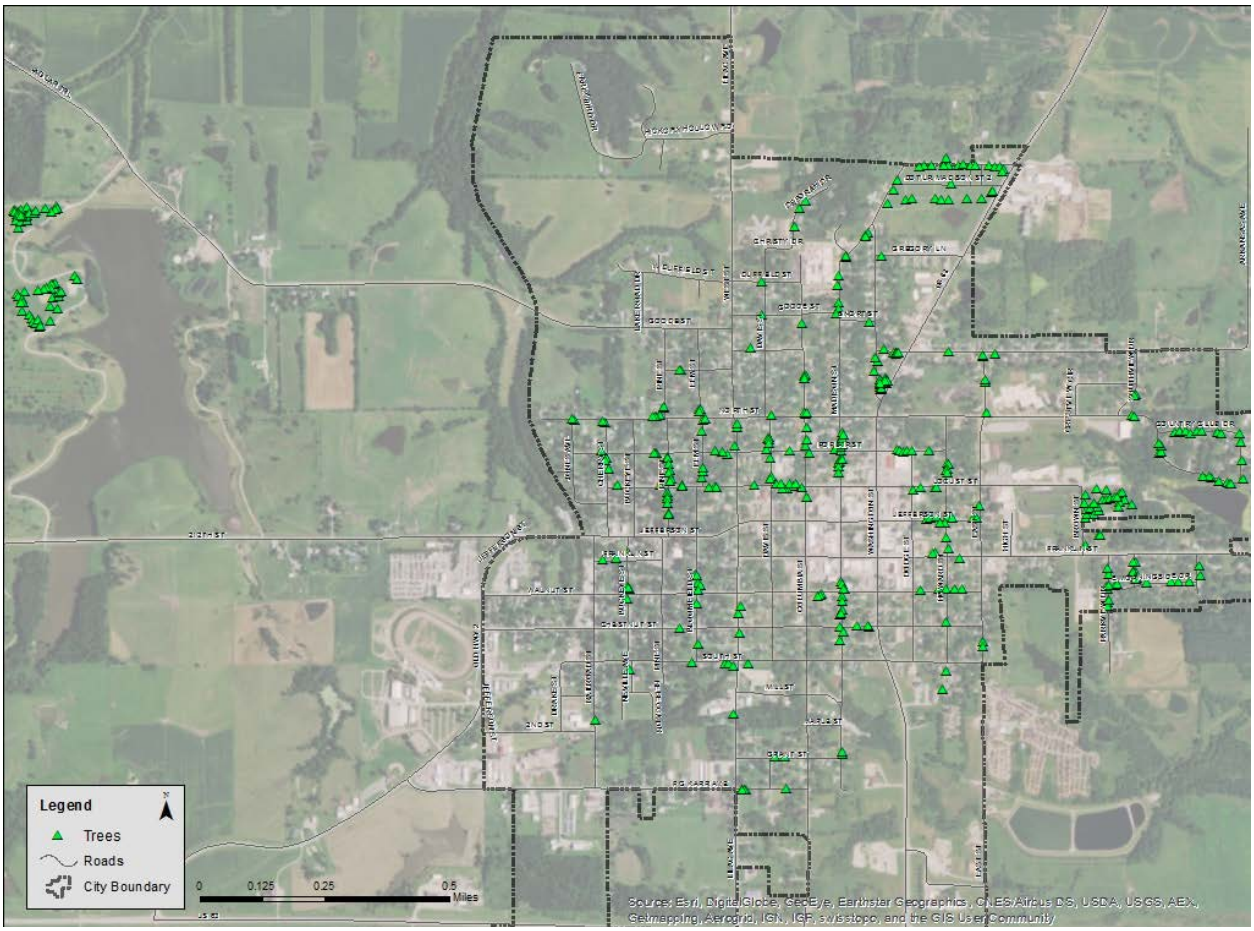
BLOOMFIELD, IA



2016 Urban Forest Management Plan
Prepared by Kittelson Consulting Arborist, LLC
In Partnership with the Iowa DNR

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Executive Summary

Overview

This plan was developed to assist the City of Bloomfield 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 15.7% of Bloomfield'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 414 trees inventoried.

- Bloomfield's trees provide $88,808 of benefits annually, an average of $215 a tree
- There are over 45 species of trees
- The top three genera are: Maple 25%, Oak 17.6%, and Ash 15.7%
- 51% of trees are in need of some type of management
- 87 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 87 trees needing removal, 41 (25 are ash) 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*
- 53 of the 65 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.
- Check ash trees with a visual survey yearly
- With the current budget it could take 8 years to remove ash – Suggestion: request a budget increase to $11,500 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2016, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. 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 414 city trees was entered into the USDA Forest service program i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Bloomfield's trees reduce energy related costs by approximately $22,090 annually (Appendix A, Table 1). These savings are both in Electricity (106.5 MWh) and in Natural Gas (14,292.8 Therms).

Annual Stormwater Benefits

Bloomfield's trees intercept about 1,241,640 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $33,648 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 mater (ozone). In Bloomfield, it is estimated that trees remove 1,374 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $3,856 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Bloomfield, trees sequester about 296,131 lbs. of carbon a year with an associated value of $3,367 (Appendix A, Table 4). In addition, the trees store 5,153,550 lbs of carbon, with a yearly benefit of $38,652 (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. Bloomfield receives $25,848 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree analysis, Bloomfield's trees provide $88,808 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 414 trees in Bloomfield provide approximately $214 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Bloomfield has over 45 different tree species along city streets and parks (Appendix A, Figure 1).
The top 10 distribution of trees by genera is as follows:

Maple	103	25%
Oak	73	18%
Ash	65	16%
Apple (Crab)	21	5%
Walnut	20	4.8%
Elm	20	4.8%
Pine	16	3.9%
Sycamore	13	3%
Spruce	12	2.9%
Honeylocust	11	2.6%
Others	60	14.5%

Age Class

Most of Bloomfield's trees (50%) are between 12 and 30 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. Bloomfield's size curve is in the middle, indicating a fairly balanced 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 Bloomfield indicate that 88% of the trees are in good health, with only 12% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 73% of Bloomfield'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 27% of the population. This 27% 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 7).

Crown Cleaning	108	26%
Crown Raising	1	.2%
Tree Staking	0	0%
Tree Removal	87	21%
Crown Reduction	20	4.8%

Treat	5	1.2%

Canopy Cover

The total canopy with both private and public trees is 23%, 331 acres. The canopy cover included in the Bloomfield inventory includes approximately 13 acres (Appendix A, Figure 5).

Land Use and Location

The majority of Bloomfield'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	60%
Park/vacant/other	34%
Industrial/Large commercial	.24%
Small commercial	2.9%
Multifamily residential	2.66%

Location	
Planting strip	65.8%
Other maintained locations	34%
Cutout (surrounded by pavement)	.48%
Front yard	0.0%

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

Bloomfield has 6 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 5 trees over 36 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 immediate maintenance. There are a total of 6 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 88 removals, 59 are ash trees. There are a total of 65 ash trees, and 49 of those have signs and symptoms that have been associated with EAB. In addition, there are 24 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising 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 Bloomfield.

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 (25%) (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.

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 @$10,000/yr. with <u>No Additional Funding</u>

Year 1

Removal: 6 critical concern trees and 5 additional ash trees with poor health

Planting and Replacement: 13 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 6 immediate concern trees and 4 additional ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 12 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: 10 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 12 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: 10 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 12 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: 10 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 12 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: 10 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 12 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

*Reduction of ash over 6 years: Approximately 50 ash trees removed (approximately 77% of ash). It will take approximately 8 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
** To remove all ash trees within 6 years, the budget would need to be increased to $11,500 a year.

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 restriction in city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and should 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 or treating ash trees on their property upon arrival of EAB. Bloomfield City Codes 151.05 and 151.06 state:

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

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

(Code of Iowa, Sec. 364.12[3b & h])

Budget

Current Budget
Total $56,300 over 6 years ($9,940/year)

FY 2011 Budget
Removal: $7,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $1300
Watering & Maintenance: $500

FY 2012 Budget
Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $1200
Routine trimming: $1,700
Watering & Maintenance: $500

FY 2013 Budget
Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2014 Budget
Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

FY 2015 Budget
Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2016 Budget
Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

*Reduction of ash over 6 years: Approximately 50 ash trees removed (approximately 77% of ash). It will take approximately 8 years to remove all ash with the current budget
** To remove all ash trees within 6 years, the budget would need to be increased to $11,500 a year.

Purposed Budget Increase

EAB could potentially kill all ash trees in Bloomfield within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $11,500 a year. If the budget were increased to $10,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Bloomfield 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 24 inches and at $15 per inch, about 3 trees could be treated per year (every other year treatment). This would be 3 trees selected for treatment, and would still need to find $5,920 for removal. Alternatively, if there are 6 treatable trees, it would cost approximately $2,160 every 2 years for treatment of all 6 and leave $4,840 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees when EAB is found in Bloomfield. It is suggested to consider increasing the budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species									
Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Silver maple	23.96	1,818.29	3,148.30	3,085.33	4,903.63	(N/A)	17.15	22.20	69.07
Green ash	15.41	1,169.46	2,063.62	2,022.35	3,191.80	(N/A)	13.53	14.45	57.00
Pin oak	15.09	1,145.32	2,019.13	1,978.74	3,124.07	(N/A)	12.32	14.14	61.26
Apple	0.93	70.28	157.63	154.48	224.76	(N/A)	5.07	1.02	10.70
Norway maple	4.42	335.69	622.22	609.78	945.46	(N/A)	4.83	4.28	47.27
Black walnut	4.66	354.04	635.26	622.56	976.59	(N/A)	4.83	4.42	48.83
White oak	6.09	462.44	796.97	781.03	1,243.47	(N/A)	4.35	5.63	69.08
American sycamore	4.47	339.56	627.62	615.06	954.62	(N/A)	3.14	4.32	73.43
Honeylocust	3.24	245.58	413.91	405.63	651.21	(N/A)	2.66	2.95	59.20
Eastern white pine	0.72	54.95	104.00	101.92	156.87	(N/A)	2.66	0.71	14.26
Siberian elm	3.22	244.10	432.51	423.86	667.96	(N/A)	2.42	3.02	66.80
Black maple	2.39	181.10	312.84	306.58	487.68	(N/A)	2.42	2.21	48.77
White ash	2.75	208.80	330.26	323.65	532.45	(N/A)	2.17	2.41	59.16
Eastern redbud	1.07	81.16	157.67	154.52	235.67	(N/A)	1.93	1.07	29.46
Blue spruce	0.32	24.13	47.19	46.24	70.38	(N/A)	1.93	0.32	8.80
Northern hackberry	1.86	140.95	244.52	239.63	380.58	(N/A)	1.45	1.72	63.43
American elm	2.68	203.52	352.58	345.53	549.05	(N/A)	1.45	2.49	91.51
Callery pear	0.95	71.82	118.76	116.39	188.21	(N/A)	1.21	0.85	37.64
Scotch pine	0.43	32.41	57.75	56.60	89.01	(N/A)	1.21	0.40	17.80
Chinese elm	1.48	112.03	204.44	200.35	312.38	(N/A)	0.97	1.41	78.10
Others	10.38	787.69	1,445.64	1,416.73	2,204.42		12.32	9.98	1,153.00
Total	106.50	8,083.32	14,292.82	14,006.97	22,090.29	(N/A)	100.00	100.00	53.36

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species						
Species	Total Rainfall Interception (Gal)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Silver maple	354,527.18	9,607.69	(N/A)	17.15	28.55	135.32
Green ash	180,680.04	4,896.43	(N/A)	13.53	14.55	87.44
Pin oak	157,006.73	4,254.88	(N/A)	12.32	12.65	83.43
Apple	3,685.39	99.87	(N/A)	5.07	0.30	4.76
Norway maple	39,190.58	1,062.06	(N/A)	4.83	3.16	53.10
Black walnut	44,582.79	1,208.19	(N/A)	4.83	3.59	60.41
White oak	78,082.86	2,116.05	(N/A)	4.35	6.29	117.56
American sycamore	58,436.24	1,583.62	(N/A)	3.14	4.71	121.82
Honeylocust	28,276.42	766.29	(N/A)	2.66	2.28	69.66
Eastern white pine	11,798.82	319.75	(N/A)	2.66	0.95	29.07
Siberian elm	34,231.71	927.68	(N/A)	2.42	2.76	92.77
Black maple	19,133.98	518.53	(N/A)	2.42	1.54	51.85
White ash	35,647.40	966.04	(N/A)	2.17	2.87	107.34
Eastern redbud	4,749.47	128.71	(N/A)	1.93	0.38	16.09
Blue spruce	3,401.93	92.19	(N/A)	1.93	0.27	11.52
Northern hackberry	14,630.51	396.49	(N/A)	1.45	1.18	66.08
American elm	25,534.74	691.99	(N/A)	1.45	2.06	115.33
Callery pear	5,648.58	153.08	(N/A)	1.21	0.45	30.62
Scotch pine	4,863.80	131.81	(N/A)	1.21	0.39	26.36
Chinese elm	20,810.65	563.97	(N/A)	0.97	1.68	140.99
Others	116,719.96	3,163.11		12.32	9.40	1,610.90
Citywide total	1,241,639.78	33,648.44	(N/A)	100.00	100.00	81.28

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species																	
Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Tree Numbers	Avg. $/tree
Silver maple	62.42	10.58	30.49	2.77	336.10	112.89	16.53	15.78	108.36	706.38	- 32.34	- 121.29	327.47	921.20	(N/A)	17.15	12.97
Green ash	25.61	4.10	11.90	1.15	135.37	73.16	10.68	10.19	69.83	456.75	0.00	0.00	206.61	592.12	(N/A)	13.53	10.57
Pin oak	26.71	4.68	13.86	1.20	146.69	71.55	10.45	9.97	68.34	446.84	- 50.17	- 188.14	156.60	405.39	(N/A)	12.32	7.95
Apple	0.82	0.13	0.43	0.04	4.48	4.69	0.66	0.63	4.20	28.55	0.00	- 0.02	11.59	33.01	(N/A)	5.07	1.57
Norway maple	7.87	1.36	3.89	0.35	42.56	21.31	3.09	2.94	20.07	132.31	- 1.86	- 6.97	59.01	167.91	(N/A)	4.83	8.40
Black walnut	4.77	0.76	2.41	0.21	25.77	22.24	3.24	3.09	21.14	138.62	0.00	0.00	57.87	164.39	(N/A)	4.83	8.22
White oak	13.42	2.14	6.02	0.60	70.30	28.76	4.21	4.02	27.61	179.99	0.00	0.00	86.78	250.29	(N/A)	4.35	13.90
American sycamore	7.97	1.27	3.67	0.36	42.04	21.50	3.12	2.97	20.27	133.57	0.00	0.00	61.14	175.61	(N/A)	3.14	13.51
Honeylocust	5.26	0.87	2.45	0.24	27.91	15.17	2.23	2.13	14.65	95.14	- 3.85	- 14.42	39.14	108.63	(N/A)	2.66	9.88
Eastern white pine	1.27	0.25	1.09	0.16	8.48	3.49	0.51	0.48	3.28	21.66	- 5.53	- 20.74	4.99	9.40	(N/A)	2.66	0.85
Siberian elm	5.76	0.98	2.81	0.25	31.03	15.28	2.23	2.13	14.57	95.34	0.00	0.00	44.01	126.37	(N/A)	2.42	12.64
Black maple	4.44	0.76	2.08	0.20	23.69	11.26	1.65	1.57	10.81	70.45	- 1.52	- 5.69	31.25	88.45	(N/A)	2.42	8.85
White ash	7.91	1.26	3.50	0.35	41.32	12.70	1.88	1.80	12.45	80.14	0.00	0.00	41.86	121.46	(N/A)	2.17	13.50
Eastern redbud	1.54	0.25	0.72	0.07	8.19	5.20	0.75	0.71	4.85	32.17	- 0.01	- 0.03	14.09	40.33	(N/A)	1.93	5.04
Blue spruce	0.32	0.06	0.31	0.04	2.24	1.55	0.22	0.21	1.44	9.56	- 1.07	- 4.00	3.09	7.79	(N/A)	1.93	0.97
Northern hackberry	2.08	0.36	1.11	0.09	11.49	8.80	1.29	1.23	8.42	54.99	0.00	0.00	23.37	66.47	(N/A)	1.45	11.08
American elm	6.49	1.11	3.09	0.29	34.73	12.68	1.86	1.77	12.15	79.29	0.00	0.00	39.43	114.02	(N/A)	1.45	19.00
Callery pear	0.87	0.15	0.47	0.04	4.83	4.43	0.65	0.62	4.29	27.84	- 0.23	- 0.86	11.30	31.81	(N/A)	1.21	6.36
Scotch pine	0.49	0.10	0.45	0.06	3.38	2.03	0.30	0.28	1.93	12.66	- 1.59	- 5.96	4.05	10.07	(N/A)	1.21	2.01
Chinese elm	3.01	0.48	1.36	0.13	15.82	7.07	1.03	0.98	6.69	43.98	0.00	0.00	20.76	59.80	(N/A)	0.97	14.95
Others	17.87	3.02	9.29	0.99	98.21	49.76	7.23	6.89	47.03	309.46	- 12.43	- 46.61	129.66	361.06		12.32	191.18
Citywide Total	206.89	34.68	101.41	9.59	1,114.61	505.50	73.80	70.40	482.39	3,155.71	- 110.59	- 414.73	1,374.07	3,855.59	(N/A)	100.00	9.31

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species						
Species	Total stored CO2 (lbs)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Silver maple	1,432,276.89	10,742.08	(N/A)	17.15	27.79	151.30
Green ash	861,829.19	6,463.72	(N/A)	13.53	16.72	115.42
Pin oak	698,528.31	5,238.96	(N/A)	12.32	13.55	102.72
Apple	14,991.41	112.44	(N/A)	5.07	0.29	5.35
Norway maple	130,276.26	977.07	(N/A)	4.83	2.53	48.85
Black walnut	154,854.42	1,161.41	(N/A)	4.83	3.00	58.07
White oak	462,287.02	3,467.15	(N/A)	4.35	8.97	192.62
American sycamore	260,583.35	1,954.38	(N/A)	3.14	5.06	150.34
Honeylocust	66,313.65	497.35	(N/A)	2.66	1.29	45.21
Eastern white pine	12,928.53	96.96	(N/A)	2.66	0.25	8.81
Siberian elm	140,082.41	1,050.62	(N/A)	2.42	2.72	105.06
Black maple	48,479.12	363.59	(N/A)	2.42	0.94	36.36
White ash	111,582.56	836.87	(N/A)	2.17	2.17	92.99
Eastern redbud	23,860.39	178.95	(N/A)	1.93	0.46	22.37
Blue spruce	1,578.43	11.84	(N/A)	1.93	0.03	1.48
Northern hackberry	31,372.61	235.29	(N/A)	1.45	0.61	39.22
American elm	131,203.31	984.02	(N/A)	1.45	2.55	164.00
Callery pear	14,513.48	108.85	(N/A)	1.21	0.28	21.77
Scotch pine	3,110.54	23.33	(N/A)	1.21	0.06	4.67
Chinese elm	99,602.51	747.02	(N/A)	0.97	1.93	186.75
Others	453,295.27	3,399.71		12.32	8.80	1,864.93
Citywide total	5,153,549.68	38,651.62	(N/A)	100.00	100.00	93.36

Table 5: Annual Carbon Sequestered

Annual CO2 Benefits of Public Trees by Species													
Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Tree	% of Total $	Avg. $/tree
Silver maple	103,004.36	772.53	- 6,876.33	- 268.32	- 53.58	40,183.83	301.38	136,043.55	1,020.33	(N/A)	17.15	30.31	14.37
Green ash	32,549.76	244.12	- 4,136.78	- 164.97	- 32.26	25,844.64	193.83	54,092.65	405.69	(N/A)	13.53	12.05	7.24
Pin oak	62,141.78	466.06	- 3,352.94	- 156.39	- 26.32	25,311.34	189.84	83,943.79	629.58	(N/A)	12.32	18.70	12.34
Apple	1,639.92	12.30	- 72.27	- 16.38	- 0.66	1,553.25	11.65	3,104.52	23.28	(N/A)	5.07	0.69	1.11
Norway maple	6,544.43	49.08	- 625.43	- 44.07	- 5.02	7,418.58	55.64	13,293.50	99.70	(N/A)	4.83	2.96	4.99
Black walnut	10,956.20	82.17	- 743.30	- 47.58	- 5.93	7,824.08	58.68	17,989.40	134.92	(N/A)	4.83	4.01	6.75
White oak	10,495.76	78.72	- 2,218.98	- 67.08	- 17.15	10,219.78	76.65	18,429.48	138.22	(N/A)	4.35	4.11	7.68
American sycamore	10,966.45	82.25	- 1,250.80	- 48.75	- 9.75	7,504.19	56.28	17,171.09	128.78	(N/A)	3.14	3.83	9.91
Honeylocust	8,902.83	66.77	- 318.31	- 24.57	- 2.57	5,427.23	40.70	13,987.18	104.90	(N/A)	2.66	3.12	9.54
Eastern white pine	792.37	5.94	- 62.06	- 14.24	- 0.57	1,214.36	9.11	1,930.43	14.48	(N/A)	2.66	0.43	1.32
Siberian elm	6,139.05	46.04	- 672.40	- 34.32	- 5.30	5,394.59	40.46	10,826.92	81.20	(N/A)	2.42	2.41	8.12
Black maple	3,186.68	23.90	- 232.70	- 21.06	- 1.90	4,002.37	30.02	6,935.29	52.01	(N/A)	2.42	1.55	5.20
White ash	5,067.01	38.00	- 535.60	- 25.35	- 4.21	4,614.37	34.61	9,120.44	68.40	(N/A)	2.17	2.03	7.60
Eastern redbud	1,949.58	14.62	- 114.53	- 13.65	- 0.96	1,793.55	13.45	3,614.95	27.11	(N/A)	1.93	0.81	3.39
Blue spruce	180.99	1.36	- 7.59	- 5.85	- 0.10	533.34	4.00	700.88	5.26	(N/A)	1.93	0.16	0.66
Northern hackberry	1,862.15	13.97	- 150.59	- 15.60	- 1.25	3,114.97	23.36	4,810.93	36.08	(N/A)	1.45	1.07	6.01
American elm	3,284.54	24.63	- 629.78	- 25.74	- 4.92	4,497.80	33.73	7,126.82	53.45	(N/A)	1.45	1.59	8.91
Callery pear	1,549.22	11.62	- 69.72	- 8.00	- 0.58	1,587.22	11.90	3,058.72	22.94	(N/A)	1.21	0.68	4.59
Scotch pine	388.97	2.92	- 14.93	- 7.41	- 0.17	716.22	5.37	1,082.84	8.12	(N/A)	1.21	0.24	1.62
Chinese elm	3,490.99	26.18	- 478.09	- 16.38	- 3.71	2,475.77	18.57	5,472.28	41.04	(N/A)	0.97	1.22	10.26
Others	21,037.96	157.78	- 2,175.99	- 128.12	- 17.28	17,407.75	130.56	36,141.61	271.06		12.32	8.05	151.01
Citywide Total	296,130.99	2,220.98	- 24,739.10	- 1,153.83	- 194.20	178,639.24	1,339.79	448,877.30	3,366.58	(N/A)	100.00	100.00	8.13

Table 6: Annual Social and Aesthetic Benefits

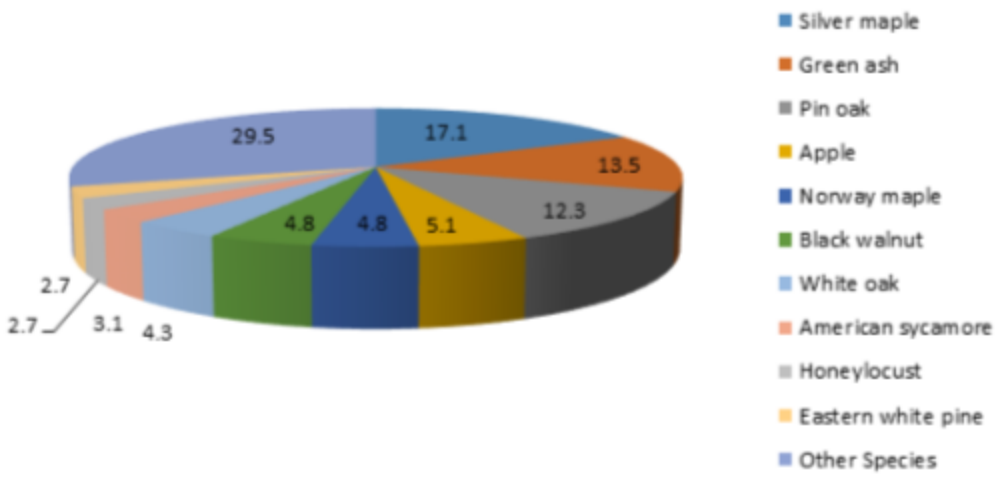
Annual Aesthetic/Other Benefit of Public Trees by Species					
Species	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Silver maple	7,886.38	(N/A)	17.15	30.51	111.08
Green ash	2,696.71	(N/A)	13.53	10.43	48.16
Pin oak	4,950.74	(N/A)	12.32	19.15	97.07
Apple	90.54	(N/A)	5.07	0.35	4.31
Norway maple	633.11	(N/A)	4.83	2.45	31.66
Black walnut	989.46	(N/A)	4.83	3.83	49.47
White oak	810.30	(N/A)	4.35	3.13	45.02
American sycamore	817.49	(N/A)	3.14	3.16	62.88
Honeylocust	2,100.91	(N/A)	2.66	8.13	190.99
Eastern white pine	185.01	(N/A)	2.66	0.72	16.82
Siberian elm	434.31	(N/A)	2.42	1.68	43.43
Black maple	432.31	(N/A)	2.42	1.67	43.23
White ash	566.61	(N/A)	2.17	2.19	62.96
Eastern redbud	114.57	(N/A)	1.93	0.44	14.32
Blue spruce	105.63	(N/A)	1.93	0.41	13.20
Northern hackberry	288.96	(N/A)	1.45	1.12	48.16
American elm	431.07	(N/A)	1.45	1.67	71.84
Callery pear	159.37	(N/A)	1.21	0.62	31.87
Scotch pine	110.90	(N/A)	1.21	0.43	22.18
Chinese elm	249.22	(N/A)	0.97	0.96	62.31
Others	1,793.97		12.32	6.94	992.77
Citywide Total	25,847.60	(N/A)	100.00	100.00	62.43

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species ($/tree)							
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/ Other	Total	Standard Error
Silver maple	69.07	14.37	12.97	135.32	111.08	342.81	(N/A)
Green ash	57.00	7.24	10.57	87.44	48.16	210.41	(N/A)
Pin oak	61.26	12.34	7.95	83.43	97.07	262.05	(N/A)
Apple	10.70	1.11	1.57	4.76	4.31	22.45	(N/A)
Norway maple	47.27	4.99	8.40	53.10	31.66	145.41	(N/A)
Black walnut	48.83	6.75	8.22	60.41	49.47	173.68	(N/A)
White oak	69.08	7.68	13.90	117.56	45.02	253.24	(N/A)
American sycamore	73.43	9.91	13.51	121.82	62.88	281.55	(N/A)
Honeylocust	59.20	9.54	9.88	69.66	190.99	339.27	(N/A)
Eastern white pine	14.26	1.32	0.85	29.07	16.82	62.32	(N/A)
Siberian elm	66.80	8.12	12.64	92.77	43.43	223.75	(N/A)
Black maple	48.77	5.20	8.85	51.85	43.23	157.90	(N/A)
White ash	59.16	7.60	13.50	107.34	62.96	250.55	(N/A)
Eastern redbud	29.46	3.39	5.04	16.09	14.32	68.30	(N/A)
Blue spruce	8.80	0.66	0.97	11.52	13.20	35.16	(N/A)
Northern hackberry	63.43	6.01	11.08	66.08	48.16	194.76	(N/A)
American elm	91.51	8.91	19.00	115.33	71.84	306.60	(N/A)
Callery pear	37.64	4.59	6.36	30.62	31.87	111.08	(N/A)
Scotch pine	17.80	1.62	2.01	26.36	22.18	69.98	(N/A)
Chinese elm	78.10	10.26	14.95	140.99	62.31	306.60	(N/A)
Other	1,153.00	151.01	191.18	1,610.90	992.77	4,098.86	(N/A)
Citywide Total	53.36	8.13	9.31	81.28	62.43	214.51	(N/A)

Species Distribution of Public Trees

12/12/2016

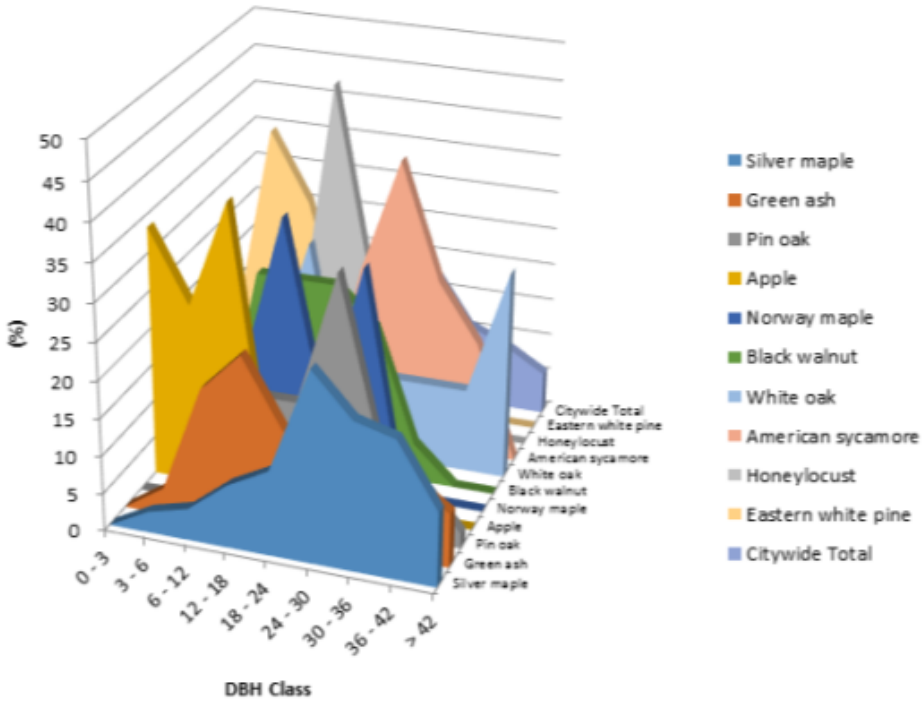


Species	Percent
Silver maple	17.1
Green ash	13.5
Pin oak	12.3
Apple	5.1
Norway maple	4.8
Black walnut	4.8
White oak	4.3
American sycamore	3.1
Honeylocust	2.7
Eastern white pine	2.7
Other Species	29.5
Total	100.0

Figure 1: Species Distribution

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

12/12/2016



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Silver maple	0.00	2.82	4.23	8.45	11.27	25.35	19.72	18.31	9.86
Green ash	0.00	3.57	17.86	23.21	14.29	10.71	12.50	10.71	7.14
Pin oak	0.00	0.00	13.73	15.69	15.69	33.33	11.76	7.84	1.96
Apple	33.33	23.81	38.10	0.00	4.76	0.00	0.00	0.00	0.00
Norway maple	10.00	0.00	15.00	35.00	10.00	30.00	0.00	0.00	0.00
Black walnut	0.00	0.00	25.00	25.00	25.00	20.00	5.00	0.00	0.00
White oak	0.00	0.00	11.11	27.78	0.00	11.11	11.11	11.11	27.78
American sycamore	0.00	0.00	0.00	0.00	23.08	38.46	23.08	15.38	0.00
Honeylocust	0.00	0.00	9.09	45.45	18.18	27.27	0.00	0.00	0.00
Eastern white pine	9.09	36.36	27.27	9.09	9.09	9.09	0.00	0.00	0.00
Citywide Total	4.11	5.31	14.25	20.29	12.56	18.36	10.87	8.70	5.56

Figure 2: Relative Age Class

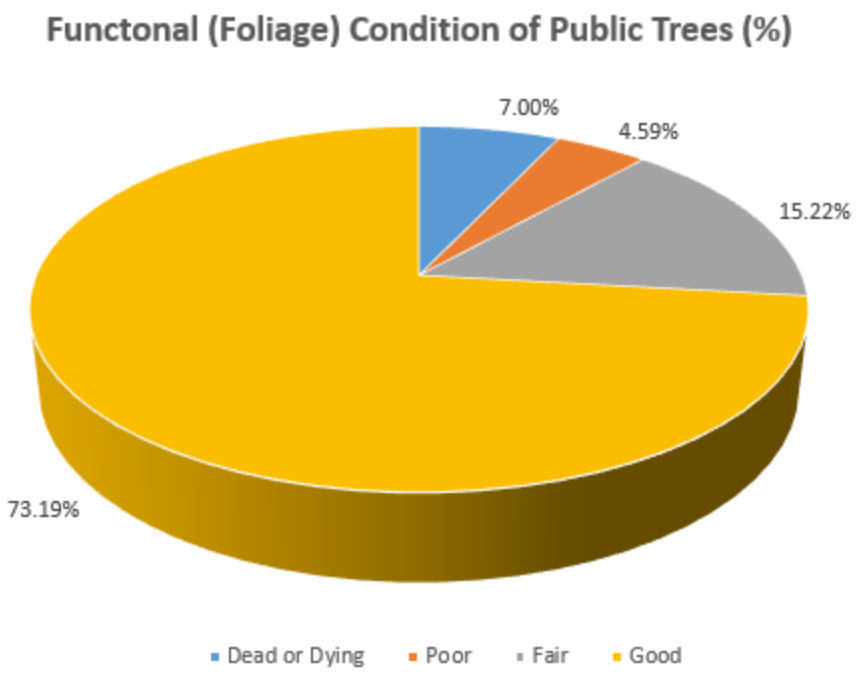


Figure 3: Foliage Condition

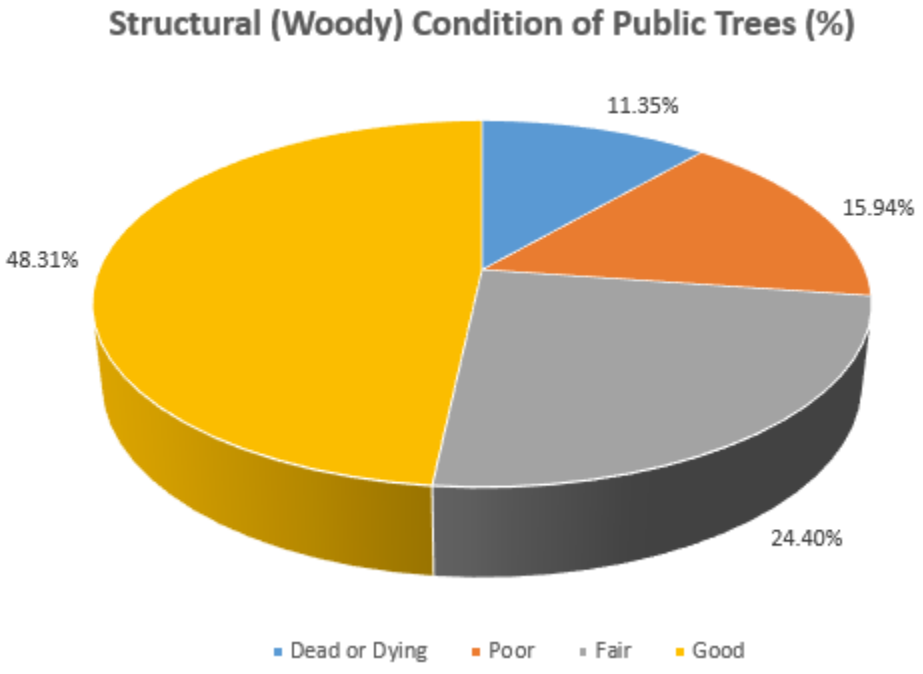
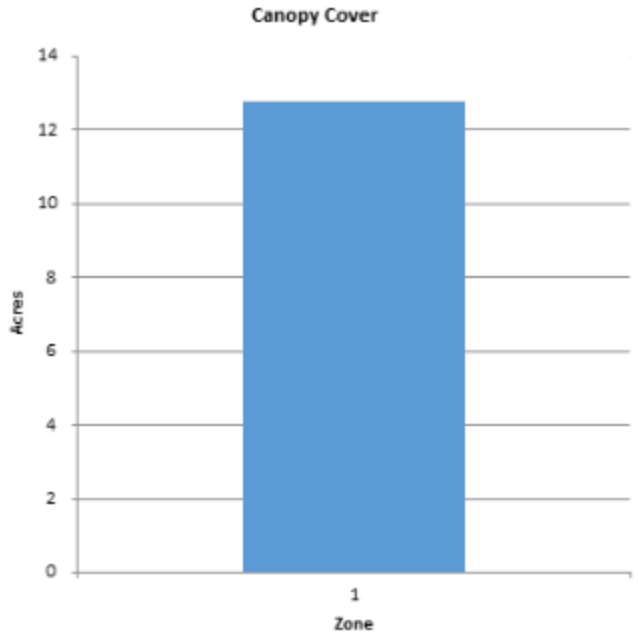


Figure 4: Wood Condition

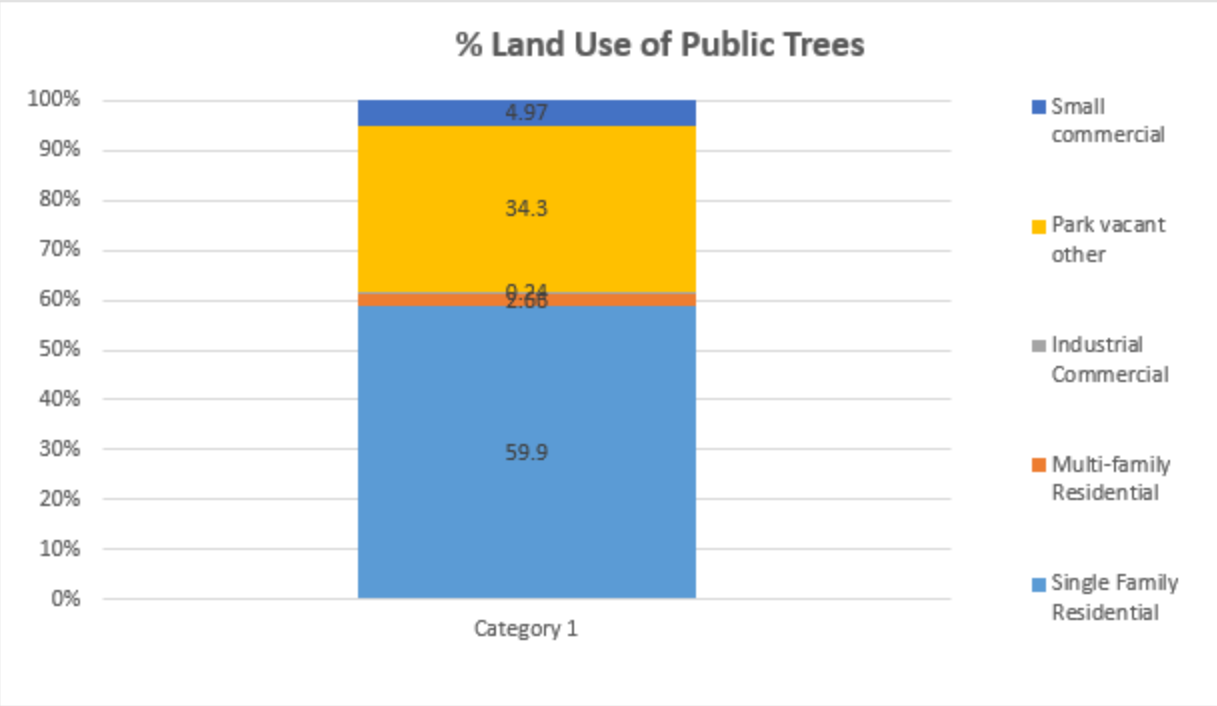
Canopy Cover of Public Trees (Acres)

12/13/2016



Zone	Acres	% of Total Canopy Cover
1	13	100.0
Citywide total	13	100.0

Figure 5: Canopy Cover in Acres

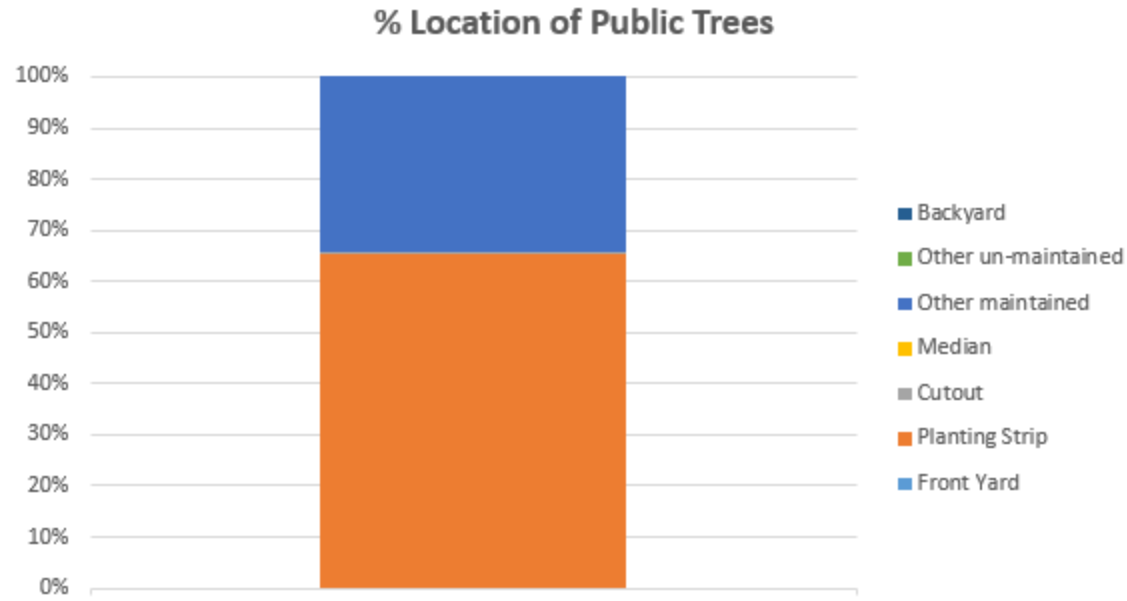


Land Use of Public Trees by Zone

12/13/2016

Zone	Land Use	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Single family residential	248	(NA)	59.90	59.90
	Multi-family residential	11	(NA)	2.66	2.66
	Industrial/Large commercial	1	(NA)	0.24	0.24
	Park/vacant/other	142	(NA)	34.30	34.30
	Small Commercial	12	(NA)	2.90	2.90
	Total	414	(NA)	100.00	100.00
Citywide	Single family residential	248	(NA)	59.90	59.90
	Multi-family residential	11	(NA)	2.66	2.66
	Industrial/Large commercial	1	(NA)	0.24	0.24
	Park/vacant/other	142	(NA)	34.30	34.30
	Small Commercial	12	(NA)	2.90	2.90
	Total	414	(NA)	100.00	100.00

Figure 6: Land Use of city/park trees



Citywide	Front yard	0	(N/A)	0.00
	Planting strip	270	(N/A)	65.20
	Cutout	2	(N/A)	0.48
	Median	0	(N/A)	0.00
	Other maintained locations	142	(N/A)	34.30
	Other un-maintained locations	0	(N/A)	0.00
	Backyard	0	(N/A)	0.00
	Total	414	(N/A)	100.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

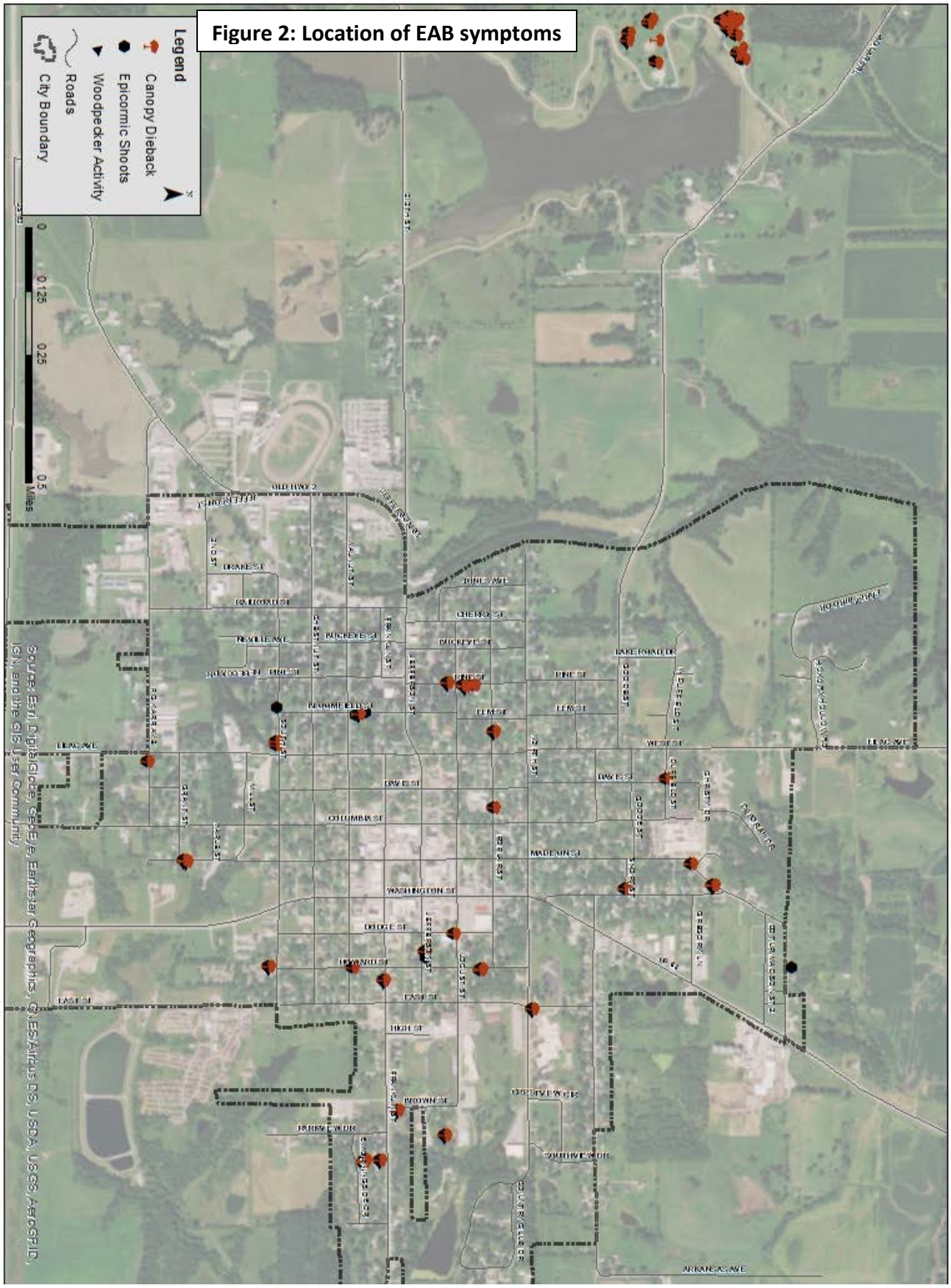


Figure 2: Location of EAB symptoms
Legend
Canopy Dieback
Epicormic Shoots
Woodpecker Activity
Roads
City Boundary
0
0.125
0.25
0.5
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 3: Location of Ash with Canopy Dieback

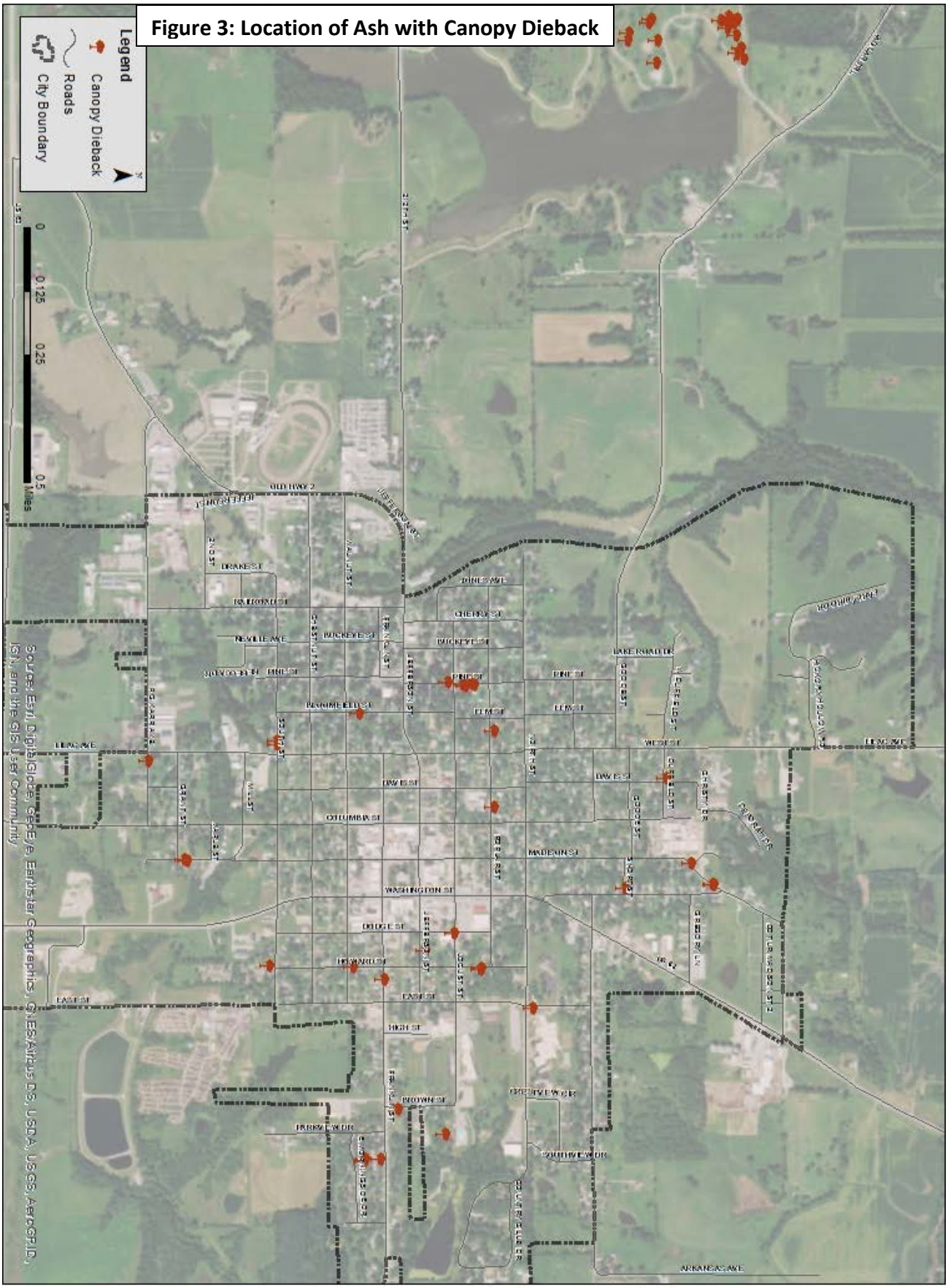


Figure 4: Location of Ash with Epicormic Shoots

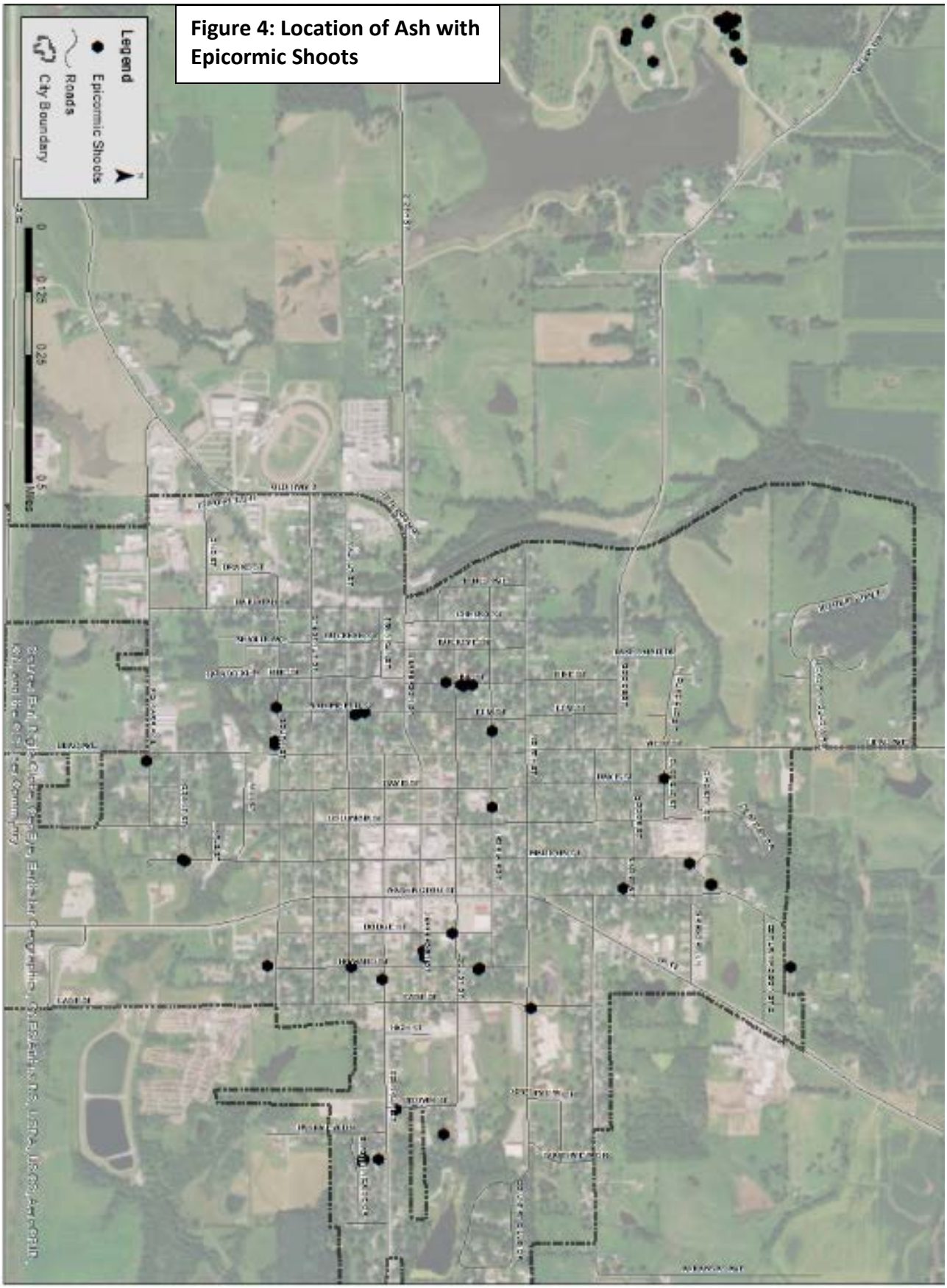


Figure 5: Location of Ash with Woodpecker Activity

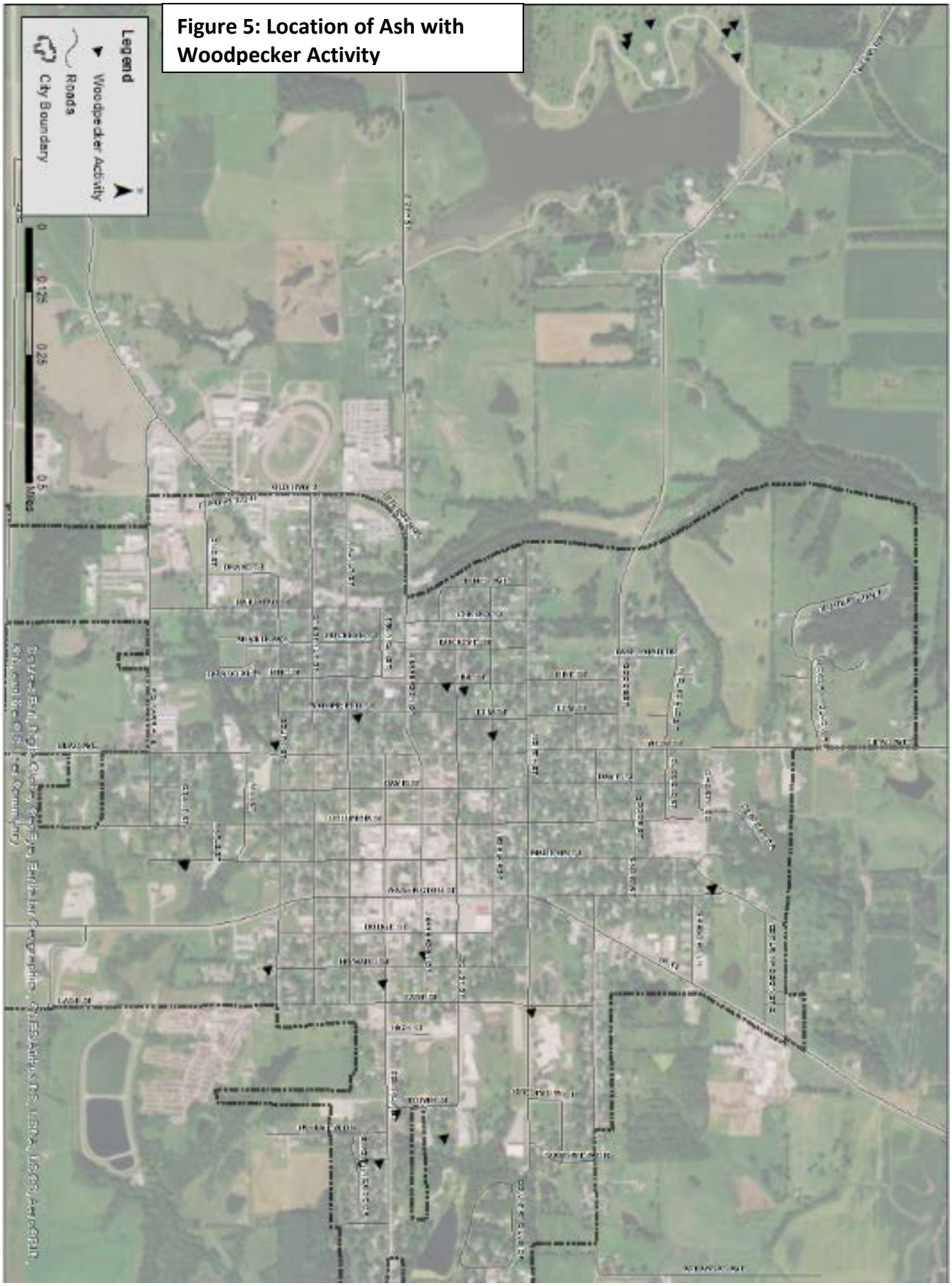
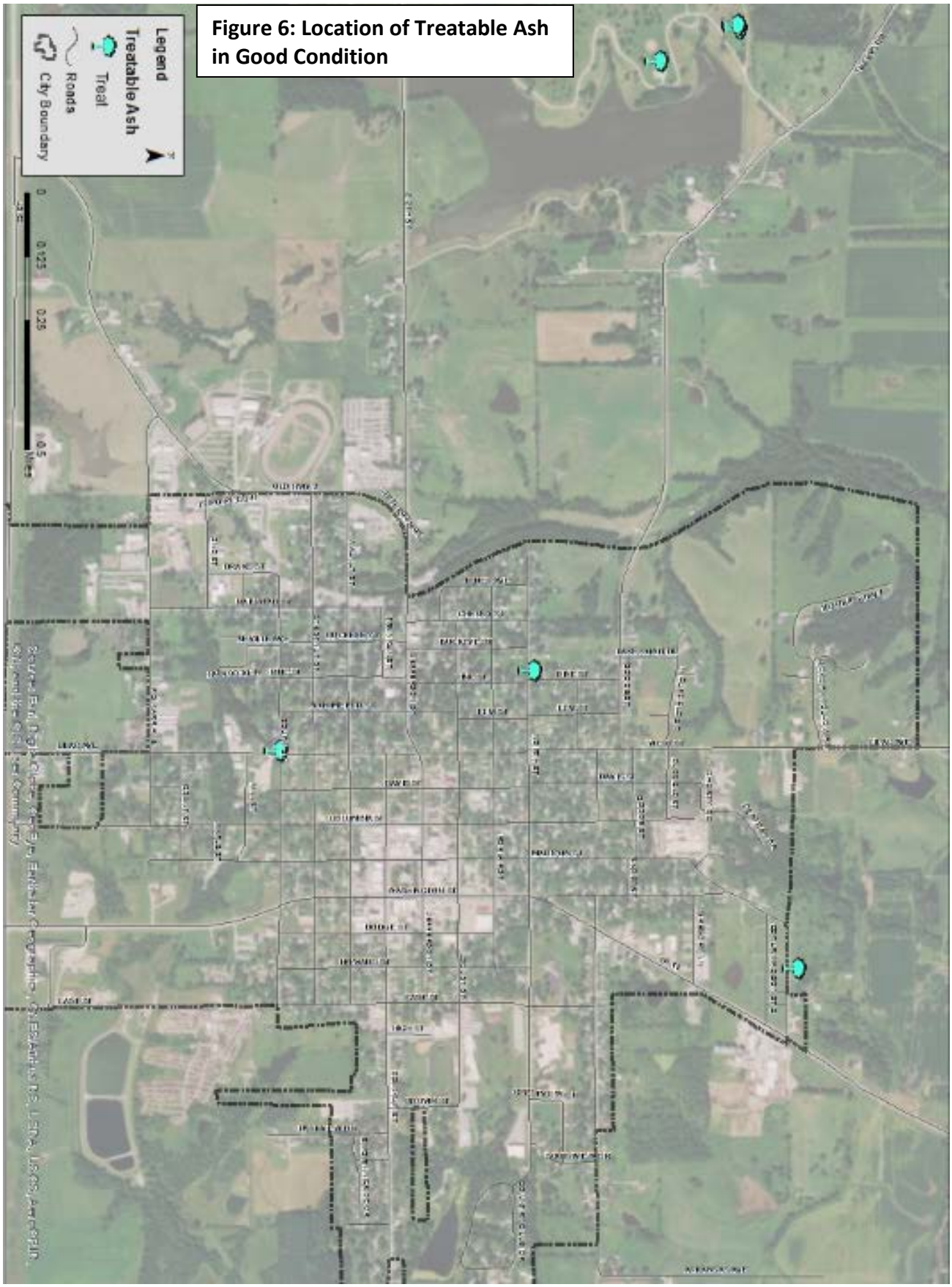


Figure 6: Location of Treatable Ash in Good Condition



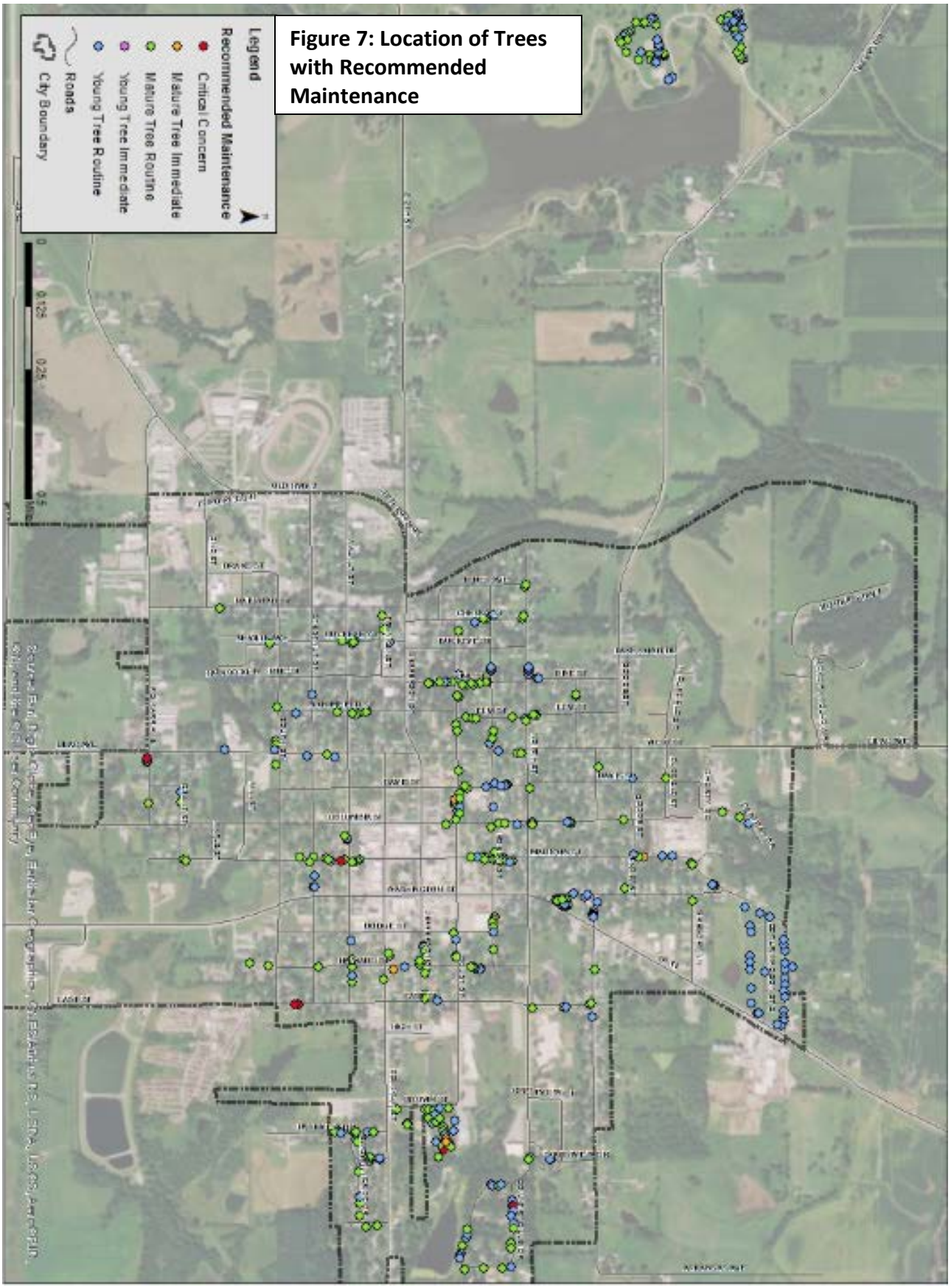
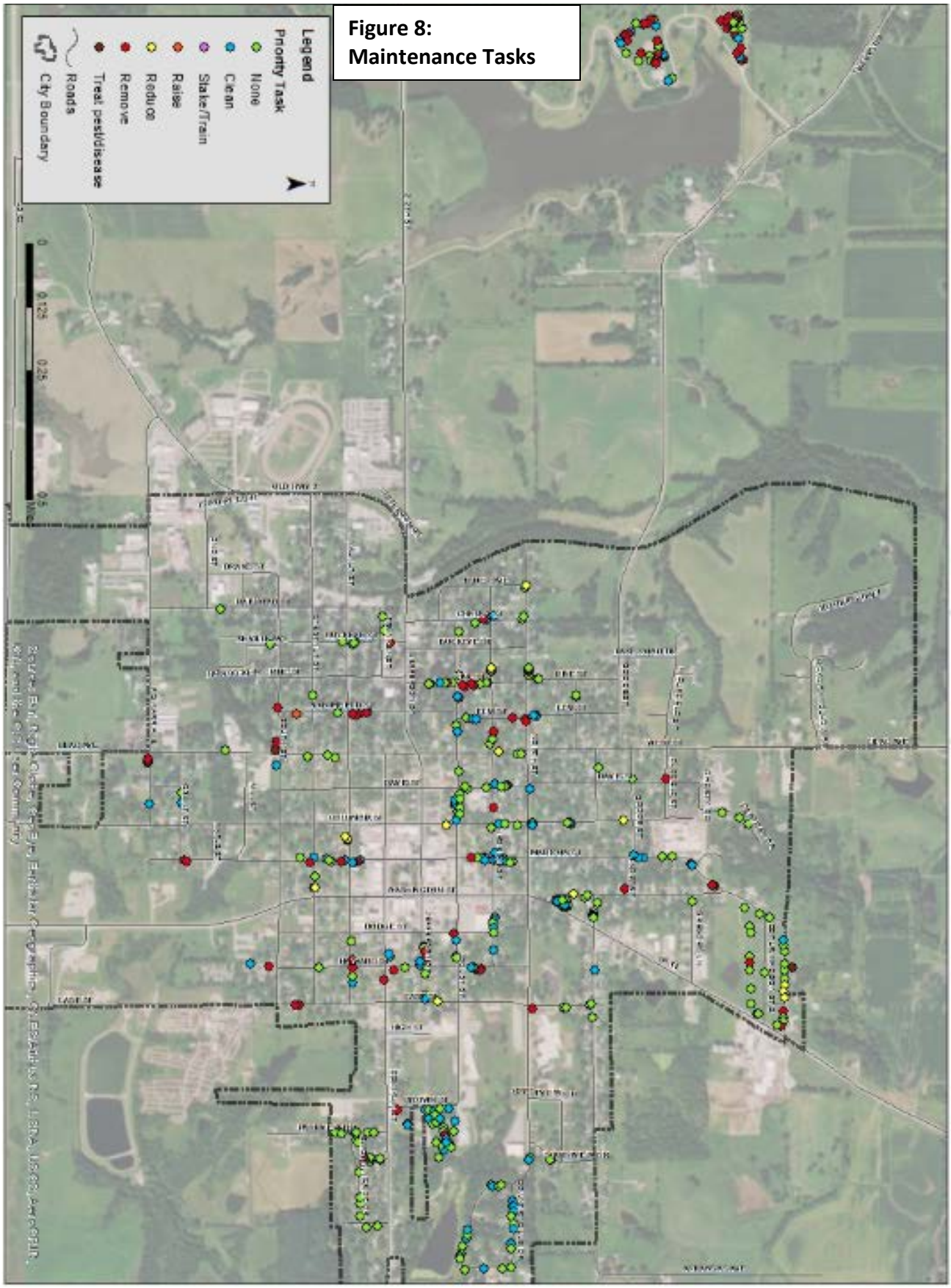


Figure 7: Location of Trees with Recommended Maintenance

Figure 8:
Maintenance Tasks



Appendix C: Bloomfield Tree Ordinances

CHAPTER 151

TREES

151.01 DEFINITION. For use in this chapter, "parking" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING PROHIBITED. No tree shall be planted in any parking or street.

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

(Code of Iowa, Sec. 364.12[2c, d & e])

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

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

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

(Code of Iowa, Sec. 364.12[3b & h])

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.