ROWLEY, IA

2011 Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Rowley with managing its park trees, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 15% of Rowley's city park trees (ash) will die once EAB becomes established in the community. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2011, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 48 trees inventoried.

- Rowley's trees provide $5,557 of benefits annually, an average of $116 a tree
- There are 21 species of trees
- The top three genus are: Maple 33%, Ash 15% and Blue Spruce 10%
- 6% of trees are in need of some type of management
- 2 tree is recommended for removal

Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.

- Of the 2 trees needing removal, both trees is between 3 and 12 inches in diameter at 4.5 ft and one is a River Birch and the other a small white oak. They must be addressed in the near future.*City ownership of the trees recommended for removal should be verified prior to any removal*
- None of the 7 ash trees are in need of follow up because they are not displaying signs and symptoms associated with EAB
- All trees should be pruned on a routine schedule- one half of the park trees every other year, then wait 3 years.
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Siberian elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

This plan was developed to assist Rowley with the management, budgeting and future planning of their park trees. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the anticipated arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal and replacement planting. With proper planning and management of the current tree canopy in Rowley, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Rowley's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Rowley and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Rowley's urban forestry goals.

Inventory

In 2011, a tree inventory was conducted that included 100% of the city owned trees in the parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms of EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 48 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Rowley's trees reduce energy related costs by approximately $1,424 annually (Appendix A, Table 1). These savings are both in Electricity (6.7 MWh) and in Natural Gas (933.1 Therms).

Annual Stormwater Benefits

Rowley's trees intercept about 68,651 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $1,861 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic mater (ozone). In Rowley, it is estimated that trees remove 82.9 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $230 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Rowley, trees sequester about 29,311 lbs of carbon a year with an associated value of $220 (Appendix A, Table 4). In addition, the trees store 251,317 lbs of carbon, with a yearly benefit of $1,885 (Appendix A, Table 5).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Rowley receives $1,822 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Rowley's trees provide $5,557 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 48 trees in Rowley provide approximately $116 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Rowley has 21 different tree species in its parks (Appendix A, Figure 1).
The distribution of trees by genus is as follows:

Maple(Red,Norway,Sugar,Silver)	17	33%
Ash	7	15%
Blue Spruce	5	10%

Size Class

Most of Rowley's trees (52%) are between 6 and 12 inches in diameter at 4.5 ft (Appendix A, Figure 2 For size, a Bell Curve is preferred and shows the highest amount of trees around 8 inches in diameter at 4.5 ft. Rowley's size curve is on the small side, indicating a smaller than average stand. Generally with trees size does not indicate age.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Rowley indicate that 90% of the trees are in good health, with 4% foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 83% of Rowley's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 4% of the population. This 6% is an estimate of trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

Crown Cleaning	1	2%
Tree Removal	2	4%

Canopy Cover

The canopy cover of Rowley is approximately 1 acre (Appendix A, Figure 4). According to the 2000 census, Rowley parks occupies about 4 acres. Thus the canopy cover on city land is about 25%.

Land Use and Location

The all of Rowley's city trees are in the city parks (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

<u>Land Use</u>

Park/vacant/other	100%

Location

Park 100%

Recommendations

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

Hazardous trees

Rowley has 2 critical concern trees that need removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). The removal is critical concerns and should be address as soon as possible. These trees are not large diameter and are River Birch and White Oak. The river birch is one the south side of the park by the fire station. The white oak is on the south side of the park next to Park Street. Please refer to the six year maintenance plan at the end of this section. After the critical concern tree is addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming.

Poor tree species

Ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). There are a total of 7 ash trees, and none of those have signs and symptoms that have been associated with EAB. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However,

maintaining the same number of trees helps ensure continuation of the benefits of the existing trees in the parks in Rowley.

It is important to plant a diverse mix of species in the parks to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 20% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 10% of the total parks trees. Presently, the forest is moderately planted with Maple (33%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, Siberian elm, evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance.

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Six Year Maintenance Plan with <u>No Additional Funding</u>

Year 1

- Removal: 2 critical concern trees 1 white oak & 1 river birch
- Visual Survey for signs and symptoms of EAB
- Replant 2 trees

Year 2

- Removal: none needed
- Routine trimming: Contract to trim ½ of the city trees
- Visual Survey for signs and symptoms of EAB
- Replant 1 tree

Year 3

- Visual Survey for signs and symptoms of EAB

Year 4

- Routine trimming: Contract to trim 1/2 of the city trees
- Visual Survey for signs and symptoms of EAB

Year 5

- Visual Survey for signs and symptoms of EAB

Year 6

- Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: EAB could potentially start killing ash within 6 years of its arrival. This should leave adequate time for a strategy, the tree removals will increase once it arrives, but if they are kept up, the EAB population will be reduced decreasing their impact.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). There are none now but that can change. *City ownership of the tree recommended for removal should be verified prior to any removal*

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:
- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed ash trees will be replaced. All trees will meet the restrictions in city ordinance. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Siberian/Chinese elm, evergreen, willow or black walnut.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genus other than ash will be prioritized by hazardous or emergency situations only.

Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB.

Budget

Current Budget
Total $2,100 over 6 years ($350/year)

FY 2012 Budget
Removal: $1,000
Replanting 2 trees: $200
FY 2013 Budget
Routine trimming: $400
Replanting 1 tree: $100
FY 2014 Budget
FY 2015 Budget
Routine trimming: $400
FY 2016 Budget
FY 2017 Budget

*Reduction of ash over 6 years: EAB could potentially start killing ash within 6 years of its arrival. This should leave adequate time for a strategy, the tree removals will increase once it arrives, but if they are keep up, the EAB population will be reduced, decreasing there impact.

Purposed Budget Increase
EAB could potentially kill all ash trees in Rowley's city park within 10-12 years of its arrival. To remove all ash trees within 10-12 years after the discovery of EAB the budget would need to be increased to $500 a year. If the budget were increased to $3,500 a year all ash could be removed within 1 year. Additionally, it is recommended that Rowley apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

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Rowley, IA
Legend
Miles
0
0.05
0.1
0.2
0.3
0.4

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species

10/14/2011

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	1.0	76	143.2	140	216	(N/A)	14.6	15.2	30.85
Silver maple	2.2	164	286.3	281	444	(N/A)	12.5	31.2	74.02
Red maple	0.4	34	57.8	57	90	(N/A)	10.4	6.3	18.05
Blue spruce	0.6	48	75.9	74	123	(N/A)	10.4	8.6	24.51
Sugar maple	0.3	26	49.1	48	74	(N/A)	8.3	5.2	18.45
Apple	0.2	13	29.5	29	42	(N/A)	6.3	2.9	13.93
Northern hackberry	0.4	29	52.5	51	81	(N/A)	4.2	5.7	40.39
Kentucky coffeetree	0.2	14	27.5	27	41	(N/A)	4.2	2.9	20.64
Littleleaf linden	0.2	12	24.9	24	37	(N/A)	4.2	2.6	18.25
Norway maple	0.1	8	16.9	17	24	(N/A)	2.1	1.7	24.47
Ohio buckeye	0.1	8	16.9	17	24	(N/A)	2.1	1.7	24.47
Broadleaf Deciduous	0.1	6	12.8	13	18	(N/A)	2.1	1.3	18.19
River birch	0.1	8	16.9	17	24	(N/A)	2.1	1.7	24.47
Conifer Evergreen	0.1	5	10.2	10	15	(N/A)	2.1	1.0	14.80
Eastern white pine	0.1	10	14.6	14	24	(N/A)	2.1	1.7	24.14
White oak	0.0	2	3.7	4	6	(N/A)	2.1	0.4	5.82
Bur oak	0.1	7	13.7	13	21	(N/A)	2.1	1.5	20.64
Pin oak	0.1	8	15.8	15	24	(N/A)	2.1	1.7	23.64
Northern red oak	0.1	7	14.2	14	21	(N/A)	2.1	1.5	21.11
Japanese tree lilac	0.1	6	12.8	13	18	(N/A)	2.1	1.3	18.19
Elm	0.3	20	38.1	37	57	(N/A)	2.1	4.0	57.32
Other street trees	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	6.7	510	933.1	914	1,424	(N/A)	100.0	100.0	29.67

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

10/14/2011

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	5,748	156	(N/A)	14.6	8.4	22.25
Silver maple	37,052	1,004	(N/A)	12.5	54.0	167.36
Red maple	2,515	68	(N/A)	10.4	3.7	13.63
Blue spruce	7,721	209	(N/A)	10.4	11.3	41.85
Sugar maple	1,779	48	(N/A)	8.3	2.6	12.06
Apple	598	16	(N/A)	6.3	0.9	5.40
Northern hackberry	2,044	55	(N/A)	4.2	3.0	27.69
Kentucky coffeetree	1,216	33	(N/A)	4.2	1.8	16.47
Littleleaf linden	921	25	(N/A)	4.2	1.3	12.48
Norway maple	586	16	(N/A)	2.1	0.9	15.88
Ohio buckeye	586	16	(N/A)	2.1	0.9	15.88
Broadleaf Deciduous	264	7	(N/A)	2.1	0.4	7.17
River birch	586	16	(N/A)	2.1	0.9	15.88
Conifer Evergreen	755	20	(N/A)	2.1	1.1	20.47
Eastern white pine	1,539	42	(N/A)	2.1	2.2	41.70
White oak	172	5	(N/A)	2.1	0.3	4.65
Bur oak	608	16	(N/A)	2.1	0.9	16.47
Pin oak	579	16	(N/A)	2.1	0.8	15.69
Northern red oak	529	14	(N/A)	2.1	0.8	14.33
Japanese tree lilac	264	7	(N/A)	2.1	0.4	7.17
Elm	2,591	70	(N/A)	2.1	3.8	70.21
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	68,651	1,861	(N/A)	100.0	100.0	38.76

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

10/14/2011

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Ash	0.7	0.1	0.4	0.0	4	4.8	0.7	0.7	4.5	30	-0.2	-1	11.8	33	(N/A)	14.6	4.74
Silver maple	7.6	1.3	3.6	0.3	41	10.2	1.5	1.4	9.7	64	-4.1	-15	31.6	89	(N/A)	12.5	14.85
Red maple	0.4	0.1	0.2	0.0	2	2.1	0.3	0.3	2.0	13	-0.2	-1	5.3	15	(N/A)	10.4	2.95
Blue spruce	1.0	0.2	0.8	0.1	6	2.9	0.4	0.4	2.9	18	-2.8	-10	5.9	14	(N/A)	10.4	2.89
Sugar maple	0.1	0.0	0.1	0.0	1	1.6	0.2	0.2	1.5	10	-0.1	0	3.7	10	(N/A)	8.3	2.59
Apple	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.0	6	(N/A)	6.3	1.93
Northern hackberry	0.2	0.0	0.1	0.0	1	1.8	0.3	0.3	1.8	12	0.0	0	4.4	13	(N/A)	4.2	6.25
Kentucky coffeetree	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6	(N/A)	4.2	2.99
Littleleaf linden	0.1	0.0	0.1	0.0	0	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5	(N/A)	4.2	2.55
Norway maple	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	2.1	3.47
Ohio buckeye	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	2.1	3.47
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	2.1	2.55
River birch	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	2.1	3.47
Conifer Evergreen	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	2.1	1.53
Eastern white pine	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3	(N/A)	2.1	2.82
White oak	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	2.1	0.87
Bur oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3	(N/A)	2.1	2.99
Pin oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	-0.1	0	1.1	3	(N/A)	2.1	3.05
Northern red oak	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	-0.1	0	1.1	3	(N/A)	2.1	2.89
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	2.1	2.55
Elm	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9	(N/A)	2.1	9.34
Other street trees	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.0	0.00
Citywide total	11.1	1.9	6.0	0.6	62	32.2	4.7	4.5	30.4	200	-8.4	-32	82.9	230	(N/A)	100.0	4.80

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species

10/14/2011

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	12,752	96	(N/A)	14.6	5.1	13.66
Silver maple	197,759	1,483	(N/A)	12.5	78.7	247.20
Red maple	5,179	39	(N/A)	10.4	2.1	7.77
Blue spruce	5,591	42	(N/A)	10.4	2.2	8.39
Sugar maple	3,520	26	(N/A)	8.3	1.4	6.60
Apple	1,994	15	(N/A)	6.3	0.8	4.98
Northern	2,105	16	(N/A)	4.2	0.8	7.89
Kentucky	2,069	16	(N/A)	4.2	0.8	7.76
Littleleaf linden	2,049	15	(N/A)	4.2	0.8	7.68
Norway maple	1,101	8	(N/A)	2.1	0.4	8.26
Ohio buckeye	1,101	8	(N/A)	2.1	0.4	8.26
Broadleaf	908	7	(N/A)	2.1	0.4	6.81
River birch	1,101	8	(N/A)	2.1	0.4	8.26
Conifer Evergreen	284	2	(N/A)	2.1	0.1	2.13
Eastern white pine	1,170	9	(N/A)	2.1	0.5	8.78
White oak	185	1	(N/A)	2.1	0.1	1.39
Bur oak	1,035	8	(N/A)	2.1	0.4	7.76
Pin oak	1,025	8	(N/A)	2.1	0.4	7.68
Northern red oak	1,025	8	(N/A)	2.1	0.4	7.68
Japanese tree lilac	908	7	(N/A)	2.1	0.4	6.81
Elm	8,458	63	(N/A)	2.1	3.4	63.43
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	251,317	1,885	(N/A)	100.0	100.0	39.27

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees by Species

10/14/2011

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	1,892	14	-61	-1	0	1,669	13	3,498	26	(N/A)	14.6	11.9	3.75
Silver maple	11,965	90	-949	-1	-7	3,614	27	14,629	110	(N/A)	12.5	49.9	18.29
Red maple	729	5	-25	-1	0	744	6	1,447	11	(N/A)	10.4	4.9	2.17
Blue spruce	454	3	-27	-1	0	1,064	8	1,490	11	(N/A)	10.4	5.1	2.23
Sugar maple	505	4	-17	-1	0	568	4	1,056	8	(N/A)	8.3	3.6	1.98
Apple	266	2	-10	-1	0	285	2	541	4	(N/A)	6.3	1.9	1.35
Northern hackberry	278	2	-10	0	0	649	5	917	7	(N/A)	4.2	3.1	3.44
Kentucky coffeetree	418	3	-10	0	0	318	2	725	5	(N/A)	4.2	2.5	2.72
Littleleaf linden	447	3	-10	0	0	267	2	704	5	(N/A)	4.2	2.4	2.64
Norway maple	224	2	-5	0	0	176	1	394	3	(N/A)	2.1	1.4	2.96
Ohio buckeye	224	2	-5	0	0	176	1	394	3	(N/A)	2.1	1.4	2.96
Broadleaf Deciduous	114	1	-4	0	0	124	1	233	2	(N/A)	2.1	0.8	1.75
River birch	224	2	-5	0	0	176	1	394	3	(N/A)	2.1	1.4	2.96
Conifer Evergreen	39	0	-1	0	0	106	1	143	1	(N/A)	2.1	0.5	1.07
Eastern white pine	116	1	-6	0	0	216	2	326	2	(N/A)	2.1	1.1	2.45
White oak	74	1	-1	0	0	49	0	122	1	(N/A)	2.1	0.4	0.91
Bur oak	209	2	-5	0	0	159	1	362	3	(N/A)	2.1	1.2	2.72
Pin oak	163	1	-5	0	0	180	1	338	3	(N/A)	2.1	1.2	2.54
Northern red oak	147	1	-5	0	0	160	1	302	2	(N/A)	2.1	1.0	2.27
Japanese tree lilac	114	1	-4	0	0	124	1	233	2	(N/A)	2.1	0.8	1.75
Elm	660	5	-41	0	0	441	3	1,060	8	(N/A)	2.1	3.6	7.95
Other street trees	0	0	0	0	0	0	0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	19,260	144	-1,206	-9	-9	11,267	84	29,311	220	(N/A)	100.0	100.0	4.58

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

10/14/2011

Species	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	209	(N/A)	14.6	11.5	29.92
Silver maple	822	(N/A)	12.5	45.1	136.97
Red maple	110	(N/A)	10.4	6.1	22.07
Blue spruce	126	(N/A)	10.4	6.9	25.23
Sugar maple	71	(N/A)	8.3	3.9	17.81
Apple	15	(N/A)	6.3	0.8	4.95
Northern hackberry	64	(N/A)	4.2	3.5	31.91
Kentucky coffeetree	57	(N/A)	4.2	3.1	28.56
Littleleaf linden	62	(N/A)	4.2	3.4	31.20
Norway maple	26	(N/A)	2.1	1.4	26.22
Ohio buckeye	26	(N/A)	2.1	1.4	26.22
Broadleaf Deciduous	6	(N/A)	2.1	0.4	6.40
River birch	26	(N/A)	2.1	1.4	26.22
Conifer Evergreen	21	(N/A)	2.1	1.2	21.08
Eastern white pine	32	(N/A)	2.1	1.8	32.32
White oak	15	(N/A)	2.1	0.8	14.73
Bur oak	29	(N/A)	2.1	1.6	28.56
Pin oak	23	(N/A)	2.1	1.3	23.14
Northern red oak	16	(N/A)	2.1	0.9	16.24
Japanese tree lilac	6	(N/A)	2.1	0.4	6.40
Elm	58	(N/A)	2.1	3.2	57.69
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	1,822	(N/A)	100.0	100.0	37.97

Table 7: Summary of Benefits in Dollars

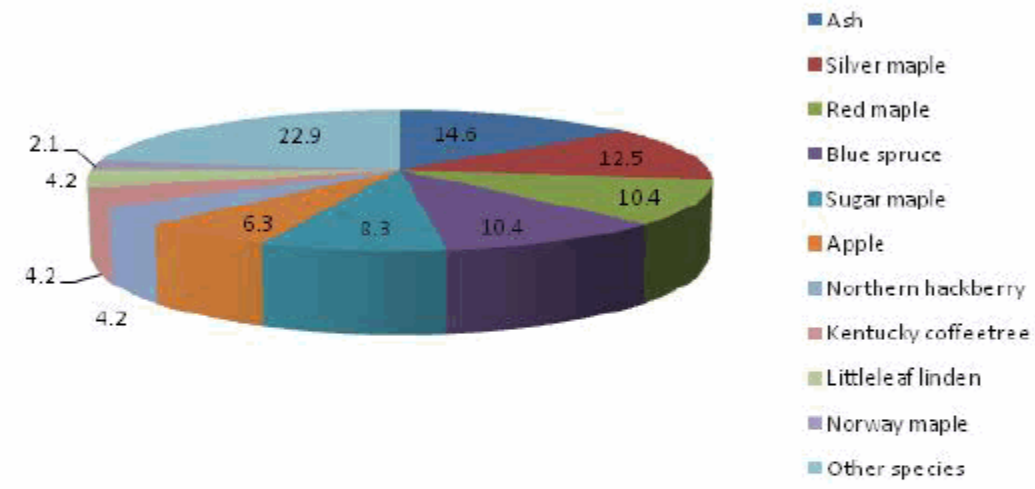
Total Annual Benefits of Public Trees by Species ($)

10/14/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Ash	216	26	33	156	209	641	(±0)	11.5
Silver maple	444	110	89	1,004	822	2,469	(±0)	44.4
Red maple	90	11	15	68	110	294	(±0)	5.3
Blue spruce	123	11	14	209	126	484	(±0)	8.7
Sugar maple	74	8	10	48	71	212	(±0)	3.8
Apple	42	4	6	16	15	83	(±0)	1.5
Northern hackberry	81	7	13	55	64	219	(±0)	3.9
Kentucky coffeetree	41	5	6	33	57	143	(±0)	2.6
Littleleaf linden	37	5	5	25	62	134	(±0)	2.4
Norway maple	24	3	3	16	26	73	(±0)	1.3
Ohio buckeye	24	3	3	16	26	73	(±0)	1.3
Broadleaf Deciduous	18	2	3	7	6	36	(±0)	0.6
River birch	24	3	3	16	26	73	(±0)	1.3
Conifer Evergreen	15	1	2	20	21	59	(±0)	1.1
Eastern white pine	24	2	3	42	32	103	(±0)	1.9
White oak	6	1	1	5	15	27	(±0)	0.5
Bur oak	21	3	3	16	29	71	(±0)	1.3
Pin oak	24	3	3	16	23	68	(±0)	1.2
Northern red oak	21	2	3	14	16	57	(±0)	1.0
Japanese tree lilac	18	2	3	7	6	36	(±0)	0.6
Elm	57	8	9	70	58	203	(±0)	3.6
Other street trees	0	0	0	0	0	0	(±0)	0.0
Citywide Total	1,424	220	230	1,861	1,822	5,557	(±0)	100.0

Species Distribution of Public Trees (%)

10/14/2011

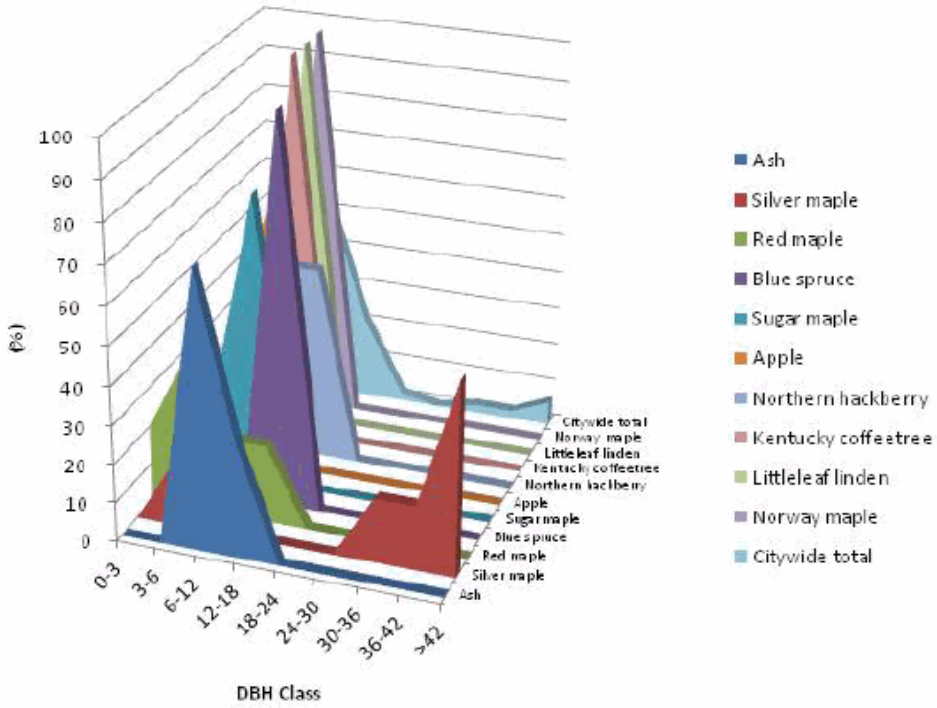


Species	Percent
Ash	14.6
Silver maple	12.5
Red maple	10.4
Blue spruce	10.4
Sugar maple	8.3
Apple	6.3
Northern hackberry	4.2
Kentucky coffeetree	4.2
Littleleaf linden	4.2
Norway maple	2.1
Other species	22.9
Total	100.0

Figure 1: Species Distribution

Relative Age Distribution of Top 10 Public Tree Species (%)

10/14/2011



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Ash	0.0	0.0	71.4	28.6	0.0	0.0	0.0	0.0	0.0
Silver maple	0.0	16.7	0.0	0.0	0.0	0.0	16.7	16.7	50.0
Red maple	20.0	40.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0
Blue spruce	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Sugar maple	0.0	25.0	75.0	0.0	0.0	0.0	0.0	0.0	0.0
Apple	0.0	33.3	66.7	0.0	0.0	0.0	0.0	0.0	0.0
Northern hackberry	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0
Kentucky coffeetree	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Littleleaf linden	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Norway maple	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Citywide total	2.1	12.5	52.1	20.8	2.1	0.0	2.1	2.1	6.3

Figure 2: Relative Age Class

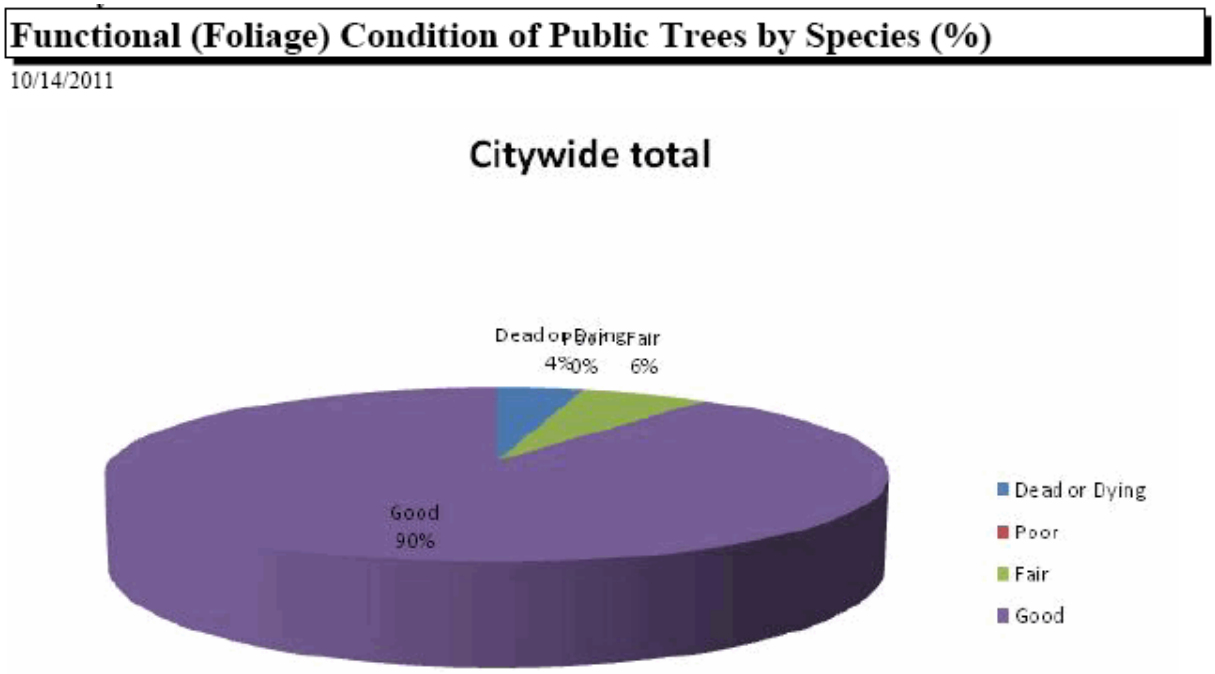


Figure 3: Foliage Condition

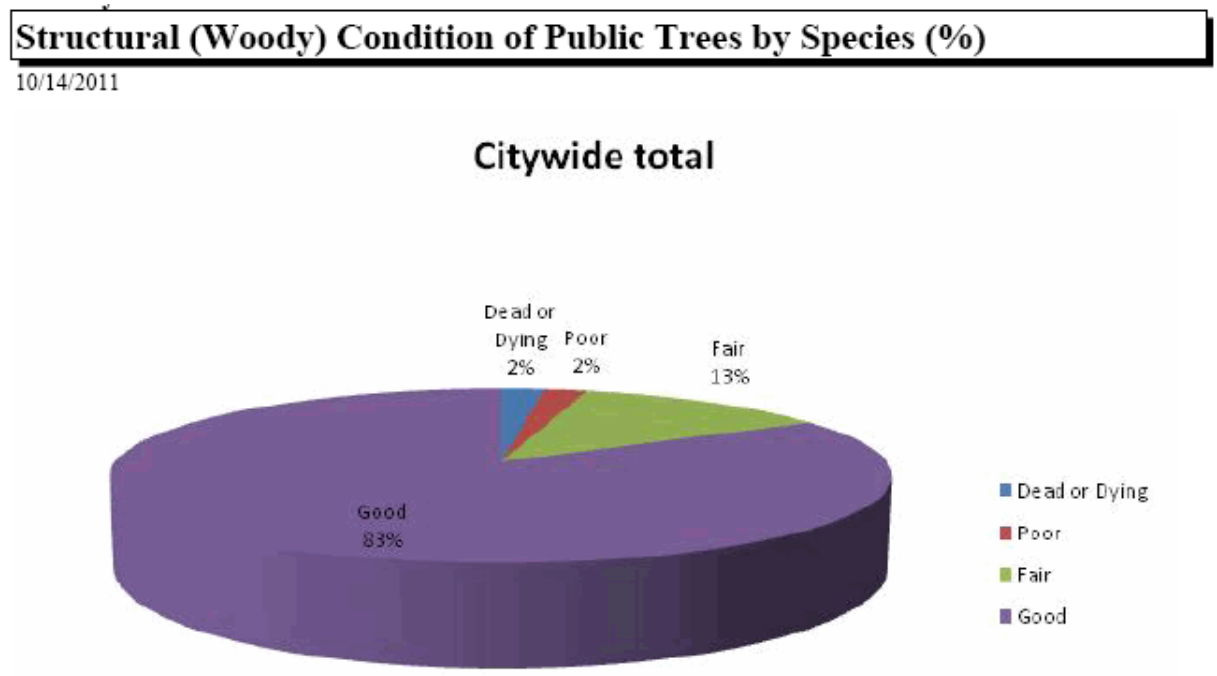
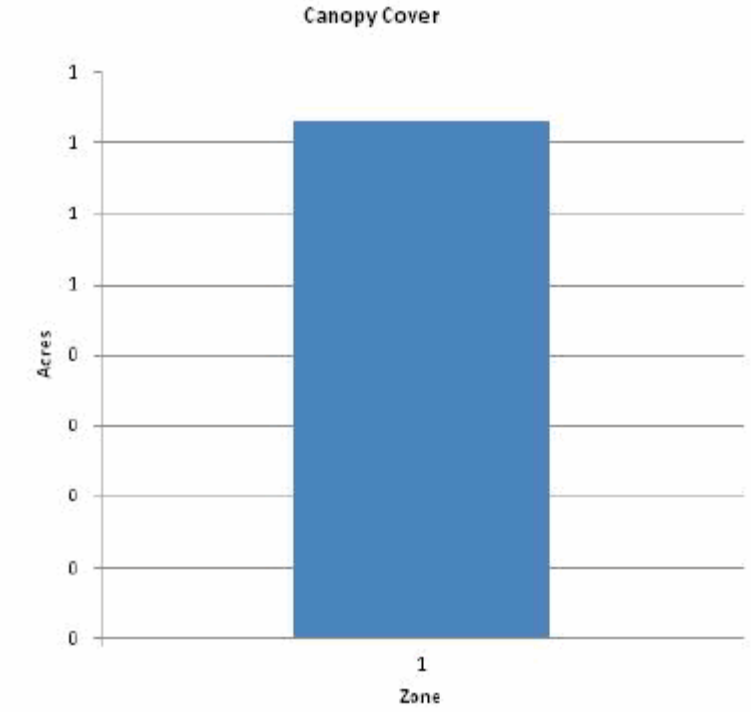


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

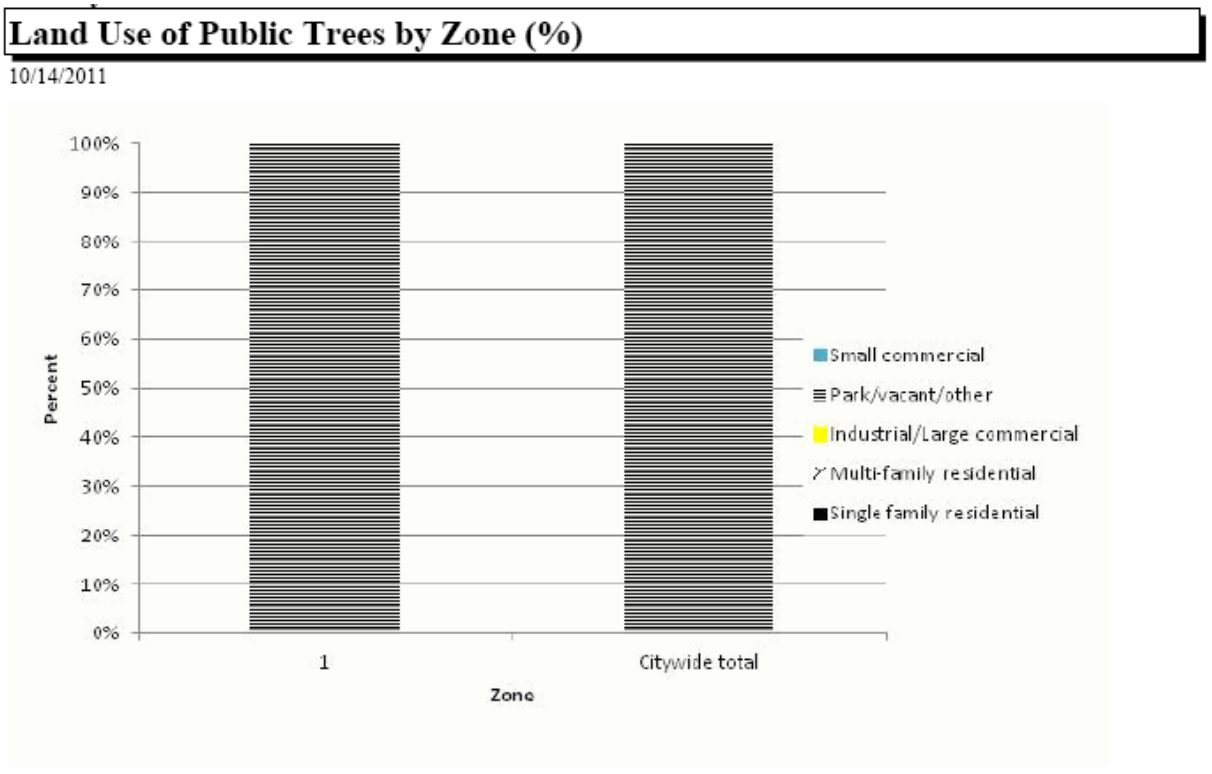
10/14/2011



Zone	Acres	% of Total Canopy Cover
1	1	100.0
Citywide total	1	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	1		

Figure 5: Canopy Cover in Acres

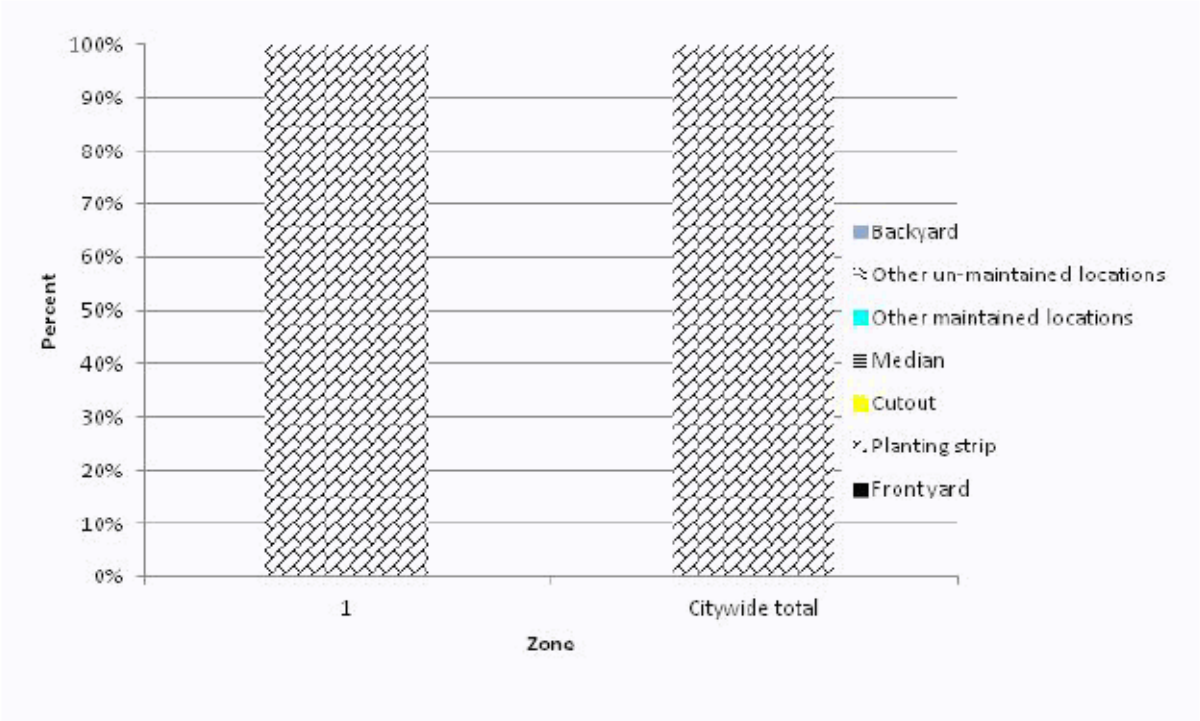


Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	0.0	0.0	0.0	100.0	0.0
Citywide total	0.0	0.0	0.0	100.0	0.0

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

10/14/2011



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Citywide total	0.0	100.0	0.0	0.0	0.0	0.0	0.0

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

NO SIGNS OR SYMPTOMS OF EAB

Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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