

# Cascade, IA



## 2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES



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# Executive Summary

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## Overview

This plan was developed to assist the City of Cascade 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 15% of Cascade'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 338 trees inventoried.

- Cascade's trees provide \$39,218 of benefits annually, an average of \$116 per tree
- There are over 42 species of trees
- The top three genera are: Maple 26%, Ash 15%, and Oak 7%
- 14% of trees need some type of management
- 18 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 18 trees needing removal, address removal in descending order from largest DBH (diameter at breast height) to smallest. [\\*City ownership of the trees recommended for removal should be verified prior to any removal\\*](#)
- 10 of the 51 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 8 years to remove ash alone. We suggest that city officials request a budget increase to \$6,000 annually and apply for grants to plant replacement trees.

# Introduction

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This plan was developed to assist Cascade 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 Cascade, 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 Cascade's 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 Cascade 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 Cascade's\* urban forestry goals.

## Inventory

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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

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JEO entered the data collected for the 338 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

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### **Annual Energy Benefits**

Trees conserve energy by shading buildings and blocking winds. Cascade's trees reduce energy-related costs by approximately \$10,898 annually (Appendix A, Table 1). These savings are both in electricity (52.9 MWh) and in natural gas (7,019.5 Therms).

### **Annual Stormwater Benefits**

Cascade's trees intercept about 493,887 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides \$13,384 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 Cascade, it is estimated that trees remove 6,138 lbs of air pollution (ozone (O<sub>3</sub>), particulate matter less than 10 microns (PM<sub>10</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>)) per year with a net value of \$1,685 (Appendix A, Table 3).

### **Annual Carbon Benefits**

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Cascade, trees sequester about 103,657 lbs of carbon per year with an associated value of \$777 (Appendix A, Table 5). In addition, the trees store 1,337,661 lbs of carbon, with a yearly benefit of \$10,032 (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. Cascade receives \$11,860 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, Cascade's trees provide \$39,218 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 338 trees in Cascade provide approximately \$116 annually (Appendix A, Table 7).

# Forest Structure

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## Species Distribution

Cascade has over 42 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	87	2%
Ash	51	15%
Spruce	36	11%
Cedar	32	9%
Oak	25	7%
Walnut	15	4%
Apple	12	4%
Locust	10	3%
Linden/Basswood	8	2%
Hackberry	5	2%
Pine	4	1%
Elm	4	1%
Lilac	3	1%
Birch	2	<1%
Pear	2	<1%
Cherry	2	<1%
Willow	1	<1%
Boxelder	1	<1%
Alder	1	<1%
Other Evergreen	20	6%
Other Deciduous	2	<1%

## Age Class

Most of Cascade's trees (51%) 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. Cascade'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 Cascade indicate that 75% of the trees are in good health, with only 4% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 79% of Cascade'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).

Tree Removal	18	5%
Tree Staking	14	4%
Crown Cleaning	13	4%
Crown Raising	4	1%
Crown Reduction	0	0%

## Land Use and Location

The majority of Cascade’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.

<u>Land Use</u>	
Single family residential	54%
Industrial/Large commercial	45%
Small commercial	1%
Multi-family residential	0%
Park/vacant/other	0%

# Recommendations

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## 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

Cascade has 18 trees that need attention for immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter trees first. There is 1 tree over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Proposed Work Schedule and Budget at the end of this section. After all the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 31 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 18 removals, 3 are ash trees. [\\*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 Cascade.

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 (26%) (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 and black walnut. While the city currently has no existing City Code in reference to tree species planting restrictions, we encourage the city to work with the Iowa Department of Natural Resources to develop a plan moving forward.

## **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

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## 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](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 outlined by the Iowa Department of Natural Resources. While the city currently has no existing City Code in reference to tree species restrictions, we encourage the city to work with the Iowa Department of Natural Resources to develop a plan moving forward. We encourage the new plantings to be a diverse mix and 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 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 infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:

1. Removal from City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, and that danger to other trees within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the nuisance to be removed and the cost assessed against the property.”

# Proposed Work Schedule and Budget

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Budget Allowance of \$4,300/Year – (Based off \$2/Capita Calculation Due to no City Reporting)

## YEAR 1

### ESTIMATED COSTS

Remove 4 trees recommended for immediate removal	\$2,800
Remove 1 ash tree recommended for immediate removal	\$700
Plant 5 trees in open locations	\$750
Visual Survey of EAB Signs/Symptoms	

## YEAR 2

Remove 2 trees recommended for immediate removal	\$1,400
Plant 8 trees in open locations	\$1,200
Prune 1/3 of City Owned Trees (113 trees)	\$1,695
Visual Survey of EAB Signs/Symptoms	

## YEAR 3

Remove 4 trees recommended for immediate removal	\$2,800
Remove 1 ash tree recommended for immediate removal	\$700
Plant 5 trees in open locations	\$750
Visual Survey of EAB Signs/Symptoms	

## YEAR 4

Remove 2 trees recommended for immediate removal	\$1,400
Plant 8 trees in open locations	\$1,200
Prune 1/3 of City Owned Trees (113 trees)	\$1,695
Visual Survey of EAB Signs/Symptoms	

## YEAR 5

Remove 3 trees recommended for immediate removal	\$2,100
Remove 1 ash tree recommended for immediate removal	\$700
Plant 10 trees in open locations	\$1,500
Visual Survey of EAB Signs/Symptoms	

## YEAR 6

Remove 2 ash trees in poor health	\$1,400
Plant 8 trees in open locations	\$1,200
Prune 1/3 of City Owned Trees (113 trees)	\$1,695
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 \$5,950 a year. If the budget were increased to \$5,000 a year all ash could be removed in 7 years.

## Proposed Work Schedule with Increased Budget

Budget Allowance of \$6,000/Year – (Budget Increase Suggested to Best Manage City Trees)

### YEAR 1

### ESTIMATED COSTS

Remove 4 trees recommended for immediate removal	\$2,800
Remove 3 ash tree recommended for immediate removal	\$2,100
Plant 7 trees in open locations	\$1,050
Visual Survey of EAB Signs/Symptoms	

### YEAR 2

Remove 4 trees recommended for immediate removal	\$2,800
Plant 10 trees in open locations	\$1,500
Prune 1/3 of City Owned Trees	\$1,695
Visual Survey of EAB Signs/Symptoms	

### YEAR 3

Remove 7 trees recommended for immediate removal	\$4,900
Plant 7 trees in open locations	\$1,050
Visual Survey of EAB Signs/Symptoms	

### YEAR 4

Remove 5 ash trees	\$3,500
Plant 5 trees in open locations	\$750
Prune 1/3 of City Owned Trees	\$1,695
Visual Survey of EAB Signs/Symptoms	

### YEAR 5

Remove 7 ash trees	\$4,900
Plant 7 trees in open locations	\$1,050
Visual Survey of EAB Signs/Symptoms	

### YEAR 6

Remove 5 ash trees	\$3,500
Plant 5 trees in open locations	\$750
Prune 1/3 of City Owned Trees	\$1,695
Visual Survey of EAB Signs/Symptoms	

### Purposed Budget Increase

EAB could potentially kill all ash trees in Cascade within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to \$5,950 a year. If the budget were increased to \$5,000 per year all ash could be removed within 7 years. Additionally, we recommend that Cascade 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 Cascade would still need \$30,000 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 \$1,300 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 Cascade. We suggest considering an increased budget to plan for this.

## Works Cited

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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									
4/7/2020									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	9.1	691	1,195.4	1,172	1,863	(N/A)	10.7	17.1	51.74
Silver maple	6.7	511	849.6	833	1,344	(N/A)	10.7	12.3	37.32
Blue spruce	2.7	207	349.2	342	549	(N/A)	7.7	5.0	21.11
Norway maple	5.0	380	692.7	679	1,059	(N/A)	7.1	9.7	44.12
Eastern red cedar	2.0	149	289.9	284	433	(N/A)	5.6	4.0	22.78
Sugar maple	3.4	260	428.2	420	680	(N/A)	4.4	6.2	45.31
Black walnut	3.7	278	456.9	448	726	(N/A)	4.4	6.7	48.39
Swamp white oak	0.5	38	81.9	80	119	(N/A)	4.4	1.1	7.92
Northern white cedar	0.6	43	89.9	88	131	(N/A)	3.8	1.2	10.10
Apple	1.0	79	159.2	156	235	(N/A)	3.6	2.2	19.60
White ash	3.0	226	353.1	346	572	(N/A)	3.6	5.2	47.64
Conifer Evergreen Medium	0.3	24	53.4	52	76	(N/A)	3.3	0.7	6.94
Northern red oak	1.3	102	182.7	179	281	(N/A)	2.7	2.6	31.23
Bur oak	0.9	69	125.4	123	192	(N/A)	2.7	1.8	21.30
Red maple	0.7	56	109.5	107	163	(N/A)	2.4	1.5	20.40
Conifer Evergreen Small	0.1	10	19.8	19	29	(N/A)	2.4	0.3	3.62
Honeylocust	1.7	132	226.7	222	354	(N/A)	2.1	3.3	50.62
Littleleaf linden	1.2	93	153.5	150	244	(N/A)	1.8	2.2	40.64
Northern hackberry	1.2	92	167.0	164	255	(N/A)	1.5	2.3	51.04
Pin oak	1.1	84	142.3	139	224	(N/A)	1.5	2.1	44.72
Norway spruce	0.8	61	107.9	106	166	(N/A)	1.5	1.5	33.26
Eastern white pine	0.5	41	73.5	72	113	(N/A)	1.2	1.0	28.17
Spruce	0.2	17	38.0	37	54	(N/A)	1.2	0.5	13.58
American elm	0.9	68	120.4	118	186	(N/A)	0.9	1.7	61.98
Ash	0.7	56	98.6	97	152	(N/A)	0.9	1.4	50.75
Black locust	0.8	62	116.5	114	176	(N/A)	0.9	1.6	58.77
Lilac	0.1	5	11.4	11	16	(N/A)	0.9	0.1	5.40
Maple	0.0	1	2.2	2	3	(N/A)	0.9	0.0	1.03
Pear	0.0	1	1.2	1	2	(N/A)	0.6	0.0	0.87
Northern pin oak	0.3	25	48.2	47	72	(N/A)	0.6	0.7	35.97
American basswood	0.2	19	30.6	30	48	(N/A)	0.6	0.4	24.25
Black cherry	0.4	28	49.3	48	76	(N/A)	0.6	0.7	38.13
River birch	0.2	18	29.5	29	47	(N/A)	0.3	0.4	46.78
Black spruce	0.0	2	4.9	5	7	(N/A)	0.3	0.1	6.94
Broadleaf Deciduous Small	0.0	0	0.6	1	1	(N/A)	0.3	0.0	0.87
Broadleaf Evergreen Small	0.0	2	4.0	4	6	(N/A)	0.3	0.1	5.61
Siberian elm	0.2	18	26.8	26	44	(N/A)	0.3	0.4	44.29
Paper birch	0.2	18	27.0	26	44	(N/A)	0.3	0.4	44.23
Amur maple	0.2	14	24.7	24	38	(N/A)	0.3	0.3	38.13
Boxelder	0.3	22	40.7	40	62	(N/A)	0.3	0.6	62.01
Alder	0.2	14	24.7	24	38	(N/A)	0.3	0.3	38.13
Willow	0.0	3	6.2	6	9	(N/A)	0.3	0.1	8.99
Broadleaf Deciduous Medium	0.0	3	6.2	6	9	(N/A)	0.3	0.1	8.99
<b>Total</b>	<b>52.9</b>	<b>4,019</b>	<b>7,019.5</b>	<b>6,879</b>	<b>10,898</b>	<b>(N/A)</b>	<b>100.0</b>	<b>100.0</b>	<b>32.24</b>



**Table 2: Annual Stormwater Benefits**

<b>Annual Stormwater Benefits of Public Trees</b>						
4/7/2020						
Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	79,638	2,158	(N/A)	10.7	16.1	59.95
Silver maple	62,311	1,689	(N/A)	10.7	12.6	46.91
Blue spruce	34,161	926	(N/A)	7.7	6.9	35.61
Norway maple	37,909	1,027	(N/A)	7.1	7.7	42.81
Eastern red cedar	28,630	776	(N/A)	5.6	5.8	40.84
Sugar maple	31,140	844	(N/A)	4.4	6.3	56.26
Black walnut	30,274	820	(N/A)	4.4	6.1	54.70
Swamp white oak	2,262	61	(N/A)	4.4	0.5	4.09
Northern white cedar	6,006	163	(N/A)	3.8	1.2	12.52
Apple	3,731	101	(N/A)	3.6	0.8	8.43
White ash	25,190	683	(N/A)	3.6	5.1	56.89
Conifer Evergreen Medium	2,821	76	(N/A)	3.3	0.6	6.95
Northern red oak	11,739	318	(N/A)	2.7	2.4	35.35
Bur oak	10,203	277	(N/A)	2.7	2.1	30.72
Red maple	4,026	109	(N/A)	2.4	0.8	13.64
Conifer Evergreen Small	1,467	40	(N/A)	2.4	0.3	4.97
Honeylocust	18,717	507	(N/A)	2.1	3.8	72.46
Littleleaf linden	8,664	235	(N/A)	1.8	1.8	39.13
Northern hackberry	11,902	323	(N/A)	1.5	2.4	64.51
Pin oak	12,907	350	(N/A)	1.5	2.6	69.95
Norway spruce	19,014	515	(N/A)	1.5	3.8	103.06
Eastern white pine	11,139	302	(N/A)	1.2	2.3	75.46
Spruce	2,382	65	(N/A)	1.2	0.5	16.14
American elm	7,763	210	(N/A)	0.9	1.6	70.12
Ash	5,297	144	(N/A)	0.9	1.1	47.85
Black locust	7,653	207	(N/A)	0.9	1.5	69.13
Lilac	206	6	(N/A)	0.9	0.0	1.86
Maple	35	1	(N/A)	0.9	0.0	0.32
Pear	15	0	(N/A)	0.6	0.0	0.20
Northern pin oak	3,777	102	(N/A)	0.6	0.8	51.17
American basswood	1,307	35	(N/A)	0.6	0.3	17.70
Black cherry	1,333	36	(N/A)	0.6	0.3	18.06
River birch	1,409	38	(N/A)	0.3	0.3	38.19
Black spruce	256	7	(N/A)	0.3	0.1	6.95
Broadleaf Deciduous Small	7	0	(N/A)	0.3	0.0	0.20
Broadleaf Evergreen Small	78	2	(N/A)	0.3	0.0	2.10
Siberian elm	1,370	37	(N/A)	0.3	0.3	37.14
Paper birch	1,466	40	(N/A)	0.3	0.3	39.72
Amur maple	667	18	(N/A)	0.3	0.1	18.06
Boxelder	4,024	109	(N/A)	0.3	0.8	109.04
Alder	667	18	(N/A)	0.3	0.1	18.06
Willow	163	4	(N/A)	0.3	0.0	4.41
Broadleaf Deciduous Medit	163	4	(N/A)	0.3	0.0	4.41
Citywide total	493,887	13,384	(N/A)	100.0	100.0	39.60

**Table 3: Annual Air Quality Benefits**

Annual Air Quality Benefits of Public Trees																
Species	Deposition (lb)				Total Depos (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard (\$)	% of Total Error	Avg. Trees \$/tree
	O <sub>3</sub>	NO <sub>2</sub>	PM <sub>10</sub>	SO <sub>2</sub>		NO <sub>2</sub>	PM <sub>10</sub>	VOC	SO <sub>2</sub>							
Green ash	8.0	1.3	4.2	0.4	44	43.0	6.3	6.0	41.3	269	0.0	0	110.3	313 (N/A)	10.7	8.69
Silver maple	6.9	1.2	3.9	0.3	39	31.4	4.6	4.4	30.5	198	-4.8	-18	78.5	218 (N/A)	10.7	6.06
Blue spruce	4.2	0.8	3.6	0.5	28	12.8	1.9	1.8	12.3	80	-12.1	-45	25.7	63 (N/A)	7.7	2.41
Norway maple	6.8	1.2	3.5	0.3	37	24.0	3.5	3.3	22.7	149	-1.7	-6	63.7	180 (N/A)	7.1	7.51
Eastern red cedar	5.9	1.2	4.7	0.7	38	9.5	1.4	1.3	8.9	59	-15.8	-59	17.7	38 (N/A)	5.6	2.00
Sugar maple	3.9	0.7	2.0	0.2	21	16.0	2.4	2.2	15.5	100	-3.1	-12	39.7	110 (N/A)	4.4	7.33
Black walnut	3.1	0.5	1.6	0.1	17	17.1	2.5	2.4	16.6	108	0.0	0	43.9	124 (N/A)	4.4	8.28
Swamp white oak	0.1	0.0	0.1	0.0	1	2.5	0.4	0.3	2.3	16	-0.1	0	5.7	16 (N/A)	4.4	1.08
Northern white cedar	0.5	0.1	0.5	0.1	3	2.8	0.4	0.4	2.6	17	-1.8	-7	5.5	14 (N/A)	3.8	1.09
Apple	0.9	0.1	0.5	0.0	5	5.1	0.7	0.7	4.7	32	0.0	0	12.8	36 (N/A)	3.6	3.04
White ash	2.9	0.5	1.5	0.1	16	13.7	2.0	1.9	13.5	87	0.0	0	36.1	102 (N/A)	3.6	8.52
Conifer Evergreen Medium	0.2	0.0	0.2	0.0	1	1.6	0.2	0.2	1.4	10	-0.7	-3	3.2	8 (N/A)	3.3	0.75
Northern red oak	2.4	0.4	1.2	0.1	13	6.4	0.9	0.9	6.1	40	-3.3	-12	15.0	40 (N/A)	2.7	4.48
Bur oak	1.3	0.2	0.6	0.1	7	4.3	0.6	0.6	4.1	27	0.0	0	11.8	34 (N/A)	2.7	3.74
Red maple	0.5	0.1	0.3	0.0	3	3.6	0.5	0.5	3.3	22	-0.2	-1	8.6	24 (N/A)	2.4	3.01
Conifer Evergreen Small	0.1	0.0	0.1	0.0	0	0.6	0.1	0.1	0.6	4	-0.7	-3	0.8	2 (N/A)	2.4	0.20
Honeylocust	3.6	0.6	1.7	0.2	19	8.2	1.2	1.1	7.9	51	-2.8	-11	21.7	60 (N/A)	2.1	8.56
Littleleaf linden	1.2	0.2	0.6	0.1	7	5.8	0.8	0.8	5.6	36	-0.6	-2	14.4	40 (N/A)	1.8	6.72
Northern hackberry	1.9	0.3	1.0	0.1	11	5.8	0.8	0.8	5.5	36	0.0	0	16.2	46 (N/A)	1.5	9.30
Pin oak	2.4	0.4	1.2	0.1	13	5.2	0.8	0.7	5.0	33	-4.5	-17	11.4	29 (N/A)	1.5	5.82
Norway spruce	2.3	0.5	1.8	0.3	15	3.8	0.6	0.5	3.6	24	-11.6	-44	1.8	-5 (N/A)	1.5	-0.96
Eastern white pine	1.3	0.3	1.1	0.2	9	2.6	0.4	0.4	2.4	16	-5.8	-22	2.7	3 (N/A)	1.2	0.70
Spruce	0.2	0.0	0.2	0.0	1	1.1	0.2	0.2	1.0	7	-0.7	-2	2.3	6 (N/A)	1.2	1.48
American elm	1.8	0.3	0.9	0.1	9	4.3	0.6	0.6	4.1	27	0.0	0	12.5	36 (N/A)	0.9	12.00
Ash	0.9	0.2	0.5	0.0	5	3.5	0.5	0.5	3.3	22	-0.2	-1	9.2	26 (N/A)	0.9	8.66
Black locust	1.6	0.3	0.8	0.1	8	4.0	0.6	0.5	3.7	25	-0.4	-1	11.1	32 (N/A)	0.9	10.55
Lilac	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.8	2 (N/A)	0.9	0.71
Maple	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.1	0 (N/A)	0.9	0.13
Pear	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.6	0.11
Northern pin oak	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.8	14 (N/A)	0.6	6.86
American basswood	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.7	7 (N/A)	0.6	3.67
Black cherry	0.4	0.1	0.2	0.0	2	1.7	0.3	0.2	1.7	11	0.0	0	4.6	13 (N/A)	0.6	6.56
River birch	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)	0.3	7.92
Black spruce	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.3	1 (N/A)	0.3	0.75
Broadleaf/Deciduous Small	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)	0.3	0.11
Broadleaf/Evergreen Small	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)	0.3	0.75
Siberian elm	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.7	7 (N/A)	0.3	7.49
Paper birch	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.3	7.42
Amur maple	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.3	6.56
Boxelder	0.6	0.1	0.3	0.0	3	1.4	0.2	0.2	1.3	9	-0.2	-1	3.9	11 (N/A)	0.3	11.20
Alder	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.3	6.56
Willow	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)	0.3	1.21
Broadleaf/Deciduous Medi	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)	0.3	1.21
Citywide total	67.7	11.8	39.5	4.2	386	2506	36.7	35.0	2400	1,567	-71.5	-268	6138	1,685 (N/A)	1000	4.98

**Table 4: Annual Carbon Stored**

<b>Stored CO2 Benefits of Public Trees</b>						
4/7/2020						
Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	259,476	1,946 (N/A)		10.7	19.4	54.06
Silver maple	161,547	1,212 (N/A)		10.7	12.1	33.66
Blue spruce	24,964	187 (N/A)		7.7	1.9	7.20
Norway maple	113,365	850 (N/A)		7.1	8.5	35.43
Eastern red cedar	19,055	143 (N/A)		5.6	1.4	7.52
Sugar maple	114,451	858 (N/A)		4.4	8.6	57.23
Black walnut	102,384	768 (N/A)		4.4	7.7	51.19
Swamp white oak	3,353	25 (N/A)		4.4	0.3	1.68
Northern white cedar	2,721	20 (N/A)		3.8	0.2	1.57
Apple	14,928	112 (N/A)		3.6	1.1	9.33
White ash	64,289	482 (N/A)		3.6	4.8	40.18
Conifer Evergreen N	472	4 (N/A)		3.3	0.0	0.32
Northern red oak	47,295	355 (N/A)		2.7	3.5	39.41
Bur oak	43,965	330 (N/A)		2.7	3.3	36.64
Red maple	7,041	53 (N/A)		2.4	0.5	6.60
Conifer Evergreen S	344	3 (N/A)		2.4	0.0	0.32
Honeylocust	46,706	350 (N/A)		2.1	3.5	50.04
Littleleaf linden	26,193	196 (N/A)		1.8	2.0	32.74
Northern hackberry	30,378	228 (N/A)		1.5	2.3	45.57
Pin oak	66,362	498 (N/A)		1.5	5.0	99.54
Norway spruce	30,218	227 (N/A)		1.5	2.3	45.33
Eastern white pine	14,432	108 (N/A)		1.2	1.1	27.06
Spruce	1,027	8 (N/A)		1.2	0.1	1.93
American elm	37,004	278 (N/A)		0.9	2.8	92.51
Ash	15,194	114 (N/A)		0.9	1.1	37.98
Black locust	25,850	194 (N/A)		0.9	1.9	64.62
Lilac	533	4 (N/A)		0.9	0.0	1.33
Maple	51	0 (N/A)		0.9	0.0	0.13
Pear	28	0 (N/A)		0.6	0.0	0.10
Northern pin oak	14,297	107 (N/A)		0.6	1.1	53.61
American basswood	3,782	28 (N/A)		0.6	0.3	14.18
Black cherry	6,074	46 (N/A)		0.6	0.5	22.78
River birch	3,624	27 (N/A)		0.3	0.3	27.18
Black spruce	43	0 (N/A)		0.3	0.0	0.32
Broadleaf Deciduou	14	0 (N/A)		0.3	0.0	0.10
Broadleaf Evergreen	178	1 (N/A)		0.3	0.0	1.33
Siberian elm	3,037	23 (N/A)		0.3	0.2	22.78
Paper birch	3,672	28 (N/A)		0.3	0.3	27.54
Amur maple	3,037	23 (N/A)		0.3	0.2	22.78
Boxelder	22,806	171 (N/A)		0.3	1.7	171.04
Alder	3,037	23 (N/A)		0.3	0.2	22.78
Willow	218	2 (N/A)		0.3	0.0	1.64
Broadleaf Deciduou	218	2 (N/A)		0.3	0.0	1.64
Citywide total	1,337,661	10,032 (N/A)		100.0	100.0	29.68

**Table 5: Annual Carbon Sequestered**

Annual CO <sub>2</sub> Benefits of Public Trees												
4/7/2020												
Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total (\$)	Standard % of Total Trees	% of Total \$	Avg. \$/tree
Green ash	20,583	154	-1,245	-87	-10	15,278	115	34,526	259(N/A)	10.7	18.6	7.19
Silver maple	18,714	140	-778	-66	-6	11,292	85	29,162	219(N/A)	10.7	15.7	6.08
Blue spruce	1,991	15	-120	-44	-1	4,567	34	6,393	48(N/A)	7.7	3.4	1.84
Norway maple	8,205	62	-545	-48	-4	8,401	63	16,013	120(N/A)	7.1	8.6	5.00
Eastern red cedar	225	2	-91	-35	-1	3,285	25	3,383	25(N/A)	5.6	1.8	1.34
Sugar maple	6,481	49	-549	-34	-4	5,745	43	11,642	87(N/A)	4.4	6.3	5.82
Black walnut	7,553	57	-491	-34	-4	6,146	46	13,174	99(N/A)	4.4	7.1	6.59
Swamp white oak	1,202	9	-23	-8	0	850	6	2,020	15(N/A)	4.4	1.1	1.01
Northern white cedar	505	4	-13	-12	0	953	7	1,433	11(N/A)	3.8	0.8	0.83
Apple	1,571	12	-72	-14	-1	1,750	13	3,235	24(N/A)	3.6	1.7	2.02
White ash	6,867	52	-309	-24	-3	4,986	37	11,519	86(N/A)	3.6	6.2	7.20
Conifer Evergreen Medium	133	1	-2	-6	0	532	4	656	5(N/A)	3.3	0.4	0.45
Northern red oak	1,773	13	-227	-17	-2	2,256	17	3,786	28(N/A)	2.7	2.0	3.15
Bur oak	1,972	15	-211	-12	-2	1,520	11	3,269	25(N/A)	2.7	1.8	2.72
Red maple	1,069	8	-34	-8	0	1,234	9	2,261	17(N/A)	2.4	1.2	2.12
Conifer Evergreen Small	107	1	-2	-5	0	211	2	311	2(N/A)	2.4	0.2	0.29
Honeylocust	4,438	33	-225	-14	-2	2,921	22	7,120	53(N/A)	2.1	3.8	7.63
Littleleaf linden	3,361	25	-126	-12	-1	2,064	15	5,287	40(N/A)	1.8	2.9	6.61
Northern hackberry	1,458	11	-146	-12	-1	2,022	15	3,322	25(N/A)	1.5	1.8	4.98
Pin oak	5,643	42	-319	-12	-2	1,859	14	7,171	54(N/A)	1.5	3.9	10.76
Norway spruce	565	4	-145	-18	-1	1,338	10	1,740	13(N/A)	1.5	0.9	2.61
Eastern white pine	683	5	-69	-10	-1	898	7	1,502	11(N/A)	1.2	0.8	2.82
Spruce	211	2	-5	-5	0	378	3	579	4(N/A)	1.2	0.3	1.08
American elm	1,108	8	-178	-9	-1	1,502	11	2,423	18(N/A)	0.9	1.3	6.06
Ash	1,242	9	-73	-7	-1	1,230	9	2,392	18(N/A)	0.9	1.3	5.98
Black locust	1,226	9	-124	-8	-1	1,374	10	2,467	19(N/A)	0.9	1.3	6.17
Lilac	114	1	-3	-2	0	112	1	221	2(N/A)	0.9	0.1	0.55
Maple	8	0	0	-1	0	20	0	28	0(N/A)	0.9	0.0	0.07
Pear	17	0	0	0	0	11	0	28	0(N/A)	0.6	0.0	0.10
Northern pin oak	375	3	-69	-4	-1	546	4	849	6(N/A)	0.6	0.5	3.18
American basswood	350	3	-18	-3	0	409	3	738	6(N/A)	0.6	0.4	2.77
Black cherry	535	4	-29	-4	0	617	5	1,119	8(N/A)	0.6	0.6	4.20
River birch	386	3	-17	-2	0	395	3	762	6(N/A)	0.3	0.4	5.71
Black spruce	12	0	0	-1	0	48	0	60	0(N/A)	0.3	0.0	0.45
Broadleaf Deciduous Sm	9	0	0	0	0	6	0	14	0(N/A)	0.3	0.0	0.10
Broadleaf Evergreen Sm	27	0	-1	-1	0	38	0	64	0(N/A)	0.3	0.0	0.48
Siberian elm	314	2	-15	-2	0	397	3	695	5(N/A)	0.3	0.4	5.21
Paper birch	445	3	-18	-2	0	393	3	819	6(N/A)	0.3	0.4	6.14
Amur maple	268	2	-15	-2	0	308	2	560	4(N/A)	0.3	0.3	4.20
Boxelder	1,454	11	-109	-4	-1	490	4	1,830	14(N/A)	0.3	1.0	13.73
Alder	268	2	-15	-2	0	308	2	560	4(N/A)	0.3	0.3	4.20
Willow	96	1	-2	-1	0	65	0	158	1(N/A)	0.3	0.1	1.18
Broadleaf Deciduous M	96	1	-2	-1	0	65	0	158	1(N/A)	0.3	0.1	1.18
Citywide total	103,657	777	-6,435	-589	-53	88,316	666	185,449	1,391(N/A)	100.0	100.0	4.11

**Table 6: Annual Social and Aesthetic Benefits**

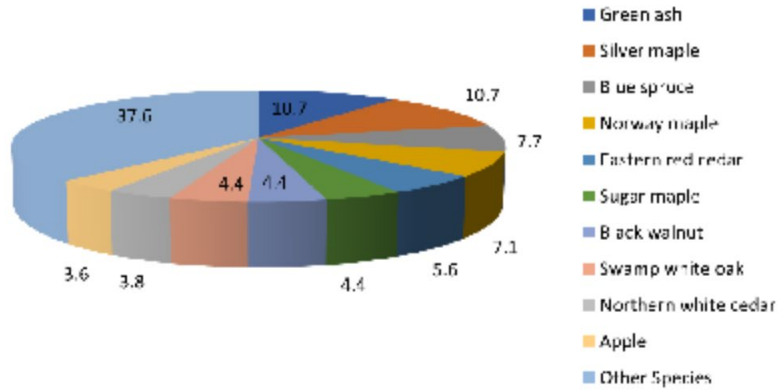
<b>Annual Aesthetic/Other Benefits of Public Trees</b>					
4/7/2020					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	1,873 (N/A)		10.7	15.8	52.02
Silver maple	1,945 (N/A)		10.7	16.4	54.02
Blue spruce	587 (N/A)		7.7	5.0	22.59
Norway maple	825 (N/A)		7.1	7.0	34.35
Eastern red cedar	89 (N/A)		5.6	0.8	4.71
Sugar maple	709 (N/A)		4.4	6.0	47.28
Black walnut	719 (N/A)		4.4	6.1	47.90
Swamp white oak	166 (N/A)		4.4	1.4	11.07
Northern white cedar	157 (N/A)		3.8	1.3	12.10
Apple	89 (N/A)		3.6	0.8	7.42
White ash	816 (N/A)		3.6	6.9	68.01
Conifer Evergreen Medium	135 (N/A)		3.3	1.1	12.31
Northern red oak	141 (N/A)		2.7	1.2	15.65
Bur oak	222 (N/A)		2.7	1.9	24.67
Red maple	194 (N/A)		2.4	1.6	24.20
Conifer Evergreen Small	107 (N/A)		2.4	0.9	13.37
Honeylocust	1,083 (N/A)		2.1	9.1	154.73
Littleleaf linden	357 (N/A)		1.8	3.0	59.49
Northern hackberry	203 (N/A)		1.5	1.7	40.69
Pin oak	419 (N/A)		1.5	3.5	83.80
Norway spruce	68 (N/A)		1.5	0.6	13.59
Eastern white pine	136 (N/A)		1.2	1.1	33.96
Spruce	62 (N/A)		1.2	0.5	15.42
American elm	153 (N/A)		0.9	1.3	51.07
Ash	121 (N/A)		0.9	1.0	40.46
Black locust	114 (N/A)		0.9	1.0	37.89
Lilac	6 (N/A)		0.9	0.1	2.06
Maple	0 (N/A)		0.9	0.0	0.04
Pear	0 (N/A)		0.6	0.0	0.03
Northern pin oak	34 (N/A)		0.6	0.3	17.10
American basswood	33 (N/A)		0.6	0.3	16.51
Black cherry	31 (N/A)		0.6	0.3	15.48
River birch	39 (N/A)		0.3	0.3	39.16
Black spruce	12 (N/A)		0.3	0.1	12.31
Broadleaf Deciduous Small	0 (N/A)		0.3	0.0	0.03
Broadleaf Evergreen Small	1 (N/A)		0.3	0.0	0.99
Siberian elm	32 (N/A)		0.3	0.3	32.00
Paper birch	46 (N/A)		0.3	0.4	45.86
Amur maple	15 (N/A)		0.3	0.1	15.48
Boxelder	79 (N/A)		0.3	0.7	78.52
Alder	15 (N/A)		0.3	0.1	15.48
Willow	13 (N/A)		0.3	0.1	12.89
Broadleaf Deciduous Medit	13 (N/A)		0.3	0.1	12.89
Citywide total	11,860 (N/A)		100.0	100.0	35.09

**Table 7: Summary of Benefits in Dollars**

<b>Annual Benefits of Public Trees by Species (\$/tree)</b>						
4/7/2020						
Species	Energy	CO <sub>2</sub>	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
Green ash	51.74	7.19	8.69	59.95	52.02	179.59 (N/A)
Silver maple	37.32	6.08	6.06	46.91	54.02	150.39 (N/A)
Blue spruce	21.11	1.84	2.41	35.61	22.59	83.56 (N/A)
Norway maple	44.12	5.00	7.51	42.81	34.35	133.80 (N/A)
Eastern red cedar	22.78	1.34	2.00	40.84	4.71	71.66 (N/A)
Sugar maple	45.31	5.82	7.33	56.26	47.28	162.00 (N/A)
Black walnut	48.39	6.59	8.28	54.70	47.90	165.86 (N/A)
Swamp white oak	7.92	1.01	1.08	4.09	11.07	25.16 (N/A)
Northern white cedar	10.10	0.83	1.09	12.52	12.10	36.63 (N/A)
Apple	19.60	2.02	3.04	8.43	7.42	40.51 (N/A)
White ash	47.64	7.20	8.52	56.89	68.01	188.26 (N/A)
Conifer Evergreen N	6.94	0.45	0.75	6.95	12.31	27.41 (N/A)
Northern red oak	31.23	3.15	4.48	35.35	15.65	89.86 (N/A)
Bur oak	21.30	2.72	3.74	30.72	24.67	83.16 (N/A)
Red maple	20.40	2.12	3.01	13.64	24.20	63.36 (N/A)
Conifer Evergreen S	3.62	0.29	0.20	4.97	13.37	22.45 (N/A)
Honeylocust	50.62	7.63	8.56	72.46	154.73	294.00 (N/A)
Littleleaf linden	40.64	6.61	6.72	39.13	59.49	152.60 (N/A)
Northern hackberry	51.04	4.98	9.30	64.51	40.69	170.51 (N/A)
Pin oak	44.72	10.76	5.82	69.95	83.80	215.04 (N/A)
Norway spruce	33.26	2.61	-0.96	103.06	13.59	151.54 (N/A)
Eastern white pine	28.17	2.82	0.70	75.46	33.96	141.11 (N/A)
Spruce	13.58	1.08	1.48	16.14	15.42	47.70 (N/A)
American elm	61.98	6.06	12.00	70.12	51.07	201.23 (N/A)
Ash	50.75	5.98	8.66	47.85	40.46	153.70 (N/A)
Black locust	58.77	6.17	10.55	69.13	37.89	182.51 (N/A)
Lilac	5.40	0.55	0.71	1.86	2.06	10.58 (N/A)
Maple	1.03	0.07	0.13	0.32	0.04	1.58 (N/A)
Pear	0.87	0.10	0.11	0.20	0.03	1.31 (N/A)
Northern pin oak	35.97	3.18	6.86	51.17	17.10	114.28 (N/A)
American basswood	24.25	2.77	3.67	17.70	16.51	64.90 (N/A)
Black cherry	38.13	4.20	6.56	18.06	15.48	82.43 (N/A)
River birch	46.78	5.71	7.92	38.19	39.16	137.75 (N/A)
Black spruce	6.94	0.45	0.75	6.95	12.31	27.41 (N/A)
Broadleaf Deciduous	0.87	0.10	0.11	0.20	0.03	1.31 (N/A)
Broadleaf Evergreen	5.61	0.48	0.75	2.10	0.99	9.94 (N/A)
Siberian elm	44.29	5.21	7.49	37.14	32.00	126.14 (N/A)
Paper birch	44.23	6.14	7.42	39.72	45.86	143.36 (N/A)
Amur maple	38.13	4.20	6.56	18.06	15.48	82.43 (N/A)
Boxelder	62.01	13.73	11.20	109.04	78.52	274.49 (N/A)
Alder	38.13	4.20	6.56	18.06	15.48	82.43 (N/A)
Willow	8.99	1.18	1.21	4.41	12.89	28.68 (N/A)
Broadleaf Deciduous	8.99	1.18	1.21	4.41	12.89	28.68 (N/A)
Citywide Total	32.24	4.11	4.98	39.60	35.09	116.03 (N/A)

# Species Distribution of Public Trees

4/7/2020

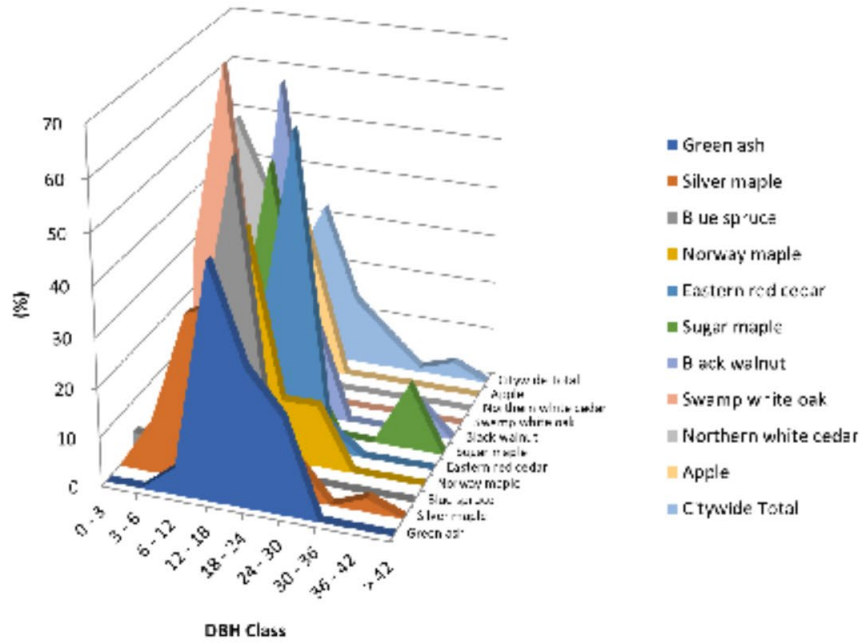


Species	Percent
Green ash	10.7
Silver maple	10.7
Blue spruce	7.7
Norway maple	7.1
Eastern red cedar	5.6
Sugar maple	4.4
Black walnut	4.4
Swamp white oak	4.4
Northern white cedar	3.8
Apple	3.6
Other Species	37.6
Total	100.0

Figure 1: Species Distribution

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

4/7/2020



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Green ash	0.00	0.00	5.56	47.22	27.78	19.44	0.00	0.00	0.00
Silver maple	0.00	11.11	33.33	36.11	8.33	8.33	0.00	2.78	0.00
Blue spruce	3.85	3.85	23.08	61.54	7.69	0.00	0.00	0.00	0.00
Norway maple	0.00	4.17	25.00	45.83	12.50	12.50	0.00	0.00	0.00
Eastern red cedar	0.00	5.26	5.26	21.05	63.16	5.26	0.00	0.00	0.00
Sugar maple	6.67	0.00	13.33	53.33	13.33	0.00	0.00	13.33	0.00
Black walnut	0.00	0.00	6.67	66.67	20.00	0.00	0.00	6.67	0.00
Swamp white oak	26.67	66.67	6.67	0.00	0.00	0.00	0.00	0.00	0.00
Northern white cedar	0.00	53.85	38.46	7.69	0.00	0.00	0.00	0.00	0.00
Apple	8.33	16.67	50.00	25.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	5.62	18.93	18.05	32.54	13.61	7.10	0.89	3.25	0.00

Figure 2: Relative Age Class



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

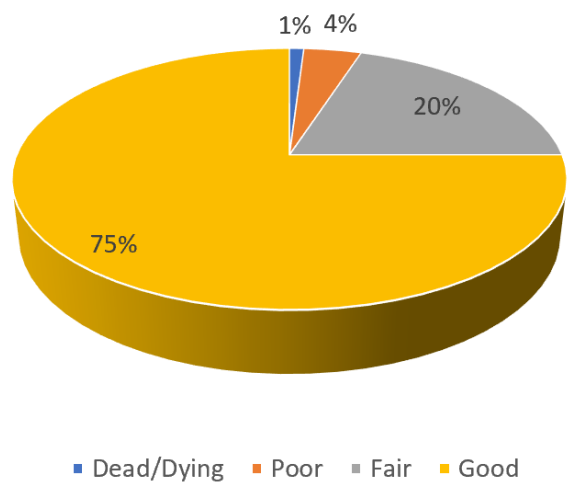


Figure 3: Foliage Condition

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

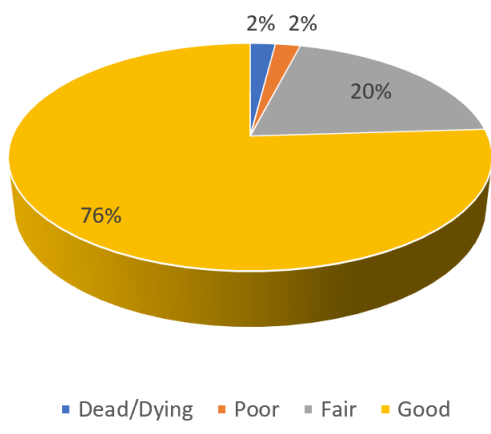
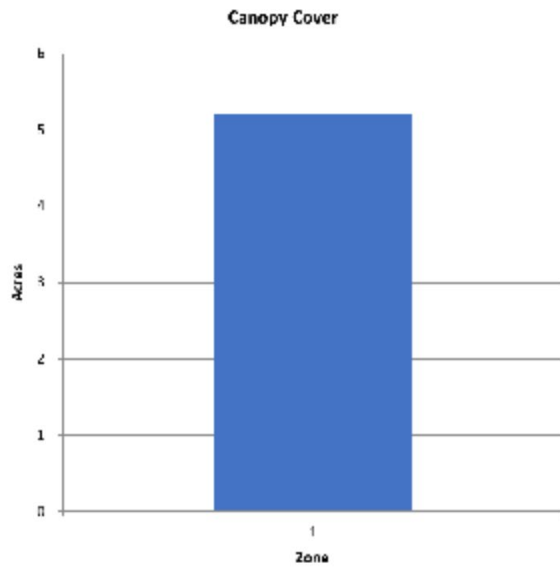


Figure 4: Wood Condition

## Canopy Cover of Public Trees (Acres)

4/7/2020



Zone	Acres	% of Total Canopy Cover
1	5	100.0
Citywide total	5	100.0

Figure 5: Canopy Cover in Acres

## Land Use of Public Trees by Zone (%)

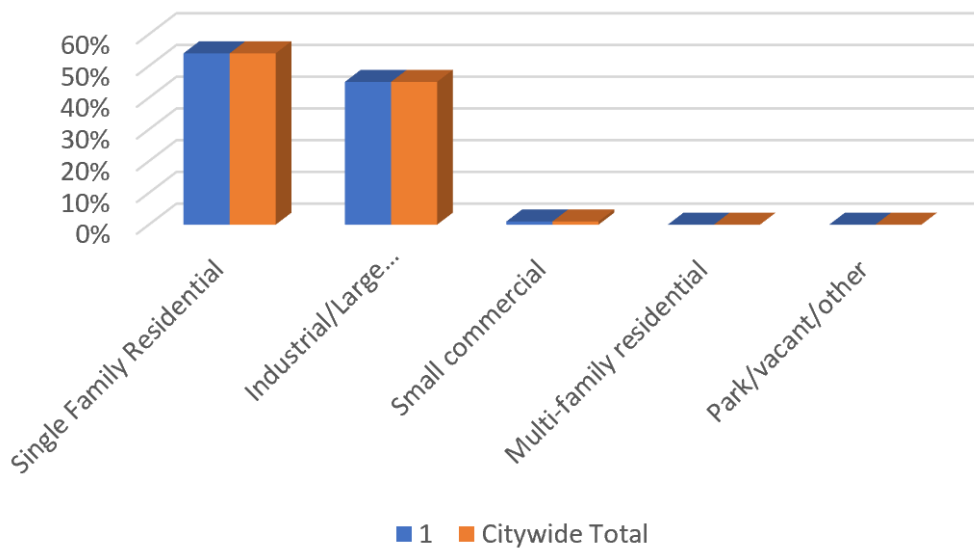
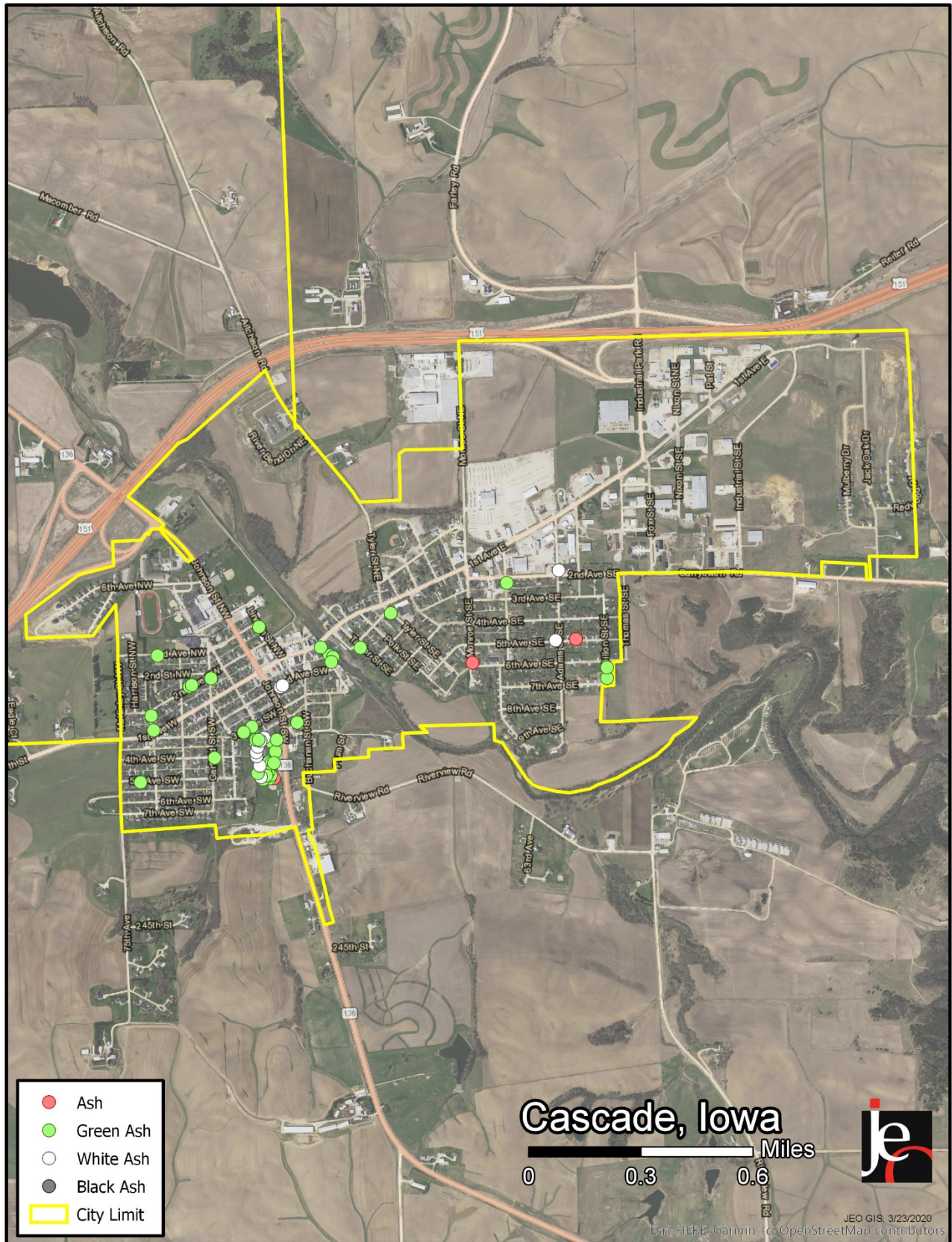


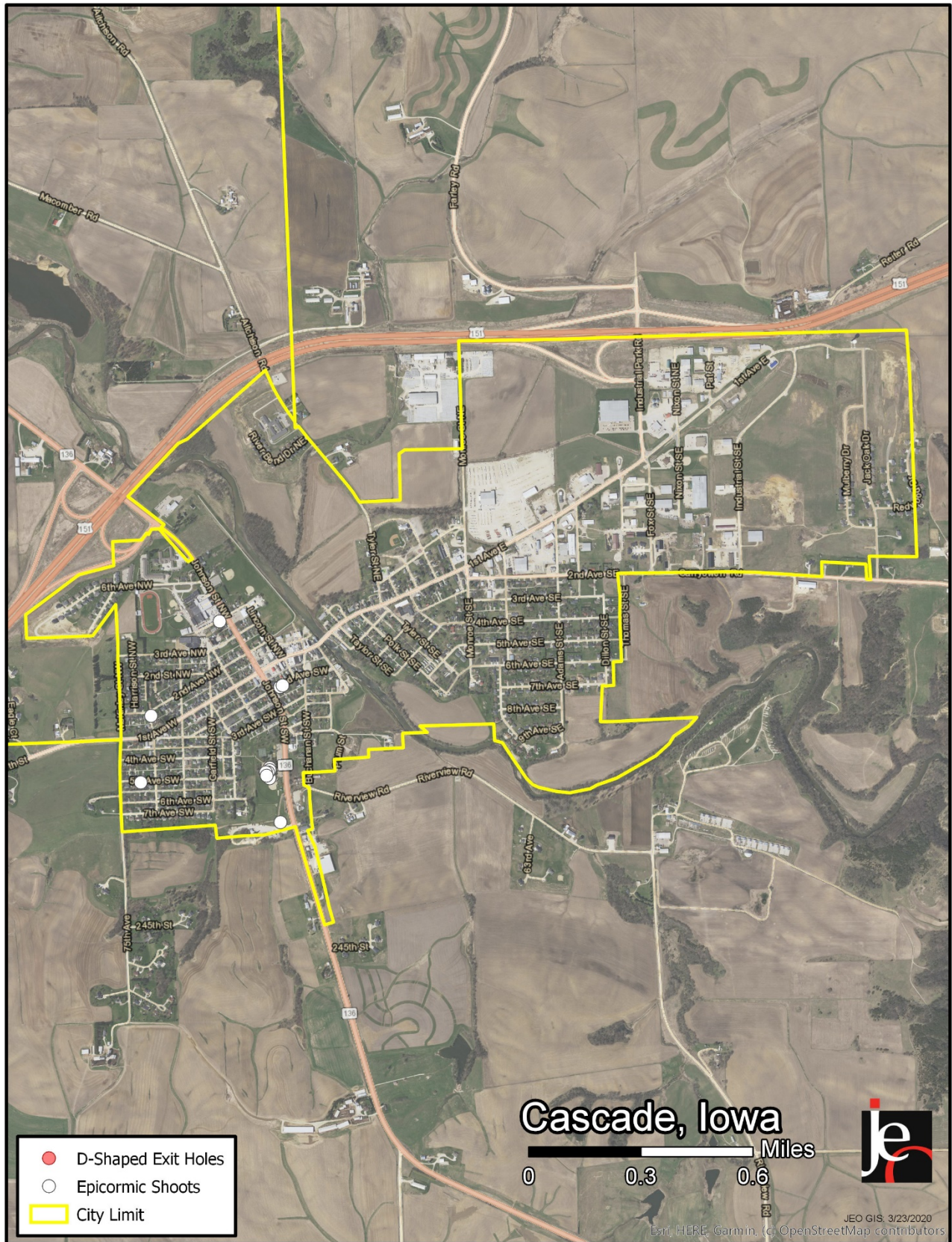
Figure 6: Land Use of city/park trees

## Appendix B: ArcGIS Mapping

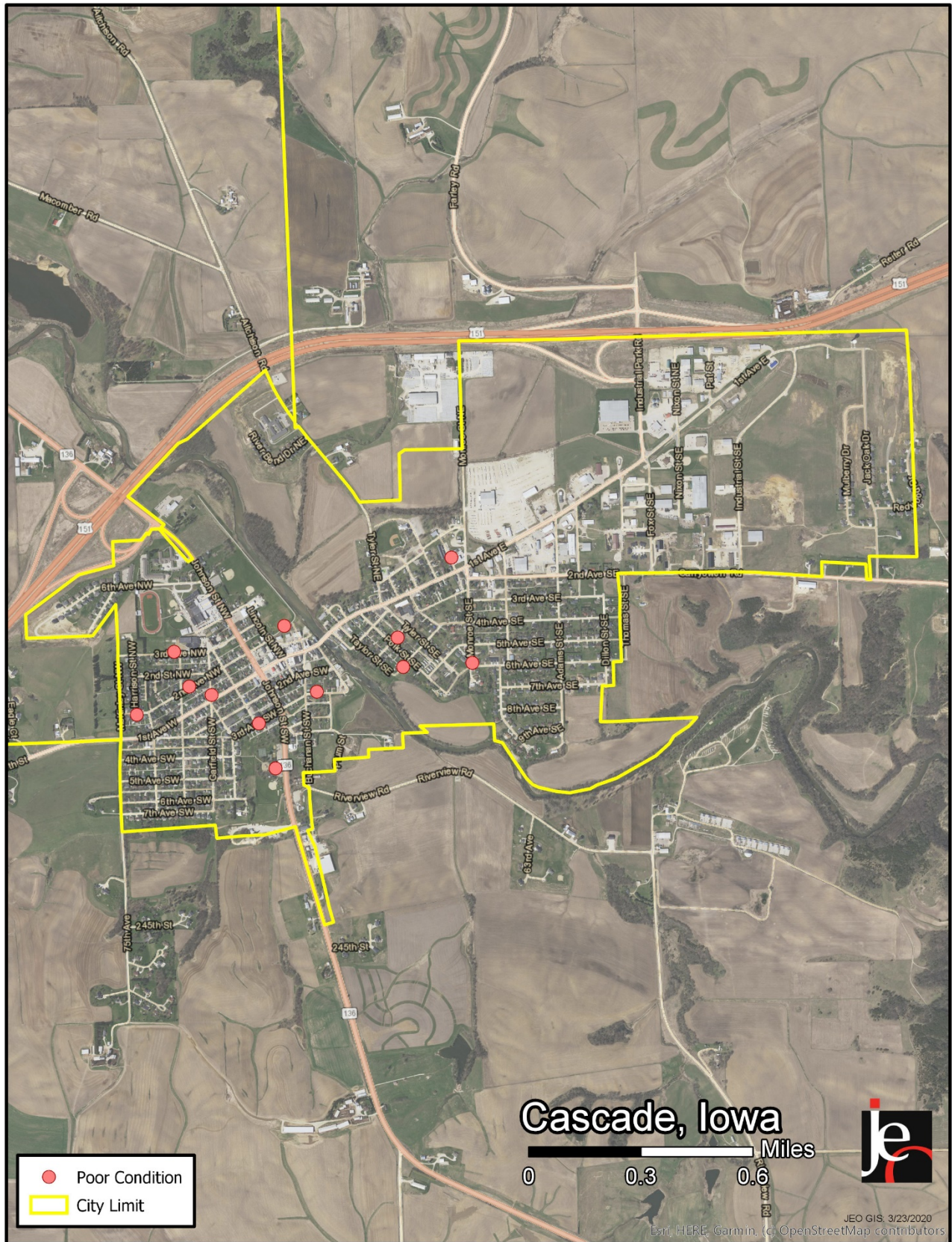
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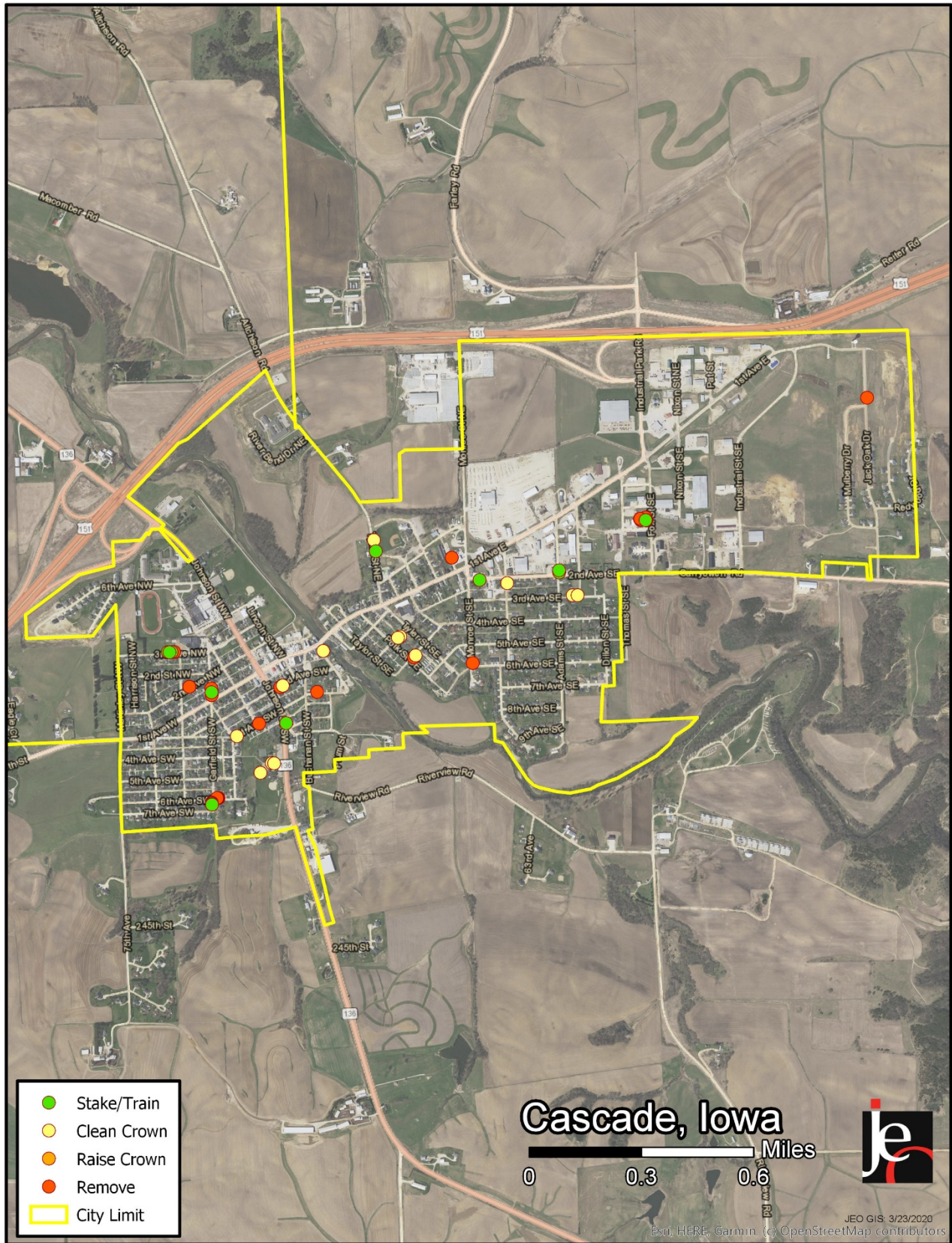
**Figure 1: Location of Ash Trees**



**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: Cascade Tree Ordinances

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## **150.01 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.

## **150.02 PLANTING PROHIBITED.**

No person shall plant any tree or shrub in any parking or street.

## **150.03 DUTY TO TRIM TREES.**

The owner or agent of the abutting property shall keep the trees currently 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])

## **150.04 TRIMMING TREES TO BE SUPERVISED.**

Except as allowed in Section 150.03, 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.

## **150.05 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.

## **150.06 INSPECTION AND REMOVAL.**

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

1. Removal from City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, and that danger to other trees within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the nuisance to be removed and the cost assessed against the property.



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 9<sup>th</sup> 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.