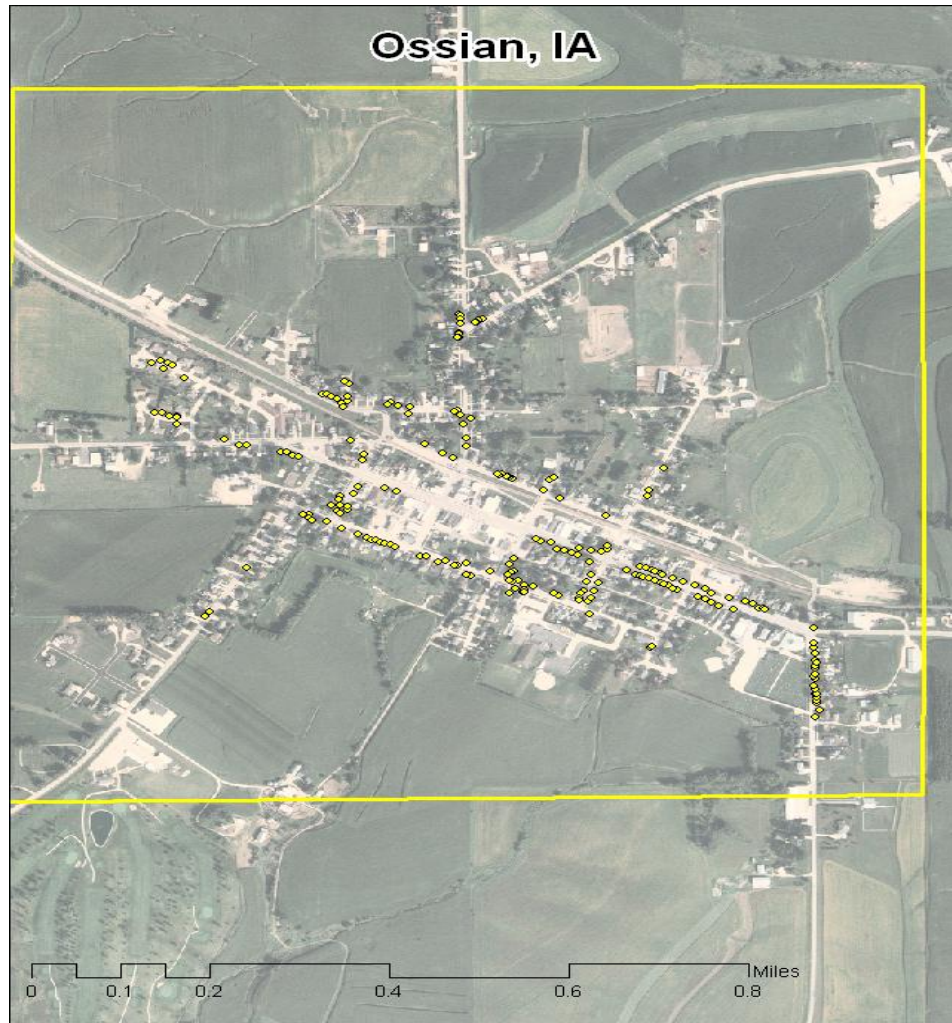


OSSIAN, IA



2010 Management Plan

Provided by Northeast Iowa R,C&D

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In cooperation with the Iowa DNR, Forestry Bureau



Table of Contents

Executive Summary	3
Overview.....	3
Inventory and Results.....	3
Recommendations.....	3
Introduction	4
Inventory	4
Inventory Results	5
<i>Annual Benefits</i>	5
Annual Energy Benefits	5
Annual Stormwater Benefits	5
Annual Air Quality Benefits	5
Annual Carbon Benefits.....	5
Annual Aesthetics Benefits	5
Financial Summary of all Benefits.....	5
<i>Forest Structure</i>	6
Species Distribution	6
Age Class	6
Condition: Wood and Foliage	6
Management Needs.....	7
Canopy Cover	7
Land Use and Location	7
Recommendations	7
Risk Management	7
Pruning Cycle.....	8
Planting	8
Continual Monitoring.....	9
Emerald Ash Borer	9
Ash Tree Removal	9
EAB Quarantines	9
Wood Disposal.....	9
Canopy Replacement	10
Postponed Work.....	10
Monitoring	10
Private Ash Trees.....	10
Proposed Work Schedule and Estimated Costs	11
Proposed Budget Increase	12
Works Cited	12
Appendix A: i-Tree Data	13
Appendix B: ArcGIS Mapping	23

Executive Summary

Overview

This plan was developed to assist the City of Ossian 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 21% (44 ash trees) of Ossian's city owned trees 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 2010, 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 211 trees inventoried.

- Ossian's trees provide \$41,493 of benefits annually, an average of \$196.65 a tree
- There are over 22 species of trees
- The top three genus are: Maple 51%, Ash 21%, and Linden 9%.
- 56% of trees are in need of some type of management, and 9% need immediate attention.
- 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, 4 trees are 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*](#)
- 3 of the 44 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 other year
- Plant a diverse mix of trees that do not include: ash, maple, autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, or willow.
- Check ash trees with a visual survey yearly

Introduction

This plan was developed to assist Ossian 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 Ossian, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2010, a tree inventory was conducted that included 100% of the city owned trees on streets, commercial areas, and 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 211 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. Ossian's trees reduce energy related costs by approximately \$11,072 annually (Appendix A, Table 1). These savings are both in Electricity (51.9 MWh) and in Natural Gas (7,276.5 Therms).

Annual Stormwater Benefits

Ossian's trees intercept about 613,725 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$16,633 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 Ossian, it is estimated that trees remove 684.1 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$1,932 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Ossian, trees sequester about 189,090 lbs of carbon a year with an associated value of \$1,418 (Appendix A, Table 5). In addition, the trees store 2,410,286 lbs of carbon, with a yearly benefit of \$18,077 (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. Ossian receives \$10,438 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, Ossian's trees provide \$41,493 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 211 trees in Ossian provide approximately \$196.65 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Ossian has over 22 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees on city property by genus is as follows:

<u>GENUS</u>	<u># OF TREES</u>	<u>% OF TOTAL</u>
Maple	108	51
Ash	44	21
Basswood/Linden	18	9
Evergreens	12	6
Walnut	7	3
Crabapples	6	3
Birch	5	2
Elm	4	2
Oak	3	1

Age Class

Most of Ossian's trees (44%) are between 18 and 30 inches in diameter at 4.5 ft (Appendix A, Figure 2). Approximately 68% of the city's trees are over 18 inches in diameter. For age, a Bell Curve is preferred and shows the highest amount of trees around 18 inches in diameter at 4.5 ft. Ossian's size curve is on the larger side, indicating an older than average stand.

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 Ossian 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, 82% of Ossian's trees are in good to fair health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 18% of the population. This 18% (38 trees) 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	94	46%
Crown Reduction	13	6%
Tree Removal	6	3%
Crown Raising	2	1%

Canopy Cover

The canopy cover of the city owned trees in Ossian is approximately 6 acres (Appendix A, Figure 4). According to the 2000 census, Ossian occupies 704 acres. Thus the canopy cover created by the city owned trees is about 1% of the total land area of Ossian.

Land Use and Location

The majority of Ossian's city and park 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	94.3%
Park/vacant/other	3.3%
Industrial/Large commercial	1.4%
Small commercial	0.5%
Multifamily residential	0.5%

Location

Planting strip	90%
Front yard	9%
Backyard	0.5%
Cutout (surrounded by pavement)	0.5%

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

Ossian has 3 critical concern trees 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. 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 15 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, there is one ash tree. There are a total of 44 ash trees, and 3 of those have signs and symptoms that have been associated with EAB. All of these ash trees are over 18 inches in diameter. In addition, there are 32 trees that are in poor condition structurally. These trees could be hazardous and should be pruned to remove weak branches or removed if warranted. [*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 6 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 forest in Ossian.

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 (51%) (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: autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, or willow.

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.

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*](#)

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. The new plantings will be a diverse mix and will not include ash, maple, autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, or willow.

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

Private property owners should inspect their ash trees and remove them when they exhibit symptoms of Emerald Ash Borer. Trees on private property are a vital component of Ossian's urban forest. It is important that private property owners have guidance as to the proper species to plant, planting location, and maintenance to insure a healthy urban forest in Ossian. The tree ordinance for Ossian is outdated and should be revised. A comprehensive tree ordinance can educate and guide the citizens of Ossian to plant beneficial species, in the right location, and maintain their trees to provide a healthy urban woodland.

Emma Bruemmer, the Urban Forester with the Iowa Department of Natural Resources can help Ossian develop a comprehensive city tree ordinance. Emma can be contacted at 515/281-5600.

PROPOSED WORK SCHEDULE AND ESTIMATED COSTS

YEAR 1

ESTIMATED COST

Remove 6 trees recommended for removal plus 3 ash trees exhibiting signs of Emerald Ash Borer	\$6,300
Plant 10 trees in open locations	\$1,500
Inspect ash trees for symptoms of Emerald Ash Borer	

YEAR 2

Remove 8 ash trees	\$5,600
Plant 9 trees in open locations	\$1,350
Prune 1/3 of city owned trees	\$600
Inspect ash trees for signs of EAB	

YEAR 3

Remove 8 ash trees	\$5,600
Plant 9 trees in open locations	\$1,350
Inspect ash trees for signs of EAB	

YEAR 4

Remove 8 ash trees	\$5,600
Plant 9 trees in open locations	\$1,350
Prune 1/3 of city owned trees	\$600
Inspect ash trees for signs of EAB	

YEAR 5

Remove 8 ash trees	\$5,600
Plant 9 trees in open locations	\$1,350
Inspect ash trees for signs of EAB	

YEAR 6

Remove 8 ash trees	\$5,600
Plant 9 trees in open locations	\$1,350
Prune 1/3 of city owned trees	\$600

Estimated costs based on \$700/tree for removal, \$150/tree for planting and maintenance, and \$10/tree for pruning.

Purposed Budget Increase

EAB could potentially kill all ash trees in Ossian within 4 years of its arrival. To remove all ash trees and critical concern trees, plant trees to replace the trees removed, and properly prune the city trees within 6 years the budget would need to be increased to **\$7,400** a year. It is recommended that Ossian 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

Annual Energy Benefits of Public Trees by Species									
10/18/2010									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	11.8	895	1,740.3	1,705	2,601	(N/A)	20.9	23.5	59.10
Green ash	10.5	797	1,469.7	1,440	2,238	(N/A)	19.0	20.2	55.94
Sugar maple	11.8	899	1,603.8	1,572	2,470	(N/A)	16.6	22.3	70.58
Silver maple	3.6	270	465.4	456	726	(N/A)	6.2	6.6	55.84
Littleleaf linden	3.0	229	439.3	431	659	(N/A)	5.7	6.0	54.93
Black maple	2.6	194	359.1	352	546	(N/A)	4.3	4.9	60.68
Red maple	0.3	20	40.5	40	60	(N/A)	2.8	0.5	10.02
Black walnut	2.2	170	310.3	304	474	(N/A)	2.8	4.3	79.05
Apple	0.1	10	22.3	22	32	(N/A)	2.8	0.3	5.27
American basswood	2.0	152	292.6	287	439	(N/A)	2.8	4.0	73.19
Spruce	0.5	38	62.9	62	100	(N/A)	2.4	0.9	19.91
Paper birch	0.8	61	94.7	93	153	(N/A)	1.9	1.4	38.33
White ash	0.8	61	112.7	110	171	(N/A)	1.9	1.6	42.85
Blue spruce	0.2	13	22.4	22	35	(N/A)	1.9	0.3	8.69
American elm	0.3	25	46.8	46	71	(N/A)	1.9	0.6	17.66
Conifer Evergreen	0.0	1	3.6	4	5	(N/A)	1.4	0.0	1.65
Other street trees	1.4	106	190.3	187	292	(N/A)	4.7	2.6	29.23
Citywide total	51.9	3,941	7,276.5	7,131	11,072	(N/A)	100.0	100.0	52.47

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species						
10/18/2010						
Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	124,539	3,375	(N/A)	20.9	20.3	76.71
Green ash	120,308	3,261	(N/A)	19.0	19.6	81.51
Sugar maple	162,458	4,403	(N/A)	16.6	26.5	125.80
Silver maple	48,444	1,313	(N/A)	6.2	7.9	100.99
Littleleaf linden	36,401	987	(N/A)	5.7	5.9	82.21
Black maple	25,801	699	(N/A)	4.3	4.2	77.70
Red maple	1,423	39	(N/A)	2.8	0.2	6.43
Black walnut	31,990	867	(N/A)	2.8	5.2	144.50
Apple	424	11	(N/A)	2.8	0.1	1.92
American basswood	25,330	686	(N/A)	2.8	4.1	114.41
Spruce	5,807	157	(N/A)	2.4	1.0	31.47
Paper birch	5,004	136	(N/A)	1.9	0.8	33.91
White ash	7,677	208	(N/A)	1.9	1.3	52.02
Blue spruce	1,877	51	(N/A)	1.9	0.3	12.72
American elm	1,729	47	(N/A)	1.9	0.3	11.72
Conifer Evergreen	114	3	(N/A)	1.4	0.0	1.03
Other street trees	14,399	390	(N/A)	4.7	2.4	39.02
Citywide total	613,725	16,633	(N/A)	100.0	100.0	78.83

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species																	
10/18/2010																	
Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total (\$)	Standard Error	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂								
Norway maple	27.0	4.7	13.1	1.2	145	57.5	8.3	7.9	53.5	355	-6.2	-23	167.0	478 (N/A)	20.9	10.86	
Green ash	14.9	2.4	7.1	0.7	80	50.4	7.3	7.0	47.6	313	0.0	0	137.5	393 (N/A)	19.0	9.82	
Sugar maple	23.9	4.1	11.4	1.1	128	56.3	8.2	7.8	53.6	351	-18.4	-69	148.0	410 (N/A)	16.6	11.72	
Silver maple	8.1	1.4	4.0	0.4	44	16.7	2.5	2.3	16.1	105	-4.4	-16	47.1	132 (N/A)	6.2	10.17	
Littleleaf linden	6.8	1.2	3.3	0.3	36	14.6	2.1	2.0	13.7	91	-3.2	-12	40.8	115 (N/A)	5.7	9.59	
Black maple	6.7	1.1	3.1	0.3	36	12.3	1.8	1.7	11.6	76	-2.2	-8	36.4	104 (N/A)	4.3	11.54	
Red maple	0.2	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	-0.1	0	3.1	9 (N/A)	2.8	1.46	
Black walnut	4.7	0.7	2.1	0.2	24	10.7	1.6	1.5	10.2	67	0.0	0	31.7	91 (N/A)	2.8	15.22	
Apple	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.6	4	0.0	0	1.5	4 (N/A)	2.8	0.71	
American basswood	3.7	0.6	1.8	0.2	20	9.8	1.4	1.3	9.1	60	-3.1	-11	24.8	69 (N/A)	2.8	11.44	
Spruce	0.6	0.1	0.5	0.1	4	2.3	0.3	0.3	2.3	15	-2.0	-7	4.6	11 (N/A)	2.4	2.28	
Paper birch	0.4	0.1	0.2	0.0	2	3.7	0.5	0.5	3.6	23	0.0	0	9.0	25 (N/A)	1.9	6.31	
White ash	0.8	0.1	0.4	0.0	4	3.9	0.6	0.5	3.6	24	0.0	0	9.9	28 (N/A)	1.9	7.04	
Blue spruce	0.2	0.0	0.2	0.0	1	0.8	0.1	0.1	0.8	5	-0.6	-2	1.6	4 (N/A)	1.9	1.00	
American elm	0.1	0.0	0.1	0.0	0	1.6	0.2	0.2	1.5	10	0.0	0	3.6	10 (N/A)	1.9	2.54	
Conifer Evergreen	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	1 (N/A)	1.4	0.18	
Other street trees	2.7	0.5	1.6	0.2	16	6.6	1.0	0.9	6.3	41	-2.5	-9	17.3	48 (N/A)	4.7	4.77	
Citywide total	100.7	17.1	49.0	4.6	542	249.4	36.2	34.5	235.3	1,550	-42.6	-160	684.1	1,932 (N/A)	100.0	9.16	

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species						
10/18/2010						
Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	445,260	3,339	(N/A)	20.9	18.5	75.90
Green ash	488,817	3,666	(N/A)	19.0	20.3	91.65
Sugar maple	699,672	5,248	(N/A)	16.6	29.0	149.93
Silver maple	188,221	1,412	(N/A)	6.2	7.8	108.59
Littleleaf linden	142,967	1,072	(N/A)	5.7	5.9	89.35
Black maple	71,508	536	(N/A)	4.3	3.0	59.59
Red maple	2,470	19	(N/A)	2.8	0.1	3.09
Black walnut	154,634	1,160	(N/A)	2.8	6.4	193.29
Apple	1,305	10	(N/A)	2.8	0.1	1.63
American Spruce	136,188	1,021	(N/A)	2.8	5.7	170.23
Spruce	4,024	30	(N/A)	2.4	0.2	6.04
Paper birch	12,050	90	(N/A)	1.9	0.5	22.59
White ash	18,984	142	(N/A)	1.9	0.8	35.60
Blue spruce	1,166	9	(N/A)	1.9	0.1	2.19
American elm	3,632	27	(N/A)	1.9	0.2	6.81
Conifer Evergreen	7	0	(N/A)	1.4	0.0	0.02
Other street trees	17,864	295	(N/A)	4.7	1.6	29.54
Citywide total	2,410,286	18,077	(N/A)	100.0	100.0	85.67

Table 5: Annual Carbon Sequestered

Annual CO₂ Benefits of Public Trees by Species													
10/18/2010													
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	
Norway maple	13,832	104	-2,137	-9	-16	19,781	148	31,467	236 (N/A)	20.9	16.6	5.36	
Green ash	25,205	189	-2,346	-8	-18	17,620	132	40,471	304 (N/A)	19.0	21.4	7.59	
Sugar maple	31,216	234	-3,358	-7	-25	19,859	149	47,710	358 (N/A)	16.6	25.2	10.22	
Silver maple	14,159	106	-903	-3	-7	5,964	45	19,217	144 (N/A)	6.2	10.2	11.09	
Littleleaf linden	9,025	68	-686	-2	-5	5,052	38	13,389	100 (N/A)	5.7	7.1	8.37	
Black maple	0	0	-343	-2	-3	4,293	32	3,948	30 (N/A)	4.3	2.1	3.29	
Red maple	378	3	-12	-1	0	452	3	817	6 (N/A)	2.8	0.4	1.02	
Black walnut	5,260	39	-742	-1	-6	3,762	28	8,279	62 (N/A)	2.8	4.4	10.35	
Apple	216	2	-6	-1	0	215	2	424	3 (N/A)	2.8	0.2	0.53	
American basswood	7,579	57	-654	-1	-5	3,368	25	10,292	77 (N/A)	2.8	5.4	12.87	
Spruce	452	3	-19	-1	0	838	6	1,270	10 (N/A)	2.4	0.7	1.90	
Paper birch	1,545	12	-58	-1	0	1,337	10	2,824	21 (N/A)	1.9	1.5	5.29	
White ash	2,054	15	-91	-1	-1	1,348	10	3,310	25 (N/A)	1.9	1.8	6.21	
Blue spruce	106	1	-6	-1	0	282	2	382	3 (N/A)	1.9	0.2	0.72	
American elm	443	3	-17	-1	0	549	4	974	7 (N/A)	1.9	0.5	1.83	
Conifer Evergreen	5	0	0	-1	0	31	0	36	0 (N/A)	1.4	0.0	0.09	
Other street trees	2,136	16	-189	-2	-1	2,337	18	4,282	32 (N/A)	4.7	2.3	3.21	
Citywide total	113,612	852	-11,569	-41	-87	87,089	653	189,090	1,418 (N/A)	100.0	100.0	6.72	

Table 6: Annual Social and Aesthetic Benefits

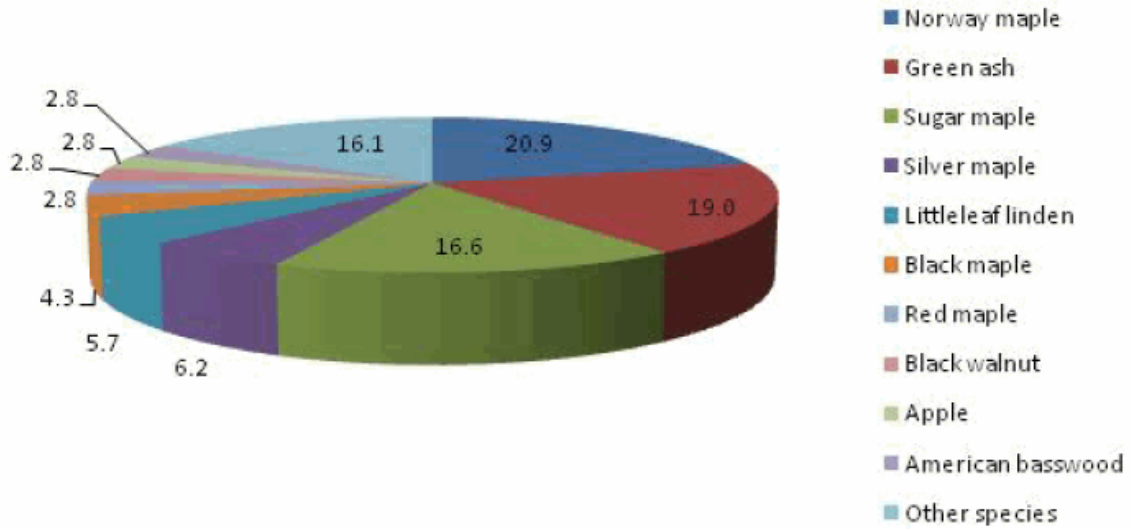
Annual Aesthetic/Other Benefits of Public Trees by Species					
10/18/2010					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	1,261	(N/A)	20.9	12.1	28.67
Green ash	2,094	(N/A)	19.0	20.1	52.35
Sugar maple	3,036	(N/A)	16.6	29.1	86.73
Silver maple	1,159	(N/A)	6.2	11.1	89.18
Littleleaf linden	885	(N/A)	5.7	8.5	73.79
Black maple	0	(N/A)	4.3	0.0	0.00
Red maple	67	(N/A)	2.8	0.6	11.18
Black walnut	373	(N/A)	2.8	3.6	62.19
Apple	11	(N/A)	2.8	0.1	1.77
American basswood	518	(N/A)	2.8	5.0	86.29
Spruce	128	(N/A)	2.4	1.2	25.56
Paper birch	166	(N/A)	1.9	1.6	41.53
White ash	270	(N/A)	1.9	2.6	67.39
Blue spruce	48	(N/A)	1.9	0.5	11.90
American elm	80	(N/A)	1.9	0.8	19.89
Conifer Evergreen	15	(N/A)	1.4	0.1	5.03
Other street trees	328	(N/A)	4.7	3.1	32.79
Citywide total	10,438	(N/A)	100.0	100.0	49.47

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species (\$)								
10/18/20								
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Norway maple	2,601	236	478	3,375	1,261	7,951	(±0)	19.2
Green ash	2,238	304	393	3,261	2,094	8,289	(±0)	20.0
Sugar maple	2,470	358	410	4,403	3,036	10,677	(±0)	25.7
Silver maple	726	144	132	1,313	1,159	3,474	(±0)	8.4
Littleleaf linden	659	100	115	987	885	2,747	(±0)	6.6
Black maple	546	30	104	699	0	1,379	(±0)	3.3
Red maple	60	6	9	39	67	181	(±0)	0.4
Black walnut	474	62	91	867	373	1,868	(±0)	4.5
Apple	32	3	4	11	11	61	(±0)	0.1
American basswood	439	77	69	686	518	1,789	(±0)	4.3
Spruce	100	10	11	157	128	406	(±0)	1.0
Paper birch	153	21	25	136	166	501	(±0)	1.2
White ash	171	25	28	208	270	702	(±0)	1.7
Blue spruce	35	3	4	51	48	140	(±0)	0.3
American elm	71	7	10	47	80	215	(±0)	0.5
Conifer Evergreen	5	0	1	3	15	24	(±0)	0.1
Other street trees	292	32	48	390	328	1,090	(±0)	2.6
Citywide Total	11,072	1,418	1,932	16,633	10,438	41,493	(±0)	100.0

Species Distribution of Public Trees (%)

10/18/2010

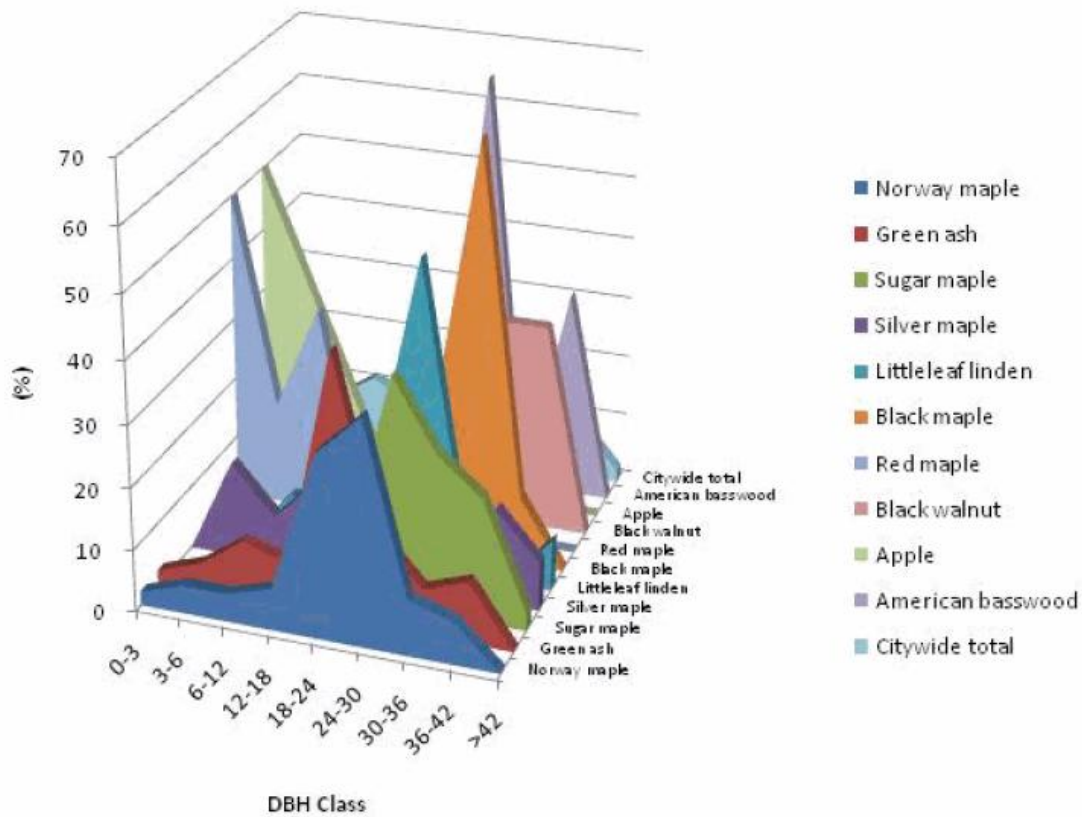


Species	Percent
Norway maple	20.9
Green ash	19.0
Sugar maple	16.6
Silver maple	6.2
Littleleaf linden	5.7
Black maple	4.3
Red maple	2.8
Black walnut	2.8
Apple	2.8
American basswood	2.8
Other species	16.1
Total	100.0

Figure 1: Species Distribution

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

10/18/2010



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Norway maple	2.3	4.5	4.5	6.8	29.5	36.4	9.1	6.8	0.0
Green ash	2.5	5.0	10.0	7.5	42.5	15.0	7.5	10.0	0.0
Sugar maple	0.0	0.0	5.7	0.0	8.6	37.1	25.7	20.0	2.9
Silver maple	0.0	15.4	7.7	15.4	7.7	30.8	0.0	15.4	7.7
Littleleaf linden	0.0	0.0	8.3	8.3	16.7	50.0	8.3	0.0	8.3
Black maple	0.0	0.0	0.0	0.0	0.0	22.2	66.7	11.1	0.0
Red maple	50.0	16.7	33.3	0.0	0.0	0.0	0.0	0.0	0.0
Black walnut	0.0	0.0	0.0	0.0	16.7	16.7	33.3	33.3	0.0
Apple	50.0	33.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0
American basswood	0.0	0.0	0.0	0.0	0.0	66.7	0.0	33.3	0.0
Citywide total	6.2	6.6	11.4	8.1	19.0	25.1	11.8	10.0	1.9

Figure 2: Relative Age Class

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

10/18/2010

Citywide total

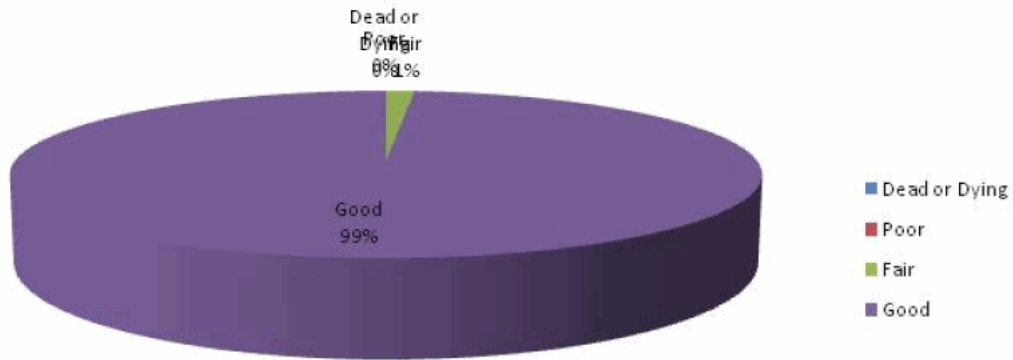


Figure 3: Foliage Condition

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

10/18/2010

Citywide total

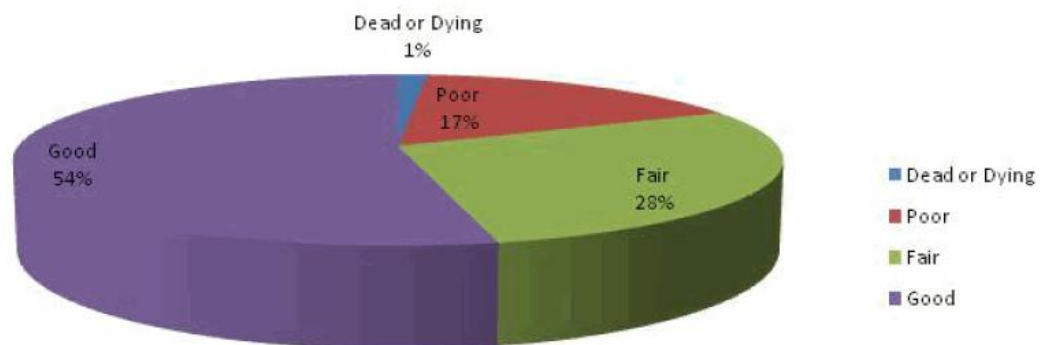
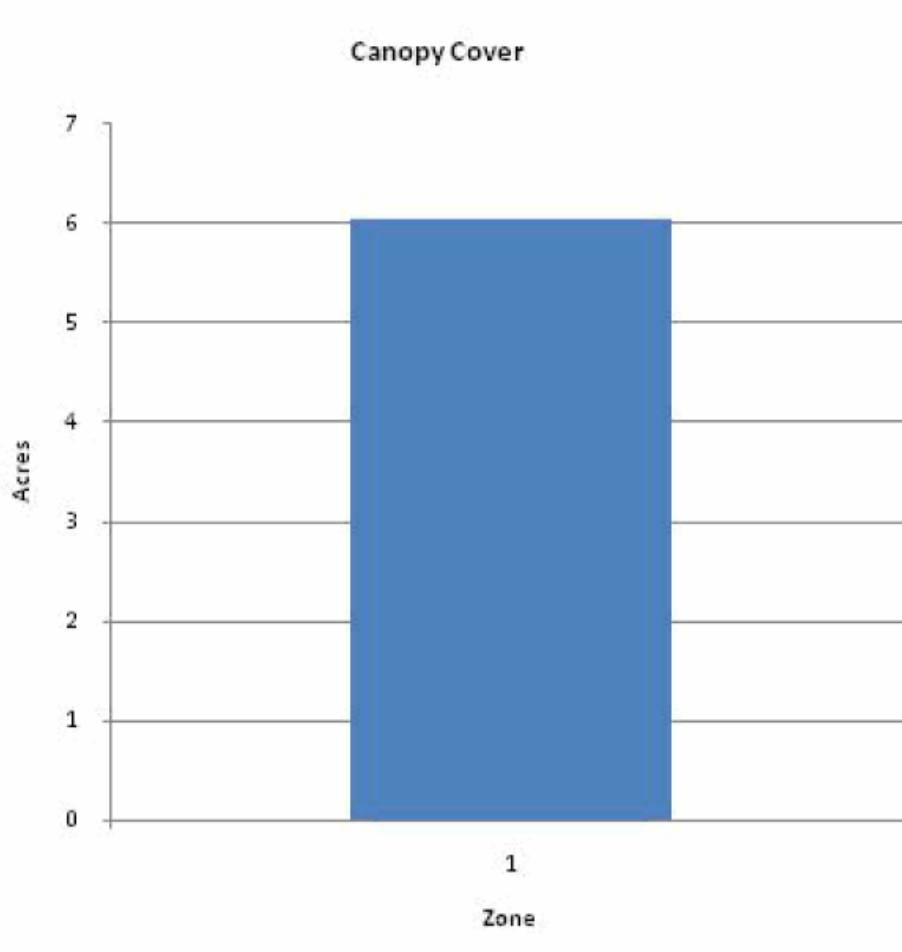


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

10/18/2010

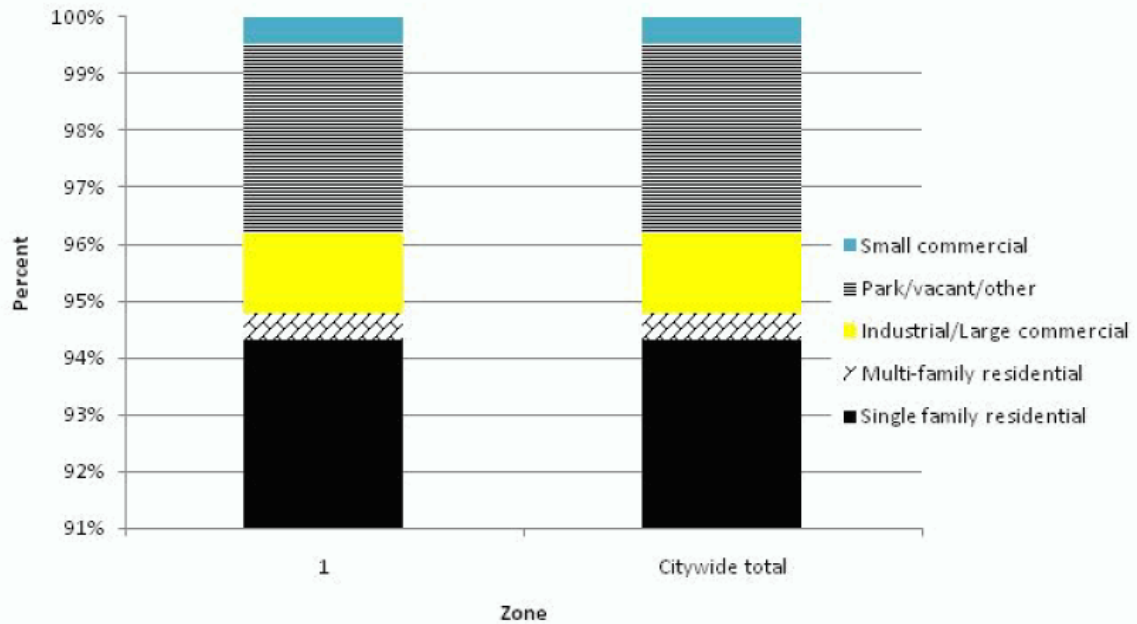


Zone	Acres	% of Total Canopy Cover
1	6	100.0
Citywide total	6	100.0

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

10/18/2010

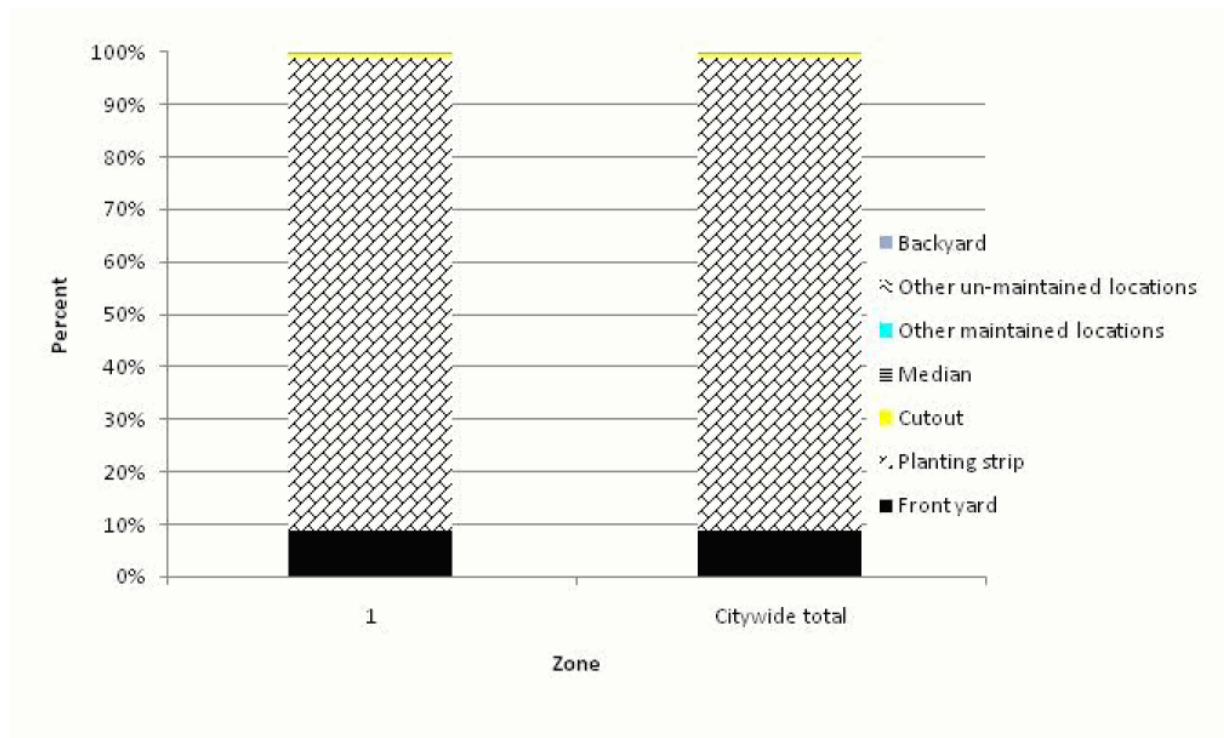


Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant/other	Small commercial
1	94.3	0.5	1.4	3.3	0.5
Citywide total	94.3	0.5	1.4	3.3	0.5

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

10/18/2010



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	9.0	90.0	0.5	0.0	0.0	0.0	0.5
Citywide total	9.0	90.0	0.5	0.0	0.0	0.0	0.5

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping



Figure 1: Location of Ash Trees



Figure 2: Location of EAB symptoms

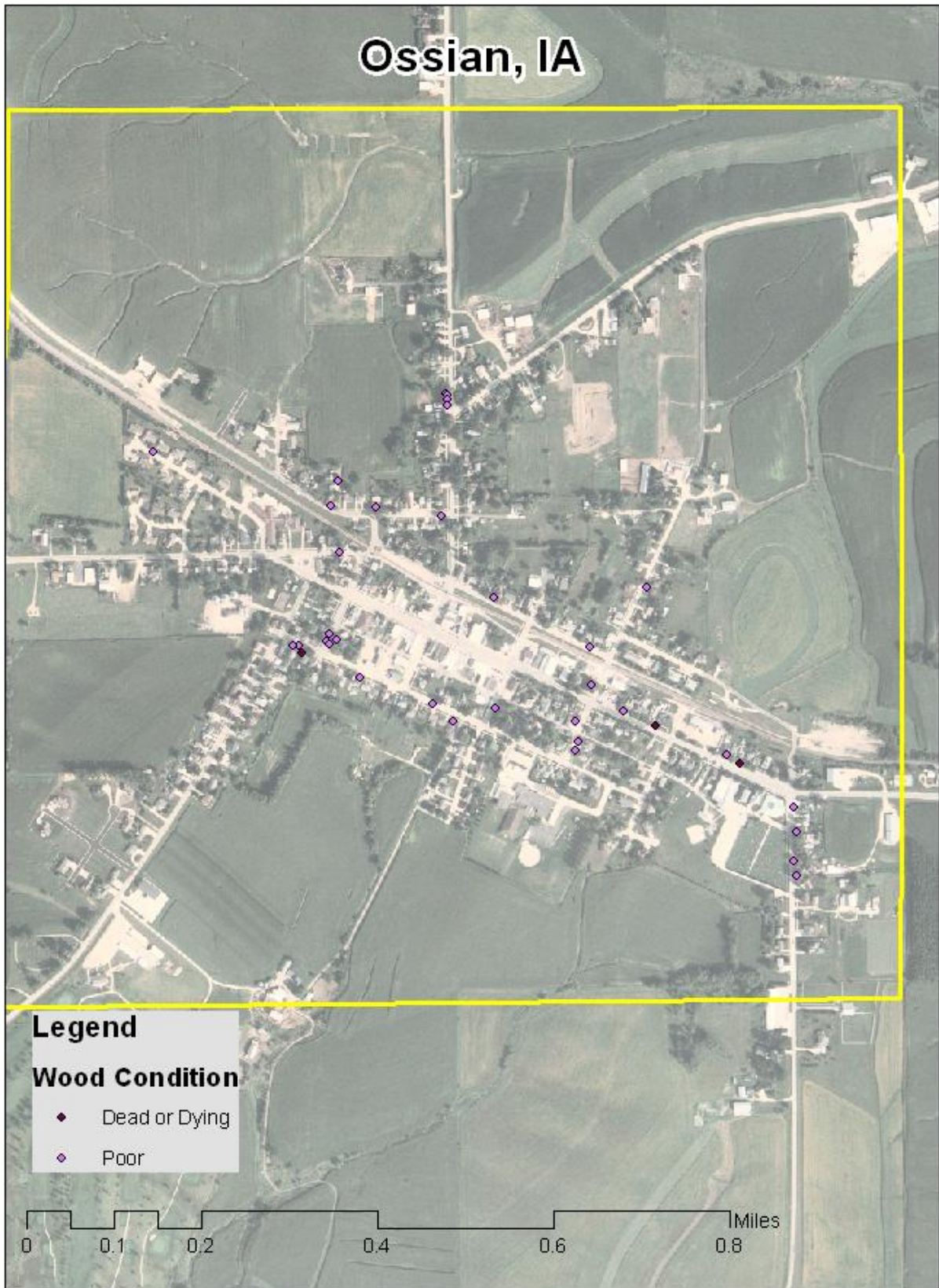


Figure 3: Location of Poor Condition Trees

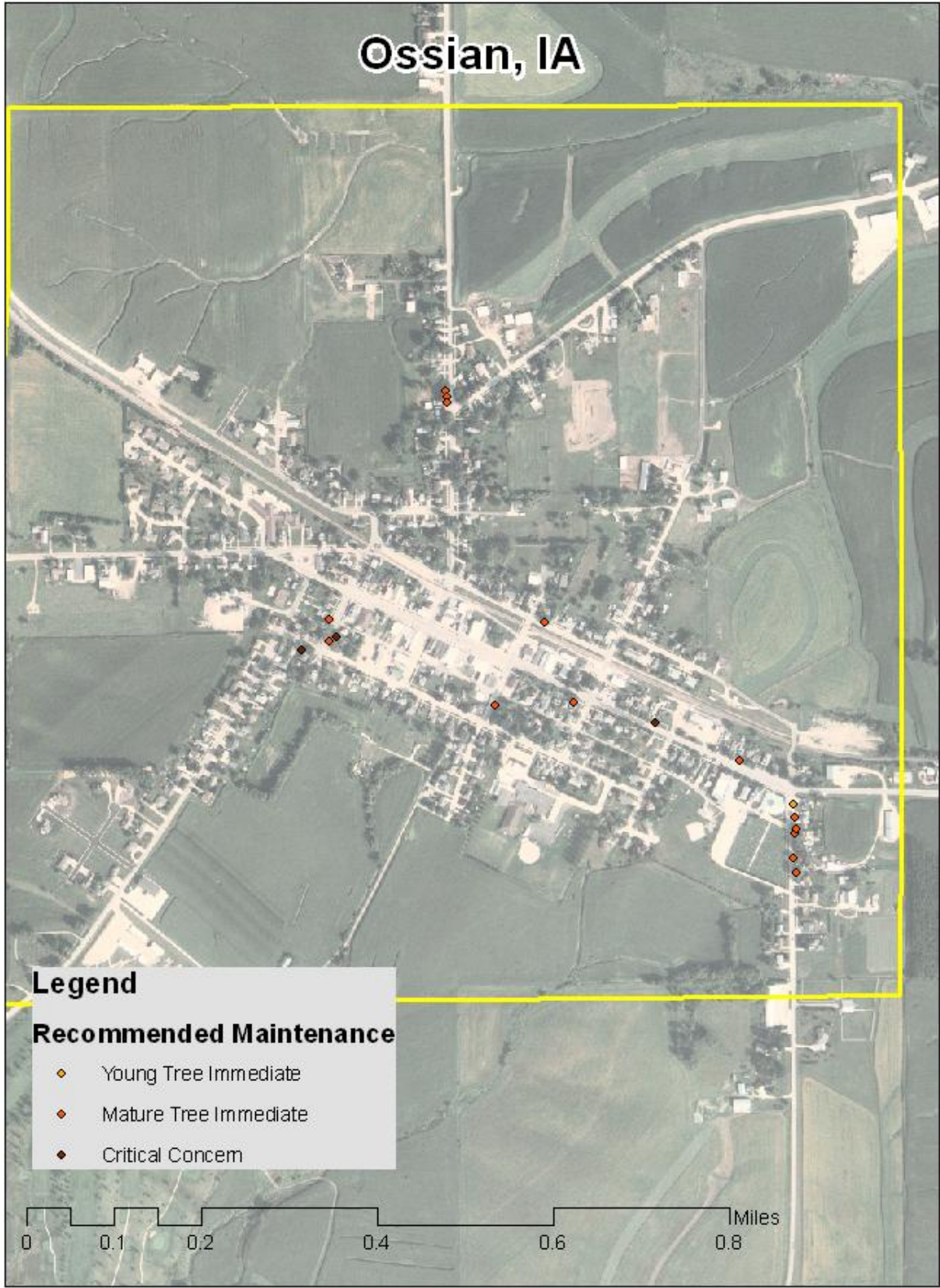


Figure 4: Location of Trees with Recommended Maintenance

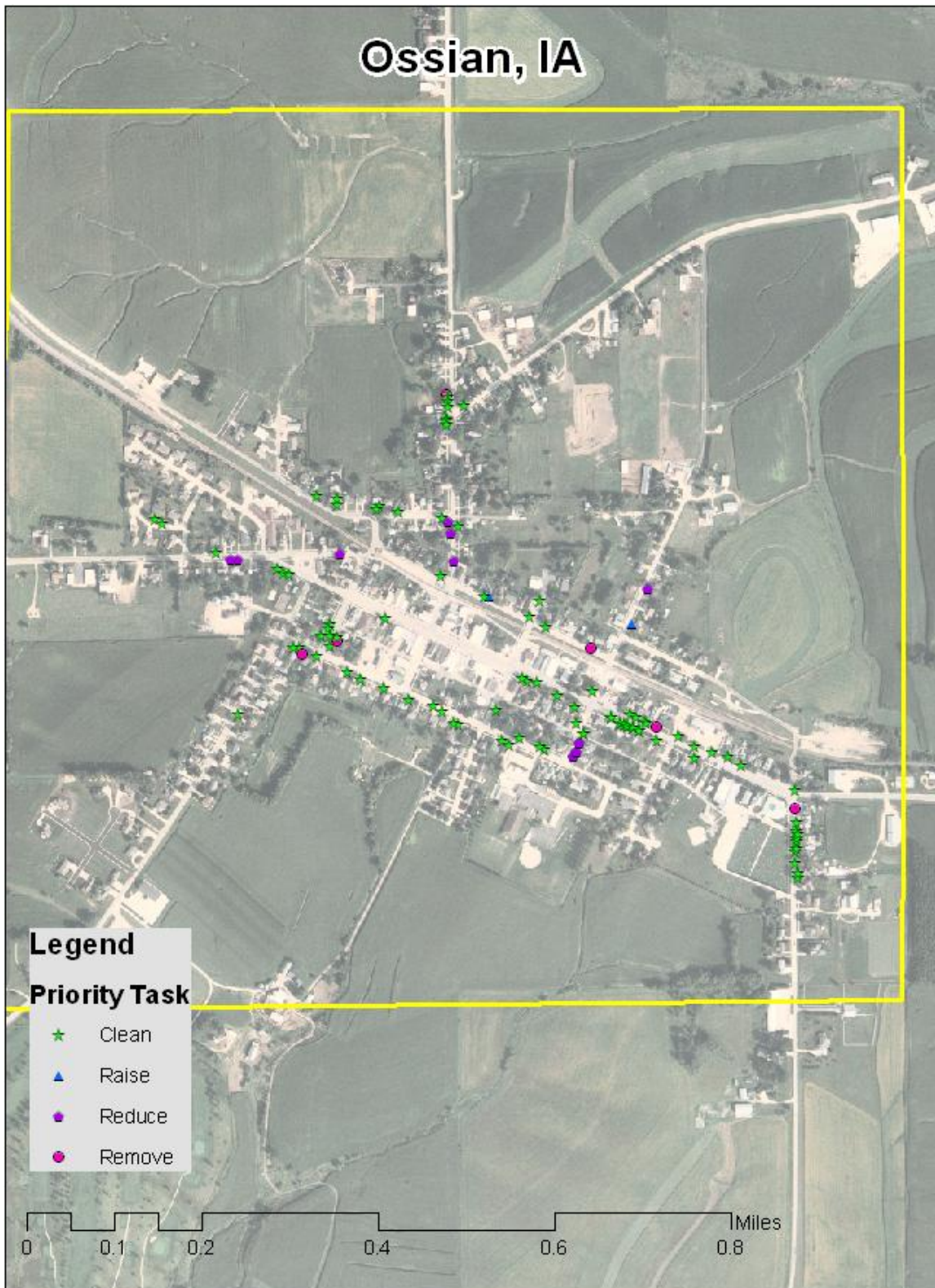


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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