



SAN FRANCISCO STREET TREE NURSERY STUDY

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Table of Contents

Executive Summary	01	4. Site Selection fro a Street Tree Nursery	29
1. Introduction	05	Site Requirements	29
Benefits of Street Trees	06	Critical Conditions	30
Urban Forest Plan	07	Secondary Conditions	32
2. Existing Street Tree Supply & Procurement Process	09	Shortlisting of Sites	33
Current Street Tree Supply	10	Methodology for Shortlisting of Sites	34
Street Tree Planing Process	11	Challenges of Site Selection	35
Sources of Street Tree	12	Site Evaluation and Recommendations	36
Street Tree Cost	13	Further Research on Possible Sites	38
Environmental Cost	13	5. Study Recommendations	39
Evaluation of Current Street Tree Supply Process	14	Review of Previous Discussion	40
Benefits from Current Street Tree Supply Process	15	Recommendations	41
Challenges from Current Street Tree Supply Process	16	Options	43
Key Findings	17	Proposal	44
3. Community-based Tree Growing Models	19	Cost Estimates and Funding	46
Overview of Nursery Operations in San Francisco Bay Area	20	Suggested Implementation Time Line	47
Community-based Nursery Operations and Management Model	22	6. Conclusion	49
Key Factors for a Successful Community-based Nursery	26	Appendices	50
		Appendix A: References	51
		Appendix B: Street Tree Demand for Next 20 Years	52
		Appendix C: Space Requirements for Street Tree Nursery	53
		Appendix D: Quantitative Analysis of Site Factors	56
		Appendix E: Field Visit Reports	60



Street trees are an important component of our urban forest. Enhancing the city's street tree population requires a better understanding of where our trees come from and how they are grown.

Executive Summary

The Department's recently adopted Urban Forest Plan (Phase 1: Street Trees) calls for increasing San Francisco's street tree population by half (50,000 new trees) over the next 20 years. To meet the demand for new street trees, the Plan recommends establishing a Street Tree Nursery to promote a locally-based system of tree propagation and care. A Street Tree Nursery run by the City or through a community partnership has the potential to reduce the transportation and environmental costs associated with distant tree delivery, eliminate transplanting shock from trees grown in other climates, increase species availability and provide opportunities for local green jobs and educational opportunities.

This report assesses the potential for a community-based street tree nursery in San Francisco. In particular, the report seeks to:

- Understand the existing street tree sourcing and supply process;
- Examine existing community-based tree growing models and key learning points from these models;
- Highlight crucial criteria in the site selection for a street tree nursery;
- Evaluate possible site locations for the nursery;
- Assess viable management models for a street tree nursery and implementation strategy.

Key Findings

- Street trees are planted mainly by the Department of Public Works (DPW) and Friends of the Urban Forest (FUF), with more than 85% of the tree stock coming from Valley Crest Tree Nursery (Farmington, CA) and Pacific Nurseries (Colma, CA). The cost of a single tree ranges from \$68 to \$300 dependent on the tree species and container size. These trees are usually grown outside the Bay Area and transported here when they reach larger sizes as the cooler climate in the Bay Area is generally not as conducive for fast tree growth.
- Key benefits of the existing procurement method include the development of strong partners with existing nurseries which increases staff productivity at the DPW. There was also lower risk of tree mortality. However, the current procurement process had resulted in limited tree species available, a lack of availability of the more uncommon species, an inconsistent supply of high quality trees and inability of trees to acclimatize to local climate. All these factors reduce the resiliency of the urban forest and add to maintenance and management issues downstream.
- There are about ten community-based (non-commercial) nurseries in the Bay Area of which only two grow trees. Field visits and interviews conducted for this report have revealed five key elements of a successful community-based nursery. These include a facility that has essential nursery components, appropriate staff to manage the nursery, a reliable supply of high quality water, production of high-quality trees and a sense of ownership among the volunteers.
- Critical conditions in the selection of a suitable site for the street tree nursery include ample sunlight and water, sufficient land space, accessibility to volunteers, availability of land and existing infrastructure and partnership opportunities. Other environmental factors like topography, wind speeds and air quality are also considered to be important factors. While a meticulous methodology was developed to evaluate site conditions, an overriding factor was determined to be partnership opportunities with existing organizations and land owners.



Recommendations for Starting a San Francisco Street Tree Nursery

1. Start small

Starting on a small scale (200+/- trees) will allow for the accumulation of experience and keep nursery startup costs low.

2. Build confidence

Starting the nursery with easier to grow species will help build confidence and experience. Achieving early success will be important to motivating staff and supporting nursery expansion to more trees and more challenging species.

3. Staff appropriately

An experienced nursery manager with a background in growing trees is essential to ensure adequate technical expertise is available to contribute to a successful nursery.

4. Tap existing resources

Where possible, the street tree nursery should build off of existing infrastructure or facilities to reduce startup costs. Lower upfront costs can help build support for the nursery and make it easier to secure funding. Identifying a site already in operation also allows sharing of nursery management knowledge which will benefit the nursery.

5. Establish strong partnerships

Strong partners are essential to a nursery's success. These could include partners willing to provide space for the nursery, help fund operations or contribute to the staffing or volunteer requirements.

Recommended Management Model

Study findings indicate that the preferred model for a Street Tree Nursery in San Francisco would be to start a small street tree nursery growing uncommon and/or expensive but easy to grow trees species from smaller tree stocks by expanding operations at an existing nursery. This model will help reduce cost and risk by building upon existing infrastructure, facilities and nursery management knowledge. Partnering with an established nursery will also remove issues associated with site selection as land is already secured and available.

The capital cost for this model is estimated at approximately \$25,000-50,000 with an annual operating cost of \$50,000- 100,000 depending on the scale of operations. Funding opportunities include federal and state grants relating to urban forestry, non-profit organization partnerships, and future funding related to discussions currently underway for a Citywide Street Tree Maintenance Program.

Key Opportunity Site(s)

The Garden Project Farm & Nursery located in San Bruno on the grounds of the San Francisco County Jail presents a key site and partnership opportunity. Garden Project staff has expressed interest in collaborating with the City agencies and Friends of the Urban Forest (FUF) to create a street tree nursery within their existing farm and nursery on an identified site. The site is able to fulfil most of the environmental requirements except site accessibility and tight security which may restrict volunteer activity. The Garden Project's strong youth employment programs provide promising staffing resources as well. Additional research should be conducted to explore other potential site opportunities on San Francisco International Airport, Port or Recreation & Park Department properties.



1. Introduction

The Department's recently adopted Urban Forest Plan (Phase 1: Street Trees) calls for increasing San Francisco's street tree population by half (50,000 new trees) over the next 20 years. To meet the demand for new street trees, the Plan recommends establishing a Street Tree Nursery to promote a locally-based system of tree propagation and care.

A Street Tree Nursery run by the City or through a community partnership can:

- Ensure reliable supply of high quality street trees
- Eliminate transplanting shock from trees grown in other climates
- Increase species availability
- Provide opportunities for local green jobs and educational opportunities
- Reduce the transportation and environmental costs associated with distant tree delivery

This report assesses the potential for a Street Tree Nursery in San Francisco. The report is divided into four main sections:

- 1. Street Tree Sourcing + Supply Analysis**
- 2. Public and Community-based Tree Growing Models**
- 3. Site Selection + Evaluation**
- 4. Study Recommendations & Proposal**



BENEFITS OF STREET TREES

Healthy tree-lined streets are a key component of San Francisco’s urban forest. An estimated 105,000 trees grow along the city’s streets. These trees contribute to a more walkable, livable and sustainable city.

Given the prominence of street trees within the city, they play a vital role in the city’s urban forest providing social, economic and environmental benefits. Some of these benefits are listed below.

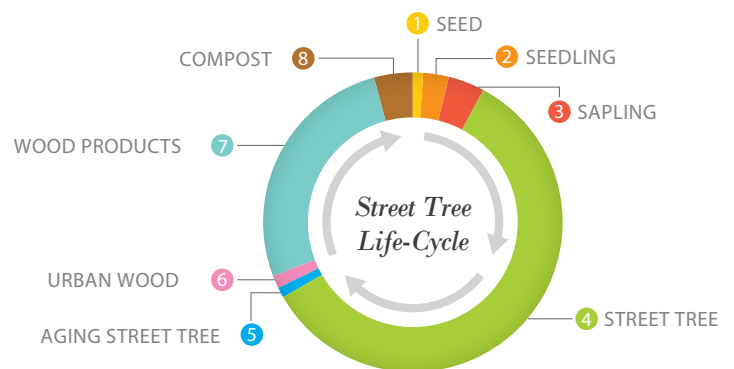
SOCIAL BENEFITS	ECONOMIC BENEFITS	ENVIRONMENTAL BENEFITS
<ol style="list-style-type: none"> 1 Create memorable and beautiful places 2 Strengthen communities 3 Improve physical health 4 Calm traffic and promote pedestrian/bicyclist safety 5 Reduce violence and crime 6 Connect people to nature (“biophilia”) 	<ol style="list-style-type: none"> 1 Increase property values 2 Boost commercial activities 3 Reduce building heating & cooling costs 4 Reduce infrastructure costs 5 Increase worker productivity 	<ol style="list-style-type: none"> 1 Improve air quality & absorb pollution 2 Slow climate change 3 Reduce building heating & cooling costs 4 Decrease noise pollution 5 Provide wildlife habitat 6 Produce local food

THE URBAN FOREST PLAN

The City of San Francisco's Urban Forest Plan presents a phased approach to planning for trees in the city's landscape. The Plan is broken down into three phases providing comprehensive strategies to improve the urban forest in San Francisco. The first phase (2015) focused on the management and maintenance of street trees within the city, the second phase (forthcoming) will focus on trees within the parks and open spaces and the last phase (forthcoming) will address the greening of buildings and trees on private property. Phase One of the Urban Forest Plan was adopted by the Board of Supervisors in the General Plan's Recreation and Open Space Element in January 2015.

This report focuses on two of the Urban Forest Plan's (Phase 1: Street Trees) key recommendations:

1. Grow the street tree population by half
Increase the city's tree canopy by planting 50,000 new street trees over the next 20 years.
2. Manage trees throughout their entire life-cycle.
Develop a San Francisco street tree nursery, succession strategy, and urban wood re-use program.

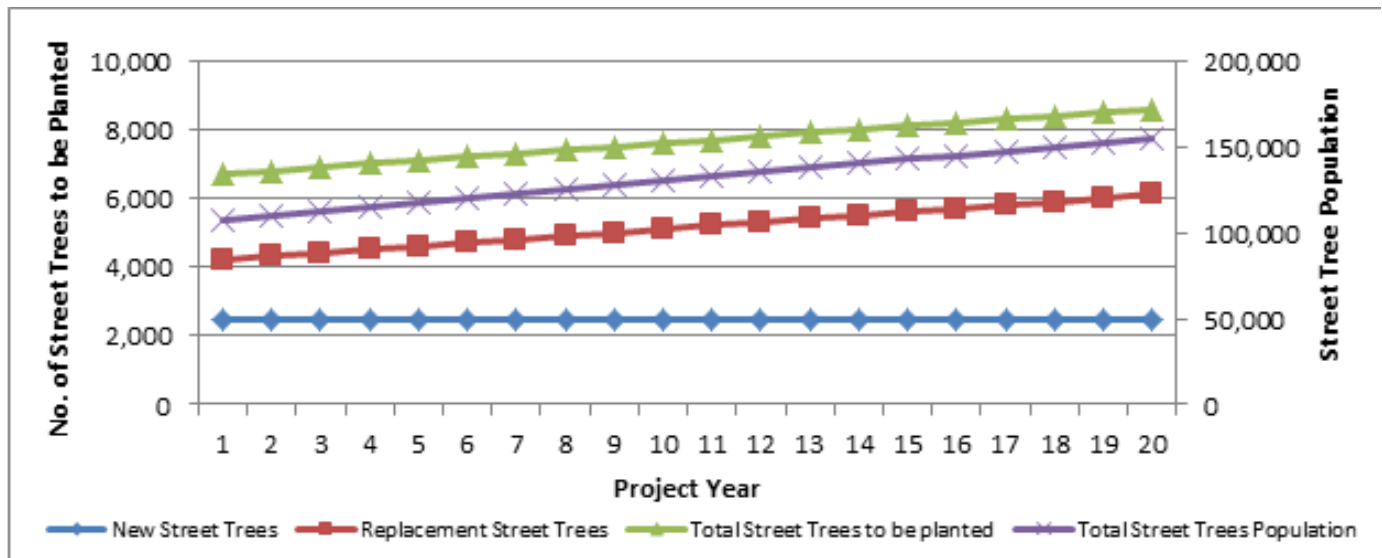


To achieve the goal of planting 50,000 new street trees within the city over the next 20 years would require the planting of 2,500 new street trees every year for the next 20 years. In addition, assuming an annual tree mortality of 4%, an additional 4,200 street trees would need to be planted to replace dying or removed trees in the first year. This will require a total supply of 6,700 street trees to maintain and grow the street tree population in year one. In the 20th year, 8,600 trees would be required (refer to Appendix B for year on year breakdown).

The Urban Forest Plan will have major impacts on the landscaping industry in the City. These include nursery operators who will need to be able to grow sufficient trees to achieve the City's planting goals. Tree pruning and planting needs will also significantly increase as the street tree population expands over time by 50%. An understanding of the current street tree supply and workflow is crucial in informing decisions as the Urban Forest Plan is implemented.

	YEAR 1	YEAR 5	YEAR 10	YEAR 15	YEAR 20	TOTAL OVER 20 YEARS
New Street Trees Required	2,500	2,500	2,500	2,500	2,500	50,000
Replacement Street Trees Required*	4,200	4,600	5,100	5,600	6,100	103,000
Total Street Trees Required	6,700	7,100	7,600	8,100	8,600	153,000
Total Street Trees in San Francisco	107,500	117,500	130,000	142,500	155,000	

* Assumes 4% annual tree mortality based on figure reported in the Street Tree Financing Study completed by AECOM in December 2013



2. Existing Street Tree Supply & Procurement Process

This section of the report analyses the existing street tree supply by providing an overview of the procurement process for street trees planted by the Department of Public Works (DPW) and the Friends of the Urban Forest (FUF) - the two groups largely responsible for planting the majority of street trees in San Francisco.

This evaluation of the existing procurement method highlights the benefits, challenges and opportunities for the future street tree supply and will inform a proposal for a street tree nursery to help achieve the 50,000 new street trees target set out in the Urban Forest Plan.



CURRENT STREET TREE SUPPLY

There are two major organizations that are actively planting the majority of street trees in San Francisco.

The Department of Public Works

The Department of Public Works has jurisdiction over all trees and greening in the public right of way. DPW plants street trees and actively maintains about 20,000 street trees annually. DPW has been in the process of transferring the responsibility for street tree maintenance to adjacent property owners due to existing funding constraints. They are also involved in the issuance of permits to property owners for new and replacement street trees.



Tree Planting with volunteers by the Department of Public Works

Friends of the Urban Forest

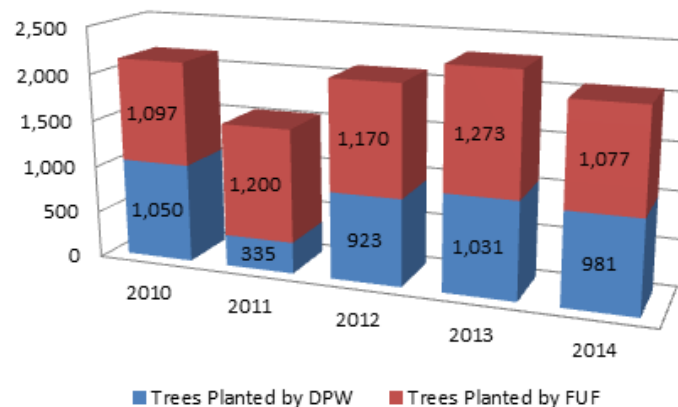
The non-profit, Friends of the Urban Forest, carries out the majority of street tree planting in San Francisco. FUF and its volunteers have planted more than 48,000 new and replacement trees in San Francisco. The organization offers a variety of programs include planting, young tree care, sidewalk landscaping, community engagement, training and education. In addition, FUF advocates for city policy surrounding urban forestry and greening issues.



Tree Planting by the Friends of the Urban Forest

About 2,000 trees are planted each year between the two organizations with the exception of 2011. FUF, a non-profit organization, has contributed to the planting of more than half of the city's new street trees over the last 5 years.

Street Trees Planted by DPW and FUF



Source: Urban Forest Council Report 2010 to 2014

STREET TREE PLANTING PROCESS

Today, street trees are planted by DPW and FUF on a request basis. Due to limited resources, as highlighted in the Urban Forest Council Annual Report 2014, there are more requests each year than the number of trees planted. To prioritize these requests, street tree planting requests are reviewed based on availability of planting spaces and urgency of request. When a request is approved, the street tree species will be selected to tie in with the existing streetscape. DPW will consolidate the species selected in batches of 10 to 15 to check for species availability with the nurseries. DPW will then select the trees based on a catalogue from the nurseries, ensuring that the trees meet the quality requirements before placing an order for the trees. FUF, on the other hand, handpicks the trees physically at the nurseries. The selected species are then delivered

for a fee to the planting site or a storage facility. DPW is able save substantially on transportation costs by negotiating for free delivery. Trees from nurseries typically come in a range of sizes and containers depending on their size and age ranging from one gallon containers for seedlings to 24" boxes for more mature trees.

In the event that the preferred tree species is not available, both DPW and FUF will contact smaller boutique nurseries. If the species is still not available, they will go through the tree species selection process again and select an alternative species. The alternative species chosen usually have similar attributes (form, shape, branching, and color) to the existing streetscape. When re-selection is required, delays to street tree planting and additional resources are required.

STREET TREE SOURCING PROCESS



1

STREET TREES GROWN OUTSIDE BAY AREA

Street Trees are grown in commercial nurseries outside the Bay Area 3 to 5 years prior to planting.



2

STREET TREES TRANSPORTED TO LOCAL NURSERIES

The trees are then transported to commercial nurseries in the vicinity of San Francisco to be sold.



3

STREET TREES SELECTION

DPW and FUF receive tree planting request and selects appropriate species to tie in with existing streetscape. A new species is selected if previously selected species is not available.



4

STREET TREES TRANSPORTATION & STORAGE

Selected street trees are delivered to an in-house storage facility for small scale events or directly to the tree planting site for large-scale events.



5

NEW STREET TREE PLANTED

SOURCES OF STREET TREES

Almost all new street trees are bought from nurseries located outside the City of San Francisco, except for Flora Grubb Gardens. There are two major suppliers that provide about 88% of trees planted in the City. They are Valley Crest Tree Co. and Pacific Nurseries.

Trees at Pacific Nurseries and the Sunol location are imported from other nurseries in Southern California or Oregon as the local climate is not conducive for fast tree growth.



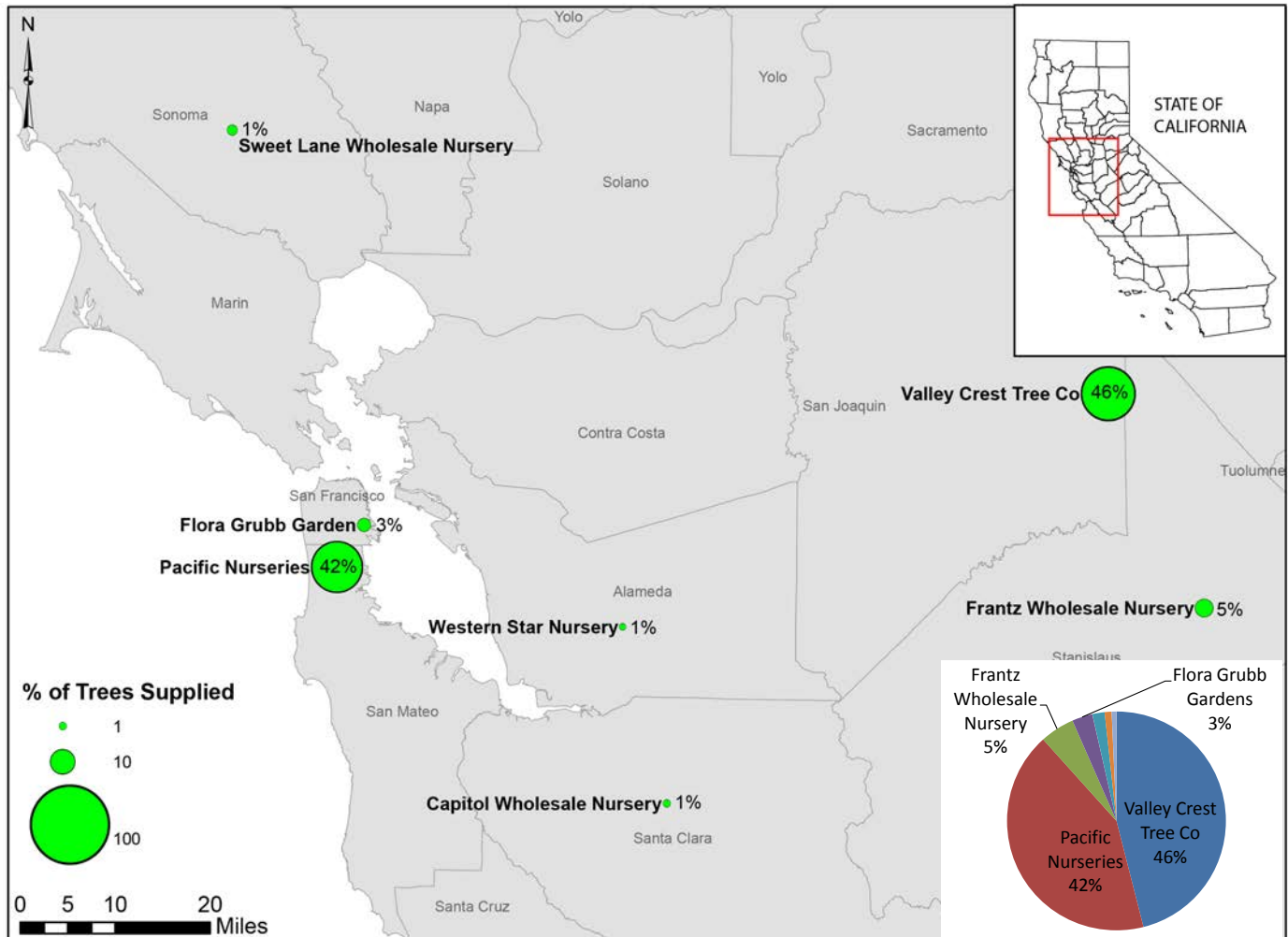
Pacific Nurseries
Colma, CA (11.6 miles*)



ValleyCrest
Landscape Companies

At 2 locations:
Sunol, CA (45.8 miles*)
Farmington, CA (102 miles*)

* Distances from San Francisco



* Applies to trees supplied to Friends of the Urban Forest and the Department of Public Works only.

STREET TREE COST

Cost of street tree planting varies between DPW and FUF. DPW faces higher cost per tree as larger trees in 24" boxes) are selected for tree planting compared to FUF which uses mostly smaller size trees 15 gallon containers.

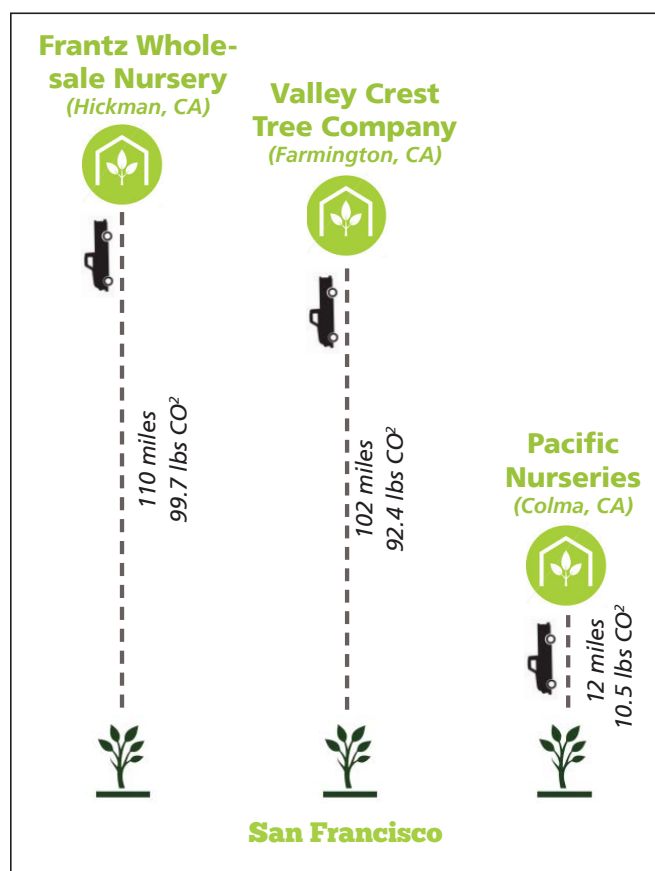


ENVIRONMENTAL COST

Beyond the physical cost of trees, there are also environmental costs associated with the transportation of street trees from nurseries located outside of San Francisco.

A typical truck trip generates about 411g CO₂ (or equivalents) per mile of carbon emission (US EPA). This adds up to about 3619 metric tons of carbon emission annually from the transportation of the trees into San Francisco.

While the planting of street trees will offset a portion of these emissions, reducing transportation distances between street tree suppliers and San Francisco can further reduce overall emissions.



EVALUATION OF CURRENT STREET TREE SUPPLY PROCESS

This section reviews the benefits and challenge of the current street tree supply process. The main benefits are the reduction in staff hours arising from strong partnerships between city agencies and the nurseries and the low risk of plant mortality. However, there are major challenges related to expanding the urban forest and creating a resilient urban ecosystem within the existing street tree supply process.

These challenges include a limited range of tree species availability at commercial nurseries which in turn limits the diversity of tree species required to enhance the resiliency of the city and creating a more diverse urban forest. There are also issues of obtaining high quality street trees that are acclimatized to the many different micro-climates in San Francisco.



BENEFITS FROM CURRENT STREET TREE SUPPLY PROCESS

Strong Partnerships with Nurseries. The current procurement process of street trees has resulted in strong working relationships between DPW and the commercial nurseries. Through these relationships, DPW is able to eliminate the need to pick and select trees personally at the nurseries. Instead, DPW staff pick trees through a photo catalogue and nursery staff provide quality control by selecting trees based on DPW's requirements. This eliminates travel time to the nurseries and time taken to review a larger pool of stock. This selection process has emerged over time through a long standing relationship that allows the nurseries to understand DPW's needs for a reliable supply of high quality street trees that meet the department's high standards.



Pacific Nurseries has a strong partnership with the Department of Public Works

Low risk of tree mortality prior to planting. Another major benefit of the existing procurement process is that both DPW and FUF are able to obtain the trees with a low risk of mortality prior to planting. The risk involved in growing a tree from seedling or cutting is borne by the nurseries and not by DPW and FUF. Nurseries are only required to ensure tree health for a short period between delivery and tree planting. The risks of growing trees (typically 3-5 years) are borne by the nursery and not by FUF or DPW.



Tree storage area at the Department of Public Works

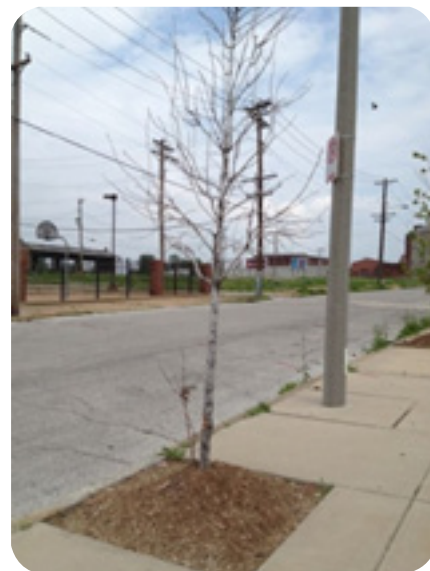
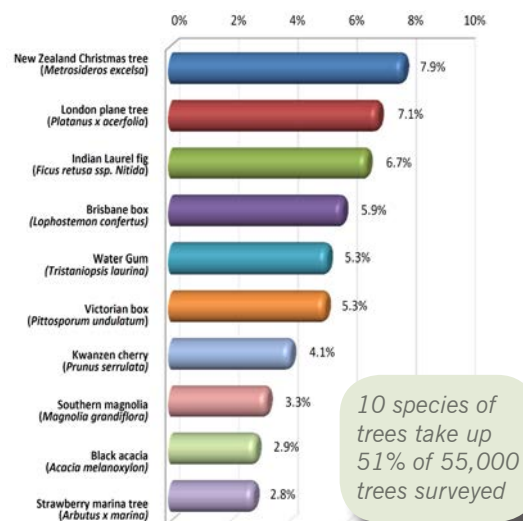
CHALLENGES FROM CURRENT STREET TREE SUPPLY PROCESS

Limited Tree Species/ Lack of Availability of Uncommon Species.

Having limited number of species available at nearby nurseries can delay operational schedules and result in a less diverse and resilient urban forest, higher per tree costs and the inability to plant unique or uncommon species. Currently, the street tree species planted in San Francisco are limited by species available at the commercial nurseries. When selected species are not available, staff must select alternative species. This also presents a missed opportunity to experiment with a variety of street tree species and diversify the urban forest so it will be more resilient to pests or other threats. Even when uncommon species are available, like the Primrose Tree, they are often sold at a premium price which is prohibitive for large scale planting.

Inconsistent supply of high quality trees. Another challenge faced was obtaining a constant source of high quality trees. While most of the street trees are of good quality, the quality can be inconsistent among the nurseries or species. For instance, it is difficult to obtain good quality Ginkgo trees. While FUF staff have come up with techniques to improve the overall quality through additional treatment prior to tree planting, these treatments take up additional time and effort which could otherwise be diverted to increasing the number of street trees planted or to other areas like public engagement and publicity to increase public awareness. Poor quality trees also pose issues for subsequent management and maintenance.

Inability to acclimatize to local climate. Obtaining trees grown outside the city in much drier and sunnier climates, can result in highly stressed trees that are not acclimatized to San Francisco's micro-climates and urban environment. Trees growing in nurseries are usually well taken care of with the necessary growing requirements. However, when trees are planted in highly constrained urban locations, these trees may face difficulty adapting to the new environment which can lead to higher mortality rates and require subsequent replacement.



The inability for a street trees to acclimatize to the local climate and harsh growing conditions can result in the death of tree.

KEY FINDINGS

Benefits:

1. Strong partnership with Nurseries
2. Lowers the risk of tree mortality

Challenges:

1. Limited tree species/ Lack of availability of uncommon species
2. Inconsistent supply of high quality trees
3. Inability to acclimatize to local climate

Call for a Street Tree Nursery

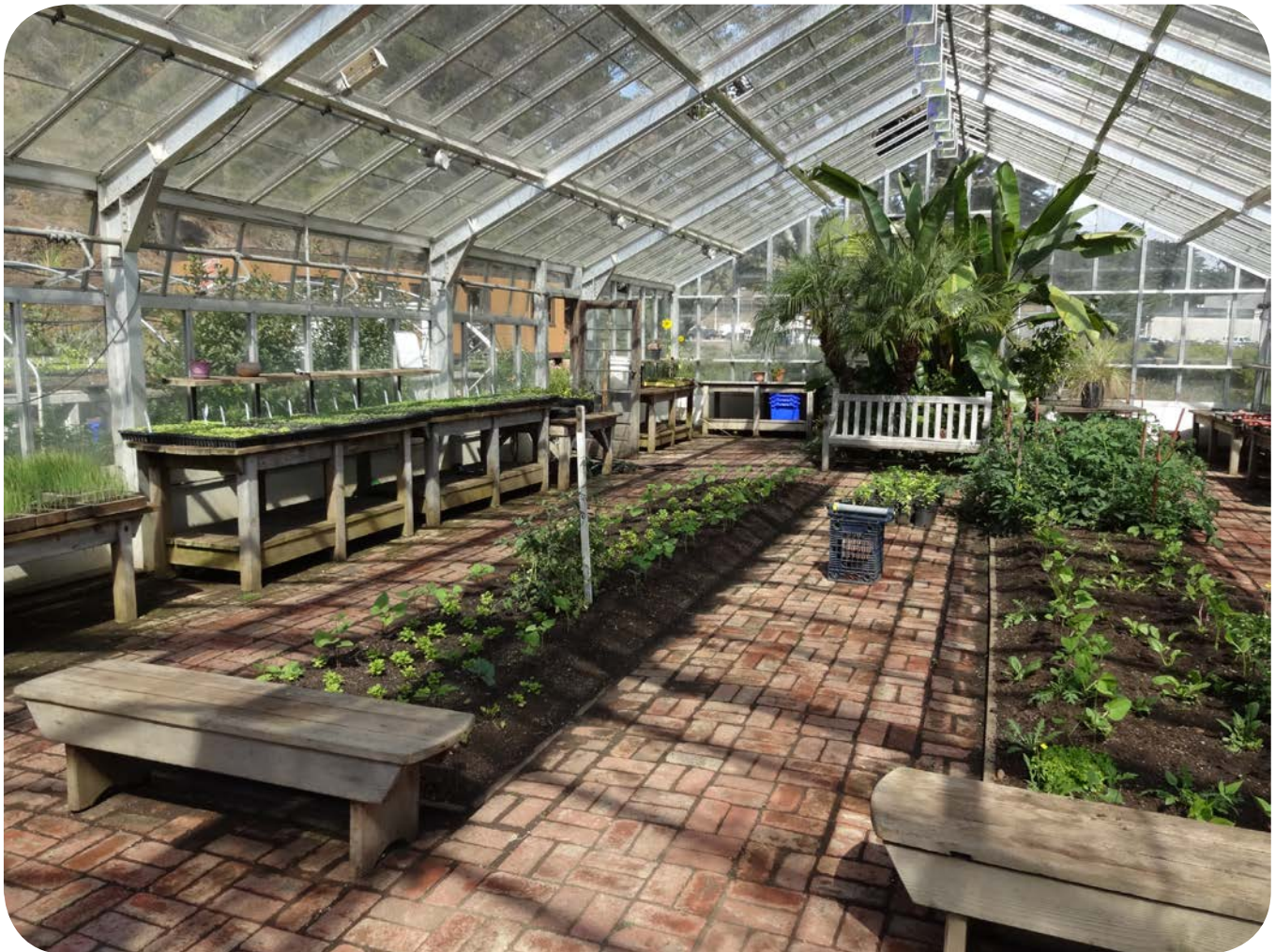
These challenges make the case for a local street tree nursery within San Francisco as recommended by the Urban Forest Plan. The street tree nursery could fill the gap of existing nurseries and start producing uncommon species to enhance diversity and create a more resilient urban forest that will be less susceptible to external pressures like changes in climate, diseases and pest. It would also allow DPW and FUF to experiment with new tree species including native species that will be suitable as street planting. Additionally, the nursery has the potential to reduce resources currently spent on looking for alternatives and provide a consistent supply of quality trees. Locating a nursery locally would also contribute to a more sustainable environment through the reduction of transportation costs and associated carbon emissions and provide opportunities for local green jobs and educational opportunities.





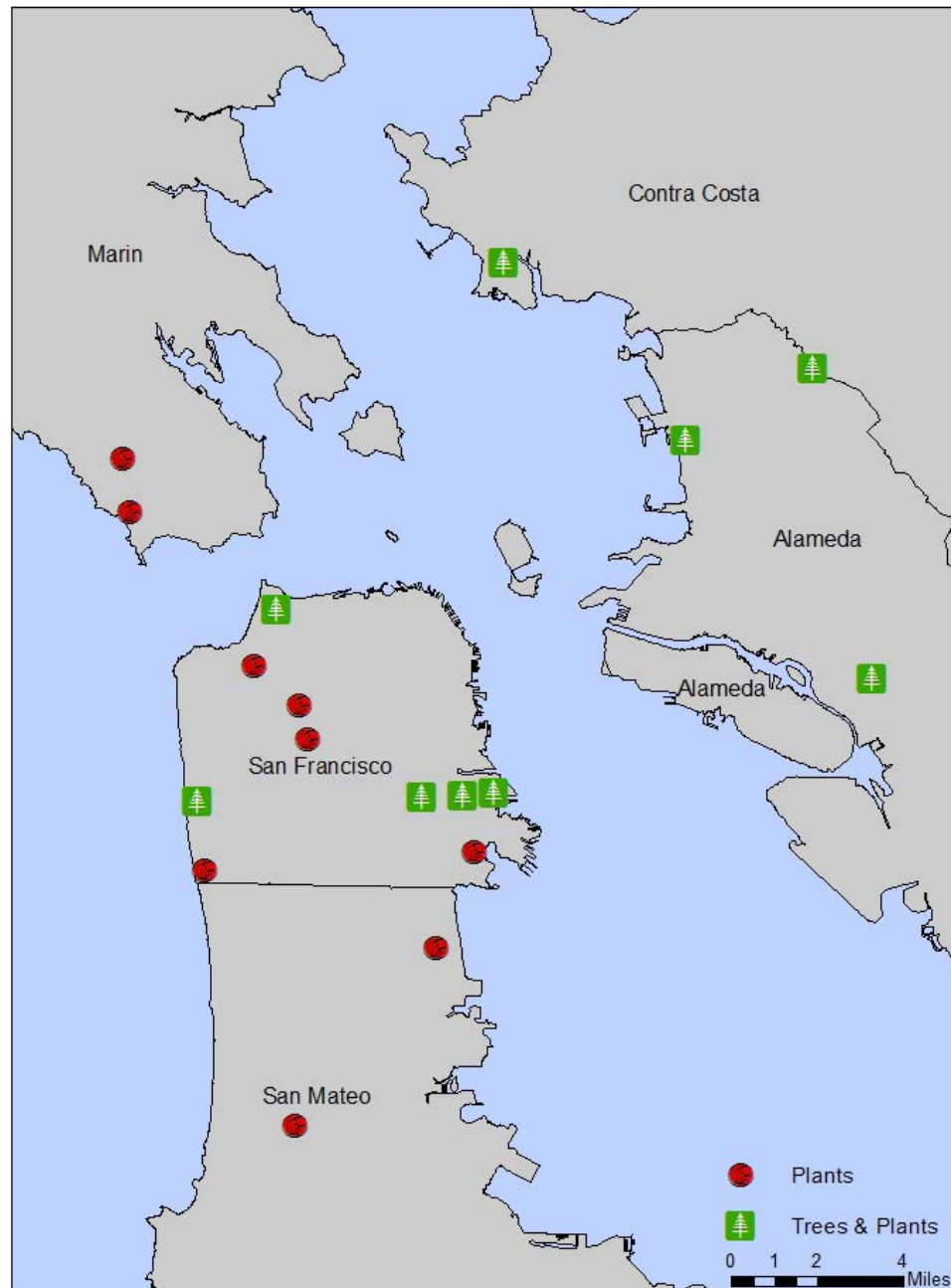
3. Community-based Tree Growing Models

Beyond the local commercial nurseries, there are at least ten community-based nurseries located within or near San Francisco. These community-based nurseries are run by non-profit organizations or federal parks groups. They often actively engage the local community in daily nursery operations and tree planting through volunteer programs, usually with an accompanying educational component. This section explores the management and operation of community-based nurseries providing insights into their key success factors.



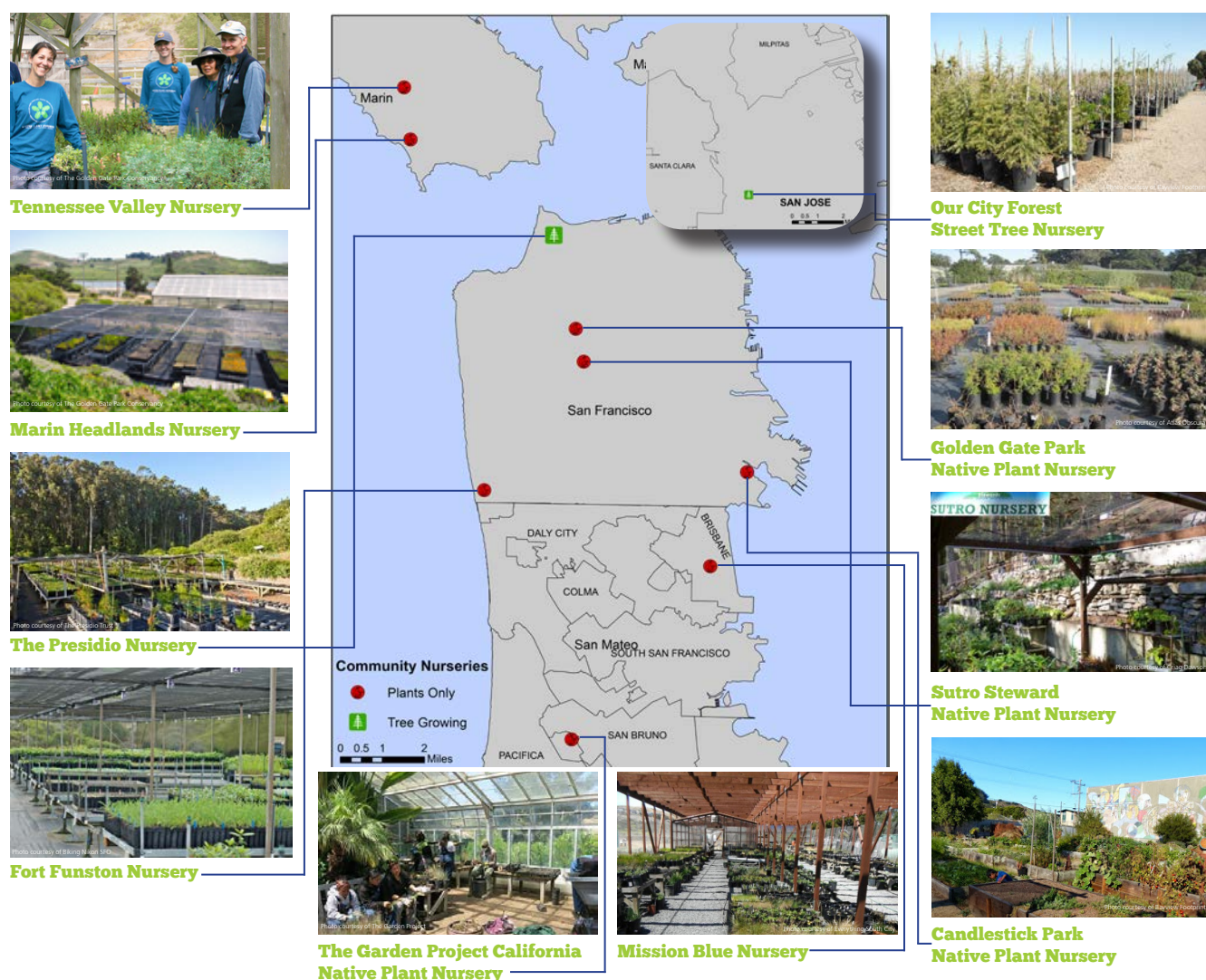
OVERVIEW OF NURSERY OPERATIONS IN SAN FRANCISCO BAY AREA

There are about 20 major nurseries within or around San Francisco which include a mixture of commercial (both wholesaler and retailers) and community-based nurseries. However, not all of these nurseries grow trees as part of their operation.



Map identifying Bay Area nurseries that grow both trees and plants and those that grow plants only.

Most of the community-based nurseries are producing native plants to support various social or environmental objectives with only the Presidio Nursery (San Francisco) and Our City Forest Nursery (San Jose) producing both trees and plants. The Presidio Nursery grows mainly native plants with only about five species of trees being grown over a one year production cycle. The Our City Forest Nursery run by the non-profit Our City Forest, is primarily a street tree nursery and specializes in the production of street trees for planting in the South Bay.



Map identifying Bay Area community-based nurseries that grow plants and/or trees.

COMMUNITY-BASED NURSERY OPERATIONS AND MANAGEMENT MODEL

As part of this study, site visits and in-depth interviews with staff and volunteers were conducted at the Presidio Nursery, Our City Forest's Street Tree Nursery and the Garden Project Farm & Nursery. This section captures the funding, staffing, operations and production capacity of these community-based nurseries to provide to inform a San Francisco Street Tree Nursery proposal.

Funding, Development and Operating Cost. The community-based nurseries contacted are generally funded through government grants, other non-profit organizations, sale of plants and private donations to their organizations. This funding goes towards the development and operating costs of the nursery.

COMMUNITY-BASED NURSERY	FUNDING SOURCE	DEVELOPMENT COST	OPERATION COST
Presidio Nursery	Presidio Trust Public Donations	N.A.	N.A.
	Recovery Act Grant CalFire Grant AmeriCorps Planting Grant Reimbursement Plant Sale Public Donations		
Our City Forest Street Tree Nursery		\$450,000	\$250,000
The Garden Project Farm & Nursery	SFPUC Funding Public Donations	N.A	N.A.

Staffing. Each nursery surveyed has at least one full-time nursery manager as paid staff to oversee daily operations. The nursery manager ensures high-quality plants and/or trees are being produced and provides training to other staff. There is also a full-time manager or volunteer coordinator that supervises the organization of volunteers at the nursery and educational programs.

COMMUNITY-BASED NURSERY	NO. OF NURSERY MANAGER	OTHER FULL-TIME POSITIONS	NO. OF VOLUNTEERS
Presidio Nursery	2	1	N.A.
Our City Forest Street Tree Nursery	1	8	200/month
The Garden Project Farm & Nursery	15 full-time positions (include participants of the Earth Steward Program)		300 high school students (summer program) Ad-hoc volunteers

Operations and Production

(i) Production Method and Tree Source

The community-based nurseries visited as part of this study utilized the container growing system for trees. This system is the least land intensive and least expensive which is appropriate given the high cost of land in the San Francisco and Bay Area. The Garden Project Nursery has both a container and a field system to grow crops as part of the farm.

The Presidio Nursery is on a one year production cycle and grows all of its plants and trees from seeds with the seed source handpicked within the Presidio. More recently, the nursery has expanded its range to the region to introduce genetic diversity to its stock. About 80,000 plants and a small number of trees, primarily Monterey cypress, are produced annually.

The trees in **Our City Forest Street Tree Nursery**, on the other hand, are on a three year production cycle with trees being potted and re-potted until they reach 15 gallon sizes and are ready for planting. Our City Forest has a range of production methods including growing from seeds or cuttings and importing bare root trees and smaller container trees. Tree species that are not commonly available at nurseries are typically grown from seeds. The nursery produces about 2,000 trees annually.

The Garden Project Farm & Nursery, on the other hand, grows about 60 to 70 tons of vegetables each year on its farm that is donated to local food pantries and non-profit meal providers in San Francisco such as Project Open Hand. In addition, the Garden Project grows about 25,000 native plants of which 85% are planted on SFPUC properties while the rest are donated to non-profits and schools for education purposes. Their seeds are bought, donated by the public or picked from the natural areas within SFPUC's jurisdiction.



Container production method



Seed collection in Presidio, San Francisco, CA

COMMUNITY-BASED NURSERY	PRESIDIO NURSERY	OUR CITY FOREST STREET TREE	THE GARDEN PROJECT FARM & NURSERY
Nursery size (acres)	4	2	143
Production method	Container	Container	Container and Field
Production cycle	1 year	3 years	1 year
Seed/Plant source	Seeds and cutting picked from native plants in San Francisco	Seeds and cutting Bare roots trees from Oregon Smaller container trees from other nurseries	Seeds donated from public or handpicked from natural areas in San Francisco Bought from various sources
No. of plants/tree produced annually	80,000 plants	2,000 trees	60 - 70 tons of vegetables 25,000 plants

(ii) Water management & Irrigation System

There are three typical water sources used to support nursery operations. The first is from the City, the second through a recycled water facility and third from a nearby stream or pond.

The Presidio Nursery uses City water for its irrigation. It is undergoing a series of restructuring to improve water use and re-use in response to California's drought. These include a newly completed shade house and an upgrade to the plumbing and sewage systems. A new drainage system has been installed to allow for the nursery to recycle storm and irrigation water reducing use of potable City water. There are also plans to put in a wetland system as part of the transition from the use of City water to a combination of recycled water and use of water from the wetland.

At the **Our City Forest Street Tree Nursery**, recycled water is supplied by the South Bay Water Reclamation Plant (SPWRP). This arrangement was worked out at the early planning stage of the nursery with SPWRP installing the main frame and piping for the irrigation system and the subsequent supply of recycled water to the nursery. There is also a separate piping system to provide fresh water for drinking.

Water for **The Garden Project Farm & Nursery** is supplied through a gravity-fed system with a tank located on a nearby hill. The water is drawn from the Hetch Hetchy watershed supplied by the SFPUC.



Drains in Presidio Nursery capturing irrigation runoff for reuse



Irrigation frame using recycled water for watering of trees and plants at Our City Forest Street Tree Nursery

(iii) Pest & Disease management

The nurseries are generally sensitive to the environment and try to use natural and environmentally-friendly methods of pest and disease management.

The **Presidio Nursery** has a stricter disease control regime that includes sterilizing all soil medium which is then stored temporary in the head house and the sterilizing of shoes prior to entering the greenhouse to ensure that diseases are not brought into the greenhouse. Plants are also stored on tables which reduce spread of disease through the back-splash of water from the ground into the pots. The risk of disease is controlled by maintaining a one year production cycle.

For both **Presidio Nursery** and **Our City Forest Street Tree Nursery**, there is higher tolerance for pests as long as the plants remain functional and healthy despite their appearance.

Our **City Forest Street Tree Nursery**, in particular, relies on natural predators to control pests and reduces the need for pesticides and herbicides.

At **The Garden Project Farm & Nursery**, all vegetables grown are organic and do not use any chemicals. Natural predation, fencing and timing of harvesting periods are used to control pests.

Based on the field visits and interviews conducted as part



Storage area for sterilized soil in Presidio Nursery



Aphids usually do not harm trees but can cause mold and curling of leaves. Lady beetles are natural predators and can control aphid populations.

KEY FACTORS FOR A SUCCESSFUL COMMUNITY-BASED NURSERY

of this report, the following primary factors have been identified for creating a successful nursery.

Create a facility. At the most fundamental level, the main components for a functioning nursery must be provided. This include a head house or seed propagation area connected to a greenhouse, a shade house, open yard, soil mixing areas, storage facilities for equipment, circulation spaces for trucks. Given that the operation of the nursery is dependent on staff and volunteers, it is vital to provide space to engage volunteers through a structured volunteer program and provide social spaces for breaks and causal interaction.

Staff Appropriately. An experienced and skilled nursery manager with a direct background in the types of plants or trees being grown is essential to the success of the nursery. The manager's technical expertise is vital to the day to day operation of the nursery. The manager also needs to be agile and resourceful to response to unforeseen circumstances especially when dealing with living materials which can be unpredictable when subjected to various environmental factors.

Reliable High Quality Water Supply. A constant supply of water is required to ensure the survival of young trees in the nursery. Young plants require constant irrigation, especially in containers with low soil volume and low water storage capacity. Using recycled water would be the most appropriate as it is a more sustainable water source. However, the quality of the recycled water needs to be verified to ensure its suitability for landscaping use. If recycled water is or can be made available, tests should be conducted for salts and suspended solids to determine suitability for use. When recycled water is not available, City water sources should be secured. Alternative water sources including the re-use of runoff from the nursery should be developed as feasible to further conserve water.



Propagation shed at Our City Forest Street Tree Nursery



Shade houses at Our City Forest Street Tree Nursery



Classrooms at Presidio Nursery

Be creative - create a special place. It is important to create a “place” and unique identity for the nursery to make a pleasant and inviting environment for staff and volunteers. This can be done through the personalization of the nursery through artwork and creative signage or sculpture created by staff or volunteers. This can help create a sense of ownership and also shared investment among the volunteers. Additionally, creating comfortable shaded space for volunteers and staff to eat, relax and socialize can contribute the nursery’s feel. These elements can boost morale and attract high-energy volunteers who are passionate and enthusiastic about the nursery. A positive atmosphere can support other volunteers as they come on board, creating a strong dependable pool of volunteers and a nursery that exudes the true spirit of a community based nursery.



“The Bucket Man” at Our City Forest Street Tree Nursery

Ensure quality trees. One of the main challenges of a community nursery is ensuring quality control. A main way to address this is by hiring a skilled and competent nursery manager to oversee operations. Since nursery volunteers come from various backgrounds with different levels of experience, it is important for the manager to conduct training and to help manage the work of volunteers. Additional quality checks will be required to ensure tasks such as tree potting and re-potting or root pruning are done to a high standard. This will ensure that quality trees are produced and not lead to subsequent maintenance and management issues after the tree is planted.



Volunteer area at Our City Forest Street Tree Nursery

The development of a community-based nursery is a challenging task that will require a team of people with various expertise to oversee the funding, construction and management of the nursery. Active engagement of the staff and volunteers through programing is crucial to create a positive and high-energy environment and develop a sense of ownership among volunteers. With a combination of these success factors in place, a community-based nursery can be sustainable over the long run producing quality trees.





4. Site Selection for a Street Tree Nursery

A street tree nursery within or close to San Francisco can contribute towards a more resilient and sustainable urban forest by allowing more variety of trees to be grown and lower the carbon footprint from transportation of trees from further away nurseries. It will also allow high quality streets trees that are acclimatized to local climates to be produced reducing downstream management and maintenance issues. To locate a community-based nursery in San Francisco, the site would need to meet several critical and secondary conditions. This section identifies a list of site requirements for consideration when locating a community-based nursery, describes the methodology for the shortlisting of sites and completes a site evaluation of the shortlisted sites. The analysis results in a description of the most suitable locations for a community-based street tree nursery.

SITE REQUIREMENTS

In selecting a site for a street tree nursery, there are several critical conditions required. Some of these conditions are tied to the basic growth and survival requirement of trees including light, water and space. In addition to these fundamental growth factors, existing infrastructure and partnerships with land managers at each of the site are crucial as well. As the street tree nursery will rely in large part on volunteer labor, it is preferable that the nursery be highly accessible and located in close proximity to public transportation. Other secondary conditions for consideration include site topography, climate and environmental factors such as wind speeds and air quality.

Critical Conditions

1. Ample sunlight
2. Ample water
3. Sufficient land
4. Accessibility by volunteers
5. Availability of existing infrastructure
6. Partnership opportunities

Secondary Conditions

1. Slope angle
2. Aspect
3. Wind speed
4. Air quality

CRITICAL CONDITIONS

Ample Sunlight and Water. Two critical conditions when siting a nursery are ample sunlight and accessibility to a reliable, clean and affordable water supply. For optimal growth, the site should be in an open area unobstructed by shade cast by buildings and trees. As trees in containers require frequent irrigation due to the low moisture reserves in containers, an affordable and reliable water source is vital. The water supply will need to be low in salt and suspended sediments as salt can inhibit plant metabolic process while suspended sediments will wear out irrigation equipment.

Sufficient Land. The availability of land is also a critical site selection requirement as adequate space is required for healthy root and branch growth. Trees grown in crowded conditions have been shown to develop structural issues or poor rooting systems which in turn produce lower quality trees. Estimations of the appropriate area required for a nursery have been identified in nursery planning and development documents from the Food and Agriculture Organization, US Department of Agriculture, Forest Service, and the SF Bay Area Network. The area required for a street tree nursery was estimated for three potential scenarios described below:

Scenario 1: Community-based nursery will meet all demand for new and replacement street trees for the next 20 years with the ability to produce 8,600 street trees in year 20.

Scenario 2: Community-based nursery will meet 50% demand for new and replacement street trees for the next 20 years producing 4,300 street trees in year 20. The rest of the street trees would need to be bought from existing nurseries.

Scenario 3: Community-based nursery will only meet demand for new street trees for the next 20 years producing 2,500 street trees each year. Supply of replacement trees will need to be met by existing nurseries.



Ample Sunlight and water is required for healthy plant growth

<i>GROWTH SCENARIO</i>	<i>SITE AREA REQUIREMENT (FT²)</i>	<i>SITE AREA REQUIRED (ACRES)</i>
Scenario 1: 8,600 trees	250,000	5.74
Scenario 2: 4,300 trees	130,000	2.98
Scenario 3: 2,500 trees	80,000	1.84

Note: A detailed breakdown for each scenario is included in Appendix C.

Based on the three scenarios, an approximate 5.74 acre, 2.98 acre and 1.84 acre of land will be required for scenario 1, 2 and 3 respectively.

Accessibility by volunteers. If the nursery will depend on significant numbers of volunteers for its operation, it would be a major advantage to locate the nursery near high quality public transportation access. This will encourage volunteer participation and ensure long term sustainability of the street tree nursery. Where possible, a better understanding of the volunteer population would provide additional information on where these volunteers will be traveling from allowing the nursery to be located nearby to increase the likely participation of these volunteers.



An accessible site can encourage volunteer participation

Availability of Existing Infrastructure and Partnership Opportunities. Building a nursery from scratch will necessitate more resources compared to establishing one which can utilize existing facilities, infrastructure and labor networks. Available infrastructure on site will reduce the resources required to establish a nursery and decrease the overall investment risk of setting up a nursery. To gain access to such a site is one of the key challenges in site selection, especially in San Francisco where land value is high. For the nursery to be successfully established, it will require the partnership with an existing landowner (public, private or non-profit).



A completed nursery with existing infrastructure

SECONDARY CONDITIONS

Slope Angle and Aspect. Preferably, the nursery should be sited on land that is gently sloping. This creates a natural gradient which helps to drain the site, preventing stagnation of water in turn reducing pest and diseases. Gently sloping topography is also an advantage when moving equipment, supplies and vehicle on site as it would be easier to maneuver compared to an undulating site. Where possible, a south facing slope should be chosen to increase exposure to sunlight. A site with different micro-climates can also help trees acclimatize to the harsh and varied growing conditions found along San Francisco's streets.



Southern slope covered with grass while northern slope shows steep unvegetated cliff

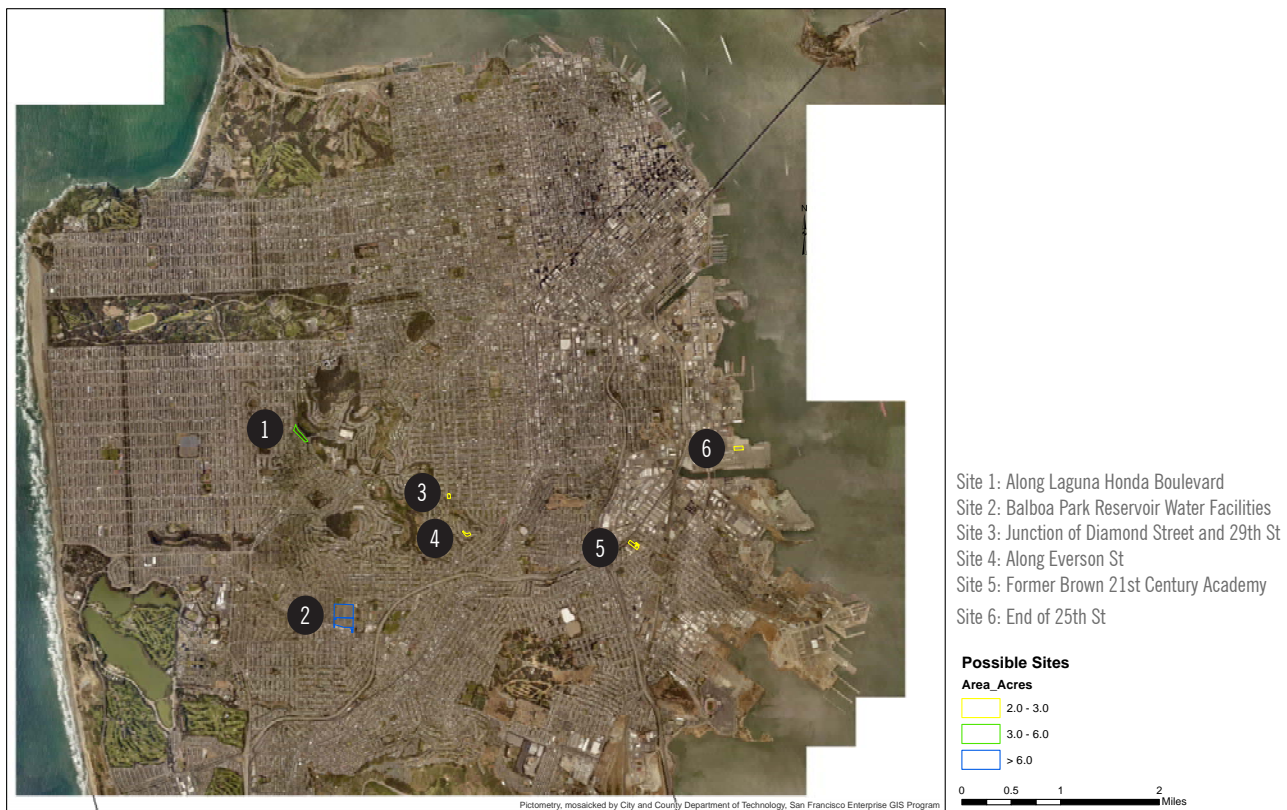
Wind Speeds and Air Quality. Sites with high wind speeds are not suitable for the siting of a nursery as they are not conducive to growth. Seeds sown may be blown off the trays and containers may be toppled damaging trees in the process. High wind speeds also dry out the plants more quickly requiring more frequent irrigation. Preferred sites should have gentle breezes with wind speeds of less than 11 miles/hr. Areas with high air pollution levels (e.g. smog) are also not suitable for the nursery as plants that are exposed to air pollution over an extended period grow at a slower rate, produce fewer blossoms and are more susceptible to disease and insect damage.



Leaves turning black due to stress from smog

SHORTLISTING OF SITES

A shortlist of opportunity sites was developed through the use of GIS analysis and the solicitation of ideas from various stakeholders. GIS analysis was conducted to shortlist sites that were on vacant city properties and have a minimum size of two acres. Six sites were shortlisted from this analysis. The detailed methodology for the GIS analysis is described in the next section. Through interviews with the stakeholders, a site located outside of the city with high potential was identified - an existing nursery and farm at the City & County of San Francisco's San Bruno Jail where the Garden Project currently grows vegetables and native plants with the possibility to expand operations to include street trees. Another site is the planned Urban Agriculture Park on Treasure Island, where a street tree nursery could possibly be incorporated as part of the park. A total of eight sites were identified.



METHODOLOGY FOR SHORTLISTING OF SITES

Information on existing public lands (city, state and federal properties), open spaces and existing buildings in San Francisco was used to identify the most promising potential nursery sites. Vacant land (land without buildings), the most suitable for a nursery, was filtered out resulting in 2,000 potential sites. City properties were prioritized since the City has no jurisdiction over State and Federal property and negotiating the use of these sites for a Street Tree nursery would likely prove challenging and time consuming. These 2,000 sites were then filtered again to remove open spaces to ensure that the street tree nursery will not compromise existing recreational opportunities. The remaining 1,500 sites were then sorted into four categories based on size:

- Less than 2 acres;
- 2-3 acres;
- 3-6 acres;
- More 6 acres.

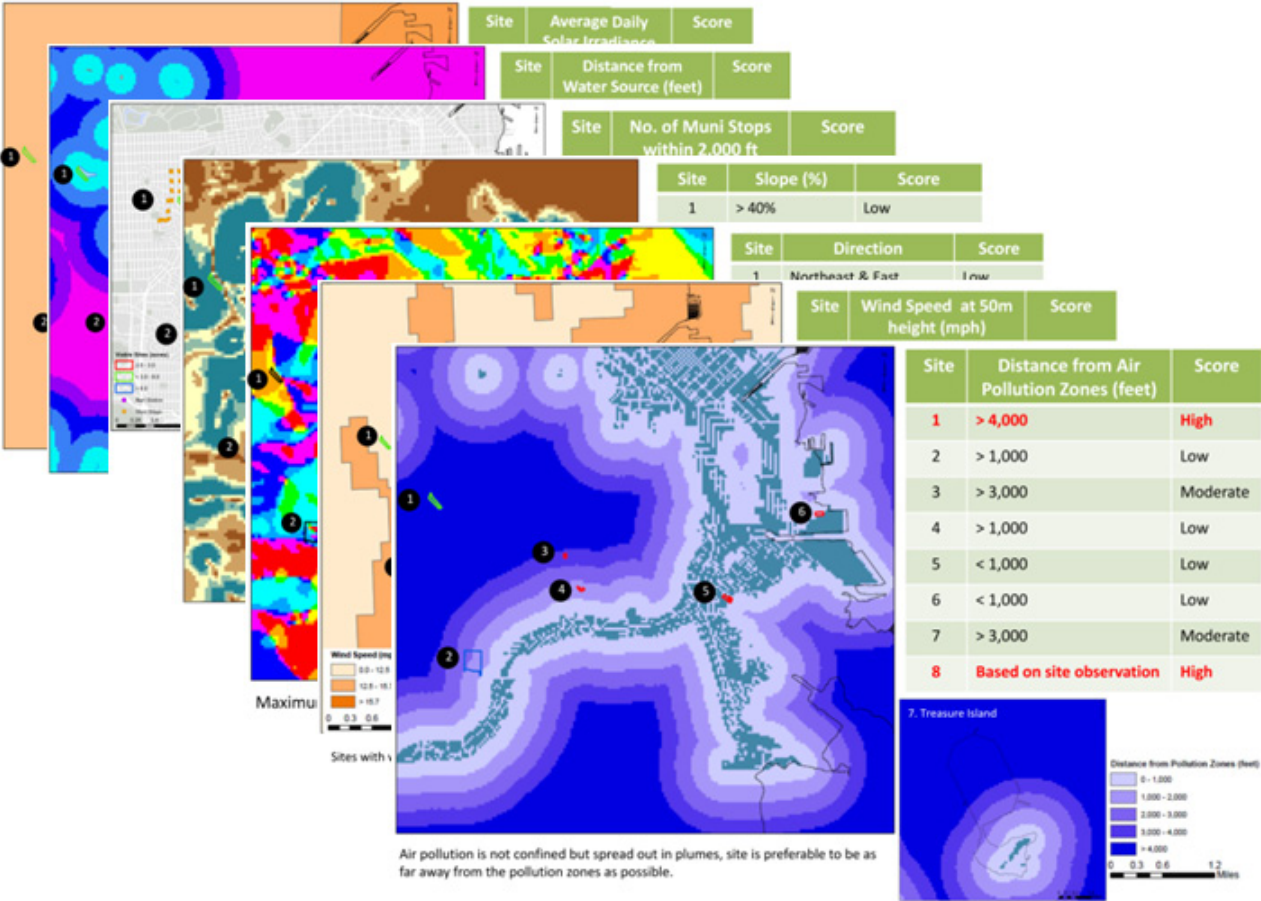
These categories were based on nursery sizes estimated in the earlier section. Sites that are smaller than 2 acres were removed as these sites are too small for the nursery leaving only 94 sites. Of the 94 sites, areas along the Port's piers were removed as they were considered high value sites where the opportunity cost of siting the nursery would likely be too high. The remaining sites were verified with satellite imagery to ensure that the sites are vacant and of a regular size. Sites that located in narrow stripes, with buildings, reservoirs, train tracks or part of open spaces in neighborhoods were removed. After this preliminary site screening, six sites were shortlisted and considered for the street tree nursery. Most of these sites are between two to three acres where the preferred site would be between three to six acres to allow future nursery expansion. The eight sites are



Site 1: Site adjacent to Laguna Honda Boulevard;
Site 2: Balboa Park Reservoir;
Site 3: Site at Diamond Street and 29th Street;
Site 4: Along Everson St;
Site 5: Former Brown 21st Century Academy;
Site 6: End of 25th St;
Site 7: Urban Agriculture Park on Treasure Island;
Site 8: The Garden Project Farm & Nursery at San Francisco County Jail (San Bruno).

CHALLENGES OF SITE SELECTION

While we have methodically worked out the site requirements and shortlisted various sites within San Francisco, on the ground, these sites might not be available due to severe land constraint within the City. Given that the nursery needs to be of a sizeable area, the project will result in high land cost and in turn high opportunity cost to the City. With other competing uses for these sites which may be of higher priority within the City, it is an uphill task securing either one of these sites. Exploring smaller sites can be one alternative to reduce the trade-offs involved but the nursery may longer be operationally efficient or may be too small to contribute significantly to the Urban Forest Plan.



SITE EVALUATION AND RECOMMENDATIONS

No single site emerged in the analysis that fulfilled all desired site attributes based on the quantitative factors outlined above. Evaluated solely on the environmental factors and proximity to public transportation access, site 2, at the Balboa Park Reservoir was found to be the most suitable. Currently a paved parking lot, the site is undergoing a planning process exploring the potential of redeveloping the area for housing and open space. However, redevelopment of the site will take a number of years and it is uncertain at this point whether a nursery could be incorporated into these future plans. The site currently lacks a good water source nearby which will require the use of City water or investment in a reliable water source. The detailed analysis of the quantitative factors for all sites is available in appendix D.

However, when availability of existing Infrastructure and partnership opportunities were taken into

consideration, site 8, at the Garden Project Farm & Nursery appears to be most suitable. Located in the town San Bruno (approximately 15-20 minutes outside of San Francisco by car) on San Francisco County jail property, the site is accessed only through a high security gate. It is an existing nursery which would allow for the sharing of existing facilities and infrastructure (i.e. buildings, water source, soil and expertise on nursery and volunteer management). The Garden Project staff has also expressed interest in working with the City and Friends of the Urban Forest to create a street tree nursery on their land. Such an opportunity is seen as desirable since it could bring additional funding to the Garden Project and create skill development opportunities for low-income students, at-risk youth and former offenders. In contrast, the other sites would all require a nursery to be created from scratch and with no interested land partners. These two factors gave the Garden Project site an overwhelming advantage.



Proposed street tree nursery site at The Garden Project Farm & Nursery



Ample sunlight at The Garden Project Farm & Nursery for their vegetable farm

When considering the other factors, the Garden Project Farm & Nursery scored relatively well except for two components on the amount of sunlight and the proximity to public transportation access. In terms of sunlight, this appears not to be a problem despite the low score as the Garden Project managed to grow 65 and 70 tons of vegetables in 2013 and 2014 respectively. The main concern would be the inaccessibility of the site and the tight security involved in getting to a nursery located on jail property. There would also be a need to evaluate staffing requirements including ensuring sufficient expertise in tree growing can be made available and that there is sufficient labor available to run the nursery.

Site evaluation summary table

Site Conditions	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
<i>Critical</i>								
1. Ample sunlight	0	0	0	0	0	+	+	-
2. Adequate, reliable, clean water supply	0	-	0	0	-	-	-	+
3. Proximity to transport node	0	+	0	+	0	-	-	-
4. Availability of existing Infrastructure	-	-	-	-	-	-	-	+
5. Available partnerships opportunities	-	-	-	-	-	-	-	+
<i>Secondary</i>								
6. Gently sloping topography	-	+	-	-	-	+	+	+
7. South facing site	-	+	0	+	-	-	N.A	N.A
8. Low wind speeds	+	0	+	0	0	+	0	0
9. Good air quality	+	-	0	-	-	-	0	+
10. Space for Expansion	+	+	-	-	-	-	+	+

Site 1: Site adjacent to Laguna Honda Boulevard;
 Site 2: Balboa Park Reservoir;
 Site 3: Site at Diamond Street and 29th Street;
 Site 4: Along Everson St;
 Site 5: Former Brown 21st Century Academy;
 Site 6: End of 25th St;
 Site 7: Urban Agriculture Park on Treasure Island;
 Site 8: The Garden Project Farm & Nursery at San Francisco County Jail (San Bruno).

Score Rating:

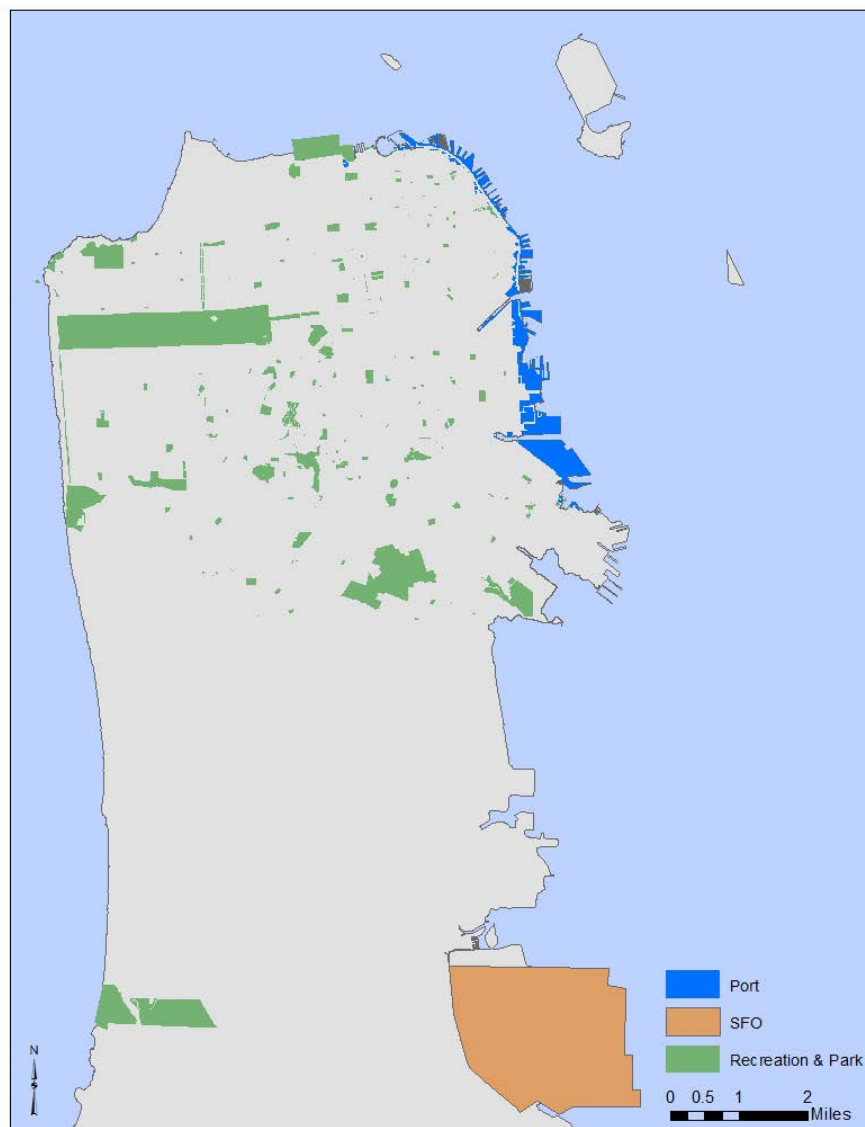
High Suitability: +

Moderate Suitability: 0

Low Suitability: -

FURTHER RESEARCH ON POSSIBLE SITES

In our site selection analysis, properties owned by Recreation and Park Department, Port of San Francisco and the San Francisco International Airport (SFO) were not considered given time constraints. Additional research and potential collaboration with these departments may prove fruitful in identifying additional locations for the siting of a street tree nursery.



5. Study Recommendations

The review of San Francisco's existing street tree supply chain conducted as part of this study highlighted both the benefits and need for a local street tree nursery to support the City's goal of planting 50,000 new street trees over the next 20 years. In addition, field visits and interviews with staff at various local community-based nurseries revealed the key components and potential for establishing a nursery focused on growing street trees for San Francisco (see Appendix E for field visits reports).

Several nurseries within the Bay Area have also demonstrated the viability of a community-based nursery model when there is adequate funding. There are also available sites near to San Francisco that the nursery can be located. In the subsequent section, we will highlight key considerations for the setting up of a street tree nursery distilled from various interviews with stakeholders and provide recommendations for the management model of a street tree nursery to support the Urban Forest Plan. A brief discussion on the cost, funding and implementation time line are also included.

Benefits of a street tree nursery

- Ensure consistent supply of high quality street trees
- Reduce transplanting shock by growing trees better acclimatize to local climate
- Grow uncommon tree species that are difficult to buy from commercial nurseries
- Create green jobs
- Provide educational and volunteer opportunities
- Reducing the environmental costs (carbon emissions) associated with distant tree delivery



REVIEW OF PREVIOUS DISCUSSION

Prior to this study, additional efforts had been pursued to pilot a street tree nursery. Friends of the Urban Forest (FUF) used to operate a small nursery in the Bayview at the Alice Griffith Public Housing site. The nursery used to supplement street tree planting producing 200 easy to grow, unique or more costly species street trees per year. It was discontinued after plans for redevelopment of the site began to move forward.



Friends of the Urban Forest operated a small street tree nursery at the Alice Griffith Public Housing site in the Bayview

There has also been discussion of creating several micro-nurseries at various locations throughout the city to address the issue of space constraints and the challenge of finding a large site for a single centralized nursery. Having smaller nurseries at different locations may prove to be challenging at the start as each location would have its own set of micro-climates and operational challenges, having to deal with multiple set of issues at the same time may prove to be sub-optimal. Instead a centralized nursery will allow the focus of attention and resources on it, increasing the chances of a success.



Centralized Nursery



Micro-Nurseries

RECOMMENDATIONS

Arising from the study, there are 5 key recommendations in furthering the proposal for a street tree nursery.

Start small. Starting on a small scale (200+/- trees) will allow for the accumulation of experience and keep nursery startup costs low. Setting up a nursery can be challenging and unpredictable as trees are living things that interact with the environment. It requires an eye for detail and going through a series of trial and error to ensure healthy tree growth even with various best practices established. As such, we recommend for the street tree nursery to be developed through a two phased approach. Phase One of the nursery should be a small nursery focus on growing species that are more expensive to buy from local nurseries or uncommon species that cannot be found. Others tree species that are reasonably price and common at local nursery can be bought instead. Phase Two of the street tree nursery involves creating a larger nursery when experience has been amassed.

Build confidence. One of the main recommendations from existing nursery operators is to start with easy to grow species and to bring in smaller trees in one or five gallon containers instead of growing trees from seeds. Starting small and with easy to grow species will allow nursery staff to accumulate experience and gain confidence and comfort with growing street trees. Growing trees from seeds takes a much longer time (3 to 5 years per tree) compared with starting with young trees (2 years per tree). This will allow the nursery to see success sooner and serve as a motivation for both

2 Phase Approach

Phase 1: Small nursery (200+/- trees)



Phase 2: Expanding existing nursery when experience amassed



Starting with smaller container trees instead of sprouting seeds

volunteers and staff at the nursery.

Staff Appropriately. As seen across various commercial and community-based nurseries, the presence of an experience nursery manager that has technical expertise on nursery operations is crucial in the success of a nursery. Under the strong leadership of a nursery manager, the nursery's trees or planter were able to thrive and be safeguarded from the threats of pests and disease, substandard quality care and tree damage. The manager is necessary to ensure high-quality trees are produced to reduce subsequent maintenance issues after the trees are planted.

Tap existing resources. Where possible, the street tree nursery should build off of existing infrastructure or facilities to reduce startup costs. Lower up-front costs can help build support for the nursery and make it quicker able to secure funding. A low cost startup will likely be more palatable to decision makers and reduce the risk should the nursery be unsuccessful. Existing nurseries are also good locations to start the street tree nursery as staff are already familiar with nursery operations and management. While a plant nursery and a tree nursery may not be the same, there are likely to be some similarities and lessons to be shared. There are also possibilities to tap on other resources like labor for the nursery as existing community-based nurseries are likely to have their own suite of volunteer programs and staffing.

Establish strong partnerships. One of the key challenges in starting a street tree nursery is securing a suitable site. This is due to high land costs and competition for vacant land within San Francisco. To overcome this challenge, strong partners need to be found that will not only be willing to provide the space for the nursery but are also committed to the objectives and goals of the street tree nursery. Only when mature understanding is established between the partners can



Appropriate staffing is required to ensure smooth operation of the nursery



Possibility of sharing existing facilities and knowledge

OPTIONS

a successful street tree nursery be developed.

Based on the recommendations above, two options were developed that are appropriate for consideration

The two options are:

Option 1: Collaborate with existing community-based nurseries and expand the nursery

Option 2: Creating a new nursery

OPTIONS	STRENGTHS	WEAKNESSES
Option 1: Collaborate with existing community-based nurseries and expand the nursery	<ul style="list-style-type: none"> • Able to tap on existing infrastructure, nursery operations experience and management knowledge • Cost savings 	<ul style="list-style-type: none"> • Requires a willing partner • No control over size of nursery and future expansion
Option 2: Creating a new nursery	<ul style="list-style-type: none"> • Flexibility in nursery design and customization to specific needs • Control over site 	<ul style="list-style-type: none"> • More costly

in the context of San Francisco.

Option 1 suggests for the City to work with an existing community nursery to expand operations to include a tree growing component. This option builds upon the existing infrastructure already in place at the nursery while also adding a facility to support the growing of street trees. This option reduces the startup costs of a street tree nursery significantly as fewer improvements will be required. The street tree nursery would not only benefit from sharing existing infrastructure, it would also benefit from utilizing the knowledge of existing nursery operators and experience of staff. However, for this option to work, a willing partner must be found that has sufficient space within the existing nursery to accommodate the growing of trees. One challenge with this option may be that there could be less control over the operation of the nursery since it will be dedicated to growing more than trees and compromises will need

to be made.

Option 2 looks at the starting up of a new nursery from scratch. This would imply that the entire infrastructure for the nursery would need to be built which would definitely require more up-front investment compared to option 1. However, one major benefit is the flexibility to design a nursery for the unique needs of growing primarily street trees. There would also likely be less need to adapt existing systems or adhere to requirements from partners. In addition, there would likely be no space issues as the whole site would be dedicated to the street tree nursery.

After evaluating the five key recommendations and the two options presented above, **option 1 appears to be the most appropriate option for establishing a community-street tree nursery in San Francisco.** By collaborating with an existing nursery, the costs and risks will be reduced. Partnering with another nursery will also help overcome issues with site selection as the land has already been secured. The street tree nursery can also start out small allowing for idea testing and confidence building in the operation of

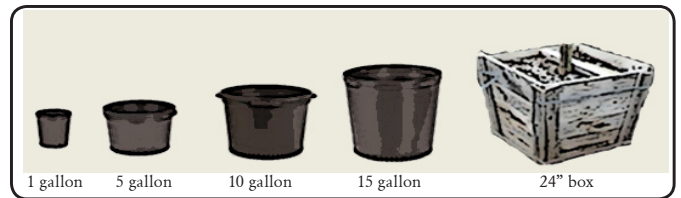
PROPOSAL

the nursery over time.

This report recommends the following proposal:

Start a small street tree nursery growing uncommon and/or expensive but easy to grow trees species from smaller tree stocks by setting up a tree growing component within the Garden Project Farm and Nursery site (San Bruno, CA).

Through interviews and conversations with various nurseries conducted for this report, the Garden Project emerged as a strong potential partner meeting the recommendations and site requirements for a street tree nursery. The site has existing infrastructure (available water) and facilities in place to allow a street tree nursery to be developed. In addition, the nursery has over 20 years of experience growing plants and crops. Staff there have shown great interest in collaborating with City agencies and FUF in the establishment of a street tree nursery and have even identified a site on their property where a trees could be grown. Given the location on county jail property, there are issues of accessibility to be resolved. However, these issues can be overcome as there are already staff and youth working on the existing farm and nursery.



Instead of purchasing trees in 15 gallon containers or 24" boxes, the street tree nursery could start with 1 or 5 gallon containers.



Olive trees are adapted to the harsh environment of San Francisco's streets and adapted to local climate. However, these trees are hard to come by in local nurseries and cost three times more than a common species, making them too expensive to be planted extensively.

A new street tree nursery at the Garden Project should start out small, growing about 200 trees at the start. These trees should be species that are uncommon and/or expensive trees difficult to find in large quantities from local nurseries while at the same time easy to grow. These trees can be ordered from local nursery prior to the completion of the nursery so that they will be available when the nursery is completed. The trees would be in smaller sizes (1 to 5 gallons containers) which will keep costs low and reduce the time for the trees to reach maturity and become ready for planting.



Proposed street tree nursery site at The Garden Project Farm & Nursery showing existing access route to site.



Existing storage shed at The Garden Project Farm & Nursery with the potential to be converted to an office or storage space.

COST ESTIMATION AND FUNDING

Capital and Operational Cost

If the proposal is pursued and most of the infrastructure and facilities on site can be shared, the capital cost of starting a nursery for about 200 trees could be as little as between \$25,000 and \$50,000. The capital cost will go into the installation of the irrigation system, minor grading of the site or creation of access routes, purchase of smaller trees for propagation and containers and building a storage and office. A better estimate of the actual cost can be calculated after working out the details with the existing nursery and understanding the scope of works required. Comparing the operational cost to the Our City Forest Nursery, annual operating costs should not exceed \$250,000. It is also highly likely costs will be lower as the proposed street tree nursery would be started as small operation at first. We expect operation cost to be between \$50,000 to \$100,000 to fund for a dedicated nursery manager, the purchase of materials related to the operations of the nursery and for utilities.

<i>TYPE OF COST</i>	<i>COST ESTIMATION</i>	<i>COST COVERAGE</i>
Capital Cost	\$25,000 - \$50,000	<ul style="list-style-type: none"> - Installation of irrigation system and tree rows - Creation of access routes for vehicles - Purchase of smaller trees for propagation - Purchase of equipment - Construction of storage and office space - Fencing
Operation Cost	\$50,000 - \$100,000	<ul style="list-style-type: none"> - Salary for Nursery Manager - Purchase of materials required - Utilities

Funding Sources

Some possible funding sources for street tree nursery startup costs include partnerships with non-profit organizations such as Friends of the Urban Forest, federal and state grants relating to urban forestry and financing discussions currently underway to create a Citywide Street Tree Maintenance Program. These funding opportunities should be pursued and a funding plan should be developed as part of a detailed street tree nursery implementation plan.

<i>GRANT</i>	<i>DISPENSE BY</i>	<i>TYPE</i>	<i>OBJECTIVES</i>
Community Forest Program	National Urban and Community Forestry Advisory Council	Federal	Establish community forests with a focus on economic and environmental benefits, education, forest stewardship, and recreation opportunities
CALFIRE Grant	California ReLeaf	State	Support tree planting, tree inventories, urban wood and biomass utilization, blighted urban lands improvements, and leading edge work that advance the goals and objectives of supporting healthy urban forests and reducing greenhouse gas emissions.
Urban Forest Ecosystems Institute Grants	Urban Forest Ecosystems Institute	State	To create or implement projects that benefit California urban forestry and urban greening efforts

SUGGESTED IMPLEMENTATION TIMELINE

The suggested time line for implementation begins with detailed street tree nursery planning beginning in Fall 2015 and a proposed opening date of Fall 2017. During this time a detailed proposal should be developed with nursery partners that includes securing funding, nursery design and construction and a staffing and hiring process. The first batch of street trees will be ready for planting approximately two to three years after the completion of the nursery (either 2019 or 2020). A proposed time line is shown below.

A street tree nursery will be a step towards enhancing San Francisco's urban forest by fulfilling the





6. Conclusion

recommendations set out in the Urban Forest Plan (Phase One: Street Trees). The nursery will allow for rare and uncommon species to be grown locally diversifying our urban ecosystem adding to its resiliency. At the same time, these street trees will also be better acclimatized to the local climate and will thrive better reducing subsequent management and maintenance costs. The nursery will also reduce the environmental impacts associated with the transportation of trees from distant nurseries while creating green jobs and educational and volunteer opportunities.

Five primary recommendations in developing a successful street tree nursery in San Francisco were distilled through site visits and interviews with existing nurseries operators. They include starting small using a phased approach, tapping on to existing resources, building confidence before expanding and providing appropriate staff and to form strong partnership in the development of the nursery.

This report identifies a prime opportunity spot at the Garden Project Farm & Nursery located on City land in San Bruno, CA to start a small street tree nursery growing uncommon and/or expensive but easy to grow trees species from smaller tree stocks. The Garden Project Farm & Nursery located in San Bruno on the grounds of the San Francisco County Jail presents a key site and partnership opportunity. Garden Project staff have expressed interest in collaborating with the City agencies and Friends of the Urban Forest (FUF) to create a street tree nursery within their existing farm and nursery on an identified site. The site is able to fulfil most of the environmental requirements except site accessibility and tight security which may limit volunteer access. However, the Garden Project's strong youth employment programs provide promising staffing resources as well.

In addition, further exploration of potential nursery sites on property managed by the San Francisco Recreation & Park Department, San Francisco International Airport (SFO) and Port of San Francisco should be explored.

Moving forward, further details of the street tree nursery would need to be worked out between the partners and different funding sources would need to be identified. In the longer term, upon the completion of the Citywide Street Tree Census, it would be appropriate to develop a Street Tree Planting Plan which looks into the tree planting sites for the 50,000 trees to achieve an equitable distribution throughout the city.



APPENDICES

APPENDIX A

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APPENDIX B**STREET TREE DEMAND FOR THE NEXT 20 YEARS**

	<i>YEAR 1</i>	<i>YEAR 2</i>	<i>YEAR 3</i>	<i>YEAR 4</i>	<i>YEAR 5</i>	<i>YEAR 6</i>	<i>YEAR 7</i>	<i>YEAR 8</i>	<i>YEAR 9</i>	<i>YEAR 10</i>
New Street Trees Required	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Replacement Street Trees Required	4,200	4,300	4,400	4,500	4,600	4,700	4,800	4,900	5,000	5,100
Total Street Trees Required	6,700	6,800	6,900	7,000	7,100	7,200	7,300	7,400	7,500	7,600
Total Street Trees in San Francisco	107,500	110,000	112,500	115,000	117,500	120,000	122,500	125,000	127,500	130,000

	<i>YEAR 11</i>	<i>YEAR 12</i>	<i>YEAR 13</i>	<i>YEAR 14</i>	<i>YEAR 15</i>	<i>YEAR 16</i>	<i>YEAR 17</i>	<i>YEAR 18</i>	<i>YEAR 19</i>	<i>YEAR 20</i>
New Street Trees Required	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Replacement Street Trees Required	5,200	5,300	5,400	5,500	5,600	5,700	5,800	5,900	6,000	6,100
Total Street Trees Required	7,700	7,800	7,900	8,000	8,100	8,200	8,300	8,400	8,500	8,600
Total Street Trees in San Francisco	132,500	135,000	137,500	140,000	142,500	145,000	147,500	150,000	152,500	155,000

APPENDIX C

SPACE REQUIREMENTS FOR STREET TREE NURSERY

SCENARIO 1: COMMUNITY-BASED NURSERY WILL MEET ALL DEMAND FOR NEW AND REPLACEMENT STREET TREES FOR THE NEXT 20 YEARS WITH THE ABILITY TO PRODUCE 8,600 STREET TREES IN YEAR 20.			
	NO OF TREES PLANTED *	NO. OF TREES PER FT.	SPACE REQUIRED (SQFT) ^
Headhouse (includes education space)			1,500
Greenhouse	9,460	49	251
Shadehouse			4,783
<i>For pot size 2"x2"x5"</i>	9,460	36	342
<i>For pot size 4"x4"x14"</i>	9,460	9	1,366
<i>For pot size 6"x6"x16"</i>	9,460	4	3,075
Open Yard			138,011
<i>For pot size 5 gallon</i>	9,460	0.45	27,329
<i>For pot size 10 gallon</i>	9,460	0.25	49,192
<i>For pot size 15 gallon</i>	9,460	0.2	61,490
Office			2,500
Soil Mixing Area			1,000
Circulation Space			71,397
Volunteer Area (outdoors)			1,000
Parking lots (10 lots)			1,500
Storage Space			3,000
Space Required			224,941
Future Expansion			22,494
Total Space Required			247,435
			<i>say 250,000 sqft</i>
			<i>or 5.74 acres</i>

Notes:

* Assuming a 10% mortality rate, 9460 trees need to be propagated

^ Additional 30% of space is added to prevent overcrowding

Scenario 2: Community-based nursery will meet 50% demand for new and replacement street trees for the next 20 years producing 4,300 street trees in year 20. The rest of the street trees would need to be bought from existing nurseries.			
	No of trees planted *	No. of trees per ft.	Space required (sqft) ^
Headhouse (includes education space)			1,250
Greenhouse	4,730	49	125
Shadehouse			2,391
<i>For pot size 2"x2"x5"</i>	4,730	36	171
<i>For pot size 4"x4"x14"</i>	4,730	9	683
<i>For pot size 6"x6"x16"</i>	4,730	4	1,537
Open Yard			69,567
<i>For pot size 5 gallon</i>	4,730	0.45	13,837
<i>For pot size 10 gallon</i>	4,730	0.25	24,596
<i>For pot size 15 gallon</i>	4,730	0.2	31,134
Office			2,000
Soil Mixing Area			1,000
Circulation Space			35,979
Volunteer Area (outdoors)			1,000
Parking lots (10 lots)			1,500
Storage Space			1,500
Space Required			116,313
Future Expansion			11,631
Total Space Required			127,944
			say 130,000 sqft
			or 2.98 acres

Notes:

* Assuming a 10% mortality rate, 4,730 trees need to be propagated

^ Additional 30% of space is added to prevent overcrowding

Scenario 3: Community-based nursery will only meet demand for new street trees for the next 20 years producing 2,500 street trees each year. Supply of replacement trees will need to be met by existing nurseries.

	No of trees planted *	No. of trees per ft.	Space required (sqft) ^
Headhouse (includes education space)			1,250
Greenhouse	2,750	49	150
Shadehouse			1,390
<i>For pot size 2"x2"x5"</i>	<i>2,750</i>	<i>36</i>	<i>99</i>
<i>For pot size 4"x4"x14"</i>	<i>2,750</i>	<i>9</i>	<i>397</i>
<i>For pot size 6"x6"x16"</i>	<i>2,750</i>	<i>4</i>	<i>894</i>
Open Yard			40,119
<i>For pot size 5 gallon</i>	<i>2,750</i>	<i>0.45</i>	<i>7,944</i>
<i>For pot size 10 gallon</i>	<i>2,750</i>	<i>0.25</i>	<i>14,300</i>
<i>For pot size 15 gallon</i>	<i>2,750</i>	<i>0.2</i>	<i>17,875</i>
Office			1,800
Soil Mixing Area			800
Circulation Space			20,755
Volunteer Area (outdoors)			1,000
Parking lots (10 lots)			1,500
Storage Space			1,200
Space Required			69,965
Future Expansion			6,996
Total Space Required			76,961
			say 80,000 sqft
			or 1.84 acres

Notes:

* Assuming a 10% mortality rate, 2,750 trees need to be propagated

^ Additional 30% of space is added to prevent overcrowding

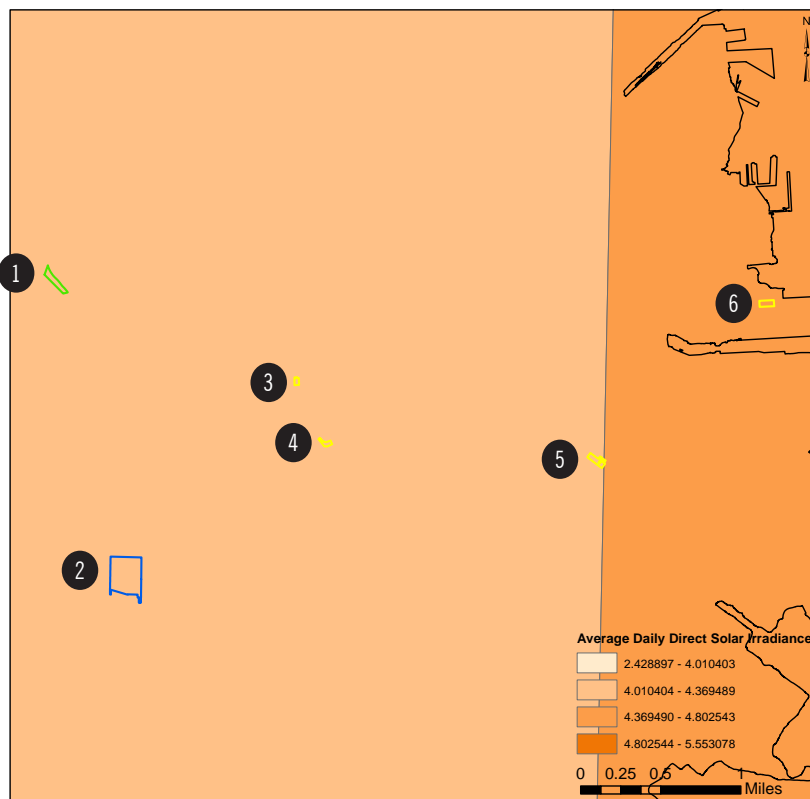
APPENDIX D

QUANTITATIVE ANALYSIS OF SITE FACTORS

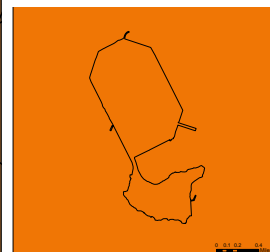
An evaluation of the quantitative factors of the 8 selected sites were completed through the use of GIS. Both the critical and secondary factors were considered and the following measurements were as proxy to those factors. The proxy measurements are as follows:

1. Amount of solar irradiance
2. Proximity to water source
3. Proximity to MUNI and BART station and bus stops
4. Slope angle
5. Aspect
6. Wind speeds
7. Air Quality

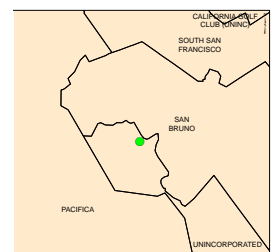
Amount of Solar Irradiance



SITE	AVERAGE DAILY SOLAR IRRADIANCE	SCORE
1	4.01 - 4.37	Moderate
2	4.01 - 4.37	Moderate
3	4.01 - 4.37	Moderate
4	4.01 - 4.37	Moderate
5	4.01 - 4.37	Moderate
6	4.37 - 4.80	High
7	> 4.80	High
8	2.43 - 4.01	Low

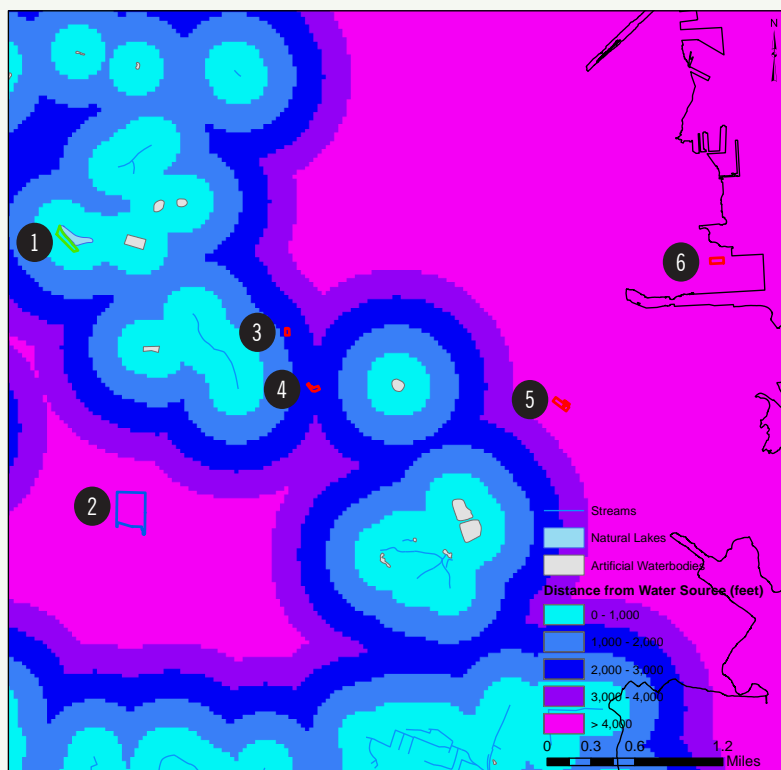


7. Treasure Island



8. The Garden Project Farm & Nursery

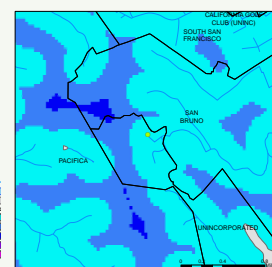
Proximity to Water Source



SITE	DISTANCE FROM WATER SOURCE (FT)	SCORE
1	< 1,000	High
2	> 4,000	Low
3	> 3,000	Moderate
4	> 3,000	Moderate
5	> 4,000	Low
6	> 4,000	Low
7	> 4,000	Low
8	< 1,000	High

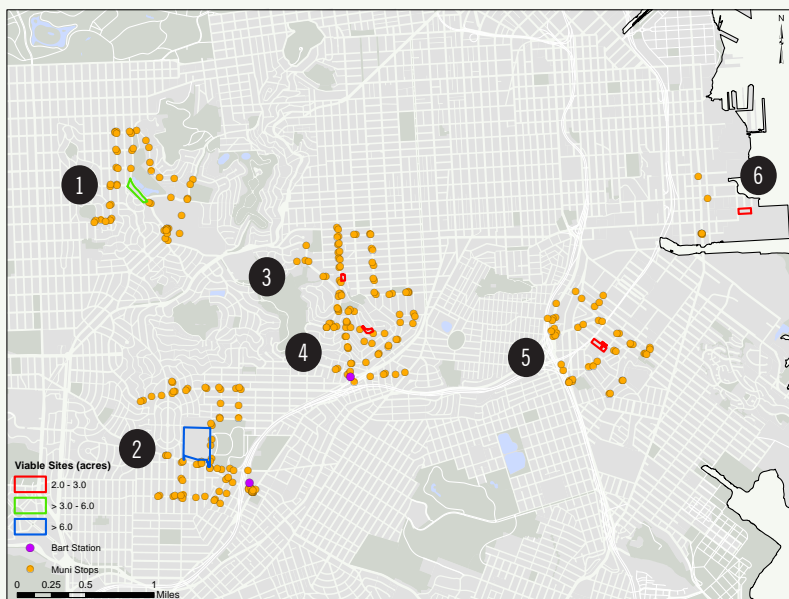


7. Treasure Island

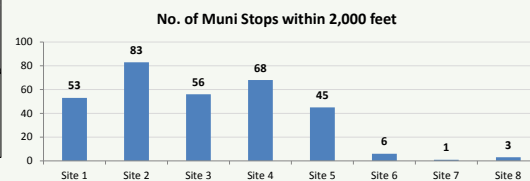


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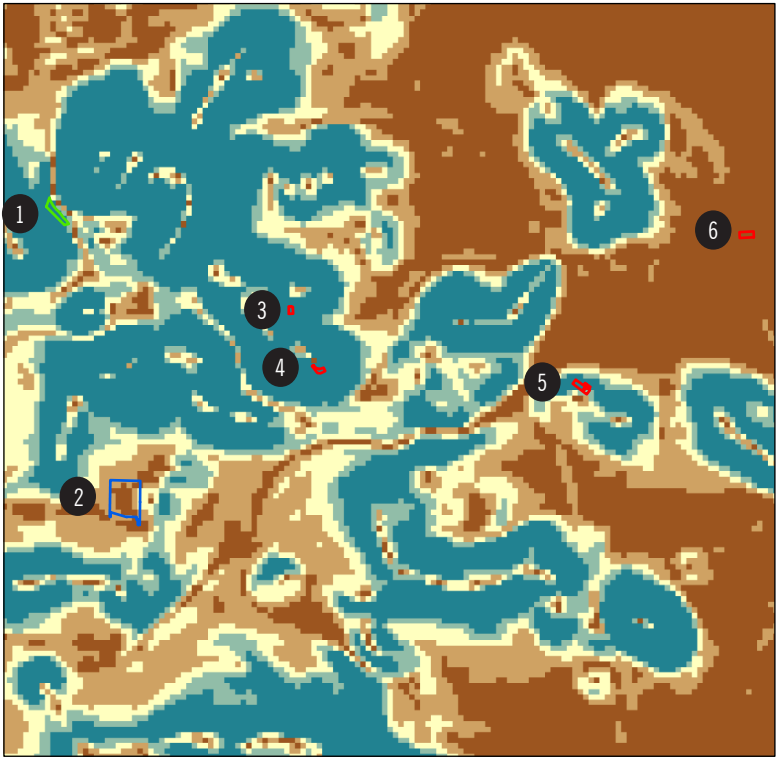
Proximity to MUNI and BART Stations and Bus Stops



SITE	NO. OF MUNI STOPS WITHIN 2,000 FT	SCORE
1	53	Moderate
2	83 + 1 Bart Station	High
3	56	Moderate
4	68 + 1 Bart Station	High
5	45	Moderate
6	6	Low
7	1	Low
8	3	Low

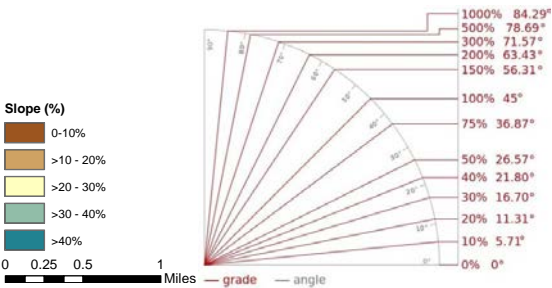


Slope Angle

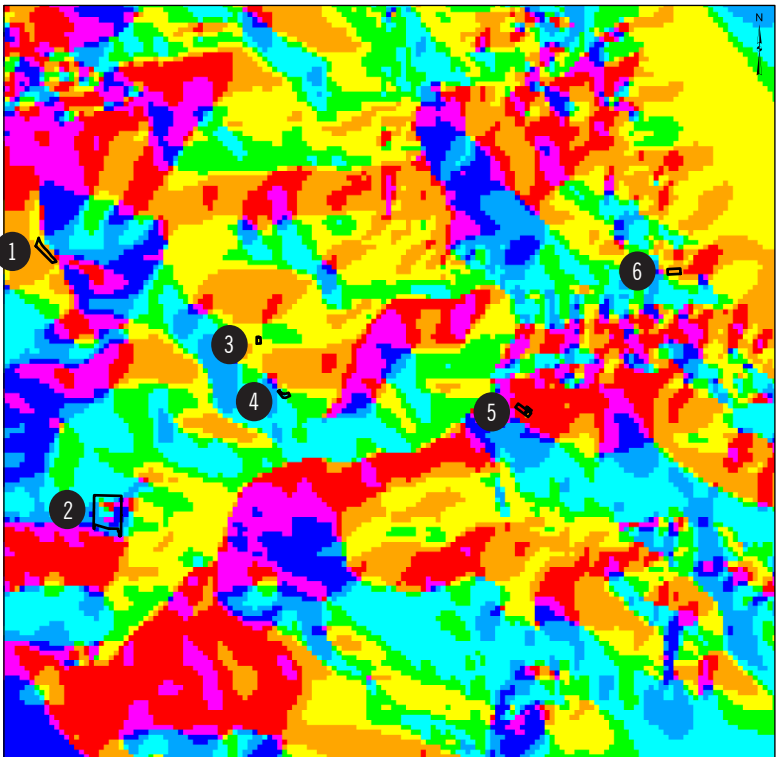


SITE	SLOPE (%)	SCORE
1	> 40%	Low
2	0 - 20%	High
3	> 40%	Low
4	> 40%	Low
5	> 30% - 40%	Low
6	< 10%	High
7	0 - 20%	High
8	0 - 20%	High

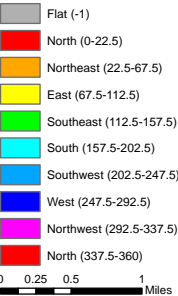
* Estimated from Goggle Maps



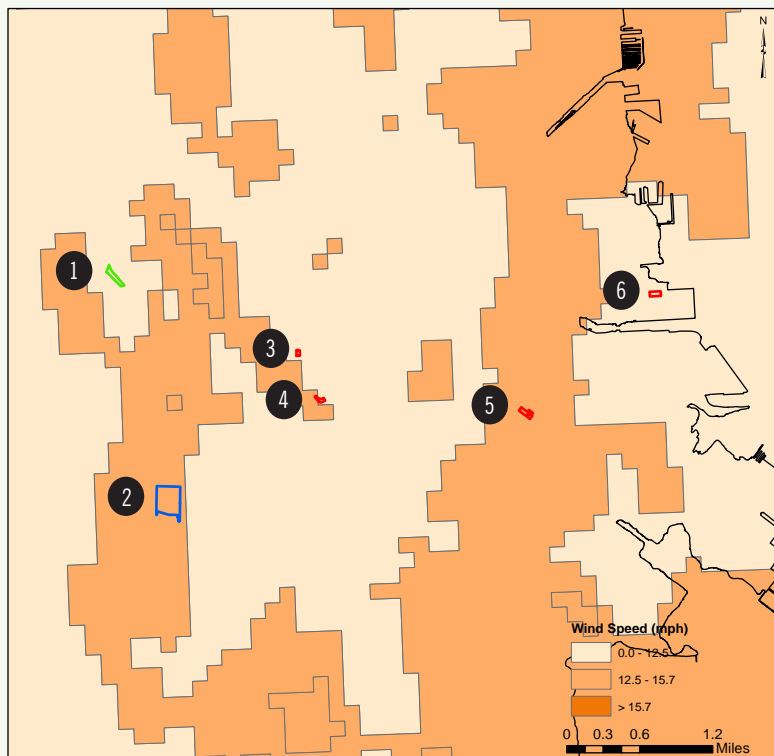
Aspect



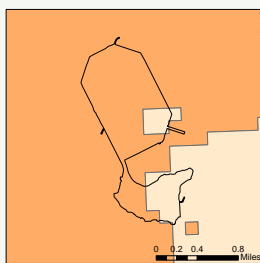
SITE	SLOPE DIRECTION	SCORE
1	Northeast & East	Low
2	Range of directions, mostly south and west	High
3	East	Moderate
4	South & Southeast	High
5	North	Low
6	Northeast	Low
7	Data not available	-
8	Data not available	-



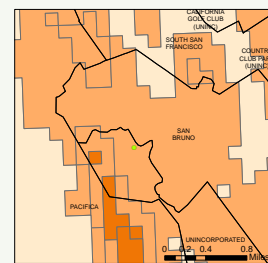
Wind Speed



SITE	WIND SPEED AT 50M HEIGHT (MPH)	SCORE
1	0.0 - 12.5	High
2	12.5 - 15.7	Moderate
3	0.0 - 12.5	High
4	Partial in 0.0-12.5 and 12.5 - 15.7	Moderate
5	12.5 - 15.7	Moderate
6	0.0 - 12.5	High
7	12.5 - 15.7	Moderate
8	12.5 - 15.7	Moderate



7. Treasure Island



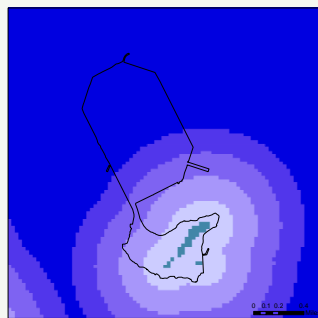
8. The Garden Project Farm & Nursery

Air Quality

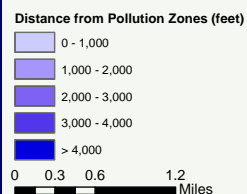


Air pollution is not confined but spread out in plumes, site is preferable to be as far away from the pollution zones as possible.

SITE	DISTANCE FROM AIR POLLUTION ZONES (FT)	SCORE
1	> 4,000	High
2	> 1,000 - 2,000	Low
3	> 3,000 - 4,000	Moderate
4	> 1,000 - 2,000	Low
5	< 1,000	Low
6	< 1,000	Low
7	> 3,000 - 4,000	Moderate
8	Based on observation	High



7. Treasure Island



APPENDIX E

FIELD VISIT REPORTS

Our City Forest Street Tree Nursery (San Jose, CA)

About Our City Forest Street Tree Nursery

Our City Forest (OCF) is a non-profit organization based in San Jose, CA which engages the community in the protection, growth, maintenance and appreciation of urban ecosystems in the Silicon Valley area. To overcome the issue of lack of species availability and an unreliable supply of quality tree stock, OCF started a community-based street tree nursery in 2010 in partnership with CalFire, the City of San Jose and South Bay Water Reclamation Plant (SBWRP). The street tree nursery is located in San Jose. While the nursery started out solely propagating street trees for wholesale to the City of San Jose and OCF themselves, the operations has evolved to also include growing and retailing of plants to the public. We conducted a field visit (June 2015) to understand the operations of a successful community-based street tree nursery.

Key Components of Street Tree Nursery

The nursery sits on a 2 acre site close to the San Jose airport and contains about 12,000 trees and 5,000 plants at various sizes. There are over 100 varieties of trees and plants grown in the nursery.

The nursery consists of the following:

1. Propagation shed and 3 shade houses where young trees are potted and stored;
2. Soil mixing area;
3. Storage shed for tools and containers and storage area for stakes;
4. Open yards for older trees;
5. Sheltered area to welcome visitors and to register volunteers and open spaces for volunteer briefing and demonstrations and;
6. Wide circulation spaces for truck access and about 6 parking lots.



Propagation shed



Shade houses



Soil Mixing Area



Storage shed for tools and containers



Storage area for stakes



Sheltered area for to welcome visitors and volunteer sign up



Gathering space for volunteers

Storage yard for older trees creating shade conditions for smaller trees beneath



Parking spaces



Wide circulation spaces

Nursery Operations and Management

(i) Funding, Development and Operational Cost

The nursery was developed over four years and funded through three primary grants from the Recovery Act (\$750,000 one-time only) between 2010 and 2012 and CalFire (\$300,000 one-time only). Only 60% of the grant from the Recovery Act was put into nursery development (\$450,000). Development cost is about \$750,000 and were spent mainly on fencing, installation of recycled and fresh water, trenching, irrigation, staking the rows, building greenhouse (from a kit), building the shade house and installing electricity. The operation cost of the nursery is about \$250,000 each year inclusive of staff and plant costs. Annual plant costs are between \$30,000 and \$40,000 and the water bill is about \$6,000. The operations of the nursery are largely funded by AmeriCorps (\$180,000 yearly) and also through planting grant reimbursements for trees that are provided through the nursery (\$40,000), occasional purchase from agencies and donations from the public.

SOURCE	AMOUNT	ITEMS COVERED
Recovery Act Grant	\$450,000	Fencing Installation of recycle and fresh water Trenching Irrigation
CalFire Grant	\$300,000	Staking the rows Greenhouse (from a kit) Shade house Installing electricity
Total Development Cost	\$750,000	
AmeriCorps	\$180,000	
Planting Grant Reimbursement	\$40,000	Staff cost Plant cost (\$30,000 - \$40,000)
Purchase from agencies and donations from public	\$30,000	Water bill (\$6,000)
Total Operating Cost	\$250,000	

(ii) Staffing and Volunteer Program

The nursery is run by one full time staff (the nursery manager) and eight full-time trainees who are paid AmeriCorps staff. AmeriCorps volunteers work on the nursery over a period of 11 months carrying out the administrative work, monitoring plant inventory in the nursery, managing of the volunteer program, and organizing community outreach programs and day to day tree and plant care in the nursery under the guidance of the nursery management. There is also one volunteer that works half time at the nursery. Other volunteers (about 200 per month) also help out at the nursery on a less structured basis participating in the day to day operations of the nursery (potting of plants, cleaning and caring for the grounds) or programs organized by the nursery.



(iii) Nursery Operation

The nursery adopted the container system where trees and plants are grown in containers and laid out in rows within the nursery. This is the least expensive alternative but there are some disadvantages as trees can become root-bound in containers. To overcome this, the nursery obtains some of its tree stock from Oregon where these trees are grown on open ground before they are potted into containers and sold. For species that are not available at other nurseries, it is necessary to grow them from seeds or cuttings. The nursery produces about 2,000 street trees annually for street tree planting with a mortality rate of 10%. These trees are managed through an electronic inventory system where staff update changes in tree status every week.

(iv) Water management & Irrigation System

The nursery uses recycled water supplied by the SPWRP. This arrangement was worked out at the early planning stage of the nursery and the OCF was able to negotiate for the SPWRP to install the main frame and piping for the irrigation system as well as to supply recycled water to the nursery. There is also a separate piping system to provide fresh water for consumption.

(v) Pest & Disease management

An important component of nursery management is the control of pests and diseases to ensure plant survival. When new plants arrive at the nursery, they are disinfected to remove any pest or diseased parts to prevent the spread to other plants in the nursery. For existing plants, the nursery relies on natural predators to control pests and diseases that do not significantly affect tree health before using pesticides or herbicides. This is to prevent an over reliance on chemicals and create a more sustainable nursery.



Irrigation system using recycled water



Close up of irrigation system

Benefits & Challenges for Nursery

(i) Reliable supply of uncommon tree species

With the street tree nursery, OCF was able to overcome the challenge they faced in obtaining uncommon tree species supplying about 2,000 trees each year to the street tree planting efforts. This has diversified the tree species in the urban forest and increased the city's resiliency. The nursery also allowed for experiments to be carried out. In particular, the nursery was using gravel and sand based soil medium to understand how well some species do in such harsh growing conditions (see photo 13). These experiments are important steps in understanding tree growth in urban environments and also finding additional suitable street trees to diversify the existing pool of street trees.

(ii) Ensuring Quality Control

However, quality control of trees is an issue when working with volunteers as they have different skill sets and experience with nursery operations. Quality control of nursery work is necessary to ensure quality trees are grown. For technical work at the nursery, training is needed to ensure volunteers could perform the various tasks.

(iii) Nursery Location and Facilities

The nursery location may not be the best location for growing of trees due to the air quality, sound impacts and higher wind speeds generated by airport nearby. Due to the nature of the site, the planting conditions were mostly homogenous and the nursery manager needed to create his own micro-climates within the nursery to provide the appropriate conditions for the different life stages of a tree. In terms of facilities, the nursery manager highlighted that the soil mixing area was not constructed to code as the soil mix and the native soil were not segregated (usually with a cement slab). There was also a lack of a proper sheltered area for volunteers to gather and for training demonstrations. These items need to be thought through at the early planning and design stages as they were difficult to change once the site is chosen and facilities built.



Experiment using gravel and sand based medium



Trained volunteers carrying repotting of trees

Strengths of the OCF Nursery

Based on field observations, the OCF has created a very positive atmosphere at the nursery, where the staff are passionate and enthusiastic about the work at the nursery and committed to share their passion with visitors. This has resulted in an organized nursery that is creative and dedicated to educate the public about their larger objective of creating a healthy urban forest in the city. Throughout the nursery, storyboards and educational signage can be seen together with various artwork done by the volunteers, creating a sense of ownership and a shared community space within the nursery. The success of the nursery strongly relies on the hiring of an experienced nursery manager who has the technical expertise on the day to day operation of the nursery. In addition, a strong core of volunteers who take pride in their work translates into a high energy environment exuding the true spirit of a community-based nursery.

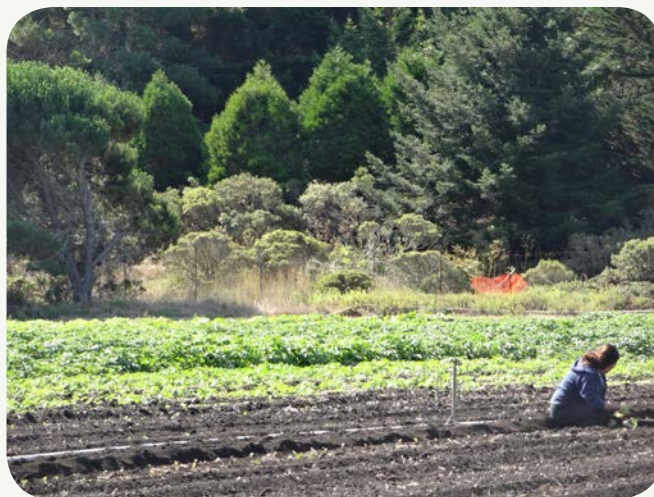


Educational study boards and signage informing the public about the characteristics of trees and the conditions they will thrive in. Personalized artwork and signage creates a sense of ownership and a welcoming environment.

The Garden Project Nursery (San Bruno, CA)

About The Garden Project

The Garden Project was founded by Catherine Sneed in 1992. It began by providing former offenders environmental based job training, assistance in continuing education and counseling to reduce the rates of recidivism. This is achieved through the provision of employment and training in growing of organic vegetables and native plants. It has now expanded its program to include at-risk young adults in learning organic horticulture and landscaping skills. The nursery is a collaboration between the San Francisco Sheriff's Department and the San Francisco Public Utilities Commission (SFPUC).



Vegetable Field at The Garden Project Farm & Nursery

Key Components of the Nursery

The nursery is located on a 140 acres site in San Bruno, CA at the San Francisco County Jail #5. It has a main building which includes an office, kitchen and storage space. Outside the building, there is a small parking lot and a dining area for volunteers. The nursery also has a greenhouse and a shade house but the shades have been removed. Outside of these two structures are the open yard spaces where native plants are grown. There is also a storage building close by. When the plants are ready to be planted, they are taken out to the vegetable farm area and planted. To support the nursery, there is also a large soil mixing area.



Shade house with the shades removed

Nursery Operations and Management

(i) Funding Development and Operational Cost

The nursery is funded largely by the San Francisco Public Utilities Commission (SFPUC) and through public donations. The Sheriff's Department is the land owner at the San Francisco County Jail and allows the use of the land outside the jail complex for the nursery and farm.

(ii) Staffing and Volunteer Program

The Garden Project is managed by a nursery and farm manager who is on the staff of the Sheriff's Department. The nursery has 15 full-time staff that run the operations which include participants from the Earth Stewards Program. The program has two target groups, lower income young adults attending college and at-risk high school students. The program makes available a stable labor pool while providing income generating and skill developing opportunities for participants. In the summer, as many as 300+ high school students help out at the nursery and carry out care and maintenance work around the natural areas owned and operated by the SFPUC during the rest of the year. There are also plans to add 2 to 3 part time staff in the coming year. These positions are funded by the SFPUC.

(iii) Nursery Operations

The farm grows vegetables as part of their nutrition education program and delivers fresh organic vegetable gaily to various food pantries and meal providers around the city. The nursery element grows native plants to be used in the rehabilitation and enhancement of natural areas owned by the SFPUC. Two different production systems are utilized. The field system is utilized for the growing of vegetables and the container system is utilized for growing of native plants. About 60 to 70 tons of vegetables and 25,000 of native plants are produced annually. The seeds of these plants are mostly collected from around the area or through donation. A portion of the seeds were also purchased. Mortality of plants is estimated at less than 1%.



Storage building



Greenhouse

(iv) Water Source

The water serving the nursery comes from the Hetch Hetchy watershed and is stored in a tank located on a hill next to the nursery. The terrain difference allows the irrigation pipes, built in 1950s, to make use of gravity to supply water to the fields. There is a separate set of pipes which provide portable water to the jail and also the main building.

(v) Pest and Disease Management

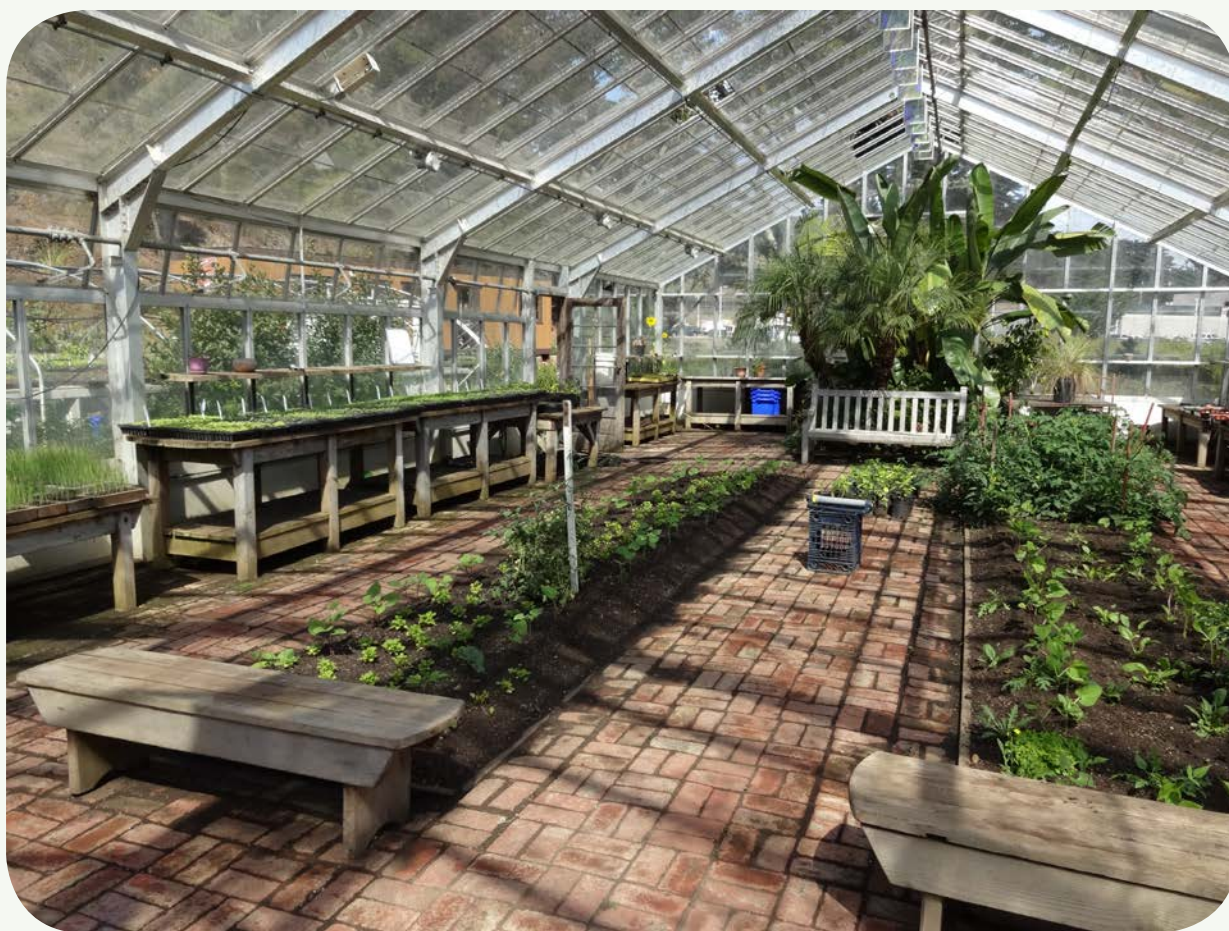
As the nursery is an organic establishment, no chemicals are used on site, instead the nursery makes use of natural predation and mechanical measures to prevent pest and diseases. For instance, fences are built around the field to prevent grazing by deer. Vegetables that are susceptible to beetles at a certain life stage are harvested before damage occurs.



Main office building



Soil mixing area



Inside of greenhouse

Challenges faced by Nursery

As a non-profit organization, resources are extremely limited. For example, the irrigation system is from the 1950s and is not updated to the latest technology. With limited funding, the nursery also faces a shortage in stable ongoing funding to ensure stable staffing operations.

Another major challenge faced by the nursery is grazing by the deer population in the vicinity. The deer damage the vegetables and native plants. The nursery has tried to control this by placing plants that the deer do not feed on in unfenced areas and putting fences up in vulnerable areas to prevent the deer from entering.

Opportunity

The Garden Project has expressed interest in working with the City and Friends of the Urban Forest on a Street Nursery proposal. During the field visit, they also identified a possible location for the street tree nursery. The site is gently sloping and will be able to tap on the existing water supply and also the various infrastructures already in place to support the Garden Project Nursery.



Site identified by the Garden Project for proposed street tree nursery



Existing storage shed that could be transformed to support a street tree nursery

Presidio Nursery (San Francisco, CA)

About Presidio Nursery

The Presidio Nursery was established in 1995 through a collaboration between the Presidio Trust, National Park Service and Golden Gate National Parks Conservancy to support habitat restoration work within the Presidio. It is primarily a native plant nursery with some production of native trees for planting within Presidio itself.

Facilities at Nursery

The nursery together with its educational garden is estimated to be about 4 acres. The nursery consist of a head house that is connected to its greenhouse, a large shade house with 42 tables that can hold about 80,000 plants, storage sheds for equipment and an indoor and outdoor volunteer area.

Nursery Operations

(i) Operations

All plants in the nursery are on a 1-year production cycle starting from February each year in a container nursery system. From February to April, the nursery starts sowing and germinating seeds. When the seeds are germinated, they are moved to the shade house for the next 6 months (May to October) until the next rainfall before they are planted (usually in October). After the plants are moved to their permanent site, the team then begins sourcing and preparing seeds for the next year. This production cycle also applies to the 300 Monterey cypresses that are grown at the nursery.

The seeds for the plants and trees are picked within the Presidio but the nursery has been expanding to outside the Presidio to increase genetic diversity. About 80,000 plants and trees are grown at the nursery. In addition to the Monterey Cypress, the California buckeye, Coast live oak and Wax myrtle are also grown in the nursery.



Inside of greenhouse



Storage area within head house for sterilized soil



Shade house



Storage Facilities



Trees grown at the Presidio Nursery

(ii) Water

The nursery is currently using water from the City for irrigation purposes. Within the greenhouse, irrigation is controlled through a temperature gage that will water the plants automatically at 70 degrees Fahrenheit. However, the nursery manager highlighted that this is not an ideal system as the temperatures in San Francisco are unpredictable and there are instances where the plants are either not watered sufficiently or are over-irrigated. The nursery has since turned the system off and is watering by hand. They are also looking into adopting a vapor pressure deficit control system instead.

The nursery is also undergoing a series of facility upgrades. These include a newly completed shade house and an upgrade to the plumbing and sewage system. New pipes and drainage systems have been installed to allow for the nursery to recycle storm and irrigation water. There are also plans to put in a wetland system as part of the transition from the use of City water to recycled water.

(iii) Pest and Disease Management

The nursery has a strict disease control regime which includes sterilizing all soil medium which is stored in the head house. Shoes are also sterilized before entering the greenhouse to ensure that diseases are not brought in through contact with shoes. Plants are also stored on tables which reduce spread of disease through the back-splash of water from the ground into the pots. The spread of disease is also controlled by ensuring that plants do not stay in the nursery longer than a year as the risk increases with the length of stay. For pest management, there is higher tolerance as long as the plants remain functional and healthy despite their appearance.



Container storage



New drainage system for collection of irrigation water for reuse



Volunteer Area



Classroom



Education Area



[HTTP://URBANFOREST.SFPLANNING.ORG](http://urbanforest.sfplanning.org)