Inventory & Information Systems

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Street Tree Inventory

Including the Bay Street & Hermitage Road Design Areas

City of Beaufort, SC

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"The five components of life-long tree care are biology-first design, tree installation and establishment, young tree training, mature tree tune-ups, and risk management. A carefully prepared program of arboricultural practices, that effectively moves from life stage to life stage, is critical to quality management of trees. Through total quality management, arborists can generate a high quality of life for trees and tree owners."[1]

This project was partially funded by the
2001 Urban & Community Forestry Grant Assistance Program
#2001 U14
from the
South Carolina Forestry Commission

[1] From Training Young Trees, Dr. Kim D. Coder, UGA Forestry Extension, August 1996.

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APPENDIX

Statement of Purpose:

The objective of this project was to assess the extent and health of trees growing within the public right-of-way (and in other public places) for the purpose of developing a proactive community forest management plan. The information collected will provide the Tree Board and City with information to develop the long-range strategies for Beaufort's community forest plan together with a framework for completing and implementing a comprehensive management plan by the end of 2002.

Executive Summary:

An inventory of trees within the street right-of-way (ROW) of City of Beaufort was conducted between December 15, 2001 and May 15, 2002 for the purpose of establishing a baseline of information related to tree health (i.e. condition, hazard, maintenance recommendations and existing damage).

The inventory included 1,708 trees and 448 Palmetto. In addition, 268 trees in two design study areas were inventoried. These areas included the Hermitage Road median and Bay Street east of Glebe Street. A complete listing of inventory data, trees identified with a risk assessment rating, prioritized tree removals, and prioritized pruning lists are included with this report.

In general[1]...

1. The trees are relatively old (i.e. large diameter) with 41% ≥20" in diameter and 69% ≥10" in diameter;

2. The majority of trees are in average or above average condition (71%); only 6.2% of the tree inventory are in below average or poor condition (ISA condition <65);

3. However, 5.9% of the inventory (88 trees) was identified with risk assessment ranging from minor (rating 3) to extreme (ratings ≥8);

4. Many young trees (25% of trees ≤8" diameter) were identified for structural pruning to either correct previous improper pruning practices or to establish better limb structure;

5. Deadwood pruning was indicated for 505 trees (these are mostly larger oak trees with dead limbs ≥2");

6. There were 79 street trees and 11 study area trees identified for removal; 27 of these were assigned a risk assessment rating ≥3;

[1] EXCLUSIVE OF CRAPEMYRTLE AND PALMETTO

7. The most observed "damage" was improper pruning and decline symptoms (i.e. crown dieback);

8. Observations of trees did not indicate nutrient deficiencies, and any fertilization program should be based on foliage and soil samples.

9. Genus composition in the inventory area is unacceptably high for oak (47.5%); although with Live Oak at 22.6% this may be acceptable.

Introduction

Dudley R. Hartel, Certified Arborist (DBA Inventory & Information Systems) was the project manager for the Beaufort street tree inventory and Kimberly Patton Miller, ASLA of Rick Raymond & Associates provided design assistance for the selected study areas along Bay Street and Hermitage Road. The tree inventory began in mid-December, 2001 and was completed during the first week of May, 2002. With the exception of street trees inventoried during December and the inventory of the study areas in January, all trees were in leaf for the inventory. This facilitated the assessment of tree health.

The street tree inventory (on approximately 68 miles of streets) included the measurement and evaluation of 2,156 trees. This count includes 448 palms.

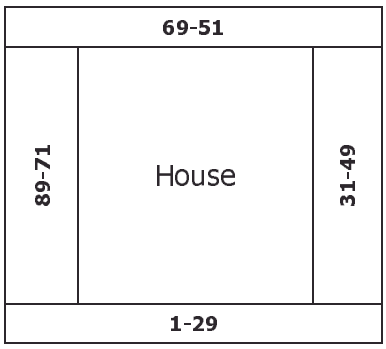
Project Methodology

Every street within the tree inventory study area was traveled to determine the location of the City ROW and, subsequently, the trees located on public property.

The following data was collected for each street tree:

1. **Tree Location**: Location was established by property address. When addresses were not posted, the tree was identified with the nearest property with a posted address by assigning the next sequential address (from next door or across the street). The database of tree data includes a flag that identifies "assigned" addresses. Location also includes a sequential tree number assigned as follows:

Tree Sequence – Beaufort 2002



Address Street

91-99

2. **Species**: Trees were identified based on bark, leaf and flower evaluations.
3. **Diameter**: Tree diameter was measured consistent with the procedure identified in the *Guide for Plant Appraisal (9th Edition)*. The inventory data indicates diameter, height of the diameter measurement and the number of stems measured when an average diameter was recorded.
4. **Condition Components**: Each tree was evaluated for the health of roots, trunk, structural limbs, branches and foliage on a scale from 0-4; and for the structure of the roots, trunk, and structural limbs on a scale from 0-4. The **Condition** reported is the summation of these components multiplied by 3.125 (to place the index on a 0 to 100 scale).
5. **Risk Assessment Components**: Each tree is evaluated for existence of a target, size of tree part and probability of failure on a scale of 0-4. The **Risk** rating is the summation of these components. The higher the component and total number, the greater the perceived risk. Risks and potential hazards are most often associated with large (≥2" dead limbs or the weak attachment of large structural limbs).
6. **Specific Pruning/Maintenance Recommendations**: When pruning is advised, one of the following types as indicated: Clearance (removal of live limbs for signs, pedestrians or vehicles), Corrective (to correct past pruning mistakes), Dead Wood (removal of dead limbs ≥2" in diameter at point of cut), Storm Damage, Structural (removal of live limbs to correct limb attachment weaknesses). Structural pruning in trees less than 8" in diameter is often referred to as "young tree pruning".
7. **Utility:** When electric utilities are present, the estimated height to the lowest line was recorded along with the type of utility wire.
8. **Life Cycle:** This rating assigns the arborist's evaluation of tree longevity. Evaluation categories include: trees expected to live >15 years; trees expected to live from 6 to 15 years; trees with an expected life of 1 to 5 years; trees with an expected life <1 year. This rating is based on a combination of tree condition, hazard, and site characteristics (e.g. soil compaction, infrastructure).

Similar data was collected within the tree design study areas along Bay Street and Hermitage Road. The only modification was that location was based on a tree map number instead of a street address. An ArcView® data layer is included on the CD-ROM to map this data, and maps at 1"=25' scale are also provided on CD-ROM.

A variety of methods were used to determine the City ROW. These included:

Permanent survey markers (usually 4"x4" concrete)

Temporary survey markers (plastic survey flags)

Pavement breaks
Conversations with property owners
Above ground utilities (e.g. electric poles)
Fences and other property features (e.g. end of entrance sidewalks)
Street sidewalks
Water meters

Examples of ROW Determination Criteria

Corner markers & Fences

Permanent corner markers

Pavement edges

Survey flagging

Utility location

Sidewalks

City Provided Data & Support

The City of Beaufort provided street data (in the form of an ArcView® GIS layer), support documents and guidance for the work on the two study areas, and access to the current Landscaping and Tree Conservation ordinance on the City's web site.

The Hermitage Road study included a meeting with interested residents and members of the Tree Board. The following is a summary of that meeting:

Hermitage Road

Based on our interpretation of comments, our primary emphasis…

- Mixed deciduous and evergreen species (already enough live oak)
- Hide or eliminate cable (a temporary feature erected 40 years ago)
- Passage through median for pedestrians and bicycles
- Children's safety is an issue
- Low maintenance (water, pruning, weeding)
- Leave open areas (non-tree) for additional shrubs, perennials or annuals
- Tree & shrub design areas will be in a mulched area at the center of the median that has a delineated, curvilinear edge where it meets the turf near the street

We will probably design and recommend…

- Large tree species: Blackgum, bald cypress, longleaf pine, Magnolias, Redcedar, others
- Small tree species: Yaupon holly, Bottlebrush buckeye, Southern Crabapple, Sweetbay Magnolia, Fringetree, Silverbell, Possomhaw, others
- We will design and recommend palettes of tree species; the city & residents can then select groups of species and make desirable substitutions
- The Tree Board may opt for wider spacing for Live Oak if desired; we will use ≅50' for spacing of all species of large mature trees; wider spacing for Live Oak will require the removal of many healthy Live Oaks, this will NOT be the recommendation
- Design will include both plan and elevation views as previously discussed.

Bay Street (Bluffs)

Based on our interpretation of comments (Tree Board) and the letter we have from the residents in that area, our primary emphasis…

- Primarily the development of a healthy overstory with marsh views not significantly restricted.
- Low maintenance (water, pruning, weeding)

We will probably design and recommend…

- Large tree species: Live Oak
- The Tree Board may opt for wider spacing for Live Oak if desired; we will use ≅50' for spacing for live Oak along Bay Street; wider spacing for Live

Oak may require the removal of many healthy Live Oaks, this will NOT be the recommendation.

- Design will include both plan and elevation views as previously discussed.

General

It appears that the most difficult tree maintenance recommendation will be in the creation of large areas of mulch; we will design and recommend mulch for all tree areas. These recommendations can be easily ignored by the city if desired in favor of the more easily maintained turf. Only long-term tree health will suffer.

A letter written by Bay Street residents that expressed their concerns for the area from Glebe Street to Downtown was also provided.

Inventory & Study Areas

The area for the street tree inventory included all streets from Pigeon Point south to the Bay (downtown business district), and west to the Beaufort County Government Complex, and then south to the City of Port Royal. This included the entire Historic District (see map that follows). This area is approximately 2,418 acres with 68 miles of city streets.

The Hermitage Road design study area included all trees within the median of N. Hermitage Road and S. Hermitage Road west of Ribaut Road.

The Bay Street (Bluffs) design study area included all trees on public property south of Bay Street from Glebe Street east to Newcastle Street (the entrance to the public parking and docks). Several prominent street trees were included in this portion of the inventory.

A map of the study area and streets at a scale of 1"=800" is provided on the CD-ROM; it is formatted to plot on an HP5000 at 24" x 36". A reduced copy follows this page.

Inventory Area Map

Street Tree Inventory Summary

Nearly all trees were inventoried after full leafout in the spring (the exception were a small number of trees inventoried in December, and the Pecan). The rating for tree health (or condition) may be somewhat higher than expected because of the timing of the inventory. An inventory in mid to late summer would probably reveal considerable more stress symptoms and subsequent lower ratings for branches and foliage.

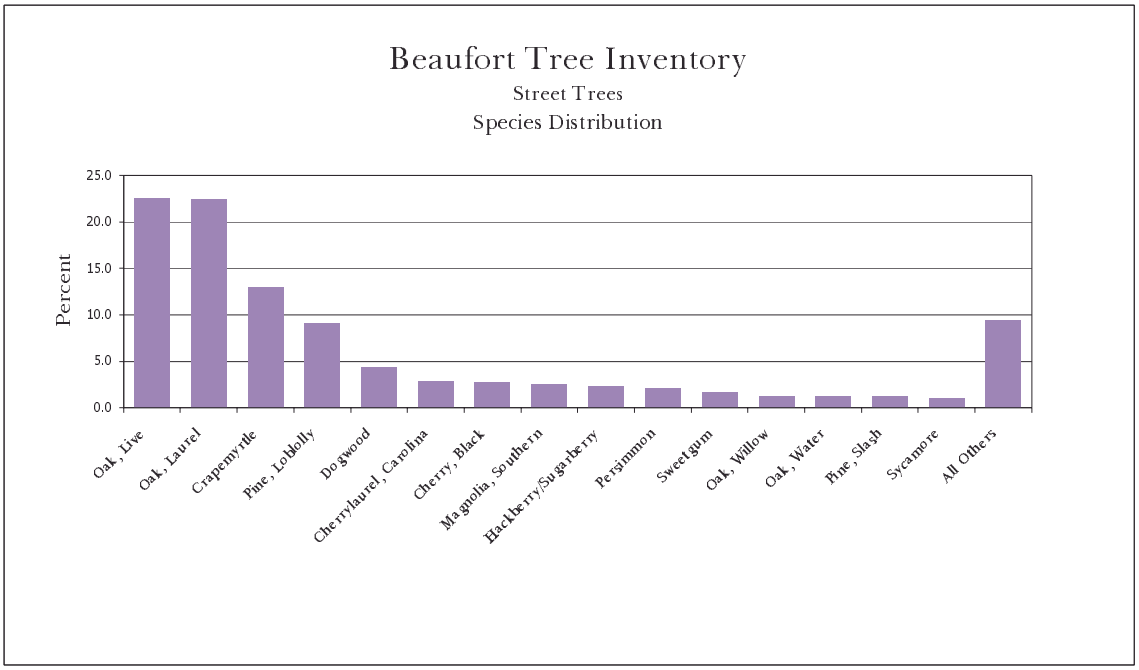
Species Distribution

Although most species are not over represented in the inventory, the oak genus (*Quercus*) at 47.5% of the street trees should be of concern. In addition, all of the species of the *Quercus* genus are in the red oak group. New tree plantings should primarily include other genus (e.g. *Acer*); the Tree Board should consider restricting red oak tree planting to Live Oak.

Street Trees

Species	Number	Percent	Cumulative
Oak, Live	385	22.6	22.6
Oak, Laurel	383	22.4	45.0
Crapemyrtle	222	13.0	58.0
Pine, Loblolly	156	9.1	67.1
Dogwood	75	4.4	71.5
Cherrylaurel, Carolina	50	2.9	74.5
Cherry, Black	47	2.8	77.2
Magnolia, Southern	43	2.5	79.7
Hackberry/Sugarberry	39	2.3	82.0
Persimmon	36	2.1	84.1
Sweetgum	28	1.6	85.8
Oak, Willow	22	1.3	87.1
Oak, Water	21	1.2	88.3
Pine, Slash	21	1.2	89.5
Sycamore	18	1.1	90.6
All Others	161	9.4	100.0
	1707		
Palmetto, Cabbage	448		

Species Distribution (Figure 1)

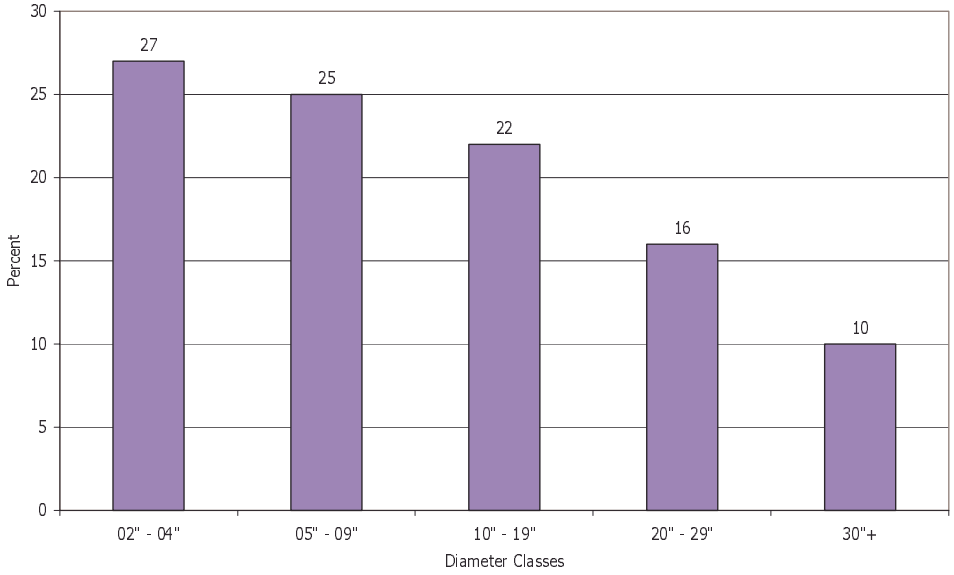


Diameter Distribution

Tree diameter is frequently used as a surrogate for age. This is convenient since diameter is much easier to measure than age and within a species and a specific geographic area can be quite reliable. It is desirable, on a city-wide basis and within some highly visible areas, to maintain sufficient younger trees to develop as replacements for trees lost to age or disaster. During the next 20 years, Beaufort's urban forest management (i.e. tree planting, tree care and tree removals) should result in 50% of the trees with a diameter <10" (see graph that follows).

An ideal diameter distribution of trees can be visualized in the following graph. This conveys the long-term need to have an adequate number of smaller trees in the management scheme at all times. Over time, these trees are reduced in number by urban stresses, young tree losses, storms, thinning to meet management objectives and eventual natural mortality.

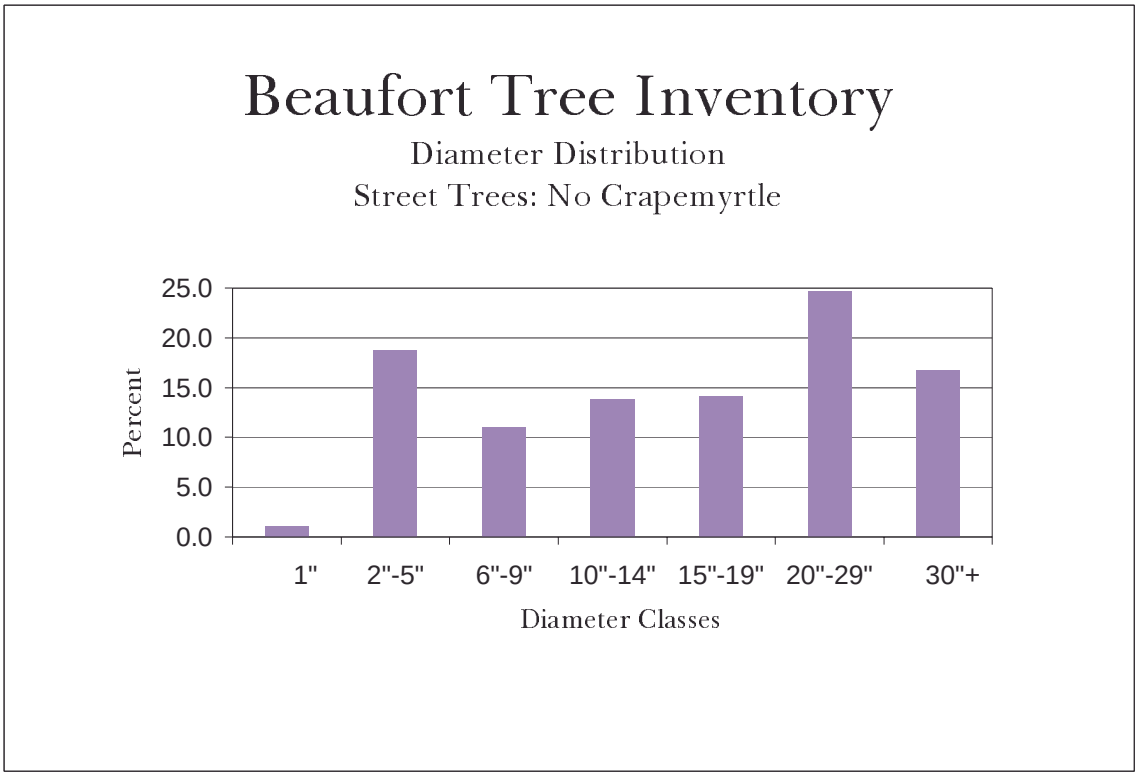
Figure 2 Ideal Diameter Class Distribution



Exclusive of Crapemyrtle and Palms, the City of Beaufort street tree inventory has a diameter class distribution that is skewed heavily to larger (and older) trees.

Street Trees (no Crapemyrtle)			
Class	Count	Percent	Cumulative
1"	15	1.0	1.0
2"-5"	279	18.8	19.8
6"-9"	163	11.0	30.8
10"-14"	205	13.8	44.5
15"-19"	210	14.1	58.7
20"-29"	366	24.6	83.3
30"+	248	16.7	100.0
	1486		

Diameter Distribution (Figure 3)



An effective, long-term street tree planting program should be established to address deficiencies in the smaller diameter classes and to correct the heavy dependence on tree species in the genus *Quercus*.

Tree Maintenance Summary

Tree Condition:

In addition to species identification and diameter measurement, tree condition was evaluated based on the *Guide for Plant Appraisal (9th Edition)* condition rating procedure. Each tree was evaluated for the general health of roots, trunk, structural limbs, branches and foliage on a scale from 0-4; and each tree was evaluated for structural integrity for roots, trunk and structural limbs on a scale from 0-4. Each tree in the inventory is assigned a composite rating that is the summation of the 8 components multiplied by 3.125 (this creates a rating on a scale of 0 to 100).

A condition rating of 60 should be considered average, a rating ≥ 75 is above average.

The primary factors that affect tree condition in urban areas are the deterioration of the site and physical damage to the tree. Site deterioration can be caused by any of these factors:

1) Soil compaction from…
   a) Pedestrians
   b) Vehicles
   c) Lawn care equipment
2) Moisture extremes from…
   a) Impervious surface run-off
   b) Grade changes during construction
   c) Changes in soil structure
3) Temperature Extremes
   a) Impervious surface heat sinks
   b) Reflection of heat and wind from buildings
4) Interruption in the nutrient cycle…
   a) From removal of leaf litter
   b) Inadequate mulch
   c) Soil chemical changes from improper construction practices (e.g. Cement wash-out near root systems)

Development of policies and landscape practices that reduce these site deterioration factors are important.

Physical damage can be caused by any of these factors:

1) Lawn care equipment
   a) Lawn mowers
   b) String trimmers
2) Construction
   a) Equipment breech of tree protection fence
   b) Damage to limbs and crown from overhead equipment

3) Other incidental damage
   a) Breakage to small limbs and branches near pedestrian and other high-use areas

Periodic inspections, mulching, regular and proper pruning and fertilization programs can all play a part in maintaining healthy trees.

Tree Longevity:

As discussed, a life cycle rating was assigned to each tree during the inventory and evaluation. An assessment of life cycle is based on the species, tree condition, and an evaluation of current site conditions. Species like Water Oak and Black Locust are considered to have a shorter life cycle than White Oak or Red Maple under similar circumstances. Site conditions that may affect the life cycle rating include: recent site disturbances (i.e. construction), evidence of flooding, and pedestrian and vehicular activity in the vicinity of the tree. Natural disasters (e.g. wind, or lightning) are not considered in this evaluation.

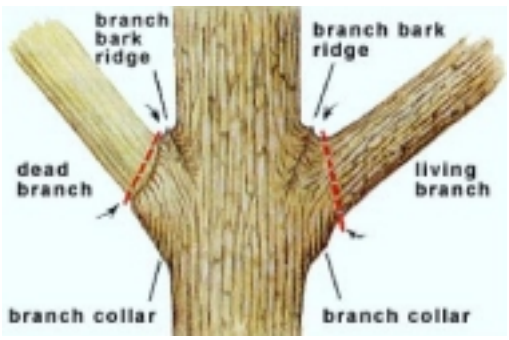
These ratings were converted to Expected Life by assigning the following years to each Life Cycle:

Pruning:

The majority of pruning recommendations were for the removal of dead limbs 2" and larger in diameter at point of cut (on small flowering trees a 1" diameter criteria was used). Many trees were identified that needed corrective (i.e. live-wood) pruning to either correct previous improper pruning (e.g. removal of stubs), or to improve structure (removal of live limbs to correct limb attachment weaknesses). Smaller trees (i.e. less than 6"-8" in diameter) should be evaluated and pruned when structure can be improved.

All pruning should conform to current standards and observe principals of "natural target" pruning as defined by Dr. Alex Shigo. Natural target pruning advocates cutting as close as possible to the branch bark ridge and branch collar at the base of the branch without damaging either one. At the base of the branch, where it meets the trunk, there is often an enlarged area called the branch collar (figure 1). The branch bark ridge is the raised bark that develops at the angle of attachment between the branch and the trunk. Natural target pruning offers several advantages:

- Prevents damage to the trunk tissue
- Limits possibility of decay to trunk tissue
- Retains branch collar as natural protection area
- Creates a smaller wound area



Only properly trained and qualified individuals (i.e. Certified Line Workers meeting 29 CFR 1910.269) should be permitted to prune trees or branches that are near above ground electric utilities. It is further recommended that all pruning be under the direct supervision of a Certified Arborist[1] with tree pruning experience.

The applicable industry standards for pruning trees include:

1) American National Standards Institute Tree Care Operations—Tree, Shrub and Other Woody Plant Maintenance—Standard Practices ANSI 300 (Part 1)-2001 Pruning Standards,
2) American National Standards Institute Standard for Tree Care Operations (ANSI Z133.1/2000 Safety Standards).
3) OSHA 29 CFR 1910.269 Electric Power Generation, Transmission, and Distribution.
4) OSHA 29 CFR 1910.268 Telecommunications.
5) OSHA 29 CFR 1910.331-335 Electrical – General

Mulching:

Mulching is the least expensive and most beneficial urban forestry maintenance activity that is available to urban forest managers. Mulching with composted wood chips and leaves improves moisture retention, keeps soil cooler, reduces soil erosion, protects tree trunks and surface roots from damage, and provides a critical environment for mycorrhizal fungi that enhance the root system.

Mycorrhizal fungi are an essential part of all healthy plant growth and survival, promoting superior root performance and providing a vigorous natural defense against root diseases and pest assault. Mycorrhiza, which means "fungus-root," work as an extension of the plant's roots to help the plant take up soil nutrients and water in exchange for a steady source of sugars. This co-dependent (symbiotic) relationship has evolved over millions of years. Research studies have shown that the fungi/plant relationship helps plants survive stress, absorb more water and nutrients, and increase resistance to soil-borne diseases. In natural soils, mycorrhizae are abundant and readily available to plants. However, in artificial landscapes, urban settings and commercial development, mycorrhizal fungi are often not present in adequate quantities. This is especially true for soils that have been moved or compacted; soils that are low in organic matter; or soils with pronounced fertilizer and pH imbalances. In addition, commercial potting mixes and fumigated soils (in which transplant trees are grown) are often sterile and may contain no mycorrhizal fungi.[2]

Mulch should be from 4”-6” in depth and the minimum mulch area for trees is an area with a 3’ radius (i.e. 6’ circle); the recommended radius of the mulch area (in feet) is tree diameter (in inches) times 0.8 (e.g. a 10” diameter tree should have a mulch area with an 8’ radius). Mulch should not be placed against the trunk of the tree; leave an

[1] Arborist certification is conducted by the International Society of Arboriculture, P.O. Box 3129, Champaign, IL 61826-3129 (217) 355-9411

[2] From Plant Health Care Internet site: http://www.planthealthcare.com/.

un-mulched area approximately 6”-12” in radius around the trunk. Hand or chemical weeding should be used in this area next to the trunk.

Whenever possible, trees should be mulched in groups to provide a “shared” mulch and rooting area.

Fertilization:

Before any fertilization program begins, trees need to be examined for leaf color, leaf size, discoloration, and twig growth rate for any abnormalities, which may be symptoms of nutrient imbalance. This inventory did not identify any urgent need for a tree fertilization program.

Foliage and soil samples must be taken to determine tree fertilization needs. However, fertilizing trees that are under stress, such as newly planted, root damaged, or diseased trees, is not recommended because the tree often does not have the energy reserves necessary for the increased growth that would occur due to the fertilization. Gilman (1997) recommends that during the establishment period, maintenance resources should be devoted to watering, mulching and weed control, but not fertilization.

Site conditions can also provide clues to nutrient imbalances, for example construction of a new sidewalk (using concrete which is alkaline) can cause soil pH problems which impacts availability of some nutrients. If nearby turf and shrubs are being fertilized then there is typically no need to fertilize the tree more (Yeager and Gilman 1991). Also, an excess of a particular nutrient in the soil, often the result of over fertilization in an urban area, may cause symptoms of stress in a tree.

Dr. Kim D. Coder[1] recommends 1.5% as an acceptable nitrogen target (based on foliar analysis) for urban forest management until further regional research is completed.

Tree fertilization without foliar and soil analysis is not recommended. The tree inventory did not identify any significant nutrient deficiencies, but foliar and soil samples should be included in the 3 year management recommendations. Approximately 6 foliar and soil samples (by species and age class for the predominate trees; young and older oak/maples, young crapemyrtle, young Chinese elm) should be taken every 2 or 3 years.

Applicable industry standards include:

1) Tree Care Operations—Tree, Shrub and Other Woody Plant Maintenance-Standard Practices (Fertilization), ANSI A300 (Part 2)-1998

Trees in Decline:

Trees identified as declining or in advanced decline will not be helped with a fertilization program or any other arboricultural practice. These trees have life expectancies of from <5 years to <1 year, respectively. Declining trees may respond to

[1] Personal communications April 2001

a mulching program. However, these trees (the declining) may be maintained in the landscape by pruning deadwood to eliminate identified hazards.

Trees with identified root decay or damage are hazardous and in a stage of advanced decline (or decline). They should be treated as recommended in the inventory (removals).

Significant Tree Management Problems:

The following tree management issues were identified during the inventory. These represent areas where urban tree management needs to be improved in order to improve the condition of trees on the street ROW and within the two study areas and extend their useful life.

1. Mulching is an essential tree care practice for trees of all ages (i.e. sizes); it is important that **proper mulching practices** be followed. Most trees are not sufficiently mulched at this time.
2. Much of the **pruning** observed has resulted in internodal cuts that are not recommended in current arboricultural practices. Internodal pruning cuts result in excessive sprouting and higher incidence of decay; often, internodal pruning cuts result in the need for more frequent pruning (i.e. the pruning cycle is reduced) which is more costly in the long-term.
3. Tree planting is often not taking advantage of those **sites that are suitable for large maturing trees**. Large trees (e.g. Oaks) provide considerable more urban tree benefits than smaller trees (e.g. Crapemyrtle) and should be used whenever possible. Planting smaller maturing trees where larger ones can grow wastes tree space and reduces long-term urban tree benefits.
4. Many trees planted within the last 2-4 years have been planted to deeply. The recommendation is to plant so that the root collar is 2" above grade.

Recommendations for Urban Tree Management:

The following general recommendations are a direct result of the observations in the previous section and the analysis of the tree inventory data. This list is in order of priority.

1. Immediately eliminate all internodal pruning cuts (i.e. adopt ANSI and "natural target" standards).
2. Establish a tree pruning training program for any employees or contractors involved with tree pruning and require contractors to be Certified Arborists **with** verified tree pruning experience.
3. Mulch all trees. When mulching trees (either creating new mulch areas or expanding existing mulch areas), proper mulching should be followed (see Mulching). Mulch area should be as large as practical and a function of the size of the tree. For example: the radius of the mulch area (or equivalent dimensions for rectangular areas) in feet should be equal to the diameter of the tree in

inches times (x) 0.8. Therefore, a 10" diameter tree would have a circular mulch area with a radius of 8'.

4. Adopt a tree site evaluation procedure so that sites suitable for large-maturing trees are not planted with small-maturing trees. Eliminate sites where rooting space is less than 100 square feet (e.g. 4' x 25'); plant small-maturing trees in sites with less than 300 square feet.
5. Select trees at the nursery based on limb structure; do not select or accept trees with co-dominant stems or forks with included bark.
6. Start a young tree pruning program to improve the structure and form of these trees. Young tree pruning is less expensive than mature tree pruning and this action will greatly reduce future costs and improve long-term tree health.

90 Day Management:

Remove 27 trees (all trees on the **Tree Removals by Priority** list with a risk assessment ≥3);

Deadwood pruning of all trees (68) with a risk assessment rating (see **Tree Pruning by Priority** list);

1st Year Management:

Remove all other trees on the **Tree Removals by Priority** list;

Begin pruning remainder of trees on the **Tree Pruning by Priority** list; prune the "deadwood" in largest trees first;

Mulching, correct improper mulching on some younger trees;

3 Year Management:

Establish pruning cycle for all trees ≥20' diameter; use a 3-5 year cycle for these larger trees;

Young tree structural pruning cycle should be established at 2-3 years;

Mulch all trees to specification with composted woodchip/leaf mulch;

Establish fertilization program based on foliar and soils samples.

Design Study Areas

Trees in the design study areas were inventoried and mapped. In February the Landscape Architect visited the sites and discussed tree and neighborhood issues with residents and Tree Board members.

The diameter distribution of trees in the study area mirrors that found for the street tree portion of the inventory. Similar concerns must be addressed for the long-term

management of these areas. That is, sufficient new trees must be continually planted to account for losses over time in order to maintain continuous urban forestry benefits.

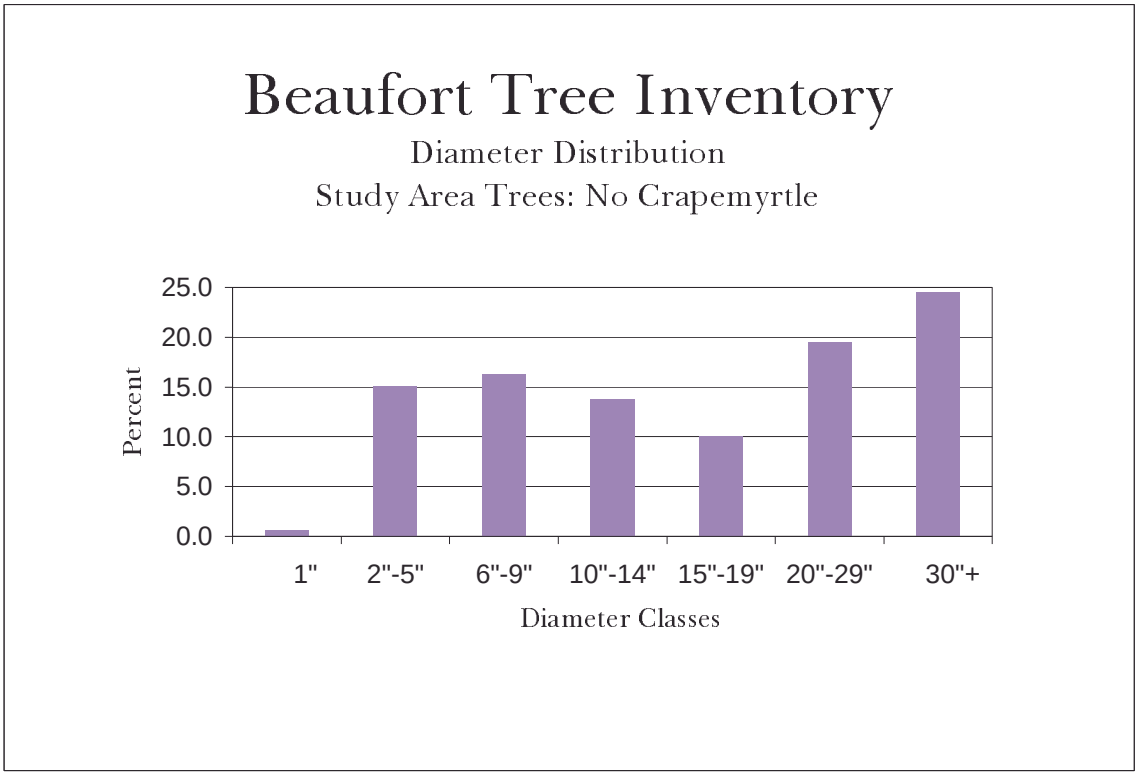
The Hermitage Road area can easily support 150 trees of mixed age/diameter classes (there are currently 64).

The Bay Street area is better stocked (95 trees) with some recent tree planting evident. With less reliance on Palmetto, this area could probably support 150 trees without interfering with marsh views.

Diameter Distribution (both areas combined)

Study Area Trees (no Crapemyrtle)			
Class	Count	Percent	Cumulative
1"	1	0.6	0.6
2"-5"	24	15.1	15.7
6"-9"	26	16.4	32.1
10"-14"	22	13.8	45.9
15"-19"	16	10.1	56.0
20"-29"	31	19.5	75.5
30"+	39	24.5	100.0
	159		

Diameter Distribution (Figure 4)



Bay Street Design Study

The plan calls for the continued planting of Live Oak (or other large-maturing species) with an overall objective of maintaining tree canopy cover and maintaining marsh views under the trees.

Tree species should not be planted over the bluff ridge, as this will directly interfere with views during a large portion of the trees life (i.e. when crowns extend above the ridge).

The plan calls for continued planting of Live Oak, which is suitable for this area. Both Live Oak and Palmetto can withstand high winds associated with storms in this exposed area and with hurricanes.

The plan shows fairly even spacing, but observations in the Coastal Plain support a wide range of spacing for mature Live Oak from 10' (i.e. groups or clusters) to 100' (i.e. individuals with their large-crowns just touching). The recommendation is to plant along Bay Street continually to gradually replace non-Live Oak species. Forty-three additional tree plantings are indicated on the plan; these should be planted over a 5 to 10 year period to replace losses.

Trees should be mulched effectively to maintain tree health and lengthen life cycle.

LA concept drawings are included with this management summary (scanned color images are also provided .on the CD-ROM)

Bay Street Design Study: 2002

Bay St bluff vista

Mature and young Live Oak

Live Oak along bluff edge

Live Oak vista from Bay St

View from Beaufort ES

Evening vista from Bay St

Hermitage Road Design Study

The plan calls for increased tree planting to establish a nearly continuous median of large and small maturing trees. Native species are appropriate and preferred. The recommendations call for a mixture of deciduous and evergreen trees.

This area is under stocked (there are 64 trees, but only 40 were evaluated for a ≥15 year life cycle) and can support an increase in planting density. An additional 100 trees can easily be planted during the next 10 years.

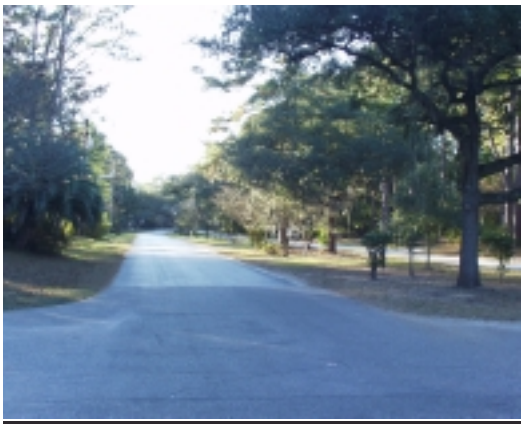
Specific species should be approved by the Tree Board and include small, medium and large maturing trees as required by the specific planting site. Native species identified for the Wando soil series (with the exception of Water Oak), and other natives on well drained coastal sites should be given priority.

Most areas of the median are designed to be mulched, but some sections may be left open with turf or ground cover if desired.

LA concept drawings are included with this management summary (scanned color images are also provided .on the CD-ROM)

Hermitage Road Design Study: 2002

Looking west from Elliott St



Looking east from Verdier St

Looking east toward Ribaut Rd

Looking east along median

Soils & Urban Forest Management

Two soil types represent over 90% of the soils in the inventory area. For purposes of urban forest management, the soils in that area (i.e. 90%) have similar characteristics and capabilities.

Soil Type	Acres	Percent
Wando (Wd) Fine Sand	1765.9	73.0
Seabrook (Sk) Fine Sand	421.6	17.4
Polawana (Po) Loamy Fine Sand	150.2	6.2
Capers (CE)	35.2	1.5
Wahee (W)	13.9	0.6
All Others	30.9	1.3
Total Inventory Area	**2417.7**	**100.0**

Wando Series (0-6% slopes)

Geographic Setting:

Landscape: Coastal Plain.

Landform: Terraces.

Elevation: 7 to 25 feet above mean sea level.

Parent Material: Sandy marine sediments.

Drainage and Permeability:

Agricultural Drainage Class: Well drained.

Permeability: Rapid.

Use and Vegetation:

Major Uses: Mostly Woodland.

Dominant (Tree) Vegetation: Where wooded--loblolly pine, longleaf pine, live oak, sweetgum, southern red oak, shumard oak, post oak, blackjack oak, and white oak. Common understory plants are red maple, turkey oak, bluejack oak, American holly, yaupon holly, sassafras, redbay, and flowering dogwood.

Seabrook Series (0-2% slopes)

Geographic Setting:

Landscape: Coastal Plain.

Landform: Terraces.

Elevation: 5 to 120 feet above mean sea level.

Parent Material: Sandy marine and fluvial sediments.

Drainage and Permeability:

Agricultural Drainage Class: Moderately well drained.

Permeability: Rapid.

Use and Vegetation:

Major Uses: Mostly Woodland.

Dominant Vegetation: Where wooded--loblolly pine, longleaf pine, slash pine, southern red oak, sweetgum, red maple, yellow-poplar, water oak, willow oak, American beech, and live oak (near the coast).

Polowana Series (0-2% slopes)

Geographic Setting:

Landscape: Lower Coastal Plain.

Landform: Nearly level areas adjacent to drainage ways, streams, and on depress ional areas.

Elevation: 5 to 120 feet above mean sea level.

Parent Material: Sandy marine sediments.

Drainage and Permeability:

Agricultural Drainage Class: Very poorly drained; ponded or very slow runoff.

Permeability: Rapid; The water table is at depths of less than 6 inches for about 6 months during most years.

Use and Vegetation:

Dominant Vegetation: Where wooded-- Most of the areas are in native vegetation consisting of blackgum, sweetgum, tupelo gum, pond pine, cypress, water oak).

Capers Series (0-2% slopes)

Geographic Setting:

Landscape: Lower Coastal Plain.

Landform: Broad level tidal flats and along the lower reaches of larger streams flowing into the tidal flats.

Elevation: 2 to 5 feet above mean sea level

Parent Material: Sandy marine sediments

Drainage and Permeability:

Agricultural Drainage Class: Very poorly drained and ponded; very slow runoff.

Permeability: Very slow permeability. They are flooded with brackish or salty water at least twice monthly and in some places twice daily. The water table is +1 to -1 foot.

Use and Vegetation:

Dominant Vegetation: These soils are used primarily as a natural habitat for wetland wildlife. A few scattered areas are used for range and pasture. The vegetation is limited to salt tolerant marshland plants with the principal species being black rush (Juncus roemerianus), smooth cordgrass (Spartina alterniflora), big cordgrass (Spartina cynosuroides), and three square (Scirpus robustus).

Wahee Series (0-4% slopes)

Geographic Setting:

Landscape: Coastal Plain.

Landform: Marine Terrace and on terraces along large streams.

Parent Material: Clayey marine or fluvial sediments.

Drainage and Permeability:

Agricultural Drainage Class: Somewhat poorly drained; surface runoff slow.

Permeability: Slow.

Use and Vegetation:

Major Uses: Most areas are wooded.

Dominant Vegetation: Where forested--blackgum, loblolly pine, water oak, willow oak, swamp chestnut, southern red oak, and sweetgum.

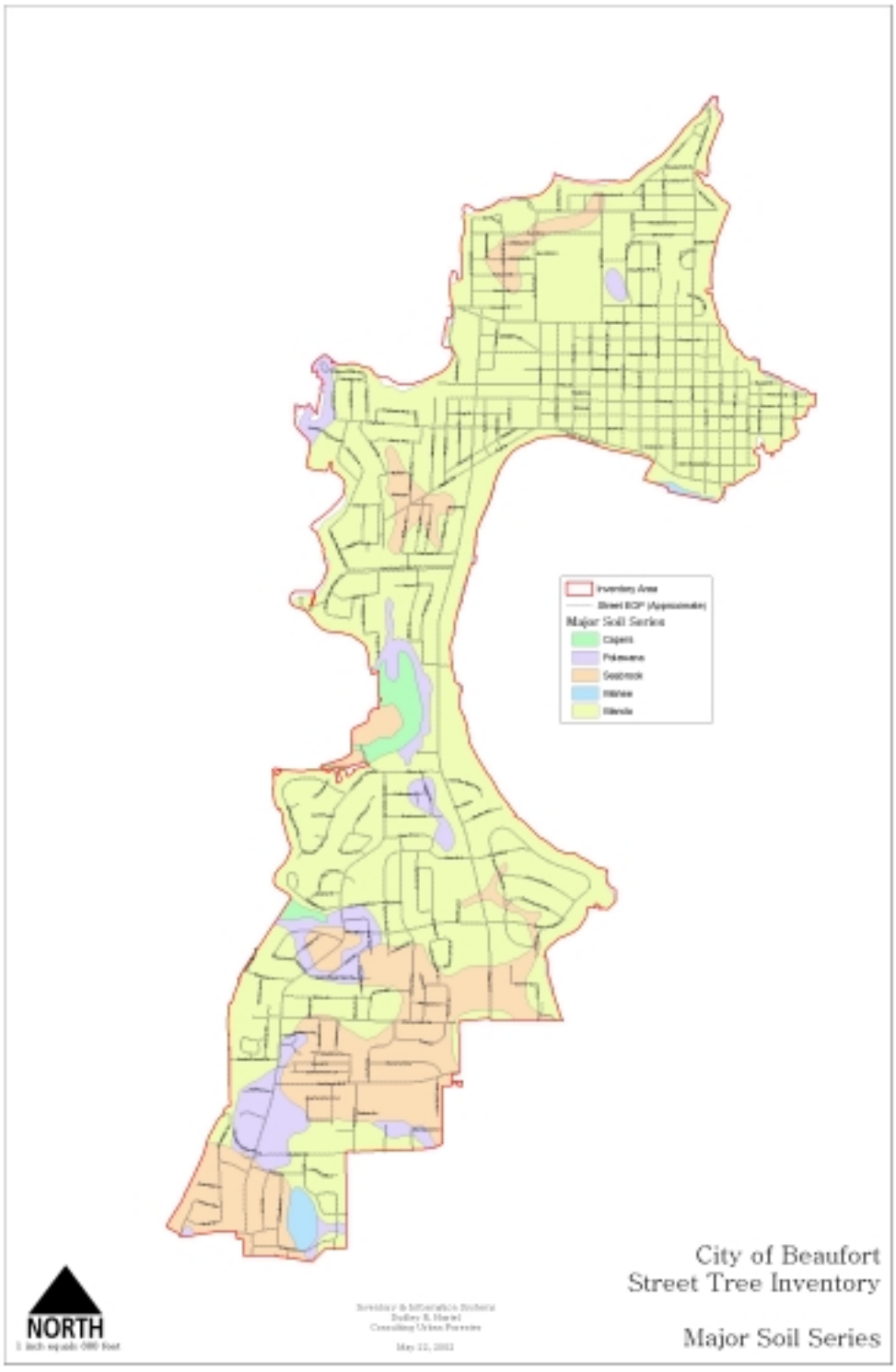
Soils Management Issues

The majority of the soil within the inventory area is moderately to well drained and supports a wide variety of native tree species suitable for the urban environment. Greater use of other natives should include: American Beech, sassafras, red maple, bald cypress, blackgum and holly (both American and yaupon).

On streets (and other public property) with the Polowana series, species should be selected consistent with the poorly drained nature of this soil. These include: bald cypress and blackgum.

The soil series is only one soil related issue that should be evaluated for urban forest management (particularly tree planting). When evaluating sites for planting, attention should be made of changes to surface drainage, backfill during construction, available rooting space, and areas compacted by equipment. All of these can have an adverse affect on newly planted trees.

Soils Map


Major Soil Series
NORTH
City of Beaufort
Street Tree Inventory
Major Soil Series

Ordinance Review

The City of Beaufort Landscaping and Tree Conservation ordinance was reviewed as part of the street tree inventory.

This ordinance applies to development, both private and public.

> Note: This ordinance does not establish the formation or authority of the Tree Board for urban forest management issues within the City (public or private).

Ordinance Issues for the Tree Board to Address:

1. Establish a clear line of activities and authority for your group.
2. Recommend a street tree planting policy that is consistent with either buffer requirements or the Tree Coverage requirements (ACI).
3. Determine the current status of the City Tree Fund.
4. The New Tree Factor (NTF) was devised to "reduce the otherwise burdensome planting requirements for properties with few existing trees". However, by providing additional credit for small trees, the result is a discrimination against existing (large and small) trees. This does not encourage tree conservation.
5. Because diameter is used to calculate the ACI, a 4" tree is calculated to be ¼ of the importance of a 16" tree (ratio of 1:4). Most tree ordinances use trunk area to more accurately reflect the benefit relationship of a 4" vs. 16" tree (ratio1:16).
6. Review tree lists in the ordinance; the first (Section 20. Significant Species) is appropriate although may need occasional revision. However, beginning with Section 21, the ordinance appears to list all native trees with the implication that any are suitable and acceptable. This list should be reviewed and revised.

Urban Forest Management Bibliography

The following are selected reference materials to guide the Tree Board (and residents) in developing and implementing an effective urban forest management plan. The Athens-Clarke County Urban Forestry BMPs, Coder, Bartlett Tree Expert, and Gilman references are on the project CD-ROM.

Coder, Kim D. 1996. Assessing construction damage: tree damage exposure values and recovery times. Publication # FOR96-036. Athens, GA: Warnell School of Forest Resources, University of Georgia.
Web Site: http://www.forestry.uga.edu/warnell/service/library/index.php3?docID=2

Coder, Kim D. 1996. Assessing extent and severity of mechanical injuries in trees. Publication # FOR96-037. Athens, GA: Warnell School of Forest Resources, University of Georgia.
Web Site: http://www.forestry.uga.edu/warnell/service/library/index.php3?docID=2

Coder, Kim D. 1996. Construction damage assessments: trees and sites. Publication # FOR96-039. Athens, GA: Warnell School of Forest Resources, University of Georgia.
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Gillman, J.; Rosen, C. 2000. Tree fertilization: A guide for fertilizing new and established trees in the landscape. Publication # FO-7410-GO. St. Paul, MN: University of Minnesota Extension Service.
Web Site: http://www.extension.umn.edu/distribution/horticulture/DG7410.html

Gilman, E.F. 1997. An illustrated guide to pruning. Albany, NY: Delmar Publishers.

Matheny, N.P.; Clark, J.R. 1994. A photographic guide to the evaluation of hazard trees in urban areas. 2nd ed. Savoy, IL: International Society of Arboriculture.

Shigo, A. L. 1986. A new tree biology dictionary. Durham, NH: Shigo and Trees, Associates.

Shigo, A. L. 1989. A new tree biology. Durham, NH: Shigo and Trees, Associates

Shigo, A. L. 1991. Modern arboriculture. Denham, NH: Shigo and Tree Associates.

Wiggington, Brooks E. 1957 Trees and Shrubs for the Southern Coastal Plain, University of Georgia Press, Athens, Georgia. (Out of print)

Additional Web resources include:

Gilman Pruning:..... http://hort.ifas.ufl.edu/woody/pruning/

ISA: .....http://www.isa-arbor.com/

TreeLink: .....http://www.treelink.org

Florida Extension:.....http://www.sfrc.ufl.edu/Extension/pubs.htm#urban

USFS NE Center for U&CF:..... http://www.umass.edu/urbantree/index.shtml

USFS NC U&CF:..... http://www.na.fs.fed.us/spfo/ucf.htm

USFS Urban Forestry South: .....http://www.urbanforestrysouth.org/

Tree Common Name & Scientific Name Cross Reference

Only species identified in the street tree inventory and Design Study Areas are included in this cross-referenced list.

Common Name	***Scientific Name***
Ash, Green	*Fraxinus pennsylvanica*
Ash, White	*Fraxinus americana*
Birch, River	*Betula nigra*
Blackgum	*Nyssa sylvatica*
Cherry, Black	*Prunus serotina*
Cherry, Carolina Laurel	*Prunus caroliniana*
Chinaberry	*Melia azedarach*
Corkwood	*Leitneria floridana*
Crabapple, Flowering	*Malus species*
Crapemyrtle	*Lagerstroemia indica*
Cypress, Leyland	*Cupressocyparis leylandi*
Dogwood, Flowering	*Cornus florida*
Elm, Chinese	*Ulmus parviflora*
Elm, Slippery	*Ulmus rubra*
Elm, Unknown	*Ulmus species*
Elm, Winged	*Ulmus alata*
Hackberry	*Celtis occidentalis*
Hawthorn	*Crataegus*
Hickory, Pignut	*Carya glabra*
Holly, American	*Ilex x attenuata 'Savannah'*
Holly, Savannah	*Ilex opaca*
Holly, Yaupon	*Ilex vomitoria*
Hornbeam, American	*Carpinus caroliniana*
Locust, Clammy	*Robinia viscosa*
Locust, Honey	*Gleditsia triacanthos*
Magnolia, Japanese	*Magnolia soulangeana*
Magnolia, Southern	*Magnolia grandiflora*
Maple, Japanese	*Acer palmatum*
Maple, Silver	*Acer saccharinum*
Maple, Trident	*Acer buergeranum*
Mimosa	*Albizia julibrissin*
Mulberry, Red	*Morus rubra*
Oak, Bluejack	*Quercus incana*
Oak, Laurel	*Quercus laurifolia*
Oak, Live	*Quercus virginiana*
Oak, Northern Red	*Quercus rubra*
Oak, Sawtooth	*Quercus acutissima*
Oak, Scarlet	*Quercus coccinea*
Oak, Shumard	*Quercus shumardii*

Scientific Name	**Common Name**
Acer buergeranum	Maple, Trident
Acer palmatum	Maple, Japanese
Acer saccharinum	Maple, Silver
Albizia julibrissin	Mimosa
Betula nigra	Birch, River
Carpinus caroliniana	Hornbeam, American
Carya glabra	Hickory, Pignut
Carya illinoensis	Pecan
Celtis occidentalis	Hackberry
Cercis canadensis	Redbud, Eastern
Cornus florida	Dogwood, Flowering
Crataegus	Hawthorn
Cupressocyparis leylandi	Cypress, Leyland
Diospyros virginiana	Persimmon
Fraxinus americana	Ash, White
Fraxinus pennsylvanica	Ash, Green
Gleditsia triacanthos	Locust, Honey
Ilex opaca	Holly, Savannah
Ilex vomitoria	Holly, Yaupon
Ilex x attenuata 'Savannah'	Holly, American
Juniperus virginiana	Redcedar, Eastern
Lagerstroemia indica	Crapemyrtle
Leitneria floridana	Corkwood
Liquidambar styraciflua	Sweetgum
Magnolia grandiflora	Magnolia, Southern
Magnolia soulangeana	Magnolia, Japanese
Malus species	Crabapple, Flowering
Melia azedarach	Chinaberry
Morus rubra	Mulberry, Red
Nyssa sylvatica	Blackgum
Peach	Peach
Persea borbonia	Redbay
Pinus elliottii	Pine, Slash
Pinus taeda	Pine, Loblolly
Pistacia chinensis	Pistache, Chinese
Platanus occidentalis	Sycamore
Prunus caroliniana	Cherry, Carolina Laurel
Prunus serotina	Cherry, Black
Prunus species	Plum, Purple Leaf

Common Name	*Scientific Name*
Oak, Southern Red	*Quercus falcata*
Oak, Water	*Quercus nigra*
Oak, White	*Quercus alba*
Oak, Willow	*Quercus phellos*
Palmetto, Cabbage	*Sabal palmetto*
Peach	*Peach*
Pear, Bradford	*Pyrus calleryana 'Bradford'*
Pecan	*Carya illinoensis*
Persimmon	*Diospyros virginiana*
Pine, Loblolly	*Pinus taeda*
Pine, Slash	*Pinus elliottii*
Pistache, Chinese	*Pistacia chinensis*
Plum, Purple Leaf	*Prunus species*
Redbay	*Persea borbonia*
Redbud, Eastern	*Cercis canadensis*
Redcedar, Eastern	*Juniperus virginiana*
Sassafras	*Sassafras albidum*
Sweetgum	*Liquidambar styraciflua*
Sycamore	*Platanus occidentalis*
Tallow, Chinese	*Sapium sebiferum*
Willow species	*Salix species*

Scientific Name	Common Name
Pyrus calleryana 'Bradford'	Pear, Bradford
Quercus acutissima	Oak, Sawtooth
Quercus alba	Oak, White
Quercus coccinea	Oak, Scarlet
Quercus falcata	Oak, Southern Red
Quercus incana	Oak, Bluejack
Quercus laurifolia	Oak, Laurel
Quercus nigra	Oak, Water
Quercus phellos	Oak, Willow
Quercus rubra	Oak, Northern Red
Quercus shumardii	Oak, Shumard
Quercus virginiana	Oak, Live
Robinia viscosa	Locust, Clammy
Sabal palmetto	Palmetto, Cabbage
Salix species	Willow species
Sapium sebiferum	Tallow, Chinese
Sassafras albidum	Sassafras
Ulmus alata	Elm, Winged
Ulmus parviflora	Elm, Chinese
Ulmus rubra	Elm, Slippery
Ulmus species	Elm, Unknown

APPENDIX

Qualifications of Principals

Dudley R. Hartel

Inventory & Information Systems (I&IS) was founded in 1991 by Dudley R. Hartel. I&IS provides consulting services for the inventory, presentation and interpretation of urban natural resource data. This company evolved from a prior consulting business, *compuFOREST Consulting*, which was engaged in the development of microcomputer applications, data collection systems, and data analysis for the forest industry. *compuFOREST Consulting* was formed in 1983.

I&IS has worked collaboratively with Landscape Architects, Biologists, Planners, Engineers, Consulting Urban Foresters, Consulting Foresters, Historic Preservationists, and other professionals to assess, manage and improve the health of urban natural resources.

During 1999, Mr. Hartel served as the Urban & Community Forestry (U&CF) program Partnership Coordinator for the state of Georgia. In that capacity he developed and coordinated U&CF education programs throughout the state for local communities and tree boards.

Mr. Hartel has degrees in Forest Management from Michigan State University and Clemson University and is a Certified Arborist (SO-0124). Urban forestry training and experience began at Michigan State University in 1971, continued with the Ohio Division of Forestry from 1973 through 1977, and more recently with consulting projects in Georgia (and other Southeastern) cities since 1991.

In addition to Urban Forest management experience, Mr. Hartel has experience with geographic information systems (ARC/Info™, Arcview®, ArcGIS 8.2®), database design and applications (Visual Basic, Visual FoxPro™ and MS®Access 2000™), and AutoCAD LT 2001™.

Kimberley Patton Miller

In August 1994, Ms. Miller joined Raymond Engineering (Presently known as Rick Raymond & Associates, P.C. as the firm's staff landscape architect. Her primary responsibilities include: site analysis, site planning and design, master planning, and the preparation of planting plans, grading plans and soil erosion control plans. She works closely with civil engineers, surveyors, soil scientists, architects and other consultants to assist in the design and production of civil-site plans and construction documents. She has worked on a variety of projects, including: multi-family residential developments, office parks, residential landscape designs, commercial / retail site planning, municipal institutional site planning, single-family subdivision developments, Georgia State Park Facility Planning, and site planning for the University of Georgia. The University of Georgia projects have ranged from traffic calming and pedestrian safety improvements to complete site development plans for major new facilities, including the Academic Achievement Center, which is currently under construction.

Ms. Miller was the lead designer of the Greystone Planned Development, the first conservation/open space design subdivision to be built in Athens-Clarke County.

Prior to the 1996 Olympic Games, Ms. Miller was involved with the Athens '96 Olympic Gateway project. This project involved tree-planting designs for three transportation "Gateways" into Athens-Clarke County.

In 1998, Ms. Miller was appointed to the Athens-Clarke County Vision Advisory Committee, which provided input and guidance to the planning team that revised and updated the Athens-Clarke County land use plan, zoning ordinances and subdivision regulations.

Contents of CD-ROM

LABEL:	BEAUFORT02	
FOLDERS:	AERIAL PHOTOGRAPHY (UTM-17N)	DOQQ COLOR INFRARED 1999
	BASE MAPS FOR STUDY AREAS (SC SP NAD83FEET)	
	HP5000PS	PLOTTER FILES: D SIZE
	HP750C	PLOTTER FILES: D SIZE
	PDF	USE "PRINT TO FIT" FOR ANY SIZE OUTPUT
	BAY STREET (SC SP NAD83FEET)	AV3.2 SHAPEFILES USED FOR BASE MAPS
	ALL TREES	AV3.2 SHAPEFILES
	MAPSHP5000ANDPDF	PLOTTER FILES: D SIZE
	CONCEPT	TIFF IMAGES OF DESIGN STUDY
	BIBLIOGRAPHY	PDF & WORD DOCUMENTS
	A-CC BMPS	
	BARTLETT	
	CODER	
	GILMAN	
	DB TABLES (ACCESS)	CONVERTED FOXPRO TABLES
	DB TABLES (FOXPRO)	ORIGINAL INVENTORY DATA USED FOR REPORTS
	HERMITAGE (SC SP NAD83FEET)	AV3.2 SHAPEFILES USED FOR BASE MAPS
	ALL TREES	AV3.2 SHAPEFILES
	MAPSHP5000ANDPDF	PLOTTER FILES: D SIZE
	CONCEPT	TIFF IMAGES OF DESIGN STUDY
	MAPS	HP5000PS & PDF FILES FOR SOIL & STREET MAPS
	REPORTS	WORD DOCUMENTS
	SOILS (UTM-17N)	NRCS BEAUFORT COUNTY
	AV3.2 SHAPEFILES	OF INVENTORY AREA ONLY

Street Tree Inventory Block & Street Summary

Street Tree Inventory Listing (by Block)

Design Study Area Tree Listing (by Tree/Map Number)

Prioritized Maintenance: Removals (Study Areas & Street Trees)

Prioritized Maintenance: Pruning (Study Areas & Street Trees)

Prioritized Maintenance: Deadwood (Study Areas & Street Trees)