# City of St Augustine Beach, Florida

# Urban Forest Management Plan

# 2019


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**APPENDICES**

# Executive Summary

The City of St Augustine Beach has retained the services of Legacy Arborist Services (LAS) to prepare an Urban Forest Management Plan for the city. Overall, this plan is intended to provide guidance and information to the City Department of Public Works and to the City Sustainability and Environmental Planning Advisory Committee (SEPAC) who provides input to the DPW and the City Council regarding the management of trees.

To prepare this plan, LAS completed an inventory of all trees on City rights of way and public parks, as well as an inventory of potential planting spaces. The inventory includes 2138 standing trees and 353 tree planting spaces, mostly large spaces. Cabbage palms comprise over 50% of the city's tree canopy, and Live Oaks comprise another 30%. The vast majority of trees on public property pose a Low risk to people and property, but some have been identified by priority as needing pruning or removal in the near future.

The inventory data indicates the need for the City to diversify the tree species population on public property as opportunities arise to do so. Increasing the percentage of hardwood trees in the population will also increase the value of the *ecosystem services* that the public tree population provides. Ecosystem services include the amenities that the city's tree population provides to community residents and visitors and can be described in both ecological and economic terms.

The city's public trees provide ecosystem services in the amount of approximately $16,000 annually, which could be significantly increased by planting more hardwood trees. Keep in mind that this figure represents a small fraction of the ecosystem services generated by the entire city tree population, both public and private. The current ecosystem services value, however, should justify carrying out an active management program for the city's tree canopy.

LAS arborists also conducted an historical tree canopy analysis for the entire area of land and water within the city limits. The current city tree canopy cover is 38.5% which compares favorably with similar cities in the area. Better than that, the canopy coverage has increased at a rate of 8.8% since 2010. Retaining large canopy trees in a healthy condition is the best way to continue this trend.

The plan presents some general observations that LAS arborists made while conducting the inventory, with input from local residents and city officials. The first priority should be to focus on pruning and removing trees identified in the database as the highest priority for treatment. As defective trees are removed, they will create additional planting spaces for replacement trees. The plan also includes suggestions for improving the success of tree planting projects, protecting larger trees during construction, planting the right trees in the right places to reduce infrastructure conflicts, proper pruning of trees, and reducing the number of palm trees growing under electrical conductors.

The plan also contains proposed strategies for educating the citizens of St Augustine Beach regarding the value of their urban forest and the need to properly care for trees on public and private property. SEPAC would coordinate these efforts with support from the City Communications and Events Coordinator, Public Works Staff, St Johns County Cooperative Extension Service, the Florida Forest Service, and interested non-profit groups. LAS arborists would continue to make themselves available to provide advice to the City as they implement these educational initiatives.

LAS arborists analyzed the provisions of the City Code of Ordinances which relate to trees. The current procedures for property owners to obtain a tree removal permit in Article V seem reasonable and should effectively protect the city tree canopy if they are enforced. They should not have to be significantly revised to accommodate the recently enacted Section 163.045 to the Florida Statutes which relaxes permitting requirements for residential property owners. The plan does include recommendations to make tree landscaping requirements in Article VI more effective. Increased protection measures for residual trees during land clearing activities are recommended for inclusion in Article III Chapter 15.

Increasing the storm resiliency of the urban forest is important for any coastal community. The City DPW has responsibility for restoring access on City streets following the storm, as well as managing the disposal of storm debris. St Augustine Beach also needs to take advantage of all potential opportunities for FEMA reimbursement of their debris disposal expenses. The plan includes storm management strategies before and immediately after the storm, as well as strategies for managing damaged trees and replanting areas which become devoid of canopy.

The plan concludes with a list of existing public tree species in St Augustine Beach, recommended trees of various sizes for planting, a glossary of urban forestry terms, and a list of additional urban forestry resources. The final section, **Managing Your Urban Forest**, is intended to serve as a supplement to the City's *Urban Forestry Standards and Specifications Manual,* which is included as part of the Land Development Code.

Legacy Arborist Services is proud to have been chosen to prepare this plan and respectfully submits the completed plan to the city at this time.

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# Introduction

**What is an Urban Forest?**
All trees residing within the geographic boundaries of a city comprise their urban forest, including those located on both public and private property. More specifically, the urban forest includes trees located in parks, cemeteries, road rights of way, other public spaces, wetlands, residential yards, gated communities, commercial properties, office complexes, educational facilities, and industrial areas. The urban forest includes trees that either stand alone, grow in clusters, or comprise a part of a forested tract of undeveloped land.

**Why Trees?**
The benefits that the urban forest provides to the residents and visitors of the City of St Augustine Beach can be categorized as Environmental, Economic, Social, or Communal**,** described by the International Society of Arboriculture (ISA) on their *treesaregood.org* website.[1] The 2007 plan elaborates on each of these amenities to where it will not be necessary to repeat those descriptions in this plan.

This plan, however, will introduce a new and very important term called ***Ecosystem Services***. Ecosystem Services include the amenities that the city's tree population provides to community residents and visitors. These amenities can be described in both ecological and economic terms. They include the following, among others:

- Air Pollution Reduction
- Carbon Storage
- Energy Conservation
- Visual Buffers
- Health Benefits
- Increased Real Property Value
- Stormwater Reduction
- Temperature Moderation
- Aesthetics
- Wildlife Habitat
- Social Benefits

***Ecosystem Services*** *include the amenities that the city's tree population provides to community residents and visitors. These amenities can be described in both ecological and economic terms.*

This plan includes the results of an Ecosystem Services Analysis that quantifies the amenities provided by the trees on public property in St Augustine Beach. Larger *canopy* tree species provide greater amounts of these ecosystem services and should be planted or retained wherever adequate space is available.

Keep in mind, however, that the majority of the city's urban forest resides on private property, where individual property owners manage the trees. Consequently, privately owned trees provide considerably more ecosystem services benefits to both the surrounding community and the owners themselves. Wherever possible, St Augustine Beach city officials need to encourage

private owners to retain canopy trees through a combined strategy of educational initiatives and minor regulations.

Ecosystem services include the ability of the local tree population to sequester and store carbon, which can help to offset the impacts of climate change. Coastal communities are particularly vulnerable to these impacts including sea level rise, more intense storms, increased temperature extremes, and variations between drought and flooding. The accompanying photo illustrates how sea level rise has already destroyed coastal forests on Jekyll Island, Georgia. Planting trees and maintaining a healthy tree canopy can significantly help to mitigate these impacts. Planting trees with higher salt tolerance closer to the coast will be especially helpful.

Sea level rise has destroyed coastal forest on Jekyll Island, Georgia

Ecosystem services also include the tree population's ability to reduce both the volume of stormwater runoff and the pollutants contained in that stormwater. This in turn reduces necessary city expenditures for stormwater containment structures and stormwater treatment facilities. The biological processes of evapotranspiration and interception significantly reduce the amount of stormwater that the nearby soils must absorb and reduces the sheet flow which causes erosion and sedimentation. These processes will also help to mitigate the impacts of impending future sea level rise. Economically, the stormwater mitigation functions that trees provide are the most valuable ecosystem service that trees provide to a developed community.

**Why an Urban Forestry Program?**

Trees growing in a natural forest environment require minimal management. They have unlimited space to extend their roots, free from disturbance, and the roots receive an unlimited supply of water and oxygen. The trunk and limbs take on a sturdy structure because their proximity to nearby trees causes them to grow tall and straight. Tree failures do occur, but damage to people and property usually does not result from those failures.

By contrast, trees in the urban environment face a number of challenges if they are going to survive and thrive. Urban soils are often disturbed and have limited fertility because they have limited organic matter. Surrounding pavement and compacted areas significantly impede root growth and reduce available oxygen. As a result, roots may not have access to adequate water and nutrients. In a coastal environment, trees are also subjected to salt spray, saltwater intrusion, and more frequent flooding. Nearby construction activities can result in damaged roots. Reflected heat from pavement or excessive shade from buildings makes the environment even more inhospitable for trees. Unrestrained limb growth can cause unbalanced weight distributions

which result in tree failure. These factors can cause trees to fail from either the roots, limbs, or trunk, putting people and property at risk.

Tree species for planting in urban areas should be selected based on their ability to withstand these numerous factors and provide the most ecosystem services. Tree species are often selected for planting in urban settings where the climate and site conditions are not suitable for them. Native species are more acclimated to local environmental conditions and more resistant to local pathogens. Some native species which grow well under natural conditions, however, tend to fail when subjected to the stresses in the urban environment.

Trees in developed areas must receive regular active management to minimize risk to people and property. A community's infrastructure components such as roads, water lines, and street lights require regular maintenance to properly function. Likewise, trees should be regarded as ***Green Infrastructure*** that also require periodic maintenance by knowledgeable professionals to continuously provide benefits to the city. Adequate funding for qualified contractors and necessary equipment and tools is essential to effectively manage the urban forest.

Citizen support is crucial to the success of an urban forestry program. So, the urban forestry program needs an active educational component to make residents aware of the benefits they derive from their city's urban forest, understand the urban forest management practices that the City performs, and learn how to care for trees on their own properties.

**Goals of the City's Urban Forestry Program**

- Improve public safety
- Enhance the diversity and resiliency of the urban forest
- Maintain and increase the city's tree canopy coverage
- Increase the ecosystem services that the city's tree population provides
- Enhance the quality of life for residents and visitors to St Augustine Beach

**Purpose of this Urban Forest Management Plan**

- Inventory and map trees currently residing on public property within the city limits.
- Provide the city with background data and information on current tree populations.
- Conduct an Ecosystem Services Analysis to determine the value that the trees included in the inventory provide to the community.
- Inventory and map potential future planting sites and provide recommended strategies for planting these sites. Tree species with exceptional salt tolerance, flood tolerance, and species for smaller spaces will be emphasized.
- Conduct a citywide historical tree canopy analysis to determine changes to the city's overall tree canopy coverage.
- Develop recommended urban forest management strategies for the City to implement based on the above collected data.

# Evaluating the State of Your Urban Forest

**The Ideal Urban Forest**

Ideally, the urban forest in the City of St Augustine Beach should have a tree canopy which covers a continually increasing portion of the city, has a diverse mixture of tree species, a wide range of tree sizes and ages, a population of mostly healthy trees, and minimal conflicts between trees and infrastructure components such as sidewalks and powerlines. A number of metrics exist for evaluating the quality of the urban forest, some of which were utilized to prepare this plan.

A diverse tree species population will show more resilience when environmental stresses occur. Stresses could include drought or excessive rain, windstorms, or pests. Various tree species have different levels of susceptibility to sources of stress. Therefore, if the tree population has sufficient species diversity, then one source of stress such as an insect infestation can only impact a limited portion of the tree canopy. If species diversity is limited, however, then that insect attack could decimate a significant percentage of the canopy. This has happened over the past 15 years in much of the Northeast, where the Emerald Ash Borer has decimated the tree population in cities where ash species predominated the canopy.

To assess the quality of species diversity in a city's tree population, urban forest managers commonly reference the *10-20-30 rule* (Clark et al. 1997).[2] This rule suggests that cities set a goal of not having any single species (for example, Live Oak) comprise more than 10% of the total tree population; any single genus (for example, Oaks) comprise more than 20%; and no single family (for example, Oaks, Beeches, etc) comprise more than 30%. Planting projects should favor species that are not overly prevalent in the city tree population. Other considerations include suitability for the site, wind resistance (see the Storms section of this plan), pest tolerance, salt tolerance, and most capable of storing and sequestering carbon.

Size (diameter) distribution reflects (although not exactly) the relative ages included in the tree population and what future management practices need to be employed to promote the longevity of the tree canopy. Dr. Norman Richards in 1983 proposed a desirable diameter distribution for an urban tree population.[3] He suggested that trees with a diameter of less than 8 inches should comprise at least 40% of the total; established trees (9-17") no more than 30% of the total; maturing trees (18-24") no more than 20% of the total; and mature trees (greater than 24 inches) should comprise no more than 10% of the population. This ideal distribution provides an adequate number of younger trees to replace older ones as they succumb to mortality, without significant reductions in the tree canopy.

This should not be regarded as a mandate to remove mature trees that do not show signs of significant decline or remove healthy younger trees to make the population comply with the ideal distribution. It should, however, indicate the need to plant more trees in general if the population does not contain an adequate number of younger trees or plant more large sized maturing species if the population does not contain enough of them.

Data compiled while conducting a *tree inventory* can be used to evaluate these parameters and several others. This section describes the tree inventory, the tree canopy cover analysis and tree risk assessment, all of which can be used to evaluate the urban forest.

## So, How Does St Augustine Beach Measure Up?

### Tree Inventory

Trees on public property are city assets which have value and require maintenance. Therefore, it would benefit the city to maintain a database of publicly owned trees with attributes recorded for each tree as described below. The inventory would identify trees where failure appears imminent and city staff needs to take immediate action. Other trees with defects or infrastructure conflicts that do not pose an immediate concern can be prioritized and scheduled for future treatment. Personnel, equipment, and contractor funding can be allocated based on inventory information, and investments in additional resources to keep the urban forest safe and healthy can be justified.

Tree inventory data can also be used to help evaluate the overall "state of the urban forest." Species and age diversity for the city tree population can be compared with the standard parameters previously discussed for measuring a healthy urban forest. A significant percentage of trees in less than good condition could indicate a need for increased resources devoted to tree maintenance or better post-planting care for younger trees. A significant number of conflicts between trees and sidewalks or utilities may indicate a need for better location of future plantings or better accommodations for trees when designing adjacent infrastructure.

LAS arborists recorded the following attributes for each tree found in St Augustine Beach's streets and parks during June and July, 2019.

- Location (GPS coordinates, street address or park, proximity to street, etc.)
- Species
- Diameter at Breast Height (DBH), Number of Trunks
- Total Height
- Available Rooting Space
- Condition of Limb Structure and Foliage
- Presence of Pest Problems and Physical Defects
- Conflicts with Utilities, Sidewalks, and Other Infrastructure
- Recommendations and Immediacy for Future Management Practices
- Overall Risk Rating

Field tools for tree inventory data collection can include a diameter tape, logger's tape, and clinometer or similar device to measure tree height, such as those pictured here. A local tree identification book is also helpful to keep within easy access and perhaps a rubber mallet to check for decay in the trunk.

Field personnel used specialized *Tree Plotter* urban forestry software housed on hand held GPS enabled tablets to record the data. The tree locations were displayed with recent digital imagery in the background. Trees are color coded by either species, size, condition, or management recommendation. Data for individual trees can be easily accessed and labelled.

The inventory data for St Augustine Beach has been exported into both an MS Excel spreadsheet and GIS shapefiles and provided to city officials. The 2019 St Augustine Beach tree inventory included a total of 2138 trees. This practically doubles the 1,097 trees included in the 2007 tree inventory. Either additional areas were included in this inventory; or additional trees have been planted since then; or we inadvertently included some trees that were actually on adjacent private property; or a combination of the above. In some instances we did deliberately include trees adjacent to the right of way which appeared to pose potential hazards to the street.

The following section summarizes the most significant tree data parameters.

*Tree Species Profile*

- 54% Cabbage Palms
- 30% Live Oaks
- 4% Redcedars
- 2% Laurel Oaks
- 10% 34 Other Species

The Appendix of this plan contains a total list of species included in the inventory. Cabbage Palms and Live Oaks predominate the tree population in public spaces. Both species are native to the area and well adapted to the local climate and site conditions. Cabbage palms are ideally suited to small planting spaces and contribute to the *Florida Beach* environment that the city would like to enhance. Several have been planted as memorials to departed local citizens.

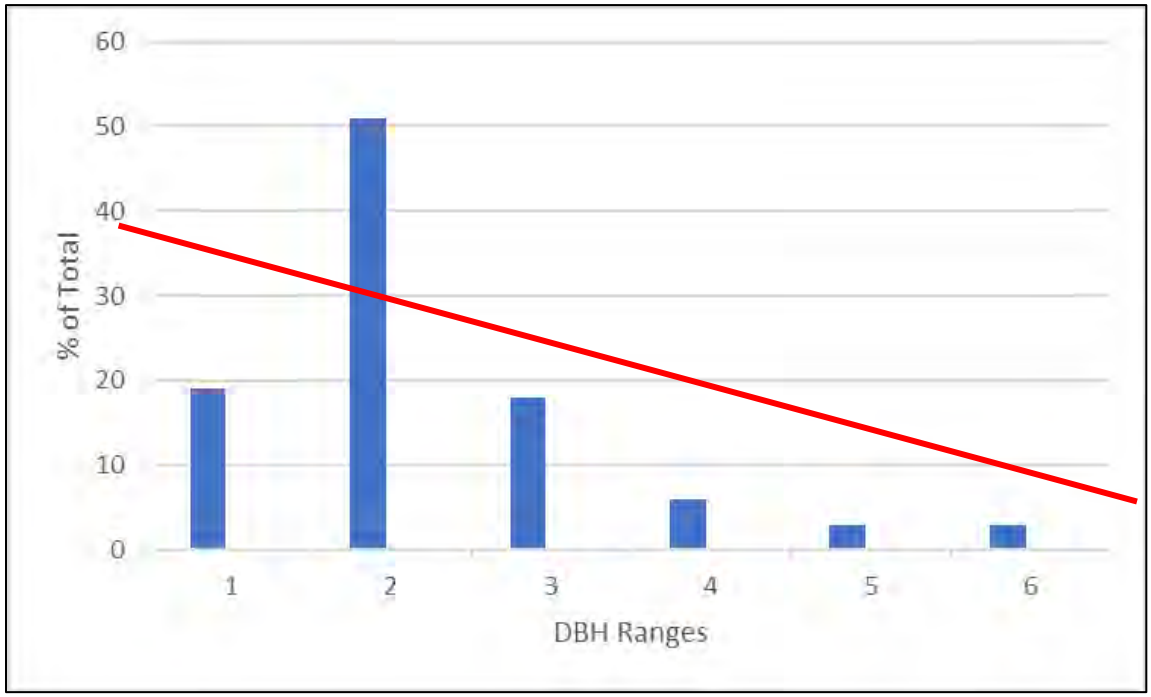
On the other hand, the predominance of these species does have some drawbacks. As previously stated, a particular pest could eradicate a significant portion of the city tree population if either of

these two species becomes vulnerable to that pest. Currently, *Lethal Bronzing* is threatening the cabbage and date palm populations within a 75 mile radius of Tampa. This is a phytoplasma disease spread by a certain beetle species originating in Asia. If Lethal Bronzing spreads to the St Johns County area, each tree would have to be vaccinated three times each year at a cost of about $50/tree for each injection.

Wholesale removal of this species is not recommended. Future plantings of Cabbage Palms should be limited, however. To enhance diversity, some expanses of this species could be replaced in the future with small hardwood tree species. This plan recommends alternative species to plant in smaller spaces instead of these palms, as well as other canopy hardwoods to plant as alternatives to live oak.

*Age/Size Distribution*

The diameters of all trees in the inventory were measured at a height of 4.5 feet (breast height). If the tree forked below that height, the diameter was measured at the narrowest location below the fork. The accompanying chart illustrates the size distribution for St Augustine Beach's public tree population. The red line illustrates what the chart would look like if the tree sizes in the population fit Dr Richards' previously described distribution. Class 1 represents the smaller diameters and Class 6 represents the largest ones.



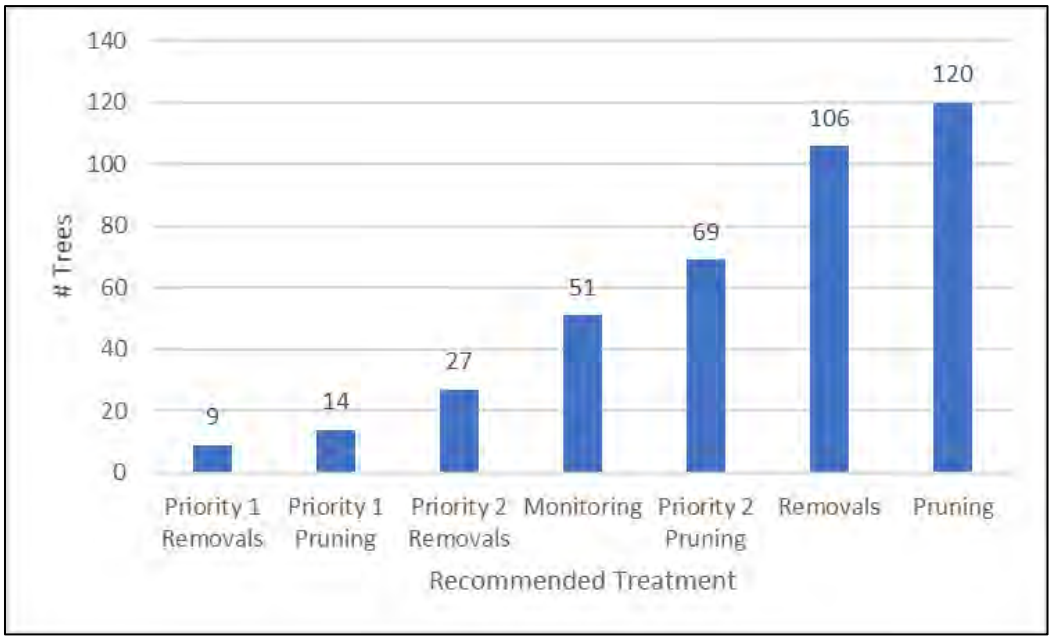

With the exception of the two smallest size classes, this distribution is pretty much in line with what Dr. Richards has recommended. Class 2 represents the 11-15 inch diameter trees which is occupied by most of the Cabbage Palms. The low percentage in Class 1 does indicate a need for additional new tree plantings sometime in the future.

*Recommended Treatments*

LAS arborists recommended treatments for 396 trees in the city population which were classified as follows:

- Priority 1 Pruning or Removal: Trees which contain defects that would warrant treatment within the next six or so months.
- Priority 2 Pruning or Removal: Trees which contain defects that would warrant treatment within the next one to two years.
- Removal: Trees that do not necessarily present a hazard but is either an invasive exotic species, resides in a poor location, conflicts with the growth of a more desirable tree, or will probably fail in the near future without impacting a target.
- Pruning: Usually applies to planted trees less than 25 years old. Tree does not present a hazard but has structural problems that will result in failure as the tree grows larger.
- Monitoring: Applies to mature trees which do not require removal and would not benefit from pruning but have minor defects which are worthy of periodic attention.

The following chart summarizes the number of trees in each of these categories that were recommended for treatment.




Treatment recommendations for the other 82% of the tree population include a few trees needing planting stakes removed, a girdling root removed, additional irrigation of newly planted trees, or application of a Tree Growth Regulator (described later in more detail). For the most part, no treatments were recommended.

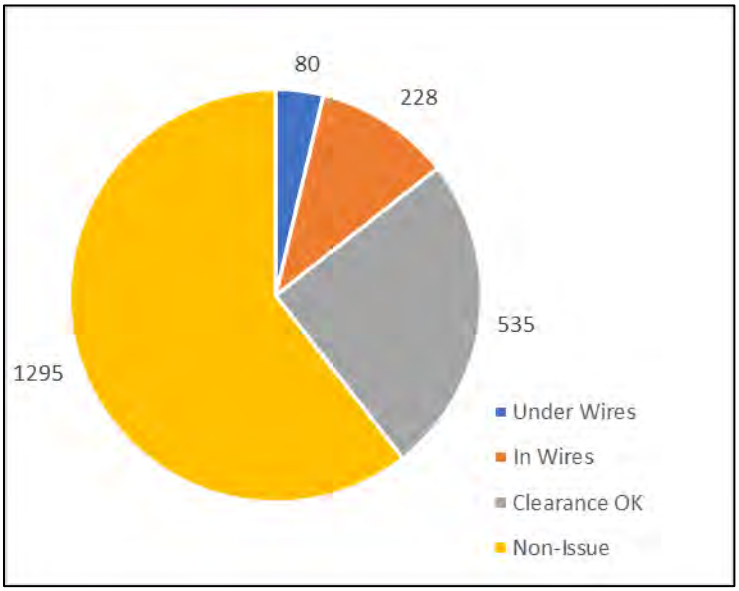
*Risk Rating*

LAS arborists evaluated each tree according to the ISA Tree Risk Assessment Protocol (TRAQ) Level 1. This takes into account both the condition and the location of a tree in proximity to a target. The plan will describe Tree Risk in more detail later.

**No** trees received a risk rating of *Extreme* and **98%** of the tree population received a risk rating of *Low*. Only **eight trees** received a *High* risk rating and **42 trees** received a *Moderate* risk rating. The latter two groups are recommended for treatment in the near future.

*Conflicts with Overhead Wires*

The chart below summarizes the relationships between the trees in the inventory and overhead wires. Most trees (yellow) were not in close enough proximity to overhead electrical wires to consider the potential for clearance issues. Another **535 trees** (gray) have limbs in proximity to wires but have adequate clearance. A total of **80 trees** (blue) are located directly under wires but do not yet have conflicts with the wires. The remaining **228 trees** have fronds or limbs which have grown into the wires and need to be pruned or removed at some point. Some have grown into the lower telephone or cable television wires while others have grown into the conductors.




The problem trees usually include Cabbage Palms which were seeded directly under wires by the local bird population. Most of them are located on side streets on either side of Beach Blvd. One tree on private property was included because the owner says the fronds catch fire pretty much on an annual basis. Very few trees along Beach Blvd had wire conflicts.

*Other Clearance Issues*

**Sixteen trees** need to be pruned to provide adequate clearance for vehicle access; **seven trees** need to be pruned to provide clearance for pedestrian access; and **17 trees** have miscellaneous conflicts with signs, buildings, and other infrastructure.

**Tree Planting Space Inventory**

LAS arborists identified 353 potential tree planting spaces within the city limits as well as a small county property on the northwest corner of the junction of Pope Road and Beach Blvd. Criteria for selecting these planting spaces included full or nearly full sunlight exposure, no overhead wires or evidence of underground utilities, and adequate rooting and crown expansion

space for a tree in that size class. Planting space size criteria included the following.

| Planting Space Class | Minimum Area | Minimum Width | Distance Between Trees | # Spaces |
|---|---|---|---|---|
| Small | 50 sq ft | 4 ft | 10 ft | 79 |
| Medium | 150 sq ft | 7 ft | 20 ft | 72 |
| Large | 300 sq ft | 10 ft | 30 ft | 202 |

Planting spaces were classified based on the largest possible sized tree class that the available space could accommodate since large maturing species provide the most ecosystem services to the community. If desired, additional trees in a smaller size class could be planted in a given area based on the above criteria.

The 2007 Urban Forest Management Plan identified a number of potential planting spaces. These were located primarily along Pope Road, Mickler Blvd, 11th Street, 16th Street, and in the pocket parks in the vicinity of B Street and 2nd Avenue. Since then, short segments of these proposed sites have been planted (although not always successfully-more on that later). For the most part, however, these recommended sites are still available for planting and were included among the above named sites. Rather than recommending four specific species for these planting sites as the previous plan did, I have merely classified them by size and left the decisions on specific species to City officials.

The next group of tree planting spaces was selected from other travel corridors, common areas, commercial areas, and residential areas where the planting spaces were not in front of homes. The size or length of the available area determined how many trees were recommended for plantings.



Recommended Large Tree Planting Sites on Pope Road, 30 Ft Apart

The maps on the previous pages illustrate the locations of recommended potential planting sites in the city. Yellow are large sites; Orange are medium sites; and Red are small sites. Several of these proposed planting spaces are located in residential areas, primarily along Mickler Blvd and on the south side of town along Sandpiper Blvd, Ocean Trace Road, and Versaggi Drive. No more than one planting space per residential lot is recommended. Sites are positioned to avoid blocking existing specimen trees or distinctive landscape features.

It is recommended that the property owners be consulted before initiating tree planting projects in their front yards. Responsibility for both initial watering and long term care (primarily pruning) needs to be clarified, as well as potential responsibility for root damage to underground infrastructure or paving. The adjacent residents may do a better job of tree care than the City can do with their existing budget and manpower.

Providing trees to residents at no or minimal cost may be preferable to City tree plantings adjacent to private residential property. This would relieve the City of the responsibility for follow-up tree care and allow the City to focus resources on remediating defects in existing trees. Owners' objections to having a tree planted in front of their property would also be eliminated.

Residents have reacted enthusiastically to tree giveaway programs in other Florida cities. The City provides the trees, usually in the 15 gallon/1.5 inch caliper size class, in a variety of species. These are small enough for an adult to carry and fit into their car but large enough to be viable in an urban environment. Before taking possession of a tree, recipients should attend an educational event where they learn about planting site selection, site preparation, transportation, installation, irrigation, and post planting care. Some nearby cities can provide St Augustine Beach with guidance on how to conduct a tree giveaway, as described in the **Education** section of this plan.

Species selection is discussed under the **Ecosystem Services** section of this plan. Tree giveaways should only include species native to the area. For the most part, the recipients will not have the site limitations that City right of way plantings have. So, there is no reason not to plant natives, which are acclimated to local soils and climate and have inherent resistance to local pathogens.

City officials have proposed *gateway plantings* for two areas. One is located in the median behind the welcome sign at the junction of route 312 and Route A1A; the other is at the junction of Pope Road and Beach Blvd. During the July, 2019 meeting of the City's SEPAC Committee, however, members voiced concerns received from nearby business owners that trees in the median on the first site would impede the visibility of their businesses for west bound drivers on Route 312. SEPAC expressed a preference for instead applying for a grant from the Florida Department of Transportation Highway Beautification Council. The City could apply in October, 2019, and potentially implement the project in 2020-2021. The DOT district landscape architect would assist the city with a site design plan to submit for review. The Appendix of this plan includes recommendations for smaller tree species that might be appropriate for inclusion in the site plan.

The other proposed planting space is currently occupied by grass and could accommodate up to 17 large maturing species planted approximately 30 feet apart. The interior core of the planting could be planted in Baldcypress (*Taxodium distichum*) with the periphery planted with species such as Tupelo Gum (Nyssa sylvatica) and either Red (*Acer rubrum*) or Florida Maple (*Acer barbatum*). All are adapted to a site such as this one and will provide colorful and attractive foliage. The Welcome sign would probably need to be moved closer to the road, and the trees will survive the first couple of years better if some chemical control of the grass is performed one to two months before planting. A basic site plan for this area is included here.


**Ecosystem Services Analysis**

The value of the *ecosystem services* that the community receives from the trees in the inventory population can be calculated by processing the tree inventory data through the *iTree Suite* of urban forestry software, as described in the **Introduction** section of this plan. If the inventory is periodically updated, then these values can serve as testimony of the effectiveness of the city's urban forest management activities. This information can also be incorporated into publicity and educational materials to enlighten the public about the value of their urban forest and to garner citizen support for proactive urban forest management. The value of these ecosystem services can be compared against the cost to maintain these trees, and the results are usually favorable.

LAS arborists entered St Augustine Beach's tree inventory information into the US Forest Service *iTree Eco* urban forestry software to calculate the ecosystem services that the city's public trees provide to their residents and visitors. The program generated the following results for the ecosystem services that the program can measure.

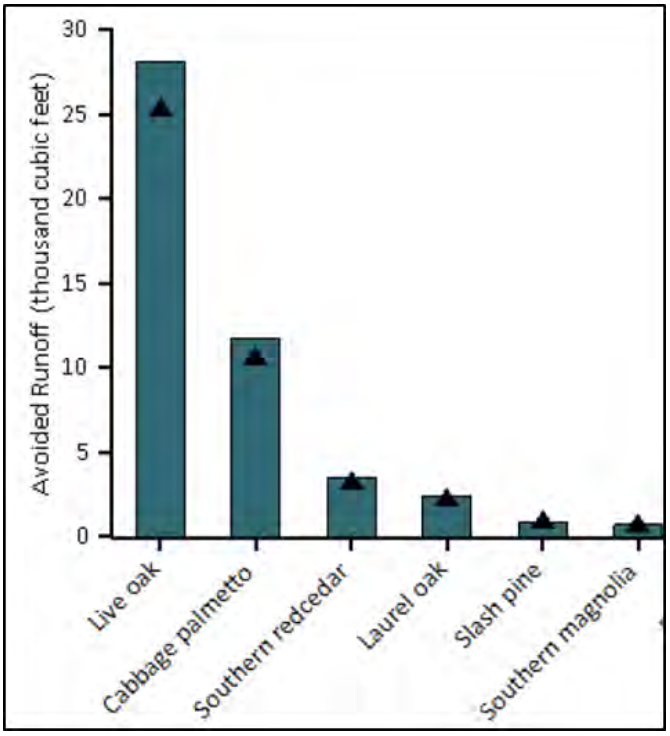
| Ecosystem Service | Quantity | Value |
|---|---|---|
| Air Pollution Removal | 1378 lb/yr | $7680/yr |
| Carbon Sequestration | 31 tons/yr | $5220/yr |
| Stormwater Runoff Absorption | 46,520 cu ft/yr | $3110/yr |
| Oxygen Production | 81.6 tons/yr | |
| | | |
| Real Estate Value | | $2.39 million |
| Carbon Storage | 992 tons | $ 169,000 |

The first four parameters are annual benefits. *Air pollution removal* includes particulate matter, ozone, carbon monoxide, nitrogen dioxide, and sulfur dioxide. *Carbon sequestration* includes the carbon that the trees absorb during photosynthesis. Stormwater runoff is simultaneously taken up through the root system and intercepted by the foliage. Oxygen is released from the leaf surfaces through photosynthesis.

The other two parameters are asset values which increase over time. The amount of carbon stored is the cumulative amount of carbon that the trees have sequestered during their lifetimes and retained within their woody tissue. The total real estate value for all inventoried trees is calculated using the standard Council of Tree and Landscape Appraisers (CTLA) equations for doing so. These formulas take into account the size, species relative value, and condition.

It's interesting to note on the chart below that the live oak population has more than twice as much leaf surface area as the cabbage palmettos, even though there are almost twice as many cabbage palmettos. The live oaks are generally larger than the cabbage palms but they also have considerably more leaf surface area per tree and therefore provide a significantly higher amount of ecosystem services.

| *Species Name* | *Percent Population* | *Percent Leaf Area* | *IV* |
|---|---|---|---|
| Live oak | 30.0 | 54.3 | 84.3 |
| Cabbage palmetto | 53.8 | 22.8 | 76.5 |
| Southern redcedar | 4.1 | 6.8 | 11.0 |
| Laurel oak | 1.9 | 4.7 | 6.6 |
| Slash pine | 0.8 | 1.8 | 2.6 |
| Southern magnolia | 1.1 | 1.4 | 2.5 |
| Mexican fan palm | 1.5 | 0.6 | 2.0 |
| Drake chinese elm | 0.8 | 1.0 | 1.9 |
| Queen palm | 1.4 | 0.4 | 1.8 |
| American elm | 0.2 | 1.0 | 1.3 |




Stormwater Runoff by Species, Total Tree Population

| *Species* | *Oxygen (ton)* | *Gross Carbon Sequestration (ton/yr)* | *Number of Trees* | *Leaf Area (acre)* |
|---|---|---|---|---|
| Live oak | 68.36 | 25.63 | 638 | 36.03 |
| Laurel oak | 4.92 | 1.84 | 40 | 3.13 |
| Southern redcedar | 2.16 | 0.81 | 88 | 4.53 |
| Southern magnolia | 1.16 | 0.44 | 24 | 0.92 |
| Slash pine | 0.86 | 0.32 | 18 | 1.18 |
| American elm | 0.50 | 0.19 | 5 | 0.69 |
| Drake chinese elm | 0.48 | 0.18 | 18 | 0.69 |
| Cabbage palmetto | 0.46 | 0.17 | 1,144 | 15.11 |
| American sycamore | 0.45 | 0.17 | 6 | 0.58 |
| Carolina laurelcherry | 0.41 | 0.15 | 9 | 0.30 |
| Common crapemyrtle | 0.41 | 0.15 | 9 | 0.14 |
| Sugarberry | 0.41 | 0.15 | 4 | 0.34 |
| Chinaberry | 0.16 | 0.06 | 1 | 0.14 |
| American holly | 0.15 | 0.06 | 8 | 0.09 |
| Red maple | 0.15 | 0.05 | 3 | 0.17 |
| Dahoon | 0.09 | 0.03 | 4 | 0.05 |
| Black cherry | 0.09 | 0.03 | 2 | 0.06 |
| Goldenrain tree | 0.09 | 0.03 | 1 | 0.07 |
| Sea grape | 0.07 | 0.03 | 1 | 0.06 |
| Water oak | 0.05 | 0.02 | 2 | 0.04 |

The previous three charts illustrate how much less oxygen production, carbon sequestration, and stormwater absorption the Cabbage Palmettos provide as opposed to the Live Oaks, which emphasizes the advantage of planting hardwood tree species instead of palms if the city wishes to optimize the ecosystem services they receive from their public tree canopy.

*Species Selection for Carbon Mitigation*

The US Forest Service concluded a study in Orlando in 2007[4], to determine the capability of the predominant tree species in the area to generate ecosystem service benefits, including carbon sequestration. They compared annual carbon sequestration rates per tree for three common tree species 20 years after planting, a small, medium, and large species. The following chart summarizes the results. In order to provide consistent comparisons, LAS arborists recently redid the analysis using the latest version of *iTree Eco* urban forestry software.

| **Species** | **Diameter at Breast Height** | **Carbon Sequestered (lb/yr)** |
|---|---|---|
| Live Oak | 14 | 54 |
| Magnolia | 10 | 30 |
| Crapemyrtle | 8 | 21 |

Note that the magnolia sequestered 43% more carbon than the crapemyrtle, and that the live oak sequestered 54% more carbon than the magnolia. These results illustrate the importance of

creating adequate space to plant large canopy tree species whenever possible to optimize the amount of carbon sequestered and other ecosystem services provided by the tree canopy.

The species type also matters. The accompanying chart compares species that are either commonly planted or grow naturally within the city limits of St Augustine Beach. All species have 20 inch diameters at breast height in this example. An analysis of these species in *iTree Eco* illustrates that the species with the greatest amount of leaf surface area mitigate the greatest amount of carbon and generate the highest amount of ecosystem services.

| Species | Carbon Sequestered |
|---|---|
| Live Oak | 92 lb/yr |
| Slash Pine | 44 lb/yr |
| Sabal Paln | <1 lb/yr |

Note that the amount of carbon sequestered by live oak is more than double that for the conifers. Carbon mitigated by the palm species is negligible because of their limited leaf surface. This analysis supports including a higher percentage of broadleaf canopy hardwoods over conifers or palms when planning urban tree planting projects. Palms and conifers do have their place in the urban landscape and can provide a number of visual amenities to their immediate environment by their presence. Carbon sequestration rates for additional species can be measured using iTree Eco software, which can be downloaded for free at www.itreetools.org.

***Mature Canopy Hardwoods Sequester Significantly More Carbon than Conifers or Palms.***

The importance of planting smaller species, however, should not be minimized. These species provide important habitat components for a number of wildlife species. They also contribute to the vegetative species diversity where they are allowed to grow. Nursery stock should have a caliper diameter of at least 1.5 inches diameter if they are to be planted along street rights of way or in parks which receive a high number of visitors. Smaller trees can be purchased and then grown to acceptable size at a city managed nursery if desired. Or, seedlings can be planted in natural areas with minimal human traffic. Private homeowners should always be encouraged to plant native tree species. The local chapter of the Florida Native Plant Society can provide recommendations for smaller species suitable for planting in this area, in addition to the ones listed in the Appendix of this plan.

FEMA does not yet accept the loss of ecosystem services as part of the lost value of a storm damaged tree. The 10th edition of the CTLA Guide to Plant Appraisal (listed in the Reference section of this plan), however, includes ecosystem services in their calculations of a tree's real estate value. Private property owners should utilize an ISA Certified Arborist who is familiar with these appraisal procedures to provide the necessary information to insurance providers on their behalf.

If local officials or citizens would like to re-run these analyses themselves, they can download the software from www.itreetools.org at no cost. The *iTree Eco* file used to run this analysis has been provided to the City under separate cover. Users can modify the data as trees are added or removed. They can also use the online module called *iTree Design* to calculate the ecosystem

services provided by an individual tree. Inputs include species, diameter, and proximity to a building.

**Tree Canopy Cover**

The tree canopy cover represents the percentage of total land within the city limits that is covered by tree limbs and foliage. To quote Dr. David Nowak of the US Forest Service, *"Tree canopy cover is a critical measure of the urban and community forest resource. Tree canopy cover gives a broad indication of the overall forest resource and its associated benefits."* [5] This means that cities with a higher tree canopy coverage are receiving a greater amount of ecosystem services from their urban forest. People instinctively experience a heightened sense of well-being when they visit a city or a neighborhood with a higher tree canopy coverage. Anecdotally, residents of South Florida who visit cities like Gainesville or Tallahassee where the tree canopy coverage is greater frequently report experiencing this feeling.

Tree canopy cover serves as a convenient metric for the health of the urban forest if periodically evaluated over time. It also indicates the effectiveness of city ordinances intended to retain tree canopy. Canopy loss can result from significant storms, pest epidemics, and development activities. Increases in canopy primarily result from retaining mature canopy trees whose crowns expand over time. Planting new trees also increases tree canopy. Typically, however, it takes at least 10-15 years before the crowns of newly planted trees expand enough to be measurable. This is not meant to discourage tree plantings; it simply emphasizes the importance of retaining existing trees during development activities.

Some loss of tree canopy usually results as the human population increases. This does not mean, however, that tree canopy losses are inevitable. For example, Gainesville experienced a slight increase in tree canopy cover between 2006 and 2015,[6] even though their population increased during that time period.

Development which minimizes the creation of *impervious surfaces* (concrete, asphalt, etc) conserves spaces for potential new tree plantings and provides adequate rooting space for existing trees. Minimizing the creation of these surfaces also encourages infiltration of stormwater and reduces the need for new stormwater structures.

There is no one ideal tree canopy coverage which applies to all cities. Each city should first measure their current canopy coverage using recent aerial imagery and software designed to analyze the imagery for this purpose. Then, perform the same analysis using imagery from approximately 10 years ago and compare the results. This information will help the city determine if they need to implement new measures to retain and increase their tree canopy coverage.

Once the city calculates their current tree canopy coverage, they should set a goal of achieving a measurable increase in canopy coverage (maybe 2%) every ten years through tree planting and protection initiatives. Retaining larger canopy trees and allowing them to freely grow in a healthy environment usually results in the greatest amount of canopy coverage increase. Tree plantings also help, but their contribution to the increase doesn't become apparent for some time.

LAS Arborists utilized *iTree Canopy* urban forestry software to compare St Augustine Beach's current tree canopy with their canopy coverage in early 2010. The software places 1500 random points throughout the city, and the tree canopy coverages at each of the points were compared for the two years. The study includes both public and privately owned land within the city limits. This historical tree canopy analysis yielded the results in the accompanying chart.

| Cover Type | 2019 | 2010 | % Change |
|---|---|---|---|
| Tree Cover | 38.5 | 35.4 | 8.80% |
| Shrub | 3.6 | 4.0 | -10% |
| Grass | 15.1 | 17.3 | -12.70% |
| Bare Soil | 1.9 | 2.7 | -29.60% |
| Impervious Surface | 31.3 | 31.0 | 1.00% |
| Fresh Water | 2.5 | 2.5 | 0 |
| Dune | 4.3 | 4.1 | 4.90% |
| Beach | 2.9 | 3.2 | -9.40% |

Shrub, bare soil, and grass cover types represent potential future tree planting spaces while the others are not available for tree planting. Impervious surfaces primarily include roads, parking lots, roofs, sidewalks, and driveways where trees cannot be planted and rooting space on adjacent plantable cover types is reduced. Most tree cover in St Augustine Beach is provided by hardwood species. Pines and palms combined account for less than 10% of the tree canopy.

Dune and beach acreages were also included in this analysis because suitable shrub and small maturing tree species could potentially be planted on the dunes. The area encompassed by these cover types is relatively minor. Analysis of the imagery, however, would indicate that changes in the acreages of these two cover types has mainly resulted from dune accretion rather than beach erosion. Increased stability of the dunes should be viewed as a positive trend.

City officials should be encouraged that the amount of tree canopy increased during the past nine years at an annual rate of almost one percent. Expansion of the crowns of canopy trees during this time period has accounted for most of the canopy increase. Canopy expanding to cover existing impervious surfaces helped to offset the creation of new impervious surfaces and removal of tree canopy during development. Although more impervious surface increases stormwater runoff, expanded leaf surface area decreases the amount of stormwater that ever reaches the ground. The city's urban forest is trending in a positive direction and hopefully can continue to increase tree canopy.

**Tree Risk Assessment**

Every tree poses some risk to nearby people and property by its mere presence, just as every automobile poses a risk to people and property when in motion. Eliminating all trees from the landscape would eliminate all risk, as would eliminating all cars from the highway. The value of the local tree population, however, far exceeds the risk the trees pose, just as the benefits that cars provide far outweigh their risk.

Risk of personal injury from trees is extremely low as opposed to other potential sources of harm. The British Centre for Decision Analysis and Risk Management (DARM) recently concluded that tree failures have a likelihood of *one in ten million* of causing a death in a given year. A total of 55 non-fatal injuries resulting from tree failures were reported in the United Kingdom during the study period, as opposed to 262,000 injuries from soccer balls.[7] Risks from

trees should not be ignored, but they should not be over-emphasized either. Most trees have a low risk, particularly if they receive periodic care. Communities like St Augustine Beach, however, need to do everything possible to minimize potential injuries or property damage caused by trees.

*Tree Risk Assessment* involves evaluating both the likelihood of a tree or tree part failing and the severity of the consequences that would occur in the event of failure. This term is now used as opposed to *hazard assessment*. A hazard now refers to a part of the tree (limb, trunk, root, etc) that could cause harm.

Arborists can conduct tree risk assessments at three levels. *Level 1 assessments* typically involve assessing large numbers of trees in a specified area to identify problems needing immediate attention. *Level 2 assessments* involve a 360 degree examination of the tree and the use of minor tools to evaluate defects. *Level 3 assessments* additionally involve aerial examinations and use of more sophisticated analysis tools. High value and historic trees typically receive Level 3 assessments. Detailed notes are made on the standard two page ISA TRAQ form during Level 2 and 3 assessments.

Tree risk ratings range from Low to Moderate to High to Extreme. A tree in a natural area away from trails or picnic areas could be in poor condition and about to fail but would still receive a Low risk rating since no targets exist in the tree's proximity. Likewise, a tree surrounded by significant pedestrian and vehicle traffic could receive a higher risk rating even though an identified defect has a lower likelihood of failure.

Possessing the TRAQ qualification lends credibility to the assessor's reports. When risk assessments are necessary, the city should utilize third party consultants with TRAQ qualification to perform tree risk assessments to provide adequate knowledge and objectivity to the process.

As previously stated, the recently completed tree inventory found that over 98% of the trees on public property in St Augustine Beach have a low risk rating and only nine trees have a high rating.

# Observations from the Inventory

Examining every tree on every street and in every park within the city limits of St. Augustine Beach has led LAS arborists to a few general observations about issues with the tree population that we recommend City staff address. Input from the city public works staff, members of SEPAC, and residents who have approached the arborists on the street with their concerns have also contributed to the information that is presented here.

**Care of Mature Trees**

St Augustine Beach has a significant number of large hardwood trees, particularly in the area between A and F Streets but also in some neighborhoods north of A Street. The primary concern is for trees located within the right of way, as well as those located on adjacent private property which could impact the right of way if they fail. Residents value the tree canopy and have expressed a desire to have the canopy trees in their neighborhoods retained. They have also expressed concerns about the condition of some trees near their homes which LAS arborists have confirmed with their own observations.

The tree inventory data provided to city staff documents the locations of trees needing treatment with priorities. The photos below provide examples of trees that need either pruning or removal in the near future. Laurel oaks should receive priority for needed pruning or removal since they generally have a higher likelihood of failure than live oaks. The live oaks, however, also need to receive treatment particularly if their failure could impact the right of way. If trees are located on private property but the canopy extends over the right of way, then the city has the right to prune their portion of the tree. This does, however, provide an opportunity to educate residents about the need for timely tree care and provide them with information about how to properly care for their trees.

Laurel Oak with Significant Trunk Decay, Needs Removal

Live Oak with a Decayed Limb Over the Road, Needs Pruning

Older trees do require special care. The contractor does not need to remove any more wood than necessary. The city should hire a tree care company who has an ISA certified arborist to oversee the pruning and ensure that they follow the universally recognized ANSI A300 pruning standards. The **Managing the Urban Forest** section of this plan describes these standards in more detail.

**Site Clearing Practices**

Regardless of the size or the species of a tree, the majority of the tree's root system lies within three feet of the soil surface. The tree may have a tap root, but most of the root volume spreads out horizontally from the trunk. This makes the root system vulnerable to damage during construction activities.

Damage to the root system can undermine the health of a tree even more than damage to the trunk or the limbs. Unfortunately, root damage usually does not leave a visible wound that the average person would recognize as a cause of tree decline. Often, this decline does not become apparent for one to five years after the construction activity takes place.

Operating equipment within the tree's Critical Protection Zone (CPZ) can physically injure roots and cause soil compaction which limits the ability of the root system to absorb rain water, oxygen, and nutrients in sufficient quantities to keep the tree healthy. Severing larger roots near the trunk, cutting an excessive amount of the root system, or applying an excessive amount of fill over the root system to change the grade can also result in tree decline. The worst case scenario would be for the root system to fail and the tree to unexpectedly topple over.

These activities can undermine the city's efforts to maintain their tree canopy. The **Managing the Urban Forest** section of this plan describes how to determine the size of the CPZ for a given tree and provides examples of practices to protect the root zone. City maintenance personnel should follow these practices when conducting any ground disturbing activity in the vicinity of a canopy tree. If construction activities are planned for private property where canopy trees are to be retained, the issuance of a site development permit should ideally be contingent upon the contractor implementing these tree protection practices. At a minimum, contractors should be informed about the importance of following these practices. By and large, they probably care about not impacting the tree's health or structural stability; they just don't possess the information on how to protect trees on the site.

The photo on the left on the next page shows an example of a canopy live oak in a new subdivision which is currently under construction and not included in the inventory. It is apparent that the foliage has died back considerably due to root injuries and the tree may succumb to mortality within the next couple of years. The other photo is from a residential lawn where clearing the lot physically injured the base of the trunk and has resulted in significant tree decline. This wound was probably not as apparent immediately after the lot was cleared. This further illustrates the need to educate land clearing contractors about tree protection.

This plan recommends that additional verbiage be added to Article III Chapter 15 of the City Code of Ordinances to mandate practices to protect a tree's CPZ during land clearing activities. These are described in more detail in the **Tree Regulations in St Augustine Beach** section.

Root damage has caused this tree to decline

Root damage from land clearing that has impacted the tree.

**Mature Trees in Residential Medians**

A number of residential subdivisions in the city have narrow medians containing large trees. The road systems for these residential areas were probably constructed several years ago, covering the majority of the trees' root systems with impervious pavement and limiting their access to water, oxygen, and nutrients. Some trees have remained healthy in spite of these conditions, but others are starting to show decline.

If the City wishes to retain these trees or ensure the success of replacement trees, a better root system environment needs to be created to help the trees in these medians survive and thrive. Sometime in the future, perhaps when the roads are due for re-paving, some type of pervious surface needs to be installed on either side of the median. The **Managing the Urban Forest** section of this plan includes suggestions for various pervious materials that could be installed. Vehicle traffic probably tends to be light in these neighborhoods, but the chosen material needs to be durable enough to withstand that level of traffic.


The **Managing the Urban Forest** section of the plan also describes the beneficial results derived from applying a *Tree Growth Regulator* to the root systems of trees that are under light to moderate stress. Basically, the TGR re-allocates carbohydrates to where tree growth above ground is reduced but the growth of fine feeder roots is enhanced.

The accompanying photo provides an example of one of these large trees growing in one of the medians described above. This tree is in better condition than most of the ones growing under these conditions. Branch dieback is evident on the left side of the canopy, however.

**Success of Tree Planting Projects**

Since 2007, the city has planted new trees in various parts of the city. SEPAC has also indicated a desire to plant additional trees. At this juncture, we would like to offer some suggestions to make future planting projects more successful.

The **Managing the Urban Forest** section of this plan provides detailed recommendations for how to successfully plant a tree to ensure short term survival and long term growth, including irrigation requirements for new plantings. In a nutshell, the city needs to ensure that either the contractor, city personnel, or committed volunteers take care of the following details.

- Provide the trees with adequate water. Results may improve if the installation contractor is held responsible for watering the trees for at least the first year. The photos below compare trees planted in a pocket park within the past year. The next door neighbor "adopted" the healthier looking tree and made sure it received frequent water. The other tree has received water exclusively from City crews.

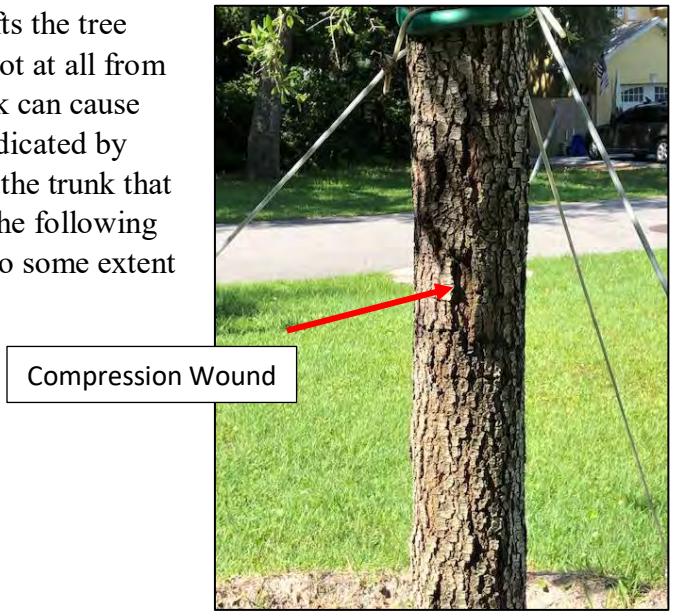
City Maintained Tree with Dieback

Resident Maintained Tree Looking Much Healthier

*Tree Diapers* are a newer alternative for watering newly planted trees in isolated areas. These devices are made from a material similar to a disposable diaper. The diaper is shaped like a large donut which fits around the base of the tree. Unlike a gator bag, however, the diaper absorbs rain water and can be placed under the mulch layer, where they refill themselves by capturing and holding rainwater. They release the stored water more slowly and evenly, and only need to be refilled during drought periods.

- Consider planting smaller nursery stock. For instance, plant trees with two or three inch caliper instead of four to six inch caliper trees like the ones pictured above. This will reduce the amount of necessary irrigation and also help avoid injuries to the trunk during installation.
- Remove all staking and strapping within no more than 12 months after installation. Strapping materials can constrict the flow of water and nutrients from the roots to the crown and can reduce the vitality of the tree if left in place too long.
- Make sure that the contractor plants the tree at the proper depth. This is extremely critical to the tree's long term vitality. Planting too deep restricts the amount of oxygen and rain water available to the roots and reduces the long term vitality of the tree. Lichens growing on the trunk is a sign that the tree was planted too deep, as is slower than expected growth. A visible *root flare* at the base of the tree similar to the bottom end of a dressmaker's mannequin indicates that the tree is planted at the proper depth. No flare indicates that the tree is planted too deep, and the photo to the right provides an example.

- Make sure that the contractor lifts the tree entirely from the root ball and not at all from the trunk. Strapping on the trunk can cause *compression wounds* that are indicated by sloughing bark and swelling on the trunk that results in tree mortality within the following year. This may have happened to some extent in the accompanying photo.




The city may want to consider having a private arborist oversee future tree planting installations to ensure they are properly completed. Or, a member of the public works staff could be trained to become a certified arborist and take on this role.

**Palms Growing Under Wires**

This is a widespread problem on city property and adjacent residential lots. Birds tend to feed on palm berries when they become ripe. Then, they sit on the wire while the seed passes through their digestive systems and drop to the ground below the wire where they germinate. As the palms grow, they cause conflicts with electrical conductors and other overhead utility wires. One tree on private property has fronds which catch fire from the conductors at least once each year according to the homeowner.

Perhaps someone who is in the business of harvesting and reselling palm trees could be invited to harvest at least some of these palms with no cost to the city. Unfortunately, several of them are nestled into the surrounding infrastructure to where mechanical extraction would be difficult. As opportunities arise, these palms could be sheared at ground line. However, some may have to be manually extracted from their location.

Another coastal Florida city *leans* their palm trees away from the wires when possible rather than totally removing them. They use trenching equipment to sever roots on the lee side of the tree and then pulls the tree to a 15-20 degree angle where future growth is directed away from the wires. It may be necessary to brace the tree with wooden supports for 1-2 growing seasons until the tree establishes new roots, as described for palm plantings in the **Managing Your Urban Forest** section of this plan.

Palm Tree Embedded in the Wires and Conductors

Palm with Burned Fronds from the Conductors

**Size of Tree Planting Spaces**

This appears to be a particular problem on private residential lots in the Seagrove subdivision on the west side of A1A. Live oaks were planted 10-15 years ago in planting spaces with an inadequate amount of soil for root expansion and inadequate space for the crowns to expand without hitting against the nearby buildings. As a result, the roots are causing damage to nearby

sidewalks and curbs. Meanwhile, the limbs need to be pruned to provide clearance in a manner that results in an inadequate sized crown and a trunk with no taper that cannot support the crown. This could eventually cause a decline in the health of the tree and could make the tree vulnerable to blow over if the area experiences tropical storms.

Ideally, these trees should be replaced with species from the Small or Medium species lists provided later in this plan. A species with an upright (decurrent) growth form would be best. In lieu of removal, the roots need to be cleanly pruned at the edge of the sidewalk. Then, root barrier needs to be installed at the edge of the sidewalk to direct future root growth below the concrete. The trees can also receive applications of *Tree Growth Regulator* as a root drench every other year. This treatment can be relatively inexpensive if the city does the application themselves. The growth regulator concentrate can be mixed with water at an 11:1 ratio and poured around the trunk. Doses per tree are low while the trees are still young.

Going forward, the choice of tree species to plant should be specified in the plans submitted for development review before a building permit is issued. If the site does not provide adequate space for the tree specified in the plan, then the species selected needs to be amended before construction begins. The **Tree Regulations in St Augustine Beach** section of this plan recommends that Section 6.06.03C be modified to allow species selection based first on the amount of available plantable space.

**Hardwood Tree Pruning Practices**

This happens primarily with trees growing on private property since the city does not appear to do much tree pruning. The **Managing the Urban Forest** section of this plan provides examples of a number of common tree pruning practices which can ruin the limb structure and make limb failure more likely in the event of a tropical storm. These practices can also cause the tree health to decline by removing an excessive amount of foliage. The accompanying photo provides an example of *lion tailing*, which reduces limb taper and makes it more likely that the tree will experience limb failure as it grows larger.

Article V of the City Code of Ordinances mandates that companies which perform tree care in the City need to be licensed and demonstrate a familiarity with the national ANSI A300 Standards for Tree Pruning. In the absence of a cadre of designated code enforcement officers to police these companies, however, the only viable strategy to address this problem is to educate homeowners on the proper way to prune a tree and to avoid allowing tree care companies to perform these bad practices on their trees. Homeowners should be encouraged to hire a tree care company that will have an ISA certified arborist on site to oversee the pruning. At a minimum, they should ask the company personnel if they know what *ANSI A300* tree pruning practices are and not hire them unless they can demonstrate that they can perform the pruning according to those standards.

The live oaks previously discussed in Seagrove have a number of structural flaws which need to be corrected with structural pruning if the trees are to be retained. This becomes more expensive and the likelihood of a limb failure increases as the trees grow in size. City staff should proactively address this situation in the near future with local residents and business owners.

**Palm Pruning Practices**

Palm trees have less leaf surface area than either conifers or hardwoods. For that reason, palms should not be pruned at all unless dead fronds or fruiting bodies need to be removed for safety and for desirable appearance. Live fronds should definitely not be removed. If they *must* be removed, however, the base of the remaining fronds should be no higher than 90 degrees to the ground. The accompanying photo provides an example of over pruned palms. Palm trees on city property appear to be properly pruned for the most part. Private homeowners need to be educated about proper palm pruning practices as previously described for hardwoods. They are not that difficult to properly prune.

Improperly Pruned Palm Trees

# Citizen Education and Engagement

Quote from the City of Miami Urban Forest Master Plan: *Developing a sustainable tree canopy requires educating the residents, local businesses and developers of the value of learning more about trees*[8]. The following information is based in part on input from City of St Augustine Beach staff, the City's Sustainability and Environmental Planning Advisory Committee (SEPAC) members, and Miami's plan for public engagement.

Successful efforts to improve St Augustine Beach's tree canopy depend upon making residents aware of the importance of trees in their daily lives. The city entities listed above wish to initiate a public awareness campaign to increase residents' knowledge regarding the importance of trees and their local urban tree canopy, as well as how to maintain and protect existing trees in the City of St Augustine Beach. The campaign would ideally involve the city's Communications and Events Coordinator, SEPAC members, other concerned citizens, the UF/IFAS Cooperative Extension Service of St Johns County, Florida Forest Service, and City Public Works staff.

The city should also solicit guidance from local non-profit groups whose mission includes environmental improvement. Examples from other cities include *Greenscape Jacksonville* and *Keep Orlando Beautiful,* both of whom regularly make significant contributions to their local urban forestry programs. Although these are larger cities with considerably more available resources than are available to St Augustine Beach, both groups should be willing to provide guidance to local leaders in St Augustine Beach. Local groups who could provide assistance include Anastasia State Park, Captain of the *Litter Gitter* Adam Morley, The Alligator Farm and Zoological Park, Matanzas Riverkeepers, the Sea Oats Chapter of the Florida Native Plant Society, and Friends of A1A Scenic and Historic Coastal Byway.

Topics to be addressed could include the following:

- Benefits that the tree canopy provides to local residents and visitors.
- Social benefits that trees provide to a community.
- What the city already does to maintain their tree canopy.
- Why residents should retain and plant trees on their home sites and building lots.
- Why residents should not be afraid to retain and plant trees on their properties.
- Preparing trees for the upcoming hurricane season.
- How residents can care for their own trees.
    - Protecting
    - Pruning
    - Planting
- How residents should go about hiring a company to care for their own trees.
- Sources of additional tree information for residents.
- Economic benefits of retaining and managing trees for business owners.
- Improving compatibility between trees and infrastructure.

Educational efforts could also focus on developers, land clearing contractors, realtors, and people in similar professions whose activities can impact community trees. Perhaps the City could put

on educational events where these professionals could earn continuing education credits. or have booths at existing events like Arbor Day and Government Week.

With the City Manager's concurrence, SEPAC could design *a logo and slogan* related to trees which they would use in all literature, outreach efforts, community workshops, and professional development programs related to the city's urban forestry program. A consistent and concise message linking all components of the program together would create a unified focus across all City departments and participating community organizations.

The City Communications and Events Coordinator has indicated that tree related information could be disseminated to the public through the following venues:

- The City e-newsletter, to which residents can subscribe. Timely tree information and events could be posted in the newsletter.
- The City Instagram account where photos with brief captions could be posted.
- The City Facebook account where links to more detailed information on community trees could be posted.

Utilizing these resources for the benefit of the City tree population will take a deliberate coordinated effort involving all the entities previously listed.

SEPAC has also expressed an interest in developing written materials to increase citizen awareness about trees. This plan provides pretty much all the technical information that board members will need to include in these publications. In addition, a number of online resources and sources of expertise are available to assist with these efforts. SEPAC could also create a tri-fold pamphlet to be placed on City Hall's flyer table for the public to take at their convenience, as well as handed out at public meetings.

SEPAC could also hold workshops where either local speakers with urban forestry expertise or speakers with more universal renown could deliver presentations. These events may attract more interested citizens if these workshops are held concurrently with an established local public event which regularly attracts a good crowd. Piggybacking tree events with established events could also increase the attendance at City Arbor Day celebrations, the tree giveaway events described in a previous section of this plan, or at the Seagrove Library discussions.

The City could also establish public demonstration areas where residents could view properly planted and pruned trees, or examples of how to protect trees during construction. A kiosk on the site would provide supporting information and the demonstration area could be periodically used for tree education events.

SEPAC could also enlist, with oversight from the City Manager, a cadre of volunteers and train them to be *Citizen Tree Rangers* or some similar name. This program could be modeled after the successful program conducted by the *Tree People* of Los Angeles. The goal would be to encourage both community leaders and the general public to actively participate in the management of *their* urban forest. New and existing partnerships with community based organizations could create an agenda of citizen education workshops to be held at parks and other public venues. Outcomes could include increases in tree planting on public and private

property, increased survival rates for these plantings, and more effective protection and care of existing trees. Youth groups such as the Boy Scouts could also be enlisted to help with this effort.

Participants who enroll in this program could receive an *information kit*. Kits could contain urban forestry related materials such as informational brochures and perhaps coupons from local hardware stores and nurseries to purchase trees at a discounted cost. Guidance on how to further "spread the word" about urban trees would also be included. Kits would be customized for adults, youth, and developers.

This group could also reach out to local businesses and institutions who have property with space for tree plantings. They could provide information on the benefits of the trees to the property owner and to the community, and the necessary information to establish new trees. The participants could also potentially assist the property owner with the tree planting and follow-up care.

LAS arborists will remain available to provide guidance to SEPAC and City officials in implementing this plan.

# St Augustine Beach Codes Addressing Trees

City regulations regarding **Tree Protection** are contained in Appendix A (Land Development Regulations) Article V (Resource Protection Standards) of the City Code of Ordinance. In addition, *The St Augustine Beach Standards and Specifications Manual* developed by Board Certified Master Arborist Chuck Lippi has been incorporated as a part of this ordinance since September, 2008. The appendix of this plan entitled **Managing Your Urban Forest** serves as a supplement to that manual.

Article V states that property owners need to obtain **a tree removal permit** from the Building and Zoning Department for the removal of any trees with a diameter at breast height (dbh) greater than six inches. *Removal* includes actual removal of the tree, removal of at least 33% of the limb volume, or disturbance of the site within the dripline of the tree that causes the tree to significantly decline in health.

The tree removal permit application must include a site plan with the location, species, size, and condition of trees to be removed and those to be retained indicated. The plan also needs to include measures that the property owner will employ to protect retained trees from damage during construction activities, consistent with the stipulations in the **Urban Forestry Manual**.

The city's Building and Zoning Department evaluates tree removal permit applications. The code states that a tree removal permit shall be granted if one of the following criteria are met.

- The tree is located within the proposed primary building pad.
- Retention of the tree will probably result in structural damage to either an existing or proposed structure.
- No reasonable economic use can be made of the property without removing the tree.
- Proposed improvements cannot be constructed without removing the tree.
- The tree blocks the installation of a solar energy system.
- The tree in question is a palm tree, with limits.

A higher level of Comprehensive Plan Review is also required for the following reasons.

- The tree is providing habitat to a designated listed endangered or protected bird species.
- The tree has a DBH of 30 inches and greater.

No permit is necessary if the following situations exist.

- The condition and location of the tree poses a significant risk to either people and/or property.
- It is in the "interest of the general public's health, safety, and welfare" to remove the tree.

Issuance of a permit would ideally be approved based upon a field inspection from either a certified arborist or landscape architect. If neither is available from city government, the property owner can enlist their own private arborist. If a permit is denied, the property owner does have

the right to retain the services of their own certified arborist to evaluate the denial of the permit and provide evidence as to any legitimate reasons to grant the permit.

The cost of a tree permit is $45, which can be waived if the permit is denied. Article V lists fines for removing trees without permit or paying a fee into a City Tree and Landscape Fund. The fund can be used for tree installation and related costs for purchasing equipment and supplies. Property owners can receive "after the fact" permits under certain circumstances.

Tree pruning within the city limits shall follow the nationally recognized ANSI A300 standards. Anyone wishing to conduct tree pruning in the city as a vendor must obtain a Tree Business License and certify that they will employ these standards during all tree pruning operations.

These standards shall also apply to the management of trees on public property.

As of July 1, 2019, the Florida legislature and the Governor enacted Section 163.045 of the Florida Statutes. That section is created to read as follows:

> *163.045 Tree pruning, trimming, or removal on residential property.—*
> *(1) A local government may not require a notice, application, approval, permit, fee, or mitigation for the pruning, trimming, or removal of a tree on residential property if the property owner obtains documentation from an arborist certified by the International Society of Arboriculture or a Florida licensed landscape architect that the tree presents a danger to persons or property.*
> *(2) A local government may not require a property owner to replant a tree that was pruned, trimmed, or removed in accordance with this section.*

While this legislation may at first appear ominous to those who wish to preserve trees in their local community, please first note that this section appears to apply only to existing privately owned residential properties. It should not apply to public parks or rights of way, multi-family, commercial, governmental, or industrial land uses, or to the development of previously undeveloped property for any land uses including residential property.

This legislation also should allow local governments to regulate the removal of trees on existing residential properties that do not *present a danger to persons or property.* A permit should still be needed to remove a healthy tree if the reason for removal meets any of the other previously listed criteria for issuing a tree removal permit and a permit should be denied if the reason for removal does not meet those criteria. The city should also be able to continue either collecting fines, mandating replanting, or requiring deposits into the Tree and Landscape Fund if healthy trees are removed without permit or without the certification of either a certified arborist or landscape architect.

Building and Zoning has indicated they intend to revise Article V to be consistent with Chapter 163.045 by early in Calendar Year 2020. Please be advised that the perspectives stated in the previous two paragraphs should be reviewed by the city's legal staff for corroboration. Also, residents should be encouraged to seek the services of a certified arborist who also possesses the ISA Tree Risk Assessment Qualification (TRAQ) which indicates they possess adequate

knowledge and experience in evaluating tree risk. Registered Landscape Architects are not required to possess this knowledge and experience to maintain their credentials. Documentation of need for tree removal provided by these professionals should ideally receive additional scrutiny.

Overall, the mechanisms currently in place in Article V to limit capricious canopy tree removals appear to be adequate if employed as written. Exempting removal of Category 1 Invasive Exotic species from permitting could be considered in the future. Also, measures to retain small maturing tree species such as Flowering Dogwood which are currently disappearing from the landscape should be considered.

City regulations regarding **Landscaping** are contained in Appendix A (Land Development Regulations) Article VI (Development Design and Improvement Standards) of the City Codes of Ordinance.

Section 6.06 lists specific landscaping standards. This plan addresses these standards for the following reasons:

- Reducing the likelihood of damage to public infrastructure caused by roots from mandated planted trees.
- Increasing the potential longevity of these tree plantings.
- Reducing needed maintenance of these planted trees.
- Reducing the likelihood that these trees will succumb to tropical storm damage and become part of the debris load following such a storm.

The following additions and amendments to this section are recommended.

*Section 6.06.01:* This section should reference the *The St Augustine Beach Standards and Specifications Manual* developed by Board Certified Master Arborist Chuck Lippi, which has been codified since September, 2008 (section 5.01.04). The appendix of this plan entitled **Managing Your Urban Forest** serves as a supplement to the aforementioned manual.

*Section 6.06.03:* Paragraph B mandates the use of native species and prohibits the use of non-natives. While the exclusion of non-natives is a noble goal, it is not necessarily a desirable goal in the urban environment for the following reasons.

Native species sometimes cannot sufficiently survive and thrive under the harsh conditions of the urban environment with limited rooting space and more extreme temperature variations as opposed to the natural environment where these species grow in nature. Non-natives often grow better under these conditions.

Utilizing selected non-natives provides an opportunity to diversify the city's tree species population, which makes that population more resilient to natural forces such as tropical storms and pest infestations. The recently completed public tree inventory already contains 15 non-native tree species, most notably Drake Elm and Queen Palm. The list of recommended species contains a few non-native tree species which would benefit the local tree population by their presence.

It is therefore recommended that SEPAC consider endorsing approval of planting selected non-native species on a case by case basis if those species are not listed as invasive exotic by the Florida Exotic Pest Plant Council (FLEPPC).

Paragraph C requires a total revision to achieve the goals listed at the beginning of this section for the following reasons.

- Species selection should be based on the size of the available planting space. Minimum square footage and planting site dimensions for trees in various size classes are provided elsewhere in this plan. A minimum size of 20 square feet is too small.
- Installation of root barrier at the edge of sidewalks and other hardscape should be recommended to re-route root growth under the hardscape and therefore minimize damage to the hardscape.
- Dimensions of the planting stock should be based on those listed for a particular species of Grade 1 quality in the *Florida Grades and Standards Manual*, which is already cited in Paragraph A of this section. It is recommended that the dimensions currently listed in this section be deleted because they can contradict those in the Grades and Standards Manual.
- This paragraph specifies that *Trees shall be species having an average mature spread of crown of greater than fifteen (15) feet in northern Florida and having trunks which can be maintained in a clean condition for over seven (7) feet of clear wood measured from the ground.* This verbiage may encourage the planting of trees that will be too big for the planting space, probably before they reach maturity. It also encourages over-pruning of trees. Specifications such as…"Single trunked species with an inherently excurrent crown shape should be planted, particularly in small spaces" are suggested.
- Mandating the planting of a three inch dbh tree is excessive, especially with smaller species where planting stock of this size may not be available. Specifying a three inch caliper diameter (measured 12 inches above ground line) is a more reasonable standard. Establishment costs are less; irrigation requirements are less; root systems are probably in better condition; survival rates increase; and more planting stock of small species will be available.

*Section 6.06.05:* Paragraph B mandates that at least one tree per 100 linear feet be planted with internal landscape sites. Additional verbiage needs to be inserted mandating a minimum width for the tree planting spaces as previously described. For example, large maturing species need to have a planting space at least eight feet wide. Also, these planting spaces need to provide at least three feet deep of desirable soil. If possible, these planting strips should be constructed as swales rather than berms so that they can contribute to the stormwater management capabilities of the site.

*Section 6.06.06:* Ditto above as it applies to plantings at intersections.

City regulations regarding **Planning and Development** are contained in Chapter 15 (Land Development Regulations) Article III (Excavations and Land Clearing on Private Property) of the City Codes of Ordinance. Content of this section includes provisions to minimize soil

erosion, sediment control, and stormwater management. No verbiage is included, however, for the protection of trees during land clearing activities.

I was verbally informed that contractors had to install temporary rigid fencing around trees during land clearing and construction activities. After construction is completed, however, the contractor is free to perform any clearing and grading activities that they deem necessary right up next to the trunk.

This totally negates the purpose of the fence in the first place. Minor damage to the trunk and limbs usually does not result in significant decline or mortality to the tree. Damage to the roots, however, produces long term impacts which often result in gradual tree decline and mortality. Soil compaction from operating tracked equipment in the root zone reduces the ability of the roots to absorb necessary water and oxygen. So does the addition of more than four inches of fill. Torn or damaged roots are susceptible to infection by various pathogens and usually do not re-sprout new roots.

It is recommended to add a Tree Protection Standards section to Chapter 15 Article III. This section should contain the following information.

- This section should reference tree protection standards included in the *The St Augustine Beach Standards and Specifications Manual* developed by Board Certified Master Arborist Chuck Lippi, which has been codified since September, 2008 (section 5.01.04). The appendix of this plan entitled **Managing Your Urban Forest** also provides information about tree protection during construction.
- Trees greater than XX inches dbh [City decides] which have been selected for retention should be surrounded by a durable fence during land clearing activities. A clump of trees in the same area can be enclosed by a single fence. The radius of the fenced area needs to be at least nine times the dbh of the tree to be protected (Example, a 20 inch tree needs a fenced area with a radius of at least 15 feet). This would be known as the Critical Protection Zone (CPZ).
- If entry within the CPZ during construction activities is necessary, then
- Protection barriers need to be installed directly around the trunk.
- Soils in the CPZ need to be protected from compaction by either durable plywood or a layer of mulch at least eight inches thick laid over *Geotextile* or similar material.
- Following construction activities, no blade work or clearing with tracked equipment within the CPZ is allowed. Manual clearing and felling (hand or power tools), mowing with a bush hog powered by a light gauge or low ground pressure wheeled tractor, or application of a foliar active herbicide labelled as having no soil activity can be employed to clear vegetation within the CPZ.

City officials may wish to consider adopting codes that emphasize the role of trees in stormwater management as opposed to engineered systems and favor the use of pervious materials as opposed to concrete or asphalt surfaces to reduce surface runoff. Model ordinances can be found on the websites of the Green Infrastructure Center http://www.gicinc.org/ trees_stormwater.htm and the Ohio/Kentucky/Indiana Regional Council of Governments http://treesandstormwater.org.

# Storm Management

**Why a Storm Management Plan for the Urban Forest?**
Reducing the negative consequences of a storm to the city tree canopy provides sufficient justification for adequately funding and supporting an effective urban forestry program. The City of St Augustine Beach is located along the Atlantic coast. Since 1999, nine named storms have inflicted either tropical storm or hurricane force winds upon the city, most recently Hurricane Irma in 2017 and Hurricane Matthew in 2016. Damage to the tree canopy and associated recovery costs have always resulted from these storms. The city currently has an estimated population of almost 7,000 residents, which represents a population increase of almost 50% since 2000. Consequently, resources devoted to response and recovery efforts following storms need to increase to accommodate this population increase. Clearing and disposal of woody vegetation can be one of the most significant costs related to storm management.

Tree failures impact residences and businesses by damaging property, blocking roads, and disabling utilities. Personal safety issues increase because tree failures can occur for some time following a storm. Trees in developed areas are more prone to failure because their roots have often been previously damaged during site clearing. In addition, roots covered by pavement do not receive adequate water, oxygen, and nutrients, making them more prone to failure. Compacted soils prevalent in urban areas don't allow roots to expand far enough to support the weight of the above ground portions of the tree. Root failure frequently results when trees growing in this environment are subjected to an exceptional wind load. Limb failures also occur when necessary structural pruning and care has been neglected or improperly conducted.

The risk of tree failures should not persuade city officials to eliminate trees from the urban landscape. As an integral part of the city's infrastructure, trees provide a number of benefits that citizens value, as described in previous sections of this plan. Following a storm management plan for the urban forest can provide substantial benefits to the City of St Augustine Beach, including the following:

- Fewer potential injuries to people or damage to property caused by trees.
- Less time to clear roads and restore utility service and other infrastructure components.
- Reduced woody debris volume to clear and dispose, saving both time and cost.
- Fewer trees lost or unnecessarily removed.
- Greater retention of the city tree canopy and associated ecosystem and climactic benefits.
- Fewer damaged standing trees which can pose potential hazards following the storm.
- Increased ability to recover storm management funds from FEMA.

Achieving these outcomes involves activities that take place before the storm (**Preparation**), immediately following the storm (**Response**), and after most essential infrastructure is restored (**Recovery**). This Storm Management Plan is intended to complement the city's current Emergency Operations Plan with additional details pertaining to managing the urban forest.

## Preparing the Urban Forest for Storm Events

*Increasing Storm Resiliency*

Studies conducted in the aftermath of Hurricane Andrew in 1992 provided testimony that poor management of the urban forest results in more extensive storm impacts. This applies to trees which reside on both public and private property. Reducing these impacts justifies efforts to enforce the city tree ordinance, educate residents in proper tree care, and invest in keeping trees in city street rights-of-way, parks, and other public spaces in a healthy condition. Healthy, well maintained trees will cause less private property damage and generate less storm debris for the city to manage. A program of proactive public tree maintenance and properly executed tree planting projects can reduce the time and resources that must be devoted to future storm response and recovery. The **Managing the Urban Forest** section of this plan provides detailed information on how to create and maintain a more resilient urban forest.

From 2001-2006, the City of Columbus, GA increased their efforts to proactively manage their public trees. During that time, they achieved the following results:

- Claims received by Risk Management related to trees decreased by 72%.
- Work orders to resolve tree related issues decreased by 55%.
- Overtime expenditures for resolving tree issues decreased by almost 70%. [9]

City officials can use the information contained in the recently completed public tree inventory to identify and treat trees most in need of pruning and removal. These could include trees on adjacent private property where the tree could fall onto the public right of way. This can significantly reduce the debris load which must be handled after the storm.

Certain geographic areas need to receive priority focus for treatment. These would include the following.

- Primary storm evacuation routes and zones as established by St Johns County.
- Access routes and grounds surrounding critical facilities within the city.
- Major city transportation arteries. Those with higher average traffic volumes should receive first priority for tree care.
- Residential and commercial rights-of-way with higher tree canopy coverage and more mature trees that have a higher likelihood of failure.
- Public spaces and facilities which receive the most pedestrian and vehicle traffic.

*Minimizing Unnecessary Tree Damage*

The city may need public spaces for post-storm functions such as temporary housing and feeding of displaced residents, parking additional service vehicles for contractors and mutual aid crews, establishing supply depots and distribution centers for needed commodities, and other suddenly necessary operations. For the most part, public buildings and facilities are available for these

purposes. Following Hurricane Andrew, however, well stocked forested areas were sometimes destroyed to provide spaces for these operations. At the beginning of the hurricane season, city officials who provide these other operational functions need to select places where desirable tree canopy does not need to be cleared to any great extent. This also applies to proposed Debris Management Sites (DMS'). Personnel involved in debris management activities who do not normally work in urban forestry need training to avoid unnecessary tree damage or removal of trees during response activities as previously described.

Public Works Department officials also need to confer with any vendors who conduct clearing, tree removals or pruning following the storm. They need to discuss strategies to minimize unnecessary tree removals and damage to residual trees during debris removal and infrastructure restoration. Certified arborists should be utilized in post-storm tree management decisions, and equipment operators and workers should have proper training and instructions to keep them from causing unnecessary tree damage.

*Preparing Public Informational Strategies*

Once the storm passes, residents and businesses will need information on how to deal with issues involving trees. Outreach strategies which utilize printed materials, mailouts, radio and television, websites, school presentations, and public events should be prepared in advance. Outreach efforts – to provide education and encouragement for their preparation for storms – should begin prior to the start of the hurricane season and continue post storm to assist residents in their cleanup efforts. Relationships with media contacts need to be established or renewed in advance of hurricane season to make these efforts effective.

Message topics pertaining to urban forestry could include the following.

- All trees are not hazards/Don't remove healthy trees for no reason!
- Don't be afraid to replant.
- Safe practices for debris clearing/chainsaw safety.
- Reporting tree hazards on public property.
- Tree risk assessment by a certified arborist.
- Proper tree pruning/restoration techniques.
- Selecting tree care companies for post-storm work.
- Replanting guidelines, including:
    - Tree species selection.
    - Right tree/right place.
    - Proper installation and post-planting care.

Public service announcements involving local officials or recognized public figures as spokesmen can lend credibility to these messages. Messages that request assistance from local volunteer organizations will provide sources of manpower for recovery activities and perhaps sources of funding for post-storm tree planting projects or tree giveaways.

SEPAC can work with the City Communications and Events Coordinator beginning several months in advance of hurricane season to initiate these efforts. Resources available through the St Johns County Cooperative Extension Service should also be utilized.

*Other Logistical Concerns*

The Emergency Operations Plan lists other preparation measures to be implemented before the storm arrives. Public Works Department crews need to ensure they have sufficient resources to operate for at least a week following the storm. Resources include food, water, fuel for vehicles and equipment, operable equipment, replacement parts for equipment, communications devices, staging areas, shelter, first aid supplies, and any other logistical needs that may arise. They need to assume that none of these resources will be available from external sources following the storm. They also need to know how to obtain repairs to vehicles and equipment, communications systems, and emergency medical treatment.

**Response Following the Storm**

Response functions commence immediately after the storm passes. Those involving the urban forestry program focus on re-opening transportation corridors and re-establishing infrastructure. This includes clearing, processing, and disposal of woody debris, as well as removing damaged trees where necessary to facilitate the restoration of the various utility networks. Management of the urban forest takes a back seat until these functions are at least significantly completed, with the exception of preventing damage to healthy residual trees while conducting these operations.

*Organization*

The Emergency Operations Plan designates the Police Chief and City Manager as the Incident Commanders when a storm event occurs. The Director of Public Works, Building and Zoning, and a representative from the City Council work with the Incident Commanders to carry out the operational aspects of the plan. The plan designates the Public Works Department's primary mission as "to secure and protect City buildings and property, so that the City can provide essential services; to keep streets clean of obstructions; and to provide cleanup services during the post-hurricane phase."

More specifically, Public Works will have ensured before the storm's arrival that all key evacuation routes and City streets were clear of debris, with input from the Police Department. They will also have conferred with the St Johns County Solid Waste Department and City debris management vendors to ensure that all city and county resources for debris management will be in place after the storm.

Following the storm, Public Works personnel will clear streets of debris and obstructions on a prioritized, coordinated basis so that residents and property owners can return to secure their properties, and so that National Guard and City Police can patrol to prevent looting. These efforts will begin with access roads leading into the City.

Once again, contact St Johns County's Solid Waste Department to confirm that either landfills or debris management sites are available for the City to deposit storm debris. If the County cannot

provide facilities for storm debris disposal and/or roads are impassable, Pubic Works crews need to deposit this debris at designated sites within the City for future removal when possible.

*Communication with Residents*

A call center should be established for residents to report tree issues on public property in need of resolution. Information collected from callers should include the following information, to the extent that the caller can evaluate these parameters.

- Name and phone number of caller.
- Exact location or address of situation.
- Personal injuries? Elderly people/pets involved?
- Ownership of damaged tree: Public property or proximity to public property.
- Threat or damage to utilities, residential or commercial structures.
- Threat or damage to roads, utilities, signage, lighting, walls, fences, etc
- Tree condition - leaning, overturned, uprooted, split, snapped, downed or hanging limbs.
- Tree or branch diameter, tree height, size of uplifted rootball, etc.
- Likelihood of further damage.

Response to calls received could be prioritized in this order.

- Injured people, people trapped in car or home by trees.
- Live utility lines down caused by tree failure.
- Trees or limbs blocking arterial streets.
- Overturned trees impacting infrastructure or utilities in a non life threatening manner.
- Debris from trees on public land blocking access to private residences.
- Trees split, leaning, or with significant hangers threatening roads, rails, or sidewalks.
- Trees or large fallen limbs blocking minor streets.
- Trees or limbs fallen on automobiles.
- Damaged trees on public facilities.

A record keeping system needs to be utilized to ensure that calls receive timely response and the total volume of calls is tabulated.

*Technical Urban Forestry Assistance*

If possible, assistance from an ISA Certified Arborist should be sought to monitor debris removal activities to ensure that healthy trees are not capriciously removed or that residual trees are not inadvertently damaged. Certified arborists can have a larger role once initial response activities have concluded and recovery activities are begun.

*Media Releases*

More citizen injuries, often serious, occur after the storm passes as opposed to during the storm itself. Immediately following the storm, any previously listed media messages should be released

that address recognizing and avoiding tree hazards, safely handling storm debris, chainsaws, or other equipment used for storm cleanup on private property.

**Recovering the Urban Forest After the Storm**

Recovery activities involving trees are highly dependent upon the severity of the storm damage but would typically begin within two to three months after the storm passes. Recovery may commence more quickly, pending available resources in areas where road clearing has been completed and utility services have been restored. In addition, debris removal needs to have progressed to where remaining debris piles do not hinder the ability to safely access standing trees, personnel and equipment are available to work on standing trees, and work on standing trees does not interfere with ongoing debris disposal efforts.

*Certified Arborist Involvement* – Arborists need to be increasingly involved in the recovery phase where the possibility of injuring or removing otherwise healthy trees exists, in the same manner as they did during the response phase. Their most time consuming function during the recovery phase, however, would be to validate the need and the costs associated with removing standing damaged trees, pruning hazardous tree limbs, righting suitable downed trees, and removing large uprooted stumps which meet the criteria for financial assistance from FEMA according to their Debris Management Guide #325. Public and/or private arborists may be available to assist with this function where necessary or provide guidance to the contractor if their monitoring staff does not include an experienced certified arborist.

Other tasks performed by arborists during the recovery phase could include the following.

- Establishing priorities for pruning or removing standing trees impacted by the storm.
- Determining when downed trees can be safely and effectively righted.
- Deciding when to remove a non-FEMA eligible tree which poses significant risk.
- Deciding when to prune a non-FEMA eligible tree where an impacted part poses significant risk.
- Determining how best to prune a storm impacted tree to sufficiently reduce risk or prevent potential related decline.
- Conducting or overseeing tree canopy analysis and tree inventory updates.
- Preparing or overseeing a post-storm reforestation plan.
- Providing assistance with public education efforts regarding trees.
- Providing information, guidance and assistance as needed to the City.

The US Forest Service *Urban Forestry Strike Team* can be made available during the recovery period to assess standing trees and provide data for FEMA reimbursement. The team consists of a team leader and four two person data collection crews. All team members are ISA certified arborists who have been trained to assess the need for the FEMA eligible practices described later in this section. They are fully equipped with data collection gear and a GIS specialist on the team provides them with technical support. They can be deployed for up to two weeks in a given location. The Forest Service provides all their expenses and the local host provides a liaison to handle logistical support (securing meals and lodgings, questions about routes and data

collection locations, etc). The team recently provided assistance to the City of Naples in 2017, following Hurricane Irma. Their services can be requested by contacting the Florida Forest Service Forest Management Bureau in Tallahassee or the local FFS public assistance forester at the St Johns County Cooperative Extension Service office.

*Assessing Tree Damage*

During recovery, urban forest managers can select street segments to re-inventory after the storm. Information from these segments can be extrapolated and help refine the city's estimate of potential storm debris volume. Information such as the total number of trees lost, species that were most impacted, windthrown trees as opposed to broken trees, and trees in need of pruning, removal, or other treatments can prove useful for planning recovery efforts. The number of new tree plantings needed, species to avoid, and resources necessary for recovery can be derived from comparing the inventory before and after the storm. Arborists can also redo the city Tree Canopy Analysis once post-storm digital imagery becomes available to assess the extent that the storm reduced the city tree canopy coverage.

Urban Forestry Practices Eligible for FEMA Reimbursement – This plan summarizes details contained in FEMA Debris Management Guide #325 regarding urban forestry management practices eligible for reimbursement. Practices must be necessary and caused by the disaster event, located within the impacted area, and be the legal responsibility of the City. Their purpose must be to eliminate immediate threats to life, public health and safety, immediate threats of significant damage to improved public or private property, or to ensure economic recovery to the benefit of the community at large.[10] Funding for contracted entities to perform this work is eligible to the extent that it meets this criteria.

*Removal costs of individual impacted trees* that pose significant risk can be reimbursed on a per unit basis, typically based on the size. Their condition must have been caused by the storm. The tree must have a diameter at breast height (4.5 feet above the ground) of at least six inches and meet one or more of the following criteria, as illustrated in the accompanying photographs.

- More than 50 percent of the crown is damaged or destroyed.
- Trunk is split or broken limbs exist that expose the heartwood.
- Tree is fallen or uprooted within a public area.
- Tree is leaning at an angle greater than 30 degrees.

Debris from removed trees as described above can be included with downed vegetative debris and included in the amount for reimbursement on a per cubic yard basis. Trees determined to be hazardous and that have less than 50 percent of the root-ball exposed should be cut flush at the ground level. Stump grinding after flush cutting the stump does not qualify for reimbursement. Expenses for removing the tree and the stump cannot be separately charged.



*Straightening and bracing damaged trees* may be eligible for FEMA reimbursement in lieu of removal if these operations are less costly than removal and disposal. The trees must be located on public property and pose an immediate risk to people and property in their current condition. They must also meet criteria for straightening as summarized below and expounded upon in the **Managing Your Urban Forest** section.

- Generally, qualifying trees <u>less than 10 inches in diameter</u> could be straightened if adequate space exists to properly brace the tree, as shown in the accompanying photo.
- Qualifying trees 10-18 inches in diameter and located in an open park setting could be straightened.
- Trees greater than 18 inches diameter would only be straightened on a limited basis.

In all instances, a certified arborist would approve suitability for straightening, devise a plan to do so, and oversee the operation and follow up care. If straightened trees do not survive, removal and disposal costs would not be eligible for later FEMA reimbursement.

*Removing hanging limbs* may be eligible for FEMA reimbursement if the limbs are greater than two inches in diameter at the point of breakage and still attached to the tree. See the accompanying photos below. Reimbursement is typically provided on a per tree basis. FEMA 325 cautions against charging pruning work which does not meet the above criteria. This includes maintenance pruning or removing hangers that existed before the storm. All qualifying limbs on the same tree need to be removed in one treatment, not "in passes for particular sizes."

Hangers Eligible (left) and Ineligible for Reimbursement

FEMA 325 further states that "only the minimum amount of work necessary to remove the hazard can be reimbursed."[11] This means remove only enough of the limb to sufficiently mitigate the likelihood of failure. It does not mean that a damaged limb must be cut at the breakage point, leaving a stub. FEMA 325 states that a damaged limb can be pruned back to the closest branch node or junction, which is consistent with ANSI A300 pruning standards and ISA Tree Pruning Best Management Practices. Refer to the **Managing Your Urban Forest** section for more detail.

"Stub cutting" therefore should only be performed when the damaged limb has a long expanse with no branch nodes or junctions. If potential limb failure poses a risk to a building, road, sidewalk, or other public use area, then reduce the length of the limb enough to minimize risk but not enough to remove an excessive amount of the overall crown volume.

Sprouts will often appear on damaged limbs the following Spring, both at the end of the limb and along the expanse of the limb. Sprout management, which is discussed in the **Managing Your Urban Forest** section of this plan, will need to be employed over the next few years to encourage the development of strong limb connections and improve the damaged tree's appearance.

Damaged trees (as previously defined) whose bases lie on private property sometimes pose hazards to adjacent public rights-of-way. Removing damaged limbs or damaged portions of their upper trunk may be eligible for FEMA reimbursement if they pose a significant risk to the right-of-way and meet the previously listed criteria. Removal of limbs or portions of the trunk that do not threaten public property are not eligible.

*Removal of hazardous tree stumps* located on public property may be eligible for FEMA reimbursement on a per-unit cost basis if the stump meets the criteria listed on the following page.

- The stump poses an immediate threat to public health and safety.
- The stump has a cross sectional diameter greater than 24 inches, as measured 24 inches above the ground if the stump is taller than 24 inches.
- At least 50 percent of the root-ball is exposed.

FEMA reimbursement for eligible stump removal may include the cost of removal, transport, disposal, and refilling the hole. In some instances, grinding an uprooted stump and filling the resulting cavity may cost less than complete extraction as described here. In these cases, the city can present cost comparison documentation to FEMA for consideration. Stumps extracted from public property that do not fit the above criteria may be added to the storm debris piles for pickup and can be added to the overall debris volume (cubic yards) eligible for reimbursement.

*Monitoring debris removal operations*, including tree related practices, is eligible for FEMA reimbursement as previously described in this section. FEMA requires the city to monitor debris removal operations in order to document completed work and reasonable expenses to ensure FEMA eligibility. Although FEMA personnel periodically validate the city's monitoring efforts, debris monitoring is primarily the city's responsibility. Contractors, temporary employees, or city staff may perform this function. Costs for training, oversight, and data compilation may be eligible for FEMA reimbursement.

FEMA requires debris monitors to have *appropriate qualifications*, but not necessarily be certified professionals. This plan, however, strongly recommends that ISA certified arborists monitor operations involving management of standing trees and stumps as described in this section. Additional guidance on monitoring debris removal operations is located in Appendix G, FEMA DAP9580.203, Fact Sheet: Debris Monitoring.

FEMA 325 does indicate that debris operations in private homeowner associations or gated communities may be eligible for post-storm reimbursement. Criteria for their eligibility can be discussed with FEMA representatives in advance of the storm season.

Please refer to Chapter 3 of FEMA 325 and various appendices of that document for necessary forms and procedures to obtain prior FEMA approvals to implement these practices and document them while in progress. Generally, photos and GPS coordinates need to be recorded for each involved tree or stump. Concise written explanations should also be provided. An inventory using LAS' *Tree Plotter* software, which LAS used to collect inventory data, could be quite helpful for recording locations and other tree information in the field. Documented hours devoted to storm recovery by involved personnel and equipment should also be recorded on the appropriate forms.

FEMA Ineligible but Necessary Urban Forestry Practices – In many cases, storm force winds exacerbate pre-existing weaknesses in trees. This can create hazardous situations where remediation activities are necessary but unfortunately do not meet FEMA reimbursement criteria. The city should still make every effort to minimize public risk in these situations.

*Torsions* occur when storm force winds whip the limbs of standing trees back and forth, causing their trunks to violently twist. The accompanying photo shows the after effects from a torsion. Following the storm, affected trees often have obvious vertical cracks extending several feet up from the base. This condition weakens the trunk and increases the likelihood of failure. A certified arborist should determine the need for removal or reduction pruning to where the trunk can still support the upper portion of the tree.

*Other tree removals* may be deemed necessary by a certified arborist, even though the tree does not meet the FEMA criteria. Pre-existing defects such as decay or poor structure may be exacerbated by the storm to where an increased urgency exists to remove the tree.

Broken limbs where the broken end has a surface diameter greater than two inches often result from storm force winds. If no hangers exist, FEMA reimbursement for pruning or removal costs for these limbs is not eligible. If left untreated, however, broken ends of limbs are less likely to seal and can become infection sites for decay fungus that eventually spreads to the entire tree. Long, thick broken limbs with minimal taper and without many branches are likely to fail and can threaten public safety.

Wherever possible, broken ends of limbs of any size should be cleanly pruned to encourage wound sealing. As previously described, pruning cuts should be made at either a branch node or the trunk, depending on the size and location of the impacted limb and consistent with ANSI standards and ISA BMP's. "Stub cuts" can be made where the distance from the cut to either a node or the trunk is excessively long. Remove enough of the limb to ensure public safety but retain as much crown volume as possible. Sprouts that develop on damaged limbs in ensuing years should be allowed to grow and managed as previously described.

*Removal of small broken limbs less than two inches diameter* does not qualify for FEMA reimbursement. Generally, these broken limbs do not present a safety hazard. They can be removed, however, if desired.

Defoliated limbs should not be immediately removed unless the limbs themselves have broken. Live buds remaining after the storm indicate that the limb will refoliate during the following growing season. Overall, delay removal or pruning of defoliated limbs until Spring. This will probably apply to the defoliated live oaks pictured in the accompanying photo.

**Re-Assess the Tree Canopy and Update the Tree Inventory** – Plans to conduct these activities should have been put in place at the beginning of the hurricane season. The city tree canopy plays a significant role in reducing greenhouse gases and improving public health. For that reason, it is important to update the tree canopy coverage after the storm and identify areas of the city where the most severe canopy losses occurred. Updated aerial imagery of the storm impacted area should be obtained as soon as possible following the storm and analyzed to determine the degree of tree canopy loss and the areas which suffered the most loss.

County Geographic Information System (GIS) specialists can randomly delineate street segments where arborists can update tree inventory data during the recovery period. These can encompass as much as one percent of the city street mileage in total. Results will provide an estimate of storm impact to the city tree population, as described under storm preparation. Funding for reforestation and tree remediation can be calculated using data from these inventory updates.

For the most part, involved arborists should follow the same procedures to conduct a post-storm inventory as they would for a normal situation.. It would be helpful, however, to collect the following additional data for FEMA reimbursement and for future storm planning.

- Degree of damage to the tree.
- Tree parts impacted.
- Estimated tree condition before the storm.
- Tree properly maintained
- Constricted site/infrastructure intrusions.

*Test Soils for Salt Intrusion* – Storm generated winds exceeding Category 1 levels (75 mph) can transport water vapor with a high salt content inland from the ocean. This water vapor eventually lands on the foliage of trees and on the soil surface within their root zones. Once the water evaporates, the sodium content on the leaves and in the soil can become toxic to the tree. The sodium can cause trees to excessively transpire and suffer decline and mortality. The leaves will take on a desiccated appearance as shown in the accompanying photo and prematurely drop. Decline may begin at the top of the crown.

As previously stated, defoliation following a storm is not uncommon and does not necessarily mean that a tree is dead. In fact, trees may slough these impacted leaves and re-grow healthy ones. Retained leaves that begin to dry up, however, may indicate that sodium concentrations in the soil have become toxic. Soil testing can confirm that sodium levels have become excessive. Soil additives which provide calcium ions to displace the sodium ions are recommended. Gypsum or commercial products such as Arborjet's *NA-X* can be used for this purpose. They can also improve overall soil structure at the same time. Desalinization is addressed in the **Managing Your Urban Forest** section of this plan.

**Public Education/Reforestation** – The education plan described in the storm preparation section should be fully implemented during the recovery period. "Reforestation without Fear" should be one of the central themes of education efforts. City officials with the assistance of SEPAC members and cooperators will need to make an exceptional effort to attain public support for reforestation following a significant storm. Following a storm, they need to increase their efforts to persuade the community that reforestation is in their best interest. Demonstration reforestation practices can be installed in highly visible public places to serve as teaching tools for the public. Previously described tree giveaways for local residents will encourage replacement of damaged tree canopy on private property. Make sure that recipients of these trees receive information on how to properly install and care for them.

When planning post-storm reforestation, the following items need to be considered.

Locations: Use recent aerial imagery, ground reconnaissance, and citizen input to determine areas in need of planting. A number of areas in the city needed additional tree canopy before the storm, and now a number of others will also need to be replanted. Previously planned reforestation projects may now receive a lower priority because other areas also need to be planted. Since there will probably be more of a demand for reforestation than available funding for that purpose, projects and sites could be ranked as follows.

- *Site Suitability for Larger Species*. These areas will provide the greatest amount of future tree canopy and ecosystem services such as carbon mitigation. Refer to the site selection criteria in the **Managing Your Urban Forest** section of this plan. Some sites may have held mature canopy trees before the storm; however, the trees may have failed because they had inadequate growing space. Therefore, all potential planting sites need to be evaluated to see what sized trees (if any) can grow there. Don't put trees back on a site where they shouldn't have been planted in the first place.

- *Site Visibility and Traffic Frequency*. Planting sites in areas which receive higher pedestrian and vehicular traffic should receive priority over less travelled areas. Storm recovery includes making an area appealing once again for residents and visitors to frequent, and tree canopy is a key element of this effort. Trees in the urban environment primarily exist to benefit people, so the trees need to be replanted where the most people will benefit.

- *Interest from local residents.* Trees planted in areas of the city where residents and businesses are most likely to support them will most likely survive and grow to maturity. This is not meant to discriminate against lower income neighborhoods where local support may be more difficult to garner. If a group of local residents, volunteer group, or non-profit group will come forward and pledge to protect and care for the new trees, then the project should receive consideration.

Species: From 1992 to 2004, the University of Florida conducted a study following each hurricane in Florida to determine which tree species tended to suffer the least amount of storm damage. Results of this study can be found at: https://hort.ifas.ufl.edu/treesandhurricanes/. This information plus the recommended species listed in this plan can provide good guidance for selecting species. A diversity of species should be planted to the greatest extent possible; however, there are advantages to planting the same species throughout a particular block. Canopy species should be selected to the greatest possible extent. On the other hand, some smaller flowering trees will enhance the appeal of these plantings.

Nursery Stock: Nursery availability may govern the species palette for the new plantings. A sufficient quantity of good quality nursery stock may not be available for some time after the storm. The city is better off waiting for a couple of years to replant good quality stock rather than planting poor quality or undersized stock that will never achieve a mature size or strong structure.

Bare root saplings can be planted in natural or low traffic areas. Trees in containers with root balls from one to 15 gallon size can be used for public tree giveaways. Undersized stock will be vandalized if planted in higher vehicular or pedestrian traffic areas. Therefore, trees in public spaces should have at least a 1.5 inch caliper, preferably larger. Some leeway can be given on height, but the overall quality of trees larger than one inch caliper should either meet Grade 1 standards or be capable of being pruned to that standard.

Other considerations for implementing tree planting projects should be followed as described in the **Managing Your Urban Forest** section of this plan. Publicity and fanfare are especially important for tree giveaways and community tree plantings. Solicit citizen and business support in advance. Involve residents in the effort as much as possible, even if they just put the soil back in the hole or apply the first watering. Appearances by local officials and community leaders will also help make the event more successful.

Funding sources for tree plantings and giveaways can include state, federal (not FEMA), and local government entities, non-profit groups and foundations, and private businesses. The Florida Forest Service and Florida Urban Forestry Council can be particularly helpful in locating funding sources. Local tree vendors such as retail nurseries or "big box stores" could perhaps provide vouchers for free trees for customers who purchase a certain value of goods.

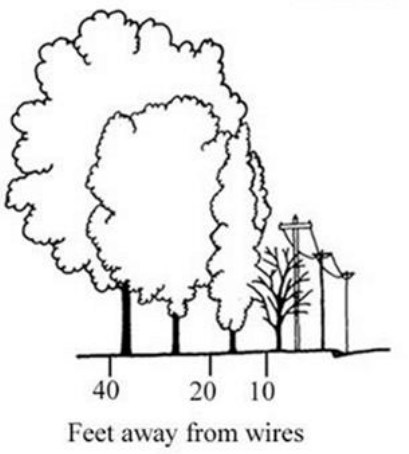
**More information** to assist the city with storm management can be found at the University of Florida website https://hort.ifas.ufl.edu/treesandhurricanes/. This site was developed following the 2004 hurricanes and contains a considerable amount of information for all vestiges of managing urban trees in conjunction with storms.

# Public Trees in St Augustine Beach

| Common Name | Latin Name | Size at Maturity | # Trees | Suitable for ROW Planting? |
|---|---|---|---|---|
| American elm | *Ulmus americana* | Large | 5 | *No* |
| American holly | *Ilex opaca* | Medium | 8 | *No* |
| American sycamore | *Plantanus occidentalis* | Large | 6 | *No* |
| Bamboo | | Small | 2 | *No* |
| Banana tree | *Musa sp* | Medium | 1 | *No* |
| Black cherry | *Prunus serotina* | Large | 2 | *No* |
| Cabbage palmetto | *Sabal palmetto* | Large | 1146 | *Yes* |
| Canary island date palm | *Phoenix canariensis* | Large | 5 | *Yes* |
| Carolina laurelcherry | *Prunus caroliniana* | Large | 9 | *No* |
| Chinaberry | *Melia azedarach* | Large | 1 | *No* |
| Chinese fan palm | *Livistona chinensis* | Large | 9 | *No* |
| Citrus | *Citrus sp* | Medium | 1 | *No* |
| Common crapemyrtle | *Largerstroemia indica* | Medium | 9 | *Yes* |
| Dahoon Holly | *Ilex cassine* | Medium | 4 | *Yes* |
| Date palm | *Phoenix dactylifera* | Large | 9 | *Yes* |
| Drake elm | *Ulmus parvifolia* | Medium | 18 | *No* |
| Elderberry | *Sambucus sp* | Small | 1 | *No* |
| Goldenrain tree | *Koelreuteria paniculata* | Large | 1 | *No* |
| Green Buttonwood | *Conocarpus erectus* | Large | 1 | *No* |
| Holly | *Ilex sp* | Medium | 1 | *Yes* |
| Jelly palm | *Butia capita* | Medium | 11 | *Yes* |
| Laurel oak | *Quercus laurifolia* | Large | 40 | *No* |
| Live oak | *Quercus virginiana* | Large | 638 | *Yes* |
| Loquat tree | *Eriobotrya japonica* | Medium | 1 | *No* |
| Mexican Fan Palm | *Washingtonia robusta* | Large | 31 | *No* |
| Pygmy date palm | *Phoenix roebellini* | Small | 3 | *No* |
| Queen palm | *Syagrus romanzoffiana* | Large | 30 | *No* |
| Red maple | *Acer rubrum* | Large | 3 | *No* |
| Red mulberry | *Morus rubra* | Medium | 1 | *No* |
| Sea grape | *Coccoloba uvifera* | Large | 1 | *No* |
| Slash pine | *Pinus elliottii* | Large | 18 | *Yes* |
| Southern magnolia | *Magnolia grandiflora* | Large | 24 | *Yes* |
| Southern redcedar | *Juniperus solicicola* | Large | 88 | *Yes* |
| Sugarberry | *Celtis laevigata* | Large | 4 | *Yes* |
| Unknown tree | | | 1 | |
| Water oak | *Quercus nigra* | Large | 2 | *No* |
| Waxmyrtle | *Morella cerifera* | Small | 2 | *Yes* |
| Wild olive | *Osmanthus americana* | Medium | 1 | *Yes* |

Note: Less than half of these species are not recommended for right of way plantings because they are either invasive exotic, not well adapted to the local climate, easily subject to disease or wind damage, not readily available from local nurseries, or just not a desirable species for planting in St Augustine Beach. Some may be desirable for plantings in parks, natural areas, or residential sites, however.

# Tree Planting Recommendations for St Augustine Beach




--Large tree species: At least 30-40 feet from conductors, depending on species.

--Medium tree species: At least 20 feet from conductors.

--Small tree species/Palms: At least 10 feet from conductors.

| Planting Space Class | Minimum Area | Minimum Width | Distance Between Trees |
|---|---|---|---|
| Small | 50 sq ft | 4 ft | 10 ft |
| Medium | 150 sq ft | 7 ft | 20 ft |
| Large | 300 sq ft | 10 ft | 30 ft |

Park plantings can be planted in *clusters* as opposed to individually as specimen trees to increase wildlife habitat value and wind resistance. However, the above spacings should still be used. Homeowners should also be encouraged to plant trees in clusters whenever possible.

**All trees need to be planted at least 30 feet away from any intersection, as per Section 6.06.06 of Article VI of the City Code of Ordinances.**

**Large Species –** Maximum height greater than 40 feet

| | | | Tolerances | | | |
|---|---|---|---|---|---|---|
| Common Name | Latin Name | Size Class | Shade | Wind | Salt | Flowers |
| Cabbage palmetto | *Sabal palmetto* | Large | Partial | High | High | No |
| Canary island date palm | *Phoenix canariensis* | Large | No | High | Moderate | No |
| Date palm | *Phoenix dactylifera* | Large | No | High | Moderate | No |
| Live oak | *Quercus virginiana* | Large | Partial | High | High | No |
| Slash pine | *Pinus elliottii* | Large | Partial | Low | High | No |
| Southern magnolia | *Magnolia grandiflora* | Large | Partial | High | High | White |
| Southern redcedar | *Juniperus solicicola* | Large | Partial | Lowest | High | No |
| Sugarberry | *Celtis laevigata* | Large | Partial | Low | High | No |
| Florida Maple | *Acer barbatum* | Large | Yes | Moderate | Unknown | No |
| Persimmon | *Diospyros virginiana* | Large | No | Moderate | High | No |
| Winged Elm | *Ulmus alata* | Large | Partial | Moderate | Moderate | No |
| Baldcypress | *Taxodium distichum* | Large | Partial | High | Moderate | No |
| Tupelo Gum | *Nyssa sylvatica* | Large | Partial | Moderate | High | No |
| Sweetbay | *Magnolia virginiana* | Large | Partial | Moderate | No | White |

**Medium Sized Trees** – Trees with a maximum height of 15 to 40 feet

| | | | Tolerances | | | |
|---|---|---|---|---|---|---|
| Common Name | Latin Name | Size Class | Shade | Wind | Salt | Flowers |
| Yaupon Holly | *Ilex vomitoria* | Medium | Full | High | High | Red Berries |
| Dahoon Holly | *Ilex cassine* | Medium | Partial | High | Moderate | White |
| Jelly palm | *Butia capita* | Medium | Partial | High | High | White |
| Wild olive | *Osmanthus americana* | Medium | Partial | Unknown | High | White |
| American Hornbeam | *Carpinus caroliniana* | Medium | Full | Moderate | No | No |
| Sand Live Oak | *Quercus geminata* | Medium | Partial | High | High | No |
| Podocarpus | *Podocarpus macrophylla* | Medium | Full | High | High | No |
| Waxmyrtle | *Morella cerifera* | Medium | Full | Low | High | No |
| Japanese Blueberry | *Eleocarpus decipiens* | Medium | Partial | Unknown | Unknown | White |
| Florida Maple | *Acer barbatum* | Medium | Full | Low | No | No |

**Small Species** – Mature height less than 15 feet. Suitable for planting near powerlines.

| | | | Tolerances | | | |
|---|---|---|---|---|---|---|
| Common Name | Latin Name | Size Class | Shade | Wind | Salt | Flowers |
| Red Buckeye | *Aesculus pavia* | Small | Full | Unknown | Moderate | Red |
| Dwarf Yaupon Holly | *Ilex vomitoria* | Small | Full | High | High | Red Berries |
| Flatwoods Plum | *Prunus umbellata* | Small | Partial | Unknown | No | White |
| Walter's Viburnum | *Viburnum obovatum* | Small | Partial | Unknown | Moderate | White |
| Fringe, Granny Gray Beard | *Chionanthus virginicus* | Small | Full | Moderate | No | White |
| Devilwood, Wild Olive | *Cordia bossieri* | Small | No | Unknown | Moderate | White |
| Possumhaw | *Ilex decidua* | Small | Full | Unknown | Unknown | No |
| Buckthorn | *Rhamnus caroliniana* | Small | No | Unknown | Unknown | No |
| Single Stemmed Oleander | *Nerium oleander* | Small | Partial | Unknown | Moderate | White |
| Florida Privet | *Foresteria segregata* | Small | Partial | Unknown | High | No |
| Sparkleberry | *Vaccinium arboreum* | Small | Full | High | Unknown | White |
| Coral Bean | *Erythrina herbacea* | Small | Partial | Unknown | High | Red |

In some cases, it may not be possible to purchase nursery stock of adequate size for out planting for the small species. When this occurs, the city may have to grow these trees out for two or so years to achieve a 1.5 inch caliper which is necessary to successfully plant a tree in an urban environment and withstand all the sources of stress there.

Other species can be included if City staff and SEPAC members find them to be desirable and suited to the site. For more information about these species, refer to the University of Florida website: http://lyra.ifas.ufl.edu/TREESServlet?command=getFloridaTree&classoid=1116.

# Glossary

Information herein derived from the American Society of Consulting Arborists (ASCA) and the Coast Redwood Adventurers.

**ANSI A300**: American National Standards Institute - standards tree care practices.

**Arboriculture:** The science and art of caring for trees, shrubs and other woody plants in landscape settings.

**Arborist:** A person possessing the technical competence through experience and related training to provide for or supervise the management of trees or other woody plants in a landscape setting.

**Backfill**: Soil and amendments to refill a hole around roots / in a trench.

**Balled and burlapped**: Trees grown and wrapped in burlap with twine or wire - B&B.

**Bare root**: Plants shipped without ball of soil, may be in moist compost.

**Bark**: Outer layer of branches, twig and trunks; the protective outer layer.

**Branch**: A stem that is attached to another larger stem, leader or trunk.

**Bracing:** Installation of steel rods or bolts through the stems or limbs, to reduce twisting or splitting of the wood.

**Branch bark ridge**: Protruding bark above the union (crotch) of two branches or leaders.

**Branch collar**: An overlap of tissue of branch and branch, or branch and trunk, often appearing as a small bulge or collar giving a ringed appearance.

**Bud**: Small dormant apical or lateral meristem tissue which can "break forth" from a leaf axil, twig tip, apex of the tree, or from beneath the bark, and develop into a flower, twig or leaves.

**Buttress root** – large root that flares from the trunk near ground level.

**Cabling:** Installation of steel cables, attached to lag screws or bolts placed in tree limbs, to provide additional support or to limit movement and stress of limbs.

**Cambium**: Layer of meristematic cells, not far under the bark; producing the phloem layer which is closer to the bark, and the xylem tissue which is toward the inside; xylem basically being called" wood".

**Canopy**: The branches and leaves altogether - the top of the tree. (the crown)

**Carbohydrate**: "Energy" food like sugars, starches, produced by photosynthesis.

**Carbon Sequestration**: A natural or artificial process by which a tree removes carbon dioxide from the atmosphere through photosynthesis, to be stored within the tree's biomass in solid or liquid form. Usually expressed as weight of carbon sequestered at an annual rate.

**Carbon Storage**: Storage of sequestered carbon within the biomass of a tree where it remains until the tree reaches overmaturity and releases the carbon into the atmosphere during the decay process.

**Cavity:** An open and exposed area of wood, where the bark is missing and internal wood has been decayed and dissolved.

**Central leader**: Main central stem of a tree - "central" often implies the presence of one leader rather than several existing. A leader that's outstanding amongst several leaders may be called the central leader, but all leaders together mean a tree is a multiple-leader tree.

**Certified arborist**: Professional tree service person certified with International Society of Arboriculture. Experience and tests and continuing education involved.

**Co-dominant stems or trunks**: Two equally competing terminal branches or leaders.

**Compaction:** The compression of soil, causing a reduction of pore space and an increase in the density of the soil. Tree roots cannot grow in compacted soil.

**Conifer:** Plant that bears seeds in a cone.

**Critical root zone:** Portion of the root system that is the minimum necessary to maintain vitality or stability of the tree. Encroachment or damage to the critical root zone will put the tree at risk of failure.

**Crotch**: Top of the union or merging of two branches, or branch and trunk, or two leaders.

**Crown**: Portion of the tree above ground comprised of all the branches and foliage.

**Crown cleaning**: Removal of water sprouts, dead growth, dying growth, diseased tissue, broken limbs and structurally bad growth. Suckers are from ground level.

**Crown reduction**: It's not topping. It is a reduction of the canopy incorporating proper pruning cuts and acceptable foliage removal.

**Decay:** Progressive deterioration of organic tissues, usually caused by fungal or bacterial organisms, resulting in loss of cell structure, strength, and function. In wood, the loss of structural strength.

**Deciduous:** Perennial plant that loses all its leaves at one time during the year.

**Defoliation:** Loss of leaves.

**Desiccation**: Drying-out, or dried-out.

**Dieback**: When ends of twig or branches defoliate, decline and die back to remaining live plant parts. A totally dead tree has no dieback.

**Dormant:** Seasonal quiescent state in which the plant suspends growth. Usually occurs during winter months.

**Drip line**: The perimeter or boundary of the canopy at ground level. However far the branches extend to each side of the trunk, that's how far out on the ground the drip line is - a circular area in general terminology.

**Evergreen:** Plant that retains its leaves for more than one growing season. Could be hardwood or conifer.

**Ecosystem Services**: Benefits that humans receive from their local tree population. These can include both economic and environmental services which can be quantified as either quantities or commodities.

**Fail**: When a tree, trunk or branch breaks or falls. It did not succeed - hence "fail".

**Fertilization:** The process of adding nutrients to a tree or plant; usually done by incorporating the nutrients into the soil, but sometimes by foliar application or injection directly into living tissues.

**Flush cut**: An improper pruning cut that removes the branch collar and damages trunks or leaders. Flush cutting is not a "technique" but lack of it.

**Foliage:** The live leaves or needles of the tree; the plant part primarily responsible for photosynthesis.

**Girdling root**: A root growing around part of the trunk or all of it that is restricting its expansion or outward growth.

**Green Infrastructure**: The living portion of a city's infrastructure which provides the previously referenced ecosystem services. Trees are the most visible and productive component of green infrastructure.

**Hardened off**: Gradually and successfully adjusted or acclimatized to a new environment whether it is a change in light, heat, cold or moisture.

**Hardiness zone**: Sections of a country, states or regions designated or assigned a number or letter or both, indicating the high and low temperatures as known from years in the past.

**Hardwood:** Trees that lose their leaves in autumn; also refers to the wood produced by these trees. Hardwoods are the predominant type of tree in the deciduous forest.

**Heartwood**: The inner wood of a trunk.

**Herbicide:** A chemical that kills plants or inhibits their growth; intended for weed control.

**Horizon:** A layer of the soil profile - a horizontal layer - depth varies.

**Horticulture:** Cultivation of fruits, vegetables and ornamental plants.

**Included bark**: The bark or tissue lodged in the crotch of two branches, two leaders, or branch and trunk, which is a weak attachment. It is at the same area a bark ridge would be, only a bark ridge "ridges-up" whereas included bark is enfolded like a crease.

**Insecticide:** A chemical that kills insects.

**Integrated Pest Management:** System of controlling pests and their damaging effects through mechanical, chemical, biological, cultural and regulatory techniques.

**Landscape:** Areas of land that are distinguished by differences in landforms, vegetation, land use, and aesthetic characteristics.

**Lateral**: A side branch or twig extending from another one.

**Leader**: A main terminal leader of the tree. There can be two or more in which case the tree is a multiple leader tree. In very loose vocabulary, these could be considered trunks, but since they emerge from the trunk, above ground level, the correct term is "leader" or "leaders".

**Mature height**: The tallest anticipated height a tree is expected to reach. This can be a deceptive term. It could be considered the highest the average group of gardeners and tree experts "envision" a tree becoming.

**Mitigation:** Action taken to alleviate potential adverse effects on wetlands and fish habitat undergoing modification. Also commonly used to mean compensation for damage done.

**Mulch:** Any material such as wood chips, straw, sawdust, leaves, and stone that is spread on the surface of the soil to protect the soil and plant roots from the effects of raindrops, soil crusting, freezing, and evaporation.

**Multiple leaders**: Co-dominant stems competing for the dominant growth extension of tree. The term "competing" can be misleading, because many multiple leaders function and grow almost equally as if in unison at nearly identical rates. If not thinned to just one "leader", the group of them is nearly all needed after the tree matures to a degree.

**Mycorrhizae**: "Fungus root" is the meaning and this is a symbiotic relation of fungus on, or attached, to roots and the roots with the fungus. Each benefit. Healthy soil retains this, but compaction and pesticides can damage or prevent it.

**Native**: A species that historically occurred or naturalized in a geographic region as opposed to being introduced.

**Natural target pruning:** Pruning technique in which only branch tissue is removed, with the cut placed just beyond the branch collar.

**Node**: The point of attachment of leaves and axillary buds (the area of stem between nodes is called an internode).

**Nutrients:** The substances, such as mineral elements and compounds, including water and air, that a plant synthesizes into the complex compounds of tissue.

**Overmature:** Tree or stand that has passed the age of maturity where the rate of growth has diminished and the trees are weakened.

**pH**: The measure of acidity or alkalinity in soil or mulch.

**Phloem**: The food transport tissue of the tree, just outside the cambium and below the bark - basically the trees "downward freeway" for nutrient transport.

**Photosynthesis**: The food producing process usually occurring in leaves that results in the use of carbon dioxide and the release of oxygen.

**Pruning:** Selective removal of woody plant parts of any size, using saws, pruners, clippers, or other pruning tools.

**Radial trenching**: A technique for improving soil aeration or drainage in root zones the trenches radiate from trunk in a pattern resembling bicycle spokes. This prevents cross-cutting large roots.

**Raising**: Removal of lower, lowest, branches for headroom, clearance or improved air circulation in the environment of the tree.

**Reduction**: A branch removal pruning, with technique, to reduce the overall dimensions of a tree canopy

**Resistograph®:** A gear-driven drilling instrument which inserts a three-millimeter-diameter probe into a tree, and graphically or digitally records resistance to the probe; used to detect decay and defects.

**Restoration**: Pruning to bring a tree's form, branch structure or health to an improved state.

**Root ball**: The remaining roots and soil around the base of a tree trunk after it is dug for transplanting, or after harvest in a tree farm.

**Root flare**: The base of the tree that "flares" outward at the trunk collar between the main trunk and buttress roots.

**Root pruning**: Cutting roots, for whatever planned profitable reason, to prepare for transplant, to protect concrete like sidewalks, to prepare to sink root barrier in the ground, to eliminate root grafts with other trees that could transfer disease in the soil area.

**Root System:** The portion of the tree containing the root organs, including buttress roots, transport roots, and fine absorbing roots; all underground parts of the tree.

**Root Zone:** The area and volume of soil around the tree in which roots are normally found. May extend to three or more times the branch spread of the tree, or several times the height of the tree.

**Senescence:** The process of aging, decline and death.

**Softwood:** Cone-bearing trees with needles or scale-like leaves; also refers to the wood produced by these trees. Softwoods are the predominant tree type in coniferous forests.

**Soil:** A dynamic natural body composed of mineral and organic materials and living forms in which plants grow.

**Soil analysis**: The results of a chemical test that determines soil pH, and nutrient content including nitrogen, phosphorus and potassium, as well as other minerals.

**Species:** The main category of taxonomic classification into which living organisms are subdivided, comprising a group of similar individuals having a number of correlated characteristics.

**Stomata:** Plural of "stoma" - the minute openings in a leaf though which gases and moisture can pass. Most often on the underside of the leaf.

**Stress:** Unfavorable deviation from normal. The action on a body of any system of balanced forces whereby strain or deformation results. In arboriculture, the adverse alteration of tree health by abiotic or biotic factors.

**Subordinate**: Pruning a branch or leader to reduce it's domination in relation to nearby branches and leaders.

**Sucker**: A shoot originating from a root or lower trunk - sprouts and water sprouts are shoots from up above.

**Sunscald or Sunburn**: Damage to tissue from too much exposure to sun, or because exposure to sun was increased too rapidly, as when a tree is removed from the sunset side of another tree causing immediate change from full shade to full sun on the trunk of the remaining tree.

**Taper**: A decrease in the diameter of trunk and branches from the base toward the tip.

**Target:** Any person or object within reach of a falling tree or part of a tree, that may be injured or damaged.

**Terminal bud**: The bud at the apex of a stem - main central leader tip, the bud there.

**Topping**: Non-selective, "crew-cut" or severe style cutting of, and across the top of the tree, usually leaving large cross-cut stubs. Loose term is "hat rack" or "hat racking".

**Transpiration**: the exuding of water vapor from pores - stomata- in leaves aiding nutrient transport.

**Transplant**: Moving a tree or shrub from one location to another - not usually thought of as from nursery or tree farm to a landscape.

**Tree protection zone:** A designated area around trees where maximum protection and preservation efforts are implemented to minimize soil compaction, etc.

**Tunneling**: Boring a hole - a tunnel to be specific - under root zones, or through root zones, as opposed to trenching across entire roots - this is to reduce root damage, and can leave the soil surface undisturbed in many cases. Turgid: Sufficient water pressure in tissues.

**Undercut**: An undercut is the first of 3 cuts in the multiple 3 cut system to remove a branch without tearing bark. The undercut, and top cut are both made a little way out from the branch collar and trunk.

**Urban forestry:** Management of naturally occurring and planted trees in urban areas

**Vertical mulching**: A boring or drilling of soil in the root zone and filling with porous material or other soil to improve aeration and water penetration, as well as introduce mycorrhizae, nutrients or organic matter.

**Vigor:** Overall health; the capacity to grow and resist physiological stress.

**Visual Tree Assessment:** Method of evaluating structural defects and stability in trees.

**Water sprout**: A vertical shoot from a branch, or upper trunk, that is usually fairly speedy growing compared to most other branches.

**Weak crotch**: When 2 or more branches or leaders meet at a union which is weak - in most cases a weak "V" shaped crotch or union. Often, the bark in-between has included bark, contributing to the weakness.

**Wound dressing**: A coating or paint originally made to coat pruning cuts or wounds, proven to cause acceleration of decay. Not recommended except in isolated specific cases for control of insect or disease on a few species of trees.

**Xylem**: Water and nutrient conducting tissue inside the cambium, and produced by the cambium. It is usually the greater portion of the inside of the trunk called, in general terms - "wood".

# Footnotes

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LEGACY ARBORIST SERVICES

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# Managing the Urban Forest

## Planting/Transplanting

The following information is based upon the American National Standards Institute (ANSI) A300 Standards, Part 6, Planting and Transplanting, last revised in 2005. In addition, the Florida Division of Plant Industry's Florida Grades and Standards for Nursery Plants, last revised in 2015. Appendix A of the latter publication also contains Best Management Practices for planting trees in the urban environment. The author's experience is also incorporated where appropriate.

**Timing**

Containerized and balled/burlap trees can be planted at any time of year, with advantages and disadvantages to each season. During the winter months (Thanksgiving through Valentine's Day), the flow of sap in the vascular tissue tends to be significantly reduced. Therefore, the root system does not need to expend as much energy to support metabolism in the crown or upper portions of the tree. This gives trees planted in the winter the chance to establish their root systems before they need to begin providing significant nutrients to the crown. Local rainfall during this time period tends to be lower which means the new plantings are more dependent on irrigation.

Trees planted during the summer months usually receive the maximum amounts of annual rainfall and are not as dependent on irrigation. These plantings, however, are more subject to transpiration stress which impedes root establishment and can cause leaf desiccation, making the trees look unsightly for at least the first few months. Deciduous species are especially subject to these summer heat stress impacts and should not be planted during the summer months. In addition, wind events during the hurricane season can wipe out recently installed tree plantings where the root systems have not had time to become established.

Spring and Fall may be the least desirable seasons to plant trees. March through May can have both low rainfall and high temperatures which stress new plantings, with Fall plantings also experiencing these conditions to a lesser extent. In all situations, however, city staff may have to alter timing of tree installations to accommodate nursery suppliers or installation contractors.

**Site Selection**

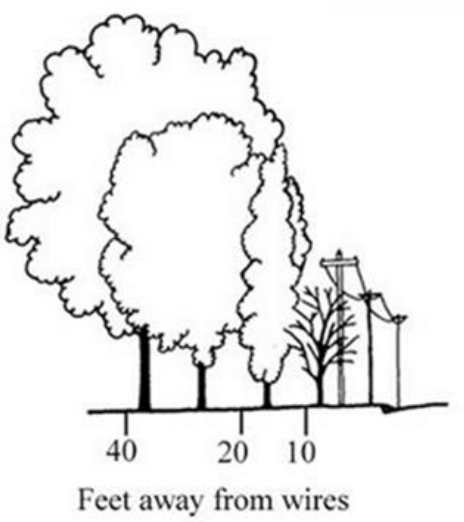
*Right Tree/Right Place* is a mantra that is easy to remember and will help to ensure the success and effectiveness of a tree planting project. The consequences of ignoring proper site selection procedures may not become apparent until several years after installation, when trees decline and eventually die well before their anticipated lifespan. Poor site selection can also result in either infrastructure damage, road visibility constraints, or maintenance issues.

A potential planting site must have adequate above ground clearance. Planners need to envision how far tree limbs will extend at maturity when choosing planting site locations. Adequate clearance from nearby buildings, lighting fixtures, traffic signs, and other structures at maturity must be calculated to minimize the need for future pruning and reduce the likelihood of infrastructure damage. Unplanted spaces for emergency response access must also be maintained at strategic locations. Consult fire department officials as part of the project planning process.

*Park planting site locations* also need to consider crown size at maturity. Plantings should maintain a border of at least 20 feet from boundary fences or structures. New plantings should be located at least ten feet outside the drip line of existing trees, unless the species to be planted is known to be shade tolerant. Roadside plantings that border a wooded area need to be set forward by at least 20 feet from the border of the wooded area. It has proven to be a waste of time to plant trees any closer unless the woods will be cleared in the near future.

In order to minimize the likelihood of future power outages, power companies have established guidelines that specify acceptable species for planting in proximity to their distribution lines. While utility pruning is usually performed in a judicious manner that protects the structural integrity of the tree, excessive and unsightly pruning can become necessary where canopy tree species are planted either directly underneath or close to powerlines.

As a general rule, follow these guidelines to provide adequate clearance space for utility lines when planting trees, as illustrated by the accompanying diagram.




Underground utility conflicts also need to be avoided. Consult existing Public Utility underground maps when selecting tree planting sites or utilize the *811* services to locate unmapped utility lines. Planners need to consider the logistics of accessing these lines for future maintenance and locate trees where minimal root conflicts will occur.

Utility lines located more than three feet deep should present minimal conflicts with tree roots, since the majority of tree roots grow within the uppermost three feet of soil. If the utilities are located closer to the surface, then trees need to be planted at least ten feet away from them to minimize future conflicts, perhaps with root barriers installed.

Providing adequate below ground rooting space is the most critical factor in site selection, however. This includes space unencumbered by hardscape as well as space containing utilities. If a mature tree does not have adequate rooting space, both structural and health problems will result. These structural problems can cause the tree to fail, resulting in potentially extensive damage to property and danger to human lives. Declining tree health can also cause these impacts in a more gradual manner.

In general, follow these guidelines to provide adequate rooting and above ground space:

| Tree Size | Rooting Space | Planting Strip Width | Space Between Trees |
|---|---|---|---|
| Canopy | 300 $ft^2$ | 8-10 ft | 30-35 ft |
| Mid-Stpry | 150 $ft^2$ | 6-8 ft | 20-25 ft |
| Small | 40 $ft^2$ | >4 ft | >10 ft |

Trees can also be planted at a wider spacing if less shade or a wider spreading crown is desired.

The soil in the planting area must be free of debris, including *calcareous material* (limerock) to a minimum depth of either six inches greater than the depth of the root ball or two feet total depth, whichever is greater. The width of the suitable soil area also needs to be a minimum of ten inches on either side of the root ball.

Soil pH measures the acidity or alkalinity of the soil in the planting site. The pH impacts the tree's ability to access necessary soil nutrients, and each tree species has a preferred soil pH range for optimum growth. In general, however, a soil pH of between 4.8 and 7.2 should provide a suitable planting environment for most species recommended for this area. The naturally occurring soil pH, however, often changes over time in an urban environment. Nearby construction activities that involve either the application of limerock or the erosion of concrete structures tend to increase the soil pH. When this situation arises, project planners need to treat the site before planting based on soil test information and other factors. For example, application of a sulfur compound at least a month before planting can reduce the soil pH on a site.

A simple soil test can be performed to test for pH or nutrient deficiencies, either with a kit or by sending a sample to the Cooperative Extension Service or private lab. Some labs can also perform foliar analysis on nearby trees to determine pH and nutrient needs. Certain tree species, particularly palms, may have more specific requirements for pH and nutrients.

Generally, most soils are deep sands, with drainage varying from excessive to poorly drained in nature. Tree species selected for planting should be adapted to sandy, infertile soils. Irrigation is necessary, especially for the first year after planting.

Soil compaction frequently presents a problem for potential urban planting sites. Soil compaction impedes the root system's ability to adequately expand. This diminishes the tree's ability to absorb sufficient soil nutrients and makes the tree more vulnerable to windthrow. If you cannot push a soil probe into the ground to a depth of at least 18 inches, consider the soil to be compacted.

Where adequate exposed soil surface exists, soil compaction can be corrected in advance of planting. Compacted soils can be excavated and aerated to a depth of three to four feet and perhaps amended with organic matter. This can be accomplished with either a backhoe or an *air spade* which is described in the Protection section.

**Species Selection**

A list of recommended species for planting was included in a previous section, as are guidelines for selecting species to focus on sequestering carbon. Species recommended for planting in St

Augustine Beach must have proven themselves suitable for planting in USDA Hardiness Zone 9A. They must also have a tolerance for the previously described soil conditions, have adequate tolerance of drought, high winds, and pests, require minimum maintenance, and are available in sufficient quantities from Florida nurseries. Pleasing visual characteristics such as flowers or colorful foliage also make a species desirable for planting if the species possesses the other previously listed traits.

Maintaining and enhancing species diversity in the city is an additional consideration when selecting tree species for planting. As stated in the inventory section, species diversity reduces the likelihood that a single pathogen can destroy a significant portion of the city tree canopy at one time. Species which predominate the existing tree population should not be emphasized in a tree planting project in most cases.

*Native tree species* tend to be better adapted to local soils and climate, and they tend to be less vulnerable to attack by various pathogens. In addition, native species are an indigenous component of local ecosystems. Various invertebrate and wildlife species depend on native tree species for habitat, and non-natives do not make suitable substitutes. Mature live oaks, for example, are known to support as many as 140 species of fauna.

On the other hand, *non-native tree species* which have a greater tolerance to adverse conditions may sometimes be more appropriate for planting in developed areas, since rooting space is more constricted and soil temperatures tends to be higher on urban sites. Some non-native tree species often acclimate to disturbed site conditions better than natives which may be more accustomed to pristine forested conditions. Non-natives may also have more distinctive and attractive visual features than native species, such as flowers or colorful foliage.

*Invasive exotic species* are non-natives that regularly produce bountiful seed crops and summarily colonize and eventually dominate native habitats where they previously did not exist. Both the Florida Exotic Pest Plant Council and the Florida Division of Plant Industry maintain a current list of invasive exotic species. The current tree inventory only includes a few trees that would be considered invasive. These include Queen Palm, Chinese Fan Palm, and Mexican Fan Palm. These should be avoided in future plantings.

Whenever adequate space permits, large maturing broadleaf canopy species should be selected for planting. Canopy species have the largest crowns, provide the greatest amount of shade and other ecosystem services as previously described in this plan, and do the most to improve the visual character of the community. Make sure that adequate space exists for a larger species when it reaches maturity.

Palm trees can be planted in small places, tend to sustain minimal damage during tropical storms, and contribute to a tropical or *Floridian* ambience where they are planted. Palms, however, require more annual maintenance and fertilization and have less leaf surface area than broadleaf species. This means that palms provide less shade than broadleaf species and the ecosystem services as previously stated.

Baldcypress is highly recommended for both street and park plantings. Although found in wet places in nature, this species has proven to be a desirable species for upland sites. The photo below provides an example of baldcypress trees growing well in an urban environment.

Baldcypress Street Trees in Lafayette, LA

**Purchasing Quality Nursery Stock**

Whenever possible, locally grown planting stock should be purchased from local nursery vendors. This increases the likelihood that the trees come from a local genetic seed source which is well adapted to the local area and will best survive and grow in the future.

The size of the nursery stock to be planted depends on the location and use of the trees. For example, plantings in a natural area with minimal traffic require a larger quantity of trees and could be planted with seedlings. Conversely, larger trees (at least two inch caliper or greater) would be needed on city streets with vehicular traffic and potential vandalism. Plus, people expect more immediate visual impact from tree plantings in more visible areas. The higher cost of the nursery stock, as well as the additional time and expense involved in transport, installation, and post-planting care increases with tree size.

The Florida Division of Plant Industry, working with the Florida Nursery Growers Association, has maintained a publication for over 50 years known as *The Florida Grades and Standards for Nursery Plants.* Any trees planted on city property should meet the standards for a Grade 1 tree, or at least be suitable enough to prune into a tree with Grade 1 form at the time of planting.

City staff who plan tree planting projects should refer to the latest (2015) edition of the Grades and Standards manual found at http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Plant-Industry-Publications. Grading cards are available for use in the field to facilitate the grading process. The basic elements in the tree grading process include the following elements:

- **Minimum height, caliper diameter, and crown spread are adequate for a specified sized root ball or container.**
- **Note: Do not buy a tree where the trunk and crown are too big for the container. Unscrupulous tree vendors try to sell undesirable stock by offering such trees at low prices. They usually do not perform well once they are outplanted because their root balls cannot support the above ground portion of the tree.**
- **The main stem form is not excessively forked or crooked, particularly in the lower portion of the tree.**
- **The tree crown is symmetrically shaped with a minimum of voids or bare spots.**
- **The support roots do not circle around the trunk more than a minimal amount. This can be most important grading criteria. Girdling roots are described in the Pruning section.**
- **The tree has a minimum of defects such as trunk wounds, flush cuts, branch stubs, or foliar dieback.**

Ideally, a city employee knowledgeable in grading trees should visit the supplier and tag the trees for the city to plant. If this is not possible, the city contract with the nursery or landscape contractor should stipulate that the trees must meet the minimum standard and will be rejected at the time of delivery if they do not.

**Tree Installation Procedures**

*Why Do Tree Plantings Fail?*

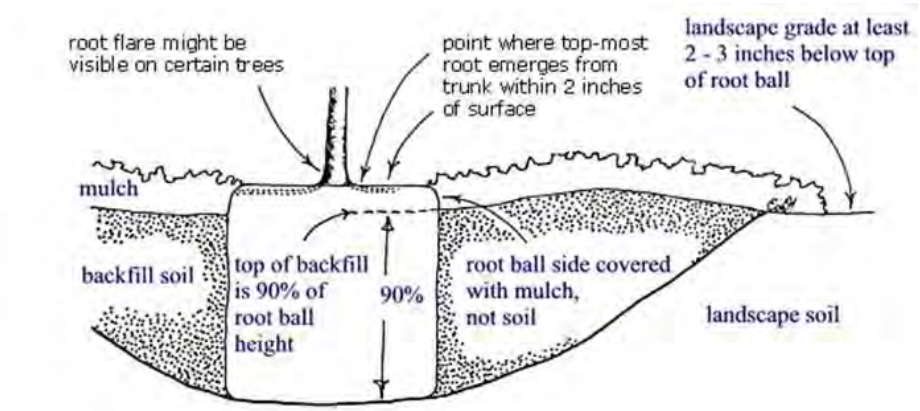
These are the most common reasons.

- **Poor location**
- **Poor quality nursery stock.**
- **Poor handling during transportation and installation.**
- **Planting at improper depth, usually too deep.**
- **Inadequate irrigation during the first year.**
- **Over pruning during the first few years.**
- **Mechanical injury and vandalism.**

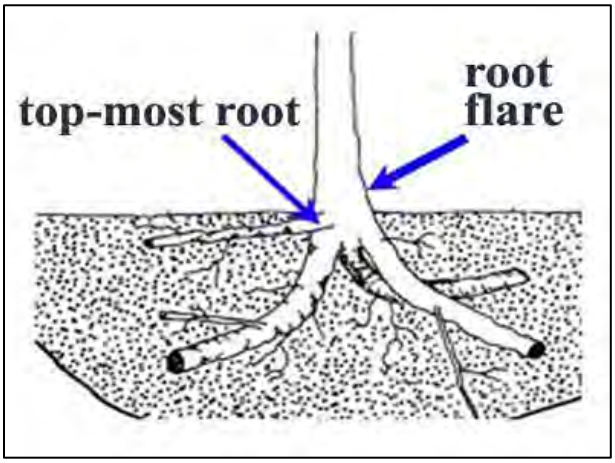
Location and tree quality have already been discussed at length. The following information describes how to minimize the likelihood that the other circumstances will occur.

Digging the Hole – Research has shown that it is better to plant the tree a little too shallow than to plant too deep. Tree roots need oxygen just as much as the above ground part of the plant. For that reason, most tree roots (even on very large trees) in nature grow out from the trunk (NOT down) within three feet of the ground surface because oxygen is more plentiful there. The tendency of tree roots to extend sideways rather than downward also provides more support for the trunk.

Refer to the accompanying diagram for proper hole depth and root ball placement. Digging the planting hole at least 1.5 times the width of the root ball will encourage lateral root growth. Conversely, the depth of the hole should be similar to or slightly less than the height of the root ball, If the hole is initially dug too deep, add more soil under the root ball and compact it firmly.




*Preparing the Root Ball* – The root ball should remain intact. Remove trees from containers, and then use a sharp square pointed shovel to shave a small amount of soil from the outer edge of the root ball to sever circling roots that will impede future root growth and tree stability. Most healthy nursery stock has a distinctive root flare at the ground line. If the root flare is buried, remove soil from the top of the root ball until that flare is visible. If no root flare exists (trees that have been grown from cuttings), soil from the top of the root ball needs to be removed until the top-most root emerging from the trunk lies within 1-2 inches of the surface, as illustrated below in the diagram and photograph.




*Pruning at the Time of Planting* – Dead and defective branches can be easily removed at the time of planting. It's easier to turn a taller tree on its side to correct structural defects before planting the tree. These defects may include multiple vertical leaders or a significant sized fork in the lower trunk. Be sure, however, to retain an adequately sized healthy crown.

*Placing the Tree in the Hole* – To avoid damage when setting the tree in the hole, lift the tree with straps or rope fastened around the root ball, never by the trunk. Special strapping mechanisms can be constructed to carefully place trees in the planting hole. Once the tree is lowered into the hole, use a straight stick to ensure it has been placed at the proper depth, as previously described. If the tree is too deep in the hole, lift it from the hole and firmly pack additional soil in the bottom to adequately raise the root ball. If the hole is only a little too deep, tip the ball to one side and slide some soil underneath. Then, tip the tree back the other way and slide some more soil under the ball. Continue this until the root ball is set at the appropriate depth. Be careful not to loosen the trunk or the root ball itself while adjusting the depth.

Once the tree is set at the appropriate depth, remove all string and wiring from the top of the root ball of field grown trees as well as all burlap from the sides of the ball. These items will impede future root growth. Wire supporting the sides of the root ball, however, can be left in place. Research has shown over time that the roots grow around and eventually through this wire with no significant growth loss. The wire also provides initial stability for larger newly planted trees.

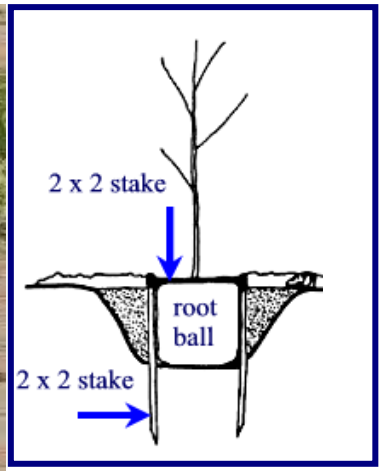
*Backfilling the Hole* - Straighten the tree by having a second person eyeball the trunk from perpendicular angles. While one person holds the trunk in place, the other uses a shovel to place enough backfill soil under and around the root ball to stabilize it. Check the straightness of the trunk one more time, and then replace the remainder of the backfill soil on the sides of the root ball. Do not place any backfill soil over the top of the root ball. During backfilling, stop occasionally and repeatedly jab the shovel into the backfill soil to break up dirt clods and remove air pockets. Step on the soil during these interludes before adding additional soil. The root ball should resemble the above photo, with a slight crown above the ground level.

*Initial Watering* – Begin adding water while the backfill soil is being replaced in the hole. Once most of the soil is replaced, build a berm with soil or mulch about two inches high, just outside the perimeter of the root ball. This will direct irrigation water toward the root ball for the first few months after planting. Apply a total of five to 10 gallons of water to each newly planted tree, depending on the size of the tree. Apply the water slowly, so that the water can be absorbed into the soil and not run off or through the berm.

*Staking* – Remove bamboo stakes if they are attached to the trunk when delivered. If the tree cannot stand without the stake, reject the tree.

Although staking can provide stability to a newly planted tree during the establishment period, staking has a number of drawbacks. Elaborate and expensive commercial staking systems are often stolen soon after they are installed. Staking with wires or strapping is often left in place too long without adjustment, girdling the trunk and causing mortality or vitality loss to the tree. In public places, the guy wires can present a trip hazard.

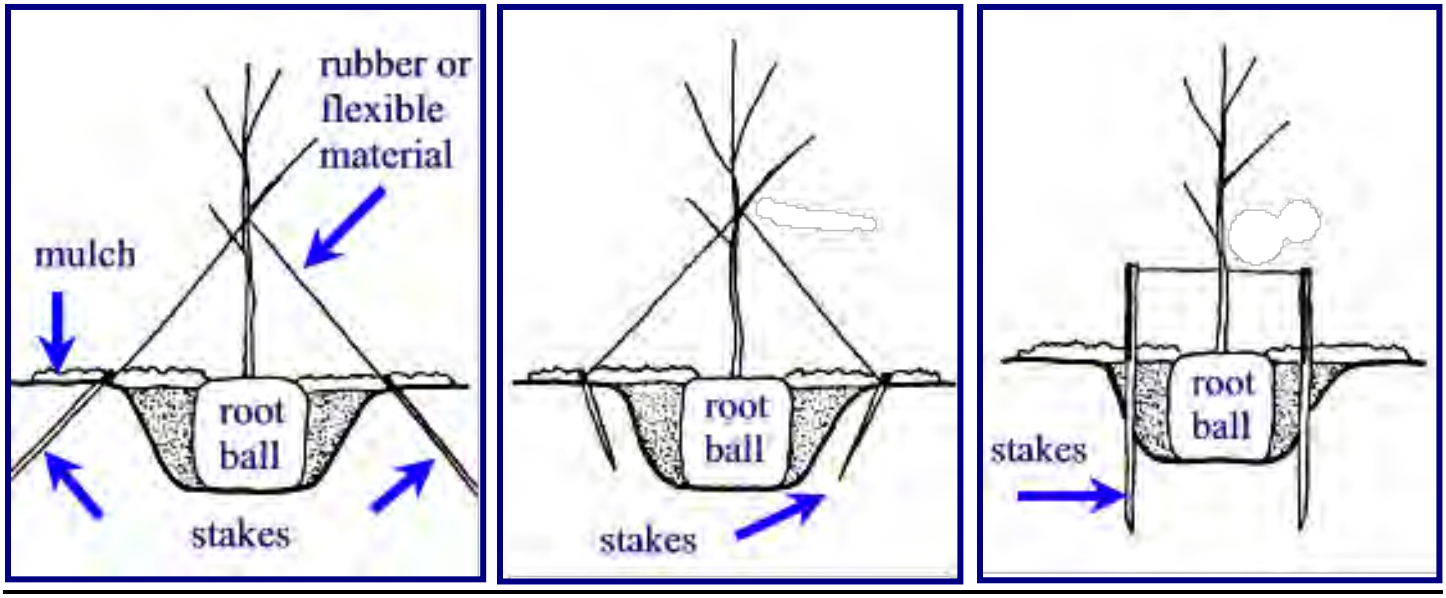
A simple inexpensive staking system is shown below, which can be installed and has none of these drawbacks. ANSI A300 Standards Part 6 refers to this staking system as *root stapling*. For each tree, the materials list includes two eight-foot 2x2" non-pressure treated boards and four non-galvanized screws. A cordless drill, a saw, a small sledge hammer, and a tape measure are the only tools required.




This system reduces movement of the root ball in the event of a significant wind storm while avoiding damage to the trunk. In fact, this method of staking will allow the trunk to move just enough to increase stability at ground line. Over the course of a year, the system will decompose of its own accord and will be gone by the time the tree sufficiently extends its root system to support itself. Mowing should avoid the immediate area where these trees are installed, and the area around the tree should be defined by a ring of mulch.

- **Cut 2 two-foot lengths from each board, leaving a four foot length uncut.**
- **Cut points on one end of the two foot lengths. These will serve as stakes.**
- **Lay the four foot lengths across the root ball, about three inches from the trunk on either side of the trunk.**
- **Pound the two foot stakes into the ground just outside the edge of the root ball, right next to the four foot lengths to where they can be connected. Leave two to three inches of wood above the surface.**
- **Fasten each four foot length of wood to two of the two foot stakes using the screws and the drill. Cut off the portion of the four foot lengths that protrudes past the stakes.**
- **Pound the stakes further into the ground to where the four foot pieces rest firmly**
- **on the surface of the root ball.**

If guy lines are deemed necessary, use one of the configurations in Figure 60. Use either wide webbing or wires encased in rubber hose to prevent the guy wires from damaging the trunk. Then, pound the support stakes flush into the ground to prevent a tripping hazard. Flagging the guy lines enhances their visibility in public areas. The tree can also be stabilized by installing two rigid stakes in the ground on either side of the tree. Wide webbing is strung between the two stakes, twisted to where the webbing holds the trunk in place but allows some trunk movement and does not constrict the trunk. <u>These support systems need to be removed from the tree no more than a year after establishment.</u>




For additional stability, either stake the root ball underground before installing the backfill or use the same staking method used for palms that is described later in this section.

*Mulch* – Mulch defining the area surrounding the root ball, discourages the use of string trimmers near the trunk base, reduces weed and sod growth within the root zone, helps retain soil moisture, and provides nutrients to the root zone as the mulch decomposes. Mulch can also have some negative effects. When applied too thick, mulch can absorb soil moisture making inaccessible to the tree. Deep mulch can also limit the oxygen supply to the roots, as well as encourage the tree to grow girdling roots within the mulch layer that eventually girdle the trunk and cause reduced vitality.

Do not apply mulch more than four to six inches thick. Some sources recommend a mulch ring up to eight feet in diameter, which is desirable but not always practical. A radius of three feet would be the minimum for the mulch to be effective. Do not apply mulch directly against the trunk; this can cause decay problems in the tree. Any composted organic material, including bark, pine straw, or wood chips will suffice. The mulch will need to be replaced at least once or perhaps twice each year. Green mulch contains too much carbon and could make nitrogen unavailable to the root system.

*Irrigation During the First Year* - Is Really Important! Regular irrigation immediately after planting encourages rapid root growth that is essential for tree establishment. Irrigation helps maintain and encourage the growth of the desirable dominant leader on large-maturing trees. Trees that are under-irrigated during the establishment period, by contrast, often develop undesirable low codominant stems (described in the Pruning section) and double leaders that can split as the tree grows larger. Frost cracks and sunscald along the lower trunk have also been associated with under-irrigation after planting. An entire year's root growth can be lost if the tree is under-irrigated during the first growing season.

Research clearly shows that recently transplanted trees and shrubs establish more quickly with frequent irrigation. Use the following chart included below for guidance on irrigation frequency and rates during the first growing season. At each irrigation, apply 1 to 2 gallons of water per inch trunk diameter (e.g. 2 to 4 gallons for a 2-inch tree) over the root ball only. If the mulched area is maintained weed-free, irrigation does not need to be applied outside of the root ball.

Irrigate plantings throughout the first growing season. After the first year, weekly watering may again become necessary if drought conditions occur during the warmer months. If the foliage starts to die back, or the sod grass in the area starts to become blue and brittle, resumption of irrigation is probably necessary.

Installing an irrigation system with efficient water conserving heads is the most effective way to irrigate new plantings. Truck watering is less expensive but more labor intensive. Personnel who apply the water to the trees need to be cautioned to apply the water at a volume and pressure to where the soil can absorb the water. This may require some trial and error to see how well local soils absorb irrigation water.

| Size of nursery stock | Irrigation schedule for vigor | Irrigation schedule for survival |
|---|---|---|
| < 2 inch caliper | Daily for 2 weeks; every other day for 2 months; weekly until established. | Twice weekly for 2-3 months |
| 2-4 inch caliper | Daily for 1 month; every other day for 3 months; weekly until established. | Twice weekly for 3-4 months |
| > 4 inch caliper | Daily for 6 weeks; every other day for 5 months; weekly until established. | Twice weekly for 4-5 months |
| Notes on Irrigation: | Delete daily irrigation when planting in winter or when planting in cool climates. | |
| | | |
| 1 | Never apply irrigation if the soil is saturated. | |
| 2 | At each irrigation, apply 1-2 gallons per inch trunk caliper to the root ball. | |
| 3 | Apply it in a manner so all water soaks into the root ball. | |

UF-IFAS Irrigation Schedule for Newly Planted Nursery Stock

*Gator Bags* and other similar devices have been used for new plantings in isolated locations where irrigation is impractical and regularly providing water to trees is difficult. These devices are similar to inner tubes made in various configurations which are loaded with enough water to last the tree for perhaps a week. They have small nozzles that continuously drip water onto the soil surrounding the tree at a slow rate. Unfortunately, gator bags can block rainwater from reaching the root zone. They also attract stinging insects and are often not regularly refilled.

*Tree Diapers* are a newer alternative for watering newly planted trees in isolated areas which were described in detail in an earlier section of this plan. They have a number of advantages over using Gator bags. They do not block rain water from reaching the tree's root zone. They also absorb and store rain water, rather than repelling it, making refilling unnecessary unless extreme drought occurs. The tree diaper allows water to gradually flow into the root zone over a wider area than the small nozzle on the Gator bag. They are placed underneath the mulch layer where they blend into the surrounding landscape, and after a year they biodegrade.

*Compression Wounds* – Compression wounds can appear as swellings on the trunk of newly planted trees approximately three to four months after the trees are installed. These are caused by the impacted trees having been lifted by the trunk, rather than by the root ball as previously described. Crown dieback and eventual mortality occurs as the result of compression wounds, because the vascular tissue has been irreparably damaged. When city officials detect compression wounds, the supplier needs to replace the impacted trees in a timely manner. This stipulation needs to be included in the contract for purchase and installation.

***Do Not Use of a String Trimmer within 12 inches of the Base of a Tree!!***

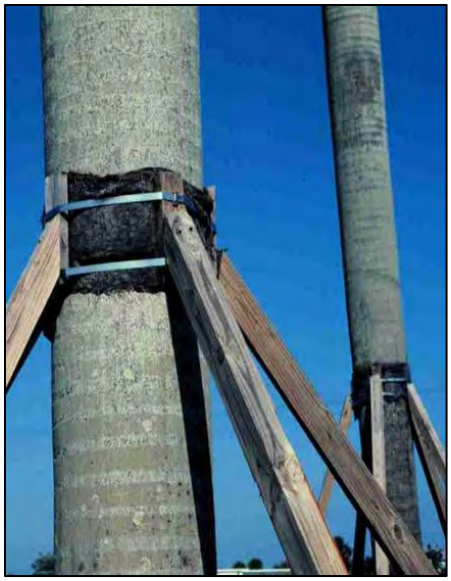
This item is singled out for emphasis because string trimmers do more damage to shade trees (particularly young ones) than any other potential source of harm. In an effort to maintain a manicured appearance throughout their work area, maintenance workers are often overzealous in mowing down weeds directly against the tree trunk. When small to medium sized trees show signs of decline, gashes in the base of the trunk from repeated string trimmer injury are often found.

Maintenance workers need to be cautioned to stay several inches away from trees when using string trimmers. When warnings go unheeded, installing tree guards and mulch rings around the base of the trees offer some protection. Weeds directly at the base of the tree can either be reduced by hand clipping or simply tolerated.

**Planting Palm Trees**

One of the most insidious and common practices of palm tree installers is to plant the tree at least two feet deep in the ground to save them the expense and trouble of staking the trunk. Burying the root ball to that depth can cause a variety of disease problems with accompanying decline and eventual mortality. Plus, the city is short changed because they are in essence receiving a smaller tree than for what they paid. Insist that the palms be installed at the same depth at which they were grown in the nursery or in the field.

Of course, this means that the palms need to be properly staked for the first growing season to ensure proper root establishment and stability. A layer of burlap or similar material is first placed to protect the trunk. Wood blocks are then placed over the padding, and this entire assembly is held in place by metal strapping (not nails). Timbers are nailed to the wood blocks (not to the trunk) and held in place at roughly a 45 to 60 degree angle by stakes in the ground. At least three timbers, preferably more, are used for this purpose. The staking should be left in place for at least a year, until the conclusion of the following hurricane season.



**Preventing Vandalism**

If theft of newly planted trees becomes a problem, *underground staking* can help remedy the problem. Before replacing backfill soil, secure the root ball with at least two lengths of biodegradable (hemp) rope staked tightly at the base of the root ball.

Keep in mind that larger trees are more difficult to steal. Installing a tree with at least a twenty five gallon root ball, which requires equipment and a larger truck to transport, will discourage vandalism.

Officials who have carried out community tree plantings for several years recommend *community engagement* as a means of reducing vandalism of newly planted trees in neighborhoods where this has occurred in the past. Potential strategies include the following.

Inform residents in advance about the planting projects and why they are important. Mailings and media efforts can be employed to accomplish this.

Although resident participation in tree plantings has not worked well in the past, find a way for local residents or youth groups to become involved in the installation. Let them replace the backfill soil, apply mulch, or manually apply the initial watering.

Conduct a tree giveaway for residents at the same time as the city right-of-way tree planting is taking place. Certain ethnic groups value fruit trees more than shade trees, so consider including them in the species mix.

Create a festival environment around the tree planting project, similar to a typical weekend celebration or crafts fair.

Replace trees or repair tree damage promptly to show that the city actually values them.

# Tree Protection

This plan lists numerous benefits that the tree canopy provides to the urban environment. Retaining larger trees and maintaining them in a healthy condition will increase a city's tree canopy faster and more expediently than tree planting programs, where the new trees don't significantly contribute to the tree canopy coverage for at least 10-15 years.

Healthy trees provide more benefits to a community than damaged trees. Damaged trees can also create risks for people and property. Therefore, tree damage resulting from either random vandalism or avoidable negligence needs to be minimized.

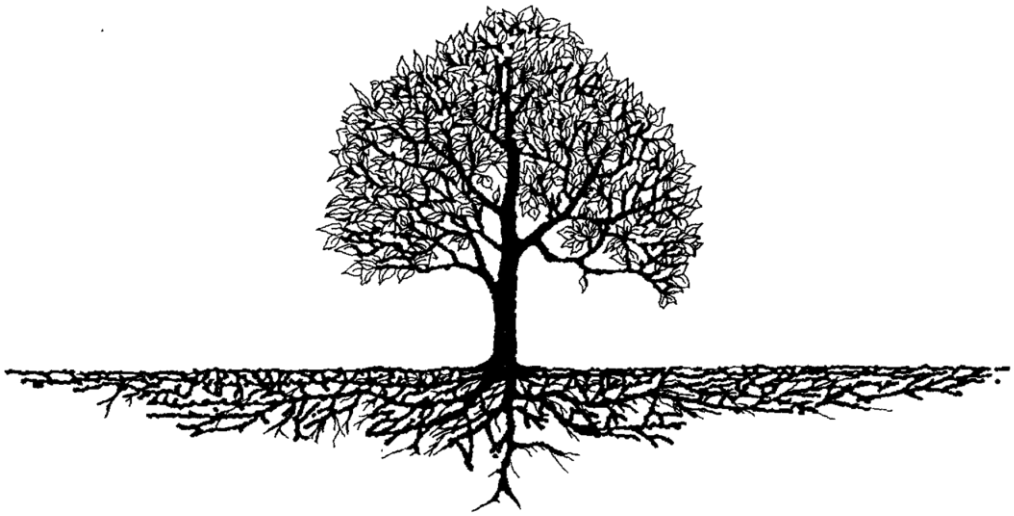
The following strategies for protecting trees are derived from the American National Standards Institute (ANSI) A300 (Part 5) Standard Practices for the Management of Trees and Shrubs during Site Development and Construction, as well as the companion International Society of Arboriculture (ISA) publication, *Best Management Practices (BMP's) for Managing Trees During Construction,* both last revised in 2008, as well as the author's own experience.

**Potential Impacts to Trees Associated with Construction Activities**

Most tree roots, even on larger trees, can extend radially from the trunk for a considerable distance. Most roots, however, lie no more than three feet below the surface, as illustrated in the diagram on the next page. For that reason, root and soil damage is commonly inflicted upon trees during site development or infrastructure maintenance. The following potential injuries to trees can occur as a result of these activities and should be prevented or mitigated to the greatest possible extent to prevent tree decline and mortality.

- A significant portion of a tree's root system is often severed during land clearing, grading, trenching, or excavation. The remaining root system is often insufficient to physically support the trunk and crown. In addition, the damaged root system can no longer deliver sufficient water and nutrients to the upper portions of the tree.
- Roots severed by excavation equipment, as opposed to being cleanly pruned at the cut ends, can become infected with disease spores and die off. By contrast, cleanly pruned root ends can sprout new feeder roots and remain healthy.
- Applying an excessive amount of fill soil over the root system can deprive the roots of sufficient oxygen and water to properly function. The fill soil, when applied too close to the trunk, can also introduce decay fungal spores to the roots. The growth of stem girdling roots can also result from excessive fill soil applied over the root system.
- Soil compaction occurs as the result of excessive vehicular and equipment traffic in the root zone, parking equipment in the root zone, or deliberately compacting soil to facilitate paving or other construction activities. Compacted soil impedes root growth and the root system's access to water, oxygen, and nutrients, resulting in decline and mortality.
- Storing piles of fill material or disposing chemicals and construction debris within the root zone can compact the soil, reduce water and oxygen, introduce toxins into the root system, and change the soil pH to where the availability of soil nutrients is reduced.
- Directing drainage from a newly developed site into an adjacent wetland area containing trees can result in decline and mortality. Covering tree roots systems by an unaccustomed

volume of water reduces oxygen supplies to where the tree can no longer function. Dead trees may present hazards to adjacent developed areas or powerline rights-of-way.



Construction equipment can also inflict above ground tree damage to the trunk and crown by mechanical injury and excessive pruning to facilitate construction as shown in the accompanying photo.

- Bark injuries can create wounds that serve as infection sites for decay fungal spores or insect pests. If severe enough, *compression wounds* to the trunk can damage the vascular system just under the bark. These wounds can reduce the flow of nutrients, water, and carbohydrates between the root system and the crown, resulting in decline.
- Broken limbs can be hazardous to nearby pedestrians and property within their fall zone.
- Excessive removal of limbs to provide space for construction reduces the tree's ability to produce adequate carbohydrates to remain healthy, resulting in decline and mortality. If pruning is necessary, it should be discussed in advance with a city arborist to ensure a sufficient amount of the crown is retained. Proper pruning techniques are described later in this plan.
- Above ground damage can also leave the tree with an unsightly appearance from which it may never sufficiently recover.

**Some Trees are just not Worth Protecting!**

The following are legitimate criteria for allowing removal, which are paraphrased and further explained here for clarification.

- Sufficiently poor condition, location, or otherwise a threat to public safety. Before considering removal, mitigation practices such as pruning, sidewalk alterations, or cabling and bracing should first be considered.
    - Poor condition would mean that adequately pruning the crown to remove dead or defective limbs would not allow the retention of a sufficient crown volume to support tree health or retain an aesthetic appearance. It would also refer to a significant defect in the trunk or the root system that would make these tree parts prone to failure even if the afore mentioned mitigation practices were conducted.
    - The value, condition, and significance of the tree would have to justify the expense and effort required to implement these mitigation practices.
    - The location could cause damage to nearby structures, compromise pedestrian or vehicular safety, or threaten the reliability of utility lines without frequent or excessive pruning. Altering hardscapes and other structures to increase tree rooting space and reduce tree risk should be considered before removing the tree.
- The species is included in the list of invasive exotics.
- The tree location *unreasonably* prevents the potential development of a buildable area, where the alteration of the site design or applying mitigation practices to the tree cannot accommodate retention.
- The tree does not fit the definition of either a *Historic* or *Specimen* tree, based on the species, age, size, historic significance, or similar traits.
- City officials determine that removal of the tree "will be in the public interest."

Decisions on tree removals should be reviewed in the field by a sufficiently experienced ISA certified arborist, preferably one who also holds the ISA Tree Risk Assessment Qualification (TRAQ), which was described in a previous section of this plan.

***But, What About the Healthy Trees?***

Once trees have been deemed sufficiently healthy and structurally sound by using the previously described procedures, other factors need to be considered when deciding whether to retain a tree in conjunction with a construction project. It is usually impossible to retain all existing healthy trees on a development site. The species should first be considered. Some tree species have historically exhibited a greater tolerance for sustaining mechanical damage than others. Trees that compartmentalize wounds well, such as live oak, withstand construction damage better than other species such as laurel oak which are normally more prone to disease infection. Species that have demonstrated a higher wind resistance are also better candidates for retention.

The previously mentioned BMP Manual lists common tree species and their tolerance to development impacts. The Clark and Matheny publication listed at the end of this section contains a similar, more expansive list. Value ratings for most Florida species can be found in a pdf document located on the Florida ISA website, www.floridaisa.org. Look under the Tree Care Information/Professional Tree Care section of that website. These value ratings are based at least in part on tolerance to development impacts. The list of recommended trees for planting included later in this manual indicates species which are especially wind resistant. A more complete list of wind resistant Florida trees can be found at the University of Florida website, https://hort.ifas.ufl.edu/treesandhurricanes/selecting_tropical.shtml.

The proximity to construction activities also determines whether trees should be retained. The nature and degree of impact to the tree's Critical Root Zone (CRZ) (explained below) will help to determine if the tree should be retained. Appropriate protection and mitigation practices need to be implemented if desirable trees are to be retained.

Soil characteristics also matter. Soils with higher organic matter, as well as clay or loam soils, are more liable than sandier soils to becoming compacted during construction. Soil compaction results in tree decline and mortality as previously described. Root failure which results in windthrow is more common on compacted soils, particularly with heavier textures that become more easily saturated during storms or heavy rain.

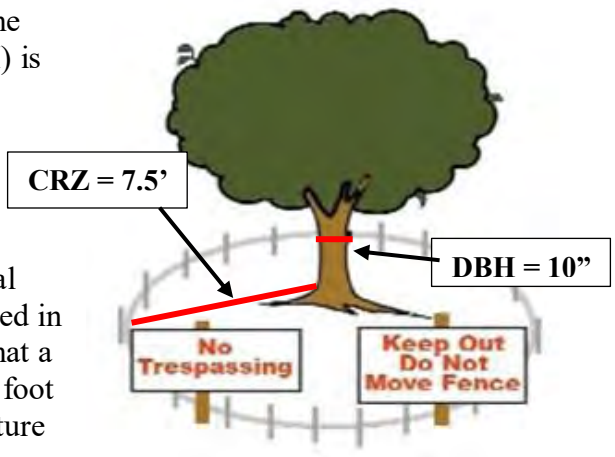
Configuration of retained trees also matters. Individual trees do not survive construction impacts as well as trees in groups or clumps, because the individual trees can have root impacts on all sides. In addition, if trees that were formerly growing in groups are released to grow by themselves during site clearing, they will often fail because they do not have adequate taper to withstand periodic high winds. Trees growing in groups, by contrast, only have potential impacts to their roots growing on the outside of the clump. The other trees in the group buffer high wind impacts and reduce development impacts to any individual tree in the group.

Of course, smaller and younger trees are more likely to survive development impacts as opposed to larger or older trees.

***How Much of the Root System Needs to be Protected?***

Measures to protect the root system of each retained tree need to be planned in advance and effectively communicated to each member of the construction team. Measures to protect the root system will also protect the trunk and the majority of the limbs. The previously cited Critical Root Zone (CRZ) needs to be protected from vehicle or equipment operation and parking, storage or disposal of materials, and grade changes. A fence which prevents access to the CRZ needs to be erected at the perimeter, before construction activities begin. Signage needs to be erected to indicate the purpose of the CRZ.

*How is the CRZ determined?* In the past, the dripline method has defined the outer edges of the crown as the boundaries of the CRZ. While this method is easy to follow, not enough of the root zone may be protected if the crown of a larger tree has been either damaged or overpruned in the past. Calculating the CRZ based on the trunk diameter at breast height (DBH) is more likely to protect a sufficient amount of the root system.




The recommended radius of the CRZ based on trunk diameter varies among authoritative sources. *Ideally*, the radius of the Critical Root Zone should equal **0.75 foot of diameter foreach inch of DBH** as illustrated in the accompanying diagram. This means, for example, that a 10 inch DBH tree would need a CRZ with at least a 7.5 foot radius. The CRZ radius should be increased for overmature

trees or trees of more vulnerable species. For a protected group of trees, the radius of the CRZ for the entire group should be based on the DBH of the largest tree on the outer perimeter, although this can be adjusted where tree diameters in the group significantly vary.

At an absolute minimum, the radius of the *root plate* needs to be protected. The root plate extends underground from the *root flare* (where the trunk meets the soil) to where the larger support roots are differentiated from one another and begin to extend in various directions (*zone of rapid taper*). Coder (1996)[12] has developed a chart of estimated root plate radii for trees of various diameters. The chart would need to be consulted for exact details, but can be summarized as follows.

- 10 inch DBH = 6 foot root plate radius
- 20 inch DBH = 9 foot root plate radius
- 30 inch DBH = 10 foot root plate radius
- >30 inch DBH = increase the root plate radius by one foot for every 10 inch DBH increase.

Root damage can also occur if excavations of paved surfaces are made within a tree's CRZ, although roots are not as numerous in the compacted soils under pavement. Workers need to look for roots greater than one inch diameter in these situations and employ appropriate mitigation measures. Those could include working around significant roots or cleanly pruning the ends of cut roots.

Site conditions and the nature of certain projects, however, may necessitate entry into the CRZ in some instances. When this occurs, travel corridors and zones of equipment use need to be established and protected in advance. First, lay down a taut sheet of geotextile on the ground surface. Then, lay down a six to twelve inch deep layer of wood mulch or a four to six inch layer of gravel. Plywood or landing mats can also be used, either by themselves or in combination with the mulch. The mulch or other materials need to be carefully removed as soon as possible after access to the area is no longer necessary.

**Protecting the Trunk**

Trunk protection needs to be employed for small projects where a CRZ is not employed, or when equipment must enter the CRZ as just described. Refer to the accompanying photo. First, wrap the trunk to the necessary height with a thick pad. Then, fasten a number of two inch wood planks over the padding by binding them with straps or wire. **Never attach fasteners into the tree itself.** Remove the protection apparatus as soon as possible once protection is no longer necessary, particularly in the Spring when the most rapid diameter growth occurs.

If trunk wounds occur, never apply wound paint. Those compounds have never been shown to be effective, and they

may actually delay wound sealing. The wound should be left to callus over by itself using natural processes.

Damaged bark and wood should be removed from the edges of the wound using a process called *bark tracing*. This involves removing the loose bark and wood back to the edge of the wound, which facilitates sealing and reduces moisture on the wound site which can cause decay. Figure 22 provides an example of bark tracing being performed.

**Installing and Maintaining Underground Infrastructure**

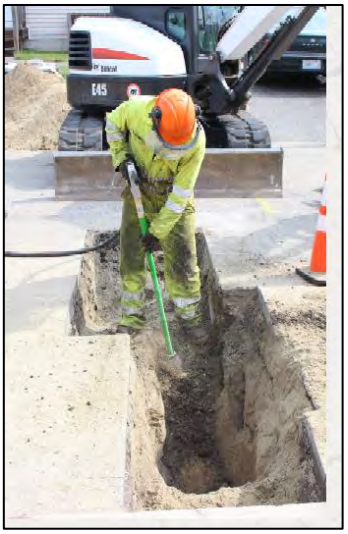
Digging a trench to install underground utilities has the potential to sever a significant percentage of a tree's root system if conducted within the tree's CRZ. Therefore, trenching should only be performed outside the CRZ. Within the CRZ, *a directional boring machine* can install utility lines about five feet below the soil surface, well below the zone where most tree roots grow as shown in the figure below. The entrance and exit holes for the borer should be located outside the CRZ whenever possible.

An *air spade* can create a trench or larger excavation where necessary with minimal impact to roots, as shown in the figure below. This tool can also locate larger roots that need to be avoided during operations. Larger installations such as sewer pipes have been installed in air spaded ditches by various Florida cities. The air spade can also be used to expose underground utilities in need of repair. Where careful hand digging indicates the presence of significant sized roots in the construction area, the air spade can be employed in a less intrusive manner than a backhoe.


Directional Boring Machine

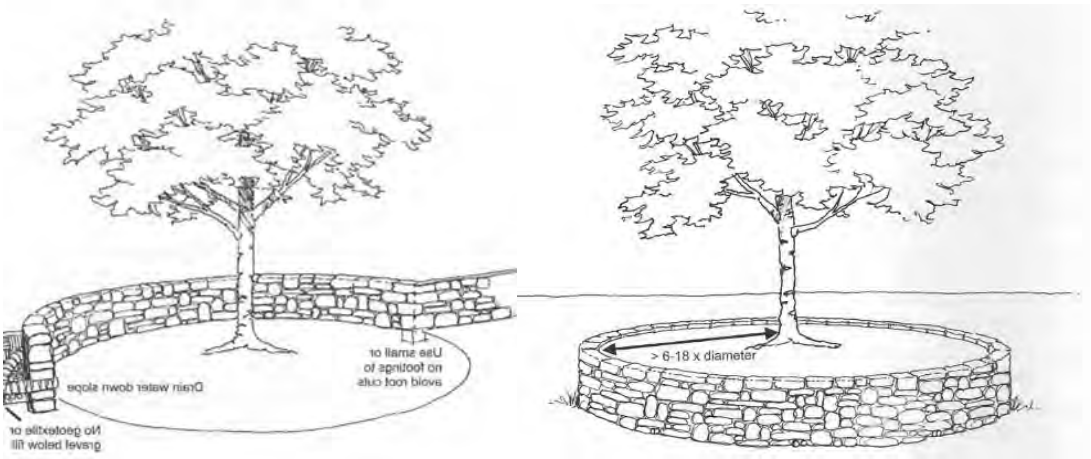
**Managing Grade Changes**

Grade changes of more than four inches need to be made outside the tree's CRZ to avoid tree decline and mortality. Sometimes, however, it is necessary to either raise or lower soil grades within the CRZ of one or more trees. Mitigation measures need to be implemented in these instances to reduce the likelihood of tree decline and mortality.



Air Spade

The grade needs to be reduced or raised as gradually as possible within the CRZ. Fill soil should be added as far away as possible from the trunk and with a gradual slope. Add coarse materials or the alternative hardscape materials described later in this section as opposed to regular soil. If necessary, *a retaining wall* can be built as far from the tree as possible, where a sufficient radius of the root system remains at original grade. In some cases, the wall can be built all the way around the tree and is referred to as a *tree island*. The following diagrams provides examples of a retaining wall and a tree island.




**General Mitigation Measures**

*Root pruning* should be performed if roots greater than one inch diameter could be impacted during a project. Ideally, root pruning should be performed a few months before project initiation to reduce damage during the project and to give the root ends time to form calluses and sprout new roots. An *air spade* or similar device can remove soil and locate roots large enough to protect, without unduly impacting the root system. Either a mechanical device designed to prune a large number of roots, or hand loppers and saws can be used to perform root pruning. If roots are torn during the construction process, they need to be cleanly pruned as soon as possible to reduce the likelihood of root mortality or the introduction of disease pathogens.

If possible, measures to improve the health of potentially impacted trees should be implemented six to twelve months before construction activities begin. One strategy is to apply a *Tree Growth Regulator (TGR)* to the root system of the tree. TRG's reduce stem elongation by as much as 40% during the growing season following application. Meanwhile, carbohydrates are re-directed to wound sealing and increasing the growth of fine feeder roots. Fertilization during this time

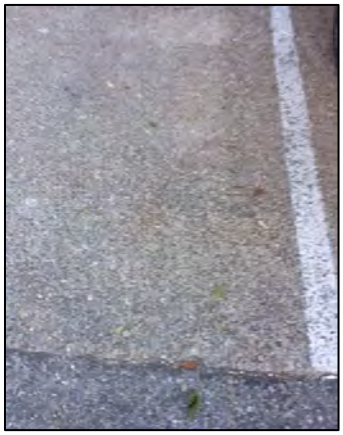
period may also help the tree to withstand adverse impacts from development. Coder (1995) recommends an application of slow release elemental nitrogen at a rate of ¼ to ½ pound per 1,000 square feet of open space within the Critical Root Zone (CRZ).

Installing *alternative hardscape materials* will allow trees to receive adequate water and oxygen and will also allow root systems to expand with fewer encumbrances. The cost, durability, and required maintenance will dictate the material chosen. Examples of various materials are described below.

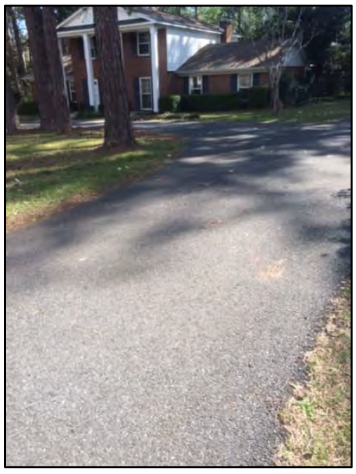
*Mulch* is the least expensive alternative, particularly in lower traffic areas where prompt maintenance is not as critical. *Gravel* is more durable and can be used instead of organic mulch. *Brick pavers* also allow permeability and can be removed as the trunk expands at ground level. *Asphalt* can be a better alternative to concrete because it is more permeable for water and oxygen and will allow some tree root expansion where a smooth paved surface is not absolutely required. *Pervious concrete* is mixed *without* sand, creating permeability pores. Unfortunately, it is not as durable as regular concrete and needs to be periodically pressure washed to maintain permeability. *Permeable pavers* are durable and often installed in parking lots. *Crushed granite* is the most expensive and the most durable alternative to concrete, and aesthetically pleasing and can be used to maintain a smooth surface.

Brick Pavers

Gravel



Pervious Concrete



Asphalt

Permeable Pavers

Crushed Granite

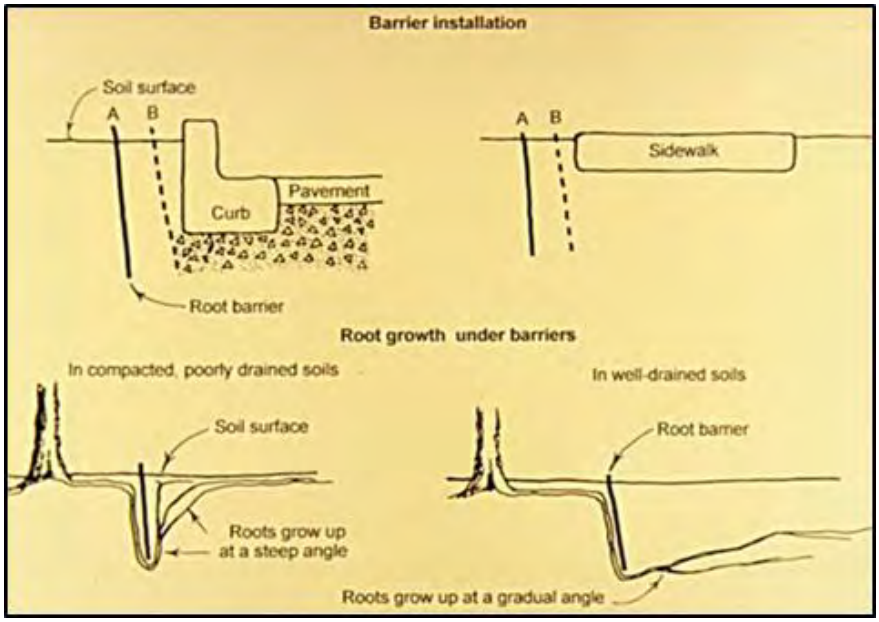
**Infrastructure Conflicts**

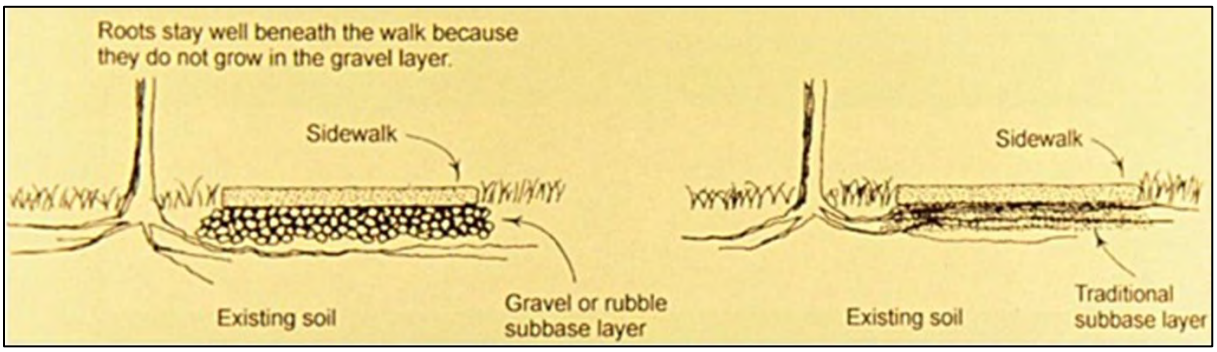
*Above ground conflicts* between trees and infrastructure can be resolved by proper pruning as described in the next section of this document. Application of tree growth regulators will reduce limb growth but must be applied at least every two years. The infrastructure itself can be modified to accommodate the tree limbs. Or, as a last resort, the tree can be removed and replaced with a species that has a smaller size at maturity. Mitigation procedures such as root barriers must be installed where appropriate. Homeowners associations and private property owners are responsible for necessary operations on their properties.

*Conflicts between roots and infrastructure*, however, are more difficult to resolve. New infrastructure that limits the root system's ability to expand can result in the decline and eventual mortality of the tree. As the tree grows expanding roots can damage sidewalks, sewer lines, and other underground utilities. Before re-doing the sidewalk, keep in mind that cutting an excessive amount of tree roots or filling over the roots with an excessive amount of fill can adversely impact the health of the tree. This can increase the likelihood of either limb failure or perhaps failure of the entire tree.

The following website provides a number of strategies for resolving conflicts between trees and sidewalks **if the tree is healthy and desirable enough to be worth saving:** http://hort.ifas.ufl.edu/woody/urban-sidewalk.shtml. Briefly, recommended strategies include the following:

- Limiting root pruning to no more than 1-2 inch diameter cuts.
- Re-routing the sidewalk around the tree's root zone.
- Installing root barriers to divert root growth either under or around the sidewalk.
- Installing re-bar or pouring a thicker slab that the tree roots cannot penetrate.
- Using alternative materials to concrete such as those previously described that will accommodate tree root growth.






Reinforced Concrete and Expanded Mulch Beds

Bridge

Where conflicts exist between tree roots and either sewer lines or other underground utilities, retention of the tree will depend on the percentage of the root system that must be removed to remedy the situation. If the tree is retained, installing root barrier once the situation is remedied will reduce the likelihood of similar repeated damage.

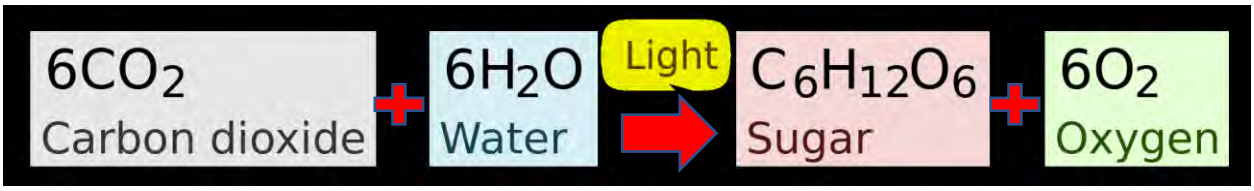
Reference publications for protecting trees include Trees and Development – A Technical Guide to Preservation of Trees During Land Development, authored by Clark and Matheny and published by the International Society of Arboriculture (ISA) in 1998. An additional reference, also published by the ISA is Reducing Infrastructure Damage by Tree Roots – A Compendium of Strategies, authored by L.R. Costello and K.S. Jones in 2003. Up by Roots - Healthy Soils and Trees in the Built Environment, authored by Jim Urban and published by the ISA in 2008, also contains considerable information about protecting tree root systems.

# Pruning

The following strategies are derived from these standards, as well as the companion ISA publication *Tree Pruning Best Management Practices (BMP's),* both last revised in 2008. Online information posted by the University of Florida School of Horticulture are also referenced. The author's own personal experiences, observations, and training, as well as developments to the science of pruning which have taken place since the publication of the cited references are also included.

**Why Prune, or Why Not?**

In many cases, **trees would be better served if they were not pruned at all**. Trees sustain themselves through the process of *photosynthesis*, which is illustrated below. Trees ingest carbon dioxide and water on the surface of their leaves. Following a chemical reaction fueled by sunlight, they release oxygen and then produce carbohydrates which the tree transports down the vascular system and uses to fuel their metabolic processes.




How Photosynthesis Works

This means that the more leaf surface a tree retains, the greater its capacity to conduct photosynthesis. Subsequently, this also means increased growth, more efficient sealing of wounds, increased resistance to pathogens, increased flowering/seed production, and overall improved health. Conversely, reducing the amount of foliage on a tree through pruning reduces these beneficial outcomes.

Pruning can also reduce limb and trunk taper, resulting in increased failure rates. *Taper* is the increase in diameter along the expanse of the limb or trunk extending from the apex to the trunk base or point of limb attachment. Good taper is necessary for urban trees to develop wind resistance and decrease the likelihood of future failure. Taper is created as limbs and branches act like straws and feed carbohydrates back into the larger limbs or trunk to which they are attached. When too many feeder limbs are removed or excessively shortened, particularly near the base of the trunk or a structural limb, less taper is created and the likelihood of future failure increases.

In addition, pruning is expensive. Proper pruning requires adequate trained personnel with appropriate equipment, as well as traffic control and limited access to roads or public spaces. If the tree is improperly pruned, its health can deteriorate, and the tree can eventually pose hazards to nearby people and property.

<u>Therefore, pruning should not be performed unless there is a compelling reason to do so.</u>

**So, what are compelling reasons to prune?**

- Mitigate existing hazardous conditions – Damaged or decayed limbs need to be either removed or reduced in length as soon as possible if the tree resides in a place where limb failure can likely result in either personal injury or property damage.
- Maintain clearance and visibility – This is probably the most common reason to prune a tree in an urban setting. Trucks on city roads require a minimum overhead clearance, and sidewalks require a minimum of both overhead and horizontal clearance for pedestrians. Signs, street lights, fencing, and other structures also need to clearance from tree limbs.
- Encourage the development of wind resistant structure – This requires a proactive pruning program which begins when the tree is planted and is periodically continued for the first 25-30 years after the tree has been planted. Basically, the goal is to eventually develop a structure that replicates what a tree would look like in a natural forested setting. Features would include a dominant central leader, adequate trunk and limb taper, and a branching structure with minimal potential failure points.
- Influence flower or fruit production – The timing and manner in which pruning is conducted can influence the future flowering and fruit production of a tree. This applies to crapemyrtles and other urban trees with showy flowers. Urban forest managers need to research the species characteristics of the trees they manage and how pruning influences their flowering tendencies.
- Increase sunlight penetration – A thinner tree canopy cover can provide increased sunlight to encourage the growth of vibrant lawns, planting beds, and ground covers.
- Improve aesthetics – Certain tree species need to be pruned in a certain manner in the urban environment to attain a desirable appearance. Once a consensus is reached on what constitutes a pleasing appearance for a tree, pruning can be used to achieve that appearance. Pruning can also open viewscapes in scenic areas.
- Remove girdling roots – Girdling roots are often found either at the ground line or just below the soil surface. They wrap around a significant portion of the trunk circumference, sometimes all the way around. They are more common with trees planted from containerized nursery stock but can also occur on field grown or naturally seeded trees. Figure 32 provides an example of a girdling root.

Girdling roots do not provide a significant amount of water and nutrients to the tree, nor do they provide any structural support. They do, however, detract from the health of the tree and can cause premature mortality. Think of wearing a necktie all day that's too tight around your neck. The tie will constrict the flow of both blood from your heart and air from your lungs from travelling to your brain. You will become light headed and not be able to function as well as you normally do. If you leave the tie in place, you will eventually die from oxygen deprivation. A girdling root does the same thing to a tree. Since the vascular tissue that carries water, nutrients, and carbohydrates up and

Girdling Root

down the tree is located just inside the trunk, the girdling root will constrict the flow of these essential items and the same health impacts will result.

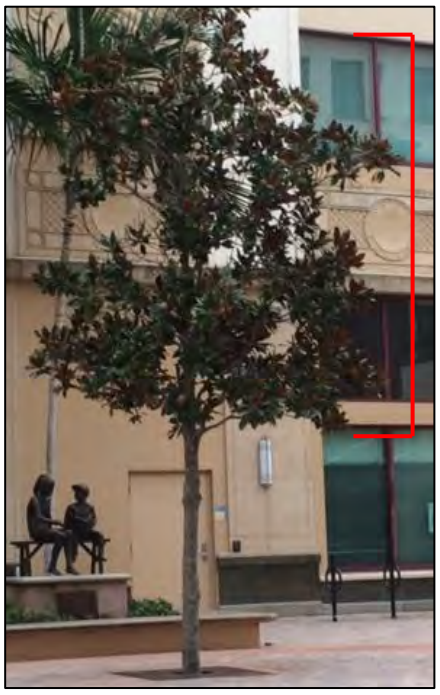
City tree workers should carry hand saws, chisels, and mallets whenever they are doing tree work. If they see trees with girdling roots, they need to sever and remove at least a one to two inch section of the girdling root as close to the trunk as possible. This will allow the tree to resume healthy growth without constriction at the base.

**When to Prune?**
Cleaning, raising, and restoration pruning are usually performed when needed, regardless of the time of year. For proactive pruning projects, however, the dormant season is usually the best time of year to prune. Trees tend to seal their pruning wounds more thoroughly when pruning is conducted during the season of less rapid growth, generally the period from Thanksgiving to Valentine's Day.

As previously mentioned, the time of year for pruning to promote flowering or fruiting depends on the tree species. Consult the Cooperative Extension Service for recommendations on the timing to prune various tree species to optimize flowering.

**Equipment**
Equipment should be appropriate for the job and well-maintained in the judgement of the supervising city arborist. Under no circumstances should climbing spurs or any other devices that cause peripheral damage to the bark or the trunk be used.

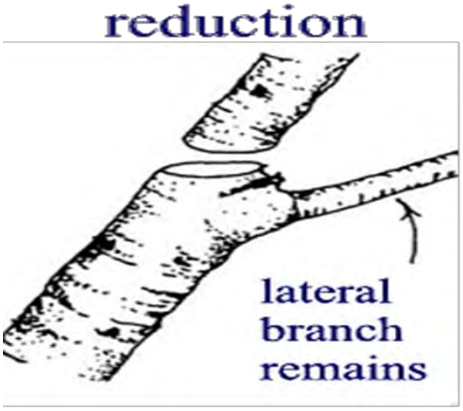
**Types of Pruning**
*Raising* – Raising involves either removing or reducing lower limbs to maintain clearance for roads, sidewalks, and selected structures. Urban forest managers can cause considerable damage to street trees, particularly young trees, if raising is improperly performed. Trees need to retain a *live crown ratio of at least 50%* as illustrated in the accompanying photo. to achieve adequate taper for wind resistance and maintain a healthy condition. If necessary, limbs should be shortened rather than totally removed to maintain this ratio. Also, the maximum diameter of the pruning cut needs to be specified in advance to avoid creating large pruned surfaces.



Healthy Live Crown Ratio

*Reduction* – Sometimes referred to as "drop crotch." Reduction is used to reduce the height of a tree or the length of a limb in a manner that minimizes future sprouting and re-growth. Reduction can also be used instead of total limb removal to increase clearance with

structures or thoroughfares. Reduction cuts can reduce the growth rate and of certain limbs and encourage the growth of more desirable adjacent limbs. This is called *subordination* and can be used as part of a structural pruning project. The accompanying diagram illustrates a properly placed reduction cut, which is made at a branch node. The smaller, horizontally oriented branch remains afterwards.




Reduction Cut

- Structural - This would be the preferred method for encouraging the development of desirable structure in small to medium sized trees. Vertically oriented limbs would be reduced in length so that the tree eventually develops one central leader, or a minimum of central leaders with some species. The growth of horizontally oriented limbs is favored because they form stronger branch unions than vertical limbs. *Co-dominant stems* occur where two limbs of similar size grow out of the same trunk or branch union, as illustrated in the accompanying photo. To remedy this situation, the right stem is reduced (or subordinated) by pruning at the indicated location to encourage the growth of the left hand limb which will eventually occupy the entire crown and become the dominant leader.

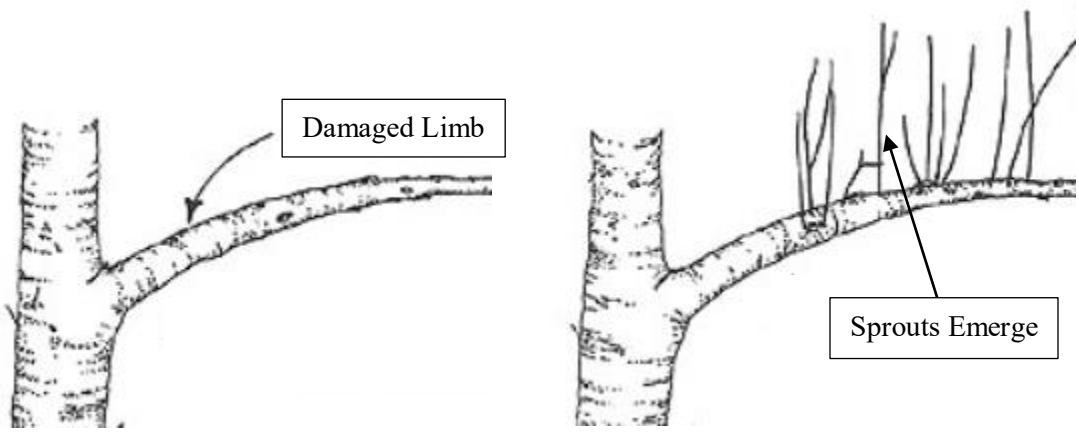
Structural Pruning to Reduce Codominant Stems

- Cleaning – This involves removing dead, decayed, detached, cracked, or broken limbs. Cleaning reduces the risk of failure and its adverse consequences. Cleaning also reduces the movement of pests into adjacent healthy tissue. It may be best to remove some healthy wood to reduce the limb back to a node, which will be discussed later. Figure 36 illustrates a tree in need of crown cleaning.

A Tree in Need of Crown Cleaning

- Restoration – Limb structure is often significantly damaged following a storm, and additional limb failures may occur afterwards if no action is taken. Restoration first involves removing or reducing potentially hazardous limbs, including long limbs with few or no branches. Making a clean cut at the end of the limb encourages wound sealing and discourages the introduction of decay. Sprouts will usually appear at the end of the limb and along its length beginning the following Spring, as illustrated in below, in response to limb damage.

  The next step in restoration pruning involves encouraging the growth of the more desirable sprouts along the expanse of the limb to promote the development of taper and strong structure. After a couple of years, thin out the least desirable sprouts to give the more desirable sprouts adequate room to grow. Retain the most desirable sprout at the end of the limb to encourage wound sealing and form a new terminal branch leader.




A Storm Damaged Limb and Subsequent Sprout Growth

Restoration can also include measures to correct structural deficiencies caused by previous improper pruning practices. It may take several pruning treatments to totally restore desirable structure.

**Identifying Strong Branch/Limb Attachments**

The point where two limbs attach to one another (called a *node*), or where a limb attaches to the trunk, can often be a failure point. The likelihood of failure is significantly reduced if one of the following conditions exist:

- The *aspect ratio* is less than 1/2. This means that the diameter of one limb is *less than 1/2* the diameter of the other limb at the point of attachment; or, the diameter of the limb is less than 1/2 the diameter of the trunk to which it is attached. For example, a strong attachment would exist where the trunk diameter of a tree is ten inches and the attached limb is five inches or less in diameter at the point of attachment. The diagram below illustrates good and poor aspect ratio.


Good (left) and Poor Aspect Ratio
ISA Publication Photo

- The junction of the limbs, or the junction between a limb and the trunk, has a *rounded* shape (or a *saddle crotch*), as illustrated in both examples in Figure 38 above. This contrasts with a *V-crotch*, which indicates a weaker attachment as illustrated in the accompanying photo.

If the aspect ratio is greater than 1/2, or a V-crotch exists, then one limb needs to be either reduced in length or totally removed. That decision is based upon the overall size of the tree, the size of the resulting cut surface, and what percentage of the crown would be removed.

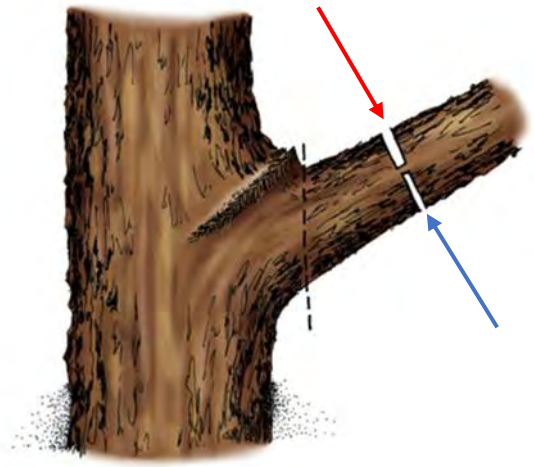
V-Crotch

The likelihood of failure at a V-crotch increases as the tree grows larger. The amount of attachment does not increase, but the amount of interface between the two limbs grows gradually larger. An increasing amount of pressure accumulates as the larger limbs push against each other. *Included bark* forms between the two limbs, which prevents the limbs from growing together and joining connective tissue. Eventually, the wood starts to split below the attachment and failure occurs. Therefore, cost and consequence can be reduced if this situation is remedied while the limbs are still relatively small.

**How to Properly Make Pruning Cuts**

- Branch Removal Cut – This type of cut is used to remove an entire limb. Limbs often have a *branch collar* located at the base of the branch/limb, a swollen area formed by overlapping wood that strengthens the attachment as indicated by the arrow in Figure 40. The branch collar is not as distinct on larger trees. It can be estimated, however, as occurring at roughly an angle of 135 degrees in relation to the trunk. A limb should be removed from the trunk at the branch collar, regardless of whether the limb is still alive. The pruning wound is more likely to seal in the shortest amount of time with a minimum of infection from pathogens if the pruning cut is made at this point.

Branch Collar Location



Pruning Cuts for a Large Limb

Removing a large limb all at once can cause the trunk to split and create a hazardous situation for tree workers or nearby citizens. Smaller sections of the limb which can be safely handled should be progressively removed. First, an *undercut* is made as shown by the blue arrow in Figure 41 at each section to keep the wood from tearing at the severance point. Then, the *top* cut is made at the red arrow to remove the limb section. The next to last section should terminate about a foot away from the trunk to facilitate the sawyer's ability to precisely make the final cut at the branch collar.

- Reduction Cut – This type of cut either reduces the height of a tree or the length of a limb. In all cases, the limb or trunk needs to be cut back to a *node*. Pruning cuts made at a node will seal more quickly than *heading cuts* made between nodes and will have less decay and fewer sprouts. The remaining limb should have an aspect ratio with the cut limb of between 1/2 and 1/3 for these cuts to be most effective and to ensure the future vitality of the tree, Once again, if the cut limb is six inches in diameter at the node, then the remaining limb should be at least two inches in diameter and preferably three inches.

The accompanying photo indicates where a reduction cut should be made, as previously described. For a large limb, the length should be gradually reduced in the same manner previously described for a horizontal limb.

A Vertical Reduction Cut

Wherever possible, the size of the cut surface should be minimized. A larger cut surface creates a larger infection site for decay fungal spores. Cut surfaces greater than 6-8 inches should be avoided wherever possible. Some species like live oak seals wounds well, but others like mahogany are more prone to decay infection following pruning.

**How Much to Prune?**

As previously stated, all pruning reduces the growth and vitality of the tree. Therefore, no more pruning should be conducted than is necessary to achieve the pruning objective. For cleaning, raising, or restoration pruning, less is always better. Pruning of mature or overmature trees should be limited to resolving immediate hazards and infrastructure conflicts. Older trees are less capable of sealing wounds or responding to structural modifications than actively growing trees.

Younger and moderate aged trees, however, can better respond to a greater amount of crown reduction and seal wounds more rapidly. This makes them better candidates for structural pruning, which is not effective unless enough of the crown is removed to re-direct limb growth in the desired manner. The ANSI standards suggest a maximum of 25% of the crown being removed during a single year. Estimating this figure, however, is extremely nebulous.

For that reason, all structural pruning should be conducted under the supervision of an experienced ISA certified arborist. This arborist should specify the location, size, and number of cuts to be made. This holds true whether pruning is conducted by city employees or by contractors.

**Use of Wound Dressings**

Wound dressings have been historically used to ostensibly enhance wound sealing and reduce decay. Research has found, however, that these “pruning paints” are not effective. In fact, they may impede the tree’s ability to seal wounds by natural processes. They may be recommended, however, for species that exude copious sap flow or have a tendency to grow mistletoe. Applications should be made in light coatings.

**Examples of Poor Pruning Practices**

The photos below show examples of poor pruning practices. City employees need to remember that these practices are often made by experienced tree care companies. They either didn't properly train their employees or never learned proper pruning practices themselves. In-house personnel also need to avoid these practices. Section 94-446(2b) of the City Code of Ordinances alludes to the following improper pruning practices.

- *Stub Cutting* – As previously mentioned, the proper way to prune a limb is to cut it back to either the branch collar or to a branch node if the limb is to be shortened. This facilitates sealing of the wound and allows an adjacent branch to occupy the space. When a stub is left, the wound does not seal as quickly and the site becomes a point of entry for fungal spores that introduce decay into the tree. Also, more sprouting occurs which looks unsightly and requires follow-up treatments.

- *Flush Cutting* – This is the opposite of stub cutting. The cut is made past the branch collar and into the tissue of the trunk or adjacent limb, causing structural weakness and encouraging the introduction of decay fungus. Once again, make the final cut at the branch collar to reduce the likelihood of decay fungal infection.

- *Heading Cut* - If a large limb remains after pruning where the cut is not made at a node, the type of pruning described above is called a heading cut. The only time a heading cut is appropriate is when performing restoration pruning following a storm. In these cases, the tree has been significantly damaged and you can't cut back to a branch collar or node without removing a large portion of the tree's crown. Numerous sprouts tend to form following a heading cut, which will need to be managed in the future as previously described.

- *Topping* – Topping either leaves a flat topped or *hat-rack* shape, or a rounded over or lollipop shape. Supposedly, these treatments make the crown symmetrical. They actually weaken the crown, however, because numerous heading and stub cuts are performed to achieve this shape. Also, an insufficient amount of foliage remains for good tree health. Pruning cuts should be made judiciously, as previously described.

- *Overlifting* – This occurs when the live crown ratio is reduced to less than 50% while raising the crown for clearance. Overlifting ruins the structure of the tree and removes excessive foliage, causing reduced growth. To promote strong structure, a tree needs to have sufficient trunk taper to develop wind resistance. As previously mentioned, a healthy tree should have limbs connected to at least 50 % of the length of the trunk. To achieve this goal, shorten limbs rather than removing them wherever possible.

- *Removing Large Limbs* – As previously mentioned, a large branch wound provides a large infection surface. If the wound is more than 6-8 inches in diameter, the tree has limited capacity to seal over large wounds. These wounds also weaken the structure of the trunk. Wherever possible, shorten large limbs rather than totally removing them.

- *Lion-Tailing* – This common practice involves removing all interior branches, leaving only large limbs and foliage at the end of those limbs remaining. The reason is ostensibly to

"allow the wind to pass through the crown" or to increase sunlight penetration to the ground to maintain a healthy lawn underneath. Lion-Tailing actually increases limb movement and resulting breakage during storms, which has been experimentally proven. In reality, interior branches "damp" the wind velocity and reduce breakage. Lion tailing also reduces the development of limb taper and places increasing amounts of limb weight at the end of the branch, increasing the potential for breakage. Most pruning should take place in the exterior of the crown to maintain a healthy tree in the long term.

Stub Cut

Flush Cut

Round Over Cut

Overlift Cut

Lion Tail Cut

Oversized Pruning Cut

Examples of Poor Pruning Practices

**Palm Pruning**

Palms have less leaf surface area per tree than either conifers or hardwoods. Any reduction of crown volume has a significant negative impact on the ability of a palm to grow and remain healthy. Therefore, **NO** live palm fronds should be removed if it can be avoided. Unfortunately, over-pruning palms is an extremely common practice among landscape maintenance companies. These companies will tell you that removing all but the very topmost fronds (known as a *hurricane cut)* makes the tree more wind resistant. Experience has shown, however, that just the

opposite is true. Hurricane cuts will, however, reduce transpiration during transport of the palms and increase survival during transplant. That is the only time to hurricane cut a palm, however.

Ideally, only dead fronds and fruiting structures should be removed during pruning to promote safety and sanitation. If additional clearance or a more *aesthetic* appearance is desired, no live fronds should be removed above a 90 degree angle. Don't remove live fronds just to access the fruit stalks. The photos below provide examples of good and excessive palm pruning.

Palm frond stalks should be cut as close to the trunk as possible, but not flush cut. Although shaving or sanding the trunk may be perceived as improving the tree's appearance, it does not improve the health of the tree in any way. Doing so up to a height of eight feet, however, can improve safety for pedestrians using adjacent sidewalk areas.

Good (left) and Excessive Palm Pruning

# Additional Tree Care Practices

**Fertilizing Palms**

Since palms have a differently constructed system for moving nutrients and carbohydrates up and down the trunk, and because most palm species are not native to Florida, they tend to have a more significant need for fertilization than broadleaf hardwoods. Extension Publication #27300/ENH, authored by Dr. Timothy Broschat, describes various common nutrients deficiencies of palms and how to visually identify each one. The publication identifies low potassium as the most common palm nutrient deficiency, regardless of species, as shown in the accompanying photo.

Potassium Deficiency

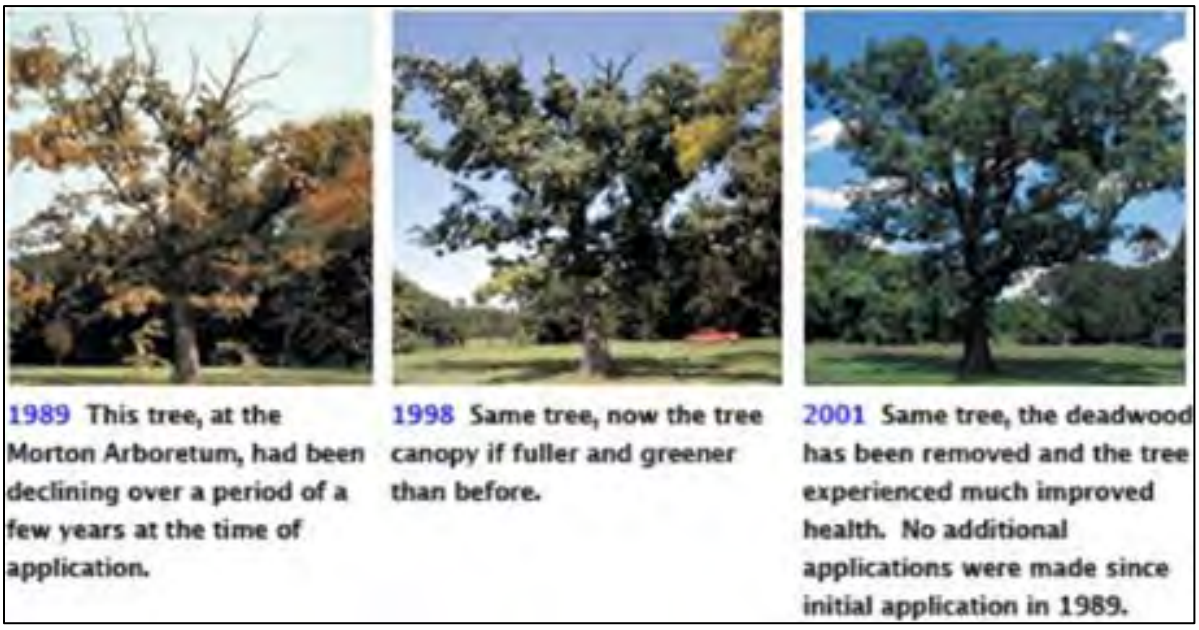
Dr. Broschat also authored Extension Publication #26100/ENH1009, *Fertilization of Field Grown and Landscape Palms*. The above cited publication recommends a formulation of 8N-2P2O512K2O +4Mg with micronutrients for fertilizing most palm species in most situations. Either soil or foliar tests or more severe decline symptoms, however, may indicate the need for a more specific formulation.

All Nitrogen, Phosphorous, Potassium, and Magnesium must be applied in a slow release formulation, since local soils do not retain these nutrients well. Slow release formulations remain in the soil for 3-4 months, don't leach out as readily following heavy rainfall or irrigation, and don't tend to cause damage to parts of the tree. Micro-nutrients, by contrast, are most effective when applied in water soluble formulations. This publication lists a number of commercial formulations that suit these criteria. Soil and/or foliar test reports will also provide these recommendations.

Broschat further recommends uniform *surface* applications throughout the area under the canopy. *Soil* injection tends to be less effective for palms and can cause root damage in palms if concentrations in one location are too high. He also recommends against trunk injections because palms have no true bark or cambium and cannot seal wounds. Those wounds can later become infection sites for pests. Quarterly seasonal applications are recommended for either health maintenance or to correct low to moderate deficiencies. A formulation with no phosphorous could be used for summer applications to prevent runoff impacts.

If fertilizer is specifically applied to increase potassium, the author recommends that magnesium also be applied in a formulation such as 0N-0P2O5-16K2O+6Mg. Otherwise, the tree will exhibit the symptoms of magnesium deficiency. All nutrient deficiencies in palms may take one to three years to correct.

**Tree Growth Regulators (TGR's)**
Utility companies have used TGR's for over 30 years to manage desirable trees in proximity to power lines with minimal pruning. In recent years, it has been discovered that TGR's can also improve tree health. TGR's can reduce stem growth by as much as 40% for one to two years after application. Nutrients normally used for stem growth are then re-allocated to support sealing wounds, discouraging pest attacks, growing more extensive feeder roots, and thickening leaf cuticles which reduces drought stress. Mature broadleaf hardwoods which don't respond well to fertilization can particularly benefit from TGR applications. Beneficial results have been shown on Florida trees, and TGR's could be used more extensively in the future to improve tree health. They can be applied by someone with a Limited Commercial Landscape Maintenance certification, minimal protective equipment, and using a simple soil drench. More information available at: https://www.extension.purdue.edu/extmedia/fnr/fnr-252-w.pdf. The photos below illustrate the potential benefits of applying TGR's.




Benefits of TGR Applications Over Time

**Righting and Guying** blown over trees can be performed following a significant wind event until the trees' root systems have adequately re-established themselves. This practice can be considered under the following circumstances.

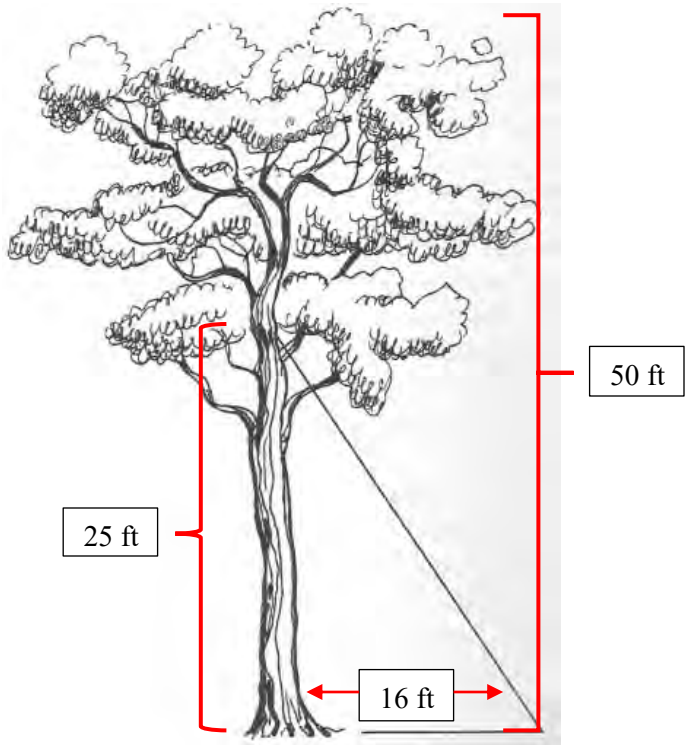
- Recently Planted Trees: Includes trees ten inches or less in caliper and a significant portion of the root system has remained intact. In all likelihood, restricted root systems with circling or girdling roots at the time of planting contributed to root system failure. Before replanting, the root balls need to be shaved to eliminate these defects. In addition, these trees need to be replanted at the proper depth as previously described in the Planting section. Planting too deep can be worse than shallow planting because the root system can deteriorate due to lack of oxygen and decay can occur at the root flare.

- More Established or Mature Trees: To quote the above referenced BMP manual, *Established trees are rarely guyed.* Guying larger trees is expensive because it requires employing a crane to right the tree and hold it in place during installation. Guyed trees may also fail, in spite of all precautions being taken, resulting in a risk to people and property. The support cables require periodic attention as previously described for cabling systems to maintain adequate tension. They also present an ongoing public hazard since they may need to be in place for years after installation. An irrigation system needs to be installed and regularly operated for at least 1-2 years after installation.

  With that said, guying mature trees could be considered under the following circumstances.

  - Palm trees, since they can exist with a much smaller root mass than broadleaf hardwoods.
  - Trees with either unique physical or historical characteristics, or which are somehow particularly endearing to the local community.
  - Fair Condition and Low Risk Rating Low before the incident occurred.
  - Maximum height of 50 feet, or the height can be reduced to 50 feet without ruining the form or structure of the tree.
  - A diameter at breast height of no more than 18 inches diameter.
  - The location provides an adequate sized Critical Root Zone free of impervious surfaces or any impediments to root expansion. The rule of one foot of CRZ radius for every inch of diameter at breast height applies here. In other words, in parks and usually not along street rights of way.
  - The species tends to be inherently shallow rooted, such as with members of the *Ficus* genus.
  - A sufficient number of the structural flare roots remain intact in the soil, as described in the Protection section of this document. Judgement of an experienced certified arborist needs to be employed here.
  - An irrigation system which regularly provides adequate amounts of water to the tree for an extended period of time can be installed.
  - The tree has been out of the ground for no more than one month.

The *root stapling* system previously described should suffice for supporting smaller trees, perhaps supplemented with straps as described in the same section. *Underground staking* can also be used if the root ball is sufficiently intact. Mature trees require a much more substantial system using cables, attachment hardware, and ground anchors. The attachment devices, usually lag hooks or through-bolts, need to be installed at least half the height of the tree, as illustrated in the accompanying figure. A 50 foot tall tree needs to have the attachment devices installed at a height of at least 25 feet, for example. The attachment devices also need to be at least 12 inches apart to avoid splitting the wood. Ground anchors would typically resemble a mobile home type anchor which is screwed into the ground. The distance between the anchor and the trunk needs to be at least 2/3 the height of the attachment device placement. If the attachment devices are installed at a height of 25 feet, the anchors need to be at least 16 feet from the trunk to provide adequate support. Once again, inspect components and cable tension on at least an annual basis.



Guying System ISA Publication

An alternative to steel cables would be to install a support system similar to the way that was previously described for newly planted palm trees, supported by 2x4 inch boards attached to a collar around the trunk. This system would work particularly well with shorter trees which have a larger diameter. Use the longest available boards (16 feet?) and calculate the anchor distance from the trunk in the manner described in the previous paragraph. If the system is in place for more than one years, the support straps on the trunk will need to be readjusted to accommodate radial growth and not constrict the vascular system.

The ends of the residual roots need to be cleanly pruned to encourage sprouting before the tree is re-installed. Anecdotally, the installation depth should probably be where at least a portion of the root flare is exposed and the ends of the upper roots are about six to eight inches deep. The consequences of deep planting have previously been discussed and they apply to this situation as well. Install mulch at the appropriate depth at a radius where it reaches the anchors and maintain irrigation on the root system.

Once again, righting and guying large trees is a job for experienced vendors only, and city engineering staff should review plans before a large tree which has blown over is supported in this manner.

**Note:** *Neither Legacy Arborist Services nor the author of this document take any responsibility in the event that the previously described system fails and results in either property damage or bodily injury.*

**Pests**

In recent years, this topic has come to be commonly referred to as **Forest Health,** since it addresses both the causative factors of why a pest has attacked a tree and the impact of the pest itself. This is an extensive topic where a considerable amount of information is available through a variety of sources. Answers to specific questions or diagnoses of specific situations can be addressed to either the Florida Department of Agriculture (Division of Plant Industry or Florida Forest Service) http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Our-Forests/Forest-Health, the University of Florida School of Forest Resources and Conservation http://sfrc.ufl.edu/treehealth/forum/, or the Palm Beach County Cooperative Extension Service.

This section will provide general information about pest diagnosis to help city personnel recognize situations in the field. As opportunities arise, city personnel should take continuing education classes that address pest management. These should be an integral part of the continuing education agenda for Certified Arborists.

Pests that negatively impact trees can be classified as either *Bugs* or *Rot* (including fungi, bacteria, etc). Collectively, these are known as *biotic factors***.** Insect damage is usually more visible than the insects themselves because the insects have often moved on by the time the damage becomes evident. See the White Fly damage on the leaf below in Figure 72. Insects may also reside underneath the bark and may be invisible except by microscope. Fungal hyphae are also microscopic and their presence only becomes evident when the tree begins to decline.

Trees can also be negatively impacted by *abiotic factors***.** Many abiotic factors result from various types of nearby human activity which have been discussed in more detail in previous sections of this plan. These include physical disturbances within the tree's root zone, drainage changes, chemicals applied nearby (including fertilizers and lawn maintenance chemicals), excessive irrigation, or physical injury to the tree. Natural abiotic factors include prolonged drought or flooding and excessive heat or freezing weather. Abiotic factors by themselves can cause a tree to decline and eventually die. They can also make it more likely that biotic factors will attack a tree. The species, age, location, and past management practices can also predispose the tree to decline and mortality by either biotic or abiotic factors.

Tree decline can become visible when foliage discolors or fruiting bodies (*conks*) appear as in the photos below. Decay or insect damage can appear on the branches or trunk and root injuries or weaknesses can become evident. City personnel should look for these symptoms, but also note whether several trees are impacted as opposed to a single isolated tree. Experience will indicate whether a symptom is significant enough to take further action, or just some innocuous damage that the tree will tolerate and recover from soon.

Impact from Biotic Factors

If a forest health situation is suspected, the following information needs to be recorded so that the forest health specialists at the previously listed sources can identify the problem and recommend a course of action.

- Tree Species, Size, Location.
- Part of the tree impacted (Foliage, trunk, limbs, roots, etc)
- Presence or signs of insects, fungal decay, etc.
- Physical changes such as limb dieback, leaning, etc.
- Number of Trees/Area Impacted.
- Date when the damage was first noticed.
- Soil Compaction in the root zone.
- Recent site changes, soil disturbance or construction in the area. This could include a new lawn or new infrastructure.
- Chemicals recently applied for lawn maintenance and other purposes in the area.
- Significant weather events within the past year, such as flooding, drought, freeze, wind events, etc.

Take photos of the entire tree, as well as a closeup of the damaged area and the transition area between healthy and damaged tree parts. If signs of a pathogen are present, photograph those as well. Compress the photos to the smallest possible size to facilitate submission by email. Foliage or branch samples can also be submitted, with these materials packed for shipping according to guidelines of the receiving agency.

Consult Sustainability Policy 10-3 which addresses Integrated Pest Management and Pesticide Reduction before prescribing a pest treatment. Treat pest problems using either *physical* or *cultural* treatments wherever possible. These could include pruning, soil aeration, fertilization, or other previously described treatments to improve tree health. Tree removal is appropriate to keep a pest epidemic from spreading or to reduce tree risk.

Chemical applications can enhance the effectiveness of these treatments, or when they can expediently resolve a situation. These applications should **only** be performed by someone with the appropriate certification and training. The product label mandates the application rate, target pests and purpose, and personal protective equipment that the applicator must wear. *Restricted use pesticides* can only be applied by a licensed commercial applicator. Other pesticides with the "Caution" label need to be applied by someone with at least a limited commercial landscape maintenance certification. Information on obtaining these certifications is available through the County Cooperative Extension Service or Florida Division of Plant Industry. Note the pesticides listed in Policy 10-3 which can negatively impact bee populations.