Strawberry Point, 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 Strawberry Point 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 8% of Strawberry Point'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 626 trees inventoried.

- Strawberry Point's trees provide $79,754 of benefits annually, an average of $127.40 per tree
- There are over 50 species of trees
- The top three genera are: Maple 44%, Ash 8%, and Apple 4%
- 32% of trees need some type of management
- 15 trees should be removed

Recommendations

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

- Out of the 15 trees needing removal, two 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*
- Sixteen of the 51 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 tree care budget provided, it could take 14.5 years to remove all ash trees including both Emerald Ash borer infested and non-infested trees. We suggest that city officials request a budget increase to at least $6,000 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist Strawberry Point 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 Strawberry Point, 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 Strawberry Point'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 Strawberry Point 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 Strawberry Point'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 noted signs and symptoms associated with EAB including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 626 city trees were entered 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. Strawberry Point's trees reduce energy-related costs by approximately $22,223 annually (Appendix A, Table 1). These savings are both in electricity (105.5 MWh) and in natural gas (14,508.0 Therms).

Annual Stormwater Benefits

Strawberry Point's trees intercept about 1,077,864 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $29,210 in benefits 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 Strawberry Point, it is estimated that trees remove 1,330.1lbs 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 $3,723 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Strawberry Point, trees sequester about 226,030lbs of carbon per year with an associated value of $1,695 (Appendix A, Table 5). In addition, the trees store 3,746,432lbs of carbon, with a yearly benefit of $28,098 (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. Strawberry Point receives $21,720 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, Strawberry Point's trees provide $79,754 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 626 trees in Strawberry Point provide approximately $127.40 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Strawberry Point 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	275	44%
Ash	51	8%
Apple (Crab)	51	8%
Lilac	35	6%
Linden/Basswood	30	5%
Other Deciduous (S,M,L)	32	5%
Oak	25	4%
Pear	14	2%
Locust	13	2%
Eastern Redbud	12	2%
Hackberry	11	2%
Walnut	11	2%
Other Large Evergreen	11	2%
Birch	9	1%
Elm	9	1%
Spruce	8	1%
Pine	8	1%
Ginkgo	6	1%
Cottonwood	5	<1%
Mountain Ash	5	<1%
Dogwood	3	<1%
Catalpa	2	<1%

Age Class

Most of Strawberry Point's trees (44%) are between six 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. Strawberry Point'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 Strawberry Point indicate that 71% of the trees are in good health, with only 6% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 80% of Strawberry Point's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Six percent of the tree population's wood condition is in poor health, dead or dying. This 6% 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	111	18%
Crown Raising	4	<1%
Tree Staking	10	2%
Tree Removal	15	2%
Crown Reduction	23	4%

Land Use and Location

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

Land Use	
Single family residential	67%
Park/vacant/other	<1%
Industrial/Large commercial	32%
Small commercial	<1%
Multifamily residential	<1%

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

Strawberry Point has 15 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter, critical concern trees first. There are 14 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Six Year Maintenance Plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 17 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 15 removals, two are ash trees. There are a total of 51 ash trees, and 16 of those have signs and symptoms that have been associated with EAB. In addition, there are two 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 Strawberry Point.

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 (44%) (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 69.08 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 69.08 (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 annually 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 signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be 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 69.08 (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 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. Strawberry Points current City Code 70.05 states "If the superintendent upon inspection or examination, in person or by some qualified person acting for the superintendent shall determine with reasonable certainty that any condition as herein defined exists in or upon private premises and that the danger to other elm trees within the city is imminent, the superintendent shall immediately notify by certified mail the owner, occupant or person in 195 charge of such property, to correct such condition within 14 days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt thereof, the council may cause the nuisance to be removed and the cost assessed against the property as provided in Chapter 46. (Code of Iowa, 2013, Sec. 364.12 3 (b and h) If the superintendent is unable to determine with reasonable certainty whether or not a tree in or upon private premises is infected with Dutch elm disease, he is authorized to remove or cut specimens from said tree, and obtain a diagnosis of such specimens." A similar code could be drafted in response to the Emerald Ash borer infestation and would be advised by JEO.

Proposed Work Schedule and Budget

Budget Allowance of $2,466/Year – (Calculated at $2/Capita, No Budget Provided)

YEAR 1	**ESTIMATED COSTS**
Remove 2 recommended trees plus 1 ash tree in poor condition	$2,100
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	

YEAR 2	
Remove 2 recommended trees plus 1 ash tree in poor condition	$2,100
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	

YEAR 3	
Remove 3 recommended trees	$2,100
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 3 recommended trees	$2,100
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 3 recommended trees	$2,100
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 3 recommended trees	$2,100
Plant 2 trees in open locations	$300
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, the budget would need to be increased to $5,950 a year. If the budget were increased to $3,500 per year, all ash could be removed in 10 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of $6,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	**ESTIMATED COSTS**
Remove 5 critical concern trees plus 2 ash trees in poor condition	$4,900
Plant 7 trees in open locations	$1,050
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 4 critical concern trees	$2,800
Prune 1/3 of city-owned trees	$3,120
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 4 critical concern trees and 2 ash trees	$4,200
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 3 ash trees	$2,100
Plant 5 trees in open locations	$750
Prune 1/3 of city-owned trees	$3,120
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 6 ash trees	$4,200
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 3 ash trees	$2,100
Plant 5 trees in open locations	$750
Prune 1/3 of city-owned trees	$3,120
Visual Survey of EAB Signs/Symptoms	

Proposed Budget Increase

EAB could potentially kill all ash trees in Strawberry Point within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $5,950 a year. If the budget were increased to $10,000 per year, all ash could be removed within 3.5 years. Additionally, we recommend that Strawberry Point 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 four trees could be treated per year (every other year treatment). Eight trees would be selected for treatment, and Strawberry Point would still have $1,200 for removal. Alternatively, if there are 10 treatable trees, it would cost approximately $1,500 a year for treatment and leave around $1,000 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Strawberry Point. We suggest considering an increased budget to plan for this.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, DJ and JF Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J; McPherson, E Gregory; Simpson, James R; Vargas, Kelaine E; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

3/2/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	19.1	1,447	2,7415	2,687	4,135	(N/A)	13.5	18.6	49.80
Silver maple	18.9	1,434	2,4807	2,431	3,865	(N/A)	9.4	17.4	65.52
Apple	3.0	228	5048	495	723	(N/A)	8.1	3.3	14.18
Sugar maple	9.8	747	1,3212	1,295	2,042	(N/A)	6.9	9.2	47.49
Black maple	9.4	714	1,2853	1,260	1,973	(N/A)	5.9	8.9	53.34
Green ash	9.2	695	1,2106	1,186	1,882	(N/A)	5.6	8.5	53.77
Japanese tree lilac	1.5	117	2590	254	371	(N/A)	5.6	1.7	10.59
Red maple	3.0	224	3826	375	599	(N/A)	4.8	2.7	19.98
Broadleaf Deciduous Sm	0.4	29	65.9	65	94	(N/A)	3.2	0.4	4.68
Littleleaf linden	2.0	154	2829	277	431	(N/A)	2.7	1.9	25.37
White ash	3.1	235	3840	376	612	(N/A)	2.6	2.8	38.24
Northern red oak	1.7	126	2272	223	349	(N/A)	2.4	1.6	23.28
Pear	0.7	54	1155	113	167	(N/A)	2.2	0.8	11.93
American basswood	3.2	243	4527	444	687	(N/A)	2.1	3.1	52.84
Honeylocust	2.5	186	3308	324	510	(N/A)	2.1	2.3	39.27
Eastern redbud	0.4	27	62.7	61	89	(N/A)	1.9	0.4	7.40
Amur maple	0.9	71	146.7	144	214	(N/A)	1.8	1.0	19.49
Northern hackberry	2.2	164	3019	296	460	(N/A)	1.8	2.1	41.79
Black walnut	2.5	193	3397	333	526	(N/A)	1.8	2.4	47.82
Elm	1.1	81	1419	139	220	(N/A)	1.4	1.0	24.49
Maple	0.2	15	29.1	28	43	(N/A)	1.4	0.2	4.82
Northern white cedar	1.3	97	1719	168	265	(N/A)	1.3	1.2	33.17
Ginkgo	0.3	23	38.1	37	60	(N/A)	1.0	0.3	10.04
Eastern cottonwood	1.2	91	1461	143	234	(N/A)	0.8	1.1	46.85
Mountain ash	0.3	20	46.1	45	65	(N/A)	0.8	0.3	13.08
Paper birch	0.9	70	1257	123	193	(N/A)	0.6	0.9	48.27
River birch	0.5	37	69.4	68	105	(N/A)	0.6	0.5	26.18
Swamp white oak	0.3	22	46.1	45	67	(N/A)	0.6	0.3	16.73
Red pine	0.6	45	73.6	72	117	(N/A)	0.6	0.5	29.23
Broadleaf Deciduous Lar	0.7	50	87.6	86	136	(N/A)	0.5	0.6	45.26
Bur oak	0.1	8	14.7	14	22	(N/A)	0.5	0.1	7.32
Norway spruce	0.5	35	58.9	58	93	(N/A)	0.5	0.4	30.93
Broadleaf Deciduous Me	0.1	6	13.2	13	19	(N/A)	0.5	0.1	6.36
Kentucky coffeetree	0.2	17	31.1	31	47	(N/A)	0.5	0.2	15.70
American sycamore	0.4	27	44.4	44	71	(N/A)	0.5	0.3	23.56
Blue spruce	0.4	29	45.6	45	74	(N/A)	0.5	0.3	24.51
Northern pin oak	0.9	69	1344	132	200	(N/A)	0.5	0.9	66.79
Hickory	0.5	36	54.0	53	88	(N/A)	0.3	0.4	44.23
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	0.3	0.2	24.57
Scotch pine	0.3	22	39.4	39	61	(N/A)	0.3	0.3	30.47
Spruce	0.2	14	24.1	24	38	(N/A)	0.3	0.2	18.86
Dogwood	0.0	3	7.6	7	11	(N/A)	0.3	0.0	5.40
Northern catalpa	0.0	2	3.7	4	6	(N/A)	0.2	0.0	5.82
Southern magnolia	0.2	18	24.2	24	41	(N/A)	0.2	0.2	41.29
Flowering dogwood	0.0	0	0.6	1	1	(N/A)	0.2	0.0	0.87
Catalpa	0.0	0	0.5	0	1	(N/A)	0.2	0.0	0.66
Austrian pine	0.1	10	15.2	15	25	(N/A)	0.2	0.1	24.51
Black poplar	0.3	20	38.1	37	57	(N/A)	0.2	0.3	57.32
Eastern white pine	0.2	14	24.6	24	38	(N/A)	0.2	0.2	38.17
Birch	0.2	18	29.5	29	47	(N/A)	0.2	0.2	46.78
Total	105.5	8,005	14,5080	14,218	22,223	(N/A)	1000	1000	35.50

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of All Trees

5/27/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg $/tree
Norway maple	175,572	4,758	(N/A)	15.5	16.5	57.55
Silver maple	279,353	7,570	(N/A)	9.4	25.9	128.31
Apple	11,944	324	(N/A)	8.1	1.1	6.35
Sugar maple	110,206	2,987	(N/A)	6.9	10.2	69.46
Black maple	87,943	2,383	(N/A)	5.9	8.2	64.41
Green ash	95,818	2,597	(N/A)	5.6	8.9	74.19
Japanese tree lilac	5,290	143	(N/A)	5.6	0.5	4.10
Red maple	17,047	462	(N/A)	4.8	1.6	15.40
Broadleaf Deciduous Smal	1,202	33	(N/A)	3.2	0.1	1.63
Littleleaf linden	15,114	410	(N/A)	2.7	1.4	24.09
White ash	28,130	762	(N/A)	2.6	2.6	47.65
Northern red oak	10,981	298	(N/A)	2.4	1.0	19.84
Pear	2,489	67	(N/A)	2.2	0.2	4.82
American basswood	34,744	942	(N/A)	2.1	3.2	72.43
Honeylocust	20,861	565	(N/A)	2.1	1.9	43.49
Eastern redbud	1,240	34	(N/A)	1.9	0.1	2.80
Amur maple	3,322	90	(N/A)	1.8	0.3	8.18
Northern hackberry	13,029	353	(N/A)	1.8	1.2	32.10
Black walnut	27,006	732	(N/A)	1.8	2.5	66.53
Elm	11,215	304	(N/A)	1.4	1.0	33.77
Maple	733	20	(N/A)	1.4	0.1	2.21
Northern white cedar	29,557	801	(N/A)	1.3	2.7	100.12
Ginkgo	1,271	34	(N/A)	1.0	0.1	5.74
Eastern cottonwood	8,453	229	(N/A)	0.8	0.8	45.81
Mountain ash	931	25	(N/A)	0.8	0.1	5.04
Paper birch	8,607	233	(N/A)	0.6	0.8	58.31
River birch	2,744	74	(N/A)	0.6	0.3	18.59
Swamp white oak	1,497	41	(N/A)	0.6	0.1	10.14
Red pine	10,651	289	(N/A)	0.6	1.0	72.16
Broadleaf Deciduous Larg	6,016	163	(N/A)	0.5	0.6	54.35
Bur oak	644	17	(N/A)	0.5	0.1	5.81
Norway spruce	9,112	247	(N/A)	0.5	0.8	82.32
Broadleaf Deciduous Medi	338	9	(N/A)	0.5	0.0	3.05
Kentucky coffeetree	1,387	38	(N/A)	0.5	0.1	12.53
American sycamore	2,245	61	(N/A)	0.5	0.2	20.28
Blue spruce	4,633	126	(N/A)	0.5	0.4	41.85
Northern pin oak	10,008	271	(N/A)	0.5	0.9	90.41
Hickory	2,931	79	(N/A)	0.3	0.3	39.72
Eastern red cedar	3,269	89	(N/A)	0.3	0.3	44.30
Scotch pine	5,938	161	(N/A)	0.3	0.6	80.46
Spruce	2,134	58	(N/A)	0.3	0.2	28.92
Dogwood	137	4	(N/A)	0.3	0.0	1.86
Northern catalpa	172	5	(N/A)	0.2	0.0	4.65
Southern magnolia	1,775	48	(N/A)	0.2	0.2	48.11
Flowering dogwood	7	0	(N/A)	0.2	0.0	0.20
Catalpa	18	0	(N/A)	0.2	0.0	0.48
Austrian pine	1,544	42	(N/A)	0.2	0.1	41.85
Black poplar	2,591	70	(N/A)	0.2	0.2	70.21
Eastern white pine	4,605	125	(N/A)	0.2	0.4	124.79
Birch	1,409	38	(N/A)	0.2	0.1	38.19
Citywide total	1,077,864	29,210	(N/A)	1000	1000	46.66

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of All Trees

3/2/2020

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 Total	Avg. Trees	$/tree
Norway maple	35.7	6.2	17.6	1.6	193	92.3	13.4	12.7	86.5	572	-8.4	-31	257.5	734	(N/A)	13.3	#####	
Silver maple	49.3	8.3	24.1	2.2	265	89.0	13.0	12.4	85.5	557	-26.0	-98	257.9	725	(N/A)	9.4	#####	
Apple	2.7	0.4	1.4	0.1	15	15.2	2.1	2.0	13.6	92	0.0	0	37.7	107	(N/A)	8.1	#####	
Sugar maple	15.1	2.6	7.5	0.7	82	46.7	6.8	6.5	44.6	292	-11.9	-45	118.6	329	(N/A)	6.9	#####	
Black maple	22.3	3.8	10.3	1.0	118	44.8	6.5	6.2	42.6	279	-7.3	-27	130.2	370	(N/A)	5.9	#####	
Green ash	11.6	1.9	5.6	0.5	62	43.4	6.3	6.1	41.5	271	0.0	0	116.8	333	(N/A)	5.6	#####	
Japanese tree lilac	0.8	0.1	0.5	0.0	5	7.8	1.1	1.0	7.0	47	0.0	0	18.4	52	(N/A)	5.6	#####	
Red maple	2.9	0.5	1.5	0.1	16	13.9	2.0	1.9	13.4	87	-1.1	-4	35.2	99	(N/A)	4.8	#####	
Broadleaf Deciduous Smal	0.1	0.0	0.1	0.0	1	1.9	0.3	0.3	1.7	12	0.0	0	4.4	12	(N/A)	3.2	#####	
Littleleaf linden	2.0	0.4	1.1	0.1	11	9.8	1.4	1.3	9.2	61	-1.1	-4	24.2	68	(N/A)	2.7	#####	
White ash	3.8	0.6	1.9	0.2	20	14.4	2.1	2.0	14.0	91	0.0	0	39.1	111	(N/A)	2.6	#####	
Northern red oak	1.8	0.3	1.0	0.1	10	7.9	1.2	1.1	7.5	49	-2.6	-10	18.3	50	(N/A)	2.4	#####	
Pear	0.5	0.1	0.3	0.0	3	3.5	0.5	0.5	3.2	22	0.0	0	8.6	24	(N/A)	2.2	#####	
American basswood	4.7	0.8	2.3	0.2	26	15.5	2.2	2.1	14.5	96	-4.0	-15	38.4	106	(N/A)	2.1	#####	
Honeylocust	3.8	0.6	1.8	0.2	20	11.7	1.7	1.6	11.1	73	-2.7	-10	29.7	83	(N/A)	2.1	#####	
Eastern redbud	0.2	0.0	0.1	0.0	1	1.8	0.3	0.2	1.6	11	0.0	0	4.3	12	(N/A)	1.9	#####	
Amur maple	0.7	0.1	0.4	0.0	4	4.6	0.7	0.6	4.2	28	0.0	0	11.4	32	(N/A)	1.8	#####	
Northern hackberry	1.3	0.2	0.8	0.1	7	10.4	1.5	1.4	9.8	64	0.0	0	25.5	72	(N/A)	1.8	#####	
Black walnut	3.3	0.5	1.6	0.1	17	12.1	1.8	1.7	11.5	75	0.0	0	32.6	93	(N/A)	1.8	#####	
Elm	1.3	0.2	0.7	0.1	7	5.1	0.7	0.7	4.9	32	0.0	0	13.7	39	(N/A)	1.4	#####	
Maple	0.0	0.0	0.0	0.0	0	1.0	0.1	0.1	0.9	6	0.0	0	2.2	6	(N/A)	1.4	#####	
Northern white cedar	3.6	0.7	2.9	0.4	23	6.1	0.9	0.8	5.8	38	-17.2	-65	3.9	-4	(N/A)	1.3	#####	
Ginkgo	0.2	0.0	0.1	0.0	1	1.4	0.2	0.2	1.4	9	-0.1	0	3.4	10	(N/A)	1.0	#####	
Eastern cottonwood	0.7	0.1	0.4	0.0	4	5.6	0.8	0.8	5.4	35	0.0	0	13.9	39	(N/A)	0.8	#####	
Mountain ash	0.1	0.0	0.1	0.0	1	1.4	0.2	0.2	1.2	8	0.0	0	3.2	9	(N/A)	0.8	#####	
Paper birch	0.9	0.1	0.5	0.0	5	4.4	0.6	0.6	4.2	27	0.0	0	11.4	32	(N/A)	0.6	#####	
River birch	0.3	0.1	0.2	0.0	2	2.3	0.3	0.3	2.2	15	-0.1	0	5.7	16	(N/A)	0.6	#####	
Swamp white oak	0.1	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	9	0.0	0	3.3	9	(N/A)	0.6	#####	
Red pine	1.3	0.2	1.0	0.2	8	2.7	0.4	0.4	2.7	17	-5.3	-20	3.6	6	(N/A)	0.6	#####	
Broadleaf Deciduous Larg	0.6	0.1	0.3	0.0	3	3.1	0.5	0.4	3.0	19	0.0	0	8.1	23	(N/A)	0.5	#####	
Bur oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.1	3	(N/A)	0.5	#####	
Norway spruce	1.1	0.2	0.9	0.1	7	2.2	0.3	0.3	2.1	14	-4.8	-18	2.4	5	(N/A)	0.5	#####	
Broadleaf Deciduous Medi	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)	0.5	#####	
Kentucky coffeetree	0.1	0.0	0.0	0.0	0	1.1	0.2	0.1	1.0	7	0.0	0	2.4	7	(N/A)	0.5	#####	
American sycamore	0.1	0.0	0.1	0.0	1	1.7	0.2	0.2	1.6	10	0.0	0	4.0	11	(N/A)	0.5	#####	
Blue spruce	0.6	0.1	0.5	0.1	4	1.8	0.3	0.2	1.7	11	-1.7	-6	3.6	9	(N/A)	0.5	#####	
Northern pin oak	2.2	0.4	1.1	0.1	12	4.4	0.6	0.6	4.1	27	-0.5	-2	13.0	37	(N/A)	0.5	#####	
Hickory	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	14	0.0	0	5.3	15	(N/A)	0.3	#####	
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)	0.3	#####	
Scotch pine	0.7	0.1	0.6	0.1	5	1.4	0.2	0.2	1.3	9	-2.8	-10	1.8	3	(N/A)	0.3	#####	
Spruce	0.2	0.0	0.2	0.0	2	0.9	0.1	0.1	0.8	5	-0.7	-3	1.7	4	(N/A)	0.3	#####	
Dogwood	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	0.3	#####	
Northern catalpa	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	#####	
Southern magnolia	0.1	0.0	0.1	0.0	1	1.0	0.2	0.1	1.0	7	-0.5	-2	2.1	5	(N/A)	0.2	#####	
Flowering dogwood	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	#####	
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	#####	
Austrian pine	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	#####	
Black poplar	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9	(N/A)	0.2	#####	
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	#####	
Birch	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8	(N/A)	0.2	#####	
Citywide total	179.1	30.5	91.0	8.7	976	503.9	73.3	69.9	477.9	3,138	-104.2	-391	1,330.1	3,723	(N/A)	100.0	5.95	

Table 4: Annual Carbon Stored

Stored CO2 Benefits of All Trees

3/2/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	592,726	4,445	(N/A)	13.3	15.8	53.56
Silver maple	1,163,370	8,725	(N/A)	9.4	31.1	147.89
Apple	48,890	367	(N/A)	8.1	1.3	7.19
Sugar maple	443,940	3,330	(N/A)	6.9	11.8	77.43
Black maple	237,822	1,784	(N/A)	5.9	6.3	48.21
Green ash	380,593	2,854	(N/A)	5.6	10.2	81.56
Japanese tree lilac	17,679	133	(N/A)	5.6	0.5	3.79
Red maple	35,359	265	(N/A)	4.8	0.9	8.84
Broadleaf Deciduou	3,302	25	(N/A)	3.2	0.1	1.24
Littleleaf linden	46,594	349	(N/A)	2.7	1.2	20.56
White ash	73,323	550	(N/A)	2.6	2.0	34.37
Northern red oak	33,943	255	(N/A)	2.4	0.9	16.97
Pear	9,073	68	(N/A)	2.2	0.2	4.86
American basswoo	176,852	1,326	(N/A)	2.1	4.7	102.03
Honeylocust	47,722	358	(N/A)	2.1	1.3	27.53
Eastern redbud	4,070	31	(N/A)	1.9	0.1	2.54
Amur maple	12,785	96	(N/A)	1.8	0.3	8.72
Northern hackberry	17,319	130	(N/A)	1.8	0.5	11.81
Black walnut	107,455	806	(N/A)	1.8	2.9	73.27
Elm	46,776	351	(N/A)	1.4	1.2	38.98
Maple	1,160	9	(N/A)	1.4	0.0	0.97
Northern white ced	44,394	333	(N/A)	1.3	1.2	41.62
Ginkgo	2,497	19	(N/A)	1.0	0.1	3.12
Eastern cottonwood	23,145	174	(N/A)	0.8	0.6	34.72
Mountain ash	3,079	23	(N/A)	0.8	0.1	4.62
Paper birch	28,937	217	(N/A)	0.6	0.8	54.26
River birch	6,044	45	(N/A)	0.6	0.2	11.33
Swamp white oak	2,638	20	(N/A)	0.6	0.1	4.95
Red pine	13,174	99	(N/A)	0.6	0.4	24.70
Broadleaf Deciduou	20,479	154	(N/A)	0.5	0.5	51.20
Bur oak	1,059	8	(N/A)	0.5	0.0	2.65
Norway spruce	12,003	90	(N/A)	0.5	0.3	30.01
Broadleaf Deciduou	454	3	(N/A)	0.5	0.0	1.13
Kentucky coffeetre	2,255	17	(N/A)	0.5	0.1	5.64
American sycamore	4,892	37	(N/A)	0.5	0.1	12.23
Blue spruce	3,355	25	(N/A)	0.5	0.1	8.39
Northern pin oak	36,506	274	(N/A)	0.5	1.0	91.26
Hickory	7,344	55	(N/A)	0.3	0.2	27.54
Eastern red cedar	2,204	17	(N/A)	0.3	0.1	8.27
Scotch pine	6,685	50	(N/A)	0.3	0.2	25.07
Spruce	1,427	11	(N/A)	0.3	0.0	5.35
Dogwood	356	3	(N/A)	0.3	0.0	1.33
Northern catalpa	185	1	(N/A)	0.2	0.0	1.39
Southern magnolia	1,851	14	(N/A)	0.2	0.0	13.88
Flowering dogwood	14	0	(N/A)	0.2	0.0	0.10
Catalpa	12	0	(N/A)	0.2	0.0	0.09
Austrian pine	1,118	8	(N/A)	0.2	0.0	8.39
Black poplar	8,458	63	(N/A)	0.2	0.2	63.43
Eastern white pine	7,490	56	(N/A)	0.2	0.2	56.18
Birch	3,624	27	(N/A)	0.2	0.1	27.18
Citywide total	3,746,432	28,098	(N/A)	100.0	100.0	44.89

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

3/3/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standar d Error	% of Total Trees	% of Total $	
Norway maple	21,793	163	-2,846	-208	-23	31,971	240	50,709	380	(N/A)	13.3	13.2	58
Silver maple	82,665	620	-5,584	-214	-43	31,700	238	108,566	814	(N/A)	9.4	28.3	80
Apple	4,731	35	-235	-51	-2	5,045	38	9,490	71	(N/A)	8.1	2.5	40
Sugar maple	22,340	168	-2,132	-109	-17	16,517	124	36,615	275	(N/A)	6.9	9.5	39
Black maple	4,068	31	-1,142	-88	-9	15,776	118	18,615	140	(N/A)	5.9	4.9	77
Green ash	20,769	156	-1,827	-93	-14	15,368	115	34,217	257	(N/A)	5.6	8.9	33
Japanese tree lilac	2,440	18	-85	-28	-1	2,585	19	4,911	37	(N/A)	5.6	1.3	05
Red maple	4,943	37	-170	-29	-1	4,959	37	9,704	73	(N/A)	4.8	2.5	43
Broadleaf Deciduous Sm	659	5	-16	-10	0	641	5	1,274	10	(N/A)	3.2	0.3	48
Littleleaf linden	5,930	44	-225	-25	-2	3,404	26	9,083	68	(N/A)	2.7	2.4	01
White ash	7,579	57	-353	-28	-3	5,203	39	12,402	93	(N/A)	2.6	3.2	81
Northern red oak	2,096	16	-163	-20	-1	2,796	21	4,709	35	(N/A)	2.4	1.2	35
Pear	1,099	8	-44	-12	0	1,187	9	2,232	17	(N/A)	2.2	0.6	20
American basswood	10,278	77	-849	-37	-7	5,377	40	14,769	111	(N/A)	2.1	3.8	52
Honeylocust	6,630	50	-229	-20	-2	4,118	31	10,499	79	(N/A)	2.1	2.7	06
Eastern redbud	583	4	-20	-7	0	605	5	1,161	9	(N/A)	1.9	0.3	73
Amur maple	1,408	11	-61	-13	-1	1,560	12	2,894	22	(N/A)	1.8	0.8	97
Northern hackberry	1,769	13	-83	-18	-1	3,619	27	5,286	40	(N/A)	1.8	1.4	50
Black walnut	5,836	44	-516	-27	-4	4,267	32	9,560	72	(N/A)	1.8	2.5	52
Elm	2,281	17	-225	-13	-2	1,798	13	3,841	29	(N/A)	1.4	1.0	20
Maple	205	2	-6	-4	0	329	2	525	4	(N/A)	1.4	0.1	44
Northern white cedar	683	5	-213	-30	-2	2,142	16	2,582	19	(N/A)	1.3	0.7	42
Ginkgo	243	2	-12	-5	0	506	4	732	5	(N/A)	1.0	0.2	91
Eastern cottonwood	2,441	18	-111	-11	-1	2,013	15	4,332	32	(N/A)	0.8	1.1	50
Mountain ash	418	3	-15	-5	0	447	3	845	6	(N/A)	0.8	0.2	27
Paper birch	2,171	16	-139	-9	-1	1,545	12	3,568	27	(N/A)	0.6	0.9	59
River birch	929	7	-30	-5	0	811	6	1,706	13	(N/A)	0.6	0.4	20
Swamp white oak	639	5	-14	-4	0	481	4	1,102	8	(N/A)	0.6	0.3	07
Red pine	675	5	-63	-10	-1	990	7	1,591	12	(N/A)	0.6	0.4	98
Broadleaf Deciduous Lar	1,511	11	-98	-7	-1	1,104	8	2,510	19	(N/A)	0.5	0.7	27
Bur oak	214	2	-5	-2	0	168	1	375	3	(N/A)	0.5	0.1	94
Norway spruce	559	4	-58	-8	0	774	6	1,267	10	(N/A)	0.5	0.3	17
Broadleaf Deciduous Me	197	1	-4	-1	0	136	1	328	2	(N/A)	0.5	0.1	82
Kentucky coffeetree	492	4	-11	-3	0	366	3	844	6	(N/A)	0.5	0.2	11
American sycamore	728	5	-23	-4	0	600	5	1,301	10	(N/A)	0.5	0.3	25
Blue spruce	272	2	-16	-6	0	639	5	889	7	(N/A)	0.5	0.2	22
Northern pin oak	840	6	-175	-11	-1	1,517	11	2,171	16	(N/A)	0.5	0.6	43
Hickory	891	7	-35	-4	0	786	6	1,637	12	(N/A)	0.3	0.4	14
Eastern red cedar	43	0	-11	-4	0	374	3	402	3	(N/A)	0.3	0.1	51
Scotch pine	375	3	-32	-5	0	493	4	830	6	(N/A)	0.3	0.2	11
Spruce	168	1	-7	-3	0	311	2	469	4	(N/A)	0.3	0.1	76
Dogwood	76	1	-2	-1	0	74	1	147	1	(N/A)	0.3	0.0	55
Northern catalpa	74	1	-1	-1	0	49	0	121	1	(N/A)	0.2	0.0	91
Southern magnolia	143	1	-9	-2	0	388	3	520	4	(N/A)	0.2	0.1	90
Flowering dogwood	9	0	0	0	0	6	0	14	0	(N/A)	0.2	0.0	10
Catalpa	3	0	0	0	0	4	0	7	0	(N/A)	0.2	0.0	05
Austrian pine	91	1	-5	-2	0	213	2	296	2	(N/A)	0.2	0.1	22
Black poplar	660	5	-41	-3	0	441	3	1,058	8	(N/A)	0.2	0.3	93
Eastern white pine	0	0	-36	-4	0	311	2	271	2	(N/A)	0.2	0.1	03
Birch	386	3	-17	-2	0	395	3	762	6	(N/A)	0.2	0.2	71
Citywide total	226,030	1,695	-17,994	-1,205	-144	176,911	1,327	383,742	2,878	(N/A)	100.0	100.0	00

Table 6: Annual Social and Aesthetic Benefits

Strawberry Point

Annual Aesthetic/Other Benefits of Public Trees

5/5/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	2,178	(N/A)	13.3	10.0	26.25
Silver maple	6,295	(N/A)	9.4	29.0	106.69
Apple	266	(N/A)	8.1	1.2	5.22
Sugar maple	2,330	(N/A)	6.9	10.7	54.19
Black maple	549	(N/A)	5.9	2.5	14.84
Green ash	1,777	(N/A)	5.6	8.2	50.78
Japanese tree lilac	136	(N/A)	5.6	0.6	3.87
Red maple	743	(N/A)	4.8	3.4	24.77
Broadleaf Deciduous Small	33	(N/A)	3.2	0.2	1.67
Littleleaf linden	689	(N/A)	2.7	3.2	40.53
White ash	947	(N/A)	2.6	4.4	59.21
Northern red oak	215	(N/A)	2.4	1.0	14.32
Pear	60	(N/A)	2.2	0.3	4.30
American basswood	731	(N/A)	2.1	3.4	56.21
Honeylocust	1,500	(N/A)	2.1	6.9	115.35
Eastern redbud	30	(N/A)	1.9	0.1	2.49
Amur maple	80	(N/A)	1.8	0.4	7.26
Northern hackberry	367	(N/A)	1.8	1.7	33.40
Black walnut	508	(N/A)	1.8	2.3	46.22
Elm	249	(N/A)	1.4	1.1	27.64
Maple	37	(N/A)	1.4	0.2	4.06
Northern white cedar	136	(N/A)	1.3	0.6	16.98
Ginkgo	27	(N/A)	1.0	0.1	4.58
Eastern cottonwood	241	(N/A)	0.8	1.1	48.22
Mountain ash	23	(N/A)	0.8	0.1	4.66
Paper birch	198	(N/A)	0.6	0.9	49.42
River birch	104	(N/A)	0.6	0.5	26.12
Swamp white oak	78	(N/A)	0.6	0.4	19.55
Red pine	138	(N/A)	0.6	0.6	34.49
Broadleaf Deciduous Large	140	(N/A)	0.5	0.6	46.67
Bur oak	39	(N/A)	0.5	0.2	13.03
Norway spruce	106	(N/A)	0.5	0.5	35.22
Broadleaf Deciduous Medit	29	(N/A)	0.5	0.1	9.50
Kentucky coffeetree	72	(N/A)	0.5	0.3	23.95
American sycamore	89	(N/A)	0.5	0.4	29.72
Blue spruce	76	(N/A)	0.5	0.3	25.23
Northern pin oak	75	(N/A)	0.5	0.3	24.84
Hickory	92	(N/A)	0.3	0.4	45.86
Eastern red cedar	14	(N/A)	0.3	0.1	6.84
Scotch pine	94	(N/A)	0.3	0.4	47.08
Spruce	48	(N/A)	0.3	0.2	23.87
Dogwood	4	(N/A)	0.3	0.0	2.06
Northern catalpa	15	(N/A)	0.2	0.1	14.73
Southern magnolia	35	(N/A)	0.2	0.2	34.98
Flowering dogwood	0	(N/A)	0.2	0.0	0.03
Catalpa	5	(N/A)	0.2	0.0	5.26
Austrian pine	25	(N/A)	0.2	0.1	25.23
Black poplar	58	(N/A)	0.2	0.3	57.69
Eastern white pine	0	(N/A)	0.2	0.0	0.00
Birch	39	(N/A)	0.2	0.2	39.16
Citywide total	21,720	(N/A)	100.0	100.0	34.70

Table 7: Summary of Benefits in Dollars

Strawberry Point

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

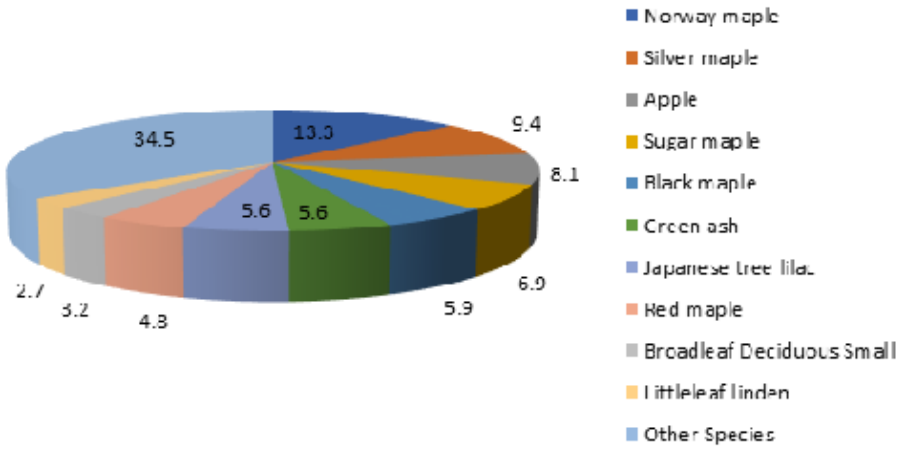
3/3/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($) Standard Error
Norway maple	49.80	4.58	8.84	57.33	26.25	146.79 (N/A)
Silver maple	65.52	13.80	12.29	128.31	106.69	326.61 (N/A)
Apple	14.18	1.40	2.10	6.35	5.22	29.24 (N/A)
Sugar maple	47.49	6.39	7.65	69.46	54.19	185.17 (N/A)
Black maple	53.34	3.77	10.00	64.41	14.84	146.36 (N/A)
Green ash	53.77	7.33	9.51	74.19	50.78	195.58 (N/A)
Japanese tree lilac	10.59	1.05	1.49	4.10	3.87	21.10 (N/A)
Red maple	19.98	2.43	3.29	15.40	24.77	65.87 (N/A)
Broadleaf Deciduous	4.68	0.48	0.62	1.63	1.67	9.08 (N/A)
Littleleaf linden	25.37	4.01	3.99	24.09	40.53	98.00 (N/A)
White ash	38.24	5.81	6.95	47.65	59.21	157.86 (N/A)
Northern red oak	23.28	2.35	3.32	19.84	14.32	63.11 (N/A)
Pear	11.93	1.20	1.74	4.82	4.30	23.98 (N/A)
American basswood	52.84	8.52	8.19	72.43	56.21	198.18 (N/A)
Honeylocust	39.27	6.06	6.35	43.49	115.35	210.51 (N/A)
Eastern redbud	7.40	0.73	1.02	2.80	2.49	14.44 (N/A)
Amur maple	19.49	1.97	2.94	8.18	7.26	39.85 (N/A)
Northern hackberry	41.79	3.60	6.54	32.10	33.40	117.42 (N/A)
Black walnut	47.82	6.52	8.44	66.53	46.22	175.53 (N/A)
Elm	24.49	3.20	4.32	33.77	27.64	93.43 (N/A)
Maple	4.82	0.44	0.68	2.21	4.06	12.21 (N/A)
Northern white cedar	33.17	2.42	-0.44	100.12	16.98	152.26 (N/A)
Ginkgo	10.04	0.91	1.59	5.74	4.58	22.87 (N/A)
Eastern cottonwood	46.85	6.50	7.80	45.81	48.22	155.19 (N/A)
Mountain ash	13.08	1.27	1.81	5.04	4.66	25.87 (N/A)
Paper birch	48.27	6.69	8.06	58.31	49.42	170.76 (N/A)
River birch	26.18	3.20	4.02	18.59	26.12	78.10 (N/A)
Swamp white oak	16.73	2.07	2.34	10.14	19.55	50.83 (N/A)
Red pine	29.23	2.98	1.38	72.16	34.49	140.24 (N/A)
Broadleaf Deciduous	45.26	6.27	7.63	54.35	46.67	160.18 (N/A)
Bur oak	7.32	0.94	1.05	5.81	13.03	28.15 (N/A)
Norway spruce	30.93	3.17	0.90	82.32	35.22	152.52 (N/A)
Broadleaf Deciduous	6.36	0.82	0.85	3.05	9.50	20.58 (N/A)
Kentucky coffeetree	15.70	2.11	2.29	12.53	23.95	56.57 (N/A)
American sycamore	23.56	3.25	3.76	20.28	29.72	80.57 (N/A)
Blue spruce	24.51	2.22	2.89	41.85	25.23	96.70 (N/A)
Northern pin oak	66.79	5.43	12.44	90.41	24.84	199.90 (N/A)
Hickory	44.23	6.14	7.42	39.72	45.86	143.36 (N/A)
Eastern red cedar	24.57	1.51	2.19	44.30	6.84	79.40 (N/A)
Scotch pine	30.47	3.11	1.45	80.46	47.08	162.58 (N/A)
Spruce	18.86	1.76	2.15	28.92	23.87	75.55 (N/A)
Dogwood	5.40	0.55	0.71	1.86	2.06	10.58 (N/A)
Northern catalpa	5.82	0.91	0.87	4.65	14.73	26.98 (N/A)
Southern magnolia	41.29	3.90	5.49	48.11	34.98	133.78 (N/A)
Flowering dogwood	0.87	0.10	0.11	0.20	0.03	1.31 (N/A)
Catalpa	0.66	0.05	0.08	0.48	5.26	6.53 (N/A)
Austrian pine	24.51	2.22	2.89	41.85	25.23	96.70 (N/A)
Black poplar	57.32	7.93	9.34	70.21	57.69	202.49 (N/A)
Eastern white pine	38.17	2.03	-1.58	124.79	0.00	163.42 (N/A)
Birch	46.78	5.71	7.92	38.19	39.16	137.75 (N/A)
Citywide Total	35.50	4.60	5.95	46.66	34.70	127.40 (N/A)

Strawberry Point

Species Distribution of Public Trees

3/3/2020



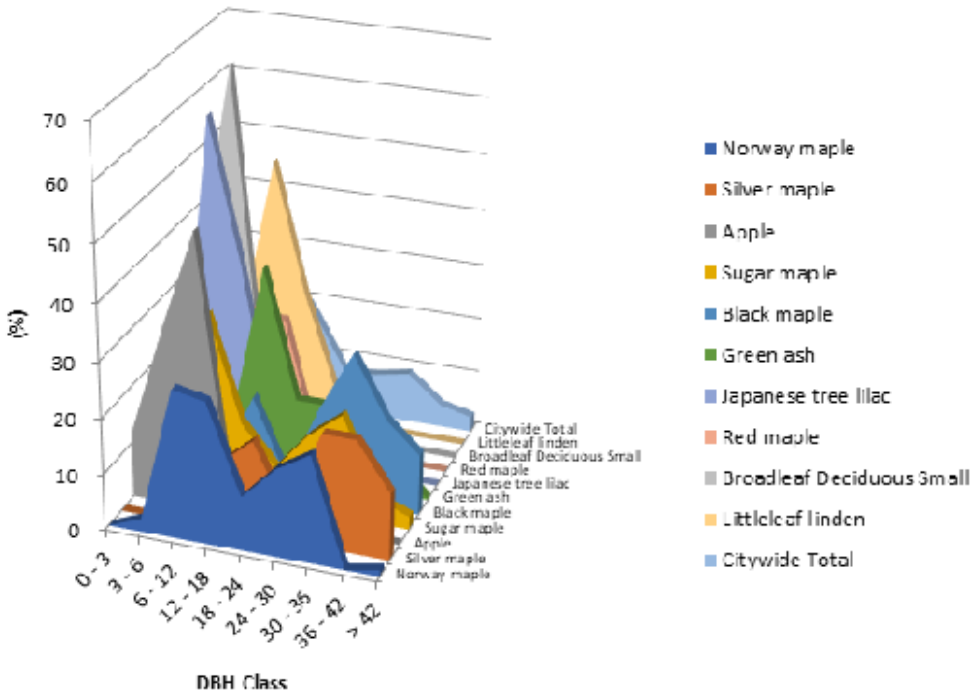
Species	Percent
Norway maple	13.3
Silver maple	9.4
Apple	8.1
Sugar maple	6.9
Black maple	5.9
Green ash	5.6
Japanese tree lilac	5.6
Red maple	4.8
Broadleaf Deciduous Sm	3.2
Littleleaf linden	2.7
Other Species	34.5
Total	100.0

Figure 1: Species Distribution

Strawberry Point

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

3/3/2020



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Norway maple	0.00	2.41	26.51	25.30	9.64	15.66	19.28	0.00	1.20
Silver maple	0.00	0.00	13.56	11.86	16.95	5.08	20.34	20.34	11.86
Apple	11.76	31.37	49.02	1.96	3.92	1.96	0.00	0.00	0.00
Sugar maple	2.33	4.65	32.56	13.95	6.98	13.95	18.60	4.65	2.33
Black maple	2.70	5.41	2.70	16.22	2.70	16.22	27.03	16.22	10.81
Green ash	0.00	5.71	8.57	37.14	14.29	14.29	14.29	5.71	0.00
Japanese tree lilac	2.86	60.00	34.29	2.86	0.00	0.00	0.00	0.00	0.00
Red maple	20.00	33.33	23.33	23.33	0.00	0.00	0.00	0.00	0.00
Broadleaf Deciduous S	30.00	65.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
Littleleaf linden	0.00	17.65	47.06	23.53	5.88	5.88	0.00	0.00	0.00
Citywide Total	7.03	17.57	26.36	17.73	7.35	7.99	9.11	4.15	2.72

Figure 2: Relative Age Class

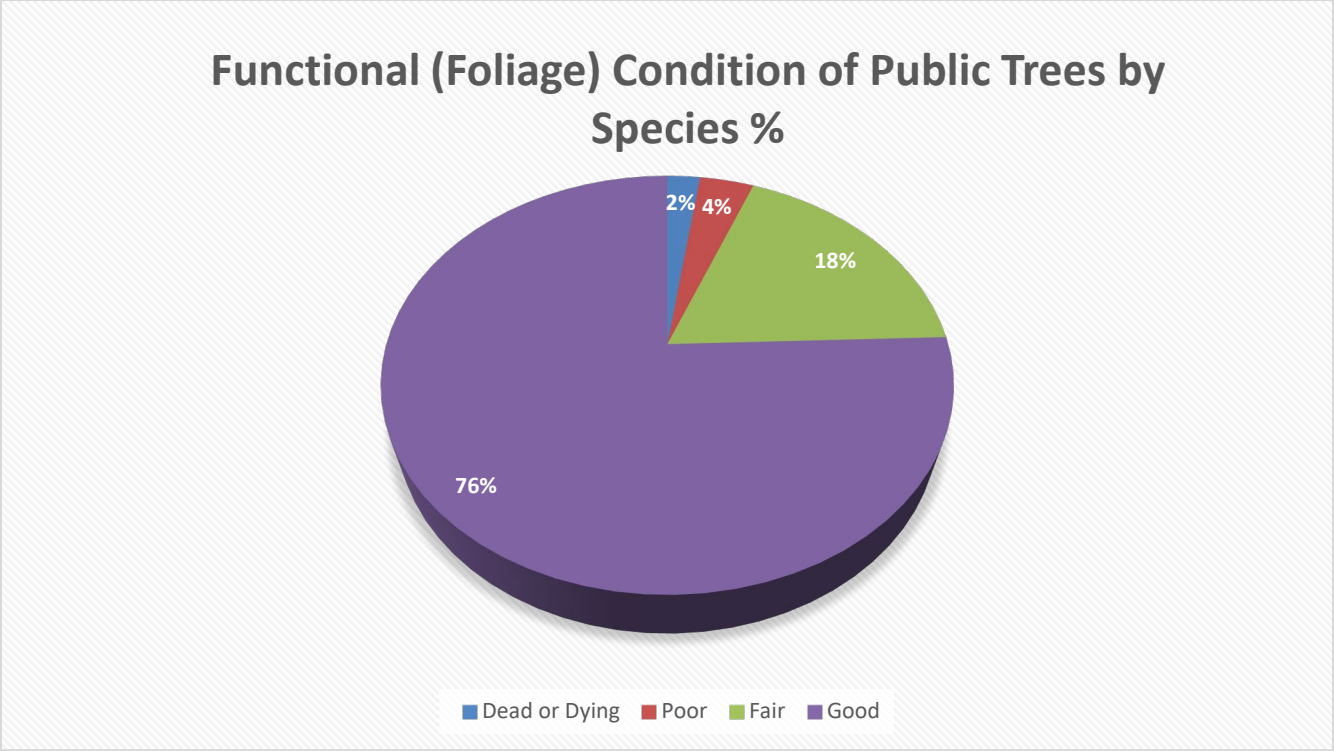


Figure 3: Foliage Condition

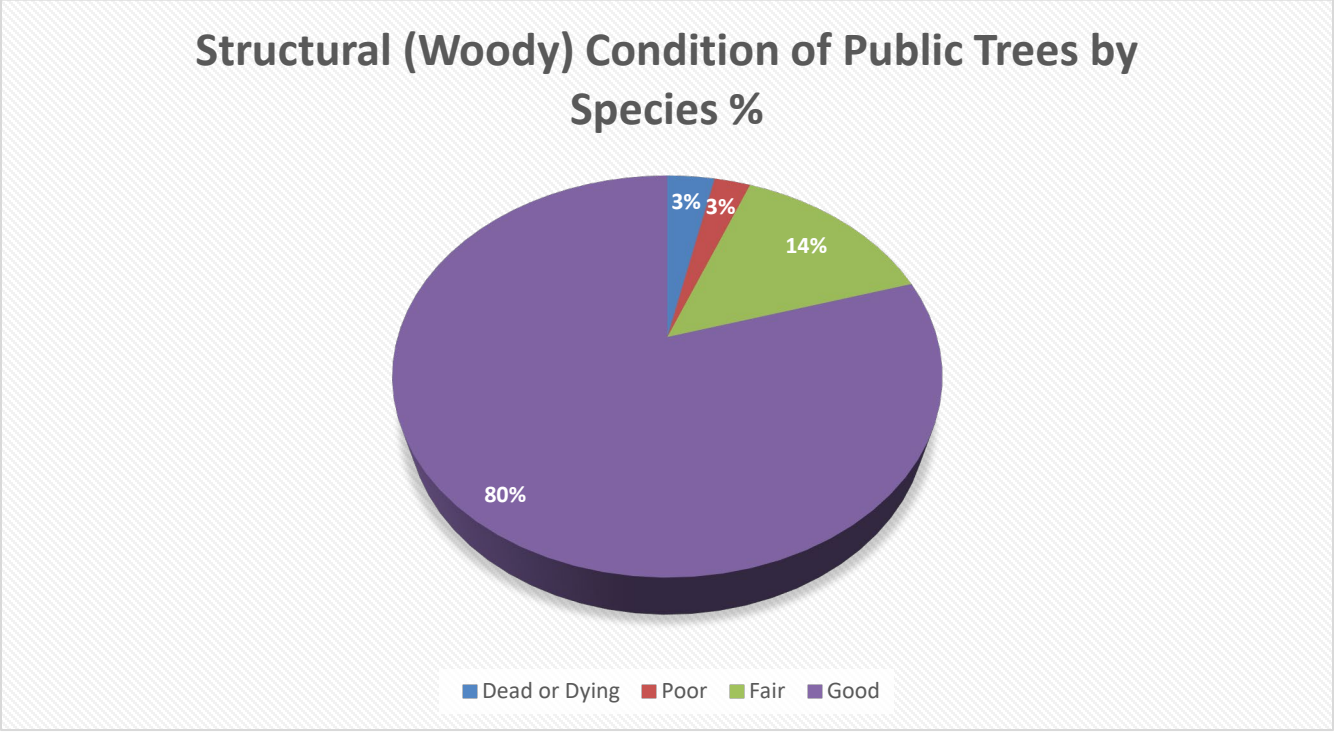
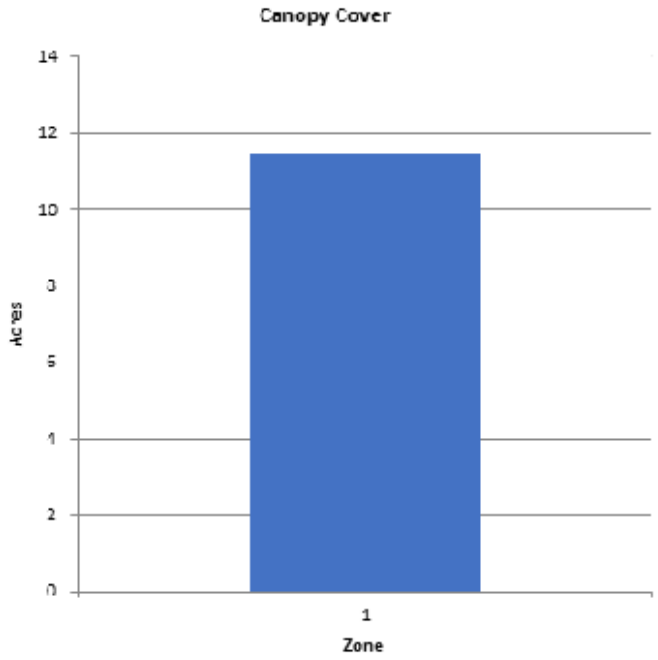


Figure 4: Wood Condition

Strawberry Point

Canopy Cover of Public Trees (Acres)

3/3/2020



Zone	Acres	% of Total Canopy Cover
1	11	100.0
Citywide total	11	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	11	0.00	0.00

Figure 5: Canopy Cover in Acres

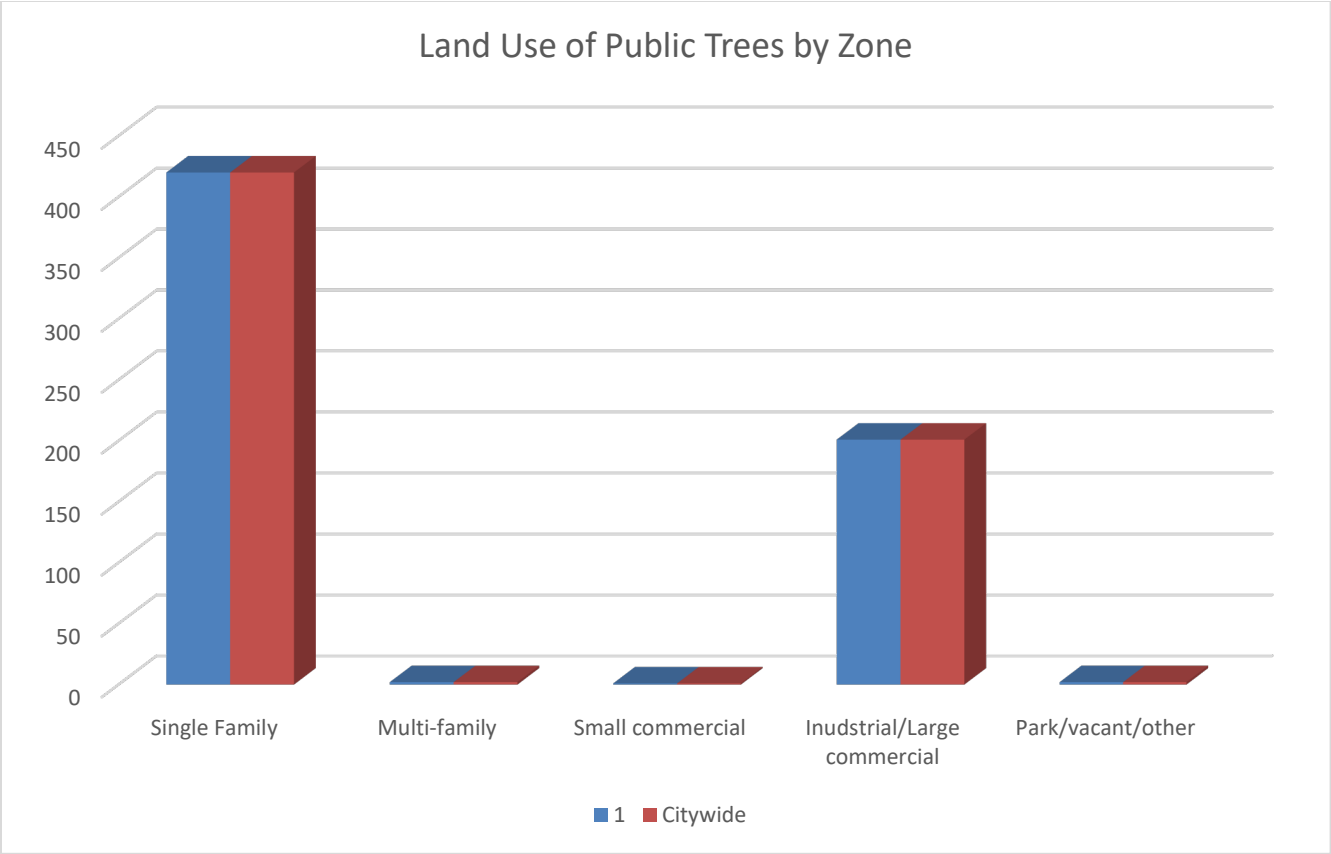


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

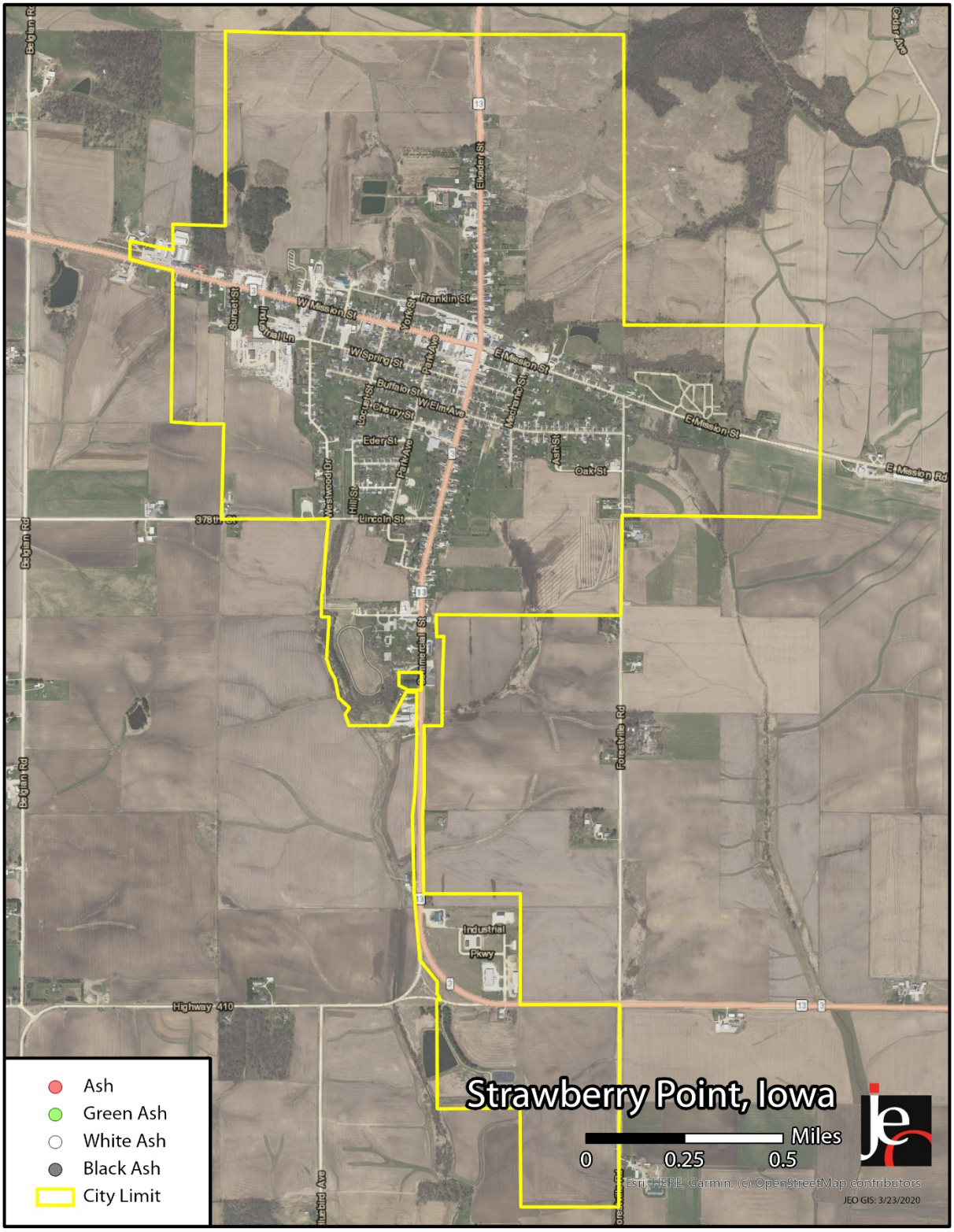


Figure 1: Location of Ash Trees

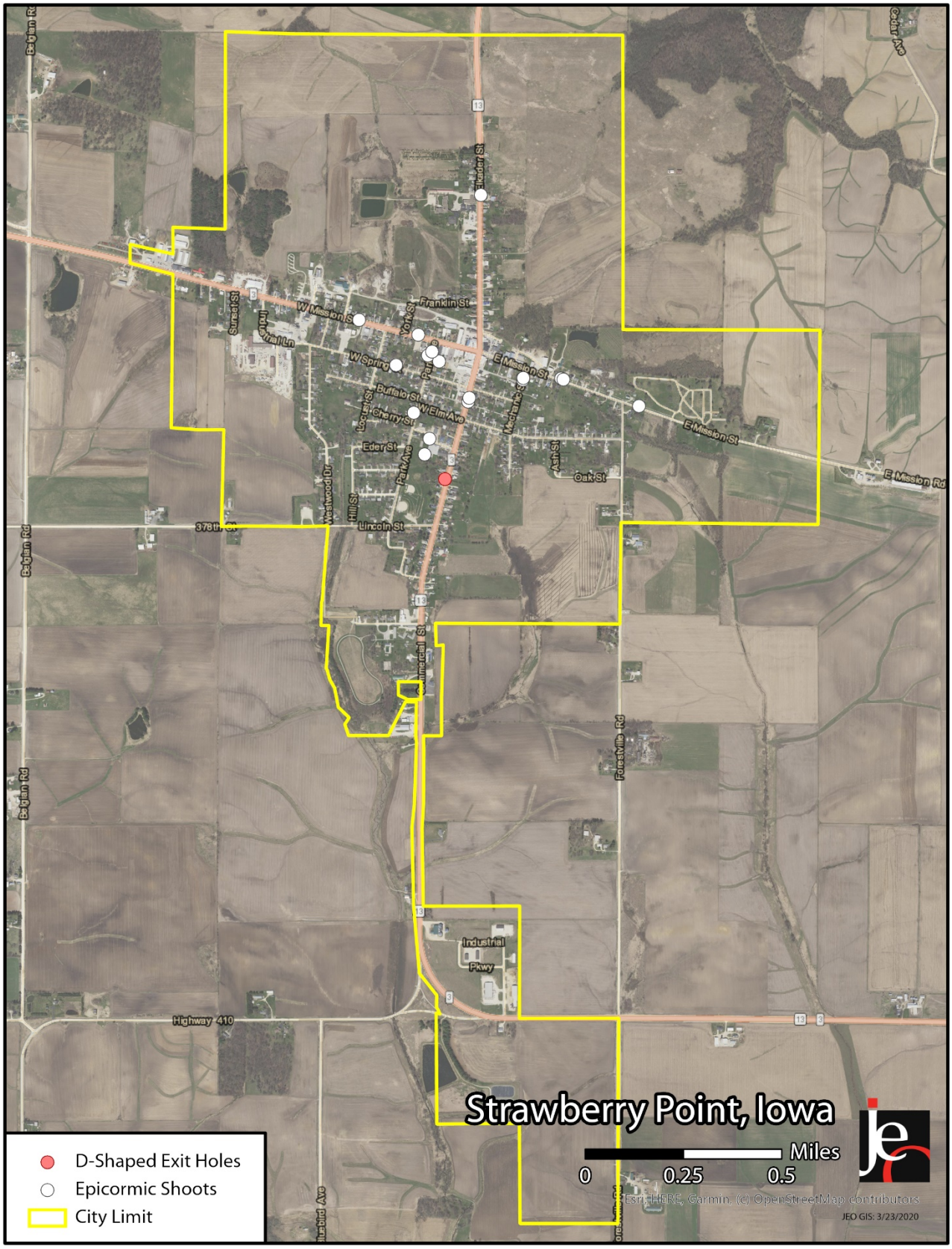


Figure 2: Location of EAB symptoms

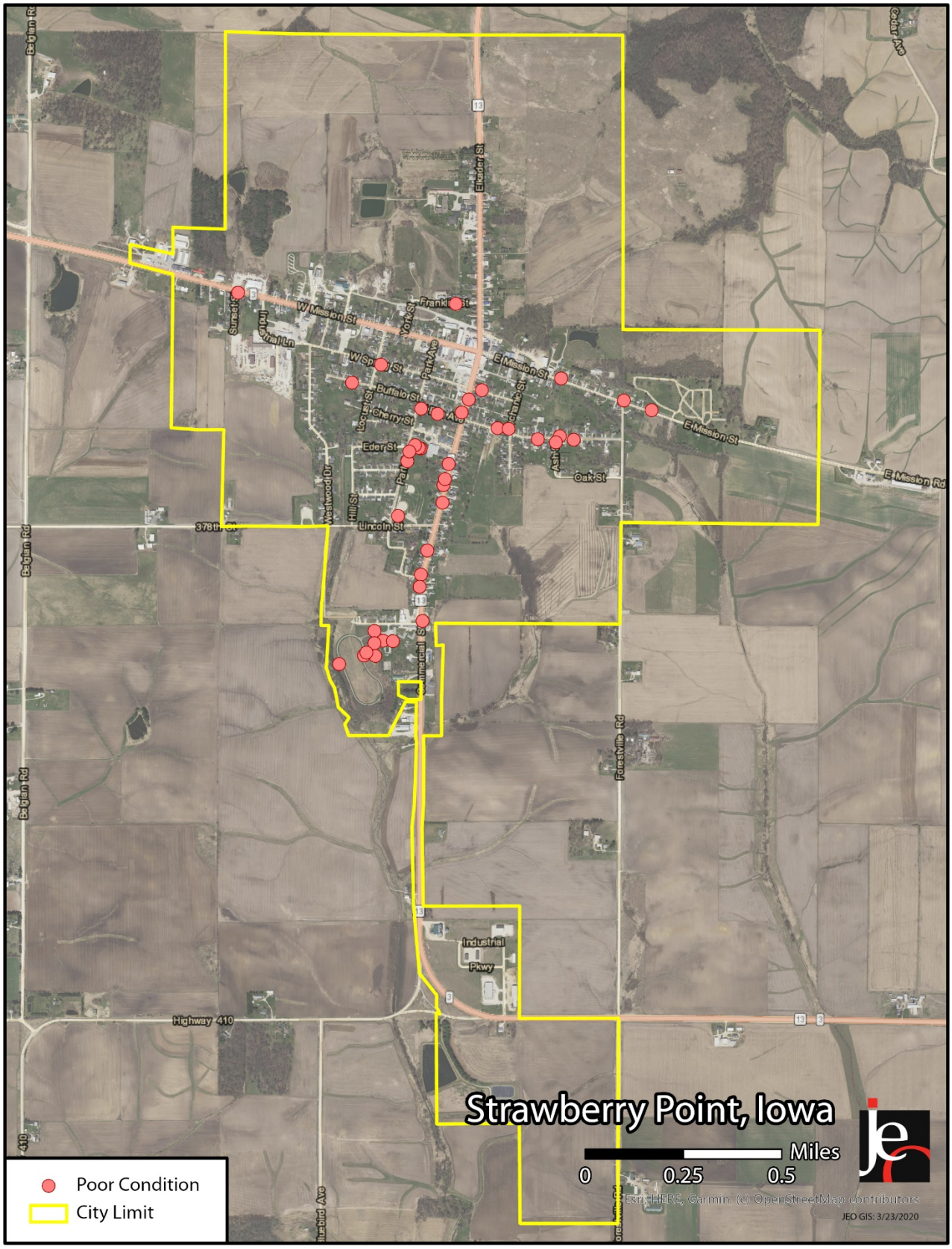


Figure 3: Location of Poor Condition Trees

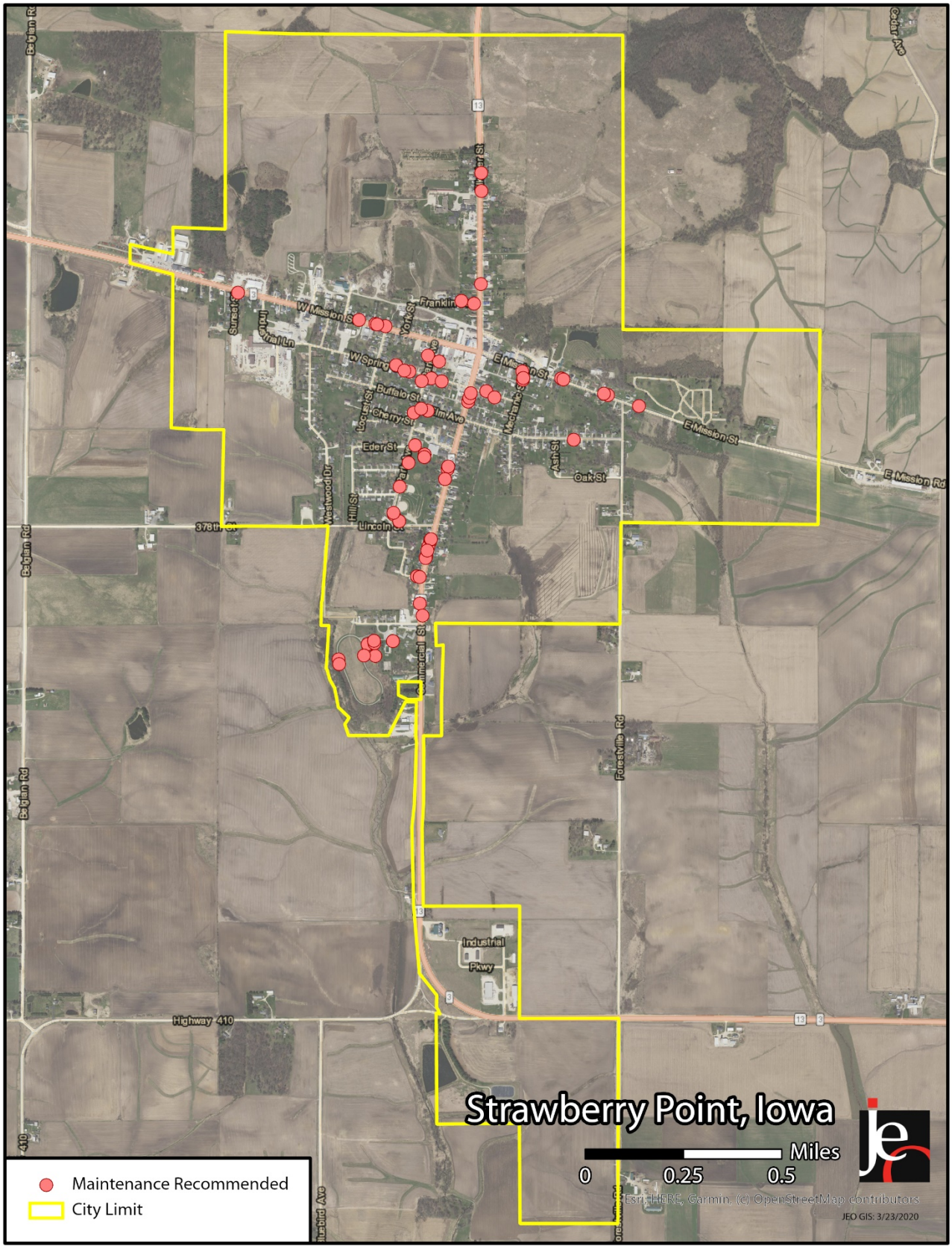


Figure 4: Location of Trees with Recommended Maintenance

Appendix C: Strawberry Point Tree Ordinances

TITLE VI - COMMUNITY DEVELOPMENT AND ENVIRONMENT CHAPTER 2

TREES ARTICLE 69 TREE BOARD

69.01 PURPOSE.
The purpose of this chapter is to form a board to administer and control planting, removal, and trimming of trees in Strawberry Point, Iowa, and:
1. To act as liaison between the citizens of the community and the City Council.
2. To promote tree planting and care of trees within the city.
3. To explore grants and investigate other opportunities for funding.
4. To submit to the City Council an annual report on the condition of trees on city property.
5. To issue permits, upon proper application and qualification for tree planting and/or removal on city property.
6. To consider items referred to the Board by the City Council and to report back in a timely fashion.

60.01A DEFINITIONS.
For use in this chapter the following terms are defined:
1. "City Arboricultural Specifications and Standards of Practice" shall mean the document containing the detailed performance standards and specifications to be used in carrying out the provisions of this chapter as developed by the Tree Board.
2. "City Property" or "Public Property" shall mean real property owned by, leased to, or upon which the City has a right of way.
3. "Contractor" shall mean any person who or business that received compensation for the performance of the work done.
4. "Maintain" or "Maintenance" shall mean, when used in reference to trees: pruning, spraying, mulching fertilizing, cultivating, supporting, treating for disease, or injury or any similar act which promotes the life, growth, health or beauty of trees.
5. "Public Tree" shall mean trees growing on city property, including street right of ways, city parks, and easements.
6. "Right of Way" shall mean land intended to be occupied for streets, sidewalks, utilities and other public purposes.
7. "Shrubs" shall mean woody vegetation usually growing with multiple stems and a height of less than ten (10) feet.
8. "Toppings" shall mean heading, stubbing, rounding, tipping, or "dehorning", which shall mean the drastic removal of large branches, severely cutting back limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree.
9. "Tree" shall mean woody vegetation usually growing with a single stem and a height over ten (10) feet.

69.02 TREE BOARD.
The Tree Board of the City, hereinafter referred to as the board, shall consist of five (5) members, all of whom shall be appointed by the mayor with the approval of the council.

69.03 QUALIFICATIONS OF BOARD MEMBERS.
All of the members of the board shall be bona fide citizens and residents of the city, and shall be at least eighteen years of age.

69.04 ORGANIZATION OF BOARD.
1. Term of Office. All appointments to the board shall be for three (3) years, except to fill vacancies. Each term shall commence on September first. Appointments to the first board shall be made for such a length as to stagger the terms of the members so that one-third are appointed every year.
2. Vacancies. The position of any board member shall be vacant if he or she permanently moves from the city, or if he or she is absent from three consecutive regular board meetings, except due to illness or death of family members. Vacancies in the board shall be filled by appointment by the mayor with approval by the council, and the new board member shall fill out the unexpired term for which the appointment is made.
3. Compensation. Board members shall receive no compensation.

69.05 POWERS AND DUTIES.
The board shall have and exercise the following powers and duties:
1. Officers. To meet and elect from its members a Chairperson, Secretary and such other officers as the board shall deem necessary.
2. Hiring and removal of Personnel. The board shall not employ or remove anyone.
3. Purchases and Expenditures. All funds acquired by the board shall be deposited in a city "trust account", which shall be administered by the city administrator, who shall track said 191 account, making all deposits and withdrawals, as approved by the council. The board shall make no purchases or expenditures without prior written approval of the council, nor shall the board have direct control of any funds, nor shall it write checks.
4. Rules and Regulations. The board shall make, adopt, amend, modify or repeal rules and regulations not inconsistent with the Code and the law, for its operation.
5. Proceedings. The board shall keep a record of all of its proceedings, which record shall belong to the City.
6. Standards and Specifications. The board may develop arboricultural specifications and standards, and prepare a manual containing such specifications and standards not inconsistent with the City Code and the law.

69.06 ANNUAL REPORT.
The board shall make a report to the council at the first regular council meeting of each July describing the functions for the board of the last year, planned functions for the next year, and additional information as may be requested by the council.

69.07 PROCEDURES.
Any tree located on city property which is to be trimmed, pruned or removed shall require board approval, except in the case of a bona fide emergency to prevent harm to person or property, under the following procedure:
1. Anyone seeking board approval to trim, prune, plant or remove a tree on city property shall obtain a form for such purpose from the city administrator, complete such form and return it to the city administrator who shall refer it to the board for consideration.

2. The form shall include the applicant's name and address, the location or proposed location of the tree for which the applicant seeks approval, the species of tree, its age, current size, estimated mature size, health, the reason the applicant seeks to take action on the tree, and any other information the board shall have included on the form.
3. The board shall review and consider the application, returning it to the city administrator within thirty (30) days marked as approved, denied or requesting further information. The city administrator shall notify the applicant of the action of the board, and if denied the applicant, or any other citizen of the city, may request of the city administrator that the City Council review the action of the board within fifteen (15) days, and no trimming, pruning, planting or removal of such tree shall take place until such final review by the city council, if requested.
4. Any applicant receiving approval from the board or city council to plant or remove a tree or trees from city property shall contact Iowa Utilities, at the current telephone number of 1-800- 292-8989 for location of all utilities near the planting or removal, and care shall be used to not disturb the utilities.
5. The board shall not approve for planting any tree which is inappropriate because of size, species, fruit, flower, nut, leaves, girth, insect attraction, or for any other reason for the place it is proposed to be located.
6. No trees shall be planted on city property or right of way without prior approval of the City Superintendent.

69.08 SELECTION, SPACING AND CARE OF TREES.
Size. The board shall rate all trees as small, medium or large. Small trees shall be up to twenty-five (25') feet of mature height, medium trees shall be from twenty-six to forty (25'- 40') feet of mature height, and large trees shall be over forty (40') feet of mature height. Species. Each tree chosen for planting shall be a high-quality, healthy tree with evidence of vigorous growth during the previous year. All trees shall have a comparatively straight, single trunk, well developed leaders and crowns, and the roots shall not only be characteristic of the species, cultivar or variety, but also exhibit evidence of proper nursery pruning practices. Ornamental trees may be multiple-stemmed if they can be pruned for adequate clearance. At the time of planting, all trees must have a full, healthy crown, be free of mechanical injuries and display no other objectionable features that will affect the future form, health or beauty of the tree. Location. To allow for maintenance, minimize infrastructure damage and promote safety, trees shall be planted using the following guidelines. Exceptions to these guidelines may be made by the Tree Board and City Superintendent when circumstances warrant and public safety is not threatened.
1. Small trees shall be planted no closer together than fifteen (15') feet; medium trees, twenty-five (25') feet; large trees, thirty-five (35') feet.
2. Street trees shall be planted midway between the curb and sidewalk (or where the sidewalk would be if there is no sidewalk), unless in the opinion of the Tree Board there is sufficient reason to plant the trees off-center. Location of street trees that are also on state highway rights of way, shall be dictated by the Iowa Department of Transportation rules, unless waivers are granted.
3. Trees shall not be planted closer than thirty-five (35') feet from any street corner, nor closer than ten (10') feet from any driveway or fire hydrant.
4. Trees, other than small trees, shall not be planted under or within ten (10') lateral feet of any overhead power line or overhead utility wire, and no tree shall be planted within five (5') lateral feet of any underground water, sewer, transmission or other utility line. Species. Each tree chosen for planting shall be a high-quality, healthy tree with evidence of vigorous growth during the previous year. All trees shall have a comparatively straight, single trunk, well developed leaders and crowns

69.09 PROTECTION OF TREES.
Any tree on city property, and its roots out to the drip line shall be protected during construction to prevent damage to the tree and its roots by use of snow fence, barricade or other device.

69.10 DUTY TO TRIM TREES.
The owner of abutting property shall trim trees not located on city property so all branches shall be fifteen (15') feet above any street and eight (8') feet above any sidewalk. After failure to so trim trees upon notice by the city, by mailing such notice to the owner's last known address by regular U.S. Mail, within a reasonable time, the city may trim the trees and certify the cost for collection in the same manner as property taxes.

69.11 RECOMMENDED REQUIREMENTS FOR NURTURING TREES.
The city recommends the following care of newly planted or transplanted trees: Locate carefully and lawfully. Align when appropriate. Space as required by law. Plant correctly. Select appropriate tree species. Fertilize properly. Provide lateral support. Wrap for winter and sun scald. Mow carefully and control weeds. Water as required. Responsibly for the care of trees on City property, right of way, etc.

ARTICLE 70 DUTCH ELM DISEASE CONTROL

70.01 TREES SUBJECT TO REMOVAL.
The council having determined that the health of the elm trees within the city is threatened by a fatal disease known as Dutch elm disease hereby declares the following shall be removed: (Code of Iowa, 2013, Sec. 364.12 (3b))
1. Living or standing tress. Any living or standing elm tree or part thereof infected with the Dutch elm disease fungus or which harbors any of the elm bark beetles, that is colytus multistriatus (eichb.) or hylurgopinus rufipes (marsh).
2. Dead Trees. Any dead elm tree or part thereof, including logs, branches, stumps, firewood or other material from which the bark has not been removed and burned or sprayed with an effective bark beetle destroying insecticide.

70.02 DUTY TO REMOVE.
No person, firm or corporation shall permit any tree or material as defined in Section 1 of this article to remain on the premises owned, controlled or occupied by him or her within the city. (Code of Iowa, 2013, Sec. 364.12 (3b)) 70.03 INSPECTION. The superintendent shall inspect or cause to be inspected all premises and places within the city to determine whether any condition as defined in Section 1 of this article exists thereon, and shall also inspect or cause to be inspected any elm trees reported or suspected to be infected with Dutch elm disease or any elm bark bearing material reported or suspected to be infected with the elm bark beetles.

70.04 REMOVAL FROM CITY PROPERTY.
If the superintendent upon inspection or examination, in person or by some qualified person acting for him, shall determine that any condition as herein defined exists in or upon any public street, alley, park or any public place, including the strip between the curb and the lot line of private property, within the city and that the danger of other elm trees within the city is imminent, the superintendent shall

immediately cause it to be destroyed or prevent as fully as possible the spread of Dutch elm disease or the insect pests or vectors know to carry such disease fungus.

70.05 REMOVAL FROM PRIVATE PROPERTY.
If the superintendent upon inspection or examination, in person or by some qualified person acting for the superintendent shall determine with reasonable certainty that any condition as herein defined exists in or upon private premises and that the danger to other elm trees within the city is imminent, the superintendent shall immediately notify by certified mail the owner, occupant or person in 195 charge of such property, to correct such condition within 14 days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt thereof, the council may cause the nuisance to be removed and the cost assessed against the property as provided in Chapter 46. (Code of Iowa, 2013, Sec. 364.12 3 (b and h) If the superintendent is unable to determine with reasonable certainty whether or not a tree in or upon private premises is infected with Dutch elm disease, he is authorized to remove or cut specimens from said tree, and obtain a diagnosis of such specimens.

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.