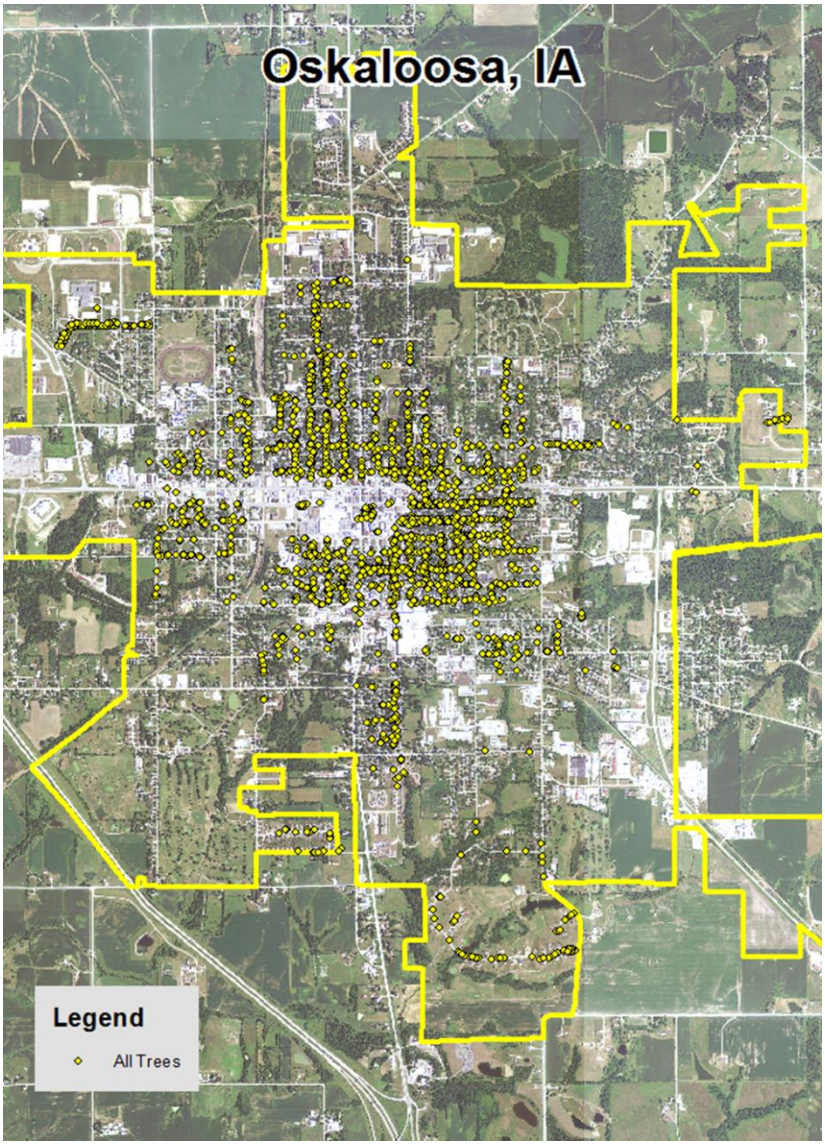
Urban Forest Management Plan



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Executive Summary

Overview

This plan was developed to assist the City of Oskaloosa 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). It is likely that 10% of Oskaloosa's city owned trees (ash) will die because EAB is 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 2015, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street trees. Below are some key findings of the 2,211 trees inventoried.

- Oskaloosa's trees provide $418,397 of benefits annually, an average of $189 a tree
- There are over 56 species of trees
- The top three genera are: Maple 46%, Ash 10%, and Oak 14%
- 29% of trees are in need of some type of management
- 292 trees are recommended for removal; 263 are ash and 29 are other species
- 1,569 trees have satisfactory health and do not need any management at this time

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 292 trees needing removal, 82 trees are over 24 inches in diameter at 4.5 feet and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 54 of the 221 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, Siberian elm (often called Chinese), evergreens, willow or black walnut
- Check ash trees with a visual survey semi-annually
- To remove and replace *only* ash trees will cost $210,400. If the budget were increased to $35,067 a year all ash could be removed within 6 years. Suggestion: request a budget increase and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Oskaloosa 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 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 Oskaloosa, these costs can be extended over a few years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Oskaloosa'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 Oskaloosa 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 Oskaloosa's urban forestry goals.

Inventory

In 2015, a tree inventory was conducted that included 100% of the city owned street trees. 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 feet, 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 2,211 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.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Oskaloosa's trees reduce energy related costs by approximately $112,167 annually (Appendix A, Table 1). These savings are both in Electricity (534.5 MWh) and in Natural Gas (73,058.1 Therms).

Annual Stormwater Benefits

Oskaloosa's trees intercept about 5,918,886 gallons of rainfall or snowmelt a year (Appendix A, Table 2). This interception provides $160,402 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 Oskaloosa, it is estimated that trees remove 6,923 lbs.. of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $19,430 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Oskaloosa, trees store about 23,719,437 lbs. of carbon a year with an associated value of $177,896 (Appendix A, Table 4). In addition, the trees sequester 1,230,004 lbs. of carbon, with a yearly benefit of $9,225 (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. Oskaloosa receives $117,173 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, Oskaloosa's trees provide $418,397 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 2,211 trees in Oskaloosa provide approximately $189 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Oskaloosa has over 56 different tree species along city streets (Appendix A, Figure 1). The distribution of trees by the top ten *species* is as follows:

Species	Percent
Silver maple	18.82
Norway maple	12.94
Sugar maple	10.40
Ash	10.00
Northern red oak	5.56
Pin oak	4.25
Red maple	3.84
Apple	3.66
Pear	3.48
Swamp white oak	2.85
Other species	24.20
Total	100.00

Age Class

Oskaloosa has respectable age distribution (54%) of trees between 6 and 24 inches in diameter at 4.5 feet (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. Only 10 % of Oskaloosa's trees are less than 6 inches diameter which indicates the need for new tree planting to establish a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf (foliage) condition are good indicators of the overall health of the urban forest. The foliage condition results for Oskaloosa indicate that 66% of the trees are in good health, with 11% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 32% of Oskaloosa'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 21% of the population.

Management Needs

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

None	1,569	71%
Tree Removal	292	13%
Crown Cleaning	203	9%

Crown Raising	144	7%
Tree Staking	3	<1%
Treat pest/disease	0	
Crown Reduction	0	

Canopy Cover

The total canopy with both private and public trees is 21 %, 1,011 acres. The canopy cover included in the Oskaloosa inventory includes approximately 62 acres (Appendix A, Figure 4). The City's Canopy goal, at the bare minimum, should be to restore and maintain the current canopy throughout and after the destruction from EAB. To achieve this goal it is estimated that 350 trees need to be planted just to make up for needed removals. The actual number is higher due to natural mortality throughout your urban forest.
The following examples show how much tree planting would be needed to increase your canopy cover:
116 annually to increase 1%
348 annually to increase 3%
695 annually to increase 6%

Land Use and Location

The majority of Oskaloosa's city 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 trees.

Land Use	
Single family residential	96%
Park/vacant/other	2%
Industrial/Large commercial	1%
Small commercial	<1%
Multifamily residential	<1%

Location	
Planting strip	92%
Front yard	8%
Other maintained locations	0%
Cutout (surrounded by pavement)	<1%

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

Oskaloosa has 56 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) or identified on the inventory spreadsheets. It is recommended to start with the large diameter critical concern trees first. There are 29 trees over 24 inches in diameter at 4.5 feet 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 350 trees with these needs.

Poor tree species

After the removal of the 56 critical concern trees, the remaining 263 trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). *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 Oskaloosa.

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. oak) not make up more than 20% of the urban forest and a single species (i.e. white oak, bur oak, swamp white, pin oak, red oak) not make up more than 10% of the total urban forest. Presently, the forest is heavily planted with maple (46%) (Appendix A, Figure 1). Maples must not be planted for at least 10 years until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other trees to avoid because they are public nuisances include: cottonwood, poplar, box elder, Siberian elm (often called Chinese elm), evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance 12.40.40 b (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

Year 1

- Removal: 29 largest critical concern trees and 20 additional trees with poor health
- Planting and Replacement: 59 trees to be planted in open locations
- Young Tree Pruning & Maintenance
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 49 trees with poor health & removal of any new critical concern trees
- Planting and Replacement: 59 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: 49 trees with poor health & removal of any new critical concern trees
- Planting and Replacement: 59 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: 49 trees with poor health & removal of any new critical concern trees
- Planting and Replacement: 59 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: 49 trees with poor health & removal of any new critical concern trees
- Planting and Replacement: 59 trees in open locations from previous removals
- Young Tree Pruning & Maintenance
- Visual Survey for signs and symptoms of EAB

Year 6

- Removal: 49 trees with poor health & removal of any new critical concern trees
- Planting and Replacement: 59 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

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. 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 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 quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 12.40.40 b (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.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. Homeowners may refer to the following resources:
www.iowatreeplanting.com

http://www.iowadnr.gov/Portals/idnr/uploads/forestry/urban/RethinkingMaple.pdf

http://www.iowadnr.gov/Portals/idnr/uploads/forestry/Forest%20Health/species%20list%20(links).pdf

Budget

Estimated Budget

Total $313,600 over 6 years ($52,267/year)

FY 2017 Budget
- Removals: $34,300
- Plantings: $5,900
- Watering & Maintenance: $500

FY 2018 Budget
- Removals: $34,300
- Planting: $5,900
- Routine trimming: $23,133
- Watering & Maintenance: $500

FY 2019 Budget
- Removals: $34,300
- Planting: $5,900
- Watering & Maintenance: $500

FY 2020 Budget
- Removals: $34,300
- Planting: $5,900
- Routine trimming: $23,133
- Watering & Maintenance: $500

FY 2021 Budget
- Removals: $34,300
- Planting: $5,900
- Watering & Maintenance: $500

FY 2022 Budget
- Removals: $34,300
- Planting: $5,900
- Routine trimming: $23,133
- Watering & Maintenance: $500

Purposed Budget Increase

EAB will likely kill all ash trees in Oskaloosa within 4 years of its arrival. To remove and replace *only* ash trees will cost $210,400. If the budget were increased to $35,067 a year all ash could be removed within 6 years. Additionally, it is recommended that Oskaloosa 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 being considered by many communities is treating a number of 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 removed 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, every other year treatments would cost $300 per tree. If you treat 10 trees ($3,000 cost) that would leave $31,300 for removals. This is an alternative 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Oskaloosa

Annual Energy Benefits of Public Trees

3/3/2016

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	136.2	10,340	17,975.3	17,616	27,955	(N/A)	18.8	24.9	67.20
Norway maple	70.2	5,329	10,147.3	9,944	15,273	(N/A)	12.9	13.6	53.40
Sugar maple	57.2	4,343	7,656.2	7,503	11,847	(N/A)	10.4	10.6	51.51
Ash	48.6	3,688	7,038.2	6,897	10,586	(N/A)	10.0	9.4	47.90
Northern red oak	20.7	1,574	2,778.1	2,723	4,297	(N/A)	5.6	3.8	34.93
Pin oak	34.0	2,584	4,524.0	4,434	7,017	(N/A)	4.3	6.3	74.65
Red maple	13.8	1,048	1,851.1	1,814	2,862	(N/A)	3.8	2.6	33.67
Apple	5.6	422	869.2	852	1,274	(N/A)	3.7	1.1	15.72
Pear	8.7	660	1,285.3	1,260	1,919	(N/A)	3.5	1.7	24.93
Swamp white oak	9.8	741	1,379.2	1,352	2,093	(N/A)	2.8	1.9	33.22
Siberian elm	19.7	1,494	2,602.4	2,550	4,044	(N/A)	2.5	3.6	73.53
Littleleaf linden	7.4	563	974.1	955	1,517	(N/A)	2.3	1.4	29.75
Northern hackberry	13.8	1,044	1,909.0	1,871	2,915	(N/A)	1.8	2.6	74.74
American sycamore	13.1	994	1,766.8	1,731	2,726	(N/A)	1.5	2.4	82.60
Honeylocust	9.5	719	1,246.7	1,222	1,941	(N/A)	1.3	1.7	66.92
Tulip tree	6.2	473	835.4	819	1,291	(N/A)	1.0	1.2	56.15
Ginkgo	2.7	203	342.0	335	538	(N/A)	1.0	0.5	23.38
Black walnut	6.4	488	873.8	856	1,344	(N/A)	1.0	1.2	61.10
Bur oak	3.7	278	485.7	476	754	(N/A)	0.9	0.7	37.69
Eastern redbud	1.8	140	284.2	278	418	(N/A)	0.9	0.4	20.91
Broadleaf Deciduous Mediu	2.6	200	394.4	386	586	(N/A)	0.9	0.5	30.87
American basswood	4.3	326	625.4	613	939	(N/A)	0.8	0.8	52.18
Southern magnolia	2.9	217	353.9	347	563	(N/A)	0.8	0.5	33.14
Basswood	3.8	292	523.8	513	805	(N/A)	0.7	0.7	50.34
Catalpa	5.3	399	714.3	700	1,099	(N/A)	0.7	1.0	73.28
Blue spruce	0.9	70	135.8	133	203	(N/A)	0.6	0.2	15.62
American elm	4.0	307	522.4	512	819	(N/A)	0.5	0.7	81.90
Broadleaf Deciduous Large	2.5	192	331.0	324	516	(N/A)	0.3	0.5	73.73
Northern pin oak	2.2	171	331.9	325	496	(N/A)	0.3	0.4	70.84
Cottonwood	2.6	197	356.7	350	547	(N/A)	0.3	0.5	78.12
Eastern red cedar	0.6	45	89.5	88	133	(N/A)	0.3	0.1	18.96
Boxelder	1.3	97	171.0	168	264	(N/A)	0.3	0.2	44.05
Broadleaf Deciduous Small	0.2	16	37.1	36	53	(N/A)	0.2	0.0	10.52
Scotch pine	0.6	49	73.2	72	121	(N/A)	0.2	0.1	24.14
Ohio buckeye	1.5	113	221.4	217	330	(N/A)	0.2	0.3	65.98
Sweetgum	0.8	62	108.6	106	168	(N/A)	0.2	0.1	33.64
Mulberry	0.8	59	119.5	117	177	(N/A)	0.2	0.2	44.14
Spruce	0.4	29	53.3	52	82	(N/A)	0.2	0.1	20.44
Dogwood	0.1	9	21.0	21	30	(N/A)	0.2	0.0	7.47
Birch	0.8	57	112.5	110	167	(N/A)	0.2	0.1	41.81
Eastern white pine	0.6	44	78.4	77	120	(N/A)	0.2	0.1	30.10
Oak	0.7	54	81.4	80	133	(N/A)	0.2	0.1	33.33
Chinese elm	1.5	112	204.4	200	312	(N/A)	0.2	0.3	78.10
Kentucky coffeetree	0.7	56	92.1	90	146	(N/A)	0.1	0.1	48.59
Elm	0.5	36	54.4	53	89	(N/A)	0.1	0.1	29.70
White oak	0.6	43	67.7	66	109	(N/A)	0.1	0.1	36.36
Cherry plum	0.0	1	1.9	2	3	(N/A)	0.1	0.0	0.87
Maple	0.4	30	56.4	55	85	(N/A)	0.1	0.1	42.63
Black locust	0.6	42	76.9	75	118	(N/A)	0.1	0.1	58.81
Plum	0.0	1	1.2	1	2	(N/A)	0.1	0.0	0.87
Amur maple	0.3	21	44.5	44	64	(N/A)	0.1	0.1	32.17
Scarlet oak	0.3	20	30.7	30	50	(N/A)	0.1	0.0	25.02
Broadleaf Evergreen Large	0.1	7	14.0	14	21	(N/A)	0.0	0.0	20.59
Northern catalpa	0.5	37	63.1	62	99	(N/A)	0.0	0.1	98.63
Paper birch	0.0	2	3.7	4	6	(N/A)	0.0	0.0	5.82
Willow	0.0	3	6.2	6	9	(N/A)	0.0	0.0	8.99
Broadleaf Evergreen Small	0.0	1	1.5	1	2	(N/A)	0.0	0.0	2.12
Conifer Evergreen Large	0.1	11	19.7	19	30	(N/A)	0.0	0.0	30.47
Amur corktree	0.2	18	29.5	29	47	(N/A)	0.0	0.0	46.78
Norway spruce	0.1	4	9.5	9	14	(N/A)	0.0	0.0	13.58
Total	534.5	40,570	73,058.1	71,597	112,167	(N/A)	100.0	100.0	50.73

Table 2: Annual Stormwater Benefits

Oskaloosa

Annual Stormwater Benefits of Public Trees

3/3/2016

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,955,219	52,986	(N/A)	18.8	33.0	127.37
Norway maple	646,521	17,521	(N/A)	12.9	10.9	61.26
Sugar maple	624,689	16,929	(N/A)	10.4	10.6	73.60
Ash	432,773	11,728	(N/A)	10.0	7.3	53.07
Northern red oak	169,967	4,606	(N/A)	5.6	2.9	37.45
Pin oak	425,950	11,543	(N/A)	4.3	7.2	122.80
Red maple	105,198	2,851	(N/A)	3.8	1.8	33.54
Apple	19,710	534	(N/A)	3.7	0.3	6.59
Pear	33,068	896	(N/A)	3.5	0.6	11.64
Swamp white oak	62,263	1,687	(N/A)	2.8	1.1	26.78
Siberian elm	226,403	6,136	(N/A)	2.5	3.8	111.56
Littleleaf linden	55,443	1,502	(N/A)	2.3	0.9	29.46
Northern hackberry	145,790	3,951	(N/A)	1.8	2.5	101.31
American sycamore	189,920	5,147	(N/A)	1.5	3.2	155.96
Honeylocust	109,771	2,975	(N/A)	1.3	1.9	102.58
Tulip tree	70,512	1,911	(N/A)	1.0	1.2	83.08
Ginkgo	15,576	422	(N/A)	1.0	0.3	18.35
Black walnut	71,835	1,947	(N/A)	1.0	1.2	88.49
Bur oak	31,399	851	(N/A)	0.9	0.5	42.55
Eastern redbud	7,481	203	(N/A)	0.9	0.1	10.14
Broadleaf Deciduous Medium	20,744	562	(N/A)	0.9	0.4	29.59
American basswood	54,829	1,486	(N/A)	0.8	0.9	82.55
Southern magnolia	29,208	792	(N/A)	0.8	0.5	46.56
Basswood	51,759	1,403	(N/A)	0.7	0.9	87.67
Catalpa	74,514	2,019	(N/A)	0.7	1.3	134.62
Blue spruce	11,458	311	(N/A)	0.6	0.2	23.89
American elm	36,460	988	(N/A)	0.5	0.6	98.81
Broadleaf Deciduous Large	32,729	887	(N/A)	0.3	0.6	126.71
Northern pin oak	26,350	714	(N/A)	0.3	0.4	102.01
Cottonwood	34,583	937	(N/A)	0.3	0.6	133.89
Eastern red cedar	8,516	231	(N/A)	0.3	0.1	32.97
Boxelder	11,845	321	(N/A)	0.3	0.2	53.50
Broadleaf Deciduous Small	735	20	(N/A)	0.2	0.0	3.98
Scotch pine	7,693	208	(N/A)	0.2	0.1	41.70
Ohio buckeye	16,252	440	(N/A)	0.2	0.3	88.08
Sweetgum	8,190	222	(N/A)	0.2	0.1	44.39
Mulberry	4,189	114	(N/A)	0.2	0.1	28.38
Spruce	5,699	154	(N/A)	0.2	0.1	38.61
Dogwood	409	11	(N/A)	0.2	0.0	2.77
Birch	8,127	220	(N/A)	0.2	0.1	55.06
Eastern white pine	12,774	346	(N/A)	0.2	0.2	86.54
Oak	4,415	120	(N/A)	0.2	0.1	29.91
Chinese elm	20,811	564	(N/A)	0.2	0.4	140.99
Kentucky coffeetree	5,522	150	(N/A)	0.1	0.1	49.88
Elm	2,949	80	(N/A)	0.1	0.0	26.64
White oak	3,539	96	(N/A)	0.1	0.1	31.97
Cherry plum	22	1	(N/A)	0.1	0.0	0.20
Maple	3,492	95	(N/A)	0.1	0.1	47.32
Black locust	5,173	140	(N/A)	0.1	0.1	70.10
Plum	15	0	(N/A)	0.1	0.0	0.20
Amur maple	1,439	39	(N/A)	0.1	0.0	19.49
Scarlet oak	1,637	44	(N/A)	0.1	0.0	22.18
Broadleaf Evergreen Large	750	20	(N/A)	0.0	0.0	20.32
Northern catalpa	7,239	196	(N/A)	0.0	0.1	196.17
Paper birch	172	5	(N/A)	0.0	0.0	4.65
Willow	163	4	(N/A)	0.0	0.0	4.41
Broadleaf Evergreen Small	24	1	(N/A)	0.0	0.0	0.64
Conifer Evergreen Large	2,969	80	(N/A)	0.0	0.1	80.46
Amur corktree	1,409	38	(N/A)	0.0	0.0	38.19
Norway spruce	596	16	(N/A)	0.0	0.0	16.14
Citywide total	5,918,886	160,402	(N/A)	100.0	100.0	72.55

Table 3: Annual Air Quality Benefits

Oskaloosa

Annual Air Quality Benefits of Public Trees

3/3/2016

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							
Silver maple	342.0	58.0	167.7	15.2	1,843	642.7	94.1	89.8	616.3	4,020	-180.7	-677	1,845.0	5,186 (N/A)	18.8	12.47
Norway maple	130.3	22.5	64.2	5.8	705	340.6	49.2	46.8	318.5	2,109	-30.7	-115	947.4	2,699 (N/A)	12.9	9.44
Sugar maple	86.1	14.7	42.8	3.8	466	271.3	39.6	37.8	259.2	1,694	-67.8	-254	687.5	1,906 (N/A)	10.4	8.29
Ash	85.4	14.7	42.5	3.8	463	235.9	34.1	32.4	220.5	1,460	-20.3	-76	649.0	1,847 (N/A)	10.0	8.36
Northern red oak	33.2	5.7	16.6	1.5	180	98.3	14.4	13.7	94.0	614	-47.0	-176	230.4	618 (N/A)	5.6	5.03
Pin oak	80.6	14.1	40.5	3.6	439	161.1	23.6	22.5	154.2	1,007	-147.8	-554	352.4	892 (N/A)	4.3	9.48
Red maple	23.2	3.9	11.1	1.0	124	65.5	9.6	9.1	62.5	409	-8.0	-30	177.8	503 (N/A)	3.8	5.91
Apple	4.4	0.7	2.3	0.2	24	27.5	3.9	3.7	25.2	169	0.0	0	68.0	193 (N/A)	3.7	2.38
Pear	9.2	1.5	4.5	0.4	50	42.4	6.1	5.8	39.4	262	0.0	0	109.3	311 (N/A)	3.5	4.04
Swamp white oak	9.2	1.6	5.0	0.4	51	47.1	6.8	6.5	44.3	292	-2.5	-9	118.5	334 (N/A)	2.8	5.30
Siberian elm	41.7	7.1	19.9	1.8	223	93.1	13.6	13.0	89.1	582	0.0	0	279.4	805 (N/A)	2.5	14.64
Littleleaf linden	7.8	1.4	4.1	0.3	43	35.1	5.1	4.9	33.7	220	-4.1	-15	88.4	247 (N/A)	2.3	4.85
Northern hackberry	27.2	4.7	13.4	1.2	147	66.0	9.6	9.1	62.4	411	0.0	0	193.7	558 (N/A)	1.8	14.30
American sycamore	31.7	5.1	14.1	1.4	166	62.3	9.1	8.7	59.4	389	0.0	0	191.7	554 (N/A)	1.5	16.80
Honeylocust	21.6	3.6	9.8	1.0	114	44.7	6.5	6.2	42.9	279	-16.9	-63	119.4	330 (N/A)	1.3	11.38
Tulip tree	10.4	1.7	4.8	0.5	55	29.6	4.3	4.1	28.2	185	0.0	0	83.6	240 (N/A)	1.0	10.42
Ginkgo	3.7	0.6	1.8	0.2	20	12.5	1.8	1.8	12.1	78	-1.2	-4	33.3	94 (N/A)	1.0	4.08
Black walnut	9.4	1.5	4.5	0.4	50	30.6	4.5	4.3	29.1	191	0.0	0	84.3	241 (N/A)	1.0	10.96
Bur oak	3.0	0.5	1.6	0.1	17	17.3	2.5	2.4	16.6	108	0.0	0	44.1	125 (N/A)	0.9	6.25
Eastern redbud	2.1	0.3	1.0	0.1	11	9.1	1.3	1.2	8.3	56	0.0	0	23.5	67 (N/A)	0.9	3.35
Broadleaf Deciduous Medium	3.7	0.6	1.9	0.2	20	12.9	1.9	1.8	12.0	80	-0.9	-3	33.9	96 (N/A)	0.9	5.06
American basswood	8.1	1.4	3.9	0.4	43	20.9	3.0	2.9	19.5	129	-6.7	-25	53.3	148 (N/A)	0.8	8.20
Southern magnolia	3.6	0.7	3.5	0.4	25	13.2	1.9	1.9	12.8	83	-8.1	-30	30.0	78 (N/A)	0.8	4.59
Basswood	9.2	1.5	4.1	0.4	48	18.3	2.7	2.5	17.4	114	0.0	0	56.2	163 (N/A)	0.7	10.16
Catalpa	12.8	2.0	5.7	0.6	67	25.1	3.7	3.5	23.8	156	0.0	0	77.1	223 (N/A)	0.7	14.88
Blue spruce	1.3	0.2	1.1	0.2	9	4.5	0.6	0.6	4.2	28	-3.8	-14	8.9	22 (N/A)	0.6	1.68
American elm	9.9	1.7	4.7	0.4	53	19.0	2.8	2.7	18.3	119	0.0	0	59.5	172 (N/A)	0.5	17.21
Broadleaf Deciduous Large	5.6	0.9	2.5	0.3	29	11.9	1.7	1.7	11.4	75	0.0	0	36.1	104 (N/A)	0.3	14.86
Northern pin oak	6.0	1.0	2.9	0.3	32	11.0	1.6	1.5	10.2	68	-1.4	-5	33.1	95 (N/A)	0.3	13.58
Cottonwood	5.8	0.9	2.6	0.3	30	12.4	1.8	1.7	11.8	77	0.0	0	37.3	108 (N/A)	0.3	15.38
Eastern red cedar	1.6	0.3	1.3	0.2	10	2.9	0.4	0.4	2.7	18	-4.7	-17	5.0	11 (N/A)	0.3	1.51
Boxelder	1.4	0.2	0.7	0.1	7	6.0	0.9	0.8	5.8	38	-0.6	-2	15.3	43 (N/A)	0.3	7.15
Broadleaf Deciduous Small	0.1	0.0	0.1	0.0	1	1.1	0.2	0.1	1.0	7	0.0	0	2.6	7 (N/A)	0.2	1.44
Scotch pine	0.8	0.2	0.7	0.1	6	2.9	0.4	0.4	2.9	19	-2.7	-10	5.8	14 (N/A)	0.2	2.82
Ohio buckeye	3.6	0.6	1.7	0.2	19	7.3	1.0	1.0	6.7	45	-0.8	-3	21.3	61 (N/A)	0.2	12.21
Sweetgum	1.0	0.2	0.5	0.0	5	3.9	0.6	0.5	3.7	24	0.0	0	10.3	29 (N/A)	0.2	5.84
Mulberry	1.5	0.2	0.7	0.1	8	3.8	0.6	0.5	3.5	24	0.0	0	11.0	32 (N/A)	0.2	7.90
Spruce	0.6	0.1	0.5	0.1	4	1.9	0.3	0.3	1.8	12	-2.3	-8	3.2	7 (N/A)	0.2	1.81
Dogwood	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4 (N/A)	0.2	1.02
Birch	1.8	0.3	0.9	0.1	10	3.7	0.5	0.5	3.4	23	-0.4	-2	10.7	31 (N/A)	0.2	7.69
Eastern white pine	1.5	0.3	1.2	0.2	10	2.7	0.4	0.4	2.6	17	-7.3	-27	2.1	0 (N/A)	0.2	-0.06
Oak	0.3	0.1	0.2	0.0	2	3.2	0.5	0.5	3.2	20	0.0	0	8.0	22 (N/A)	0.2	5.59
Chinese elm	3.0	0.5	1.4	0.1	16	7.1	1.0	1.0	6.7	44	0.0	0	20.8	60 (N/A)	0.2	14.95
Kentucky coffeetree	0.5	0.1	0.3	0.0	3	3.4	0.5	0.5	3.3	21	0.0	0	8.6	24 (N/A)	0.1	8.06
Elm	0.2	0.0	0.1	0.0	1	2.2	0.3	0.3	2.1	14	0.0	0	5.3	15 (N/A)	0.1	4.97
White oak	0.2	0.0	0.2	0.0	1	2.6	0.4	0.4	2.6	16	0.0	0	6.4	18 (N/A)	0.1	5.95
Cherry plum	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.1	0.11
Maple	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	-0.3	-1	5.3	15 (N/A)	0.1	7.59
Black locust	1.1	0.2	0.5	0.0	6	2.7	0.4	0.4	2.5	17	-0.3	-1	7.5	21 (N/A)	0.1	10.75
Plum	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.1	0.11
Amur maple	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)	0.1	5.45
Scarlet oak	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.2	8	0.0	0	3.0	8 (N/A)	0.1	4.15
Broadleaf Evergreen Large	0.0	0.0	0.1	0.0	0	0.4	0.1	0.1	0.4	3	-0.2	-1	0.8	2 (N/A)	0.0	2.16
Northern catalpa	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23 (N/A)	0.0	22.55
Paper birch	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)	0.0	0.87
Willow	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	0.0	1.21
Broadleaf Evergreen Small	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.0	0.27
Conifer Evergreen Large	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1 (N/A)	0.0	1.45
Amur corktree	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)	0.0	7.92
Norway spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	1 (N/A)	0.0	1.48
Citywide total	1,051.2	178.9	518.1	47.5	5,678	2,549.7	371.3	354.1	2,421.6	15,887	-569.1	-2,134	6,923.3	19,430 (N/A)	100.0	8.79

Table 4: Annual Carbon Stored

Oskaloosa

Stored CO2 Benefits of Public Trees

3/3/2016

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	7,976,874	59,827	(N/A)	18.8	33.6	143.81
Norway maple	2,141,609	16,062	(N/A)	12.9	9.0	56.16
Sugar maple	2,516,601	18,875	(N/A)	10.4	10.6	82.06
Ash	1,416,150	10,621	(N/A)	10.0	6.0	48.06
Northern red oak	670,056	5,025	(N/A)	5.6	2.8	40.86
Pin oak	2,192,226	16,442	(N/A)	4.3	9.2	174.91
Red maple	258,055	1,935	(N/A)	3.8	1.1	22.77
Apple	76,053	570	(N/A)	3.7	0.3	7.04
Pear	145,579	1,092	(N/A)	3.5	0.6	14.18
Swamp white oak	157,399	1,180	(N/A)	2.8	0.7	18.74
Siberian elm	1,016,799	7,626	(N/A)	2.5	4.3	138.65
Littleleaf linden	175,044	1,313	(N/A)	2.3	0.7	25.74
Northern hackberry	439,925	3,299	(N/A)	1.8	1.9	84.60
American sycamore	1,078,329	8,087	(N/A)	1.5	4.5	245.07
Honeylocust	278,308	2,087	(N/A)	1.3	1.2	71.98
Tulip tree	352,752	2,646	(N/A)	1.0	1.5	115.03
Ginkgo	51,812	389	(N/A)	1.0	0.2	16.90
Black walnut	313,444	2,351	(N/A)	1.0	1.3	106.86
Bur oak	98,515	739	(N/A)	0.9	0.4	36.94
Eastern redbud	33,800	254	(N/A)	0.9	0.1	12.68
Broadleaf Deciduous	62,448	468	(N/A)	0.9	0.3	24.65
American basswood	309,836	2,324	(N/A)	0.8	1.3	129.10
Southern magnolia	43,568	327	(N/A)	0.8	0.2	19.22
Basswood	317,033	2,378	(N/A)	0.7	1.3	148.61
Catalpa	436,248	3,272	(N/A)	0.7	1.8	218.12
Blue spruce	7,016	53	(N/A)	0.6	0.0	4.05
American elm	198,427	1,488	(N/A)	0.5	0.8	148.82
Broadleaf Deciduous	192,967	1,447	(N/A)	0.3	0.8	206.75
Northern pin oak	99,961	750	(N/A)	0.3	0.4	107.10
Cottonwood	196,538	1,474	(N/A)	0.3	0.8	210.58
Eastern red cedar	5,240	39	(N/A)	0.3	0.0	5.61
Boxelder	39,029	293	(N/A)	0.3	0.2	48.79
Broadleaf Deciduous	2,349	18	(N/A)	0.2	0.0	3.52
Scotch pine	5,851	44	(N/A)	0.2	0.0	8.78
Ohio buckeye	58,731	440	(N/A)	0.2	0.2	88.10
Sweetgum	31,696	238	(N/A)	0.2	0.1	47.54
Mulberry	23,265	174	(N/A)	0.2	0.1	43.62
Spruce	5,026	38	(N/A)	0.2	0.0	9.42
Dogwood	1,277	10	(N/A)	0.2	0.0	2.39
Birch	29,678	223	(N/A)	0.2	0.1	55.65
Eastern white pine	18,580	139	(N/A)	0.2	0.1	34.84
Oak	11,028	83	(N/A)	0.2	0.0	20.68
Chinese elm	99,603	747	(N/A)	0.2	0.4	186.75
Kentucky coffeetree	15,801	119	(N/A)	0.1	0.1	39.50
Elm	7,356	55	(N/A)	0.1	0.0	18.39
White oak	8,378	63	(N/A)	0.1	0.0	20.95
Cherry plum	41	0	(N/A)	0.1	0.0	0.10
Maple	9,046	68	(N/A)	0.1	0.0	33.92
Black locust	17,904	134	(N/A)	0.1	0.1	67.14
Plum	28	0	(N/A)	0.1	0.0	0.10
Amur maple	7,651	57	(N/A)	0.1	0.0	28.69
Scarlet oak	3,857	29	(N/A)	0.1	0.0	14.46
Broadleaf Evergreen T	1,025	8	(N/A)	0.0	0.0	7.68
Northern catalpa	55,982	420	(N/A)	0.0	0.2	419.86
Paper birch	185	1	(N/A)	0.0	0.0	1.39
Willow	218	2	(N/A)	0.0	0.0	1.64
Broadleaf Evergreen S	14	0	(N/A)	0.0	0.0	0.10
Conifer Evergreen La	3,343	25	(N/A)	0.0	0.0	25.07
Amur corktree	3,624	27	(N/A)	0.0	0.0	27.18
Norway spruce	257	2	(N/A)	0.0	0.0	1.93
Citywide total	23,719,437	177,896	(N/A)	100.0	100.0	80.46

Table 5: Annual Carbon Sequestered

Oskaloosa

Annual CO Benefits of Public Trees

3/3/2016

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
Silver maple	579,515	4,346	-38,292	-1,516	-11	0	0	539,706	4,048 (N/A)	18.8	43.9	9.73
Norway maple	100,024	750	-10,286	-735	-6	0	0	89,004	668 (N/A)	12.9	7.2	2.33
Sugar maple	128,737	966	-12,088	-621	-5	0	0	116,028	870 (N/A)	10.4	9.4	3.78
Ash	64,349	483	-6,802	-521	-4	0	0	57,025	428 (N/A)	10.0	4.6	1.94
Northern red oak	27,744	208	-3,216	-247	-2	0	0	24,280	182 (N/A)	5.6	2.0	1.48
Pin oak	148,295	1,112	-10,523	-375	-3	0	0	137,398	1,030 (N/A)	4.3	11.2	10.96
Red maple	24,883	187	-1,239	-130	-1	0	0	23,514	176 (N/A)	3.8	1.9	2.07
Apple	8,471	64	-366	-82	-1	0	0	8,024	60 (N/A)	3.7	0.7	0.74
Pear	13,658	102	-699	-110	-1	0	0	12,848	96 (N/A)	3.5	1.0	1.25
Swamp white oak	17,780	133	-759	-95	-1	0	0	16,927	127 (N/A)	2.8	1.4	2.02
Siberian elm	37,930	284	-4,881	-214	-2	0	0	32,835	246 (N/A)	2.5	2.7	4.48
Littleleaf linden	19,038	143	-842	-85	-1	0	0	18,111	136 (N/A)	2.3	1.5	2.66
Northern hackberry	17,909	134	-2,112	-136	-1	0	0	15,661	117 (N/A)	1.8	1.3	3.01
American sycamore	25,290	190	-5,176	-149	-1	0	0	19,965	150 (N/A)	1.5	1.6	4.54
Honeylocust	17,092	128	-1,336	-74	-1	0	0	15,682	118 (N/A)	1.3	1.3	4.06
Tulip tree	12,511	94	-1,693	-67	-1	0	0	10,751	81 (N/A)	1.0	0.9	3.51
Ginkgo	2,493	19	-249	-38	0	0	0	2,206	17 (N/A)	1.0	0.2	0.72
Black walnut	14,309	107	-1,505	-67	-1	0	0	12,737	96 (N/A)	1.0	1.0	4.34
Bur oak	8,330	62	-473	-37	0	0	0	7,820	59 (N/A)	0.9	0.6	2.93
Eastern redbud	2,658	20	-162	-27	0	0	0	2,470	19 (N/A)	0.9	0.2	0.93
Broadleaf Deciduous Medi	3,712	28	-301	-30	0	0	0	3,381	25 (N/A)	0.9	0.3	1.33
American basswood	16,747	126	-1,487	-54	0	0	0	15,206	114 (N/A)	0.8	1.2	6.34
Southern magnolia	2,513	19	-209	-28	0	0	0	2,275	17 (N/A)	0.8	0.2	1.00
Basswood	6,686	50	-1,522	-45	0	0	0	5,119	38 (N/A)	0.7	0.4	2.40
Catalpa	9,926	74	-2,094	-60	0	0	0	7,771	58 (N/A)	0.7	0.6	3.89
Blue spruce	635	5	-34	-17	0	0	0	585	4 (N/A)	0.6	0.0	0.34
American elm	4,888	37	-952	-39	0	0	0	3,897	29 (N/A)	0.5	0.3	2.92
Broadleaf Deciduous Large	4,380	33	-926	-28	0	0	0	3,426	26 (N/A)	0.3	0.3	3.67
Northern pin oak	1,480	11	-480	-27	0	0	0	973	7 (N/A)	0.3	0.1	1.04
Cottonwood	5,053	38	-943	-29	0	0	0	4,081	31 (N/A)	0.3	0.3	4.37
Eastern red cedar	120	1	-25	-11	0	0	0	83	1 (N/A)	0.3	0.0	0.09
Boxelder	3,615	27	-187	-15	0	0	0	3,412	26 (N/A)	0.3	0.3	4.27
Broadleaf Deciduous Small	342	3	-11	-4	0	0	0	326	2 (N/A)	0.2	0.0	0.49
Scotch pine	578	4	-28	-10	0	0	0	540	4 (N/A)	0.2	0.0	0.81
Ohio buckeye	1,680	13	-282	-17	0	0	0	1,381	10 (N/A)	0.2	0.1	2.07
Sweetgum	1,825	14	-152	-9	0	0	0	1,664	12 (N/A)	0.2	0.1	2.50
Mulberry	746	6	-112	-12	0	0	0	623	5 (N/A)	0.2	0.1	1.17
Spruce	408	3	-24	-7	0	0	0	377	3 (N/A)	0.2	0.0	0.71
Dogwood	198	1	-6	-3	0	0	0	190	1 (N/A)	0.2	0.0	0.36
Birch	229	2	-143	-10	0	0	0	77	1 (N/A)	0.2	0.0	0.14
Eastern white pine	496	4	-89	-12	0	0	0	394	3 (N/A)	0.2	0.0	0.74
Oak	1,339	10	-53	-6	0	0	0	1,280	10 (N/A)	0.2	0.1	2.40
Chinese elm	3,491	26	-478	-16	0	0	0	2,997	22 (N/A)	0.2	0.2	5.62
Kentucky coffeetree	1,550	12	-76	-7	0	0	0	1,468	11 (N/A)	0.1	0.1	3.67
Elm	893	7	-35	-4	0	0	0	854	6 (N/A)	0.1	0.1	2.13
White oak	1,099	8	-40	-5	0	0	0	1,054	8 (N/A)	0.1	0.1	2.64
Cherry plum	26	0	0	-1	0	0	0	25	0 (N/A)	0.1	0.0	0.06
Maple	1,089	8	-43	-4	0	0	0	1,041	8 (N/A)	0.1	0.1	3.90
Black locust	386	3	-86	-6	0	0	0	294	2 (N/A)	0.1	0.0	1.10
Plum	17	0	0	0	0	0	0	17	0 (N/A)	0.1	0.0	0.06
Amur maple	592	4	-37	-4	0	0	0	552	4 (N/A)	0.1	0.0	2.07
Scarlet oak	520	4	-19	-3	0	0	0	498	4 (N/A)	0.1	0.0	1.87
Broadleaf Evergreen Large	197	1	-5	-1	0	0	0	191	1 (N/A)	0.0	0.0	1.44
Northern catalpa	479	4	-269	-6	0	0	0	204	2 (N/A)	0.0	0.0	1.53
Paper birch	74	1	-1	-1	0	0	0	73	1 (N/A)	0.0	0.0	0.55
Willow	96	1	-2	-1	0	0	0	93	1 (N/A)	0.0	0.0	0.70
Broadleaf Evergreen Small	4	0	0	0	0	0	0	4	0 (N/A)	0.0	0.0	0.03
Conifer Evergreen Large	187	1	-16	-3	0	0	0	169	1 (N/A)	0.0	0.0	1.26
Amur corktree	386	3	-17	-2	0	0	0	367	3 (N/A)	0.0	0.0	2.75
Norway spruce	53	0	-1	-1	0	0	0	50	0 (N/A)	0.0	0.0	0.38
Citywide total	1,349,751	10,123	-113,886	-5,861	-44	0	0	1,230,004	9,225 (N/A)	100.0	100.0	4.17

Table 6: Annual Social and Aesthetic Benefits

Oskaloosa

Annual Aesthetic/Other Benefits of Public Trees

3/3/2016

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	44,535	(N/A)	18.8	38.0	107.05
Norway maple	9,514	(N/A)	12.9	8.1	33.27
Sugar maple	13,346	(N/A)	10.4	11.4	58.03
Ash	6,409	(N/A)	10.0	5.5	29.00
Northern red oak	2,327	(N/A)	5.6	2.0	18.92
Pin oak	11,075	(N/A)	4.3	9.5	117.82
Red maple	3,394	(N/A)	3.8	2.9	39.93
Apple	475	(N/A)	3.7	0.4	5.87
Pear	786	(N/A)	3.5	0.7	10.20
Swamp white oak	1,906	(N/A)	2.8	1.6	30.25
Siberian elm	2,528	(N/A)	2.5	2.2	45.96
Littleleaf linden	2,124	(N/A)	2.3	1.8	41.65
Northern hackberry	2,267	(N/A)	1.8	1.9	58.12
American sycamore	1,759	(N/A)	1.5	1.5	53.31
Honeylocust	4,025	(N/A)	1.3	3.4	138.79
Tulip tree	1,062	(N/A)	1.0	0.9	46.17
Ginkgo	210	(N/A)	1.0	0.2	9.14
Black walnut	1,187	(N/A)	1.0	1.0	53.94
Bur oak	807	(N/A)	0.9	0.7	40.33
Eastern redbud	152	(N/A)	0.9	0.1	7.61
Broadleaf Deciduous Medium	417	(N/A)	0.9	0.4	21.93
American basswood	1,134	(N/A)	0.8	1.0	63.00
Southern magnolia	396	(N/A)	0.8	0.3	23.31
Basswood	518	(N/A)	0.7	0.4	32.36
Catalpa	705	(N/A)	0.7	0.6	47.01
Blue spruce	255	(N/A)	0.6	0.2	19.61
American elm	645	(N/A)	0.5	0.6	64.54
Broadleaf Deciduous Large	331	(N/A)	0.3	0.3	47.35
Northern pin oak	126	(N/A)	0.3	0.1	17.98
Cottonwood	371	(N/A)	0.3	0.3	53.04
Eastern red cedar	64	(N/A)	0.3	0.1	9.15
Boxelder	285	(N/A)	0.3	0.2	47.54
Broadleaf Deciduous Small	19	(N/A)	0.2	0.0	3.80
Scotch pine	162	(N/A)	0.2	0.1	32.32
Ohio buckeye	149	(N/A)	0.2	0.1	29.81
Sweetgum	175	(N/A)	0.2	0.1	34.97
Mulberry	44	(N/A)	0.2	0.0	11.07
Spruce	110	(N/A)	0.2	0.1	27.56
Dogwood	11	(N/A)	0.2	0.0	2.64
Birch	29	(N/A)	0.2	0.0	7.24
Eastern white pine	89	(N/A)	0.2	0.1	22.19
Oak	143	(N/A)	0.2	0.1	35.71
Chinese elm	249	(N/A)	0.2	0.2	62.31
Kentucky coffeetree	149	(N/A)	0.1	0.1	49.80
Elm	97	(N/A)	0.1	0.1	32.32
White oak	120	(N/A)	0.1	0.1	40.09
Cherry plum	0	(N/A)	0.1	0.0	0.03
Maple	139	(N/A)	0.1	0.1	69.46
Black locust	39	(N/A)	0.1	0.0	19.58
Plum	0	(N/A)	0.1	0.0	0.03
Amur maple	35	(N/A)	0.1	0.0	17.60
Scarlet oak	61	(N/A)	0.1	0.1	30.29
Broadleaf Evergreen Large	58	(N/A)	0.0	0.0	58.26
Northern catalpa	29	(N/A)	0.0	0.0	28.57
Paper birch	15	(N/A)	0.0	0.0	14.73
Willow	13	(N/A)	0.0	0.0	12.89
Broadleaf Evergreen Small	0	(N/A)	0.0	0.0	0.50
Conifer Evergreen Large	47	(N/A)	0.0	0.0	47.08
Amur corktree	39	(N/A)	0.0	0.0	39.16
Norway spruce	15	(N/A)	0.0	0.0	15.42
Citywide total	117,173	(N/A)	100.0	100.0	53.00

Table 7: Summary of Benefits in Dollars

Oskaloosa

Total Annual Benefits of Public Trees by Species ($)

3/3/2016

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	27,955	4,048	5,186	52,986	44,535	134,710	(N/A)	32.2
Norway maple	15,273	668	2,699	17,521	9,514	45,675	(N/A)	10.9
Sugar maple	11,847	870	1,906	16,929	13,346	44,899	(N/A)	10.7
Ash	10,586	428	1,847	11,728	6,409	30,998	(N/A)	7.4
Northern red oak	4,297	182	618	4,606	2,327	12,030	(N/A)	2.9
Pin oak	7,017	1,030	892	11,543	11,075	31,558	(N/A)	7.5
Red maple	2,862	176	503	2,851	3,394	9,786	(N/A)	2.3
Apple	1,274	60	193	534	475	2,536	(N/A)	0.6
Pear	1,919	96	311	896	786	4,008	(N/A)	1.0
Swamp white oak	2,093	127	334	1,687	1,906	6,147	(N/A)	1.5
Siberian elm	4,044	246	805	6,136	2,528	13,759	(N/A)	3.3
Littleleaf linden	1,517	136	247	1,502	2,124	5,527	(N/A)	1.3
Northern hackberry	2,915	117	558	3,951	2,267	9,808	(N/A)	2.3
American sycamore	2,726	150	554	5,147	1,759	10,336	(N/A)	2.5
Honeylocust	1,941	118	330	2,975	4,025	9,388	(N/A)	2.2
Tulip tree	1,291	81	240	1,911	1,062	4,584	(N/A)	1.1
Ginkgo	538	17	94	422	210	1,280	(N/A)	0.3
Black walnut	1,344	96	241	1,947	1,187	4,814	(N/A)	1.2
Bur oak	754	59	125	851	807	2,595	(N/A)	0.6
Eastern redbud	418	19	67	203	152	859	(N/A)	0.2
Broadleaf Deciduous M	586	25	96	562	417	1,687	(N/A)	0.4
American basswood	939	114	148	1,486	1,134	3,821	(N/A)	0.9
Southern magnolia	563	17	78	792	396	1,846	(N/A)	0.4
Basswood	805	38	163	1,403	518	2,927	(N/A)	0.7
Catalpa	1,099	58	223	2,019	705	4,105	(N/A)	1.0
Blue spruce	203	4	22	311	255	795	(N/A)	0.2
American elm	819	29	172	988	645	2,654	(N/A)	0.6
Broadleaf Deciduous La	516	26	104	887	331	1,864	(N/A)	0.4
Northern pin oak	496	7	95	714	126	1,438	(N/A)	0.3
Cottonwood	547	31	108	937	371	1,994	(N/A)	0.5
Eastern red cedar	133	1	11	231	64	439	(N/A)	0.1
Boxelder	264	26	43	321	285	939	(N/A)	0.2
Broadleaf Deciduous Sn	53	2	7	20	19	101	(N/A)	0.0
Scotch pine	121	4	14	208	162	509	(N/A)	0.1
Ohio buckeye	330	10	61	440	149	991	(N/A)	0.2
Sweetgum	168	12	29	222	175	607	(N/A)	0.1
Mulberry	177	5	32	114	44	371	(N/A)	0.1
Spruce	82	3	7	154	110	356	(N/A)	0.1
Dogwood	30	1	4	11	11	57	(N/A)	0.0
Birch	167	1	31	220	29	448	(N/A)	0.1
Eastern white pine	120	3	0	346	89	558	(N/A)	0.1
Oak	133	10	22	120	143	428	(N/A)	0.1
Chinese elm	312	22	60	564	249	1,208	(N/A)	0.3
Kentucky coffeetree	146	11	24	150	149	480	(N/A)	0.1
Elm	89	6	15	80	97	287	(N/A)	0.1
White oak	109	8	18	96	120	351	(N/A)	0.1
Cherry plum	3	0	0	1	0	4	(N/A)	0.0
Maple	85	8	15	95	139	342	(N/A)	0.1
Black locust	118	2	21	140	39	321	(N/A)	0.1
Plum	2	0	0	0	0	3	(N/A)	0.0
Amur maple	64	4	11	39	35	154	(N/A)	0.0
Scarlet oak	50	4	8	44	61	167	(N/A)	0.0
Broadleaf Evergreen La	21	1	2	20	58	103	(N/A)	0.0
Northern catalpa	99	2	23	196	29	347	(N/A)	0.1
Paper birch	6	1	1	5	15	27	(N/A)	0.0
Willow	9	1	1	4	13	28	(N/A)	0.0
Broadleaf Evergreen Sm	2	0	0	1	0	4	(N/A)	0.0
Conifer Evergreen Large	30	1	1	80	47	161	(N/A)	0.0
Amur corktree	47	3	8	38	39	135	(N/A)	0.0
Norway spruce	14	0	1	16	15	47	(N/A)	0.0
Citywide Total	112,167	9,225	19,430	160,402	117,173	418,397	(N/A)	100.0

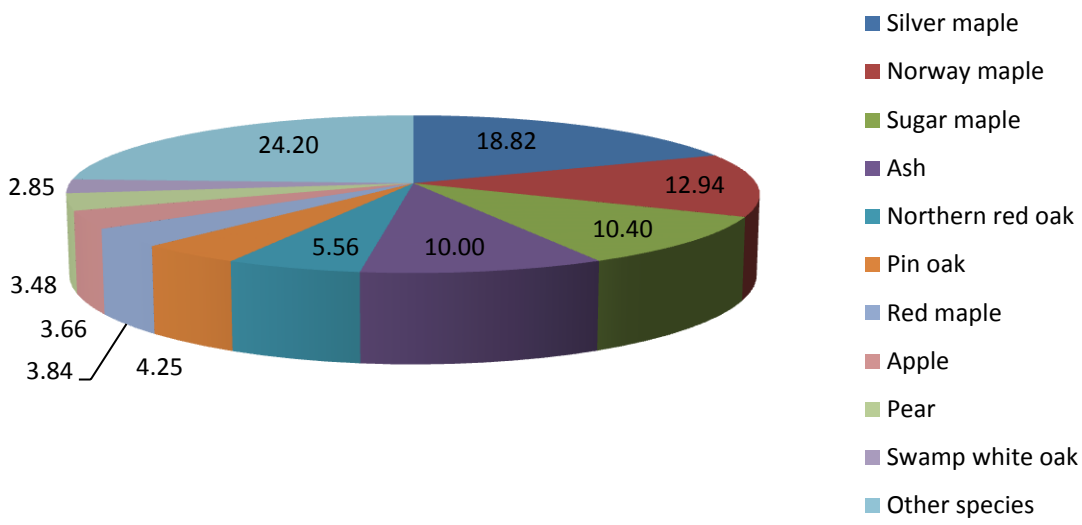

Figure 1: Species Distribution

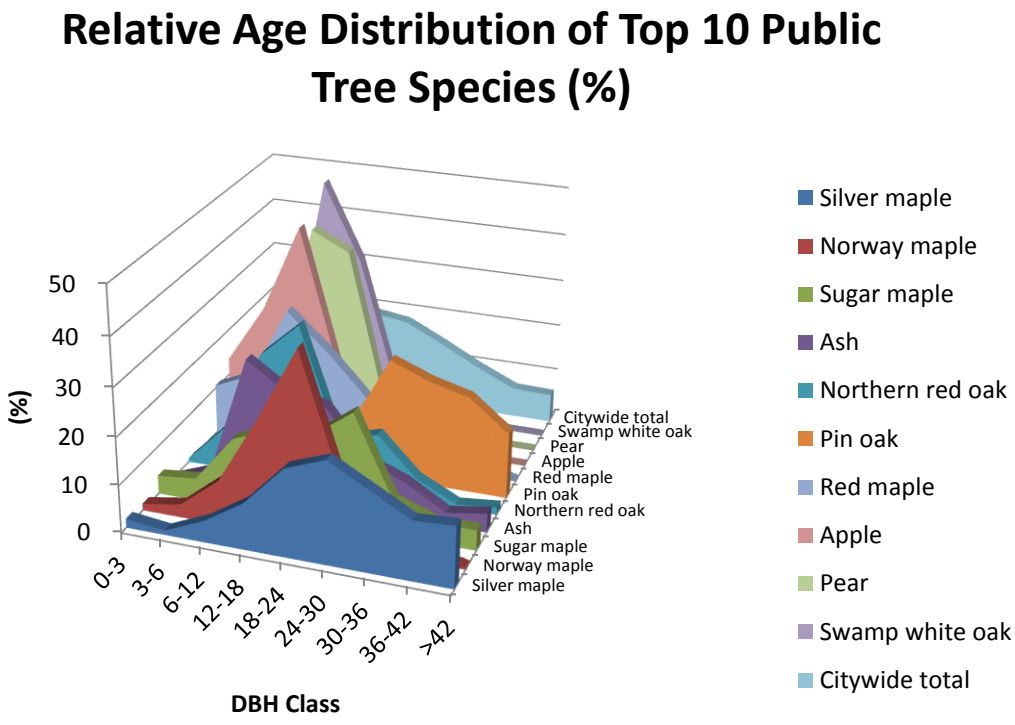

Figure 2: Relative Age Class

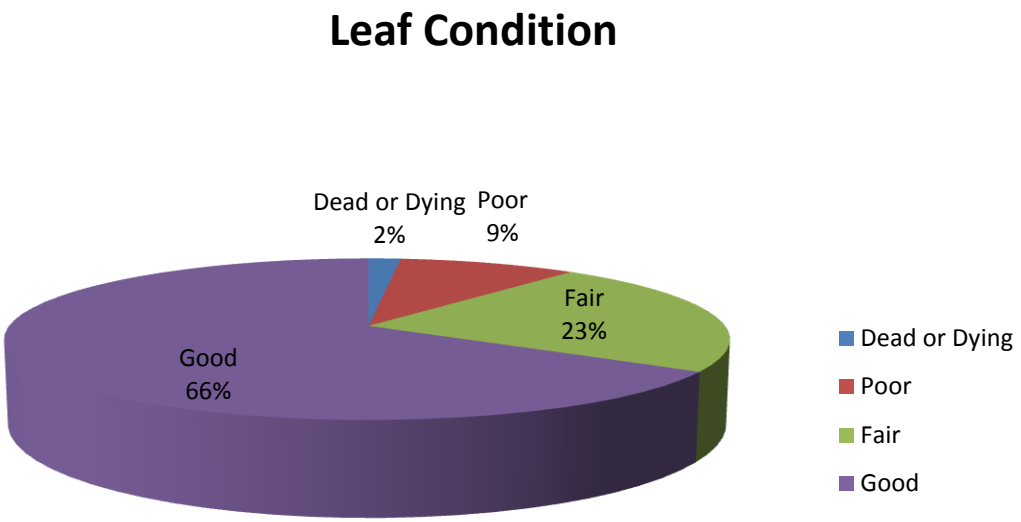

Figure 3: Foliage Condition

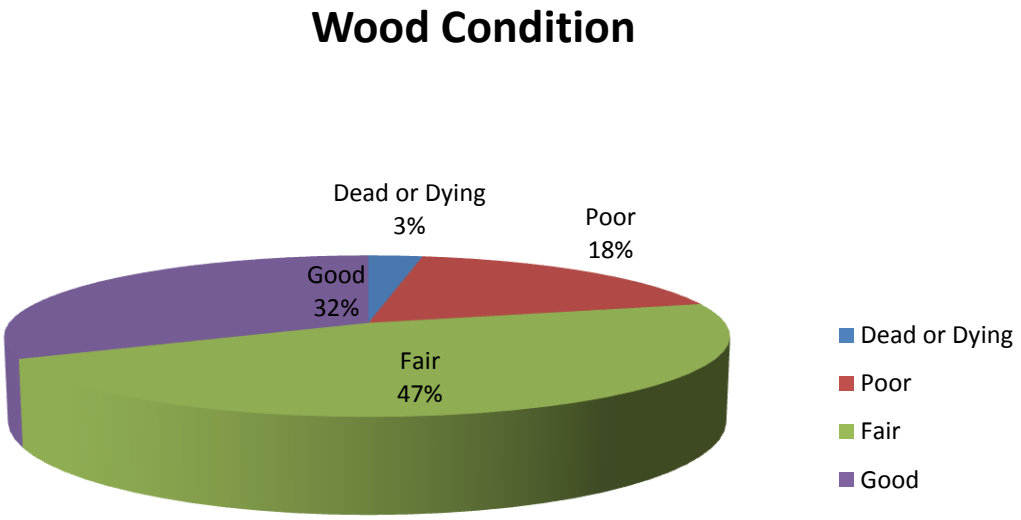

Figure 4: Wood Condition

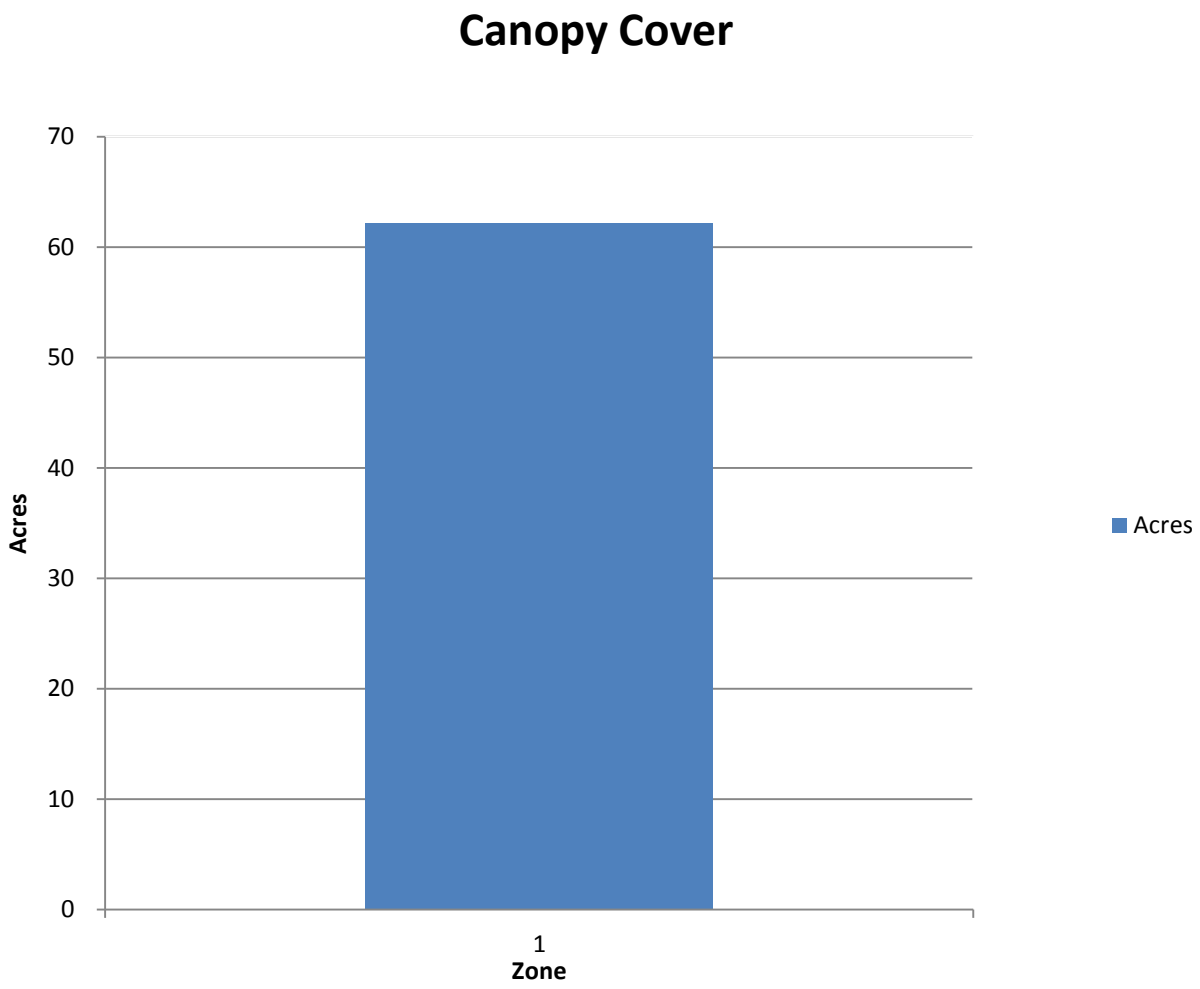

Figure 5: Canopy Cover in Acres

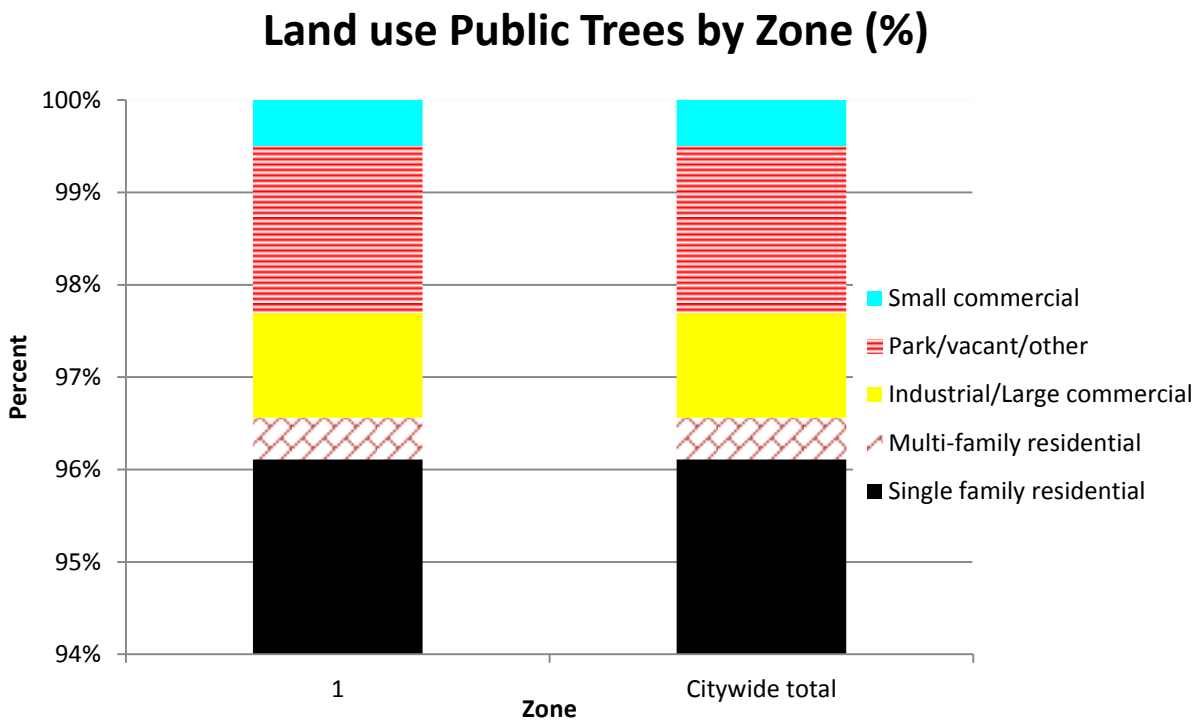

Figure 6: Land Use of city/park trees

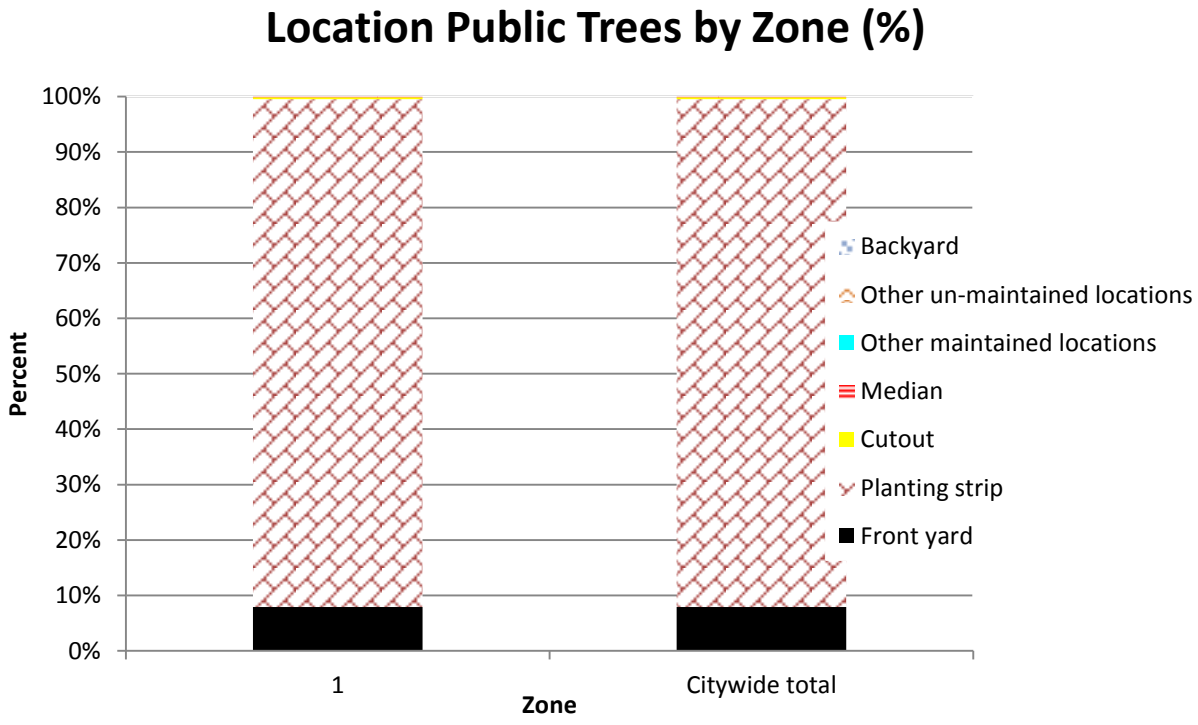

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

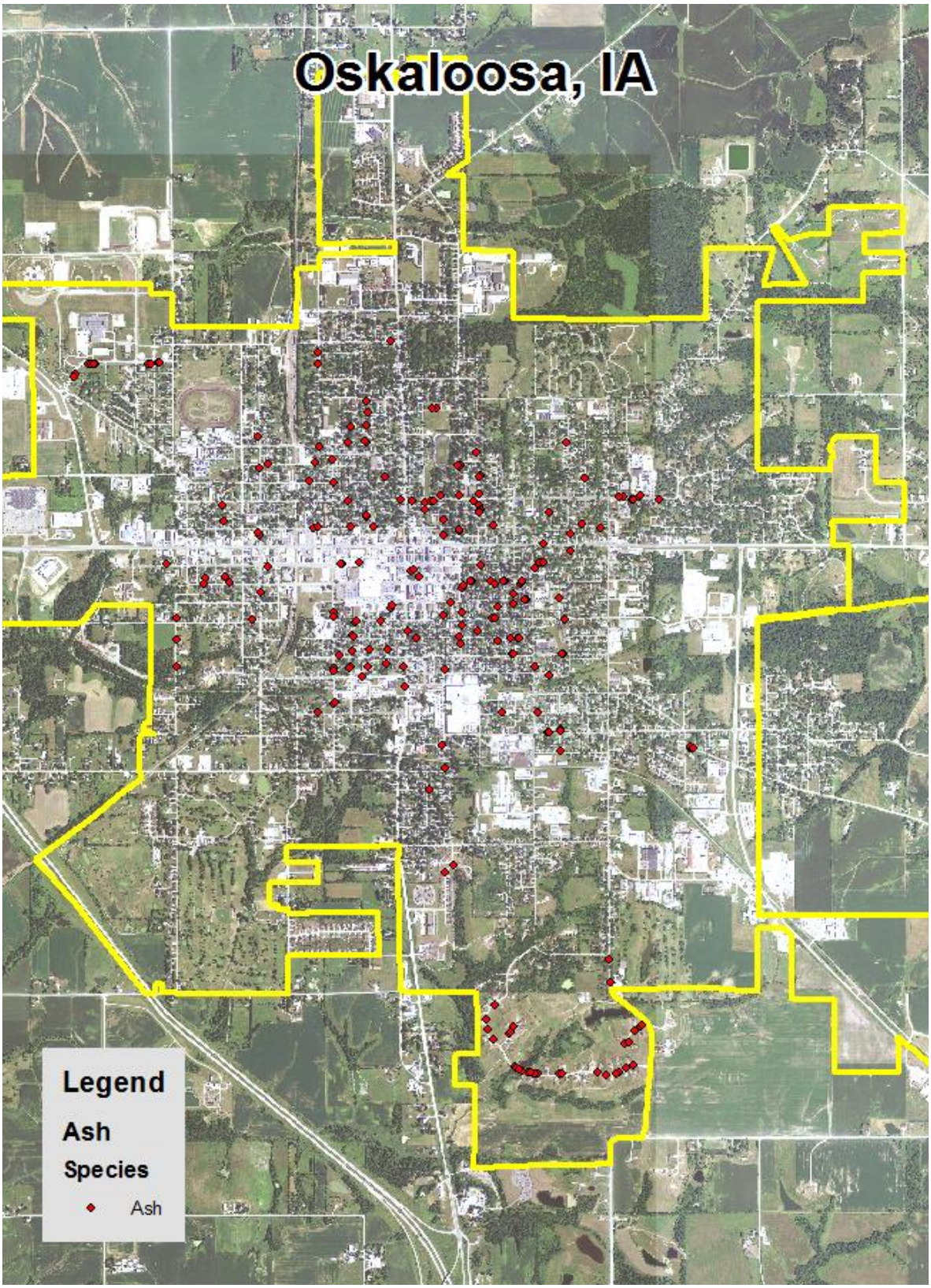

Figure 1: Location of Ash Trees

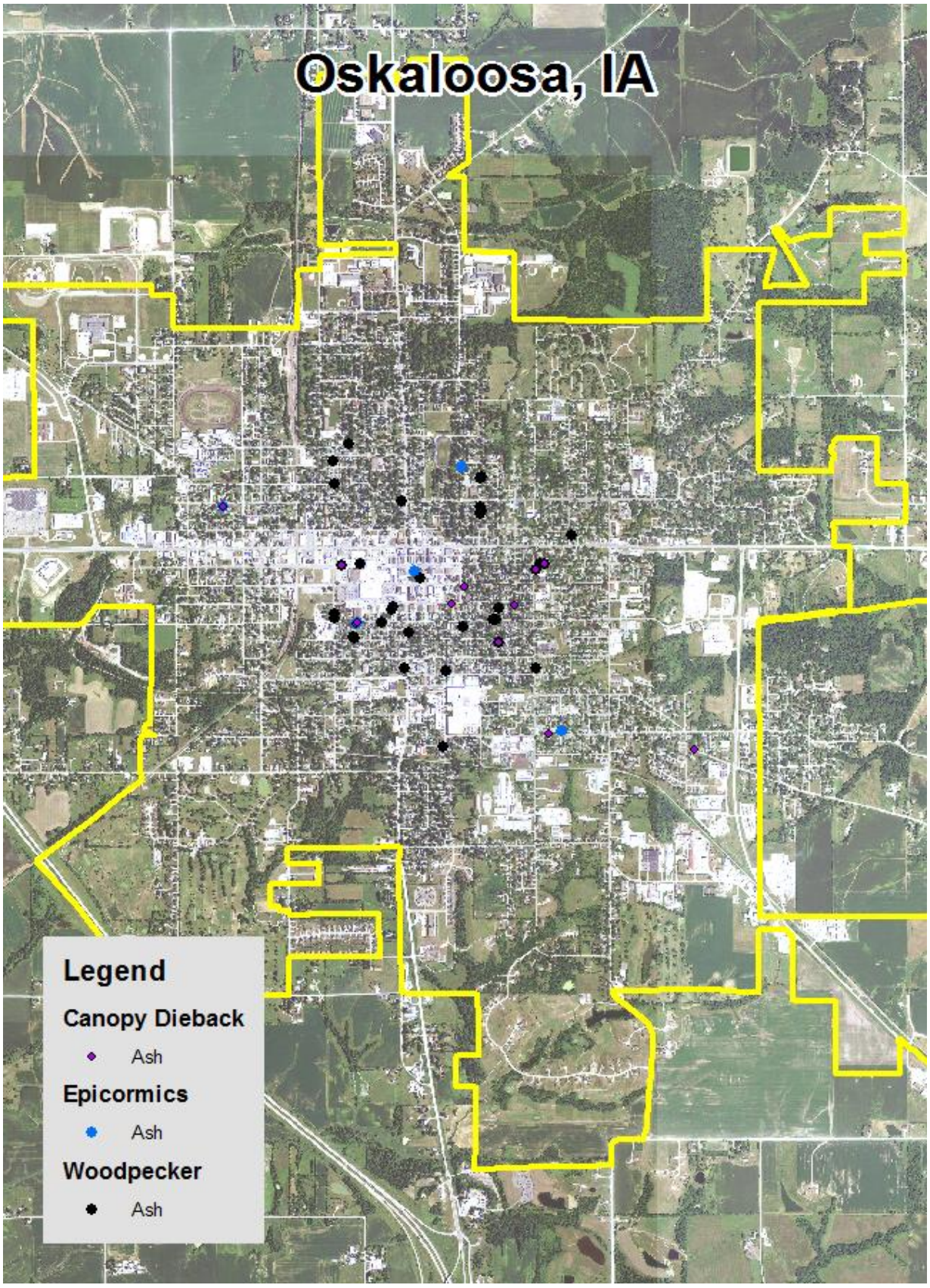

Figure 2: Location of EAB symptoms

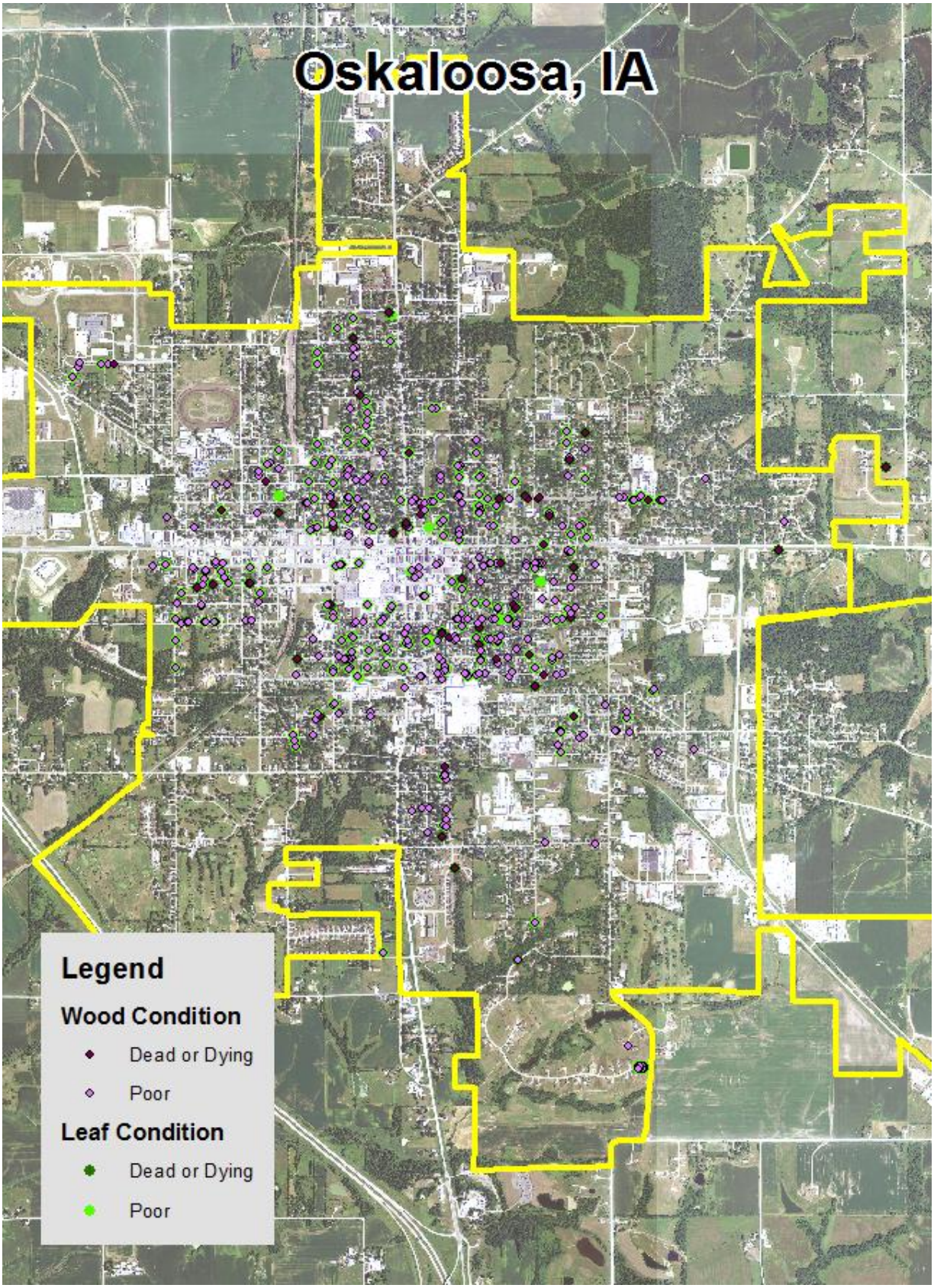

Figure 3: Location of Poor Condition Trees

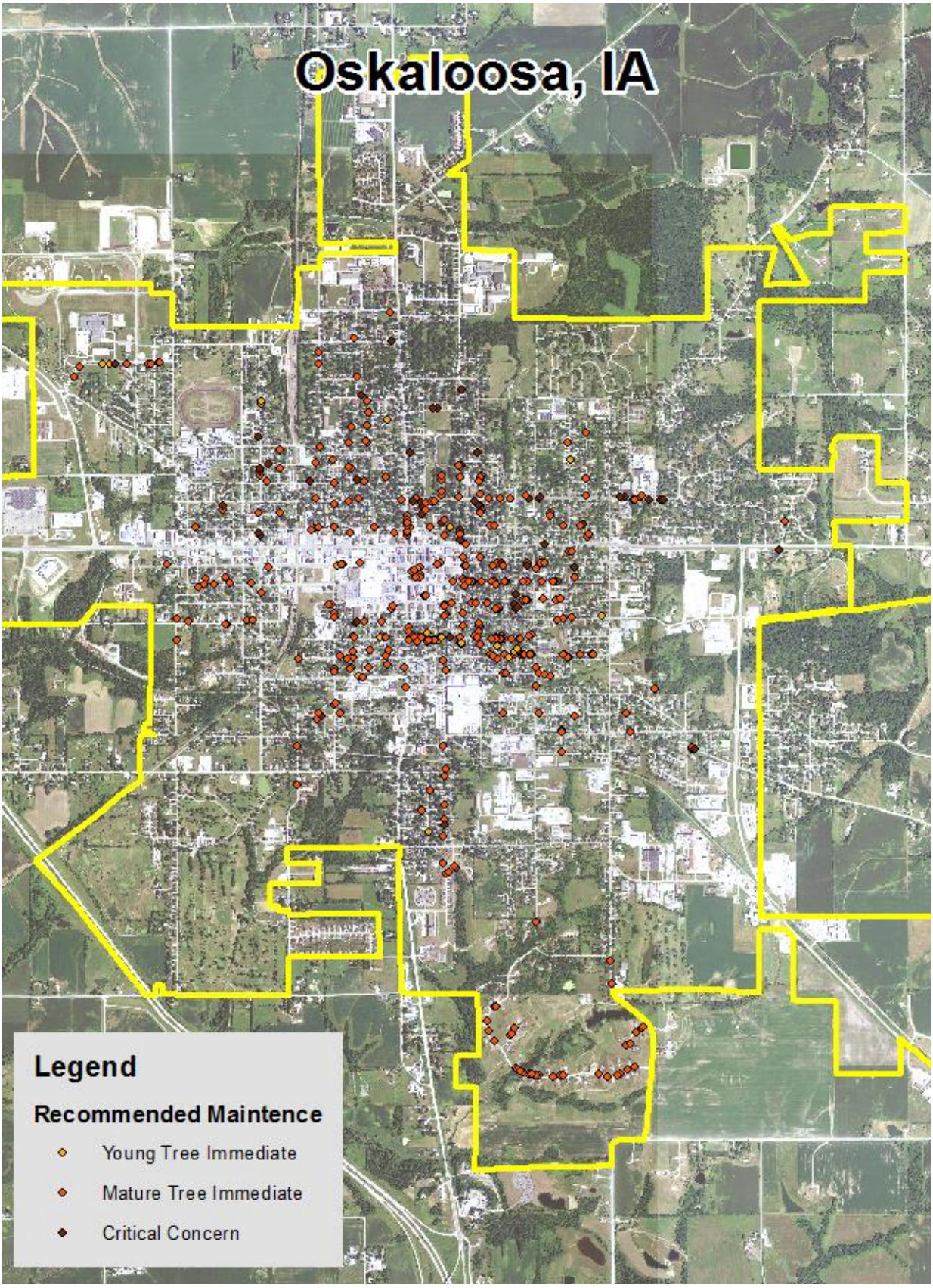

Figure 4: Location of Trees with Recommended Maintenance

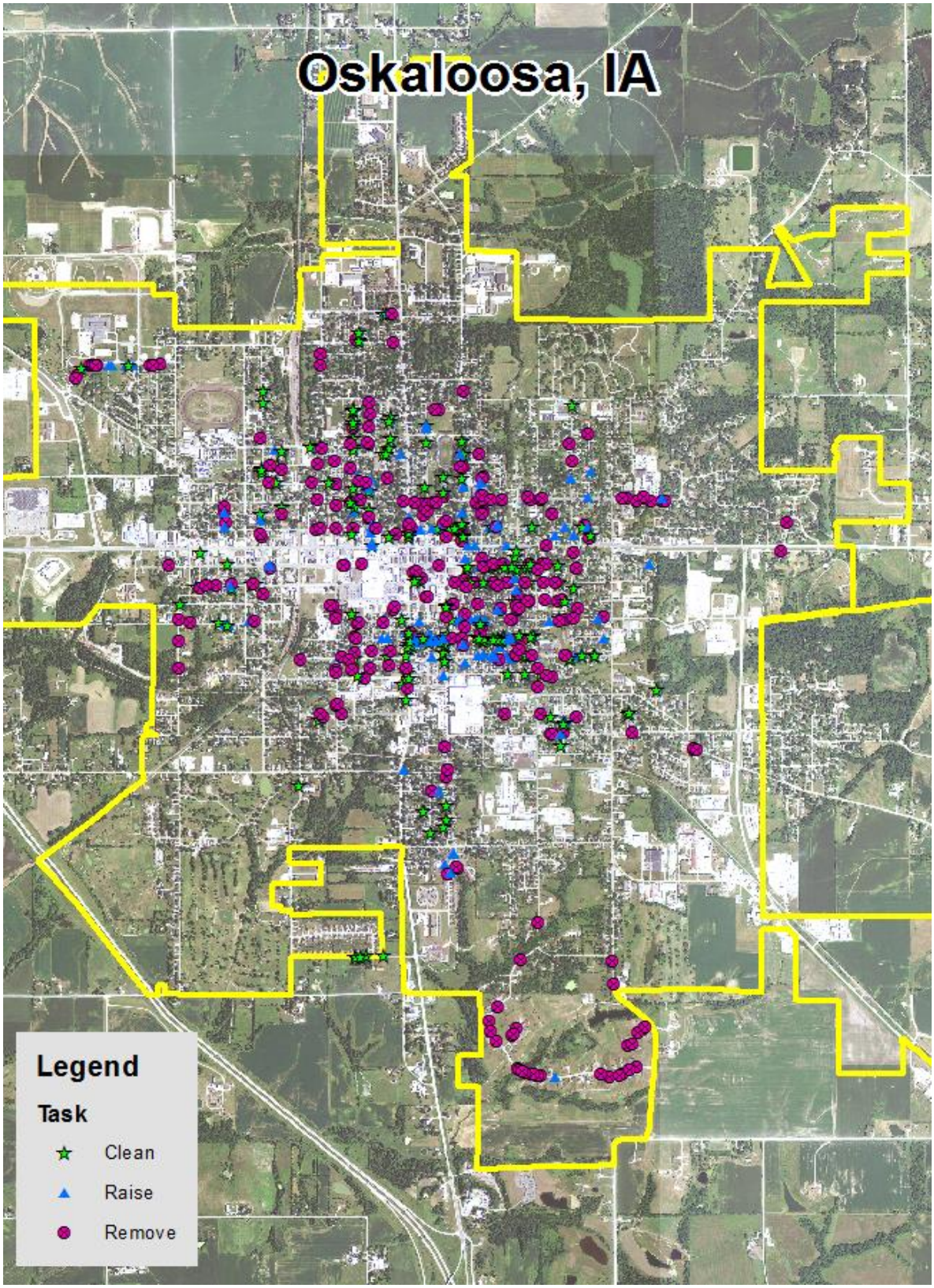

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Oskaloosa Tree Ordinances

PUBLIC NOTICE

The public is hereby notified that the following Ordinance of the City of Oskaloosa will become effective upon publication.

ORDINANCE NO. 1379

AN ORDINANCE AMENDING THE OSKALOOSA MUNICIPAL CODE 12.40.00 TREES, 15.04.04.230 PERMIT APPLICATION PLANS AND SPECIFICATIONS, AND 17.34.020 SITE PLAN REVIEW PROCEDURE

BE IT ENACTED by the City Council of the City of Oskaloosa, Iowa:

SECTION 1. Chapter 12.40- Trees is herby deleted in its entirety:
SECTION 2. Chapter 12.40- Trees shall read as follows:

12.40.000 Trees

12.40.010 Purpose

The purpose of this chapter is to protect and promote public health and safety, and to improve the aesthetic qualities of the community by regulating tree management and landscaping activities. The intent of the regulations is to reduce wind turbulence, heat, and noise; to prevent erosion and reduce stormwater runoff; to protect private and public property and vehicular and pedestrian rights-of-way; and to promote aesthetic quality and otherwise create a pleasant community environment.

12.40.020 Definitions

For use in this chapter, the following terms are defined:

"Approved Tree List" is a list of acceptable shade and small trees that have been proven adaptable to, and suitable for urban conditions in the city.

"Prohibited Tree List" is a list of unacceptable trees which have characteristics that are not ideal for the right-of-way.

"Right-of-way" means that part of the street, avenue, or highway within city limits lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue, or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

"Right-of-Way Tree Plan" is a plan requiring the planting of trees in the right-of-way for all new residential and commercial development.

"Shade tree" means a deciduous woody plant which is characteristically over thirty (30) feet in height when it reaches maturity and has a single trunk rooted in the ground which supports all of its branches, rather than several stems supporting the main leafy growth.

"Small Tree" is a shade tree that is less than thirty (30) feet in height at maturity.

"Tree topping" means the severe cutting back or indiscriminate removal of a majority of a tree's branches or limbs so that stubs remain within a tree crown so as to remove the normal canopy and disfigure the tree.

"Urban Forester" is the person designated by the city manager to be charged with the responsibilities of enforcement of the City of Oskaloosa's tree ordinance.

12.40.030 Urban Tree Canopy and Species Diversification Goals

The City of Oskaloosa will work to maintain the Urban Tree Canopy Goal stated in the Approved Tree List. The city will also work to promote the diversification of tree species. The diversification goal is that no single tree species exceeds ten percent (10%) of the right-of-way tree total along any given street.

12.40.40 Right-of-Way Trees

1. Planting. The city wishes to encourage the orderly planting of trees along public right-of- way. Therefore, the city is authorized to provide, or allow residents to provide, trees for planting with the cooperation of the property owner adjacent to the right-of-way. Right- of-way trees shall be selected and located in order to avoid interference with overhead and underground utilities. Right-of-way trees shall be installed in accordance with the following:
    a. Permit. A right-of-way permit from the Oskaloosa Public Works Department is required prior to the planting of a tree within the public right-of-way to ensure appropriate species, spacing, location, and size.
    b. Species. Trees planted in the right-of-way must be from the Approved Tree List and promote the species diversification goal. Trees planted in the right-

of-way that are not on the approved tree list may be subject to removal by the Urban Forester at the expense of the adjacent property owner.

c. Minimum Spacing. Approved shade trees shall have minimum spacing of forty (40) feet. Approved small trees shall have a minimum spacing of thirty (30) feet. The minimum tree spacing requirements shall apply to all newly planted trees only.

d. Location. All right-of-way trees shall be planted at least forty (40) feet from any city street intersection. Right-of-way trees shall be planted at least ten (10) feet

from any driveway or alley entrance. Shade trees require a minimum right-of-way width of nine (9) feet. Small trees require a right-of-way minimum width of five (5) feet. For best practice, trees must be planted mid-way between the curb or street edge and the edge of the sidewalk or property line. Tree spacing may be altered at the discretion of the Urban Forester if utilities or other restrictions exist.

e. Size. All new trees shall have a minimum diameter of one (1) inch measured four (4) feet above grade immediately after planting.

2. Removal. The Urban Forester shall have the authority to evaluate the health of any tree located within the right-of-way and shall have the authority to determine whether said tree is dead or diseased. The Urban Forester shall also have the authority to determine if tree removal is warranted and has the authority to remove any tree that poses risk of personal injury or property damage. All tree stumps must be ground down, backfilled with soil to match the existing grade, and reseeded. Property owners shall not be required to remove dead or diseased trees on publicly owned property or right-of-way.

   a. Permit. A right-of-way permit from the Oskaloosa Public Works Department is required prior to the removal of any tree within the public right-of-way.

   b. Insurance. Prior to issuing a right-of-way permit and as a condition thereto, the property owner shall file proof of liability insurance coverage in the amount of not less than three hundred thousand dollars ($300,000) with the Public Works Department. Contractors and professional tree removal companies shall file proof of liability insurance coverage in the amount of not less than five hundred thousand dollars ($500,000).

3. Right-of-Way Tree Plan. Residential and commercial developments shall submit a right- of-way tree plan meeting the provisions of this chapter for the right-of-way adjacent to that development. The right-of-way tree plan shall clearly denote the locations of existing utilities and the proposed tree species, spacing, and locations.

   a. Site Plan Review. A right-of-way tree plan meeting the provisions of this chapter shall be submitted for review as part of the site plan requirements in Section 17.34.020.

   b. Residential Development. A right-of-way tree plan meeting the provisions of

this chapter shall be submitted for review for all building permit applications meeting the requirements of Section 15.04.230.

c. Number of Trees. The required number of trees on any given site plan, will be determined by the tree spacing requirements and the length of the right-of-way abutting the developed property.

d. The Public Works Director, in consultation with the Urban Forester, may approve minor plan modifications or an alternative landscaping plan, provided that those plans are consistent with the goals and purposes of this chapter.

12.40.050 Responsibility for Maintenance of Right-of-Way Trees

The owner, tenant and their agent, if any, of the property abutting the public right-of-way on which trees exist shall be jointly and severally responsible for the maintenance of those trees under this chapter. Such trees shall be maintained in good condition so as to present a healthy and orderly appearance and shall be kept free from refuse and debris. The owner or agent of the abutting property shall keep the trees on or overhanging the street trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above sidewalks. The city will take responsibility for the trimming or removal of all damaged right-of-way trees in the event of a state or federal government state of emergency declaration for the City of Oskaloosa.

12.40.060 Assessment

If the owner, tenant and their agent, if any, of the property abutting the public right-of-way on which trees exist fails to trim the trees as required by this chapter, the city may serve notice to said property owner requiring them to do so within thirty (30) days. If the property owner fails to trim the trees within that time or does not perform the trimming to the satisfaction of the Urban Forester, the city may complete the required action and assess the costs against the abutting property for collection in the same manner as a property tax. The tree trimming fee rates are set by resolution by the city council and are stated in the Oskaloosa Fee Schedule.

12.40.070 Protection of Trees in Public Places

No person shall fasten any sign, box, wire, rope, or other material to any tree in any right-of-way, park, or public place, except by permission of the city. No person shall break, deface, injure, or destroy any tree or shrub in any right-of-way, park, or public place. Wiring and staking trees to protect and encourage proper growth is allowed.

12.40.080 Tree Topping Prohibited.

It is unlawful for any person to top any tree located upon public grounds or right-of-way.

Trees damaged by storms or other causes, or trees near or under utility wires or other obstructions where other pruning practices are impractical may be exempted from this prohibition at the determination of the Urban Forester.

12.40.090 Urban Forester

The city shall appoint an Urban Forester. The employee shall be appointed by the City Manager or designee. The Urban Forester shall direct, regulate, and control the planting, care, and removal of all trees and shrubs growing in any street right-of-way, park, or public place. The Urban Forester shall advise the owners and occupants of private property regarding the kind, culture, care, and disposal of any tree or shrub within the city limits. The Urban Forester shall cause the provisions of this code relating to trees and shrubs in the right-of-way, parks, and public places to be enforced.

12.40.100 Penalty

Any person violating any provision of this chapter shall be guilty of a simple misdemeanor.

SECTION 3: 15.04.04.230 PERMIT APPLICATION PLANS AND SPECIFICATIONS shall include the
following in paragraph A: The plans and specifications shall include a Right-of-Way Tree Plan meeting the requirements of Section 12.40.00

SECTION 4: 17.34.020 - SITE PLAN REVIEW PROCEDURE shall include the following in Section F paragraph 10: The plans and specifications shall include a Right-of-Way Tree Plan meeting the requirements of Section 12.40.00.

SECTION 5: REPEALER. All ordinances or parts thereof in conflict with the provisions of this ordinance are hereby repealed.

SECTION 6: SEVERABILITY CLAUSE. If any section, provision, or part of this ordinance shall be adjudged invalid or unconstitutional such adjudication shall not affect the validity of this ordinance as a whole or any section, provision, or part thereof not adjudged invalid or unconstitutional.

SECTION 7: WHEN EFFECTIVE. This ordinance shall be in effect from and after its final passage, approval, and publication as provided by law.

Passed by the Council the 21st day of December 2015, and approved this 21 day of December 2015.

_____

David Krutzfeldt, Mayor

ATTEST:

_____

Amy Miller, City Clerk

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.