

Clemons, IA



2020 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Clemons 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 20% of Clemons'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 74 trees inventoried.

- Clemons' trees provide \$12,251 of benefits annually, an average of \$165 a tree
- There are over 23 species of trees
- The top three genera are: maple 21%, spruce 20%, and ash 20%
- 95% of trees are in need of some type of management
- 15 trees are recommended for removal

Recommendations

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

- Of the 11 trees needing removal, 5 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- The 15 ash trees should be carefully examined for symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the proposed budget it could take 6 years to remove ash – Suggestion: request a budget increase to \$3,758 annually and apply for grants to plant replacement trees
- Create a public tree ordinance.

Introduction

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

Trees are an important component of Clemons' 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 Clemons 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 Clemons' 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 74 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. Clemons' trees reduce energy related costs by approximately \$2,981 annually (Appendix A, Table 1). These savings are both in Electricity (14.3 MWh) and in Natural Gas (1,936.5 Therms).

Annual Stormwater Benefits

Clemons' trees intercept about 187,524 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$5,082 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 Clemons, it is estimated that trees remove 196.6 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 \$558 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Clemons, trees sequester about 37,531 lbs of carbon a year with an associated value of \$281 (Appendix A, Table 5). In addition, the trees store 842,687 lbs of carbon, with a yearly benefit of \$6,320 (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. Clemons receives \$3,201 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, Clemons' trees provide \$12,251 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 74 trees in Clemons provide approximately \$165 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Clemons has over 23 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	16	21%
Spruce	15	20%
Ash	15	20%
Oak	5	6%
Elm	3	4%
Yellowwood	2	2%
Honeylocust	2	2%
Hackberry	2	2%
Tulip tree	2	2%
Mulberry	2	2%
Kentucky Coffeetree	2	2%
Sycamore	1	1%
Apple	1	1%
Ginkgo	1	1%
River birch	1	1%
Other Broadleaf	2	2%
Other Coniferous	1	1%
Unknown (dead)	1	1%

Age Class

Most of Clemons' trees (41%) are 24 inches in diameter or more 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. Clemons' size curve is on the larger side, indicating a 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 Clemons indicate that 81% of the trees are in good health, with only 17% of the foliage in fair health, and only one tree that is dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). However, only 20% of Clemons' 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 27% of the population. This 27% 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).

Tree Staking	25	33%
Crown Cleaning	22	14%
Tree Removal	15	20%
Crown Raising	8	10%
Crown Reduction	1	1%

Canopy Cover

The total canopy with both private and public trees is 22%, 37.9 acres. The canopy cover included in the Clemons inventory includes approximately 1.8 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 13 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Clemons' city and park trees are in a park (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use

Park/vacant/other	70%
Single family residential	29%

Location

Front yard	89%
Planting strip	9%
Cutout (surrounded by pavement)	1%

Recommendations

Risk Management

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

Hazardous trees

Clemons has 5 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately and 11 trees under 6 inches in diameter that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the immediate need trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 55 trees with these needs.

Poor tree species

After the maintenance of immediate need trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 16 trees recommended for removal, 3 are ash trees. There are a total of 15 ash trees, and none of those have signs and symptoms that have been associated with EAB. In addition, there are 19 trees that are in poor health. [**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 Clemons.

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 (21%) (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.

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Emerald Ash Borer Plan

Ash Tree Removal

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

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. 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. 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.

PROPOSED WORK SCHEDULE AND ESTIMATED COSTS

YEAR 1

ESTIMATED COSTS

Remove 5 large immediate concern trees	\$2,100
Plant 7 trees in open locations	\$700
Water & Maintenance	\$350
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 2

Remove 3 ash trees	\$2,100
Plant 7 trees in open locations	\$700
Water & Maintenance	\$350
Prune 1/3 of city owned trees	\$750
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 3

Remove 3 ash trees	\$2,100
Plant 7 trees in open locations	\$700
Water & Maintenance	\$350
Inspect ash trees for signs of EAB	

YEAR 4

Remove 3 ash trees	\$2,100
Plant 7 trees in open locations	\$700
Water & Maintenance	\$350

Prune 1/3 of city owned trees	\$750
Inspect ash trees for signs of EAB	

YEAR 5

Remove 3 ash trees	\$2,100
Plant 7 trees in open locations	\$700
Water & Maintenance	\$350
Inspect ash trees for signs of EAB	

YEAR 6

Remove 3 ash trees	\$2,100
Plant 7 trees in open locations	\$700
Water & Maintenance	\$350
Prune 1/3 of city owned trees	\$750

Average annual budget: \$3,758

Estimated costs based on average costs of \$700/tree for removal, \$100/tree for planting, \$50/tree for water and maintenance, and \$30/tree for pruning.

This plan removes 15 ash trees, or 100% of all ash trees in the city.

Purposed Budget Increase

EAB could potentially kill all ash trees in Clemons within 4 years of its arrival. The proposed budget and work plan above removes all 15 ash trees within 6 years. Additionally, it is recommended that Clemons 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 many 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, the average ash diameter is 20 inches and at \$15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Clemons would still need to find \$4,900 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately \$2,250 a year for treatment and leave \$0 for removal. These are alternatives 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 if EAB is found in Clemons. 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, DJ and JF Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

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

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

4/9/2020

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard (\$ Error)	% of Total Trees	% of Total \$	Avg. \$/tree
Spruce	0.1	4	10.0	10	14 (N/A)	20.3	0.5	0.93
Green ash	5.3	400	702.5	688	1,088 (N/A)	20.3	36.5	72.56
Silver maple	3.2	243	416.8	408	651 (N/A)	10.8	21.8	81.38
Norway maple	1.1	84	153.8	151	235 (N/A)	5.4	7.9	58.81
Northern red oak	0.1	9	17.8	17	26 (N/A)	5.4	0.9	6.53
Black maple	0.9	65	119.7	117	182 (N/A)	4.1	6.1	60.68
Yellowwood	0.0	1	1.6	2	2 (N/A)	2.7	0.1	1.10
Broadleaf Deciduous Small	0.0	3	7.6	7	11 (N/A)	2.7	0.4	5.40
Honeylocust	0.7	56	94.8	93	149 (N/A)	2.7	5.0	74.28
Northern hackberry	0.8	60	110.9	109	168 (N/A)	2.7	5.6	84.12
American elm	0.0	0	0.3	0	0 (N/A)	2.7	0.0	0.23
Tulip tree	0.0	2	4.2	4	6 (N/A)	2.7	0.2	3.24
Mulberry	0.4	30	63.2	62	92 (N/A)	2.7	3.1	46.14
Kentucky coffeetree	0.0	0	0.9	1	1 (N/A)	2.7	0.0	0.66
American sycamore	0.4	33	59.0	58	91 (N/A)	1.4	3.1	91.02
Pin oak	0.4	33	56.2	55	88 (N/A)	1.4	3.0	87.97
Maple	0.1	8	16.5	16	25 (N/A)	1.4	0.8	24.58
Elm	0.4	29	53.7	53	82 (N/A)	1.4	2.8	82.02
Apple	0.2	15	31.6	31	46 (N/A)	1.4	1.5	46.14
Conifer Evergreen Small	0.0	4	7.9	8	11 (N/A)	1.4	0.4	11.47
Ginkgo	0.0	0	0.4	0	1 (N/A)	1.4	0.0	0.57
River birch	0.0	3	6.2	6	9 (N/A)	1.4	0.3	8.99
Broadleaf Deciduous Medium	0.0	0	0.8	1	1 (N/A)	1.4	0.0	1.10
Total	14.3	1,083	1,936.5	1,898	2,981 (N/A)	100.0	100.0	40.28

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
Spruce	731	20	(N/A)	20.3	0.4	1.32
Green ash	70,553	1,912	(N/A)	20.3	37.6	127.46
Silver maple	53,890	1,460	(N/A)	10.8	28.7	182.55
Norway maple	10,347	280	(N/A)	5.4	5.5	70.10
Northern red oak	586	16	(N/A)	5.4	0.3	3.97
Black maple	8,601	233	(N/A)	4.1	4.6	77.70
Yellowwood	24	1	(N/A)	2.7	0.0	0.33
Broadleaf Deciduous Small	137	4	(N/A)	2.7	0.1	1.86
Honeylocust	9,370	254	(N/A)	2.7	5.0	126.96
Northern hackberry	8,924	242	(N/A)	2.7	4.8	120.93
American elm	7	0	(N/A)	2.7	0.0	0.09
Tulip tree	190	5	(N/A)	2.7	0.1	2.57
Mulberry	2,348	64	(N/A)	2.7	1.3	31.82
Kentucky coffeetree	36	1	(N/A)	2.7	0.0	0.48
American sycamore	7,239	196	(N/A)	1.4	3.9	196.17
Pin oak	6,412	174	(N/A)	1.4	3.4	173.76
Maple	625	17	(N/A)	1.4	0.3	16.95
Elm	5,491	149	(N/A)	1.4	2.9	148.79
Apple	1,174	32	(N/A)	1.4	0.6	31.82
Conifer Evergreen Small	659	18	(N/A)	1.4	0.4	17.86
Ginkgo	7	0	(N/A)	1.4	0.0	0.19
River birch	163	4	(N/A)	1.4	0.1	4.41
Broadleaf Deciduous Medium	12	0	(N/A)	1.4	0.0	0.33
Citywide total	187,524	5,082	(N/A)	100.0	100.0	68.67

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							
Spruce	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.2	2	-0.3	-1	0.4	1 (N/A)	20.3	0.05
Green ash	10.2	1.6	4.6	0.5	53	25.0	3.7	3.5	23.9	156	0.0	0	72.9	210 (N/A)	20.3	13.97
Silver maple	10.6	1.8	5.1	0.5	57	15.0	2.2	2.1	14.5	94	-5.6	-21	46.2	130 (N/A)	10.8	16.25
Norway maple	2.2	0.4	1.1	0.1	12	5.3	0.8	0.7	5.1	33	-0.5	-2	15.1	43 (N/A)	5.4	10.75
Northern red oak	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	3	-0.1	0	1.3	4 (N/A)	5.4	0.88
Black maple	2.2	0.4	1.0	0.1	12	4.1	0.6	0.6	3.9	25	-0.7	-3	12.1	35 (N/A)	4.1	11.54
Yellowwood	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)	2.7	0.14
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	2.7	0.71
Honeylocust	1.9	0.3	0.8	0.1	10	3.4	0.5	0.5	3.3	22	-1.5	-6	9.3	26 (N/A)	2.7	12.87
Northern hackberry	1.5	0.3	0.8	0.1	8	3.8	0.5	0.5	3.6	23	0.0	0	11.1	32 (N/A)	2.7	15.91
American elm	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)	2.7	0.03
Tulip tree	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)	2.7	0.48
Mulberry	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)	2.7	8.35
Kentucky coffeetree	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)	2.7	0.08
American sycamore	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19 (N/A)	1.4	19.04
Pin oak	1.3	0.2	0.7	0.1	7	2.0	0.3	0.3	2.0	13	-2.4	-9	4.5	11 (N/A)	1.4	10.96
Maple	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.3	4 (N/A)	1.4	3.64
Elm	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	1.4	15.71
Apple	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	1.4	8.35
Conifer Evergreen Small	0.1	0.0	0.1	0.0	0	0.2	0.0	0.0	0.2	1	-0.3	-1	0.3	1 (N/A)	1.4	0.62
Ginkgo	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)	1.4	0.07
River birch	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	1.4	1.21
Broadleaf Deciduous Medium	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)	1.4	0.14
Citywide total	33.4	5.6	15.7	1.5	178	67.9	9.9	9.4	64.6	424	-11.5	-43	196.6	558 (N/A)	100.0	7.54

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
Spruce	37	0	(N/A)	20.3	0.0	0.02
Green ash	338,983	2,542	(N/A)	20.3	40.2	169.49
Silver maple	268,513	2,014	(N/A)	10.8	31.9	251.73
Norway maple	35,809	269	(N/A)	5.4	4.2	67.14
Northern red oak	1,062	8	(N/A)	5.4	0.1	1.99
Black maple	23,836	179	(N/A)	4.1	2.8	59.59
Yellowwood	34	0	(N/A)	2.7	0.0	0.13
Broadleaf Deciduous	356	3	(N/A)	2.7	0.0	1.33
Honeylocust	24,490	184	(N/A)	2.7	2.9	91.84
Northern hackberry	24,655	185	(N/A)	2.7	2.9	92.46
American elm	28	0	(N/A)	2.7	0.0	0.10
Tulip tree	198	1	(N/A)	2.7	0.0	0.74
Mulberry	13,485	101	(N/A)	2.7	1.6	50.57
Kentucky coffeetree	24	0	(N/A)	2.7	0.0	0.09
American sycamore	39,259	294	(N/A)	1.4	4.7	294.44
Pin oak	37,616	282	(N/A)	1.4	4.5	282.12
Maple	1,101	8	(N/A)	1.4	0.1	8.26
Elm	25,943	195	(N/A)	1.4	3.1	194.57
Apple	6,743	51	(N/A)	1.4	0.8	50.57
Conifer Evergreen Sn	277	2	(N/A)	1.4	0.0	2.08
Ginkgo	5	0	(N/A)	1.4	0.0	0.03
River birch	218	2	(N/A)	1.4	0.0	1.64
Broadleaf Deciduous	17	0	(N/A)	1.4	0.0	0.13
Citywide total	842,687	6,320	(N/A)	100.0	100.0	85.41

Table 5: Annual Carbon Sequestered

Annual CO₂ 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
Spruce	53	0	0	-3	0	91	1	141	1 (N/A)	20.3	0.2	0.07
Green ash	11,697	88	-1,627	-57	-13	8,837	66	18,850	141 (N/A)	20.3	32.9	9.43
Silver maple	16,652	125	-1,289	-39	-10	5,360	40	20,684	155 (N/A)	10.8	36.1	19.39
Norway maple	1,142	9	-172	-12	-1	1,867	14	2,826	21 (N/A)	5.4	4.9	5.30
Northern red oak	162	1	-5	-2	0	192	1	347	3 (N/A)	5.4	0.6	0.65
Black maple	0	0	-114	-8	-1	1,431	11	1,308	10 (N/A)	4.1	2.3	3.27
Yellowwood	11	0	0	0	0	14	0	25	0 (N/A)	2.7	0.0	0.09
Broadleaf Deciduous Small	76	1	-2	-1	0	74	1	147	1 (N/A)	2.7	0.3	0.55
Honeylocust	1,486	11	-118	-5	-1	1,230	9	2,592	19 (N/A)	2.7	4.5	9.72
Northern hackberry	1,064	8	-118	-8	-1	1,315	10	2,253	17 (N/A)	2.7	3.9	8.45
American elm	15	0	0	0	0	4	0	18	0 (N/A)	2.7	0.0	0.07
Tulip tree	77	1	-1	-1	0	53	0	128	1 (N/A)	2.7	0.2	0.48
Mulberry	0	0	-65	-7	-1	670	5	598	4 (N/A)	2.7	1.0	2.24
Kentucky coffeetree	5	0	0	0	0	9	0	13	0 (N/A)	2.7	0.0	0.05
American sycamore	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	1.4	2.5	10.90
Pin oak	2,912	22	-181	-5	-1	728	5	3,454	26 (N/A)	1.4	6.0	25.90
Maple	165	1	-5	-1	0	186	1	344	3 (N/A)	1.4	0.6	2.58
Elm	960	7	-125	-4	-1	650	5	1,481	11 (N/A)	1.4	2.6	11.11
Apple	0	0	-32	-4	0	335	3	299	2 (N/A)	1.4	0.5	2.24
Conifer Evergreen Small	40	0	-1	-1	0	82	1	119	1 (N/A)	1.4	0.2	0.89
Ginkgo	2	0	0	0	0	4	0	6	0 (N/A)	1.4	0.0	0.04
River birch	96	1	-2	-1	0	65	0	158	1 (N/A)	1.4	0.3	1.18
Broadleaf Deciduous Medi	5	0	0	0	0	7	0	12	0 (N/A)	1.4	0.0	0.09
Citywide total	37,531	281	-4,046	-165	-32	23,937	180	57,257	429 (N/A)	100.0	100.0	5.80

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
Spruce	86	(N/A)	20.3	2.7	5.76
Green ash	865	(N/A)	20.3	27.0	57.65
Silver maple	1,157	(N/A)	10.8	36.2	144.67
Norway maple	110	(N/A)	5.4	3.4	27.44
Northern red oak	21	(N/A)	5.4	0.7	5.21
Black maple	0	(N/A)	4.1	0.0	0.00
Yellowwood	5	(N/A)	2.7	0.2	2.74
Broadleaf Deciduous Small	4	(N/A)	2.7	0.1	2.06
Honeylocust	389	(N/A)	2.7	12.2	194.45
Northern hackberry	131	(N/A)	2.7	4.1	65.33
American elm	4	(N/A)	2.7	0.1	1.91
Tulip tree	20	(N/A)	2.7	0.6	10.00
Mulberry	0	(N/A)	2.7	0.0	0.00
Kentucky coffeetree	11	(N/A)	2.7	0.3	5.26
American sycamore	58	(N/A)	1.4	1.8	58.34
Pin oak	206	(N/A)	1.4	6.4	205.74
Maple	30	(N/A)	1.4	0.9	29.84
Elm	67	(N/A)	1.4	2.1	66.60
Apple	0	(N/A)	1.4	0.0	0.00
Conifer Evergreen Small	21	(N/A)	1.4	0.7	21.34
Ginkgo	0	(N/A)	1.4	0.0	0.37
River birch	13	(N/A)	1.4	0.4	12.89
Broadleaf Deciduous Medium	3	(N/A)	1.4	0.1	2.74
Citywide total	3,201	(N/A)	100.0	100.0	43.25

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 \$
Spruce	14	1	1	20	86	122 (N/A)	1.0
Green ash	1,088	141	210	1,912	865	4,216 (N/A)	34.4
Silver maple	651	155	130	1,460	1,157	3,554 (N/A)	29.0
Norway maple	235	21	43	280	110	690 (N/A)	5.6
Northern red oak	26	3	4	16	21	69 (N/A)	0.6
Black maple	182	10	35	233	0	460 (N/A)	3.8
Yellowwood	2	0	0	1	5	9 (N/A)	0.1
Broadleaf Deciduous Sm	11	1	1	4	4	21 (N/A)	0.2
Honeylocust	149	19	26	254	389	837 (N/A)	6.8
Northern hackberry	168	17	32	242	131	589 (N/A)	4.8
American elm	0	0	0	0	4	5 (N/A)	0.0
Tulip tree	6	1	1	5	20	34 (N/A)	0.3
Mulberry	92	4	17	64	0	177 (N/A)	1.4
Kentucky coffeetree	1	0	0	1	11	13 (N/A)	0.1
American sycamore	91	11	19	196	58	375 (N/A)	3.1
Pin oak	88	26	11	174	206	504 (N/A)	4.1
Maple	25	3	4	17	30	78 (N/A)	0.6
Elm	82	11	16	149	67	324 (N/A)	2.6
Apple	46	2	8	32	0	89 (N/A)	0.7
Conifer Evergreen Smal	11	1	1	18	21	52 (N/A)	0.4
Ginkgo	1	0	0	0	0	1 (N/A)	0.0
River birch	9	1	1	4	13	29 (N/A)	0.2
Broadleaf Deciduous M	1	0	0	0	3	4 (N/A)	0.0
Citywide Total	2,981	429	558	5,082	3,201	12,251 (N/A)	100.0

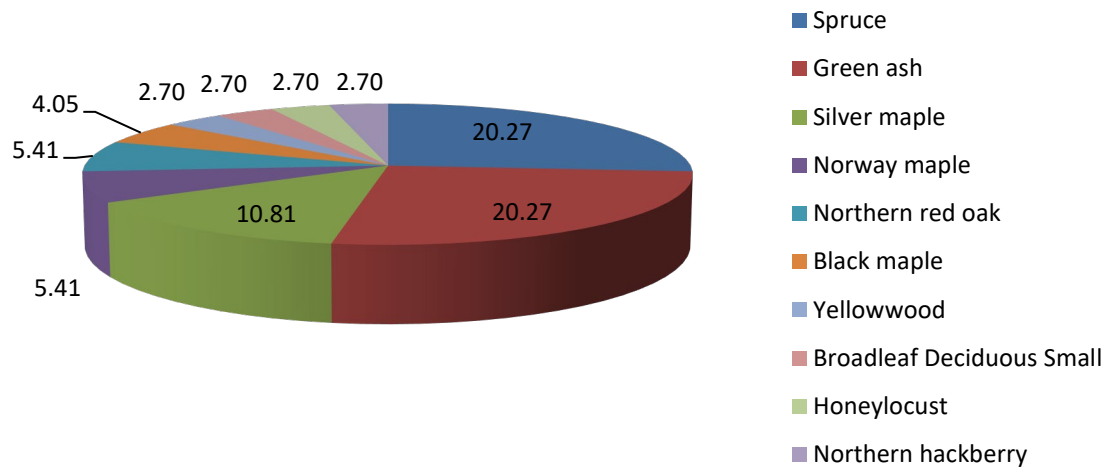


Figure 1: Species Distribution

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

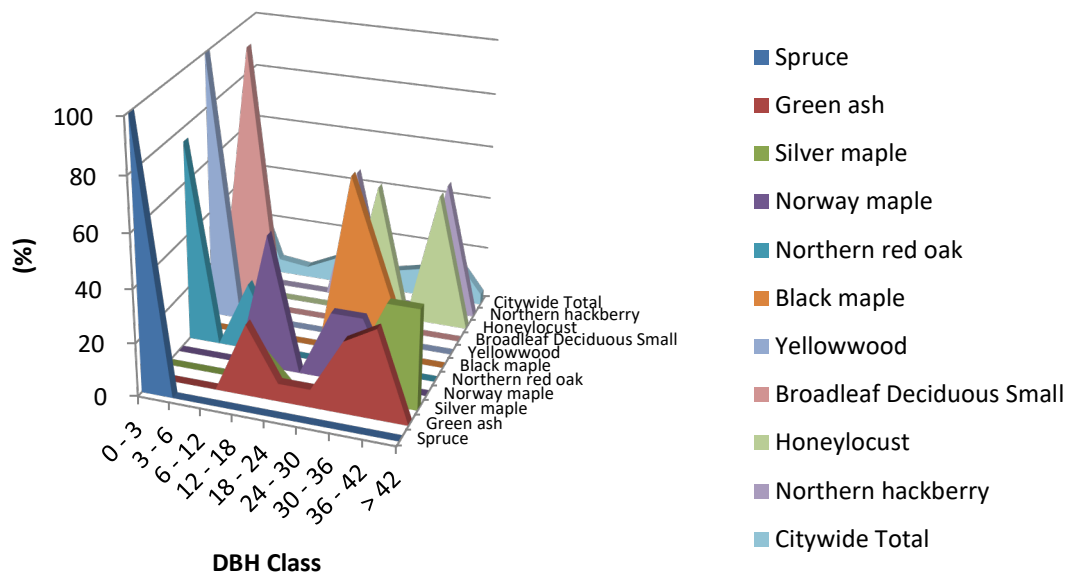


Figure 2: Relative Age Class

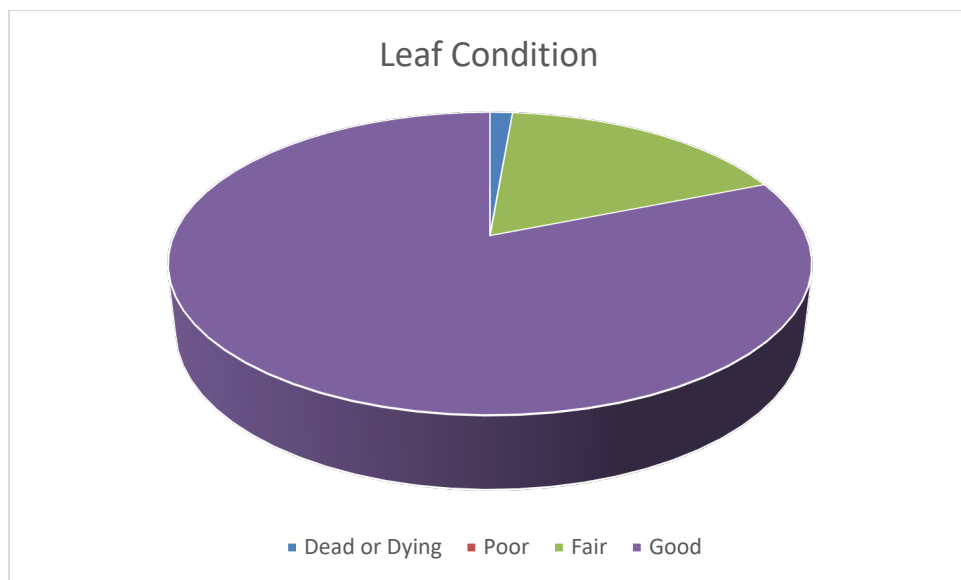


Figure 3: Foliage Condition

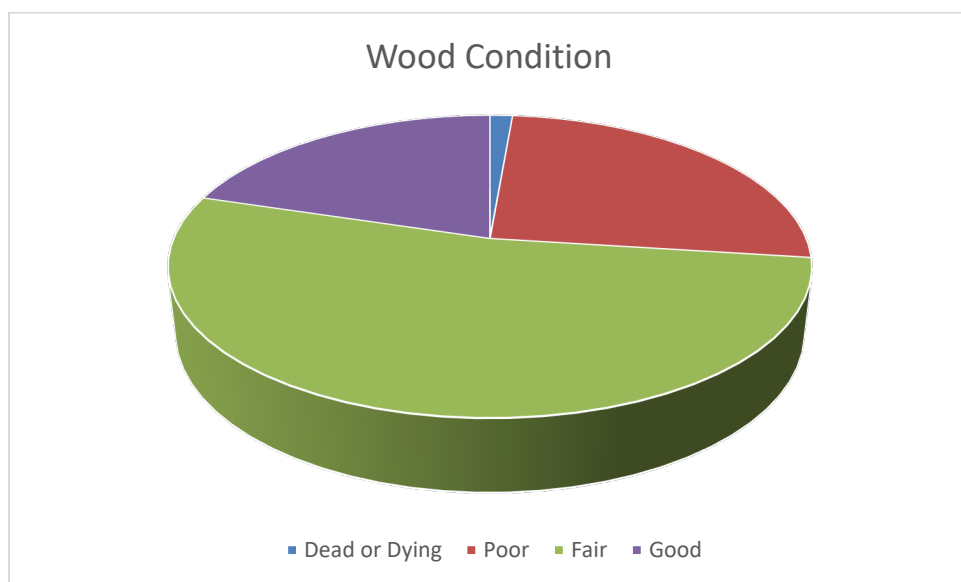


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

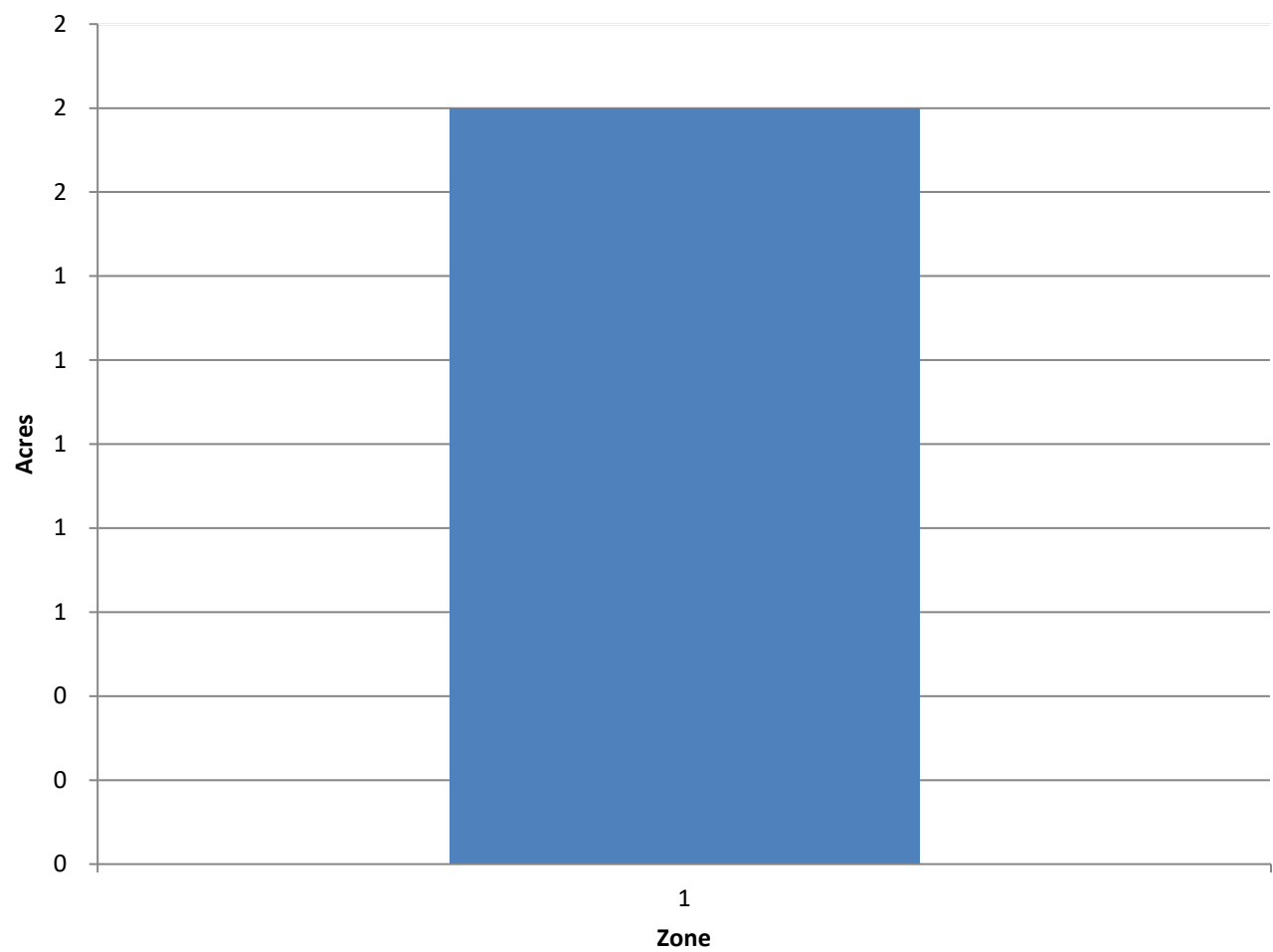


Figure 5: Canopy Cover in Acres

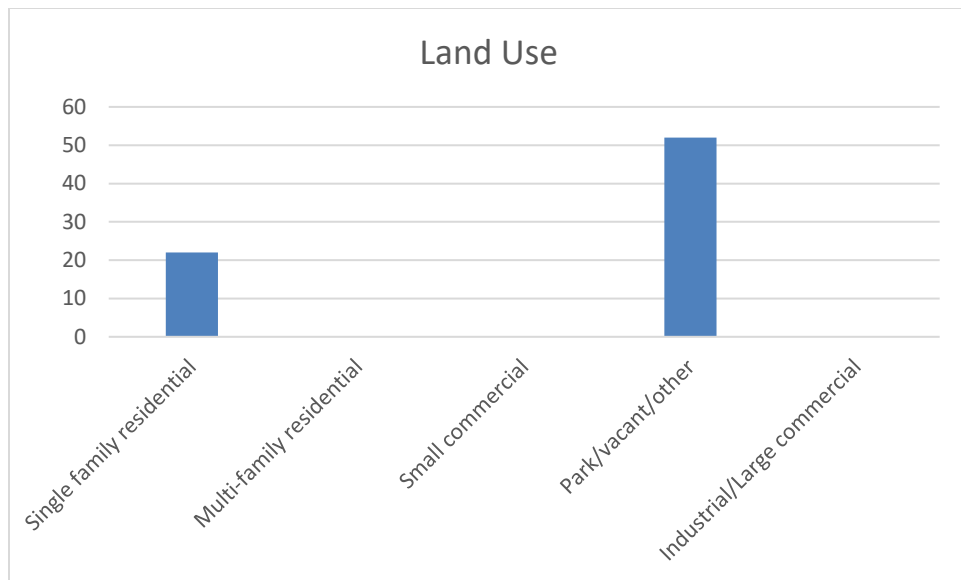


Figure 6: Land Use of city/park trees

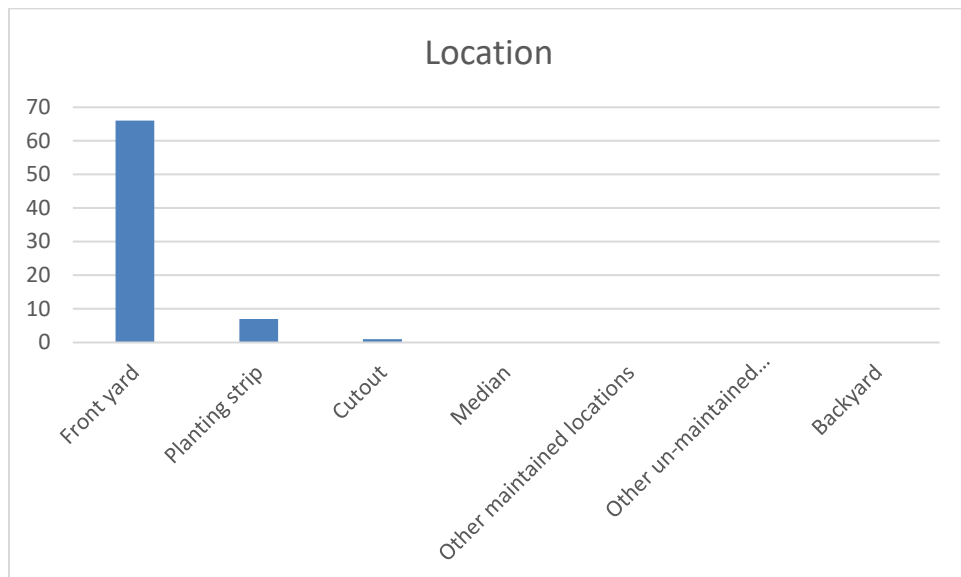


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping



Figure 1: Location of Ash Trees

None

Figure 2: Location of EAB symptoms

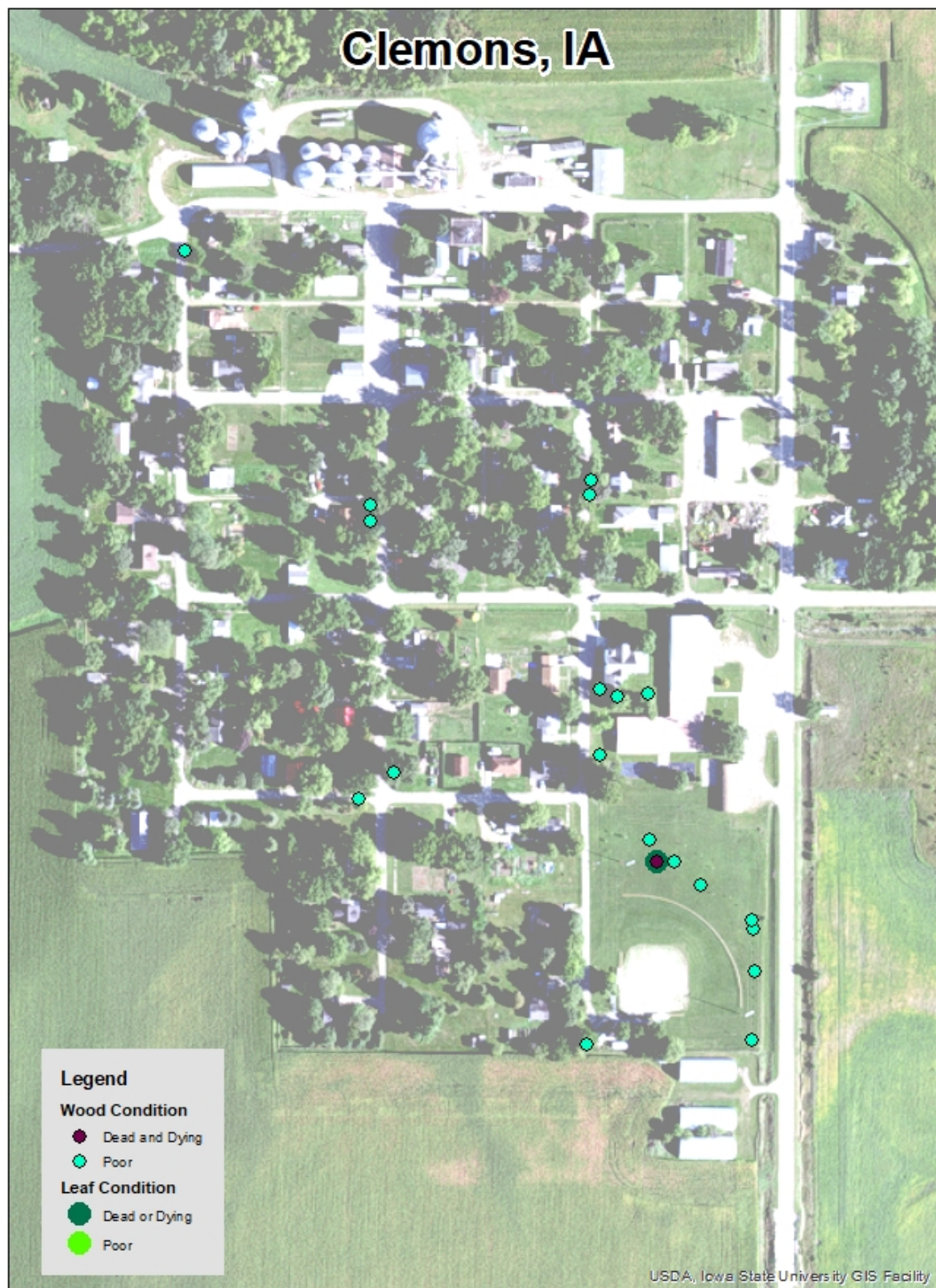


Figure 3: Location of Poor Condition Trees



Figure 4: Location of Trees with Recommended Maintenance

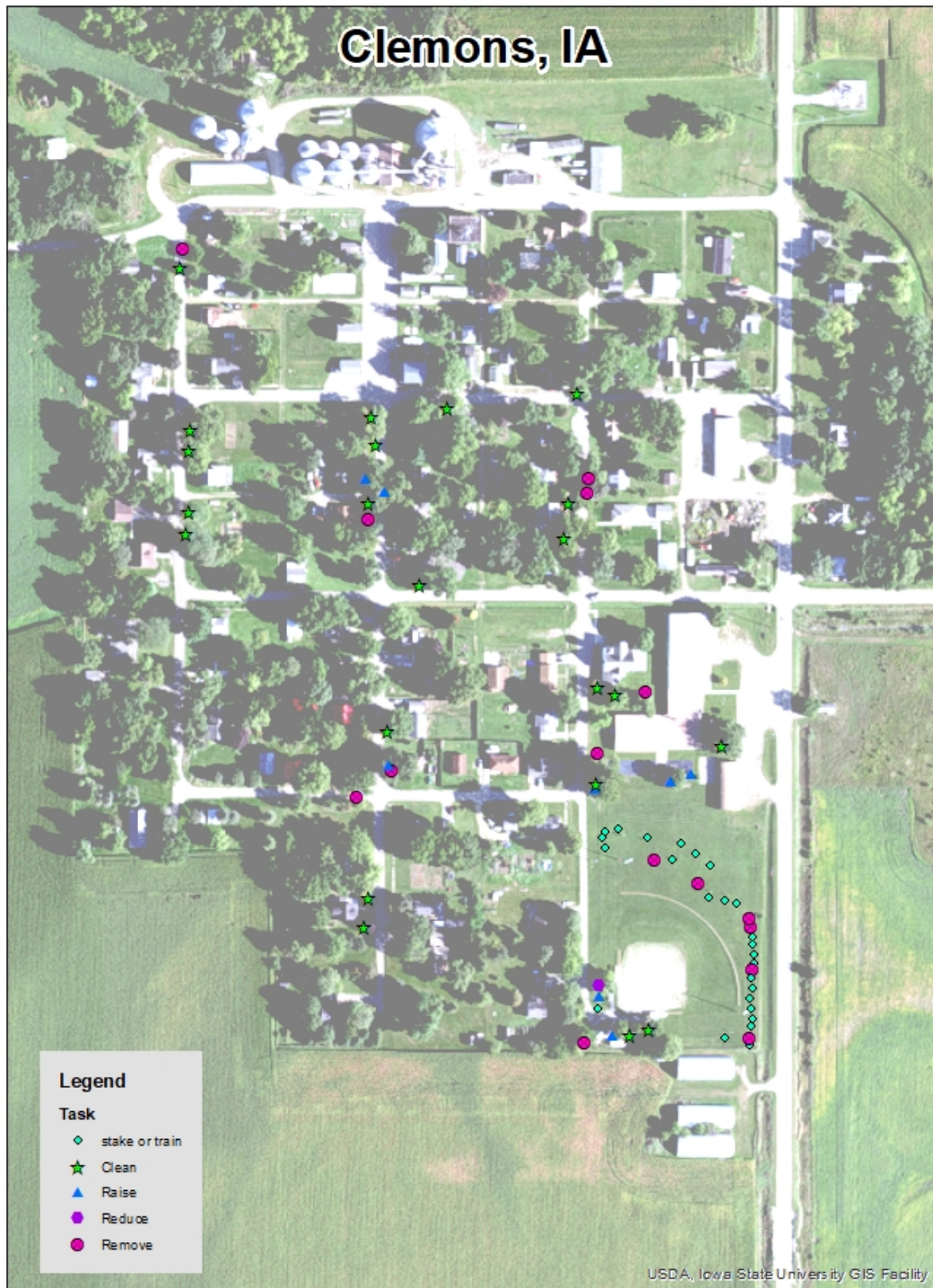


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Clemons Tree Ordinances

None

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If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-725-8200.