Mechanicsville, IA

2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES

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Executive Summary

Overview

This plan was developed to assist the City of Mechanicsville 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 9% of Mechanicsville'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 528 trees inventoried.

- Mechanicsville's trees provide $83,000 of benefits annually, an average of $157 per tree
- There are over 50 species of trees
- The top three genera are: Maple 48%, Ash 9%, and Apple 7%
- 8% of trees need some type of management
- 27 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 27 trees needing removal, 18 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*
- All ash trees should be carefully examined for signs and 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 14 years to remove ash. We suggest that city officials request a budget increase to $4,000 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist Mechanicsville 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 Mechanicsville, 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 Mechanicsville'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 Mechanicsville 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 Mechanicsville'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 528 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. Mechanicsville's trees reduce energy-related costs by approximately $22,640 annually (Appendix A, Table 1). These savings are both in electricity (106.6 MWh) and in natural gas (14,842.4 Therms).

Annual Stormwater Benefits

Mechanicsville's trees intercept about 1,177,689 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $31,915 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 Mechanicsville, it is estimated that trees remove 1,372 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 $3,847 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Mechanicsville, trees sequester about 226,735 lbs of carbon per year with an associated value of $1,701 (Appendix A, Table 5). In addition, the trees store 4,406,153 lbs of carbon, with a yearly benefit of $33,046 (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. Mechanicsville receives $21,724 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, Mechanicsville's trees provide $83,000 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 528 trees in Mechanicsville provide approximately $157 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Mechanicsville has over 50 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	253	48%
Ash	47	9%
Apple	39	7%
Oak	37	7%
Locust	19	4%
Pear	13	2%
Cedar	10	2%
Lilac	7	1%
Walnut	5	1%
Kentucky Coffeetree	4	<1%
Sycamore	3	<1%
Mulberry	3	<1%
Elm	2	<1%
Chokecherry	2	<1%
Catalpa	1	<1%
Tulip Tree	1	<1%
Cottonwood	1	<1%
Birch	1	<1%
Buckeye	1	<1%
Ginkgo	1	<1%
Callery Pear	1	<1%
Redbud	1	<1%
Willow	1	<1%
Mountain Ash	1	<1%
Alder	1	<1%
Cherry	1	<1%
Pine	1	<1%
Other Deciduous	13	2%

Age Class

Most of Mechanicsville's trees (23%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). To prepare for natural mortality and to maintain canopy cover, most trees should be in the smallest size category (a downward slope), indicating youth. Mechanicsville's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Mechanicsville indicate that 76% of the trees are in good health, with only 8% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 68% of Mechanicsville's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Nine percent of the tree population's wood condition is in poor health, dead, or dying. This 9% is an estimate of trees that need management follow up.

Management Needs

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

Tree Removal	27	5%
Crown Cleaning	15	3%
Tree Staking	1	<1%
Crown Raising	0	0%
Crown Reduction	0	0%

Land Use and Location

The majority of Mechanicsville'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	86%
Industrial/Large commercial	1%
Park/vacant/other	13%
Small commercial	1%
Multifamily residential	0%

Recommendations

Risk Management

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

Hazardous trees

Mechanicsville has 27 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 18 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 43 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 27 removals, 23 are ash trees. There are a total of 47 ash trees, which should be carefully inspected for signs and symptoms that have been associated with EAB. In addition, there are 11 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 Mechanicsville.

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 (48%) (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 "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."

Proposed Work Schedule and Budget

Budget Allowance of $2,292/Year – (Based off $2/Capita Calculation Due to no City Reporting)

YEAR 1	**ESTIMATED COSTS**
Remove 3 trees recommended for immediate removal	$2,100
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 2 trees recommended for immediate removal	$1,400
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 3 trees recommended for immediate removal	$2,100
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 2 trees recommended for immediate removal	$1,400
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 3 trees recommended for immediate removal	$2,100
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 2 trees recommended for immediate removal	$1,400
Plant 5 trees in open locations	$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 $5,500 a year. If the budget were increased to $4,000 a year all ash could be removed in 8 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of $4,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	**ESTIMATED COSTS**
Remove 5 trees recommended for immediate removal	$3,500
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 1 tree recommended for immediate removal	$700
Plant 4 trees in open locations	$600
Prune 1/3 of City Owned Trees	$2,640
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 5 trees recommended for immediate removal	$3,500
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 1 tree recommended for immediate removal	$700
Plant 4 trees in open locations	$600
Prune 1/3 of City Owned Trees	$2,640
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 5 trees recommended for immediate removal	$3,500
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 1 tree recommended for immediate removal	$700
Plant 4 trees in open locations	$600
Prune 1/3 of City Owned Trees	$2,640
Visual Survey of EAB Signs/Symptoms	

Purposed Budget Increase

EAB could potentially kill all ash trees in Mechanicsville within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $5,500 a year. If the budget were increased to $4,000 per year all ash could be removed within 8 years. Additionally, we recommend that Mechanicsville 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 Mechanicsville would still need to find $27,300 for removal of the remaining ash. Alternatively, if there are 10 treatable trees, it would cost approximately $3,000 a year for treatment and leave $1,000 for removal with the proposed budget increase. 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 Mechanicsville. 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

4/24/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	28.3	2,150	4,172.9	4,089	6,240	(N/A)	20.6	27.6	57.24
Sugar maple	15.3	1,158	2,063.5	2,022	3,180	(N/A)	11.0	14.0	54.83
Silver maple	10.3	785	1,369.0	1,342	2,127	(N/A)	10.4	9.4	38.67
Green ash	13.5	1,025	1,868.3	1,831	2,856	(N/A)	8.5	12.6	63.47
Apple	2.6	200	405.9	398	598	(N/A)	7.4	2.6	15.34
Red maple	5.0	377	634.0	621	998	(N/A)	5.9	4.4	32.21
Honeylocust	4.1	311	540.2	529	840	(N/A)	3.6	3.7	44.23
Northern hackberry	4.2	322	587.8	576	898	(N/A)	2.8	4.0	59.85
Pin oak	3.9	298	520.4	510	807	(N/A)	2.8	3.6	53.83
Blue spruce	1.8	138	245.3	240	378	(N/A)	2.8	1.7	25.22
American basswood	2.9	221	416.1	408	628	(N/A)	2.7	2.8	44.89
Pear	0.2	15	35.7	35	50	(N/A)	2.5	0.2	3.88
Northern red oak	1.3	97	173.2	170	267	(N/A)	1.9	1.2	26.65
Broadleaf Deciduous Me	0.5	41	79.0	77	119	(N/A)	1.7	0.5	13.18
Bur oak	1.8	137	245.0	240	377	(N/A)	1.7	1.7	41.90
Northern white cedar	1.1	87	152.2	149	236	(N/A)	1.5	1.0	29.49
Swamp white oak	0.8	62	117.2	115	176	(N/A)	1.3	0.8	25.21
Black walnut	1.4	105	194.5	191	296	(N/A)	0.9	1.3	59.20
Littleleaf linden	0.9	65	115.5	113	178	(N/A)	0.8	0.8	44.52
Japanese tree lilac	0.2	16	29.7	29	45	(N/A)	0.8	0.2	11.32
Kentucky coffeetree	0.3	23	42.7	42	64	(N/A)	0.8	0.3	16.11
Lilac	0.3	25	50.3	49	75	(N/A)	0.6	0.3	24.84
Broadleaf Deciduous Lar	0.5	38	57.7	57	94	(N/A)	0.6	0.4	31.42
American sycamore	1.0	74	126.7	124	198	(N/A)	0.6	0.9	65.97
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	0.4	0.2	24.57
Mulberry	0.3	20	37.5	37	56	(N/A)	0.4	0.2	28.16
Norway spruce	0.2	18	34.1	33	52	(N/A)	0.4	0.2	25.88
White ash	0.5	41	56.8	56	96	(N/A)	0.4	0.4	48.12
Common chokecherry	0.2	15	32.2	32	47	(N/A)	0.4	0.2	23.50
Cottonwood	0.5	37	63.1	62	99	(N/A)	0.2	0.4	98.63
Black spruce	0.1	10	15.2	15	25	(N/A)	0.2	0.1	24.51
Ginkgo	0.2	14	26.5	26	40	(N/A)	0.2	0.2	40.40
Northern catalpa	0.0	0	0.5	0	1	(N/A)	0.2	0.0	0.66
River birch	0.0	3	6.2	6	9	(N/A)	0.2	0.0	8.99
Elm	0.0	2	3.7	4	6	(N/A)	0.2	0.0	5.82
American elm	0.1	6	11.7	11	18	(N/A)	0.2	0.1	17.66
Broadleaf Deciduous Sm	0.0	0	0.6	1	1	(N/A)	0.2	0.0	0.87
Ohio buckeye	0.3	24	47.4	46	71	(N/A)	0.2	0.3	70.84
Alder	0.2	15	31.6	31	46	(N/A)	0.2	0.2	46.14
Callery pear	0.0	3	6.2	6	9	(N/A)	0.2	0.0	8.99
Eastern white pine	0.2	14	24.6	24	38	(N/A)	0.2	0.2	38.17
Mountain ash	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Northern pin oak	0.3	20	39.6	39	59	(N/A)	0.2	0.3	58.69
Eastern redbud	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Tulip tree	0.0	2	3.7	4	6	(N/A)	0.2	0.0	5.82
White oak	0.4	29	53.7	53	82	(N/A)	0.2	0.4	82.02
Oak	0.0	2	3.7	4	6	(N/A)	0.2	0.0	5.82
White mulberry	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Black cherry	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Willow	0.1	8	16.9	17	24	(N/A)	0.2	0.1	24.47
Total	106.6	8,094	14,842.4	14,546	22,640	(N/A)	100.0	100.0	42.88

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

4/24/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	279,892	7,585	(N/A)	20.6	23.8	69.59
Sugar maple	192,963	5,229	(N/A)	11.0	16.4	90.16
Silver maple	140,839	3,817	(N/A)	10.4	12.0	69.40
Green ash	156,791	4,249	(N/A)	8.5	13.3	94.42
Apple	10,744	291	(N/A)	7.4	0.9	7.47
Red maple	33,209	900	(N/A)	5.9	2.8	29.03
Honeylocust	48,613	1,317	(N/A)	3.6	4.1	69.34
Northern hackberry	50,556	1,370	(N/A)	2.8	4.3	91.34
Pin oak	51,468	1,395	(N/A)	2.8	4.4	92.99
Blue spruce	26,900	729	(N/A)	2.8	2.3	48.60
American basswood	26,301	713	(N/A)	2.7	2.2	50.91
Pear	672	18	(N/A)	2.5	0.1	1.40
Northern red oak	11,239	305	(N/A)	1.9	1.0	30.46
Broadleaf Deciduous Medi	2,711	73	(N/A)	1.7	0.2	8.16
Bur oak	23,139	627	(N/A)	1.7	2.0	69.67
Northern white cedar	23,220	629	(N/A)	1.5	2.0	78.66
Swamp white oak	6,567	178	(N/A)	1.3	0.6	25.42
Black walnut	17,887	485	(N/A)	0.9	1.5	96.95
Littleleaf linden	7,252	197	(N/A)	0.8	0.6	49.13
Japanese tree lilac	750	20	(N/A)	0.8	0.1	5.08
Kentucky coffeetree	2,798	76	(N/A)	0.8	0.2	18.96
Lilac	1,196	32	(N/A)	0.6	0.1	10.80
Broadleaf Deciduous Large	3,103	84	(N/A)	0.6	0.3	28.03
American sycamore	14,496	393	(N/A)	0.6	1.2	130.94
Eastern red cedar	3,269	89	(N/A)	0.4	0.3	44.30
Mulberry	931	25	(N/A)	0.4	0.1	12.62
Norway spruce	5,200	141	(N/A)	0.4	0.4	70.46
White ash	3,325	90	(N/A)	0.4	0.3	45.05
Common chokecherry	1,181	32	(N/A)	0.4	0.1	16.01
Cottonwood	7,239	196	(N/A)	0.2	0.6	196.17
Black spruce	1,544	42	(N/A)	0.2	0.1	41.85
Ginkgo	1,240	34	(N/A)	0.2	0.1	33.60
Northern catalpa	18	0	(N/A)	0.2	0.0	0.48
River birch	163	4	(N/A)	0.2	0.0	4.41
Elm	172	5	(N/A)	0.2	0.0	4.65
American elm	432	12	(N/A)	0.2	0.0	11.72
Broadleaf Deciduous Small	7	0	(N/A)	0.2	0.0	0.20
Ohio buckeye	3,764	102	(N/A)	0.2	0.3	102.01
Alder	1,174	32	(N/A)	0.2	0.1	31.82
Callery pear	163	4	(N/A)	0.2	0.0	4.41
Eastern white pine	4,605	125	(N/A)	0.2	0.4	124.79
Mountain ash	264	7	(N/A)	0.2	0.0	7.17
Northern pin oak	2,479	67	(N/A)	0.2	0.2	67.19
Eastern redbud	264	7	(N/A)	0.2	0.0	7.17
Tulip tree	172	5	(N/A)	0.2	0.0	4.65
White oak	5,491	149	(N/A)	0.2	0.5	148.79
Oak	172	5	(N/A)	0.2	0.0	4.65
White mulberry	264	7	(N/A)	0.2	0.0	7.17
Black cherry	264	7	(N/A)	0.2	0.0	7.17
Willow	586	16	(N/A)	0.2	0.0	15.88
Citywide total	1,177,689	31,915	(N/A)	100.0	100.0	60.45

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

4/24/2020

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Trees	Total	Avg $/tree
Norway maple	58.3	10.1	28.5	2.6	315	138.1	19.9	18.9	128.5	854	-13.6	-51	391.4	1,117	(N/A)	20.6	10.25	
Sugar maple	27.0	4.6	13.1	1.2	145	72.5	10.6	10.1	69.1	453	-21.0	-79	187.3	519	(N/A)	11.0	8.95	
Silver maple	23.6	4.0	11.7	1.0	127	48.9	7.1	6.8	46.8	306	-12.7	-48	137.2	385	(N/A)	10.4	7.01	
Green ash	20.7	3.3	9.7	0.9	110	64.7	9.4	9.0	61.2	402	0.0	0	178.9	512	(N/A)	8.5	11.38	
Apple	3.0	0.5	1.5	0.1	16	13.0	1.9	1.8	12.0	80	0.0	0	33.7	96	(N/A)	7.4	2.47	
Red maple	6.7	1.1	3.3	0.3	36	23.3	3.4	3.3	22.5	146	-2.4	-9	61.5	173	(N/A)	5.9	5.59	
Honeylocust	9.6	1.6	4.3	0.4	50	19.3	2.8	2.7	18.5	121	-7.6	-29	51.7	143	(N/A)	3.6	7.52	
Northern hackberry	10.0	1.7	4.8	0.4	54	20.3	3.0	2.8	19.2	126	0.0	0	62.3	180	(N/A)	2.8	12.00	
Pin oak	10.0	1.7	5.0	0.4	54	18.5	2.7	2.6	17.7	116	-18.2	-68	40.6	102	(N/A)	2.8	6.80	
Blue spruce	3.9	0.8	3.2	0.5	26	8.6	1.3	1.2	8.2	54	-10.0	-38	17.7	42	(N/A)	2.8	2.80	
American basswood	3.1	0.5	1.6	0.1	17	14.1	2.0	1.9	13.2	87	-2.8	-11	33.9	94	(N/A)	2.7	6.70	
Pear	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	0.0	0	2.4	7	(N/A)	2.5	0.53	
Northern red oak	2.3	0.4	1.1	0.1	12	6.1	0.9	0.8	5.8	38	-3.2	-12	14.2	38	(N/A)	1.9	3.80	
Broadleaf Deciduous Medi	0.3	0.0	0.2	0.0	2	2.6	0.4	0.4	2.5	16	-0.1	0	6.3	18	(N/A)	1.7	1.96	
Bur oak	3.2	0.5	1.5	0.1	17	8.6	1.3	1.2	8.2	54	0.0	0	24.6	71	(N/A)	1.7	7.84	
Northern white cedar	2.7	0.5	2.2	0.3	18	5.4	0.8	0.8	5.2	34	-11.9	-45	6.0	7	(N/A)	1.5	0.87	
Swamp white oak	1.2	0.2	0.6	0.1	7	3.9	0.6	0.5	3.7	24	-0.3	-1	10.5	30	(N/A)	1.3	4.26	
Black walnut	2.4	0.4	1.1	0.1	13	6.7	1.0	0.9	6.3	41	0.0	0	18.9	54	(N/A)	0.9	10.84	
Littleleaf linden	1.1	0.2	0.6	0.0	6	4.1	0.6	0.6	3.9	25	-0.6	-2	10.5	29	(N/A)	0.8	7.33	
Japanese tree lilac	0.2	0.0	0.1	0.0	1	1.0	0.1	0.1	1.0	6	0.0	0	2.6	7	(N/A)	0.8	1.87	
Kentucky coffeetree	0.3	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	9	0.0	0	3.7	10	(N/A)	0.8	2.59	
Lilac	0.3	0.0	0.2	0.0	2	1.6	0.2	0.2	1.5	10	0.0	0	4.1	12	(N/A)	0.6	3.88	
Broadleaf Deciduous Large	0.2	0.0	0.1	0.0	1	2.3	0.3	0.3	2.3	14	0.0	0	5.6	16	(N/A)	0.6	5.24	
American sycamore	3.2	0.5	1.4	0.1	16	4.6	0.7	0.6	4.4	29	0.0	0	15.5	45	(N/A)	0.6	15.06	
Eastern red cedar	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)	0.4	2.19	
Mulberry	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.2	9	(N/A)	0.4	4.55	
Norway spruce	0.6	0.1	0.5	0.1	4	1.2	0.2	0.2	1.1	7	-3.0	-11	0.9	0	(N/A)	0.4	-0.05	
White ash	0.2	0.0	0.1	0.0	1	2.4	0.4	0.3	2.4	15	0.0	0	5.9	17	(N/A)	0.4	8.32	
Common chokecherry	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)	0.4	4.23	
Cottonwood	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23	(N/A)	0.2	22.55	
Black spruce	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3	(N/A)	0.2	2.89	
Ginkgo	0.3	0.1	0.1	0.0	2	0.9	0.1	0.1	0.9	6	-0.1	0	2.4	7	(N/A)	0.2	6.92	
Northern catalpa	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.2	0.08	
River birch	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	0.2	1.21	
Elm	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)	0.2	0.87	
American elm	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	2	0.0	0	0.9	3	(N/A)	0.2	2.54	
Broadleaf Deciduous Smal	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.2	0.11	
Ohio buckeye	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)	0.2	13.58	
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)	0.2	8.35	
Callery pear	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	0.2	1.21	
Eastern white pine	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2	(N/A)	0.2	-1.58	
Mountain ash	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.2	2.55	
Northern pin oak	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	0.2	10.16	
Eastern redbud	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.2	2.55	
Tulip tree	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)	0.2	0.87	
White oak	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16	(N/A)	0.2	15.71	
Oak	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	0.2	0.87	
White mulberry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.2	2.55	
Black cherry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.2	2.55	
Willow	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	0.2	3.47	
Citywide total	201.1	34.3	100.4	9.6	1,091	511.3	74.3	70.8	483.3	3,180	-113.1	-424	1,371.9	3,847	(N/A)	100.0	7.29	

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

4/24/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	956,309	7,174	(N/A)	20.6	21.7	65.81
Sugar maple	785,792	5,893	(N/A)	11.0	17.8	101.61
Silver maple	545,151	4,089	(N/A)	10.4	12.4	74.34
Green ash	676,858	5,076	(N/A)	8.5	15.4	112.81
Apple	48,954	367	(N/A)	7.4	1.1	9.41
Red maple	76,593	574	(N/A)	5.9	1.7	18.53
Honeylocust	124,291	932	(N/A)	3.6	2.8	49.06
Northern hackberry	164,515	1,234	(N/A)	2.8	3.7	82.26
Pin oak	273,790	2,053	(N/A)	2.8	6.2	136.90
Blue spruce	29,296	220	(N/A)	2.8	0.7	14.65
American basswood	115,011	863	(N/A)	2.7	2.6	61.61
Pear	2,131	16	(N/A)	2.5	0.0	1.23
Northern red oak	47,135	354	(N/A)	1.9	1.1	35.35
Broadleaf Deciduou	5,372	40	(N/A)	1.7	0.1	4.48
Bur oak	107,490	806	(N/A)	1.7	2.4	89.58
Northern white ceda	29,779	223	(N/A)	1.5	0.7	27.92
Swamp white oak	19,784	148	(N/A)	1.3	0.4	21.20
Black walnut	79,447	596	(N/A)	0.9	1.8	119.17
Littleleaf linden	23,626	177	(N/A)	0.8	0.5	44.30
Japanese tree lilac	3,243	24	(N/A)	0.8	0.1	6.08
Kentucky coffeetree	8,667	65	(N/A)	0.8	0.2	16.25
Lilac	4,853	36	(N/A)	0.6	0.1	12.13
Broadleaf Deciduou	7,529	56	(N/A)	0.6	0.2	18.82
American sycamore	111,976	840	(N/A)	0.6	2.5	279.94
Eastern red cedar	2,204	17	(N/A)	0.4	0.1	8.27
Mulberry	3,945	30	(N/A)	0.4	0.1	14.79
Norway spruce	7,747	58	(N/A)	0.4	0.2	29.05
White ash	7,344	55	(N/A)	0.4	0.2	27.54
Common chokecher	6,756	51	(N/A)	0.4	0.2	25.34
Cottonwood	55,982	420	(N/A)	0.2	1.3	419.86
Black spruce	1,118	8	(N/A)	0.2	0.0	8.39
Ginkgo	4,203	32	(N/A)	0.2	0.1	31.52
Northern catalpa	12	0	(N/A)	0.2	0.0	0.09
River birch	218	2	(N/A)	0.2	0.0	1.64
Elm	185	1	(N/A)	0.2	0.0	1.39
American elm	908	7	(N/A)	0.2	0.0	6.81
Broadleaf Deciduou	14	0	(N/A)	0.2	0.0	0.10
Ohio buckeye	14,280	107	(N/A)	0.2	0.3	107.10
Alder	6,743	51	(N/A)	0.2	0.2	50.57
Callery pear	218	2	(N/A)	0.2	0.0	1.64
Eastern white pine	7,490	56	(N/A)	0.2	0.2	56.18
Mountain ash	908	7	(N/A)	0.2	0.0	6.81
Northern pin oak	7,945	60	(N/A)	0.2	0.2	59.59
Eastern redbud	908	7	(N/A)	0.2	0.0	6.81
Tulip tree	185	1	(N/A)	0.2	0.0	1.39
White oak	25,943	195	(N/A)	0.2	0.6	194.57
Oak	185	1	(N/A)	0.2	0.0	1.39
White mulberry	908	7	(N/A)	0.2	0.0	6.81
Black cherry	908	7	(N/A)	0.2	0.0	6.81
Willow	1,101	8	(N/A)	0.2	0.0	8.26
Citywide total	4,406,153	33,046	(N/A)	100.0	100.0	62.59

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

4/24/2020

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	40,296	302	-4,594	-303	-37	47,518	356	82,916	622	(N/A)	20.6	21.6	5.71
Sugar maple	37,546	282	-3,773	-172	-30	25,595	192	59,196	444	(N/A)	11.0	15.4	7.65
Silver maple	41,254	309	-2,619	-115	-21	17,358	130	55,878	419	(N/A)	10.4	14.6	7.62
Green ash	31,993	240	-3,249	-143	-25	22,658	170	51,260	384	(N/A)	8.5	13.4	8.54
Apple	4,080	31	-236	-39	-2	4,430	33	8,235	62	(N/A)	7.4	2.1	1.58
Red maple	8,155	61	-368	-44	-3	8,336	63	16,080	121	(N/A)	5.9	4.2	3.89
Honeylocust	6,518	49	-599	-33	-5	6,871	52	12,758	96	(N/A)	3.6	3.3	5.04
Northern hackberry	5,917	44	-790	-45	-6	7,108	53	12,191	91	(N/A)	2.8	3.2	6.10
Pin oak	17,031	128	-1,314	-45	-10	6,575	49	22,246	167	(N/A)	2.8	5.8	11.12
Blue spruce	1,467	11	-141	-33	-1	3,048	23	4,340	33	(N/A)	2.8	1.1	2.17
American basswood	7,520	56	-552	-33	-4	4,878	37	11,813	89	(N/A)	2.7	3.1	6.33
Pear	353	3	-11	-5	0	342	3	679	5	(N/A)	2.5	0.2	0.39
Northern red oak	1,532	11	-226	-16	-2	2,139	16	3,428	26	(N/A)	1.9	0.9	2.57
Broadleaf Deciduous M	1,151	9	-31	-7	0	911	7	2,024	15	(N/A)	1.7	0.5	1.69
Bur oak	4,003	30	-516	-20	-4	3,027	23	6,494	49	(N/A)	1.7	1.7	5.41
Northern white cedar	1,174	9	-143	-23	-1	1,918	14	2,927	22	(N/A)	1.5	0.8	2.74
Swamp white oak	1,438	11	-96	-9	-1	1,361	10	2,694	20	(N/A)	1.3	0.7	2.89
Black walnut	3,360	25	-381	-15	-3	2,329	17	5,292	40	(N/A)	0.9	1.4	7.94
Littleleaf linden	2,607	20	-113	-9	-1	1,434	11	3,918	29	(N/A)	0.8	1.0	7.35
Japanese tree lilac	323	2	-16	-3	0	357	3	661	5	(N/A)	0.8	0.2	1.24
Kentucky coffeetree	739	6	-42	-4	0	499	4	1,192	9	(N/A)	0.8	0.3	2.24
Lilac	495	4	-23	-4	0	557	4	1,025	8	(N/A)	0.6	0.3	2.56
Broadleaf Deciduous La	965	7	-36	-4	0	834	6	1,759	13	(N/A)	0.6	0.5	4.40
American sycamore	960	7	-538	-12	-4	1,630	12	2,041	15	(N/A)	0.6	0.5	5.10
Eastern red cedar	0	0	-11	-4	0	374	3	359	3	(N/A)	0.4	0.1	1.35
Mulberry	382	3	-19	-3	0	433	3	792	6	(N/A)	0.4	0.2	2.97
Norway spruce	309	2	-37	-5	0	405	3	672	5	(N/A)	0.4	0.2	2.52
White ash	987	7	-35	-4	0	898	7	1,846	14	(N/A)	0.4	0.5	6.92
Common chokecherry	487	4	-32	-3	0	340	3	792	6	(N/A)	0.4	0.2	2.97
Cottonwood	479	4	-269	-6	-2	813	6	1,017	8	(N/A)	0.2	0.3	7.63
Black spruce	91	1	-5	-2	0	213	2	296	2	(N/A)	0.2	0.1	2.22
Ginkgo	225	2	-20	-3	0	319	2	521	4	(N/A)	0.2	0.1	3.91
Northern catalpa	3	0	0	0	0	4	0	7	0	(N/A)	0.2	0.0	0.05
River birch	96	1	-2	-1	0	65	0	158	1	(N/A)	0.2	0.0	1.18
Elm	74	1	-1	-1	0	49	0	121	1	(N/A)	0.2	0.0	0.91
American elm	111	1	-4	-1	0	137	1	242	2	(N/A)	0.2	0.1	1.82
Broadleaf Deciduous Sn	9	0	0	0	0	6	0	14	0	(N/A)	0.2	0.0	0.10
Ohio buckeye	0	0	-69	-4	-1	539	4	466	3	(N/A)	0.2	0.1	3.49
Alder	0	0	-32	-4	0	335	3	299	2	(N/A)	0.2	0.1	2.24
Callery pear	96	1	-2	-1	0	65	0	158	1	(N/A)	0.2	0.0	1.18
Eastern white pine	256	2	-36	-4	0	311	2	528	4	(N/A)	0.2	0.1	3.96
Mountain ash	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Northern pin oak	470	4	-38	-3	0	440	3	869	7	(N/A)	0.2	0.2	6.52
Eastern redbud	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Tulip tree	74	1	-1	-1	0	49	0	121	1	(N/A)	0.2	0.0	0.91
White oak	960	7	-125	-4	-1	650	5	1,481	11	(N/A)	0.2	0.4	11.11
Oak	74	1	-1	-1	0	49	0	121	1	(N/A)	0.2	0.0	0.91
White mulberry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Black cherry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.2	0.1	1.74
Willow	224	2	-5	-1	0	176	1	393	3	(N/A)	0.2	0.1	2.95
Citywide total	226,735	1,701	-21,167	-1,193	-168	178,876	1,342	383,251	2,874	(N/A)	100.0	100.0	5.44

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

4/24/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	3,724	(N/A)	20.6	17.1	34.16
Sugar maple	3,754	(N/A)	11.0	17.3	64.72
Silver maple	3,474	(N/A)	10.4	16.0	63.16
Green ash	2,547	(N/A)	8.5	11.7	56.60
Apple	229	(N/A)	7.4	1.1	5.88
Red maple	1,160	(N/A)	5.9	5.3	37.41
Honeylocust	1,581	(N/A)	3.6	7.3	83.19
Northern hackberry	711	(N/A)	2.8	3.3	47.38
Pin oak	1,243	(N/A)	2.8	5.7	82.86
Blue spruce	293	(N/A)	2.8	1.4	19.55
American basswood	579	(N/A)	2.7	2.7	41.33
Pear	15	(N/A)	2.5	0.1	1.17
Northern red oak	128	(N/A)	1.9	0.6	12.75
Broadleaf Deciduous Medi	142	(N/A)	1.7	0.7	15.81
Bur oak	330	(N/A)	1.7	1.5	36.68
Northern white cedar	262	(N/A)	1.5	1.2	32.79
Swamp white oak	146	(N/A)	1.3	0.7	20.91
Black walnut	262	(N/A)	0.9	1.2	52.39
Littleleaf linden	273	(N/A)	0.8	1.3	68.29
Japanese tree lilac	18	(N/A)	0.8	0.1	4.40
Kentucky coffeetree	83	(N/A)	0.8	0.4	20.74
Lilac	28	(N/A)	0.6	0.1	9.43
Broadleaf Deciduous Large	106	(N/A)	0.6	0.5	35.48
American sycamore	62	(N/A)	0.6	0.3	20.80
Eastern red cedar	0	(N/A)	0.4	0.0	0.00
Mulberry	22	(N/A)	0.4	0.1	10.94
Norway spruce	42	(N/A)	0.4	0.2	20.84
White ash	127	(N/A)	0.4	0.6	63.74
Common chokecherry	29	(N/A)	0.4	0.1	14.42
Cottonwood	29	(N/A)	0.2	0.1	28.57
Black spruce	25	(N/A)	0.2	0.1	25.23
Ginkgo	17	(N/A)	0.2	0.1	17.46
Northern catalpa	5	(N/A)	0.2	0.0	5.26
River birch	13	(N/A)	0.2	0.1	12.89
Elm	15	(N/A)	0.2	0.1	14.73
American elm	20	(N/A)	0.2	0.1	19.89
Broadleaf Deciduous Small	0	(N/A)	0.2	0.0	0.03
Ohio buckeye	0	(N/A)	0.2	0.0	0.00
Alder	0	(N/A)	0.2	0.0	0.00
Callery pear	13	(N/A)	0.2	0.1	12.89
Eastern white pine	26	(N/A)	0.2	0.1	26.25
Mountain ash	6	(N/A)	0.2	0.0	6.40
Northern pin oak	43	(N/A)	0.2	0.2	43.05
Eastern redbud	6	(N/A)	0.2	0.0	6.40
Tulip tree	15	(N/A)	0.2	0.1	14.73
White oak	67	(N/A)	0.2	0.3	66.60
Oak	15	(N/A)	0.2	0.1	14.73
White mulberry	6	(N/A)	0.2	0.0	6.40
Black cherry	6	(N/A)	0.2	0.0	6.40
Willow	26	(N/A)	0.2	0.1	26.22
Citywide total	21,724	(N/A)	100.0	100.0	41.14

Table 7: Summary of Benefits in Dollars

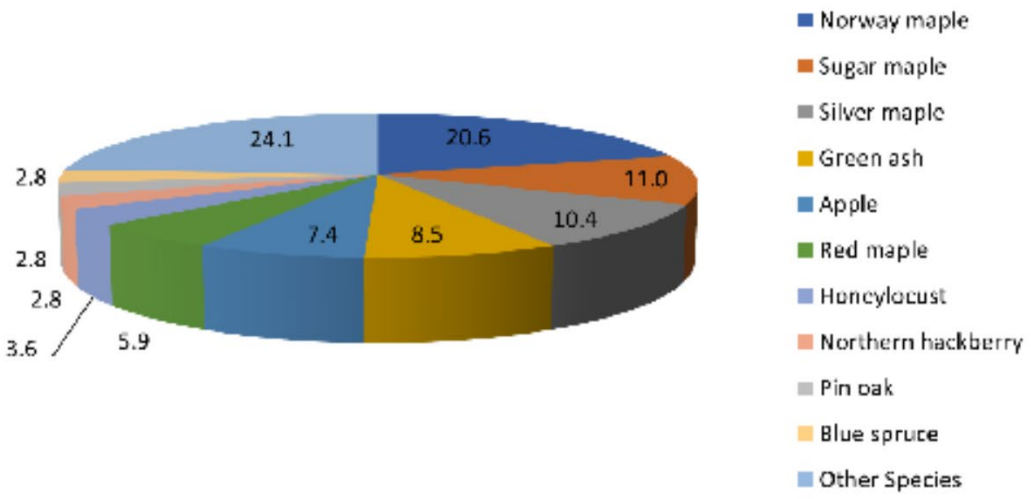
Annual Benefits of Public Trees by Species ($/tree)

4/24/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error
Norway maple	57.24	5.71	10.25	69.59	34.16	176.95	(N/A)
Sugar maple	54.83	7.65	8.95	90.16	64.72	226.33	(N/A)
Silver maple	38.67	7.62	7.01	69.40	63.16	185.85	(N/A)
Green ash	63.47	8.54	11.38	94.42	56.60	234.42	(N/A)
Apple	15.34	1.58	2.47	7.47	5.88	32.74	(N/A)
Red maple	32.21	3.89	5.59	29.03	37.41	108.13	(N/A)
Honeylocust	44.23	5.04	7.52	69.34	83.19	209.31	(N/A)
Northern hackberry	59.85	6.10	12.00	91.34	47.38	216.66	(N/A)
Pin oak	53.83	11.12	6.80	92.99	82.86	247.59	(N/A)
Blue spruce	25.22	2.17	2.80	48.60	19.55	98.35	(N/A)
American basswood	44.89	6.33	6.70	50.91	41.33	150.17	(N/A)
Pear	3.88	0.39	0.53	1.40	1.17	7.37	(N/A)
Northern red oak	26.65	2.57	3.80	30.46	12.75	76.24	(N/A)
Broadleaf Deciduou	13.18	1.69	1.96	8.16	15.81	40.79	(N/A)
Bur oak	41.90	5.41	7.84	69.67	36.68	161.51	(N/A)
Northern white ceda	29.49	2.74	0.87	78.66	32.79	144.55	(N/A)
Swamp white oak	25.21	2.89	4.26	25.42	20.91	78.69	(N/A)
Black walnut	59.20	7.94	10.84	96.95	52.39	227.31	(N/A)
Littleleaf linden	44.52	7.35	7.33	49.13	68.29	176.61	(N/A)
Japanese tree lilac	11.32	1.24	1.87	5.08	4.40	23.91	(N/A)
Kentucky coffeetree	16.11	2.24	2.59	18.96	20.74	60.64	(N/A)
Lilac	24.84	2.56	3.88	10.80	9.43	51.51	(N/A)
Broadleaf Deciduou	31.42	4.40	5.24	28.03	35.48	104.57	(N/A)
American sycamore	65.97	5.10	15.06	130.94	20.80	237.88	(N/A)
Eastern red cedar	24.57	1.35	2.19	44.30	0.00	72.40	(N/A)
Mulberry	28.16	2.97	4.55	12.62	10.94	59.24	(N/A)
Norway spruce	25.88	2.52	-0.05	70.46	20.84	119.65	(N/A)
White ash	48.12	6.92	8.32	45.05	63.74	172.15	(N/A)
Common chokecher	23.50	2.97	4.23	16.01	14.42	61.13	(N/A)
Cottonwood	98.63	7.63	22.55	196.17	28.57	353.55	(N/A)
Black spruce	24.51	2.22	2.89	41.85	25.23	96.70	(N/A)
Ginkgo	40.40	3.91	6.92	33.60	17.46	102.29	(N/A)
Northern catalpa	0.66	0.05	0.08	0.48	5.26	6.53	(N/A)
River birch	8.99	1.18	1.21	4.41	12.89	28.68	(N/A)
Elm	5.82	0.91	0.87	4.65	14.73	26.98	(N/A)
American elm	17.66	1.82	2.54	11.72	19.89	53.63	(N/A)
Broadleaf Deciduou	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)
Ohio buckeye	70.84	3.49	13.58	102.01	0.00	189.93	(N/A)
Alder	46.14	2.24	8.35	31.82	0.00	88.55	(N/A)
Callery pear	8.99	1.18	1.21	4.41	12.89	28.68	(N/A)
Eastern white pine	38.17	3.96	-1.58	124.79	26.25	191.60	(N/A)
Mountain ash	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Northern pin oak	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)
Eastern redbud	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Tulip tree	5.82	0.91	0.87	4.65	14.73	26.98	(N/A)
White oak	82.02	11.11	15.71	148.79	66.60	324.23	(N/A)
Oak	5.82	0.91	0.87	4.65	14.73	26.98	(N/A)
White mulberry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Black cherry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Willow	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
Citywide Total	42.88	5.44	7.29	60.45	41.14	157.20	(N/A)

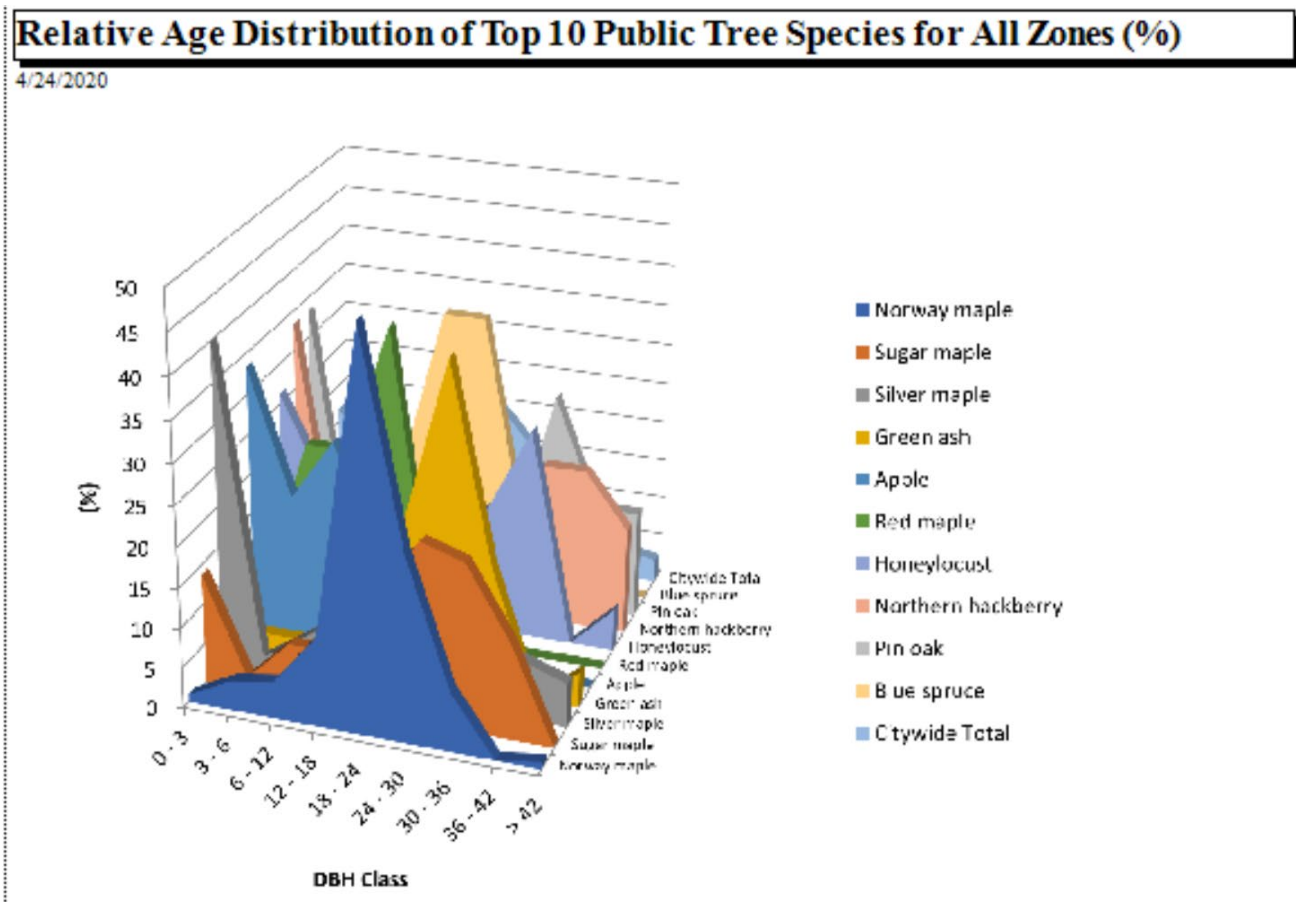
Species Distribution of Public Trees

4/24/2020



Species	Percent
Norway maple	20.6
Sugar maple	11.0
Silver maple	10.4
Green ash	8.5
Apple	7.4
Red maple	5.9
Honeylocust	3.6
Northern hackberry	2.8
Pin oak	2.8
Blue spruce	2.8
Other Species	24.1
Total	100.0

Figure 1: Species Distribution



Species	DBH class (in) 0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Norway maple	0.92	3.67	4.59	11.01	48.62	22.94	7.34	0.00	0.92
Sugar maple	13.79	1.72	6.90	6.90	15.52	22.41	20.69	12.07	0.00
Silver maple	40.00	1.82	5.45	9.09	10.91	10.91	9.09	7.27	5.45
Green ash	2.22	2.22	2.22	13.33	20.00	40.00	15.56	0.00	4.44
Apple	33.33	17.95	25.64	15.38	5.13	0.00	2.56	0.00	0.00
Red maple	6.45	22.58	22.58	38.71	3.23	6.45	0.00	0.00	0.00
Honeylocust	26.32	15.79	0.00	0.00	10.53	15.79	26.32	0.00	5.26
Northern hackberry	33.33	0.00	6.67	0.00	6.67	0.00	20.00	20.00	13.33
Pin oak	33.33	0.00	0.00	0.00	6.67	6.67	26.67	13.33	13.33
Blue spruce	0.00	6.67	13.33	33.33	33.33	6.67	6.67	0.00	0.00
Citywide Total	16.86	8.71	9.66	13.07	20.83	14.96	9.09	3.98	2.84

Figure 2: Relative Age Class

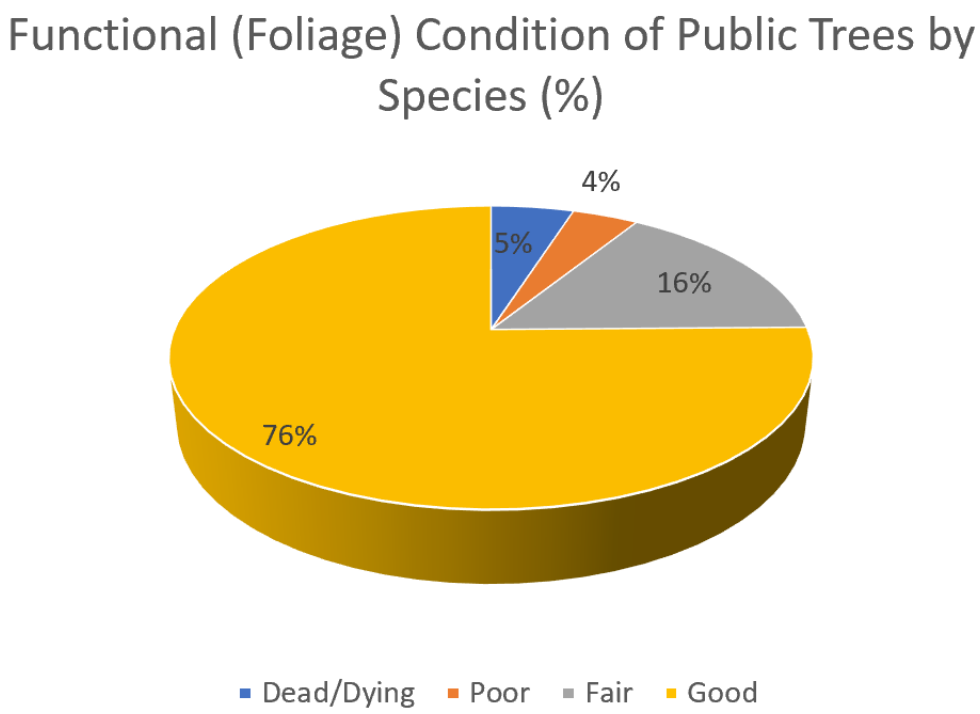


Figure 3: Foliage Condition

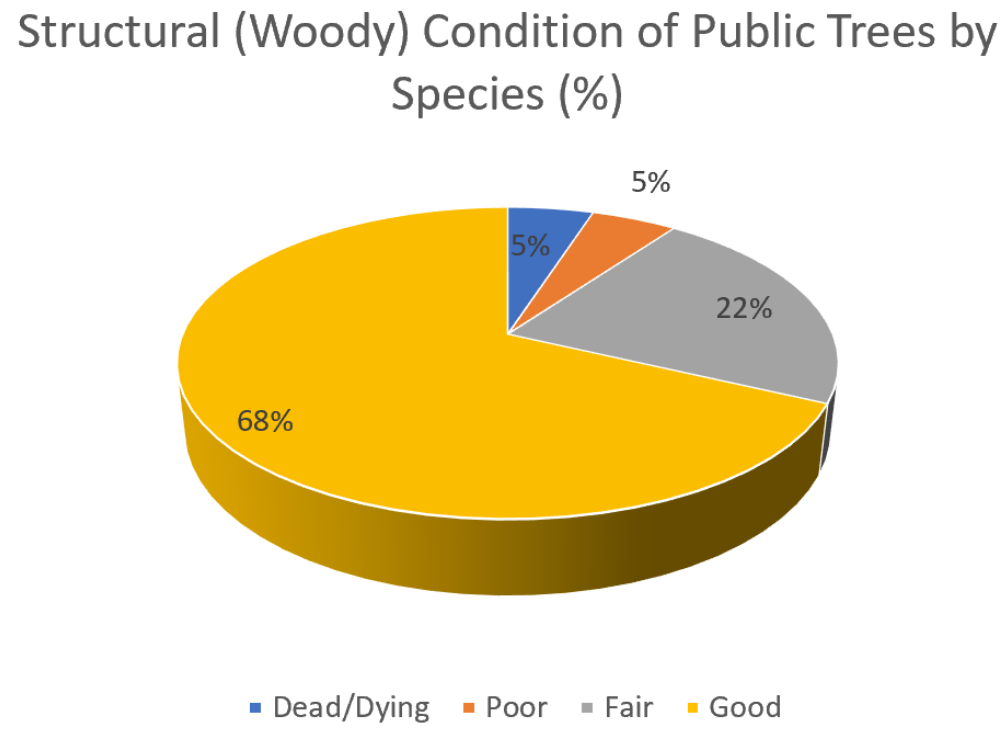
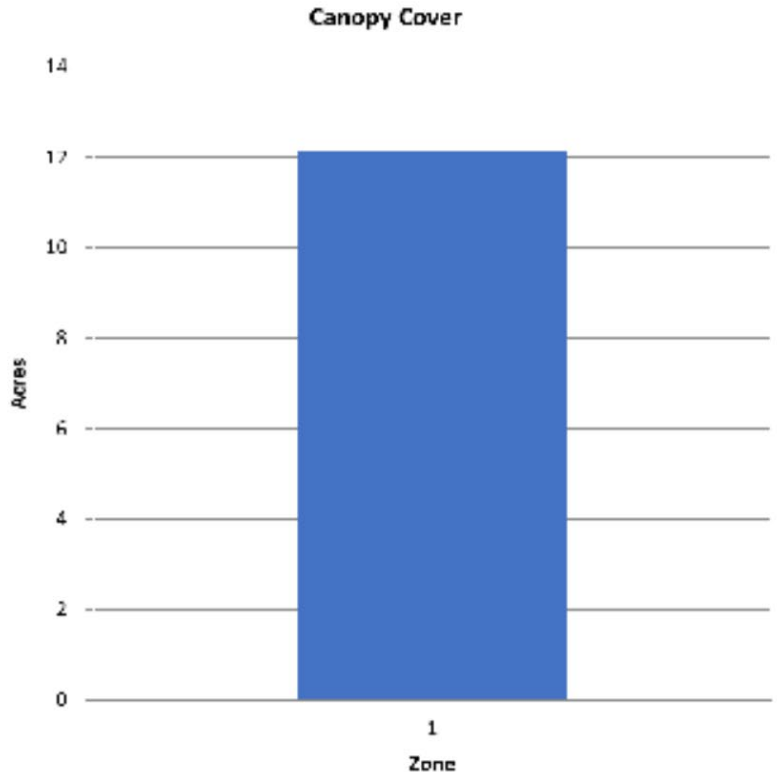


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

4/24/2020



Zone	Acres	% of Total Canopy Cover
1	12	100.0
Citywide total	12	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	12	0.00	0.00

Figure 5: Canopy Cover in Acres

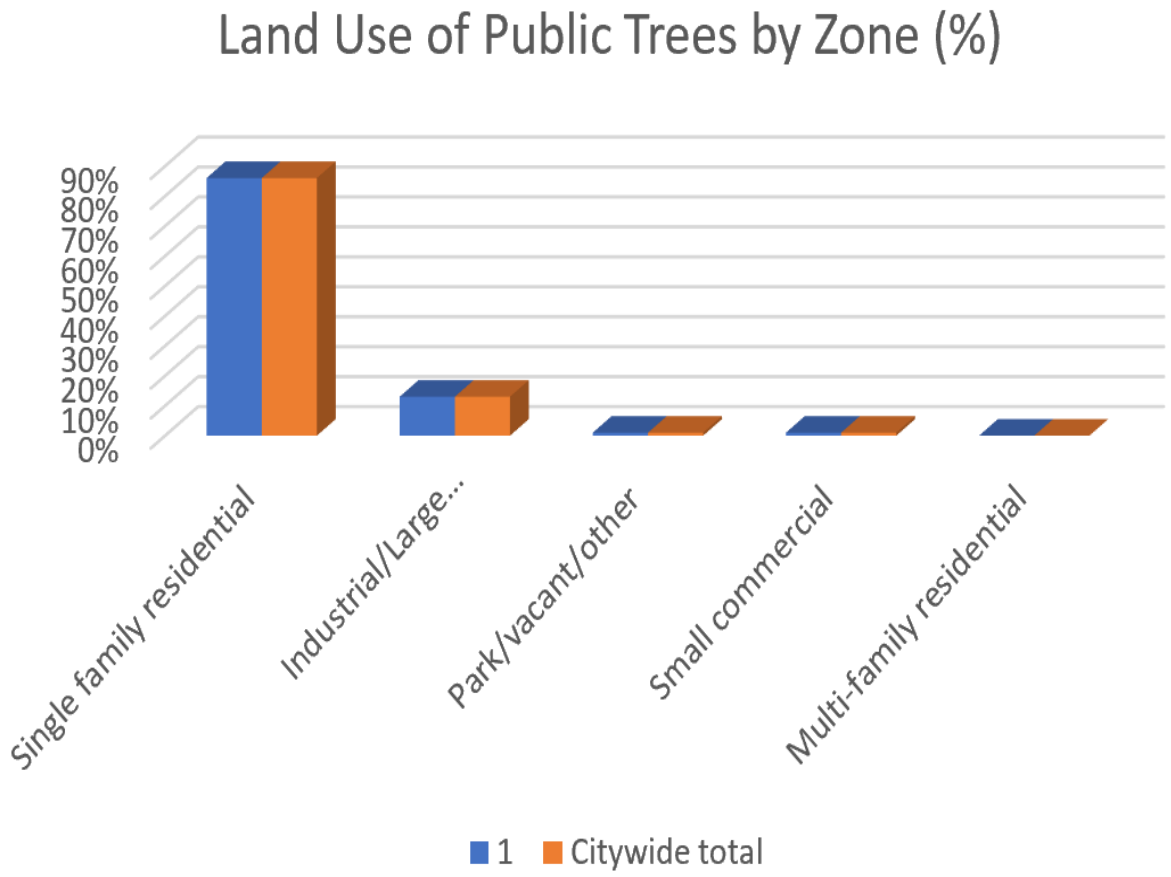


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

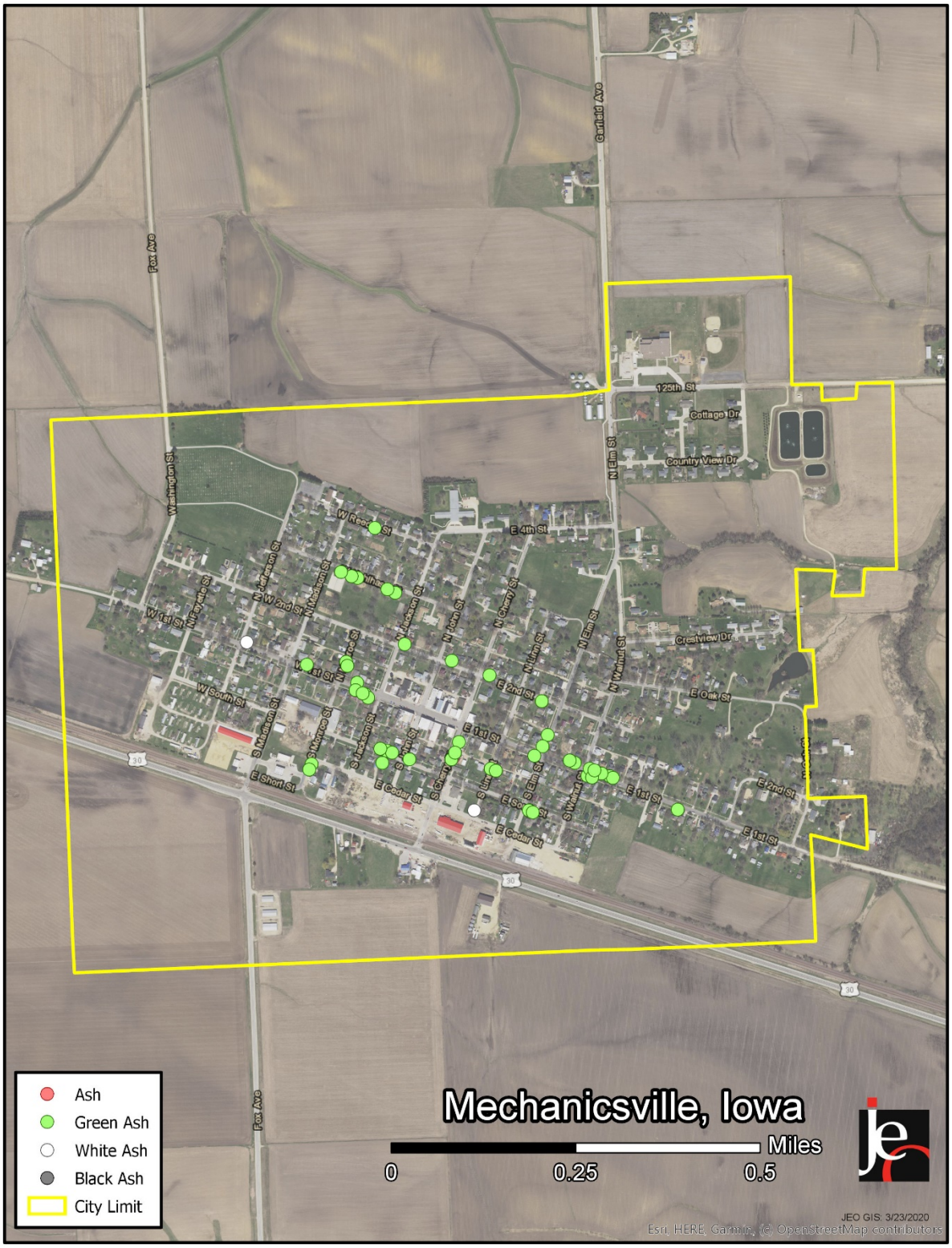


Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

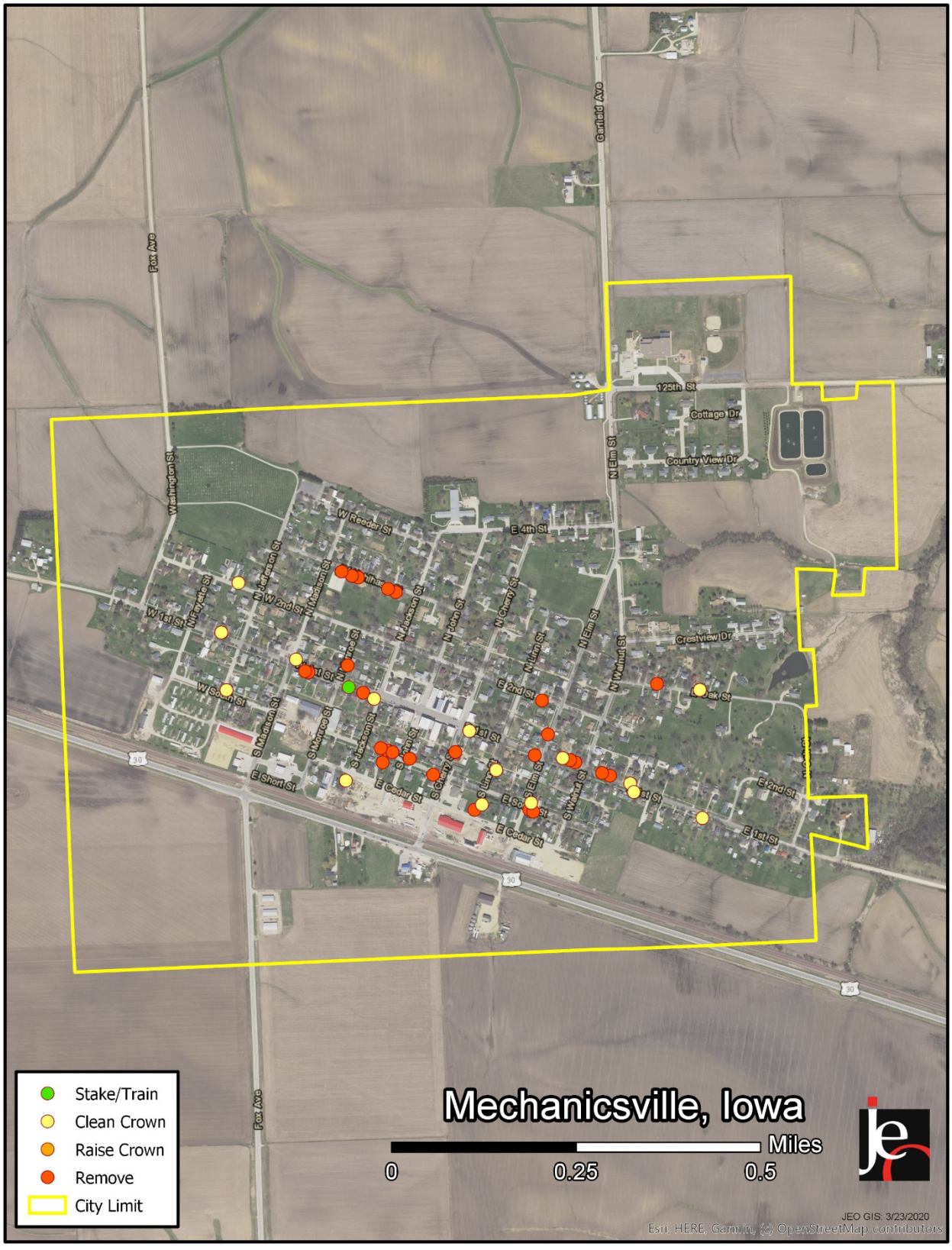


Figure 4: Location of Trees with Recommended Maintenance ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: Mechanicsville Tree Ordinances

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 fruitbearing 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, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

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.

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.