software for Analyzing Tree Inventory:** i-Tree<sup>95</sup> is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. i-Tree tools can help strengthen forest management and advocacy efforts by quantifying forest structure and the environmental benefits that trees provide.



Whether your interest is a single tree or an entire forest, i-Tree provides baseline benefit data that can be used to demonstrate value and set priorities for more effective decision-making.

Developed by USDA Forest Service and numerous cooperators, i-Tree Tools are freely available. The U.S. Forest Service, Davey Tree Expert Company, National Arbor Day Foundation,

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<sup>95</sup> i-Tree Software: <https://www.itreetools.org/>

Society of Municipal Arborists, International Society of Arboriculture, and Casey Trees have entered into a cooperative partnership to further develop, disseminate and provide technical support for the suite.

## 8. Ecosystem Valuation

Trees provide several tangible environmental benefits that often go unrecognized. In recent years, there has been increased research on quantification of “ecosystem services”, the direct benefits that natural systems provide to people. Enumeration of these benefits can raise citizen awareness of the value of their public resources, such as trees on publicly owned lands, as well as provide a basis for management to maximize benefits while controlling costs.

a) Ecosystem Valuation of Urban Trees: i-Tree provides urban forestry analysis and benefits assessment tools ([www.itreetools.org](http://www.itreetools.org)). These models take individual tree data (for trees > 1-inch DBH) from complete inventories and/or samples, and estimate ecosystem services that the trees provide annually, including: energy savings; carbon sequestration; removal of air pollutants; stormwater run-off reduction; and aesthetics. In addition to these annual benefits, the models also estimate one-time asset values of:

- i. total CO2 sequestered (economic value in \$ based on CO2 emission control costs);
- ii. replacement value (full cost in \$ to replace a tree with a tree of similar species, size, and condition).

b) Ecosystem Valuation of Urban and Rural Forest: i-Tree Eco version 6 is a flexible software application designed to use data collected in the field from single trees, complete inventories, or randomly located plots throughout a study area along with local hourly air pollution and meteorological data to quantify forest structure, environmental effects, and value to communities. i-Tree Eco is currently designed to provide estimates of:

- i. Urban forest structure - Species composition, number of trees, tree density, tree health, etc.;
- ii. Pollution reduction - Hourly amount of pollution removed by the urban forest, and associated percent air quality improvement throughout a year. Pollution removal

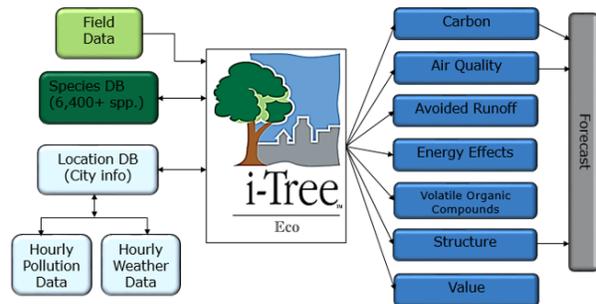


Figure 3 Courtesy of iTree

- is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter 2.5 (<2.5 microns);
- iii. Public health impacts – Health incidence reduction and economic benefit based on the effect of trees on air quality improvement for the U.S. only;
  - iv. Carbon - Total carbon stored and net carbon annually sequestered by the urban forest;
  - v. Energy Effects - Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power plants;
  - vi. Avoided runoff - Yearly avoided runoff attributed to trees summarized by tree species or strata;
  - vii. Forecasting - Models tree and forest growth over time and considers factors like mortality rates, tree planting inputs, pest and disease impacts and storm effects. Some ecosystem services including carbon and pollution benefits are also forecasted;
  - viii. Bio emissions - Hourly urban forest volatile organic compound emissions and the relative impact of tree species on net ozone and carbon monoxide formation throughout the year;
  - ix. Values - Compensatory value of the forest, as well as the estimated economic value of ecosystem services; and,
  - x. Potential pest impacts - based on host susceptibility, pest/disease range and tree structural value.

#### [APPENDIX D: Project Template - Forest Management Plan](#)

A forest management plan is a site-specific plan, which addresses one or more resource concerns on land where forestry-related conservation activities or practices will be planned and applied. The Plan should include:

##### 1. General Criteria

- a. A Forest Management Plan shall be developed by in-house or contracted certified technical service providers.

## 2. Background and Site Information

- b. Landowner information – name, address, operation, size
- c. Location and plan map of parcel
- d. Documentation of existing practices
- e. Past harvest or restoration history
- f. Identification of resource concerns

## 3. Department's Objectives

Which may include these considerations and others

- g. Expected income (if any)
- h. Forest stand and or individual tree improvement
- i. Wildlife habitat/riparian areas
- j. Recreation
- k. Aesthetics
- l. Stormwater management
- m. Agroforestry
- n. Pollinator Habitat and Protection
- o. Heritage Tree Protection

## 4. Existing Conditions

- p. Identify resource concerns based on an inventory to assess these concerns and opportunity for treatment. A forest inventory should be conducted using generally accepted forest inventory methods (stand level and/or individual trees). Describe the inventory process in the plan. The inventory typically includes forest management unit and stand boundaries, site index, basal area, species, size class, wood product potential, soil conditions, slopes, topography, aspect, natural and cultural features, roads, wildfire risk (surface and crown fires), risk of insect and disease infestation, fish and wildlife species and habitat elements, noxious and invasive species, water quality and other important features as applicable.

5. Desired Future Conditions

- q. Goals such as stocking, basal area, species composition, wildlife, pollinator habitat and protection, stormwater management, bioswales, recreation, aesthetics, etc., for stands where practices/activities are recommended to meet future goals.

6. Forest Management Plan Documentation

- r. Forest management plan map – boundaries, fields (i.e., foresters may refer to them as different stands of trees), scale, north arrow, stand boundaries, appropriate map symbols.
- s. Soils map – legend, interpretations, suitability index for forest activities.
- t. A wetland delineation map and associated wetland compliance documentation (if applicable).
- u. Conservation plan (record of decisions), the amounts to be applied, the schedule for implementation.

7. Site-Specific Specification

When any of the following practices are used in this plan, the site-specific specifications shall be noted. A Forest Management Plan may include as appropriate, but is not limited to, the conservation practices listed below:

| <b>Practice Name</b>                     |
|--|
| Alley Cropping                           |
| Multi-Story Cropping                     |
| Windbreak/Shelterbelt Establishment      |
| Silvopasture Establishment               |
| Fuel Break                               |
| Woody Residue Treatment                  |
| Firebreak                                |
| Access Control                           |
| Tree/Shrub Site Preparation              |
| Tree/Shrub Establishment                 |
| Windbreak/Shelterbelt Renovation         |
| Road/Trail/Landing Closure and Treatment |
| Forest Trails and Landings               |
| Tree/Shrub Pruning                       |
| Forest Stand Improvement                 |

For all other practices, the practice shall be documented for the planned amount, the fields where the practice is to be applied, and the planned year of application. Below are examples of additional conservation practices that may be planned on forestland:

| <b>Practice name</b>                              |
|---|
| Brush Management                                  |
| Herbaceous Weed Control                           |
| Conservation Cover                                |
| Prescribed Burning                                |
| Critical Area Planting                            |
| Fence   |
| Stream Habitat Improvement and Management         |
| Access Road                                       |
| Stream Crossing                                   |
| Streambank and Shoreline Protection               |
| Integrated Pest Management                        |
| Restoration and Management of Declining Habitats  |
| Wetland Wildlife Habitat Management               |
| Upland Wildlife Habitat Management                |
| Early Successional Habitat Development/Management |

#### 8. Data Points for Project Plan Template

| <b>Caption</b>                                  | <b>Definition/Description/Values</b>                           |
|---|--|
| <b>Project Number</b>                           | XXX000   |
| <b>Project Reference</b>                        | DEPT-1-mm-dd-yyyy-Location-Sub-Location                        |
| <b>Property Ownership</b>                       | DEPT-County  |
| <b>Owner's Name</b>                             | DEPT   |
| <b>Mailing Address</b>                          | Street No, Street Name, City, County, State, Zip Code, Country |
| <b>Contact Information (Name, Phone, Email)</b> | Name, Address, Telephone, Email                                |
| <b>County/State</b>                             | County, State  |
| <b>Plan Author (if not author)</b>              | Name   |
| <b>Plan Author's contact information</b>        | Name, Address, Telephone, Email                                |
| <b>Date of Original Plan Completion</b>         | Date Range   |
| <b>Plan Revision Dates</b>                      | Date Range   |
| <b>Budget</b>                                   | \$   |
| <b>Funding Sources</b>                          |  |
| <b>Property Description</b>                     |  |
| <b>Nearest City or Town</b>                     | City or Town   |

|   |  |
|---|--|
| County  | Value  |
| Total Ownership Acreage   | Acres  |
| Total Forested Acreage  | Acres  |
| Basic Topography  |  |
| Percent of land that is   | Flat (<5% grade), Gentle slope (<20% grade), Steep slope (>20% grade)  |
| Forest access to vehicles   | Excellent (80% accessible), Good (at least 50% accessible), Fair (at least 25% accessible), Poor (less than 10% accessible)  |
| Estimated improved road length (bulldozed and graveled length)              | Linear and Acres   |
| Estimated unimproved road length (bulldozed with but original soil bedrock) | Linear and Acres   |
| Estimated total permanent skid trail length (drivable but no earthwork)     | Linear and Acres   |
| Watershed tract is in   |  |
| Number of unique stands of trees, or management units                       | XX00   |
| Eco-Valuation Parameters  | Add lookup values  |
| County Forest Category  | FAF – Urban & Community Areas<br>HHS - Urban & Community Areas<br>PRK – Use Areas<br>PRK – Backcountry Areas<br>PRK – Infrastructure & Operational Facilities Areas<br>PRK – Trails Areas<br>RDA – Rural Roads Right-of-Way Areas<br>RDA – Mountain Roads Right-of-Way Areas<br>RDA – Expressways Right-of-Way Areas<br>Countywide - Cultural Sites & Heritage Trees Areas |
| Forest Cover Types  | Add look values.   |
| Eco-Region: Geography and Climate   | Add weather link   |
| Property History  | A brief description of ownership record, past management activities.   |
| Forest Management Goals   | Add lookup values  |
| Property Maps   | Delineate property boundaries, stands (management units, individual trees if   |

|  |   |
|--|---|
|  | applicable, special sites, threatened and endangered species present, water resources, roads, and a directional arrow, counter maps, aerial photo, GIS.   |
| <b>Soil Analysis</b>                                 | Soil map including legend, interpretation.  |
| <b>Protection of sites and social considerations</b> | Draw impacted areas on map.   |
| <b>Special sites and social considerations</b>       | Are archeologically, culturally, historically, geologically, biologically, ecologically valuable sites or high conservation value forests that may need to be protected.                                |
| <b>Adjacent stand or ownership concerns</b>          | How does surrounding management affect your forest and how do your actions affect your neighbors? Consider aesthetic quality, wildfire concerns, privacy, wildlife movement and habitat, noxious weeds. |
| <b>Recreation</b>                                    | If recreation is one of your objectives, identify resources, describe and plan for opportunities.   |
| <b>Access</b>  | Are property boundaries posted?   |
| <b>Water and Soil Protection</b>                     | What goals do you have, or steps will you take to conserve and enhance your forest's air, water and soil resources?   |
| <b>Soil Protection</b>                               | Steep slopes, woody debris, nutrient recycling, vehicle travel, soil compaction, flood run-off, livestock issues, best management practices if applicable. Include a soil map if desired.               |
| <b>Roads</b>   | General maintenance, erosion potential, best management practices, if applicable, road surface condition, road run-off, drain-dips, culverts, stream crossings, weed control, time-of-year use.         |
| <b>Streams, wetlands, ponds, lakeshore</b>           | Best management practices, if applicable, riparian habitat, wildlife, road crossings. If a wetlands delineation map is available, include as a reference.   |
| <b>Fish, Wildlife and Biodiversity</b>               |   |
| <b>Fish and Wildlife</b>                             | Desired species, habitat improvement, animal control, den sites, nest boxes, snag retention, access, hunting.   |

|   |  |
|---|--|
| State and Federal threatened or endangered species – plants and animals |  |
| Management of Forest Resources  | Draw impacted areas on your map.   |
| Protection from Pests   | Includes insects, disease, weeds, invasive species. Inventory control, monitoring, prevention guidelines. Consider using the range of integrated pest management including mechanical, physical, biological, cultural and chemical management. |
| Reforestation and Afforestation   | Natural seedling recruitment, planting, site preparation.  |
| Prescribed Fire/Burns   | Fire for stand/habitat improvement, fuel reduction, home fire-wise safety.   |
| Management Plan Implementation Constraints                              | Narrative  |
| Professional Assistance   | Assistance (list of agencies and individuals that you have consulted for special sites, threatened and endangered species, desired species, plan preparation, etc.   |
| Other   |  |
| Stand Level Information   | For each stand or management unit, write your management objectives are, and a brief description of the forest management unit and its conditions. Further detailed inventory/plot area can be included if desired.                            |
| Stand 1 Description   | Narrative or add lookup narrative values   |
| Stand 1   | 00   |
| Acres   | 00   |
| Objectives  | Narrative or add lookup values   |
| Current Description   | Examples include tree species present/forest type, stand age, history, site index, elevation, slope, size class, stocking, etc.  |
| Stand Management Recommendations  | Narrative or add lookup values   |
| Desired Future Stand Conditions   | Narrative or add lookup values   |
| Desired mature tree species   | Percent of forested area and expected longevity (maximum age you expect trees to reach before they die of natural causes or are harvested.   |
| Species   | Add lookup values  |

|  |   |
|--|---|
| Percent of forested area<br>Age                          | Percent values  |
| Desired species to naturally regenerate                  | Add lookup values   |
| Desired species to plant                                 | Add lookup values   |
| Bird's eye view of desired future forest stand condition | Wild Stand, Even spaced, evenly spaced with openings, variable density spaced with openings.  |
| Desired spacing (in feet)                                | Large (>9" DBH), Pole (5-8" DBH), Seedling (<5" DBH), Size and shape of openings.   |
| Desired structure (layer)                                | One canopy layer, two canopy layer, three canopy layers.  |
| Forest Harvesting Activities                             | Identify which stand (management unit) you are describing your activities. If a subset of the stand is being treated, the general area can either be described or identify the impacted areas on your map.  |
| Harvesting   | Describe type of treatment: Even aged: clear-cut, thinning; Uneven aged: group select, single tree selects, overstory removal, understory removal, etc. Treatment methods: ground based or skyline, time of year, type of harvest; see tree, multiage, sanitation, etc. |
| Slash management   | Leave slash at the stump, jackpot pile, whole tree skid, chipping, pulp, post & pole, large woody debris, nutrient cycling.   |
| Post-harvest activities                                  | Burning landings, piles, or broadcast, seeding roads and landings, weed spray roadsides.  |
| Permits  | Include a list of permits of which you applied, if necessary.   |
| Best Management Practices                                | If there a wetland or stream within your harvest area, is it properly marked and are the appropriate laws being followed?   |
| Monitoring   | How often do you plan on evaluating harvest units to ensure your overall forest management goals are being met?   |
| Management Activity Schedule and Tracking                |   |
| Stand management Unit                                    | XX00  |
| Acres/feet   | Unit  |

|  |  |
|--|--|
| Treatment Activity                                       | Add lookup values  |
| Dates  | Planned, Completed   |
| Budget   | \$   |
| Return on Investment                                     | \$   |
| Estimated Stand Level acres (Forest land)                | Unit   |
| Total Number of Trees (urban and peri-urban forest land) | 00   |
| Trees Removed  | 00   |
| Trees Planted  | 00   |
| Natural growth sapling progress                          | 00   |
| Empty Planting Sites                                     | 00   |
| Proposed Planting Sites                                  | 00   |
| Trees Maintained   | 00   |
| Eco-Benefits or Eco-valuation                            |  |
| Total annual benefit                                     | \$00.00Xnumber of trees or stand level/acre count  |
| Carbon Sequestration                                     | Current estimated tons of standing carbon per acre plus growth rate-sequestration per year |
| Energy conserved   | 00,000,000 kwh/year saved \$0,000,000  |
| Stormwater filtered                                      | 000,000,000 gal/year saved \$000,000   |
| Air quality improved                                     | -00,000 lbs./year saved \$000,000  |
| Carbon dioxide removed                                   | 00,000,000 lbs./year saved \$000,000   |
| Carbon dioxide stored to date                            | 00,000,000 lbs. saved \$0,000,000  |

## APPENDIX E: Best Management Practices

### 1. *California Arboriculture Law*

- a. Tree Pass
- b. Encroaching Roots and Branches
- c. Solar Panels and Shade
- d. Line Trees
- e. A Neighbor Poisons A Tree
- f. Hazardous Trees
- g. View
- h. Arboriculture Malpractice
- i. Utility Line Clearance
- j. A Tree Blocks A Stop Sign

- k. Roots vs. Sidewalks
- l. State Laws and Orders Which Impact Arboriculture
- 2. *County of Santa Clara Trees Related Policies and Ordinance*
- 3. *Safety Requirements for Arboriculture Operations*
  - a. General
    - i. Scope
    - ii. Purpose
    - iii. Application
    - iv. Responsibilities of the Employee
  - b. General Safety Requirements
    - i. General
    - ii. Emergency Procedures and Readiness
    - iii. Personal Protective Equipment (PPE)
    - iv. Job Briefing and Worksite Setup
    - v. Traffic Control
    - vi. Fire Protection
  - c. Electrical Hazards
    - i. General
    - ii. Working in Proximity to Electrical Hazards – Incidental Line Clearance (29 CFR 1910, Subpart S)
    - iii. Working in Proximity to Electrical Hazards – Utility Line Clearance (29 CFR 1910.269)
  - d. Safe Use of Vehicles, Mobile, and Towed Equipment Used in Arboriculture
    - i. Vehicles and Mobile Equipment
    - ii. Aerial Devices
    - iii. Brush Chippers
    - iv. Sprayers and Related Equipment
    - v. Stump Grinders
    - vi. Vehicles
    - vii. Cranes and Knucklebooms
    - viii. Specialized Units
    - ix. Equipment-Mounted Winches
  - e. Portable Power Hand Tools
    - i. General
    - ii. Portable Power Tools
    - iii. Chain Saws
    - iv. Powered Pole Tools and Backpack Power Units
  - f. Hand Tools and Ladders
    - i. General
    - ii. Cant Hooks, Cant Dogs, Peaveys, and Tongs

- iii. Wedges, Chisels, and Gouges
- iv. Chopping Tools
- v. Ladders
- g. Tree Climbing
  - i. Climbing Procedures
  - ii. Ropes and Arborist Equipment
  - iii. Pruning and Trimming
  - iv. Cabling
  - v. Rigging
  - vi. Tree Removal
  - vii. Brush Removal and Chipping
  - viii. Limbing and Bucking
  - ix. Pesticide Application
    - x. Mixing Pesticides
    - xi. High Pressure Air-Excavation Equipment
    - xii. Fertilization/Soil Management
  - h. Recommended Guidelines for Standard Performance and Safety Training for Qualified Line-Clearance Arborists/Qualified Line-Clearance Arborist Trainees and Qualified Arborists/Qualified Arborist Trainees
  - i. General Safety Procedures That Apply to All Tree Work
  - j. Weight of Green Logs
  - k. Aerial Rescue Flowchart
  - l. Hand Signals for Crane Operations
  - m. Electrical Hazard Abatement
  - n. Fall-Protection Systems
  - o. Live-Line Tools

#### 4. *Tree Inventory*

- a. Introduction
  - i. Purpose
  - ii. Definition and Components
- b. Goals and Objectives
  - i. Needs
  - ii. Inventory Objectives
    - a. Determine Population Size and Characteristics
    - b. Assess Tree Risk
    - c. Determine Maintenance Needs
    - d. Record Work History
- c. Benefits and Costs
  - a. Inventory Benefits

- i. Increased Efficiency
  - ii. Improved Community Relations
  - iii. Emergency Preparedness
  - iv. Justified Budgets
  - v. Comprehensive Planting Plans
  - vi. Improved Pest Response
  - vii. Document Actions
  - viii. Environmental Benefits
- d. Inventory Costs
  - i. Office Personnel
  - ii. Data Collection Personnel
  - iii. Data Collection Equipment
  - iv. Computing Needs
  - v. Software Type
  - vi. Software Compatibility
  - vii. Data Ownership
  - viii. Budget
- e. Inventory Types
  - i. Periodic versus Continuous Inventories
  - ii. Sample Tree Inventories
  - iii. Partial Tree Inventories
  - iv. Complete Tree Inventories
- f. Work Specifications
  - i. Location Information
  - ii. General Location
  - iii. Detailed Location
  - iv. Detailed Location-Street Trees
  - v. Detailed Location – Other Than Street Trees
- g. Tree Information -Standard
  - i. Species
  - ii. Diameter
  - iii. Condition
  - iv. Rating Tree Risk
  - v. Maintenance
  - vi. Work Priority
  - vii. Height
  - viii. Crown Width/Spread
  - ix. Community Status
  - x. Secondary Maintenance

- xi. Plant Health Care
- xii. Images
- xiii. Comments
- xiv. Extra Fields
- xv. Supplemental Information
- xvi. Site Attributes
- xvii. Other Site Information

h. Quality

- 1. Data Quality
- 2. Attributes
- 3. Values
- 4. Data Integrity
  - a. Data Entry Errors
  - b. Software
  - c. Storage
- 5. Keep it Fresh

5. *Tree, Shrub and Woody Plant Management - Standard Practices (Approved American National Standard)*

- a. Tree Risk Assessment Best Management Practices
- b. Tree Risk Assessment: Tree Failure
- c. Root Management)
- d. Integrated Pest Management
- e. Integrated Vegetation Management: Utility Rights-of-way
- f. Planting and Transplanting
- g. During Site Planning, Site Development, and Construction
- h. Lightning Protection Systems
- i. Soil Management a. Modification, b. Fertilization, c. Drainage
- j. Supplemental Support Systems
- k. Pruning

APPENDIX F

1. Table 1- Major groups of pests that occur on trees

| Pest                    | Description   |
|-------------------------|---|
| <b>Fungi</b>            | A living microorganism characterized by a cell wall containing chitin and lacking chlorophyll. A common cause of disease. Associated with a wide range of symptoms. Diverse group of pest organisms: some with large fruiting bodies visible with the naked eye but many only “visible” when grown in an artificial culture in the laboratory. Fungi also play a secondary role in decays and rots.   |
| <b>Bacteria</b>         | A living microorganism characterized by cell membranes and cell walls. An uncommon cause of disease but several species have caused widespread losses in trees. Cannot be detected with the naked eye except <i>en masse</i> in bacterial oozes.  |
| <b>Viruses</b>          | An ultramicroscopic (one dimension less than 200 µm) organism. Viruses cannot reproduce alone (and thus are not living organisms according to some definitions) but must first infect a living cell and take over its synthetic and reproductive facilities. More common cause of symptoms than generally perceived. Symptoms may resemble those of other pests and factors. Transfer to new host plants by (insect) vectors, sometimes by manual transmission. |
| <b>Phytoplasmas</b>     | Extremely small, phloem-limited, plant-pathogenic, bacteria-like prokaryotes that lack a cell wall. Uncommon cause of disease but more widespread than usually thought, mainly because typical symptoms are not recognized.   |
| <b>Insects</b>          | Widespread, extremely common cause of damage, and rarely host-tree specific (unlike many pathogens). Readily seen and often assumed to be the cause of more damage than is supported by biological evidence. Different insect orders are associated with patterns of feeding and breeding on trees.   |
| <b>Mites</b>            | Common pests whose feeding results typically in distinct symptoms (e.g. galls); mites are not readily seen with the naked eye.  |
| <b>Parasitic plants</b> | Widely present in many tree species that have been weakened by other factors. Rarely the cause of major losses.   |
| <b>Weeds</b>            | Some weeds outcompete trees, especially when young; others grow in the canopy and can strangle trunks and branches.   |
| <b>Larger animals</b>   | Includes mammals such as deer, rodents and birds that feed on the foliage and bark. Damage and losses can be significant, although plants often recover.  |

2. Table 2- Non-living factors that impair the health of trees

| Main Factor              | Categories and Examples  | Notes  |
|--------------------------|--|--|
| <b>Chemicals</b>         | Toxins: pesticides, herbicides<br>Pollution: deposition on plant, atmospheric, industrial waste<br>Miscellaneous: salt, oil poured into soil | The role of atmospheric pollution in tree declines may be overstated.            |
| <b>Mechanical agents</b> | Machinery: used in agriculture and for construction<br>Human: malicious, accidental  | Mechanical damage can provide means for pathogens (mostly fungi) to enter.       |
| <b>Soil conditions</b>   | Availability of Nutrients: deficiency, excess<br>Physical Structure: poor drainage, inhibition of root development                           | Trees respond in different ways to lack of nutrients.                            |
| <b>Water</b>             | Too Much: flooding; waterlogging<br>Not Enough: drought  | Trees differ in their ability to withstand excess or poor availability of water. |
| <b>Weather</b>           | Temperature: too low or too high<br>Other: lightning, hail, wind, snow   | The effects of climate on tree health are often not immediate.                   |

3. Table 3- Scheme for classifying symptoms.

| Category/Feature                     | Notes   |
|--------------------------------------|---|
| <b>Altered growth or development</b> |   |
| <b>Color changes in crown</b>        | Change of color; loss of color (discoloration)  |
| <b>Change in form or shape</b>       | Galls, swellings and knots; cracked or split surface, distorted leaves and stems, malformation                                |
| <b>Growth disturbance</b>            | Growth stimulation; stunted or reduced growth   |
| <b>Premature loss or development</b> | Early leaf drop, senescence or ripening   |
| <b>General death</b>                 |   |
| <b>Blight</b>                        | Characterized by widespread and rapid killing of plant parts (i.e., leaves, flowers, stems)                                   |
| <b>Dieback</b>                       | Progressive death of shoots, leaves or roots, beginning at the tips   |
| <b>Wilt and collapse</b>             | Drooping of plants because of insufficient water supply   |
| <b>Localize death or necrosis</b>    |   |
| <b>Spots and lesions</b>             | Many words are used to describe these small localized areas in addition to the common "leafspot", e.g., blotches, scabs, pits |

|  |   |
|--|---|
| <b>Cankers</b>                             | Cankers vary from those with sunken centers to others with raised edges and some with more general swellings            |
| <b>Rots and decays</b>                     | Rots and decays, commonly occurring inside major stems or trunks  |
| <b>Physical evidence</b>                   |   |
| <b>Damage by animal and insect feeding</b> | Exit holes, frass, webbing, internal or external shredding, spittle mass  |
| <b>Pest infestation</b>                    | Visible insects, visible fungal sporing structures (e.g., bracket fungi), mycelium, growth of molds or sooty appearance |
| <b>General damage</b>                      | Bleeding, ooze (not bacterial); mechanical damage; adverse climatic conditions  |
| <b>Other growths on trees</b>              | Parasitic plants, epiphytes, lichens, mosses, algae   |

#### 4. Scientific Literature Sources on Tree Disorders

Suggested sources are as follows:

##### [Suggested Literature on Biotic and Abiotic Disorders of Trees, Shrubs and Woody Ornamentals](#)

1. Pests of Trees, shrubs, & woody ornamentals  
(<http://ipm.ucanr.edu/PMG/GARDEN/plantmenu.html>)
2. Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide  
([http://ipm.ucanr.edu/IPMPROJECT/ADS/manual\\_landscape.html](http://ipm.ucanr.edu/IPMPROJECT/ADS/manual_landscape.html))
3. Abiotic Disorders of Landscape Plants  
(<https://anrcatalog.ucanr.edu/Details.aspx?itemNo=3420>)
4. California Forest Insect and Disease Training Manual  
([https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fsbdev3\\_046410.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_046410.pdf))

#### 5. Specific instructions on collecting and mailing plant, insect, and soil samples

**Collecting and sending samples:** Separate guidelines are provided for sending plant material, cultures of fungi or bacteria and insect samples.

The guidelines for sending plant material are as follows:

- a) Collect fresh material that shows the early stages of symptom development or has evidence of pest infestation (e.g., fungus fruiting bodies).
- b) Send to the investigating laboratory as quickly as possible.
- c) Pack it loosely, yet securely, to keep humidity low and reduce the chance of mold fungi developing en route. Do not pack in plastic bags.
- d) Provide information on symptoms and other details of the problem.
- e) Give each sample a unique code that will allow the receiving laboratory to keep track of your query.

The type of plant material to send depends greatly on the type of tree health problem. A good preliminary diagnosis based on a visual assessment of the symptoms will assist significantly in deciding what sample to send for investigation.

Do not send wilted leaves, for example, since these indicate a systemic disruption or root disease. Dead leaves have limited value in diagnostic investigations. Examine the roots and stems for internal staining and send small portions showing the symptoms. Leaf materials with lesions can be simply pressed by inserting them between sheets of absorbent paper such as newspaper or paper towels and then placing them inside a book or under an object to apply light pressure.

Excise the parts of the stems that show symptoms such as cankers or staining at the junction of healthy and stained or decaying tissue. Materials with suspected virus diseases are best preserved before dispatch. Press leaves between absorbent material (best to use filter paper but improvise if necessary) soaked in 50 percent glycerol to help keep leaf material fresh.

Material with suspected phytoplasma diseases can be sent dried or with leaves and young stems preserved in one-percent borax. Use rigid bottles (preferably plastic) that have a tight seal and do not leak. Reinforce the seal with plastic tape stretched around the container top.

It is vital that all material be carefully and permanently labelled.

The guidelines for sending specimens or cultures of fungi and/or bacteria are as follows.

- a) Some fungi sporulate on plant structures but others must be isolated from plant material. Where possible, attempt to do these isolations in situ or at a local

laboratory. Simple tap water agar (1.5 percent agar in sterilized tap water) is a useful medium for general purposes.

- b) Only send the most commonly isolated fungi or bacteria for identification. This reduces the potential cost of the investigation and increases the chances of getting a quick reply to your query.
- c) Micro-fungi should be sent as young, pure cultures. Test tubes, small glass tubes and plastic petri dishes are the simplest containers for sending live fungal material. The safest methods (e.g. freeze-drying) require specialist equipment for preparing cultures.
- d) Always check cultures for mites. These are best kept in check through sound laboratory techniques.
- e) Macro-fungi (mushrooms, bracket fungi and so on) should be dried and sent in envelopes or paper. Do not use plastic bags.

The guidelines for sending insect specimens are as follows.

- a) Larvae are difficult to identify; therefore, try to rear the insects to adult stage before sending.
- b) Large insects should be air dried or frozen prior to dispatch and carefully packed in a small tube or vial with tissue paper or cotton to avoid damage.
- c) Small insects can be preserved in 75 percent alcohol. Place identifying labels (written in pencil or indelible black ink on paper) inside the containers.
- d) All specimens should be carefully labelled with collector's name, date of collection, site and any host information (species, size, age).
- e) Keep a carefully labelled reference collection of all insects sent for identification for future cross-referencing.

#### 6. Soil Test collection instructions

The following Guide details soil collection methods, sample analysis, and data translation. It outlines what field soil scientists need to make accurate interpretations of site information:

1. A Guide to Soil Sampling and Analysis on the National Forests of the Inland Northwest United States  
([https://forest.moscowfsl.wsu.edu/smp/solo/documents/GTRs/INT\\_326/GTR326.php#anchor737882](https://forest.moscowfsl.wsu.edu/smp/solo/documents/GTRs/INT_326/GTR326.php#anchor737882))

#### 7. Suggested laboratory locations

The following document provides a list of plant and soil laboratories in Northern and Central California. Analyses performed include: plant and soil nutrients; manure and compost; plant pathology; nematology; irrigation water testing; hazardous wastes and pesticide residue:

Plant and Soil Laboratories in Northern and Central California  
(<http://cesonoma.ucanr.edu/files/27431.pdf>)

This list of labs closer to Santa Clara County are as follows:

1. Caltest Analytical Lab, Napa (<https://www.caltestlabs.com/Home.aspx>)
2. CERCO Analytical, Inc., Pleasanton (<http://www.cercoanalytical.com/>)
3. Control Laboratories, Watsonville (<http://controllabwatsonvilleca.com/soil-testing-equipments>)
4. Perry Laboratory, Watsonville (<http://perrylaboratory.com/index.shtml>)
5. Waypoint Analytical, San Jose (<http://www.waypointanalytical.com/>)

### Appendix G: Qualifications and scope of work for County consulting arborist contract

#### Arborist Qualifications

The consulting Arborist must have/be:

- a) Bachelor's Degree from a regionally accredited educational institute in the field of arboriculture, urban forestry, forestry, landscape architecture or International Society of Arboriculture (ISA) Certification as an Arborist.

- b) Certification from ISA and provide proof of credentials as a “certified arborist” in “active status” who has undertaken ongoing education to keep their knowledge and certification up to date.
- c) Three or more years of experience in arboriculture as an Urban Forester, Forester, or Certified Arborist.
- d) Trained and knowledgeable in all aspects of arboriculture.
- e) Working knowledge of municipal policies, operation, procedures, and functions.
- f) Effective communication skills both written and oral with citizens, staff and governmental officials.
- g) Ability to coordinate multiple tasks related to urban forestry and management.
- h) Ability to prepare routine reports and correspondence.
- i) Ability to read and interpret technical documents, regulations, and procedure manuals.
- j) Hold a valid California State Driver’s license.
- k) Ability to perform site visits using personal vehicle.

### Sample Scope of Work

**Hazardous Tree Management Related Work:** When requested only on “as needed basis”:

- a) Help County to determine what trees are hazardous and should be pruned or removed. Provide the level and details of the assessment. For all levels of assessment, if the assessor arborist determines that a higher level of assessment or different type of assessment is needed, then that recommendation should be made to County accordingly.
- b) Provide pest and disease diagnostics and provide protection strategies from the physical stresses of surroundings.
- c) Report on tree conditions, both orally and in written form, and provide an accurate and detailed assessment of trees’ species, size and health, evaluation of root conditions, structure, risk factors, and monetary value. Risk assessments typically should include a rating of the current tree risk, options and/or recommendations for mitigating risk, evaluation of the residual risk after mitigation, and recommended inspection interval, if applicable. Report should include recommended timetable for work to be carried out based on the inspection. If a situation is encountered where tree failure is imminent and a high-value target is present and likely to be impacted, then the situation should be reported to the County representative as soon as possible. In addition, immediate action may be required to restrict access to target zone.
- d) Help County in determining what type of trees and where trees should be removed or planted on County property.
- e) Advice on the strategic addition of new trees and the replacement of lost trees, and care and maintenance of trees.

- f) Advise County on the policies, standards, guidelines and regulations related to tree management
- g) Provide the County access to a tree inspection inventory (record keeping system) consisting of an internet-based software program that allows the County to view and maintain information about its hazardous tree population, including the description of each tree by species, height, diameter, photographs, work history, and tree and planting site location. The tree inventory software program shall be an Internet-driven tracking program. The program shall have the capability to produce detailed listings of tree and site information, work histories, service requests, summary reports and pictures of County tree species. The Arborist shall provide software support to the County for the entire term of the contract and release all data to the County for records at the end of contract.

**Sustainable Tree Management Related Training:** When requested only on “as needed basis”:

1. Develop and/or deliver a comprehensive and consistent training program on topics such as sustainable tree management, best management practices, tree identification and basic tree physiology, ANSI A300 pruning, maintenance, and protection standards, ANSI Z133.1 safety requirements, ANSI Z60.1 standards for nursery stock, job site setup, flagging, and safety, First Aid, CPR, OSHA compliance, electrical hazards awareness program, tree worker and arborist training, tree hazard identification, tree valuation, insects and disease diagnosis and management

**Department of Planning and Development - Tree Preservation and Removal:** When requested only on “as needed basis”:

1. Review arborist reports submitted for development proposals through Planning and Building Permit review. Identify any missing or inaccurate information in arborist reports and project plans. Request additional info and/or clarification as needed to provide recommendations.
2. Review project plans for potential impacts to Heritage Trees and Street Trees through construction activities (e.g., buildings, grading, drainage, irrigation, utilities, etc.)
3. Visit the subject site to verify tree protection measures are in place as specified prior to permitting.
4. Provide written comments to the Project Planner and/or Building Division Plan Checker when revisions to reports and/or plans are necessary.
5. If a Heritage Tree removal is proposed as part of the development project, provide recommendation to Project Planner/Building Division Plan Checker.
6. Monthly visits to active job sites where Heritage Tree protection is mandated through a Conditional Use permit or Building permit to verify tree protection measures are being maintained.

7. Provide sound solutions for review of denial by County staff on appeals regarding tree removals.
8. Supplemental tasks may be assigned as needed.

#### Tree Inventory/Assessment Related Work:

- a) Conduct or facilitate tree inventory/assessment to:
  1. identify accurate tree and planting site locations,
  2. determine condition, safety risk, and maintenance needs,
  3. analyze tree inventory data to calculate the value of the tree benefits in the community,
  4. provide recommendations for proactive management, and
  5. deliver inventory data/reports in a format that is easy use and implement.

Data shall be collected by using hand-held computers compatible with the County's GIS maps and data fields in conjunction with GPS units.

#### Hazardous Tree Inspection Inventory

The hazardous tree inspection work inventory at a minimum but not limited collect data with specific attributes and produce a geographic information system (GIS) based inventory and maps including:

1. Maintain hazardous tree inventory that includes all County owned or managed trees within the County boundaries, including but not limited to public rights-of-ways, County easements, streets, parkways, medians, parks and open spaces, County facilities, public parking lots, etc.
2. GIS functions should be compatible with existing county GIS software and data layers.
3. Data collected for tree location shall be collected with global positioning system (GPS) equipment.
4. Minimum collection attributes (Attachment ISA Tree Risk Assessment Form \_\_\_\_ ) for a complete tree inventory shall include but not limited to:
  - a. Mapping coordinate. X and Y coordinate locations (latitude and longitude). Each tree and planting site shall be located using GPS equipment and GIS maps.
  - b. Area. Tree location shall be identified by subdivision or code number.
  - c. Location. The tree's physical location in relation to the public Right-of-way and/or public spaces will be recorded.
  - d. Site information. Street name, address, site location information such as side, front, right, left, rear, or median using a consistent method of location trees on corners.
  - e. Species. Trees shall be identified by genus and species, and by common name.

- f. Trunk size. Tree trunk circumference and diameter shall be measured and recorded at four and one-half (4 ½') feet above grade.
- g. Height and Spread. Trees height and spread shall be measured in feet and/or classified by range of size.
- h. Stems and Canopy type. The number of stems and canopy type shall be recorded.
- i. Condition. In general, the condition of each tree will be recorded using methods and rating system accepted and/or established by the International Society of Arboriculture (ISA).  
Example: Excellent-100%; Very Good-90%; Good-80%; Fair-60% Poor-40% Critical-20% Dead-0%
- j. Observations. General observations referring to a tree's health and structure.
- k. Clearance Required. Trees, which are causing or may cause visibility or clearance difficulties for pedestrians or vehicles, will be identified, as well as those trees blocking line-of-sight visibility of signs or traffic signals.
- l. Hardscape Damage. Damage to sidewalks and curbs by tree roots are noted and recommendations for potential fixes for the problem are encouraged.
- m. Overhead Utilities. The inventory indicates whether overhead conductors or other utilities are present at the tree site that could result in conflicts with the tree.
- n. Grow space. The area within the growing space is categorized as (example):
  - o L Lawn
  - o C Concrete cut-out
  - o M Median
  - o Pw Parkway
  - o PL Planter
  - o PK Park
  - o O Open space
  - o U Unmaintained Area
- o. Space size. The narrowest dimension of the grow space, measured in feet (i.e., 3'x3' cutout, 4' parkway, open parkland, etc....).
- p. Damage or infestation. Identify any damage caused by abiotic factors such as fire, mechanical equipment, loss of water or biotic factors such as significant pest, insect, or disease infestation.
- q. Tree hazard description and risk to the community
- r. Available Planting Space. Identify all available tree planting spaces.
- s. Available Open Space. Identify potential open spaces for mass tree planting or urban agriculture activities.

t. Maintenance. Primary maintenance needs shall be included using the ANSI A300 pruning standards for primary maintenance needs and type of pruning requirement:

1) Priority 1 Removal. Trees designated for removal have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have a large percentage of a dead crown and pose an elevated level of risk or failure. Any hazards that could be seen as potential dangers to persons or property and seen as potential liabilities would be in this category.

Large dead and dying trees that are high liability of risks and are included in this category. These trees are the first ones that should be removed.

2) Priority 2 Removal. Trees that should be removed but do not pose a liability as great as the first priority will be identified. This category would need attention as soon as "Priority One" trees are removed.

3) Priority 3 Removal. Trees that should be removed, but pose minimal liability to persons or property, will be identified in this category.

4) Priority 1 Prune. Trees that require the removal of hazardous deadwood, hangers, or broken branches. These trees have broken or hanging limbs, hazardous deadwood, and dead, dying, or diseased limbs or leaders greater than four (4) inches in diameter.

5) Priority 2 Prune. These trees have dead, dying, diseased, or weakened branches between two (2) and four (4) inches in diameter and are potential safety hazards.

6) Large Tree Routine Prune. These trees require routine horticultural pruning to correct structural problems or growth patterns, which would eventually obstruct traffic or interfere with utility wires or buildings. Trees in this category are large enough to require bucket truck access or manual climbing.

7) Small Tree Routine Prune. These trees require routine horticultural pruning to correct structural problems or growth patterns, which would eventually obstruct traffic or interfere with utility wires or buildings. These trees are small growing, mature trees that can be evaluated and pruned from the ground.

8) Training Prune. Young, large-growing trees that are still small must be pruned to correct or eliminate weak, interfering, or objectionable branches in order to minimize future maintenance requirements.

These trees, up to 20 feet in height, can be worked with a pole-pruner or by a person standing on the ground.

- 9) Stump Grind/Removal. This category indicates a stump that should be stump ground below grade level and/or removed.
- 10) Plant Tree. During the inventory, vacant planting sites will be identified by street and address. The size of the site is designated as small, medium, or large (indicating the ultimate size that the tree will attain), depending on the growing space available and presence of overhead wires.

#### Appendix H: Wildlife Management

Wildlife management is the management or stewardship of wildlife resources by humans; it addresses game and non-game animals (that are potentially threatened) and their habitats. When people think about wildlife they tend to think about birds and mammals, but numerous other animal taxa, such as reptiles, amphibians and insects, are also subject to use by humans. Wildlife is a renewable resource that plays a key role in regulating natural processes at all levels of the food chain and delivers “provisioning” services (such as those that produce food and income).

Wildlife populations are managed for several reasons, such as to control overabundance (and thereby mitigate human–wildlife conflicts); restore ecological processes (e.g., species’ reintroductions); and maintain populations at levels compatible with the sustained yield of products.

Wildlife may be subject to a wide range of uses, which can be classified broadly according to whether wildlife is removed from its habitat. Extractive (or consumptive) use generally involves reductions in wildlife populations by killing (e.g., hunting). Non-extractive (or non-consumptive) use implies no intrusive action on the wildlife population (e.g., wildlife photography).

The ability of many wildlife species to move freely over large areas can complicate their ownership and management. Depending on the circumstances, wildlife may be a public good, communally owned, government-owned or privately owned. Wildlife management may involve widely varying spatial scales, according to the biology and movement of species. It, therefore, often requires compromises between the interests and needs of different stakeholders such as forest owners, farmers, hunters, and tourists.

Sustainable wildlife management requires appropriate policies, social acceptability, and good governance. It can be best achieved through the generation of local benefits, which may include income (e.g., through commercial harvesting), subsistence (e.g., wild-meat consumption) and

"satisfaction" (e.g., gained through recreation). In jurisdictions that have the appropriate legal framework and policies, local stakeholders can be excellent wildlife managers.

## Appendix I: Site Evaluation

### *Climate*

Santa Clara County's climate generally consists of moist, mild winters and dry summers. However, diverse topographical variety can result in microclimates that vary moisture and temperature for a limited geographic area. These climatic settings are important considerations in planning decisions and influence the natural distribution of tree species throughout the area.

In Santa Clara County, redwood and madrone can be found growing in the Santa Cruz Mountains. Oaks grow on the valley floor, and sycamores and willows are often near watersheds. Tree identification and species range maps can be found in CalScape database by California Native Plant Society.<sup>96</sup> The main factors influencing climate ranges include temperatures as well as timing and amounts of precipitation.

### *Soils*

Soil type will determine the amount of water and nutrients available to trees. Soil types span a range from sand to loam to clay, and every combination in between. Sandy soils drain easily, and so tend to be dry and low in nutrients. Clay soils tend to be higher in nutrients, but wet because they drain poorly. Loam soils are a combination of sand, silt, and clay. Their nutrient and water holding capacity varies, depending on the degree of clay, sand, and organic matter present.

Most tree species are adapted to grow in specific soil conditions, so some will grow best in sandy soils while others prefer clay soils. County soil surveys and maps<sup>97</sup> can provide an idea of what soils are in specific areas or can be general. Detailed information on soil type and available nutrients can be obtained by having soil tested.

### *Competing Vegetation*

In any given area, there is a set amount of moisture, nutrients and light available for plant growth.

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<sup>96</sup> CalScape. Available at <https://calscape.org/loc-California/cat-Trees/ord-popular?srchcr=sc5bad614e45ce3>.

<sup>97</sup> Supplement to the Soil Survey of Santa Clara Area, California, Western Part by Natural Resource Conservation Service of US Department of Agriculture. Available at [https://www.nrcs.usda.gov/Internet/FSE\\_MANUSCRIPTS/california/santaclaraCAwest2015/Santa-Clara-CA\\_West.pdf](https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/santaclaraCAwest2015/Santa-Clara-CA_West.pdf).

Existing vegetation can compete with new plantings for these essentials. It can also harbor insects and diseases that may spread to new trees. Look carefully both at the vegetation that is already present on the site and at what may grow as new trees establish themselves.

Eliminating problem vegetation or seed sources early can avoid larger problems once trees are planted. When planting in an open area, it may be necessary to mow between trees for the first few years to control competing vegetation. If planting in an established forest, the seedlings may face competition for light from larger trees. If removal of existing trees is not desired, planting of shade-tolerant species is necessary.

### *Topography*

Topographic factors that may influence where and what to plant include elevation, slope, aspect (which direction the slope is facing), and drainage.

Site direction, or aspect, affects temperature, sunlight, and moisture levels. For example, a north-facing slope tends to get direct sunlight and so has cooler temperatures and less evaporation. This means that there will also be more moisture in the soil available to support growth.

Slope and drainage affect whether the water moves off-site or pools. Pooling water can slow tree growth in many species. Topography can also restrict the types of equipment used when preparing a site and may limit you to hand planting only.

### *Location in the Landscape*

Look at the landscape around your planting site. What is growing near the site might be an indicator of what grows best in the area. Neighboring landscapes can be used to encourage trees that may be declining. For example, if there are old, large oaks, but most of the smaller trees are maples, it may be preferable to plant oaks to replace them as they age. If the area has smaller parcels of disconnected woodlands, the sites can be planted to connect the two parcels, which can act as a corridor for wildlife to travel.

### *Forest Pests*

Pests such as insects, diseases, and animals may negatively impact the success of planting. Be aware of what insect and disease problems are present in the area. Avoid planting large quantities of the species preferred by those pests. For example, if western pine beetle is a concern in the area, it would be best to avoid planting conifers.

Deer and rodents are the biggest culprits in the animal pest category. Deer may damage new tree plantings, mainly by feeding on buds and leaves. Erecting physical barriers such as fencing, and tree shelters is one way to deter deer. Rodents will also damage trees but by controlling competing vegetation. Their impact can be reduced by removing potential nesting sites.

## Appendix J: Selecting the Right Trees for Your Planting Plan

### *Planting Design*

Using the site evaluation, develop a planting design that meets the goals and is appropriate for the conditions found on the planting site. A local forester or arborist can help with the specific details for the creation and management of planting.

### *Size, Shape, Location*

Several factors will determine the size and scale of a planting project. Current site conditions, available time, costs, and desired benefits will all be factors. Planting projects are often of a size that can be completed in a single planting. However, in some cases, it may be beneficial to stagger a large project over time. In the short term, staggering the planting over several years can spread out up-front costs, labor, and risk (weather extremes such as drought). In the long term, staggered planting can create age diversity in the landscape.

The best-designed plantings are those that take existing features into account.

In most cases, a site visit and/or review of maps/aerial photos is essential in determining the optimum location and shape of a planting site. It can be as important to consider where not to plant trees, as it is to consider where to plant them. Creative consideration of size, shape, and location can often meet multiple objectives in a single planting. An example of this is a planting designed for timber production that links two natural habitats together, creating an important wildlife travel corridor.

### *Arrangement*

Arrangement, or layout, refers to the pattern or distribution of species across a planting site. The arrangement of species may be varied to suit different soil and landscape conditions identified during a site evaluation. Consider planting species with similar growth rates next to each other or grouped so that one species doesn't dominate another. Tree spacing will depend on the species selected, any current infrastructure, the need for intermediate canopy coverage, and cost. If the goal of planting is to attract wildlife, space trees farther apart to promote crown development and seed production.

### *Interplanting*

Interplanting is the practice of planting seedlings by hand into an existing forest. This practice supplements natural regeneration in areas of mortality or poor natural seedling growth. Plant larger seedlings that will become established quickly, and use weed control to help combat existing unwanted vegetation.

### *Reforestation Plan and Map*

A written planting plan and map will clarify the details and allow for modifications before planting. The plan will outline details such as, the size of the planting area, number of trees, species, spacing, arrangement, site preparation and planting method, layout of roads and infrastructure, post-planting maintenance, and harvest procedures. A map will help visualize how the planting area will look when completed.

## Appendix K: Selecting Nursery Stock

### *Seed Source*

Selecting nursery stock (i.e., the seedlings a nursery has in its inventory for sale) that is grown from a good seed source is a key consideration. Ideally, select stock grown from seed collected within Santa Clara County. Seedlings grown from seed collected in the same region will be adapted to the weather conditions found in that area. These trees may also have developed some natural resistance to certain insect and disease problems. Use the American Standard for Nursery Stock as a guide for selection.<sup>98</sup>

### *Stock Type*

Code numbers for nursery stock types will be found in nursery catalogs. Stock is identified with a two-number code indicating its age and growth history in the nursery. The first number indicates the time the seedling was grown in its original seedbed and the second number indicates the time (if any) the seedling grew in a transplant bed. Therefore, a designation of 2-0 means a two-year-old seedling that has never been transplanted or moved within the nursery fields. A 2-1 seedling is three years old, grown in the original seedbed for two years and then moved to another bed for one year. Transplanting a seedling in the nursery provides the tree more room to grow and will result in a larger plant. Since transplants are larger, they are well-suited for planting on harsh, difficult-to-establish sites. Transplants are generally more expensive than smaller 2-0 or 3-0 seedlings.

Many nurseries now offer “plug plus” seedlings (they are identified as “plug+1”). These seedlings were started in a greenhouse and then transplanted into the nursery fields for one or more growing seasons.

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<sup>98</sup> [https://cdn.ymaws.com/americanhort.site-ym.com/resource/collection/38ED7535-9C88-45E5-AF44-01C26838AD0C/ANSI\\_Nursery\\_Stock\\_Standards\\_AmericanHort\\_2014.pdf](https://cdn.ymaws.com/americanhort.site-ym.com/resource/collection/38ED7535-9C88-45E5-AF44-01C26838AD0C/ANSI_Nursery_Stock_Standards_AmericanHort_2014.pdf)

### *Direct Seeding*

Another possible planting option to consider is direct seeding. This is a relatively new concept that in certain situations has resulted in successful establishment of trees. Instead of planting trees, the tree seed is planted directly into the field. Additional information on this practice can be obtained from a local forester.

### *Bare Root Versus Container Stock*

Bare root seedlings are lifted from the nursery fields and packed without any soil around the roots. Bare root seedlings need to be moved from the nursery to the planting site while still dormant to minimize transplant shock. If bare root stock for a dormant species, such as fruit trees, is being used then winter dormant season is the optimum time to plant them.

Container, or potted, seedlings are raised in greenhouses. They are shipped in containers (to be removed before planting) with soil surrounding the root system like any potted plant. This allows the trees to be planted later in the growing season with less transplant shock. These seedlings are usually more expensive than bare root stock and can be difficult to machine plant due to their larger root size.

### *Ordering Stock*

Ordering trees well in advance (four to six months before the planting season) will provide the best chance of obtaining the species and quantities desired. Private nurseries offer variable ordering dates and should be contacted for details.

## *Appendix L: Site Preparation*

### *Mechanical*

Mechanical site preparation may only be appropriate in some cases. It uses plowing, disking, chopping, crushing, furrowing, or other approaches to reduce vegetation. Mechanical preparation is most effective on “light” soils with few weeds. The height of competing plants can be reduced (mow or crush), the vegetation on the surface can be scraped away (scarification), or the roots can be plowed and destroyed.

There are some downsides to using mechanical control. Heavy machinery compacts the soil, which makes it difficult for tree roots to grow. Mechanical preparation exposes more soil to the air, which increases the chance of erosion. Finally, mechanical techniques usually provide only short-term relief from competing vegetation, which means that more treatments are needed over time.

### *Chemical*

Chemical treatments are more thorough and use less labor than most mechanical techniques. However, chemical site preparation also has drawbacks. Environmental impacts can occur from improper storage, application, and disposal of herbicides. Chemical treatments are dramatically affected by weather conditions, soil texture, and the stage of weed development. Proper application requires specific equipment and knowledge of application rates, and all herbicides must be applied in accordance with label recommendations and their registered use, as well as be pre-approved by the County's Integrated Pest Management (IPM) program (see IPM and pesticide use reduction ordinance<sup>99</sup>).

### *Other Methods*

Additional natural resource area site preparation techniques include prescribed burning and use of cover crops. Both are best used in combination with chemical and mechanical methods as this will be most effective.

With prescribed, or controlled, burning the competing vegetation is only slightly affected for a short time. The resulting regrowth is usually heavier than the original vegetative cover, so use of a chemical following a burn is recommended. Chemical application alone should not be considered as panacea. Check with County policy to ensure that fire protection best practices are integrated into any tree management project.<sup>100</sup>

Cover crops can provide erosion control, suppress weed growth, and help retain soil moisture. It is important to select a cover crop that will inhibit weeds but not compete with seedling growth. Common choices are cereal grasses, vetches, cowpea and strawberry clover. Cover crops are most easily planted in former agriculture fields due to the equipment needed to seed the crop and the flat nature of the terrain. However, if a planting area is small, rocky, or has rough topography, cover crops can be planted by broadcast seeding or with smaller, specialized equipment.

Some cover crops may attract deer, which can increase seedling losses through browsing. Cover crops may also provide shelter and nesting areas for small rodents. Therefore, limit the use of cover crops if mice and voles are a concern. A local forester or arborist can help determine which techniques work well in an area and how best to prepare a site for trees.

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<sup>100</sup> <http://www.sccfd.org/>

## Appendix M: Caring for Seedlings

Three key points to remember when caring for your tree seedlings:

1. Keep trees cool
2. Keep trees moist
3. Keep trees free from physical damage.

If you maintain the trees under these conditions, you have taken a major step toward planting success.

### *Transporting of Seedlings*

The ideal method of transporting seedlings is under refrigeration, between 34° and 36°F. If refrigerated trucking is not available, there are other ways to minimize overheating of the seedlings. If using a pickup truck for transporting of trees, place a layer of foam insulation on the bed of the truck to prevent heat from the exhaust system from reaching the packaged stock. Covering the load with a solar reflective tarp can greatly reduce solar heat. If possible, pick up trees early or late in the day when temperatures are most likely to be cooler. If stopped for any length of time with a load of trees, park in a shaded location. Also, leave air gaps between the packages to allow air movement and reduce heat buildup.

### *Storage and Handling of Seedlings*

It is best to plant seedlings within a day or two of reception. When storing the seedlings either short term (< 3 days) or long-term (4-7 days), keep the seedlings as cool as possible, but not frozen. Refrigerated storage is ideal. If refrigerated storage isn't available, a good alternative is a root cellar. If nighttime temperatures are cool, a barn or shed floor will keep the trees at acceptable temperatures. However, sheds can heat significantly on sunny days and may not be a good storage area during daylight hours.

Bare root nursery stock will often require sorting prior to planting. Weak and damaged seedlings should be removed. Sorting should be done in a sheltered location out of the sun and wind. Keep the trees moist throughout the sorting process.

If the root system of the seedlings is too large to plant properly, some root pruning may be needed. Prune the roots using a sharp implement such as large scissors, pruning shears, or a machete. Leave at least eight inches of root after pruning, as measured from the root collar. Once the seedlings are sorted and pruned, dip them in water and repack them in the original container. Do not let roots stand submerged in water because this can drown the fine root hairs. Moisture enhancers or root gels have become popular recently. Root gels are intended to help

tree roots retain moisture. If planting on a windy day or on a very dry site, root gels may help prevent tree roots from drying out. Consult a local forester or arborist for advice and ordering information.

### Appendix N: Planting Process

The best times to plant are on a cool, overcast days with low wind to minimize exposure to drying conditions. If the planting site is located away from the storage site, then take only as many trees as can be planted in one day out to the planting site. If trees are being stored at the planting site and there is no building nearby, put the trees in heavy shade or under a solar reflective tarp.

Do not use canvas tarps to cover the packaged trees. The less time seedlings spend outside of ideal storage conditions, the more vigorous they will be.

#### *Correct placement and depth*

It is critical to place the seedling in the planting hole or slit properly. Whether machine planting or hand planting, four basic planting steps are necessary for seedling survival:

1. Create a planting hole, slit, or furrow large enough to accommodate a seedling's root system.
2. Place the roots straight and hanging freely within the hole and not twisted or bent.
3. Plant the seedling with the root collar at, or no more than, half an inch below the soil. Note: the root collar can be recognized by a change in color and slight swelling on the stem.
4. Pack the soil firmly around the seedling to anchor it and eliminate air pockets.

#### *Hand Planting*

Hand planting is necessary when the terrain is rough, the seedlings are too large for a machine planter, or when planting within an existing forest. Various tools can be used for hand planting seedlings. These include a shovel, planting bar (dibble), hoedad tool, or power auger.

When carrying the seedlings to the planting site, avoid exposing the roots to the air. Carry seedlings in a planting bag or bucket along with wet burlap to keep the roots moist. Handle the roots as little as possible and do not immerse the seedlings in water. Follow the correct placement and depth guidelines mentioned above to insure good seedling survival. A properly planted seedling should remain in the ground when gently tugged upward by the terminal tip. If planting by hand and assistance is required, a local forester or arborist may be able to provide the names of planting crews that work locally. It may be necessary to book a planting crew several months ahead, so ask the forester or arborist about availability well in advance of the spring planting season.

### *Machine Planting*

Machine planting is better suited for large sites and level terrain. While quick and efficient, machine planters should not be used if a site is rocky, steep, contains logging slash or stumps, or has heavy clay soil. A planting machine plows a slit about 10 inches deep in the soil. As the machine moves forward, a person on the machine inserts a seedling into the slit and holds it at the appropriate planting depth until the rear packing wheels close the slit and compress the soil into place around the roots. Make sure to plow to the proper depth for the stock being planted. Hardwoods, with their large roots, need deeper and wider planting slits than do conifers.

Planting machines generally require a 30-50 horsepower tractor and a crew of four people – one person to drive the tractor, another to ride the planting machine and do the planting, a third to provide seedlings to the planter and check for proper planting depth, and a fourth person to follow behind the planter to fill in gaps and make sure trees are planted correctly and packed firmly.

The average number of trees planted with a machine planter is about 5,000 per day. The same seedling care and handling techniques used for hand planting apply to machine planting. Do not load too many seedlings in the machine's storage bins at one time. Instead, supply stock in small amounts to keep seedlings moist and cool. To prevent drying out, protect the seedlings that are on the planting machine with moist burlap or a reflective tarp. Consult your local forester or arborist for more information.

### *Appendix O: Maintaining a Forest Plantation*

The success of a new tree planting will often be determined by the follow-up care it receives. Caring for new tree plantings includes monitoring survival, continuing control of competing vegetation, providing protection from animal damage such as deer or rodents, and monitoring for disease and insects. Weather will also play a role in the success of a new tree planting.

The weather cannot be controlled, but by following through on the factors that can be controlled many of the impacts from the weather can be reduced. This section will help develop skills to assess tree survival and stocking levels, identify and contend with pest and disease problems, and keep ahead of competing vegetation. These steps are often overlooked but are just as important to the success of your efforts as are proper planning, site preparation, and planting.

#### *Evaluating Survival*

The primary reason for evaluating seedling survival is to determine whether it will be necessary to replant seedlings to meet management goals. Survival checks are usually done in late summer after planting and again at year three. If the situation warrants, and there is time,

annual inspections for the first three years can be very beneficial. This will allow identification of any potential problems early during the plantings' critical establishment period. Refer to the goals and desired planting density to determine if the survival rate is acceptable. If stocking levels are not adequate, there may still be enough time for a successful replant. A local forester or arborist can help assess whether additional planting may be needed.

Rather than count all the trees within an area, it is easier to count the trees in a portion of the area and use that to estimate the numbers for the rest of the site. This is called "taking sample plots." The circular and row, explained in detail below, are the common sampling methods used for checking seedling survival. The row method is quicker, but the circular plot method is generally more accurate. At least ten sample plots should be taken across the entire site and an average calculated to determine the survival rate.

### *The Circular Method*

The best size for a circular plot is 1/100<sup>th</sup> of an acre. To estimate survival using this method, you will need a stake and an 11.8-foot long rope. This will measure the radius of a 1/100th acre circle. Choose a random spot within your site and put the stake in the ground there. Stretch the rope out and walk in a circle around the stake, marking the perimeter. Count all live trees and the total number of trees planted within the resulting circle. Repeat this process for each of your circular plots, making sure none overlap. Below is the formula for calculating percent survival using the circular plot method. An average of this number from the 10 sampling circles will tell you the survival rate for the whole plantation.

#### Calculations for 100th acre circular plots

Seedling survival rate:  $\text{Live trees} / \text{total trees} \times 100 = \text{percent of survival}$

Stocking level:  $\text{Live trees} \times 100 = \text{trees} / \text{acre}$

### *The Row Method*

The row method is a very quick way to determine survival. Simply choose a row in the planting and count the number of live trees and the total number of trees planted. Do this for several of the rows. If the rows are particularly long, just do a portion of each row. To calculate stocking level, you will need to know the total number of trees planted and the total acreage planted. The formula below will help determine percent survival using the row method.

#### Calculations for row method

Seedling survival rate:  $\text{Live trees} / \text{total trees} \times 100 = \text{percent of survival}$

Stocking level:  $\text{Live trees planted} / \text{total acreage} \times \text{percent of survival} = \text{live trees per acre}$

## Appendix P: Controlling Competing Vegetation

### Herbicides

Though not the only alternative, herbicides are the most commonly used weed control measure. This is because herbicides kill the entire plant, root and stem, and their application is not very labor intensive. The proper choice of herbicide, timing, and method of application are critical to ensure that planted trees are not damaged. A local forester, arborist, UC extension agent, and County IPM program staff are good sources for this information.

### Mechanical Control

Mechanical weed control may be suitable for some situations. Shallow disking or rototilling between is effective if care is taken to avoid damaging trees and their root systems. Mowing can reduce weed maturation and seed production and minimize rodent habitat. Be aware that good weed control using mechanical methods requires extra attention and time since it may not eliminate the roots, and weeds may regrow. Also, be aware that mechanical equipment has the potential to cause sparking, leading to fire hazard in dry vegetation.

## Appendix Q: Limiting Animal Damage

First, determine the type and source of the tree damage. For instance, a branch or bud torn off may indicate deer browsing. Rabbits leave a clean edge much like a knife cut. Rodents chew the bark just above or below soil level.

### Deer

Deer are capable of serious damage in a tree planting. Browsing damage typically occurs on hardwoods during the growing season and on conifers throughout the year, although most frequently during the winter. Discouraging the presence of deer in and around tree plantings during the first few years is the best way to avoid damage. The following are some other ways to reduce deer damage:

Polypropylene mesh fencing:

- provides a barrier for the entire planting
- is labor intensive
- must be installed immediately after planting

However, fencing is generally not used in County parks because it can ensnare wildlife.

Tree shelters:

- provides a barrier for individual trees
- is labor intensive
- must be installed immediately after planting
- encourage vertical growth

Bud caps or nets:

- provides a barrier for the main buds of individual trees in winter
- need to be removed prior to each growing season

Repellents:

- are sprayed on individual trees
- rely on unpleasant smell or taste to discourage browsing
- may need to be reapplied during the growing season.

#### *Small Mammals*

Mice, rats, ground squirrels, voles, gophers, porcupines, rabbits and other small mammals are often responsible for serious damage to tree plantings. Mowing, removing brush and brush piles, and maintaining one-foot-wide vegetation-free zones around the trees are helpful ways to control these animals. Encouraging fox, coyotes, owls, and hawks will help control rodent populations. Constructing raptor perches will give aerial predators spots from which to hunt. Sometimes controlling a pest before planting is the best bet. Trapping can be effective, and rodenticides and repellents should only be used as a last resort when other techniques have failed.

#### *Insects and Diseases*

Insects and diseases are present in all tree plantings. Whether or not their presence is considered harmful depends on the specific pest as well as how you intend to use the trees. It can be very difficult to diagnose insects and diseases because they may be underground, inside the tree, or microscopic. Sometimes multiple factors or a combination of insects and diseases may be causing the problems.

### *Insect Pests*

Three main types of harmful insects are stem and root feeders, shoot or branch pests, and defoliators. Weevils and white grubs feeding on stems and roots are typically the most destructive insects in a tree planting. Ask a local forester or arborist about site sanitation and other preparations to reduce their populations before planting. Usually, by the time there is the recognition of stem or root feeding symptoms, the seedling is dead or dying. Most seedlings can overcome some shoot and branch feeding or defoliation, so control is not always necessary, but the situation should still be monitored.

### *Diseases*

Disease problems fall into three categories: root rots, cankers and rusts, and foliar diseases. Root rots tend to cause slow twig and leader growth and an overall yellowing of the crown. Root rots often form in pockets rather than randomly across the planting. Controlling root rots is usually not practical. Swelling, lesions, and/or weeping sap on the stems and branches could be signs of cankers and rusts.

Cutting and removing infected parts of the tree is the best option for control. Foliar diseases affect the needles or leaves. Controlling foliar diseases is generally not necessary or practical. Maintaining good tree health and vigor are the best prevention measures for fighting off the insects and diseases that attack trees. This means selecting the appropriate species for the site, obtaining healthy stock, storing and handling seedlings properly, maintaining good soil fertility, controlling competing vegetation, and preventing animal damage.

Appendix R: Samples of reporting dashboards:

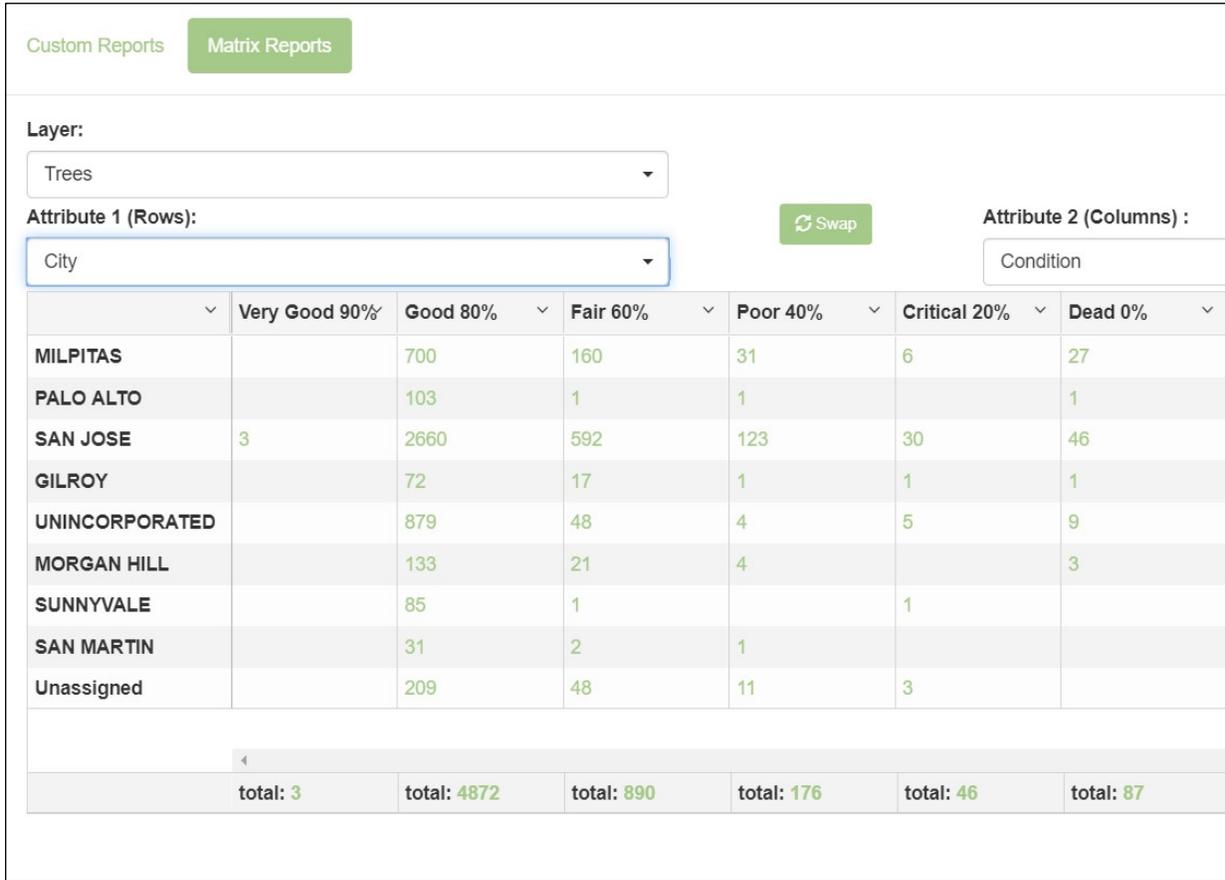


Figure 4 – Courtesy of Davey Resource Group

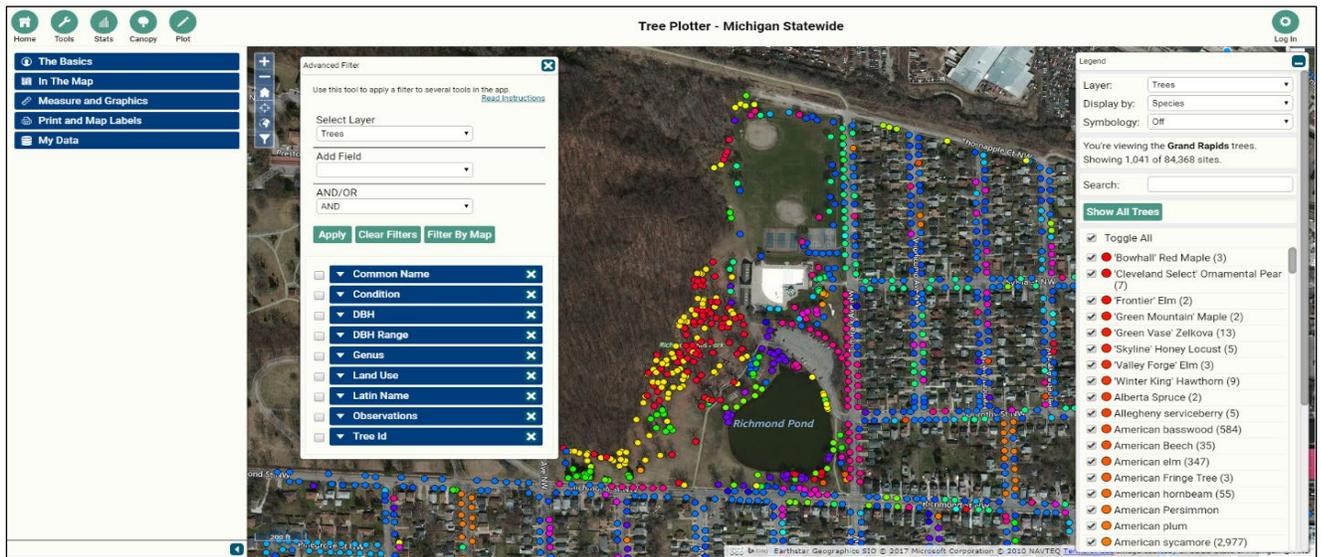


Figure 5 – Courtesy of Plan-It Geo

Search by Species

Search by Location

Advanced Reset

Search

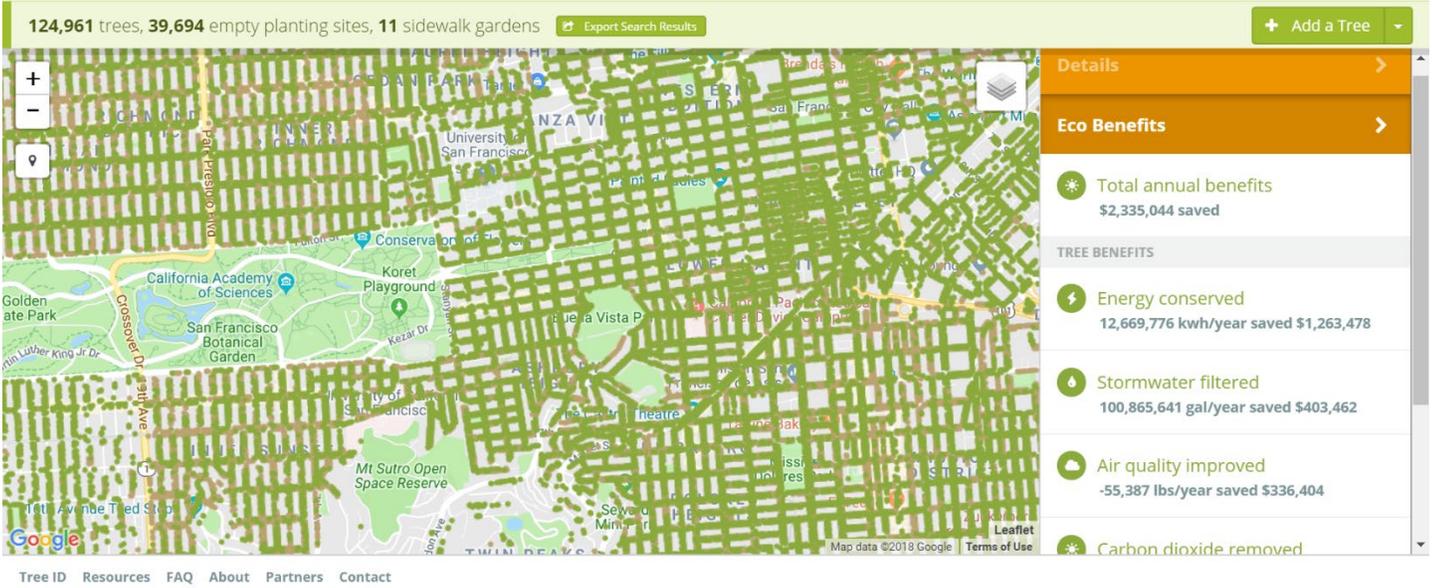


Figure 6 – Courtesy of OpenTreeMap

