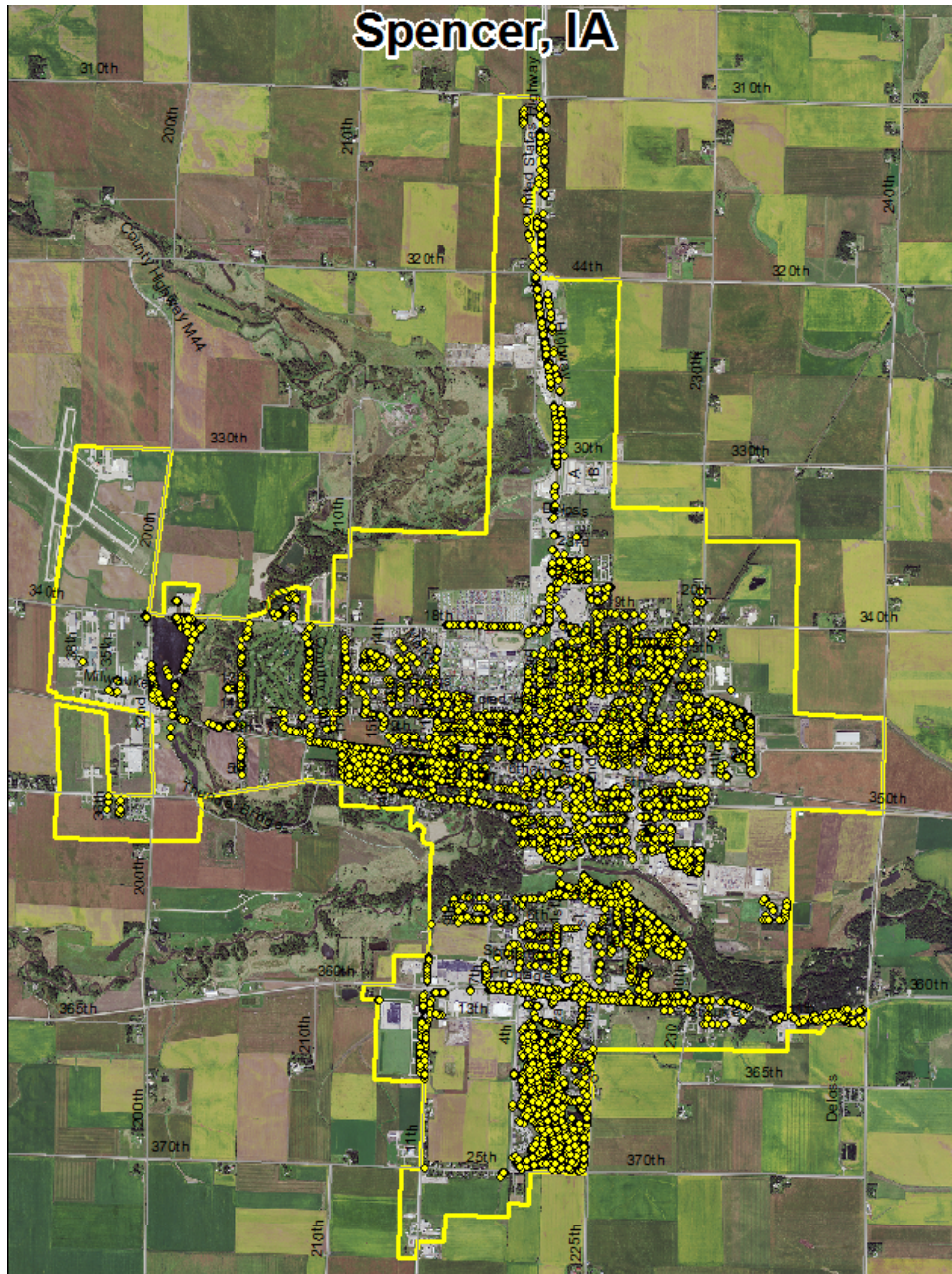


Spencer, IA



2017 Urban Forest Management Plan
Prepared by Jason Walker
Iowa DNR



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Executive Summary

Overview

This plan was developed to assist the City of Spencer with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 20% of Spencer's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. 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 2016, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 10,927 trees inventoried.

- Spencer's trees provide \$1,597,703 of benefits annually, an average of \$146 a tree
- There are over 75 species of trees
- The top three genera are: Maple 22%, Ash 20%, and Oak 10%
- 18% of trees are in need of some type of management
- 223 trees are recommended for removal

Recommendations

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

- Of the 223 trees needing removal, 60 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 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 with a visual survey yearly
- With the current budget of \$40,000 it could take 30 years to remove ash – Suggestion: request a budget increase to \$100,000 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Spencer with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the 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 and replacement planting. With proper planning and management of the current canopy in Spencer, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

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

Inventory

In 2016, a tree inventory was conducted that included 100% of the city owned trees on streets, parks, golf course and the cemetery. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

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

Inventory Results

The data collected for the 10,927 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Spencer's trees reduce energy related costs by approximately \$450,298 annually (Appendix A, Table 1). These savings are both in Electricity (2122.2 MWh) and in Natural Gas (295,122.9 Therms).

Annual Stormwater Benefits

Spencer's trees intercept about 21,815,157 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$591,191 of 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 emitting volatile organic matter (ozone). In Spencer, it is estimated that trees remove 3,829 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$21,066 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Spencer, trees sequester about 4,194,662 lbs of carbon a year with an associated value of \$31,460 (Appendix A, Table 4). In addition, the trees store 77,142,723 lbs of carbon, with a yearly benefit of \$578,570 (Appendix A, Table 5).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Spencer receives \$425,547 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Spencer's trees provide \$1,597,703 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 10,927 trees in Spencer provide approximately \$146 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Spencer has over 75 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	2,438	22%
Ash	2,231	20%
Oak	1,109	10%
Spruce	714	7%
Broadleaf Deciduous M	480	4%
Linden/Basswood	469	4%
Apple	415	4%
Hackberry	393	3%

Honeylocust	339	3%
Other Misc Species	2,239	21%

Age Class

Most of Spencer’s trees (46%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Spencer’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 overall health of the urban forest. The foliage condition results for Spencer indicate that 89% of the trees are in good health, with only 1.5% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 89% of Spencer’s trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 3% of the population. This 3% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	507	5%
Crown Raising	1,165	11%
Tree Staking	3	<1%
Tree Removal	223	2%
Crown Reduction	31	<1%

Canopy Cover

The total canopy with both private and public trees is 11%, 773 acres. The canopy cover included in the Spencer inventory includes approximately 230 acres (Appendix A, Figure 4). The City’s Canopy goal is 20%, in 30 years. To achieve this goal it is estimated that 175 trees need to be planted annually.

Land Use and Location

The majority of Spencer’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	48%
Park/vacant/other	46%
Industrial/Large commercial	3%
Small commercial	2%
Multifamily residential	1%

Location

Planting strip	63%
Median	13%
Front yard	24%

Recommendations

Risk Management

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

Hazardous trees

Spencer has 135 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 6 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 16 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 68 removals, 6 are ash trees. *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 is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended 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 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Spencer.

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 (22%) (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 chapter 5 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance chapter 5 (Appendix C).

Continual Monitoring

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

Six Year Maintenance Plan with No Additional Funding

Year 1

Removal: 80 largest critical concern trees
Planting and Replacement: 96 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 55 critical concern trees and 25 additional trees marked as needing removal.
Planting and Replacement: 96 trees in open locations from year one removals
Young Tree Pruning & Maintenance:
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 63 trees marked for removal in inventory trees – remove 17 additional ash in poor condition.
Planting and Replacement: 96 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 80 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 96 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 80 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 96 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 80 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 96 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Budget Considerations

- Reduction of ash over 6 years: Approximately 300 to 305 ash trees removed (approximately 13% of ash). It will take approximately 30 years to remove all ash with the current budget. EAB could potentially kill all ash within 6 to 15 years of its arrival.

- To remove all ash trees within 6 years, the budget would need to be increased to \$~ 201,000 a year. If the budget were increased to \$100,000 a year all ash could be removed in 12 years.
- Current routine trimming and maintenance of newly planted trees is completed by city staff. If that workload becomes too much and is to be contracted out the budget will need additional funding to address those costs.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3).

City ownership of the tree recommended for removal should be verified prior to any removal

Treatment of Ash Trees

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

visit <http://extension.entm.purdue.edu/treecomputer/>

EAB Quarantines

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

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

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

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website

http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance Chapter 5 (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 the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Spencer

Annual Energy Benefits of Public Trees

1/9/2017

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Ash	456.4	34,638	65,759.5	64,444	99,082	(N/A)	18.0	22.0	50.40
Silver maple	265.0	20,113	35,021.7	34,321	54,434	(N/A)	8.3	12.1	59.88
Spruce	61.5	4,671	8,063.6	7,902	12,573	(N/A)	5.9	2.8	19.40
Norway maple	150.0	11,386	21,407.0	20,979	32,365	(N/A)	5.8	7.2	50.65
Broadleaf Deciduous Small	34.8	2,644	5,758.3	5,643	8,287	(N/A)	4.4	1.8	17.30
American basswood	113.4	8,611	15,865.0	15,548	24,158	(N/A)	4.3	5.4	51.73
Apple	38.9	2,953	6,047.8	5,927	8,880	(N/A)	3.8	2.0	21.55
White oak	44.8	3,399	5,935.8	5,817	9,216	(N/A)	3.6	2.0	23.39
Northern hackberry	106.4	8,073	15,121.1	14,819	22,892	(N/A)	3.3	5.1	62.89
Honeylocust	98.3	7,464	12,820.4	12,564	20,028	(N/A)	3.1	4.4	58.56
Maple	59.4	4,506	7,973.0	7,814	12,320	(N/A)	2.6	2.7	42.78
Blue spruce	29.9	2,272	4,099.2	4,017	6,289	(N/A)	2.5	1.4	23.29
Green ash	50.9	3,867	6,806.4	6,670	10,537	(N/A)	2.3	2.3	41.32
Northern red oak	31.3	2,372	4,318.3	4,232	6,604	(N/A)	2.1	1.5	28.96
Sugar maple	49.5	3,754	6,571.8	6,440	10,194	(N/A)	2.0	2.3	45.71
Amur maple	27.0	2,053	3,870.4	3,793	5,846	(N/A)	1.9	1.3	27.58
Swamp white oak	25.7	1,954	3,872.4	3,795	5,748	(N/A)	1.9	1.3	27.91
Oak	46.1	3,499	6,287.8	6,162	9,661	(N/A)	1.9	2.1	47.36
Broadleaf Deciduous Medium	27.6	2,098	4,016.8	3,936	6,035	(N/A)	1.7	1.3	32.98
Austrian pine	20.0	1,518	2,704.7	2,651	4,168	(N/A)	1.6	0.9	23.82
Birch	26.9	2,042	3,854.5	3,777	5,820	(N/A)	1.3	1.3	40.14
Cottonwood	40.9	3,105	5,436.6	5,328	8,433	(N/A)	1.2	1.9	63.41
Boxelder	18.3	1,390	2,493.7	2,444	3,834	(N/A)	1.0	0.9	34.54
Broadleaf Evergreen Large	31.4	2,384	4,063.6	3,982	6,367	(N/A)	0.9	1.4	63.04
Lilac	16.3	1,234	2,400.1	2,352	3,586	(N/A)	0.9	0.8	37.75
Quaking aspen	9.9	751	1,301.7	1,276	2,027	(N/A)	0.8	0.5	22.27
Conifer Evergreen Large	12.0	912	1,497.0	1,467	2,379	(N/A)	0.8	0.5	26.43
River birch	25.0	1,896	3,662.8	3,590	5,486	(N/A)	0.8	1.2	63.06
Willow	14.9	1,133	2,174.9	2,131	3,264	(N/A)	0.8	0.7	38.86
American elm	26.6	2,016	3,353.0	3,286	5,302	(N/A)	0.6	1.2	75.74
Elm	15.5	1,179	2,098.8	2,057	3,236	(N/A)	0.6	0.7	47.59
Eastern white pine	7.1	541	979.8	960	1,501	(N/A)	0.6	0.3	22.41
Eastern redbud	3.3	253	513.0	503	756	(N/A)	0.6	0.2	11.63
Norway spruce	2.9	218	425.6	417	635	(N/A)	0.6	0.1	10.24
Scotch pine	7.5	572	952.4	933	1,505	(N/A)	0.5	0.3	25.08
Chinese elm	11.0	835	1,492.7	1,463	2,297	(N/A)	0.5	0.5	41.03
Red maple	9.8	748	1,291.8	1,266	2,014	(N/A)	0.5	0.4	36.61
Pin oak	15.0	1,135	1,979.7	1,940	3,075	(N/A)	0.5	0.7	56.94
Black cherry	8.6	652	1,266.1	1,241	1,893	(N/A)	0.5	0.4	35.06
Ohio buckeye	5.7	432	860.5	843	1,275	(N/A)	0.5	0.3	25.50
Conifer Evergreen Medium	3.3	250	503.7	494	743	(N/A)	0.4	0.2	15.48
Broadleaf Deciduous Large	11.2	847	1,512.5	1,482	2,329	(N/A)	0.4	0.5	54.16
Mulberry	4.4	335	694.3	680	1,016	(N/A)	0.4	0.2	26.05
Black walnut	9.2	696	1,252.2	1,227	1,923	(N/A)	0.3	0.4	60.09
Paper birch	3.2	242	442.2	433	676	(N/A)	0.2	0.2	28.15
Sumac	1.4	106	228.0	223	330	(N/A)	0.2	0.1	14.33
Conifer Evergreen Small	0.7	56	118.1	116	172	(N/A)	0.2	0.0	7.49
Eastern red cedar	2.1	160	313.7	307	467	(N/A)	0.2	0.1	21.24
Bur oak	1.7	126	236.1	231	357	(N/A)	0.2	0.1	16.24
Kentucky coffeetree	5.5	419	748.8	734	1,153	(N/A)	0.2	0.3	57.63
Broadleaf Evergreen Medium	3.5	269	448.9	440	709	(N/A)	0.2	0.2	37.33
Littleleaf linden	3.3	252	474.1	465	716	(N/A)	0.1	0.2	44.76
Ginkgo	1.5	117	207.4	203	320	(N/A)	0.1	0.1	20.02
American sycamore	3.6	277	511.5	501	778	(N/A)	0.1	0.2	55.58
Basswood	3.5	268	488.2	478	746	(N/A)	0.1	0.2	57.42
Black poplar	3.5	265	490.4	481	746	(N/A)	0.1	0.2	62.15

White ash	1.2	91	161.7	158	249 (N/A)	0.1	0.1	22.65
Eastern cottonwood	4.6	349	606.6	594	943 (N/A)	0.1	0.2	94.34
Broadleaf Evergreen Small	1.0	74	135.8	133	207 (N/A)	0.1	0.0	20.71
Catalpa	3.1	234	402.1	394	628 (N/A)	0.1	0.1	69.75
Common chokecherry	0.7	53	114.5	112	165 (N/A)	0.1	0.0	20.69
Black spruce	0.3	24	51.0	50	74 (N/A)	0.0	0.0	14.80
Black locust	0.5	39	79.5	78	117 (N/A)	0.0	0.0	29.15
Mountain ash	0.3	21	44.5	44	64 (N/A)	0.0	0.0	32.17
Northern pin oak	0.1	11	23.0	23	33 (N/A)	0.0	0.0	16.73
Northern catalpa	0.8	62	110.0	108	170 (N/A)	0.0	0.0	84.77
Northern white cedar	0.2	13	23.7	23	36 (N/A)	0.0	0.0	18.04
Red pine	0.4	28	49.2	48	76 (N/A)	0.0	0.0	38.17
Hickory	0.3	25	47.3	46	72 (N/A)	0.0	0.0	35.78
Eastern hophornbeam	0.1	6	12.8	13	18 (N/A)	0.0	0.0	18.19
Southern magnolia	0.1	6	12.7	12	19 (N/A)	0.0	0.0	18.82
Japanese tree lilac	0.1	6	12.8	13	18 (N/A)	0.0	0.0	18.19
Flowering dogwood	0.2	15	31.6	31	46 (N/A)	0.0	0.0	46.14
Black maple	0.3	19	30.1	29	49 (N/A)	0.0	0.0	48.95
Alder	0.2	15	31.6	31	46 (N/A)	0.0	0.0	46.14
Cherry plum	0.2	14	24.7	24	38 (N/A)	0.0	0.0	38.13
American holly	0.2	17	28.2	28	44 (N/A)	0.0	0.0	44.11
Total	2,122.2	161,078	295,122.9	289,220	450,298 (N/A)	100.0	100.0	41.22

Table 2: Annual Stormwater Benefits

Spencer

Annual Stormwater Benefits of Public Trees

1/9/2017

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Ash	4,227,855	114,575	(N/A)	18.0	19.4	58.28
Silver maple	3,918,877	106,202	(N/A)	8.3	18.0	116.83
Spruce	919,944	24,930	(N/A)	5.9	4.2	38.47
Norway maple	1,335,240	36,185	(N/A)	5.8	6.1	56.63
Broadleaf Deciduous Small	129,702	3,515	(N/A)	4.4	0.6	7.34
American basswood	1,129,754	30,616	(N/A)	4.3	5.2	65.56
Apple	173,622	4,705	(N/A)	3.8	0.8	11.42
White oak	349,546	9,473	(N/A)	3.6	1.6	24.04
Northern hackberry	1,019,193	27,620	(N/A)	3.3	4.7	75.88
Honeylocust	989,786	26,823	(N/A)	3.1	4.5	78.43
Maple	476,727	12,919	(N/A)	2.6	2.2	44.86
Blue spruce	433,899	11,759	(N/A)	2.5	2.0	43.55
Green ash	535,982	14,525	(N/A)	2.3	2.5	56.96
Northern red oak	252,981	6,856	(N/A)	2.1	1.2	30.07
Sugar maple	481,744	13,055	(N/A)	2.0	2.2	58.54
Amur maple	103,336	2,800	(N/A)	1.9	0.5	13.21
Swamp white oak	182,352	4,942	(N/A)	1.9	0.8	23.99
Oak	520,096	14,095	(N/A)	1.9	2.4	69.09
Broadleaf Deciduous Medium	215,073	5,828	(N/A)	1.7	1.0	31.85
Austrian pine	283,678	7,688	(N/A)	1.6	1.3	43.93
Birch	219,964	5,961	(N/A)	1.3	1.0	41.11
Cottonwood	539,063	14,609	(N/A)	1.2	2.5	109.84
Boxelder	182,342	4,941	(N/A)	1.0	0.8	44.52
Broadleaf Evergreen Large	489,892	13,276	(N/A)	0.9	2.2	131.45
Lilac	76,456	2,072	(N/A)	0.9	0.4	21.81
Quaking aspen	77,063	2,088	(N/A)	0.8	0.4	22.95
Conifer Evergreen Large	196,822	5,334	(N/A)	0.8	0.9	59.27
River birch	267,955	7,262	(N/A)	0.8	1.2	83.47
Willow	127,523	3,456	(N/A)	0.8	0.6	41.14
American elm	217,295	5,889	(N/A)	0.6	1.0	84.12
Elm	180,916	4,903	(N/A)	0.6	0.8	72.10
Eastern white pine	125,774	3,408	(N/A)	0.6	0.6	50.87
Eastern redbud	11,679	317	(N/A)	0.6	0.1	4.87
Norway spruce	42,209	1,144	(N/A)	0.6	0.2	18.45
Scotch pine	120,367	3,262	(N/A)	0.5	0.6	54.37
Chinese elm	105,553	2,860	(N/A)	0.5	0.5	51.08
Red maple	71,658	1,942	(N/A)	0.5	0.3	35.31
Pin oak	161,217	4,369	(N/A)	0.5	0.7	80.91
Black cherry	38,745	1,050	(N/A)	0.5	0.2	19.44
Ohio buckeye	36,619	992	(N/A)	0.5	0.2	19.85
Conifer Evergreen Medium	39,207	1,063	(N/A)	0.4	0.2	22.14
Broadleaf Deciduous Large	137,080	3,715	(N/A)	0.4	0.6	86.39
Mulberry	21,294	577	(N/A)	0.4	0.1	14.80
Black walnut	110,441	2,993	(N/A)	0.3	0.5	93.53
Paper birch	33,316	903	(N/A)	0.2	0.2	37.62
Sumac	4,941	134	(N/A)	0.2	0.0	5.82
Conifer Evergreen Small	9,793	265	(N/A)	0.2	0.0	11.54
Eastern red cedar	30,607	829	(N/A)	0.2	0.1	37.70
Bur oak	11,430	310	(N/A)	0.2	0.1	14.08

Kentucky coffeetree	63,744	1,727 (N/A)	0.2	0.3	86.37
Broadleaf Evergreen Medium	38,426	1,041 (N/A)	0.2	0.2	54.81
Littleleaf linden	36,194	981 (N/A)	0.1	0.2	61.30
Ginkgo	10,349	280 (N/A)	0.1	0.0	17.53
American sycamore	44,958	1,218 (N/A)	0.1	0.2	87.03
Basswood	41,701	1,130 (N/A)	0.1	0.2	86.93
Black poplar	44,286	1,200 (N/A)	0.1	0.2	100.01
White ash	7,799	211 (N/A)	0.1	0.0	19.21
Eastern cottonwood	69,093	1,872 (N/A)	0.1	0.3	187.24
Broadleaf Evergreen Small	7,701	209 (N/A)	0.1	0.0	20.87
Catalpa	36,590	992 (N/A)	0.1	0.2	110.18
Common chokecherry	2,518	68 (N/A)	0.1	0.0	8.53
Black spruce	3,777	102 (N/A)	0.0	0.0	20.47
Black locust	3,814	103 (N/A)	0.0	0.0	25.84
Mountain ash	1,439	39 (N/A)	0.0	0.0	19.49
Northern pin oak	749	20 (N/A)	0.0	0.0	10.14
Northern catalpa	11,182	303 (N/A)	0.0	0.1	151.51
Northern white cedar	3,182	86 (N/A)	0.0	0.0	43.12
Red pine	9,209	250 (N/A)	0.0	0.0	124.79
Hickory	3,961	107 (N/A)	0.0	0.0	53.67
Eastern hophornbeam	264	7 (N/A)	0.0	0.0	7.17
Southern magnolia	677	18 (N/A)	0.0	0.0	18.34
Japanese tree lilac	264	7 (N/A)	0.0	0.0	7.17
Flowering dogwood	1,174	32 (N/A)	0.0	0.0	31.82
Black maple	1,604	43 (N/A)	0.0	0.0	43.46
Alder	1,174	32 (N/A)	0.0	0.0	31.82
Cherry plum	667	18 (N/A)	0.0	0.0	18.06
American holly	2,052	56 (N/A)	0.0	0.0	55.60
Citywide total	21,815,157	591,191 (N/A)	100.0	100.0	54.11

Table 3: Annual Air Quality Benefits

Spencer

Annual Air Quality Benefits of Public Trees

1/9/2017

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard Error (\$)	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂							
Ash	860.1	148.4	423.5	38.1	4,650	2,212.2	319.8	304.4	2,070.6	13,704	-202.1	-758	6,175.1	17,596 (N/A)	18.0	8.95
Silver maple	721.0	122.2	351.0	32.0	3,879	1,251.0	183.0	174.7	1,198.8	7,823	-392.7	-1,473	3,640.9	10,229 (N/A)	8.3	11.25
Spruce	101.1	20.0	86.4	12.4	676	289.9	42.5	40.6	278.7	1,815	-394.4	-1,479	477.2	1,012 (N/A)	5.9	1.56
Norway maple	265.7	45.8	131.5	11.8	1,438	725.4	105.0	100.0	680.7	4,498	-62.9	-236	2,002.9	5,700 (N/A)	5.8	8.92
Broadleaf Deciduous Small	27.6	4.5	14.7	1.3	152	175.0	24.8	23.5	157.9	1,069	-0.2	-1	429.3	1,220 (N/A)	4.4	2.55
American basswood	147.1	25.1	74.0	6.5	799	545.7	79.2	75.5	514.8	3,391	-128.1	-480	1,339.9	3,710 (N/A)	4.3	7.94
Apple	52.6	8.7	25.0	2.4	281	192.0	27.5	26.1	176.3	1,180	-0.3	-1	510.2	1,460 (N/A)	3.8	3.54
White oak	31.5	5.0	17.6	1.4	175	211.8	31.0	29.6	202.9	1,324	0.0	0	530.9	1,499 (N/A)	3.6	3.81
Northern hackberry	170.6	29.5	86.4	7.6	930	513.7	74.4	70.8	482.4	3,186	0.0	0	1,435.5	4,116 (N/A)	3.3	11.31
Honeylocust	189.3	31.2	87.1	8.6	1,002	462.9	67.8	64.8	445.2	2,899	-144.2	-541	1,212.7	3,359 (N/A)	3.1	9.82
Maple	109.2	18.6	51.6	4.8	583	281.7	41.1	39.2	268.9	1,759	-37.3	-140	777.9	2,202 (N/A)	2.6	7.65
Blue spruce	60.3	12.0	50.1	7.4	399	142.5	20.8	19.8	135.5	888	-159.8	-599	288.4	688 (N/A)	2.5	2.55
Green ash	68.3	10.9	32.8	3.1	364	241.7	35.3	33.7	230.9	1,509	0.0	0	656.6	1,873 (N/A)	2.3	7.35
Northern red oak	48.1	8.3	24.4	2.1	262	149.3	21.7	20.7	141.6	930	-68.2	-256	348.1	936 (N/A)	2.1	4.11
Sugar maple	61.0	10.4	31.4	2.7	333	234.1	34.2	32.7	224.0	1,463	-48.8	-183	581.7	1,613 (N/A)	2.0	7.23
Amur maple	30.6	5.0	14.6	1.4	163	130.7	18.9	18.0	122.6	810	-0.2	-1	341.7	973 (N/A)	1.9	4.59
Swamp white oak	28.7	4.9	15.5	1.3	159	126.2	18.1	17.3	116.8	779	-7.5	-28	321.3	909 (N/A)	1.9	4.41
Oak	70.0	11.2	33.0	3.1	371	219.8	32.0	30.5	208.9	1,370	0.0	0	608.7	1,742 (N/A)	1.9	8.54
Broadleaf Deciduous Medium	38.3	6.6	19.7	1.7	209	134.3	19.4	18.5	125.5	831	-9.5	-36	354.4	1,005 (N/A)	1.7	5.49
Austrian pine	39.3	7.8	32.7	4.8	260	94.9	13.8	13.2	90.5	592	-104.0	-390	193.1	462 (N/A)	1.6	2.64
Birch	41.1	7.1	20.7	1.8	223	130.2	18.8	17.9	122.1	807	-10.0	-37	349.9	993 (N/A)	1.3	6.85
Cottonwood	93.8	15.0	42.0	4.2	491	193.9	28.3	27.0	185.4	1,211	0.0	0	589.6	1,703 (N/A)	1.2	12.80
Boxelder	22.2	3.5	10.7	1.0	118	87.1	12.7	12.1	83.0	543	-8.1	-30	224.3	632 (N/A)	1.0	5.69
Broadleaf Evergreen Large	77.5	15.3	62.9	9.5	508	147.5	21.6	20.6	141.2	922	-223.1	-837	273.0	594 (N/A)	0.9	5.88
Lilac	26.1	4.3	12.0	1.2	138	79.2	11.4	10.9	73.7	489	-0.1	-1	218.5	627 (N/A)	0.9	6.60
Quaking aspen	7.4	1.2	4.0	0.3	41	46.7	6.8	6.5	44.8	292	0.0	0	117.8	333 (N/A)	0.8	3.66
Conifer Evergreen Large	22.6	4.5	18.7	2.8	150	55.9	8.2	7.9	54.4	352	-91.0	-341	84.1	160 (N/A)	0.8	1.78
River birch	58.9	10.2	28.4	2.6	317	121.7	17.5	16.7	113.3	752	-13.5	-50	355.9	1,019 (N/A)	0.8	11.71
Willow	24.4	4.2	12.3	1.1	133	72.6	10.5	10.0	67.7	449	-5.9	-22	196.8	560 (N/A)	0.8	6.66
American elm	69.9	11.9	32.9	3.1	373	124.4	18.3	17.5	120.4	781	0.0	0	398.3	1,154 (N/A)	0.6	16.48
Elm	27.1	4.3	12.6	1.2	143	73.9	10.8	10.3	70.4	461	0.0	0	210.7	604 (N/A)	0.6	8.89
Eastern white pine	14.4	2.8	12.0	1.8	95	34.0	5.0	4.7	32.3	212	-63.6	-238	43.4	69 (N/A)	0.6	1.02
Eastern redbud	2.6	0.4	1.4	0.1	14	16.4	2.4	2.2	15.1	101	0.0	0	40.7	115 (N/A)	0.6	1.78
Norway spruce	4.1	0.8	3.7	0.5	28	14.0	2.0	1.9	13.0	86	-18.0	-67	21.9	47 (N/A)	0.6	0.75
Scotch pine	13.7	2.7	11.4	1.7	91	35.2	5.2	4.9	34.1	221	-54.1	-203	54.8	109 (N/A)	0.5	1.81

Chinese elm	11.9	1.9	6.0	0.5	64	52.4	7.6	7.3	49.8	327	0.0	0	137.4	391 (N/A)	0.5	6.97
Red maple	15.4	2.6	7.4	0.7	82	46.5	6.8	6.5	44.6	291	-5.4	-20	125.0	353 (N/A)	0.5	6.42
Pin oak	28.3	5.0	14.6	1.3	155	70.7	10.3	9.9	67.7	442	-53.0	-199	154.8	399 (N/A)	0.5	7.38
Black cherry	12.8	2.1	5.9	0.6	68	41.8	6.0	5.7	38.9	259	-0.1	0	113.9	326 (N/A)	0.5	6.04
Ohio buckeye	5.1	0.9	2.9	0.2	29	27.9	4.0	3.8	25.8	172	-1.4	-5	69.2	195 (N/A)	0.5	3.91
Conifer Evergreen Medium	3.8	0.8	3.7	0.5	27	16.1	2.3	2.2	14.9	99	-12.6	-47	31.7	79 (N/A)	0.4	1.64
Broadleaf Deciduous Large	19.4	3.1	9.0	0.9	102	53.1	7.7	7.4	50.5	331	0.0	0	151.1	434 (N/A)	0.4	10.08
Mulberry	6.9	1.1	3.2	0.3	36	21.9	3.1	3.0	20.0	134	0.0	0	59.5	171 (N/A)	0.4	4.37
Black walnut	15.0	2.4	7.0	0.7	79	43.7	6.4	6.1	41.5	272	0.0	0	122.8	352 (N/A)	0.3	11.00
Paper birch	3.7	0.6	1.8	0.2	20	15.3	2.2	2.1	14.5	95	0.0	0	40.4	115 (N/A)	0.2	4.80
Sumac	1.0	0.2	0.5	0.0	5	7.0	1.0	0.9	6.3	43	0.0	0	17.0	48 (N/A)	0.2	2.10
Conifer Evergreen Small	1.0	0.2	0.9	0.1	7	3.7	0.5	0.5	3.4	23	-5.1	-19	5.2	10 (N/A)	0.2	0.44
Eastern red cedar	6.1	1.2	4.8	0.7	40	10.2	1.5	1.4	9.5	63	-16.8	-63	18.7	40 (N/A)	0.2	1.81
Bur oak	0.6	0.1	0.4	0.0	4	8.0	1.2	1.1	7.5	50	0.0	0	18.9	53 (N/A)	0.2	2.41
Kentucky coffeetree	8.6	1.4	4.0	0.4	46	26.3	3.8	3.7	25.0	164	0.0	0	73.2	210 (N/A)	0.2	10.48
Broadleaf Evergreen Medium	5.8	1.1	5.2	0.7	39	16.5	2.4	2.3	15.9	103	-10.4	-39	39.6	104 (N/A)	0.2	5.47
Littleleaf linden	6.4	1.1	3.1	0.3	35	16.0	2.3	2.2	15.0	99	-3.1	-11	43.5	123 (N/A)	0.1	7.66
Ginkgo	2.7	0.5	1.3	0.1	14	7.3	1.1	1.0	7.0	46	-0.8	-3	20.1	57 (N/A)	0.1	3.55
American sycamore	6.4	1.0	2.9	0.3	34	17.5	2.5	2.4	16.5	109	0.0	0	49.6	142 (N/A)	0.1	10.18
Basswood	5.8	0.9	2.7	0.3	31	16.9	2.5	2.3	16.0	105	0.0	0	47.5	136 (N/A)	0.1	10.47
Black poplar	5.9	0.9	2.8	0.3	31	16.8	2.4	2.3	15.8	104	0.0	0	47.3	136 (N/A)	0.1	11.30
White ash	0.3	0.0	0.3	0.0	2	5.7	0.8	0.8	5.4	35	0.0	0	13.3	37 (N/A)	0.1	3.40
Eastern cottonwood	13.9	2.2	6.1	0.6	72	21.8	3.2	3.0	20.8	136	0.0	0	71.6	208 (N/A)	0.1	20.84
Broadleaf Evergreen Small	2.3	0.5	1.9	0.3	15	4.6	0.7	0.6	4.4	29	0.0	0	15.2	44 (N/A)	0.1	4.38
Catalpa	6.3	1.0	2.9	0.3	33	14.5	2.1	2.0	14.0	91	0.0	0	43.1	124 (N/A)	0.1	13.80
Common chokecherry	0.5	0.1	0.3	0.0	3	3.5	0.5	0.5	3.2	21	0.0	0	8.6	24 (N/A)	0.1	3.05
Black spruce	0.3	0.1	0.3	0.0	2	1.6	0.2	0.2	1.4	10	-1.2	-4	3.1	8 (N/A)	0.0	1.53
Black locust	0.6	0.1	0.3	0.0	3	2.5	0.4	0.3	2.3	16	-0.2	-1	6.5	18 (N/A)	0.0	4.58
Mountain ash	0.5	0.1	0.2	0.0	3	1.4	0.2	0.2	1.2	8	0.0	0	3.8	11 (N/A)	0.0	5.45
Northern pin oak	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	4	0.0	0	1.7	5 (N/A)	0.0	2.34
Northern catalpa	2.1	0.3	0.9	0.1	11	3.9	0.6	0.5	3.7	24	0.0	0	12.1	35 (N/A)	0.0	17.51
Northern white cedar	0.4	0.1	0.3	0.0	2	0.8	0.1	0.1	0.8	5	-1.4	-5	1.1	2 (N/A)	0.0	1.00
Red pine	1.1	0.2	0.9	0.1	7	1.8	0.3	0.2	1.7	11	-5.7	-21	0.6	-3 (N/A)	0.0	-1.58
Hickory	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	13 (N/A)	0.0	6.28
Eastern hophornbeam	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)	0.0	2.55
Southern magnolia	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	-0.2	-1	0.8	2 (N/A)	0.0	2.10
Japanese tree lilac	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)	0.0	2.55
Flowering dogwood	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)	0.0	8.35
Black maple	0.3	0.1	0.2	0.0	2	1.2	0.2	0.2	1.2	7	-0.1	0	3.1	9 (N/A)	0.0	8.75
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)	0.0	8.35
Cherry plum	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.0	6.56
American holly	0.7	0.1	0.5	0.1	4	1.0	0.1	0.1	1.0	6	0.0	0	3.7	11 (N/A)	0.0	10.84
Citywide total	3,829.9	658.8	1,994.8	198.3	21,066	10,173.5	1,478.2	1,408.7	9,617.8	63,273	-2,365.1	-8,869	26,994.9	75,470 (N/A)	100.0	6.91

Table 4: Annual Carbon Stored

Spencer

Stored CO2 Benefits of Public Trees

1/9/2017

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Ash	14,219,471	106,646	(N/A)	18.0	18.4	54.25
Silver maple	18,083,989	135,630	(N/A)	8.3	23.4	149.21
Spruce	908,044	6,810	(N/A)	5.9	1.2	10.51
Norway maple	4,384,599	32,884	(N/A)	5.8	5.7	51.46
Broadleaf Deciduous	499,454	3,746	(N/A)	4.4	0.6	7.82
American basswood	5,516,434	41,373	(N/A)	4.3	7.2	88.59
Apple	845,024	6,338	(N/A)	3.8	1.1	15.38
White oak	1,109,476	8,321	(N/A)	3.6	1.4	21.12
Northern hackberry	2,679,973	20,100	(N/A)	3.3	3.5	55.22
Honeylocust	2,419,890	18,149	(N/A)	3.1	3.1	53.07
Maple	1,200,249	9,002	(N/A)	2.6	1.6	31.26
Blue spruce	426,282	3,197	(N/A)	2.5	0.6	11.84
Green ash	2,280,328	17,102	(N/A)	2.3	3.0	67.07
Northern red oak	962,262	7,217	(N/A)	2.1	1.2	31.65
Sugar maple	1,771,202	13,284	(N/A)	2.0	2.3	59.57
Amur maple	469,305	3,520	(N/A)	1.9	0.6	16.60
Swamp white oak	494,458	3,708	(N/A)	1.9	0.6	18.00
Oak	2,353,313	17,650	(N/A)	1.9	3.1	86.52
Broadleaf Deciduous	645,077	4,838	(N/A)	1.7	0.8	26.44
Austrian pine	276,503	2,074	(N/A)	1.6	0.4	11.85
Birch	682,258	5,117	(N/A)	1.3	0.9	35.29
Cottonwood	3,237,883	24,284	(N/A)	1.2	4.2	182.59
Boxelder	760,050	5,700	(N/A)	1.0	1.0	51.35
Broadleaf Evergreen l	880,705	6,605	(N/A)	0.9	1.1	65.40
Lilac	399,661	2,997	(N/A)	0.9	0.5	31.55
Quaking aspen	261,290	1,960	(N/A)	0.8	0.3	21.53
Conifer Evergreen La	218,563	1,639	(N/A)	0.8	0.3	18.21
River birch	972,369	7,293	(N/A)	0.8	1.3	83.82
Willow	407,436	3,056	(N/A)	0.8	0.5	36.38
American elm	1,378,820	10,341	(N/A)	0.6	1.8	147.73
Elm	922,167	6,916	(N/A)	0.6	1.2	101.71
Eastern white pine	155,658	1,167	(N/A)	0.6	0.2	17.42
Eastern redbud	45,290	340	(N/A)	0.6	0.1	5.23
Norway spruce	38,978	292	(N/A)	0.6	0.1	4.72
Scotch pine	128,501	964	(N/A)	0.5	0.2	16.06
Chinese elm	394,749	2,961	(N/A)	0.5	0.5	52.87
Red maple	172,227	1,292	(N/A)	0.5	0.2	23.49
Pin oak	759,252	5,694	(N/A)	0.5	1.0	105.45
Black cherry	196,966	1,477	(N/A)	0.5	0.3	27.36
Ohio buckeye	89,694	673	(N/A)	0.5	0.1	13.45
Conifer Evergreen M	17,328	130	(N/A)	0.4	0.0	2.71
Broadleaf Deciduous	650,650	4,880	(N/A)	0.4	0.8	113.49
Mulberry	109,009	818	(N/A)	0.4	0.1	20.96
Black walnut	496,460	3,723	(N/A)	0.3	0.6	116.36
Paper birch	122,451	918	(N/A)	0.2	0.2	38.27
Sumac	18,077	136	(N/A)	0.2	0.0	5.89
Conifer Evergreen Sn	4,115	31	(N/A)	0.2	0.0	1.34
Eastern red cedar	19,887	149	(N/A)	0.2	0.0	6.78
Bur oak	22,541	169	(N/A)	0.2	0.0	7.68
Kentucky coffeetree	285,911	2,144	(N/A)	0.2	0.4	107.22
Broadleaf Evergreen l	62,614	470	(N/A)	0.2	0.1	24.72
Littleleaf linden	137,154	1,029	(N/A)	0.1	0.2	64.29
Ginkgo	38,288	287	(N/A)	0.1	0.0	17.95
American sycamore	211,000	1,583	(N/A)	0.1	0.3	113.04
Basswood	196,191	1,471	(N/A)	0.1	0.3	113.19

Black poplar	193,855	1,454 (N/A)	0.1	0.3	121.16
White ash	14,017	105 (N/A)	0.1	0.0	9.56
Eastern cottonwood	486,164	3,646 (N/A)	0.1	0.6	364.62
Broadleaf Evergreen	24,959	187 (N/A)	0.1	0.0	18.72
Catalpa	218,965	1,642 (N/A)	0.1	0.3	182.47
Common chokecherry	9,393	70 (N/A)	0.1	0.0	8.81
Black spruce	1,421	11 (N/A)	0.0	0.0	2.13
Black locust	10,365	78 (N/A)	0.0	0.0	19.43
Mountain ash	7,651	57 (N/A)	0.0	0.0	28.69
Northern pin oak	1,319	10 (N/A)	0.0	0.0	4.95
Northern catalpa	71,755	538 (N/A)	0.0	0.1	269.08
Northern white cedar	3,381	25 (N/A)	0.0	0.0	12.68
Red pine	14,981	112 (N/A)	0.0	0.0	56.18
Hickory	15,785	118 (N/A)	0.0	0.0	59.19
Eastern hophornbeam	908	7 (N/A)	0.0	0.0	6.81
Southern magnolia	484	4 (N/A)	0.0	0.0	3.63
Japanese tree lilac	908	7 (N/A)	0.0	0.0	6.81
Flowering dogwood	6,743	51 (N/A)	0.0	0.0	50.57
Black maple	3,624	27 (N/A)	0.0	0.0	27.18
Alder	6,743	51 (N/A)	0.0	0.0	50.57
Cherry plum	3,037	23 (N/A)	0.0	0.0	22.78
American holly	6,743	51 (N/A)	0.0	0.0	50.57
Citywide total	77,142,723	578,570 (N/A)	100.0	100.0	52.96

Table 5: Annual Carbon Sequestered

Spencer

Annual CO₂ Benefits of Public Trees

1/9/2017

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
Ash	554,036	4,155	-68,346	-4,954	-550	765,491	5,741	1,246,227	9,347 (N/A)	18.0	16.9	4.75
Silver maple	1,221,801	9,164	-86,840	-3,090	-674	444,492	3,334	1,576,364	11,823 (N/A)	8.3	21.4	13.01
Spruce	59,520	446	-4,359	-1,101	-41	103,217	774	157,278	1,180 (N/A)	5.9	2.1	1.82
Norway maple	212,401	1,593	-21,064	-1,548	-170	251,635	1,887	441,424	3,311 (N/A)	5.8	6.0	5.18
Broadleaf Deciduous Small	55,253	414	-2,398	-539	-22	58,433	438	110,749	831 (N/A)	4.4	1.5	1.73
American basswood	332,162	2,491	-26,479	-1,277	-208	190,295	1,427	494,701	3,710 (N/A)	4.3	6.7	7.94
Apple	49,200	369	-4,057	-593	-35	65,254	489	109,803	824 (N/A)	3.8	1.5	2.00
White oak	94,916	712	-5,326	-510	-44	75,123	563	164,203	1,232 (N/A)	3.6	2.2	3.13
Northern hackberry	128,999	967	-12,867	-1,027	-104	178,415	1,338	293,520	2,201 (N/A)	3.3	4.0	6.05
Honeylocust	197,313	1,480	-11,630	-765	-93	164,963	1,237	349,880	2,624 (N/A)	3.1	4.8	7.67
Maple	90,468	679	-5,761	-546	-47	99,587	747	183,748	1,378 (N/A)	2.6	2.5	4.79
Blue spruce	25,821	194	-2,046	-546	-19	50,209	377	73,438	551 (N/A)	2.5	1.0	2.04
Green ash	112,195	841	-10,946	-549	-86	85,456	641	186,157	1,396 (N/A)	2.3	2.5	5.48
Northern red oak	45,964	345	-4,619	-386	-38	52,418	393	93,376	700 (N/A)	2.1	1.3	3.07
Sugar maple	100,967	757	-8,509	-521	-68	82,958	622	174,895	1,312 (N/A)	2.0	2.4	5.88
Amur maple	41,848	314	-2,253	-327	-19	45,370	340	84,638	635 (N/A)	1.9	1.2	2.99
Swamp white oak	45,467	341	-2,404	-282	-20	43,173	324	85,954	645 (N/A)	1.9	1.2	3.13
Oak	100,449	753	-11,296	-505	-89	77,326	580	165,973	1,245 (N/A)	1.9	2.3	6.10
Broadleaf Deciduous Medium	44,638	335	-3,126	-293	-26	46,368	348	87,587	657 (N/A)	1.7	1.2	3.59
Austrian pine	16,936	127	-1,327	-358	-13	33,539	252	48,791	366 (N/A)	1.6	0.7	2.09
Birch	39,935	300	-3,283	-280	-27	45,134	339	81,506	611 (N/A)	1.3	1.1	4.22
Cottonwood	70,399	528	-15,542	-465	-120	68,627	515	123,019	923 (N/A)	1.2	1.7	6.94
Boxelder	57,993	435	-3,655	-227	-29	30,725	230	84,836	636 (N/A)	1.0	1.2	5.73
Broadleaf Evergreen Large	51,194	384	-4,227	-272	-34	52,696	395	99,390	745 (N/A)	0.9	1.4	7.38
Lilac	25,811	194	-1,919	-209	-16	27,277	205	50,960	382 (N/A)	0.9	0.7	4.02
Quaking aspen	20,520	154	-1,254	-114	-10	16,593	124	35,745	268 (N/A)	0.8	0.5	2.95
Conifer Evergreen Large	12,003	90	-1,049	-207	-9	20,147	151	30,893	232 (N/A)	0.8	0.4	2.57
River birch	21,857	164	-4,667	-289	-37	41,910	314	58,811	441 (N/A)	0.8	0.8	5.07
Willow	19,780	148	-1,968	-165	-16	25,029	188	42,676	320 (N/A)	0.8	0.6	3.81
American elm	31,879	239	-6,619	-259	-52	44,554	334	69,555	522 (N/A)	0.6	0.9	7.45
Elm	31,250	234	-4,427	-172	-34	26,065	195	52,716	395 (N/A)	0.6	0.7	5.81
Eastern white pine	5,062	38	-747	-147	-7	11,959	90	16,127	121 (N/A)	0.6	0.2	1.81
Eastern redbud	5,146	39	-218	-52	-2	5,595	42	10,471	79 (N/A)	0.6	0.1	1.21
Norway spruce	2,933	22	-187	-60	-2	4,818	36	7,503	56 (N/A)	0.6	0.1	0.91
Scotch pine	7,833	59	-617	-129	-6	12,632	95	19,719	148 (N/A)	0.5	0.3	2.46
Chinese elm	24,739	186	-1,895	-116	-15	18,443	138	41,170	309 (N/A)	0.5	0.6	5.51
Red maple	19,080	143	-827	-89	-7	16,521	124	34,685	260 (N/A)	0.5	0.5	4.73
Pin oak	56,147	421	-3,644	-158	-29	25,081	188	77,425	581 (N/A)	0.5	1.1	10.75
Black cherry	12,431	93	-945	-112	-8	14,416	108	25,790	193 (N/A)	0.5	0.4	3.58
Ohio buckeye	10,763	81	-439	-62	-4	9,539	72	19,801	149 (N/A)	0.5	0.3	2.97
Conifer Evergreen Medium	2,061	15	-83	-59	-1	5,515	41	7,434	56 (N/A)	0.4	0.1	1.16
Broadleaf Deciduous Large	24,256	182	-3,123	-122	-24	18,708	140	39,718	298 (N/A)	0.4	0.5	6.93
Mulberry	5,943	45	-523	-66	-4	7,414	56	12,767	96 (N/A)	0.4	0.2	2.46
Black walnut	21,002	158	-2,383	-98	-19	15,372	115	33,892	254 (N/A)	0.3	0.5	7.94
Paper birch	7,940	60	-588	-38	-5	5,354	40	12,668	95 (N/A)	0.2	0.2	3.96
Sumac	2,155	16	-87	-22	-1	2,347	18	4,393	33 (N/A)	0.2	0.1	1.43
Conifer Evergreen Small	562	4	-20	-20	0	1,247	9	1,770	13 (N/A)	0.2	0.0	0.58
Eastern red cedar	516	4	-95	-38	-1	3,531	26	3,912	29 (N/A)	0.2	0.1	1.33
Bur oak	3,833	29	-108	-22	-1	2,784	21	6,487	49 (N/A)	0.2	0.1	2.21
Kentucky coffeetree	12,403	93	-1,372	-59	-11	9,255	69	20,227	152 (N/A)	0.2	0.3	7.59
Broadleaf Evergreen Medium	3,433	26	-301	-37	-3	5,954	45	9,051	68 (N/A)	0.2	0.1	3.57
Littleleaf linden	6,087	46	-659	-44	-5	5,559	42	10,943	82 (N/A)	0.1	0.1	5.13
Ginkgo	1,825	14	-184	-25	-2	2,586	19	4,202	32 (N/A)	0.1	0.1	1.97
American sycamore	8,299	62	-1,013	-40	-8	6,118	46	13,364	100 (N/A)	0.1	0.2	7.16
Basswood	7,680	58	-942	-39	-7	5,923	44	12,623	95 (N/A)	0.1	0.2	7.28
Black poplar	8,529	64	-931	-38	-7	5,860	44	13,420	101 (N/A)	0.1	0.2	8.39
White ash	2,315	17	-67	-14	-1	2,004	15	4,238	32 (N/A)	0.1	0.1	2.89
Eastern cottonwood	6,033	45	-2,334	-55	-18	7,711	58	11,356	85 (N/A)	0.1	0.2	8.52
Broadleaf Evergreen Small	439	3	-120	-12	-1	1,635	12	1,942	15 (N/A)	0.1	0.0	1.46
Catalpa	5,146	39	-1,051	-33	-8	5,163	39	9,225	69 (N/A)	0.1	0.1	7.69
Common chokecherry	1,065	8	-45	-10	0	1,178	9	2,187	16 (N/A)	0.1	0.0	2.05
Black spruce	193	1	-7	-6	0	531	4	711	5 (N/A)	0.0	0.0	1.07
Black locust	1,013	8	-50	-6	0	856	6	1,814	14 (N/A)	0.0	0.0	3.40
Mountain ash	592	4	-37	-4	0	459	3	1,011	8 (N/A)	0.0	0.0	3.79
Northern pin oak	320	2	-7	-2	0	240	2	551	4 (N/A)	0.0	0.0	2.07
Northern catalpa	1,336	10	-344	-9	-3	1,365	10	2,347	18 (N/A)	0.0	0.0	8.80
Northern white cedar	205	2	-16	-3	0	284	2	470	4 (N/A)	0.0	0.0	1.76

Red pine	0	0	-72	-9	-1	622	5	>41	4 (N/A)	0.0	0.0	2.03
Hickory	859	6	-76	-4	-1	557	4	1,337	10 (N/A)	0.0	0.0	5.01
Eastern hophornbeam	114	1	-4	-1	0	124	1	232	2 (N/A)	0.0	0.0	1.74
Southern magnolia	56	0	-2	-1	0	141	1	194	1 (N/A)	0.0	0.0	1.45
Japanese tree lilac	114	1	-4	-1	0	124	1	232	2 (N/A)	0.0	0.0	1.74
Flowering dogwood	478	4	-32	-3	0	335	3	778	6 (N/A)	0.0	0.0	5.84
Black maple	483	4	-17	-2	0	431	3	895	7 (N/A)	0.0	0.0	6.71
Alder	0	0	-32	-4	0	335	3	299	2 (N/A)	0.0	0.0	2.24
Cherry plum	268	2	-15	-2	0	308	2	560	4 (N/A)	0.0	0.0	4.20
American holly	0	0	-32	-2	0	365	3	331	2 (N/A)	0.0	0.0	2.48
Citywide total	4,194,662	31,460	-370,561	-24,253	-2,961	3,559,777	26,698	7,359,625	55,197 (N/A)	100.0	100.0	5.05

Table 6: Annual Social and Aesthetic Benefits

Spencer

Annual Aesthetic/Other Benefits of Public Trees

1/9/2017

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Ash	54,293	(N/A)	18.0	12.8	27.62
Silver maple	91,866	(N/A)	8.3	21.6	101.06
Spruce	15,590	(N/A)	5.9	3.7	24.06
Norway maple	20,578	(N/A)	5.8	4.8	32.20
Broadleaf Deciduous Small	3,131	(N/A)	4.4	0.7	6.54
American basswood	24,244	(N/A)	4.3	5.7	51.91
Apple	2,828	(N/A)	3.8	0.7	6.86
White oak	11,293	(N/A)	3.6	2.7	28.66
Northern hackberry	18,026	(N/A)	3.3	4.2	49.52
Honeylocust	45,782	(N/A)	3.1	10.8	133.87
Maple	12,317	(N/A)	2.6	2.9	42.77
Blue spruce	5,571	(N/A)	2.5	1.3	20.63
Green ash	10,193	(N/A)	2.3	2.4	39.97
Northern red oak	3,948	(N/A)	2.1	0.9	17.32
Sugar maple	10,963	(N/A)	2.0	2.6	49.16
Amur maple	2,415	(N/A)	1.9	0.6	11.39
Swamp white oak	5,036	(N/A)	1.9	1.2	24.44
Oak	8,829	(N/A)	1.9	2.1	43.28
Broadleaf Deciduous Medium	4,720	(N/A)	1.7	1.1	25.79
Austrian pine	3,757	(N/A)	1.6	0.9	21.47
Birch	4,070	(N/A)	1.3	1.0	28.07
Cottonwood	5,495	(N/A)	1.2	1.3	41.32
Boxelder	4,635	(N/A)	1.0	1.1	41.76
Broadleaf Evergreen Large	9,280	(N/A)	0.9	2.2	91.88
Lilac	1,521	(N/A)	0.9	0.4	16.01
Quaking aspen	2,491	(N/A)	0.8	0.6	27.37
Conifer Evergreen Large	2,889	(N/A)	0.8	0.7	32.10
River birch	2,005	(N/A)	0.8	0.5	23.05
Willow	2,065	(N/A)	0.8	0.5	24.58
American elm	4,183	(N/A)	0.6	1.0	59.75
Elm	2,694	(N/A)	0.6	0.6	39.61
Eastern white pine	1,273	(N/A)	0.6	0.3	19.00
Eastern redbud	283	(N/A)	0.6	0.1	4.36
Norway spruce	791	(N/A)	0.6	0.2	12.77
Scotch pine	1,897	(N/A)	0.5	0.4	31.62
Chinese elm	2,346	(N/A)	0.5	0.6	41.89
Red maple	2,602	(N/A)	0.5	0.6	47.30
Pin oak	4,477	(N/A)	0.5	1.1	82.91
Black cherry	728	(N/A)	0.5	0.2	13.48
Ohio buckeye	1,217	(N/A)	0.5	0.3	24.33
Conifer Evergreen Medium	1,015	(N/A)	0.4	0.2	21.15
Broadleaf Deciduous Large	1,991	(N/A)	0.4	0.5	46.29
Mulberry	346	(N/A)	0.4	0.1	8.87
Black walnut	1,678	(N/A)	0.3	0.4	52.43
Paper birch	775	(N/A)	0.2	0.2	32.30
Sumac	120	(N/A)	0.2	0.0	5.23
Conifer Evergreen Small	371	(N/A)	0.2	0.1	16.11
Eastern red cedar	208	(N/A)	0.2	0.0	9.46

Bur oak	533 (N/A)	0.2	0.1	24.23
Kentucky coffeetree	1,012 (N/A)	0.2	0.2	50.59
Broadleaf Evergreen Medium	486 (N/A)	0.2	0.1	25.60
Littleleaf linden	644 (N/A)	0.1	0.2	40.28
Ginkgo	150 (N/A)	0.1	0.0	9.41
American sycamore	664 (N/A)	0.1	0.2	47.43
Basswood	640 (N/A)	0.1	0.2	49.24
Black poplar	664 (N/A)	0.1	0.2	55.36
White ash	398 (N/A)	0.1	0.1	36.18
Eastern cottonwood	382 (N/A)	0.1	0.1	38.23
Broadleaf Evergreen Small	23 (N/A)	0.1	0.0	2.34
Catalpa	412 (N/A)	0.1	0.1	45.79
Common chokecherry	60 (N/A)	0.1	0.0	7.54
Black spruce	105 (N/A)	0.0	0.0	21.08
Black locust	108 (N/A)	0.0	0.0	27.10
Mountain ash	35 (N/A)	0.0	0.0	17.60
Northern pin oak	39 (N/A)	0.0	0.0	19.55
Northern catalpa	94 (N/A)	0.0	0.0	47.08
Northern white cedar	54 (N/A)	0.0	0.0	26.96
Red pine	0 (N/A)	0.0	0.0	0.00
Hickory	71 (N/A)	0.0	0.0	35.43
Eastern hophornbeam	6 (N/A)	0.0	0.0	6.40
Southern magnolia	22 (N/A)	0.0	0.0	21.93
Japanese tree lilac	6 (N/A)	0.0	0.0	6.40
Flowering dogwood	29 (N/A)	0.0	0.0	28.80
Black maple	66 (N/A)	0.0	0.0	65.89
Alder	0 (N/A)	0.0	0.0	0.00
Cherry plum	15 (N/A)	0.0	0.0	15.48
American holly	0 (N/A)	0.0	0.0	0.00
Citywide total	425,547 (N/A)	100.0	100.0	38.95

Table 7: Summary of Benefits in Dollars

Spencer

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

1/9/2017

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Ash	99,082	9,347	17,596	114,575	54,293	294,893	(N/A)	18.5
Silver maple	54,434	11,823	10,229	106,202	91,866	274,553	(N/A)	17.2
Spruce	12,573	1,180	1,012	24,930	15,590	55,285	(N/A)	3.5
Norway maple	32,365	3,311	5,700	36,185	20,578	98,139	(N/A)	6.1
Broadleaf Deciduous Sn	8,287	831	1,220	3,515	3,131	16,983	(N/A)	1.1
American basswood	24,158	3,710	3,710	30,616	24,244	86,438	(N/A)	5.4
Apple	8,880	824	1,460	4,705	2,828	18,696	(N/A)	1.2
White oak	9,216	1,232	1,499	9,473	11,293	32,713	(N/A)	2.0
Northern hackberry	22,892	2,201	4,116	27,620	18,026	74,855	(N/A)	4.7
Honeylocust	20,028	2,624	3,359	26,823	45,782	98,618	(N/A)	6.2
Maple	12,320	1,378	2,202	12,919	12,317	41,136	(N/A)	2.6
Blue spruce	6,289	551	688	11,759	5,571	24,857	(N/A)	1.6
Green ash	10,537	1,396	1,873	14,525	10,193	38,524	(N/A)	2.4
Northern red oak	6,604	700	936	6,856	3,948	19,044	(N/A)	1.2
Sugar maple	10,194	1,312	1,613	13,055	10,963	37,137	(N/A)	2.3
Amur maple	5,846	635	973	2,800	2,415	12,669	(N/A)	0.8
Swamp white oak	5,748	645	909	4,942	5,036	17,280	(N/A)	1.1
Oak	9,661	1,245	1,742	14,095	8,829	35,571	(N/A)	2.2
Broadleaf Deciduous M	6,035	657	1,005	5,828	4,720	18,245	(N/A)	1.1
Austrian pine	4,168	366	462	7,688	3,757	16,442	(N/A)	1.0
Birch	5,820	611	993	5,961	4,070	17,456	(N/A)	1.1
Cottonwood	8,433	923	1,703	14,609	5,495	31,162	(N/A)	2.0
Boxelder	3,834	636	632	4,941	4,635	14,678	(N/A)	0.9
Broadleaf Evergreen La	6,367	745	594	13,276	9,280	30,262	(N/A)	1.9
Lilac	3,586	382	627	2,072	1,521	8,188	(N/A)	0.5
Quaking aspen	2,027	268	333	2,088	2,491	7,207	(N/A)	0.5
Conifer Evergreen Larg	2,379	232	160	5,334	2,889	10,993	(N/A)	0.7
River birch	5,486	441	1,019	7,262	2,005	16,212	(N/A)	1.0
Willow	3,264	320	560	3,456	2,065	9,664	(N/A)	0.6
American elm	5,302	522	1,154	5,889	4,183	17,049	(N/A)	1.1
Elm	3,236	395	604	4,903	2,694	11,833	(N/A)	0.7
Eastern white pine	1,501	121	69	3,408	1,273	6,373	(N/A)	0.4
Eastern redbud	756	79	115	317	283	1,550	(N/A)	0.1
Norway spruce	635	56	47	1,144	791	2,673	(N/A)	0.2
Scotch pine	1,505	148	109	3,262	1,897	6,921	(N/A)	0.4
Chinese elm	2,297	309	391	2,860	2,346	8,203	(N/A)	0.5
Red maple	2,014	260	353	1,942	2,602	7,170	(N/A)	0.4
Pin oak	3,075	581	399	4,369	4,477	12,900	(N/A)	0.8
Black cherry	1,893	193	326	1,050	728	4,191	(N/A)	0.3
Ohio buckeye	1,275	149	195	992	1,217	3,828	(N/A)	0.2
Conifer Evergreen Medi	743	56	79	1,063	1,015	2,956	(N/A)	0.2
Broadleaf Deciduous La	2,329	298	434	3,715	1,991	8,766	(N/A)	0.5
Mulberry	1,016	96	171	577	346	2,205	(N/A)	0.1
Black walnut	1,923	254	352	2,993	1,678	7,200	(N/A)	0.5
Paper birch	676	95	115	903	775	2,564	(N/A)	0.2
Sumac	330	33	48	134	120	665	(N/A)	0.0
Conifer Evergreen Smal	172	13	10	265	371	831	(N/A)	0.1
Eastern red cedar	467	29	40	829	208	1,574	(N/A)	0.1

Bur oak	357	49	53	310	533	1,302 (N/A)	0.1
Kentucky coffeetree	1,153	152	210	1,727	1,012	4,253 (N/A)	0.3
Broadleaf Evergreen Me	709	68	104	1,041	486	2,409 (N/A)	0.2
Littleleaf linden	716	82	123	981	644	2,546 (N/A)	0.2
Ginkgo	320	32	57	280	150	840 (N/A)	0.1
American sycamore	778	100	142	1,218	664	2,903 (N/A)	0.2
Basswood	746	95	136	1,130	640	2,747 (N/A)	0.2
Black poplar	746	101	136	1,200	664	2,847 (N/A)	0.2
White ash	249	32	37	211	398	928 (N/A)	0.1
Eastern cottonwood	943	85	208	1,872	382	3,492 (N/A)	0.2
Broadleaf Evergreen Spr	207	15	44	209	23	498 (N/A)	0.0
Catalpa	628	69	124	992	412	2,225 (N/A)	0.1
Common chokecherry	165	16	24	68	60	335 (N/A)	0.0
Black spruce	74	5	8	102	105	295 (N/A)	0.0
Black locust	117	14	18	103	108	360 (N/A)	0.0
Mountain ash	64	8	11	39	35	157 (N/A)	0.0
Northern pin oak	33	4	5	20	39	102 (N/A)	0.0
Northern catalpa	170	18	35	303	94	619 (N/A)	0.0
Northern white cedar	36	4	2	86	54	182 (N/A)	0.0
Red pine	76	4	-3	250	0	327 (N/A)	0.0
Hickory	72	10	13	107	71	272 (N/A)	0.0
Eastern hophornbeam	18	2	3	7	6	36 (N/A)	0.0
Southern magnolia	19	1	2	18	22	63 (N/A)	0.0
Japanese tree lilac	18	2	3	7	6	36 (N/A)	0.0
Flowering dogwood	46	6	8	32	29	121 (N/A)	0.0
Black maple	49	7	9	43	66	174 (N/A)	0.0
Alder	46	2	8	32	0	89 (N/A)	0.0
Cherry plum	38	4	7	18	15	82 (N/A)	0.0
American holly	44	2	11	56	0	113 (N/A)	0.0
Citywide Total	450,298	55,197	75,470	591,191	425,547	1,597,703 (N/A)	100.0

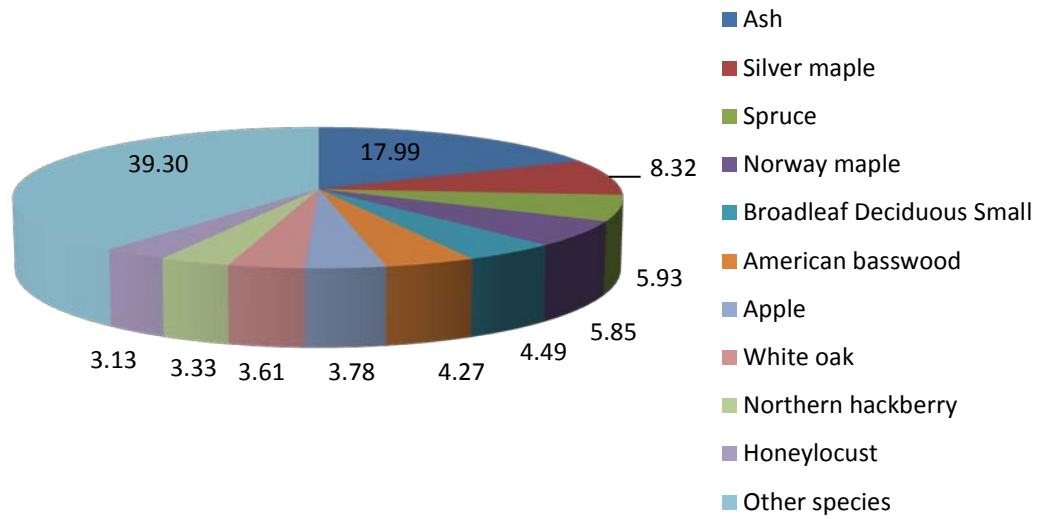


Figure 1: Species Distribution

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

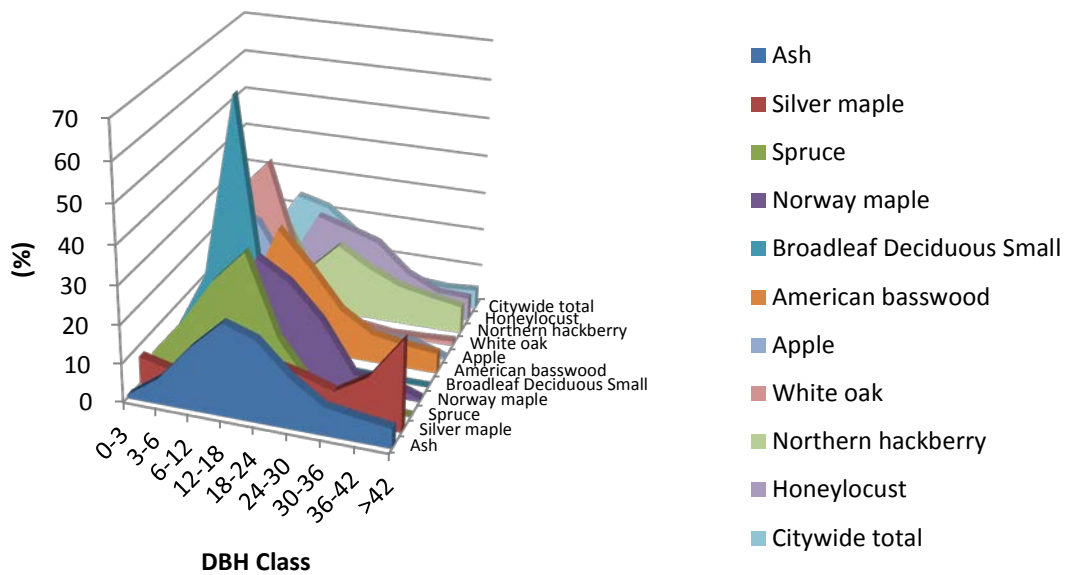


Figure 2: Relative Age Class

Leaf Condition

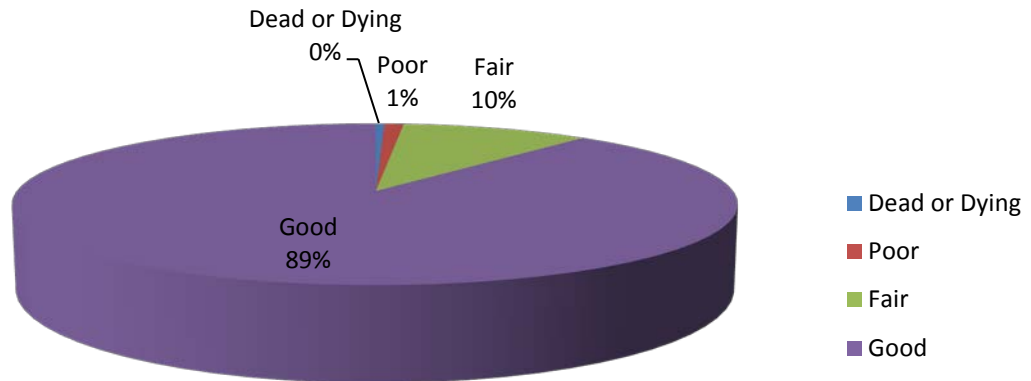


Figure 3: Foliage Condition

Wood Condition

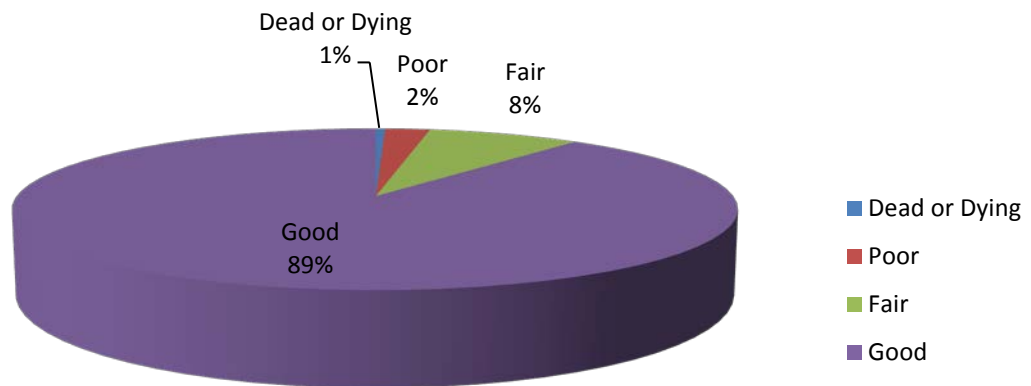


Figure 4: Wood Condition

Canopy Cover

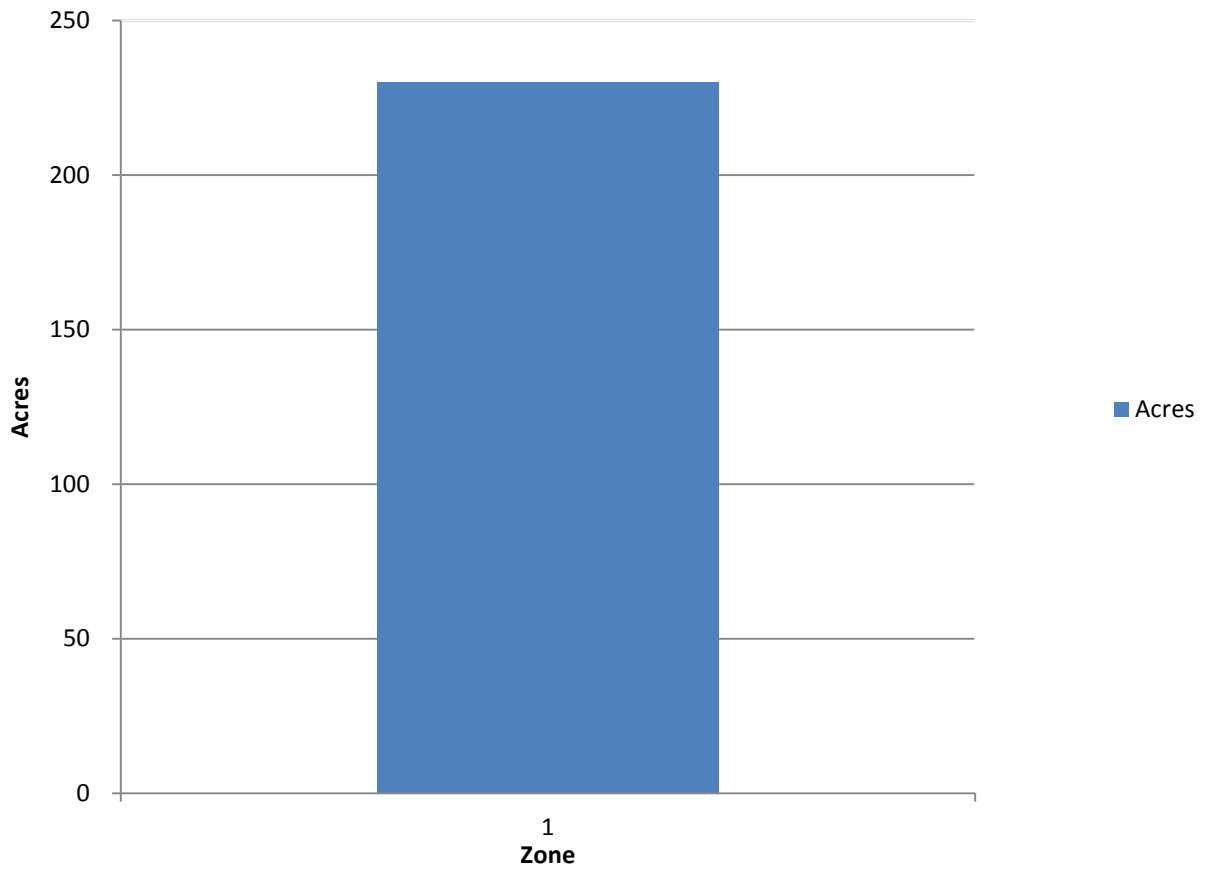


Figure 5: Canopy Cover in Acres

Land use Public Trees by Zone (%)

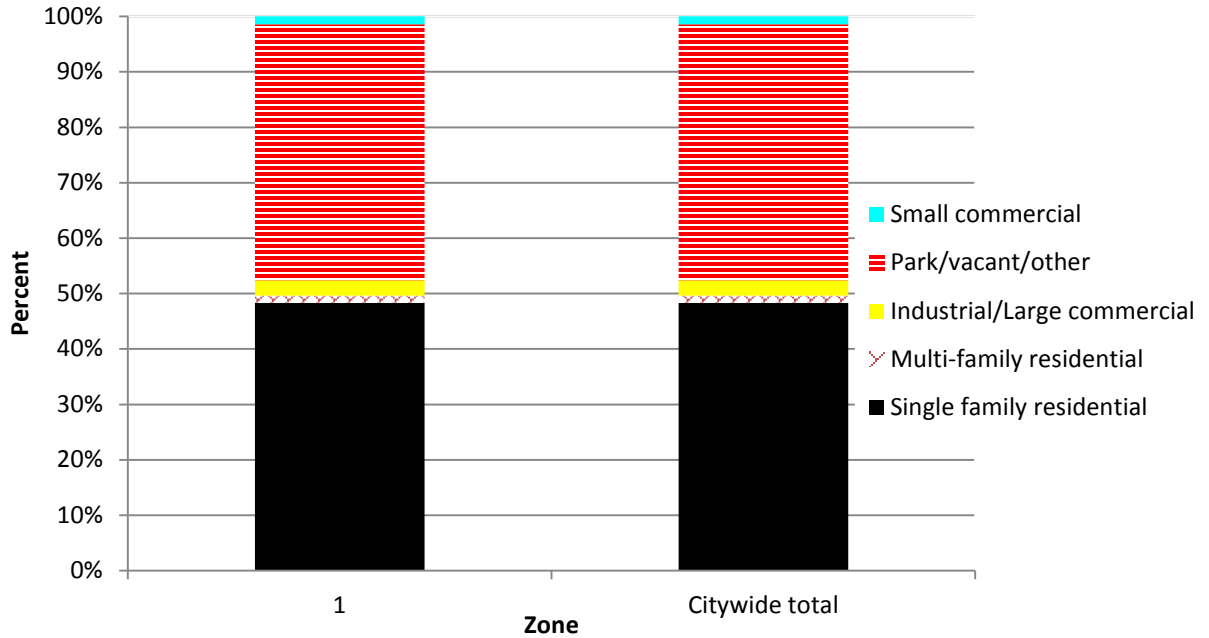


Figure 6: Land Use of city/park trees

Location Public Trees by Zone (%)

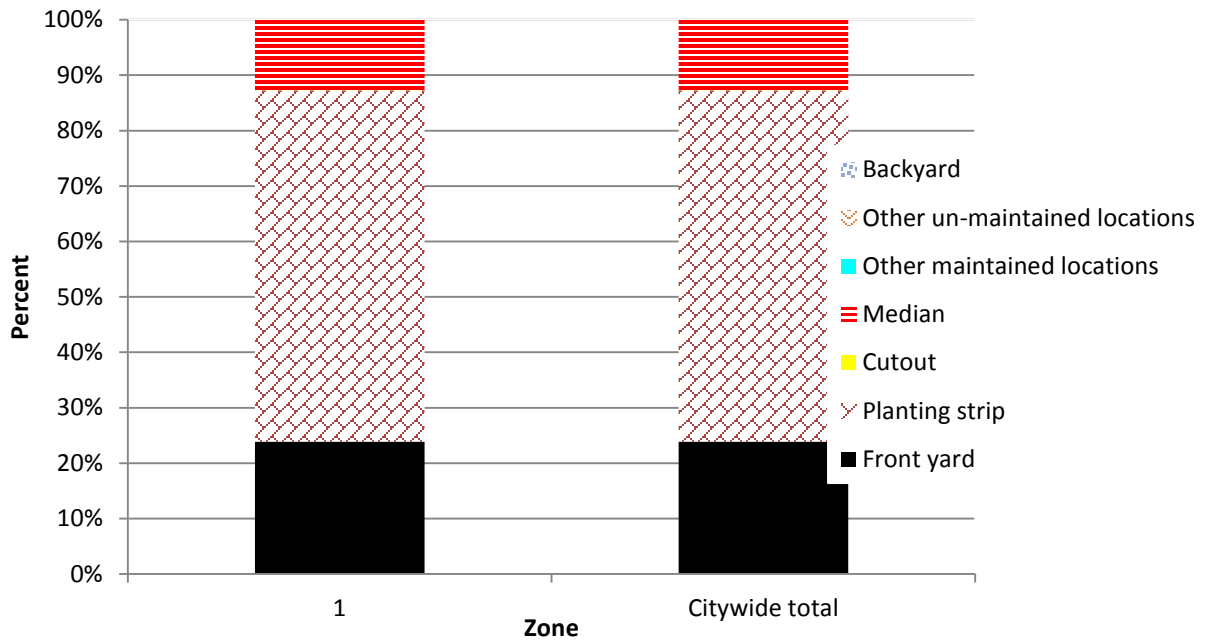


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

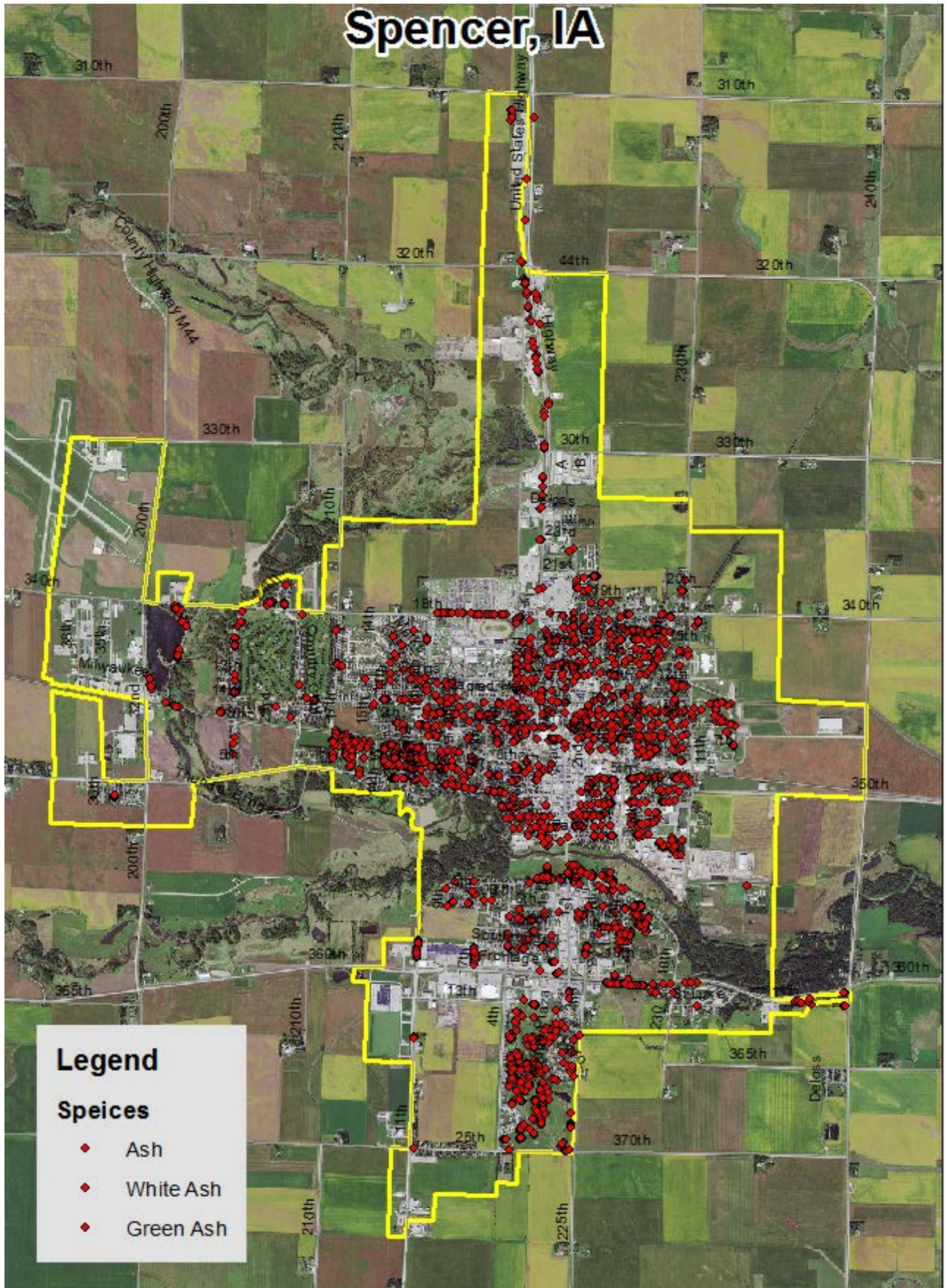


Figure 1: Location of Ash Trees

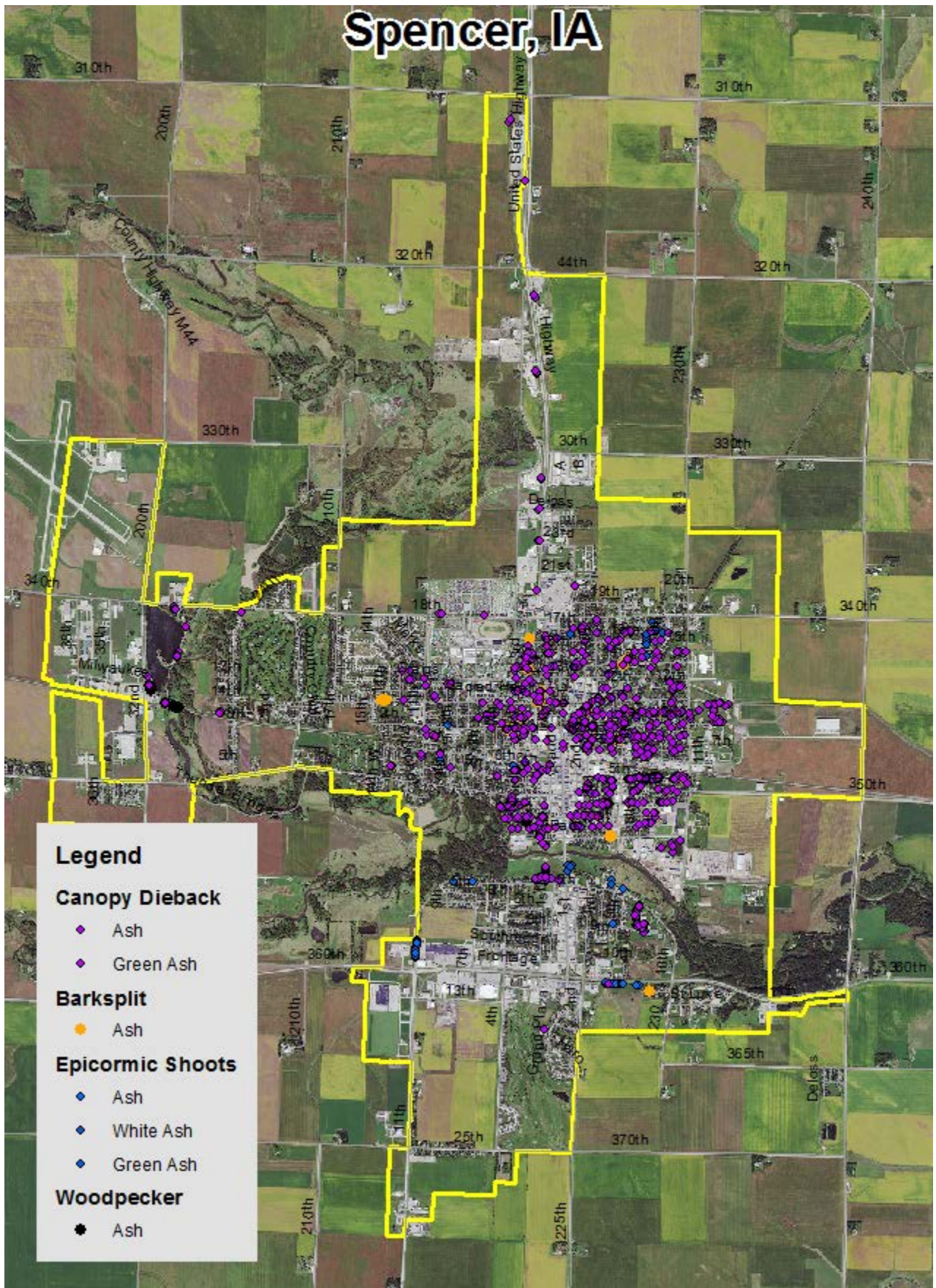


Figure 2: Location of EAB symptoms

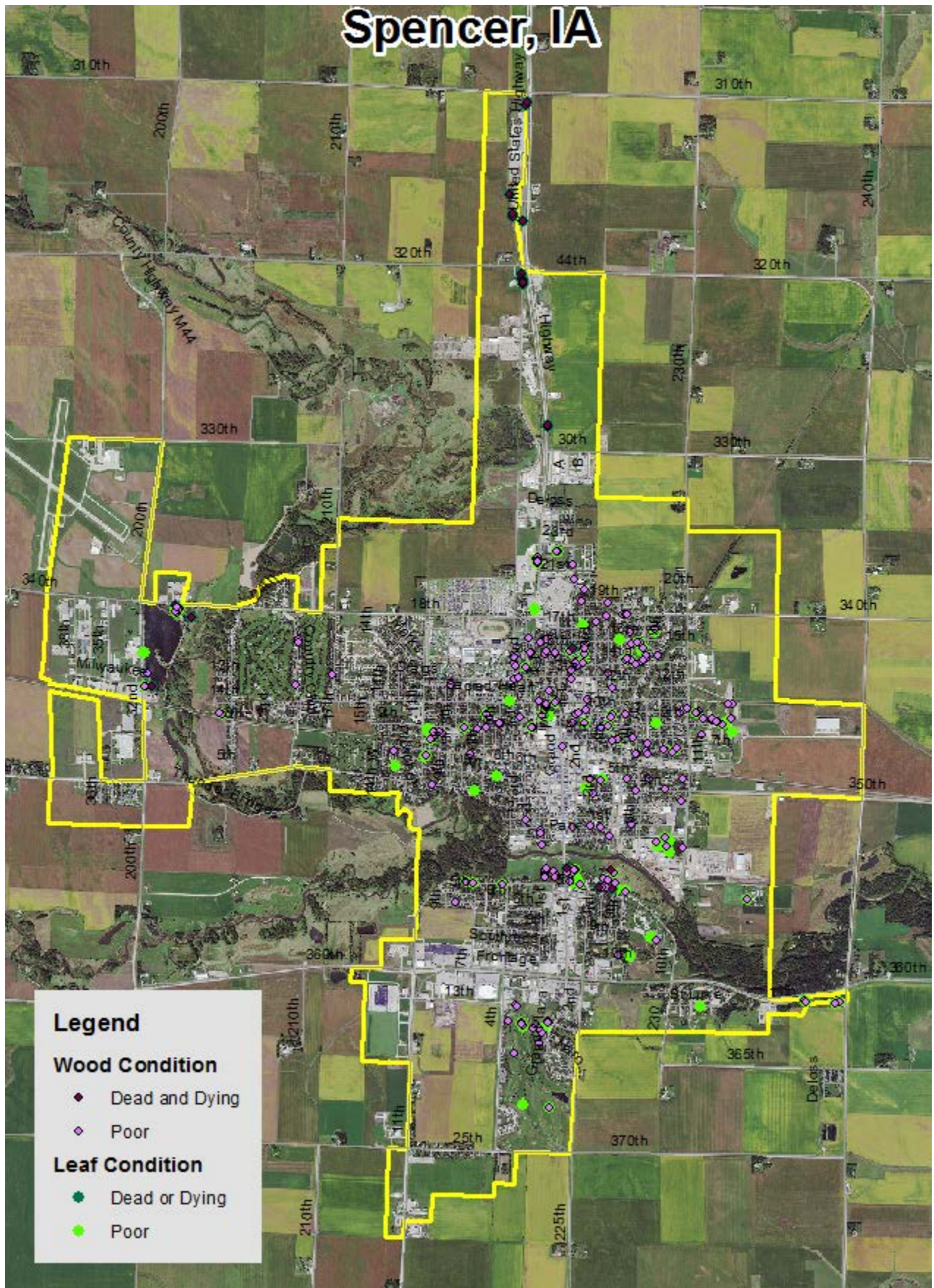


Figure 3: Location of Poor Condition Trees

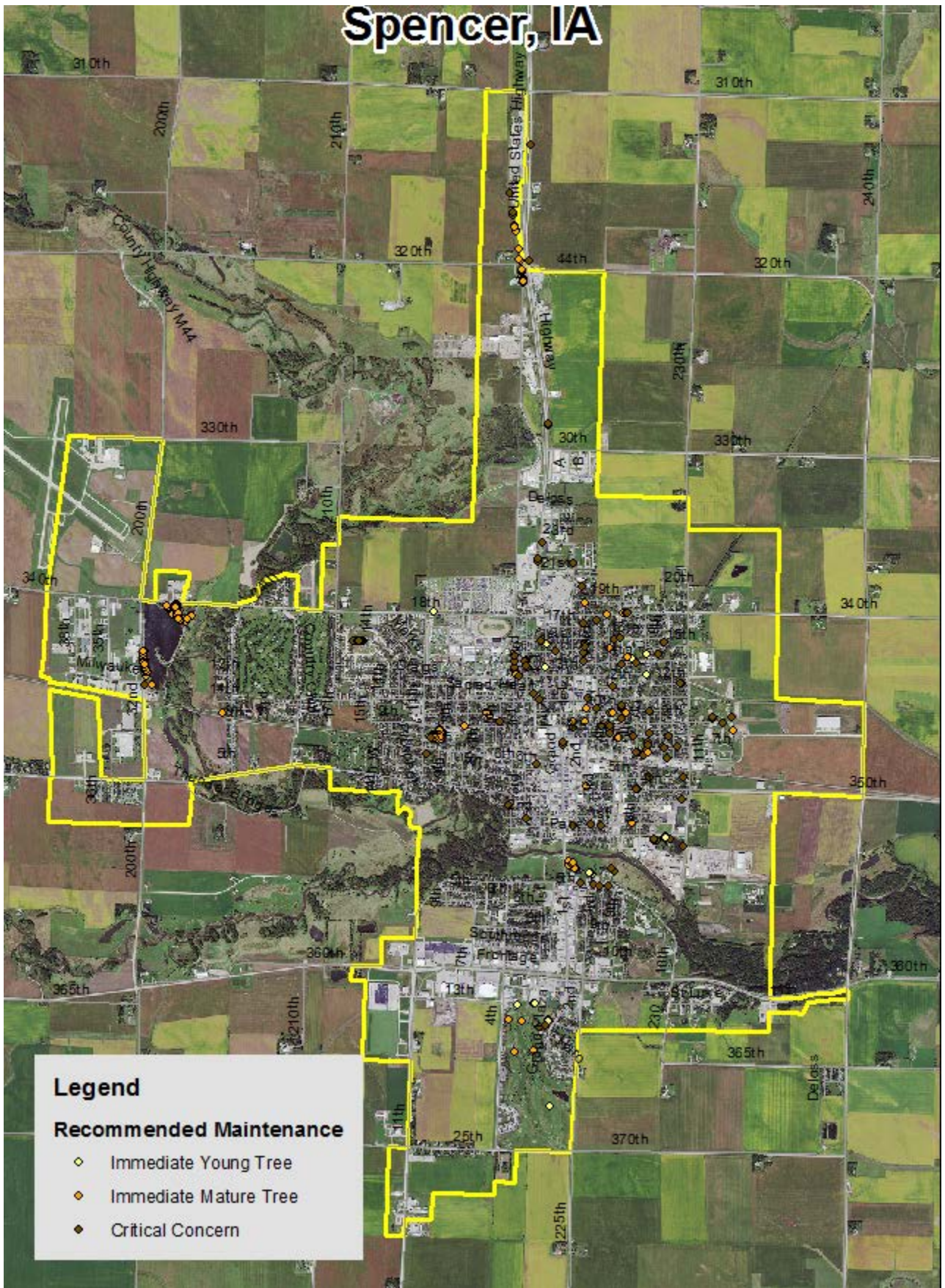


Figure 4: Location of Trees with Recommended Maintenance

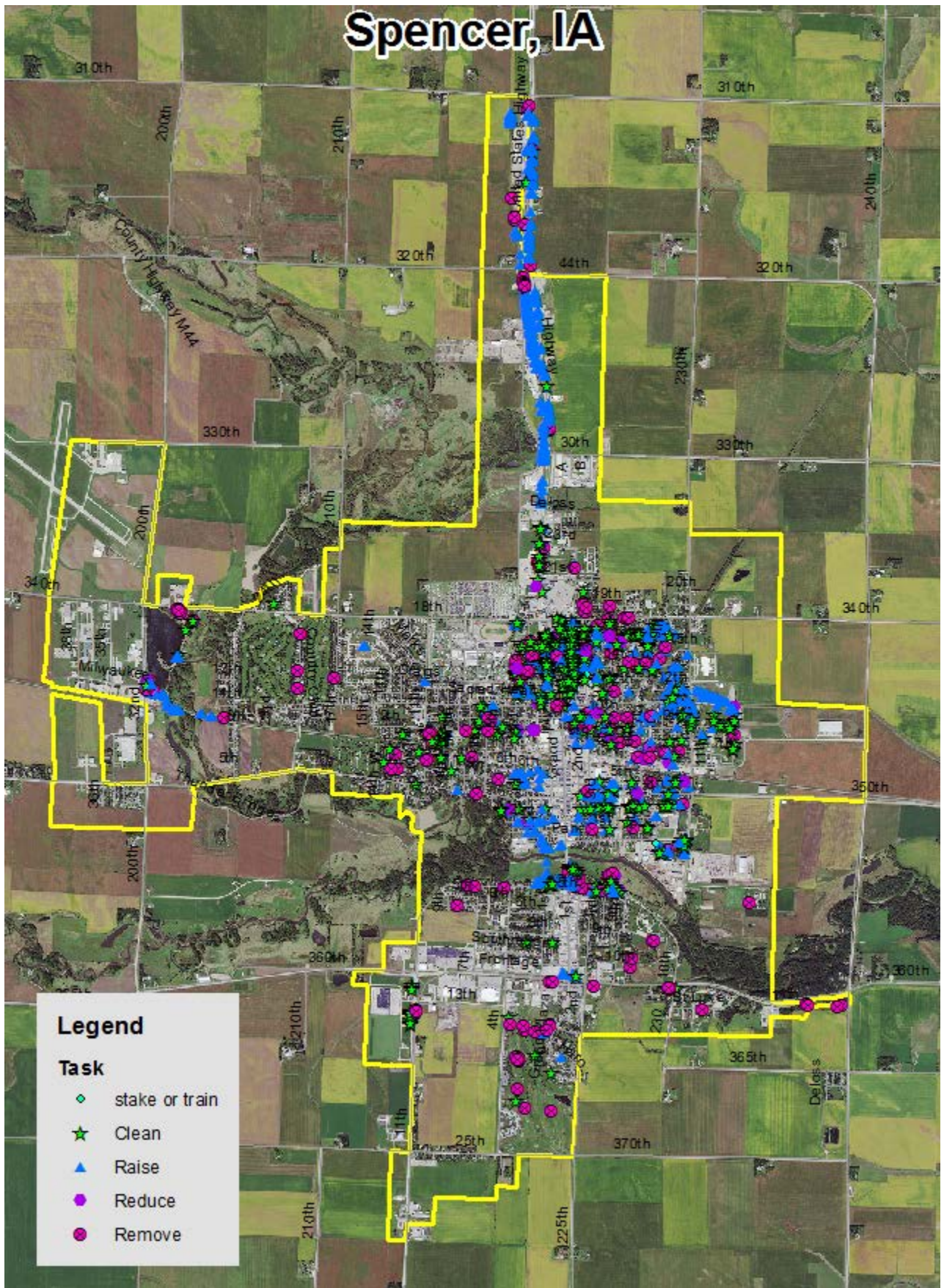


Figure 5: Maintenance Tasks **City ownership of the trees recommended for removal should be verified prior to any removal**

Chapter 5 TREES AND SHRUBS¹

5-5-1: SHORT TITLE:

This chapter shall be known and may be cited as the *TREE ORDINANCE OF THE CITY OF SPENCER, IOWA*. (Ord. 652, 4-2-2007)

5-5-2: DEFINITIONS:

For the purpose of this chapter, the following terms, phrases, words and their derivations shall have the meaning given in this section:

ABUTTING PROPERTY: Real property that has a common boundary with a city street or other public property. That portion of "right of way green space" for which the abutting property owner is responsible or may apply for a license to plant and maintain a tree is that portion of the right of way green space bounded by extensions of the property boundaries of the abutting private property to the curb line or traveled portion of the street.

CITY: The city of Spencer, Iowa.

DIRECTOR: The city of Spencer parks and recreation director, the parks superintendent, or their designees.

PERSON: Any person, firm, partnership, association, corporation, company or organization of any kind.

PLANTING STANDARDS: The standards promulgated by the director governing the planting, preservation, fertilization and care of trees planted on city property.

PROPERTY OWNER: The contract purchaser, if there is one of record; otherwise, the record holder of legal title.

PRUNING STANDARDS: The standards promulgated by the director governing the pruning, trimming and cutting of trees and shrubs located on city property.

RIGHT OF WAY GREEN SPACE: The property between a property owner's lot or property line and curb or the traveled portion of the public street and all other nontraveled portions of a public street right of way.

\$HRUB: A woody plant grown for decorative screening or enclosure purposes not exceeding a height of six feet (6') above ground level. The definitions of a "shrub" and a "bush" shall be the

same and are interchangeable.

STREET: The entire right of way, from property line to property line, of all public traveled ways, streets and alleys.

TREE: A woody growth with an expected height in excess of six feet (6').

UTILITY COMPANY: A public or privately owned electric, natural gas or communications provider legally providing utility services in the city of Spencer. (Ord. 652, 4-2-2007)

5-5=3: PLANTING, TRIMMING, SPRAYING; PERMITS REQUIRED:

- A. No person shall plant, remove, injure, damage or destroy any tree or shrub on any street or city owned property without first making application and procuring a permit from the director. The person receiving the permit shall abide by the applicable standards promulgated by the director.
- B. Commercial tree trimmers licensed by the city, and the owners or persons in control of adjacent property, may trim and prune trees or shrubs on city property without a permit.
- C. If any portion of a tree or a shrub is on a street right of way or other public property, this section shall apply.
- D. Utility companies are exempt from permits to trim or prune trees and shrubs, but are required to obtain a permit to plant or *remove* trees.
- E. No person shall spray or apply any pesticide, herbicide or other noxious spray or powder on any property within the city, whether or not owned by the city, without first making application to and procuring a permit from the director. The previous sentence notwithstanding, the owner or person in control of private property, or a licensed commercial chemical applicator, may apply appropriate chemicals to that private property and to abutting public right of way without a permit. (Ord. 688, 5-18-2009)

This section has been affected by a recently passed ordinance, 791 - TREE TRIMMER'S LICENSE . [Go to new ordinance](#)

5-5-4: TREE REMOVAL:

No person shall remove a tree on any street or city owned property without first making application and procuring a permit from the director. Application for the permit must be filed at least fourteen (14) days prior to the planned date of removal. The applicant shall clearly mark the tree to be removed with flagging ribbon-of other means that is not injurious to-the tree.

Tree removal will not be approved unless good cause is established. "Good cause" shall include: a tree that is so diseased or damaged that removal is necessary; circumstances in which growth of the tree will damage or substantially interfere with public or private improvements; or circumstances where construction on the adjacent lot requires removal for driveway construction.

If tree removal is approved for good cause other than disease or damage or to prevent damage to public or private improvements, the permit shall:

- A. Require the applicant to pay all the costs incurred for removal of the tree, including the stump, to a minimum depth of six inches (6") below the ground surface. The area will be cleaned by hand raking to remove all branches, leaves and debris caused by the removal. The area excavated in order to remove the stump shall be filled with good, clean topsoil and seeded or sodded.
- B. If the value of the removed tree is estimated by the director to be not greater than five hundred dollars (\$500.00), the applicant shall be required to purchase a balled and burlapped replacement tree having a minimum trunk diameter of not less than two inches (2") as measured at the base of the trunk. The species of tree and the time and place of planting shall be selected by the director. The planting of the replacement tree shall be accomplished under the director's supervision.
- C. If the value of the tree to be removed is estimated by the director to exceed five hundred dollars (\$500.00), the applicant shall be required to reimburse the city for the value of the removed tree at a rate set in the schedule of tree values adopted by the director.

If a tree is removed in violation of this section, the responsible party or parties shall be required to comply with the provisions of subsection A of this section and either subsection B or C of this section and shall also be subject to the provisions of section 5-5-14 of this chapter. (Ord. 652, 4-2-2007)

5-5-5: PERMITS; CONTENTS OF APPLICATION:

The applicant shall state the number, location and species of trees or shrubs to be treated, sprayed, preserved, pruned, removed, cut or otherwise disturbed; the kind of treatment to be administered; the composition of the spray material to be applied; and such other information as the director shall find reasonably necessary to a fair determination of whether a permit should be issued. (Ord. 652, 4-2-2007)

5-5-6: PERMITS; STANDARDS OF ISSUANCE:

The director shall issue the permits provided for in section 5-5-3 or 5-5-5 of this chapter if, in his judgment, the proposed work is desirable and the proposed methods are of a satisfactory nature. Any permit granted shall contain a definite date of expiration. Any permit shall be void if its terms are violated. A fee of twenty dollars (\$20.00) shall be imposed for each permit issued under this section, to be paid to the city clerk before issuance of the permit. (Ord. 652, 4-2- 2007)

5-5-7: PLANTING REGULATIONS:

- A. The planting of shrubs on any city right of way green space is prohibited.
- B. 1. Trees may be planted in an area at least three feet by three feet (3' x 3') which is free of underground and overhead utilities.
2. Trees may not be planted closer than ten feet (10') from right of way structures, including fiber vaults; fire hydrants; transformers; secondary, communications, and meter pedestals; any other structures; and underground utilities installed perpendicular to the right of way.
3. Trees shall be planted a minimum of twenty feet (20') from streetlights.
4. Trees shall not be planted closer than twenty five feet (25') from another street tree, unless buffering is required as approved by the city.
5. Trees shall be a minimum of one inch (1") in diameter at six inches (6") above ground level.
6. Trees shall not be planted closer than ten feet (10') from driveways or alleys.
7. Trees shall not be planted in the triangular area defined by the

point of intersection of the traveled portions or curbs of two (2) intersecting streets and points thirty feet (30') in distance measured along the curbs or traveled portions of the intersecting streets.

- C. No persons shall plant the following tree species on any public property: cotton bearing poplar trees, cottonwood, box elder, Siberian elm, Russian olive, silver maple, tree of heaven, mulberry, willow, evergreen or ash varieties. A list of preferable tree species to be planted in the right of way green space is available from the city parks department.
- D. A property owner who desires to plant a tree in adjacent public right of way, in accordance with this section, shall make written application on a street tree permit application form provided by the city and shall submit the street tree permit application with a site plan for the planting location and a twenty dollar (\$20.00) application fee to the city clerk. The applicant shall also place a wooden stake painted white at the proposed planting site.

The public works and park and recreation departments of the city will review the street tree permit application and may approve, modify, or deny. (Ord. 652, 4-2-2007; Ord. 688, 5-18- 2009; Ord. 765, 7-7-2014)

5-5-8: DUTIES OF PROPERTY OWNERS AND CITY TO PRUNE, TRIM AND REMOVE:

- A. Trees Up To Fourteen Feet: In all residentially zoned areas of the city of Spencer, it is the duty of the owner of any property abutting a street upon which there may be trees or shrubs, to prune such trees or shrubs up to a height of fourteen feet (14') such that they will not obstruct or shade the streetlights or obstruct the passage of pedestrians or vehicles on sidewalks or street; or obstruct the vision of traffic signs; or obstruct the view of any street intersection. Overhanging branches shall be at least fourteen feet (14') above the surface of the street and at least ten feet (10') above the surface of the sidewalk or right of way green space.
 - 1. Such owner shall also remove from such trees all dead, decayed or broken limbs or branches up to fourteen feet (14') above the ground that overhang any public highway, street, alley or public place, so that the same cannot fall on the sidewalk, street, alley or other public highway.
 - 2. All abutting property owners shall trim and maintain trees and shrubs located on private property such that no part overhangs any public property at a height below ten feet (10') nor overhangs any street at a height of less than fourteen feet (14').
 - 3. Property owners shall also remove all diseased trees and dead or dying

limbs from trees located on their property, except a forested property of any area of more than two (2) acres where individual tree maintenance is not practical.

- B. Action Compelled: If the abutting property owner fails to trim adjacent trees or shrubs, the city may serve notice on the abutting property owner requiring that such action be taken within thirty (30) 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 owner for collection in the same manner as a property tax.
- C. City's Duties (Above 14 Feet): The city shall be responsible for the pruning, trimming and removal of dead or diseased trees located on public property or streets as to that portion of any tree more than fourteen feet (14') above the ground.
- D. Tree Roots: The city shall also be responsible for the removal or trimming of roots from trees located on public property that have displaced or raised portions of the public sidewalk. The public works department shall notify the parks and recreation director when a permit is requested to repair or construct a public sidewalk. The director will then investigate the circumstances and, if necessary, arrange for roots to be removed in a timely manner.
- E. Highway Right Of Way Exemption: The provisions of this section do not apply to trees in the Highway 71 or Highway 18 right of way. These trees shall be maintained by the city. (Ord. 652, 4-2-2007)

5-5-9: ABUSE OR MUTILATION OF PUBLIC TREES:

- A. Unless specifically authorized by the director, no person shall intentionally damage, cut, carve, transplant or remove any tree or shrub; attach any rope, wire, nails or other contrivance to any tree or shrub; allow any gaseous, liquid or solid substance which is harmful to such trees or shrubs on public property to come in contact with them; or to impede the free entrance of water or air to the roots; or to set fire or to permit any fire to burn when such fire and heat thereof will injure any portion of any tree or shrub on public property.
- 8. No spurs or climbers that injure the bark of a tree on public property shall be used as an aid to climbing such tree, except when such tree is to be removed.
- C. No person shall "top" a tree that is located on a public street or other public property, except as required because of storm or ice damage or for the protection of utility wires. (Ord. 652, 4-2-2007)

5-5-10 : PERVASIVE DISEASE:

In accordance with state law, any owner, occupant or person in charge of any property shall remove, at his own expense, any tree, brush, wood or debris infected with pervasive disease found thereon when so notified by the director. Such owner, occupant or person shall be given written notice by the director to remove said trees, brush, wood or debris within thirty (30) days from the date of such written notice.

If such owner, occupant or person fails to comply with said notice within thirty (30) days of receipt thereof, the city council may cause the same to be removed and the cost assessed against the property in the following manner:

- A. The city council shall direct its agents or employees to remove same and to keep an accurate account of the expense incurred. The expense account shall be fully itemized, verified and filed with the city clerk. Such expenses shall be paid by the city.
- B. The city clerk shall mail a statement of said total cost to such owner, occupant or person failing to comply with said notice by certified mail, without return receipt, addressed to the last known address of same, and if the amount shown by the statement has not been paid within one month, the city clerk shall certify such cost to the county auditor, and it shall then be collected with and in the same manner as general taxes. (Ord. 652, 4-2-2007)

5-5-11 RIGHT TO INSPECT TREES:

The agents or employees of the city shall have access at reasonable times to all trees, brush, wood or debris for the purpose of inspecting or examining the same and carrying into effect the provisions of this chapter. (Ord. 652, 4-2-2007)

5-5-12: OBSTRUCTION OF ENFORCEMENT:

It shall be unlawful for any person to hinder, obstruct or otherwise interfere with the agents or employees of the city while they are engaged in carrying out the provisions of this chapter. (Ord. 652, 4-2-2007)

This section has been affected by a recently passed ordinance, 791 - TREE TRIMMER'S LICENSE . Go to new ordinance.

5-5-13 : COMMERCIAL TREE TRIMMER'S LICENSE:

No persons shall engage in the practice of tree trimming or removal for compensation in the city of Spencer unless licensed pursuant to this section. A license will be issued by the city clerk upon submission of a written application on forms obtained from the clerk, which application must be approved by the parks and recreation director, and upon fulfilling the fee, bonding and insurance requirements as specified herein. The licensing period shall be from February 1 to January 31. A commercial tree trimmer's license may be applied for and issued to a business entity and, when so issued, shall cover all employees of the entity. Utility companies shall be exempt from the requirements of this section.

- A. Fee: The license fee for a tree trimmer's license for the licensing period, or any part thereof, shall be fifty dollars (\$50.00).
- B. Surety Bond: A surety bond in the amount of two thousand dollars (\$2,000.00) must be filed in favor of the city. Such bond must run throughout the licensing period and shall be conditioned upon the faithful performance of all obligations required by ordinance, rules or regulations of the city.
- C. Insurance: Any person licensed as a commercial tree trimmer must file proof of liability insurance in the amount of one million dollars (\$1,000,000.00) per occurrence and two million dollars (\$2,000,000.00) aggregate liability with the city clerk. The certificate must state that there is no exclusion for tree trimming, pruning and removal. The licensee must agree, in writing, on forms provided by the clerk to hold the city harmless from any and all damages claimed by reason of negligence, incompetence or omission on the part of such person in the performance of their work.
- D. Training And Experience: The application shall include a statement of the applicant's training and experience in the field of arboriculture sufficient to establish, to the satisfaction of the parks and recreation director, that the applicant has sufficient training and experience to warrant the issuance of the license. The application shall include a certification that the applicant has received not less than three (3) hours of arboriculture continuing education in the previous twelve (12) months.
- E. Notice Of Violations: Whenever it appears to the director that any licensee has created or maintained any condition that is dangerous, unsafe, unsanitary or a menace to life, health or property, or has done business without proper license or permit, the director may mail or personally deliver an order, in writing, to the licensee directing the licensee to correct the defect or omission within twenty (20) days from the receipt of the notice. Noncompliance may result in revocation of a commercial tree trimmer's license.
- F. Cleanup: Each licensee shall promptly clean up the work site and dispose of all tree trunks, limbs, branches, twigs or brush. (Ord. 652, 4-2-2007; Ord. 688, 5-18-2009; Ord. 765, 7-7- 2014)

5-5-14: PENALTY; MUNICIPAL INFRACTION:

A violation of any provision of this chapter shall constitute a simple misdemeanor and shall be punished as provided in section 1-4-1 of this code. A violation of the provisions of this chapter may also result in the commencement of a municipal infraction proceeding by the city against the violator pursuant to title 1. chapter 4. article A of this code. (Ord. 652, 4-2-2007)

5-5-15: ADMINISTRATIVE APPEAL:

Any property owner or applicant for a permit pursuant to the provisions of this chapter who is aggrieved by the decision of the director may appeal the decision to the Spencer city council. An appeal shall be filed in writing and must be actually received by the city not later than thirty (30) days after the action or decision appealed.

The appeal shall be heard by the council in an informal proceeding. The appellant shall be provided reasonable opportunity to submit written and oral support for the appellant's position. The council shall issue a written decision within thirty (30) days of the hearing on the appeal.

Failure to properly exhaust the administrative remedy provided in this section shall constitute a bar to judicial relief. (Ord. 652, 4-2-2007)

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.