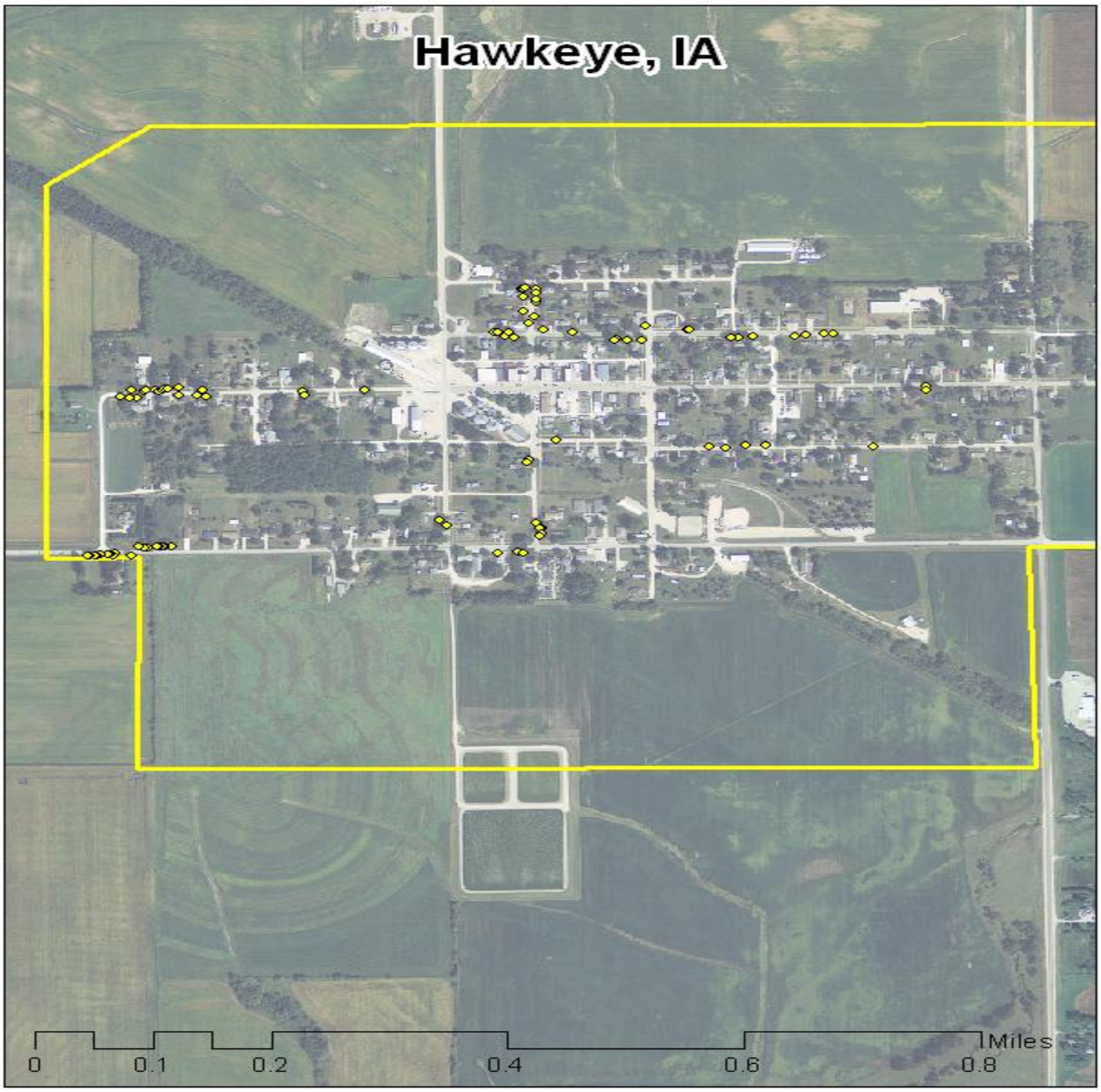
HAWKEYE, IA



2011 Management Plan

Prepared by David Asche
IDNR District Forester

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Hawkeye 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 18% of Hawkeye'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 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 89 trees inventoried.

- Hawkeye's trees provide $19,494 of benefits annually, an average of $219 a tree
- There are over 17 species of trees
- The top three genus are: Norway spruce 30%, Maple 29%, and Ash 18%
- 40% of trees are in need of some type of management
- 1 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.

- The 1 tree needing removal 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*
- 0 of the 16 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
- 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 Hawkeye 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 Hawkeye, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2010, a tree inventory was conducted that included 100% of the city owned trees along the streets. 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 89 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. Hawkeye's trees reduce energy related costs by approximately $4,676 annually (Appendix A, Table 1). These savings are both in Electricity (22.5 MWh) and in Natural Gas (3,028.8 Therms).

Annual Stormwater Benefits

Hawkeye's trees intercept about 309,624 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $8,391 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 Hawkeye, it is estimated that trees remove 259.2 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 $691 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Hawkeye, trees sequester about 49,897 lbs of carbon a year with an associated value of $374 (Appendix A, Table 5). In addition, the trees store 930,480 lbs of carbon, with a yearly benefit of $6,979 (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. Hawkeye receives $5,112 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, Hawkeye's trees provide $19,494 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 89 trees in Hawkeye provide approximately $219 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Hawkeye has over 17 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Species	# of Trees	% of Total
Norway spruce	26	30.3
Maple	26	29.2
Ash	16	18
Black walnut	4	4.5
Ohio buckeye	3	3.4
Apple	3	3.4
Eastern hophornbeam	2	2.2
Other	9	9

Age Class

Most of Hawkeye's trees are between 18 and 24" in diameter (30%) and between 24 and 30 inches in diameter (25%) at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 22 inches in diameter at 4.5 ft. Hawkeye's size curve is on the larger side, indicating an older than average stand. Only about 4% are 1" to 6" in diameter suggesting some new plantings will be needed in the near future to replace to older trees.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage that was present on trees appeared quite healthy (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 67% of Hawkeye'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 7% of the population. This 7% represents trees that need some type of 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 Raising	22	24%
Crown cleaning	11	12%
Tree Removal	1	1%

Canopy Cover

The canopy cover of Hawkeye is approximately 3 acres (Appendix A, Figure 4).

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

Hawkeye has 1 tree over 24 inches in diameter at 4.5 ft that should be addressed immediately for removal. After the removals, other trees in town are in need of various work to eliminate possible hazards (Appendix B, Figure 3).

Ash trees

After the hazardous tree work is complete, ash trees in poor health should be assessed for removal. The 1 removal recommended is an ash tree. There are a total of 16 ash trees, and 0 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 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 Hawkeye.

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 (29%) (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. This is the one ash tree already recommended for removal. In future years it will be ash in poor condition and displaying signs and symptoms of EAB. *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 the city ordinance. 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

It is strongly recommended that private property owners start removing ash trees on their property as trees are infested with Emerald Ash Borer. Trees that are on private property are part of Hawkeye's urban forest. Private property owners should be given direction to the proper species to plant, spacing, and location.

Six Year Suggested Work Plan and Estimated Costs

Year 1:

Remove 1 hazard tree	$500
Plant 1 tree in open location	$100
Visual survey of signs and symptoms of Emerald Ash Borer	

Year 2:

Appendix B, Figure 5 tree work (pruning)	$????
Maintenance of newly planted tree in city	
Visual survey of signs and symptoms of Emerald Ash Borer	

Year 3:

Appendix B, Figure 5 tree work (pruning)	$????
Remove 1 ash tree	$500
Plant 1 tree in open location	$100
Maintenance of newly planted trees in city	
Prune 1/4 of city trees	
Visual survey of signs and symptoms of Emerald Ash Borer	

Year 4:

Remove 1 ash tree	$500
Plant 1 tree in open location	$100
Maintenance of newly planted trees in city	
Prune 1/4 of city trees	
Visual survey of signs and symptoms of Emerald Ash Borer	

Year 5:

Remove 1 ash tree	$500
Plant 1 tree in open location	$100
Maintenance of newly planted trees in city	
Prune 1/4 of city trees	
Visual survey of signs and symptoms of Emerald Ash Borer	

Year 6:

Maintenance of newly planted trees in city
Prune 1/4 of city trees
Visual survey of signs and symptoms of Emerald Ash Borer

** The ash removed in this six year plan is 25% of the total ash in Hawkeye.

Funding

Hawkeye can 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.

Works Cited

Census Bureau. 2000. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2011)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J.; McPherson, E. Gregory; Simpson, James R.; Vargas, Kelaine E.; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species

12/12/2010

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway spruce	4.4	331	570.6	559	890	(N/A)	30.3	19.0	32.96
Sugar maple	5.4	412	745.6	731	1,142	(N/A)	19.1	24.4	67.21
White ash	4.5	341	572.6	561	902	(N/A)	12.4	19.3	82.04
Norway maple	1.3	99	188.6	185	284	(N/A)	5.6	6.1	56.75
Green ash	1.4	108	196.9	193	301	(N/A)	5.6	6.4	60.14
Silver maple	1.1	86	145.5	143	229	(N/A)	4.5	4.9	57.19
Black walnut	1.3	98	166.6	163	262	(N/A)	4.5	5.6	65.37
Ohio buckeye	0.7	56	98.6	97	152	(N/A)	3.4	3.3	50.75
Apple	0.1	9	20.4	20	29	(N/A)	3.4	0.6	9.67
Eastern hophornbeam	0.1	11	25.7	25	36	(N/A)	2.3	0.8	18.19
Birch	0.0	3	6.2	6	9	(N/A)	1.1	0.2	8.99
Hickory	0.3	20	38.1	37	57	(N/A)	1.1	1.2	57.32
Catalpa	0.4	29	53.7	53	82	(N/A)	1.1	1.8	82.02
Northern hackberry	0.4	28	54.0	53	81	(N/A)	1.1	1.7	81.12
Eastern red cedar	0.1	8	16.4	16	25	(N/A)	1.1	0.5	24.57
Bur oak	0.3	20	38.1	37	57	(N/A)	1.1	1.2	57.32
American basswood	0.3	23	44.7	44	67	(N/A)	1.1	1.4	66.72
Siberian elm	0.3	25	46.6	46	71	(N/A)	1.1	1.5	71.03
Other street trees	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	22.5	1,708	3,028.8	2,968	4,676	(N/A)	100.0	100.0	52.54

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

12/12/2010

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway spruce	94,065	2,549	(N/A)	30.3	30.4	94.42
Sugar maple	67,505	1,830	(N/A)	19.1	21.8	107.62
White ash	58,251	1,579	(N/A)	12.4	18.8	143.52
Norway maple	13,287	360	(N/A)	5.6	4.3	72.02
Green ash	14,532	394	(N/A)	5.6	4.7	78.77
Silver maple	17,366	471	(N/A)	4.5	5.6	117.66
Black walnut	15,659	424	(N/A)	4.5	5.1	106.10
Ohio buckeye	5,297	144	(N/A)	3.4	1.7	47.85
Apple	402	11	(N/A)	3.4	0.1	3.63
Eastern hophornbeam	529	14	(N/A)	2.3	0.2	7.17
Birch	163	4	(N/A)	1.1	0.1	4.41
Hickory	2,591	70	(N/A)	1.1	0.8	70.21
Catalpa	5,490	149	(N/A)	1.1	1.8	148.79
Northern hackberry	3,619	98	(N/A)	1.1	1.2	98.09
Eastern red cedar	1,634	44	(N/A)	1.1	0.5	44.30
Bur oak	2,591	70	(N/A)	1.1	0.8	70.21
American basswood	3,284	89	(N/A)	1.1	1.1	89.02
Siberian elm	3,359	91	(N/A)	1.1	1.1	91.03
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	309,624	8,391	(N/A)	100.0	100.0	94.29

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

12/12/2010

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
Norway spruce	11.3	2.2	9.0	1.4	74	20.5	3.0	2.9	19.7	128	-51.7	-194	18.4	8	(N/A)	30.3	0.31
Sugar maple	9.3	1.6	4.5	0.4	50	25.9	3.8	3.6	24.6	161	-7.2	-27	66.5	184	(N/A)	19.1	10.84
White ash	11.4	1.8	5.1	0.5	60	21.1	3.1	3.0	20.4	132	0.0	0	66.3	192	(N/A)	12.4	17.44
Norway maple	2.9	0.5	1.4	0.1	15	6.3	0.9	0.9	5.9	39	-0.7	-2	18.2	52	(N/A)	5.6	10.43
Green ash	1.6	0.3	0.8	0.1	9	6.8	1.0	0.9	6.4	42	0.0	0	17.9	51	(N/A)	5.6	10.21
Silver maple	3.3	0.6	1.6	0.1	18	5.3	0.8	0.7	5.1	33	-1.8	-7	15.8	44	(N/A)	4.5	11.06
Black walnut	2.2	0.3	1.0	0.1	11	6.1	0.9	0.9	5.9	38	0.0	0	17.3	50	(N/A)	4.5	12.40
Ohio buckeye	0.9	0.2	0.5	0.0	5	3.5	0.5	0.5	3.3	22	-0.2	-1	9.2	26	(N/A)	3.4	8.66
Apple	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	4	0.0	0	1.4	4	(N/A)	3.4	1.32
Eastern hophornbeam	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5	(N/A)	2.2	2.55
Birch	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	1.1	1.21
Hickory	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)	1.1	9.34
Catalpa	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16	(N/A)	1.1	15.71
Northern hackberry	0.6	0.1	0.3	0.0	3	1.8	0.3	0.2	1.7	11	0.0	0	5.0	14	(N/A)	1.1	14.21
Eastern red cedar	0.3	0.1	0.3	0.0	2	0.5	0.1	0.1	0.5	3	-0.9	-3	1.0	2	(N/A)	1.1	2.19
Bur oak	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)	1.1	9.34
American basswood	0.4	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	-0.4	-1	3.6	10	(N/A)	1.1	10.02
Siberian elm	0.5	0.1	0.3	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	13	(N/A)	1.1	12.72
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	46.2	8.0	25.7	3.0	260	106.9	15.6	14.9	101.9	667	-62.9	-236	259.2	691	(N/A)	100.0	7.77

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species

12/12/2010

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway spruce	131,335	985	(N/A)	30.3	14.1	36.48
Sugar maple	266,776	2,001	(N/A)	19.1	28.7	117.70
White ash	177,607	1,332	(N/A)	12.4	19.1	121.10
Norway maple	47,565	357	(N/A)	5.6	5.1	71.35
Green ash	52,133	391	(N/A)	5.6	5.6	78.20
Silver maple	84,537	634	(N/A)	4.5	9.1	158.51
Black walnut	72,545	544	(N/A)	4.5	7.8	136.02
Ohio buckeye	15,194	114	(N/A)	3.4	1.6	37.98
Apple	1,263	9	(N/A)	3.4	0.1	3.16
Eastern	1,816	14	(N/A)	2.3	0.2	6.81
Birch	218	2	(N/A)	1.1	0.0	1.64
Hickory	8,458	63	(N/A)	1.1	0.9	63.43
Catalpa	25,943	195	(N/A)	1.1	2.8	194.57
Northern	8,047	60	(N/A)	1.1	0.9	60.35
Eastern red cedar	1,102	8	(N/A)	1.1	0.1	8.27
Bur oak	8,458	63	(N/A)	1.1	0.9	63.43
American	15,239	114	(N/A)	1.1	1.6	114.29
Siberian elm	12,245	92	(N/A)	1.1	1.3	91.84
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	930,480	6,979	(N/A)	100.0	100.0	78.41

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees by Species

12/12/2010

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 spruce	4,572	34	-630	-5	-5	7,308	55	11,244	84	(N/A)	30.3	13.5	3.12
Sugar maple	13,177	99	-1,281	-3	-10	9,101	68	20,995	157	(N/A)	19.1	25.3	9.26
White ash	12,623	95	-853	-2	-6	7,544	57	19,312	145	(N/A)	12.4	23.2	13.17
Norway maple	1,720	13	-228	-1	-2	2,187	16	3,677	28	(N/A)	5.6	4.4	5.52
Green ash	3,478	26	-250	-1	-2	2,380	18	5,607	42	(N/A)	5.6	6.7	8.41
Silver maple	5,425	41	-406	-1	-3	1,905	14	6,923	52	(N/A)	4.5	8.3	12.98
Black walnut	2,762	21	-348	-1	-3	2,170	16	4,583	34	(N/A)	4.5	5.5	8.59
Ohio buckeye	1,242	9	-73	-1	-1	1,230	9	2,398	18	(N/A)	3.4	2.9	6.00
Apple	190	1	-6	-1	0	199	1	382	3	(N/A)	3.4	0.5	0.95
Eastern hophornbeam	228	2	-9	0	0	248	2	467	4	(N/A)	2.3	0.6	1.75
Birch	96	1	-1	0	0	65	0	159	1	(N/A)	1.1	0.2	1.19
Hickory	660	5	-41	0	0	441	3	1,060	8	(N/A)	1.1	1.3	7.95
Catalpa	960	7	-125	0	-1	650	5	1,485	11	(N/A)	1.1	1.8	11.14
Northern hackberry	499	4	-39	0	0	624	5	1,084	8	(N/A)	1.1	1.3	8.13
Eastern red cedar	43	0	-5	0	0	187	1	224	2	(N/A)	1.1	0.3	1.68
Bur oak	660	5	-41	0	0	441	3	1,060	8	(N/A)	1.1	1.3	7.95
American basswood	925	7	-73	0	-1	505	4	1,357	10	(N/A)	1.1	1.6	10.17
Siberian elm	640	5	-59	0	0	561	4	1,142	9	(N/A)	1.1	1.4	8.56
Other street trees	0	0	0	0	0	0	0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	49,897	374	-4,466	-17	-34	37,746	283	83,160	624	(N/A)	100.0	100.0	7.01

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

12/12/2010

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway spruce	857	(N/A)	30.3	16.8	31.75
Sugar maple	1,335	(N/A)	19.1	26.1	78.54
White ash	1,313	(N/A)	12.4	25.7	119.39
Norway maple	160	(N/A)	5.6	3.1	31.95
Green ash	292	(N/A)	5.6	5.7	58.48
Silver maple	405	(N/A)	4.5	7.9	101.17
Black walnut	217	(N/A)	4.5	4.2	54.16
Ohio buckeye	121	(N/A)	3.4	2.4	40.46
Apple	11	(N/A)	3.4	0.2	3.51
Eastern hophornbeam	13	(N/A)	2.3	0.3	6.40
Birch	13	(N/A)	1.1	0.3	12.89
Hickory	58	(N/A)	1.1	1.1	57.69
Catalpa	67	(N/A)	1.1	1.3	66.60
Northern hackberry	64	(N/A)	1.1	1.2	63.56
Eastern red cedar	14	(N/A)	1.1	0.3	13.68
Bur oak	58	(N/A)	1.1	1.1	57.69
American basswood	70	(N/A)	1.1	1.4	69.73
Siberian elm	46	(N/A)	1.1	0.9	46.00
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	5,112	(N/A)	100.0	100.0	57.43

Table 7: Summary of Benefits in Dollars

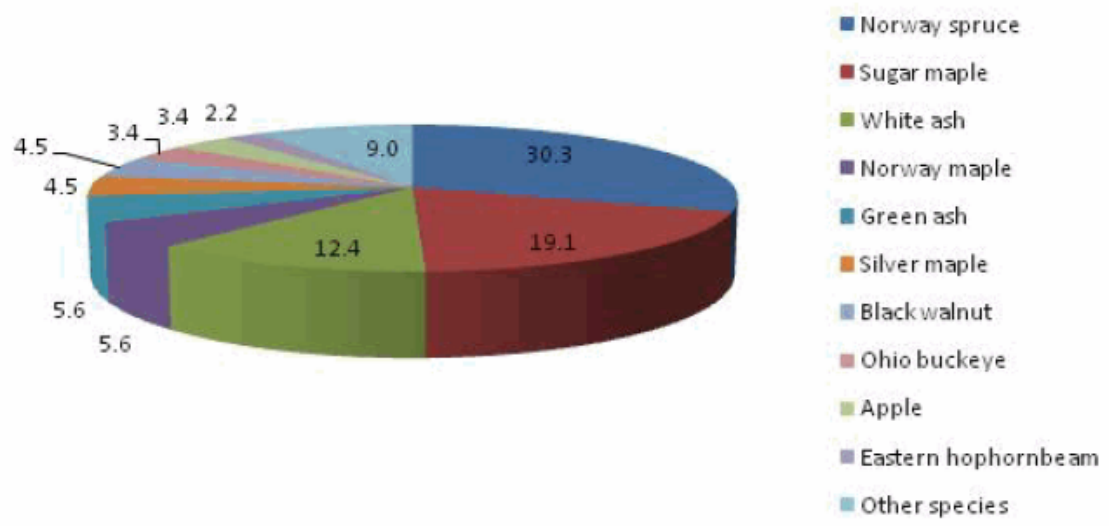
Total Annual Benefits of Public Trees by Species ($)

12/12/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway spruce	890	84	8	2,549	857	4,389	(±0)	22.5
Sugar maple	1,142	157	184	1,830	1,335	4,649	(±0)	23.8
White ash	902	145	192	1,579	1,313	4,131	(±0)	21.2
Norway maple	284	28	52	360	160	883	(±0)	4.5
Green ash	301	42	51	394	292	1,080	(±0)	5.5
Silver maple	229	52	44	471	405	1,200	(±0)	6.2
Black walnut	261	34	50	424	217	987	(±0)	5.1
Ohio buckeye	152	18	26	144	121	461	(±0)	2.4
Apple	29	3	4	11	11	57	(±0)	0.3
Eastern	36	4	5	14	13	72	(±0)	0.4
Birch	9	1	1	4	13	29	(±0)	0.1
Hickory	57	8	9	70	58	203	(±0)	1.0
Catalpa	82	11	16	149	67	324	(±0)	1.7
Northern hackberry	81	8	14	98	64	265	(±0)	1.4
Eastern red cedar	25	2	2	44	14	86	(±0)	0.4
Bur oak	57	8	9	70	58	203	(±0)	1.0
American basswood	67	10	10	89	70	246	(±0)	1.3
Siberian elm	71	9	13	91	46	229	(±0)	1.2
Other street trees	0	0	0	0	0	0	(±0)	0.0
Citywide Total	4,676	624	691	8,391	5,112	19,494	(±0)	100.0

Species Distribution of Public Trees (%)

12/12/2010

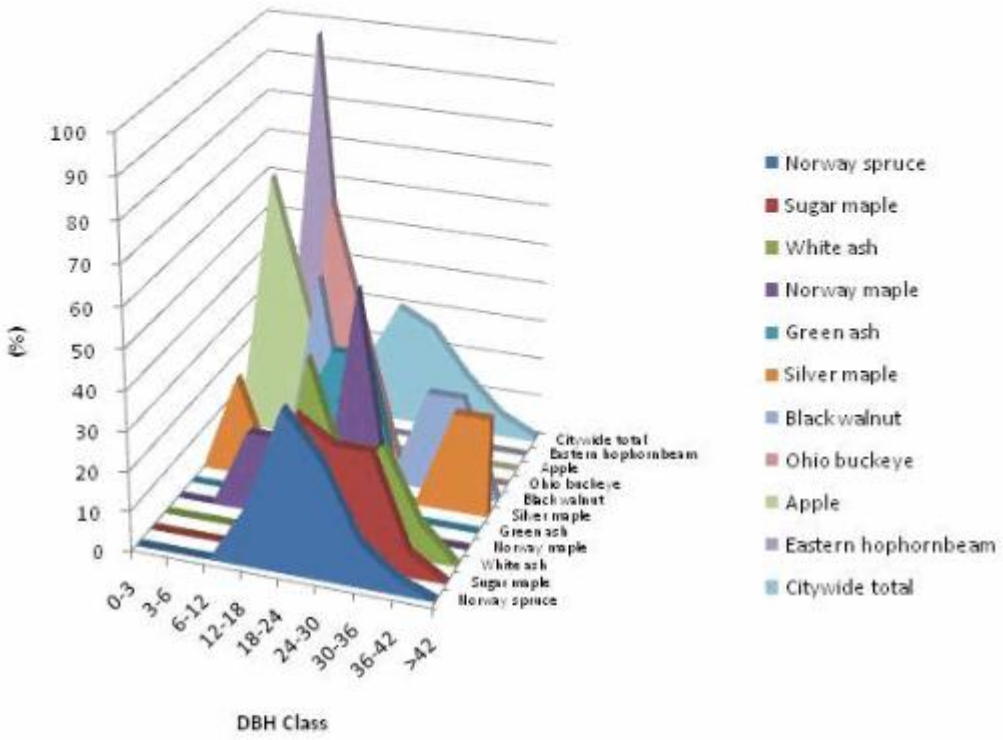


Species	Percent
Norway spruce	30.3
Sugar maple	19.1
White ash	12.4
Norway maple	5.6
Green ash	5.6
Silver maple	4.5
Black walnut	4.5
Ohio buckeye	3.4
Apple	3.4
Eastern hophornbeam	2.2
Other species	9.0
Total	100.0

Figure 1: Species Distribution

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

12/12/2010



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Norway spruce	0.0	0.0	0.0	14.8	40.7	29.6	11.1	3.7	0.0
Sugar maple	0.0	0.0	0.0	0.0	35.3	29.4	29.4	5.9	0.0
White ash	0.0	0.0	0.0	0.0	45.5	18.2	27.3	9.1	0.0
Norway maple	0.0	0.0	20.0	20.0	0.0	60.0	0.0	0.0	0.0
Green ash	0.0	0.0	0.0	20.0	40.0	40.0	0.0	0.0	0.0
Silver maple	0.0	25.0	0.0	25.0	0.0	0.0	0.0	25.0	25.0
Black walnut	0.0	0.0	0.0	50.0	0.0	0.0	25.0	25.0	0.0
Ohio buckeye	0.0	0.0	0.0	66.7	33.3	0.0	0.0	0.0	0.0
Apple	0.0	66.7	33.3	0.0	0.0	0.0	0.0	0.0	0.0
Eastern hophornbeam	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Citywide total	0.0	4.5	4.5	13.5	30.3	25.8	14.6	5.6	1.1

Figure 2: Relative Age Class

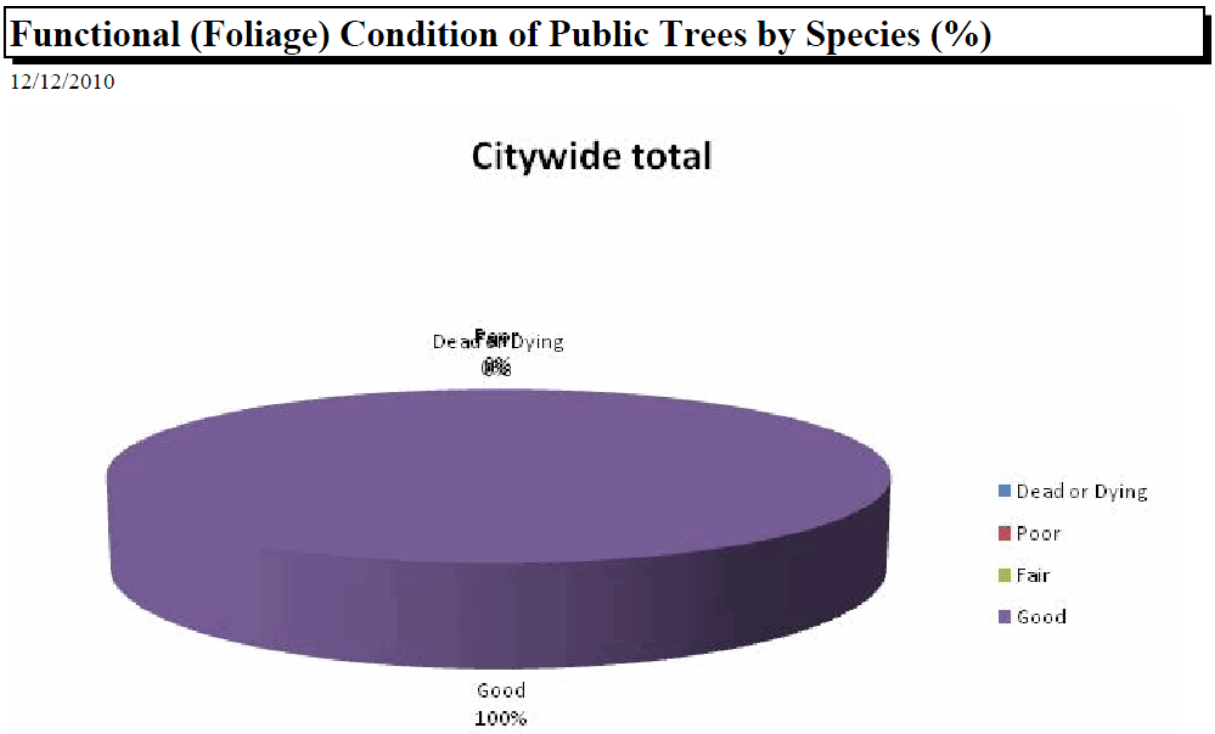


Figure 3: Foliage Condition

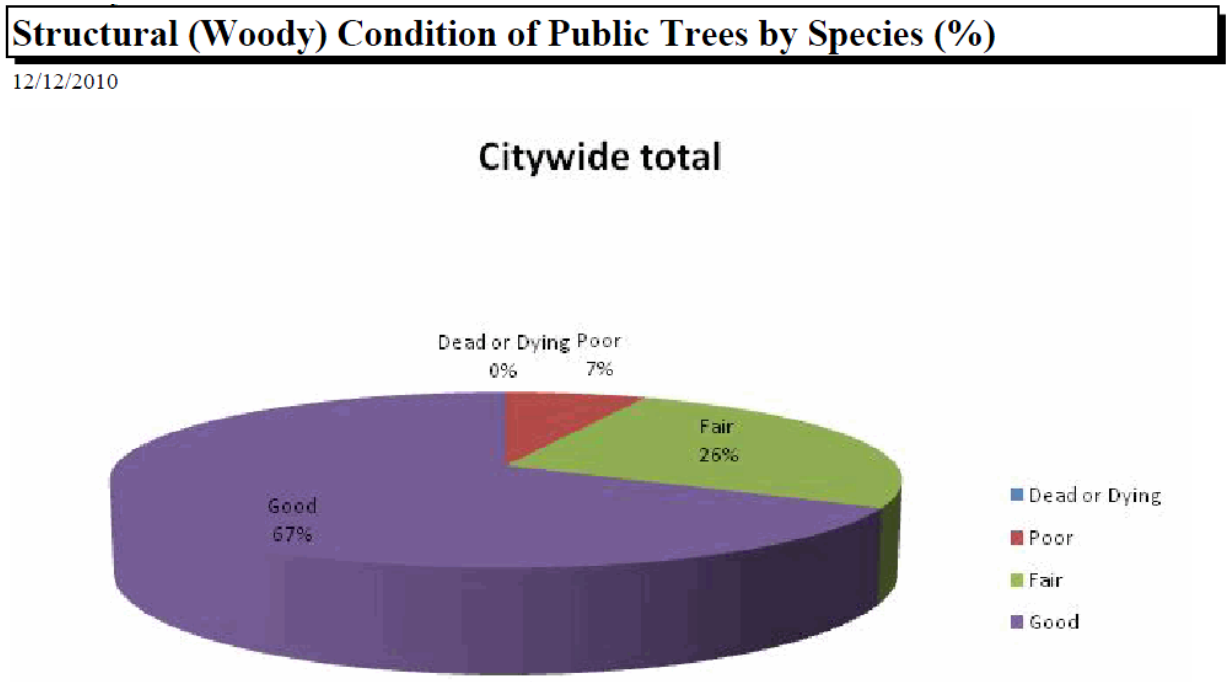
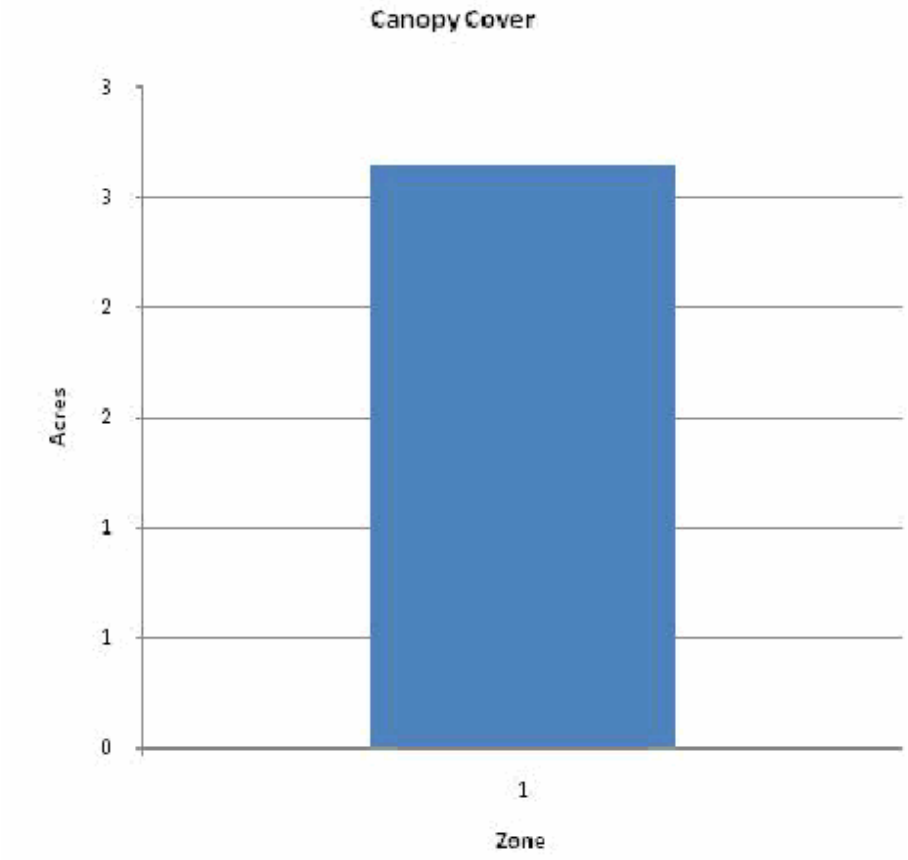


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

12/12/2010



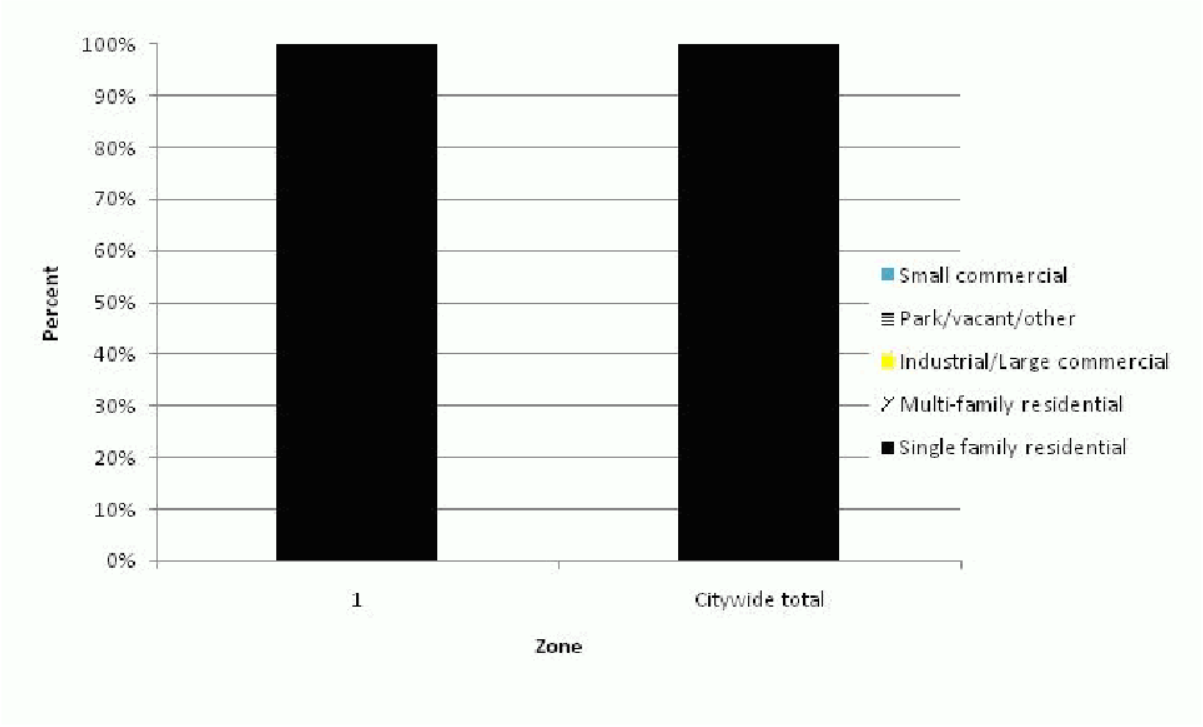
Zone	Acres	% of Total Canopy Cover
1	3	100.0
Citywide total	3	100.0

	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	3		

Figure 5: Canopy Cover in Acres

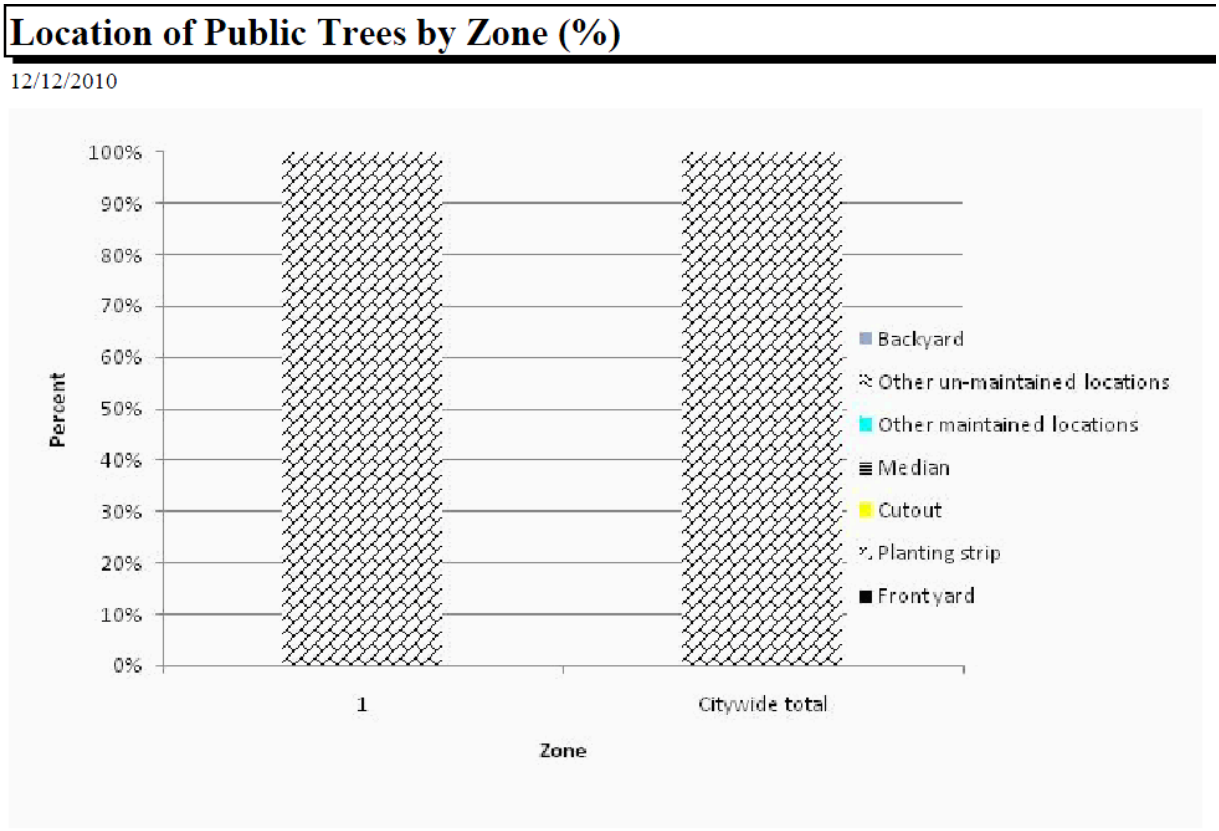
Land Use of Public Trees by Zone (%)

12/12/2010



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

Figure 6: Land Use of city/park trees



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

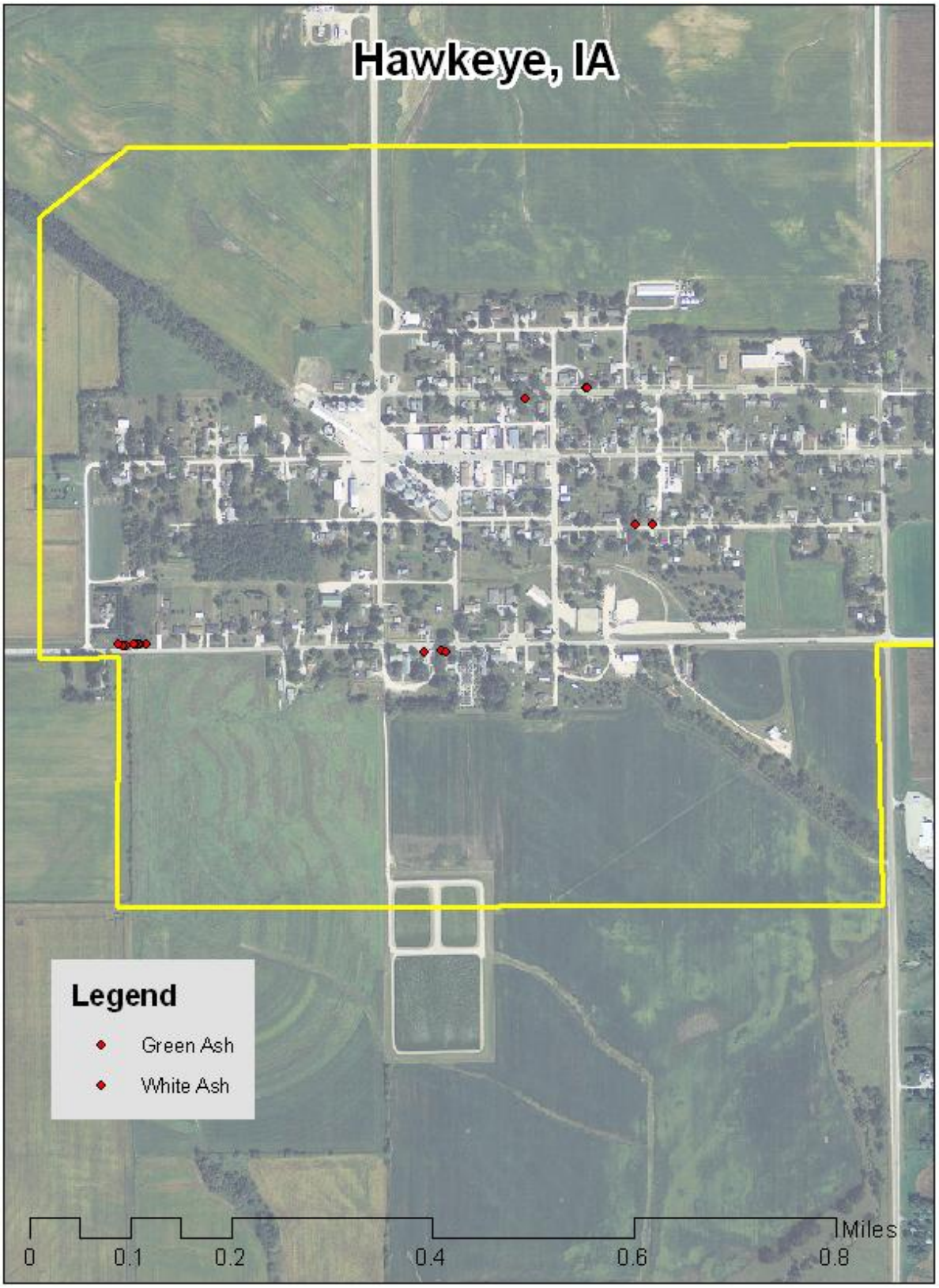


Figure 1: Location of Ash Trees

NO SYMPTOMS

Figure 2: Location of EAB symptoms

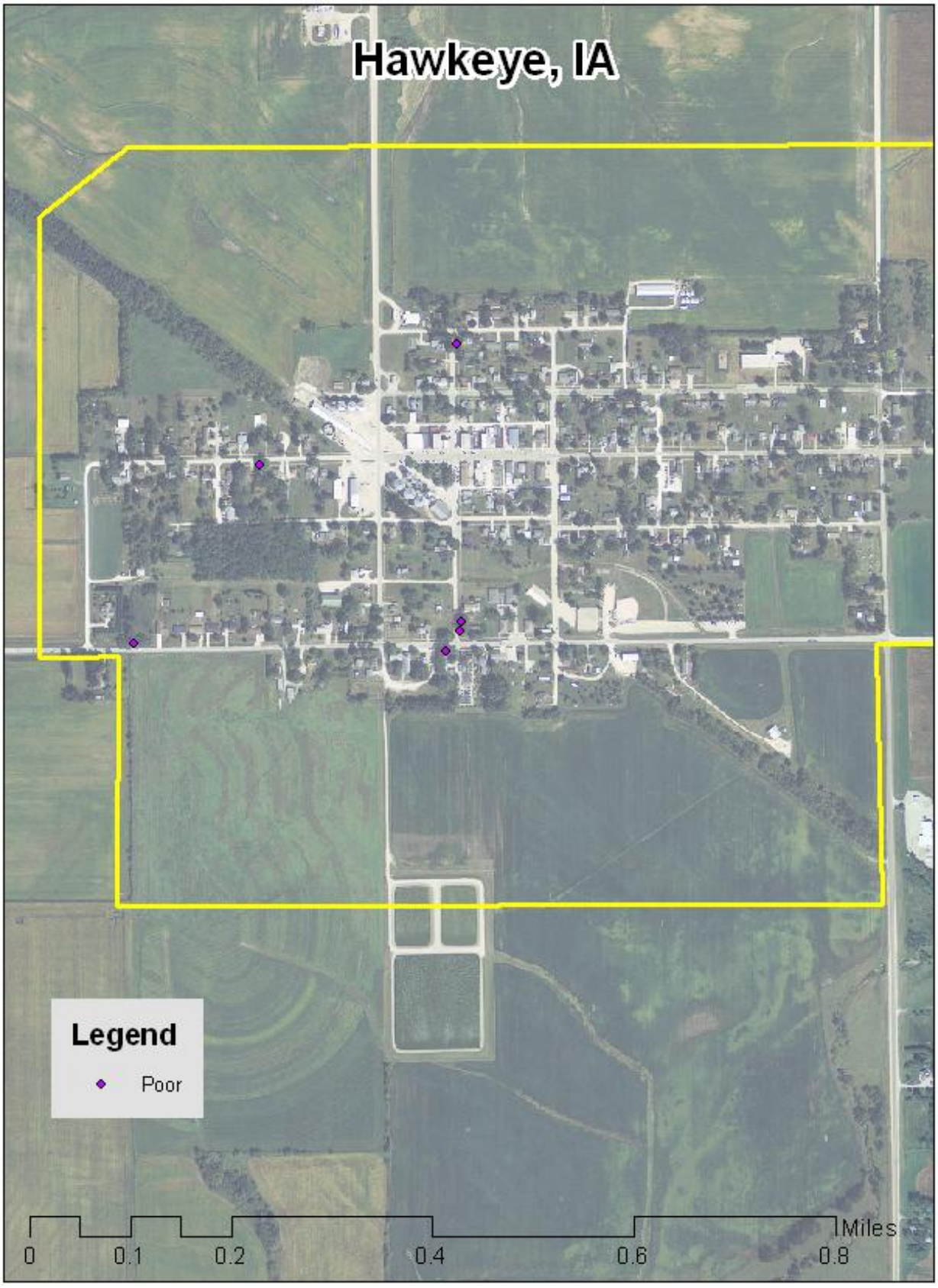


Figure 3: Location of Poor Condition Trees

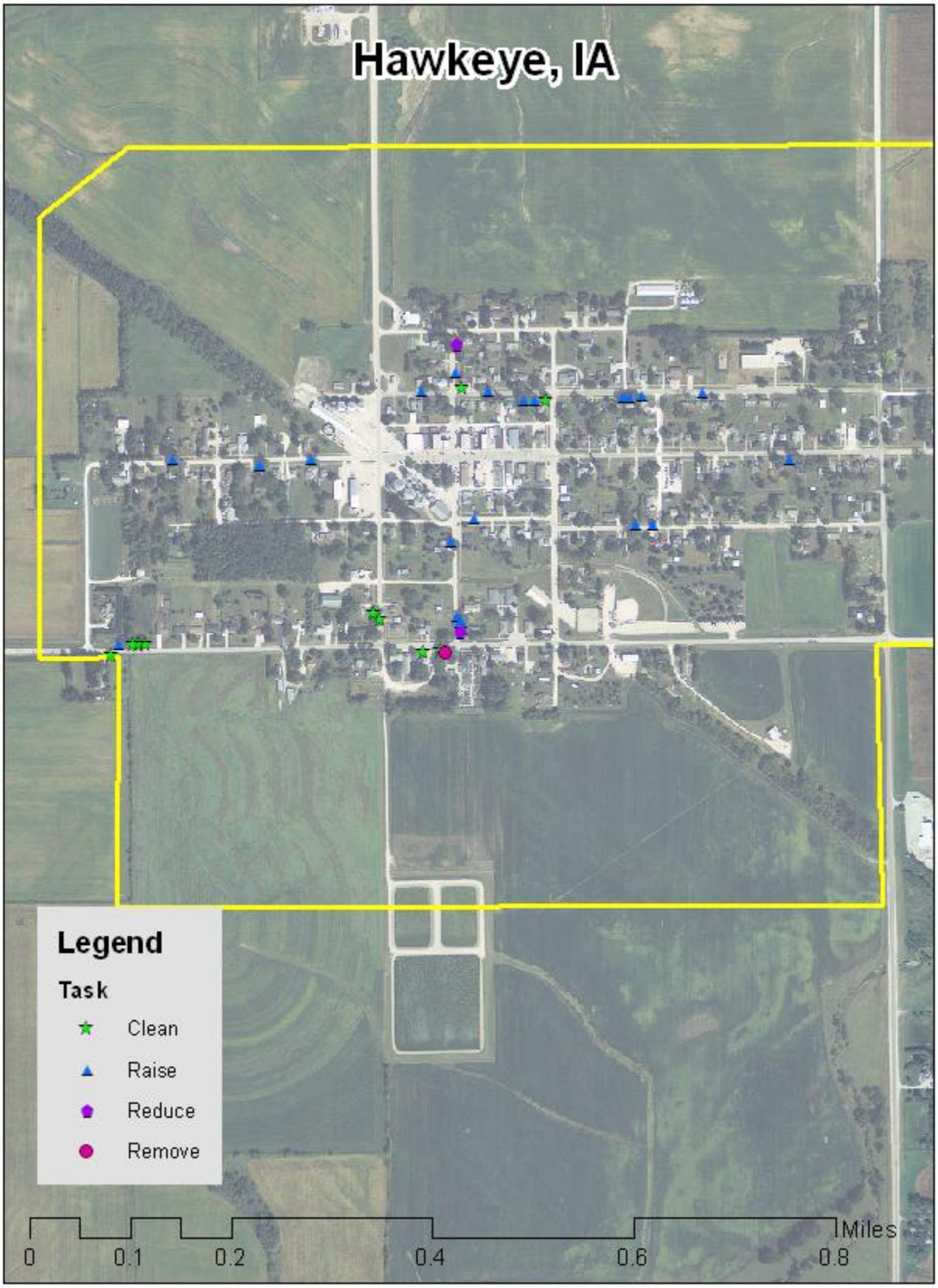


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

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 the Director at 515-281-5918.