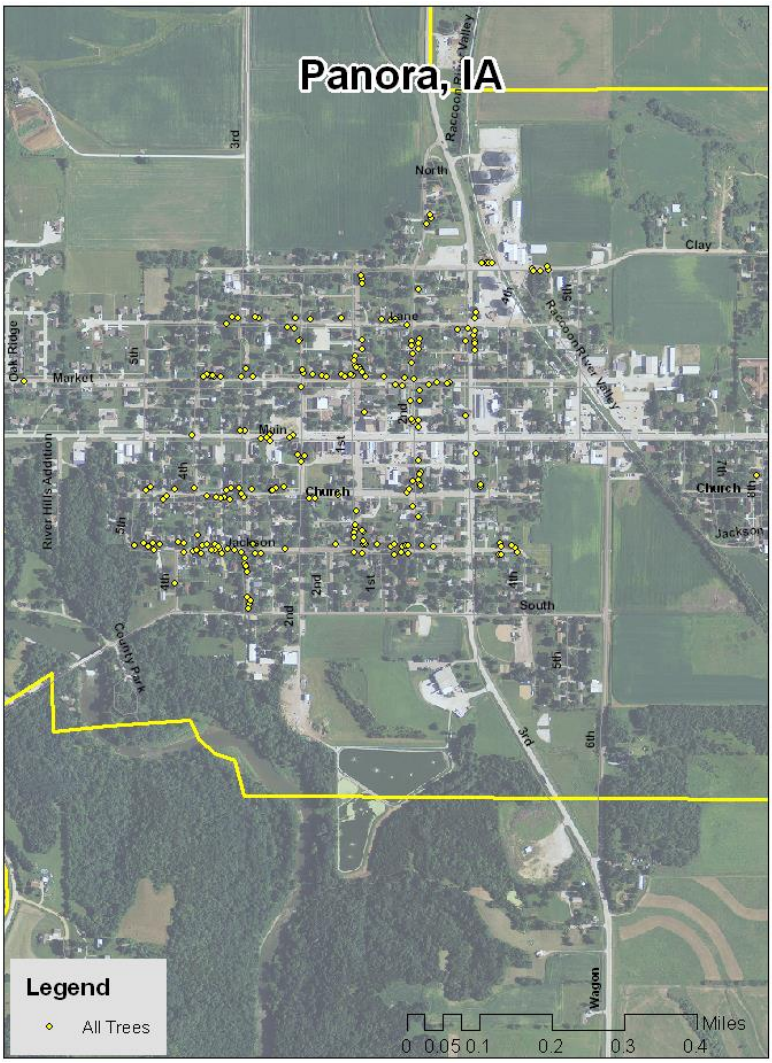
Panora, IA



2013 Management Plan
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Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Panora with managing its urban forest, 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 22% of Panora's city owned 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 2012, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street trees. Below are some key findings of the 219 trees inventoried.

- Panora's trees provide $42,127 of benefits annually, an average of $192 a tree
- There are over 23 species of trees
- The top three genus are: Maple 52.5%, Ash 22%, and Crabapple 7%
- 8% of trees are in need of some type of management
- 6 trees are 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 6 trees needing removal, 1 tree is over 24 inches in diameter at 4.5 ft and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 9 of the 49 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB
- All trees should be pruned on a routine schedule- one third of the city every 3 to 4 years
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, tree of heaven, Empress tree, or black walnut.
- Check ash trees with a visual survey yearly
- $36,000 should be budgeted over the next 10 years to remove and replace ash trees, as EAB infestations are likely.

Introduction

This plan was developed to assist Panora with the management, budgeting and future planning of their urban forest. 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 canopy in Panora, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Panora'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 Panora 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 Panora's urban forestry goals.

Inventory

In 2012, a tree inventory was conducted that included 100% of the city owned right of way trees. 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 219 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. Panora's trees reduce energy related costs by approximately $10,937 annually (Appendix A, Table 1). These savings are both in Electricity (52.6 MWh) and in Natural Gas (7,085.2 Therms).

Annual Stormwater Benefits

Panora's trees intercept about 581,186 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $15,751 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 matter (ozone). In Panora, it is estimated that trees remove 665.5 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 $1,872 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Panora, trees sequester about 134,489 lbs of carbon a year with an associated value of $1,009 (Appendix A, Table 5). In addition, the trees store 2,288,505 lbs of carbon, with a yearly benefit of $17,164 (Appendix A, Table 4).

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. Panora receives $11,998 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, Panora's trees provide $42,147 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 219 trees in Panora provide approximately $192 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Panora has over 23 different tree species along city streets (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple	115	52.5%
Ash	49	22.4%
Apple	16	7.3%
Linden	8	3.7%
Walnut	6	2.7%
Sycamore	6	2.7%
Oak	6	2.7%
Hackberry	3	1.4%
Spruce	3	1.4%
Redbud	2	0.9%
K. Coffee Tree	1	0.5%
Pine	1	0.5%
Poplar	1	0.5%
Pear	1	0.5%
Elm	1	0.5%

Age Class

Most of Panora's trees (60.3%) are between 12 and 30 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 18 inches in diameter at 4.5 ft. Panora's size curve indicates an average age distribution.

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 Panora indicate that 99% of the trees are in good health, with only 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 76% of Panora'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 8% of the population. This 8% 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	99	45%
Remove	6	3%
Stake/train	1	<1%

Canopy Cover

The canopies of the inventoried right of way trees cover approximately 6 acres (Appendix A, Figure 4). According to the 2000 census, Panora occupies 1,152 acres. Thus the canopy cover on city land is about 0.5%.

Land Use and Location

The majority of Panora's city trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use	
Single family residential	94.5%
Park/vacant/other	3.2%
Small commercial	2.3%

Location	
Planting strip	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

Panora has 1 critical concern tree that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There is one tree over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the ten year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming. There are a total of 5 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 6 removals, 2 are ash trees. There are a total of 49 ash trees, and 9 of those have signs and symptoms that have been associated with EAB. In addition, there are 6 trees that are in poor health. *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 ten year maintenance recommendations plan for further information.

Planting

Most of the planting over the next 10 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 ten year maintenance recommendations 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 forest in Panora.

It is important to plant a diverse mix of species in the urban forest 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 urban forest. Presently, the forest is heavily planted with Maple (52.5%) (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, evergreen, willow, tree of heaven, empress tree, or black walnut, as outlined in section 151.08 of the sample city ordinance (Appendix C). All trees planted must meet the restrictions in the sample city ordinance 151.08 (Appendix C).

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.

Ten Year Maintenance Recommendations Plan with <u>No Additional Funding</u>

Year 1

Removal: 6 critical concern trees
Planting and Replacement: 4 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB
Estimated costs: 6 x $500 = $3,000 for removals + 4 x $150 = $600 for replacement planting for a total of $3,600.

Years 2-10

Removal: Any new critical concern trees that develop and 5-6 additional ash trees per year that are in poor health
Planting and Replacement: 6-7 trees each year to be planted in open locations and locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees in years 2, 6, & 10.
Visual Survey for signs and symptoms of EAB
Estimated costs: Average of about $3,600 each year

EAB could potentially kill all ash within 4 years of its arrival. After the 2 critical concern ash are removed in Year 1, 47 ash trees remain. Estimated cost for removal is $500 per tree (multiplied by 53 equals $26,500). Estimated cost for replacement plantings is $150 per tree (multiplied by 63 equals $9,450). This totals $35,950 or about $3,600 per year over 10 years.

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). City ownership of the tree recommended for removal should be verified prior to any removal.

Treatment of Ash Trees

Chemical treatment can be effective, spreading removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from Panora. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/ .

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 sample city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, tree of heaven, empress tree, 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. If it is determined with reasonable certainty that any trees or shrubs in the City are suspected to be infected with or damaged by any disease or insect or disease pests on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, it is recommended the Council notify the owner, occupant or person in charge of the property to correct such condition by treatment or removal

in a timely manner. If the owner, occupant or person in charge of said property fails to comply in a timely manner, the Council may cause the condition to be corrected and the cost assessed against the property. Sample City Code 151.09, 1. Maintenance addresses these situations.

Budget

Proposed Budget

The 10 Year Maintenance Recommendations on Pages 8-9 of this plan suggest an annual budget of $3,600 per year to maintain Panora's urban forest. Additionally, it is recommended that Panora 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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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Panora

Annual Energy Benefits of Public Trees by Species

1/14/2013

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	14.8	1,127	2,003.5	1,963	3,090	(N/A)	25.6	28.3	55.19
Green ash	12.5	952	1,709.5	1,675	2,627	(N/A)	20.6	24.0	58.39
Silver maple	7.7	581	1,000.7	981	1,561	(N/A)	10.1	14.3	70.98
Norway maple	5.0	382	672.2	659	1,040	(N/A)	9.6	9.5	49.54
Apple	0.4	28	63.0	62	89	(N/A)	7.3	0.8	5.58
Red maple	1.8	137	241.0	236	373	(N/A)	6.4	3.4	26.63
Black walnut	1.9	147	256.9	252	399	(N/A)	2.7	3.7	66.46
American sycamore	2.3	178	319.7	313	491	(N/A)	2.7	4.5	81.82
American basswood	1.5	110	207.0	203	313	(N/A)	2.3	2.9	62.64
White ash	1.1	81	113.5	111	192	(N/A)	1.8	1.8	48.12
Pin oak	0.6	42	78.5	77	119	(N/A)	1.8	1.1	29.75
Northern hackberry	0.9	69	120.8	118	187	(N/A)	1.4	1.7	62.43
Littleleaf linden	0.5	34	61.7	60	95	(N/A)	1.4	0.9	31.62
Other street trees	1.7	127	237.2	232	359	(N/A)	6.4	3.3	25.66
Citywide total	52.6	3,994	7,085.2	6,943	10,937	(N/A)	100.0	100.0	49.94

Table 2: Annual Stormwater Benefits

Panora

Annual Stormwater Benefits of Public Trees by Species

1/14/2013

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	163,422	4,429	(N/A)	25.6	28.1	79.09
Green ash	128,680	3,487	(N/A)	20.6	22.1	77.50
Silver maple	124,976	3,387	(N/A)	10.1	21.5	153.96
Norway maple	37,333	1,012	(N/A)	9.6	6.4	48.18
Apple	1,184	32	(N/A)	7.3	0.2	2.01
Red maple	11,727	318	(N/A)	6.4	2.0	22.70
Black walnut	23,941	649	(N/A)	2.7	4.1	108.14
American sycamore	33,739	914	(N/A)	2.7	5.8	152.40
American basswood	16,158	438	(N/A)	2.3	2.8	87.58
White ash	6,650	180	(N/A)	1.8	1.1	45.05
Pin oak	4,818	131	(N/A)	1.8	0.8	32.64
Northern hackberry	6,472	175	(N/A)	1.4	1.1	58.47
Littleleaf linden	3,719	101	(N/A)	1.4	0.6	33.60
Other street trees	18,367	498	(N/A)	6.4	3.2	35.56
Citywide total	581,186	15,751	(N/A)	100.0	100.0	71.92

Table 3: Annual Air Quality Benefits

Panora

Annual Air Quality Benefits of Public Trees by Species

1/14/2013

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
Sugar maple	21.4	3.6	10.7	0.9	116	70.5	10.3	9.8	67.3	440	-16.8	-63	177.8	493	(N/A)	25.6	8.81
Green ash	15.2	2.4	7.5	0.7	82	59.8	8.7	8.3	56.9	373	0.0	0	159.5	455	(N/A)	20.5	10.10
Silver maple	23.1	3.9	11.1	1.0	124	36.0	5.3	5.0	34.6	225	-11.9	-45	108.1	304	(N/A)	10.0	13.84
Norway maple	6.8	1.2	3.4	0.3	37	23.9	3.5	3.3	22.8	149	-1.7	-6	63.5	180	(N/A)	9.6	8.56
Apple	0.1	0.0	0.1	0.0	1	1.9	0.3	0.2	1.6	11	0.0	0	4.3	12	(N/A)	7.3	0.75
Red maple	2.2	0.4	1.1	0.1	12	8.5	1.2	1.2	8.1	53	-0.8	-3	22.1	62	(N/A)	6.4	4.44
Black walnut	3.3	0.5	1.5	0.1	17	9.2	1.3	1.3	8.8	57	0.0	0	26.1	75	(N/A)	2.7	12.45
American sycamore	5.5	0.9	2.4	0.2	29	11.2	1.6	1.6	10.6	70	0.0	0	34.0	98	(N/A)	2.7	16.36
American basswood	2.2	0.4	1.1	0.1	12	7.0	1.0	1.0	6.6	44	-1.9	-7	17.5	48	(N/A)	2.3	9.69
White ash	0.4	0.1	0.3	0.0	3	4.8	0.7	0.7	4.9	31	0.0	0	11.9	33	(N/A)	1.8	8.32
Pin oak	0.7	0.1	0.4	0.0	4	2.7	0.4	0.4	2.5	17	-1.3	-5	5.8	15	(N/A)	1.8	3.84
Northern hackberry	0.8	0.1	0.5	0.0	5	4.3	0.6	0.6	4.1	27	0.0	0	11.1	32	(N/A)	1.4	10.51
Littleleaf linden	0.6	0.1	0.3	0.0	3	2.2	0.3	0.3	2.1	13	-0.3	-1	5.5	15	(N/A)	1.4	5.15
Other street trees	2.3	0.4	1.3	0.1	13	8.0	1.2	1.1	7.6	50	-3.7	-14	18.3	49	(N/A)	6.4	3.50
Citywide total	84.6	14.2	41.7	3.8	456	250.1	36.5	34.8	238.4	1,560	-38.4	-144	665.5	1,872	(N/A)	100.0	8.55

Table 4: Annual Carbon Stored

Panora

Stored CO2 Benefits of Public Trees by Species

1/14/2013

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	612,226	4,592	(N/A)	25.6	26.8	81.99
Green ash	496,081	3,721	(N/A)	20.6	21.7	82.68
Silver maple	554,000	4,155	(N/A)	10.1	24.2	188.86
Norway maple	111,298	835	(N/A)	9.6	4.9	39.75
Apple	3,485	26	(N/A)	7.3	0.2	1.63
Red maple	25,892	194	(N/A)	6.4	1.1	13.87
Black walnut	110,091	826	(N/A)	2.7	4.8	137.61
American	184,673	1,385	(N/A)	2.7	8.1	230.84
American	82,599	619	(N/A)	2.3	3.6	123.90
White ash	14,687	110	(N/A)	1.8	0.6	27.54
Pin oak	16,461	123	(N/A)	1.8	0.7	30.86
Northern	11,406	86	(N/A)	1.4	0.5	28.52
Littleleaf linden	12,000	90	(N/A)	1.4	0.5	30.00
Other street trees	24,315	402	(N/A)	6.4	2.3	28.72
Citywide total	2,288,505	17,164	(N/A)	100.0	100.0	78.37

Table 5: Annual Carbon Sequestered

Panora

Annual CO_2 Benefits of Public Trees by Species

1/14/2013

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	32,933	247	-2,939	-11	-22	24,906	187	54,889	412	(N/A)	25.6	25.9	7.35
Green ash	29,297	220	-2,381	-9	-18	21,043	158	47,950	360	(N/A)	20.6	22.7	7.99
Silver maple	36,410	273	-2,659	-4	-20	12,834	96	46,581	349	(N/A)	10.1	22.0	15.88
Norway maple	8,119	61	-534	-4	-4	8,432	63	16,012	120	(N/A)	9.6	7.6	5.72
Apple	613	5	-17	-3	0	611	5	1,204	9	(N/A)	7.3	0.6	0.56
Red maple	3,448	26	-124	-3	-1	3,017	23	6,338	48	(N/A)	6.4	3.0	3.40
Black walnut	4,231	32	-528	-1	-4	3,248	24	6,950	52	(N/A)	2.7	3.3	8.69
American sycamore	4,779	36	-886	-1	-7	3,925	29	7,817	59	(N/A)	2.7	3.7	9.77
American basswood	4,815	36	-396	-1	-3	2,438	18	6,856	51	(N/A)	2.3	3.2	10.28
White ash	1,975	15	-70	-1	-1	1,795	13	3,698	28	(N/A)	1.8	1.8	6.93
Pin oak	1,782	13	-79	-1	-1	931	7	2,633	20	(N/A)	1.8	1.2	4.94
Northern hackberry	898	7	-55	-1	0	1,524	11	2,367	18	(N/A)	1.4	1.1	5.92
Littleleaf linden	1,363	10	-58	-1	0	760	6	2,065	15	(N/A)	1.4	1.0	5.16
Other street trees	3,825	29	-257	-3	-2	2,803	21	6,368	48	(N/A)	6.4	3.0	3.41
Citywide total	134,489	1,009	-10,985	-43	-83	88,267	662	211,728	1,588	(N/A)	100.0	100.0	7.25

Table 6: Annual Social and Aesthetic Benefits

Panora

Annual Aesthetic/Other Benefits of Public Trees by Species

1/14/2013

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	3,440	(N/A)	25.6	28.7	61.43
Green ash	2,488	(N/A)	20.6	20.7	55.29
Silver maple	2,685	(N/A)	10.1	22.4	122.04
Norway maple	796	(N/A)	9.6	6.6	37.92
Apple	32	(N/A)	7.3	0.3	1.97
Red maple	500	(N/A)	6.4	4.2	35.74
Black walnut	332	(N/A)	2.7	2.8	55.28
American sycamore	335	(N/A)	2.7	2.8	55.85
American basswood	337	(N/A)	2.3	2.8	67.46
White ash	255	(N/A)	1.8	2.1	63.74
Pin oak	168	(N/A)	1.8	1.4	41.93
Northern hackberry	143	(N/A)	1.4	1.2	47.57
Littleleaf linden	147	(N/A)	1.4	1.2	49.03
Other street trees	340	(N/A)	6.4	2.8	24.28
Citywide total	11,998	(N/A)	100.0	100.0	54.78

Table 7: Summary of Benefits in Dollars

Panora

Total Annual Benefits of Public Trees by Species ($)

1/14/201

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Sugar maple	3,090	412	493	4,429	3,440	11,864	(±0)	28.2
Green ash	2,627	360	455	3,487	2,488	9,417	(±0)	22.3
Silver maple	1,561	349	304	3,387	2,685	8,287	(±0)	19.7
Norway maple	1,040	120	180	1,012	796	3,148	(±0)	7.5
Apple	89	9	12	32	31	174	(±0)	0.4
Red maple	373	48	62	318	500	1,301	(±0)	3.1
Black walnut	399	52	75	649	332	1,506	(±0)	3.6
American sycamore	491	59	98	914	335	1,897	(±0)	4.5
American basswood	313	51	48	438	337	1,188	(±0)	2.8
White ash	192	28	33	180	255	689	(±0)	1.6
Pin oak	119	20	15	131	168	452	(±0)	1.1
Northern hackberry	187	18	32	175	143	555	(±0)	1.3
Littleleaf linden	95	15	15	101	147	374	(±0)	0.9
Other street trees	359	48	49	498	340	1,294	(±0)	3.1
Citywide Total	10,937	1,588	1,872	15,751	11,998	42,147	(±0)	100.0

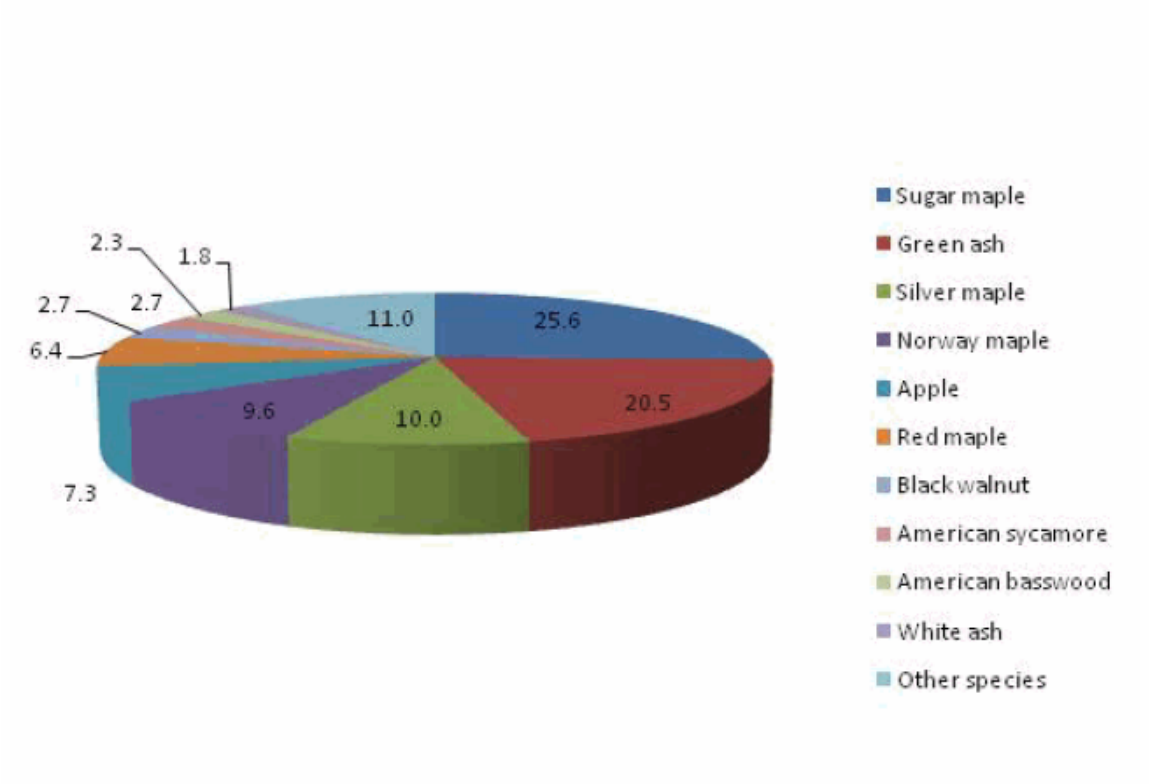
Table 8: Matrix of Maintenance Recommendations by priority tasks.

TASK	Critical – 6	Mature Tree Imm - 5	Mature Tree Routine - 4	Young Tree Imm. - 3	Young Tree Routine - 2	None - 1	Totals
None - 1						113	113
Stake/train - 2		1					1
Clean - 3		15	80	3	1		99
Raise - 4							
Reduce - 5							
Remove - 6	1	4		1			6
Treat pest/disease – 7							
Totals	1	20	80	4	1	113	**219**

Panora

Species Distribution of Public Trees (%)

1/14/2013



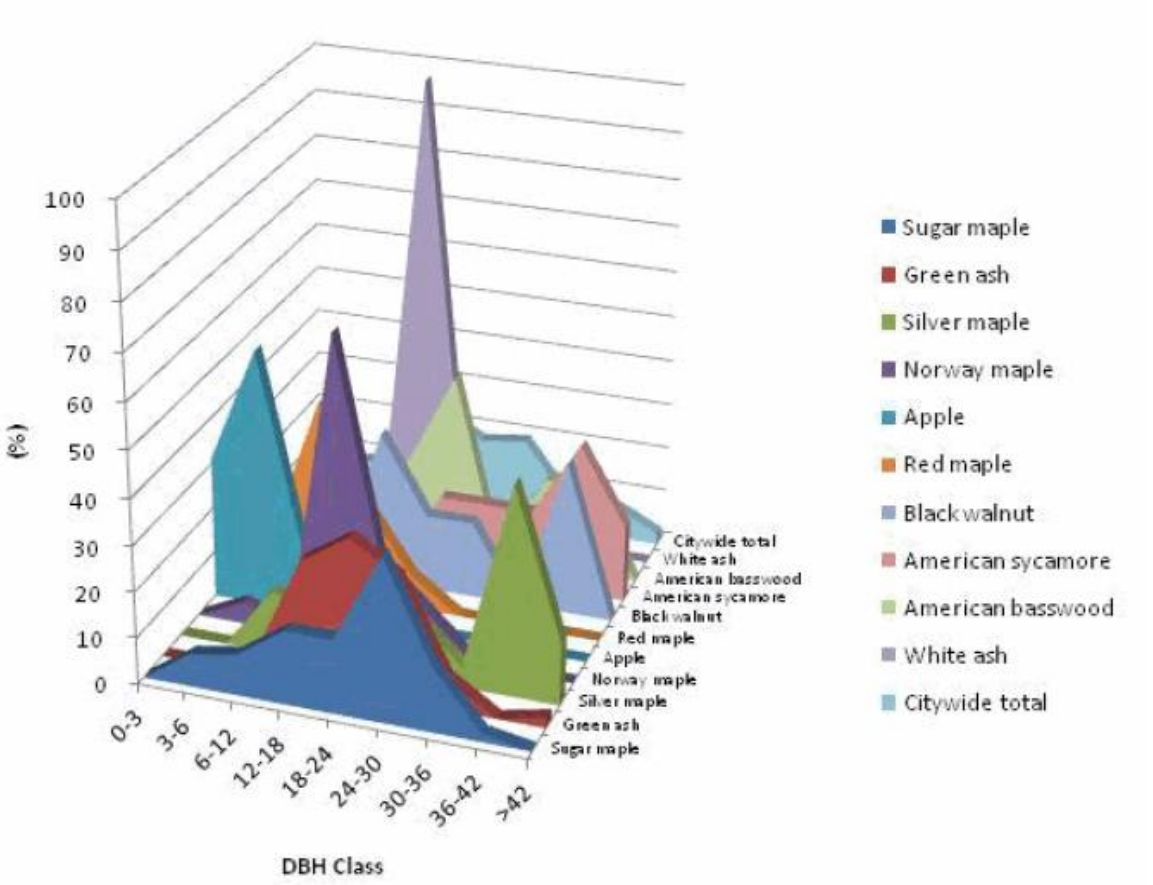
Species	Percent
Sugar maple	25.6
Green ash	20.5
Silver maple	10.0
Norway maple	9.6
Apple	7.3
Red maple	6.4
Black walnut	2.7
American sycamore	2.7
American basswood	2.3
White ash	1.8
Other species	11.0
Total	100.0

Figure 1: Species Distribution

Panora

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

1/14/2013



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Sugar maple	0.0	7.1	8.9	16.1	16.1	35.7	14.3	1.8	0.0
Green ash	0.0	0.0	4.4	26.7	33.3	26.7	6.7	0.0	2.2
Silver maple	0.0	0.0	13.6	9.1	0.0	13.6	4.5	45.5	13.6
Norway maple	0.0	4.8	0.0	66.7	19.0	9.5	0.0	0.0	0.0
Apple	31.3	56.3	12.5	0.0	0.0	0.0	0.0	0.0	0.0
Red maple	14.3	14.3	42.9	21.4	7.1	0.0	0.0	0.0	0.0
Black walnut	0.0	0.0	0.0	33.3	16.7	16.7	0.0	33.3	0.0
American sycamore	0.0	0.0	0.0	0.0	16.7	16.7	16.7	33.3	16.7
American basswood	0.0	0.0	0.0	20.0	40.0	0.0	20.0	20.0	0.0
White ash	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Citywide total	5.9	8.2	9.6	23.3	17.8	19.2	6.4	7.3	2.3

Figure 2: Relative Age Class

Panora

Functional (Foliage) Condition of Public Trees by Species (%)

1/14/2013

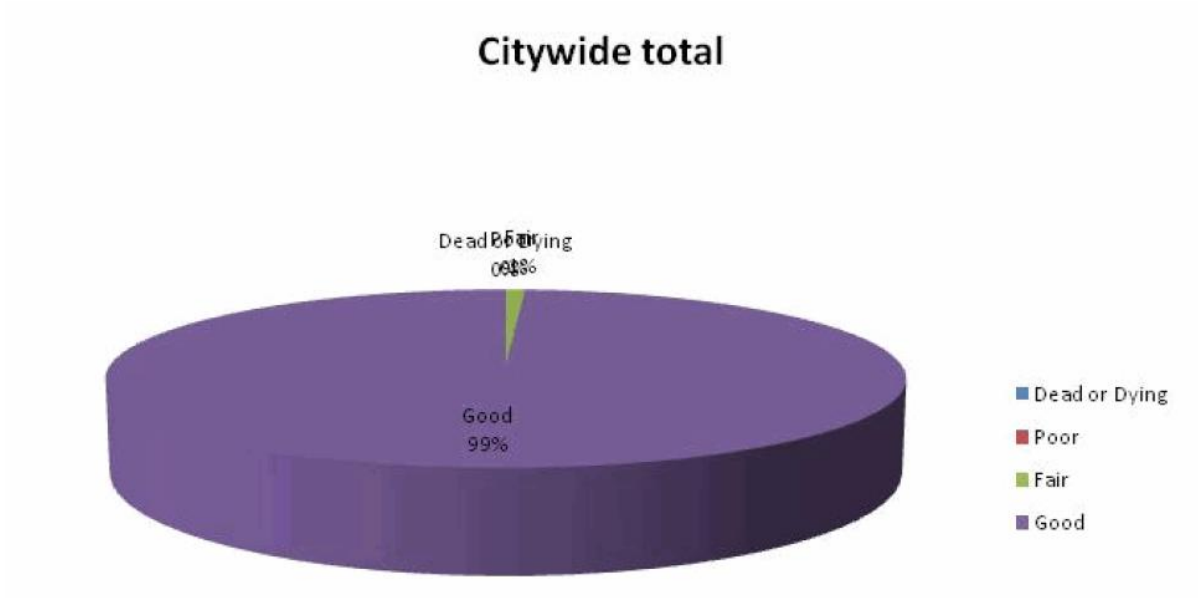


Figure 3: Foliage Condition

Panora

Structural (Woody) Condition of Public Trees by Species (%)

1/14/2013

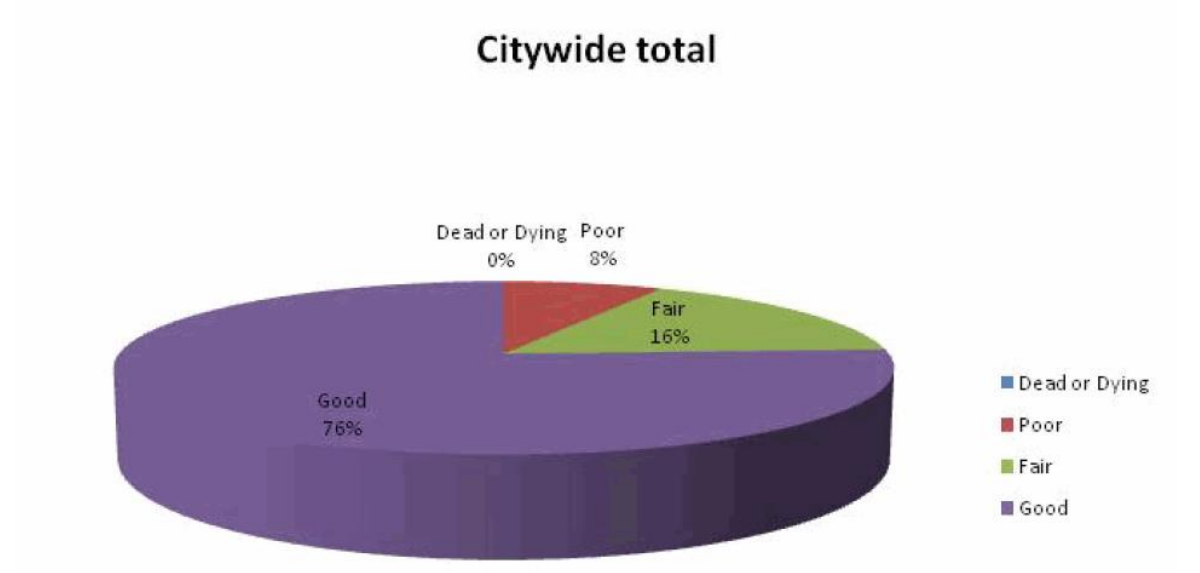
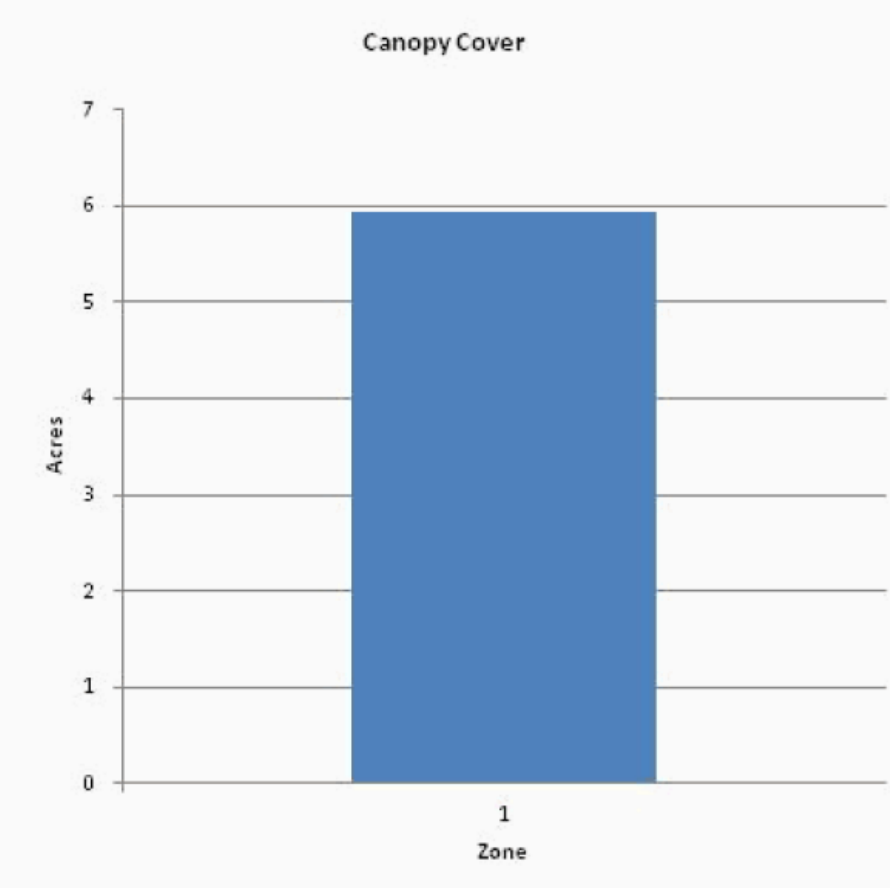


Figure 4: Wood Condition

Panora

Canopy Cover of Public Trees (Acres)

1/14/2013



Zone	Acres	% of Total Canopy Cover
1	6	100.0
Citywide total	6	100.0

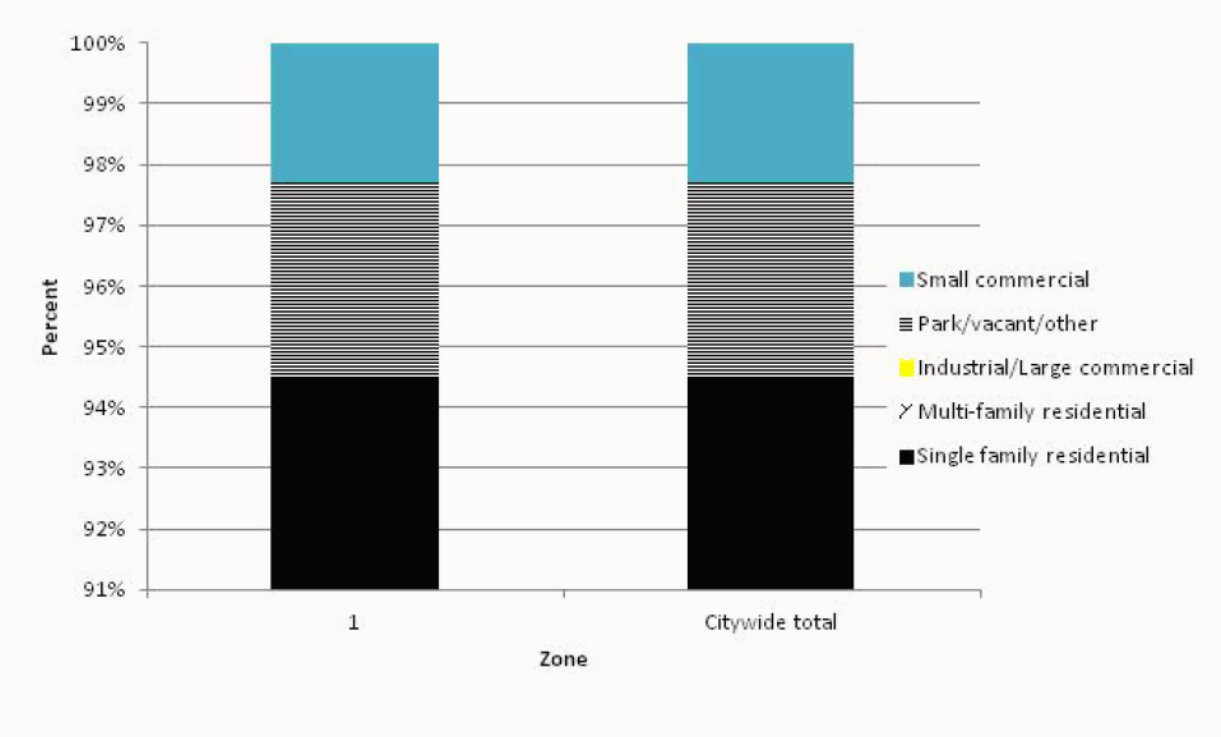
	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	6		

Figure 5: Canopy Cover in Acres

Panora

Land Use of Public Trees by Zone (%)

1/14/2013



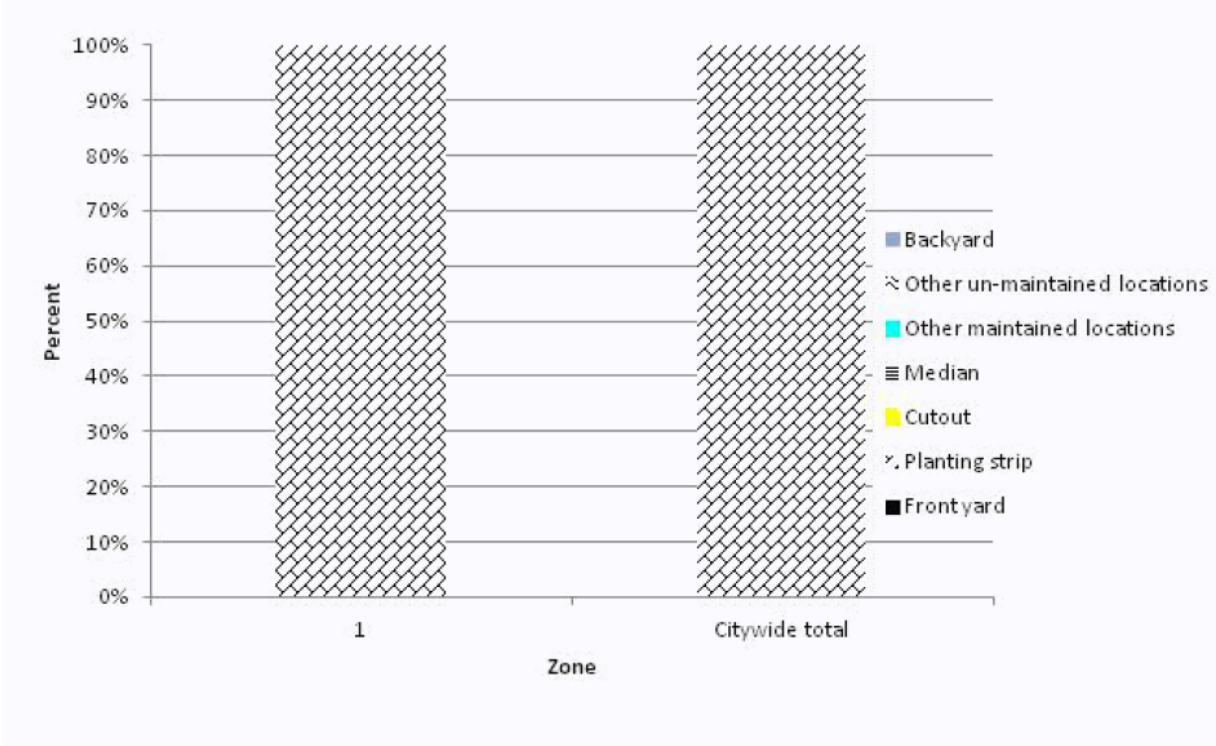
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	94.5	0.0	0.0	3.2	2.3
Citywide total	94.5	0.0	0.0	3.2	2.3

Figure 6: Land Use of city/park trees

Panora

Location of Public Trees by Zone (%)

1/14/2013



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

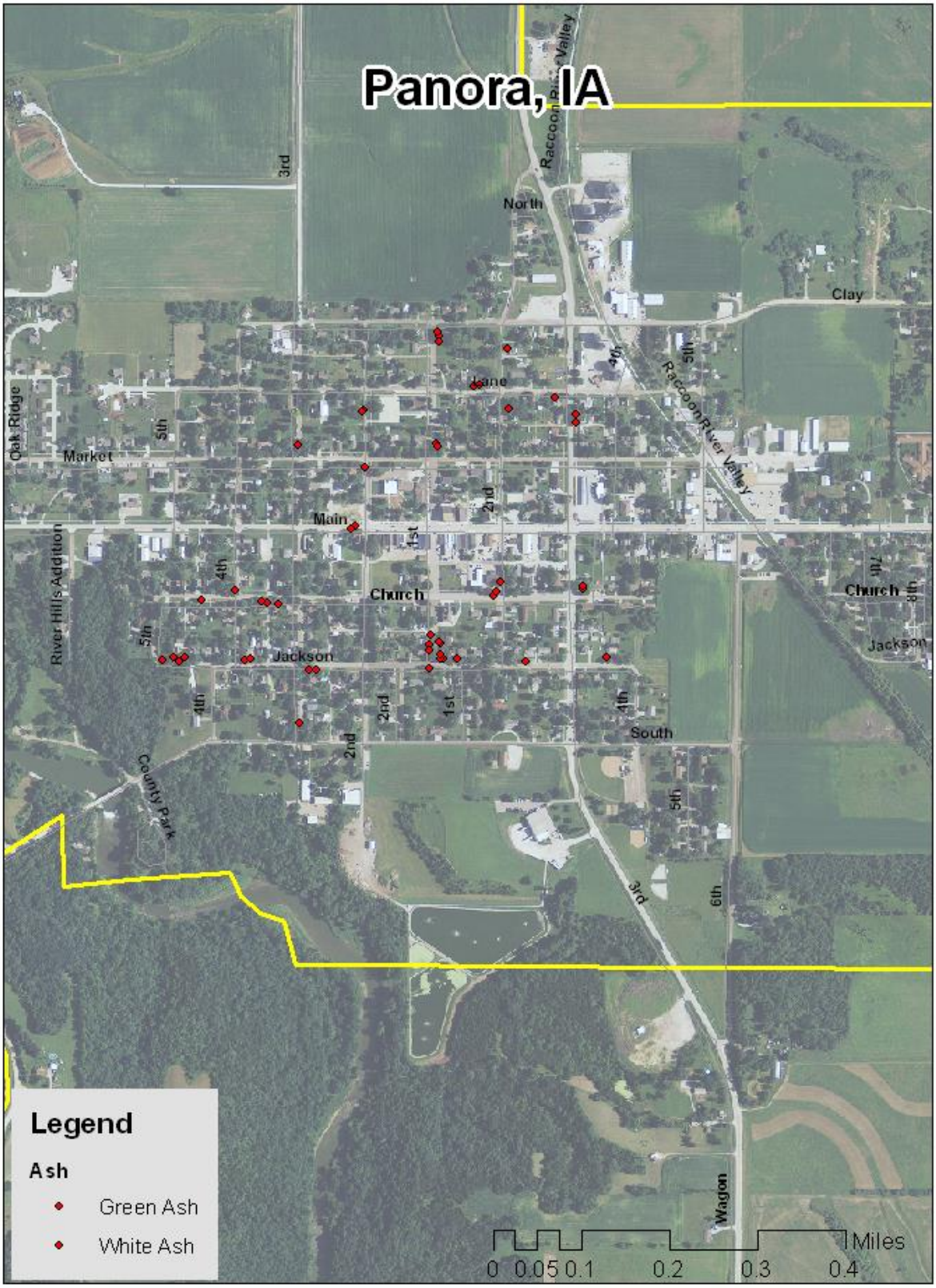


Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

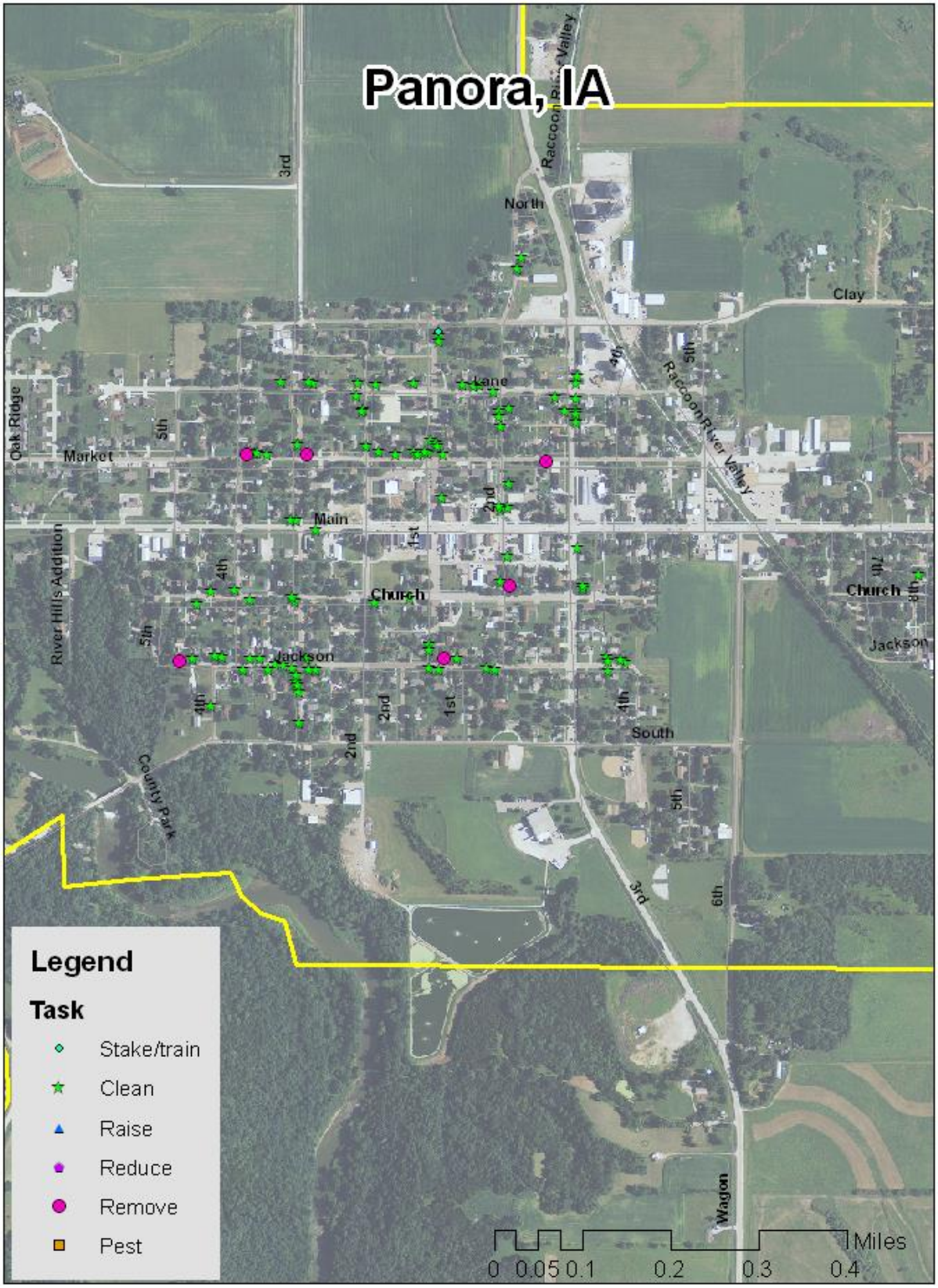


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Sample Tree Ordinances

CHAPTER 151
TREES AND GRASS

151.01 DEFINITION. For use in this chapter, "boulevard" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the
City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.
(Code of Iowa, Sec. 364.12[2c, d, & e])

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

151.05 DISEASE CONTROL. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:
1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.
(Code of Iowa, Sec. 364.12[3b & h])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E. 9th St., Des Moines, IA 50319.

If you need accommodations because of disability to access the services of this Agency, please contact Director Chuck Gipp at 515-281-5918.