

# West Bend, IA



## 2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES



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# Executive Summary

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## Overview

This plan was developed to assist the City of West Bend 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 25% of West Bend'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 332 trees inventoried.

- West Bend's trees provide \$85,394 of benefits annually, an average of \$257.21 per tree
- There are over 16 species of trees
- The top three genera are: Maple 49%, Ash 25%, and Walnut 6%
- <1% of trees need some type of management
- 1 tree should be removed

## Recommendations

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

- Out of the 1 tree needing removal, that 1 tree is over 24 inches in diameter at 4.5 ft and must be addressed immediately. [\\*City ownership of the trees recommended for removal should be verified prior to any removal\\*](#)
- 11 of the 83 ash trees should be carefully examined, as they may 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 37 years to remove ash. We suggest that city officials request a budget increase to \$3,000 annually and apply for grants to plant replacement trees.

# Introduction

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This plan was developed to assist West Bend 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 West Bend, 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 West Bend'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 West Bend 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 West Bend urban forestry goals.

## Inventory

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

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

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

# Inventory Results

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JEO entered the data collected for the 332 city trees into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Below are results from the i-Tree STREETS analysis.

## Annual Benefits

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### **Annual Energy Benefits**

Trees conserve energy by shading buildings and blocking winds. West Bend's trees reduce energy-related costs by approximately \$22,806 annually (Appendix A, Table 1). These savings are both in electricity (107.6 MWh) and in natural gas (14,939.3 Therms).

### **Annual Stormwater Benefits**

West Bend's trees intercept about 1,429,117 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides \$38,729 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 West Bend, it is estimated that trees remove 1,500.5 lbs of air pollution (ozone (O<sub>3</sub>), particulate matter less than 10 microns (PM<sub>10</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>)) per year with a net value of \$4,267 (Appendix A, Table 3).

### **Annual Carbon Benefits**

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In West Bend, trees sequester about 222,008 lbs of carbon per year with an associated value of \$1,665 (Appendix A, Table 5). In addition, the trees store 6,512,274 lbs of carbon, with a yearly benefit of \$48,842 (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. West Bend receives \$16,818 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, West Bend's trees provide \$85,394 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 332 trees in West Bend provide approximately \$257.21 annually (Appendix A, Table 7).

# Forest Structure

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## Species Distribution

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

Maple	161	49%
Ash	83	25%
Walnut	21	6%
Linden/Basswood	16	5%
Spruce	12	3.5%
Oak	7	2%
Pear	7	2%
Hackberry	6	2%
Broadleaf Deciduous	4	1.5%
Cherry	3	1%
Locust	3	1%
Birch	2	<1%
Catalpa	2	<1%
Elm	2	<1%
Cottonwood	1	<1%
Ginkgo	1	<1%
Hickory	1	<1%

## Age Class

Most of West Bend's trees (50%) are between 30 and 42 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. West Bend's size curve is on the larger side, indicating an older than average stand.

## Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for West Bend indicate that 55% of the trees are in good health, with only 6% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 43% of West Bend's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Thirteen percent of the tree population's wood condition is in poor health, dead, or dying. This 13% 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	1	<1%
Crown Reduction	0	0%

## Land Use and Location

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

<u>Land Use</u>	
Single family residential	100%
Park/vacant/other	0%
Industrial/Large commercial	0%
Small commercial	0%
Multifamily residential	0%

## Recommendations

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### Risk Management

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

### Hazardous trees

West Bend has 1 tree that needs immediate removal. This tree along with any trees needing maintenance can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter, critical concern trees first. Any critical concern trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Proposed Work Schedule and Budget at the end of this section. After all the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are no other trees with maintenance needs.

### Poor tree species

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 1 removal, 1 is an ash tree. There are a total of 83 ash trees, and 11 of those have signs and symptoms that have been associated with EAB. In addition, there are 18 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 Proposed Work Schedule and Budget for further information.

## Planting

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

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 (49%) (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 any fruit bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, pine, willow or black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

## Continual Monitoring

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

# Emerald Ash Borer Plan

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## Ash Tree Removal

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

## Treatment of Ash Trees

Chemical treatment can be an effective tool for communities to spread removal costs out over several years while allowing trees to continue providing benefits. However, treatment is not recommended if

EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit <http://extension.entm.purdue.edu/treecomputer/>

### **EAB Quarantines**

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

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

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

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

### **Wood Disposal**

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

### **Canopy Replacement**

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

### **Postponed Work**

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

### **Monitoring**

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

## Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 151.05 states “If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the authorized designee shall immediately notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the nuisance to be removed and the cost assessed against the property.”

## Proposed Work Schedule and Budget

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Budget Allowance of \$1,570/Year – (Based off \$2/Capita Calculation Due to no City Reporting)

### YEAR 1

### ESTIMATED COSTS

Remove 1 tree recommended for immediate removal	\$700
Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 1 tree in an open location	\$150
Visual Survey of EAB Signs/Symptoms	

### YEAR 2

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 5 tree in an open location	\$750
Visual Survey of EAB Signs/Symptoms	

### YEAR 3

Remove 2 ash trees (prioritize largest diameter)	\$1,400
Plant 1 tree in an open location	\$150
Visual Survey of EAB Signs/Symptoms	

### YEAR 4

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 5 tree in an open location	\$750
Visual Survey of EAB Signs/Symptoms	

### YEAR 5

Remove 2 ash trees (prioritize largest diameter)	\$1,400
Plant 1 tree in an open location	\$150
Visual Survey of EAB Signs/Symptoms	

**YEAR 6**

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 5 tree in an open location	\$750
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 \$9,700 a year. If the budget were increased to \$3,000 a year all ash could be removed in 19 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 1 tree recommended for immediate removal	\$700
Remove 2 ash trees (prioritize largest diameter)	\$1,400
Plant 6 trees in open locations	\$900
Visual Survey of EAB Signs/Symptoms	

**YEAR 2**

Remove 1 ash tree (prioritize largest diameter)	\$700
Plant 4 trees in open locations	\$600
Prune 1/3 of City Owned Trees	\$1,665
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 4 trees in open locations	\$600
Prune 1/3 of City Owned Trees	\$1,665
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 4 trees in open locations	\$600
Prune 1/3 of City Owned Trees	\$1,665
Visual Survey of EAB Signs/Symptoms	

### **Purposed Budget Increase**

EAB could potentially kill all ash trees in West Bend within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to \$9,700 a year. If the budget were increased to \$3,000 per year all ash could be removed within 19 years. Additionally, we recommend that West Bend 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 West Bend would still need to find \$52,500 for removal of the remaining ash. Alternatively, if there are 15 treatable trees, it would cost approximately \$4,500 a year for treatment and leave no funds 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 West Bend. We suggest considering an increased budget to plan for this.

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# Appendix A: i-Tree Data

**Table 1: Annual Energy Benefits**

<b>Annual Energy Benefits of Public Trees</b>									
4/21/2020									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	29.0	2,201	4,279.9	4,194	6,396	(N/A)	29.8	28.0	64.60
Green ash	31.8	2,412	4,348.7	4,262	6,674	(N/A)	25.0	29.3	80.41
Silver maple	17.4	1,317	2,265.8	2,220	3,538	(N/A)	14.5	15.5	73.70
Black walnut	9.0	686	1,219.1	1,195	1,880	(N/A)	6.3	8.2	89.54
Red maple	2.2	170	307.5	301	471	(N/A)	3.6	2.1	39.28
Norway spruce	2.0	149	264.9	260	409	(N/A)	3.6	1.8	34.08
American basswood	4.3	329	613.9	602	931	(N/A)	3.3	4.1	84.61
Pear	1.3	101	193.5	190	291	(N/A)	2.1	1.3	41.56
Northern red oak	1.4	105	186.4	183	287	(N/A)	1.8	1.3	47.90
Northern hackberry	2.6	198	353.6	347	545	(N/A)	1.8	2.4	90.77
Littleleaf linden	0.8	64	114.7	112	177	(N/A)	1.5	0.8	35.32
Black cherry	0.6	45	94.9	93	138	(N/A)	0.9	0.6	46.14
Northern catalpa	0.9	70	122.1	120	190	(N/A)	0.6	0.8	94.83
Paper birch	0.2	14	27.5	27	41	(N/A)	0.6	0.2	20.64
Broadleaf Deciduous Me	0.0	3	7.0	7	10	(N/A)	0.6	0.0	5.04
Black maple	0.6	43	79.8	78	121	(N/A)	0.6	0.5	60.68
American elm	1.0	79	132.3	130	209	(N/A)	0.6	0.9	104.40
Honeylocust	0.7	51	89.7	88	139	(N/A)	0.6	0.6	69.53
Swamp white oak	0.3	24	47.4	46	71	(N/A)	0.3	0.3	70.84
Hickory	0.3	25	46.9	46	71	(N/A)	0.3	0.3	70.91
Black locust	0.3	24	47.4	46	71	(N/A)	0.3	0.3	70.84
Cottonwood	0.3	25	46.9	46	71	(N/A)	0.3	0.3	70.91
Broadleaf Deciduous Lar	0.1	7	13.7	13	21	(N/A)	0.3	0.1	20.64
Broadleaf Deciduous Sm	0.0	2	3.8	4	5	(N/A)	0.3	0.0	5.40
Ginkgo	0.2	18	32.0	31	49	(N/A)	0.3	0.2	49.28
<b>Total</b>	<b>107.6</b>	<b>8,165</b>	<b>14,939.3</b>	<b>14,641</b>	<b>22,806</b>	<b>(N/A)</b>	<b>100.0</b>	<b>100.0</b>	<b>68.69</b>

**Table 2: Annual Stormwater Benefits**

<b>Annual Stormwater Benefits of Public Trees</b>						
4/21/2020						
Species	Totalrainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	318,693	8,637	(N/A)	29.8	22.3	87.24
Green ash	453,865	12,300	(N/A)	25.0	31.8	148.19
Silver maple	267,264	7,243	(N/A)	14.5	18.7	150.89
Black walnut	141,527	3,835	(N/A)	6.3	9.9	182.64
Red maple	17,939	486	(N/A)	3.6	1.3	40.51
Norway spruce	47,238	1,280	(N/A)	3.6	3.3	106.68
American basswood	66,429	1,800	(N/A)	3.3	4.6	163.66
Pear	6,188	168	(N/A)	2.1	0.4	23.96
Northern red oak	13,516	366	(N/A)	1.8	0.9	61.05
Northern hackberry	29,509	800	(N/A)	1.8	2.1	133.28
Littleleaf linden	7,184	195	(N/A)	1.5	0.5	38.94
Black cherry	3,522	95	(N/A)	0.9	0.2	31.82
Northern catalpa	14,478	392	(N/A)	0.6	1.0	196.17
Paper birch	1,216	33	(N/A)	0.6	0.1	16.47
Broadleaf Deciduous Medi	175	5	(N/A)	0.6	0.0	2.37
Black maple	5,734	155	(N/A)	0.6	0.4	77.70
American elm	9,102	247	(N/A)	0.6	0.6	123.33
Honeylocust	7,590	206	(N/A)	0.6	0.5	102.84
Swamp white oak	3,764	102	(N/A)	0.3	0.3	102.01
Hickory	3,943	107	(N/A)	0.3	0.3	106.85
Black locust	3,764	102	(N/A)	0.3	0.3	102.01
Cottonwood	3,943	107	(N/A)	0.3	0.3	106.85
Broadleaf Deciduous Large	608	16	(N/A)	0.3	0.0	16.47
Broadleaf Deciduous Small	69	2	(N/A)	0.3	0.0	1.86
Ginkgo	1,857	50	(N/A)	0.3	0.1	50.33
Citywide total	1,429,117	38,729	(N/A)	100.0	100.0	116.65



**Table 3: Annual Air Quality Benefits**

Annual Air Quality Benefits of Public Trees																	
4/21/2020																	
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>								
Norway maple	70.7	12.2	34.0	3.1	380	141.3	20.4	19.4	131.6	874	-16.1	-60	416.8	1,194 (N/A)	29.8	12.06	
Green ash	70.8	11.3	31.8	3.2	371	151.8	22.1	21.1	144.0	945	0.0	0	456.1	1,317 (N/A)	25.0	15.86	
Silver maple	48.1	8.2	23.4	2.1	259	81.6	12.0	11.4	78.5	511	-25.0	-94	240.4	676 (N/A)	14.5	14.09	
Black walnut	23.4	3.7	10.3	1.0	122	43.0	6.3	6.0	40.9	268	0.0	0	134.7	390 (N/A)	6.3	18.59	
Red maple	4.0	0.7	1.9	0.2	22	10.7	1.6	1.5	10.1	67	-1.4	-5	29.3	83 (N/A)	3.6	6.92	
Norway spruce	5.8	1.1	4.6	0.7	38	9.3	1.4	1.3	8.9	58	-29.0	-109	4.1	-13 (N/A)	3.6	-1.07	
American basswood	10.7	1.8	5.0	0.5	57	20.9	3.0	2.9	19.7	130	-8.7	-32	55.9	154 (N/A)	3.3	14.05	
Pear	2.1	0.4	1.0	0.1	11	6.5	0.9	0.9	6.0	40	0.0	0	17.9	51 (N/A)	2.1	7.32	
Northern red oak	2.9	0.5	1.4	0.1	15	6.6	1.0	0.9	6.2	41	-4.1	-15	15.5	41 (N/A)	1.8	6.84	
Northern hackberry	6.1	1.1	3.0	0.3	33	12.5	1.8	1.7	11.8	78	0.0	0	38.2	110 (N/A)	1.8	18.41	
Littleleaf linden	1.1	0.2	0.6	0.0	6	4.0	0.6	0.6	3.8	25	-0.6	-2	10.4	29 (N/A)	1.5	5.83	
Black cherry	1.3	0.2	0.6	0.1	7	3.0	0.4	0.4	2.7	18	0.0	0	8.7	25 (N/A)	0.9	8.35	
Northern catalpa	2.7	0.4	1.2	0.1	14	4.4	0.6	0.6	4.2	27	0.0	0	14.3	42 (N/A)	0.6	20.79	
Paper birch	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6 (N/A)	0.6	2.99	
Broadleaf Deciduous Medi	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	0.6	0.67	
Black maple	1.5	0.3	0.7	0.1	8	2.7	0.4	0.4	2.6	17	-0.5	-2	8.1	23 (N/A)	0.6	11.54	
American elm	3.1	0.5	1.5	0.1	17	4.9	0.7	0.7	4.7	31	0.0	0	16.3	47 (N/A)	0.6	23.70	
Honeylocust	1.5	0.2	0.7	0.1	8	3.2	0.5	0.4	3.0	20	-1.1	-4	8.5	23 (N/A)	0.6	11.74	
Swamp white oak	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	0.3	13.58	
Hickory	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12 (N/A)	0.3	12.48	
Black locust	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	0.3	13.58	
Cottonwood	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12 (N/A)	0.3	12.48	
Broadleaf Deciduous Large	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)	0.3	2.99	
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.3	0.71	
Ginkgo	0.5	0.1	0.3	0.0	3	1.1	0.2	0.2	1.1	7	-0.2	-1	3.3	9 (N/A)	0.3	9.29	
Citywide total	259.4	43.4	123.1	12.0	1,386	515.6	74.9	71.4	487.5	3,207	-86.9	-326	1,500.5	4,267 (N/A)	100.0	12.85	

**Table 4: Annual Carbon Stored**

Stored CO2 Benefits of Public Trees						
4/21/2020						
Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	1,167,350	8,755	(N/A)	29.8	17.9	88.44
Green ash	2,378,164	17,836	(N/A)	25.0	36.5	214.89
Silver maple	1,132,725	8,495	(N/A)	14.5	17.4	176.99
Black walnut	794,707	5,960	(N/A)	6.3	12.2	283.82
Red maple	44,751	336	(N/A)	3.6	0.7	27.97
Norway spruce	75,416	566	(N/A)	3.6	1.2	47.14
American basswood	416,808	3,126	(N/A)	3.3	6.4	284.19
Pear	32,377	243	(N/A)	2.1	0.5	34.69
Northern red oak	61,125	458	(N/A)	1.8	0.9	76.41
Northern hackberry	101,611	762	(N/A)	1.8	1.6	127.01
Littleleaf linden	24,478	184	(N/A)	1.5	0.4	36.72
Black cherry	20,228	152	(N/A)	0.9	0.3	50.57
Northern catalpa	95,241	714	(N/A)	0.6	1.5	357.15
Paper birch	2,069	16	(N/A)	0.6	0.0	7.76
Broadleaf Deciduous	235	2	(N/A)	0.6	0.0	0.88
Black maple	15,891	119	(N/A)	0.6	0.2	59.59
American elm	60,993	457	(N/A)	0.6	0.9	228.72
Honeylocust	18,988	142	(N/A)	0.6	0.3	71.20
Swamp white oak	14,280	107	(N/A)	0.3	0.2	107.10
Hickory	15,773	118	(N/A)	0.3	0.2	118.30
Black locust	14,280	107	(N/A)	0.3	0.2	107.10
Cottonwood	15,773	118	(N/A)	0.3	0.2	118.30
Broadleaf Deciduous	1,035	8	(N/A)	0.3	0.0	7.76
Broadleaf Deciduous	178	1	(N/A)	0.3	0.0	1.33
Ginkgo	7,800	59	(N/A)	0.3	0.1	58.50
Citywide total	6,512,274	48,842	(N/A)	100.0	100.0	147.11

**Table 5: Annual Carbon Sequestered**

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

4/21/2020

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	19,133	143	-3,603	-351	-45	48,652	365	61,831	464	(N/A)	29.8	16.7	4.68
Green ash	68,611	515	-11,415	-357	-88	53,314	400	110,153	826	(N/A)	25.0	29.8	9.95
Silver maple	78,038	585	-5,437	-197	-42	29,107	218	101,510	761	(N/A)	14.5	27.4	15.86
Black walnut	18,140	136	-3,815	-104	-29	15,151	114	29,372	220	(N/A)	6.3	7.9	10.49
Red maple	2,755	21	-215	-21	-2	3,758	28	6,276	47	(N/A)	3.6	1.7	3.92
Norway spruce	617	5	-362	-47	-3	3,298	25	3,507	26	(N/A)	3.6	0.9	2.19
American basswood	21,134	159	-2,001	-55	-15	7,274	55	26,352	198	(N/A)	3.3	7.1	17.97
Pear	1,549	12	-155	-18	-1	2,238	17	3,614	27	(N/A)	2.1	1.0	3.87
Northern red oak	945	7	-293	-17	-2	2,313	17	2,947	22	(N/A)	1.8	0.8	3.68
Northern hackberry	3,515	26	-488	-27	-4	4,378	33	7,379	55	(N/A)	1.8	2.0	9.22
Littleleaf linden	1,475	11	-117	-11	-1	1,419	11	2,766	21	(N/A)	1.5	0.7	4.15
Black cherry	0	0	-97	-11	-1	1,004	8	897	7	(N/A)	0.9	0.2	2.24
Northern catalpa	1,391	10	-457	-11	-4	1,547	12	2,470	19	(N/A)	0.6	0.7	9.26
Paper birch	418	3	-10	-2	0	318	2	723	5	(N/A)	0.6	0.2	2.71
Broadleaf Deciduous M	101	1	-2	-1	0	72	1	170	1	(N/A)	0.6	0.0	0.64
Black maple	0	0	-76	-5	-1	954	7	872	7	(N/A)	0.6	0.2	3.27
American elm	1,290	10	-293	-10	-2	1,749	13	2,737	21	(N/A)	0.6	0.7	10.26
Honeylocust	936	7	-91	-5	-1	1,130	8	1,970	15	(N/A)	0.6	0.5	7.39
Swamp white oak	0	0	-69	-4	-1	539	4	466	3	(N/A)	0.3	0.1	3.49
Hickory	857	6	-76	-4	-1	552	4	1,330	10	(N/A)	0.3	0.4	9.97
Black locust	0	0	-69	-4	-1	539	4	466	3	(N/A)	0.3	0.1	3.49
Cottonwood	857	6	-76	-4	-1	552	4	1,330	10	(N/A)	0.3	0.4	9.97
Broadleaf Deciduous La	209	2	-5	-1	0	159	1	361	3	(N/A)	0.3	0.1	2.71
Broadleaf Deciduous Sn	38	0	-1	-1	0	37	0	74	1	(N/A)	0.3	0.0	0.55
Ginkgo	0	0	-37	-4	0	396	3	355	3	(N/A)	0.3	0.1	2.66
Citywide total	222,008	1,665	-31,260	-1,270	-244	180,450	1,353	369,928	2,774	(N/A)	100.0	100.0	8.36

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

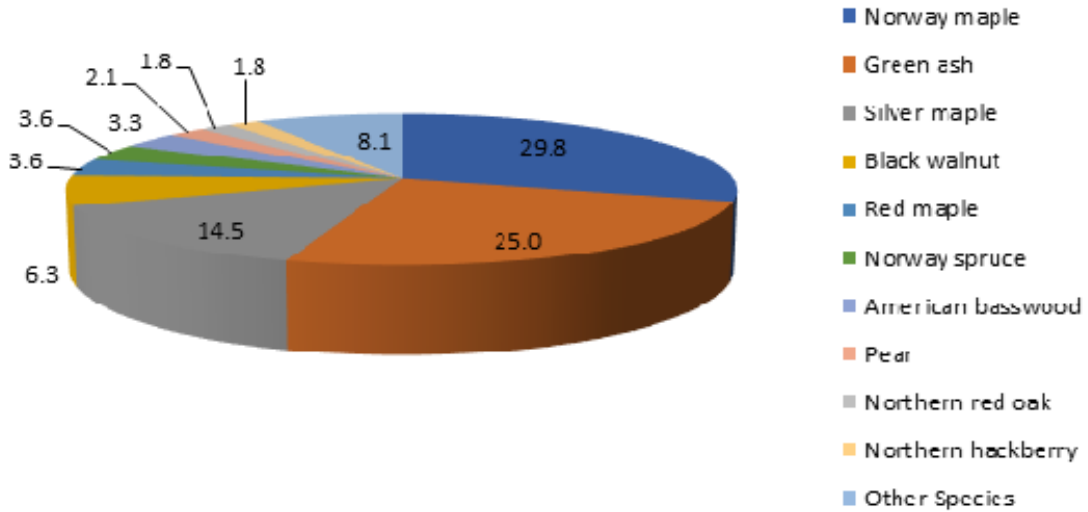
<b>Annual Aesthetic/Other Benefits of Public Trees</b>					
4/21/2020					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Norway maple	1,757	(N/A)	29.8	10.4	17.75
Green ash	4,831	(N/A)	25.0	28.7	58.20
Silver maple	5,808	(N/A)	14.5	34.5	121.00
Black walnut	1,185	(N/A)	6.3	7.0	56.45
Red maple	397	(N/A)	3.6	2.4	33.11
Norway spruce	83	(N/A)	3.6	0.5	6.95
American basswood	1,323	(N/A)	3.3	7.9	120.30
Pear	91	(N/A)	2.1	0.5	12.96
Northern red oak	76	(N/A)	1.8	0.4	12.61
Northern hackberry	417	(N/A)	1.8	2.5	69.45
Littleleaf linden	173	(N/A)	1.5	1.0	34.52
Black cherry	0	(N/A)	0.9	0.0	0.00
Northern catalpa	87	(N/A)	0.6	0.5	43.45
Paper birch	57	(N/A)	0.6	0.3	28.56
Broadleaf Deciduous Medi	16	(N/A)	0.6	0.1	7.81
Black maple	0	(N/A)	0.6	0.0	0.00
American elm	161	(N/A)	0.6	1.0	80.58
Honeylocust	195	(N/A)	0.6	1.2	97.30
Swamp white oak	0	(N/A)	0.3	0.0	0.00
Hickory	66	(N/A)	0.3	0.4	65.59
Black locust	0	(N/A)	0.3	0.0	0.00
Cottonwood	66	(N/A)	0.3	0.4	65.59
Broadleaf Deciduous Large	29	(N/A)	0.3	0.2	28.56
Broadleaf Deciduous Small	2	(N/A)	0.3	0.0	2.06
Ginkgo	0	(N/A)	0.3	0.0	0.00
Citywide total	16,818	(N/A)	100.0	100.0	50.66

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

<b>Annual Benefits of Public Trees by Species (\$/tree)</b>						
4/21/2020						
Species	Energy	CO <sub>2</sub>	Air Quality	Stomwater	Aesthetic/Other	Total (\$) Standard Error
Norway maple	64.60	4.68	12.06	87.24	17.75	186.34 (N/A)
Green ash	80.41	9.95	15.86	148.19	58.20	312.62 (N/A)
Silver maple	73.70	15.86	14.09	150.89	121.00	375.55 (N/A)
Black walnut	89.54	10.49	18.59	182.64	56.45	357.70 (N/A)
Redmaple	39.28	3.92	6.92	40.51	33.11	123.74 (N/A)
Norway spruce	34.08	2.19	-1.07	106.68	6.95	148.83 (N/A)
American basswood	84.61	17.97	14.05	163.66	120.30	400.58 (N/A)
Pear	41.56	3.87	7.32	23.96	12.96	89.68 (N/A)
Northern red oak	47.90	3.68	6.84	61.05	12.61	132.08 (N/A)
Northern hackberry	90.77	9.22	18.41	133.28	69.45	321.14 (N/A)
Littleleaf linden	35.32	4.15	5.83	38.94	34.52	118.75 (N/A)
Black cherry	46.14	2.24	8.35	31.82	0.00	88.55 (N/A)
Northern catalpa	94.83	9.26	20.79	196.17	43.45	364.51 (N/A)
Paper birch	20.64	2.71	2.99	16.47	28.56	71.37 (N/A)
Broadleaf Deciduou	5.04	0.64	0.67	2.37	7.81	16.54 (N/A)
Black maple	60.68	3.27	11.54	77.70	0.00	153.19 (N/A)
American elm	104.40	10.26	23.70	123.33	80.58	342.28 (N/A)
Honeylocust	69.53	7.39	11.74	102.84	97.30	288.81 (N/A)
Swamp white oak	70.84	3.49	13.58	102.01	0.00	189.93 (N/A)
Hickory	70.91	9.97	12.48	106.85	65.59	265.81 (N/A)
Black locust	70.84	3.49	13.58	102.01	0.00	189.93 (N/A)
Cottonwood	70.91	9.97	12.48	106.85	65.59	265.81 (N/A)
Broadleaf Deciduou	20.64	2.71	2.99	16.47	28.56	71.37 (N/A)
Broadleaf Deciduou	5.40	0.55	0.71	1.86	2.06	10.58 (N/A)
Ginkgo	49.28	2.66	9.29	50.33	0.00	111.57 (N/A)
<b>Citywide Total</b>	<b>68.69</b>	<b>8.36</b>	<b>12.85</b>	<b>116.65</b>	<b>50.66</b>	<b>257.21 (N/A)</b>

# Species Distribution of Public Trees

4/21/2020

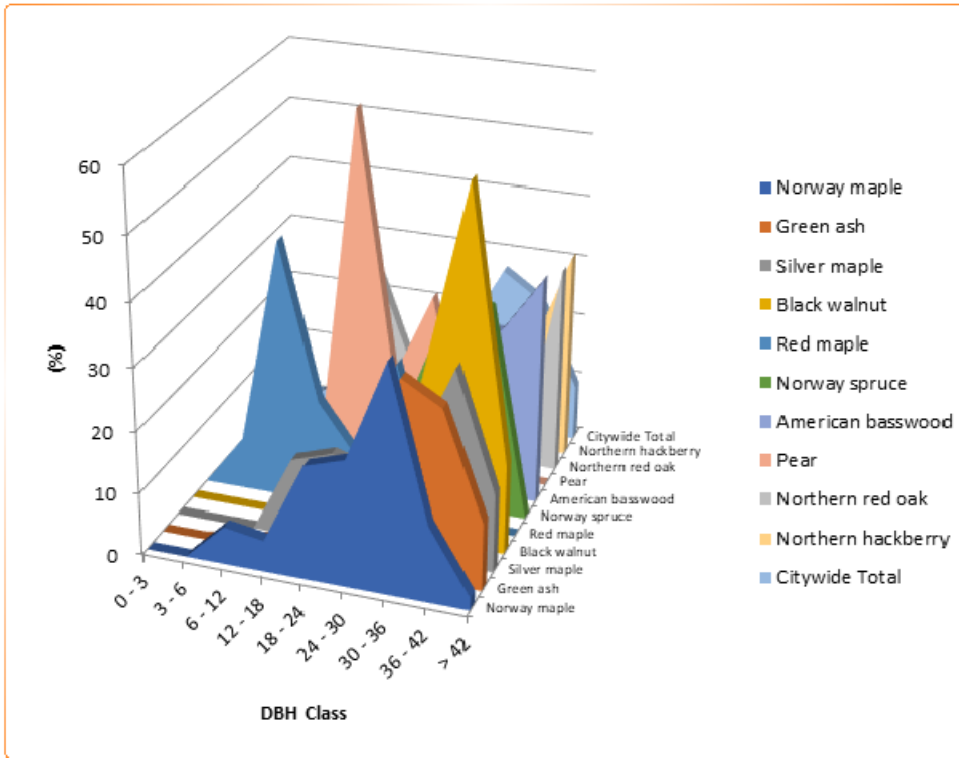


Species	Percent
Norway maple	29.8
Green ash	25.0
Silver maple	14.5
Black walnut	6.3
Red maple	3.6
Norway spruce	3.6
American basswood	3.3
Pear	2.1
Northern red oak	1.8
Northern hackberry	1.8
Other Species	8.1
Total	100.0

Figure 1: Species Distribution

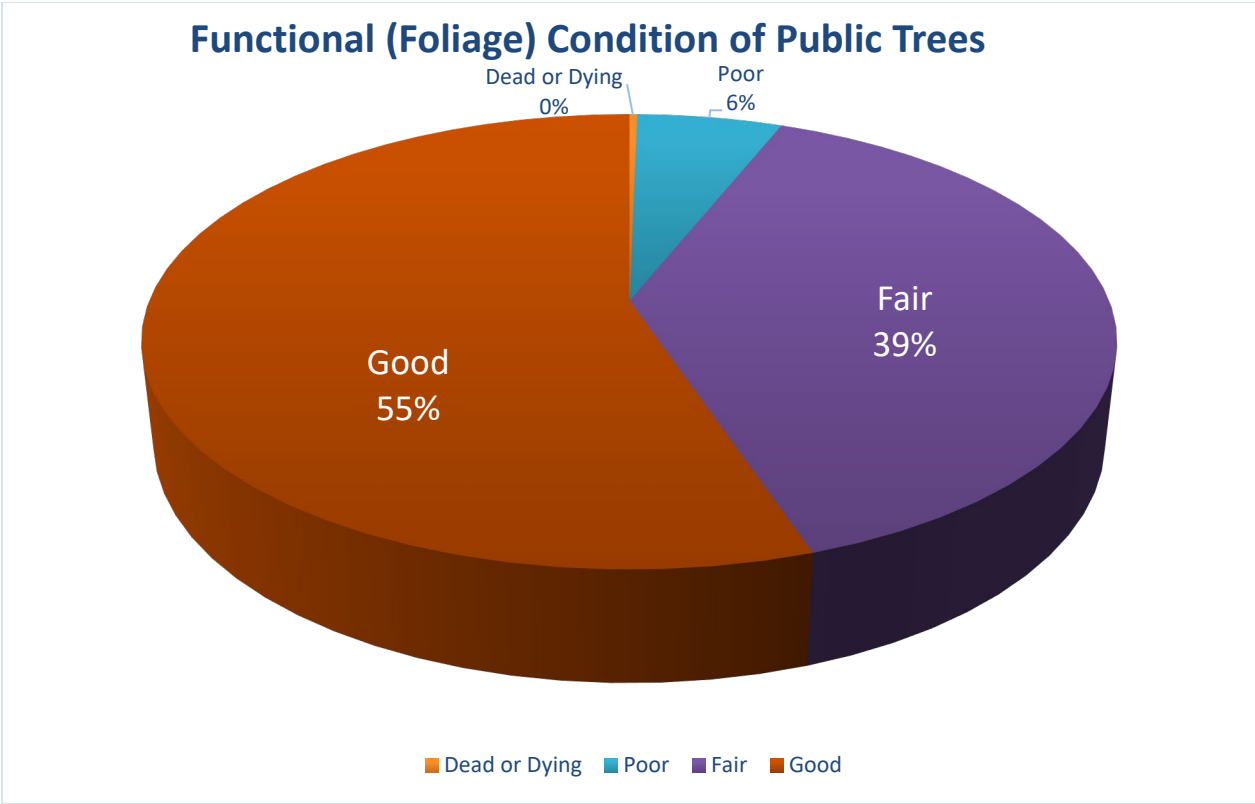
## Relative Age Distribution of Top 10 Public Tree Species for All Zones (%)

4/21/2020

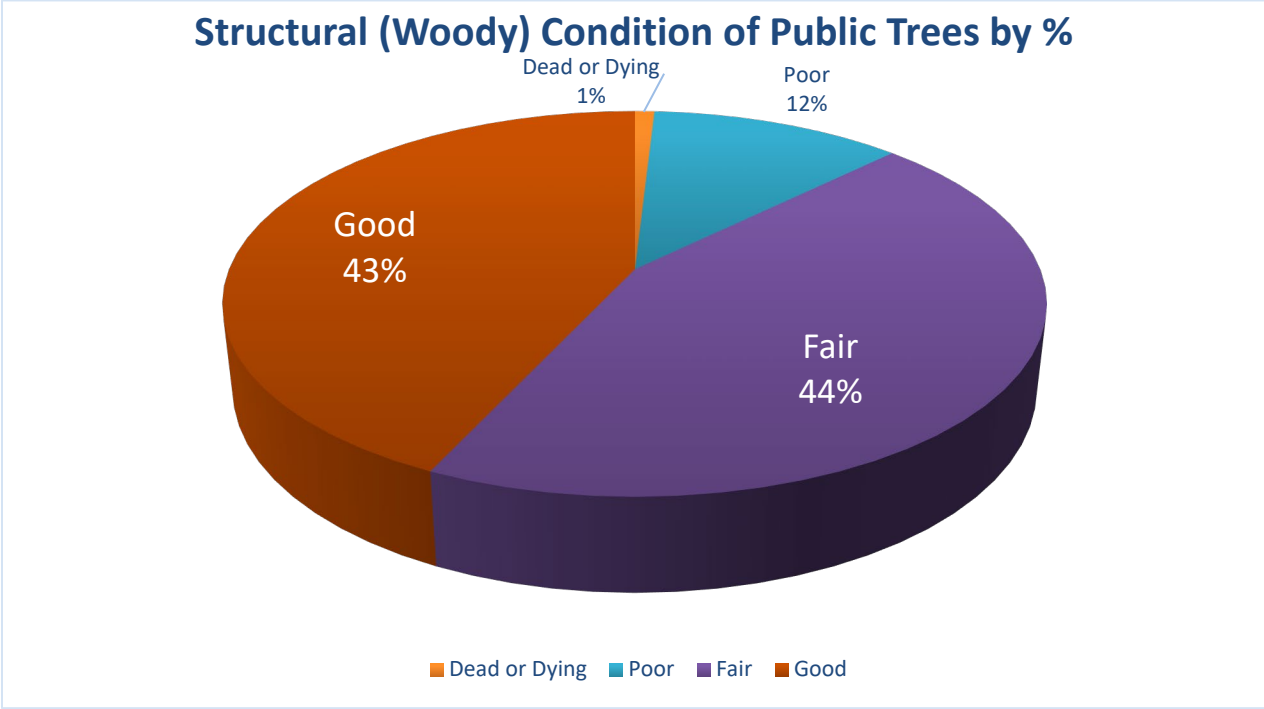


Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Norway maple	0.00	0.00	6.06	5.05	18.18	20.20	36.36	12.12	2.02
Green ash	0.00	0.00	1.20	2.41	9.64	16.87	31.33	27.71	10.84
Silver maple	0.00	0.00	0.00	12.50	14.58	12.50	16.67	31.25	12.50
Black walnut	0.00	0.00	0.00	0.00	0.00	0.00	28.57	57.14	14.29
Red maple	0.00	8.33	41.67	16.67	8.33	25.00	0.00	0.00	0.00
Norway spruce	0.00	0.00	16.67	0.00	0.00	16.67	33.33	33.33	0.00
American basswood	0.00	0.00	0.00	0.00	0.00	9.09	27.27	27.27	36.36
Pear	0.00	0.00	0.00	57.14	14.29	28.57	0.00	0.00	0.00
Northern red oak	0.00	0.00	0.00	33.33	16.67	0.00	16.67	0.00	33.33
Northern hackberry	0.00	0.00	0.00	16.67	0.00	16.67	16.67	16.67	33.33
Citywide Total	0.30	0.90	5.72	7.23	11.14	15.66	27.11	22.89	9.04

Figure 2: Relative Age Class



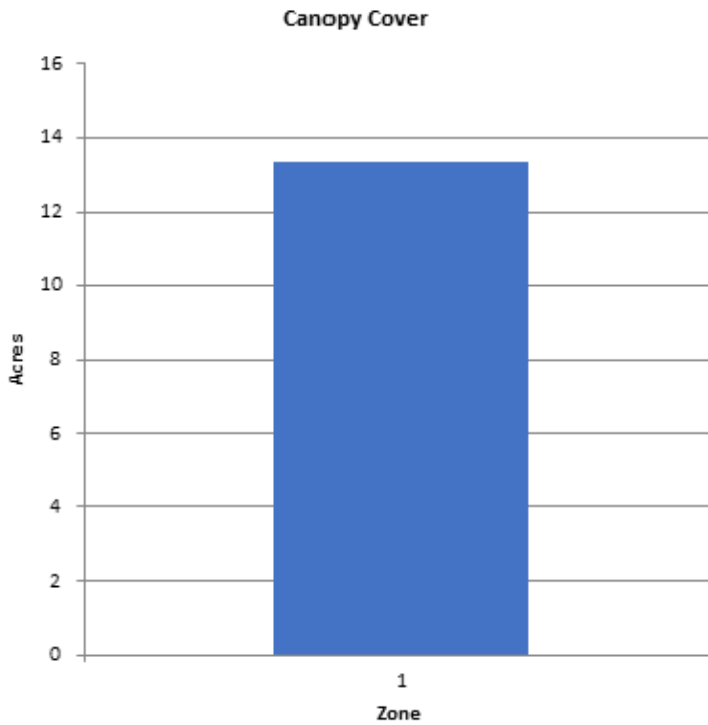
**Figure 3: Foliage Condition**



**Figure 4: Wood Condition**

# Canopy Cover of Public Trees (Acres)

4/21/2020

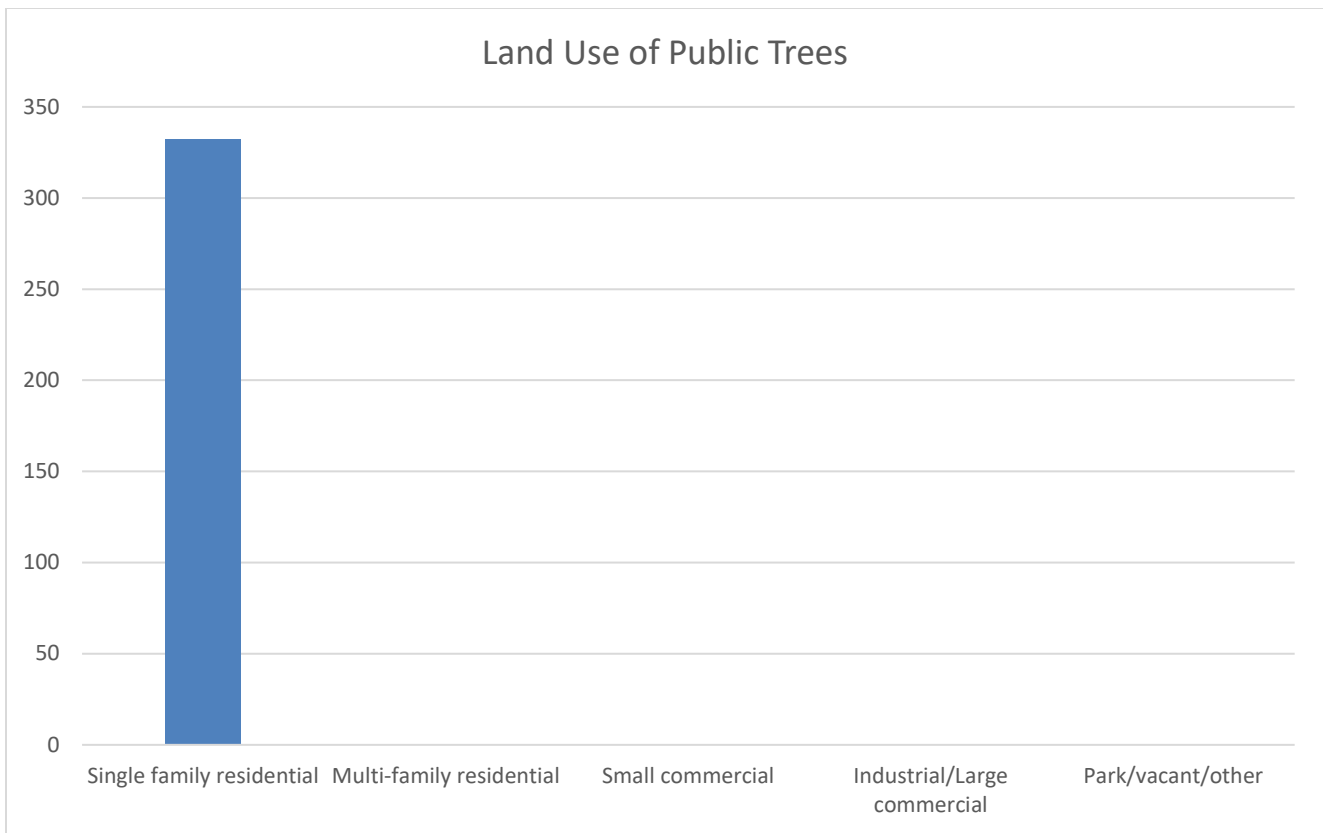


Zone	Acres	% of Total Canopy Cover
1	13	100.0
Citywide total	13	100.0

	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	13	0.00	0.00

Figure 5: Canopy Cover in Acres





**Figure 6: Land Use of city/park trees**

# Appendix B: ArcGIS Mapping

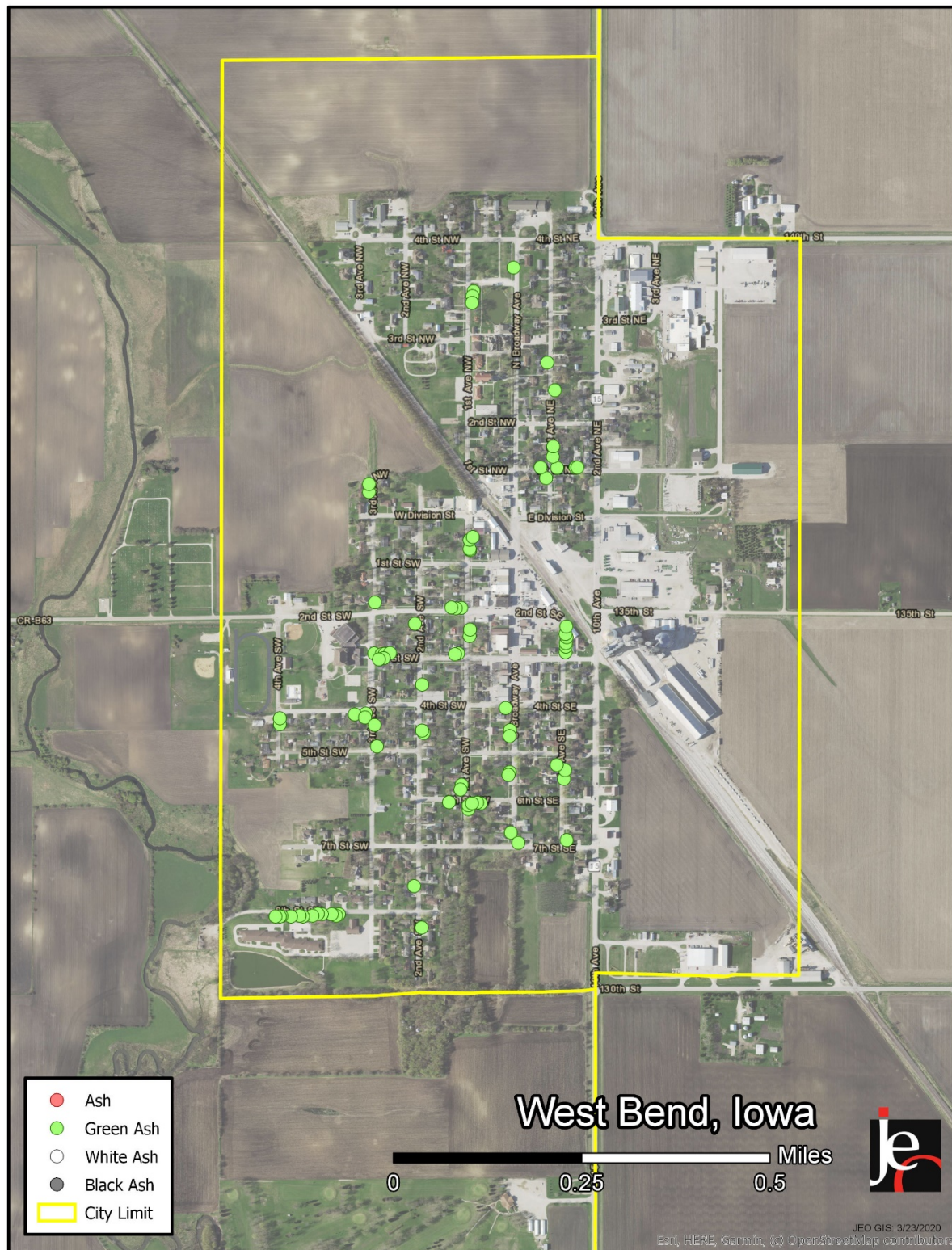
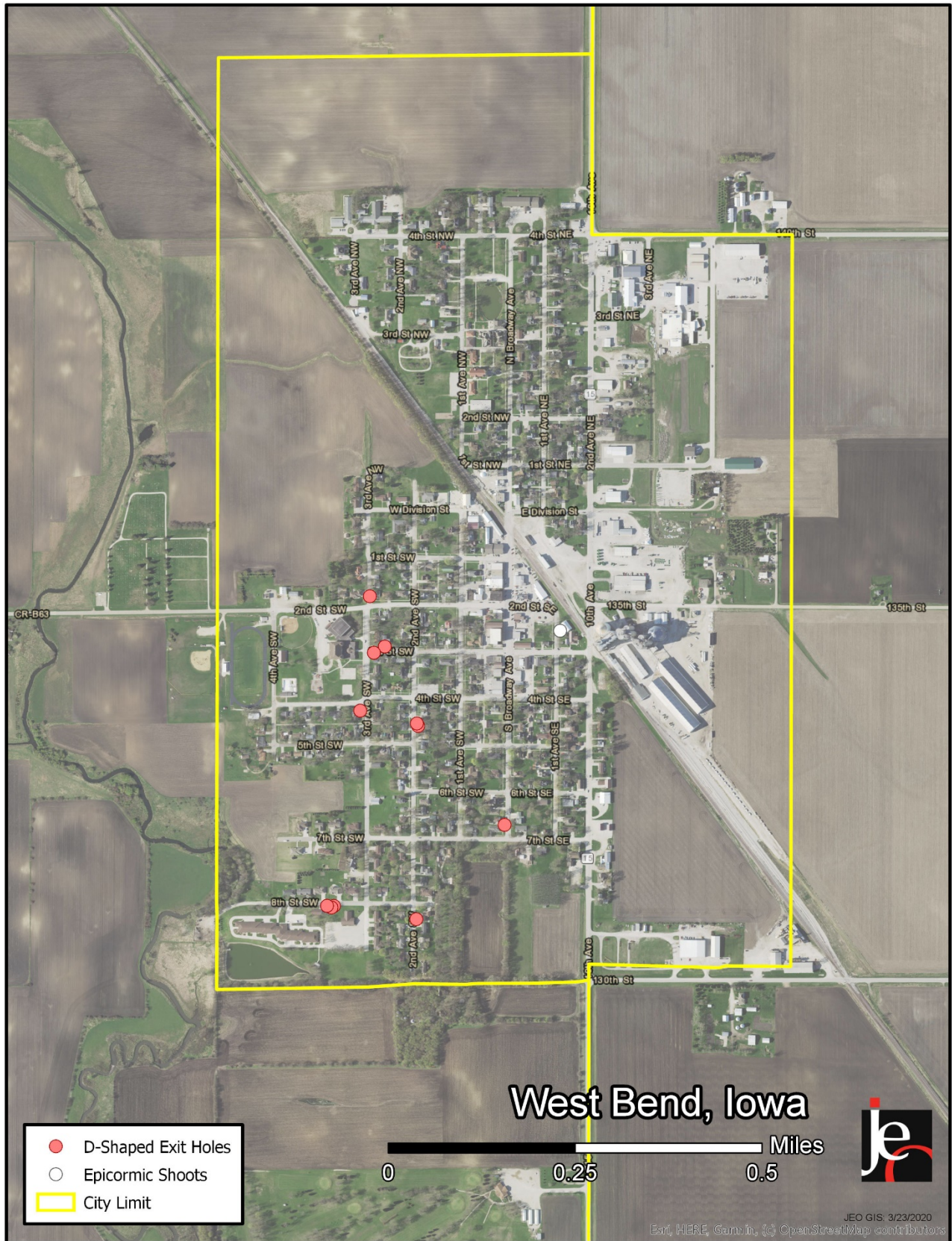
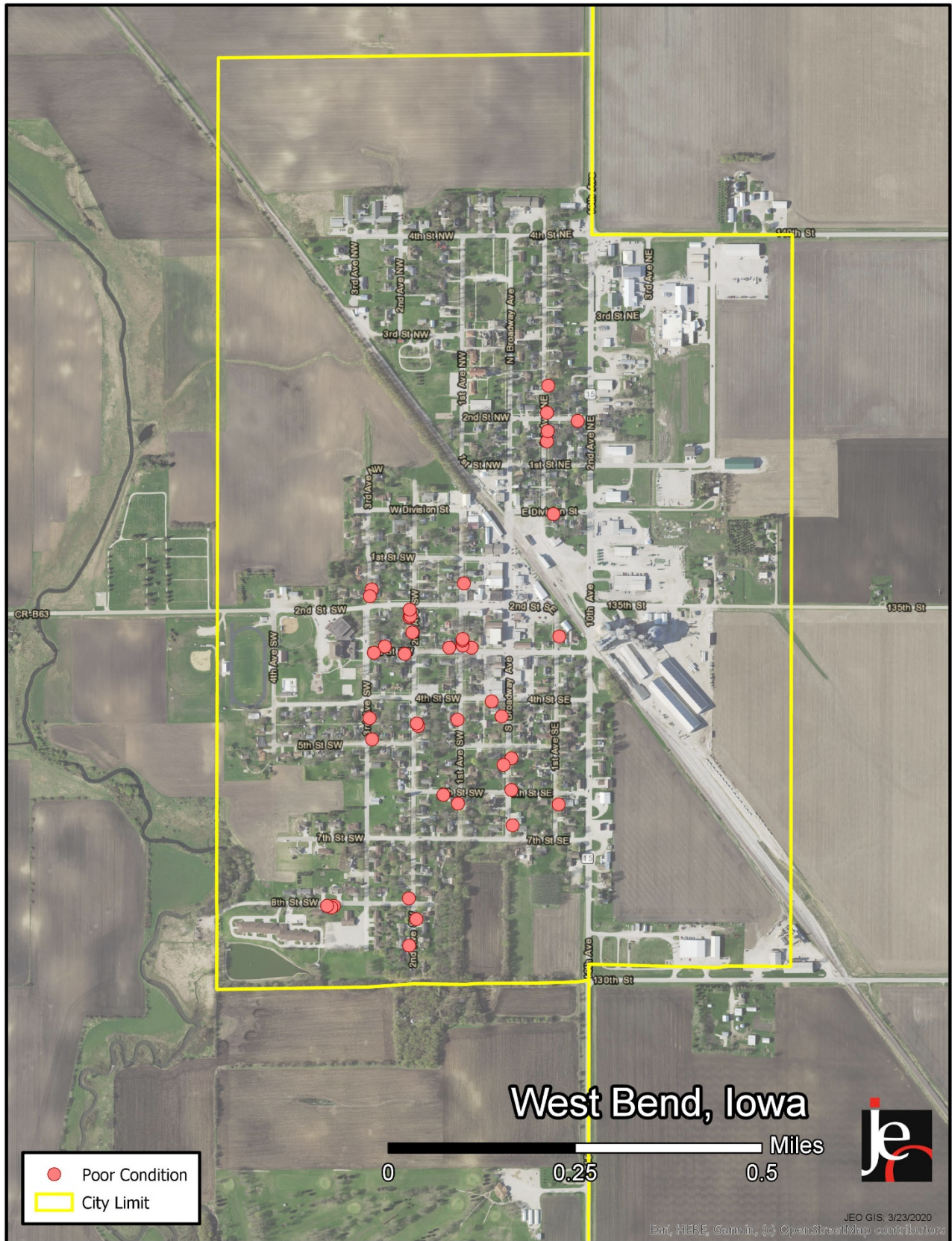


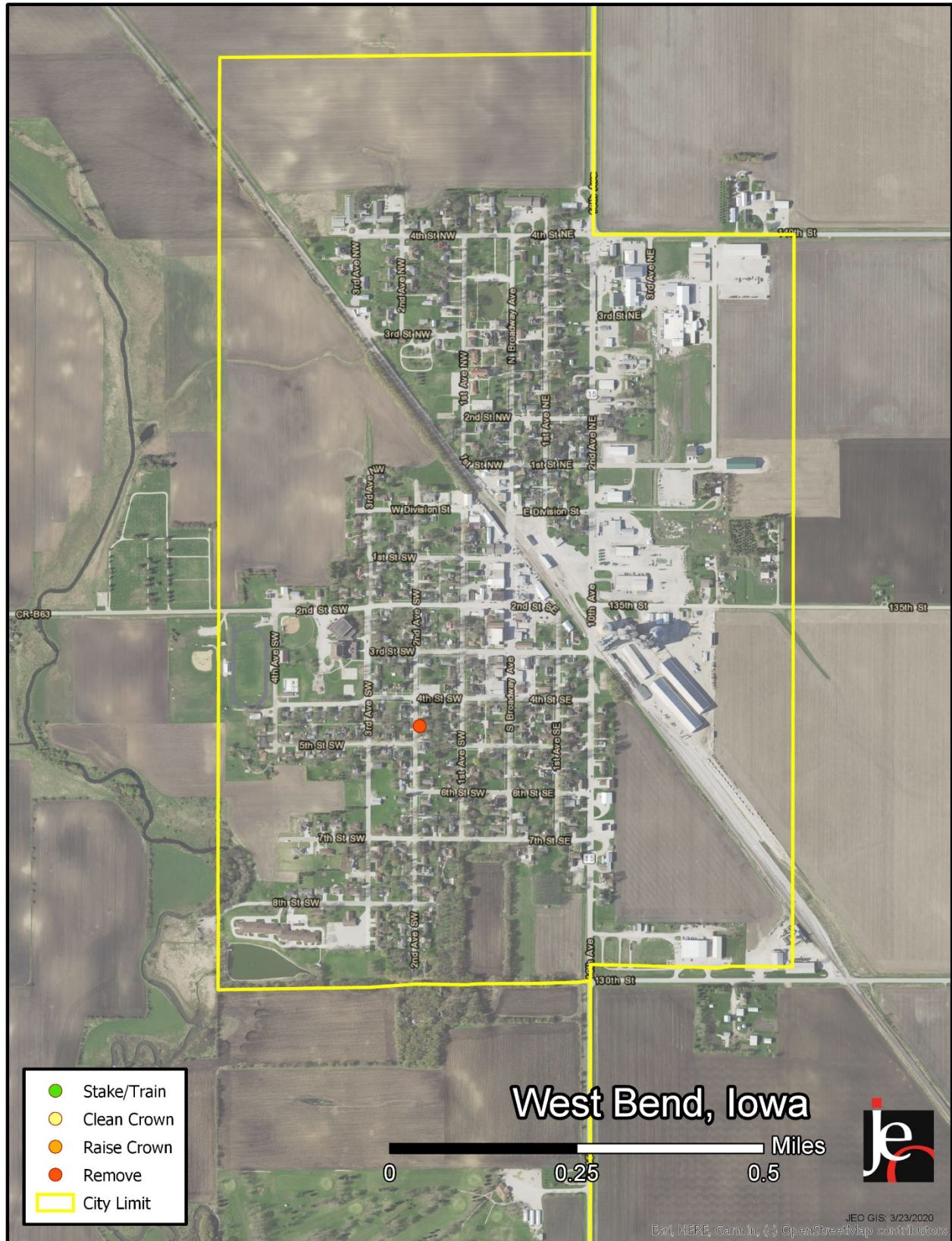
Figure 1: Location of Ash Trees



**Figure 2: Location of EAB symptoms**



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



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

# Appendix C: West Bend Tree Ordinances

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## CHAPTER 151 TREES

### 151.01 DEFINITION

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

### 151.02 PLANTING RESTRICTIONS

No tree shall be planted in any parking or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any parking which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, pine, willow or black walnut.
4. Planting Near Overhead Electric Lines. No trees will be planted closer than half the distance of the mature height of the tree to any overhead electric line. No trees will be planted in the parking where any overhead electric lines are present.
5. Planting Near Underground Electric and Gas Lines. No trees shall be planted closer than one fourth of the mature height of the tree to any underground electric or gas line. (Subsections 3-5 - Ord. 203 – Aug. 00 Supp.)

### 151.03 TRIMMING TREES TO BE SUPERV

It is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

### 151.04 DISEASE CONTROL

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

### 151.05 INSPECTION AND REMOVAL

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

1. Removal from City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, and that danger to other trees within the City is imminent, the authorized designee shall immediately cause such condition to be

corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. The Council or authorized designee may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

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

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

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

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