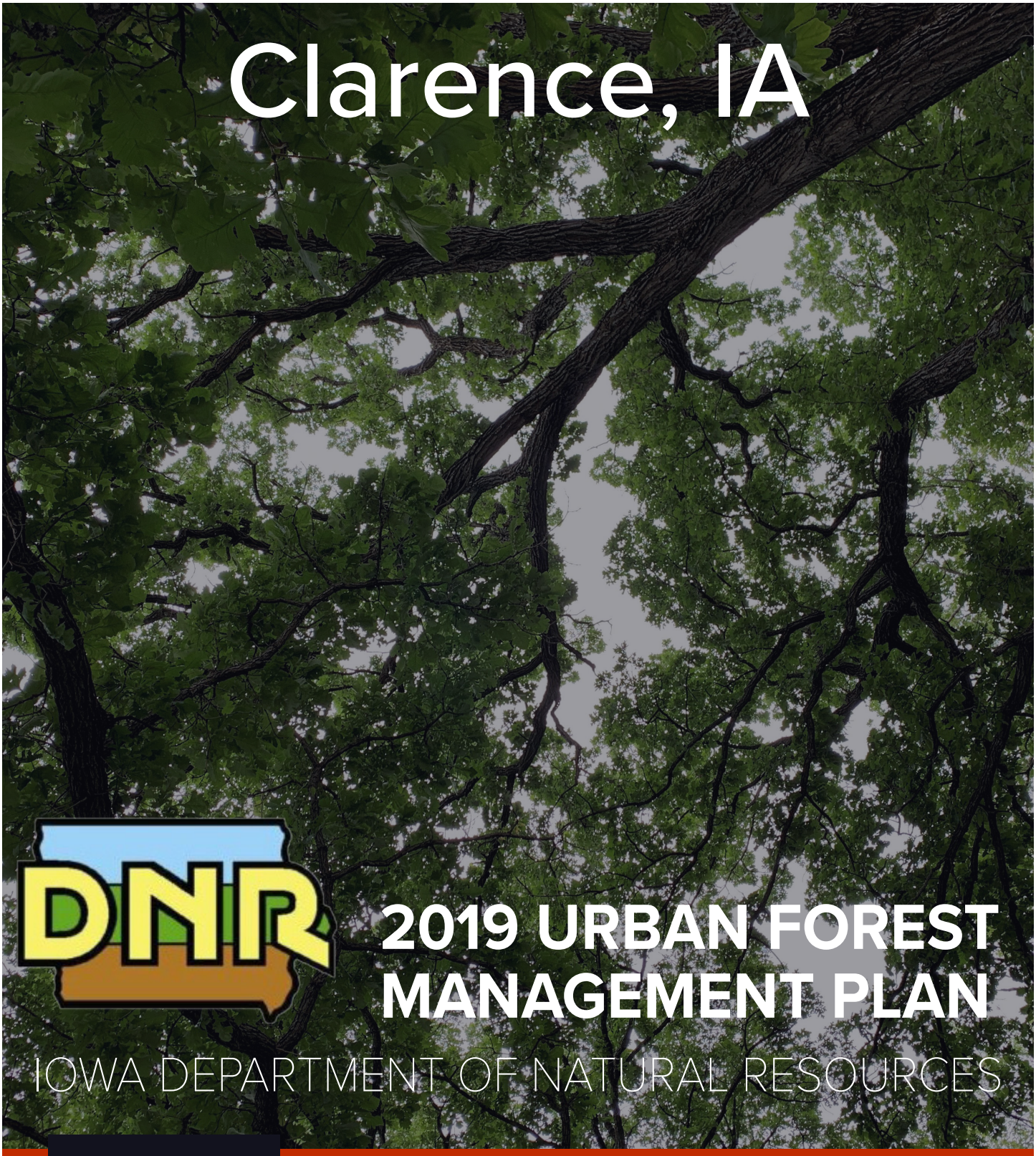
Clarence, IA



2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES

Prepared By
Andrew Larson
JEO Consulting Group, Inc.

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Executive Summary

Overview

This plan was developed to assist the City of Clarence in managing its urban forest, including budgeting and future planning. Trees bring numerous benefits to a community, and sound management helps leaders take advantage of these benefits. Management is especially important now considering the serious threats posed by forest pests like 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 except mountain ash. There is a strong possibility that 11% of Clarence's city-owned trees will die once EAB becomes established in the community, unless local leaders begin preventative treatment. 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, JEO conducted a tree inventory 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 633 trees inventoried.

- Clarence's trees provide $96,507 of benefits annually, an average of $152 per tree
- There are over 41 species of trees
- The top three genera are: Maple 34%, Ash 11%, and Oak 8%
- 6% of trees need some type of management
- 6 trees should be removed

Recommendations

We detail our core recommendations in the Recommendations Section. In the Emerald Ash Borer Plan, we include management recommendations. Below are some key recommendations.

- Out of the 6 trees needing removal, 4 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*
- 8 of the 72 ash trees should be carefully examined, as they have one or more 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 yearly with a visual survey.
- With the current budget it could take 26 years to remove ash. We suggest that city officials request a budget increase to $4,000 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist Clarence with managing, budgeting, and future planning of their urban forest. Across the state, forestry budgets continue to decrease as a higher percentage of the budgets are devoted to 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, treatment, and replacement planting. With proper planning and management of the current canopy in Clarence, these costs can be spread out over the years and public safety issues from dead and dying ash trees can be mitigated.

Trees are an important part of Clarence infrastructure and one of the city's greatest assets. The benefits of trees are immense. Trees improve air quality, intercept stormwater runoff, conserve energy, lower traffic speeds, increase property values, reduce crime, improve mental health, and create a desirable place to live, to name just a few. Good urban forestry management will maintain these important benefits for the people of Clarence and future generations.

Urban forestry management sets goals and develops management strategies to achieve them. To develop management strategies, a comprehensive public tree inventory must be conducted. The inventory informs maintenance, removal schedules, tree planting, and budgeting. Aligning management actions with the tree inventory results will help meet Clarence's urban forestry goals.

Inventory

In 2019, JEO conducted a tree inventory that included 100% of the city-owned trees on both streets and parks. The team collected tree data 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 data collectors' programming 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, for all ash trees, the team notes signs and symptoms associated with EAB including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

JEO entered the data collected for the 633 city trees into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Below are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Clarence's trees reduce energy-related costs by approximately $26,361 annually (Appendix A, Table 1). These savings are both in electricity (124.3 MWh) and in natural gas (17,268.9 Therms).

Annual Stormwater Benefits

Clarence's trees intercept about 1,290,247 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $34,966 in benefit 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 lessens emissions of volatile organic matter (ozone). In Clarence, it is estimated that trees remove 1,553 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 $4,348 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Clarence, trees sequester about 26,837 lbs of carbon per year with an associated value of $1,994 (Appendix A, Table 5). In addition, the trees store 4,449,929 lbs of carbon, with a yearly benefit of $33,374 (Appendix A, Table 4).

Annual Aesthetics Benefits

The social benefits of trees are hard to capture. The i-Tree 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. Clarence receives $27,446 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, Clarence's trees provide $96,507 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 633 trees in Clarence provide approximately $152 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Clarence has over 41 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	216	34%
Ash	72	11%
Oak	49	8%
Hackberry	25	4%
Basswood/Linden	23	4%
Pear	17	3%
Spruce	16	3%
Apple	16	3%
Cottonwood	11	2%
Hophornbeam	6	1%
Sycamore	4	<1%
Cedar	3	<1%
Pine	2	<1%
Willow	1	<1%
Buckeye	1	<1%
Cherry	1	<1%
Mulberry	1	<1%
Other Evergreen	126	20%
Other Deciduous	4	<1%

Age Class

Most of Clarence's trees (48%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). To prepare for natural mortality and to maintain canopy cover, most trees should be in the smallest size category (a downward slope), indicating youth. Clarence's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Clarence indicate that 71% of the trees are in good health, with only 3% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 70% of Clarence's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Three percent of the tree population's wood condition is in poor health, dead, or dying. This 3% 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 Cleaning	16	3%
Crown Reduction	14	2%
Tree Removal	6	1%
Crown Raising	1	<1%
Tree Staking	0	0%

Land Use and Location

The majority of Clarence's city and park trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use	
Single family residential	51%
Industrial/Large commercial	49%
Park/vacant/other	<1%
Small commercial	<1%
Multifamily residential	0%

Recommendations

Risk Management

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

Hazardous trees

Clarence has 6 trees that we suggest be immediately removed. The trees for removal along with other maintenance actions can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter, critical concern trees first. There are 4 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 critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 38 trees with maintenance needs.

Poor tree species

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 6 removals, 4 are ash trees. There are a total of 72 ash trees which should be carefully monitored for signs for disease as EAB moves into Iowa. *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 removes lower branches that are two inches in diameter or larger to provide clearance for pedestrians or vehicles. Crown reduction removes individual limbs from structures or utility wires. We recommend that all trees be pruned on a routine schedule every five to seven years. Please refer to the Proposed Work Schedule and Budget for further information.

Planting

Most of the planting over the next five years will replace the trees that are removed. We recommend planting 1.2 trees for every tree removed, since survival rates will not be 100%. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Clarence.

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 (34%) (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: fruit-bearing trees, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, or black walnut, as outlined in section 151.02 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, it is important to continuously check the health of ash trees. We recommend 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 by first removing dead, dying, hazardous trees (Appendix B, Figure 4). Next will be all ash in poor condition that display EAB signs and symptoms (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 an effective tool for communities to spread removal costs out over several years while allowing trees to continue providing 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 normally disposed of 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 ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include fruit-bearing trees, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, 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 EAB signs and symptoms including 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. City Code 151.06 states "The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant, or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property."

Proposed Work Schedule and Budget

Budget Estimate of $1,950/Year – (Based off $2/Capita Calculation Due to no City Reporting)

YEAR 1	**ESTIMATED COSTS**
Remove 2 trees recommended for immediate removal	$1,400
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 2	
Remove 2 trees recommended for immediate removal	$1,400
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 3	
Remove 2 trees recommended for immediate removal	$1,400
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 4	
Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

Estimated costs based on average costs of $700/tree for removal, $150/tree for planting and maintenance, and $15/tree for pruning.

**To remove all ash trees within 6 years alone, the budget would need to be $8,400 a year. If the budget were increased to $4,000 a year all ash could be removed in 13 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of $4,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	**ESTIMATED COSTS**
Remove 4 trees recommended for immediate removal	$2,800
Plant 8 trees in open locations	$1,200
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Plant 5 trees in open locations	$750
Prune 1/3 of City Owned Trees	$3,165
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 2 trees recommended for immediate removal	$1,400
Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 8 trees in open locations	$1,200
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Plant 5 trees in open locations	$750
Prune 1/3 of City Owned Trees	$3,165
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 4 ash trees (prioritize largest diameter)	$2,800
Plant 8 trees in open locations	$1,200
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Plant 5 trees in open locations	$750
Prune 1/3 of City Owned Trees	$3,165
Visual Survey of EAB Signs/Symptoms	

Purposed Budget Increase

EAB could potentially kill all ash trees in Clarence within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $8,400 a year. If the budget were increased to $4,000 per year all ash could be removed within 13 years. Additionally, we recommend that Clarence 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 considered by many communities is treating 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 removal 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). Eight trees would be selected for treatment, and Clarence would still need to find $44,800 for removal of the remaining ash trees. Alternatively, if there are 10 treatable trees, it would cost approximately $3,000 a year for treatment and leave $1,000 for removal. These are alternatives to straight removal of ash trees. However, whether the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Clarence. We suggest considering an increased 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

4/11/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	22.5	1,711	3,270.1	3,205	4,916	(N/A)	13.7	18.6	56.51
Green ash	21.3	1,615	2,966.7	2,907	4,522	(N/A)	11.2	17.2	63.69
Sugar maple	17.8	1,353	2,345.8	2,299	3,652	(N/A)	10.7	13.9	53.71
Broadleaf Evergreen Medi	5.4	408	812.7	796	1,204	(N/A)	10.1	4.6	18.82
Conifer Evergreen Large	3.5	265	588.8	577	842	(N/A)	9.8	3.2	13.58
Silver maple	14.3	1,087	1,883.6	1,846	2,933	(N/A)	7.6	11.1	61.10
Northern hackberry	8.4	640	1,206.3	1,182	1,822	(N/A)	3.9	6.9	72.90
Northern red oak	3.6	273	492.0	482	755	(N/A)	3.5	2.9	34.30
Honeylocust	4.3	329	545.6	535	864	(N/A)	2.7	3.3	50.80
Pear	0.9	69	157.6	154	223	(N/A)	2.7	0.8	13.15
Littleleaf linden	3.3	250	395.5	388	638	(N/A)	2.7	2.4	37.50
Apple	0.9	66	135.4	133	199	(N/A)	2.5	0.8	12.41
Pin oak	3.1	233	412.2	404	636	(N/A)	2.4	2.4	42.43
Red maple	2.0	149	253.9	249	398	(N/A)	1.9	1.5	33.14
Cottonwood	3.0	229	383.2	376	604	(N/A)	1.7	2.3	54.94
Bur oak	0.7	54	93.9	92	146	(N/A)	1.6	0.6	14.55
Black spruce	0.3	21	47.1	46	68	(N/A)	1.4	0.3	7.51
River birch	0.6	49	102.8	101	149	(N/A)	1.3	0.6	18.66
Swamp white oak	0.2	17	37.0	36	54	(N/A)	0.9	0.2	8.94
Eastern hophornbeam	0.2	18	40.8	40	58	(N/A)	0.9	0.2	9.67
American basswood	1.4	109	193.5	190	299	(N/A)	0.9	1.1	49.77
American sycamore	0.8	57	101.3	99	156	(N/A)	0.6	0.6	39.10
Blue spruce	0.6	46	85.6	84	130	(N/A)	0.6	0.5	32.56
Oak	0.1	10	17.9	18	27	(N/A)	0.5	0.1	9.04
Norway spruce	0.5	38	63.8	63	100	(N/A)	0.5	0.4	33.49
Austrian pine	0.3	21	39.0	38	59	(N/A)	0.3	0.2	29.65
White oak	0.3	22	41.8	41	63	(N/A)	0.3	0.2	31.57
Broadleaf Deciduous Larg	1.0	74	126.2	124	197	(N/A)	0.3	0.7	98.63
Siberian elm	0.6	46	84.5	83	128	(N/A)	0.3	0.5	64.22
Northern white cedar	0.2	15	29.2	29	44	(N/A)	0.3	0.2	22.02
Catalpa	0.8	63	112.7	110	173	(N/A)	0.3	0.7	86.52
Broadleaf Deciduous Sma	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Ohio buckeye	0.3	20	39.6	39	59	(N/A)	0.2	0.2	58.69
Black cherry	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Broadleaf Deciduous Med	0.1	8	16.9	17	24	(N/A)	0.2	0.1	24.47
Willow	0.2	18	29.5	29	47	(N/A)	0.2	0.2	46.78
Eastern red cedar	0.1	8	16.4	16	25	(N/A)	0.2	0.1	24.57
White mulberry	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Northern pin oak	0.3	24	47.4	46	71	(N/A)	0.2	0.3	70.84
Japanese maple	0.0	0	0.6	1	1	(N/A)	0.2	0.0	0.87
White ash	0.1	7	13.3	13	20	(N/A)	0.2	0.1	20.10
Total	124.3	9,437	17,268.9	16,924	26,361	(N/A)	100.0	100.0	41.64

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

4/11/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	218,015	5,908	(N/A)	13.7	16.9	67.91
Green ash	240,406	6,515	(N/A)	11.2	18.6	91.76
Sugar maple	187,620	5,084	(N/A)	10.7	14.5	74.77
Broadleaf Evergreen Mediu	43,316	1,174	(N/A)	10.1	3.4	18.34
Conifer Evergreen Large	36,922	1,001	(N/A)	9.8	2.9	16.14
Silver maple	204,193	5,534	(N/A)	7.6	15.8	115.28
Northern hackberry	79,444	2,153	(N/A)	3.9	6.2	86.12
Northern red oak	30,973	839	(N/A)	3.5	2.4	38.15
Honeylocust	34,367	931	(N/A)	2.7	2.7	54.79
Pear	3,199	87	(N/A)	2.7	0.2	5.10
Littleleaf linden	20,614	559	(N/A)	2.7	1.6	32.86
Apple	3,016	82	(N/A)	2.5	0.2	5.11
Pin oak	36,836	998	(N/A)	2.4	2.9	66.55
Red maple	13,949	378	(N/A)	1.9	1.1	31.50
Cottonwood	27,578	747	(N/A)	1.7	2.1	67.94
Bur oak	4,448	121	(N/A)	1.6	0.3	12.05
Black spruce	2,870	78	(N/A)	1.4	0.2	8.64
River birch	3,418	93	(N/A)	1.3	0.3	11.58
Swamp white oak	1,098	30	(N/A)	0.9	0.1	4.96
Eastern hophornbeam	804	22	(N/A)	0.9	0.1	3.63
American basswood	13,421	364	(N/A)	0.9	1.0	60.62
American sycamore	6,624	180	(N/A)	0.6	0.5	44.88
Blue spruce	10,474	284	(N/A)	0.6	0.8	70.96
Oak	797	22	(N/A)	0.5	0.1	7.20
Norway spruce	10,748	291	(N/A)	0.5	0.8	97.09
Austrian pine	4,625	125	(N/A)	0.3	0.4	62.66
White oak	2,762	75	(N/A)	0.3	0.2	37.43
Broadleaf Deciduous Large	14,478	392	(N/A)	0.3	1.1	196.17
Siberian elm	5,649	153	(N/A)	0.3	0.4	76.55
Northern white cedar	3,565	97	(N/A)	0.3	0.3	48.30
Catalpa	12,729	345	(N/A)	0.3	1.0	172.48
Broadleaf Deciduous Small	264	7	(N/A)	0.2	0.0	7.17
Ohio buckeye	2,479	67	(N/A)	0.2	0.2	67.19
Black cherry	264	7	(N/A)	0.2	0.0	7.17
Broadleaf Deciduous Mediu	586	16	(N/A)	0.2	0.0	15.88
Willow	1,409	38	(N/A)	0.2	0.1	38.19
Eastern red cedar	1,635	44	(N/A)	0.2	0.1	44.30
White mulberry	264	7	(N/A)	0.2	0.0	7.17
Northern pin oak	3,764	102	(N/A)	0.2	0.3	102.01
Japanese maple	7	0	(N/A)	0.2	0.0	0.20
White ash	614	17	(N/A)	0.2	0.0	16.63
Citywide total	1,290,247	34,966	(N/A)	100.0	100.0	55.24

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

4/11/2020

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Trees	Total	Avg $/tree
Norway maple	45.5	7.8	22.2	2.0	245	109.5	15.8	15.0	102.3	678	-10.6	-40	309.4	883	(N/A)	13.7	10.15	
Green ash	29.5	4.7	14.1	1.3	157	102.1	14.8	14.1	96.4	635	0.0	0	277.0	791	(N/A)	11.2	11.15	
Sugar maple	25.2	4.3	12.6	1.1	137	84.2	12.3	11.8	80.7	527	-19.9	-75	212.3	589	(N/A)	10.7	8.66	
Broadleaf Evergreen Medi	1.3	0.3	2.8	0.2	14	26.2	3.8	3.6	24.1	161	-10.7	-40	51.4	134	(N/A)	10.1	2.10	
Conifer Evergreen Large	3.2	0.6	3.4	0.4	23	17.6	2.5	2.4	15.8	107	-10.3	-39	35.5	92	(N/A)	9.8	1.48	
Silver maple	35.1	5.9	17.3	1.6	189	67.5	9.9	9.4	64.8	422	-18.5	-69	193.0	542	(N/A)	7.6	11.30	
Northern hackberry	12.1	2.1	6.2	0.5	66	40.8	5.9	5.6	38.3	253	0.0	0	111.5	319	(N/A)	3.9	12.76	
Northern red oak	6.1	1.1	3.1	0.3	33	17.1	2.5	2.4	16.3	107	-8.7	-33	40.1	107	(N/A)	3.5	4.88	
Honeylocust	6.2	1.0	2.9	0.3	33	20.2	3.0	2.8	19.6	127	-4.5	-17	51.6	143	(N/A)	2.7	8.43	
Pear	0.5	0.1	0.3	0.0	3	4.6	0.7	0.6	4.1	28	0.0	0	11.0	31	(N/A)	2.7	1.83	
Littleleaf linden	2.6	0.4	1.4	0.1	14	15.3	2.3	2.2	14.9	96	-1.4	-5	37.8	105	(N/A)	2.7	6.20	
Apple	0.6	0.1	0.3	0.0	3	4.3	0.6	0.6	3.9	26	0.0	0	10.5	30	(N/A)	2.5	1.86	
Pin oak	6.8	1.2	3.5	0.3	37	14.5	2.1	2.0	13.9	91	-12.6	-47	31.8	81	(N/A)	2.4	5.39	
Red maple	3.0	0.5	1.4	0.1	16	9.2	1.4	1.3	8.9	58	-1.0	-4	24.8	70	(N/A)	1.9	5.82	
Cottonwood	3.0	0.5	1.5	0.1	16	14.1	2.1	2.0	13.7	89	0.0	0	37.0	105	(N/A)	1.7	9.55	
Bur oak	0.2	0.0	0.2	0.0	1	3.3	0.5	0.5	3.2	21	0.0	0	7.9	22	(N/A)	1.6	2.22	
Black spruce	0.2	0.0	0.2	0.0	2	1.4	0.2	0.2	1.3	9	-0.8	-3	2.8	7	(N/A)	1.4	0.80	
River birch	0.3	0.1	0.2	0.0	2	3.2	0.5	0.4	2.9	20	-0.1	0	7.5	21	(N/A)	1.3	2.62	
Swamp white oak	0.1	0.0	0.1	0.0	0	1.1	0.2	0.2	1.0	7	0.0	0	2.6	7	(N/A)	0.9	1.23	
Eastern hophornbeam	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	7	0.0	0	2.8	8	(N/A)	0.9	1.32	
American basswood	1.7	0.3	0.9	0.1	9	6.8	1.0	1.0	6.5	43	-1.5	-6	16.8	46	(N/A)	0.9	7.73	
American sycamore	0.7	0.1	0.3	0.0	4	3.6	0.5	0.5	3.4	22	0.0	0	9.1	26	(N/A)	0.6	6.47	
Blue spruce	1.8	0.4	1.4	0.2	12	2.9	0.4	0.4	2.8	18	-4.1	-15	6.2	15	(N/A)	0.6	3.63	
Oak	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4	(N/A)	0.5	1.32	
Norway spruce	1.3	0.3	1.0	0.2	9	2.3	0.3	0.3	2.3	15	-6.3	-24	1.8	0	(N/A)	0.5	-0.11	
Austrian pine	0.7	0.1	0.6	0.1	5	1.3	0.2	0.2	1.3	8	-1.8	-7	2.7	6	(N/A)	0.3	3.10	
White oak	0.3	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	9	0.0	0	3.6	10	(N/A)	0.3	5.11	
Broadleaf Deciduous Larg	3.2	0.5	1.4	0.1	16	4.6	0.7	0.6	4.4	29	0.0	0	15.5	45	(N/A)	0.3	22.55	
Siberian elm	0.8	0.1	0.4	0.0	4	2.9	0.4	0.4	2.7	18	0.0	0	7.8	22	(N/A)	0.3	11.10	
Northern white cedar	0.4	0.1	0.3	0.0	3	1.0	0.1	0.1	0.9	6	-1.5	-6	1.5	3	(N/A)	0.3	1.46	
Catalpa	2.0	0.3	0.9	0.1	10	3.9	0.6	0.5	3.7	25	0.0	0	12.0	35	(N/A)	0.3	17.37	
Broadleaf Deciduous Smal	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)	0.2	2.55	
Ohio buckeye	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	0.2	10.16	
Black cherry	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)	0.2	2.55	
Broadleaf Deciduous Med	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	0.2	3.47	
Willow	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8	(N/A)	0.2	7.92	
Eastern red cedar	0.3	0.1	0.3	0.0	2	0.5	0.1	0.1	0.5	3	-0.9	-3	1.0	2	(N/A)	0.2	2.19	
White mulberry	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)	0.2	2.55	
Northern pin oak	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.2	13.58	
Japanese maple	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)	0.2	0.11	
White ash	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	1.0	3	(N/A)	0.2	2.91	
Citywide total	196.3	33.4	102.3	9.5	1,077	595.6	86.6	82.5	563.2	3,705	-115.7	-434	1,553.7	4,348	(N/A)	100.0	6.87	

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

4/11/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	747,219	5,604	(N/A)	13.7	16.8	64.42
Green ash	952,029	7,140	(N/A)	11.2	21.4	100.57
Sugar maple	731,310	5,485	(N/A)	10.7	16.4	80.66
Broadleaf Evergreen	30,967	232	(N/A)	10.1	0.7	3.63
Conifer Evergreen I	15,915	119	(N/A)	9.8	0.4	1.93
Silver maple	806,893	6,052	(N/A)	7.6	18.1	126.08
Northern hackberry	178,710	1,340	(N/A)	3.9	4.0	53.61
Northern red oak	126,021	945	(N/A)	3.5	2.8	42.96
Honeylocust	78,485	589	(N/A)	2.7	1.8	34.63
Pear	10,726	80	(N/A)	2.7	0.2	4.73
Littleleaf linden	58,545	439	(N/A)	2.7	1.3	25.83
Apple	11,320	85	(N/A)	2.5	0.3	5.31
Pin oak	185,497	1,391	(N/A)	2.4	4.2	92.75
Red maple	33,462	251	(N/A)	1.9	0.8	20.91
Cottonwood	98,964	742	(N/A)	1.7	2.2	67.48
Bur oak	8,391	63	(N/A)	1.6	0.2	6.29
Black spruce	787	6	(N/A)	1.4	0.0	0.66
River birch	6,159	46	(N/A)	1.3	0.1	5.77
Swamp white oak	1,790	13	(N/A)	0.9	0.0	2.24
Eastern hophornbea	2,527	19	(N/A)	0.9	0.1	3.16
American basswood	64,665	485	(N/A)	0.9	1.5	80.83
American sycamore	21,514	161	(N/A)	0.6	0.5	40.34
Blue spruce	15,109	113	(N/A)	0.6	0.3	28.33
Oak	1,232	9	(N/A)	0.5	0.0	3.08
Norway spruce	16,151	121	(N/A)	0.5	0.4	40.38
Austrian pine	5,322	40	(N/A)	0.3	0.1	19.96
White oak	8,643	65	(N/A)	0.3	0.2	32.41
Broadleaf Deciduou	111,964	840	(N/A)	0.3	2.5	419.86
Siberian elm	18,988	142	(N/A)	0.3	0.4	71.20
Northern white ceda	3,599	27	(N/A)	0.3	0.1	13.50
Catalpa	65,202	489	(N/A)	0.3	1.5	244.51
Broadleaf Deciduou	908	7	(N/A)	0.2	0.0	6.81
Ohio buckeye	7,945	60	(N/A)	0.2	0.2	59.59
Black cherry	908	7	(N/A)	0.2	0.0	6.81
Broadleaf Deciduou	1,101	8	(N/A)	0.2	0.0	8.26
Willow	3,624	27	(N/A)	0.2	0.1	27.18
Eastern red cedar	1,102	8	(N/A)	0.2	0.0	8.27
White mulberry	908	7	(N/A)	0.2	0.0	6.81
Northern pin oak	14,280	107	(N/A)	0.2	0.3	107.10
Japanese maple	14	0	(N/A)	0.2	0.0	0.10
White ash	1,035	8	(N/A)	0.2	0.0	7.76
Citywide total	4,449,929	33,374	(N/A)	100.0	100.0	52.72

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

4/11/2020

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	30,039	225	-3,587	-239	-29	37,819	284	64,032	480	(N/A)	13.7	14.2	5.52
Green ash	52,282	392	-4,570	-223	-36	35,682	268	83,172	624	(N/A)	11.2	18.4	8.79
Sugar maple	38,561	289	-3,513	-188	-28	29,903	224	64,763	486	(N/A)	10.7	14.3	7.14
Broadleaf Evergreen Me	3,603	27	-149	-75	-2	9,012	68	12,391	93	(N/A)	10.1	2.7	1.45
Conifer Evergreen Large	3,263	24	-76	-73	-1	5,853	44	8,967	67	(N/A)	9.8	2.0	1.08
Silver maple	59,846	449	-3,875	-159	-30	24,023	180	79,835	599	(N/A)	7.6	17.7	12.47
Northern hackberry	10,602	80	-858	-79	-7	14,149	106	23,814	179	(N/A)	3.9	5.3	7.14
Northern red oak	4,703	35	-605	-44	-5	6,023	45	10,078	76	(N/A)	3.5	2.2	3.44
Honeylocust	10,704	80	-378	-32	-3	7,267	55	17,561	132	(N/A)	2.7	3.9	7.75
Pear	1,422	11	-52	-16	-1	1,526	11	2,880	22	(N/A)	2.7	0.6	1.27
Littleleaf linden	8,451	63	-281	-32	-2	5,523	41	13,661	102	(N/A)	2.7	3.0	6.03
Apple	1,341	10	-54	-14	-1	1,454	11	2,726	20	(N/A)	2.5	0.6	1.28
Pin oak	13,003	98	-891	-35	-7	5,139	39	17,216	129	(N/A)	2.4	3.8	8.61
Red maple	3,342	25	-161	-18	-1	3,290	25	6,453	48	(N/A)	1.9	1.4	4.03
Cottonwood	6,648	50	-475	-28	-4	5,057	38	11,201	84	(N/A)	1.7	2.5	7.64
Bur oak	1,508	11	-40	-9	0	1,183	9	2,642	20	(N/A)	1.6	0.6	1.98
Black spruce	141	1	-4	-6	0	475	4	607	5	(N/A)	1.4	0.1	0.51
River birch	1,407	11	-32	-8	0	1,073	8	2,440	18	(N/A)	1.3	0.5	2.29
Swamp white oak	522	4	-11	-3	0	384	3	891	7	(N/A)	0.9	0.2	1.11
Eastern hophornbeam	380	3	-12	-5	0	397	3	760	6	(N/A)	0.9	0.2	0.95
American basswood	3,933	29	-310	-16	-2	2,408	18	6,015	45	(N/A)	0.9	1.3	7.52
American sycamore	1,720	13	-103	-8	-1	1,263	9	2,871	22	(N/A)	0.6	0.6	5.38
Blue spruce	671	5	-73	-12	-1	1,025	8	1,611	12	(N/A)	0.6	0.4	3.02
Oak	286	2	-6	-2	0	212	2	489	4	(N/A)	0.5	0.1	1.22
Norway spruce	628	5	-78	-9	-1	838	6	1,380	10	(N/A)	0.5	0.3	3.45
Austrian pine	294	2	-26	-5	0	465	3	728	5	(N/A)	0.3	0.2	2.73
White oak	734	6	-41	-3	0	490	4	1,179	9	(N/A)	0.3	0.3	4.42
Broadleaf Deciduous La	958	7	-537	-12	-4	1,626	12	2,034	15	(N/A)	0.3	0.5	7.63
Siberian elm	1,124	8	-91	-6	-1	1,009	8	2,036	15	(N/A)	0.3	0.5	7.63
Northern white cedar	240	2	-17	-4	0	341	3	560	4	(N/A)	0.3	0.1	2.10
Catalpa	1,872	14	-313	-9	-2	1,384	10	2,934	22	(N/A)	0.3	0.6	11.00
Broadleaf Deciduous Sn	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Ohio buckeye	470	4	-38	-3	0	440	3	869	7	(N/A)	0.2	0.2	6.52
Black cherry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Broadleaf Deciduous Ma	224	2	-5	-1	0	176	1	393	3	(N/A)	0.2	0.1	2.95
Willow	386	3	-17	-2	0	395	3	762	6	(N/A)	0.2	0.2	5.71
Eastern red cedar	0	0	-5	-2	0	187	1	180	1	(N/A)	0.2	0.0	1.35
White mulberry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Northern pin oak	0	0	-69	-4	-1	539	4	466	3	(N/A)	0.2	0.1	3.49
Japanese maple	9	0	0	0	0	6	0	14	0	(N/A)	0.2	0.0	0.10
White ash	182	1	-5	-1	0	156	1	331	2	(N/A)	0.2	0.1	2.49
Citywide total	265,837	1,994	-21,370	-1,388	-171	208,562	1,564	451,640	3,387	(N/A)	100.0	100.0	5.35

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

4/11/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	2,825	(N/A)	13.7	10.3	32.47
Green ash	4,216	(N/A)	11.2	15.4	59.38
Sugar maple	4,033	(N/A)	10.7	14.7	59.30
Broadleaf Evergreen Mediu	1,403	(N/A)	10.1	5.1	21.93
Conifer Evergreen Large	956	(N/A)	9.8	3.5	15.42
Silver maple	4,678	(N/A)	7.6	17.0	97.47
Northern hackberry	1,422	(N/A)	3.9	5.2	56.88
Northern red oak	391	(N/A)	3.5	1.4	17.78
Honeylocust	2,558	(N/A)	2.7	9.3	150.48
Pear	79	(N/A)	2.7	0.3	4.63
Littleleaf linden	913	(N/A)	2.7	3.3	53.69
Apple	75	(N/A)	2.5	0.3	4.70
Pin oak	1,001	(N/A)	2.4	3.6	66.76
Red maple	461	(N/A)	1.9	1.7	38.45
Cottonwood	584	(N/A)	1.7	2.1	53.12
Bur oak	215	(N/A)	1.6	0.8	21.48
Black spruce	114	(N/A)	1.4	0.4	12.64
River birch	170	(N/A)	1.3	0.6	21.22
Swamp white oak	70	(N/A)	0.9	0.3	11.73
Eastern hophornbeam	21	(N/A)	0.9	0.1	3.51
American basswood	288	(N/A)	0.9	1.1	48.06
American sycamore	169	(N/A)	0.6	0.6	42.14
Blue spruce	66	(N/A)	0.6	0.2	16.39
Oak	49	(N/A)	0.5	0.2	16.18
Norway spruce	85	(N/A)	0.5	0.3	28.27
Austrian pine	40	(N/A)	0.3	0.1	19.97
White oak	72	(N/A)	0.3	0.3	36.21
Broadleaf Deciduous Large	57	(N/A)	0.3	0.2	28.57
Siberian elm	86	(N/A)	0.3	0.3	42.97
Northern white cedar	63	(N/A)	0.3	0.2	31.25
Catalpa	125	(N/A)	0.3	0.5	62.47
Broadleaf Deciduous Small	6	(N/A)	0.2	0.0	6.40
Ohio buckeye	43	(N/A)	0.2	0.2	43.05
Black cherry	6	(N/A)	0.2	0.0	6.40
Broadleaf Deciduous Mediu	26	(N/A)	0.2	0.1	26.22
Willow	39	(N/A)	0.2	0.1	39.16
Eastern red cedar	0	(N/A)	0.2	0.0	0.00
White mulberry	6	(N/A)	0.2	0.0	6.40
Northern pin oak	0	(N/A)	0.2	0.0	0.00
Japanese maple	0	(N/A)	0.2	0.0	0.03
White ash	33	(N/A)	0.2	0.1	33.42
Citywide total	27,446	(N/A)	100.0	100.0	43.36

Table 7: Summary of Benefits in Dollars

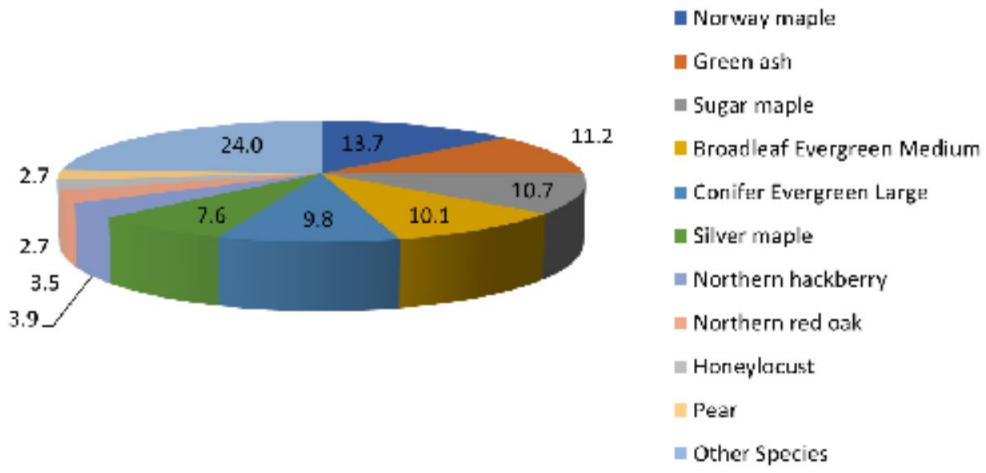
Annual Benefits of Public Trees by Species ($/tree)

4/11/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error
Norway maple	56.51	5.52	10.15	67.91	32.47	172.55	(N/A)
Green ash	63.69	8.79	11.15	91.76	59.38	234.76	(N/A)
Sugar maple	53.71	7.14	8.66	74.77	59.30	203.58	(N/A)
Broadleaf Evergreen	18.82	1.45	2.10	18.34	21.93	62.64	(N/A)
Conifer Evergreen L	13.58	1.08	1.48	16.14	15.42	47.70	(N/A)
Silver maple	61.10	12.47	11.30	115.28	97.47	297.63	(N/A)
Northern hackberry	72.90	7.14	12.76	86.12	56.88	235.79	(N/A)
Northern red oak	34.30	3.44	4.88	38.15	17.78	98.55	(N/A)
Honeylocust	50.80	7.75	8.43	54.79	150.48	272.24	(N/A)
Pear	13.15	1.27	1.83	5.10	4.63	25.97	(N/A)
Littleleaf linden	37.50	6.03	6.20	32.86	53.69	136.27	(N/A)
Apple	12.41	1.28	1.86	5.11	4.70	25.35	(N/A)
Pin oak	42.43	8.61	5.39	66.55	66.76	189.74	(N/A)
Red maple	33.14	4.03	5.82	31.50	38.45	112.95	(N/A)
Cottonwood	54.94	7.64	9.55	67.94	53.12	193.20	(N/A)
Bur oak	14.55	1.98	2.22	12.05	21.48	52.29	(N/A)
Black spruce	7.51	0.51	0.80	8.64	12.64	30.10	(N/A)
River birch	18.66	2.29	2.62	11.58	21.22	56.37	(N/A)
Swamp white oak	8.94	1.11	1.23	4.96	11.73	27.97	(N/A)
Eastern hophornbean	9.67	0.95	1.32	3.63	3.51	19.07	(N/A)
American basswood	49.77	7.52	7.73	60.62	48.06	173.69	(N/A)
American sycamore	39.10	5.38	6.47	44.88	42.14	137.98	(N/A)
Blue spruce	32.56	3.02	3.63	70.96	16.39	126.56	(N/A)
Oak	9.04	1.22	1.32	7.20	16.18	34.96	(N/A)
Norway spruce	33.49	3.45	-0.11	97.09	28.27	162.20	(N/A)
Austrian pine	29.65	2.73	3.10	62.66	19.97	118.11	(N/A)
White oak	31.57	4.42	5.11	37.43	36.21	114.74	(N/A)
Broadleaf Deciduous	98.63	7.63	22.55	196.17	28.57	353.55	(N/A)
Siberian elm	64.22	7.63	11.10	76.55	42.97	202.47	(N/A)
Northern white cedar	22.02	2.10	1.46	48.30	31.25	105.14	(N/A)
Catalpa	86.52	11.00	17.37	172.48	62.47	349.85	(N/A)
Broadleaf Deciduous	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Ohio buckeye	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)
Black cherry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Broadleaf Deciduous	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
Willow	46.78	5.71	7.92	38.19	39.16	137.75	(N/A)
Eastern red cedar	24.57	1.35	2.19	44.30	0.00	72.40	(N/A)
White mulberry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Northern pin oak	70.84	3.49	13.58	102.01	0.00	189.93	(N/A)
Japanese maple	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)
White ash	20.10	2.49	2.91	16.63	33.42	75.55	(N/A)
Citywide Total	41.64	5.35	6.87	55.24	43.36	152.46	(N/A)

Species Distribution of Public Trees

4/11/2020

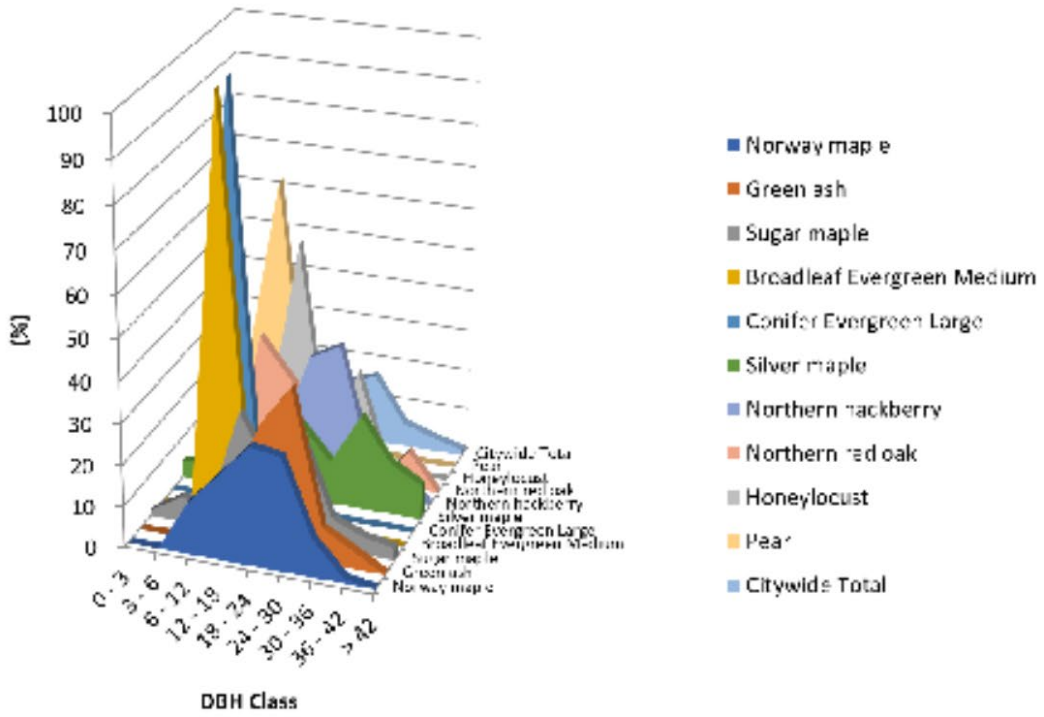


Species	Percent
Norway maple	13.7
Green ash	11.2
Sugar maple	10.7
Broadleaf Evergreen Med	10.1
Conifer Evergreen Large	9.8
Silver maple	7.6
Northern hackberry	3.9
Northern red oak	3.5
Honeylocust	2.7
Pear	2.7
Other Species	24.0
Total	100.0

Figure 1: Species Distribution

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

4/11/2020



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Norway maple	0.00	0.00	12.64	20.69	28.74	27.59	9.20	1.15	0.00
Green ash	0.00	0.00	2.82	12.68	30.99	40.85	8.45	4.23	0.00
Sugar maple	1.47	5.88	5.88	29.41	16.18	26.47	7.35	4.41	2.94
Broadleaf Evergreen M	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Conifer Evergreen Larg	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Silver maple	4.17	4.17	8.33	10.42	18.75	10.42	22.92	12.50	8.33
Northern hackberry	0.00	4.00	0.00	12.00	32.00	36.00	8.00	8.00	0.00
Northern red oak	9.09	0.00	31.82	22.73	13.64	13.64	0.00	9.09	0.00
Honeylocust	0.00	11.76	11.76	52.94	0.00	23.53	0.00	0.00	0.00
Pear	11.76	23.53	64.71	0.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	3.00	7.90	31.28	16.59	14.06	16.75	5.69	3.32	1.42

Figure 2: Relative Age Class

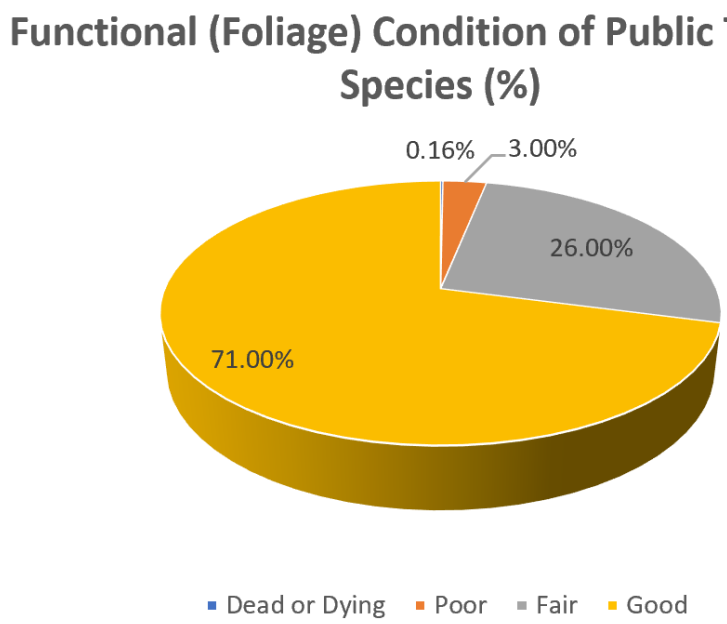


Figure 3: Foliage Condition

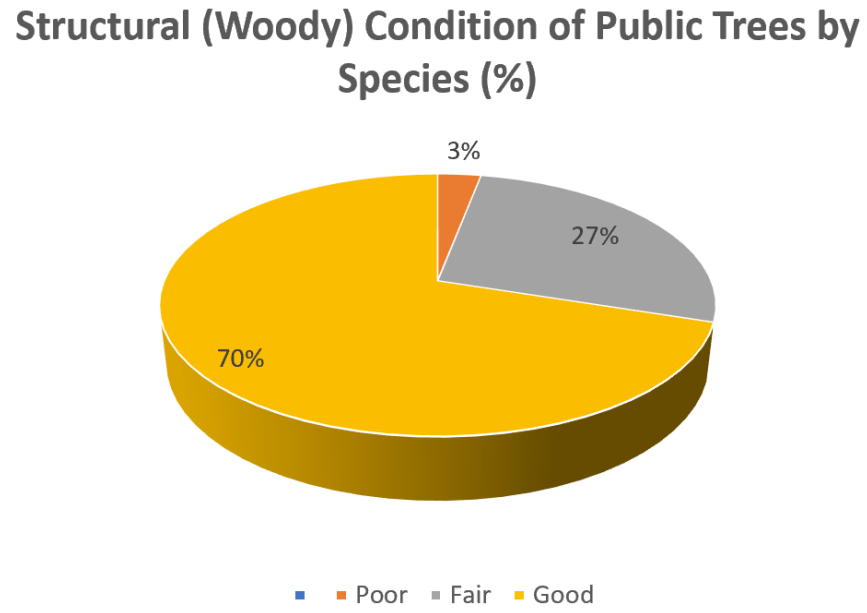
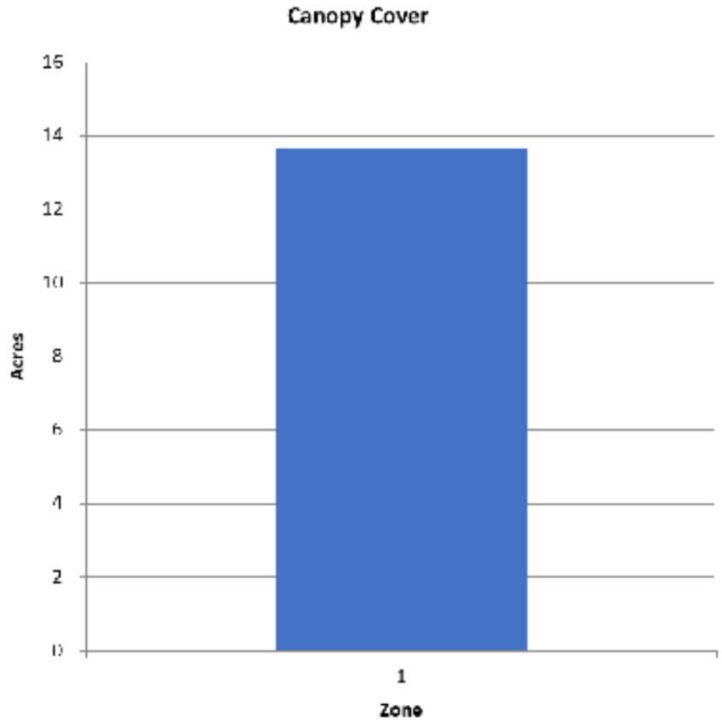


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

4/11/2020



Zone	Acres	% of Total Canopy Cover
1	14	100.0
Citywide total	14	100.0

Figure 5: Canopy Cover in Acres

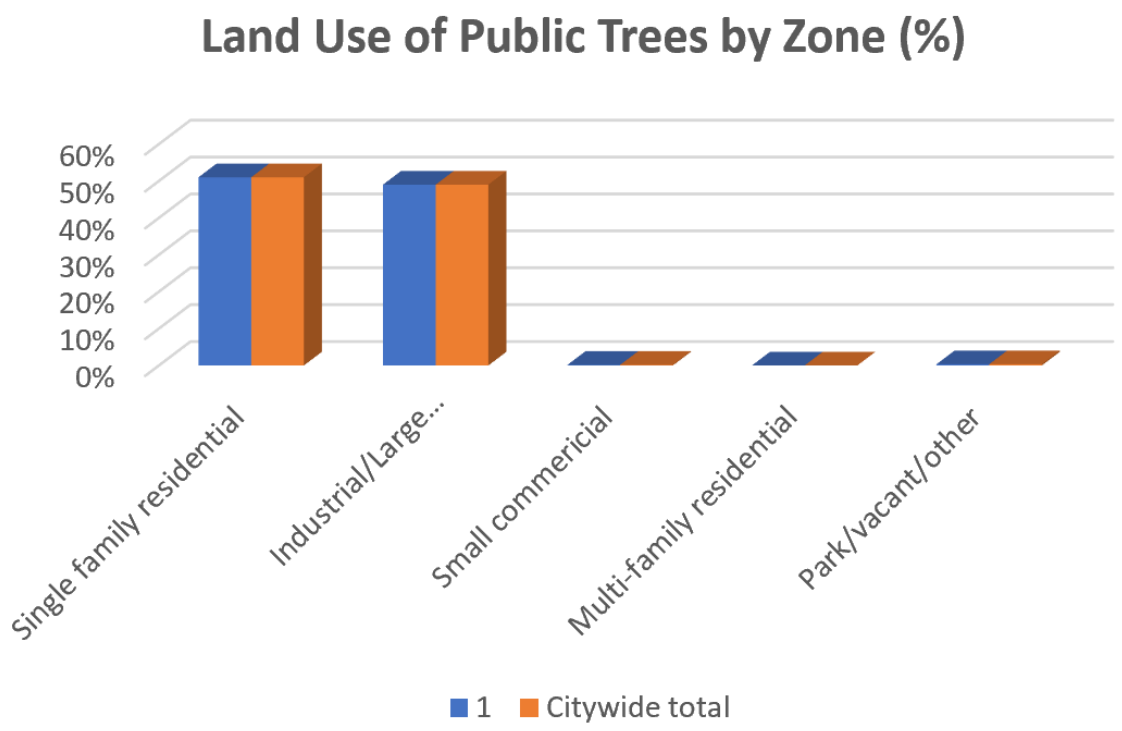


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

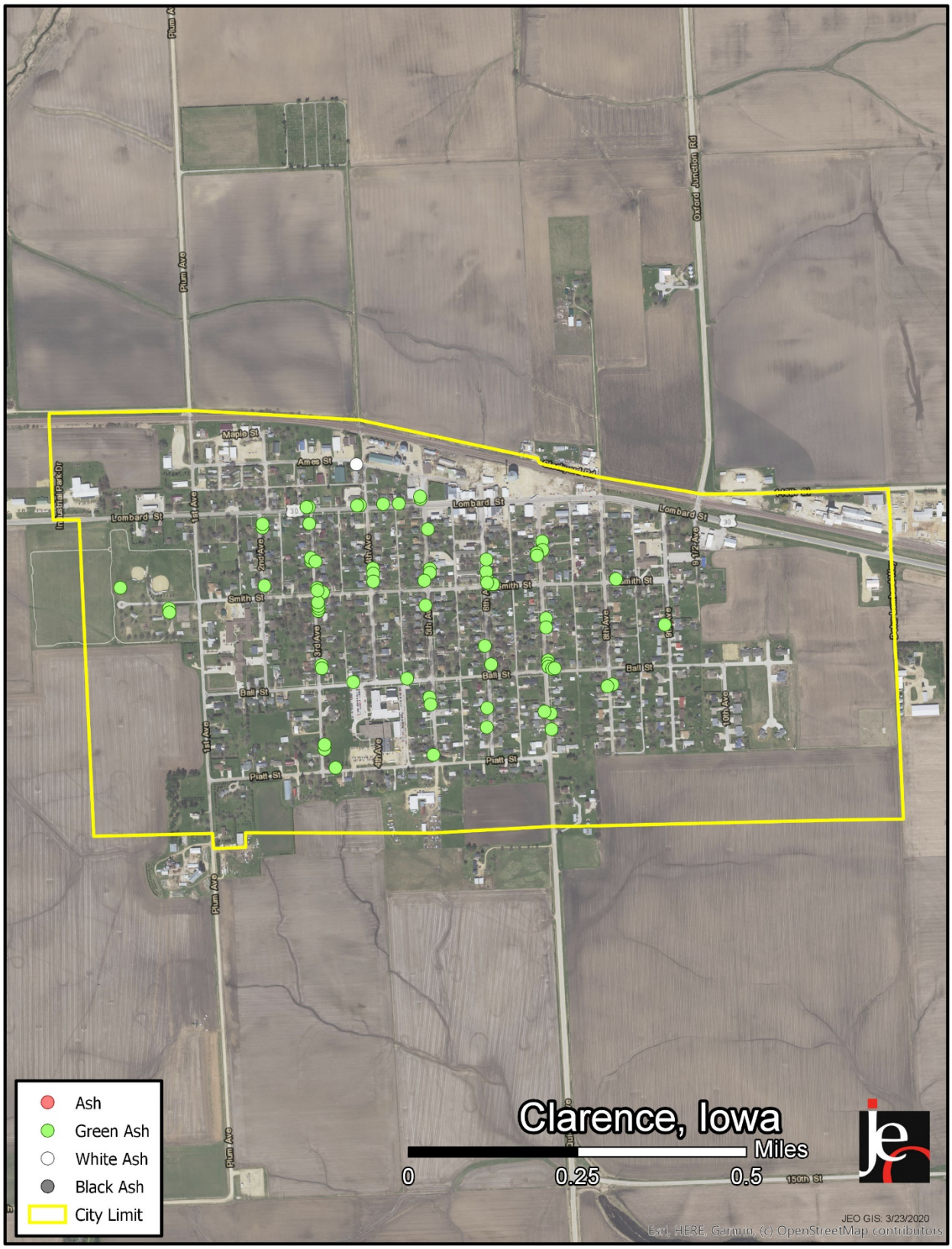


Figure 1: Location of Ash Trees

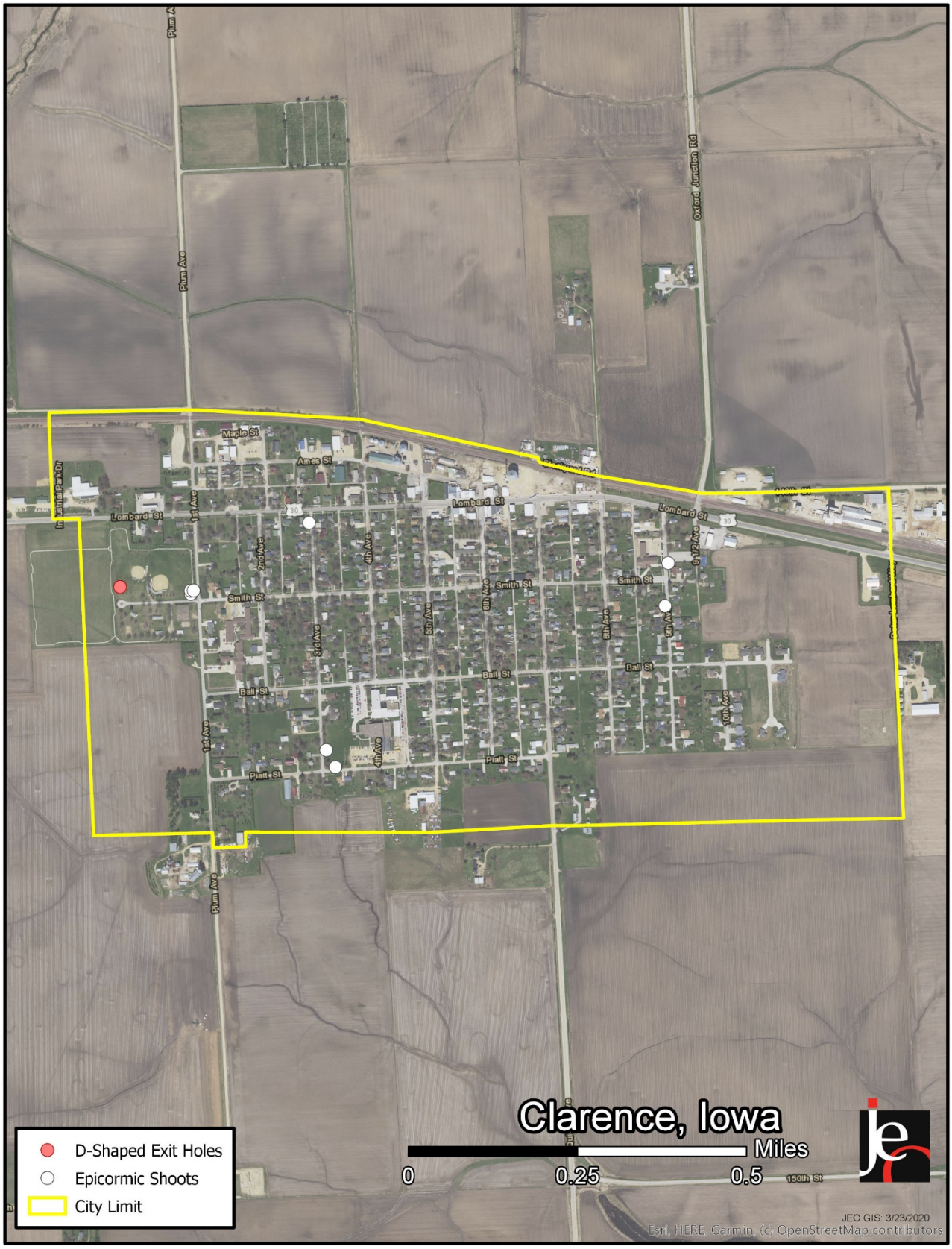


Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

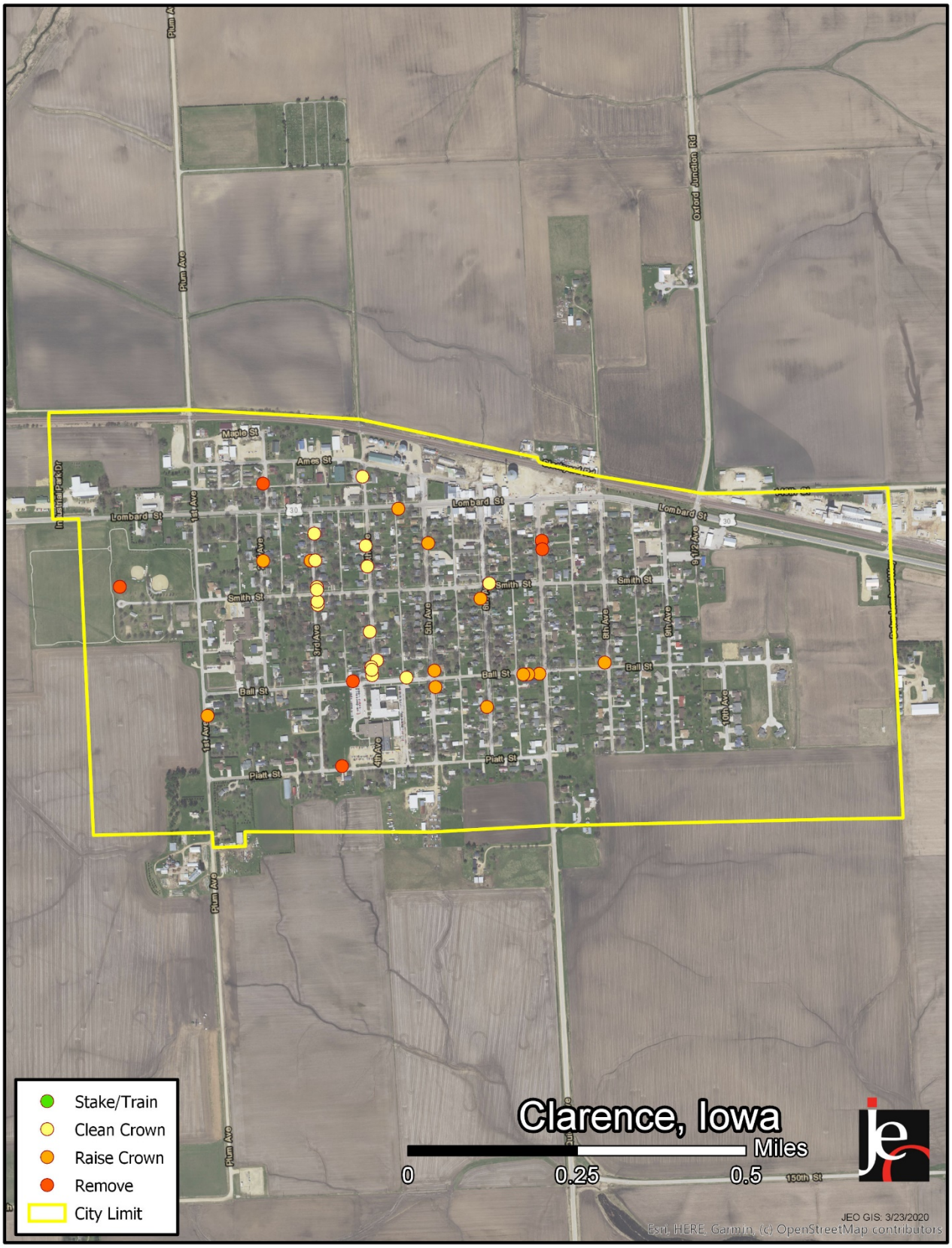


Figure 4: Location of Trees with Recommended Maintenance ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: Clarence Tree Ordinances

151.01 DEFINITION.
For use in this chapter, “parking” means that part of the street, avenue, or highway in the City not covered by sidewalk and lying between the lot line and the curb line or, on unpaved streets, that part of the street, avenue, or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS.
No tree shall be planted in any parking or street except in accordance with the following:
1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any parking which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow, or black walnut.

151.03 DUTY TO TRIM TREES.
The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax. (Code of Iowa, Sec. 364.12[2c, d & e])

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

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

151.06 INSPECTION AND REMOVAL.
The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:
1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be

corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant, or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

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

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E 9th St, Des Moines IA 50319.

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