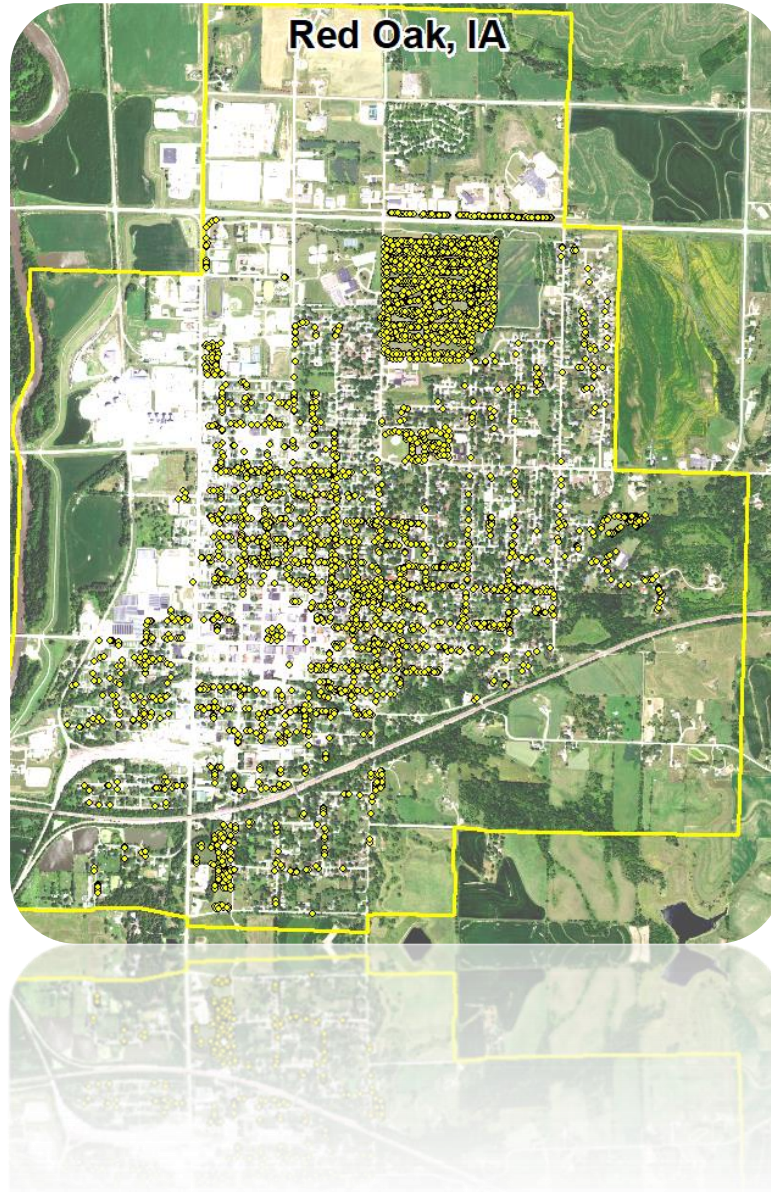


# 2019 Red Oak Community Tree Inventory & Management Plan



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# Executive Summary

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## Overview

This plan was developed to assist the City of Red Oak with managing its community forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). The 2019 inventory showed that ash trees make up 7.1% of Red Oak's community-managed tree population. EAB was confirmed in Eastern Montgomery County in 2016. The likelihood of ongoing ash decline and death in Red Oak and surrounding communities is high. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues. At the same time, replanting efforts can be planned for, so the impacts of community tree loss are hopefully more subtle.

## Inventory and Results

In 2019, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the **3,411** trees inventoried.

- Red Oak's trees provide **\$623,874** of benefits annually, an average of **\$182.90** a tree
- There are over **57** species of trees
- The top three genera are: **Maple 29.2%, Oak 15.2%, and Juniper 11.2%**
- **37% of trees are in need of some type of management (pruning, removals, young tree care)**
- **199** trees are recommended for removal (**and 91 of these trees are ash**)

## Recommendations

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

- Of the **199** trees needing removal, **72** trees are over **24** inches in diameter at 4.5 ft and are identified as being of critical concern (recommended for immediate removal) **\*City ownership of the trees recommended for removal should be verified prior to any removal\***
- **173 of the 243** ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- **834 trees were found to need some type of pruning (cleaning)** - one third of these trees should be pruned/cleaned every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar species, box elder, Chinese elm/Siberian elm, evergreen, willow or black walnut. If non-native ornamental trees are used, the species should be researched to see if the tree species has invasive tendencies. Trees with invasive potential (Bradford Pear, Empress Tree, Norway Maple, Amur Maple to name a few) should not be used.
- Check ash trees with a visual survey yearly, and schedule the tree inventory to be updated in the 7<sup>th</sup> year.
- Emergency removals (from EAB) have put strain on Street and Tree/Parks Board Budgets. It is estimated that between the 199 recommended tree removals and the 152 remaining ash (after

91 ash are removed with the 199), that the city of Red Oak will lose 351 trees in the next 5-10 years. This could cost Red Oak \$351,000 in removal costs or in staff time for the removals.

## Introduction

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This plan was developed to assist Red Oak with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the 2016 arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the ongoing costs of tree removal or treatment and replacement planting. With proper planning and management of the current canopy in Red Oak, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Red Oak's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Red Oak and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Red Oak's urban forestry goals.

## Inventory

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In 2019, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

# Inventory Results

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The data collected for the **3,411** city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban Forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

## Annual Benefits

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### Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Red Oak's trees reduce energy related costs by approximately **\$155,111** annually (Appendix A, Table 1). These savings are both in Electricity (**739.7 MWh**) and in Natural Gas (**100,989 Therms**).

### Annual Stormwater Benefits

Red Oak's trees intercept about **8,721,657** gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides **\$236,357** of benefits to the city.

### Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The community forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Red Oak, it is estimated that trees remove **8,950.6 lbs** of air pollution (ozone (O<sub>3</sub>), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>)) per year with a net value of **\$24,446** (Appendix A, Table 3).

### Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Red Oak, trees sequester about **3,112,351** lbs of carbon a year with an associated net value of **\$23,343** (Appendix A, Table 5).

### Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Red Oak receives **\$184,618** 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, Red Oak's trees provide **\$623,874** of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the **3,411** trees in Red Oak provide approximately **\$182.90** annually (Appendix A, Table 7).

## Forest Structure

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### Species Distribution

Red Oak has over **57** different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

<b>Red Oak Trees by Genus 2019</b>		
Maple	997	29.2%
Oak	519	15.2%
Juniper	381	11.2%
Ash	243	7.1%
Spruce	232	6.8%
Apple	210	6.2%
White Cedar	134	3.9%
Walnut	99	2.9%
Honey locust	70	2.1%
Conifer	68	2.0%
Linden/Basswood	68	2.0%
Elm	68	2.0%
Pear	45	1.3%
Hackberry	41	1.2%
Sycamore	35	1.0%
Broadleaf Other	34	1.0%
Pine	34	1.0%
Redbud	26	0.8%
Cherry/plum	18	0.5%
Aspen/Cottonwood/Poplar	14	0.4%
Ginkgo	9	0.3%
Catalpa	7	0.2%
Magnolia	7	0.2%
Mulberry	7	0.2%
Lilac	6	0.2%
Hemlock	6	0.2%
Birch	5	0.1%
KCT	5	0.1%
Sweetgum	5	0.1%
Broadleaf Evergreen	4	0.1%
Tulip Tree	3	0.1%
Hickory	2	0.1%
Willow	2	0.1%
Unknown	2	0.1%
Black Locust	2	0.1%
Buckeye	1	0.0%
Yellowwood	1	0.0%
Mt Ash	1	0.0%
	3411	

### Age Class

The most populous age class of trees in Red Oak’s Community forest are 24-30” diameter, which is considered mature. Many sickly trees are recommended for removal from the 2019 inventory. For this reason, even more emphasis should be placed on increasing tree numbers in the youngest categories, to replace the oldest trees and also to counteract ash losses.

### Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Red Oak indicate that **94 %** of the trees are in good or fair health, with only **6%** of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, **87%** of Red Oak’s trees are in good or fair health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about **13%** of the population.

### 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	<b>834</b>	<b>24%</b>
Tree Removal	<b>199</b>	<b>5.8%</b>
Crown Reduction	<b>122</b>	<b>3.6%</b>
Stake/Train (young trees)	<b>86</b>	<b>2.5%</b>
Raise	<b>16</b>	<b>&lt;1%</b>
Treat Pest/Disease	<b>1</b>	<b>&lt;1%</b>

### Canopy Cover

The total canopy with both private and public trees is **20%, or 514.93 acres**. The canopy cover included in the Red Oak inventory includes approximately **85.91 city managed tree canopy acres** (Appendix A, Figure 4). To maintain Red Oak’s city managed canopy (despite trees losses), it is estimated that **422 trees will be needed** to replace the **351 ash and other recommended removal trees (using a 1.2 factor replacement rate)**.

### Land Use and Location

The majority of Red Oak’s city and park trees are in front yards 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	<b>53.56%</b>
Park/vacant/other	<b>43.07%</b>
Industrial/Large commercial	<b>3.17%</b>
Multifamily residential	<b>&lt;1%</b>
Small Commercial	<b>&lt;1%</b>



<u>Location</u>	
Front Yard	<b>56.29%</b>
Planting Strip	<b>43.42%</b>
Cutout (surrounded by pavement)	<b>&lt;1%</b>

## Recommendations

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### **Risk Management**

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

#### Hazardous trees

Red Oak has **75** critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are **72** trees over **24** inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the remaining trees recommended for removal in the next 5 years. There are a total of **124** trees recommended for mature tree immediate, mature tree routine, young tree immediate, and young tree routine removals.

#### Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the **199 recommended** removals, **91** are ash trees. There are a total of **243** ash trees, and **173** of those have signs and symptoms that have been associated with EAB. **Of the 243 ash trees, 135 are considered to be in poor or dead/dying 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: crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. Please refer to the six-year maintenance plan for further information.

### **Planting**

Most of the planting over the next 6 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Red Oak.

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 **(29.2%)** (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/Siberian elm, evergreen, willow or black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

### **Continual Monitoring**

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

### **Six Year Maintenance Plan**

#### **Year 1**

**Removal:** Remove 75 trees indicated for critical concern removal

**Planting and Replacement:** Apply for tree planting programs to fill available planting spaces with suitable native trees (see attached Western Iowa Tree Species List). **At least 422 trees will be needed over the next 6 years to replace the trees recommended for removal, and all the ash trees.**

**Other Maintenance:** Address 46 trees indicated for critical concern cleaning, and the 1 tree indicated for critical concern crown reduction.

**Perform a Visual Survey for signs and symptoms of EAB**

#### **Years 2 & 3**

**Removal:** Remove 83 trees indicated for mature tree immediate removal

**Other Maintenance:** Complete cleaning (pruning) on the 311 trees indicated for mature tree immediate cleaning. Also complete work on the 4 trees indicated for mature tree immediate reduction.

**Planting and Replacement:** Continue replanting at the same pace as tree removals are made – with direct guidance and assistance from the Parks & Tree Board. Continue to seek funds for replanting using numerous replanting grant opportunities.

**Perform a Visual Survey for signs and symptoms of EAB**

#### **Years 4 & 5**

**Removal:** Remove the 30 trees indicated for mature tree routine removal, and the 11 total trees indicated for young tree removal. Factor in removals for any ash trees that have declined to the point where they are hazardous.

**Planting and Replacement:** Continue replanting at the same pace as tree removals are made

**Other Maintenance:** Cleaning is recommended on 477 additional trees, crown raising is recommended on 16 additional trees (under mature tree routine), 117 crown reductions are

recommended under mature tree routine and young tree priorities, and finally 86 trees are recommended for staking/training.

**Perform a Visual Survey for signs and symptoms of EAB**

### **Year 6**

**Removal:** Prioritize the remaining ash in poor condition for removal

**Planting and Replacement:** Replant in areas where removals have occurred – attempting to reach and surpass 422 total replacement trees

**Perform a Visual Survey for signs and symptoms of EAB on remaining ash trees**

\*\*Contact DNR District Forester in Year 6 to have inventory done again for year 7\*\*

## **Emerald Ash Borer Plan**

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### **Ash Tree Removal**

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

### **Treatment of Ash Trees**

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit <http://extension.entm.purdue.edu/treecomputer/>

### **EAB Quarantines**

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

## Wood Disposal

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

## Canopy Replacement

As budget permits, all removed trees should be replaced. All trees will meet the restrictions in city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese/Siberian elm, evergreen, willow or black walnut.

## Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash will be prioritized by hazardous or emergency situations only.

## Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

## Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used, and if trees are starting to show early symptoms of EAB infestation. City Code **151.06** states **“If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.”**

## Budget

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### Purposed Budget Increase

EAB will continue to kill ash trees in Red Oak for years to come. There are **243** total ash trees and **108** other tree removals. Between all the recommended removals in the next 5 years (**totaling 199 trees, 91 of which are ash**), and all remaining ash (**152**), it is possible that the manpower or/and funds for **351**

tree removals will be needed. Additionally, it is recommended that Red Oak continue to apply for grants to fund replacement trees. Utility Company grants are usually between \$500 and \$10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. A good current estimate for preventative or curative treatments of insecticide for EAB is \$15/diameter inch (so a 20" diameter tree would cost an estimated \$300 to treat every other year). If this scenario is desirable for portions of parks that are of high importance for shade, then only the ash trees of superior health (greater than 75% of canopy still alive) and structure should be selected for treatment. For street trees, other communities offer permits to allow the landowner to treat their trees.

These scenarios are options for moving forward, but either way it is suggested to increase the tree removal budget for Streets and also Parks & Tree Board to account for inevitable surges of necessary tree removals.

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# Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

## Red Oak

### Annual Energy Benefits of Public Trees

2/6/2020

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	164.6	12,494	21,593.1	21,161	33,655	(N/A)	14.0	21.7	70.41
Eastern red cedar	34.8	2,643	5,197.0	5,093	7,736	(N/A)	11.2	5.0	20.30
Pin oak	105.9	8,039	14,193.6	13,910	21,949	(N/A)	9.2	14.2	69.68
Green ash	64.0	4,857	8,834.0	8,657	13,514	(N/A)	6.4	8.7	61.43
Apple	26.0	1,974	4,002.6	3,923	5,897	(N/A)	6.2	3.8	28.08
Norway maple	40.8	3,100	5,806.3	5,690	8,790	(N/A)	5.3	5.7	48.30
Northern red oak	30.2	2,290	4,219.8	4,135	6,425	(N/A)	4.4	4.1	42.55
Sugar maple	41.5	3,153	5,615.2	5,503	8,656	(N/A)	4.3	5.6	59.29
Northern white cedar	15.0	1,137	2,016.2	1,976	3,113	(N/A)	3.9	2.0	23.23
Spruce	6.6	501	894.2	876	1,377	(N/A)	3.2	0.9	12.52
Blue spruce	7.5	572	1,071.8	1,050	1,623	(N/A)	3.1	1.0	15.17
Maple	20.2	1,534	2,630.0	2,577	4,112	(N/A)	3.1	2.7	39.16
Black walnut	22.4	1,703	2,909.9	2,852	4,555	(N/A)	2.9	2.9	46.01
Honeylocust	21.5	1,629	2,822.7	2,766	4,395	(N/A)	2.1	2.8	62.79
Red maple	12.0	911	1,559.6	1,528	2,439	(N/A)	1.7	1.6	42.06
American basswood	14.7	1,117	2,138.3	2,095	3,213	(N/A)	1.6	2.1	60.61
Pear	4.9	375	758.7	744	1,119	(N/A)	1.3	0.7	24.87
Northern hackberry	12.1	915	1,692.7	1,659	2,574	(N/A)	1.2	1.7	62.77
Siberian elm	12.9	983	1,737.1	1,702	2,685	(N/A)	1.1	1.7	72.57
American sycamore	12.8	969	1,737.3	1,703	2,671	(N/A)	1.0	1.7	76.33
Bur oak	9.3	703	1,275.5	1,250	1,953	(N/A)	1.0	1.3	57.45
Conifer Evergreen Small	0.5	41	84.8	83	124	(N/A)	0.9	0.1	3.99
Elm	9.6	731	1,331.0	1,304	2,035	(N/A)	0.9	1.3	70.17
Eastern redbud	2.0	148	297.9	292	440	(N/A)	0.8	0.3	16.93
White ash	5.2	393	637.6	625	1,018	(N/A)	0.6	0.7	46.27
Amur maple	1.9	145	305.7	300	444	(N/A)	0.6	0.3	21.15
Conifer Evergreen Medium	1.6	118	233.1	228	347	(N/A)	0.6	0.2	16.52
BroadleafDeciduous Small	0.9	67	142.6	140	207	(N/A)	0.5	0.1	12.15
BroadleafDeciduous Medium	3.6	276	537.8	527	803	(N/A)	0.5	0.5	50.16
Conifer Evergreen Large	1.9	147	252.4	247	394	(N/A)	0.5	0.3	24.61
Littleleaf linden	2.8	209	374.8	367	576	(N/A)	0.4	0.4	38.42
Eastern white pine	2.4	184	318.6	312	497	(N/A)	0.4	0.3	33.10
Norway spruce	1.9	144	246.4	241	385	(N/A)	0.4	0.2	32.09
Scotch pine	1.4	108	170.4	167	275	(N/A)	0.4	0.2	22.90
Cherry plum	0.5	37	84.4	83	120	(N/A)	0.4	0.1	9.98
Ginkgo	1.4	106	194.0	190	296	(N/A)	0.3	0.2	32.93
Oak	1.0	76	129.7	127	203	(N/A)	0.2	0.1	25.33
Northern catalpa	2.3	174	320.6	314	488	(N/A)	0.2	0.3	69.78
Mulberry	1.0	75	148.6	146	221	(N/A)	0.2	0.1	31.56
Southern magnolia	0.7	53	85.1	83	136	(N/A)	0.2	0.1	19.46
Black poplar	1.8	140	252.1	247	387	(N/A)	0.2	0.2	55.25
Black cherry	1.0	76	155.0	152	228	(N/A)	0.2	0.1	38.02
Lilac	0.9	71	145.2	142	213	(N/A)	0.2	0.1	35.49
Eastern hemlock	0.2	18	33.4	33	51	(N/A)	0.2	0.0	8.46
Sweetgum	1.2	90	155.0	152	242	(N/A)	0.1	0.2	48.41
Austrian pine	0.6	46	79.0	77	124	(N/A)	0.1	0.1	24.76
Kentucky coffeetree	1.3	96	171.4	168	264	(N/A)	0.1	0.2	52.83
Cottonwood	1.9	142	249.6	245	387	(N/A)	0.1	0.2	77.36
Swamp white oak	0.1	9	20.0	20	29	(N/A)	0.1	0.0	5.78
Birch	0.9	68	137.5	135	203	(N/A)	0.1	0.1	40.59
Broadleaf Evergreen Large	1.1	83	151.4	148	231	(N/A)	0.1	0.1	57.80
Black maple	0.8	63	109.9	108	170	(N/A)	0.1	0.1	56.77
Northern pin oak	0.5	39	65.2	64	103	(N/A)	0.1	0.1	34.18
Tulip tree	0.7	52	98.7	97	149	(N/A)	0.1	0.1	49.62
Black spruce	0.3	19	35.6	35	54	(N/A)	0.1	0.0	18.04
BroadleafDeciduous Large	0.6	43	67.7	66	109	(N/A)	0.1	0.1	36.36

Willow	0.6	49	94.8	93	142 (N/A)	0.1	0.1	70.84
Hickory	0.3	25	40.7	40	65 (N/A)	0.1	0.0	32.43
Red pine	0.2	15	29.2	29	44 (N/A)	0.1	0.0	22.02
American elm	0.3	19	27.7	27	46 (N/A)	0.1	0.0	23.05
White oak	0.5	36	54.0	53	88 (N/A)	0.1	0.1	44.23
Japanese maple	0.0	1	1.2	1	2 (N/A)	0.1	0.0	0.87
Black locust	0.1	11	23.0	23	33 (N/A)	0.1	0.0	16.73
Boxelder	0.2	16	29.8	29	45 (N/A)	0.1	0.0	22.45
Ash	0.3	20	39.6	39	59 (N/A)	0.0	0.0	58.69
Scarlet oak	0.0	2	3.7	4	6 (N/A)	0.0	0.0	5.82
Eastern cottonwood	0.4	29	53.7	53	82 (N/A)	0.0	0.1	82.02
Yellowwood	0.1	8	16.9	17	24 (N/A)	0.0	0.0	24.47
Mountain ash	0.0	2	3.8	4	5 (N/A)	0.0	0.0	5.40
Quaking aspen	0.1	7	13.7	13	21 (N/A)	0.0	0.0	20.64
Ohio buckeye	0.2	18	29.5	29	47 (N/A)	0.0	0.0	46.78
Total	739.7	56,142	100,989.0	98,969	155,111 (N/A)	100.0	100.0	45.47

**Table 2: Annual Stormwater Benefits**

**Red Oak**

**Annual Stormwater Benefits of Public Trees**

2/6/2020

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	2,408,739	65,277	(N/A)	14.0	27.6	136.56
Eastern red cedar	505,642	13,703	(N/A)	11.2	5.8	35.97
Pin oak	1,218,154	33,012	(N/A)	9.2	14.0	104.80
Green ash	745,520	20,204	(N/A)	6.4	8.5	91.83
Apple	123,509	3,347	(N/A)	6.2	1.4	15.94
Norway maple	343,552	9,310	(N/A)	5.3	3.9	51.16
Northern red oak	321,117	8,702	(N/A)	4.4	3.7	57.63
Sugar maple	456,991	12,384	(N/A)	4.3	5.2	84.83
Northern white cedar	309,550	8,389	(N/A)	3.9	3.5	62.60
Spruce	97,273	2,636	(N/A)	3.2	1.1	23.96
Blue spruce	100,703	2,729	(N/A)	3.1	1.2	25.51
Maple	151,049	4,093	(N/A)	3.1	1.7	38.99
Black walnut	187,360	5,077	(N/A)	2.9	2.1	51.29
Honeylocust	247,905	6,718	(N/A)	2.1	2.8	95.97
Red maple	87,793	2,379	(N/A)	1.7	1.0	41.02
American basswood	164,535	4,459	(N/A)	1.6	1.9	84.13
Pear	21,844	592	(N/A)	1.3	0.3	13.15
Northern hackberry	117,420	3,182	(N/A)	1.2	1.3	77.61
Siberian elm	143,495	3,889	(N/A)	1.1	1.6	105.10
American sycamore	182,277	4,940	(N/A)	1.0	2.1	141.13
Bur oak	107,758	2,920	(N/A)	1.0	1.2	85.89
Conifer Evergreen Small	6,837	185	(N/A)	0.9	0.1	5.98
Elm	135,031	3,659	(N/A)	0.9	1.5	126.18
Eastern redbud	8,769	238	(N/A)	0.8	0.1	9.14
White ash	45,858	1,243	(N/A)	0.6	0.5	56.49
Amur maple	7,278	197	(N/A)	0.6	0.1	9.39
Conifer Evergreen Medium	19,289	523	(N/A)	0.6	0.2	24.89
Broadleaf Deciduous Small	3,544	96	(N/A)	0.5	0.0	5.65
Broadleaf Deciduous Medium	32,525	881	(N/A)	0.5	0.4	55.09
Conifer Evergreen Large	38,622	1,047	(N/A)	0.5	0.4	65.42
Littleleaf linden	24,911	675	(N/A)	0.4	0.3	45.01
Eastern white pine	55,275	1,498	(N/A)	0.4	0.6	99.86
Norway spruce	42,932	1,163	(N/A)	0.4	0.5	96.96
Scotch pine	18,008	488	(N/A)	0.4	0.2	40.67
Cherry plum	1,681	46	(N/A)	0.4	0.0	3.80
Ginkgo	9,875	268	(N/A)	0.3	0.1	29.73
Oak	8,143	221	(N/A)	0.2	0.1	27.59
Northern catalpa	30,657	831	(N/A)	0.2	0.4	118.69
Mulberry	4,931	134	(N/A)	0.2	0.1	19.09
Southern magnolia	5,172	140	(N/A)	0.2	0.1	20.02
Black poplar	21,944	595	(N/A)	0.2	0.3	84.96
Black cherry	5,431	147	(N/A)	0.2	0.1	24.53
Lilac	4,718	128	(N/A)	0.2	0.1	21.31
Eastern hemlock	2,657	72	(N/A)	0.2	0.0	12.00
Sweetgum	12,382	336	(N/A)	0.1	0.1	67.11
Austrian pine	8,313	225	(N/A)	0.1	0.1	45.06
Kentucky coffeetree	15,256	413	(N/A)	0.1	0.2	82.69
Cottonwood	25,377	688	(N/A)	0.1	0.3	137.54
Swamp white oak	635	17	(N/A)	0.1	0.0	3.44



Birch	8,002	217 (N/A)	0.1	0.1	43.37
Broadleaf Evergreen Large	20,856	565 (N/A)	0.1	0.2	141.30
Black maple	7,338	199 (N/A)	0.1	0.1	66.29
Northern pin oak	2,981	81 (N/A)	0.1	0.0	26.93
Tulip tree	7,141	194 (N/A)	0.1	0.1	64.51
Black spruce	3,055	83 (N/A)	0.1	0.0	27.60
Broadleaf Deciduous Large	3,539	96 (N/A)	0.1	0.0	31.97
Willow	7,529	204 (N/A)	0.1	0.1	102.01
Hickory	2,073	56 (N/A)	0.1	0.0	28.09
Red pine	3,565	97 (N/A)	0.1	0.0	48.30
American elm	1,394	38 (N/A)	0.1	0.0	18.89
White oak	2,931	79 (N/A)	0.1	0.0	39.72
Japanese maple	15	0 (N/A)	0.1	0.0	0.20
Black locust	749	20 (N/A)	0.1	0.0	10.14
Boxelder	1,440	39 (N/A)	0.1	0.0	19.51
Ash	2,479	67 (N/A)	0.0	0.0	67.19
Scarlet oak	172	5 (N/A)	0.0	0.0	4.65
Eastern cottonwood	5,491	149 (N/A)	0.0	0.1	148.79
Yellowwood	586	16 (N/A)	0.0	0.0	15.88
Mountain ash	69	2 (N/A)	0.0	0.0	1.86
Quaking aspen	608	16 (N/A)	0.0	0.0	16.47
Ohio buckeye	1,409	38 (N/A)	0.0	0.0	38.19
<b>Citywide total</b>	<b>8,721,657</b>	<b>236,357 (N/A)</b>	<b>100.0</b>	<b>100.0</b>	<b>69.29</b>

**Table 3: Annual Air Quality Benefits**

Red Oak

**Annual Air Quality Benefits of Public Trees**

2/6/2020

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard (\$ Error)	% of Total Trees	Avg. \$/tree
	O <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>							
Silver maple	420.2	71.2	205.6	18.6	2,264	775.2	113.5	108.4	744.6	4,852	-215.4	-808	2,242.1	6,308 (N/A)	14.0	13.20
Eastern red cedar	100.2	19.8	79.7	12.3	653	169.5	24.4	23.2	157.6	1,047	-278.1	-1,043	308.7	657 (N/A)	11.2	1.72
Pin oak	218.7	38.3	111.5	9.8	1,195	502.4	73.4	70.0	479.7	3,137	-404.1	-1,515	1,099.7	2,817 (N/A)	9.2	8.94
Green ash	95.2	15.2	45.0	4.3	505	306.2	44.5	42.4	290.0	1,906	0.0	0	842.8	2,411 (N/A)	6.4	10.96
Apple	40.4	6.7	18.8	1.8	214	128.0	18.4	17.4	117.8	788	-0.2	-1	349.1	1,001 (N/A)	6.2	4.77
Norway maple	65.7	11.3	32.9	2.9	357	197.3	28.6	27.2	185.3	1,224	-15.8	-59	555.5	1,521 (N/A)	5.3	8.36
Northern red oak	69.1	11.9	33.4	3.1	372	144.6	21.0	20.0	136.7	899	-99.4	-373	340.4	898 (N/A)	4.4	5.95
Sugar maple	59.8	10.2	29.9	2.6	324	197.5	28.8	27.5	188.1	1,232	-47.0	-176	497.4	1,380 (N/A)	4.3	9.45
Northern white cedar	36.6	7.2	29.6	4.5	240	71.0	10.4	9.9	67.8	444	-170.8	-640	66.3	43 (N/A)	3.9	0.32
Spruce	10.4	2.1	9.0	1.3	70	31.3	4.6	4.4	29.9	196	-39.9	-150	52.9	115 (N/A)	3.2	1.05
Blue spruce	12.7	2.5	11.0	1.6	85	36.2	5.3	5.0	34.1	225	-35.5	-133	72.9	177 (N/A)	3.1	1.66
Maple	33.3	5.7	15.8	1.5	178	95.2	14.0	13.3	91.6	596	-11.6	-44	258.7	731 (N/A)	3.1	6.96
Black walnut	18.1	2.9	9.6	0.8	99	105.7	15.5	14.8	101.7	662	0.0	0	269.2	761 (N/A)	2.9	7.69
Honeylocust	48.7	8.0	22.1	2.2	257	101.2	14.8	14.1	97.1	633	-38.3	-144	270.0	746 (N/A)	2.1	10.66
Red maple	19.0	3.2	9.1	0.8	102	56.5	8.3	7.9	54.4	354	-6.7	-25	152.5	431 (N/A)	1.7	7.42
American basswood	22.3	3.8	11.0	1.0	120	71.5	10.3	9.8	66.8	443	-19.0	-71	177.4	492 (N/A)	1.6	9.27
Pear	6.7	1.1	3.2	0.3	36	24.3	3.5	3.3	22.4	150	0.0	0	64.8	185 (N/A)	1.3	4.12
Northern hackberry	19.0	3.3	9.6	0.9	104	58.0	8.4	8.0	54.7	360	0.0	0	161.9	464 (N/A)	1.2	11.32
Siberian elm	25.2	4.3	12.1	1.1	135	61.5	9.0	8.6	58.7	384	0.0	0	180.4	519 (N/A)	1.1	14.02
American sycamore	28.2	4.5	12.7	1.3	148	60.9	8.9	8.5	57.8	379	0.0	0	182.7	527 (N/A)	1.0	15.07
Bur oak	13.7	2.2	6.5	0.6	73	44.3	6.4	6.1	42.0	276	0.0	0	121.9	349 (N/A)	1.0	10.25
Comifer Evergreen Small	0.9	0.2	0.8	0.1	6	2.7	0.4	0.4	2.4	16	-3.6	-13	4.3	9 (N/A)	0.9	0.29
Elm	19.9	3.2	9.0	0.9	105	46.1	6.7	6.4	43.6	287	0.0	0	135.8	391 (N/A)	0.9	13.50
Eastern redbud	2.8	0.5	1.3	0.1	15	9.6	1.4	1.3	8.8	59	0.0	0	25.7	74 (N/A)	0.8	2.83
White ash	5.4	0.9	2.7	0.2	29	24.1	3.6	3.4	23.5	152	0.0	0	63.8	181 (N/A)	0.6	8.22
Amur maple	1.7	0.3	0.9	0.1	9	9.5	1.4	1.3	8.6	58	0.0	0	23.8	68 (N/A)	0.6	3.22
Comifer Evergreen Medium	2.0	0.4	1.9	0.3	14	7.6	1.1	1.0	7.1	47	-6.4	-24	15.0	37 (N/A)	0.6	1.77
Broadleaf Deciduous Small	0.9	0.1	0.4	0.0	5	4.4	0.6	0.6	4.0	27	0.0	0	11.1	32 (N/A)	0.5	1.87
Broadleaf Deciduous Medium	6.3	1.1	3.1	0.3	34	17.7	2.6	2.4	16.5	110	-1.5	-6	48.5	138 (N/A)	0.5	8.63
Comifer Evergreen Large	4.6	0.9	3.7	0.6	30	9.1	1.3	1.3	8.7	57	-20.2	-76	9.9	11 (N/A)	0.5	0.69
Littleleaf linden	4.0	0.7	2.0	0.2	22	13.2	1.9	1.8	12.5	82	-2.0	-7	34.3	96 (N/A)	0.4	6.42
Eastern white pine	6.7	1.3	5.3	0.8	44	11.4	1.7	1.6	11.0	72	-32.5	-122	7.4	-7 (N/A)	0.4	-0.44
Norway spruce	5.2	1.0	4.2	0.6	34	8.9	1.3	1.2	8.6	56	-25.4	-95	5.7	-5 (N/A)	0.4	-0.46
Scotch pine	2.0	0.4	1.7	0.2	13	6.6	1.0	0.9	6.4	41	-6.6	-25	12.6	30 (N/A)	0.4	2.48
Cherry plum	0.2	0.0	0.2	0.0	1	2.5	0.4	0.3	2.2	15	0.0	0	5.8	16 (N/A)	0.4	1.37

Ginkgo	2.6	0.4	1.3	0.1	14	6.7	1.0	0.9	6.3	42	-0.8	-3	18.5	53 (N/A)	0.3	5.84
Oak	0.8	0.1	0.4	0.0	4	4.7	0.7	0.7	4.5	29	0.0	0	11.9	34 (N/A)	0.2	4.19
Northern catalpa	4.3	0.7	1.9	0.2	22	11.0	1.6	1.5	10.4	68	0.0	0	31.6	91 (N/A)	0.2	12.98
Mulberry	1.7	0.3	0.8	0.1	9	4.8	0.7	0.7	4.5	30	0.0	0	13.6	39 (N/A)	0.2	5.57
Southern magnolia	0.2	0.0	0.4	0.0	2	3.2	0.5	0.5	3.1	20	-1.4	-5	6.6	17 (N/A)	0.2	2.46
Black poplar	2.9	0.5	1.3	0.1	15	8.8	1.3	1.2	8.3	55	0.0	0	24.4	70 (N/A)	0.2	10.00
Black cherry	1.9	0.3	0.9	0.1	10	4.9	0.7	0.7	4.5	30	0.0	0	14.1	41 (N/A)	0.2	6.78
Lilac	1.6	0.3	0.7	0.1	8	4.6	0.7	0.6	4.2	28	0.0	0	12.8	37 (N/A)	0.2	6.11
Eastern hemlock	0.2	0.0	0.2	0.0	2	1.1	0.2	0.2	1.1	7	-0.9	-3	2.2	6 (N/A)	0.2	0.92
Sweetgum	1.5	0.2	0.7	0.1	8	5.6	0.8	0.8	5.4	35	0.0	0	15.1	43 (N/A)	0.1	8.62
Austrian pine	1.2	0.2	1.0	0.1	8	2.9	0.4	0.4	2.8	18	-3.0	-11	5.9	14 (N/A)	0.1	2.87
Kentucky coffeetree	2.0	0.3	0.9	0.1	11	6.0	0.9	0.8	5.7	38	0.0	0	16.9	48 (N/A)	0.1	9.67
Cottonwood	4.1	0.7	1.9	0.2	22	8.9	1.3	1.2	8.5	55	0.0	0	26.8	77 (N/A)	0.1	15.44
Swamp white oak	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)	0.1	0.80
Birch	1.5	0.3	0.8	0.1	8	4.4	0.6	0.6	4.1	27	-0.4	-1	12.0	34 (N/A)	0.1	6.83
Broadleaf Evergreen Large	3.6	0.7	2.8	0.4	23	5.2	0.8	0.7	4.9	32	-9.7	-36	9.4	19 (N/A)	0.1	4.79
Black maple	1.8	0.3	0.8	0.1	10	3.9	0.6	0.5	3.7	24	-0.6	-2	11.2	32 (N/A)	0.1	10.61
Northern pin oak	0.4	0.1	0.2	0.0	2	2.4	0.4	0.3	2.3	15	-0.1	0	6.1	17 (N/A)	0.1	5.68
Tulip tree	0.8	0.1	0.4	0.0	4	3.3	0.5	0.5	3.1	21	0.0	0	8.7	25 (N/A)	0.1	8.27
Black spruce	0.3	0.1	0.3	0.0	2	1.2	0.2	0.2	1.1	8	-1.0	-4	2.4	6 (N/A)	0.1	1.99
Broadleaf Deciduous Large	0.2	0.0	0.2	0.0	1	2.6	0.4	0.4	2.6	16	0.0	0	6.4	18 (N/A)	0.1	5.95
Willow	1.7	0.3	0.8	0.1	9	3.1	0.5	0.4	2.9	19	-0.4	-1	9.5	27 (N/A)	0.1	13.58
Hickory	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.5	10	0.0	0	3.7	10 (N/A)	0.1	5.21
Red pine	0.4	0.1	0.3	0.0	3	1.0	0.1	0.1	0.9	6	-1.5	-6	1.5	3 (N/A)	0.1	1.46
American elm	0.1	0.0	0.1	0.0	0	1.1	0.2	0.2	1.1	7	0.0	0	2.8	8 (N/A)	0.1	3.86
White oak	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	14	0.0	0	5.3	15 (N/A)	0.1	7.42
Japanese maple	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)	0.1	0.11
Black locust	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	4	0.0	0	1.7	5 (N/A)	0.1	2.34
Boxelder	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	-0.1	0	2.3	7 (N/A)	0.1	3.26
Ash	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10 (N/A)	0.0	10.16
Scarlet 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)	0.0	0.87
Eastern cottonwood	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	0.0	15.71
Yellowwood	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.0	3.47
Mountain ash	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)	0.0	0.71
Quaking aspen	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	0.0	2.99
Ohio buckeye	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)	0.0	7.92
Citywide total	1,464.1	253.0	775.5	80.0	8,102	3,524.9	513.5	489.7	3,350.0	21,969	-1,500.2	-5,626	8,950.6	24,446 (N/A)	100.0	7.17

**Table 4: Annual Carbon Stored**

**Red Oak**

**Stored CO2 Benefits of Public Trees**

2/6/2020

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	9,414,461	70,608	(N/A)	14.0	30.0	147.72
Eastern red cedar	327,400	2,456	(N/A)	11.2	1.0	6.44
Pin oak	5,764,060	43,230	(N/A)	9.2	18.4	137.24
Green ash	3,103,950	23,280	(N/A)	6.4	9.9	105.82
Apple	634,249	4,757	(N/A)	6.2	2.0	22.65
Norway maple	1,083,182	8,124	(N/A)	5.3	3.5	44.64
Northern red oak	1,523,074	11,423	(N/A)	4.4	4.9	75.65
Sugar maple	1,702,808	12,771	(N/A)	4.3	5.4	87.47
Northern white cedar	431,038	3,233	(N/A)	3.9	1.4	24.13
Spruce	88,815	666	(N/A)	3.2	0.3	6.06
Blue spruce	83,658	627	(N/A)	3.1	0.3	5.86
Maple	369,374	2,770	(N/A)	3.1	1.2	26.38
Black walnut	593,065	4,448	(N/A)	2.9	1.9	44.93
Honeylocust	628,975	4,717	(N/A)	2.1	2.0	67.39
Red maple	211,417	1,586	(N/A)	1.7	0.7	27.34
American basswood	819,178	6,144	(N/A)	1.6	2.6	115.92
Pear	106,540	799	(N/A)	1.3	0.3	17.76
Northern hackberry	293,091	2,198	(N/A)	1.2	0.9	53.61
Siberian elm	610,170	4,576	(N/A)	1.1	1.9	123.68
American sycamore	946,996	7,102	(N/A)	1.0	3.0	202.93
Bur oak	445,288	3,340	(N/A)	1.0	1.4	98.23
Conifer Evergreen Spruce	3,344	25	(N/A)	0.9	0.0	0.81
Elm	660,616	4,955	(N/A)	0.9	2.1	170.85
Eastern redbud	43,600	327	(N/A)	0.8	0.1	12.58
White ash	117,657	882	(N/A)	0.6	0.4	40.11
Amur maple	29,828	224	(N/A)	0.6	0.1	10.65
Conifer Evergreen Mountain Pine	10,606	80	(N/A)	0.6	0.0	3.79
Broadleaf Deciduous	15,277	115	(N/A)	0.5	0.0	6.74
Broadleaf Deciduous	103,774	778	(N/A)	0.5	0.3	48.64
Conifer Evergreen Large Pine	50,450	378	(N/A)	0.5	0.2	23.65
Littleleaf linden	86,809	651	(N/A)	0.4	0.3	43.40
Eastern white pine	83,967	630	(N/A)	0.4	0.3	41.98
Norway spruce	65,608	492	(N/A)	0.4	0.2	41.01
Scotch pine	14,388	108	(N/A)	0.4	0.0	8.99
Cherry plum	5,456	41	(N/A)	0.4	0.0	3.41
Ginkgo	37,301	280	(N/A)	0.3	0.1	31.08
Oak	25,222	189	(N/A)	0.2	0.1	23.65
Northern catalpa	139,498	1,046	(N/A)	0.2	0.4	149.46
Mulberry	26,494	199	(N/A)	0.2	0.1	28.39
Southern magnolia	4,748	36	(N/A)	0.2	0.0	5.09
Black poplar	95,173	714	(N/A)	0.2	0.3	101.97
Black cherry	30,186	226	(N/A)	0.2	0.1	37.73
Lilac	25,081	188	(N/A)	0.2	0.1	31.35
Eastern hemlock	1,508	11	(N/A)	0.2	0.0	1.89
Sweetgum	49,072	368	(N/A)	0.1	0.2	73.61
Austrian pine	8,532	64	(N/A)	0.1	0.0	12.80
Kentucky coffeetree	67,173	504	(N/A)	0.1	0.2	100.76
Cottonwood	140,628	1,055	(N/A)	0.1	0.4	210.94
Swamp white oak	1,168	9	(N/A)	0.1	0.0	1.75
Birch	25,527	191	(N/A)	0.1	0.1	38.29
Broadleaf Evergreen Loblolly Pine	38,708	290	(N/A)	0.1	0.1	72.58
Black maple	19,515	146	(N/A)	0.1	0.1	48.79
Northern pin oak	7,467	56	(N/A)	0.1	0.0	18.67
Tulip tree	25,265	189	(N/A)	0.1	0.1	63.16
Black spruce	1,687	13	(N/A)	0.1	0.0	4.22

Broadleaf Deciduous	8,378	63 (N/A)	0.1	0.0	20.95
Willow	28,560	214 (N/A)	0.1	0.1	107.10
Hickory	4,706	35 (N/A)	0.1	0.0	17.65
Red pine	3,599	27 (N/A)	0.1	0.0	13.50
American elm	3,051	23 (N/A)	0.1	0.0	11.44
White oak	7,344	55 (N/A)	0.1	0.0	27.54
Japanese maple	28	0 (N/A)	0.1	0.0	0.10
Black locust	1,319	10 (N/A)	0.1	0.0	4.95
Boxelder	2,201	17 (N/A)	0.1	0.0	8.26
Ash	7,945	60 (N/A)	0.0	0.0	59.59
Scarlet oak	185	1 (N/A)	0.0	0.0	1.39
Eastern cottonwood	25,943	195 (N/A)	0.0	0.1	194.57
Yellowwood	1,101	8 (N/A)	0.0	0.0	8.26
Mountain ash	178	1 (N/A)	0.0	0.0	1.33
Quaking aspen	1,035	8 (N/A)	0.0	0.0	7.76
Ohio buckeye	3,624	27 (N/A)	0.0	0.0	27.18
Citywide total	31,341,319	235,060 (N/A)	100.0	100.0	68.91

**Table 5: Annual Carbon Sequestered**

**Red Oak**

**Annual CO<sub>2</sub> Benefits of Public Trees**

2/6/2020

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
Silver maple	692,792	5,196	-45,191	-1,819	-353	276,108	2,071	921,890	6,914 (N/A)	14.0	29.6	14.46
Eastern red cedar	4,307	32	-1,572	-639	-17	58,407	438	60,504	454 (N/A)	11.2	1.9	1.19
Pin oak	513,211	3,849	-27,668	-1,131	-216	177,667	1,333	662,080	4,966 (N/A)	9.2	21.3	15.76
Green ash	153,910	1,154	-14,899	-677	-117	107,335	805	245,668	1,843 (N/A)	6.4	7.9	8.38
Apple	35,018	263	-3,046	-374	-26	43,624	327	75,222	564 (N/A)	6.2	2.4	2.69
Norway maple	64,282	482	-5,201	-408	-42	68,510	514	127,183	954 (N/A)	5.3	4.1	5.24
Northern red oak	21,512	161	-7,311	-398	-58	50,603	380	64,406	483 (N/A)	4.4	2.1	3.20
Sugar maple	92,084	691	-8,174	-443	-65	69,677	523	153,144	1,149 (N/A)	4.3	4.9	7.87
Northern white cedar	14,051	105	-2,069	-301	-18	25,124	188	36,805	276 (N/A)	3.9	1.2	2.06
Spruce	6,873	52	-427	-123	-4	11,066	83	17,388	130 (N/A)	3.2	0.6	1.19
Blue spruce	5,875	44	-402	-138	-4	12,649	95	17,984	135 (N/A)	3.1	0.6	1.26
Maple	33,466	251	-1,773	-180	-15	33,904	254	65,416	491 (N/A)	3.1	2.1	4.67
Black walnut	49,428	371	-2,847	-215	-23	37,640	282	84,006	630 (N/A)	2.9	2.7	6.36
Honeylocust	68,380	513	-3,020	-167	-24	35,998	270	101,192	759 (N/A)	2.1	3.3	10.84
Red maple	24,935	187	-1,015	-105	-8	20,134	151	43,949	330 (N/A)	1.7	1.4	5.68
American basswood	47,934	360	-3,932	-173	-31	24,687	185	68,516	514 (N/A)	1.6	2.2	9.70
Pear	6,167	46	-512	-71	-4	8,298	62	13,882	104 (N/A)	1.3	0.4	2.31
Northern hackberry	14,989	112	-1,407	-115	-11	20,219	152	33,687	253 (N/A)	1.2	1.1	6.16
Siberian elm	25,036	188	-2,929	-139	-23	21,721	163	43,689	328 (N/A)	1.1	1.4	8.86
American sycamore	27,787	208	-4,546	-143	-35	21,411	161	44,510	334 (N/A)	1.0	1.4	9.54
Bur oak	22,462	168	-2,137	-98	-17	15,544	117	35,769	268 (N/A)	1.0	1.1	7.89
Conifer Evergreen Small	212	2	-16	-15	0	900	7	1,080	8 (N/A)	0.9	0.0	0.26
Elm	22,446	168	-3,171	-108	-25	16,145	121	35,313	265 (N/A)	0.9	1.1	9.13
Eastern redbud	3,200	24	-210	-28	-2	3,275	25	6,236	47 (N/A)	0.8	0.2	1.80
White ash	12,357	93	-565	-44	-5	8,689	65	20,436	153 (N/A)	0.6	0.7	6.97
Amur maple	2,587	19	-143	-28	-1	3,197	24	5,613	42 (N/A)	0.6	0.2	2.00
Conifer Evergreen Medium	1,049	8	-51	-28	-1	2,619	20	3,589	27 (N/A)	0.6	0.1	1.28
Broadleaf Deciduous Small	1,070	8	-74	-15	-1	1,478	11	2,459	18 (N/A)	0.5	0.1	1.09
Broadleaf Deciduous Medium	6,167	46	-498	-37	-4	6,091	46	11,722	88 (N/A)	0.5	0.4	5.49
Conifer Evergreen Large	2,371	18	-242	-35	-2	3,238	24	5,331	40 (N/A)	0.5	0.2	2.50
Littleleaf linden	8,707	65	-417	-31	-3	4,619	35	12,877	97 (N/A)	0.4	0.4	6.44
Eastern white pine	1,392	10	-403	-54	-3	4,073	31	5,008	38 (N/A)	0.4	0.2	2.50
Norway spruce	1,190	9	-315	-40	-3	3,173	24	4,008	30 (N/A)	0.4	0.1	2.50
Scotch pine	1,333	10	-69	-23	-1	2,384	18	3,624	27 (N/A)	0.4	0.1	2.27
Cherry plum	776	6	-26	-9	0	818	6	1,559	12 (N/A)	0.4	0.1	0.97
Ginkgo	1,732	13	-179	-21	-2	2,348	18	3,880	29 (N/A)	0.3	0.1	3.23
Oak	2,173	16	-121	-10	-1	1,669	13	3,710	28 (N/A)	0.2	0.1	3.48
Northern catalpa	5,611	42	-670	-25	-5	3,850	29	8,766	66 (N/A)	0.2	0.3	9.39
Mulberry	582	4	-127	-15	-1	1,664	12	2,104	16 (N/A)	0.2	0.1	2.25
Southern magnolia	417	3	-23	-7	0	1,168	9	1,555	12 (N/A)	0.2	0.0	1.67
Black poplar	4,251	32	-457	-20	-4	3,088	23	6,863	51 (N/A)	0.2	0.2	7.35
Black cherry	1,262	9	-145	-15	-1	1,685	13	2,787	21 (N/A)	0.2	0.1	3.48
Lilac	974	7	-120	-14	-1	1,561	12	2,401	18 (N/A)	0.2	0.1	3.00
Eastern hemlock	211	2	-7	-5	0	399	3	598	4 (N/A)	0.2	0.0	0.75
Sweetgum	2,710	20	-236	-12	-2	1,992	15	4,455	33 (N/A)	0.1	0.1	6.68
Austrian pine	499	4	-41	-11	0	1,025	8	1,472	11 (N/A)	0.1	0.0	2.21
Kentucky coffeetree	2,877	22	-322	-13	-3	2,125	16	4,666	35 (N/A)	0.1	0.1	7.00
Cottonwood	3,653	27	-675	-21	-5	3,142	24	6,100	46 (N/A)	0.1	0.2	9.15
Swamp white oak	246	2	-6	-2	0	205	2	442	3 (N/A)	0.1	0.0	0.66
Birch	1,512	11	-123	-10	-1	1,506	11	2,886	22 (N/A)	0.1	0.1	4.33
Broadleaf Evergreen Large	2,494	19	-186	-10	-1	1,831	14	4,129	31 (N/A)	0.1	0.1	7.74
Black maple	483	4	-94	-7	-1	1,385	10	1,767	13 (N/A)	0.1	0.1	4.42
Northern pin oak	868	7	-37	-4	0	855	6	1,681	13 (N/A)	0.1	0.1	4.20
Tulip tree	1,725	13	-121	-7	-1	1,152	9	2,749	21 (N/A)	0.1	0.1	6.87
Black spruce	168	1	-8	-4	0	425	3	581	4 (N/A)	0.1	0.0	1.45
Broadleaf Deciduous Large	1,099	8	-40	-5	0	944	7	1,999	15 (N/A)	0.1	0.1	5.00
Willow	740	6	-137	-7	-1	1,077	8	1,673	13 (N/A)	0.1	0.1	6.27
Hickory	654	5	-23	-3	0	552	4	1,180	9 (N/A)	0.1	0.0	4.43
Red pine	240	2	-17	-4	0	341	3	560	4 (N/A)	0.1	0.0	2.10
American elm	229	2	-15	-2	0	420	3	632	5 (N/A)	0.1	0.0	2.37
White oak	891	7	-35	-4	0	786	6	1,637	12 (N/A)	0.1	0.1	6.14
Japanese maple	17	0	0	0	0	11	0	28	0 (N/A)	0.1	0.0	0.10
Black locust	320	2	-7	-2	0	240	2	551	4 (N/A)	0.1	0.0	2.07
Boxelder	361	3	-11	-2	0	346	3	694	5 (N/A)	0.1	0.0	2.60
Ash	470	4	-38	-3	0	440	3	869	7 (N/A)	0.0	0.0	6.52
Scarlet oak	74	1	-1	-1	0	49	0	121	1 (N/A)	0.0	0.0	0.91
Eastern cottonwood	960	7	-125	-4	-1	650	5	1,481	11 (N/A)	0.0	0.0	11.11
Yellowwood	224	2	-5	-1	0	176	1	393	3 (N/A)	0.0	0.0	2.95
Mountain ash	38	0	-1	-1	0	37	0	74	1 (N/A)	0.0	0.0	0.55
Quaking aspen	209	2	-5	-1	0	159	1	361	3 (N/A)	0.0	0.0	2.71
Ohio buckeye	386	3	-17	-2	0	395	3	762	6 (N/A)	0.0	0.0	5.71
Citywide total	2,030,713	15,230	-150,450	-8,634	-1,193	1,240,723	9,305	3,112,351	23,343 (N/A)	100.0	100.0	6.84

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

**Red Oak**

**Annual Aesthetic/Other Benefits of Public Trees**

2/6/2020

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	53,252	(N/A)	14.0	28.8	111.40
Eastern red cedar	2,187	(N/A)	11.2	1.2	5.74
Pin oak	38,731	(N/A)	9.2	21.0	122.96
Green ash	12,362	(N/A)	6.4	6.7	56.19
Apple	2,037	(N/A)	6.2	1.1	9.70
Norway maple	6,271	(N/A)	5.3	3.4	34.46
Northern red oak	1,650	(N/A)	4.4	0.9	10.93
Sugar maple	9,595	(N/A)	4.3	5.2	65.72
Northern white cedar	2,715	(N/A)	3.9	1.5	20.26
Spruce	1,999	(N/A)	3.2	1.1	18.18
Blue spruce	1,796	(N/A)	3.1	1.0	16.79
Maple	4,574	(N/A)	3.1	2.5	43.56
Black walnut	4,691	(N/A)	2.9	2.5	47.38
Honeylocust	17,036	(N/A)	2.1	9.2	243.38
Red maple	3,355	(N/A)	1.7	1.8	57.85
American basswood	3,463	(N/A)	1.6	1.9	65.33
Pear	354	(N/A)	1.3	0.2	7.87
Northern hackberry	2,026	(N/A)	1.2	1.1	49.41
Siberian elm	1,700	(N/A)	1.1	0.9	45.96
American sycamore	1,968	(N/A)	1.0	1.1	56.23
Bur oak	1,814	(N/A)	1.0	1.0	53.35
Conifer Evergreen Small	230	(N/A)	0.9	0.1	7.41
Elm	1,617	(N/A)	0.9	0.9	55.74
Eastern redbud	183	(N/A)	0.8	0.1	7.02
White ash	1,485	(N/A)	0.6	0.8	67.52
Amur maple	147	(N/A)	0.6	0.1	6.98
Conifer Evergreen Medium	445	(N/A)	0.6	0.2	21.21
Broadleaf Deciduous Small	58	(N/A)	0.5	0.0	3.41
Broadleaf Deciduous Medium	591	(N/A)	0.5	0.3	36.91
Conifer Evergreen Large	470	(N/A)	0.5	0.3	29.38
Littleleaf linden	908	(N/A)	0.4	0.5	60.53
Eastern white pine	244	(N/A)	0.4	0.1	16.29
Norway spruce	196	(N/A)	0.4	0.1	16.35
Scotch pine	369	(N/A)	0.4	0.2	30.73
Cherry plum	42	(N/A)	0.4	0.0	3.53
Ginkgo	136	(N/A)	0.3	0.1	15.15
Oak	230	(N/A)	0.2	0.1	28.78
Northern catalpa	417	(N/A)	0.2	0.2	59.55
Mulberry	33	(N/A)	0.2	0.0	4.72
Southern magnolia	123	(N/A)	0.2	0.1	17.61
Black poplar	351	(N/A)	0.2	0.2	50.17
Black cherry	75	(N/A)	0.2	0.0	12.52
Lilac	57	(N/A)	0.2	0.0	9.52
Eastern hemlock	73	(N/A)	0.2	0.0	12.15
Sweetgum	229	(N/A)	0.1	0.1	45.83
Austrian pine	110	(N/A)	0.1	0.1	21.92
Kentucky coffeetree	233	(N/A)	0.1	0.1	46.55
Cottonwood	265	(N/A)	0.1	0.1	52.99

Swamp white oak	37 (N/A)	0.1	0.0	7.43
Birch	153 (N/A)	0.1	0.1	30.64
Broadleaf Evergreen Large	392 (N/A)	0.1	0.2	97.97
Black maple	66 (N/A)	0.1	0.0	21.96
Northern pin oak	91 (N/A)	0.1	0.0	30.40
Tulip tree	152 (N/A)	0.1	0.1	50.61
Black spruce	67 (N/A)	0.1	0.0	22.47
Broadleaf Deciduous Large	120 (N/A)	0.1	0.1	40.09
Willow	63 (N/A)	0.1	0.0	31.46
Hickory	74 (N/A)	0.1	0.0	37.21
Red pine	63 (N/A)	0.1	0.0	31.25
American elm	39 (N/A)	0.1	0.0	19.35
White oak	92 (N/A)	0.1	0.0	45.86
Japanese maple	0 (N/A)	0.1	0.0	0.03
Black locust	39 (N/A)	0.1	0.0	19.55
Boxelder	54 (N/A)	0.1	0.0	27.10
Ash	43 (N/A)	0.0	0.0	43.05
Scarlet oak	15 (N/A)	0.0	0.0	14.73
Eastern cottonwood	67 (N/A)	0.0	0.0	66.60
Yellowwood	26 (N/A)	0.0	0.0	26.22
Mountain ash	2 (N/A)	0.0	0.0	2.06
Quaking aspen	29 (N/A)	0.0	0.0	28.56
Ohio buckeye	39 (N/A)	0.0	0.0	39.16
Citywide total	184,618 (N/A)	100.0	100.0	54.12



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

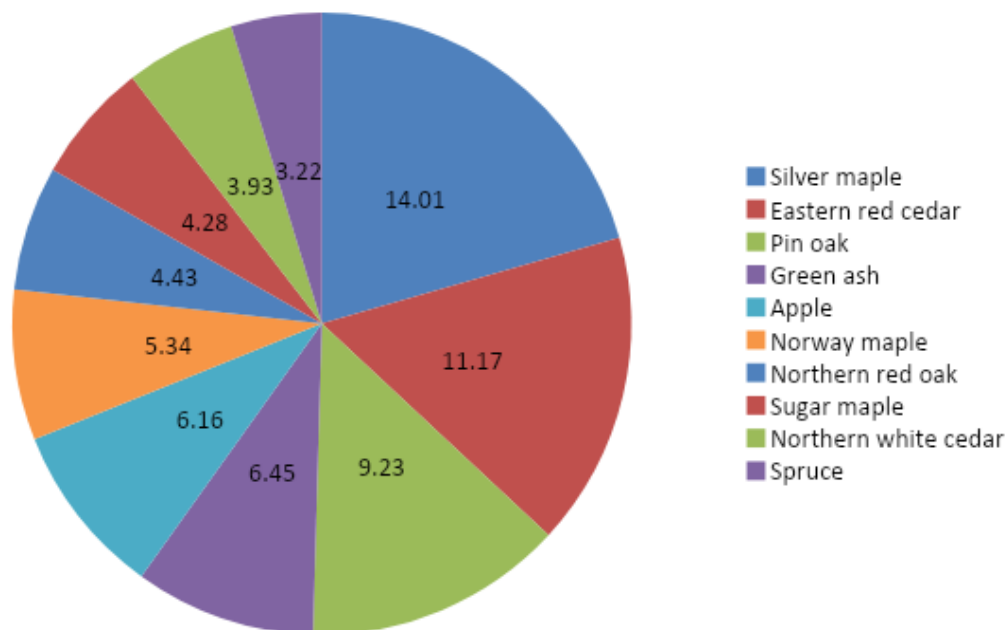
**Red Oak**

**Total Annual Benefits of Public Trees by Species (\$)**

2/6/2020

Species	Energy	CO <sub>2</sub>	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Silver maple	33,655	6,914	6,308	65,277	53,252	165,406	(N/A)	26.5
Eastern red cedar	7,736	454	657	13,703	2,187	24,737	(N/A)	4.0
Pin oak	21,949	4,966	2,817	33,012	38,731	101,475	(N/A)	16.3
Green ash	13,514	1,843	2,411	20,204	12,362	50,333	(N/A)	8.1
Apple	5,897	564	1,001	3,347	2,037	12,846	(N/A)	2.1
Norway maple	8,790	954	1,521	9,310	6,271	26,847	(N/A)	4.3
Northern red oak	6,425	483	898	8,702	1,650	18,159	(N/A)	2.9
Sugar maple	8,656	1,149	1,380	12,384	9,595	33,163	(N/A)	5.3
Northern white cedar	3,113	276	43	8,389	2,715	14,536	(N/A)	2.3
Spruce	1,377	130	115	2,636	1,999	6,258	(N/A)	1.0
Blue spruce	1,623	135	177	2,729	1,796	6,460	(N/A)	1.0
Maple	4,112	491	731	4,093	4,574	14,000	(N/A)	2.2
Black walnut	4,555	630	761	5,077	4,691	15,715	(N/A)	2.5
Honeylocust	4,395	759	746	6,718	17,036	29,655	(N/A)	4.8
Red maple	2,439	330	431	2,379	3,355	8,934	(N/A)	1.4
American basswood	3,213	514	492	4,459	3,463	12,140	(N/A)	1.9
Pear	1,119	104	185	592	354	2,355	(N/A)	0.4
Northern hackberry	2,574	253	464	3,182	2,026	8,499	(N/A)	1.4
Siberian elm	2,685	328	519	3,889	1,700	9,121	(N/A)	1.5
American sycamore	2,671	334	527	4,940	1,968	10,440	(N/A)	1.7
Bur oak	1,953	268	349	2,920	1,814	7,304	(N/A)	1.2
Conifer Evergreen Smal	124	8	9	185	230	556	(N/A)	0.1
Elm	2,035	265	391	3,659	1,617	7,967	(N/A)	1.3
Eastern redbud	440	47	74	238	183	981	(N/A)	0.2
White ash	1,018	153	181	1,243	1,485	4,080	(N/A)	0.7
Amur maple	444	42	68	197	147	898	(N/A)	0.1
Conifer Evergreen Medi	347	27	37	523	445	1,379	(N/A)	0.2
Broadleaf Deciduous Sn	207	18	32	96	58	411	(N/A)	0.1
Broadleaf Deciduous Mi	803	88	138	881	591	2,501	(N/A)	0.4
Conifer Evergreen Large	394	40	11	1,047	470	1,962	(N/A)	0.3
Littleleaf linden	576	97	96	675	908	2,352	(N/A)	0.4
Eastern white pine	497	38	-7	1,498	244	2,270	(N/A)	0.4
Norway spruce	385	30	-5	1,163	196	1,769	(N/A)	0.3
Scotch pine	275	27	30	488	369	1,189	(N/A)	0.2
Cherry plum	120	12	16	46	42	236	(N/A)	0.0
Ginkgo	296	29	53	268	136	782	(N/A)	0.1
Oak	203	28	34	221	230	715	(N/A)	0.1
Northern catalpa	488	66	91	831	417	1,893	(N/A)	0.3
Mulberry	221	16	39	134	33	442	(N/A)	0.1
Southern magnolia	136	12	17	140	123	429	(N/A)	0.1
Black poplar	387	51	70	595	351	1,454	(N/A)	0.2
Black cherry	228	21	41	147	75	512	(N/A)	0.1
Lilac	213	18	37	128	57	453	(N/A)	0.1
Eastern hemlock	51	4	6	72	73	206	(N/A)	0.0
Sweetgum	242	33	43	336	229	883	(N/A)	0.1
Austrian pine	124	11	14	225	110	484	(N/A)	0.1
Kentucky coffeetree	264	35	48	413	233	994	(N/A)	0.2
Cottonwood	387	46	77	688	265	1,462	(N/A)	0.2

Swamp white oak	29	3	4	17	37	91 (N/A)	0.0
Birch	203	22	34	217	153	629 (N/A)	0.1
Broadleaf Evergreen Lau	231	31	19	565	392	1,238 (N/A)	0.2
Black maple	170	13	32	199	66	480 (N/A)	0.1
Northern pin oak	103	13	17	81	91	304 (N/A)	0.0
Tulip tree	149	21	25	194	152	540 (N/A)	0.1
Black spruce	54	4	6	83	67	215 (N/A)	0.0
Broadleaf Deciduous La	109	15	18	96	120	358 (N/A)	0.1
Willow	142	13	27	204	63	448 (N/A)	0.1
Hickory	65	9	10	56	74	215 (N/A)	0.0
Red pine	44	4	3	97	63	210 (N/A)	0.0
American elm	46	5	8	38	39	135 (N/A)	0.0
White oak	88	12	15	79	92	287 (N/A)	0.0
Japanese maple	2	0	0	0	0	3 (N/A)	0.0
Black locust	33	4	5	20	39	102 (N/A)	0.0
Boxelder	45	5	7	39	54	150 (N/A)	0.0
Ash	59	7	10	67	43	186 (N/A)	0.0
Scarlet oak	6	1	1	5	15	27 (N/A)	0.0
Eastern cottonwood	82	11	16	149	67	324 (N/A)	0.1
Yellowwood	24	3	3	16	26	73 (N/A)	0.0
Mountain ash	5	1	1	2	2	11 (N/A)	0.0
Quaking aspen	21	3	3	16	29	71 (N/A)	0.0
Ohio buckeye	47	6	8	38	39	138 (N/A)	0.0
<b>Citywide Total</b>	<b>155,111</b>	<b>23,343</b>	<b>24,446</b>	<b>236,357</b>	<b>184,618</b>	<b>623,874 (N/A)</b>	<b>100.0</b>



**Figure 1: Species Distribution**

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

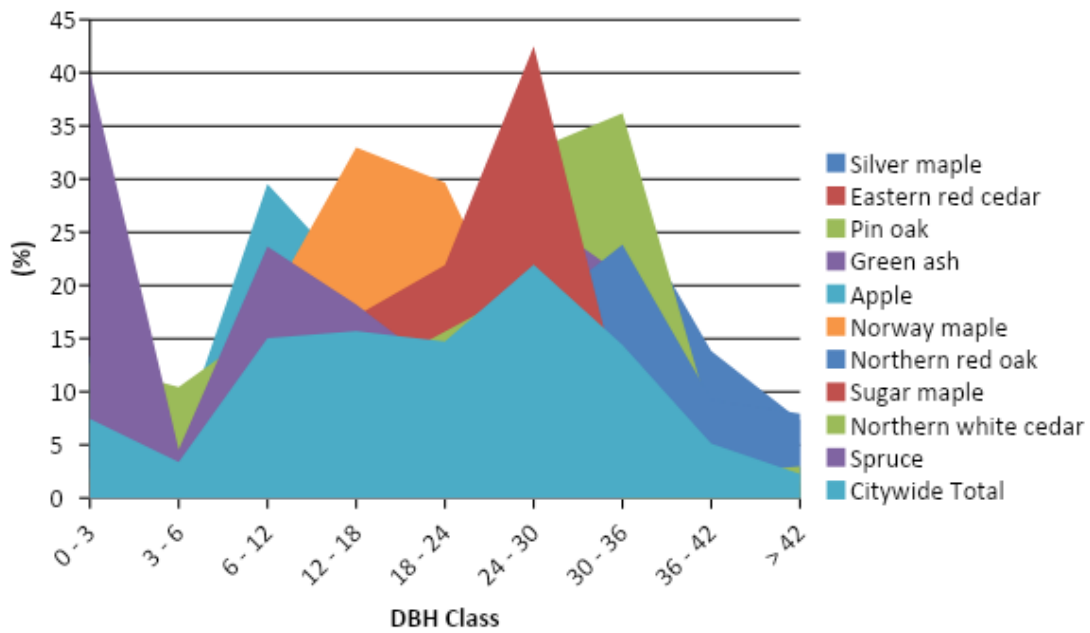


Figure 2: Relative Age Class

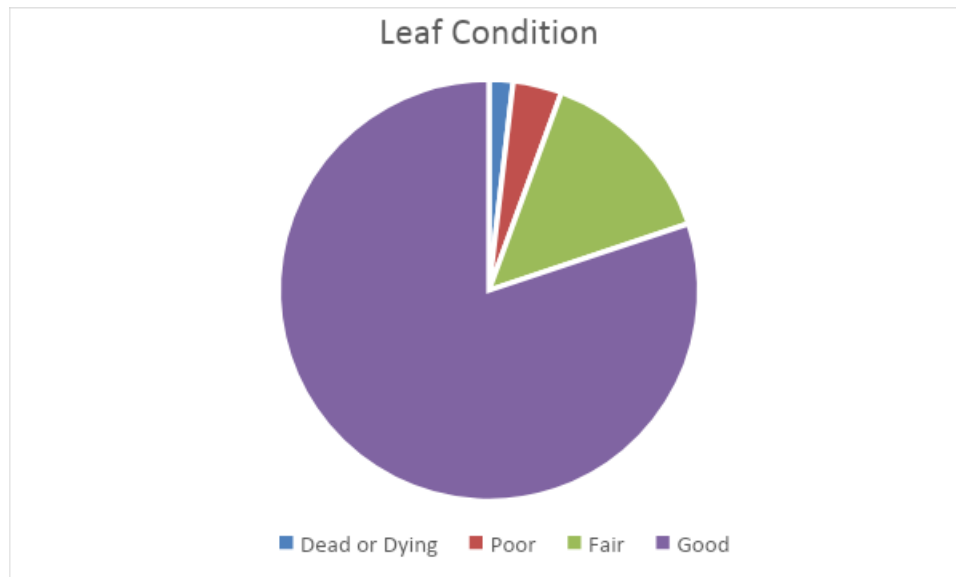
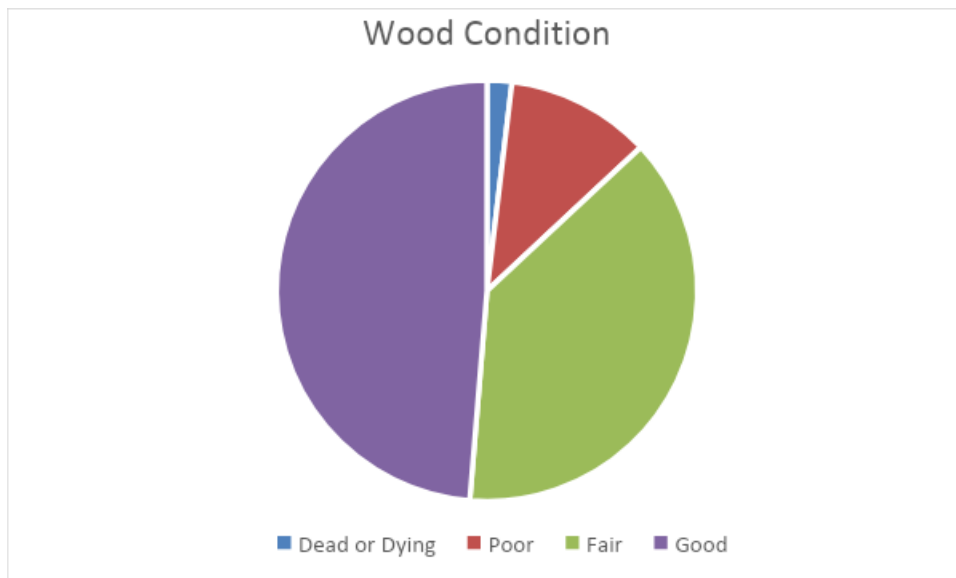
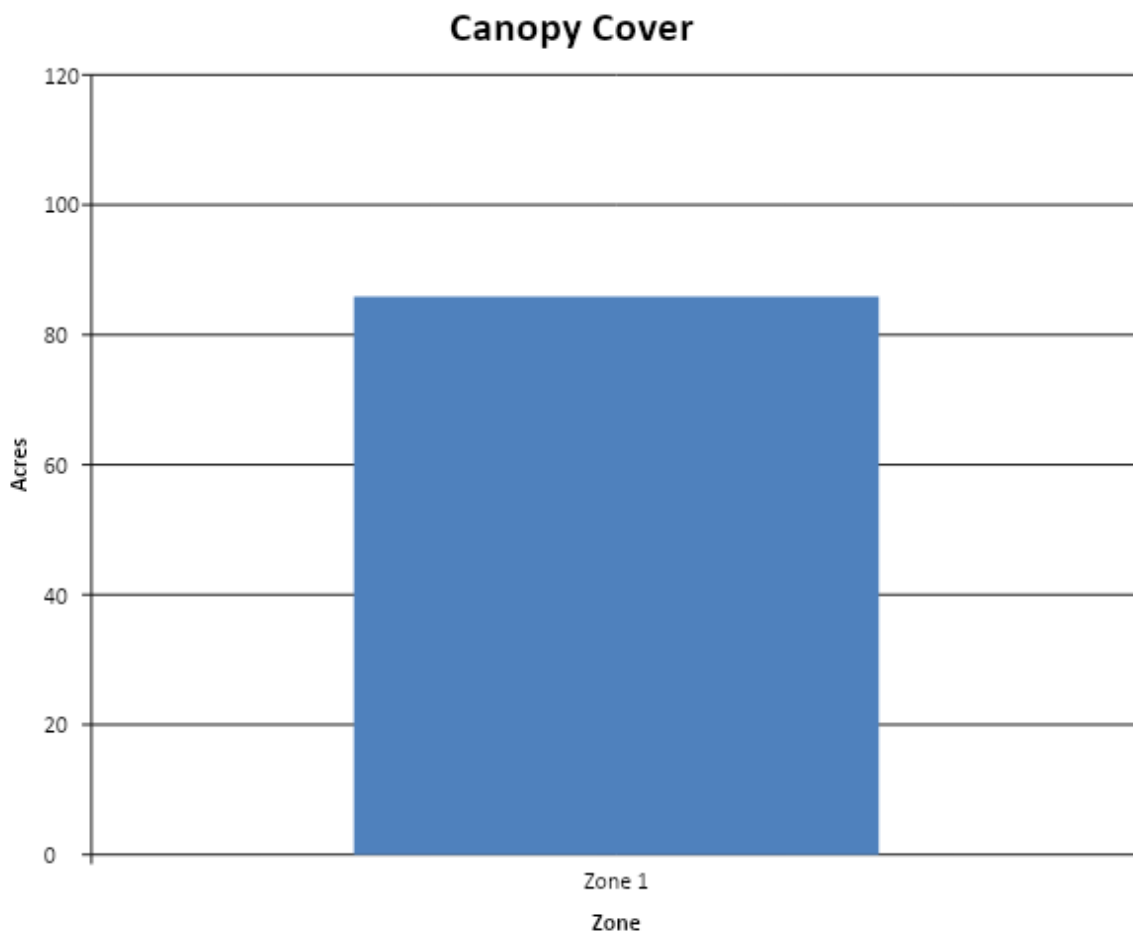


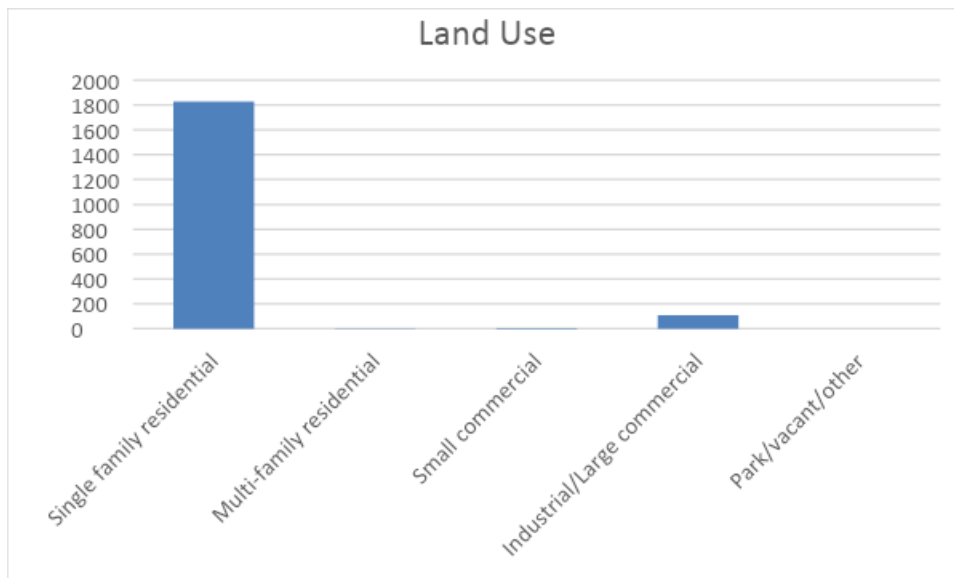
Figure 3: Foliage Condition



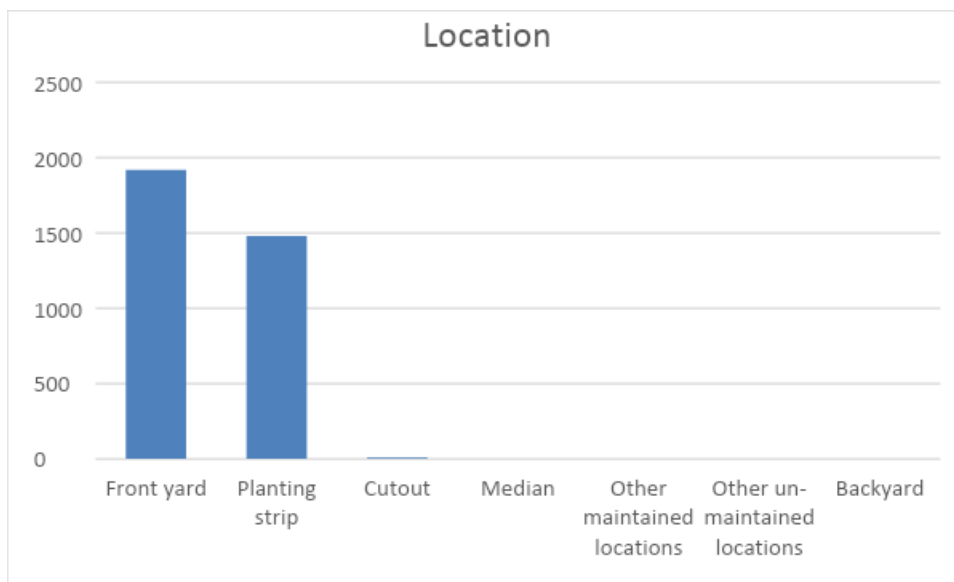
**Figure 4: Wood Condition**



**Figure 5: Canopy Cover in Acres**



**Figure 6: Land Use of city/park trees** (NOTE: the bar on the graph for Industrial/Large Commercial is actually for Parks/Vacant/Other.)



**Figure 7: Location of city/park trees**

# Appendix B: ArcGIS Mapping

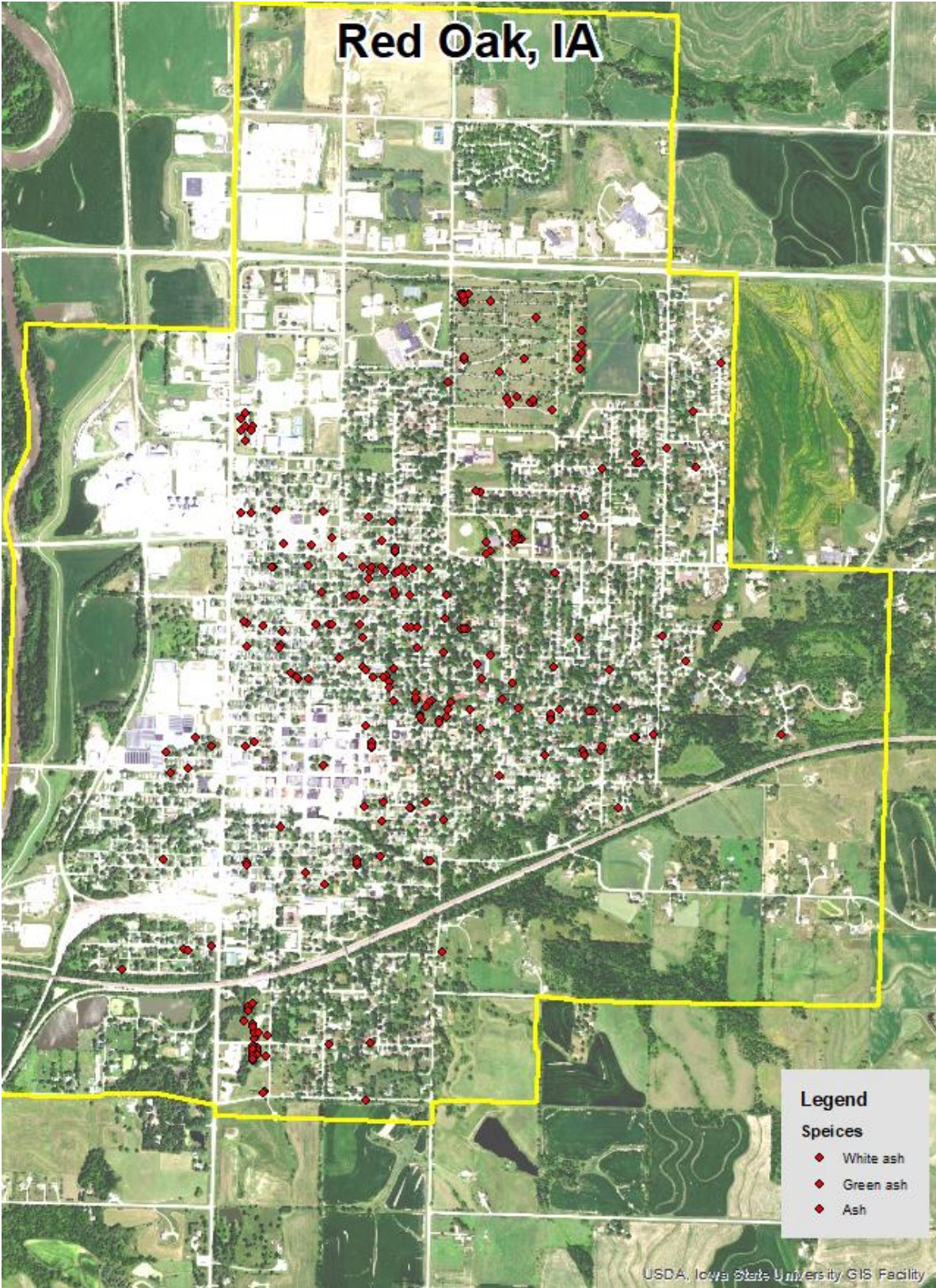


Figure 1: Location of Ash Trees

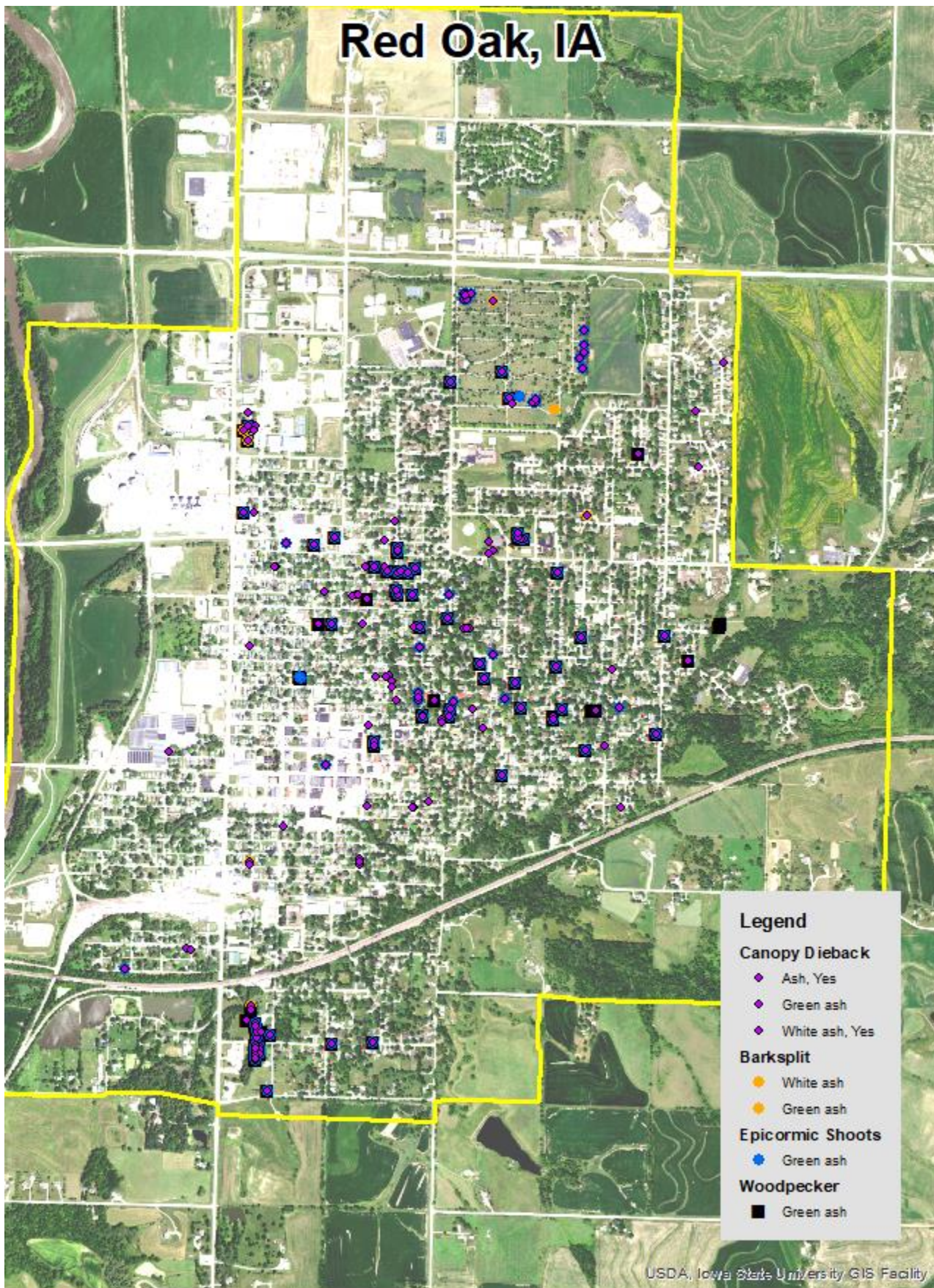
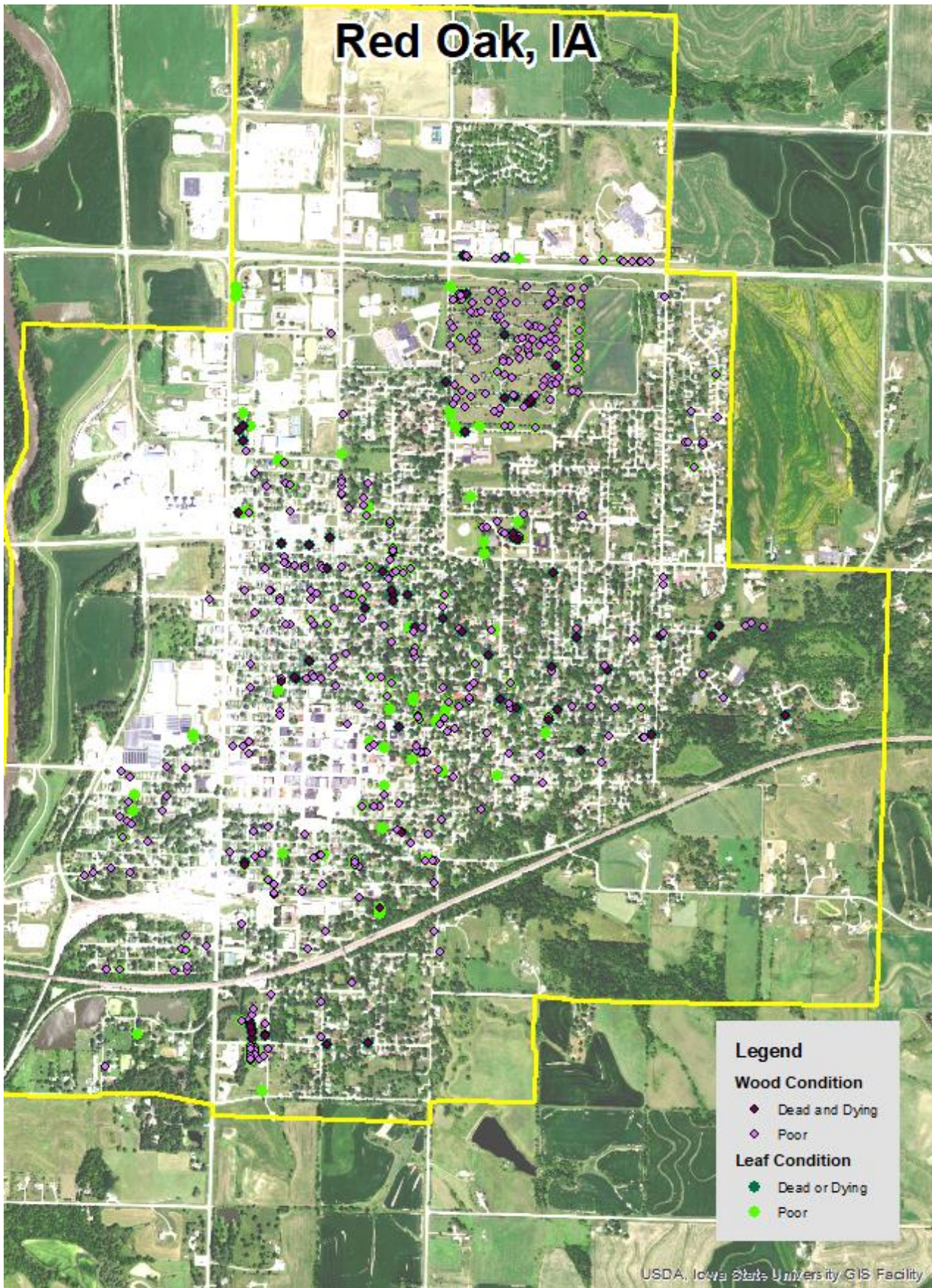
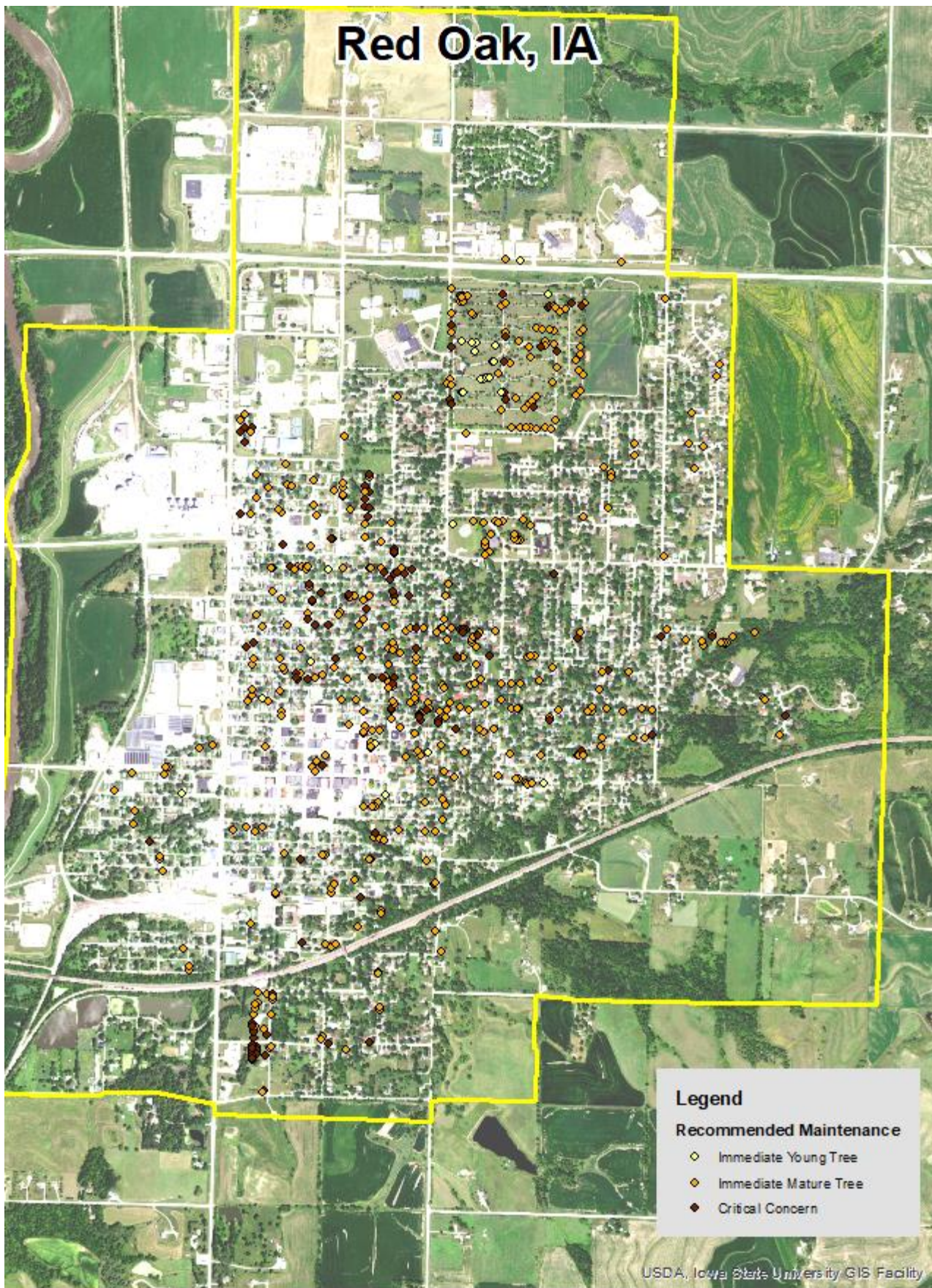


Figure 2: Location of EAB symptoms

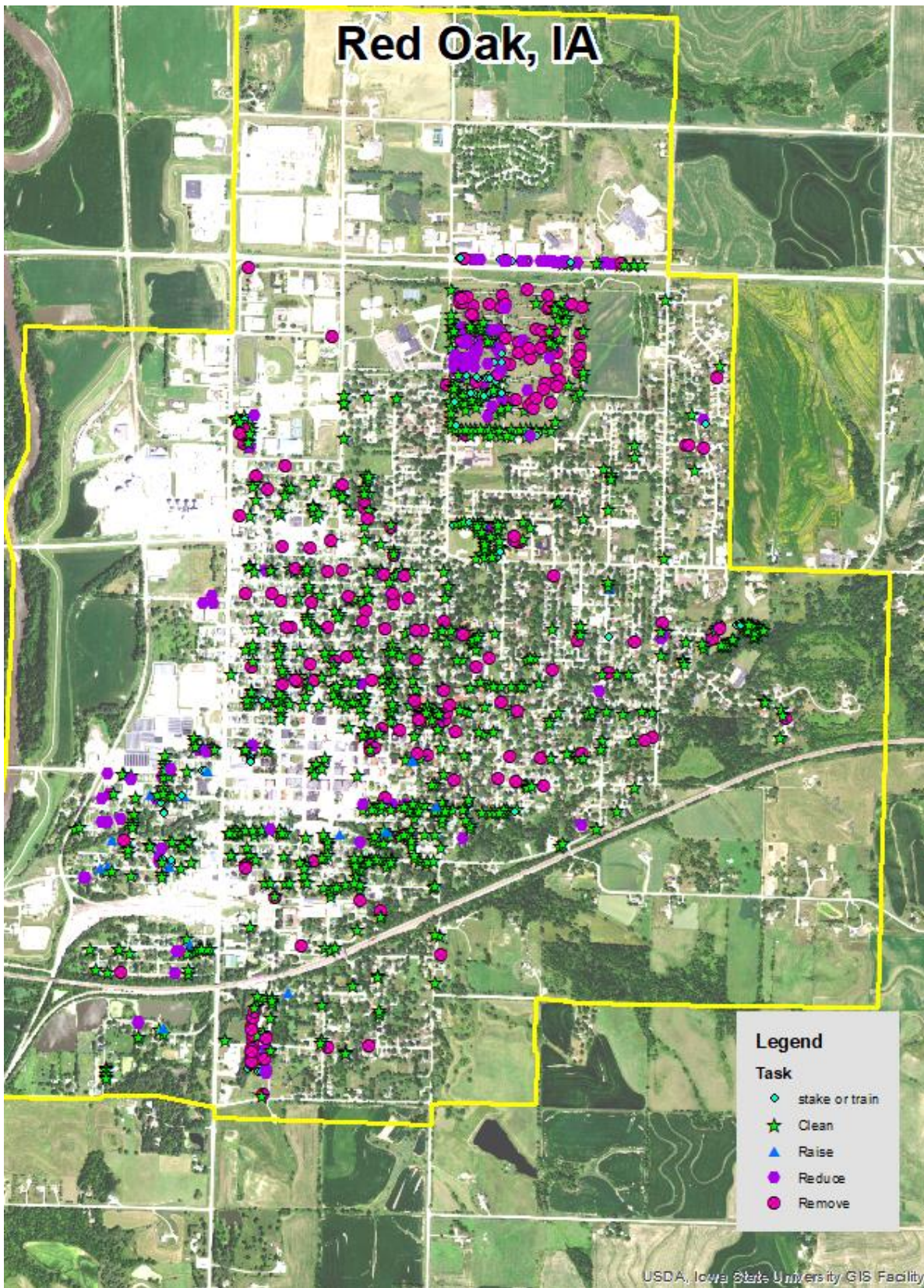


**Figure 3: Location of Poor Condition Trees**





**Figure 4: Location of Trees with Recommended Maintenance**



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

# Appendix C: Red Oak Tree Ordinances

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See attached ordinance draft and 2010 Tree Ordinance

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.