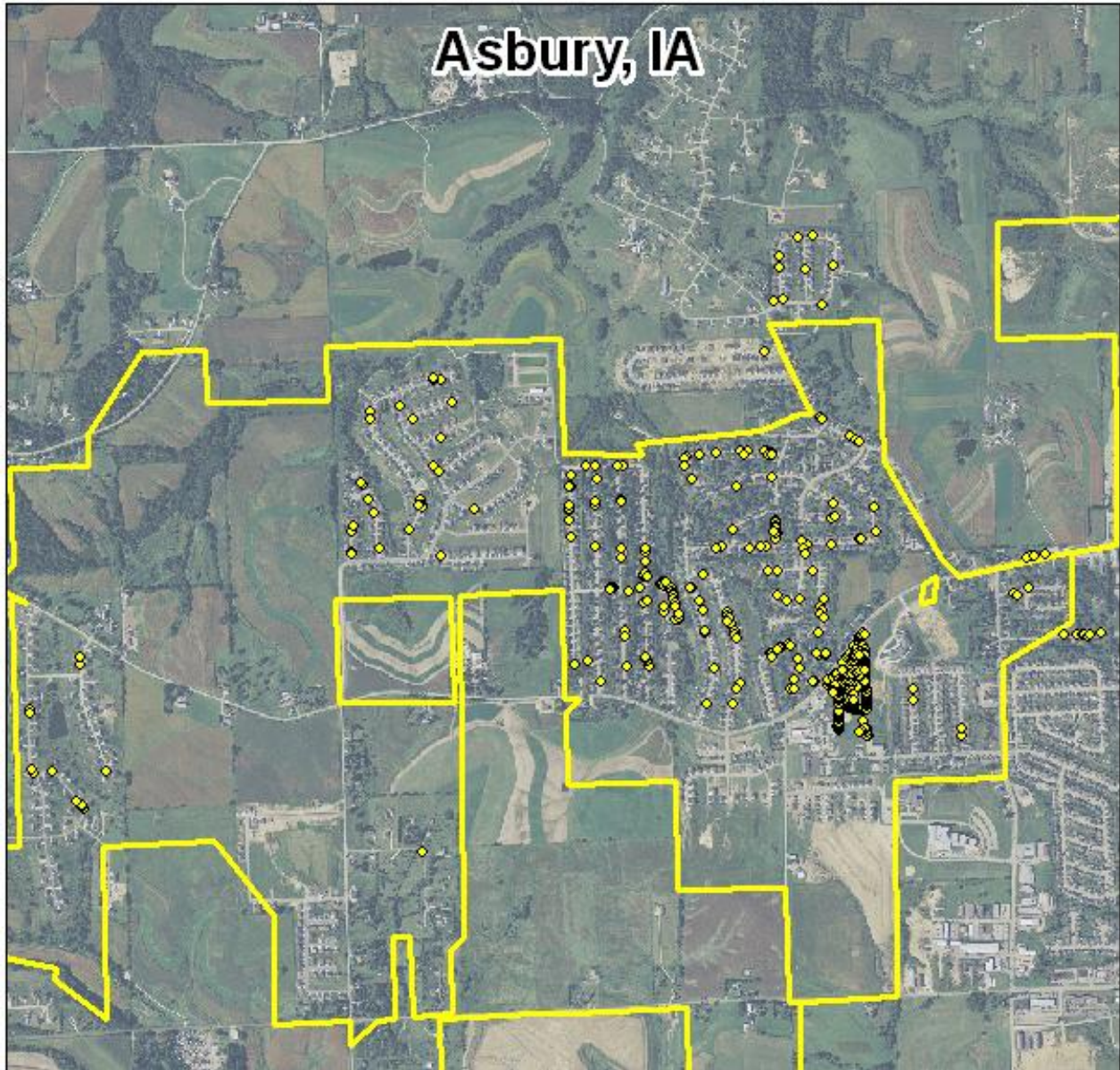


ASBURY, IA



2012 Management Plan
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Executive Summary

Overview:

This plan was developed to assist the City of Asbury with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows communities 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 that kills all species of our native ash trees. There is a strong possibility that over 22% of Asbury's city-managed ash trees could 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 several years mitigating public safety issues.

Inventory and Results:

In the summer of 2011, a street tree inventory was conducted using an integrated Global Positioning System (GPS) data collector. This involved a complete inventory of street trees within the City's Right-of-Way and some parkland. Below are some key findings of the 430 trees inventoried.

- Asbury street trees provide roughly \$30,620 of annual benefits, an average of \$71 per tree.
- The top three species groups are: Maples (25%), Spruce (17%) and Arborvitae (12%).
- Approximately 20% of trees are in need of some type of management.
- For various reasons, 10 trees are recommended for removal.

Recommendations:

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

- One of the 39 ash trees inventoried are in need of follow up checking because they are displaying some 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 *does not include*: ash, soft maple, autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar and tree-of-heaven.
- Check ash trees with a visual survey yearly.

Introduction

This plan was developed to assist Asbury with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with a great proportion 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 Asbury, these costs can be extended over several years and public safety issues from dead and dying ash trees can be mitigated.

Trees are an important component of Asbury's infrastructure and are one of the greatest assets to the community. Through research, it has been shown that trees provide a community with numerous public benefits including: improved air quality, storm water runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and creating a desirable place to live. It is essential that these benefits be maintained for the people of Asbury and future generations through sound urban forestry management.

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

Inventory

In the summers of 2010 and 2011, a tree inventory was conducted that included the city-owned street trees and some park trees. The tree data was collected using a handheld Global Positioning System (GPS) receiver/data logger. This device records Geographic Information System (GIS) coordinates with an accuracy of 3 meters. The data can then 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 collector was written to be compatible with a state-of-the-art software suite called i-Tree. This software was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. This software is in the public domain and can be accessed for free.

To quantify the urban forest structure and its benefits, specific data is collected for each tree. This data includes: location, land use, tree species, diameter at 4.5 ft (DBH), 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 by the data loggers was downloaded and analyzed by software developed by the USDA Forest service called *Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM)*. This software is also part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis of Asbury's inventory data.

Annual Benefits

Annual Energy Benefits:

Trees conserve energy by shading buildings and blocking winds. Asbury's trees reduce energy related costs by approximately \$8,864 annually (Appendix A, Table 1). These savings are both in Electricity (42.7 MWh) and in Natural Gas (5735 Therms).

Annual Storm water Benefits:

Asbury's trees intercept about 329,680 gallons of rainfall and snow melt per year (Appendix A, Table 2). This interception provides \$8,935 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 that emit volatile organic matter (ozone). In Asbury, it is estimated that trees remove 484 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 \$1,334 (Appendix A, Table 3).

Annual Carbon Benefits:

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. Of the 430 trees inventoried, the amount of carbon stored amounts to approximately 696,555 total lbs of CO₂ (Appendix A, Table 4). Those trees are sequestering about 74,287 lbs of carbon per year (Appendix A, Table 5). The benefits these trees provide from summer shading and from reductions in household wind infiltration in the winter result in approximately 71,684 fewer lbs of CO₂ being released into the atmosphere (Appendix A Table 5).

Annual Aesthetics Benefits:

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Asbury receives approximately \$10,391 in annual social benefits from its street trees (Appendix A, Table 6).

Financial Summary of all Benefits:

According to the USDA Forest Service i-Tree STRATUM analysis, Asbury's trees provide \$30,620 of benefits annually. Benefits of individual trees vary based on size, species, health and

location. On average, each of the 430 trees in Asbury’s inventory provides approximately \$71/tree annually (Appendix A, Table 7).

Forest Structure

Species Distribution:

There were over 45 different tree species surveyed. The distribution of trees by genus is as follows:

Genus	# of trees	% of total
Maple (acer)	107	24.9%
Spruce (picea)	75	17.4%
Arborvitae (Thuja)	50	11.6%
Ash (fraxius)	39	9.1%
Apple (malus)	35	8.1%
Birch (betula)	24	5.6%
Other broadleaves	14	3.3%
Other evergreens	12	2.8%
Pine (Pinus)	12	2.8%
Pear (Pyrus)	12	2.8%
Honeylocust (gleditsia)	10	2.3%
Linden (tilia)	10	2.3%
Oak (quercus)	7	1.6%
Lilac (Syringa)	7	1.6%
Cottonwood (populus)	4	0.9%
White Mulberry (morus)	3	0.7%
Cherry (prunus)	2	0.5%
Elm (ulmus)	1	0.2%
Sumac	1	0.2%
Willow (Salix)	1	0.2%
Redbud (cercis)	1	0.2%
Tulip Tree (1	0.2%
Hickory (<i>Carya</i>)	1	0.2%
Eastern red cedar (<i>Juniperus</i>)	1	0.2%
	430	100.0%

Size Distribution:

The table below summarizes distribution of surveyed trees by their diameter in inches when measured at 4.5 above the ground. The bulk of the City’s trees are younger with 69.3% being from 0 to 12 inches in diameter. This would obviously be a reflection of all the more recent

house construction and park plantings. See Appendix A, Figure 2 for a breakdown of size distributions by species.

Size Classes (inches of diameter at 4.5 feet)	# of trees	% of trees
0 - 3	61	14.2%
3 - 6	113	26.3%
6 - 12	124	28.8%
12 - 18	111	25.8%
18 - 24	16	3.7%
24 - 30	2	0.5%
30 - 36	1	0.2%
36 - 42	1	0.2%
42+	1	0.2%
	430	100.0%

Condition: Wood and Foliage:

Leaf condition is a good indicator of the overall health of urban trees. The foliage condition results for Asbury indicated that 79% of the trees were in good health, 19% in fair health, 2% in poor health and <1 dead or dying. (Appendix A, Figure 3). Leaf health is largely a function of climatic factors during the growing season. This year was not too cool or too wet, therefore, leaf diseases were not a much of an issue. The many trees in the fair health category are probably due to the outbreaks of the leaf eating Japanese beetle of the past few years.

The condition of the wood in urban trees is another important indicator of tree health. The wood forms the structural support system for the leaves and branches. Extensive decay in the main stem makes a tree structurally unsafe which leads to a tree becoming a safety hazard. In Asbury, 81% of the surveyed trees were in good health, 16% in fair health, 3% in poor health and <1% dead or dying for wood condition (Appendix A, Figure 4). The 3% in poor or dead or dying condition should be assessed more carefully. The 16% in fair health is to a large extent a reflection of having so many maples with poor branching architecture.

Management Needs:

Each surveyed tree was assessed for recommended maintenance needs. The following tables list the specific management needs and recommendations. Of the trees recommended for removal, only one was judged to be of critical concern for public safety and should be removed as soon as possible (See Appendix B, figure 4).

Priority Task	# of trees	% of trees
none	346	80.5%
stake/train	41	9.5%
clean	11	2.6%
treat pest/disease	11	2.6%
remove	10	2.3%
raise	9	2.1%
reduce	2	0.5%
	430	100.0%

Maintenance Recommendation	# of trees	% of trees
None	192	44.7%
young tree (routine)	119	27.7%
mature tree (routine)	113	26.3%
young tree (immediate)	5	1.2%
mature tree (immediate)	1	0.2%
critical concern (public safety)	0	0.0%
	430	100.0%

Land Use and Location:

The majority of Asbury's surveyed trees are 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	51%
Park/vacant/other	49%

Location

Front yard	46%
Back yard	3%
Other maintained locations	49%
Other unmaintained locations	2%
Planting Strip	<1%

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:

A total of 10 trees are recommended for removal for one reason or another. Of those, one Norway maple is dying and 6 trees have severely damaged or decaying main stems. These trees with severe decay could easily break off or topple over in storms or under ice and snow loads. Two spruce trees were planted too close to the streets and are blocking the view of pedestrians for traffic.

Poor tree species:

One of the trees recommended for removal was a volunteer white mulberry growing in a poor location.

Pruning Cycle:

Proper pruning can extend the life and improve the overall health of trees, and can reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning (stake/train), crown cleaning (clean), crown raising (raise), and crown reduction (reduce). 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. Staking and training is recommended for younger trees so they can develop good architecture. It is recommended that all trees be pruned on a routine schedule every five to seven years.

Priority Task	# of trees	% of trees
none	346	80.5%
stake/train	41	9.5%
clean	11	2.6%
treat pest/disease	11	2.6%
remove	10	2.3%
raise	9	2.1%
reduce	2	0.5%
	430	100.0%

Planting:

Most of the planting over the next six years should replace the trees that are recommended for removal. It is recommended to plant two trees for every tree removed since survival rates will

not be 100%. It is not essential that the new trees be planted in the same location as the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Asbury.

Since most insects and diseases target a particular genus (e.g. ash) or species (e.g. green ash) of trees, it is important to always plant a diverse mix of species. Current diversity recommendations advise that any genus (e.g. maple, oak or ash) not make up more than 20% of the urban forest. Any single species (e.g. silver maple, sugar maple, white oak or bur oak) not make up more than 10% of the total urban forest. Presently, the forest is fairly heavily planted with Maples (25%) (Appendix A, Figure 1). Maples should not be planted until this percentage is lowered somewhat. 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, and willow. I noticed that white poplar was recommended in your City Tree Ordinance. This tree can become invasive so should probably be taken off of your list.

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 (EAB) Plan

Ash Tree Removal:

Tree removal should be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 5). 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 many millions ash trees throughout the Eastern United States and Canada. Ash in both forestlands and urban settings constitutes a very significant portion of the canopy cover. 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 its spread beyond its known locations 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 urban 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 your budget permits, all removed ash trees should be replaced. All trees should meet the restrictions in your city's ordinance (Appendix C). The new plantings should be a diverse mix and should not include ash, 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's other than ash will be prioritized by hazardous or emergency situations only.

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 Asbury's urban forest. Private property owners should be given direction to the proper species to plant, spacing, and location. Asbury has a city ordinance for trees.

Budget

Purposed Budget Increase:

EAB could potentially kill all of the ash trees in Asbury within a decade after its arrival. It is recommended that the City apply for grants to fund replacement tree planting. 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. There were a total of 21 ash trees surveyed within the two City parks inventoried. It would probably be a good idea to remove approximately 1/2 (11 trees) of them over the next 6 years. You should replant 2 trees for everyone removed. First, you should remove the ash tree showing signs and symptoms of possible EAB infestation (Appendix B, Figure 2). Next, remove the remaining 10 ash within the City parks, especially where they may be grouped together (Appendix B, Figure 1). Finally, we recommend that the City adopt a policy of allocating somewhere between \$2 to \$4 per capita per year into a forestry budget to be used for planting, removals and maintenance of Asbury's urban forest.

Recommended Budget: \$9,450 total over 6 years.

FY 2011 Budget

Removal: \$1000
Planting: \$400
Routine trimming: \$200
Watering & Maintenance: \$100

FY 2012 Budget

Removal: \$1000
Planting: \$400
Routine trimming: \$200
Watering & Maintenance: \$100

FY 2013 Budget

Removal: \$1000
Planting: \$400
Routine trimming: \$200
Watering & Maintenance: \$100

FY 2014 Budget

Removal: \$1000
Planting: \$400
Routine trimming: \$200
Watering & Maintenance: \$100

FY 2015 Budget

Removal: \$1000

Planting: \$400
Routine trimming: \$200
Watering & Maintenance: \$100

FY 2016 Budget

Removal: \$6000
Planting: \$2400
Routine trimming: \$4000
Watering & Maintenance: \$500

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species

1/18/2012

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Northern white cedar	1.3	96	213.8	210	305 (N/A)	11.6	3.5	6.11
Green ash	7.4	560	893.9	876	1,436 (N/A)	8.1	16.2	41.02
Apple	1.8	135	287.1	281	416 (N/A)	8.1	4.7	11.90
Blue spruce	2.9	222	403.7	396	618 (N/A)	8.1	7.0	17.65
Red maple	2.0	152	281.9	276	428 (N/A)	6.5	4.8	15.30
Norway maple	3.5	268	467.8	458	727 (N/A)	6.3	8.2	26.91
Silver maple	4.7	356	609.7	598	954 (N/A)	6.3	10.8	35.32
Sugar maple	2.4	183	301.5	295	479 (N/A)	3.7	5.4	29.91
Spruce	0.7	50	112.2	110	160 (N/A)	3.7	1.8	10.00
Black spruce	1.0	79	146.7	144	222 (N/A)	3.3	2.5	15.89
River birch	2.5	187	313.4	307	494 (N/A)	3.0	5.6	38.03
Broadleaf Deciduous	0.1	6	13.8	14	19 (N/A)	2.8	0.2	1.62
Callery pear	0.7	50	97.4	95	145 (N/A)	2.8	1.6	12.11
Honeylocust	2.5	193	325.3	319	512 (N/A)	2.3	5.8	51.21
Norway spruce	0.6	48	100.1	98	146 (N/A)	2.3	1.7	14.63
Littleleaf linden	0.9	66	127.5	125	191 (N/A)	2.3	2.2	19.05
Paper birch	1.5	113	180.9	177	291 (N/A)	2.1	3.3	32.31
Conifer Evergreen Small	0.1	7	13.7	13	20 (N/A)	1.6	0.2	2.85
Maple	0.7	53	93.2	91	144 (N/A)	1.4	1.6	24.02
Austrian pine	0.6	48	77.5	76	124 (N/A)	1.4	1.4	20.62
Lilac	0.2	14	31.3	31	44 (N/A)	1.4	0.5	7.40
Eastern white pine	0.2	19	42.0	41	60 (N/A)	1.2	0.7	11.98
Other street trees	4.5	339	600.8	589	928 (N/A)	9.5	10.5	22.63
Citywide total	42.7	3,244	5,735.3	5,621	8,864 (N/A)	100.0	100.0	20.61

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

1/18/2012

Species	Total rainfall interception (Gal)	Total Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Northern white cedar	12,401	336 (N/A)	11.6	3.8	6.72
Green ash	50,015	1,355 (N/A)	8.1	15.2	38.73
Apple	6,265	170 (N/A)	8.1	1.9	4.85
Blue spruce	35,259	956 (N/A)	8.1	10.7	27.30
Red maple	10,903	295 (N/A)	6.5	3.3	10.55
Norway maple	20,439	554 (N/A)	6.3	6.2	20.52
Silver maple	49,380	1,338 (N/A)	6.3	15.0	49.57
Sugar maple	13,675	371 (N/A)	3.7	4.2	23.16
Spruce	6,903	187 (N/A)	3.7	2.1	11.69
Black spruce	12,234	332 (N/A)	3.3	3.7	23.68
River birch	14,700	398 (N/A)	3.0	4.5	30.65
Broadleaf Deciduous	212	6 (N/A)	2.8	0.1	0.48
Callery pear	3,321	90 (N/A)	2.8	1.0	7.50
Honeylocust	16,405	445 (N/A)	2.3	5.0	44.46
Norway spruce	6,898	187 (N/A)	2.3	2.1	18.69
Littleleaf linden	5,038	137 (N/A)	2.3	1.5	13.65
Paper birch	10,279	279 (N/A)	2.1	3.1	30.95
Conifer Evergreen Small	966	26 (N/A)	1.6	0.3	3.74
Maple	5,256	142 (N/A)	1.4	1.6	23.74
Austrian pine	7,345	199 (N/A)	1.4	2.2	33.18
Lilac	620	17 (N/A)	1.4	0.2	2.80
Eastern white pine	2,595	70 (N/A)	1.2	0.8	14.06
Other street trees	38,573	1,045 (N/A)	9.5	11.7	25.50
Citywide total	329,680	8,935 (N/A)	100.0	100.0	20.78

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

1/18/2012

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								
Northern white cedar	0.6	0.1	0.8	0.1	5	6.4	0.9	0.9	5.7	39	-3.4	-13	12.1	31 (N/A)	11.6	0.62	
Green ash	3.9	0.6	2.3	0.2	22	34.2	5.1	4.8	33.4	215	0.0	0	84.5	238 (N/A)	8.1	6.79	
Apple	1.3	0.2	0.7	0.1	7	8.9	1.3	1.2	8.1	54	0.0	0	21.7	61 (N/A)	8.1	1.76	
Blue spruce	3.9	0.8	3.5	0.5	26	14.0	2.0	1.9	13.3	87	-11.9	-45	27.9	69 (N/A)	8.1	1.96	
Red maple	1.5	0.3	0.9	0.1	8	9.6	1.4	1.3	9.1	60	-0.6	-2	23.5	66 (N/A)	6.5	2.35	
Norway maple	2.9	0.5	1.6	0.1	16	16.8	2.4	2.3	16.0	105	-0.8	-3	41.9	118 (N/A)	6.3	4.37	
Silver maple	6.7	1.1	3.5	0.3	37	22.1	3.2	3.1	21.2	138	-4.2	-16	57.1	159 (N/A)	6.3	5.90	
Sugar maple	1.1	0.2	0.7	0.0	7	11.2	1.7	1.6	10.9	71	-1.0	-4	26.5	73 (N/A)	3.7	4.59	
Spruce	0.5	0.1	0.6	0.1	4	3.3	0.5	0.4	3.0	20	-1.9	-7	6.6	17 (N/A)	3.7	1.07	
Black spruce	1.3	0.3	1.2	0.2	9	5.0	0.7	0.7	4.7	31	-4.1	-15	9.9	25 (N/A)	3.3	1.75	
River birch	2.2	0.4	1.2	0.1	12	11.6	1.7	1.6	11.2	73	-0.6	-2	29.5	83 (N/A)	3.0	6.38	
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	2	0.0	0	0.9	2 (N/A)	2.8	0.21	
Callery pear	0.3	0.1	0.2	0.0	2	3.2	0.5	0.4	3.0	20	-0.1	0	7.6	21 (N/A)	2.8	1.78	
Honeylocust	2.8	0.5	1.4	0.1	15	11.9	1.8	1.7	11.5	75	-1.8	-7	29.9	83 (N/A)	2.3	8.32	
Norway spruce	0.6	0.1	0.6	0.1	4	3.1	0.4	0.4	2.9	19	-2.0	-8	6.3	16 (N/A)	2.3	1.61	
Littleleaf linden	0.4	0.1	0.3	0.0	3	4.2	0.6	0.6	3.9	26	-0.3	-1	9.9	28 (N/A)	2.3	2.76	
Paper birch	0.8	0.1	0.5	0.0	5	6.9	1.0	1.0	6.8	44	0.0	0	17.2	48 (N/A)	2.1	5.36	
Conifer Evergreen Small	0.0	0.0	0.1	0.0	0	0.4	0.1	0.1	0.4	3	-0.5	-2	0.6	1 (N/A)	1.6	0.16	
Maple	1.2	0.2	0.6	0.1	6	3.3	0.5	0.5	3.2	21	-0.4	-1	9.0	25 (N/A)	1.4	4.22	
Austrian pine	0.8	0.2	0.7	0.1	5	2.9	0.4	0.4	2.8	18	-2.5	-9	5.8	14 (N/A)	1.4	2.37	
Lilac	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	6	0.0	0	2.2	6 (N/A)	1.4	1.02	
Eastern white pine	0.2	0.0	0.2	0.0	2	1.3	0.2	0.2	1.1	8	-0.7	-3	2.5	6 (N/A)	1.2	1.29	
Other street trees	4.3	0.7	2.6	0.3	25	21.2	3.1	3.0	20.3	132	-4.1	-15	51.4	142 (N/A)	9.5	3.46	
Citywide total	37.6	6.6	24.2	2.4	221	202.9	29.6	28.3	193.7	1,267	-41.0	-154	484.2	1,334 (N/A)	100.0	3.10	

Table 4: Annual Carbon Stored

Asbury

Stored CO2 Benefits of Public Trees by Species

1/18/2012

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Northern white	3,406	26	(N/A)	11.6	0.5	0.51
Green ash	131,726	988	(N/A)	8.1	18.9	28.23
Apple	23,218	174	(N/A)	8.1	3.3	4.98
Blue spruce	20,225	152	(N/A)	8.1	2.9	4.33
Red maple	20,541	154	(N/A)	6.5	3.0	5.50
Norway maple	49,489	371	(N/A)	6.3	7.1	13.75
Silver maple	156,901	1,177	(N/A)	6.3	22.5	43.58
Sugar maple	33,511	251	(N/A)	3.7	4.8	15.71
Spruce	2,725	20	(N/A)	3.7	0.4	1.28
Black spruce	6,591	49	(N/A)	3.3	1.0	3.53
River birch	37,376	280	(N/A)	3.0	5.4	21.56
Broadleaf	493	4	(N/A)	2.8	0.1	0.31
Callery pear	6,506	49	(N/A)	2.8	0.9	4.07
Honeylocust	33,524	251	(N/A)	2.3	4.8	25.14
Norway spruce	3,480	26	(N/A)	2.3	0.5	2.61
Littleleaf linden	11,979	90	(N/A)	2.3	1.7	8.98
Paper birch	27,200	204	(N/A)	2.1	3.9	22.67
Conifer Evergreen	220	2	(N/A)	1.6	0.0	0.24
Maple	12,922	97	(N/A)	1.4	1.9	16.15
Austrian pine	5,194	39	(N/A)	1.4	0.8	6.49
Lilac	2,035	15	(N/A)	1.4	0.3	2.54
Eastern white pine	1,065	8	(N/A)	1.2	0.2	1.60
Other street trees	48,184	797	(N/A)	9.5	15.3	19.43
Citywide total	696,555	5,224	(N/A)	100.0	100.0	12.15

Table 5: Annual Carbon Sequestered

Asbury

Annual CO₂ Benefits of Public Trees by Species

1/18/2012

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standar (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Northern white cedar	1,038	8	-16	-10	0	2,119	16	3,130	23 (N/A)	11.6	2.1	0.47
Green ash	14,771	111	-632	-7	-5	12,368	93	26,500	199 (N/A)	8.1	18.2	5.68
Apple	2,758	21	-111	-7	-1	2,986	22	5,626	42 (N/A)	8.1	3.9	1.21
Blue spruce	1,955	15	-97	-7	-1	4,912	37	6,763	51 (N/A)	8.1	4.6	1.45
Red maple	3,023	23	-99	-5	-1	3,362	25	6,281	47 (N/A)	6.5	4.3	1.68
Norway maple	6,218	47	-238	-5	-2	5,924	44	11,899	89 (N/A)	6.3	8.2	3.31
Silver maple	15,027	113	-753	-5	-6	7,871	59	22,140	166 (N/A)	6.3	15.2	6.15
Sugar maple	3,391	25	-161	-3	-1	4,047	30	7,275	55 (N/A)	3.7	5.0	3.41
Spruce	605	5	-13	-3	0	1,107	8	1,697	13 (N/A)	3.7	1.2	0.80
Black spruce	669	5	-32	-3	0	1,740	13	2,375	18 (N/A)	3.3	1.6	1.27
River birch	4,094	31	-179	-3	-1	4,140	31	8,053	60 (N/A)	3.0	5.5	4.65
Broadleaf Deciduous	163	1	-2	-2	0	131	1	289	2 (N/A)	2.8	0.2	0.18
Callery pear	1,386	10	-31	-2	0	1,101	8	2,453	18 (N/A)	2.8	1.7	1.53
Honeylocust	5,121	38	-161	-2	-1	4,272	32	9,230	69 (N/A)	2.3	6.3	6.92
Norway spruce	589	4	-17	-2	0	1,066	8	1,637	12 (N/A)	2.3	1.1	1.23
Littleleaf linden	2,360	18	-57	-2	0	1,449	11	3,750	28 (N/A)	2.3	2.6	2.81
Paper birch	3,037	23	-131	-2	-1	2,507	19	5,412	41 (N/A)	2.1	3.7	4.51
Conifer Evergreen	68	1	-1	-1	0	144	1	210	2 (N/A)	1.6	0.1	0.22
Maple	1,616	12	-62	-1	0	1,167	9	2,720	20 (N/A)	1.4	1.9	3.40
Austrian pine	567	4	-25	-1	0	1,055	8	1,596	12 (N/A)	1.4	1.1	2.00
Lilac	292	2	-10	-1	0	302	2	583	4 (N/A)	1.4	0.4	0.73
Eastern white pine	228	2	-5	-1	0	415	3	638	5 (N/A)	1.2	0.4	0.96
Other street trees	8,735	66	-510	-8	-4	7,496	56	15,714	118 (N/A)	9.5	10.8	2.87
Citywide total	77,714	583	-3,343	-84	-26	71,684	538	145,971	1,095 (N/A)	100.0	100.0	2.55

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

1/18/2012

Species	Total (\$)	Standar d Error	% of Total Trees	% of Total \$	Avg. \$/tree
Northern white cedar	382 (N/A)		11.6	3.7	7.64
Green ash	1,527 (N/A)		8.1	14.7	43.64
Apple	151 (N/A)		8.1	1.5	4.31
Blue spruce	760 (N/A)		8.1	7.3	21.71
Red maple	503 (N/A)		6.5	4.8	17.97
Norway maple	676 (N/A)		6.3	6.5	25.03
Silver maple	1,447 (N/A)		6.3	13.9	53.61
Sugar maple	441 (N/A)		3.7	4.2	27.54
Spruce	193 (N/A)		3.7	1.9	12.07
Black spruce	285 (N/A)		3.3	2.8	20.39
River birch	423 (N/A)		3.0	4.1	32.56
Broadleaf Deciduous	4 (N/A)		2.8	0.0	0.37
Callery pear	174 (N/A)		2.8	1.7	14.50
Honeylocust	1,068 (N/A)		2.3	10.3	106.84
Norway spruce	171 (N/A)		2.3	1.7	17.11
Littleleaf linden	315 (N/A)		2.3	3.0	31.52
Paper birch	322 (N/A)		2.1	3.1	35.74
Conifer Evergreen Small	75 (N/A)		1.6	0.7	10.77
Maple	212 (N/A)		1.4	2.0	35.36
Austrian pine	160 (N/A)		1.4	1.5	26.69
Lilac	15 (N/A)		1.4	0.1	2.49
Eastern white pine	69 (N/A)		1.2	0.7	13.70
Other street trees	1,017 (N/A)		9.5	9.8	24.80
Citywide total	10,391 (N/A)		100.0	100.0	24.17

Table 7: Summary of Benefits in Dollars

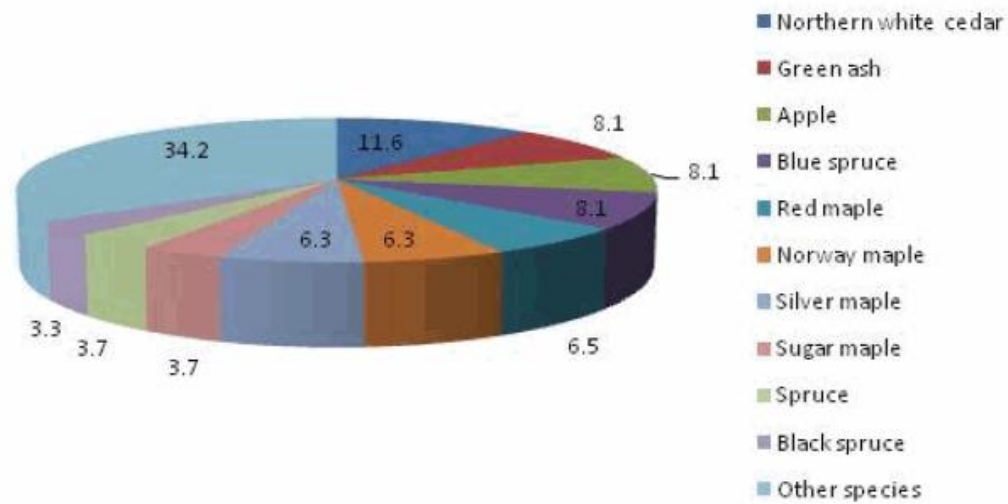
Total Annual Benefits of Public Trees by Species (\$)

1/18/201

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Northern white cedar	305	23	31	336	382	1,078	(±0)	3.5
Green ash	1,436	199	238	1,355	1,527	4,755	(±0)	15.5
Apple	416	42	61	170	151	841	(±0)	2.7
Blue spruce	618	51	69	956	760	2,453	(±0)	8.0
Red maple	428	47	66	295	503	1,340	(±0)	4.4
Norway maple	727	89	118	554	676	2,164	(±0)	7.1
Silver maple	954	166	159	1,338	1,447	4,065	(±0)	13.3
Sugar maple	479	55	73	371	441	1,418	(±0)	4.6
Spruce	160	13	17	187	193	570	(±0)	1.9
Black spruce	222	18	25	332	285	882	(±0)	2.9
River birch	494	60	83	398	423	1,459	(±0)	4.8
Broadleaf Deciduous	19	2	2	6	4	34	(±0)	0.1
Callery pear	145	18	21	90	174	449	(±0)	1.5
Honeylocust	512	69	83	445	1,068	2,178	(±0)	7.1
Norway spruce	146	12	16	187	171	533	(±0)	1.7
Littleleaf linden	191	28	28	137	315	698	(±0)	2.3
Paper birch	291	41	48	279	322	980	(±0)	3.2
Conifer Evergreen	20	2	1	26	75	124	(±0)	0.4
Maple	144	20	25	142	212	544	(±0)	1.8
Austrian pine	124	12	14	199	160	509	(±0)	1.7
Lilac	44	4	6	17	15	87	(±0)	0.3
Eastern white pine	60	5	6	70	69	210	(±0)	0.7
Other street trees	928	118	142	1,045	1,017	3,250	(±0)	10.6
Citywide Total	8,864	1,095	1,334	8,935	10,391	30,620	(±0)	100.0

Species Distribution of Public Trees (%)

1/18/2012

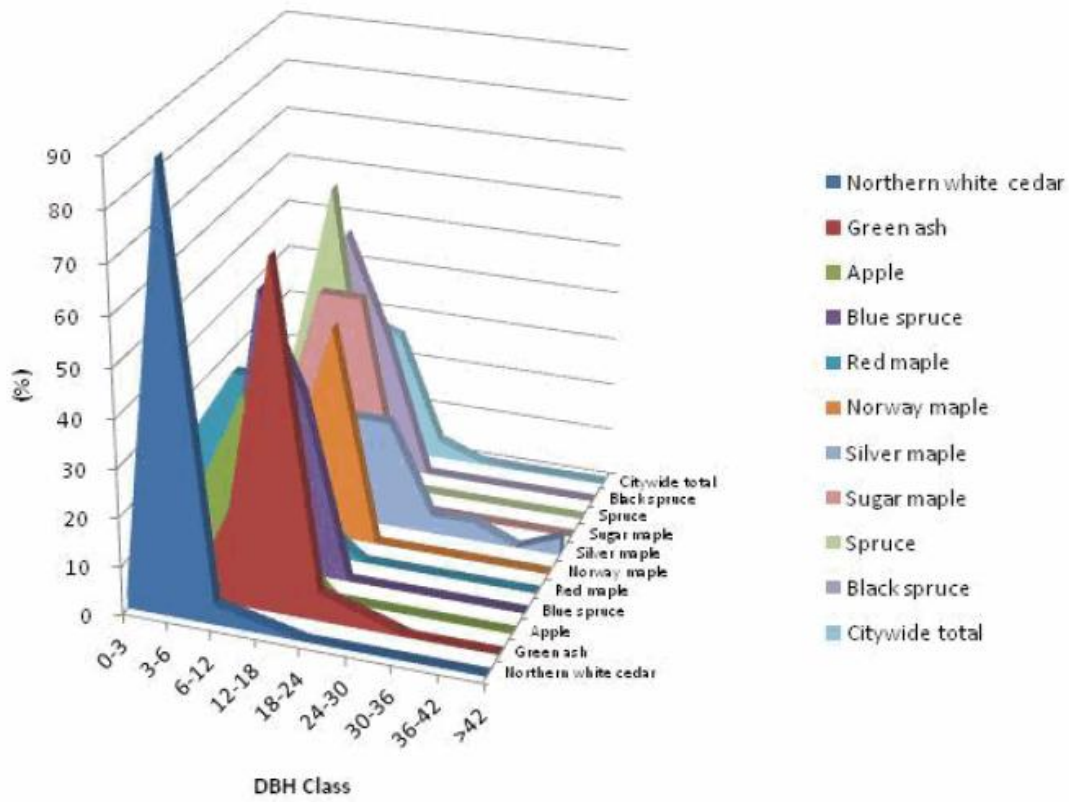


Species	Percent
Northern white cedar	11.6
Green ash	8.1
Apple	8.1
Blue spruce	8.1
Red maple	6.5
Norway maple	6.3
Silver maple	6.3
Sugar maple	3.7
Spruce	3.7
Black spruce	3.3
Other species	34.2
Total	100.0

Figure 1: Species Distribution

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

1/18/2012



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Northern white cedar	4.0	90.0	4.0	2.0	0.0	0.0	0.0	0.0	0.0
Green ash	0.0	0.0	20.0	71.4	5.7	2.9	0.0	0.0	0.0
Apple	31.4	20.0	40.0	8.6	0.0	0.0	0.0	0.0	0.0
Blue spruce	5.7	0.0	57.1	37.1	0.0	0.0	0.0	0.0	0.0
Red maple	21.4	35.7	35.7	7.1	0.0	0.0	0.0	0.0	0.0
Norway maple	14.8	25.9	14.8	44.4	0.0	0.0	0.0	0.0	0.0
Silver maple	18.5	18.5	7.4	22.2	22.2	3.7	3.7	0.0	3.7
Sugar maple	0.0	12.5	43.8	43.8	0.0	0.0	0.0	0.0	0.0
Spruce	12.5	25.0	62.5	0.0	0.0	0.0	0.0	0.0	0.0
Black spruce	0.0	21.4	50.0	28.6	0.0	0.0	0.0	0.0	0.0
Citywide total	14.2	26.3	28.8	25.8	3.7	0.5	0.2	0.2	0.2

Figure 2: Relative Age Class

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

1/18/2012

Citywide total

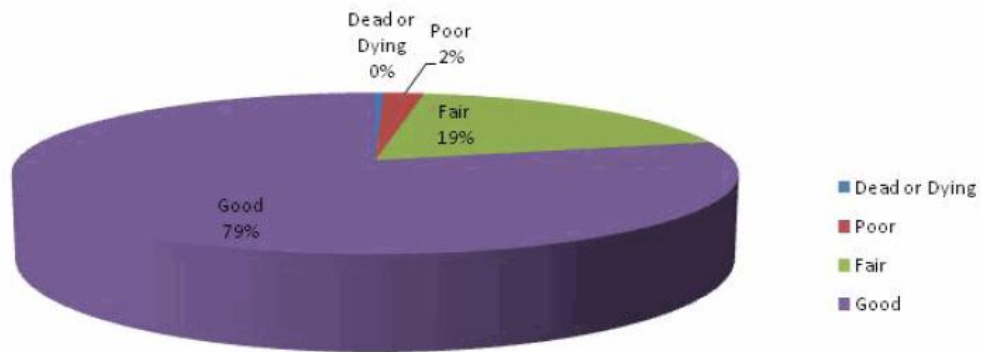


Figure 3: Foliage Condition

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

1/18/2012

Citywide total

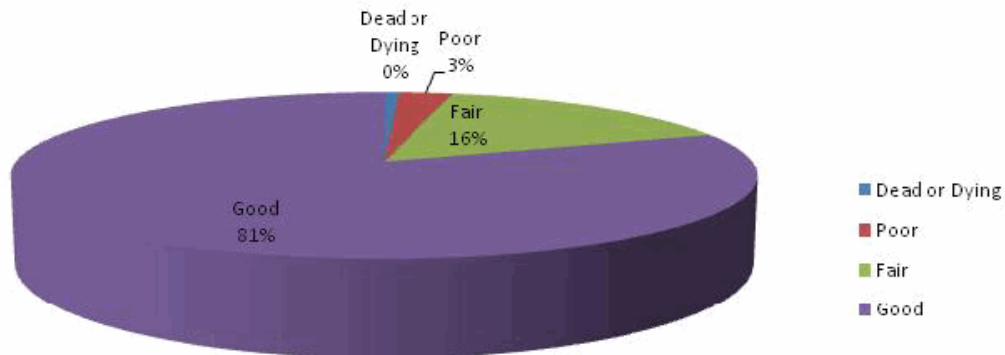
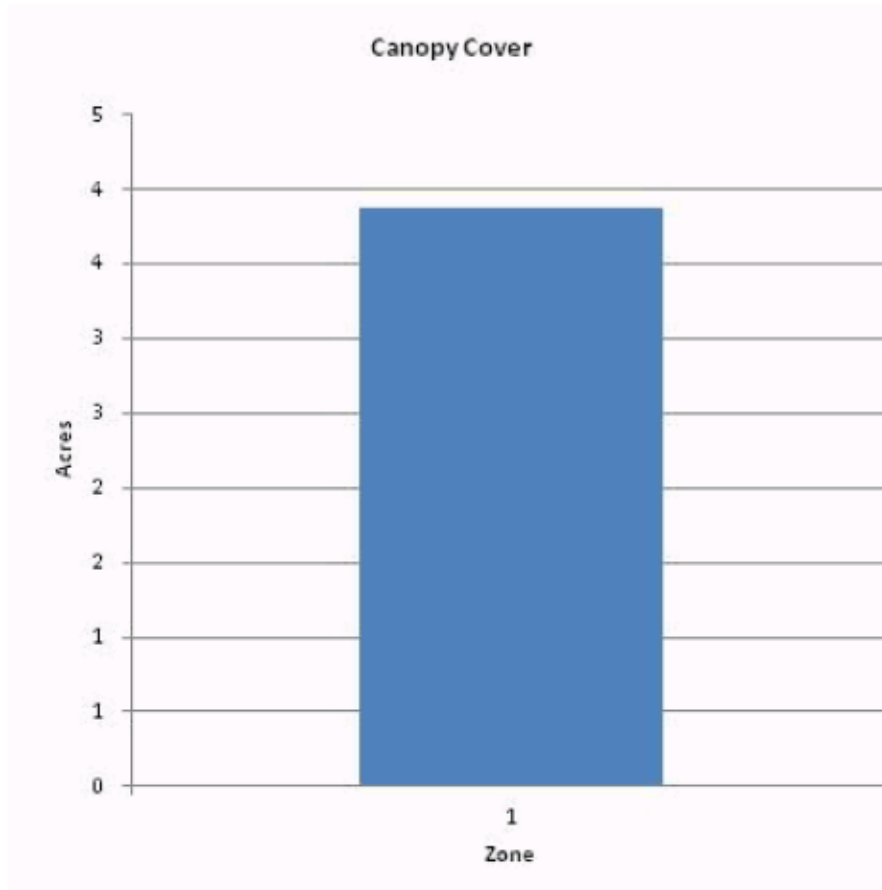


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

1/18/2012



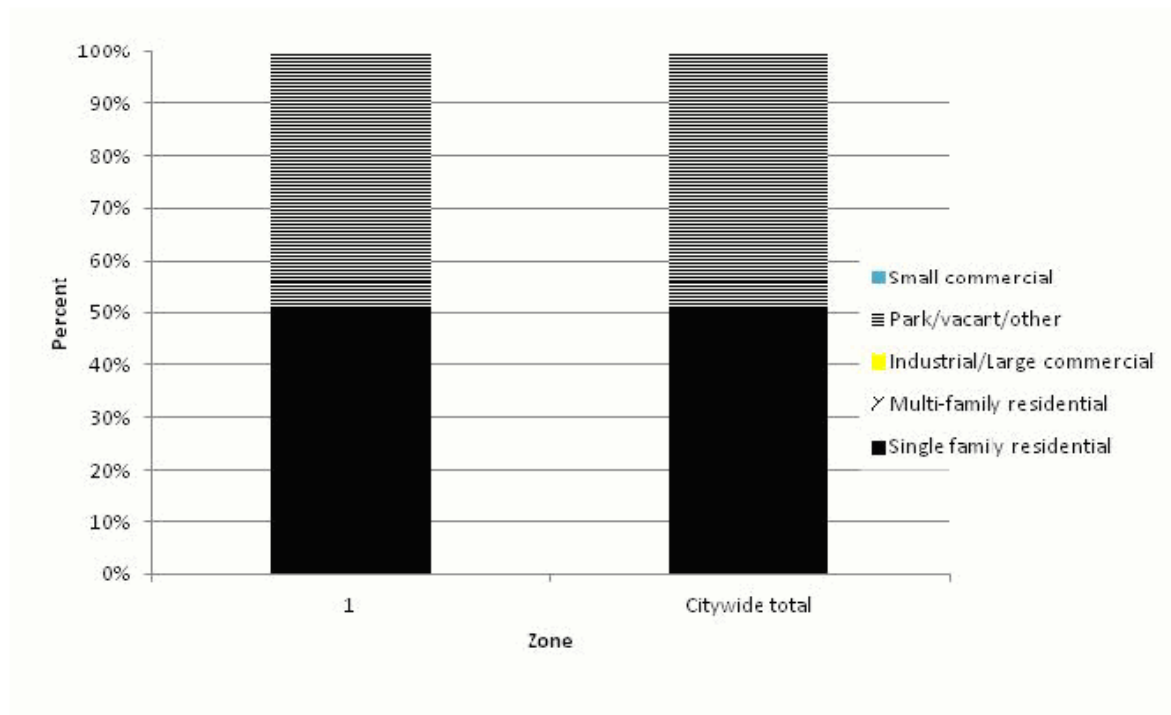
Zone	Acres	% of Total Canopy Cover
1	4	100.0
Citywide total	4	100.0

	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	4		

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

1/18/2012

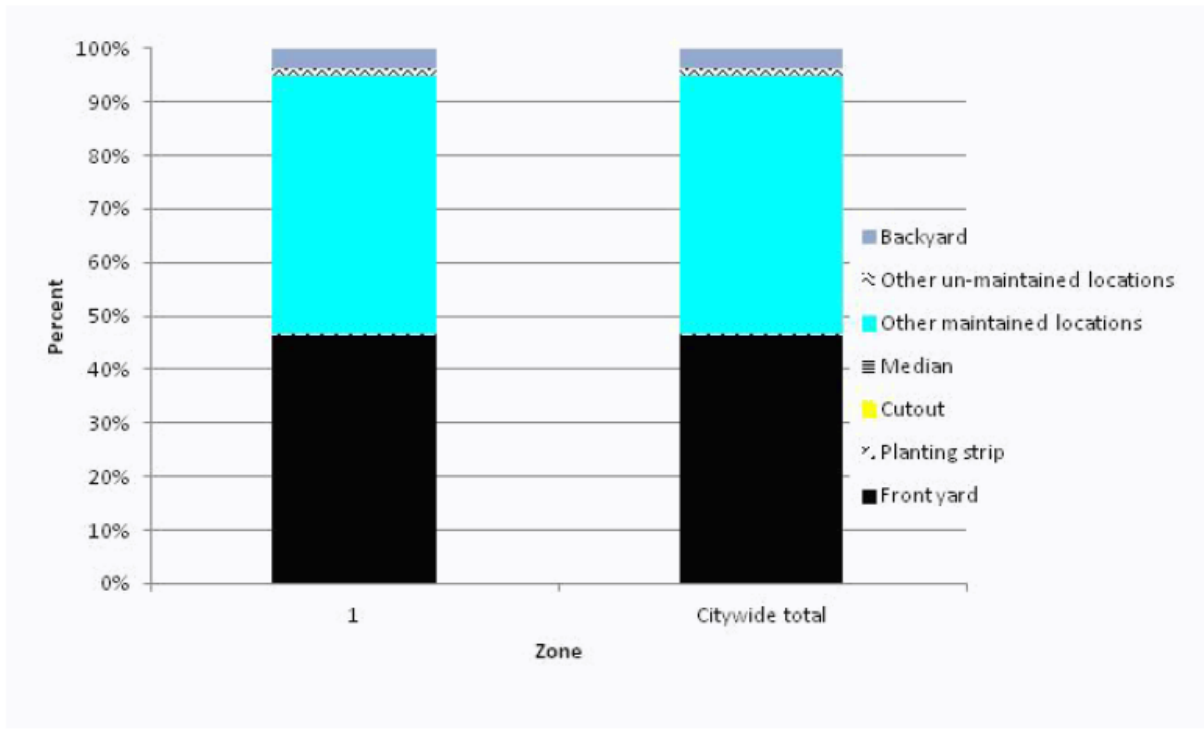


Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	50.9	0.0	0.0	49.1	0.0
Citywide total	50.9	0.0	0.0	49.1	0.0

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

1/18/2012



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	46.5	0.2	0.0	0.0	48.4	1.2	3.7
Citywide total	46.5	0.2	0.0	0.0	48.4	1.2	3.7

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

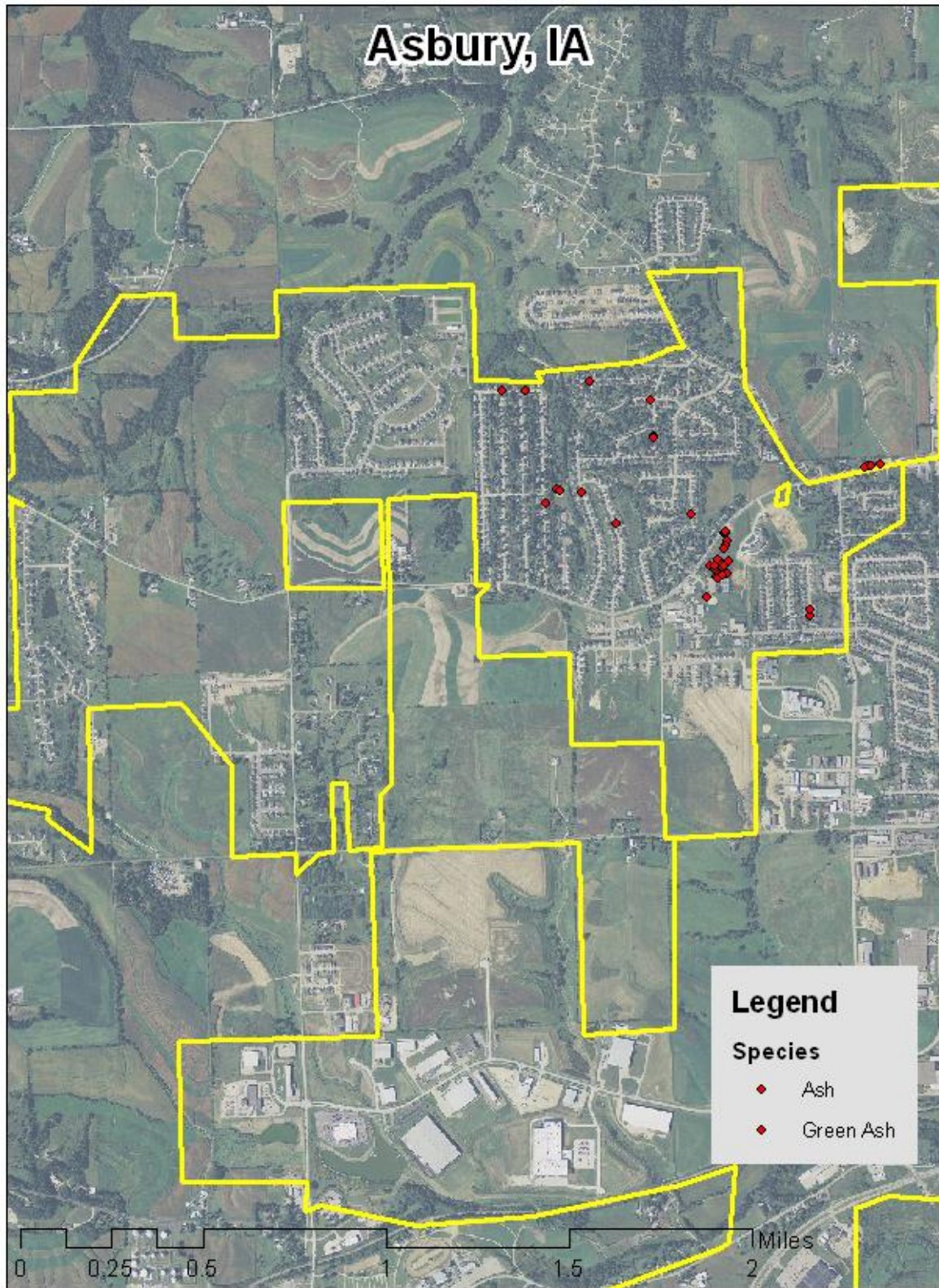


Figure 1: Location of Ash Trees

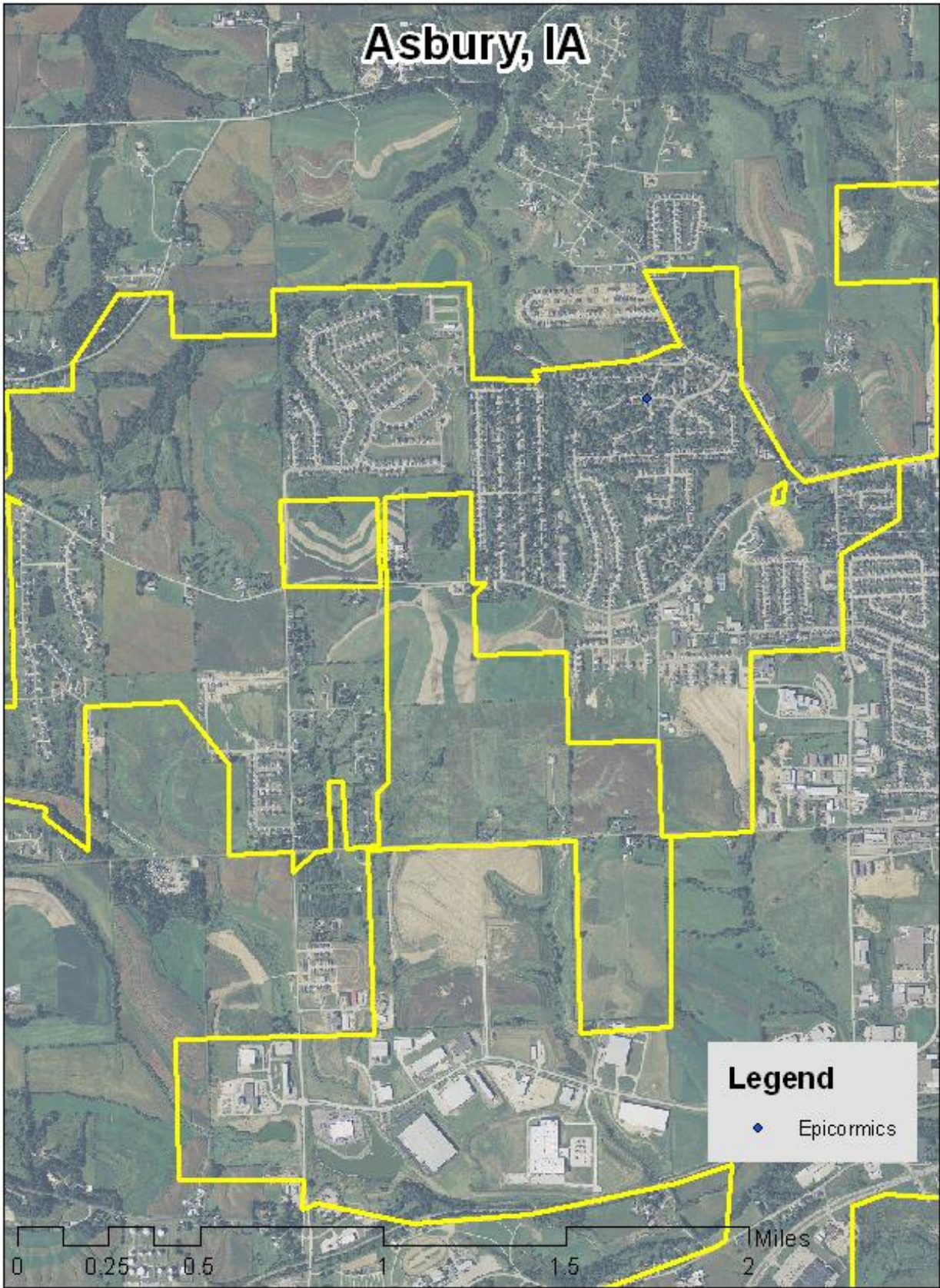


Figure 2: Location of EAB symptoms

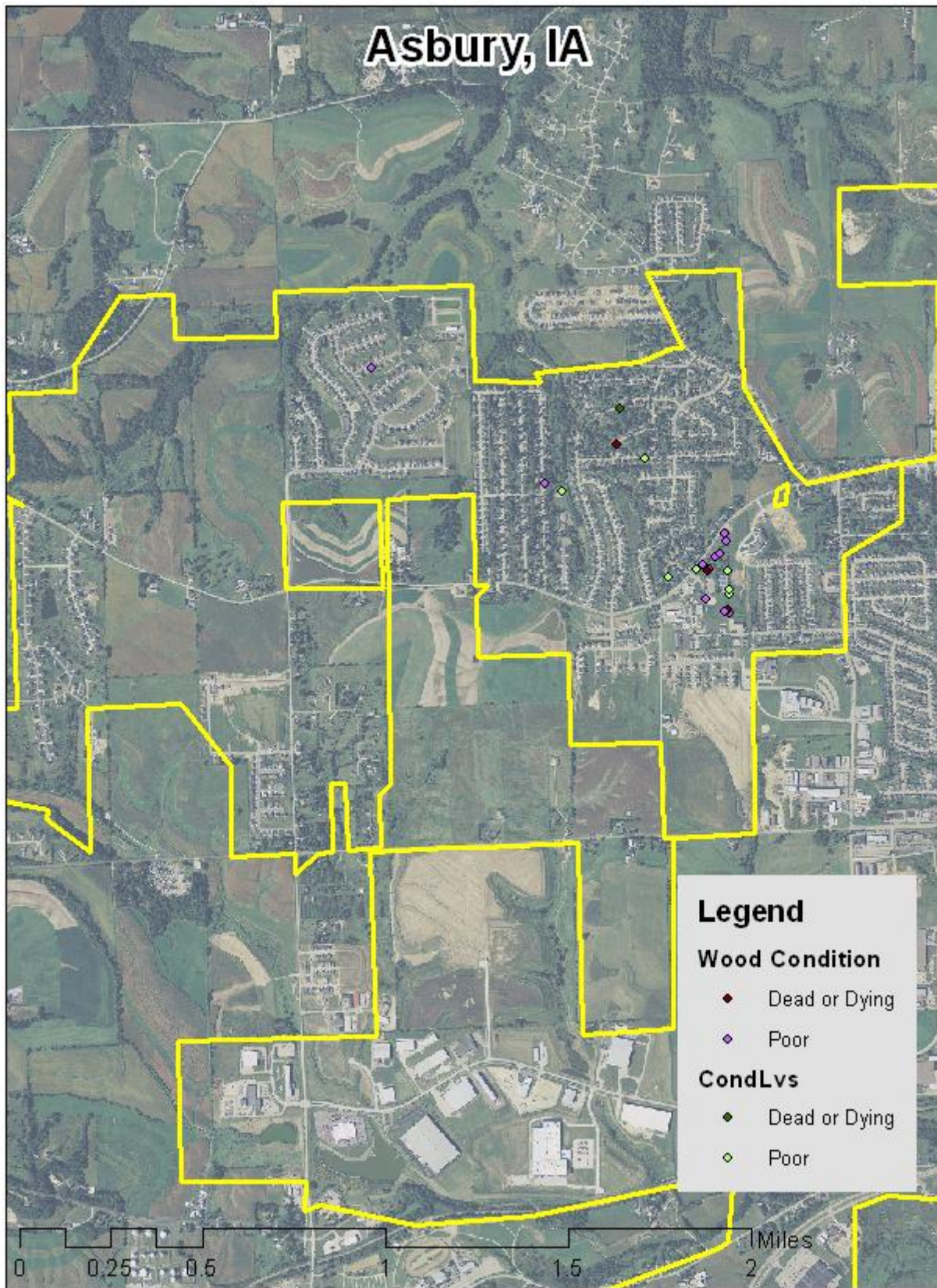


Figure 3: Location of Poor Condition Trees

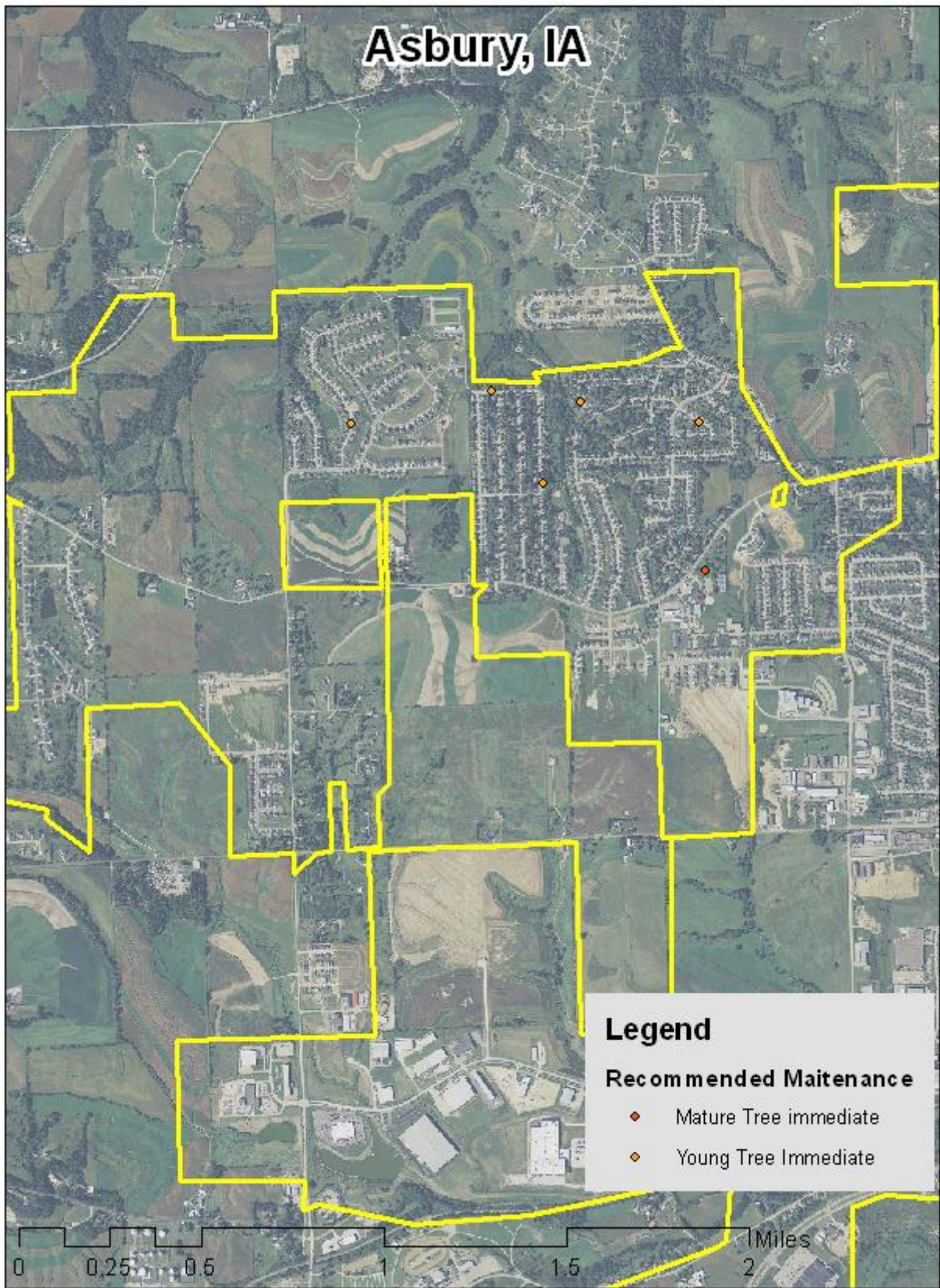


Figure 4: Location of Trees with Recommended Maintenance

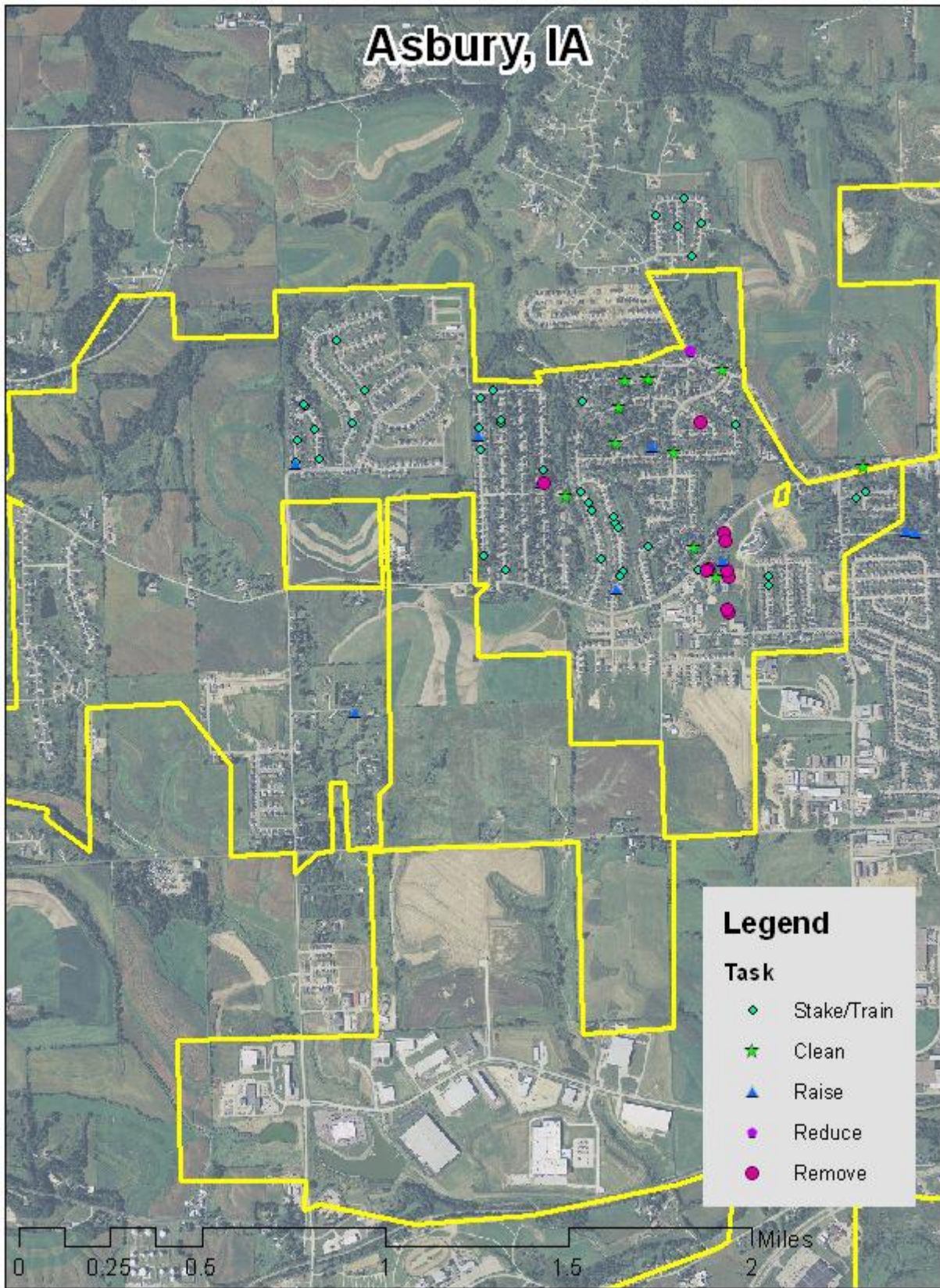


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Asbury's Tree Ordinances

CHAPTER 151

TREES

151.01 Definition
151.02 Planting Restrictions
151.03 Duty to Trim Trees

151.04 Trimming Trees to be Supervised
151.05 Disease Control
151.06 Inspection and Removal

151.01 DEFINITION. For use in this chapter, —parking‖ 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 parking or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the parking 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 parking 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 fifteen (15) feet above the surface of the street 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 dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

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 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 fourteen (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])

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.