Urban Forest Inventory Report
For the Transit Corridors and Parks
City of Austin, Texas

Executive Summary

On October 22, 2007 the City of Austin awarded a contract to ArborPro, Inc. to provide a GPS tree inventory of trees on selected City transit corridors, neighborhoods and park locations. On November 9, 2007 the inventory was initiated with the GPS data collection. ArborPro, Inc. assigned three data collectors to collect the requested tree attributes and the GPS coordinates of every tree. The collection of data continued into the spring of 2008. The objective of this report is to summarize the findings from the survey.

The survey provides information regarding the tree population of the area known as the "Transit Corridors". These 16 arterial streets were selected for their population density, mix of uses and transit facilities to encourage and support transit use. Also surveyed were 24 city parks and select representative neighborhood zones. Included in the survey are the GPS locations of the trees, species name in Latin and common form, general health assessment, maintenance recommendation and species composition.

Statistical Highlights:

- There are 6,465 trees in the street survey area representing nearly 150 different species.
- There are 8,460 trees in the park survey. 96 different species are represented.
- Crape Myrtles, Southern Live Oaks and Cedar Elms are some of the most abundant trees in the survey in both parks and streets.
- 115 trees are creating sidewalk damage on the streets and another 39 have conflicts with pathways and hardscape in the parks.
- Most trees planted on the streets are near or under utility wires. Only 12% of parks trees are under or near a power line.
- There are almost 10,000 spaces identified to plant trees on the street corridors. These spaces have been categorized into small, medium and large planting sites for simplified planning and reforestation by City staff.
- The GPS points were collected for every tree in the survey at an accuracy level of +/- 3 feet also referred to as "Sub-meter".
- Maintenance recommendations for each tree have been provided to help preserve and enhance the overall health of the tree population and appearance of the City.

Table of Contents

Introduction and Background

Prior to initiating the project, ArborPro inventory staff members conferred with the key personnel from the City of Austin. During this conference, discussions were held to outline the project objectives, inventory attributes, project timeline and layout the final report and data delivery.

Each urban forestry plan begins with a concise inventory. As requested by Austin staff, the City has been delivered more than a simple inventory of trees. Utilizing the Global Positioning System (GPS) and Geographic Information System (GIS) technology, a comprehensive tree inventory and a GIS layer was supplied to maintain and utilize the information. A GIS is a computer based tool for mapping and analyzing tree information in a visual manner. GIS technology integrates common database operations with the unique visualization and geographic benefits offered by maps. This inventory will allow the tree data to be overlaid with other relevant data including roadways and pathways, irrigation and hardscape infrastructure, building footprints and others.

The street tree data collected is a very detailed list of 16 elements with a further 46 subset codes. The park data follows with 13 attributes and 40 subcodes. Herein are summations of the primary tree population's information, species diversity, size characteristics, maintenance needs and listings of species that are in poor or declining health. Additionally, the parks have been mapped with polygons that represent larger scale planting zones to provide a guideline in the open space for park reforestation.

All of these tree sites and polygons are displayed over high resolution orthophotography for a unique, simple and effective way to access and view the information. The data and visual information provided in this report will assist and guide the future maintenance and management practices of these zones within the City.

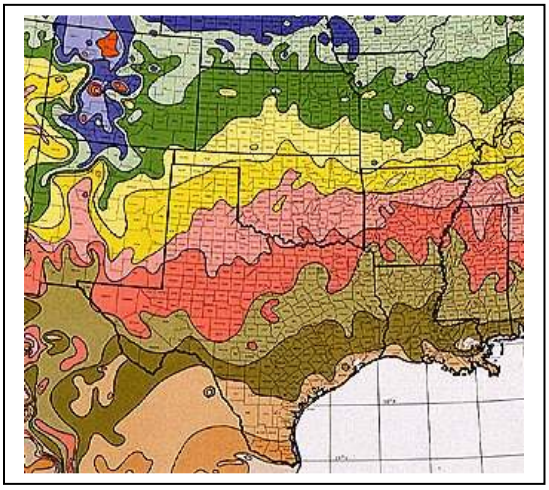
Abbreviations Used in the Report

- DBH……. Diameter at Breast Height (girth of a tree)
- GIS……... Geographic Information System
- GPS…….. Global Positioning System
- ID……. Identification
- SPP…….. Species
- USDA…….. United States Department of Agriculture

Study Site

The USDA plant hardiness map divides North America into 11 hardiness zones (USDA Misc. Publication No. 1475, January 1990). Zone 1 is the coldest; zone 11 is the warmest. This gives the user a guideline as to which plants or trees have the greatest survivability in the region. The City of Austin lies within the USDA hardiness zone 8B representing an average high temperature of nearly 72 degrees and a minimum temperature of 15 degrees. The statistics show that the most common species found in the survey are consistent with species that thrive in this region as listed by the Texas Forest Service and Texas A&M's "Texas Tree Planting Guide".

Figure 1 – Study Area Map



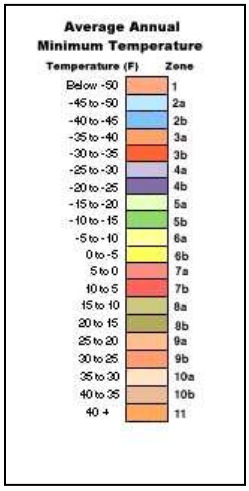


Figure 2 – Close up of Austin Climate Zone

Study Methodology

Project Description

The primary objective for this project was to provide the City with a comprehensive tree inventory of gateway streets and parks to provide guidance for the Urban Forestry staff. The following list of data was collected as well as the GPS coordinates for each tree.

Physical Address
Fabricated/fictitious addresses will be indicated with an "x" after the numeric portion.

1. Street code attribute
2. Tree number at site

TreeId - a number assigned to each tree within a particular city in order to distinguish trees and count the number of trees per city. Each record must have a TreeId; it must be numeric and unique.

Zone - an alphanumeric code. Street=1, Parks=2

SpCode - an alphanumeric code consisting of the first two letters of the genus name and the first two letters of the species name followed by two optional letters or numbers to distinguish two species with the same four-letter code.

Planting Site will be recorded as:

Vacant Large: planting space at least 10' wide, 40 ' between spaces.
Vacant Medium: planting space less than 10' wide, 30' spacing.
Vacant Small: less than 10' wide OR overhead utility present, 20' between spaces.

LandUse - a numeric code to describe the type of area where the tree is growing. The default values are as follows:

1 = residential
2 = Multi-family residential (duplex, apartments, condos)
3 = Industrial/large commercial
4 = Park/vacant/other (agricultural, riparian areas, greenbelts, park, etc.)
5 = Small commercial (minimart, retail boutiques, etc.)

LocSite - a numeric code to describe the kind of site where the tree is growing. The default values are as follows:

1 = Front yard
2 = Planting strip
3 = Cutout (tree root growth restricted on all four sides by hardscape within dripline)
4 = Median
5 = Other maintained locations
6 = Other un-maintained locations
7 = Backyard ROW

DBH – a numeric entry for the diameter at breast height (4.5 ft [1.37 m] above the ground). To nearest inch.

MtncRec - a numeric code to describe the recommended maintenance for the tree. The default values are as follows:

1 = **None** – tree does not need immediate or routine maintenance.

2 = **Young tree (routine)** – tree is less than 18 ft. tall and in need of maintenance; health or longevity of tree is not compromised by deferring maintenance for up to five years.

3 = **Young tree (immediate)** – tree is less than 18 ft. tall and in need of maintenance; deferring maintenance beyond one year would compromise health or longevity of tree.

4 = **Mature tree (routine)** – tree is more than 18 ft. tall and in need of maintenance; health or longevity of tree is not compromised by deferring maintenance for up to five years.

5 = **Mature tree (immediate)** – tree is more than 18 ft. tall and in need of maintenance; deferring maintenance beyond one year would compromise health or longevity of tree.
6 = **Critical concern (public safety)** – tree should be inspected without delay. Trees will be reported to City delegate within 24 hours.

PriorityTask - a numeric code to describe the highest priority task to perform on the tree.

The default values are as follows:

1 = **None** – tree does not need maintenance.

2 = **Stake/train** – staking or training needed to encourage a straight trunk, strong scaffold branching, or eliminate multiple leaders, crossing branches, and girdling ties. Includes removing or replacing stakes and ties to prevent damage to tree bole.

3 = **Clean** – crown needs cleaning to remove dead, diseased, damaged, poorly attached, or crossing branches to increase health or longevity of tree.
4 = **Raise** – crown should be raised by removing lower branches from the tree trunk to eliminate obstructions or clearance issues.
5 = **Reduce** – crown should be reduced/thinned by pruning to reduce tree height, spread, overcrowding, wind resistance, or an increase of light penetration.
6 = **Remove** – tree is dangerous, dead or dying, and no amount of maintenance will increase longevity or safety.
7 = **Treat pest/disease** – insects, pathogens, or parasites are present and detrimental to tree longevity; treatment should be given to maintain longevity.

SwDamg – limit to 1" or better only and record as Y/N. Trees with no sidewalk damage will be recorded as =0/null

WireConflict –a numeric code to describe utility lines that interfere with or are present above a tree. The default will be Y/N.

CondWood – a numeric code to describe the health of the tree's wood (its structural health) as per adaptation of the Council of Tree and Landscape Appraisers (CTLA) tree appraisal standards (CTLA, 2000. Guide for Plant Appraisal, 9th Ed.)

Classes must be ordered in ascending order with the poorest rating having the lowest numerical value. If no condition value is available, (0) zero will be entered for each record.

0 = **null**
1 = **Dead or Dying -** extreme problems
2 = **Poor -** major problems
3 = **Fair -** minor problems
4 = **Good -** no apparent problems

CondLvs – a numeric code for the health of the tree's leaves (its functional health) as per adaptation of CTLA tree appraisal (CTLA, 2000. Guide for Plant Appraisal, 9th Ed. Savoy, IL: ISA, 143 pp): Classes must be ordered in ascending order with the poorest rating having the lowest numerical value. If no condition value is available, (0) zero will be entered for each record.

0 = **none**

1 = **Dead or dying -** extreme problems

2 = **Poor -** major problems

3 = **Fair -** minor problems

4 = **Good -** no apparent problems

Risk Assessment
Utilize the "Guide for Risk rating Codes" companion to the Community Tree Risk Evaluation Form. Any tree receiving a risk assessment score of 10 or greater must be reported to the City representative within 24 hours of initial review.

<u>Additional Field added for Parks</u>

Highest Priority Defect – to allow for easy identification of tree defects in a park setting.

1 = **Null**
2 = **Dead Wood**
3 = **Crack**
4 = **Weak branch union**
5 = **Decay**
6 = **Canker**
7 = **Root problem**
8 = **Poor architecture**
9 = **Other**

GPS Data Collection

Using GPS and GIS for tree inventories is the preferred method for collecting data for the following reasons:

- GPS is incredibly accurate. The equipment used was a Trimble Pro XRS capable of accuracy of +/-3 feet. Offset distances were used only where signal conflicts existed which were rare on the City.
- Data is collected in real time on the handheld computer while the GPS unit acquires the satellite connection for the location.
- Data logged into the backpack system is then downloaded to a GIS system for easy handling of the information.
- GIS then allows the user to sort, calculate and otherwise process the raw data into a useful format.

Why GPS and GIS? Park's open space environments pose unique challenges to the urban forest manager. Without the constraints posed by hardscape and roadway as a limiting factor for growth and tree selection, a wider distribution of species can make the management of the properties more complex.

Further, scheduling maintenance can be difficult without the use of the street address-based tree locating method, commonplace in municipal urban forests. Using GPS and aerial mapping, the urban forest administrator for the parks environments similar to Austin's can rapidly select trees for work orders and then schedule and direct workers to the exact maintenance locations for maximum time and resource management.

GIS User Interface

ArborPro has delivered the dataset in a format that is consistent with the STRATUM system and ESRI GIS systems.

Stratum is an analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO2 reduction, storm water control, and property value increase. The baseline data provided can be used to effectively manage the resource, develop policy and set priorities. Using the inventory of street trees, this software allows managers to evaluate current benefits, costs, and management needs*.

*from the USFS Center for Urban Forest Research website.

Study Results

Size Characteristics

The size of a tree provides insight into the age and value of the tree. There are two industry-wide recognized size characteristics, height and diameter at breast height. While height was not collected as part of this survey, diameter at breast height (DBH) was determined by the diameter of the tree at 4.5 feet above grade. The DBH is represented in ranges due to the dynamic growth rate of trees.

Table 1 – Street Tree Diameter

Diameter in 10 Inch ranges	Count
0 to 10	4340
10 to 20	1567
20 to 30	401
30 to 40	125
Over 40	32

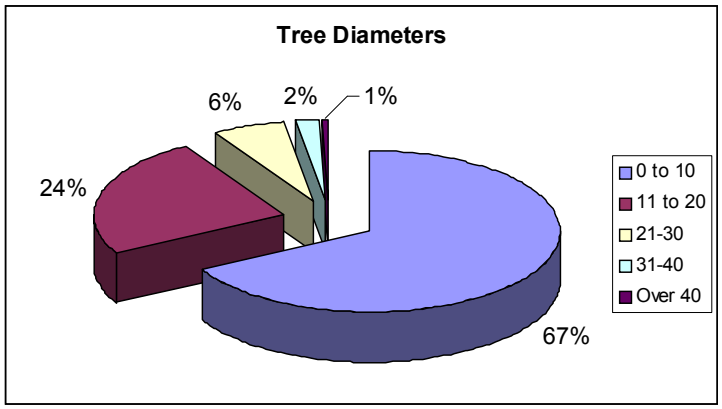
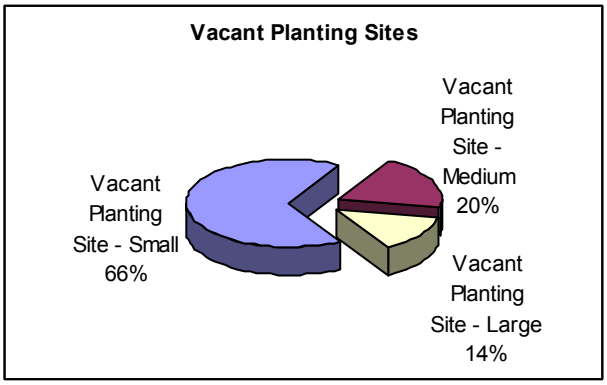


Table 2 – Vacant Planting Sites on Streets

Vacancies by Size	Count
Vacant Planting Site - Small	6609
Vacant Planting Site - Medium	1970
Vacant Planting Site - Large	1364



Size Trends

The characteristic results show an urban forest with fewer mature sized trees on the streets and an overabundance of smaller specimens as well as many available small, medium and large planting sites. The results of species selection could be a product of many of these sites being in proximity to power lines and impacted by traffic on the streets and the need for clearance. Of the top 20 trees planted under power lines, 50% are small stature trees including Crape Myrtle and Texas Mountain Laurel that will benefit the City without impacting the power infrastructure. As for the larger trees, those species known to be of large mature size show 50% are less than 12" in diameter. The City of Austin is interested in large canopy trees on it streets and the City is already facing the typical problems found in urbanized areas including carbon sequestering capabilities, rainfall capture for runoff, air quality assistance and pollution retention if only small stature trees are planted in the future. Because this survey involved many arterial streets with overhead utility, large, full canopy species may exist in other parts of the city.
The high frequencies of trees that fall into the smallest categories also represent a young urban forest. An important aspect of a young urban forest is professional tree care.

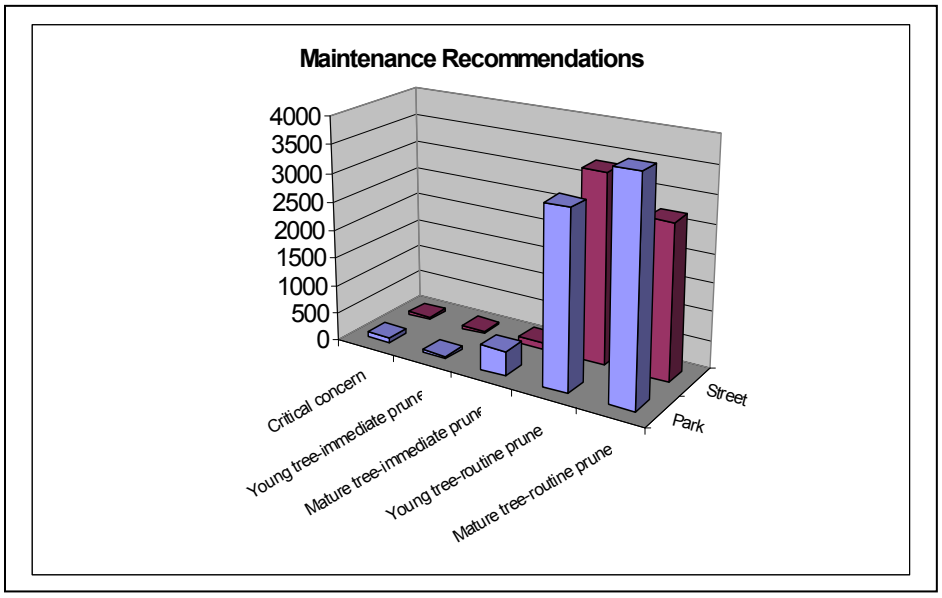
Common belief is that a tree does not require pruning until it has achieved a certain age or size. The exact opposite is true. Professional young tree maintenance provided by a certified arborist firm will alleviate many potential problems if caught early.

Maintenance Trends

Trees that are pruned properly in their first two to three years will be healthy trees that will require less maintenance in the future. Young tree maintenance will also prevent tree liability associated with un-maintained trees. Proper care of young trees begins with pruning at planting time only to remove branches damaged during handling and transplanting. Low branches should not be removed immediately because they manufacture critically needed food for the new tree.

Street Trees Priority of Tasks	Count
Treat pest/disease	24
Raise	276
Reduce	458
Remove	763
None	802
Stake/Train	1831
Clean	2316

Parks Priority of Tasks	Count
Treat pest/disease	32
Raise	367
Reduce	472
Remove	673
None	963
Stake/Train	1828
Clean	4125



Street Tree Maintenance Recommendation	Count
Young tree-immediate	49
Critical concern	36
Mature tree-immediate	115
Young tree-routine	3330
Mature tree-routine	2709

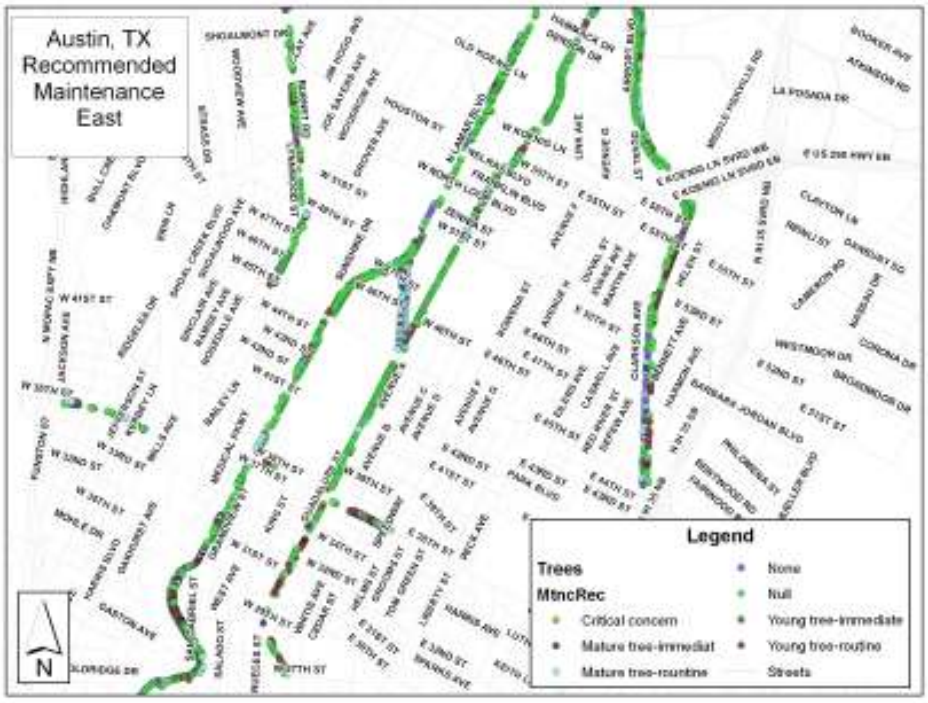
Park Tree Maintenance Recommendation	Count
Young tree-immediate	49
Critical concern	101
Mature tree-immediate	426
Young tree-routine	3090
Mature tree-routine	3960

Maintenance Category Descriptions

Immediate Prune
The trees that have been recommended for a high priority prune should be inspected. These trees are in need of corrective maintenance. The percentages of trees that fall into this category are slightly more than 3% of the entire tree population surveyed. The budget required to prune these trees should be very reasonable and easy to attain.

Routine Prune
A large majority of the trees surveyed on the City fall into the low priority prune or "none" category. It is recommended that these trees are placed on a systematic pruning program. The most cost effective program would include grid pruning or arterial pruning. Divide the City evenly into tree maintenance grids or select entire streets. Have the entire area pruned in a budget year. Low-priority pruning cycles can be developed with regard to available funds.

Critical Concern
139 trees on the City have been identified as high priority. These trees should be surveyed and scheduled for removal/remediation and replacement if appropriate. This category includes trees that reflect dangerous conditions combined with significant targets such as proximity to high volume pathways or play areas and housing structures. Many of these trees have already been inspected by City staff.



Pruning Cycle

A common pruning cycle should be created incorporating the zone of greatest interest, traffic, or needs in the first year. Thereafter, cyclic pruning on a grid system provides the greatest effect and is recommended as standard practice. Depending on the needs of the City, a 5 year cycle should be adequate. Addressing the almost 15,000 trees collected in the streets and parks, this involves either pruning or inspecting at least 3,000 trees per year or about 57 trees per week. No extrapolation was made for the entire city of Austin. Zones should be created for the best utilization of City recourses if only the data collected is used as a maintenance guide.

Proper pruning is critical in developing a tree with a strong structure and proper form. Trees that receive the appropriate pruning measures while they are young will require less corrective pruning when they mature.

Any pruning of a small tree has the effect of changing its look for its lifetime. Proper technique is essential. Damaging cuts can cause structural problems or introduce diseases that last for the life of the tree. Small cuts do less damage to the tree than large cuts. For that reason, proper pruning (training) of young trees is critical. Waiting to maintain a tree until it is mature can create the need for large cuts from which a tree cannot easily recover.

General maintenance seems to be relatively infrequent on the trees surveyed in Austin. Even though new trees are being planted there seems to be need for training in proper planting and more diligent training pruning.

ArborPro staff also recommends that the City plant *single-trunked* specimens of small-stature trees like crape myrtle, Texas mountain laurel, redbud, etc. rather than the "designer" multi-trunked stock they currently use.

While there weren't many "critical" small trees on the removal list, there were indeed signs of poor smaller trees that were splitting apart due to weak crotches and tight growth patterns of these multi-trunked trees. Maintenance costs may be reduced by investing in single-trunk, even if low-branched, tree stock.

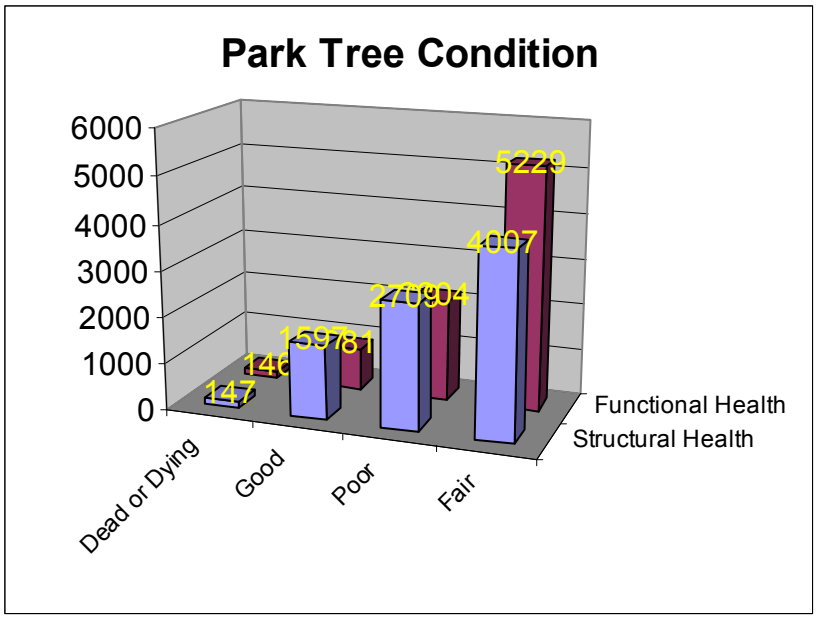
ArborPro suggests that the street work for 2008-2009 be concentrated on Lamar and Guadalupe just east and north of downtown. We further suggest that the parks maintenance be focused on the following:

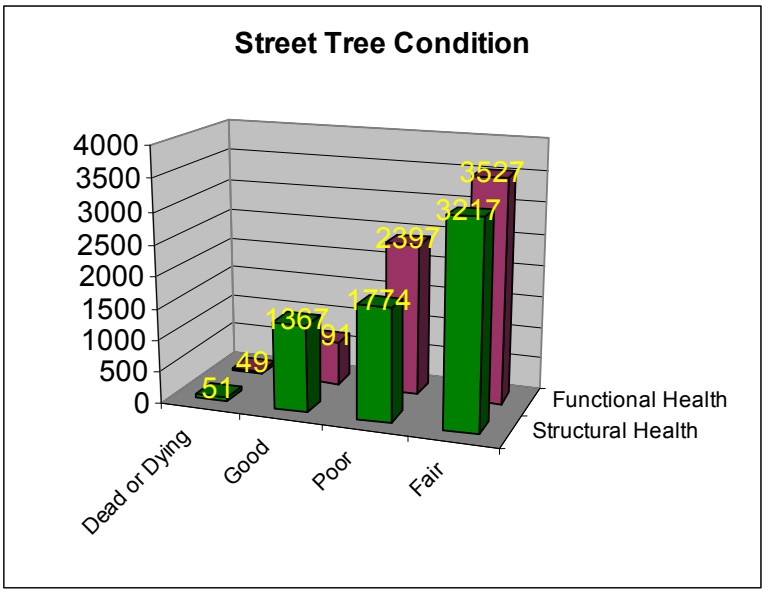
WATERLOO PARK	Mature tree-immediate	72
WATERLOO PARK	Critical concern	37
SOUTH AUSTIN PARK AND RECREATION CENTER	Mature tree-immediate	51
SOUTH AUSTIN PARK AND RECREATION CENTER	Critical concern	14
GOVALLE PARK	Mature tree-immediate	48
HANCOCK GOLF COURSE	Mature tree-immediate	30

Tree Condition Evaluation

The survey included an evaluation of the trees that have been inventoried with respect to the overall condition of structure and functional health as well as a risk factor rating. The evaluation performed was a ground-level sight inspection. There are many conditions that can exist in a tree that are not assessed from a ground-level inspection. However, the condition evaluation is helpful in determining the trees that are in the poorest condition. Below are a chart and graph of the tree conditions in the City of Austin.

Table 3 – Tree Conditions





Tree Condition Descriptions

- **Good**
  Good to Excellent branch placement, lack of uncorrectable co-dominant leaders, good pruning history. Canopy generally full and balanced, good foliage color, vigor and shoot elongation typical of species, lack of visible or uncontrollable pests. Conditions ideal to favorable for full development to species potential, sufficient room for canopy and root growth, irrigation and soils exist to sustain development.

- **Fair**
  Decent branch placement, less than ideal scaffold spacing, some co-dominance present, past pruning less than ideal but possibly correctable. Canopy relatively thin, foliage chlorotic, vigor and shoot elongation below norm for species, minor pests or possibility of infestation. Some restriction imposed by deficiencies such as proximity to competing species, proximity to sidewalks, grade changes, poor irrigation, overhanging adjacent trees.

- **Poor**
  Inferior branch placement, crowded scaffold, co-dominance likely, correction or mitigation necessary and likely extensive, restructuring needed to repair past pruning practices. Canopy sparse, dead twigs, stunted or absent new growth, declining number of growing points, pest presence visible or likely. One or more restrictions severe enough to hamper the ability of the tree to develop fully as listed above. Recent changes to the site may manifest themselves symptomatically in the future.

- **Dead or Dying**
  Majority of dead limbs and scaffold. Canopy nearly or completely dead. Restrictions to the site likely to cause failure or death of the tree. Tree may already be compromised.

Species Frequency

The species population diversity of the City survey zones is listed on the following pages. The survey identified nearly 150 tree species in the City of Austin. The most common tree identified was the *Ulmus crassifolia* commonly known as the Cedar Elm. There are 2,192 Cedar Elms trees in the City survey area. This species is highly suited for Texas climates. It is a hardy shade tree that can reach 90 feet in height. It is drought tolerant and can survive in compact soils.

Table 4 – Species Frequency/Diversity

Streets Species	Count		Parks Species	Count
Crape Myrtle	1290		Cedar Elm	1610
Southern Live Oak	1015		Eastern Red Cedar	918
Cedar Elm	582		Sugarberry	901
Sugarberry	552		Pecan	859
Pecan	284		Southern Live Oak	822
Arizona Ash	262		Crape Myrtle	546
Chinaberry	148		Ashe Juniper	461
Texas Mountain Laurel	115		Chinaberry	326
Yaupon	106		American Elm	252
Oriental Arborvitae	103		Honey Mesquite	164
American Elm	96		Box Elder	147
Texas Redbud	92		Texas Mountain Laurel	137
American Sycamore	84		Arizona Ash	101
Eastern Red Cedar	80		Post Oak	100
Honey Mesquite	79		Chinquapin Oak	82
Chinese Tallow Tree	71		Black Willow	63
Chinquapin Oak	70		Bur Oak	59
Ornamental Pear	69		Texas Madrone	58
Shumard Oak	69		American Sycamore	53
Box Elder	64		Texas Redbud	53

Table 4 – Species Frequency/Diversity Continued

Streets			Parks	
Eastern Redbud	59		Shumard Oak	51
Post Oak	55		White Mulberry	49
Ashe Juniper	54		Tree of Heaven	42
Red Oak	54		Gum Bumelia	41
Monterey Oak	50		Afghan Pine	37
Common Hackberry	45		Chinese Tallow Tree	33
Texas Red Oak	45		Cottonwood	33
Mexican Plum	38		Mexican Plum	33
Edible Pear	36		Eastern Redbud	32
White Mulberry	33		Yaupon	32
Chinese Juniper	32		Black Locust	29
Tree of Heaven	32		Monterey Oak	21
Bur Oak	30		Bald Cypress	20
Southern Magnolia	30		Oriental Arborvitae	20
Italian Cypress	29		Chaste Tree	18
Mexican Fan Palm	29		Chinese Parasol Tree	18
Afghan Pine	27		Paper Mulberry	14
Mexican Sabal Palm	26		Texas Red Oak	14
Mimosa, Silk Tree	24		Mexican Buckeye	13
Gum Bumelia	22		American Persimmon	12
Mexican Sycamore	21		Japanese Black Pine	11
Cottonwood	20		Texas Persimmon	10
Chinese Elm	19		Chitalpa	9
Chaste Tree	17		Southern Sugar Maple	9
Desert Willow	17		Osage Orange	8
Bald Cypress	16		Carolina Laurel Cherry	7
Jerusalem Thorn	15		Green Ash	7
Japanese Black Pine	13		Mexican Sabal Palm	7
Bigtooth Maple	12		Yew Pine	7
Butternut	12		Chinese Pistache	6
Mexican Buckeye	12		Red Oak	6
White Oak	12		Scarlet Oak	6
Black Locust	11		Chinese Elm	5
Purple-Leaf Plum	11		Jerusalem Thorn	7
Texas Ash	11		Smooth Sumac	5
Texas Madrone	11		Southern Magnolia	5
California Fan Palm	10		Sweet Acacia	5
Smooth Sumac	9		Texas Pistache	5
Swamp White Oak	8		Eastern Catalpa	4
Western Catalpa	8		Little Gem Magnolia	4
Black Willow	7		Bronze Loquat	3
Bronze Loquat	7		Deodar Cedar	3

Table 4 – Species Frequency/Diversity Continued

Streets			Parks	
Japanese Tree Lilac	7		Texas Ash	3
Paper Mulberry	7		Edible Loquat	2
Sawtooth Oak	7		Hybrid Elm	2
American Sweet Gum	6		Jeffrey Pine	2
Chinese Flame Tree	6		Madrone	2
Chinese Parasol Tree	6		Mexican Fan Palm	2
Chinese Pistache	6		Peach	2
Green Ash	6		Red Maple	2
Carolina Laurel Cherry	5		Saucer Magnolia	2
Eastern Catalpa	5		Sawtooth Oak	2
Lacey Oak	5		Shoestring Acacia	2
Loblolly Pine	5		Willow Oak	2
Mediterranean Fan Palm	5		Acacia Species	1
American Arborvitae	4		American Sweet Gum	1
Edible Loquat	4		Anacua	1
Pomegranate	4		Bigtooth Maple	1
Sweet Acacia	4		Common Hackberry	1
Windmill Palm	4		Desert Willow	1
Black Mulberry	3		Eastern Black Cherry	1
Carolina Buckthorn	3		Edible Fig	1
Eve's Necklace	3		Fraser Photinia	1
Globe Willow	3		Highrise Live Oak	1
Himalayan White Birch	3		Lacey Oak	1
Peach	3		Leyland Cypress	1
Redbay	3		Monterey Cypress	1
Scarlet Oak	3		Ornamental Pear	1
Shoestring Acacia	3		Overcup Oak	1
Showy Mountain Ash	3		Red Mulberry	1
Texas Crabapple	3		River Wattle	1
Willow Oak	3		Trifoliate Orange	1
Aleppo Pine	2		Valley Oak	1
Apricot	2		Washington Hawthorn	1
Australian Willow	2		Western Catalpa	1
Bamboo Species	2		White Oak	1
Deodar Cedar	2			
Holly Oak	2			
Hybrid Fan Palm	2			
Japanese Persimmon	2			
Japanese Red Pine	2			
Mexican Ash	2			

End of parks species list.

Table 4 – Species Frequency/Diversity Continued

Streets

Oleander	2
Pin Oak	2
Pindo Palm	2
Sawara False Cypress	2
Alaska Cedar	1
American Holly	1
American Persimmon	1
Amur Chokecherry	1
Anacua	1
Australian Black Pine	1
Banana	1
Bristlecone Pine	1
Cherrybark Oak	1
Chinese Photinia	1
Coolibah	1
Escarpment Black Cherry	1
Euchlora Linden	1
Fan-Tex Ash	1
Floss Silk Tree	1
Goldenrain Tree	1
Highrise Live Oak	1
Honey Locust	1
Italian Stone Pine	1
Knife Acacia	1
Kousa Dogwood	1
London Plane Tree	1
Old Man Palm	1
Orange	1
Primrose Tree	1
Queen Palm	1
Red Horsechestnut	1
Red Maple	1
Saucer Magnolia	1
Silver Dollar Gum	1
Silver Linden	1
Silver Maple	1
Smoke Tree	1
Tamarind	1
Texas Persimmon	1
Thornless Honey Locust	1
Trident Maple	1
Weeping Willow	1
Western Red Cedar	1

Trend Analysis Detail

From the data collected, some tree species stand out in the landscape for differing reasons. Listed are some of the trends found when queried from several angles.

Critical trees in Parks – varied over 5 top species. Of these 101 trees, the Sugarberry, Pecan, Eastern Red Cedar, Chinaberry and Southern Live Oak stand out. Some of the Southern Live Oaks will require some monitoring over time.

Critical trees on Streets – varied over 15 top species. Of these, no one species stands out as being a consistent problem by counts.

Priority Removals– Of the species trees listed in this category, 4 are common and should be addressed here. Sugarberry and Chinaberry are both found to be represented often and are in the "poor" category for health sometimes due to crowding. There are several Southern Live Oaks, Pecans and Cedar Elms listed as poor or diseased and dying. This is in part due to the large numbers of these trees in the landscape and the percentages are in line with what we often see in street tree inventories.

High Priority Trimming – Southern Live Oaks in the streets and Pecans in the parks were located near the top of the most apparent species. In the streetscapes, 53 trees in the Mature – Immediate category belong to Pecan, Cedar Elm and Southern Live Oak. The rest show no significant trend.

Hardscape Damage – 115 street trees are creating some type hardscape/sidewalk damage. 38 Southern Live Oaks stand out as the dominant source.

Utility Lines – 1,898 street trees, in over 50 common species categories, are under or near a Utility line. Many of these trees are of species selections that will grow to a mature size without disrupting service. Some, such as Southern Live Oak, Pecan and Cedar elm may require pruning or monitoring for in-growth into lines.

The Near Future – Trends and Recommendations for the next 5 years.

The overall form of the City forest is in good health due to the many new plantings that have been installed. This good start has the potential to fade rapidly and to create many problems in the future without the proper guidance for these young trees.

The most important part of a trees "structural" life takes place in the first 5 years. The pruning needs of the tree may not be extensive, but select trimming is necessary to remove poorly attached branches, crossing branches and co-dominant stems. This will promote healthy, strong trees for the future of the City. The Crape Myrtle species grows vigorously in its youth and should be carefully pruned.

It is advised to continue planting of replacement species that are better suited to the location. Trees that are weed-like should likely be reduced or eradicated. The City will likely need to acknowledge the presence of Glossy Privet, *Ligustrum lucidum,* as a tree of issue due to its rapid colonization of park land. This species was not collected as part of the survey.

Glossy Privet

The City will benefit from the purchase of a mobile stump grinder to grind stumps for all removed trees. A large percentage of the high risk trees (and trees in general) are multi-trunked stump sprouts that have been allowed to develop unchecked. Many are weak-wooded species (Chinaberry, hackberry, Arizona ash, plus glossy privet) that will likely fail over time.

Thinning out these "weed tree" species would dramatically improve the vitality of the remaining trees especially in the parks.

The City will need to establish a budget for tree maintenance and begin the remediation of trees in the survey that show the greatest need as seen in the following tables. ArborPro staff has provided detailed information that the City can now utilize to plan, and pursue only those trees that require assistance.

Top 5 Park Species	Count	Maintenance Trends.
Cedar Elm	1610	59% of Cedar Elms are mature trims
Eastern Red Cedar	918	Nearly 50% of Red Cedars are mature trims.
Sugarberry	901	56% of Sugarberry are young trims.
Pecan	859	66% of Pecans are mature trims.
Southern Live Oak	822	82% of Live Oaks are mature trims.

Top 5 Street Species	Count	Maintenance Trends.
Pecan	284	60% of Pecans are mature trims.
Sugarberry	552	Nearly 50% of Sugarberry are young trims.
Cedar Elm	582	Over 50% of Cedar Elms are young trims.
Southern Live Oak	1015	67% of Live Oaks are mature trims.
Crape Myrtle	1290	68% of Crape Myrtles are young trims.

The Tree Risk Ratings applied to the survey reveal that the average "elevated risk" tree is nearly 24 inches in diameter. "Elevated risk" is describing trees that fall into the 10-12 ratings on a 3-12 scale. There are 19 different species among these and no one tree shows a trend though the Southern Live Oak appears as the largest diameter trees in this group. This is typical of old growth Oaks that often display heavy spreading canopies and cavities at the base of the trunk that commonly place these in risk categories.

The budget will need to address the size and complexity of the mature trees. These will be most expensive and take longer for a crew to complete. Timelines and man-hour requirements can be created, and adjusted, after pruning begins to track and evaluate the budget goal over time.

As seen below, the maintenance tasks for each and every tree are provided in the data so that each park or street can be "mapped" with regard to where the City will apply its resources to the greatest advantage.

Parks Maintenance Tasks	Specific Task	Trend
Cedar Elm	Clean	72% of Cedar Elm need cleaning.
Pecan	Clean	Over half need cleaning and 15% need reduction.
Southern Live Oak	Clean	Over half need cleaning and 15% need raises or training.
Eastern Red Cedar	Clean	1/3 need cleaning, but 352 need nothing at this time.
Ashe Juniper	Clean	over 75% would benefit from cleaning.

Street Maintenance Tasks	Specific Task	Trend
Crape Myrtle	Stake/Train	Over half need training or restaking
Southern Live Oak	Clean	Over 40% require cleaning out. 224 need raises.
Cedar Elm	Clean	Over 40% require cleaning out.
Sugarberry	Clean	68% require either training or cleaning
Arizona Ash	Clean	60% require cleaning out.

Management Recommendations - 10 year goals

Though the trends consistently point to Cedar Elm and Southern Live Oak being categorized as troublesome, these species also represent 15% and 12% of trees in the survey and therefore will exhibit these high numbers. The numbers show us that the trees are in generally fair health, but that care should be taken to protect these dominant species here lest the City acquire a pest that infests and harms the urban forest. Cedar Elms, though not the primary target, are susceptible to Dutch Elm Disease. Southern Live Oaks are often found to have cavities in there bases, but may live for years in this condition.

There has been substantial remediation within many parks and adequate structural mass units (trunks) are present but yet there are large tracks of park land available for tree installation. Oak wilt is present within the Austin area and may explain, partially, the loss of canopy in the parks. Replanting on available street locations and park zones identified in the survey will begin a new cycle of life in the parks that will emerge in 10 years.

The urban forest in Austin, is mostly comprised of over-mature oaks and semi- mature "weedy" trees. Although most of the tree care practice is reactive versus proactive, there is potential for urban forest growth and development. Mature trees are reaching later stages of decline with little effort of improving tree vigor or vitality. Utility pruning is ongoing; throughout the city numerous trees have utilities present in their vicinity.

Much of the above sounds very negative, but there is a bright spot: trees which posed unreasonable risk have been removed; the use of polygons to demark potential planting sites is a start in the right direction. Following best management practices for planting, young tree training, utility pruning, risk remediation, and street tree pruning will enhance the urban forest. All of this follows in the foot steps of a comprehensive tree inventory... And the ground work has been laid.

Willingness of City staff to implement our recommendations, particularly of high risk tree removal, in a timely fashion, especially while Arborpro staff was present, was a very positive sign. Hopefully this will spill over into continued funding for additional maintenance of this remarkable green asset citywide.

Only a small portion of the streets and downtown neighborhoods has been collected for use in this report and to help guide the staff. We approximate that only 11% of residential areas have been surveyed. ArborPro would recommend that Austin continue to survey areas as budget funds are available or through grant funding.

ArborPro would like to see professional arborists, trained in assessing urban trees, continue to build on the structure and format that this survey has in place in order to create a data set that is cohesive, comprehensive and useful. Though volunteer labor may be used, it is our hope that certified arborists will continue the work into the future. A good goal for Austin may be to divide the City into 4 and attempt to survey the downtown region over the next 4 years.

Per request from Austin Energy, Allen, TX goals for the urban Forest are provided here. Though not nearly as large as Austin, Allen has broad but clear goals to review for adaptation or assimilation into the Urban Forest Plan for Austin. If Austin wishes to view a comprehensive report from a larger city, wwwHoustonRegionalForest.org may be a good resource.

Allen's Goals

Establish Maintenance schedule for preserving (pruning) existing trees- 1X / every 3 years.

Increased tree canopy will cover up to 10% because of park development within next 5 years.

Tree Canopy Goal -25% by 2015

Allen's Recommendations

Plant more large canopy shade trees for the next ten years, including Shumard red oak, Bur oak and Chinquapin oak, Cedar elm, Pecan and Chinese Pistachio.

Plant resistant varieties of Cotton Root Rot disease.

Do not plant Crepe Myrtles or Bradford Pears in Public
Areas.

Plant less Bald Cypress- Water Conservation

Plant more variety of drought tolerant Shade trees and ornamental trees such as Red Bud, Flame leaf Sumac, Vitex, and Desert Willow.

Conduct next GIS Tree Inventory in 10 years starting in 2015

Finally, the data collected has been delivered in the STRATUM format. The City intends to use this software program to track its changes and achieve its goals. This powerful tool may provide years of ongoing trends analysis for an ongoing "legacy" of the urban forest.

Austin's tree inventory work has just begun. A full inventory is the only true way to manage any resource. If you don't know what you have, you cannot manage it.

Final Urban Forestry Management Plan and Inventory
Summary, City of Austin, July 2008

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