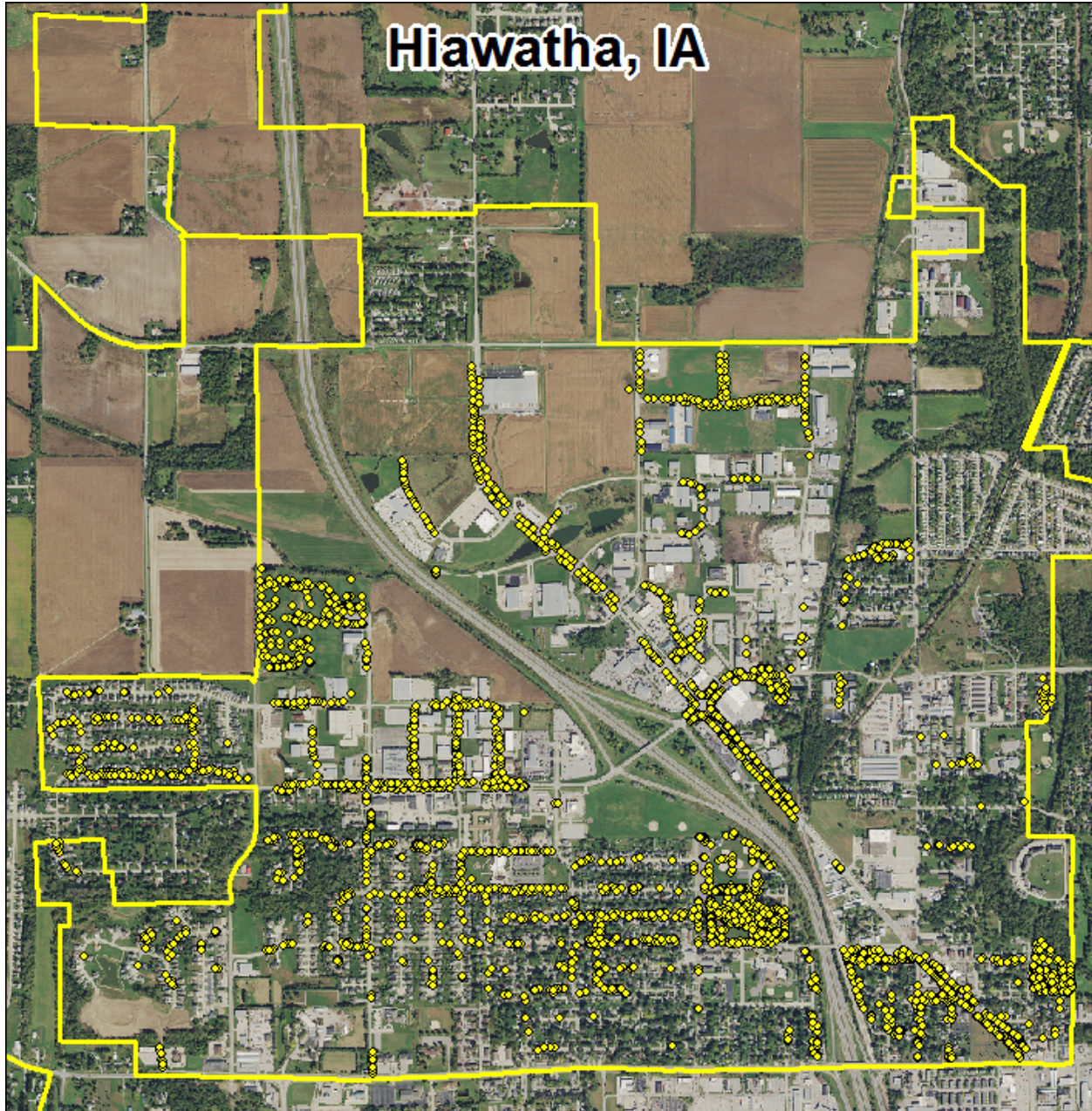


Hiawatha, IA



2017 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Hiawatha 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 13% (385) of Hiawatha's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. 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 2016, 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 2,961 trees inventoried.

- Hiawatha's trees provide \$240,066 of benefits annually, an average of \$81 a tree
- There are over 60 species of trees, but only 10 species count for 61% of the public trees
- The top three genera are: Maple 25%, Apple (Crabapple) 14%, and Ash 13%
- 28% of trees are in need of some type of management
- 109 trees are recommended for removal and 33 are of critical concern.

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 109 trees needing removal, 12 trees are 24 inches in diameter or greater at 4.5 ft and must be addressed immediately. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 89 of the 385 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation. All ash should be checked annually.
- 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 in the city right-of-way: any fruit bearing trees, ash, cottonwood, poplar, boxelder, Chinese elm, evergreen, weeping willow, silver maple, tree-of-heaven, catalpa, mulberry or pin oak. It is also recommended that a moratorium be placed on the planting of all maple on public sites until the percent falls below 20 (Currently 25%).
- With the current budget it could take ~29 years to just remove ash—Suggestion: request a budget increase to \$38,500 annually and apply for grants to plant replacement trees.

Introduction

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

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

Inventory

In 2016, a tree inventory was conducted that included 100% of the city owned trees on both streets 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 associated with 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 2,961 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Hiawatha's trees reduce energy related costs by approximately \$68,424 annually (Appendix A, Table 1). These savings are both in Electricity (326.9 MWh) and in Natural Gas (44,502.7 Therms).

Annual Stormwater Benefits

Hiawatha's trees intercept about 2,754,154 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$74,638 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 Hiawatha, it is estimated that trees remove 3,987.9 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 \$11,224 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Hiawatha, trees sequester about 1,209,470 lbs of carbon a year with an associated value of \$9,071 (Appendix A, Table 5). In addition, the trees store 9,492,875 lbs of carbon, with a yearly benefit of \$71,197 (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. Hiawatha receives \$76,710 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, Hiawatha's trees provide \$240,066 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 2,961 trees in Hiawatha provide approximately \$81 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Hiawatha has over 60 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	742	25%
Apple (Crabapple)	408	14%
Ash	385	13%
Oak	186	6%
Honeylocust	156	5%
Broadleaf Deciduous Small	144	5%
Callery Pear/Pear	128	4%
Linden/Basswood	109	4%
Black Walnut	88	3%
Conifer/Evergreen Large	72	2%

Age Class

Most of Hiawatha's trees (70%) are between 1 and 12 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Hiawatha's size curve is on the smaller side, indicating a younger than average stand. This also means many ash are smaller, which could significantly reduce average removal cost.

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 Hiawatha indicate that 88% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Only, 57% of Hiawatha'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 15% of the population. This 15% 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 Raising	537	18%
Crown Cleaning	147	5%
Tree Removal	109	4%
Tree Staking	28	1%
Crown Reduction	13	<1%

Canopy Cover

The total canopy with both private and public trees is 17%, 460 acres. The canopy cover included in the Hiawatha inventory includes approximately 33 acres (Appendix A, Figure 4). The City's Canopy goal is 3%, in 30 years. To achieve this goal it is estimated that 1,974 trees need to be planted annually.

Land Use and Location

Hiawatha's city and park trees are mostly in planting strips mixed within a number of different land use areas (Appendix A, Figure 6 & Appendix A, Figure 7). The following describes the land use and locations for the street and park trees.

Land Use

Single family residential	33%
Park/vacant/other	31%
Industrial/Large commercial	19%
Small commercial	15%
Multifamily residential	1%

Location

Planting strip	81%
Front yard	18%

Recommendations

Risk Management

Hazardous/risk 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.

Risk trees

Hiawatha has 33 trees that need removal considered critical concern, plus there are another 76 that need to be considered for 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 trees first. There are 12 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the trees needing to be addressed within the next year are removed, there should be follow up on the trees marked as needing maintenance.

Poor tree species

After the removal of the immediate concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 109 removals, 20 are ash trees and 4 of these trees are of critical concern. There are a total of 385 ash trees, and 89 of those have signs and symptoms that have been associated with EAB. ***City ownership of the trees recommended for removal should be verified prior to any removal***

Pruning Cycle

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

Planting

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

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 (25%) (Appendix A, Figure 1). Maples should not be planted on public property 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 prohibited include: fruit bearing trees, ash, cottonwood, poplar, box elder, Chinese elm, evergreen, weeping willow, silver maple, tree-of-heaven, catalpa, mulberry or pin oak as outlined in section 151.02 #3 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Continual Monitoring

Due to the threat of EAB **and the fact it is just north in Toddville**, 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 decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Six Year Maintenance Plan with No Additional Funding

Year 1

Tree Removal: \$8,000 @ ~\$600 to \$800/tree can remove 13 to 10 trees

Tree Maintenance: \$6,200

EAB Management: \$0 currently

Planting & Care: \$5,000 @\$100/tree can plant 50 trees

Management: \$6,840

Year 2

Removal: Up to 13 trees/year @~600/tree

Planting and Replacement: Up to 50 trees @\$100/tree

Young Tree Pruning & Maintenance:

Routine trimming: Contract to trim 1/3 of the city trees up to \$6,200 annually

Visual Survey for signs and symptoms of EAB

Year 3

Removal: Up to 13 trees/year @~600/tree

Planting and Replacement: Up to 50 trees @\$100/tree

Young Tree Pruning & Maintenance: Begin developmental pruning when needed

Routine trimming:

Visual Survey for signs and symptoms of EAB

Year 4

Removal: Up to 13 trees/year @~600/tree

Planting and Replacement: Up to 50 trees @\$100/tree

Young Tree Pruning & Maintenance: Begin developmental pruning when needed

Routine trimming: Contract to trim 1/3 of the city trees up to \$6,200 annually

Visual Survey for signs and symptoms of EAB

Year 5

Removal: Up to 13 trees/year @~600/tree

Planting and Replacement: Up to 50 trees @\$100/tree

Young Tree Pruning & Maintenance: Begin developmental pruning when needed

Visual Survey for signs and symptoms of EAB

Year 6

Removal: Up to 13 trees/year @~600/tree

Planting and Replacement: Up to 50 trees @\$100/tree

Routine trimming: Contract to trim 1/3 of the city trees

Young Tree Pruning & Maintenance: Begin developmental pruning when needed

Visual Survey for signs and symptoms of EAB

***Using the current tree removal budget at \$600/tree it would take ~29 years just to remove the existing public ash trees (385). This would not include cost of removing the 89 non-ash tree species listed to be removed. ** To remove all ash trees within 6 years, the budget would need to be increased to \$38,500 a year. If the current budget were increased to \$10,000 a year all ash could be removed in 23 years, and all ash 385) plus all other species needing removal (89)**

could be removed in 28 years. The concern is EAB could potentially kill all ash trees in the area in the next 4 to 15 years now that it is present in Linn County and close in Toddville.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). ***City ownership of the tree recommended for removal should be verified prior to any removal***

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. **EAB is in Linn County and in Toddville.** For more information on the cost of treatment strategies visit <http://extension.entm.purdue.edu/treecomputer/>

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of 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.

Currently, in Iowa the only quarantine related to this pest and associated regulated items is a Federal Quarantine that does not allow the movement of regulated items outside of Iowa into non-quarantined areas.

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? **There is no state quarantine in Iowa that restricts the movement of ash material and/or hardwood firewood within the boundaries of the state, but with that said communities are strongly encouraged to utilize any ash material locally and limit movement outside of the county.**

Canopy Replacement

As budget permits, all removed trees will be replaced. Species to avoid because they are prohibited include: fruit bearing trees, ash, cottonwood, poplar, box elder, Chinese elm, evergreen, weeping willow, silver maple, tree-of-heaven, catalpa, mulberry or pin oak as outlined in section 151.02 #3 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Postponed Work

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

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. City Code 15.06 # 2 states: **“Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees with the City is imminent, the Council shall immediately notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within (14) days of receipt of notice, the Council may cause the nuisance to be removed and the cost assessed against the property.”**

Budget

Current Budget

Total \$156,240 over 6 years (\$26,040/year)

Annual Budget:

Removal: \$8,000

*Or saving for ash tree treatment and/or future ash removal

Planting & Initial Care: \$5,000

Maintenance: \$6,200

Management: \$6,840

* Reduction of ash over 6 years: Approximately 64 ash trees removed annually (approximately 17% of ash) at a cost of \$38,500 a year (~\$600/tree for removal). **A significant portion of the ash are 18 inches in diameter or less which will most likely decrease the cost of removal per tree. **It will take approximately 29 years to remove all ash with the current budget.**

Purposed Budget Increase

EAB could potentially kill all ash trees in Hiawatha within 4 to 15 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to \$38,500 a year. If the budget were increased to \$10,000 a year all ash could be removed within 23 years. **This does not include an increase for the other 89 non-ash species needing removal. **Since EAB is already in Linn County (Toddville) and if Hiawatha chooses not to treat any ash trees the community may want to consider proactively starting now to reduce the population of ash (while many trees are still small in diameter) before trees begin to die on their own at a fairly quick rate.** Additionally, it is recommended that Hiawatha 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.

Another option being considered by some communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, if the average ash diameter is 12 inches and at \$15 per inch, it would cost ~\$180 every two years to treat 1 tree. Selecting 25 high quality ash trees and treating them every two years would cost ~\$4,500 for each two-year treatment or basically at a \$2,250 rate annually for the 25 trees. This is an alternative to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees when EAB is found in Hiawatha. It is suggested to consider increasing the budget to plan for this.

Works Cited

Census Bureau. 2010. <http://censtats.census.gov/data/IA/1601964290.pdf> (April, 2013)

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

Hiawatha

Annual Energy Benefits of Public Trees

4/28/2017

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	14.8	1,124	2,387.2	2,339	3,464	(N/A)	13.8	5.1	8.49
Green ash	45.7	3,468	5,920.4	5,802	9,270	(N/A)	8.1	13.5	38.46
Silver maple	46.3	3,515	6,099.7	5,978	9,493	(N/A)	7.5	13.9	42.57
Honeylocust	20.4	1,550	2,717.2	2,663	4,213	(N/A)	5.3	6.2	27.01
Broadleaf Deciduous Small	0.9	69	153.9	151	220	(N/A)	5.0	0.3	1.49
Norway maple	15.1	1,149	2,232.3	2,188	3,336	(N/A)	4.9	4.9	23.01
White ash	19.4	1,476	2,420.6	2,372	3,848	(N/A)	4.6	5.6	28.51
Maple	9.4	715	1,309.5	1,283	1,999	(N/A)	4.4	2.9	15.37
Red maple	13.0	984	1,745.7	1,711	2,695	(N/A)	4.1	3.9	22.09
Sugar maple	9.5	721	1,280.7	1,255	1,976	(N/A)	3.9	2.9	17.18
Callery pear	7.2	548	1,045.6	1,025	1,572	(N/A)	3.2	2.3	16.55
Black walnut	24.9	1,887	3,406.6	3,338	5,225	(N/A)	3.0	7.6	59.38
Littleleaf linden	6.8	518	927.8	909	1,427	(N/A)	2.4	2.1	19.82
Conifer Evergreen Large	3.5	262	470.2	461	723	(N/A)	2.4	1.1	10.04
Northern hackberry	2.9	223	424.1	416	638	(N/A)	2.0	0.9	11.01
Northern white cedar	0.5	40	92.8	91	131	(N/A)	1.7	0.2	2.61
Northern red oak	5.5	417	731.5	717	1,134	(N/A)	1.7	1.7	23.14
Willow	2.3	177	365.0	358	535	(N/A)	1.6	0.8	11.14
Elm	5.3	405	711.2	697	1,102	(N/A)	1.5	1.6	25.04
Bur oak	8.4	639	1,112.1	1,090	1,729	(N/A)	1.5	2.5	40.20
American basswood	6.5	494	917.2	899	1,392	(N/A)	1.2	2.0	37.63
Spruce	0.3	22	49.8	49	70	(N/A)	1.2	0.1	2.01
Pear	1.9	143	290.5	285	427	(N/A)	1.1	0.6	12.95
Japanese tree lilac	0.1	10	25.1	25	35	(N/A)	1.0	0.1	1.17
Swamp white oak	1.4	104	213.5	209	313	(N/A)	1.0	0.5	10.44
White oak	8.1	617	1,121.4	1,099	1,716	(N/A)	1.0	2.5	57.21
River birch	3.1	236	448.5	440	675	(N/A)	0.8	1.0	27.01
Oak	3.2	240	432.0	423	663	(N/A)	0.7	1.0	31.59
Siberian elm	5.9	446	745.5	731	1,177	(N/A)	0.7	1.7	56.03
Eastern cottonwood	6.3	475	822.3	806	1,281	(N/A)	0.7	1.9	60.98
Conifer Evergreen Small	0.1	6	14.0	14	20	(N/A)	0.7	0.0	0.93
Mulberry	1.9	147	281.1	275	422	(N/A)	0.6	0.6	23.44
Hickory	3.5	267	482.0	472	739	(N/A)	0.6	1.1	41.07
Cottonwood	6.0	457	818.1	802	1,258	(N/A)	0.6	1.8	69.91
Eastern redbud	0.4	27	61.8	61	88	(N/A)	0.5	0.1	5.84
American sycamore	2.2	168	292.9	287	455	(N/A)	0.3	0.7	45.51
Ash	1.2	91	177.0	173	265	(N/A)	0.3	0.4	29.43
Dogwood	0.0	2	5.6	6	8	(N/A)	0.3	0.0	0.87
American elm	2.5	188	319.3	313	501	(N/A)	0.3	0.7	55.69
Broadleaf Deciduous Medium	1.1	81	146.0	143	224	(N/A)	0.3	0.3	27.98
Ginkgo	0.4	28	42.5	42	70	(N/A)	0.2	0.1	9.96
Northern pin oak	1.2	87	157.3	154	241	(N/A)	0.2	0.4	34.49
Blue spruce	0.4	29	52.7	52	81	(N/A)	0.2	0.1	11.57
Scotch pine	1.0	73	122.3	120	193	(N/A)	0.2	0.3	27.54
Black cherry	0.7	52	105.2	103	155	(N/A)	0.2	0.2	25.81
Pin oak	1.5	115	203.9	200	315	(N/A)	0.2	0.5	52.51
Broadleaf Deciduous Large	0.2	19	29.3	29	48	(N/A)	0.2	0.1	7.92
Eastern white pine	0.0	1	3.3	3	5	(N/A)	0.2	0.0	0.93
Amur maple	0.6	42	85.7	84	126	(N/A)	0.2	0.2	25.21
Eastern red cedar	0.1	6	12.4	12	18	(N/A)	0.2	0.0	3.58
Yellowwood	0.0	1	3.2	3	4	(N/A)	0.1	0.0	1.10
Birch	0.5	36	60.6	59	96	(N/A)	0.1	0.1	23.94
Kentucky coffeetree	0.1	8	15.1	15	23	(N/A)	0.1	0.0	5.65
Tulip tree	0.2	15	27.9	27	42	(N/A)	0.1	0.1	13.98
Black spruce	0.1	10	21.6	21	31	(N/A)	0.1	0.0	10.41
Norway spruce	0.0	3	7.9	8	11	(N/A)	0.1	0.0	5.61

Japanese maple	0.0	1	1.2	1	2 (N/A)	0.1	0.0	0.87
Conifer Evergreen Medium	0.1	7	15.0	15	22 (N/A)	0.1	0.0	10.87
Lilac	0.0	1	1.2	1	2 (N/A)	0.1	0.0	0.87
Black locust	0.6	49	94.8	93	142 (N/A)	0.1	0.2	70.84
Eastern hophornbeam	0.4	30	63.2	62	92 (N/A)	0.1	0.1	46.14
Alder	0.1	6	12.8	13	18 (N/A)	0.0	0.0	18.19
Sweetbay	0.2	14	17.8	17	31 (N/A)	0.0	0.0	31.34
Ohio buckeye	0.0	0	0.8	1	1 (N/A)	0.0	0.0	1.10
Cherry plum	0.1	6	12.8	13	18 (N/A)	0.0	0.0	18.19
Common chokecherry	0.2	14	24.7	24	38 (N/A)	0.0	0.1	38.13
Black poplar	0.3	25	46.9	46	71 (N/A)	0.0	0.1	70.91
Boxelder	0.2	15	23.9	23	39 (N/A)	0.0	0.1	38.63
Red pine	0.1	10	14.6	14	24 (N/A)	0.0	0.0	24.14
Kwanzan cherry	0.0	2	3.8	4	5 (N/A)	0.0	0.0	5.40
Plum	0.0	0	0.6	1	1 (N/A)	0.0	0.0	0.87
Total	326.9	24,811	44,502.7	43,613	68,424 (N/A)	100.0	100.0	23.11

Table 2: Annual Stormwater Benefits

Hiawatha						
Annual Stormwater Benefits of Public Trees						
4/28/2017						
Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	54,682	1,482 (N/A)		13.8	2.0	3.63
Green ash	370,720	10,047 (N/A)		8.1	13.5	41.69
Silver maple	545,258	14,776 (N/A)		7.5	19.8	66.26
Honeylocust	124,165	3,365 (N/A)		5.3	4.5	21.57
Broadleaf Deciduous Small	3,051	83 (N/A)		5.0	0.1	0.56
Norway maple	89,018	2,412 (N/A)		4.9	3.2	16.64
White ash	134,502	3,645 (N/A)		4.6	4.9	27.00
Maple	50,861	1,378 (N/A)		4.4	1.8	10.60
Red maple	80,169	2,173 (N/A)		4.1	2.9	17.81
Sugar maple	67,545	1,830 (N/A)		3.9	2.5	15.92
Callery pear	39,970	1,083 (N/A)		3.2	1.5	11.40
Black walnut	281,559	7,630 (N/A)		3.0	10.2	86.71
Littleleaf linden	42,322	1,147 (N/A)		2.4	1.5	15.93
Conifer Evergreen Large	39,727	1,077 (N/A)		2.4	1.4	14.95
Northern hackberry	21,250	576 (N/A)		2.0	0.8	9.93
Northern white cedar	5,389	146 (N/A)		1.7	0.2	2.92
Northern red oak	44,878	1,216 (N/A)		1.7	1.6	24.82
Willow	14,642	397 (N/A)		1.6	0.5	8.27
Elm	51,171	1,387 (N/A)		1.5	1.9	31.52
Bur oak	84,088	2,279 (N/A)		1.5	3.1	53.00
American basswood	51,710	1,401 (N/A)		1.2	1.9	37.87
Spruce	3,346	91 (N/A)		1.2	0.1	2.59
Pear	6,687	181 (N/A)		1.1	0.2	5.49
Japanese tree lilac	346	9 (N/A)		1.0	0.0	0.31
Swamp white oak	7,134	193 (N/A)		1.0	0.3	6.44
White oak	103,373	2,801 (N/A)		1.0	3.8	93.38
River birch	21,347	578 (N/A)		0.8	0.8	23.14
Oak	28,562	774 (N/A)		0.7	1.0	36.83
Siberian elm	58,778	1,593 (N/A)		0.7	2.1	75.85
Eastern cottonwood	69,660	1,888 (N/A)		0.7	2.5	89.89
Conifer Evergreen Small	514	14 (N/A)		0.7	0.0	0.66
Mulberry	7,383	200 (N/A)		0.6	0.3	11.12
Hickory	29,645	803 (N/A)		0.6	1.1	44.63
Cottonwood	72,662	1,969 (N/A)		0.6	2.6	109.40
Eastern redbud	1,189	32 (N/A)		0.5	0.0	2.15
American cycamore	31,636	857 (N/A)		0.3	1.1	85.73
Ash	6,920	188 (N/A)		0.3	0.3	20.84
Dogwood	67	2 (N/A)		0.3	0.0	0.20
American elm	21,041	570 (N/A)		0.3	0.8	63.36
Broadleaf Deciduous Medium	6,160	167 (N/A)		0.3	0.2	20.87
Cranberry	1,546	42 (N/A)		0.2	0.1	5.98
Northern pin oak	7,618	206 (N/A)		0.2	0.3	29.49
Blue spruce	4,433	120 (N/A)		0.2	0.2	17.16
Scotch pine	17,390	471 (N/A)		0.2	0.6	67.32
Black cherry	3,355	91 (N/A)		0.2	0.1	15.15
Pin oak	14,717	399 (N/A)		0.2	0.5	66.47
Broadleaf Deciduous Large	1,555	42 (N/A)		0.2	0.1	7.02
Eastern white pine	244	7 (N/A)		0.2	0.0	1.32
Amur maple	2,438	66 (N/A)		0.2	0.1	13.22
Eastern red cedar	916	25 (N/A)		0.2	0.0	4.97
Yellowwood	49	1 (N/A)		0.1	0.0	0.33
Birch	2,843	77 (N/A)		0.1	0.1	19.26
Kentucky coffeetree	662	18 (N/A)		0.1	0.0	4.48
Tulip tree	1,234	33 (N/A)		0.1	0.0	11.14
Black spruce	1,549	42 (N/A)		0.1	0.1	13.99
Norway spruce	426	12 (N/A)		0.1	0.0	5.77
Japanese maple	15	0 (N/A)		0.1	0.0	0.20
Conifer Evergreen Medium	1,012	27 (N/A)		0.1	0.0	13.71
Lilac	15	0 (N/A)		0.1	0.0	0.20
Black locust	7,529	204 (N/A)		0.1	0.3	102.01
Eastern hophornbeam	2,348	64 (N/A)		0.1	0.1	31.82
Alder	264	7 (N/A)		0.0	0.0	7.17
Sweetbay	913	25 (N/A)		0.0	0.0	24.73
Ohio buckeye	12	0 (N/A)		0.0	0.0	0.33
Cherry plum	264	7 (N/A)		0.0	0.0	7.17
Common chokecherry	667	18 (N/A)		0.0	0.0	18.06
Black poplar	3,943	107 (N/A)		0.0	0.1	106.85
Boxelder	1,456	39 (N/A)		0.0	0.1	39.46
Red pine	1,539	42 (N/A)		0.0	0.1	41.70
Kwanzan cherry	69	2 (N/A)		0.0	0.0	1.86
Plum	7	0 (N/A)		0.0	0.0	0.20
Citywide total	2,754,154	74,638 (N/A)		100.0	100.0	25.21

Table 3: Annual Air Quality Benefits

Hiawatha

Annual Air Quality Benefits of Public Trees

4/28/2017

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								
Apple	12.1	2.0	6.3	0.6	66	73.9	10.5	10.0	67.1	452	-0.1	0	182.4	518 (N/A)		13.8	1.27
Green ash	35.1	5.6	18.9	1.6	193	215.1	31.5	30.1	207.1	1,348	0.0	0	545.0	1,540 (N/A)		8.1	6.39
Silver maple	82.7	14.0	42.4	3.7	451	218.5	32.0	30.5	209.6	1,367	-48.9	-183	584.5	1,634 (N/A)		7.5	7.33
Honeylocust	19.6	3.2	9.9	0.9	106	96.7	14.1	13.5	92.5	604	-12.6	-47	237.8	663 (N/A)		5.3	4.25
Broadleaf Deciduous Small	0.7	0.1	0.4	0.0	4	4.6	0.7	0.6	4.1	28	0.0	0	11.2	32 (N/A)		5.0	0.21
Norway maple	11.2	1.9	6.6	0.5	63	73.8	10.6	10.1	68.7	456	-3.3	-12	180.2	508 (N/A)		4.9	3.50
White ash	8.6	1.4	5.6	0.4	50	90.6	13.4	12.8	88.1	570	0.0	0	220.8	620 (N/A)		4.6	4.59
Maple	7.1	1.2	4.0	0.3	40	45.0	6.6	6.2	42.7	280	-2.9	-11	110.3	310 (N/A)		4.4	2.38
Red maple	14.2	2.4	7.3	0.6	77	61.5	9.0	8.6	58.8	384	-5.3	-20	157.0	442 (N/A)		4.1	3.62
Sugar maple	6.6	1.1	3.9	0.3	38	45.1	6.6	6.3	43.0	281	-5.7	-21	107.2	298 (N/A)		3.9	2.59
Callery pear	4.7	0.8	2.9	0.2	27	35.0	5.1	4.8	32.8	217	-1.4	-5	84.9	239 (N/A)		3.2	2.51
Black walnut	39.4	6.3	18.5	1.8	209	118.7	17.3	16.5	112.7	740	0.0	0	331.2	949 (N/A)		3.0	10.78
Littleleaf linden	4.8	0.8	2.8	0.2	27	32.6	4.7	4.5	31.0	203	-2.7	-10	78.7	220 (N/A)		2.4	3.05
Conifer Evergreen Large	3.6	0.7	3.4	0.4	25	16.4	2.4	2.3	15.6	102	-13.4	-50	31.5	77 (N/A)		2.4	1.07
Northern hackberry	2.6	0.4	1.5	0.1	14	14.2	2.1	2.0	13.3	88	0.0	0	36.2	103 (N/A)		2.0	1.77
Northern white cedar	0.1	0.0	0.3	0.0	1	2.7	0.4	0.4	2.4	16	-1.6	-6	4.6	12 (N/A)		1.7	0.23
Northern red oak	8.8	1.5	4.4	0.4	48	26.0	3.8	3.6	24.9	163	-12.5	-47	61.0	164 (N/A)		1.7	3.34
Willow	1.9	0.3	1.1	0.1	11	11.6	1.7	1.6	10.6	71	-0.6	-2	28.3	80 (N/A)		1.6	1.66
Elm	5.7	0.9	2.8	0.3	30	25.3	3.7	3.5	24.2	158	0.0	0	66.3	188 (N/A)		1.5	4.28
Bur oak	9.8	1.6	4.8	0.4	53	39.8	5.8	5.6	38.2	249	0.0	0	106.0	302 (N/A)		1.5	7.01
American basswood	5.6	1.0	3.1	0.2	31	31.4	4.5	4.3	29.5	195	-5.3	-20	74.3	206 (N/A)		1.2	5.57
Spruce	0.2	0.0	0.2	0.0	1	1.5	0.2	0.2	1.3	9	-1.1	-4	2.5	6 (N/A)		1.2	0.17
Pear	1.6	0.3	0.8	0.1	9	9.3	1.3	1.3	8.5	57	0.0	0	23.1	66 (N/A)		1.1	1.99
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.7	0.1	0.1	0.6	4	0.0	0	1.6	4 (N/A)		1.0	0.15
Swamp white oak	0.7	0.1	0.5	0.0	4	6.8	1.0	0.9	6.2	42	-0.2	-1	16.0	45 (N/A)		1.0	1.50
White oak	15.4	2.5	7.0	0.7	81	38.9	5.7	5.4	36.9	242	0.0	0	112.4	323 (N/A)		1.0	10.77
River birch	3.4	0.6	1.8	0.2	19	15.1	2.2	2.1	14.1	93	-0.9	-3	38.5	109 (N/A)		0.8	4.35
Oak	2.8	0.5	1.5	0.1	15	15.1	2.2	2.1	14.3	94	0.0	0	38.6	109 (N/A)		0.7	5.21
Siberian elm	9.9	1.7	4.8	0.4	53	27.5	4.0	3.9	26.6	173	0.0	0	78.9	226 (N/A)		0.7	10.76
Eastern cottonwood	10.8	1.7	5.0	0.5	57	29.6	4.3	4.1	28.3	185	0.0	0	84.4	242 (N/A)		0.7	11.52
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	-0.2	-1	0.7	2 (N/A)		0.7	0.09
Mulberry	2.1	0.4	1.0	0.1	11	9.4	1.4	1.3	8.7	58	0.0	0	24.3	69 (N/A)		0.6	3.85
Hickory	2.7	0.4	1.5	0.1	15	16.8	2.4	2.3	15.9	105	0.0	0	42.2	119 (N/A)		0.6	6.64
Cottonwood	11.0	1.8	5.1	0.5	58	28.7	4.2	4.0	27.3	179	0.0	0	82.4	237 (N/A)		0.6	13.15
Eastern redbud	0.2	0.0	0.1	0.0	1	1.8	0.3	0.2	1.6	11	0.0	0	4.2	12 (N/A)		0.5	0.80

American sycamore	6.6	1.1	2.9	0.3	34	10.5	1.5	1.5	10.0	66	0.0	0	34.4	100 (N/A)	0.3	10.00
Ash	0.8	0.1	0.5	0.0	5	5.9	0.8	0.8	5.5	36	-0.2	-1	14.3	40 (N/A)	0.3	4.46
Dogwood	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.3	0.11
American elm	3.3	0.6	1.7	0.1	18	11.7	1.7	1.6	11.2	73	0.0	0	32.0	91 (N/A)	0.3	10.13
Broadleaf Deciduous Medium	0.8	0.1	0.5	0.0	5	5.1	0.7	0.7	4.8	32	-0.2	-1	12.6	36 (N/A)	0.3	4.44
Ginkgo	0.3	0.0	0.1	0.0	1	1.7	0.3	0.2	1.7	11	-0.1	0	4.2	12 (N/A)	0.2	1.69
Northern pin oak	1.2	0.2	0.6	0.1	7	5.5	0.8	0.8	5.2	34	-0.3	-1	14.1	40 (N/A)	0.2	5.69
Blue spruce	0.5	0.1	0.4	0.1	3	1.8	0.3	0.3	1.8	11	-1.5	-6	3.7	9 (N/A)	0.2	1.31
Scotch pine	2.0	0.4	1.7	0.3	13	4.5	0.7	0.6	4.4	28	-8.9	-33	5.6	8 (N/A)	0.2	1.18
Black cherry	1.1	0.2	0.5	0.1	6	3.4	0.5	0.5	3.1	21	0.0	0	9.3	27 (N/A)	0.2	4.44
Pin oak	2.4	0.4	1.3	0.1	13	7.2	1.1	1.0	6.9	45	-4.5	-17	15.8	41 (N/A)	0.2	6.87
Broadleaf Deciduous Large	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.8	8 (N/A)	0.2	1.31
Eastern white pine	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.1	0 (N/A)	0.2	0.05
Amur maple	0.7	0.1	0.3	0.0	4	2.7	0.4	0.4	2.5	17	0.0	0	7.2	21 (N/A)	0.2	4.14
Eastern red cedar	0.1	0.0	0.1	0.0	1	0.4	0.1	0.1	0.3	2	-0.5	-2	0.5	1 (N/A)	0.2	0.21
Yellowwood	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)	0.1	0.14
Birch	0.4	0.1	0.2	0.0	2	2.2	0.3	0.3	2.2	14	-0.1	0	5.7	16 (N/A)	0.1	4.03
Kentucky coffeetree	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.1	0.81
Tulip tree	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.2	6 (N/A)	0.1	2.02
Black spruce	0.1	0.0	0.1	0.0	1	0.7	0.1	0.1	0.6	4	-0.5	-2	1.3	3 (N/A)	0.1	1.08
Norway spruce	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.1	0	0.4	1 (N/A)	0.1	0.56
Japanese maple	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.1	0.11
Conifer Evergreen Medium	0.1	0.0	0.1	0.0	1	0.5	0.1	0.1	0.4	3	-0.3	-1	0.9	2 (N/A)	0.1	1.14
Lilac	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.1	0.11
Black locust	1.7	0.3	0.8	0.1	9	3.1	0.5	0.4	2.9	19	-0.4	-1	9.5	27 (N/A)	0.1	13.58
Eastern hophornbeam	0.9	0.1	0.4	0.0	5	2.0	0.3	0.3	1.8	12	0.0	0	5.8	17 (N/A)	0.1	8.35
Alder	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.0	2.55
Sweetbay	0.2	0.0	0.2	0.0	1	0.8	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.0	6.61
Ohio buckeye	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	0.14
Cherry plum	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.0	2.55
Common chokecherry	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.0	6.56
Black poplar	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12 (N/A)	0.0	12.48
Boxelder	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6 (N/A)	0.0	6.37
Red pine	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3 (N/A)	0.0	2.82
Kwanzan cherry	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.0	0.71
Plum	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	0.11
Citywide total	370.3	61.5	193.4	17.1	2,027	1,557.7	227.0	216.5	1,481.4	9,711	-137.0	-514	3,987.9	11,224 (N/A)	100.0	3.79

Table 4: Annual Carbon Stored

Hiawatha

Stored CO2 Benefits of Public Trees

4/28/2017

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	216,302	1,622	(N/A)	13.8	2.3	3.98
Green ash	1,170,599	8,779	(N/A)	8.1	12.3	36.43
Silver maple	1,997,033	14,978	(N/A)	7.5	21.0	67.16
Honeylocust	243,286	1,825	(N/A)	5.3	2.6	11.70
Broadleaf Deciduous	12,120	91	(N/A)	5.0	0.1	0.61
Norway maple	200,125	1,501	(N/A)	4.9	2.1	10.35
White ash	282,643	2,120	(N/A)	4.6	3.0	15.70
Maple	96,917	727	(N/A)	4.4	1.0	5.59
Red maple	171,515	1,286	(N/A)	4.1	1.8	10.54
Sugar maple	198,444	1,488	(N/A)	3.9	2.1	12.94
Callery pear	86,406	648	(N/A)	3.2	0.9	6.82
Black walnut	1,320,785	9,906	(N/A)	3.0	13.9	112.57
Littleleaf linden	114,948	862	(N/A)	2.4	1.2	11.97
Conifer Evergreen La	24,937	187	(N/A)	2.4	0.3	2.60
Northern hackberry	36,256	272	(N/A)	2.0	0.4	4.69
Northern white cedar	766	6	(N/A)	1.7	0.0	0.11
Northern red oak	179,234	1,344	(N/A)	1.7	1.9	27.43
Willow	35,340	265	(N/A)	1.6	0.4	5.52
Elm	189,273	1,420	(N/A)	1.5	2.0	32.26
Bur oak	327,990	2,460	(N/A)	1.5	3.5	57.21
American basswood	210,733	1,580	(N/A)	1.2	2.2	42.72
Spruce	849	6	(N/A)	1.2	0.0	0.18
Pear	26,465	198	(N/A)	1.1	0.3	6.01
Japanese tree lilac	742	6	(N/A)	1.0	0.0	0.19
Swamp white oak	13,514	101	(N/A)	1.0	0.1	3.38
White oak	514,408	3,858	(N/A)	1.0	5.4	128.60
River birch	57,979	435	(N/A)	0.8	0.6	17.39
Oak	93,535	702	(N/A)	0.7	1.0	33.41
Siberian elm	244,319	1,832	(N/A)	0.7	2.6	87.26
Eastern cottonwood	368,962	2,767	(N/A)	0.7	3.9	131.77
Conifer Evergreen Sn	53	0	(N/A)	0.7	0.0	0.02
Mulberry	33,103	248	(N/A)	0.6	0.3	13.79
Hickory	87,534	657	(N/A)	0.6	0.9	36.47
Cottonwood	369,485	2,771	(N/A)	0.6	3.9	153.95
Eastern redbud	3,709	28	(N/A)	0.5	0.0	1.85
American sycamore	232,446	1,743	(N/A)	0.3	2.4	174.33
Ash	14,953	112	(N/A)	0.3	0.2	12.46
Dogwood	124	1	(N/A)	0.3	0.0	0.10
American elm	75,960	570	(N/A)	0.3	0.8	63.30
Broadleaf Deciduous	14,410	108	(N/A)	0.3	0.2	13.51
Ginkgo	3,669	28	(N/A)	0.2	0.0	3.93
Northern pin oak	20,355	153	(N/A)	0.2	0.2	21.81
Blue spruce	2,611	20	(N/A)	0.2	0.0	2.80
Scotch pine	22,091	166	(N/A)	0.2	0.2	23.67
Black cherry	17,622	132	(N/A)	0.2	0.2	22.03
Pin oak	60,234	452	(N/A)	0.2	0.6	75.29
Broadleaf Deciduous	3,733	28	(N/A)	0.2	0.0	4.67
Eastern white pine	12	0	(N/A)	0.2	0.0	0.02
Amur maple	11,773	88	(N/A)	0.2	0.1	17.66
Eastern red cedar	328	2	(N/A)	0.2	0.0	0.49
Yellowwood	67	1	(N/A)	0.1	0.0	0.13
Birch	7,282	55	(N/A)	0.1	0.1	13.65
Kentucky coffeetree	1,071	8	(N/A)	0.1	0.0	2.01
Tulip tree	2,081	16	(N/A)	0.1	0.0	5.20
Black spruce	571	4	(N/A)	0.1	0.0	1.43
Norway spruce	76	1	(N/A)	0.1	0.0	0.29
Japanese maple	28	0	(N/A)	0.1	0.0	0.10
Conifer Evergreen Mf	327	2	(N/A)	0.1	0.0	1.23
Lilac	28	0	(N/A)	0.1	0.0	0.10
Black locust	28,560	214	(N/A)	0.1	0.3	107.10
Eastern hophornbeam	13,485	101	(N/A)	0.1	0.1	50.57
Alder	908	7	(N/A)	0.0	0.0	6.81
Sweetbay	3,037	23	(N/A)	0.0	0.0	22.78
Ohio buckeye	17	0	(N/A)	0.0	0.0	0.13
Cherry plum	908	7	(N/A)	0.0	0.0	6.81
Common chokecherry	3,037	23	(N/A)	0.0	0.0	22.78
Black poplar	15,773	118	(N/A)	0.0	0.2	118.30
Boxelder	3,624	27	(N/A)	0.0	0.0	27.18
Red pine	1,170	9	(N/A)	0.0	0.0	8.78
Kwanzan cherry	178	1	(N/A)	0.0	0.0	1.33
Plum	14	0	(N/A)	0.0	0.0	0.10
Citywide total	9,492,875	71,197	(N/A)	100.0	100.0	24.04

Table 5: Annual Carbon Sequestered

Hiawatha Annual CO ₂ Benefits of Public Trees												
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
Apple	23,973	180	-1,046	-266	-10	24,851	186	47,512	356 (N/A)	13.8	3.9	0.87
Green ash	98,476	739	-5,619	-453	-46	76,636	575	169,040	1,268 (N/A)	8.1	14.0	5.26
Silver maple	167,797	1,258	-9,614	-499	-76	77,679	583	235,363	1,765 (N/A)	7.5	19.5	7.92
Honeylocust	38,709	290	-1,185	-170	-10	34,258	257	71,612	537 (N/A)	5.3	5.9	3.44
Broadleaf Deciduous Smal	1,594	12	-65	-35	-1	1,526	11	3,021	23 (N/A)	5.0	0.2	0.15
Norway maple	29,617	222	-982	-160	-9	25,389	190	53,864	404 (N/A)	4.9	4.5	2.79
White ash	39,235	294	-1,368	-188	-12	32,621	245	70,300	527 (N/A)	4.6	5.8	3.91
Maple	14,231	107	-466	-106	-4	15,807	119	29,445	221 (N/A)	4.4	2.4	1.70
Red maple	22,425	168	-824	-130	-7	21,755	163	43,226	324 (N/A)	4.1	3.6	2.66
Sugar maple	16,650	125	-975	-111	-8	15,930	119	31,494	236 (N/A)	3.9	2.6	2.05
Callery pear	13,907	105	-434	-79	-4	12,100	91	25,584	192 (N/A)	3.2	2.1	2.02
Black walnut	53,599	402	-6,340	-266	-50	41,702	313	88,695	665 (N/A)	3.0	7.3	7.56
Littleleaf linden	18,400	138	-562	-86	-5	11,440	86	29,193	219 (N/A)	2.4	2.4	3.04
Conifer Evergreen Large	3,069	23	-120	-66	-1	5,787	43	8,671	65 (N/A)	2.4	0.7	0.90
Northern hackberry	2,975	22	-175	-33	-2	4,925	37	7,691	58 (N/A)	2.0	0.6	0.99
Northern white cedar	437	3	-4	-17	0	875	7	1,291	10 (N/A)	1.7	0.1	0.19
Northern red oak	6,593	49	-861	-67	-7	9,219	69	14,884	112 (N/A)	1.7	1.2	2.28
Willow	4,094	31	-173	-31	-2	3,909	29	7,799	58 (N/A)	1.6	0.6	1.22
Elm	11,733	88	-909	-59	-7	8,942	67	19,707	148 (N/A)	1.5	1.6	3.36
Bur oak	18,469	139	-1,574	-88	-12	14,120	106	30,926	232 (N/A)	1.5	2.6	5.39
American basswood	14,605	110	-1,012	-73	-8	10,910	82	24,430	183 (N/A)	1.2	2.0	4.95
Spruce	271	2	-4	-10	0	478	4	735	6 (N/A)	1.2	0.1	0.16
Pear	2,873	22	-128	-27	-1	3,154	24	5,872	44 (N/A)	1.1	0.5	1.33
Japanese tree lilac	319	2	-5	-7	0	232	2	539	4 (N/A)	1.0	0.0	0.13
Swamp white oak	2,885	22	-72	-18	-1	2,300	17	5,095	38 (N/A)	1.0	0.4	1.27
White oak	17,988	135	-2,469	-91	-19	13,646	102	29,073	218 (N/A)	1.0	2.4	7.27
River birch	5,673	43	-285	-32	-2	5,213	39	10,599	79 (N/A)	0.8	0.9	3.17
Oak	7,346	55	-449	-34	-4	5,302	40	12,165	91 (N/A)	0.7	1.0	4.34
Siberian elm	10,400	78	-1,173	-61	-9	9,858	74	19,023	143 (N/A)	0.7	1.6	6.79
Eastern cottonwood	11,722	88	-1,771	-66	-14	10,489	79	20,375	153 (N/A)	0.7	1.7	7.28
Conifer Evergreen Small	12	0	0	-4	0	128	1	136	1 (N/A)	0.7	0.0	0.05
Mulberry	3,052	23	-159	-24	-1	3,238	24	6,107	46 (N/A)	0.6	0.5	2.54
Hickory	8,105	61	-420	-36	-3	5,901	44	13,550	102 (N/A)	0.6	1.1	5.65
Cottonwood	12,575	94	-1,774	-65	-14	10,094	76	20,831	156 (N/A)	0.6	1.7	8.68
Eastern redbud	592	4	-18	-8	0	598	4	1,164	9 (N/A)	0.5	0.1	0.58
American sycamore	2,588	19	-1,116	-27	-9	3,715	28	5,160	39 (N/A)	0.3	0.4	3.87
Ash	2,340	18	-72	-12	-1	2,021	15	4,277	32 (N/A)	0.3	0.4	3.56
Dogwood	78	1	-1	-2	0	51	0	126	1 (N/A)	0.3	0.0	0.10
American elm	2,823	21	-365	-23	-3	4,161	31	6,597	49 (N/A)	0.3	0.5	5.50
Broadleaf Deciduous Medi	1,931	14	-70	-10	-1	1,784	13	3,635	27 (N/A)	0.3	0.3	3.41
Ginkgo	294	2	-18	-5	0	621	5	891	7 (N/A)	0.2	0.1	0.95
Northern pin oak	2,043	15	-99	-11	-1	1,930	14	3,863	29 (N/A)	0.2	0.3	4.14
Blue spruce	248	2	-13	-7	0	649	5	878	7 (N/A)	0.2	0.1	0.94
Scotch pine	1,099	8	-106	-17	-1	1,612	12	2,588	19 (N/A)	0.2	0.2	2.77
Black cherry	428	3	-85	-11	-1	1,145	9	1,478	11 (N/A)	0.2	0.1	1.85
Pin oak	5,931	44	-289	-15	-2	2,548	19	8,174	61 (N/A)	0.2	0.7	10.22
Broadleaf Deciduous Larg	458	3	-18	-3	0	415	3	852	6 (N/A)	0.2	0.1	1.07
Eastern white pine	18	0	0	-1	0	30	0	47	0 (N/A)	0.2	0.0	0.07
Amur maple	1,012	8	-57	-8	0	929	7	1,876	14 (N/A)	0.2	0.2	2.81
Eastern red cedar	55	0	-2	-2	0	127	1	178	1 (N/A)	0.2	0.0	0.27
Yellowwood	22	0	-1	-1	0	29	0	49	0 (N/A)	0.1	0.0	0.09
Birch	783	6	-35	-4	0	804	6	1,548	12 (N/A)	0.1	0.1	2.90
Kentucky coffeetree	217	2	-5	-2	0	172	1	382	3 (N/A)	0.1	0.0	0.72
Tulip tree	420	3	-10	-3	0	322	2	730	5 (N/A)	0.1	0.1	1.82
Black spruce	79	1	-3	-3	0	223	2	296	2 (N/A)	0.1	0.0	0.74
Norway spruce	36	0	0	-1	0	76	1	110	1 (N/A)	0.1	0.0	0.41
Japanese maple	17	0	0	0	0	11	0	28	0 (N/A)	0.1	0.0	0.10
Conifer Evergreen Mediu	51	0	-2	-2	0	155	1	202	2 (N/A)	0.1	0.0	0.76
Lilac	17	0	0	0	0	11	0	28	0 (N/A)	0.1	0.0	0.10
Black locust	0	0	-137	-9	-1	1,077	8	932	7 (N/A)	0.1	0.1	3.49
Eastern hophornbeam	957	7	-65	-5	-1	670	5	1,556	12 (N/A)	0.1	0.1	5.84
Alder	114	1	-4	-1	0	124	1	232	2 (N/A)	0.0	0.0	1.74
Sweetbay	183	1	-15	-2	0	308	2	475	4 (N/A)	0.0	0.0	3.56
Ohio buckeye	5	0	0	0	0	7	0	12	0 (N/A)	0.0	0.0	0.09
Cherry plum	114	1	-4	-1	0	124	1	232	2 (N/A)	0.0	0.0	1.74
Common chokecherry	268	2	-15	-2	0	308	2	560	4 (N/A)	0.0	0.0	4.20
Black poplar	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.0	0.1	9.97
Boxelder	418	3	-17	-2	0	336	3	735	6 (N/A)	0.0	0.1	5.51
Red pine	116	1	-6	-2	0	216	2	324	2 (N/A)	0.0	0.0	2.43
Kwanzan cherry	38	0	-1	-1	0	37	0	74	1 (N/A)	0.0	0.0	0.55
Plum	9	0	0	0	0	6	0	14	0 (N/A)	0.0	0.0	0.10
Citywide total	710,555	5,329	-45,739	-3,662	-371	548,315	4,112	1,209,470	9,071 (N/A)	100.0	100.0	3.06

Table 6: Annual Social and Aesthetic Benefits

Hiawatha

Annual Aesthetic/Other Benefits of Public Trees

4/28/2017

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	1,282	(N/A)	13.8	1.7	3.14
Green ash	9,912	(N/A)	8.1	12.9	41.13
Silver maple	14,890	(N/A)	7.5	19.4	66.77
Honeylocust	7,951	(N/A)	5.3	10.4	50.97
Broadleaf Deciduous Small	24	(N/A)	5.0	0.0	0.17
Norway maple	3,368	(N/A)	4.9	4.4	23.23
White ash	5,792	(N/A)	4.6	7.6	42.90
Maple	2,341	(N/A)	4.4	3.1	18.01
Red maple	3,373	(N/A)	4.1	4.4	27.65
Sugar maple	1,960	(N/A)	3.9	2.6	17.04
Callery pear	1,658	(N/A)	3.2	2.2	17.45
Black walnut	4,466	(N/A)	3.0	5.8	50.75
Littleleaf linden	2,257	(N/A)	2.4	2.9	31.35
Conifer Evergreen Large	973	(N/A)	2.4	1.3	13.52
Northern hackberry	653	(N/A)	2.0	0.8	10.92
Northern white cedar	307	(N/A)	1.7	0.4	6.15
Northern red oak	574	(N/A)	1.7	0.7	11.71
Willow	538	(N/A)	1.6	0.7	11.20
Elm	1,208	(N/A)	1.5	1.6	27.46
Bur oak	1,733	(N/A)	1.5	2.3	40.29
American basswood	1,182	(N/A)	1.2	1.5	31.95
Spruce	231	(N/A)	1.2	0.3	6.59
Pear	157	(N/A)	1.1	0.2	4.75
Japanese tree lilac	5	(N/A)	1.0	0.0	0.17
Swamp white oak	374	(N/A)	1.0	0.5	12.48
White oak	1,420	(N/A)	1.0	1.9	47.33
River birch	616	(N/A)	0.8	0.8	24.62
Oak	741	(N/A)	0.7	1.0	35.30
Siberian elm	792	(N/A)	0.7	1.0	37.70
Eastern cottonwood	988	(N/A)	0.7	1.3	47.02
Conifer Evergreen Small	90	(N/A)	0.7	0.1	4.27
Mulberry	175	(N/A)	0.6	0.2	9.75
Hickory	793	(N/A)	0.6	1.0	44.05
Cottonwood	982	(N/A)	0.6	1.3	54.54
Eastern redbud	30	(N/A)	0.5	0.0	1.98
American sycamore	198	(N/A)	0.3	0.3	19.83
Ash	262	(N/A)	0.3	0.3	29.10
Dogwood	0	(N/A)	0.3	0.0	0.03
American elm	407	(N/A)	0.3	0.5	45.18
Broadleaf Deciduous Medium	212	(N/A)	0.3	0.3	26.47
Ginkgo	28	(N/A)	0.2	0.0	4.06
Northern pin oak	213	(N/A)	0.2	0.3	30.36
Blue spruce	106	(N/A)	0.2	0.1	15.18
Scotch pine	212	(N/A)	0.2	0.3	30.28
Black cherry	24	(N/A)	0.2	0.0	4.00
Pin oak	488	(N/A)	0.2	0.6	81.32
Broadleaf Deciduous Large	72	(N/A)	0.2	0.1	12.03
Eastern white pine	29	(N/A)	0.2	0.0	5.76
Amur maple	59	(N/A)	0.2	0.1	11.83
Eastern red cedar	48	(N/A)	0.2	0.1	9.50
Yellowwood	11	(N/A)	0.1	0.0	2.74
Birch	84	(N/A)	0.1	0.1	20.95
Kentucky coffeetree	44	(N/A)	0.1	0.1	11.09
Tulip tree	62	(N/A)	0.1	0.1	20.79
Black spruce	47	(N/A)	0.1	0.1	15.73
Norway spruce	14	(N/A)	0.1	0.0	6.83
Japanese maple	0	(N/A)	0.1	0.0	0.03
Conifer Evergreen Medium	33	(N/A)	0.1	0.0	16.70
Lilac	0	(N/A)	0.1	0.0	0.03
Black locust	0	(N/A)	0.1	0.0	0.00
Eastern hophornbeam	58	(N/A)	0.1	0.1	28.80
Alder	6	(N/A)	0.0	0.0	6.40
Sweetbay	13	(N/A)	0.0	0.0	12.82
Ohio buckeye	3	(N/A)	0.0	0.0	2.74
Cherry plum	6	(N/A)	0.0	0.0	6.40
Common chokecherry	15	(N/A)	0.0	0.0	15.48
Black poplar	66	(N/A)	0.0	0.1	65.59
Boxelder	39	(N/A)	0.0	0.1	39.36
Red pine	32	(N/A)	0.0	0.0	32.32
Kwanzan cherry	2	(N/A)	0.0	0.0	2.06
Plum	0	(N/A)	0.0	0.0	0.03
Citywide total	76,710	(N/A)	100.0	100.0	25.91

Table 7: Summary of Benefits in Dollars

Hiawatha								
Total Annual Benefits of Public Trees by Species (\$)								
4/28/2017								
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Apple	3,464	356	518	1,482	1,282	7,102	(N/A)	3.0
Green ash	9,270	1,268	1,540	10,047	9,912	32,037	(N/A)	13.3
Silver maple	9,493	1,765	1,634	14,776	14,890	42,559	(N/A)	17.7
Honeylocust	4,213	537	663	3,365	7,951	16,729	(N/A)	7.0
Broadleaf Deciduous Sm	220	23	32	83	24	381	(N/A)	0.2
Norway maple	3,336	404	508	2,412	3,368	10,028	(N/A)	4.2
White ash	3,848	527	620	3,645	5,792	14,432	(N/A)	6.0
Maple	1,999	221	310	1,378	2,341	6,249	(N/A)	2.6
Red maple	2,695	324	442	2,173	3,373	9,006	(N/A)	3.8
Sugar maple	1,976	236	298	1,830	1,960	6,300	(N/A)	2.6
Callery pear	1,572	192	239	1,083	1,658	4,744	(N/A)	2.0
Black walnut	5,225	665	949	7,630	4,466	18,936	(N/A)	7.9
Littleleaf linden	1,427	219	220	1,147	2,257	5,270	(N/A)	2.2
Conifer Evergreen Large	723	65	77	1,077	973	2,915	(N/A)	1.2
Northern hackberry	638	58	103	576	633	2,008	(N/A)	0.8
Northern white cedar	131	10	12	146	307	605	(N/A)	0.3
Northern red oak	1,134	112	164	1,216	574	3,199	(N/A)	1.3
Willow	535	58	80	397	538	1,607	(N/A)	0.7
Elm	1,102	148	188	1,387	1,208	4,033	(N/A)	1.7
Bur oak	1,729	232	302	2,279	1,733	6,274	(N/A)	2.6
American basswood	1,392	183	206	1,401	1,182	4,365	(N/A)	1.8
Spruce	70	6	6	91	231	403	(N/A)	0.2
Pear	427	44	66	181	157	875	(N/A)	0.4
Japanese tree lilac	35	4	4	9	5	58	(N/A)	0.0
Swamp white oak	313	38	45	193	374	964	(N/A)	0.4
White oak	1,716	218	323	2,801	1,420	6,479	(N/A)	2.7
River birch	675	79	109	578	616	2,058	(N/A)	0.9
Oak	663	91	109	774	741	2,379	(N/A)	1.0
Siberian elm	1,177	143	226	1,593	792	3,930	(N/A)	1.6
Eastern cottonwood	1,281	153	242	1,888	988	4,551	(N/A)	1.9
Conifer Evergreen Smal	20	1	2	14	90	126	(N/A)	0.1
Mulberry	422	46	69	200	175	913	(N/A)	0.4
Hickory	739	102	119	803	793	2,557	(N/A)	1.1
Cottonwood	1,258	156	237	1,969	982	4,602	(N/A)	1.9
Eastern redbud	88	9	12	32	30	170	(N/A)	0.1
American sycamore	455	39	100	857	198	1,649	(N/A)	0.7
Ash	265	32	40	188	262	786	(N/A)	0.3
Dogwood	8	1	1	2	0	12	(N/A)	0.0
American elm	501	49	91	570	407	1,619	(N/A)	0.7
Broadleaf Deciduous M	224	27	36	167	212	665	(N/A)	0.3
Ginkgo	70	7	12	42	28	158	(N/A)	0.1
Northern pin oak	241	29	40	206	213	729	(N/A)	0.3
Blue spruce	81	7	9	120	106	323	(N/A)	0.1
Scotch pine	193	19	8	471	212	904	(N/A)	0.4
Black cherry	155	11	27	91	24	307	(N/A)	0.1
Pin oak	315	61	41	399	488	1,304	(N/A)	0.5
Broadleaf Deciduous La	48	6	8	42	72	176	(N/A)	0.1
Eastern white pine	5	0	0	7	29	41	(N/A)	0.0
Amur maple	126	14	21	66	59	286	(N/A)	0.1
Eastern red cedar	18	1	1	25	48	93	(N/A)	0.0
Yellowwood	4	0	1	1	11	18	(N/A)	0.0
Birch	96	12	16	77	84	284	(N/A)	0.1
Kentucky coffeetree	23	3	3	18	44	91	(N/A)	0.0
Tulip tree	42	5	6	33	62	149	(N/A)	0.1
Black spruce	31	2	3	42	47	126	(N/A)	0.1
Norway spruce	11	1	1	12	14	38	(N/A)	0.0
Japanese maple	2	0	0	0	0	3	(N/A)	0.0
Conifer Evergreen Medi	22	2	2	27	33	86	(N/A)	0.0
Lilac	2	0	0	0	0	3	(N/A)	0.0
Black locust	142	7	27	204	0	380	(N/A)	0.2
Eastern hophornbeam	92	12	17	64	58	242	(N/A)	0.1
Alder	18	2	3	7	6	36	(N/A)	0.0
Sweetbay	31	4	7	25	13	79	(N/A)	0.0
Ohio buckeye	1	0	0	0	3	4	(N/A)	0.0
Cherry plum	18	2	3	7	6	36	(N/A)	0.0
Common chokecherry	38	4	7	18	15	82	(N/A)	0.0
Black poplar	71	10	12	107	66	266	(N/A)	0.1
Boxelder	39	6	6	39	39	129	(N/A)	0.1
Red pine	24	2	3	42	32	103	(N/A)	0.0
Kwanzan cherry	5	1	1	2	2	11	(N/A)	0.0
Plum	1	0	0	0	0	1	(N/A)	0.0
Citywide Total	68,424	9,071	11,224	74,638	76,710	240,066	(N/A)	100.0

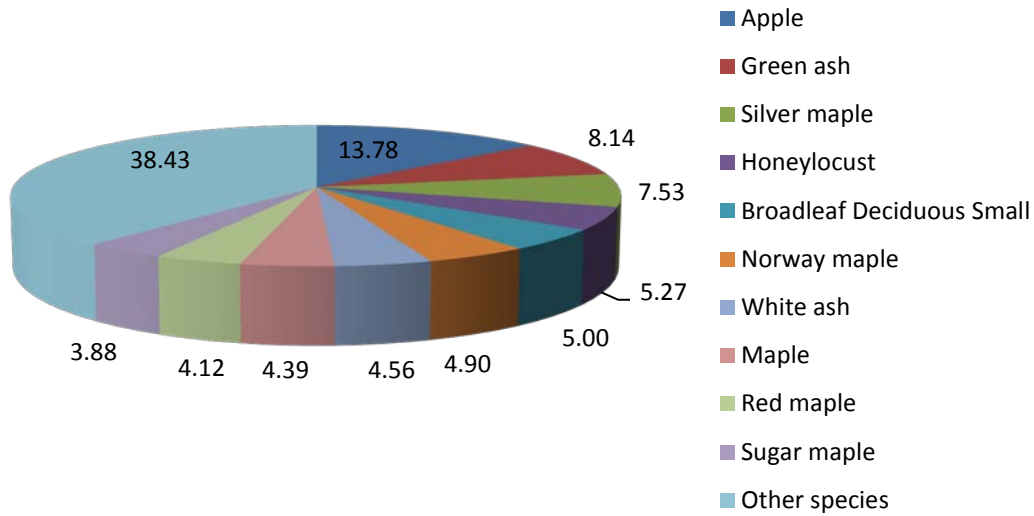


Figure 1: Species Distribution

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

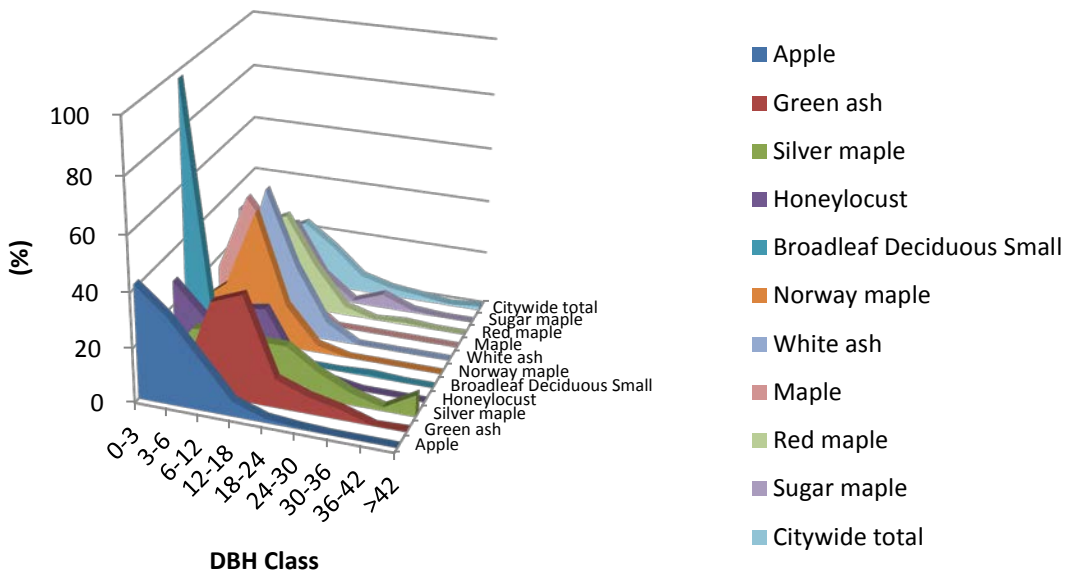


Figure 2: Relative Age Class

Leaf Condition

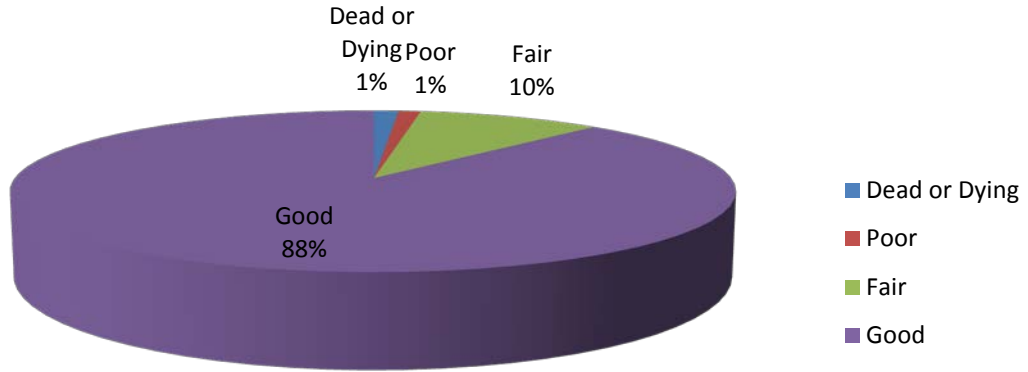


Figure 3: Foliage Condition

Wood Condition

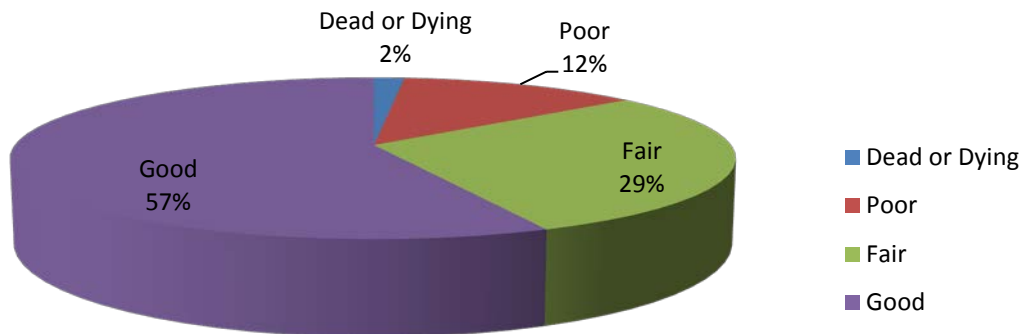


Figure 4: Wood Condition

Canopy Cover

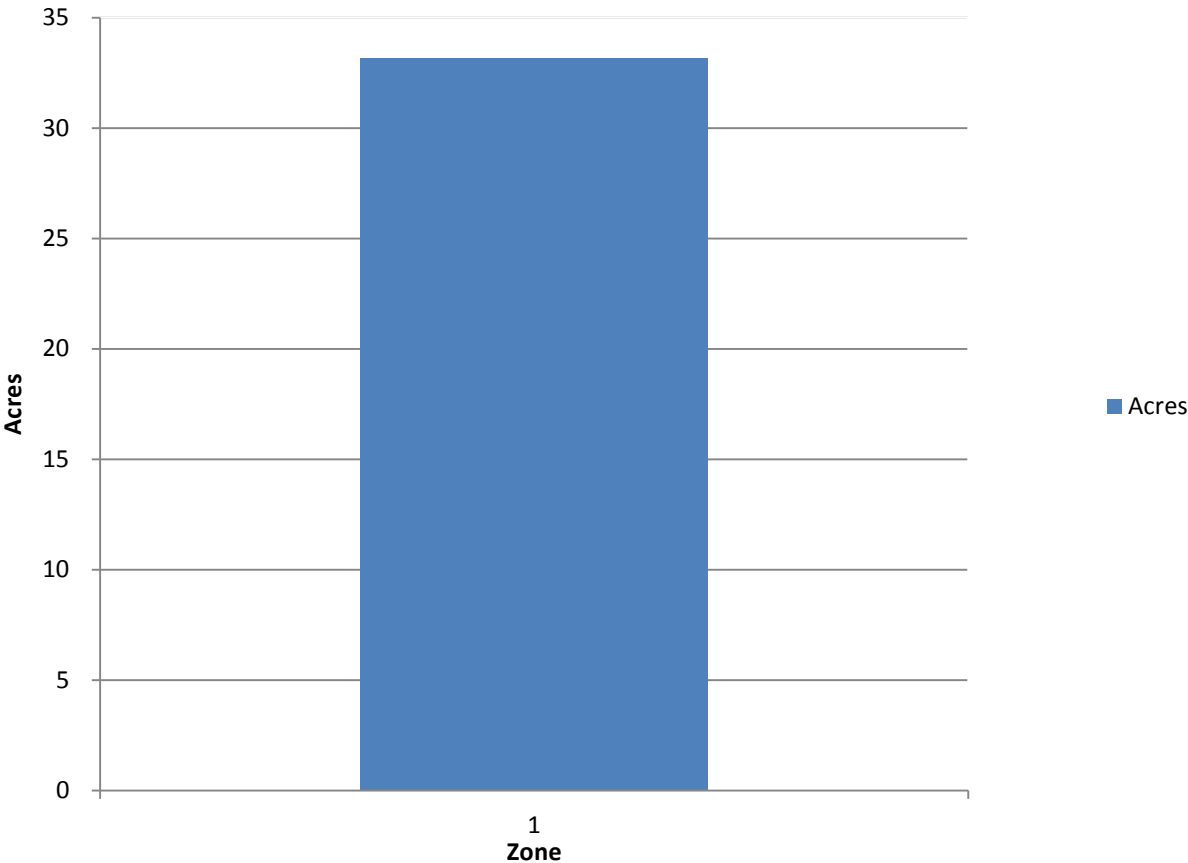


Figure 5: Canopy Cover in Acres

Land use Public Trees by Zone (%)

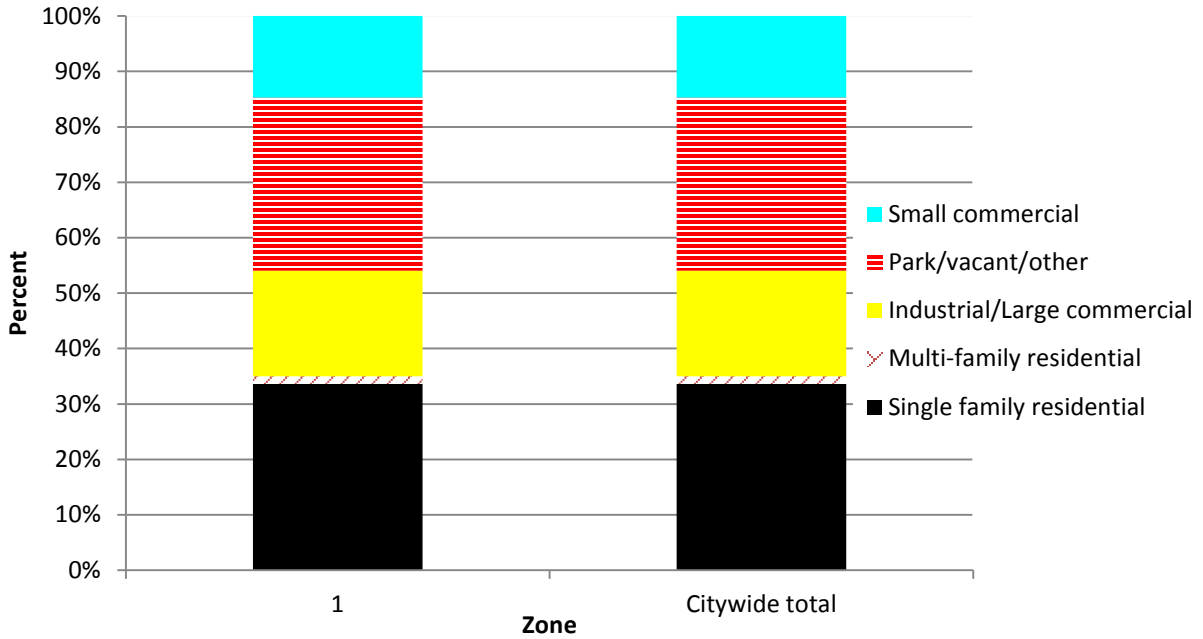


Figure 6: Land Use of city/park trees

Location Public Trees by Zone (%)

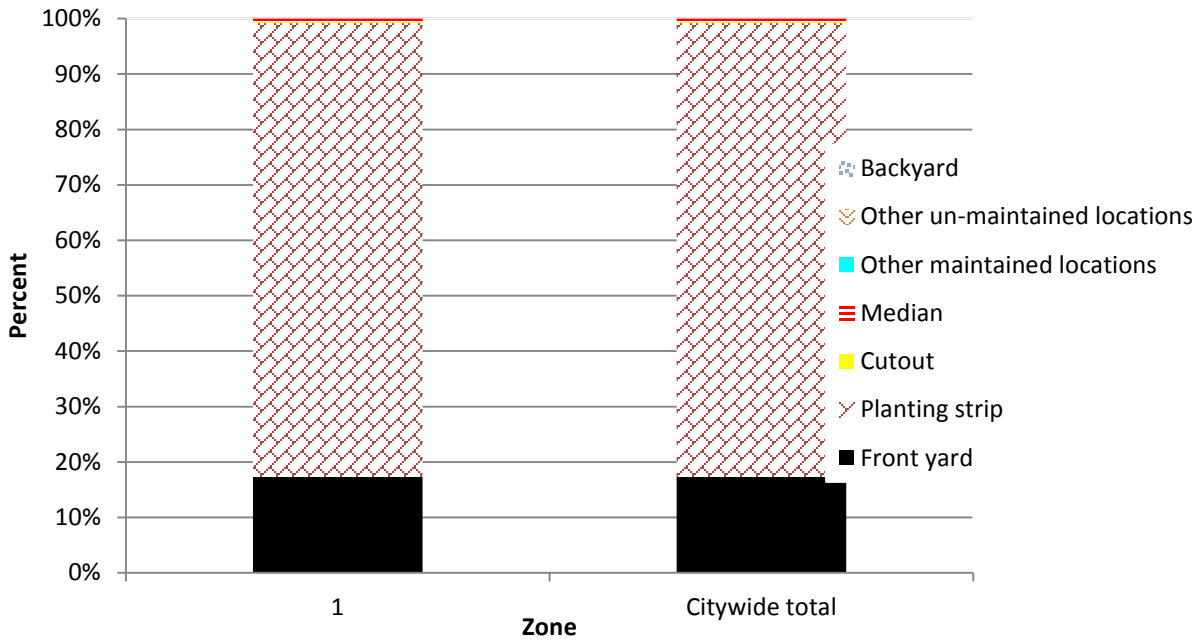


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

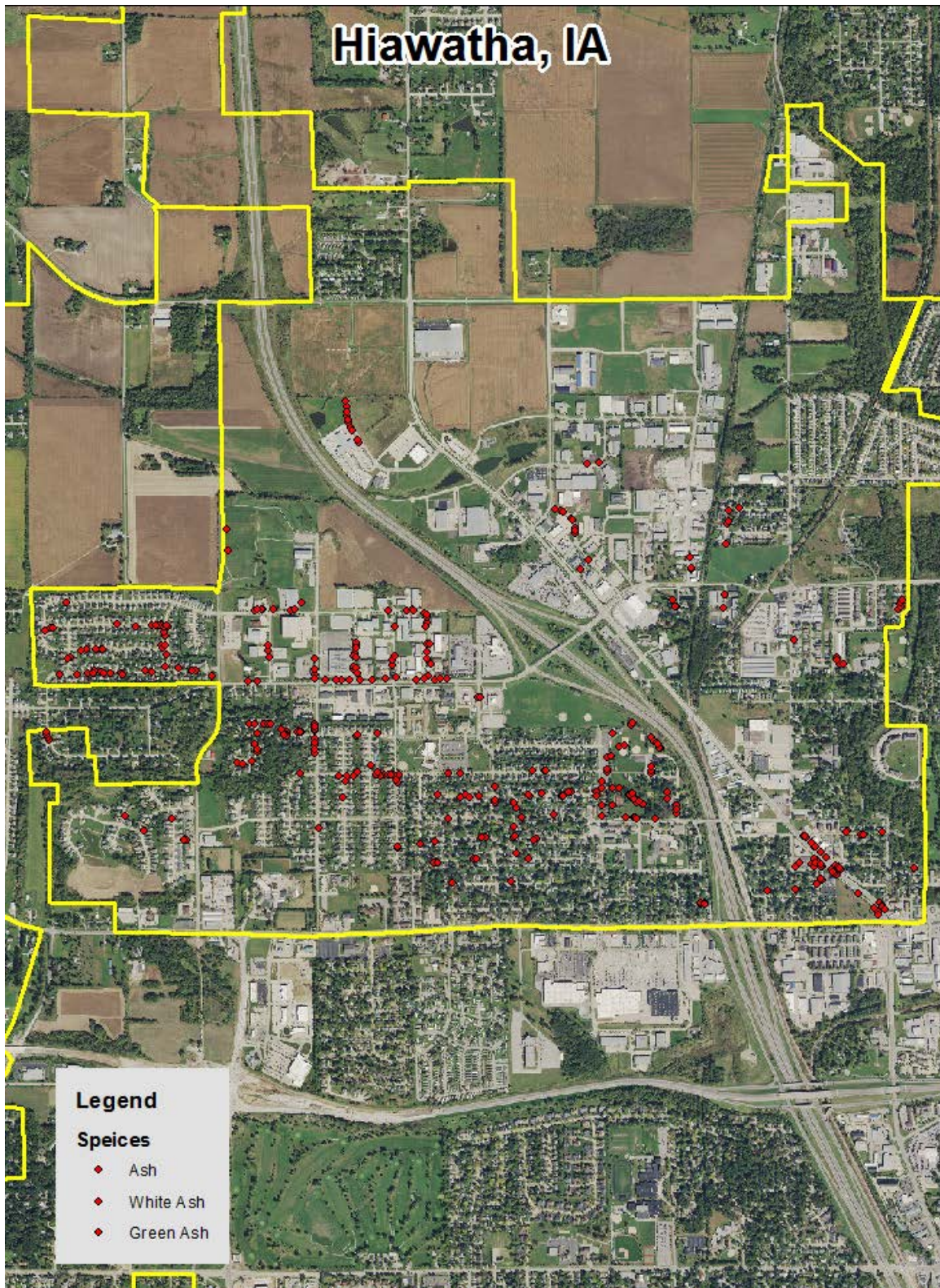


Figure 1: Location of Ash Trees

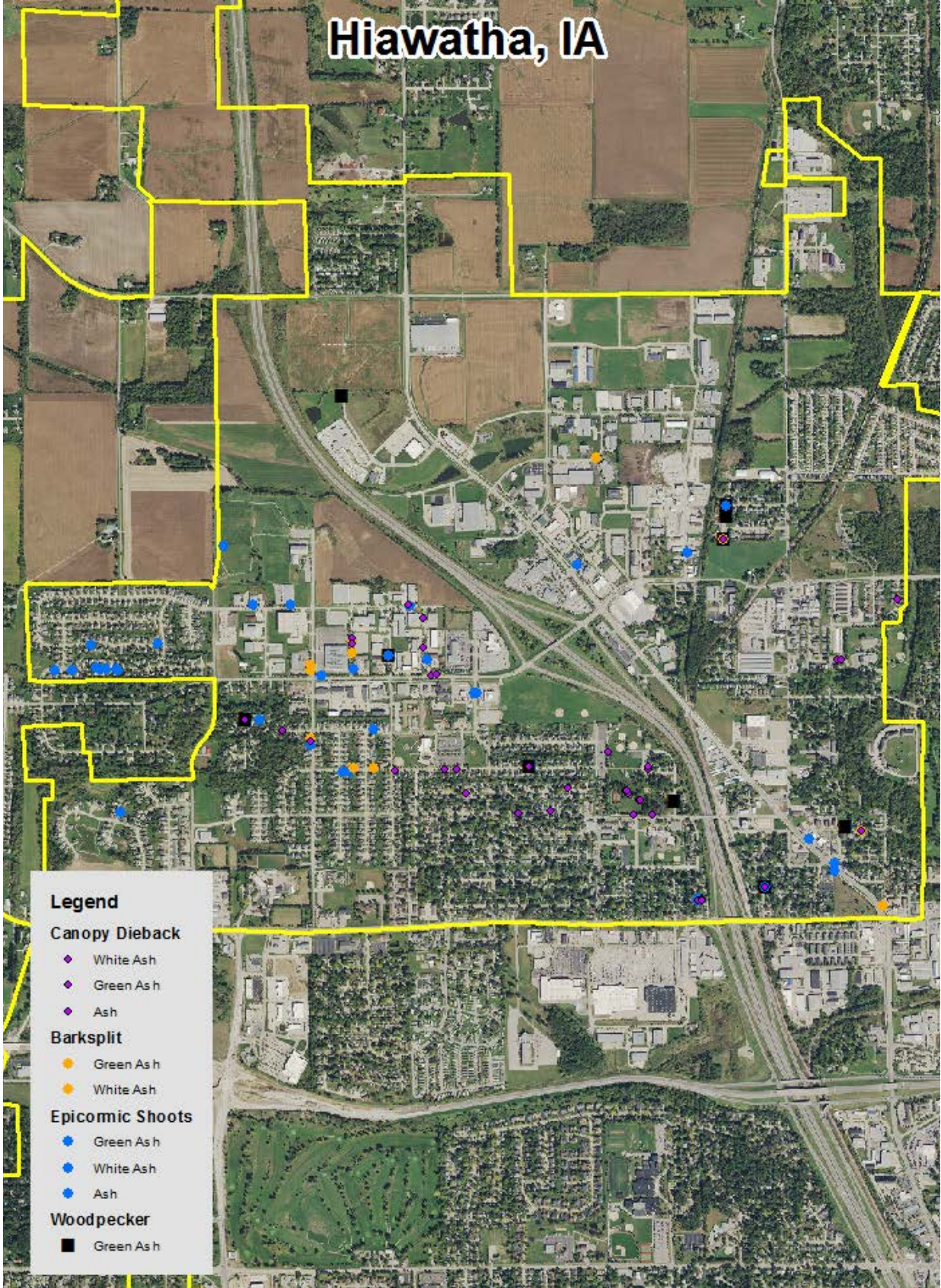


Figure 2: Location of EAB symptoms

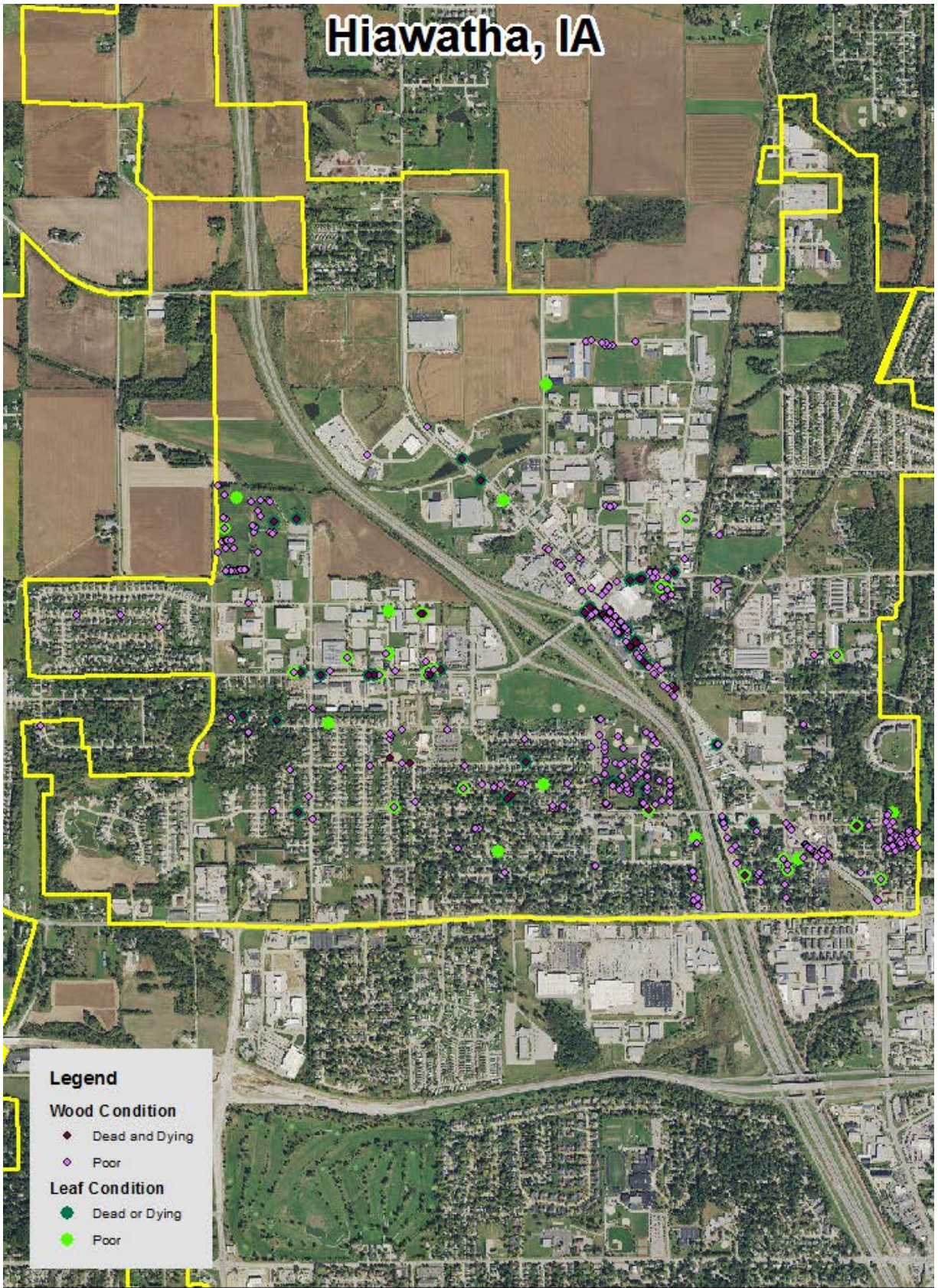


Figure 3: Location of Poor Condition Trees

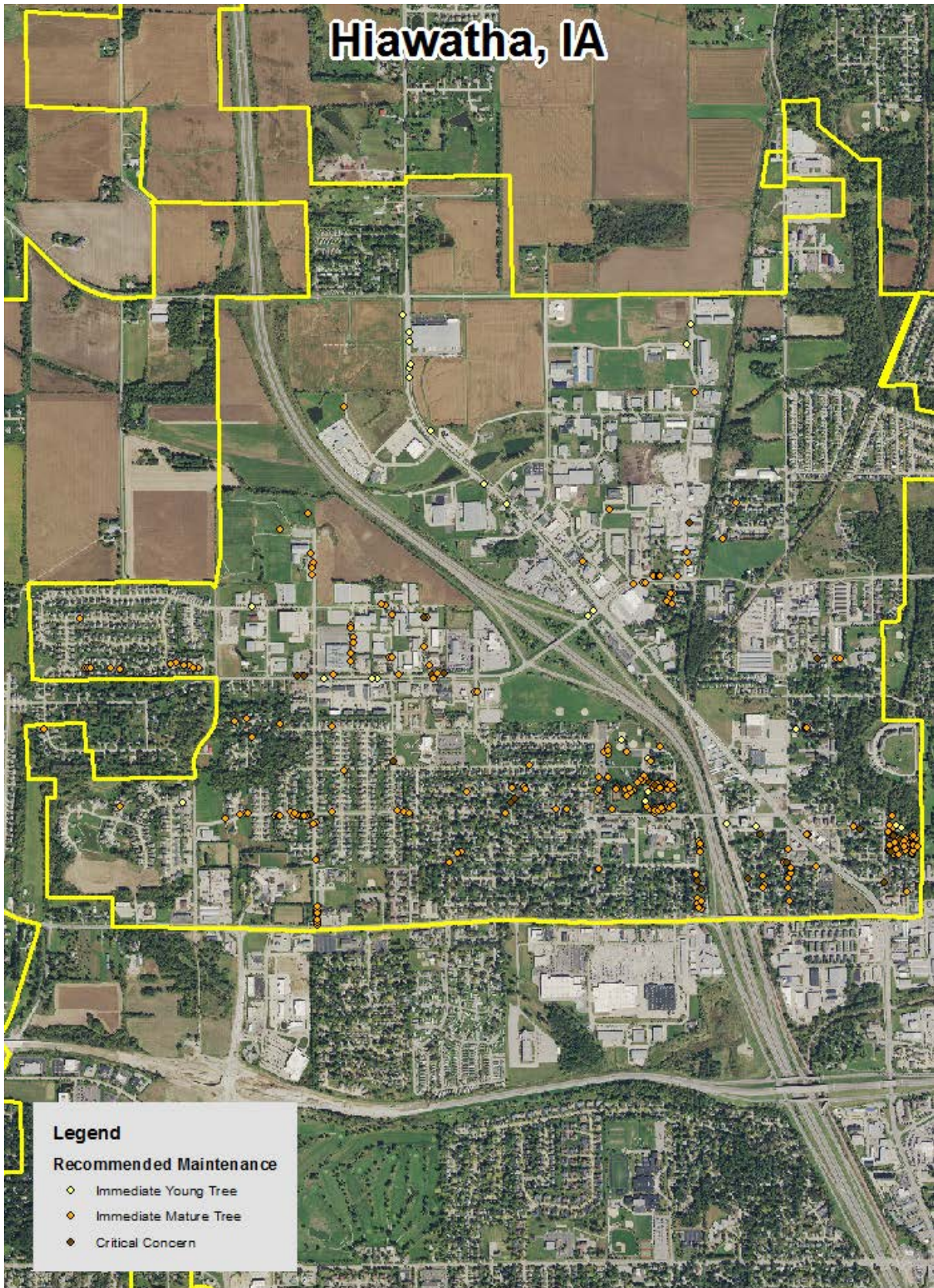


Figure 4: Location of Trees with Recommended Maintenance

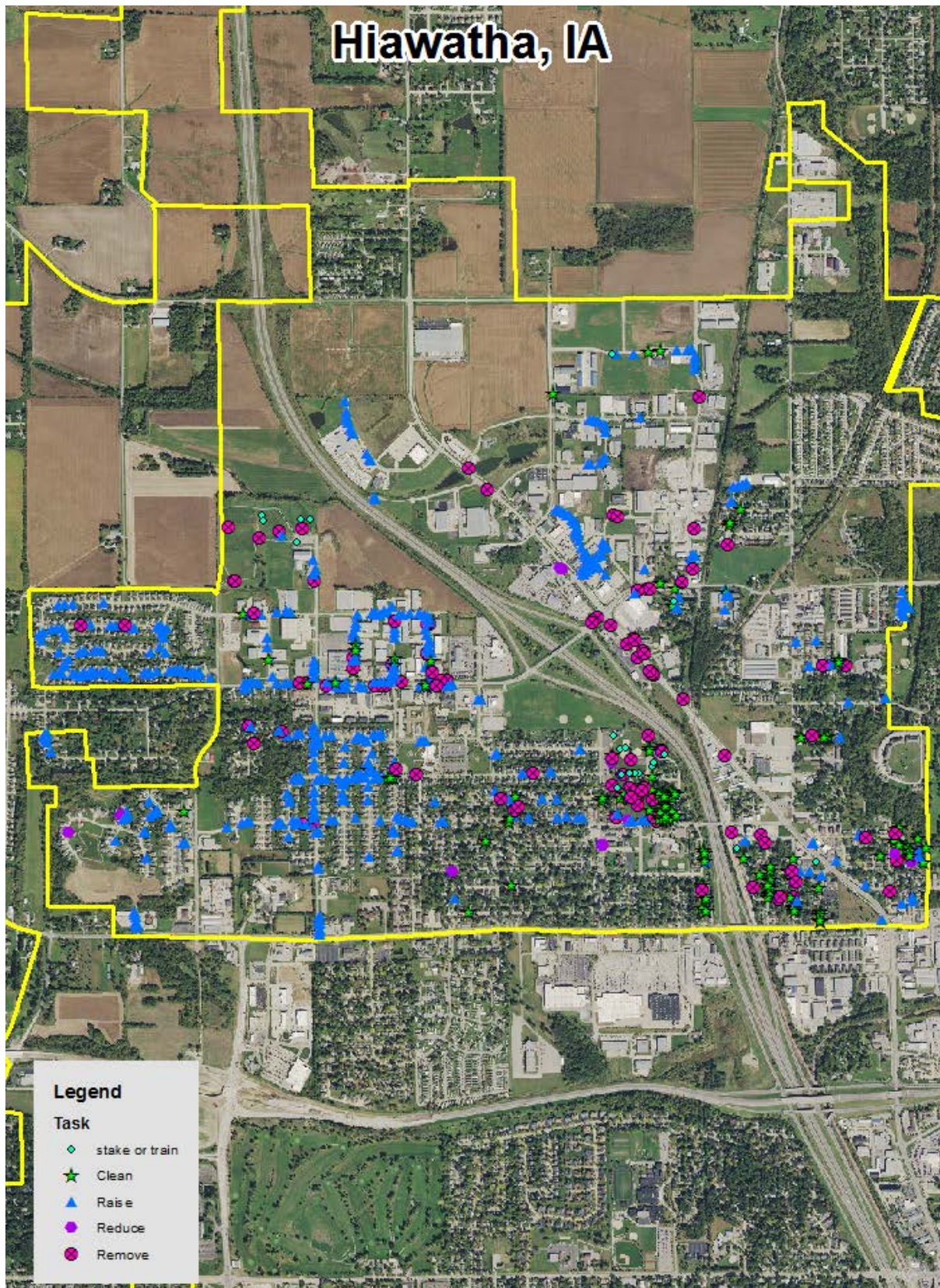


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Hiawatha 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 with a forty (40) foot minimum between trees. 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 right-of-way any fruit-bearing tree or any tree of the kinds commonly known as ash, cottonwood, poplar, box elder, Chinese elm, weeping willows, evergreen, silver maple, tree of heaven, catalpa, mulberry or pin oak.
(Ord. 639 – Feb. 10 Supp.)
4. **Exceptions.** City designed, installed and maintained streetscape projects developed on roadways featured in the Design Guidelines shall be exempt from the planting restrictions as outlined above in this chapter.
(Ord. 724 – Aug. 12 Supp.)

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. The City reserves the right to exempt, by resolution of the Council, specific and identified areas in which the City has invested in streetscape and landscaping enhancements. In areas exempted by the City, it shall specify in a written notice to the abutting property owner who shall maintain the area. This section shall be interpreted consistently with Section 135.10 of this Code of Ordinances. *(Ord. 606 – Aug. 07 Supp.)*

(Code of Iowa, Sec. 364.12[2c, d & e])

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

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

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:

1. **Removal from 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, and that danger to other trees within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. 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. **Removal from Private Property.** If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately 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 nuisance to be removed and the cost assessed against the property.

(Code of Iowa, Sec. 364.12[3b & h])

165.47: Landscaping and Shading Regulations: The purpose of this section is to promote and protect the safety and welfare of the public through requirements for landscaping and shading which prevent soil erosion, improve air and water quality and enhance and preserve the beauty and appearance of the environment.

1. **Applicability:** The provisions of this section shall apply to all new landscaping and trees planted or installed within the City in conjunction with new construction, reconstruction or structural alteration projects of a building, parking area, or subdivision after the effective date of this section.
2. **Conformance Required:** It is unlawful, after the effective date of this section, within all projects or developments in R-7, Commercial and Industrial districts requiring a building permit, site plan approval, or subdivision approval by the City, to install, construct or plant any landscaping except in conformance with the provisions hereof.
3. **Goals and Objectives:** The Planning and Zoning Commission shall take into consideration the following goals and objectives, as well as the specific criteria enumerated. When reviewing a landscape plan, the Commission shall approve the plan if it finds and determines that:
 - A. The plan provides visual, noise and access screening between conflicting land uses.
 - B. The plan takes into account and does not inhibit the exercise of solar access rights of neighboring properties.
 - C. The plan tends to decrease soil erosion.
 - D. The plan does not interfere with any line of sight for vehicular drivers entering or leaving the site.
 - E. The plan enhances the architecture of the property, e.g., the landscaping tends to break up large expanses of wall or other structure(s).
 - F. The plan facilitates the movement of pedestrians and vehicles on the site and integrates with and helps to conceal parking facilities on the site.
 - G. The plan utilizes and preserves existing and native vegetation to the greatest degree possible.
 - H. The plan does not place an unreasonable burden on the City water system and supply.
 - I. The plan retains all existing trees 18 inches in diameter or more unless the retention of such trees would unreasonably burden the development.
4. **Landscaping and Shading Requirements:** All landscape plans submitted shall meet the following requirements prior to approval:
 - A. All disturbed areas on the site shall be revegetated or landscaped in a manner as approved by the Planning and Zoning Commission.
 - B. All on-site areas prone to soil erosion shall be defined on the landscape plan and shall be controlled through landscaping.
 - C. If requested by the City, details must be submitted which show that no proposed landscaping plan shall cause interference with adjacent property owners' solar access rights.

- D. The landscape plan shall only propose plantings or construction which do not interfere with the sight line of drivers entering or leaving the site.
 - E. Where deemed necessary by the Planning and Zoning Commission, the plan must provide for visual and noise screening between lots or parcels and abutting streets or thoroughfares. In making their decision, the Planning and Zoning Commission will take into consideration the types of land uses on the abutting lots or parcels.
 - F. The plan must provide for transitional yards where required. See Section 165.23:6.
 - G. Trees shall be placed to avoid interference with the construction, maintenance and operation of public and private utilities and services above or below ground as determined by the utility companies and the City Engineer.
 - H. Maintenance: It shall be the responsibility of the owner of a lot to maintain and replace, if necessary, trees required by these provisions after their planting. Any trees on private property which overhang the public right-of-way shall be maintained in accordance with City provisions. Maintenance of trees within street rights-of-way shall be the responsibility of the property owner.
 - I. Each tree planted shall be deemed to cover two hundred (200) square feet for purposes of this ordinance. Each tree shall be at least eight (8) feet tall and have a diameter at breast height of at least two (2) inches.
 - J. Where fractional numbers of trees result, the number of trees required shall be rounded up to the closest whole number.
 - K. Evergreen trees, required for screening purposes in accordance with the provisions of 165.23:6 Transitional yards and 165.30 to 165.36 Off-street Parking Requirements, may be used to satisfy the requirements of the tree regulations provided they are of a variety suitable for screening purposes, as listed in Appendix A, and are allowed to grow to their mature height.
 - L. References to "large" or "small" trees in subsequent paragraphs refer to the mature height as suggested in the "Suggested Tree Planting List" in Appendix A.
 - M. Existing on-site trees may be used to comply with the requirements of the tree regulations.
5. **Subdivision Landscape and Shade Requirements:**
- A. In R-1, R-3, and R-5 zone districts there are no landscape nor shade requirements. Landscaping shall be done on a lot by lot basis in accordance with site plan requirements in R-7, C-ORS, C-2, C-3, C-4, C-R, C-WH, I-1 and I-2 zone districts. In the R-MH zone district, refer to Section 147.09, Soil and Ground Cover Requirements.
 - B. Screening: When undeveloped land is subdivided and undeveloped lots only are sold, the subdivider shall not be required to install any screening. Screening shall be required, if at all, only when the lots are developed, and shall be the responsibility of the developer of the lot.
 - C. Shading:

- (1) Along both sides of all newly created streets in all R-7, C-ORS, C-2 and C-R zone districts that are constructed in accordance with the public street standards set forth in Section 165.58:1 and the Cedar Rapids Metropolitan Area Engineering Design Standards there shall either be planted or retained sufficient trees so that between the paved portion of the street and a line running parallel to and 50 feet from the centerline of the street, there is for every 40 feet of street frontage at least an average of one deciduous tree that has or will have when fully mature a trunk at least 12 inches in diameter. When trees are planted pursuant to this section, the developer shall choose trees that meet the standards set forth in Appendix A.
- (2) At street intersections, trees shall not be located within 70 feet of the intersection of curb lines along arterial streets, within 50 feet along collector streets, or within 30 feet of the intersection of curb lines along local streets. In cases where two different types of streets intersect, the location of the tree shall be determined by the type of street adjacent to the proposed tree.

6. **Site Plan Landscape and Shade Requirements:**

A. Landscaping:

- (1) In R-1, R-3 and R-5 zone districts there are no landscape nor site plan requirements.
- (2) The following minimum percentages of lot or site area shall be placed in approved landscaping:
 - a. In R-7 or PUD zone districts with a multiple family dwelling of three or more units, a minimum of fifteen percent of the area of the lot shall be provided as open space. Such open space shall be provided on the ground and shall not include any of the required yard areas, nor any area provided for off-street parking or loading, nor any area in streets or drives. One-third (1/3) of the total landscaped area shall be planted with trees.
 - b. In C-ORS, C-2, C-3, C-4, C-R, C-WH, I-1 and I-2 districts: ten percent (10%). One third (1/3) of the total landscaped area shall be planted with trees. The landscaped area shall be any area that is not covered by buildings, parking areas or driveways.

B. Screening:

- (1) Transitional yards when required shall be provided in accordance with Section 165.23:6.
- (2) Any plan containing an outdoor storage area will provide visual and noise screening between adjacent lots or parcels and streets or thoroughfares.

C. Shading:

- (1) Trees are required to be planted along the streets in all R-7, C-ORS, C-2 and C-R zone districts in accordance with the provisions of Section 165.47:5C above.
- (2) Trees are required to be planted in all parking facilities with a capacity larger than forty (40) vehicles with more than two (2) aisles. The landscape plan must provide for interior plantings in order to provide shade and break up the expanse of hard-

165.47

surfaced area. Interior landscaping shall be a minimum of five percent (5%) of the total parking area. This subsection does not abrogate the parking requirements as stated in any other part of this Code.

APPENDIX A

PLANTING GUIDELINES AND SUGGESTED TREE PLANTING LIST

I. Planting Guidelines

- A. Large trees shall be placed no closer than 30 feet apart or located closer than 14 feet to a building. Small trees shall be located no closer than 16 feet apart but may be located to within eight (8) feet of a building.
- B. Trees shall be placed to avoid interference with the construction, maintenance and operation of public and private utilities and services above or below ground as determined by the utility companies and the City.
- C. Any tree planted within the street right-of-way shall have a single trunk, with a minimum of four (4) feet from grade to the first branch at the time of planting.
- D. Trees shall not be located within four (4) feet of a public sidewalk or the anticipated location of a future public sidewalk where one does not exist. Trees shall not be located within five (5) feet of the curb. No trees shall be planted in the area between a curb and a sidewalk where the width of the area is less than nine (9) feet.

II. Protection of Existing Trees 18 inches in Diameter or Greater

- A. No excavation or other subsurface disturbance may be undertaken within the drip line of any tree 18 inches in diameter or more, and no impervious surface (including, but not limited to, paving or buildings) may be located within 14 feet of any tree 18 inches in diameter or more unless compliance with this subsection would unreasonably burden the development. For purposes of this subsection, a drip line is defined as a perimeter formed by the points farthest away from the trunk of a tree where precipitation falling from the branches of that tree lands on the ground.

III. Suggested Tree Planting List

DECIDUOUS VARIETIES (large)	STREET	PARKING AREAS	OTHER USES	WITHSTANDS CITY COND.	APPROXIMATE HEIGHT IN FEET	REMARKS
BEECH American Blue		X	X		90'	Some problems with city conditions
BIRCHES European and varieties		X	X		60'	Pest problems - not recommended for streets
ELM American (D.E.D. resistant varieties)			X	X	120'	

DECIDUOUS VARIETIES (large)	STREET	PARKING AREAS	OTHER USES	WITHSTANDS CITY COND.	APPROXIMATE HEIGHT IN FEET	REMARKS
GINKJO and varieties	X	X	X	X	100'	Slow growing, few pest problems; fruit can be a problem.
HACKBERRY	X	X	X	X	75'	Susceptible to Witches Broom, pest problems
HICKORY						
Shagbark		X	X		120'	Nut can be a problem Picturesque bark
Pignut		X	X		120'	Nuts
Mockernut		X	X		90'	Nuts
HYBRID LOCUST & varieties		X	X	X	70'	Pest problems, require extra maintenance
Shademaster						
sunburst						
Skyline						
HOP HORNBEAM	X	X	X		60'	Fairly free of disease and insect pests
HORNBEAM						
European & varieties		X	X		60'	Hardiness may be a factor
KATSURA		X	X		80'	Generally pest free, has clumping tendency
KENTUCKY COFFEE TREE		X	X		90'	Pods
LINDEN						
American Linden	X	X	X		80'	Large leaves
Redmond					70'	
Little leaf & varieties	X	X	X		50'	Slower growing
Greenspire					60'	
Big leaf & varieties		X	X		90'	Not a good street tree
LONDON PLANE		X	X	X	90'	Requires extra maintenance
MAPLE						
Norway & varieties	X	X	X	X	90'	Dense shade, generally good for most uses
Red		X	X		90'	Adapts to wet soils
Sugar & varieties		X	X			Girdling roots, have problems with city conditions
OAK						
White	X	X	X		100'	Slow growing, very large at maturity
Swamp White			X		60'	Adapts to wet soil
Shingle	X	X	X		75'	Ornamental bark
Pin Oak		X	X		75'	Requires extra maintenance
English & varieties	X	X	X		80'	Little fall color, hardiness may be a factor
Red	X		X	X	80'	Bright red fall color
Shumard			X	X	80'	Good substitute for Scarlet Oak
OHIO BUCKEYE		X	X	X	70'	Good fall color
PEAR						
Bradford Callery Pear	X	X	X	X	45'	Rarely bears fruit, somewhat resistant to Fire Blight
POPLARS						
Quaking Aspen			X		90'	Ornamental, short-lived

DECIDUOUS VARIETIES (large)	STREET	PARKING AREAS	OTHER USES	WITHSTANDS CITY COND.	APPROXIMATE HEIGHT IN FEET	REMARKS
PRUNUS Black Cherry & varieties Shubert Choke Cherry	X	X	X		75' 40'	Ornamental, drooping branches Attractive, hardy cultivar
SWEET GUM	X	X	X		90'	Hardiness may be a factor
SYCAMORE		X	X	X	80'	Requires extra maintenance
TULIP TREE (Liriodendron)			X		90'	Reasonably free of disease and insect pest
WALNUT Butternut Eastern Black			X X		80' 90'	Nuts can be a problem Nuts can be a problem
UPRIGHT EVERGREEN VARIETIES (large and medium)						
AMERICAN ARBOR VITAE Pyramidal Arbor Vitae		X X	X		60' 30'	Adapts to wet soil, bronze winter color Makes excellent screening
FIRS White (Concolor)		X	X	X	100'	Bluish-green color
HEMLOCK Canada & varieties Carolina		X X	X X		85' 75'	Excellent specimen tree Excellent specimen tree
JUNIPERS - upright Eastern Red Cedar & varieties		X	X		75'	Hardy, prefer alkaline soil, makes excellent screening
PINE Austrian & varieties Red Eastern White & varieties Scotts & varieties		X	X X X X		90' 75' 95' 75'	Rapid growth rate, pyramidal Pests controlled by spraying, reddish bark Good ornamental, transplants easily Unique form, not a good shade tree
SPRUCE Norway & varieties White & varieties Colorado & varieties		X X X	X X X	X	100' 90' 100"	Mature trees thin out at top, dark green Hardy, endures heat and drought Insect pest, doesn't grow old gracefully

DECIDUOUS VARIETIES (medium & small)	STREET	PARKING AREAS	OTHER USES	WITHSTANDS CITY COND.	APPROXIMATE HEIGHT IN FEET	REMARKS
DOGWOOD Flowering & varieties		X	X		35'	Doesn't always bloom in this tree zone
HORNBEAM American & varieties	X	X	X		36"	Slow growing
MALUS (Crabapple)						Adapts well to city conditions. Resistance to disease and insect pests varies from area to area.
Adams	X	X	X		24'	Red buds open to pink, annual bearing
Arnolds Crab	X	X	X	X	20'	Red buds open to pink-white, pest problems
Centuryjian	X	X	X	X	20'	Red buds open into rose-red blossoms
Radiant	X	X	X		25'	Hardy, red buds to pink flowers
Red Splendor	X	X	X		20'	Red buds open to showy deep pink flowers
Sargent		X	X	X	10'	White flowers, shrub form, some pest problems
Snowdrift	X	X	X	X	20'	Fast growing with upright branching habit
Van Eseltine			X		20'	Buds flower pink, pest problems
Zumi			X		20'	Deep red buds opening into white flowers
MAPLE Amur & varieties	X	X	X		20'	Good specimen, fragrant flowers
Norway varieties (small)						
Columnare	X	X	X	X	25'	Pyramidal
Crimson King			X	X	40'	Hardiness sometimes a problem, good color
RED BUD Eastern & varieties	X	X	X		35'	New rosy reds are interesting, susceptible to weed spray

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