Sheldon, IA

2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES

Prepared By
Andrew Larson
JEO Consulting Group, Inc.

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Executive Summary

Overview

This plan was developed to assist the City of Sheldon 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 39% of Sheldon'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 1,718 trees inventoried.

- Sheldon's trees provide $372,608 of benefits annually, an average of $216.88 per tree
- There are over 28 species of trees
- The top three genera are: Ash 39%, Maple 33%, and Locust 4%
- 6% of trees need some type of management
- 6 trees should be removed

Recommendations

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

- Out of the 6 trees needing removal, 2 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately. *City ownership of the trees recommended for removal should be verified prior to any removal*
- 22 of the 672 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation.
- All trees should be pruned on a routine schedule: one third of the city every other year.
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.
- Check ash trees yearly with a visual survey.
- With the current estimated budget, it could take 45 years to remove ash. We suggest that city officials request a budget increase to $12,000 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist Sheldon 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 Sheldon, 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 Sheldon'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 Sheldon 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 Sheldon's urban forestry goals.

Inventory

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

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

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

Inventory Results

JEO entered the data collected for the 1,718 city trees into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Below are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Sheldon's trees reduce energy-related costs by approximately $94,543 annually (Appendix A, Table 1). These savings are both in electricity (453.3 MWh) and in natural gas (61,367 Therms).

Annual Stormwater Benefits

Sheldon's trees intercept about 5,101,637 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $138,254 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 Sheldon, it is estimated that trees remove 5,848.1 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $16,519 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Sheldon, trees sequester about 1,182,878 lbs of carbon per year with an associated value of $8,872 (Appendix A, Table 5). In addition, the trees store 18,916,377 lbs of carbon, with a yearly benefit of $141,873 (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. Sheldon receives $109,435 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, Sheldon's trees provide $372,608 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1,718 trees in Sheldon provide approximately $216.88 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Sheldon has over 28 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Ash	672	39%
Maple	575	33%
Locust	72	4%
Cottonwood	70	4%
Linden/Basswood	68	4%
Broadleaf Deciduous Other	65	4%
Oak	49	3%
Spruce	39	2.5%
Hackberry	30	2%
Birch	10	<1%
Conifer Evergreen	10	<1%
Pear	10	<1%
Walnut	9	<1%
Boxelder	5	<1%
Chokecherry	5	<1%
Mountain Ash	5	<1%
Apple	3	<1%
Buckeye	3	<1%
Catalpa	2	<1%
Elm	2	<1%
American Sycamore	2	<1%
Willow	2	<1%
Juniper	2	<1%
Alder	1	<1%
Kentucky Coffeetree	1	<1%
Ginkgo	1	<1%
Mulberry	1	<1%
Eastern redbud	1	<1%
Sumac	1	<1%

Age Class

Most of Sheldon's trees (46%) are between 18 and 30 inches in diameter at 4.5 ft (Appendix A, Figure 2). To prepare for natural mortality and to maintain canopy cover, most trees should be in the smallest size category (a downward slope), indicating youth. Sheldon's size curve indicates an average aged 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 Sheldon indicate that 68% of the trees are in good health, with only 3% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 67% of Sheldon's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Three percent of the tree population's wood condition is in poor health, dead, or dying. This 3% is an estimate of trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

Crown Cleaning	0	0%
Crown Raising	0	0%
Tree Staking	0	0%
Tree Removal	6	<1%
Crown Reduction	0	0%
Treat Pest/Disease	88	5%

Land Use and Location

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

Land Use	
Single family residential	79%
Park/vacant/other	0%
Industrial/Large commercial	21%
Small commercial	0%
Multifamily residential	0%

Recommendations

Risk Management

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

Hazardous trees

Sheldon has 6 trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter, critical concern trees first. There are 2 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 a total of 94 trees with maintenance needs.

Poor tree species

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 6 removals, 2 are ash trees. There are a total of 672 ash trees, and 5 of those have signs and symptoms that have been associated with EAB. In addition, there are 44 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising removes lower branches that are two inches in diameter or larger to provide clearance for pedestrians or vehicles. Crown reduction removes individual limbs from structures or utility wires. We recommend that all trees be pruned on a routine schedule every five to seven years. Please refer to the Six Year Maintenance Plan for further information.

Planting

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

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 both ash (39%) and maple (33%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Continual Monitoring

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

Emerald Ash Borer Plan

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

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

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

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

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

Wood Disposal

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

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

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

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

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

Proposed Work Schedule and Budget

Budget Allowance of $10,376/Year – (Based off $2/Capita Calculation Due to no City Reporting)

YEAR 1	**ESTIMATED COSTS**
Remove 6 trees recommended for immediate removal	$4,200
Remove 6 ash trees (prioritize largest diameter)	$4,200
Plant 13 trees in open locations	$1,950
Visual Survey of EAB Signs/Symptoms	

YEAR 2	
Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 2 trees in open locations	$300
Prune 1/3 of City Owned Trees	$8,595
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 12 ash trees (prioritize largest diameter)	$8,400
Plant 13 trees in open locations	$1,950
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 2 trees in open locations	$300
Prune 1/3 of City Owned Trees	$8,595
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 12 ash trees (prioritize largest diameter)	$8,400
Plant 13 trees in open locations	$1,950
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 2 ash trees (prioritize largest diameter)	$1,400
Plant 2 trees in open locations	$300
Prune 1/3 of City Owned Trees	$8,595
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 $78,400 a year. If the budget were increased to $12,000 a year all ash could be removed in 39 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of $12,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	**ESTIMATED COSTS**
Remove 6 trees recommended for immediate removal	$4,200
Remove 9 ash trees (prioritize largest diameter)	$6,300
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 3 ash trees (prioritize largest diameter)	$2,100
Plant 8 trees in open locations	$1,200
Prune 1/3 of City Owned Trees	$8,595
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 15 ash trees (prioritize largest diameter)	$10,500
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 3 ash trees	$2,100
Plant 8 trees in open locations	$1,200
Prune 1/3 of City Owned Trees	$8,595
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 15 ash trees	$10,500
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 3 ash trees	$2,100
Plant 8 trees in open locations	$1,200
Prune 1/3 of City Owned Trees	$8,595
Visual Survey of EAB Signs/Symptoms	

Purposed Budget Increase

EAB could potentially kill all ash trees in Sheldon within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $78,400 a year. If the budget were increased to $12,000 per year all ash could be removed within 39 years. Additionally, we recommend that Sheldon 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 Sheldon would still need to find $464,800 for removal of the remaining ash. Alternatively, if there are 20 treatable trees, it would cost approximately $6,000 a year for treatment and leave roughly $4,500 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 Sheldon We suggest considering an increased budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

4/22/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	174.0	13,207	23,381.4	22,914	36,121	(N/A)	38.8	38.2	54.24
Silver maple	112.1	8,505	14,759.4	14,464	22,969	(N/A)	19.8	24.3	67.56
Norway maple	34.8	2,640	5,035.4	4,935	7,575	(N/A)	7.8	8.0	56.53
Sugar maple	22.1	1,681	3,021.6	2,961	4,642	(N/A)	4.5	4.9	59.51
Cottonwood	27.9	2,119	3,755.4	3,680	5,800	(N/A)	4.0	6.1	84.05
Honeylocust	18.8	1,428	2,456.0	2,407	3,835	(N/A)	3.9	4.1	57.24
American basswood	15.1	1,146	2,148.0	2,105	3,251	(N/A)	3.8	3.4	49.25
Broadleaf Deciduous Med	4.8	366	742.4	728	1,094	(N/A)	3.6	1.2	17.64
Northern hackberry	9.9	748	1,401.5	1,373	2,121	(N/A)	1.7	2.2	70.72
Blue spruce	2.9	223	399.4	391	614	(N/A)	1.2	0.6	29.26
Red maple	3.7	281	466.5	457	738	(N/A)	1.2	0.8	36.90
Northern red oak	2.5	192	354.9	348	539	(N/A)	1.0	0.6	29.97
Norway spruce	2.3	175	294.9	289	464	(N/A)	0.9	0.5	28.97
Bur oak	1.6	118	208.3	204	323	(N/A)	0.8	0.3	23.04
River birch	1.5	117	222.9	218	336	(N/A)	0.6	0.4	33.56
Pear	1.1	82	170.8	167	250	(N/A)	0.6	0.3	24.98
Black walnut	2.4	181	333.7	327	508	(N/A)	0.5	0.5	56.50
White oak	1.4	104	192.4	189	292	(N/A)	0.5	0.3	32.48
Conifer Evergreen Large	0.4	31	68.9	68	98	(N/A)	0.5	0.1	10.92
White ash	1.9	143	233.5	229	372	(N/A)	0.3	0.4	62.02
Mountain ash	0.7	54	106.6	104	159	(N/A)	0.3	0.2	31.76
Boxelder	0.4	30	56.7	56	86	(N/A)	0.3	0.1	17.18
Black locust	1.3	100	185.5	182	282	(N/A)	0.3	0.3	56.35
Common chokecherry	0.6	46	94.8	93	139	(N/A)	0.3	0.1	27.77
Swamp white oak	0.4	27	48.1	47	74	(N/A)	0.2	0.1	18.43
Northern pin oak	1.3	97	189.7	186	283	(N/A)	0.2	0.3	70.84
Ohio buckeye	1.0	73	142.2	139	213	(N/A)	0.2	0.2	70.84
Apple	0.4	34	62.2	61	94	(N/A)	0.2	0.1	31.49
Black maple	0.9	65	119.7	117	182	(N/A)	0.2	0.2	60.68
Broadleaf Deciduous Sma	0.2	14	25.9	25	40	(N/A)	0.2	0.0	13.29
Northern catalpa	0.8	63	112.7	110	173	(N/A)	0.1	0.2	86.52
Littleleaf linden	0.3	21	36.4	36	57	(N/A)	0.1	0.1	28.48
American sycamore	0.8	59	107.4	105	164	(N/A)	0.1	0.2	82.02
Broadleaf Evergreen Medi	0.2	13	25.4	25	38	(N/A)	0.1	0.0	18.82
Juniper	0.2	17	32.9	32	49	(N/A)	0.1	0.1	24.57
Black spruce	0.3	21	39.0	38	59	(N/A)	0.1	0.1	29.65
Willow	0.6	49	94.8	93	142	(N/A)	0.1	0.1	70.84
American elm	0.5	35	61.1	60	94	(N/A)	0.1	0.1	94.34
Kentucky coffeetree	0.2	18	27.0	26	44	(N/A)	0.1	0.0	44.23
Chinese elm	0.1	7	13.7	13	21	(N/A)	0.1	0.0	20.64
Alder	0.2	15	31.6	31	46	(N/A)	0.1	0.0	46.14
Eastern redbud	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Eastern cottonwood	0.2	18	27.0	26	44	(N/A)	0.1	0.0	44.23
Sumac	0.2	14	24.7	24	38	(N/A)	0.1	0.0	38.13
Conifer Evergreen Small	0.1	8	16.4	16	25	(N/A)	0.1	0.0	24.57
White mulberry	0.2	15	31.6	31	46	(N/A)	0.1	0.0	46.14
Ginkgo	0.0	2	3.0	3	5	(N/A)	0.1	0.0	4.50
Total	453.3	34,404	61,367.0	60,140	94,543	(N/A)	100.0	100.0	55.03

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

4/22/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	1,686,514	45,705	(N/A)	38.8	33.1	68.63
Silver maple	1,629,737	44,166	(N/A)	19.8	31.9	129.90
Norway maple	335,130	9,082	(N/A)	7.8	6.6	67.78
Sugar maple	250,429	6,787	(N/A)	4.5	4.9	87.01
Cottonwood	404,424	10,960	(N/A)	4.0	7.9	158.84
Honeylocust	195,837	5,307	(N/A)	3.9	3.8	79.21
American basswood	133,970	3,631	(N/A)	3.8	2.6	55.01
Broadleaf Deciduous Medi	29,746	806	(N/A)	3.6	0.6	13.00
Northern hackberry	87,578	2,373	(N/A)	1.7	1.7	79.11
Blue spruce	46,556	1,262	(N/A)	1.2	0.9	60.08
Red maple	23,557	638	(N/A)	1.2	0.5	31.92
Northern red oak	24,394	661	(N/A)	1.0	0.5	36.73
Norway spruce	41,990	1,138	(N/A)	0.9	0.8	71.12
Bur oak	13,535	367	(N/A)	0.8	0.3	26.20
River birch	12,593	341	(N/A)	0.6	0.2	34.13
Pear	4,359	118	(N/A)	0.6	0.1	11.81
Black walnut	26,534	719	(N/A)	0.5	0.5	79.90
White oak	16,559	449	(N/A)	0.5	0.3	49.86
Conifer Evergreen Large	4,211	114	(N/A)	0.5	0.1	12.68
White ash	19,837	538	(N/A)	0.3	0.4	89.60
Mountain ash	3,036	82	(N/A)	0.3	0.1	16.46
Boxelder	2,713	74	(N/A)	0.3	0.1	14.71
Black locust	11,541	313	(N/A)	0.3	0.2	62.55
Common chokecherry	2,634	71	(N/A)	0.3	0.1	14.28
Swamp white oak	1,897	51	(N/A)	0.2	0.0	12.85
Northern pin oak	15,057	408	(N/A)	0.2	0.3	102.01
Ohio buckeye	11,293	306	(N/A)	0.2	0.2	102.01
Apple	1,598	43	(N/A)	0.2	0.0	14.43
Black maple	8,601	233	(N/A)	0.2	0.2	77.70
Broadleaf Deciduous Smal	681	18	(N/A)	0.2	0.0	6.16
Northern catalpa	12,729	345	(N/A)	0.1	0.2	172.48
Littleleaf linden	1,720	47	(N/A)	0.1	0.0	23.31
American sycamore	10,981	298	(N/A)	0.1	0.2	148.79
Broadleaf Evergreen Medi	1,354	37	(N/A)	0.1	0.0	18.34
Juniper	3,269	89	(N/A)	0.1	0.1	44.30
Black spruce	4,625	125	(N/A)	0.1	0.1	62.66
Willow	7,529	204	(N/A)	0.1	0.1	102.01
American elm	4,551	123	(N/A)	0.1	0.1	123.33
Kentucky coffeetree	1,466	40	(N/A)	0.1	0.0	39.72
Chinese elm	608	16	(N/A)	0.1	0.0	16.47
Alder	1,174	32	(N/A)	0.1	0.0	31.82
Eastern redbud	69	2	(N/A)	0.1	0.0	1.86
Eastern cottonwood	1,466	40	(N/A)	0.1	0.0	39.72
Sumac	667	18	(N/A)	0.1	0.0	18.06
Conifer Evergreen Small	1,635	44	(N/A)	0.1	0.0	44.30
White mulberry	1,174	32	(N/A)	0.1	0.0	31.82
Ginkgo	82	2	(N/A)	0.1	0.0	2.22
Citywide total	5,101,637	138,254	(N/A)	100.0	100.0	80.47

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

4/22/2020

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_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Green ash	185.8	29.7	95.0	8.3	1,001	827.0	120.7	115.1	788.7	5,161	0.0	0	2,168.4	6,162 (N/A)	38.8	9.25
Silver maple	279.2	47.3	137.0	12.4	1,505	528.2	77.3	73.8	506.8	3,305	-141.8	-532	1,520.3	4,278 (N/A)	19.8	12.58
Norway maple	69.6	12.0	34.0	3.1	375	168.8	24.4	23.2	157.8	1,045	-16.2	-61	476.7	1,360 (N/A)	7.8	10.15
Sugar maple	33.1	5.6	16.5	1.5	179	105.5	15.4	14.7	100.3	658	-25.9	-97	266.6	740 (N/A)	4.5	9.48
Cottonwood	70.3	11.2	31.2	3.1	367	132.7	19.4	18.5	126.5	828	0.0	0	413.0	1,196 (N/A)	4.0	17.33
Honeylocust	37.7	6.2	17.3	1.7	199	88.6	13.0	12.4	85.2	555	-29.0	-109	233.0	645 (N/A)	3.9	9.63
American basswood	15.6	2.7	8.2	0.7	85	72.9	10.6	10.1	68.5	452	-14.1	-53	175.0	485 (N/A)	3.8	7.35
Broadleaf Deciduous Medi	3.9	0.7	2.3	0.2	22	23.8	3.4	3.2	21.9	147	-1.1	-4	58.2	164 (N/A)	3.6	2.65
Northern hackberry	12.8	2.2	6.6	0.6	70	47.6	6.9	6.6	44.7	295	0.0	0	128.0	365 (N/A)	1.7	12.18
Blue spruce	7.1	1.4	5.8	0.9	47	14.0	2.0	1.9	13.3	87	-17.7	-67	28.6	67 (N/A)	1.2	3.20
Red maple	4.5	0.8	2.2	0.2	24	17.3	2.5	2.4	16.8	109	-1.7	-6	45.1	127 (N/A)	1.2	6.34
Northern red oak	5.0	0.9	2.5	0.2	27	12.1	1.8	1.7	11.4	75	-7.2	-27	28.4	75 (N/A)	1.0	4.19
Norway spruce	4.9	1.0	4.0	0.6	32	10.8	1.6	1.5	10.4	68	-19.4	-73	15.3	27 (N/A)	0.9	1.69
Bur oak	1.3	0.2	0.7	0.1	7	7.4	1.1	1.0	7.1	46	0.0	0	18.8	53 (N/A)	0.8	3.81
River birch	2.4	0.4	1.2	0.1	13	7.5	1.1	1.0	7.0	46	-0.6	-2	20.1	57 (N/A)	0.6	5.70
Pear	1.2	0.2	0.6	0.1	6	5.4	0.8	0.7	4.9	33	0.0	0	13.8	39 (N/A)	0.6	3.93
Black walnut	3.2	0.5	1.5	0.1	17	11.5	1.7	1.6	10.8	71	0.0	0	30.9	88 (N/A)	0.5	9.82
White oak	2.1	0.3	1.0	0.1	11	6.6	1.0	0.9	6.2	41	0.0	0	18.2	52 (N/A)	0.5	5.79
Conifer Evergreen Large	0.3	0.1	0.4	0.0	2	2.1	0.3	0.3	1.8	12	-1.2	-4	4.1	11 (N/A)	0.5	1.17
White ash	3.0	0.5	1.4	0.1	16	8.8	1.3	1.2	8.5	55	0.0	0	24.9	71 (N/A)	0.3	11.85
Mountain ash	0.9	0.2	0.4	0.0	5	3.5	0.5	0.5	3.2	22	0.0	0	9.3	27 (N/A)	0.3	5.31
Boxelder	0.2	0.0	0.1	0.0	1	1.9	0.3	0.3	1.8	12	-0.1	0	4.5	13 (N/A)	0.3	2.50
Black locust	2.3	0.4	1.1	0.1	12	6.3	0.9	0.9	6.0	39	-0.5	-2	17.5	50 (N/A)	0.3	9.95
Common chokecherry	0.8	0.1	0.4	0.0	4	3.0	0.4	0.4	2.7	18	0.0	0	7.9	23 (N/A)	0.3	4.51
Swamp white oak	0.2	0.0	0.1	0.0	1	1.7	0.2	0.2	1.6	10	-0.1	0	4.1	12 (N/A)	0.2	2.89
Northern pin oak	3.5	0.6	1.6	0.2	19	6.3	0.9	0.9	5.8	39	-0.8	-3	18.9	54 (N/A)	0.2	13.58
Ohio buckeye	2.6	0.4	1.2	0.1	14	4.7	0.7	0.6	4.4	29	-0.6	-2	14.2	41 (N/A)	0.2	13.58
Apple	0.5	0.1	0.2	0.0	2	2.1	0.3	0.3	2.0	13	0.0	0	5.5	16 (N/A)	0.2	5.22
Black maple	2.2	0.4	1.0	0.1	12	4.1	0.6	0.6	3.9	25	-0.7	-3	12.1	35 (N/A)	0.2	11.54
Broadleaf Deciduous Smal	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	0.0	0	2.4	7 (N/A)	0.2	2.26
Northern catalpa	2.0	0.3	0.9	0.1	10	3.9	0.6	0.5	3.7	25	0.0	0	12.0	35 (N/A)	0.1	17.37
Littleleaf linden	0.2	0.0	0.1	0.0	1	1.3	0.2	0.2	1.3	8	-0.1	0	3.2	9 (N/A)	0.1	4.49
American sycamore	1.6	0.3	0.7	0.1	8	3.7	0.5	0.5	3.5	23	0.0	0	10.9	31 (N/A)	0.1	15.71
Broadleaf Evergreen Medi	0.0	0.0	0.1	0.0	0	0.8	0.1	0.1	0.8	5	-0.3	-1	1.6	4 (N/A)	0.1	2.10
Juniper	0.7	0.1	0.5	0.1	4	1.1	0.2	0.1	1.0	7	-1.8	-7	2.0	4 (N/A)	0.1	2.19
Black spruce	0.7	0.1	0.6	0.1	5	1.3	0.2	0.2	1.3	8	-1.8	-7	2.7	6 (N/A)	0.1	3.10
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
American elm	0.9	0.2	0.5	0.0	5	2.2	0.3	0.3	2.1	13	0.0	0	6.4	19 (N/A)	0.1	18.52
Kentucky coffeetree	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Chinese elm	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)	0.1	2.99
Alder	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	0.1	8.35
Eastern redbud	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)	0.1	0.71
Eastern cottonwood	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Sumac	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.1	6.56
Conifer Evergreen Small	0.3	0.1	0.3	0.0	2	0.5	0.1	0.1	0.5	3	-0.9	-3	1.0	2 (N/A)	0.1	2.19
White mulberry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	0.1	8.35
Ginkgo	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	1 (N/A)	0.1	0.64
Citywide total	765.8	127.8	378.7	35.2	4,132	2,156.7	314.5	300.0	2,053.5	13,452	-284.0	-1,065	5,848.1	16,519 (N/A)	100.0	9.62

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

4/22/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	6,018,943	45,142	(N/A)	38.8	31.8	67.78
Silver maple	6,099,357	45,745	(N/A)	19.8	32.2	134.54
Norway maple	1,144,384	8,583	(N/A)	7.8	6.0	64.05
Sugar maple	938,937	7,042	(N/A)	4.5	5.0	90.28
Cottonwood	2,409,310	18,070	(N/A)	4.0	12.7	261.88
Honeylocust	483,539	3,627	(N/A)	3.9	2.6	54.13
American basswood	562,635	4,220	(N/A)	3.8	3.0	63.94
Broadleaf Deciduou	70,191	526	(N/A)	3.6	0.4	8.49
Northern hackberry	184,822	1,386	(N/A)	1.7	1.0	46.21
Blue spruce	54,868	412	(N/A)	1.2	0.3	19.60
Red maple	52,329	392	(N/A)	1.2	0.3	19.62
Northern red oak	107,451	806	(N/A)	1.0	0.6	44.77
Norway spruce	46,769	351	(N/A)	0.9	0.2	21.92
Bur oak	42,944	322	(N/A)	0.8	0.2	23.01
River birch	39,766	298	(N/A)	0.6	0.2	29.82
Pear	19,172	144	(N/A)	0.6	0.1	14.38
Black walnut	103,233	774	(N/A)	0.5	0.5	86.03
White oak	69,209	519	(N/A)	0.5	0.4	57.67
Conifer Evergreen L	1,655	12	(N/A)	0.5	0.0	1.38
White ash	55,696	418	(N/A)	0.3	0.3	69.62
Mountain ash	14,633	110	(N/A)	0.3	0.1	21.95
Boxelder	3,739	28	(N/A)	0.3	0.0	5.61
Black locust	37,419	281	(N/A)	0.3	0.2	56.13
Common chokecher	12,504	94	(N/A)	0.3	0.1	18.76
Swamp white oak	4,280	32	(N/A)	0.2	0.0	8.02
Northern pin oak	57,121	428	(N/A)	0.2	0.3	107.10
Ohio buckeye	42,840	321	(N/A)	0.2	0.2	107.10
Apple	6,982	52	(N/A)	0.2	0.0	17.46
Black maple	23,836	179	(N/A)	0.2	0.1	59.59
Broadleaf Deciduou	3,065	23	(N/A)	0.2	0.0	7.66
Northern catalpa	65,202	489	(N/A)	0.1	0.3	244.51
Littleleaf linden	4,620	35	(N/A)	0.1	0.0	17.32
American sycamore	51,886	389	(N/A)	0.1	0.3	194.57
Broadleaf Evergreen	968	7	(N/A)	0.1	0.0	3.63
Juniper	2,204	17	(N/A)	0.1	0.0	8.27
Black spruce	5,322	40	(N/A)	0.1	0.0	19.96
Willow	28,560	214	(N/A)	0.1	0.2	107.10
American elm	19,728	148	(N/A)	0.1	0.1	147.96
Kentucky coffeetree	3,672	28	(N/A)	0.1	0.0	27.54
Chinese elm	1,035	8	(N/A)	0.1	0.0	7.76
Alder	6,743	51	(N/A)	0.1	0.0	50.57
Eastern redbud	178	1	(N/A)	0.1	0.0	1.33
Eastern cottonwood	3,672	28	(N/A)	0.1	0.0	27.54
Sumac	3,037	23	(N/A)	0.1	0.0	22.78
Conifer Evergreen S	1,102	8	(N/A)	0.1	0.0	8.27
White mulberry	6,743	51	(N/A)	0.1	0.0	50.57
Ginkgo	77	1	(N/A)	0.1	0.0	0.58
Citywide total	18,916,377	141,873	(N/A)	100.0	100.0	82.58

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

4/22/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	405,364	3,040	-28,891	-1,734	-230	291,879	2,189	666,618	5,000	(N/A)	38.8	36.1	7.51
Silver maple	460,525	3,454	-29,280	-1,231	-229	187,952	1,410	617,965	4,635	(N/A)	19.8	33.4	13.63
Norway maple	49,818	374	-5,495	-362	-44	58,353	438	102,315	767	(N/A)	7.8	5.5	5.73
Sugar maple	50,149	376	-4,507	-240	-36	37,144	279	82,546	619	(N/A)	4.5	4.5	7.94
Cottonwood	50,506	379	-11,565	-319	-89	46,834	351	85,456	641	(N/A)	4.0	4.6	9.29
Honeylocust	53,055	398	-2,326	-147	-19	31,557	237	82,139	616	(N/A)	3.9	4.4	9.19
American basswood	37,390	280	-2,701	-167	-22	25,320	190	59,843	449	(N/A)	3.8	3.2	6.80
Broadleaf Deciduous M	9,796	73	-356	-57	-3	8,096	61	17,479	131	(N/A)	3.6	0.9	2.11
Northern hackberry	11,964	90	-887	-90	-7	16,531	124	27,518	206	(N/A)	1.7	1.5	6.88
Blue spruce	2,742	21	-263	-56	-2	4,927	37	7,350	55	(N/A)	1.2	0.4	2.63
Red maple	6,066	45	-251	-32	-2	6,205	47	11,989	90	(N/A)	1.2	0.6	4.50
Northern red oak	3,117	23	-516	-33	-4	4,235	32	6,803	51	(N/A)	1.0	0.4	2.83
Norway spruce	2,708	20	-224	-41	-2	3,857	29	6,300	47	(N/A)	0.9	0.3	2.95
Bur oak	3,607	27	-206	-18	-2	2,619	20	6,001	45	(N/A)	0.8	0.3	3.22
River birch	2,101	16	-193	-17	-2	2,588	19	4,479	34	(N/A)	0.6	0.2	3.36
Pear	1,811	14	-92	-15	-1	1,821	14	3,525	26	(N/A)	0.6	0.2	2.64
Black walnut	5,910	44	-496	-25	-4	4,011	30	9,400	70	(N/A)	0.5	0.5	7.83
White oak	3,395	25	-332	-16	-3	2,293	17	5,340	40	(N/A)	0.5	0.3	4.45
Conifer Evergreen Large	370	3	-8	-9	0	680	5	1,033	8	(N/A)	0.5	0.1	0.86
White ash	5,115	38	-267	-16	-2	3,166	24	7,998	60	(N/A)	0.3	0.4	10.00
Mountain ash	1,241	9	-70	-9	-1	1,200	9	2,362	18	(N/A)	0.3	0.1	3.54
Boxelder	656	5	-19	-5	0	671	5	1,303	10	(N/A)	0.3	0.1	1.95
Black locust	1,712	13	-180	-14	-1	2,209	17	3,727	28	(N/A)	0.3	0.2	5.59
Common chokecherry	1,088	8	-60	-8	-1	1,016	8	2,035	15	(N/A)	0.3	0.1	3.05
Swamp white oak	673	5	-23	-4	0	589	4	1,235	9	(N/A)	0.2	0.1	2.32
Northern pin oak	1,110	8	-274	-15	-2	2,154	16	2,975	22	(N/A)	0.2	0.2	5.58
Ohio buckeye	1,110	8	-206	-11	-2	1,616	12	2,510	19	(N/A)	0.2	0.1	6.27
Apple	649	5	-34	-5	0	741	6	1,352	10	(N/A)	0.2	0.1	3.38
Black maple	923	7	-114	-8	-1	1,431	11	2,232	17	(N/A)	0.2	0.1	5.58
Broadleaf Deciduous Sn	285	2	-15	-2	0	320	2	588	4	(N/A)	0.2	0.0	1.47
Northern catalpa	1,872	14	-313	-9	-2	1,384	10	2,934	22	(N/A)	0.1	0.2	11.00
Littleleaf linden	738	6	-22	-3	0	470	4	1,183	9	(N/A)	0.1	0.1	4.44
American sycamore	1,919	14	-249	-9	-2	1,300	10	2,962	22	(N/A)	0.1	0.2	11.11
Broadleaf Evergreen Me	113	1	-5	-2	0	282	2	387	3	(N/A)	0.1	0.0	1.45
Juniper	0	0	-11	-4	0	374	3	359	3	(N/A)	0.1	0.0	1.35
Black spruce	294	2	-26	-5	0	465	3	728	5	(N/A)	0.1	0.0	2.73
Willow	0	0	-137	-9	-1	1,077	8	932	7	(N/A)	0.1	0.1	3.49
American elm	566	4	-95	-4	-1	762	6	1,230	9	(N/A)	0.1	0.1	9.22
Kentucky coffeetree	445	3	-18	-2	0	393	3	819	6	(N/A)	0.1	0.0	6.14
Chinese elm	209	2	-5	-1	0	159	1	361	3	(N/A)	0.1	0.0	2.71
Alder	478	4	-32	-3	0	335	3	778	6	(N/A)	0.1	0.0	5.84
Eastern redbud	38	0	-1	-1	0	37	0	74	1	(N/A)	0.1	0.0	0.55
Eastern cottonwood	445	3	-18	-2	0	393	3	819	6	(N/A)	0.1	0.0	6.14
Sumac	268	2	-15	-2	0	308	2	560	4	(N/A)	0.1	0.0	4.20
Conifer Evergreen Smal	43	0	-5	-2	0	187	1	222	2	(N/A)	0.1	0.0	1.67
White mulberry	478	4	-32	-3	0	335	3	778	6	(N/A)	0.1	0.0	5.84
Ginkgo	16	0	0	-1	0	35	0	51	0	(N/A)	0.1	0.0	0.38
Citywide total	1,182,878	8,872	-90,835	-4,765	-717	760,312	5,702	1,847,591	13,857	(N/A)	100.0	100.0	8.07

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

4/22/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	35,475	(N/A)	38.8	32.4	53.27
Silver maple	36,058	(N/A)	19.8	32.9	106.05
Norway maple	4,640	(N/A)	7.8	4.2	34.63
Sugar maple	5,205	(N/A)	4.5	4.8	66.73
Cottonwood	3,491	(N/A)	4.0	3.2	50.59
Honeylocust	12,870	(N/A)	3.9	11.8	192.10
American basswood	2,960	(N/A)	3.8	2.7	44.84
Broadleaf Deciduous Medi	1,156	(N/A)	3.6	1.1	18.64
Northern hackberry	1,655	(N/A)	1.7	1.5	55.17
Blue spruce	411	(N/A)	1.2	0.4	19.59
Red maple	882	(N/A)	1.2	0.8	44.12
Northern red oak	250	(N/A)	1.0	0.2	13.87
Norway spruce	659	(N/A)	0.9	0.6	41.17
Bur oak	393	(N/A)	0.8	0.4	28.05
River birch	227	(N/A)	0.6	0.2	22.71
Pear	105	(N/A)	0.6	0.1	10.46
Black walnut	490	(N/A)	0.5	0.4	54.40
White oak	294	(N/A)	0.5	0.3	32.65
Conifer Evergreen Large	113	(N/A)	0.5	0.1	12.56
White ash	540	(N/A)	0.3	0.5	90.00
Mountain ash	73	(N/A)	0.3	0.1	14.51
Boxelder	119	(N/A)	0.3	0.1	23.90
Black locust	164	(N/A)	0.3	0.2	32.89
Common chokecherry	63	(N/A)	0.3	0.1	12.70
Swamp white oak	78	(N/A)	0.2	0.1	19.45
Northern pin oak	94	(N/A)	0.2	0.1	23.60
Ohio buckeye	94	(N/A)	0.2	0.1	31.46
Apple	37	(N/A)	0.2	0.0	12.46
Black maple	109	(N/A)	0.2	0.1	36.36
Broadleaf Deciduous Smal	16	(N/A)	0.2	0.0	5.18
Northern catalpa	125	(N/A)	0.1	0.1	62.47
Littleleaf linden	86	(N/A)	0.1	0.1	43.15
American sycamore	133	(N/A)	0.1	0.1	66.60
Broadleaf Evergreen Medit	44	(N/A)	0.1	0.0	21.93
Juniper	0	(N/A)	0.1	0.0	0.00
Black spruce	40	(N/A)	0.1	0.0	19.97
Willow	0	(N/A)	0.1	0.0	0.00
American elm	74	(N/A)	0.1	0.1	74.47
Kentucky coffeetree	46	(N/A)	0.1	0.0	45.86
Chinese elm	29	(N/A)	0.1	0.0	28.56
Alder	29	(N/A)	0.1	0.0	28.80
Eastern redbud	2	(N/A)	0.1	0.0	2.06
Eastern cottonwood	46	(N/A)	0.1	0.0	45.86
Sumac	15	(N/A)	0.1	0.0	15.48
Conifer Evergreen Small	14	(N/A)	0.1	0.0	13.68
White mulberry	29	(N/A)	0.1	0.0	28.80
Ginkgo	3	(N/A)	0.1	0.0	2.76
Citywide total	109,435	(N/A)	100.0	100.0	63.70

Table 7: Summary of Benefits in Dollars

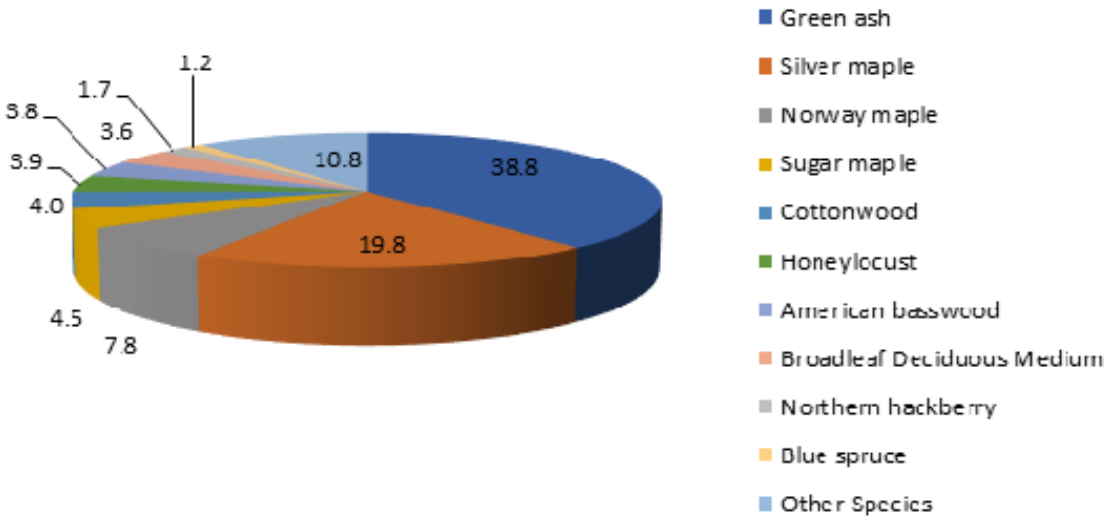
Annual Benefits of Public Trees by Species ($/tree)

4/22/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($) Standard Error
Green ash	54.24	7.51	9.25	68.63	53.27	192.89 (N/A)
Silver maple	67.56	13.63	12.58	129.90	106.05	329.72 (N/A)
Norway maple	56.53	5.73	10.15	67.78	34.63	174.81 (N/A)
Sugar maple	59.51	7.94	9.48	87.01	66.73	230.66 (N/A)
Cottonwood	84.05	9.29	17.33	158.84	50.59	320.10 (N/A)
Honeylocust	57.24	9.19	9.63	79.21	192.10	347.37 (N/A)
American basswood	49.25	6.80	7.35	55.01	44.84	163.25 (N/A)
Broadleaf Deciduous	17.64	2.11	2.65	13.00	18.64	54.05 (N/A)
Northern hackberry	70.72	6.88	12.18	79.11	55.17	224.06 (N/A)
Blue spruce	29.26	2.63	3.20	60.08	19.59	114.75 (N/A)
Red maple	36.90	4.50	6.34	31.92	44.12	123.77 (N/A)
Northern red oak	29.97	2.83	4.19	36.73	13.87	87.59 (N/A)
Norway spruce	28.97	2.95	1.69	71.12	41.17	145.90 (N/A)
Bur oak	23.04	3.22	3.81	26.20	28.05	84.32 (N/A)
River birch	33.56	3.36	5.70	34.13	22.71	99.46 (N/A)
Pear	24.98	2.64	3.93	11.81	10.46	53.82 (N/A)
Black walnut	56.50	7.83	9.82	79.90	54.40	208.45 (N/A)
White oak	32.48	4.45	5.79	49.86	32.65	125.22 (N/A)
Conifer Evergreen L	10.92	0.86	1.17	12.68	12.56	38.19 (N/A)
White ash	62.02	10.00	11.85	89.60	90.00	263.47 (N/A)
Mountain ash	31.76	3.54	5.31	16.46	14.51	71.58 (N/A)
Boxelder	17.18	1.95	2.50	14.71	23.90	60.24 (N/A)
Black locust	56.35	5.59	9.95	62.55	32.89	167.33 (N/A)
Common chokecher	27.77	3.05	4.51	14.28	12.70	62.31 (N/A)
Swamp white oak	18.43	2.32	2.89	12.85	19.45	55.94 (N/A)
Northern pin oak	70.84	5.58	13.58	102.01	23.60	215.61 (N/A)
Ohio buckeye	70.84	6.27	13.58	102.01	31.46	224.17 (N/A)
Apple	31.49	3.38	5.22	14.43	12.46	66.97 (N/A)
Black maple	60.68	5.58	11.54	77.70	36.36	191.86 (N/A)
Broadleaf Deciduous	13.29	1.47	2.26	6.16	5.18	28.35 (N/A)
Northern catalpa	86.52	11.00	17.37	172.48	62.47	349.85 (N/A)
Littleleaf linden	28.48	4.44	4.49	23.31	43.15	103.85 (N/A)
American sycamore	82.02	11.11	15.71	148.79	66.60	324.23 (N/A)
Broadleaf Evergreen	18.82	1.45	2.10	18.34	21.93	62.64 (N/A)
Juniper	24.57	1.35	2.19	44.30	0.00	72.40 (N/A)
Black spruce	29.65	2.73	3.10	62.66	19.97	118.11 (N/A)
Willow	70.84	3.49	13.58	102.01	0.00	189.93 (N/A)
American elm	94.34	9.22	18.52	123.33	74.47	319.89 (N/A)
Kentucky coffeetree	44.23	6.14	7.42	39.72	45.86	143.36 (N/A)
Chinese elm	20.64	2.71	2.99	16.47	28.56	71.37 (N/A)
Alder	46.14	5.84	8.35	31.82	28.80	120.94 (N/A)
Eastern redbud	5.40	0.55	0.71	1.86	2.06	10.58 (N/A)
Eastern cottonwood	44.23	6.14	7.42	39.72	45.86	143.36 (N/A)
Sumac	38.13	4.20	6.56	18.06	15.48	82.43 (N/A)
Conifer Evergreen S	24.57	1.67	2.19	44.30	13.68	86.40 (N/A)
White mulberry	46.14	5.84	8.35	31.82	28.80	120.94 (N/A)
Ginkgo	4.50	0.38	0.64	2.22	2.76	10.49 (N/A)
Citywide Total	55.03	8.07	9.62	80.47	63.70	216.88 (N/A)

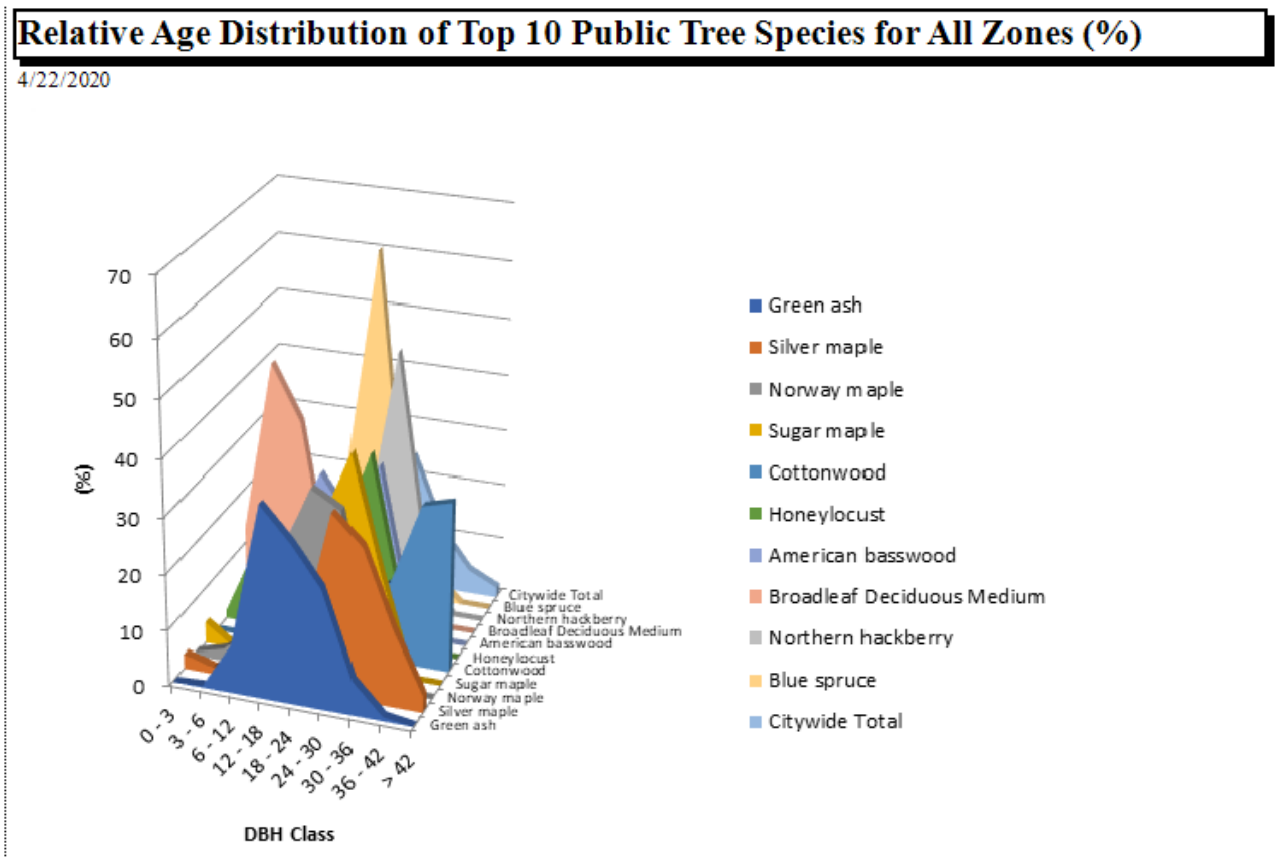
Species Distribution of Public Trees

4/22/2020



Species	Percent
Green ash	38.8
Silver maple	19.8
Norway maple	7.8
Sugar maple	4.5
Cottonwood	4.0
Honeylocust	3.9
American basswood	3.8
Broadleaf Deciduous Me	3.6
Northern hackberry	1.7
Blue spruce	1.2
Other Species	10.8
Total	100.0

Figure 1: Species Distribution



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	0.00	0.30	8.56	34.23	28.53	21.47	6.16	0.75	0.00
Silver maple	2.65	1.18	4.71	4.71	10.29	32.35	27.35	13.82	2.94
Norway maple	0.75	2.24	6.72	21.64	33.58	30.60	4.48	0.00	0.00
Sugar maple	3.85	0.00	3.85	10.26	25.64	38.46	17.95	0.00	0.00
Cottonwood	0.00	0.00	0.00	4.35	11.59	10.14	14.49	28.99	30.43
Honeylocust	1.49	13.43	4.48	17.91	19.40	34.33	8.96	0.00	0.00
American basswood	0.00	1.52	16.67	27.27	19.70	30.30	4.55	0.00	0.00
Broadleaf Deciduous ?	12.90	43.55	33.87	4.84	3.23	1.61	0.00	0.00	0.00
Northern hackberry	0.00	0.00	6.67	20.00	16.67	46.67	10.00	0.00	0.00
Blue spruce	0.00	0.00	0.00	23.81	61.90	9.52	4.76	0.00	0.00
Citywide Total	1.80	4.25	9.66	21.36	21.59	24.10	11.06	4.37	1.80

Figure 2: Relative Age Class

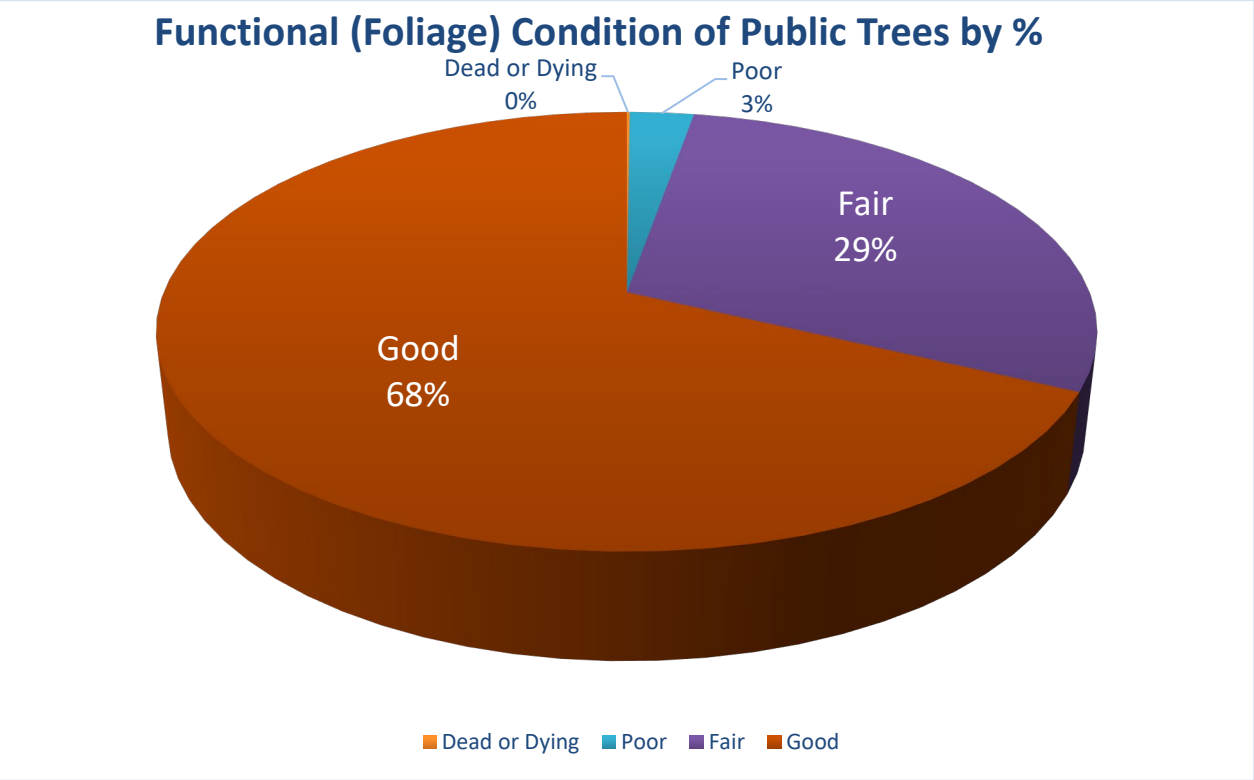


Figure 3: Foliage Condition

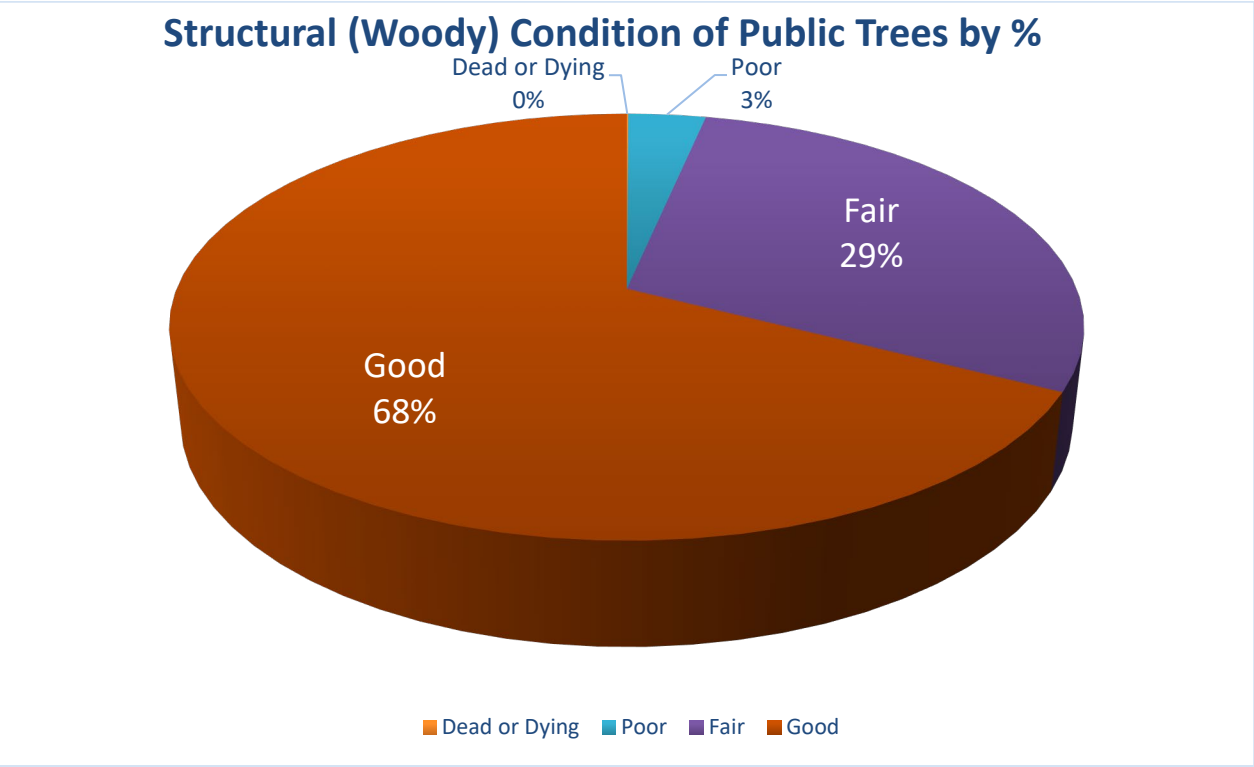
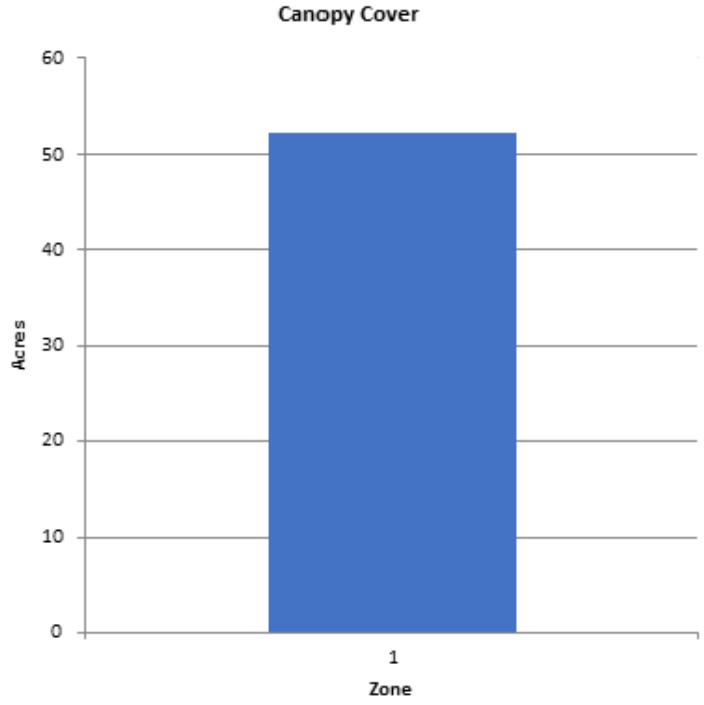


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

4/22/2020



Zone	Acres	% of Total Canopy Cover
1	52	100.0
Citywide total	52	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	52	0.00	0.00

Figure 5: Canopy Cover in Acres

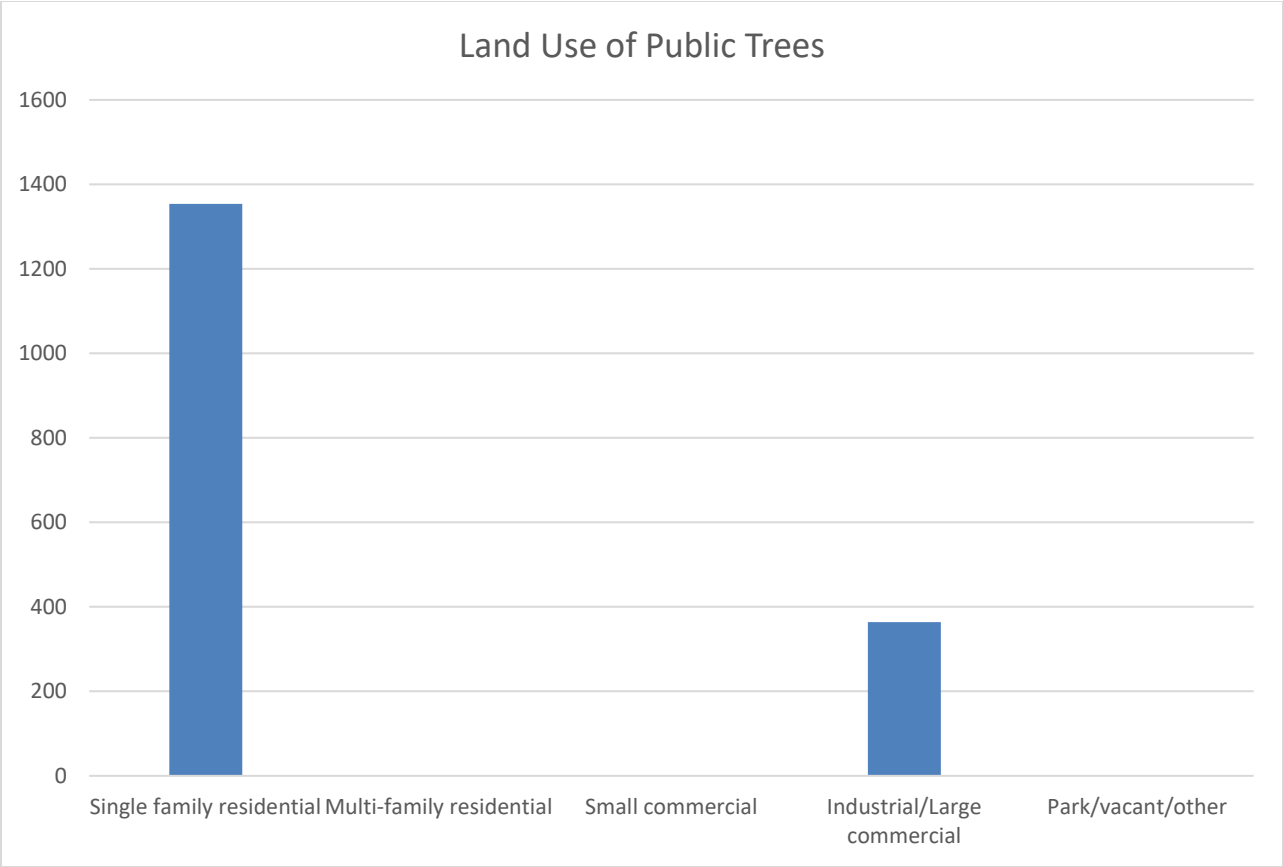


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

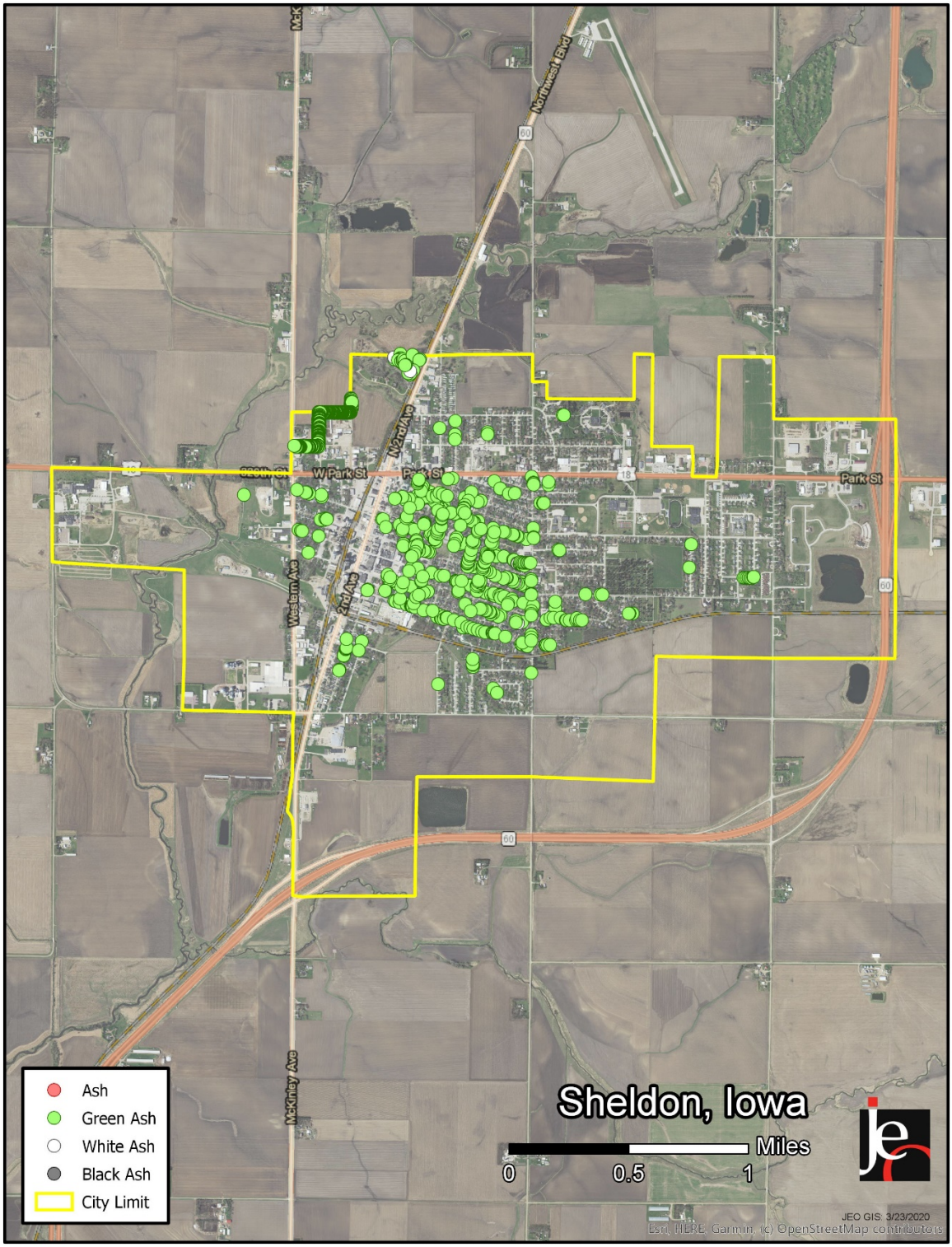


Figure 1: Location of Ash Trees

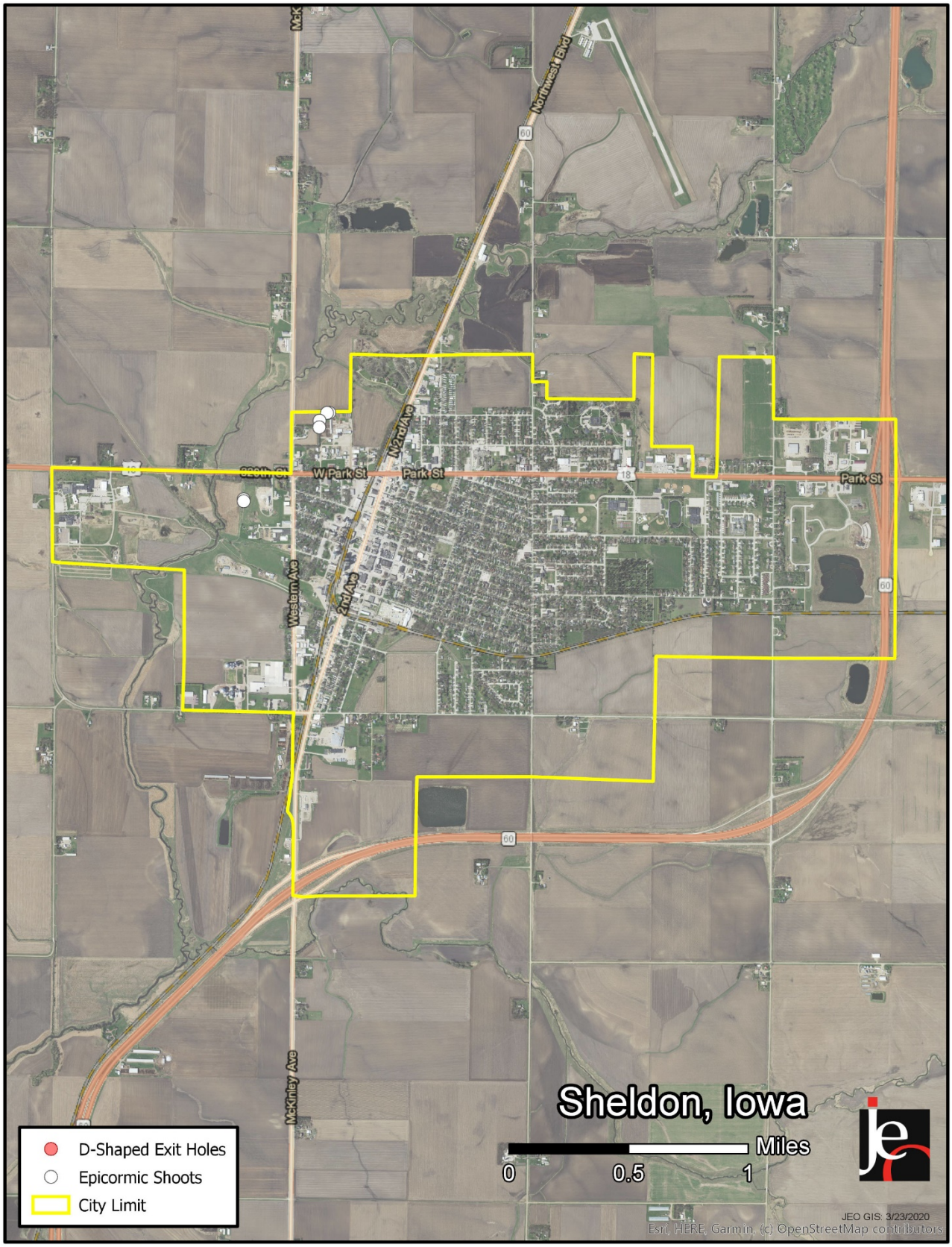


Figure 2: Location of EAB symptoms

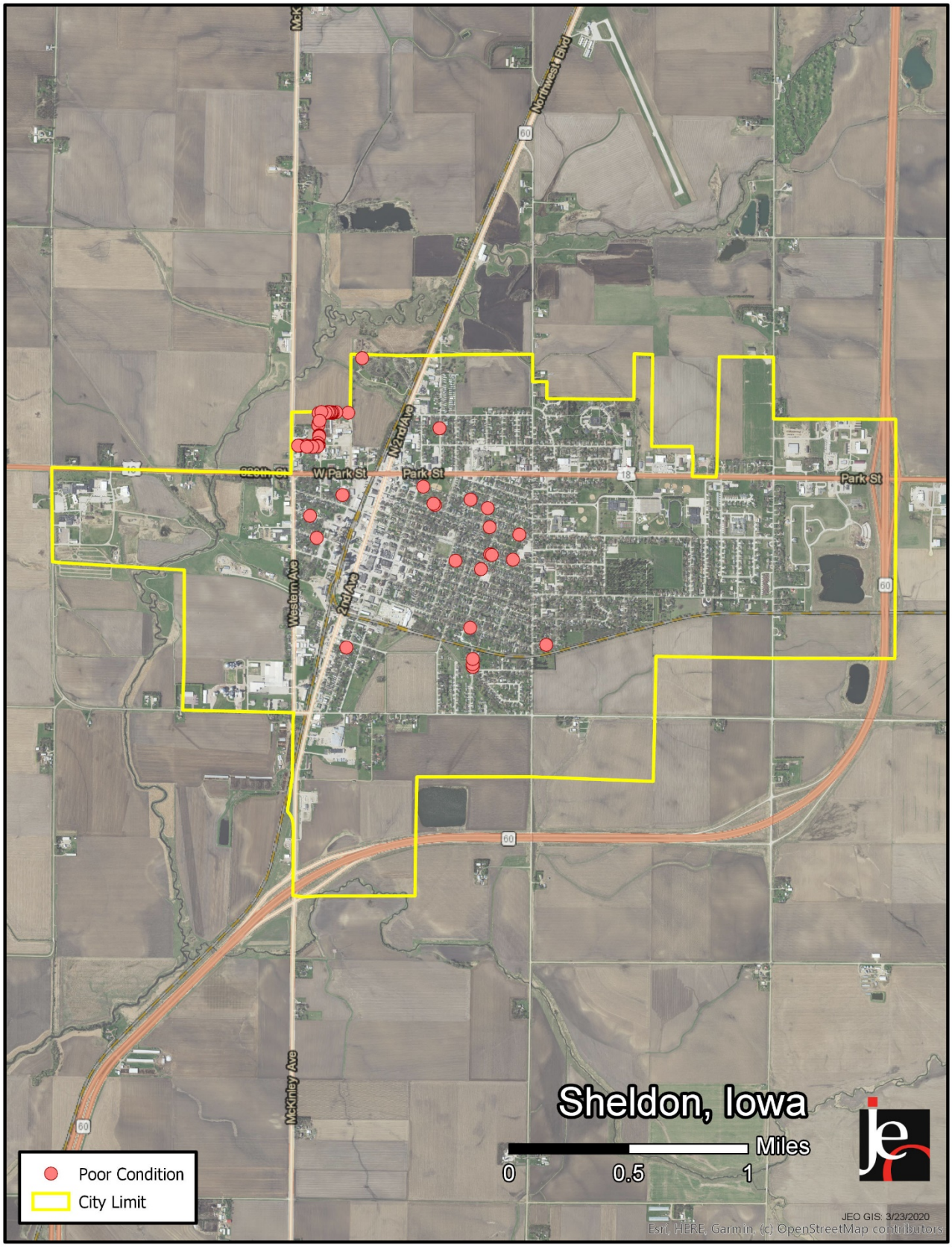


Figure 3: Location of Poor Condition Trees

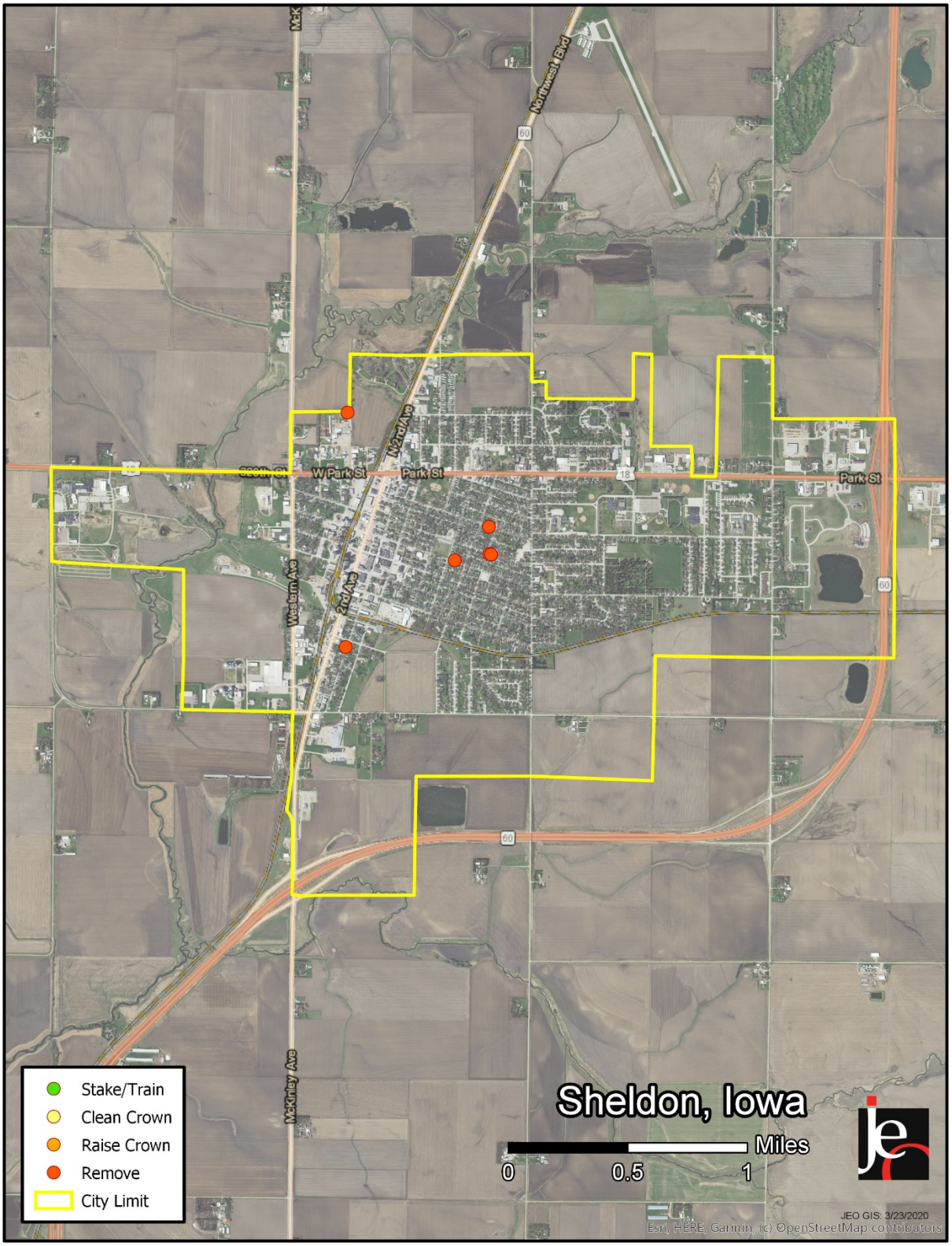


Figure 4: Location of Trees with Recommended Maintenance *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Sheldon Tree Ordinances

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 seven and one-half (71⁄2) 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. No tree or shrub shall be planted within six (6) feet of a fire hydrant. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES.
The owner or agent of the abutting property shall keep the trees on public or private property trimmed so that all branches will be at least twelve (12) feet above the sidewalk. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

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

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

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

151.07 TOPPING OF TREES.
The topping of trees on public property, as a method of trimming, is prohibited unless approved by the City Manager with respect to specific trees where other trimming practices are impractical. Selective branch thinning, proper early training or entire tree removal should be favored over the practice of topping.

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

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

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