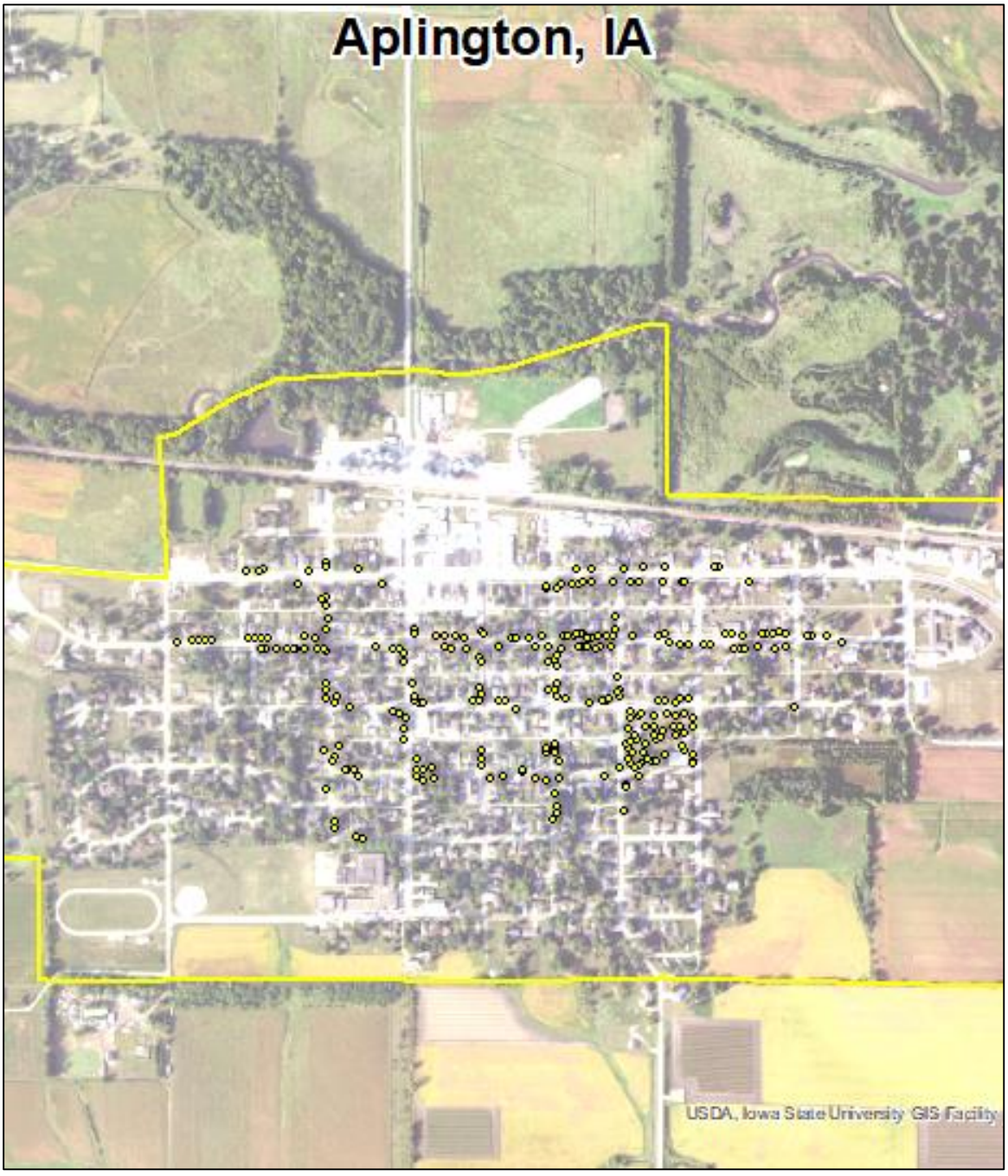
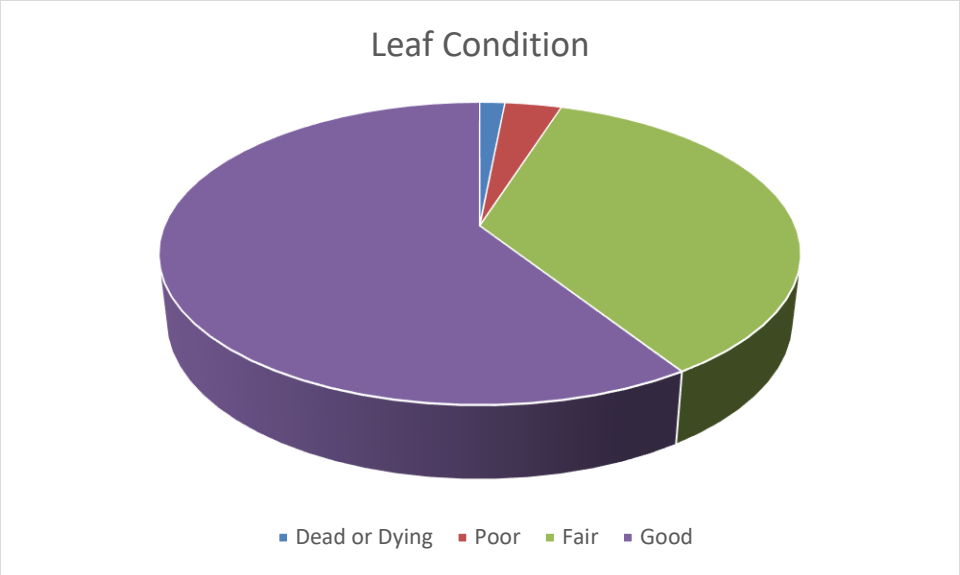
Aplington, IA



2020 Urban Forest Management Plan
Prepared by Iowa Department of Natural Resources

Table of Contents



Executive Summary

Overview

This plan was developed to assist the City of Aplington 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 27% of Aplington'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 2019, 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 264 trees inventoried.

- Aplington's trees provide $46,425 of benefits annually, an average of $176 a tree
- There are over 25 species of trees
- The top three genera are: Maple 49%, Ash 27%, and Oak 8%
- 69% of trees are in need of some type of management
- 16 trees are recommended for removal

Recommendations

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

- There are 4 trees flagged as "critical concerns" – 2 are recommended for removal and 2 for dead limb cleaning. Six (6) additional trees are flagged for "immediate" removal which implies in the next 3 years *City ownership of the trees recommended for removal should be verified prior to any removal*
- All ash trees should be examined immediately and either scheduled for removal or else designated for preventative treatment (high value trees only or to defer removals)
- Schedule routine inspections and maintenance trimming for all trees – approximately 1/3 of the city every other year
- Begin regularly planting a diverse mix of new trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. Set a goal of planting 5 new trees per year over the next 10-15 years

Introduction

This plan was developed to assist Aplington 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 or treatment and replacement planting. With proper planning and management of the current canopy in Aplington, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2019, 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 264 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. Fin

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Aplington's trees reduce energy related costs by approximately $13,119 annually (Appendix A, Table 1). These savings are both in Electricity (62.2 MWh) and in Natural Gas (8,571 Therms).

Annual Stormwater Benefits

Aplington's trees intercept about 628,135 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $17,022 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 Aplington, it is estimated that trees remove 798 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $2,255 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Aplington, trees sequester about 229,797 lbs of carbon a year with an associated value of $1,723 (Appendix A, Table 5). In addition, the trees store 2,415,703 lbs of carbon, with a yearly benefit of $18,118 (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. Aplington receives $12,305 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, Aplington's trees provide $46,425 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 264 trees in Aplington provide approximately $176 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Aplington has over 25 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Maple	130	49%
Ash	70	27%

Oak	22	8%
Apple (Crab)	7	3%

Age Class

Most of Aplington's trees (52%) are larger than 18 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. Aplington's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Aplington indicate that 95% of the trees are in good health, with only 5% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 90% of Aplington's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Trees that are rated as poor, dead, or dying should be scheduled for removal and replacement as time allows.

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).

Needs	No. of trees
Crown Cleaning	106
Crown Raising	20
Tree Staking	8
Tree Removal	16
Crown Reduction	33

Canopy Cover

The total canopy with both private and public trees is 11%, 57 acres. The canopy cover included in the Aplington inventory includes approximately 6.7 acres (Appendix A, Figure 4).

Recommendations

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

<u>Hazardous trees</u>

Aplington had 4 critical concern trees at the time of inventory that need immediate attention. This includes 2 removals and 2 cleanings. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first.

After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing “immediate” maintenance (within the next 3 years). There are a total of 40 trees with these needs.

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

Planting is recommended to help replace trees lost to disease or old age and to help balance out the aging tree population to provide for future Aplington citizens. 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 Aplington.

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 (49%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Six Year Maintenance Plan

Year 1

- Tree Removal: 16 trees flagged in 2019 inventory
- Pruning: Address 2 critical concern limbs
- Planting and Replacement: Add 5 new trees in open planting spots
- Ash trees: Visit all ash trees and schedule for either removal or immediate treatment

Year 2

- Tree Removal: any ash trees flagged for removal in Yr 1
- Pruning: Address 40 trees flagged for “immediate” pruning needs
- Planting and Replacement: Add 5 new trees in open planting spots
- Ash trees: removals and treatments as decided in Yr 1

Year 3

Tree Removal: any remaining ash trees flagged for removal in Yr 1
Pruning: Address 66 trees flagged for “routine” pruning needs
Planting and Replacement: Add 5 new trees in open planting spots
Ash trees: removals and treatments as decided in Yr 1

Year 4
Pruning: Address 65 remaining trees flagged for “routine” pruning needs
Planting and Replacement: Add 5 new trees in open planting spots
Ash trees: treatments as decided in Yr 1

Year 5
Planting and Replacement: Add 5 new trees in open planting spots
Ash trees: removals/treatments as decided in Yr 1

Year 6
Planting and Replacement: Add 5 new trees in open planting spots
Ash trees: removals and treatments as decided in Yr 1
Routine trimming: Initiate routine inspection and trimming of 1/3 of the city trees every other yr

Emerald Ash Borer Plan

Ash Tree Removal

Begin removing all ash trees immediately unless they are a high value tree or designated for preventative treatment in order to defer removal. *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 save high value trees alive and/or spread removal costs out over several years while allowing trees to continue to provide benefits. 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.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinances. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on 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 if preventative treatments are not being used.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

4/9/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	18.4	1,394	2,664.4	2,611	4,005	(N/A)	31.8	30.5	47.68
Green ash	19.3	1,468	2,599.2	2,547	4,016	(N/A)	25.8	30.6	59.05
Sugar maple	5.8	441	804.9	789	1,230	(N/A)	7.6	9.4	61.49
Red maple	2.5	188	314.9	309	497	(N/A)	4.5	3.8	41.39
Silver maple	3.3	250	436.5	428	678	(N/A)	4.2	5.2	61.61
Pin oak	2.9	222	396.2	388	610	(N/A)	3.4	4.7	67.79
Apple	0.7	56	107.3	105	162	(N/A)	2.7	1.2	23.08
Honeylocust	0.4	29	59.4	58	88	(N/A)	2.7	0.7	12.50
Northern red oak	0.7	56	95.1	93	149	(N/A)	2.3	1.1	24.80
River birch	0.7	53	100.7	99	152	(N/A)	1.9	1.2	30.43
Northern hackberry	0.3	24	48.2	47	72	(N/A)	1.9	0.5	14.32
Bur oak	1.1	87	161.1	158	244	(N/A)	1.5	1.9	61.12
American basswood	0.8	62	113.8	112	173	(N/A)	1.1	1.3	57.70
Black walnut	0.7	56	92.1	90	146	(N/A)	1.1	1.1	48.59
White oak	0.3	25	41.2	40	66	(N/A)	1.1	0.5	21.84
Littleleaf linden	0.4	30	47.9	47	77	(N/A)	0.8	0.6	38.70
American elm	0.3	19	27.7	27	46	(N/A)	0.8	0.4	23.05
Mountain ash	0.1	11	25.7	25	36	(N/A)	0.8	0.3	18.19
Boxelder	0.5	41	75.1	74	115	(N/A)	0.8	0.9	57.27
White ash	0.7	52	82.9	81	133	(N/A)	0.8	1.0	66.69
Catalpa	0.9	66	116.8	114	181	(N/A)	0.8	1.4	90.32
Ginkgo	0.4	29	53.0	52	81	(N/A)	0.8	0.6	40.40
Black maple	0.3	22	39.9	39	61	(N/A)	0.4	0.5	60.68
Cottonwood	0.5	37	63.1	62	99	(N/A)	0.4	0.8	98.63
Pear	0.0	2	3.8	4	5	(N/A)	0.4	0.0	5.40
Total	62.2	4,720	8,570.8	8,399	13,119	(N/A)	100.0	100.0	49.69

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

4/9/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	160,123	4,339	(N/A)	31.8	25.5	51.66
Green ash	209,625	5,681	(N/A)	25.8	33.4	83.54
Sugar maple	63,056	1,709	(N/A)	7.6	10.0	85.44
Red maple	17,370	471	(N/A)	4.5	2.8	39.23
Silver maple	52,026	1,410	(N/A)	4.2	8.3	128.17
Pin oak	33,794	916	(N/A)	3.4	5.4	101.76
Apple	2,666	72	(N/A)	2.7	0.4	10.32
Honeylocust	1,674	45	(N/A)	2.7	0.3	6.48
Northern red oak	5,771	156	(N/A)	2.3	0.9	26.07
River birch	5,934	161	(N/A)	1.9	0.9	32.16
Northern hackberry	2,503	68	(N/A)	1.9	0.4	13.57
Bur oak	13,984	379	(N/A)	1.5	2.2	94.74
American basswood	7,930	215	(N/A)	1.1	1.3	71.64
Black walnut	5,522	150	(N/A)	1.1	0.9	49.88
White oak	2,091	57	(N/A)	1.1	0.3	18.89
Littleleaf linden	2,519	68	(N/A)	0.8	0.4	34.14
American elm	1,394	38	(N/A)	0.8	0.2	18.89
Mountain ash	529	14	(N/A)	0.8	0.1	7.17
Boxelder	7,277	197	(N/A)	0.8	1.2	98.61
White ash	6,962	189	(N/A)	0.8	1.1	94.33
Catalpa	12,729	345	(N/A)	0.8	2.0	172.48
Ginkgo	2,479	67	(N/A)	0.8	0.4	33.60
Black maple	2,867	78	(N/A)	0.4	0.5	77.70
Cottonwood	7,239	196	(N/A)	0.4	1.2	196.17
Pear	69	2	(N/A)	0.4	0.0	1.86
Citywide total	628,135	17,022	(N/A)	100.0	100.0	64.48

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

4/9/2020

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Norway maple	31.1	5.4	15.5	1.4	168	89.2	12.9	12.3	83.3	552	-7.4	-28	243.5	693 (N/A)	31.8	8.25
Green ash	26.2	4.2	12.6	1.2	140	91.9	13.4	12.8	87.7	574	0.0	0	250.0	714 (N/A)	25.8	10.49
Sugar maple	8.1	1.4	4.1	0.4	44	27.8	4.0	3.9	26.3	173	-6.3	-24	69.5	193 (N/A)	7.6	9.65
Red maple	3.7	0.6	1.8	0.2	20	11.6	1.7	1.6	11.2	73	-1.3	-5	31.1	88 (N/A)	4.5	7.30
Silver maple	9.1	1.5	4.4	0.4	49	15.5	2.3	2.2	14.9	97	-4.6	-17	45.7	129 (N/A)	4.2	11.70
Pin oak	6.1	1.1	3.1	0.3	33	13.9	2.0	1.9	13.2	87	-11.2	-42	30.4	78 (N/A)	3.4	8.64
Apple	0.7	0.1	0.4	0.0	4	3.6	0.5	0.5	3.4	22	0.0	0	9.2	26 (N/A)	2.7	3.74
Honeylocust	0.2	0.0	0.1	0.0	1	1.9	0.3	0.3	1.8	12	-0.1	0	4.4	12 (N/A)	2.7	1.76
Northern red oak	1.1	0.2	0.6	0.0	6	3.4	0.5	0.5	3.3	22	-1.6	-6	8.1	22 (N/A)	2.3	3.62
River birch	1.1	0.2	0.6	0.1	6	3.4	0.5	0.5	3.2	21	-0.3	-1	9.3	26 (N/A)	1.9	5.26
Northern hackberry	0.3	0.1	0.2	0.0	2	1.6	0.2	0.2	1.5	10	0.0	0	4.0	11 (N/A)	1.9	2.28
Bur oak	1.8	0.3	0.8	0.1	10	5.5	0.8	0.8	5.2	34	0.0	0	15.2	44 (N/A)	1.5	10.91
American basswood	1.0	0.2	0.5	0.0	5	3.9	0.6	0.5	3.7	24	-0.9	-3	9.5	26 (N/A)	1.1	8.80
Black walnut	0.5	0.1	0.3	0.0	3	3.4	0.5	0.5	3.3	21	0.0	0	8.6	24 (N/A)	1.1	8.06
White oak	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.5	10	0.0	0	3.7	10 (N/A)	1.1	3.50
Littleleaf linden	0.3	0.1	0.2	0.0	2	1.9	0.3	0.3	1.8	12	-0.2	-1	4.6	13 (N/A)	0.8	6.42
American elm	0.1	0.0	0.1	0.0	0	1.1	0.2	0.2	1.1	7	0.0	0	2.8	8 (N/A)	0.8	3.86
Mountain ash	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5 (N/A)	0.8	2.55
Boxelder	1.1	0.2	0.5	0.0	6	2.6	0.4	0.4	2.4	16	-0.3	-1	7.2	21 (N/A)	0.8	10.29
White ash	1.0	0.2	0.5	0.0	5	3.2	0.5	0.4	3.1	20	0.0	0	8.9	26 (N/A)	0.8	12.76
Catalpa	2.4	0.4	1.0	0.1	12	4.1	0.6	0.6	4.0	26	0.0	0	13.2	38 (N/A)	0.8	19.13
Ginkgo	0.6	0.1	0.3	0.0	3	1.8	0.3	0.3	1.7	11	-0.2	-1	4.9	14 (N/A)	0.8	6.92
Black maple	0.7	0.1	0.3	0.0	4	1.4	0.2	0.2	1.3	8	-0.2	-1	4.0	12 (N/A)	0.4	11.54
Cottonwood	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23 (N/A)	0.4	22.55
Pear	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)	0.4	0.71
Citywide total	98.9	16.6	48.5	4.4	533	297.5	43.3	41.3	281.9	1,852	-34.6	-130	797.7	2,255 (N/A)	100.0	8.54

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

4/9/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	514,153	3,856	(N/A)	31.8	21.3	45.91
Green ash	866,070	6,496	(N/A)	25.8	35.9	95.52
Sugar maple	226,459	1,698	(N/A)	7.6	9.4	84.92
Red maple	41,156	309	(N/A)	4.5	1.7	25.72
Silver maple	204,380	1,533	(N/A)	4.2	8.5	139.35
Pin oak	160,410	1,203	(N/A)	3.4	6.6	133.67
Apple	11,283	85	(N/A)	2.7	0.5	12.09
Honeylocust	2,213	17	(N/A)	2.7	0.1	2.37
Northern red oak	22,815	171	(N/A)	2.3	0.9	28.52
River birch	19,240	144	(N/A)	1.9	0.8	28.86
Northern hackberry	4,161	31	(N/A)	1.9	0.2	6.24
Bur oak	58,523	439	(N/A)	1.5	2.4	109.73
American basswood	36,765	276	(N/A)	1.1	1.5	91.91
Black walnut	15,801	119	(N/A)	1.1	0.7	39.50
White oak	4,719	35	(N/A)	1.1	0.2	11.80
Littleleaf linden	7,190	54	(N/A)	0.8	0.3	26.96
American elm	3,051	23	(N/A)	0.8	0.1	11.44
Mountain ash	1,816	14	(N/A)	0.8	0.1	6.81
Boxelder	41,620	312	(N/A)	0.8	1.7	156.07
White ash	19,445	146	(N/A)	0.8	0.8	72.92
Catalpa	81,925	614	(N/A)	0.8	3.4	307.22
Ginkgo	8,406	63	(N/A)	0.8	0.3	31.52
Black maple	7,945	60	(N/A)	0.4	0.3	59.59
Cottonwood	55,982	420	(N/A)	0.4	2.3	419.86
Pear	178	1	(N/A)	0.4	0.0	1.33
Citywide total	2,415,703	18,118	(N/A)	100.0	100.0	68.63

Table 5: Annual Carbon Sequestered

Annual CO Benefits of Public Trees

4/9/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	28,546	214	-2,469	-189	-20	30,803	231	56,691	425 (N/A)	31.8	24.7	5.06
Green ash	43,650	327	-4,157	-198	-33	32,452	243	71,747	538 (N/A)	25.8	31.2	7.91
Sugar maple	12,834	96	-1,087	-62	-9	9,747	73	21,431	161 (N/A)	7.6	9.3	8.04
Red maple	3,434	26	-198	-21	-2	4,156	31	7,371	55 (N/A)	4.5	3.2	4.61
Silver maple	14,553	109	-982	-38	-8	5,522	41	19,056	143 (N/A)	4.2	8.3	12.99
Pin oak	14,405	108	-770	-32	-6	4,903	37	18,506	139 (N/A)	3.4	8.1	15.42
Apple	1,107	8	-54	-9	0	1,248	9	2,291	17 (N/A)	2.7	1.0	2.45
Honeylocust	524	4	-12	-4	0	648	5	1,157	9 (N/A)	2.7	0.5	1.24
Northern red oak	678	5	-110	-9	-1	1,230	9	1,789	13 (N/A)	2.3	0.8	2.24
River birch	1,081	8	-93	-7	-1	1,181	9	2,162	16 (N/A)	1.9	0.9	3.24
Northern hackberry	368	3	-20	-4	0	537	4	882	7 (N/A)	1.9	0.4	1.32
Bur oak	2,882	22	-281	-12	-2	1,913	14	4,502	34 (N/A)	1.5	2.0	8.44
American basswood	2,278	17	-176	-9	-1	1,360	10	3,452	26 (N/A)	1.1	1.5	8.63
Black walnut	1,550	12	-76	-7	-1	1,227	9	2,695	20 (N/A)	1.1	1.2	6.74
White oak	657	5	-23	-3	0	556	4	1,187	9 (N/A)	1.1	0.5	2.97
Littleleaf linden	1,029	8	-35	-4	0	674	5	1,664	12 (N/A)	0.8	0.7	6.24
American elm	229	2	-15	-2	0	420	3	632	5 (N/A)	0.8	0.3	2.37
Mountain ash	228	2	-9	-2	0	248	2	465	3 (N/A)	0.8	0.2	1.74
Boxelder	2,567	19	-200	-8	-2	905	7	3,265	24 (N/A)	0.8	1.4	12.24
White ash	1,809	14	-93	-5	-1	1,153	9	2,863	21 (N/A)	0.8	1.2	10.74
Catalpa	1,438	11	-393	-10	-3	1,463	11	2,498	19 (N/A)	0.8	1.1	9.37
Ginkgo	451	3	-40	-5	0	637	5	1,042	8 (N/A)	0.8	0.5	3.91
Black maple	923	7	-38	-3	0	477	4	1,359	10 (N/A)	0.4	0.6	10.20
Cottonwood	479	4	-269	-6	-2	813	6	1,017	8 (N/A)	0.4	0.4	7.63
Pear	38	0	-1	-1	0	37	0	74	1 (N/A)	0.4	0.0	0.55
Citywide total	137,737	1,033	-11,599	-651	-92	104,310	782	229,797	1,723 (N/A)	100.0	100.0	6.53

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

4/9/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	2,800	(N/A)	31.8	22.8	33.33
Green ash	3,661	(N/A)	25.8	29.8	53.84
Sugar maple	1,352	(N/A)	7.6	11.0	67.58
Red maple	492	(N/A)	4.5	4.0	41.01
Silver maple	1,120	(N/A)	4.2	9.1	101.85
Pin oak	1,099	(N/A)	3.4	8.9	122.10
Apple	63	(N/A)	2.7	0.5	9.05
Honeylocust	79	(N/A)	2.7	0.6	11.34
Northern red oak	64	(N/A)	2.3	0.5	10.69
River birch	112	(N/A)	1.9	0.9	22.49
Northern hackberry	67	(N/A)	1.9	0.5	13.40
Bur oak	226	(N/A)	1.5	1.8	56.58
American basswood	170	(N/A)	1.1	1.4	56.79
Black walnut	149	(N/A)	1.1	1.2	49.80
White oak	80	(N/A)	1.1	0.6	26.56
Littleleaf linden	110	(N/A)	0.8	0.9	55.09
American elm	39	(N/A)	0.8	0.3	19.35
Mountain ash	13	(N/A)	0.8	0.1	6.40
Boxelder	147	(N/A)	0.8	1.2	73.49
White ash	190	(N/A)	0.8	1.5	95.05
Catalpa	95	(N/A)	0.8	0.8	47.59
Ginkgo	35	(N/A)	0.8	0.3	17.46
Black maple	109	(N/A)	0.4	0.9	109.08
Cottonwood	29	(N/A)	0.4	0.2	28.57
Pear	2	(N/A)	0.4	0.0	2.06
Citywide total	12,305	(N/A)	100.0	100.0	46.61

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species ($)

4/9/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway maple	4,005	425	693	4,339	2,800	12,262	(N/A)	26.4
Green ash	4,016	538	714	5,681	3,661	14,610	(N/A)	31.5
Sugar maple	1,230	161	193	1,709	1,352	4,644	(N/A)	10.0
Red maple	497	55	88	471	492	1,602	(N/A)	3.5
Silver maple	678	143	129	1,410	1,120	3,480	(N/A)	7.5
Pin oak	610	139	78	916	1,099	2,841	(N/A)	6.1
Apple	162	17	26	72	63	341	(N/A)	0.7
Honeylocust	88	9	12	45	79	233	(N/A)	0.5
Northern red oak	149	13	22	156	64	404	(N/A)	0.9
River birch	152	16	26	161	112	468	(N/A)	1.0
Northern hackberry	72	7	11	68	67	224	(N/A)	0.5
Bur oak	244	34	44	379	226	927	(N/A)	2.0
American basswood	173	26	26	215	170	611	(N/A)	1.3
Black walnut	146	20	24	150	149	489	(N/A)	1.1
White oak	66	9	10	57	80	221	(N/A)	0.5
Littleleaf linden	77	12	13	68	110	281	(N/A)	0.6
American elm	46	5	8	38	39	135	(N/A)	0.3
Mountain ash	36	3	5	14	13	72	(N/A)	0.2
Boxelder	115	24	21	197	147	504	(N/A)	1.1
White ash	133	21	26	189	190	559	(N/A)	1.2
Catalpa	181	19	38	345	95	678	(N/A)	1.5
Ginkgo	81	8	14	67	35	205	(N/A)	0.4
Black maple	61	10	12	78	109	269	(N/A)	0.6
Cottonwood	99	8	23	196	29	354	(N/A)	0.8
Pear	5	1	1	2	2	11	(N/A)	0.0
Citywide Total	13,119	1,723	2,255	17,022	12,305	46,425	(N/A)	100.0

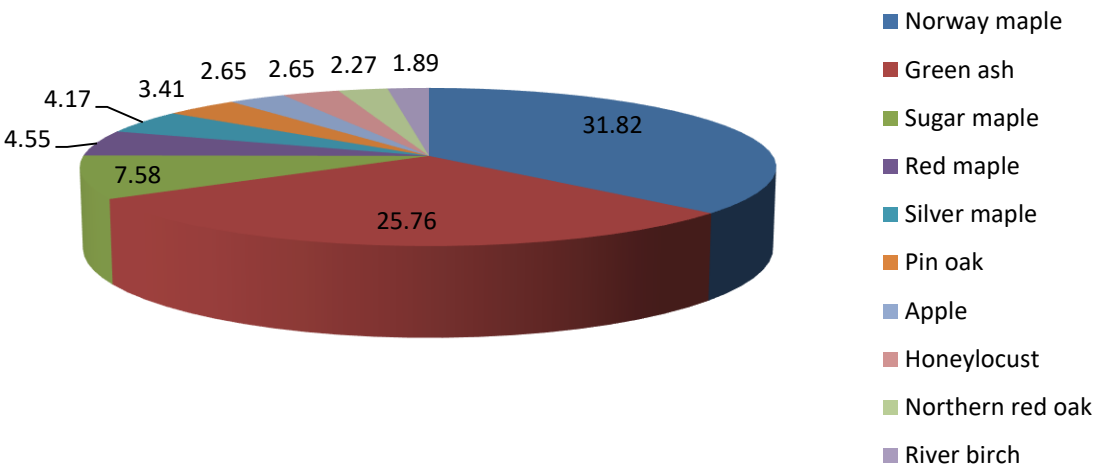

Figure 1: Species Distribution

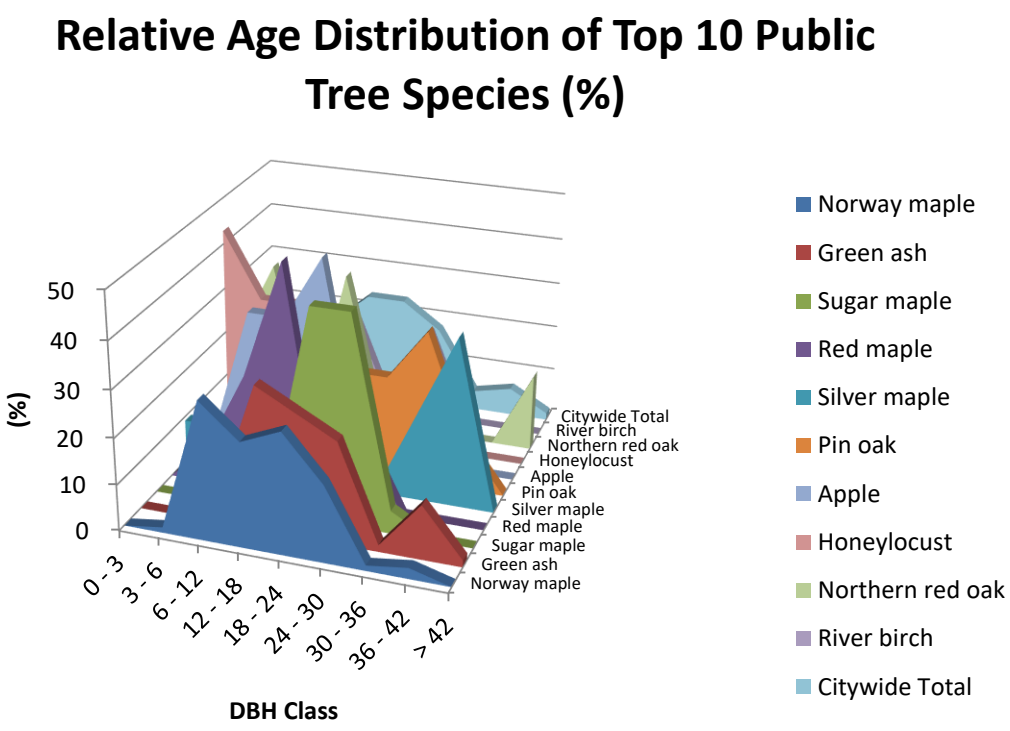

Figure 2: Relative Age Class

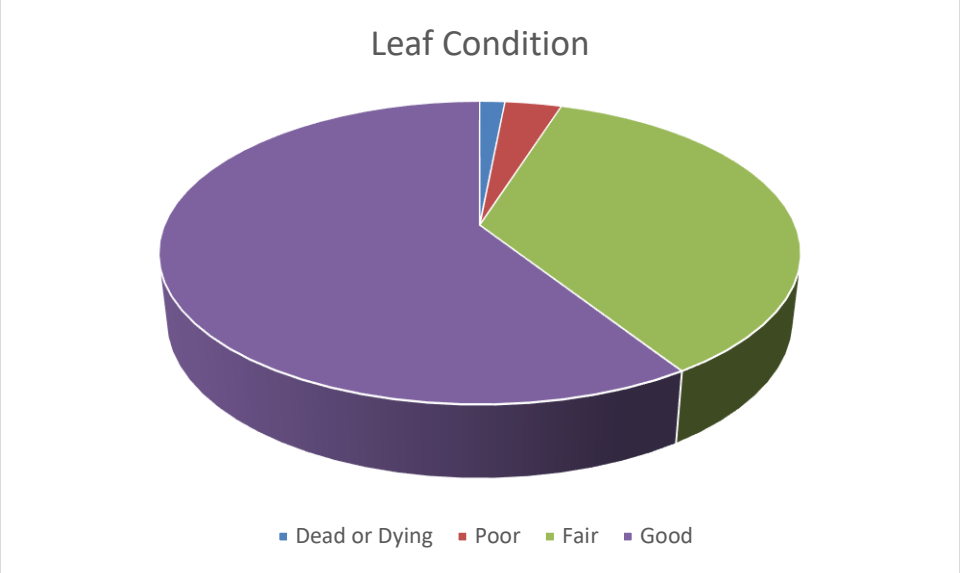

Figure 3: Foliage Condition

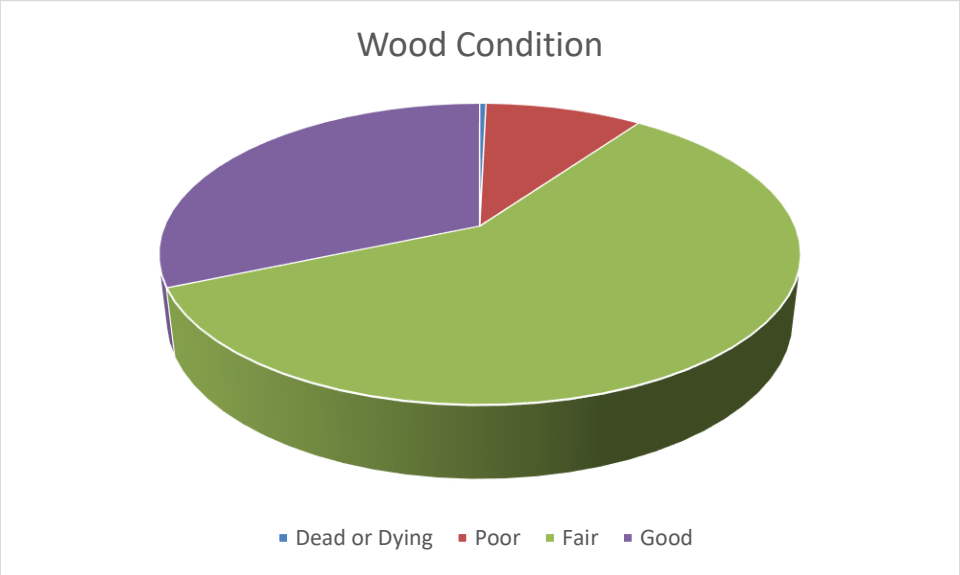

Figure 4: Wood Condition

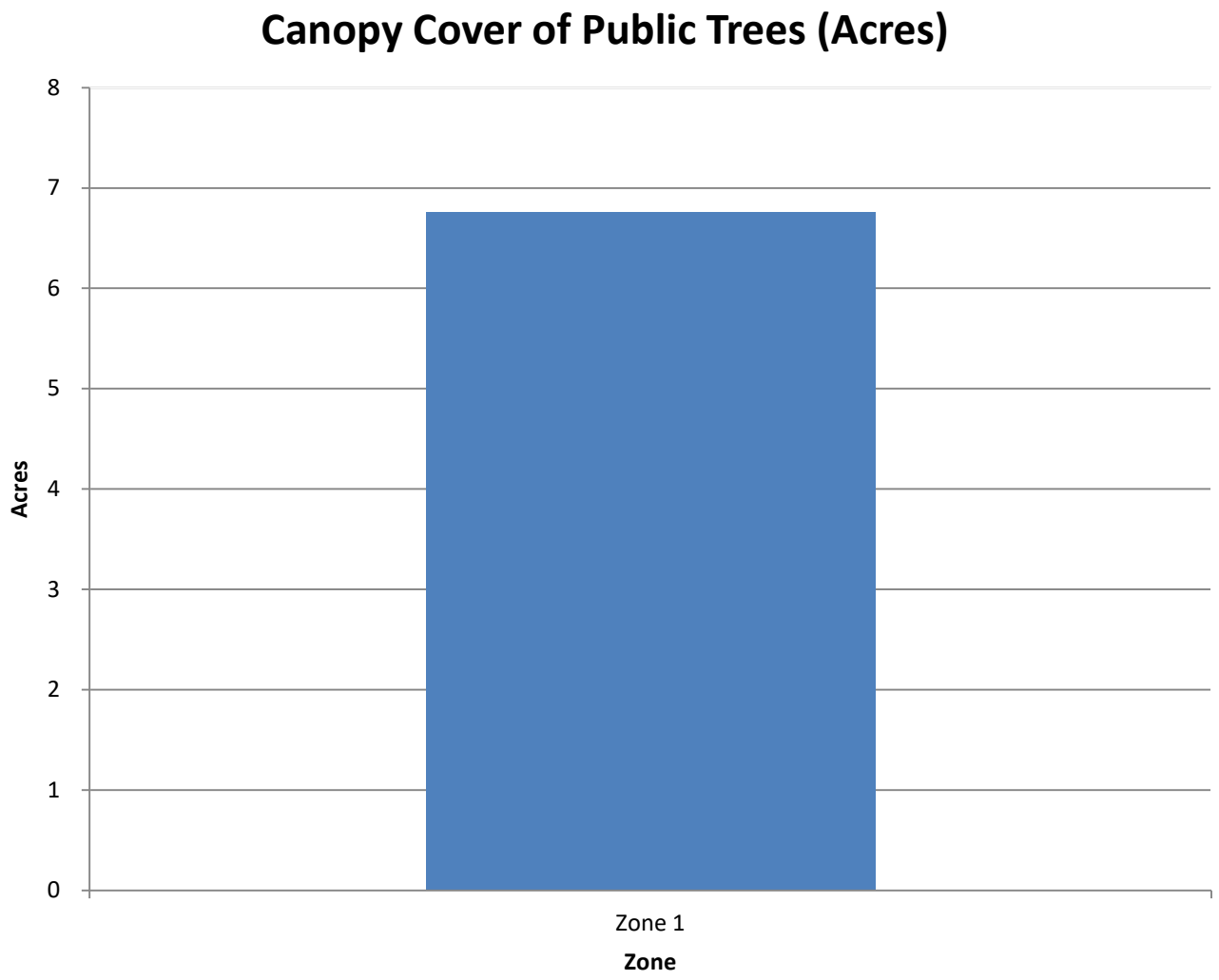

Figure 5: Canopy Cover in Acres

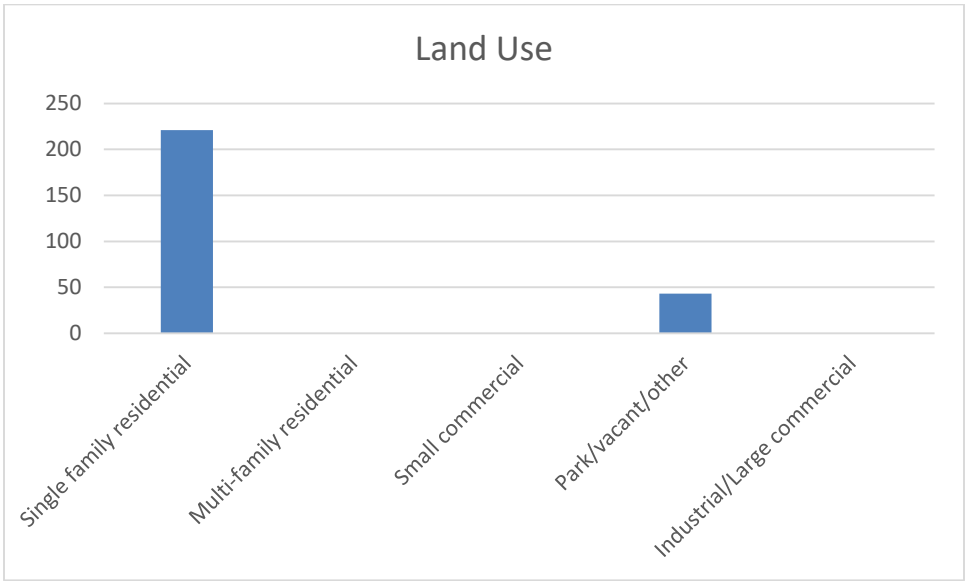

Figure 6: Land Use of city/park trees

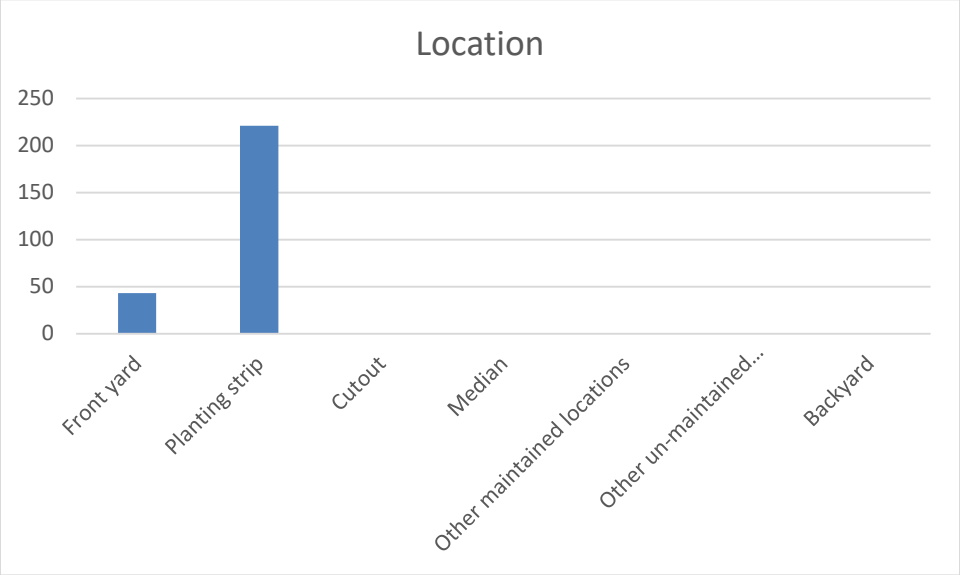

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

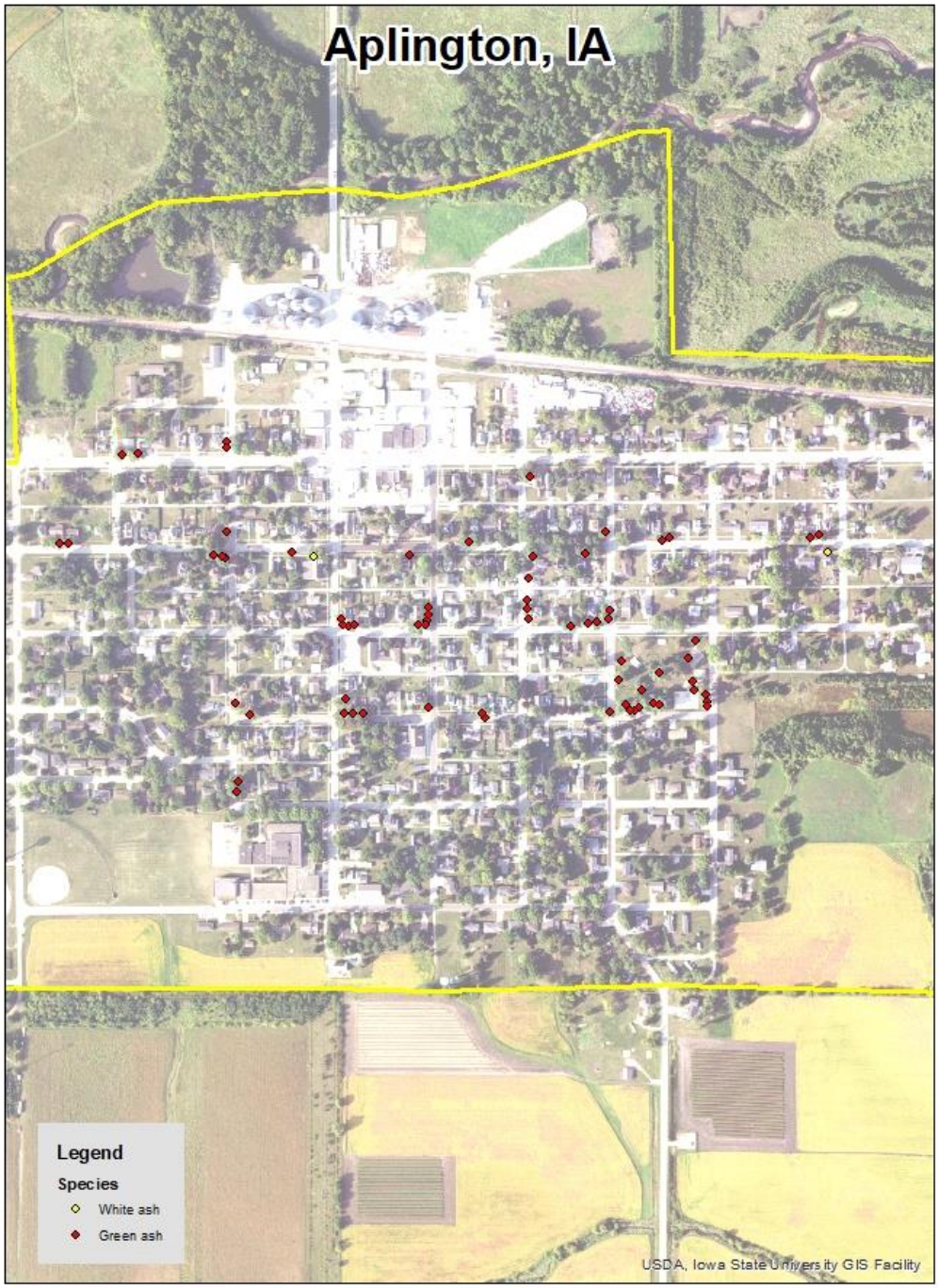

Figure 1: Location of Ash Trees

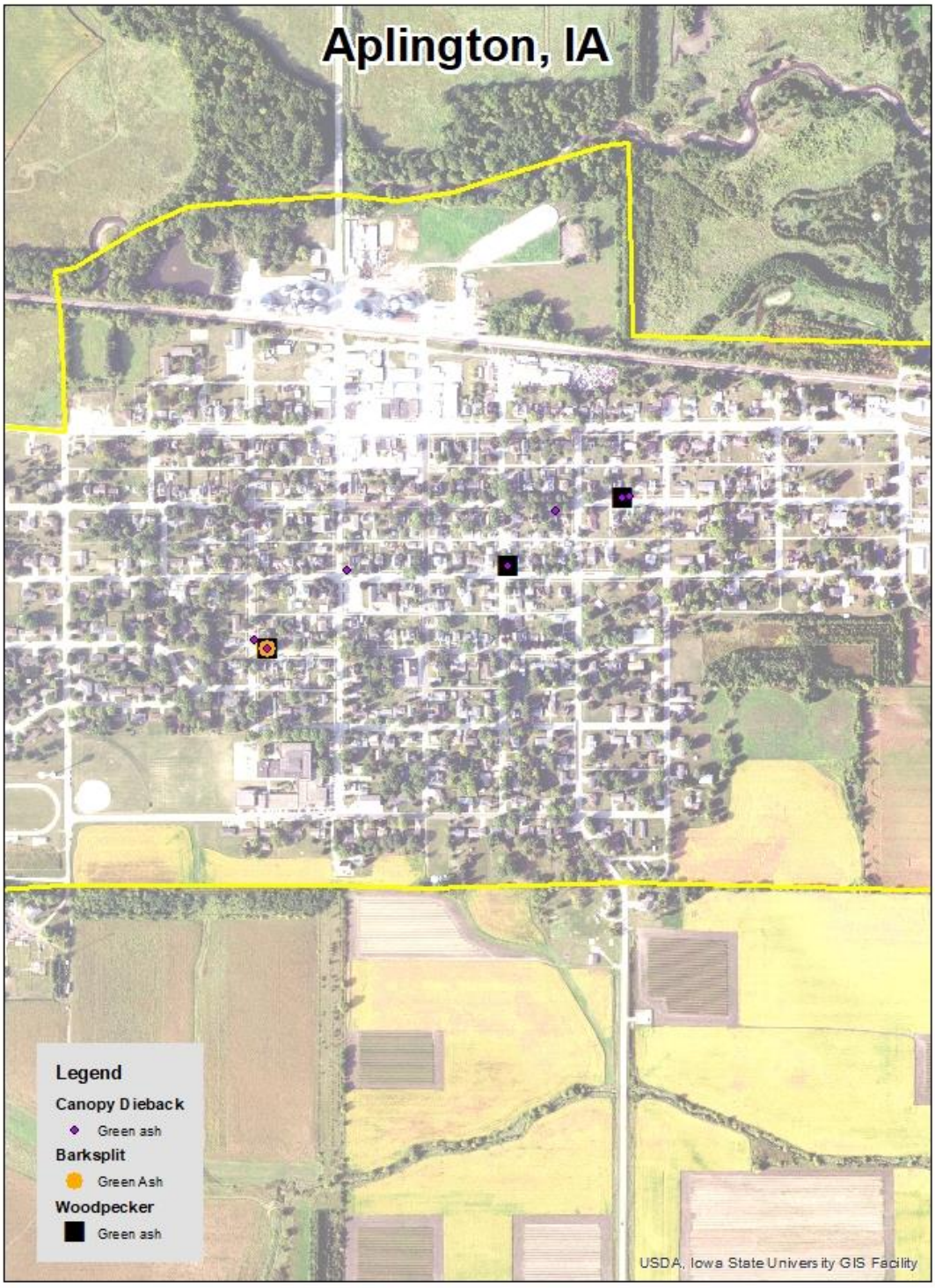

Figure 2: Location of EAB symptoms

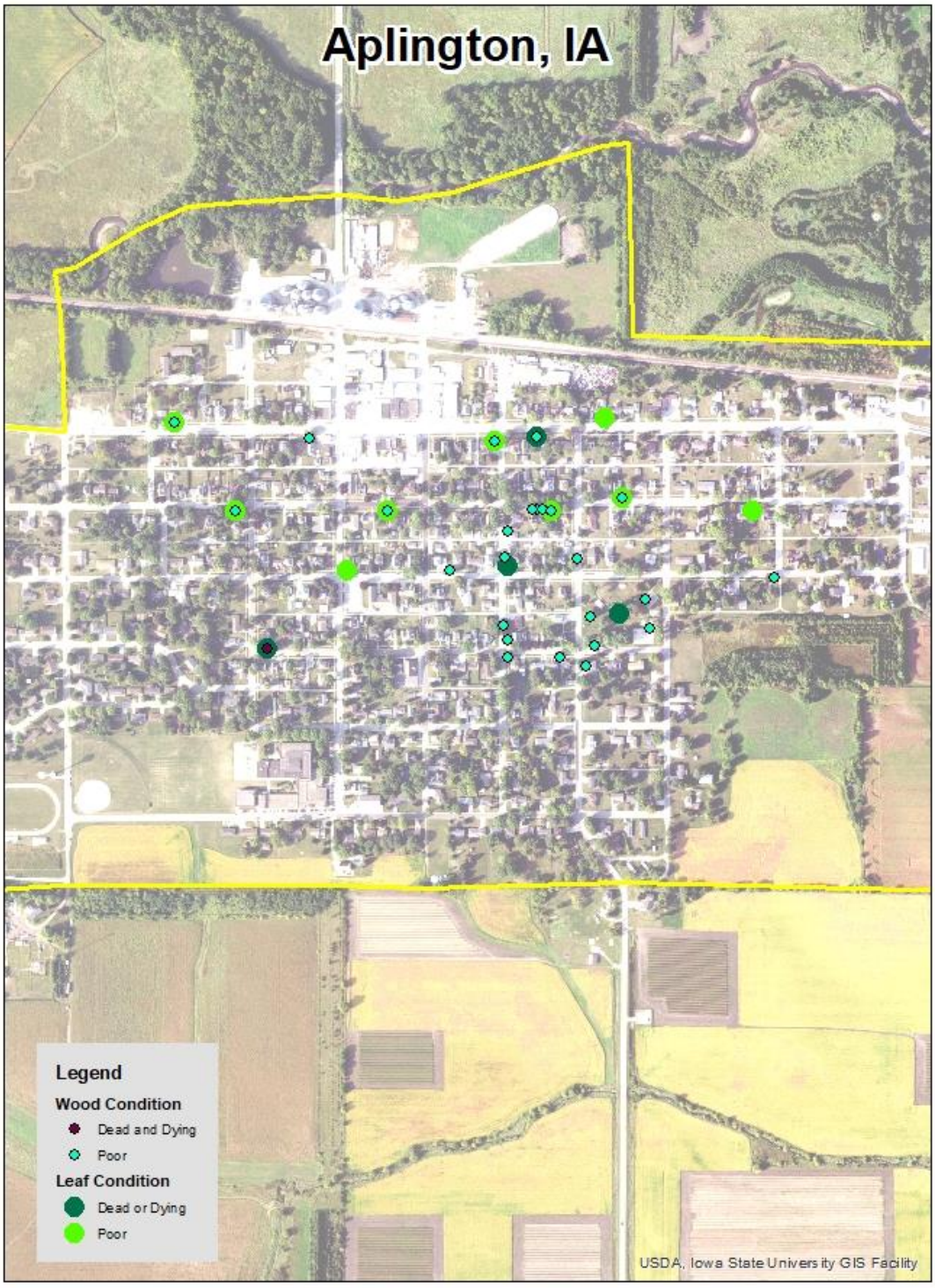

Figure 3: Location of Poor Condition Trees

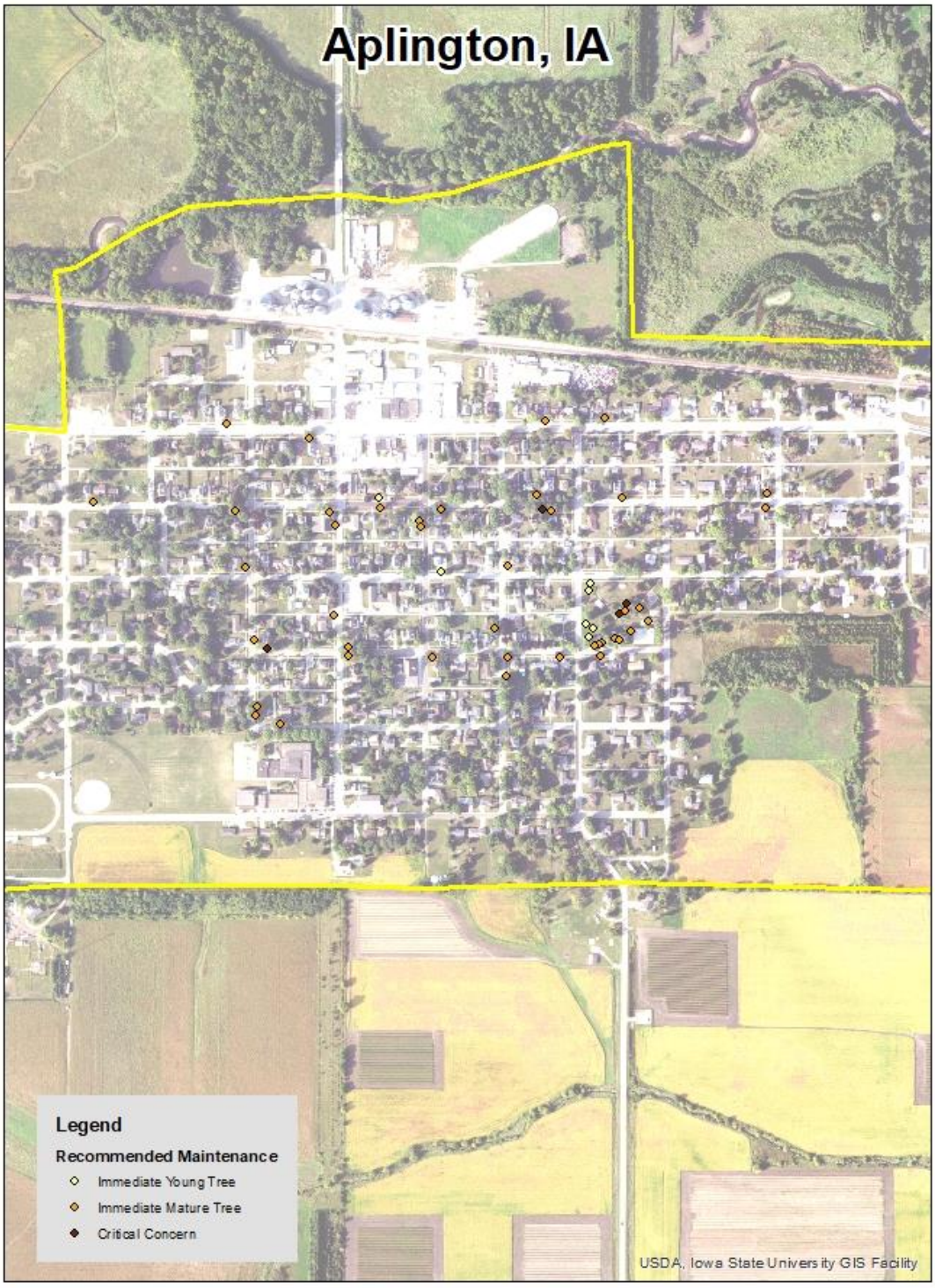

Figure 4: Location of Trees with Recommended Maintenance

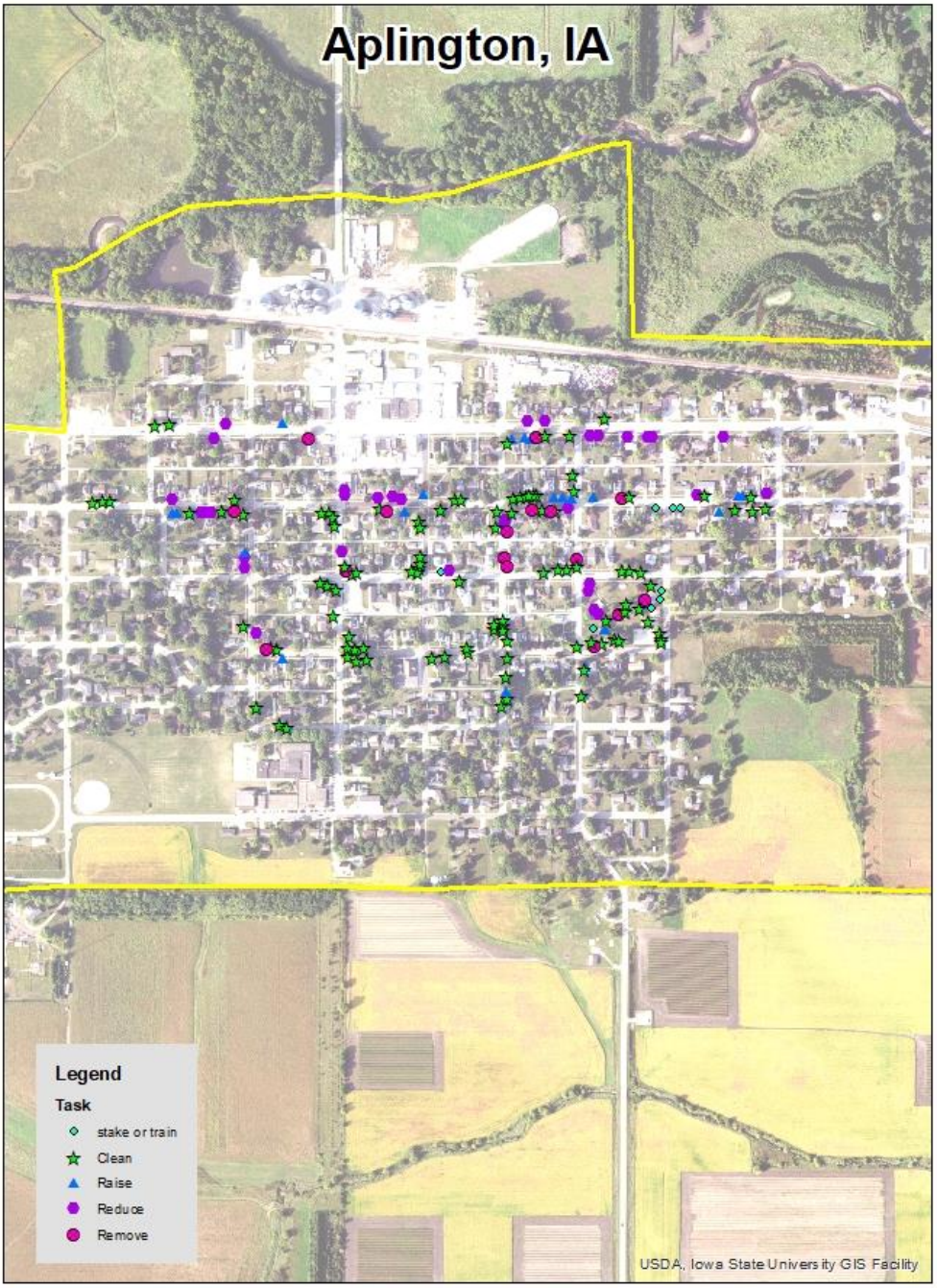

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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