

Everly, IA



2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES



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Executive Summary

Overview

This plan was developed to assist the City of Everly 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 38% of Everly'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 390 trees inventoried.

- Everly's trees provide \$73,956 of benefits annually, an average of \$189.63 per tree
- There are over 16 species of trees
- The top three genera are: Ash 38%, Maple 31%, and Oak 5%
- Currently no trees in need of some type of management
- No trees require immediate removal

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.

- While there are no trees currently needing immediate removal, focus over health concern should narrow to trees over 24 inches in diameter at 4.5 ft. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 8 of the 149 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 86 years to remove ash. We suggest that city officials request a budget increase to at least \$3,000 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist Everly 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 Everly, 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 Everly'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 Everly 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 Everly'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 390 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. Everly's trees reduce energy-related costs by approximately \$19,328 annually (Appendix A, Table 1). These savings are both in electricity (91.8 MWh) and in natural gas (12,615.5 Therms).

Annual Stormwater Benefits

Everly's trees intercept about 1,022,528 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides \$27,711 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 Everly, it is estimated that trees remove 1,188 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$3,363 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Everly, trees sequester about 226,593 lbs of carbon per year with an associated value of \$1,699 (Appendix A, Table 5). In addition, the trees store 3,732,112 lbs of carbon, with a yearly benefit of \$27,991 (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. Everly receives \$20,843 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, Everly's trees provide \$73,956 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 390 trees in Everly provide approximately \$189.63 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Everly has over 16 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Ash	149	38%
Maple	121	31%
Oak	21	5%
Spruce	16	4%
Hackberry	12	3%
Broadleaf Deciduous Medium	11	3%
Locust	8	2%
Pear	7	2%
Birch	7	2%
Alder	6	1.5%
Conifer Evergreen	6	1.5%
Linden/Basswood	5	1%
Cottonwood	5	1%
Walnut	4	1%
Broadleaf Evergreen	4	1%
Elm	3	<1%
Juniper	2	<1%
Pine	1	<1%
Broadleaf Deciduous Small	1	<1%
Broadleaf Deciduous Evergreen	1	<1%

Age Class

Most of Everly's trees (43%) are between 18 and 30 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. Everly's size curve indicates a very average stand with mostly young mature trees.

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 Everly indicate that 61% 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, 64% of Everly'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	0	0%
Crown Raising	0	0%
Tree Staking	0	0%
Tree Removal	0	0%
Crown Reduction	0	0%

Land Use and Location

The majority of Everly's city and park trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure 7). The following describes the land use and locations for the street and park trees.

<u>Land Use</u>	
Single family residential	66%
Park/vacant/other	<1%
Industrial/Large commercial	33%
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

Everly currently has no critical concern trees that need immediate removal. The location of these trees would be available on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). If any trees over 24 inches in diameter at 4.5 ft become a public safety risk, they should be addressed immediately. Please refer to the Proposed Work Schedule and Budget at the end of this section. After any critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance.

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). There are a total of 149 ash trees, and zero of those have signs and symptoms that have been associated with EAB. In addition, there are 8 trees that are in poor health. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising 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 Six Year Maintenance Plan 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 Everly.

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 ash (38%) and maple (31%) (Appendix A, Figure 1). Ash and maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. 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

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 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. While there is no existing City Code in reference to private tree care and removal, we encourage the city to work with the Iowa Department of Natural Resources to develop a plan moving forward.

Proposed Work Schedule and Budget

Budget Allowance of \$1,206/Year – (Based off \$2/Capita Calculation Due to no City Reporting)

YEAR 1

ESTIMATED COSTS

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 1 ash tree (prioritize largest diameter)	\$700
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 \$17,400 a year. If the budget were increased to \$3,000 a year all ash could be removed in 35 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of \$3,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1

ESTIMATED COSTS

Remove 3 ash trees (prioritize largest diameter)	\$2,100
Plant 6 trees in open locations	\$900
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 2 trees in open locations	\$300
Prune 1/3 of City Owned Trees	\$1,950
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 3 ash trees (prioritize largest diameter)	\$2,100
Plant 6 trees in open locations	\$900
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 2 trees in open locations	\$300
Prune 1/3 of City Owned Trees	\$1,950
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 3 ash trees (prioritize largest diameter)	\$2,100
Plant 6 trees in open locations	\$900
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 2 trees in open locations	\$300
Prune 1/3 of City Owned Trees	\$1,950
Visual Survey of EAB Signs/Symptoms	

Purposed Budget Increase

EAB could potentially kill all ash trees in Everly within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to \$17,400 a year. If the budget were increased to \$3,000 per year all ash could be removed within 35 years. Additionally, we recommend that Everly 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 Everly would still need to find \$98,700 for removal of the remaining ash trees. Alternatively, if there are 15 treatable trees, it would cost approximately \$4,500 a year for treatment and leave \$93,800 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 Everly. We suggest considering an increased budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees									
4/20/2020									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	40.9	3,103	3,644.9	3,332	8,633	(N/A)	37.7	44.7	38.74
Silver maple	17.3	1,316	2,250.6	2,206	3,521	(N/A)	14.4	18.2	62.88
Norway maple	10.1	764	1,447.9	1,419	2,183	(N/A)	9.7	11.3	57.44
Sugar maple	4.8	368	625.1	613	980	(N/A)	5.9	5.1	42.62
Northern hackberry	2.3	172	330.5	324	496	(N/A)	3.1	2.6	41.36
Broadleaf Deciduous Med	1.0	72	144.7	142	214	(N/A)	2.8	1.1	19.46
Blue spruce	0.8	59	116.1	114	173	(N/A)	2.6	0.9	17.33
Northern pin oak	2.6	199	385.3	378	577	(N/A)	2.3	3.0	64.11
Honeylocust	2.1	162	283.1	277	440	(N/A)	2.1	2.3	54.96
Pear	0.9	67	133.0	130	198	(N/A)	1.8	1.0	28.22
River birch	1.0	75	134.6	132	207	(N/A)	1.8	1.1	29.61
Alder	0.3	20	46.7	46	66	(N/A)	1.5	0.3	11.04
Northern red oak	0.6	46	83.5	82	128	(N/A)	1.3	0.7	25.58
American basswood	1.1	87	165.8	162	250	(N/A)	1.3	1.3	49.91
White oak	0.3	21	32.1	31	52	(N/A)	1.3	0.3	10.40
Norway spruce	0.2	15	27.3	27	42	(N/A)	1.3	0.2	8.38
Cottonwood	1.9	143	261.6	256	399	(N/A)	1.3	2.1	79.80
Black walnut	1.4	104	192.3	188	292	(N/A)	1.0	1.5	73.07
Red maple	0.1	9	18.7	18	28	(N/A)	1.0	0.1	6.92
Conifer Evergreen Small	0.0	1	2.7	3	4	(N/A)	1.0	0.0	0.93
American elm	1.2	92	166.8	163	255	(N/A)	0.8	1.3	85.03
Broadleaf Evergreen Med	0.2	12	23.8	23	35	(N/A)	0.8	0.2	11.68
Bur oak	0.0	2	4.2	4	6	(N/A)	0.5	0.0	3.24
Conifer Evergreen Large	0.2	18	34.1	33	52	(N/A)	0.5	0.3	25.88
White ash	0.4	27	41.7	41	68	(N/A)	0.5	0.4	34.11
Juniper	0.0	1	3.1	3	5	(N/A)	0.5	0.0	2.27
Broadleaf Deciduous Sm	0.0	0	0.6	1	1	(N/A)	0.3	0.0	0.87
Black spruce	0.0	2	4.9	5	7	(N/A)	0.3	0.0	6.94
Broadleaf Evergreen Larg	0.0	2	5.2	5	8	(N/A)	0.3	0.0	7.59
Swamp white oak	0.0	0	0.8	1	1	(N/A)	0.3	0.0	1.10
Eastern white pine	0.0	2	4.0	4	6	(N/A)	0.3	0.0	5.61
Total	91.8	6,965	12,615.5	12,363	19,328	(N/A)	100.0	100.0	49.56

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

4/20/2020

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	450,012	12,195	(N/A)	37.7	44.0	82.96
Silver maple	244,784	6,634	(N/A)	14.4	23.9	118.46
Norway maple	94,045	2,549	(N/A)	9.7	9.2	67.07
Sugar maple	42,663	1,156	(N/A)	5.9	4.2	50.27
Northern hackberry	22,343	605	(N/A)	3.1	2.2	50.46
Broadleaf Deciduous Medit	5,152	140	(N/A)	2.8	0.5	12.69
Blue spruce	11,848	321	(N/A)	2.6	1.2	32.11
Northern pin oak	27,669	750	(N/A)	2.3	2.7	83.31
Honeylocust	24,750	671	(N/A)	2.1	2.4	83.84
Pear	4,083	111	(N/A)	1.8	0.4	15.81
River birch	5,725	155	(N/A)	1.8	0.6	22.16
Alder	938	25	(N/A)	1.5	0.1	4.24
Northern red oak	4,309	117	(N/A)	1.3	0.4	23.35
American basswood	10,364	281	(N/A)	1.3	1.0	56.18
White oak	1,691	46	(N/A)	1.3	0.2	9.16
Norway spruce	4,800	130	(N/A)	1.3	0.5	26.01
Cottonwood	25,905	702	(N/A)	1.3	2.5	140.41
Black walnut	17,515	475	(N/A)	1.0	1.7	118.66
Red maple	660	18	(N/A)	1.0	0.1	4.47
Conifer Evergreen Small	98	3	(N/A)	1.0	0.0	0.66
American elm	13,653	370	(N/A)	0.8	1.3	123.33
Broadleaf Evergreen Mediu	987	27	(N/A)	0.8	0.1	8.92
Bur oak	190	5	(N/A)	0.5	0.0	2.57
Conifer Evergreen Large	5,200	141	(N/A)	0.5	0.5	70.46
White ash	2,276	62	(N/A)	0.5	0.2	30.84
Juniper	208	6	(N/A)	0.5	0.0	2.82
Broadleaf Deciduous Small	7	0	(N/A)	0.3	0.0	0.20
Black spruce	256	7	(N/A)	0.3	0.0	6.95
Broadleaf Evergreen Large	173	5	(N/A)	0.3	0.0	4.69
Swamp white oak	12	0	(N/A)	0.3	0.0	0.33
Eastern white pine	213	6	(N/A)	0.3	0.0	5.77
Citywide total	1,022,528	27,711	(N/A)	100.0	100.0	71.05

Table 3: Annual Air Quality Benefits

Species	Deposition (lb)				Total Depos (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard (\$)	Error	% of Total Trees	Avg \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂								
Green ash	54.9	8.8	26.4	2.5	293	195.6	28.5	27.1	185.3	1,218	0.0	0	529.0	1,510 (N/A)		37.7	10.27
Silver maple	40.9	6.9	20.2	1.8	221	81.4	11.9	11.4	78.4	510	-20.9	-79	232.1	652 (N/A)		14.4	11.65
Norway maple	19.2	3.3	9.4	0.9	104	48.8	7.1	6.7	45.7	302	-4.5	-17	136.4	389 (N/A)		9.7	10.23
Sugar maple	5.0	0.9	2.7	0.2	28	22.8	3.3	3.2	21.9	143	-4.1	-15	55.9	155 (N/A)		5.9	6.74
Northern hackberry	3.5	0.6	1.8	0.2	19	11.0	1.6	1.5	10.3	68	0.0	0	30.4	87 (N/A)		3.1	7.27
BroadleafDeciduous Medi	0.5	0.1	0.3	0.0	3	4.7	0.7	0.6	4.3	29	-0.2	-1	11.1	31 (N/A)		2.8	2.85
Blue spruce	1.9	0.4	1.5	0.2	12	3.8	0.5	0.5	3.5	24	-4.3	-16	8.1	20 (N/A)		2.6	1.95
Northern pin oak	6.0	1.0	2.9	0.3	32	12.8	1.8	1.8	11.9	79	-1.4	-5	37.2	106 (N/A)		2.3	11.81
Honeylocust	4.9	0.8	2.2	0.2	26	10.1	1.5	1.4	9.7	63	-3.8	-14	26.9	74 (N/A)		2.1	9.31
Pear	1.3	0.2	0.6	0.1	7	4.3	0.6	0.6	4.0	27	0.0	0	11.8	34 (N/A)		1.8	4.82
River birch	0.8	0.1	0.4	0.0	4	4.7	0.7	0.7	4.5	30	-0.2	-1	11.8	33 (N/A)		1.8	4.73
Alder	0.1	0.0	0.1	0.0	1	1.4	0.2	0.2	1.2	8	0.0	0	3.2	9 (N/A)		1.5	1.53
Northern red oak	0.8	0.1	0.4	0.0	4	2.9	0.4	0.4	2.8	18	-1.1	-4	6.7	18 (N/A)		1.3	3.66
American basswood	1.2	0.2	0.6	0.1	7	5.6	0.8	0.8	5.2	34	-1.1	-4	13.3	37 (N/A)		1.3	7.40
White oak	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.2	8	0.0	0	3.0	9 (N/A)		1.3	1.71
Norway spruce	0.6	0.1	0.5	0.1	4	1.0	0.1	0.1	0.9	6	-2.9	-11	0.4	-1 (N/A)		1.3	-0.28
Cottonwood	3.7	0.6	1.7	0.2	19	9.0	1.3	1.2	8.5	56	0.0	0	26.2	75 (N/A)		1.3	15.07
Black walnut	2.3	0.4	1.1	0.1	12	6.6	1.0	0.9	6.2	41	0.0	0	18.5	53 (N/A)		1.0	13.31
Red maple	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4 (N/A)		1.0	1.01
Conifer Evergreen Small	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)		1.0	0.09
American elm	2.0	0.3	1.0	0.1	11	5.8	0.8	0.8	5.5	36	0.0	0	16.3	47 (N/A)		0.8	15.57
BroadleafEvergreen Medi	0.0	0.0	0.1	0.0	0	0.8	0.1	0.1	0.7	5	-0.2	-1	1.6	4 (N/A)		0.8	1.40
Bur oak	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)		0.5	0.48
Conifer Evergreen Large	0.6	0.1	0.5	0.1	4	1.2	0.2	0.2	1.1	7	-3.0	-11	0.9	0 (N/A)		0.5	-0.05
White ash	0.1	0.0	0.1	0.0	1	1.7	0.2	0.2	1.6	10	0.0	0	4.0	11 (N/A)		0.5	5.61
Juniper	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.1	0 (N/A)		0.5	0.14
BroadleafDeciduous Smal	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
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
BroadleafEvergreen Large	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)		0.3	0.91
Swamp white oak	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	0.14
Eastern white pine	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.2	1 (N/A)		0.3	0.56
Citywide total	150.6	25.1	74.6	7.0	813	438.4	63.8	60.8	415.8	2,730	-48.1	-180	1,188.0	3,363 (N/A)		100.0	8.62

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees						
4/20/2020						
Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	1,785,702	13,393	(N/A)	37.7	47.8	91.11
Silver maple	890,094	6,676	(N/A)	14.4	23.8	119.21
Norway maple	314,331	2,357	(N/A)	9.7	8.4	62.04
Sugar maple	142,420	1,068	(N/A)	5.9	3.8	46.44
Northern hackberry	51,486	386	(N/A)	3.1	1.4	32.18
Broadleaf Deciduou	10,220	77	(N/A)	2.8	0.3	6.97
Blue spruce	15,664	117	(N/A)	2.6	0.4	11.75
Northern pin oak	98,861	741	(N/A)	2.3	2.6	82.38
Honeylocust	62,656	470	(N/A)	2.1	1.7	58.74
Pear	20,823	156	(N/A)	1.8	0.6	22.31
River birch	13,511	101	(N/A)	1.8	0.4	14.48
Alder	3,093	23	(N/A)	1.5	0.1	3.87
Northern red oak	13,875	104	(N/A)	1.3	0.4	20.81
American basswood	43,316	325	(N/A)	1.3	1.2	64.97
White oak	3,894	29	(N/A)	1.3	0.1	5.84
Norway spruce	7,500	56	(N/A)	1.3	0.2	11.25
Cottonwood	119,545	897	(N/A)	1.3	3.2	179.32
Black walnut	76,117	571	(N/A)	1.0	2.0	142.72
Red maple	1,151	9	(N/A)	1.0	0.0	2.16
Conifer Evergreen f	10	0	(N/A)	1.0	0.0	0.02
American elm	44,218	332	(N/A)	0.8	1.2	110.54
Broadleaf Evergreen	631	5	(N/A)	0.8	0.0	1.58
Bur oak	198	1	(N/A)	0.5	0.0	0.74
Conifer Evergreen l	7,747	58	(N/A)	0.5	0.2	29.05
White ash	4,706	35	(N/A)	0.5	0.1	17.65
Juniper	46	0	(N/A)	0.5	0.0	0.17
Broadleaf Deciduou	14	0	(N/A)	0.3	0.0	0.10
Black spruce	43	0	(N/A)	0.3	0.0	0.32
Broadleaf Evergreen	187	1	(N/A)	0.3	0.0	1.40
Swamp white oak	17	0	(N/A)	0.3	0.0	0.13
Eastern white pine	38	0	(N/A)	0.3	0.0	0.29
Citywide total	3,732,112	27,991	(N/A)	100.0	100.0	71.77

Table 5: Annual Carbon Sequestered

Annual CO ₂ Benefits of Public Trees												
4/20/2020												
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
Green ash	98,157	736	-8,571	-427	-67	68,570	514	157,728	1,183 (N/A)	37.7	43.6	8.05
Silver maple	68,726	515	-4,274	-187	-33	29,080	218	93,344	700 (N/A)	14.4	25.8	12.50
Norway maple	15,644	117	-1,509	-102	-12	16,881	127	30,914	232 (N/A)	9.7	8.5	6.10
Sugar maple	9,113	68	-685	-48	-5	8,123	61	16,503	124 (N/A)	5.9	4.6	5.38
Northern hackberry	2,981	22	-247	-23	-2	3,812	29	6,524	49 (N/A)	3.1	1.8	4.08
Broadleaf Deciduous Me	1,984	15	-53	-11	0	1,597	12	3,517	26 (N/A)	2.8	1.0	2.40
Blue spruce	342	3	-75	-16	-1	1,314	10	1,565	12 (N/A)	2.6	0.4	1.17
Northern pin oak	3,646	27	-475	-28	-4	4,408	33	7,552	57 (N/A)	2.3	2.1	6.29
Honeylocust	7,871	59	-301	-17	-2	3,585	27	11,138	84 (N/A)	2.1	3.1	10.44
Pear	725	5	-100	-13	-1	1,485	11	2,097	16 (N/A)	1.8	0.6	2.25
River birch	1,797	13	-66	-9	-1	1,666	12	3,387	25 (N/A)	1.8	0.9	3.63
Alder	426	3	-15	-5	0	452	3	859	6 (N/A)	1.5	0.2	1.07
Northern red oak	963	7	-67	-7	-1	1,019	8	1,908	14 (N/A)	1.3	0.5	2.86
American basswood	2,882	22	-208	-13	-2	1,924	14	4,586	34 (N/A)	1.3	1.3	6.88
White oak	527	4	-19	-3	0	455	3	960	7 (N/A)	1.3	0.3	1.44
Norway spruce	14	0	-36	-5	0	335	3	308	2 (N/A)	1.3	0.1	0.46
Cottonwood	4,695	35	-574	-21	-4	3,152	24	7,253	54 (N/A)	1.3	2.0	10.88
Black walnut	3,436	26	-365	-15	-3	2,294	17	5,349	40 (N/A)	1.0	1.5	10.03
Red maple	174	1	-6	-2	0	206	2	372	3 (N/A)	1.0	0.1	0.70
Conifer Evergreen Small	2	0	0	-1	0	24	0	26	0 (N/A)	1.0	0.0	0.05
American elm	1,474	11	-212	-11	-2	2,025	15	3,276	25 (N/A)	0.8	0.9	8.19
Broadleaf Evergreen Me	88	1	-3	-2	0	258	2	341	3 (N/A)	0.8	0.1	0.85
Bur oak	77	1	-1	-1	0	53	0	128	1 (N/A)	0.5	0.0	0.48
Conifer Evergreen Large	53	0	-37	-5	0	405	3	415	3 (N/A)	0.5	0.1	1.56
White ash	676	5	-23	-3	0	604	5	1,254	9 (N/A)	0.5	0.3	4.70
Juniper	14	0	0	-1	0	32	0	45	0 (N/A)	0.5	0.0	0.17
Broadleaf Deciduous Sm	9	0	0	0	0	6	0	14	0 (N/A)	0.3	0.0	0.10
Black spruce	12	0	0	-1	0	48	0	60	0 (N/A)	0.3	0.0	0.45
Broadleaf Evergreen Lar	60	0	-1	-1	0	55	0	113	1 (N/A)	0.3	0.0	0.85
Swamp white oak	5	0	0	0	0	7	0	12	0 (N/A)	0.3	0.0	0.09
Eastern white pine	18	0	0	-1	0	38	0	55	0 (N/A)	0.3	0.0	0.41
Citywide total	226,593	1,699	-17,924	-978	-142	153,915	1,154	361,605	2,712 (N/A)	100.0	100.0	6.95

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees					
4/20/2020					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	8,122	(N/A)	37.7	39.0	55.25
Silver maple	5,490	(N/A)	14.4	26.3	98.03
Norway maple	1,451	(N/A)	9.7	7.0	38.18
Sugar maple	999	(N/A)	5.9	4.8	43.45
Northern hackberry	406	(N/A)	3.1	1.9	33.86
Broadleaf Deciduous Mediu	235	(N/A)	2.8	1.1	21.34
Blue spruce	118	(N/A)	2.6	0.6	11.80
Northern pin oak	326	(N/A)	2.3	1.6	36.18
Honeylocust	1,953	(N/A)	2.1	9.4	244.10
Pear	41	(N/A)	1.8	0.2	5.93
River birch	196	(N/A)	1.8	0.9	27.96
Alder	23	(N/A)	1.5	0.1	3.89
Northern red oak	86	(N/A)	1.3	0.4	17.11
American basswood	229	(N/A)	1.3	1.1	45.75
White oak	76	(N/A)	1.3	0.4	15.28
Norway spruce	23	(N/A)	1.3	0.1	4.61
Cottonwood	332	(N/A)	1.3	1.6	66.40
Black walnut	256	(N/A)	1.0	1.2	64.12
Red maple	30	(N/A)	1.0	0.1	7.49
Conifer Evergreen Small	17	(N/A)	1.0	0.1	4.27
American elm	203	(N/A)	0.8	1.0	67.73
Broadleaf Evergreen Mediu	41	(N/A)	0.8	0.2	13.62
Bur oak	20	(N/A)	0.5	0.1	10.00
Conifer Evergreen Large	15	(N/A)	0.5	0.1	7.71
White ash	97	(N/A)	0.5	0.5	48.58
Juniper	18	(N/A)	0.5	0.1	8.82
Broadleaf Deciduous Small	0	(N/A)	0.3	0.0	0.03
Black spruce	12	(N/A)	0.3	0.1	12.31
Broadleaf Evergreen Large	17	(N/A)	0.3	0.1	16.65
Swamp white oak	3	(N/A)	0.3	0.0	2.74
Eastern white pine	7	(N/A)	0.3	0.0	6.83
Citywide total	20,843	(N/A)	100.0	100.0	53.44

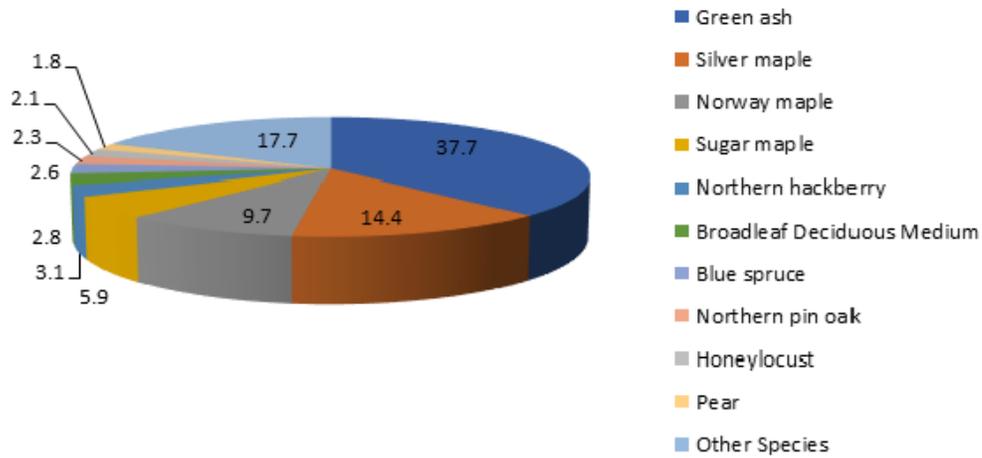
Table 7: Summary of Benefits in Dollars

Annual Benefits of Public Trees by Species (\$/tree)						
4/20/2020						
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
Green ash	58.74	8.05	10.27	82.96	55.25	215.28 (N/A)
Silver maple	62.88	12.50	11.65	118.46	98.03	303.53 (N/A)
Norway maple	57.44	6.10	10.23	67.07	38.18	179.03 (N/A)
Sugar maple	42.62	5.38	6.74	50.27	43.45	148.46 (N/A)
Northern hackberry	41.36	4.08	7.27	50.46	33.86	137.03 (N/A)
Broadleaf Deciduou	19.46	2.40	2.85	12.69	21.34	58.74 (N/A)
Blue spruce	17.33	1.17	1.95	32.11	11.80	64.36 (N/A)
Northern pin oak	64.11	6.29	11.81	83.31	36.18	201.71 (N/A)
Honeylocust	54.96	10.44	9.31	83.84	244.10	402.65 (N/A)
Pear	28.22	2.25	4.82	15.81	5.93	57.02 (N/A)
River birch	29.61	3.63	4.73	22.16	27.96	88.08 (N/A)
Alder	11.04	1.07	1.53	4.24	3.89	21.77 (N/A)
Northern red oak	25.58	2.86	3.66	23.35	17.11	72.56 (N/A)
American basswood	49.91	6.88	7.40	56.18	45.75	166.11 (N/A)
White oak	10.40	1.44	1.71	9.16	15.28	37.99 (N/A)
Norway spruce	8.38	0.46	-0.28	26.01	4.61	39.19 (N/A)
Cottonwood	79.80	10.88	15.07	140.41	66.40	312.55 (N/A)
Black walnut	73.07	10.03	13.31	118.66	64.12	279.19 (N/A)
Red maple	6.92	0.70	1.01	4.47	7.49	20.58 (N/A)
Conifer Evergreen S	0.93	0.05	0.09	0.66	4.27	6.00 (N/A)
American elm	85.03	8.19	15.57	123.33	67.73	299.86 (N/A)
Broadleaf Evergreen	11.68	0.85	1.40	8.92	13.62	36.47 (N/A)
Bur oak	3.24	0.48	0.48	2.57	10.00	16.76 (N/A)
Conifer Evergreen I	25.88	1.56	-0.05	70.46	7.71	105.56 (N/A)
White ash	34.11	4.70	5.61	30.84	48.58	123.85 (N/A)
Juniper	2.27	0.17	0.14	2.82	8.82	14.22 (N/A)
Broadleaf Deciduou	0.87	0.10	0.11	0.20	0.03	1.31 (N/A)
Black spruce	6.94	0.45	0.75	6.95	12.31	27.41 (N/A)
Broadleaf Evergreen	7.59	0.85	0.91	4.69	16.65	30.70 (N/A)
Swamp white oak	1.10	0.09	0.14	0.33	2.74	4.40 (N/A)
Eastern white pine	5.61	0.41	0.56	5.77	6.83	19.18 (N/A)
Citywide Total	49.56	6.95	8.62	71.05	53.44	189.63 (N/A)

Everly

Species Distribution of Public Trees

4/20/2020

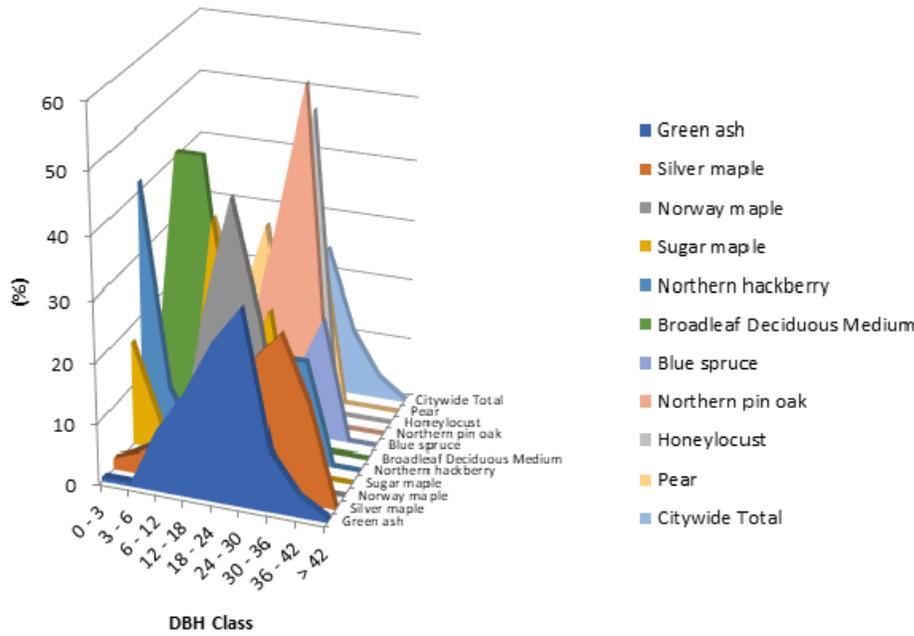


Species	Percent
Green ash	37.7
Silver maple	14.4
Norway maple	9.7
Sugar maple	5.9
Northern hackberry	3.1
Broadleaf Deciduous Me	2.8
Blue spruce	2.6
Northern pin oak	2.3
Honeylocust	2.1
Pear	1.8
Other Species	17.7
Total	100.0

Figure 1: Species Distribution

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

4/20/2020



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	0.68	0.68	10.20	17.01	25.85	31.97	9.52	3.40	0.68
Silver maple	1.79	3.57	7.14	14.29	8.93	21.43	26.79	16.07	0.00
Norway maple	0.00	2.63	0.00	26.32	44.74	26.32	0.00	0.00	0.00
Sugar maple	17.39	4.35	0.00	39.13	13.04	26.09	0.00	0.00	0.00
Northern hackberry	41.67	8.33	0.00	0.00	16.67	16.67	16.67	0.00	0.00
Broadleaf Deciduous Medium	0.00	45.45	45.45	9.09	0.00	0.00	0.00	0.00	0.00
Blue spruce	10.00	30.00	30.00	0.00	0.00	10.00	20.00	0.00	0.00
Northern pin oak	0.00	0.00	0.00	11.11	33.33	55.56	0.00	0.00	0.00
Honeylocust	12.50	12.50	0.00	0.00	25.00	50.00	0.00	0.00	0.00
Pear	0.00	28.57	14.29	28.57	0.00	28.57	0.00	0.00	0.00
Citywide Total	8.46	7.44	10.26	16.15	18.72	24.36	10.77	3.59	0.26

Figure 2: Relative Age Class

Functional (Foliage) Condition of Public Trees by %

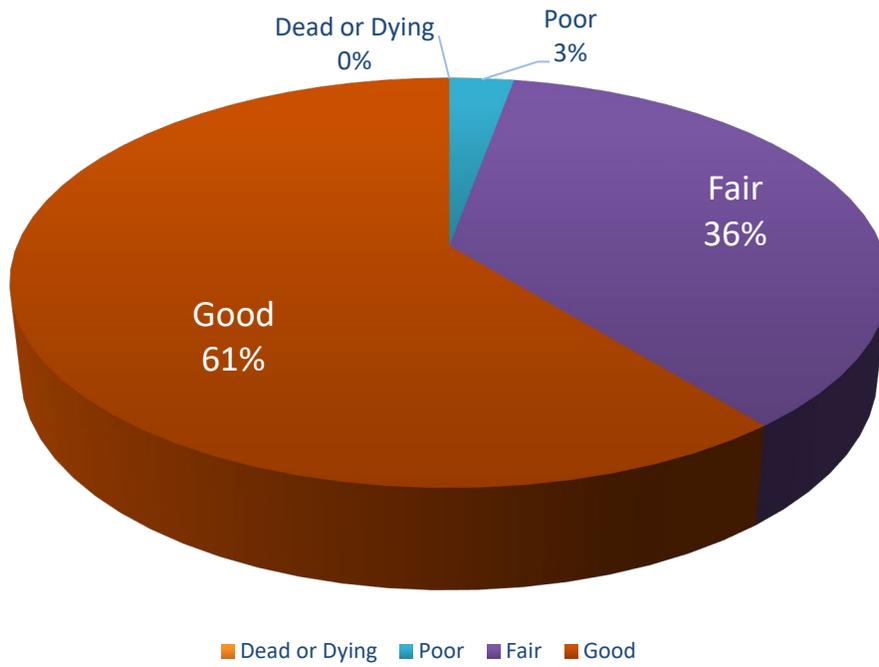


Figure 3: Foliage Condition

Structural (Woody) Condition of Public Trees by %

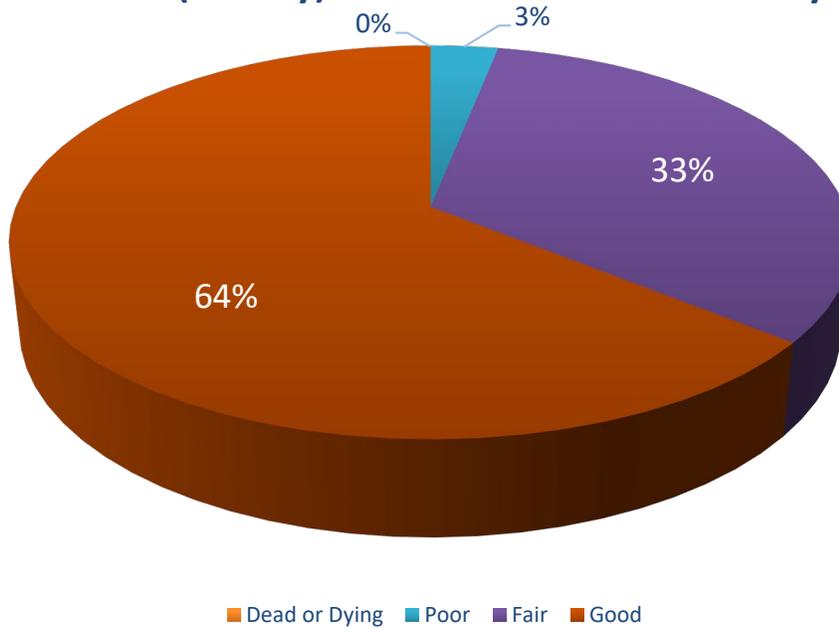
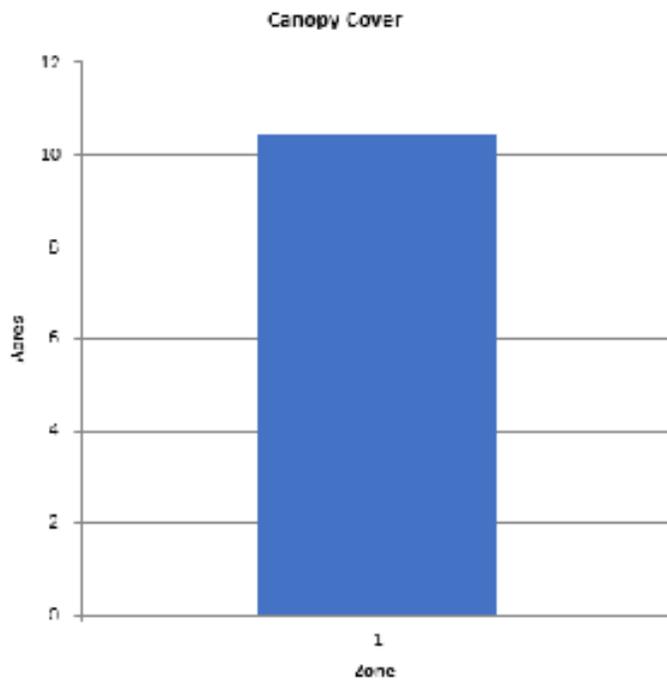


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

4/20/2020



Zone	Acres	% of Total Canopy Cover
1	10	100.0
Citywide total	10	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide Total	0	0	10	0.00	0.00

Figure 5: Canopy Cover in Acres

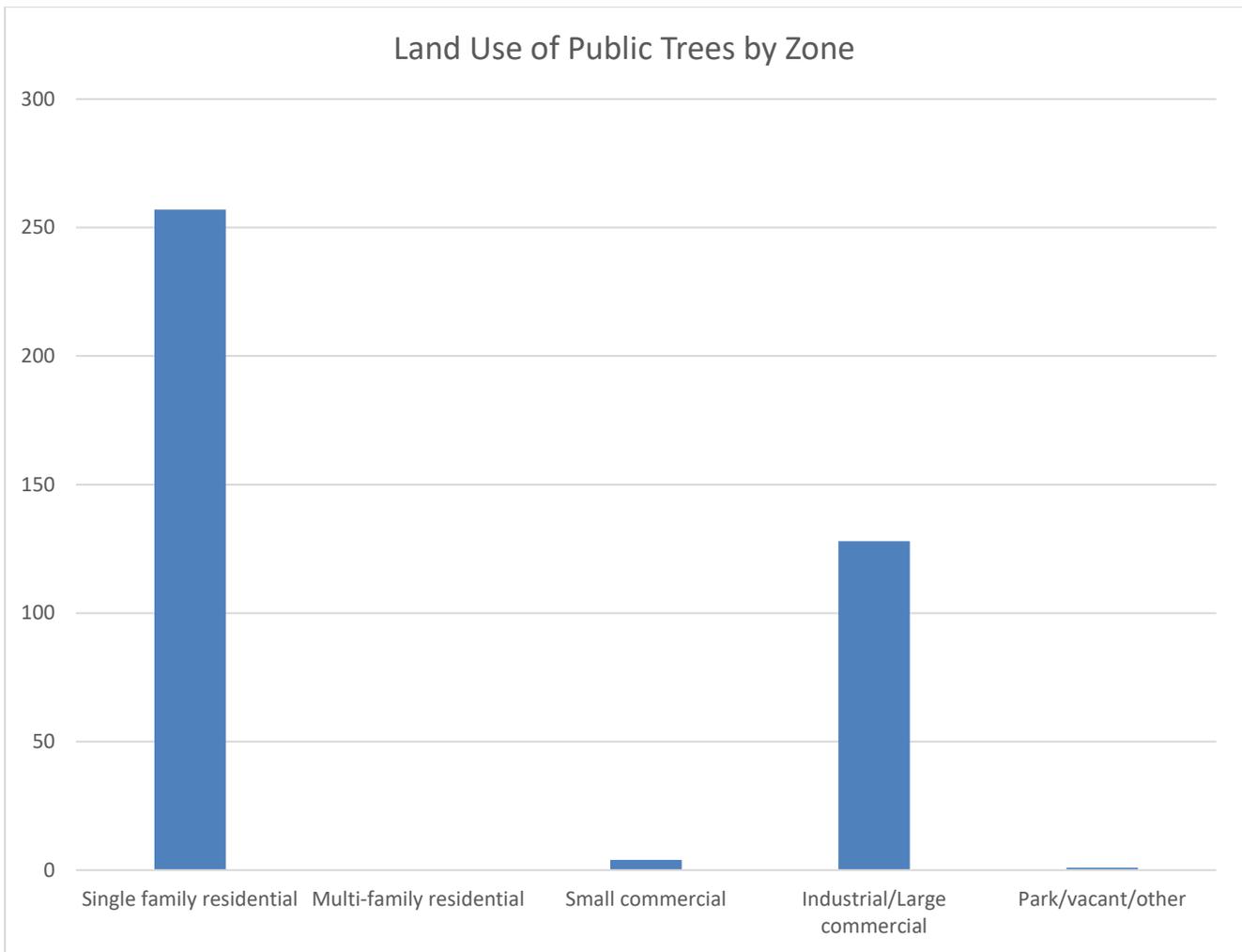


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

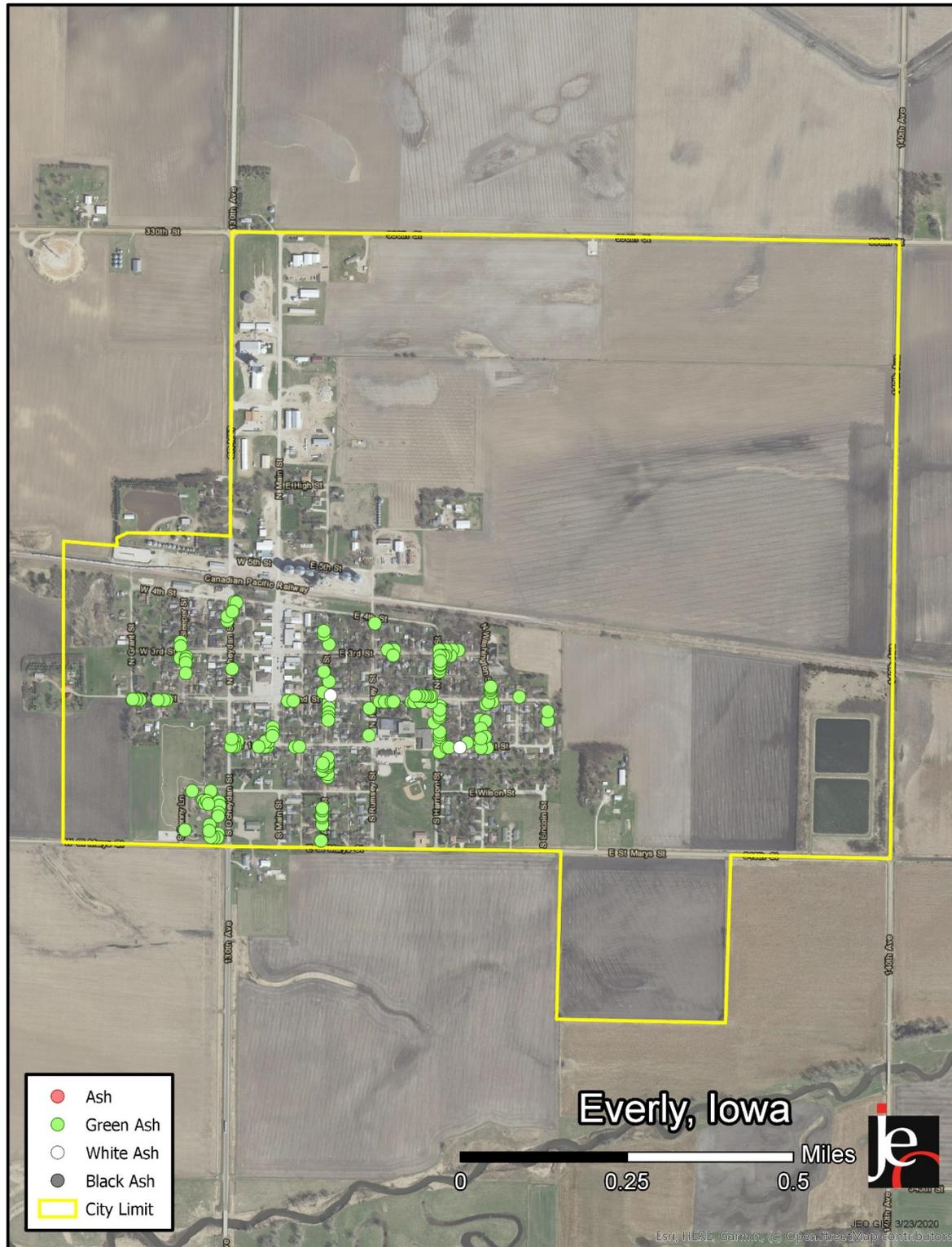


Figure 1: Location of Ash Trees

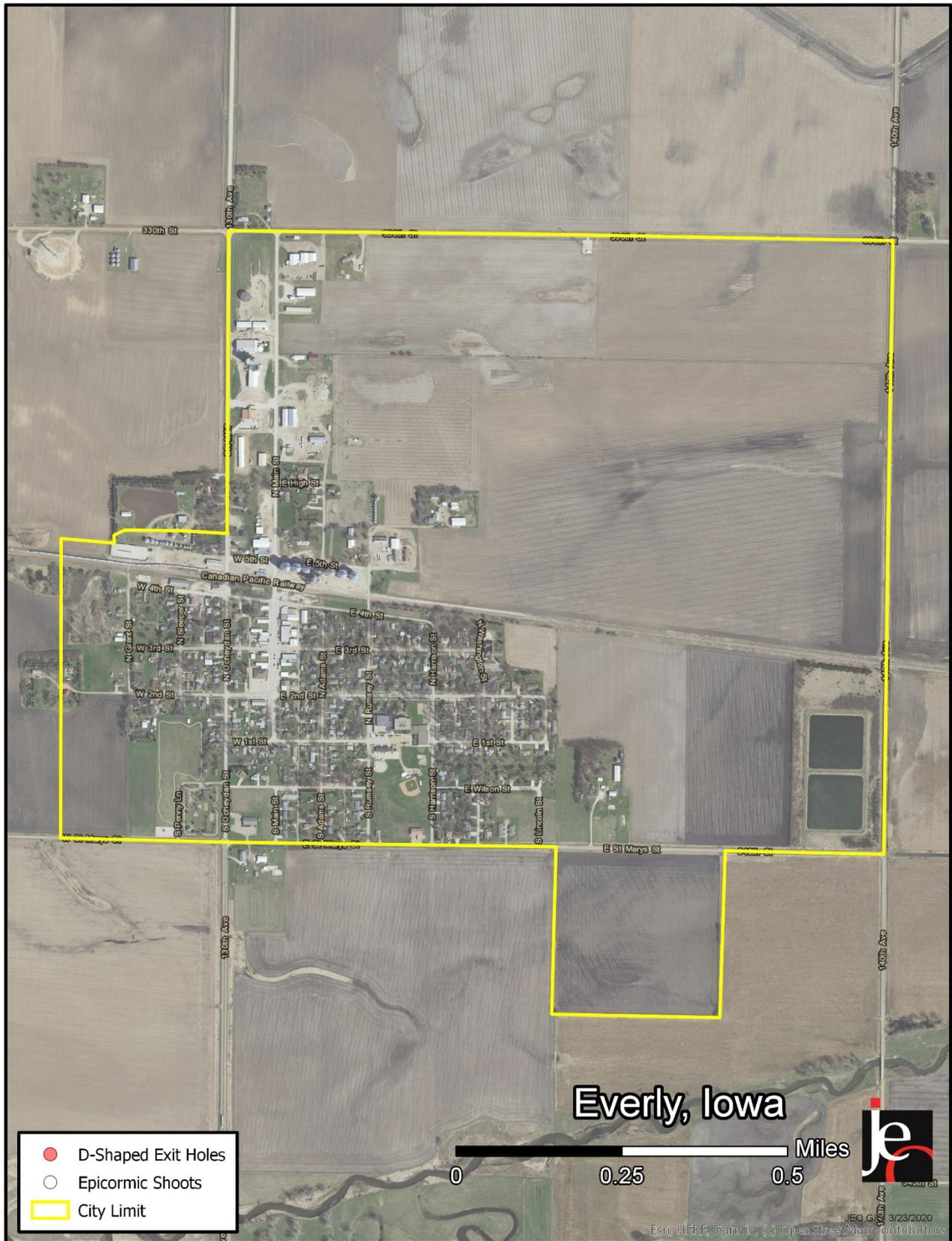


Figure 2: Location of EAB symptoms

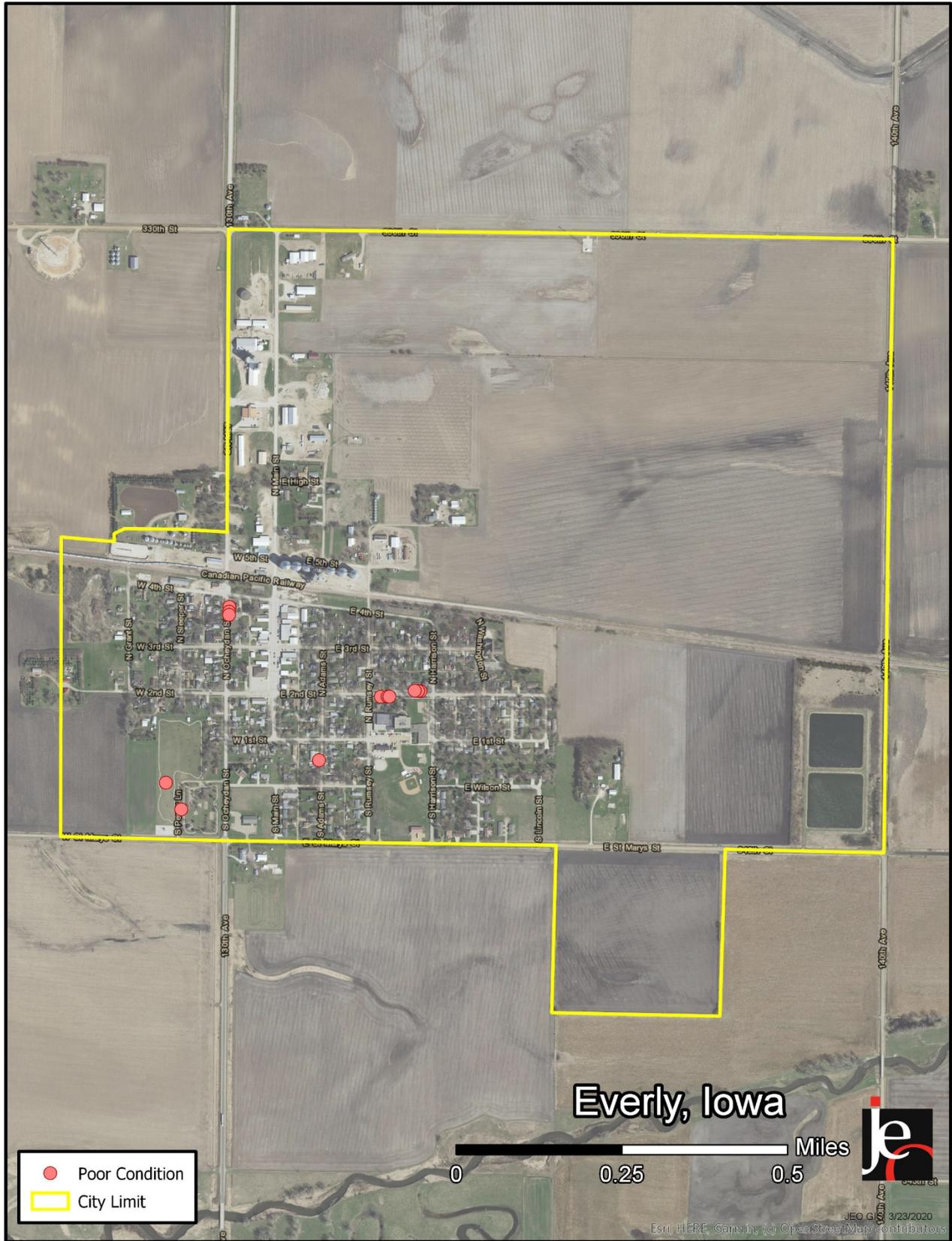


Figure 3: Location of Poor Condition Trees

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