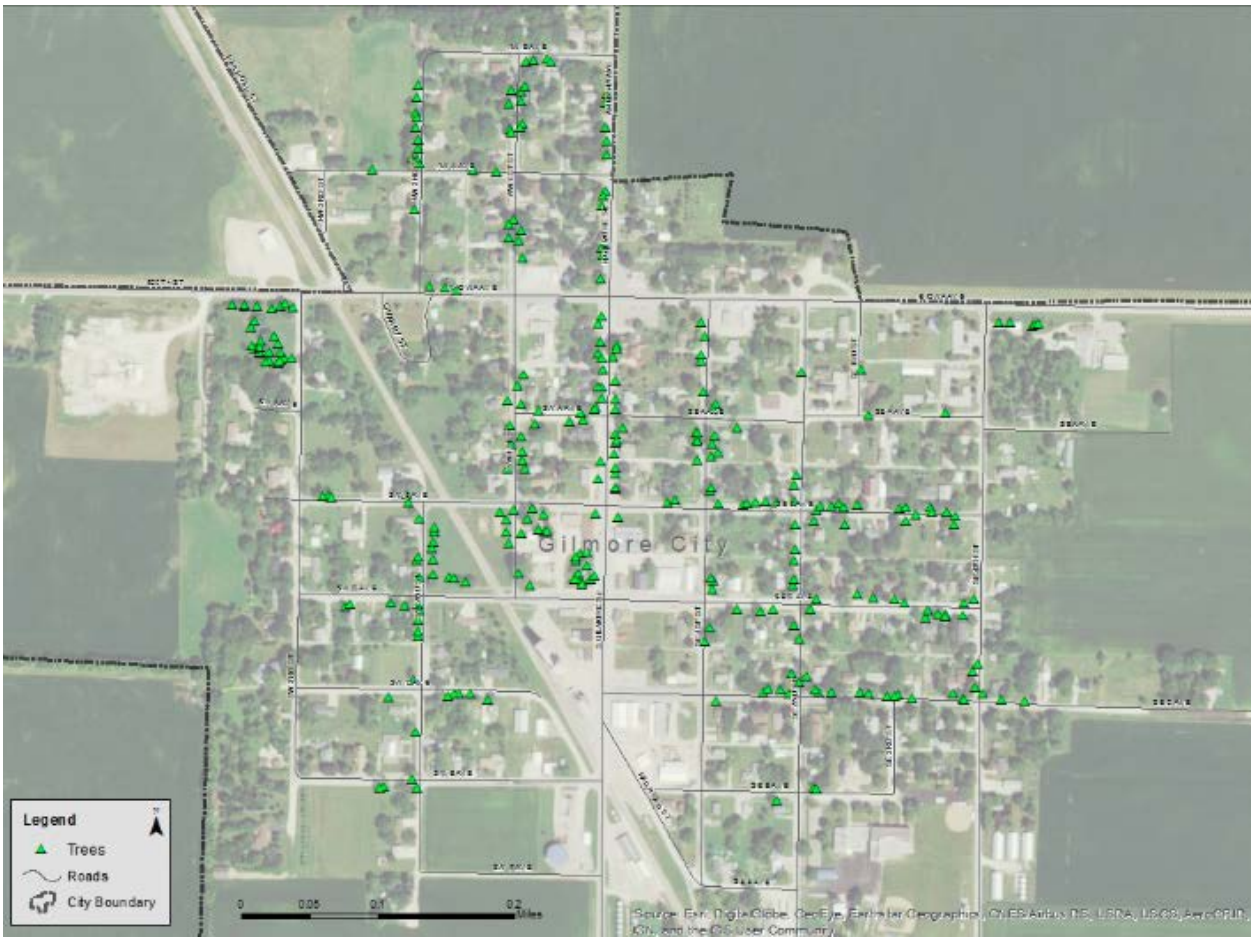
Gilmore City, IA



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 Gilmore City 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 26% of Gilmore City'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 300 trees inventoried.

- Gilmore City's trees provide $61,572 of benefits annually, an average of $205 a tree
- There are over 29 species of trees
- The top three genera are: Maple 33%, Ash 26%, and Walnut 9%
- 67% of trees are in need of some type of management
- 64 (58 ash) 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 64 (58 ash) trees needing removal, 41 (38 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*
- 74 of the 78 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 proposed budget it could take 13 years to remove ash – Suggestion: request a budget increase to $10,700 annually and apply for grants to plant replacement trees

Introduction

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

Trees are an important component of Gilmore City'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 Gilmore City 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 Gilmore City'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 300 city trees was entered into the USDA Forest service program STREETS, part of the 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. Gilmore City's trees reduce energy related costs by approximately $16,205 annually (Appendix A, Table 1). These savings are both in Electricity (77 MWh) and in Natural Gas (10,572 Therms).

Annual Stormwater Benefits

Gilmore City's trees intercept about 930,249 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $25,210 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 Gilmore City it is estimated that trees remove 1,023.9 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 $2,898 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Gilmore City trees sequester about 287,223 lbs. of carbon a year with an associated value of $2,154 (Appendix A, Table 4). In addition, the trees store 3,875,080 lbs. of carbon, with a yearly benefit of $29,063 (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. Gilmore City receives $15,105 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree analysis, Gilmore City's trees provide $61,572 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 300 trees in Gilmore City provide approximately $205 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Gilmore City has over 29 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of the top 10 trees by genera is as follows:

Maple	98	33%
Ash	78	26%
Walnut	27	9%
Linden/Basswood	19	6.3%
Apple (Crab)	16	5.3%
Spruce	16	5.3%
Oak	10	3.3%
Locust	10	3.3%
Hackberry	7	2.3%
Elm	4	1.3%
Others	15	5%

Age Class

Most of Gilmore City's trees (63%) are greater than 18 inches in diameter at 4.5 ft. (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Gilmore City's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Gilmore City indicate that 97% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 83.6% of Gilmore City'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 16.4% of the population. This 16.4% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	91	30.3%
Crown Raising	7	2.3%
Tree Staking	8	2.67%
Tree Removal	64	21.3%
Crown Reduction	3	1%
Treat	28 (20 ash)	9.33%

Canopy Cover

The total canopy with both private and public trees is 8%, 66 acres. The canopy cover included in the Gilmore City inventory includes approximately 9.1 acres (Appendix A, Figure 5).

Land Use and Location

The majority of Gilmore City'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	65.57%
Park/vacant/other	28.67%
Industrial/Large commercial	0.00%
Small commercial	4.67%
Multifamily residential	1.00%

Location	
Planting strip	67.00%
Other maintained locations	28.67%
Cutout (surrounded by pavement)	0.00%
Front yard	4.33%

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

Gilmore City 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 4 trees

over 24 inches in diameter at 4.5 ft. that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing immediate maintenance. There are a total of 17 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 64 removals, 58 are ash trees. There are a total of 78 ash trees, and 74 of those have signs and symptoms that have been associated with EAB. In addition, there are 21 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 Gilmore City.

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 (33%) (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: fruiting trees, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Continual Monitoring

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

Six Year Maintenance Plan with <u>No Additional Funding</u>

Year 1

Removal: 6 critical concern trees
Planting and Replacement: 7 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 6 ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 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: 6 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: 7 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: 6 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: 7 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: 6 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: 7 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: 6 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: 7 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 30 ash trees removed (approximately 38% of ash). It will take approximately 13 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 $10,700 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 restrictions in city ordinance 151.02 (Appendix C). "No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut." Also ash and maple should not be planted.

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. City Code 151.06 states "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the 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."

Proposed Budget -

Proposed Budget
Total $30,000 over 6 years ($5,000/year)

FY 2017 Budget
Removal: $4,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Watering & Maintenance: $100

FY 2018 Budget
Removal: $4,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Routine trimming: $100
Watering & Maintenance: $100

FY 2019 Budget
Removal: $4,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Watering & Maintenance: $100

FY 2020 Budget
Removal: $4,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Routine trimming: $100
Watering & Maintenance: $100

FY 2021 Budget
Removal: $4,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Watering & Maintenance: $100

FY 2022 Budget
Removal: $4,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $100
Watering & Maintenance: $500

*Reduction of ash over 6 years: approximately 30 ash trees removed (approximately 38% of ash). **It will take approximately 13 years to remove all ash with the proposed budget.**
Purposed Budget Increase

EAB could potentially kill all ash trees in Greene within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $10,700 a year. were increased Additionally, it is recommended that Gilmore City 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, about 10 of 20 treatable trees could be treated per year (every other year treatment). This would be 10 trees selected for treatment at $3,000, and Gilmore City would still need to find $2,000 for removal. Alternatively, if all 20 treatable trees are treated the same year (and then every other year), it would cost approximately $6,000 those years for treatment and leave nothing for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Gilmore City. 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 ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	25.00	1,897.22	3,401.98	3,333.94	5,231.16	(N/A)	26.00	32.28	67.07
Norway maple	11.54	875.81	1,657.21	1,624.06	2,499.87	(N/A)	15.00	15.43	55.55
Silver maple	10.54	800.31	1,390.57	1,362.76	2,163.06	(N/A)	12.67	13.35	56.92
Black walnut	8.58	651.55	1,193.53	1,169.66	1,821.21	(N/A)	9.00	11.24	67.45
Apple	1.70	128.95	268.00	262.64	391.59	(N/A)	5.33	2.42	24.47
Littleleaf linden	2.14	162.50	293.88	288.00	450.50	(N/A)	4.00	2.78	37.54
Honeylocust	3.58	271.43	460.03	450.83	722.26	(N/A)	3.33	4.46	72.23
Norway spruce	1.28	96.82	162.00	158.76	255.57	(N/A)	2.67	1.58	31.95
Northern hackberry	1.91	145.00	264.54	259.24	404.25	(N/A)	2.33	2.49	57.75
American basswood	2.42	183.42	341.67	334.83	518.26	(N/A)	2.33	3.20	74.04
Black maple	1.53	116.31	216.01	211.69	328.00	(N/A)	2.00	2.02	54.67
Blue spruce	0.45	34.15	62.16	60.92	95.07	(N/A)	2.00	0.59	15.84
Sugar maple	0.35	26.33	43.87	43.00	69.33	(N/A)	1.67	0.43	13.87
Bur oak	1.03	77.89	141.79	138.95	216.85	(N/A)	1.67	1.34	43.37
American elm	0.83	63.25	114.21	111.93	175.17	(N/A)	1.33	1.08	43.79
Northern red oak	0.39	29.72	55.98	54.86	84.58	(N/A)	1.00	0.52	28.19
Birch	0.27	20.56	41.15	40.33	60.89	(N/A)	1.00	0.38	20.30
Boxelder	0.61	46.55	86.39	84.66	131.21	(N/A)	1.00	0.81	43.74
Eastern cottonwood	1.45	110.36	189.32	185.54	295.89	(N/A)	1.00	1.83	98.63
Black spruce	0.25	19.26	30.37	29.76	49.02	(N/A)	0.67	0.30	24.51
Other City Trees	1.15	87.20	157.33	154.19	241.39		4.00	1.49	205.60
Total	77.00	5,844.60	10,571.97	10,360.53	16,205.13	(N/A)	100.00	100.00	54.02

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species						
Species	Total Rainfall Interception (Gal)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	312,220.94	8,461.19	(N/A)	26.00	33.56	108.48
Norway maple	112,901.69	3,059.64	(N/A)	15.00	12.14	67.99
Silver maple	159,215.44	4,314.74	(N/A)	12.67	17.12	113.55
Black walnut	102,533.64	2,778.66	(N/A)	9.00	11.02	102.91
Apple	7,890.77	213.84	(N/A)	5.33	0.85	13.36
Littleleaf linden	21,110.01	572.08	(N/A)	4.00	2.27	47.67
Honeylocust	43,719.86	1,184.81	(N/A)	3.33	4.70	118.48
Norway spruce	26,003.64	704.70	(N/A)	2.67	2.80	88.09
Northern hackberry	18,990.88	514.65	(N/A)	2.33	2.04	73.52
American basswood	32,316.77	875.78	(N/A)	2.33	3.47	125.11
Black maple	14,960.19	405.42	(N/A)	2.00	1.61	67.57
Blue spruce	5,393.05	146.15	(N/A)	2.00	0.58	24.36
Sugar maple	1,946.29	52.74	(N/A)	1.67	0.21	10.55
Bur oak	9,255.48	250.82	(N/A)	1.67	0.99	50.16
American elm	9,108.76	246.85	(N/A)	1.33	0.98	61.71
Northern red oak	3,726.46	100.99	(N/A)	1.00	0.40	33.66
Birch	2,503.69	67.85	(N/A)	1.00	0.27	22.62
Boxelder	6,976.76	189.07	(N/A)	1.00	0.75	63.02
Eastern cottonwood	21,716.76	588.52	(N/A)	1.00	2.33	196.17
Black spruce	3,088.65	83.70	(N/A)	0.67	0.33	41.85
Other City Trees	14,669.34	397.54		4.00	1.58	344.57
Citywide total	930,249.06	25,209.75	(N/A)	100.00	100.00	84.03

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 ($)	Total (lb)	Total ($)	Stand. Error	% of Total Trees	Avg. $/tree
Green ash	43.24	6.92	19.97	1.94	228.26	119.18	17.36	16.56	113.28	742.84	0.00	0.00	338.46	971.09	(N/A)	26.00	12.45
Norway maple	23.81	4.11	11.60	1.05	128.35	55.88	8.08	7.69	52.35	346.30	- 5.52	- 20.69	159.06	453.96	(N/A)	15.00	10.09
Silver maple	29.32	4.97	14.24	1.30	157.64	49.74	7.28	6.95	47.70	311.10	- 15.56	- 58.35	145.93	410.39	(N/A)	12.67	10.80
Black walnut	13.19	2.11	6.21	0.59	69.96	41.15	5.98	5.70	38.91	255.95	0.00	0.00	113.84	325.92	(N/A)	9.00	12.07
Apple	2.44	0.40	1.15	0.11	12.99	8.42	1.20	1.14	7.70	51.68	- 0.01	- 0.05	22.55	64.62	(N/A)	5.33	4.04
Littleleaf linden	3.59	0.62	1.77	0.16	19.42	10.25	1.49	1.42	9.72	63.81	- 1.74	- 6.52	27.28	76.72	(N/A)	4.00	6.39
Honeylocust	8.71	1.44	3.93	0.40	45.85	16.77	2.46	2.35	16.18	105.15	- 7.00	- 26.24	45.24	124.77	(N/A)	3.33	12.48
Norway spruce	3.12	0.62	2.51	0.38	20.42	5.96	0.88	0.84	5.78	37.45	- 14.47	- 54.27	5.62	3.60	(N/A)	2.67	0.45
Northern hackberry	3.52	0.61	1.75	0.16	19.08	9.16	1.33	1.27	8.66	57.00	0.00	0.00	26.46	76.08	(N/A)	2.33	10.87
American basswood	4.92	0.84	2.33	0.22	26.31	11.66	1.69	1.61	10.96	72.34	- 4.04	- 15.15	30.19	83.51	(N/A)	2.33	11.93
Black maple	3.82	0.65	1.76	0.17	20.30	7.36	1.07	1.02	6.94	45.73	- 1.25	- 4.68	21.54	61.34	(N/A)	2.00	10.22
Blue spruce	0.59	0.12	0.53	0.07	4.02	2.15	0.31	0.30	2.04	13.37	- 1.82	- 6.84	4.28	10.56	(N/A)	2.00	1.76
Sugar maple	0.16	0.03	0.11	0.01	0.93	1.62	0.24	0.23	1.57	10.19	- 0.15	- 0.55	3.81	10.57	(N/A)	1.67	2.11
Bur oak	0.91	0.14	0.48	0.04	4.95	4.91	0.71	0.68	4.65	30.57	0.00	0.00	12.53	35.52	(N/A)	1.67	7.10
American elm	1.46	0.25	0.72	0.06	7.89	3.98	0.58	0.55	3.78	24.79	0.00	0.00	11.39	32.69	(N/A)	1.33	8.17
Northern red oak	0.75	0.13	0.37	0.03	4.07	1.89	0.27	0.26	1.77	11.71	- 1.09	- 4.09	4.39	11.69	(N/A)	1.00	3.90
Birch	0.49	0.08	0.24	0.02	2.66	1.33	0.19	0.18	1.23	8.21	- 0.12	- 0.43	3.66	10.43	(N/A)	1.00	3.48
Boxelder	0.93	0.15	0.43	0.04	4.93	2.94	0.43	0.41	2.78	18.30	- 0.32	- 1.22	7.79	22.00	(N/A)	1.00	7.33
Eastern cottonwood	4.76	0.76	2.06	0.21	24.73	6.86	1.00	0.96	6.59	42.92	0.00	0.00	23.20	67.65	(N/A)	1.00	22.55
Black spruce	0.38	0.08	0.32	0.05	2.55	1.17	0.17	0.17	1.15	7.39	- 1.11	- 4.16	2.38	5.78	(N/A)	0.67	2.89
Other City Trees	2.62	0.46	1.58	0.20	15.15	5.47	0.80	0.76	5.19	34.07	- 2.74	- 10.26	14.32	38.95		4.00	35.16
Citywide Total	152.74	25.47	74.07	7.22	820.45	367.86	53.54	51.04	348.92	2,290.87	- 56.93	- 213.48	1,023.93	2,897.84	(N/A)	100.00	9.66

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species						
Species	Total stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	1,431,679.19	10,737.59	(N/A)	26.00	36.95	137.66
Norway maple	392,414.32	2,943.11	(N/A)	15.00	10.13	65.40
Silver maple	712,084.43	5,340.63	(N/A)	12.67	18.38	140.54
Black walnut	428,574.95	3,214.31	(N/A)	9.00	11.06	119.05
Apple	39,203.77	294.03	(N/A)	5.33	1.01	18.38
Littleleaf linden	76,744.48	575.58	(N/A)	4.00	1.98	47.97
Honeylocust	113,240.73	849.31	(N/A)	3.33	2.92	84.93
Norway spruce	36,814.63	276.11	(N/A)	2.67	0.95	34.51
Northern hackberry	56,317.59	422.38	(N/A)	2.33	1.45	60.34
American basswood	187,722.94	1,407.92	(N/A)	2.33	4.84	201.13
Black maple	40,827.10	306.20	(N/A)	2.00	1.05	51.03
Blue spruce	3,091.25	23.18	(N/A)	2.00	0.08	3.86
Sugar maple	4,775.35	35.82	(N/A)	1.67	0.12	7.16
Bur oak	29,057.04	217.93	(N/A)	1.67	0.75	43.59
American elm	32,000.38	240.00	(N/A)	1.33	0.83	60.00
Northern red oak	16,450.17	123.38	(N/A)	1.00	0.42	41.13
Birch	7,978.96	59.84	(N/A)	1.00	0.21	19.95
Boxelder	31,851.75	238.89	(N/A)	1.00	0.82	79.63
Eastern cottonwood	167,945.95	1,259.59	(N/A)	1.00	4.33	419.86
Black spruce	2,236.47	16.77	(N/A)	0.67	0.06	8.39
Other City Trees	64,068.64	480.51		4.00	1.65	468.29
Citywide total	3,875,080.12	29,063.10	(N/A)	100.00	100.00	96.88

Table 5: Annual Carbon Sequestered

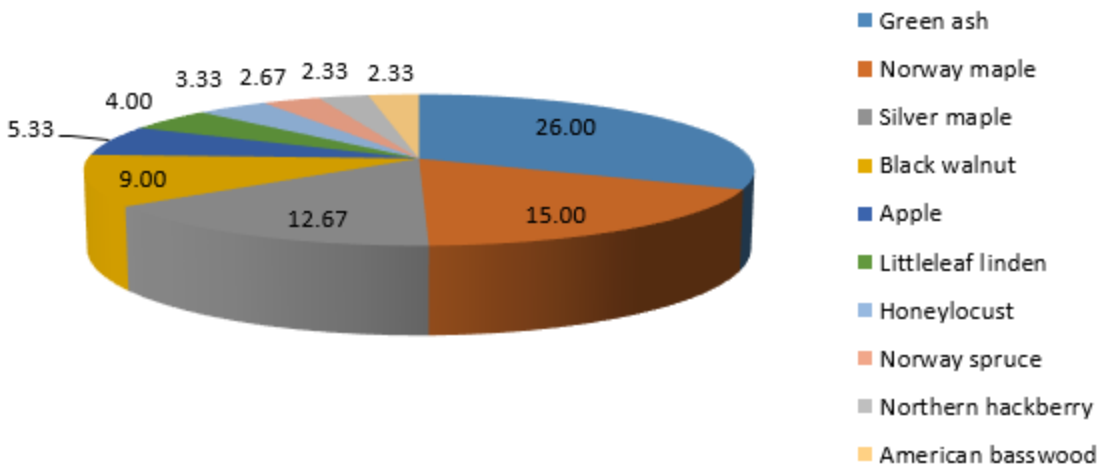
Annual CO2 Benefits of Public Trees by Species													
Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	57,215.61	429.12	- 6,872.06	- 267.54	- 53.55	41,928.09	314.46	92,004.09	690.03	(N/A)	26.00	32.03	8.85
Norway maple	12,791.20	95.93	- 1,885.74	- 126.36	- 15.09	19,355.09	145.16	30,134.19	226.01	(N/A)	15.00	10.49	5.02
Silver maple	48,489.09	363.67	- 3,419.03	- 123.05	- 26.57	17,686.56	132.65	62,633.58	469.75	(N/A)	12.67	21.81	12.36
Black walnut	21,003.31	157.52	- 2,057.16	- 90.87	- 16.11	14,399.16	107.99	33,254.44	249.41	(N/A)	9.00	11.58	9.24
Apple	2,805.64	21.04	- 188.18	- 24.96	- 1.60	2,849.77	21.37	5,442.27	40.82	(N/A)	5.33	1.89	2.55
Littleleaf linden	5,967.88	44.76	- 369.05	- 25.55	- 2.96	3,591.30	26.93	9,164.58	68.73	(N/A)	4.00	3.19	5.73
Honeylocust	3,445.83	25.84	- 543.56	- 26.52	- 4.28	5,998.61	44.99	8,874.37	66.56	(N/A)	3.33	3.09	6.66
Norway spruce	1,302.16	9.77	- 176.71	- 23.40	- 1.50	2,139.68	16.05	3,241.74	24.31	(N/A)	2.67	1.13	3.04
Northern hackberry	2,421.25	18.16	- 270.35	- 18.72	- 2.17	3,204.52	24.03	5,336.69	40.03	(N/A)	2.33	1.86	5.72
American basswood	9,983.98	74.88	- 901.07	- 29.25	- 6.98	4,053.63	30.40	13,107.29	98.30	(N/A)	2.33	4.56	14.04
Black maple	2,011.96	15.09	- 195.97	- 14.82	- 1.58	2,570.38	19.28	4,371.55	32.79	(N/A)	2.00	1.52	5.46
Blue spruce	298.97	2.24	- 14.85	- 7.61	- 0.17	754.70	5.66	1,031.21	7.73	(N/A)	2.00	0.36	1.29
Sugar maple	524.48	3.93	- 23.08	- 3.71	- 0.20	581.94	4.36	1,079.63	8.10	(N/A)	1.67	0.38	1.62
Bur oak	2,427.00	18.20	- 139.51	- 10.34	- 1.12	1,721.42	12.91	3,998.57	29.99	(N/A)	1.67	1.39	6.00
American elm	1,034.97	7.76	- 153.69	- 8.19	- 1.21	1,397.71	10.48	2,270.79	17.03	(N/A)	1.33	0.79	4.26
Northern red oak	202.49	1.52	- 78.96	- 5.27	- 0.63	656.75	4.93	775.01	5.81	(N/A)	1.00	0.27	1.94
Birch	480.75	3.61	- 38.41	- 3.12	- 0.31	454.40	3.41	893.63	6.70	(N/A)	1.00	0.31	2.23
Boxelder	2,329.31	17.47	- 152.89	- 8.19	- 1.21	1,028.77	7.72	3,197.00	23.98	(N/A)	1.00	1.11	7.99
Eastern cottonwood	1,436.60	10.77	- 806.14	- 17.55	- 6.18	2,438.82	18.29	3,051.72	22.89	(N/A)	1.00	1.06	7.63
Black spruce	181.41	1.36	- 10.74	- 3.90	- 0.11	425.68	3.19	592.45	4.44	(N/A)	0.67	0.21	2.22
Other City Trees	1,164.34	8.73	- 307.68	- 15.80	- 2.43	1,927.07	14.45	2,767.94	20.76		4.00	0.96	17.67
Citywide Total	177,518.22	1,331.39	- 18,604.82	- 854.69	- 145.95	129,164.06	968.73	287,222.76	2,154.17	(N/A)	100.00	100.00	7.18

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefit of Public Trees by Species					
Species	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	4,422.76	(N/A)	26.00	29.28	56.70
Norway maple	1,212.05	(N/A)	15.00	8.02	26.93
Silver maple	3,658.27	(N/A)	12.67	24.22	96.27
Black walnut	1,641.44	(N/A)	9.00	10.87	60.79
Apple	164.01	(N/A)	5.33	1.09	10.25
Littleleaf linden	611.39	(N/A)	4.00	4.05	50.95
Honeylocust	880.52	(N/A)	3.33	5.83	88.05
Norway spruce	222.80	(N/A)	2.67	1.48	27.85
Northern hackberry	316.69	(N/A)	2.33	2.10	45.24
American basswood	654.37	(N/A)	2.33	4.33	93.48
Black maple	247.99	(N/A)	2.00	1.64	41.33
Blue spruce	118.74	(N/A)	2.00	0.79	19.79
Sugar maple	62.31	(N/A)	1.67	0.41	12.46
Bur oak	224.18	(N/A)	1.67	1.48	44.84
American elm	142.67	(N/A)	1.33	0.94	35.67
Northern red oak	23.45	(N/A)	1.00	0.16	7.82
Birch	48.52	(N/A)	1.00	0.32	16.17
Boxelder	157.25	(N/A)	1.00	1.04	52.42
Eastern cottonwood	85.71	(N/A)	1.00	0.57	28.57
Black spruce	50.45	(N/A)	0.67	0.33	25.23
Other City Trees	159.03		4.00	1.05	128.07
Citywide Total	15,104.61	(N/A)	100.00	100.00	50.35

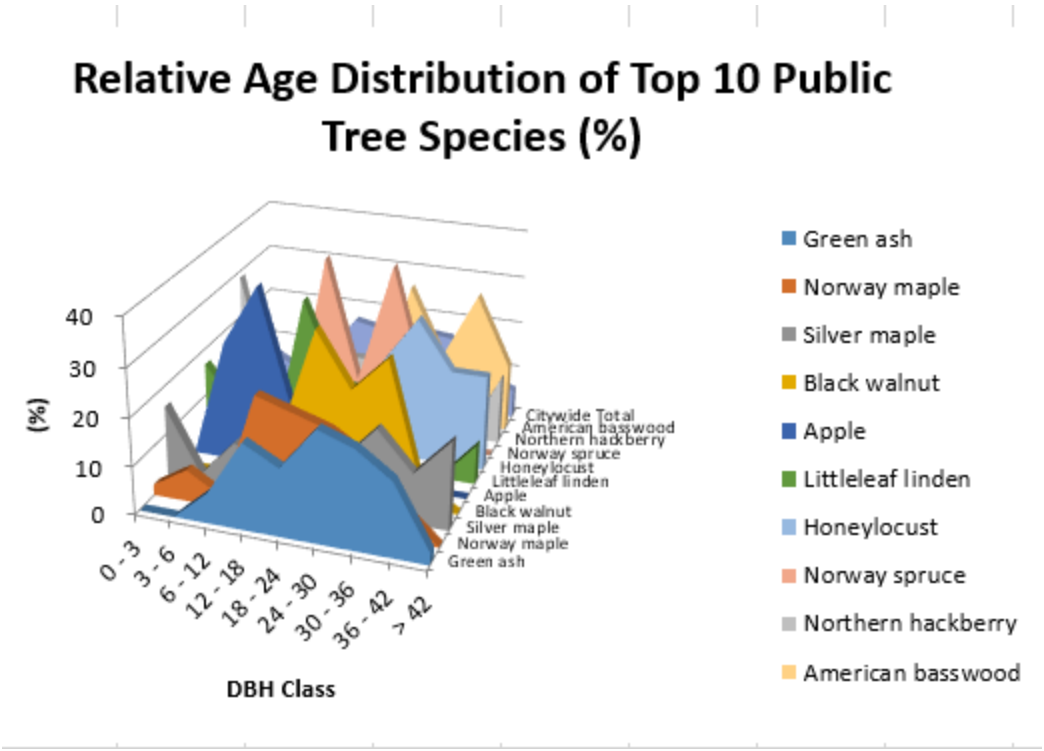
Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species ($/tree)							
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Stand. Error
Green ash	67.07	8.85	12.45	108.48	56.70	253.54	(N/A)
Norway maple	55.55	5.02	10.09	67.99	26.93	165.59	(N/A)
Silver maple	56.92	12.36	10.80	113.55	96.27	289.90	(N/A)
Black walnut	67.45	9.24	12.07	102.91	60.79	252.47	(N/A)
Apple	24.47	2.55	4.04	13.36	10.25	54.68	(N/A)
Littleleaf linden	37.54	5.73	6.39	47.67	50.95	148.29	(N/A)
Honeylocust	72.23	6.66	12.48	118.48	88.05	297.89	(N/A)
Norway spruce	31.95	3.04	0.45	88.09	27.85	151.37	(N/A)
Northern hackberry	57.75	5.72	10.87	73.52	45.24	193.10	(N/A)
American basswood	74.04	14.04	11.93	125.11	93.48	318.60	(N/A)
Black maple	54.67	5.46	10.22	67.57	41.33	179.26	(N/A)
Blue spruce	15.84	1.29	1.76	24.36	19.79	63.04	(N/A)
Sugar maple	13.87	1.62	2.11	10.55	12.46	40.61	(N/A)
Bur oak	43.37	6.00	7.10	50.16	44.84	151.47	(N/A)
American elm	43.79	4.26	8.17	61.71	35.67	153.60	(N/A)
Northern red oak	28.19	1.94	3.90	33.66	7.82	75.51	(N/A)
Birch	20.30	2.23	3.48	22.62	16.17	64.80	(N/A)
Boxelder	43.74	7.99	7.33	63.02	52.42	174.51	(N/A)
Eastern cottonwood	98.63	7.63	22.55	196.17	28.57	353.55	(N/A)
Black spruce	24.51	2.22	2.89	41.85	25.23	96.70	(N/A)
Other City Trees	205.60	17.67	35.16	344.57	128.07	731.06	(N/A)
Citywide Total	54.02	7.18	9.66	84.03	50.35	205.24	(N/A)



Species Distribution of Public Trees	
Species	Percent
Green ash	26.00
Norway maple	15.00
Silver maple	12.67
Black walnut	9.00
Apple	5.33
Littleleaf linden	4.00
Honeylocust	3.33
Norway spruce	2.67
Northern hackberry	2.33
American basswood	2.33
Other Species	17.33

Figure 1: Species Distribution



Relative Age Distribution of Top 10 Public Tree Species (%)									
Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Green ash	0.00	0.00	6.41	17.95	14.10	23.08	20.51	15.38	2.56
Norway maple	2.22	6.67	2.22	24.44	22.22	20.00	15.56	6.67	0.00
Silver maple	15.79	2.63	10.53	7.89	5.26	10.53	18.42	10.53	18.42
Black walnut	0.00	0.00	0.00	11.11	33.33	22.22	29.63	3.70	0.00
Apple	0.00	25.00	37.50	12.50	18.75	0.00	6.25	0.00	0.00
Littleleaf linden	16.67	8.33	0.00	33.33	16.67	16.67	0.00	0.00	8.33
Honeylocust	0.00	0.00	0.00	10.00	0.00	20.00	30.00	20.00	20.00
Norway spruce	0.00	0.00	0.00	37.50	12.50	37.50	12.50	0.00	0.00
Northern hackberry	28.57	0.00	0.00	14.29	14.29	14.29	14.29	0.00	14.29
American basswood	0.00	0.00	0.00	14.29	0.00	28.57	14.29	28.57	14.29
Citywide Total	8.33	4.00	8.00	17.00	15.67	16.67	16.00	8.33	6.00

Figure 2: Relative Age Class

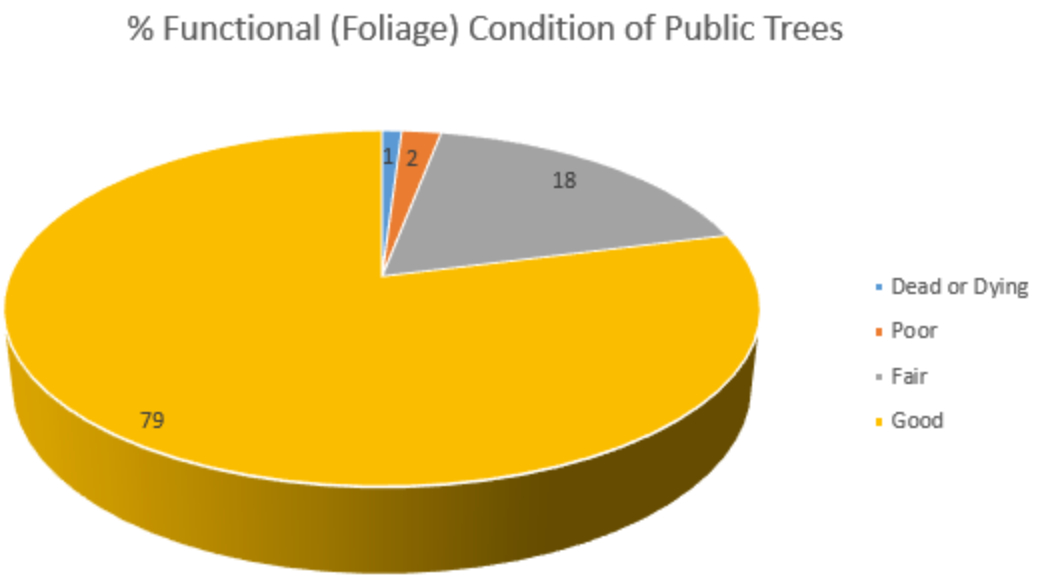


Figure 3: Foliage Condition

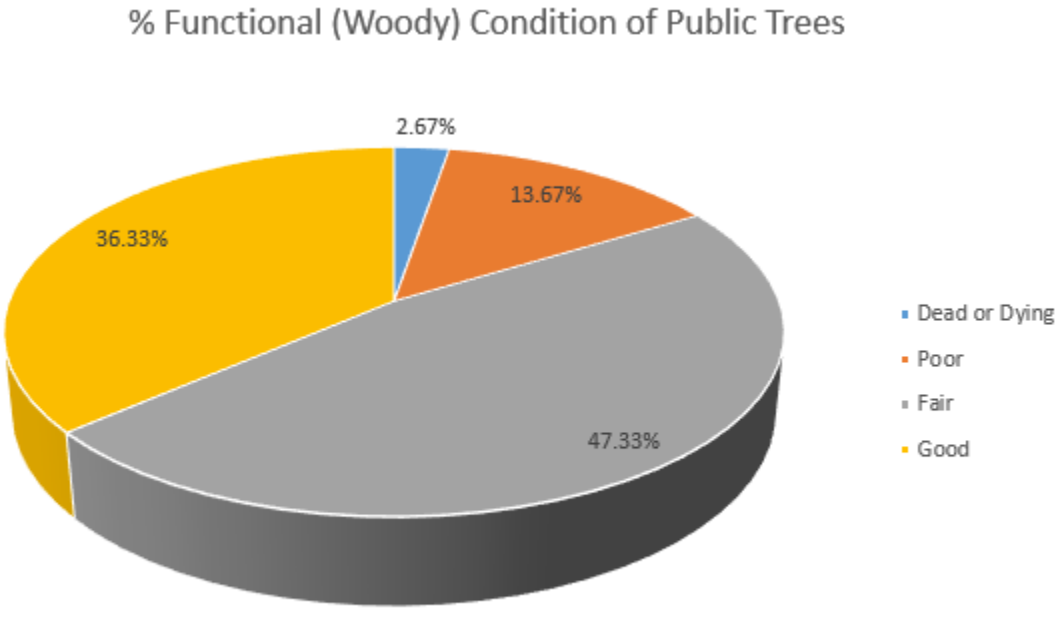
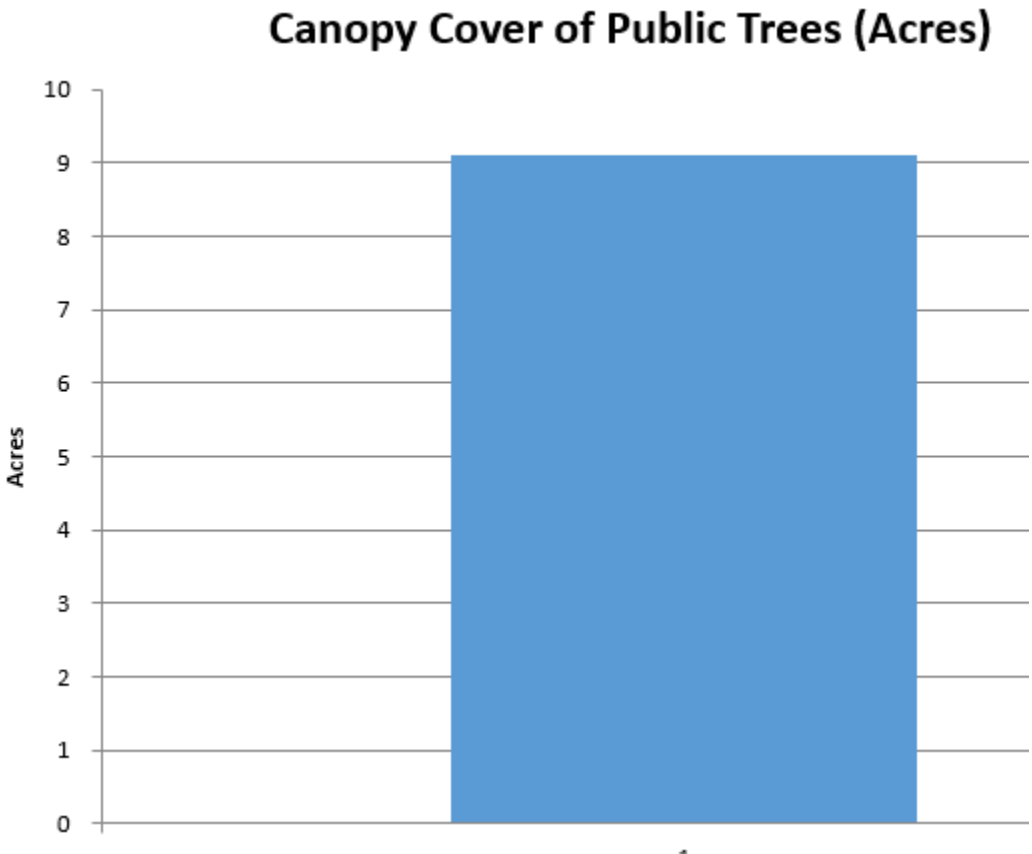
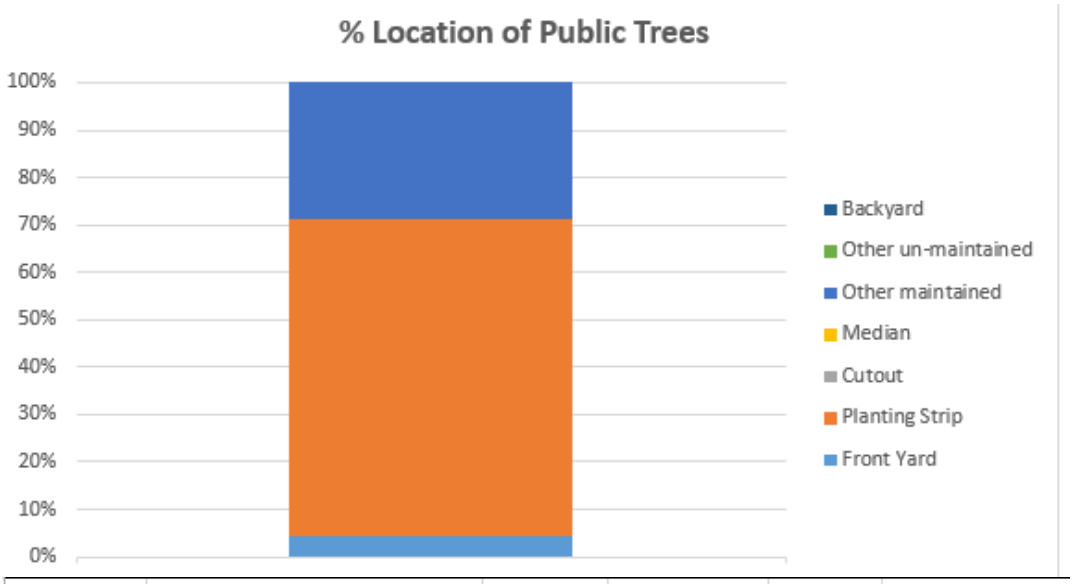


Figure 4: Wood Condition



Canopy Cover of Public Trees (Acres)		
Zone	Acres	% of Total Canopy
1	9.10	100.00
Citywide Total	9.10	100.00

Figure 5: Canopy Cover in Acres



Citywide	Front yard	13	(N/A)	4.33	4.33
	Planting strip	201	(N/A)	67.00	67.00
	Cutout	0	(N/A)	0.00	0.00
	Median	0	(N/A)	0.00	0.00
	Other maintained locations	86	(N/A)	28.67	28.67
	Other un-maintained locations	0	(N/A)	0.00	0.00
	Backyard	0	(N/A)	0.00	0.00
	Total	300	(N/A)	100.00	100.00

Figure 6: Land Use of city/park trees

Citywide	Single family residential	197	(N/A)	65.67	65.67
	Multi-family residential	3	(N/A)	1.00	1.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	86	(N/A)	28.67	28.67
	Small Commercial	14	(N/A)	4.67	4.67
	Total	300	(N/A)	100.00	100.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

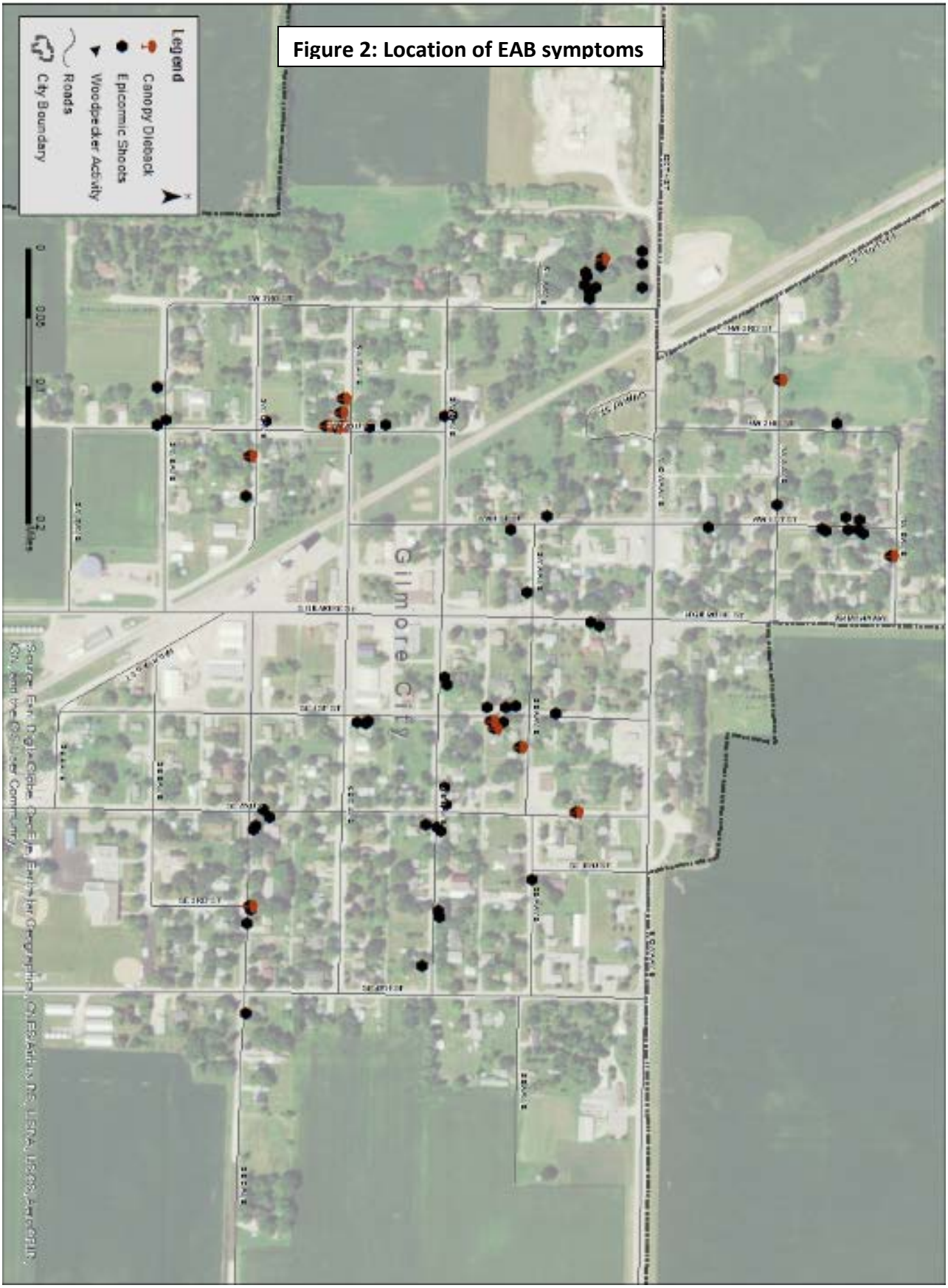


Figure 2: Location of EAB symptoms
Legend
Canopy Dieback
Epicormic Shoots
Woodpecker Activity
Roads
City Boundary
Gilmore City

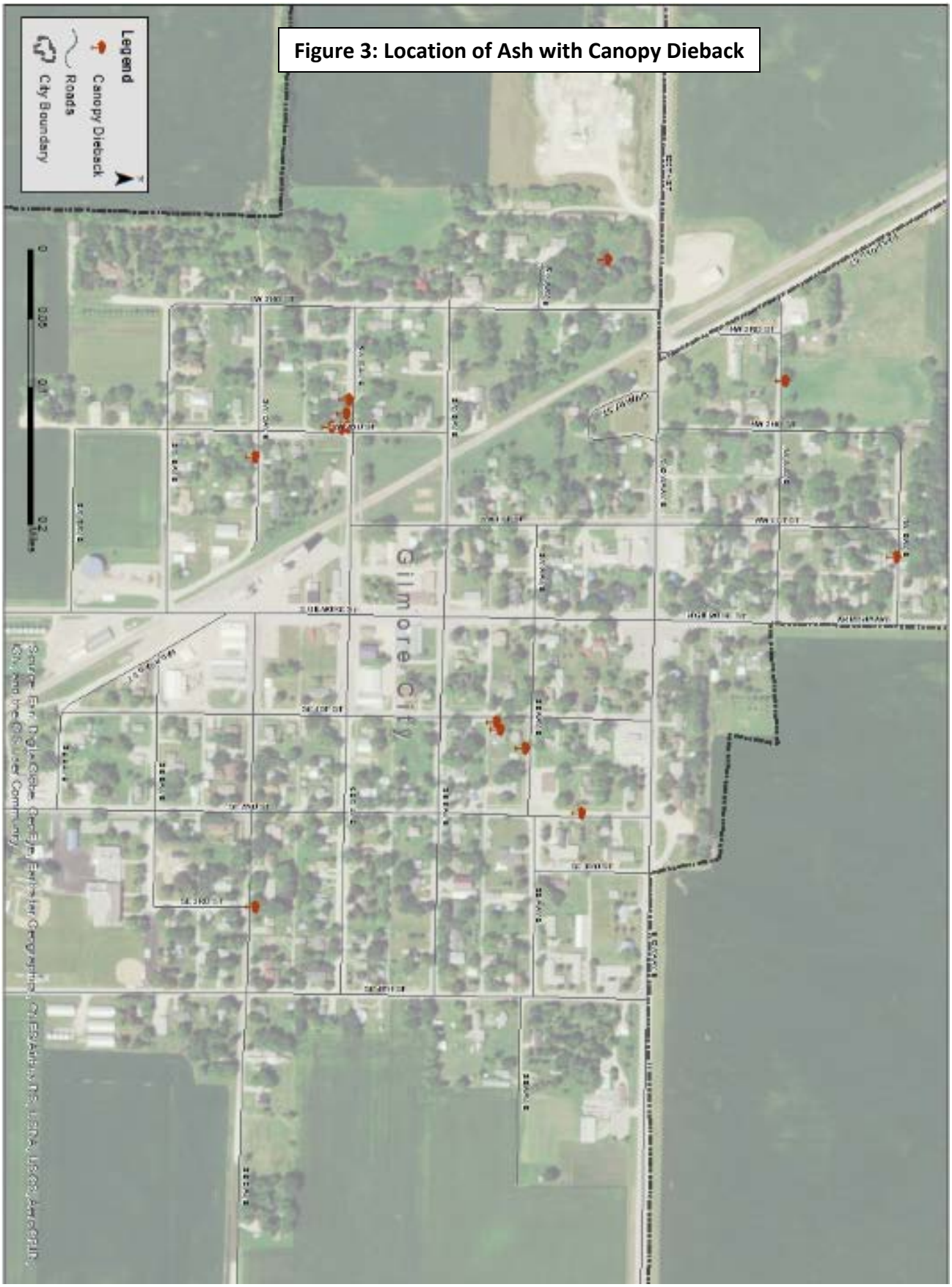


Figure 3: Location of Ash with Canopy Dieback

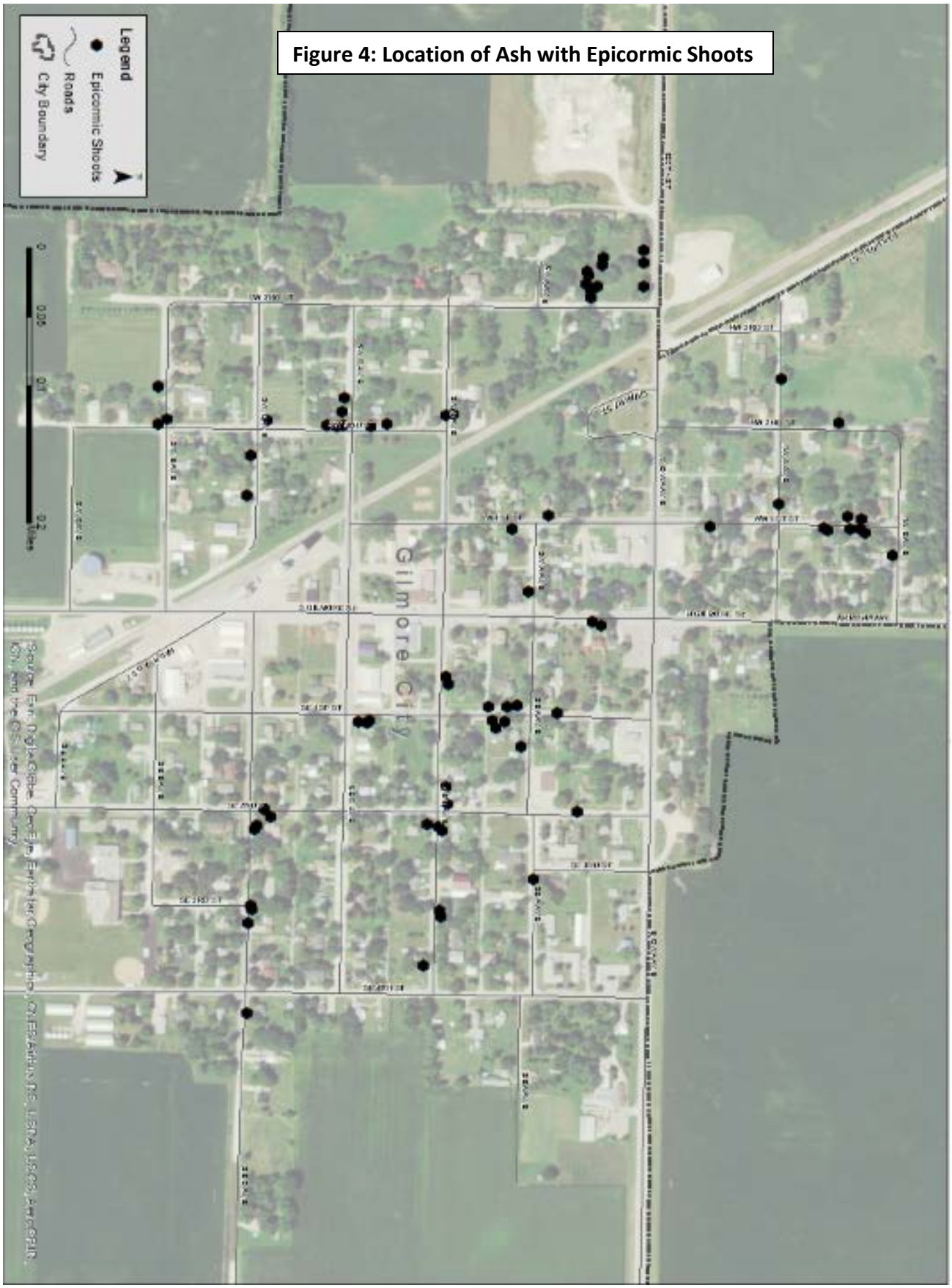


Figure 4: Location of Ash with Epicormic Shoots

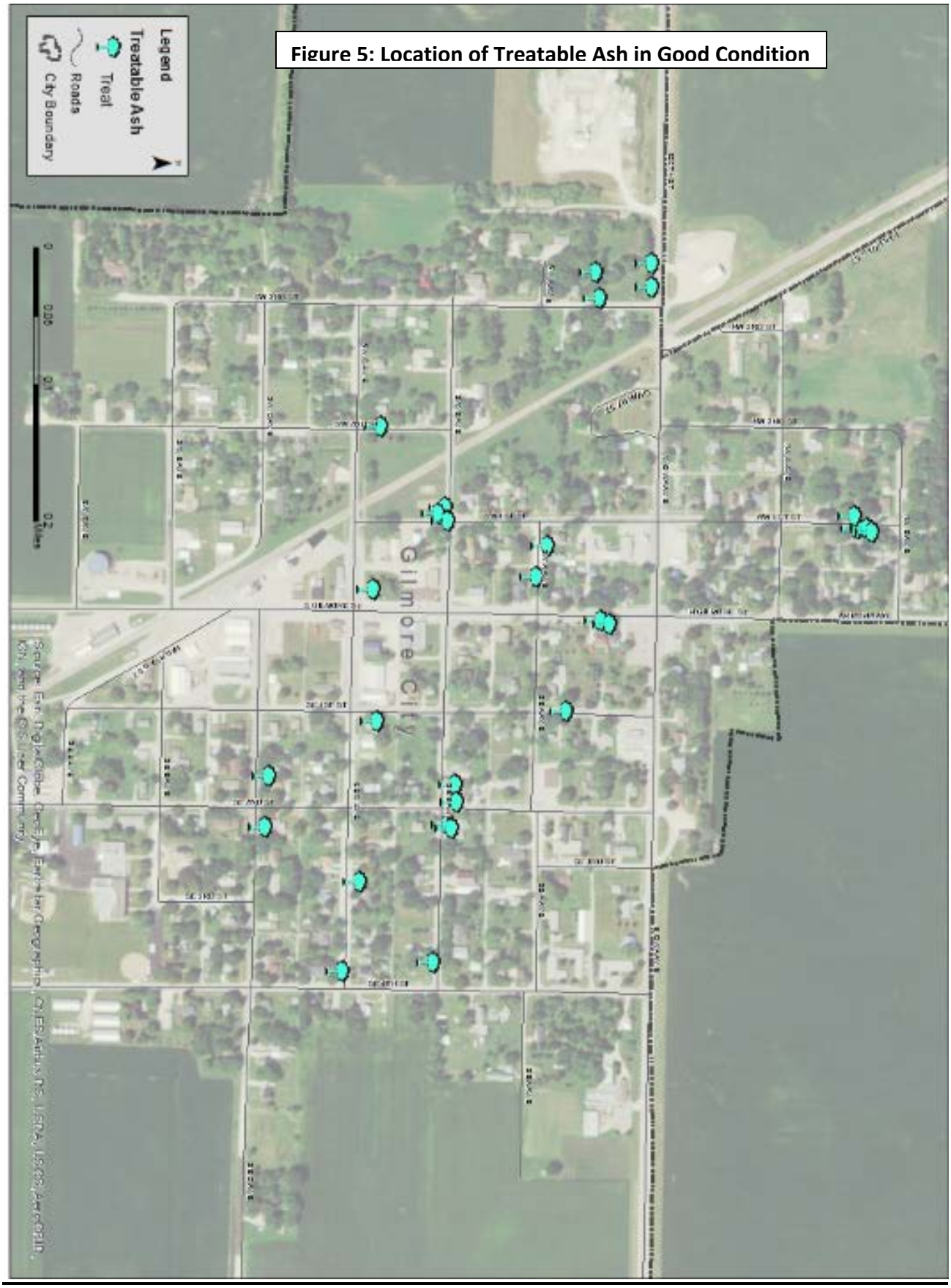


Figure 5: Location of Treatable Ash in Good Condition

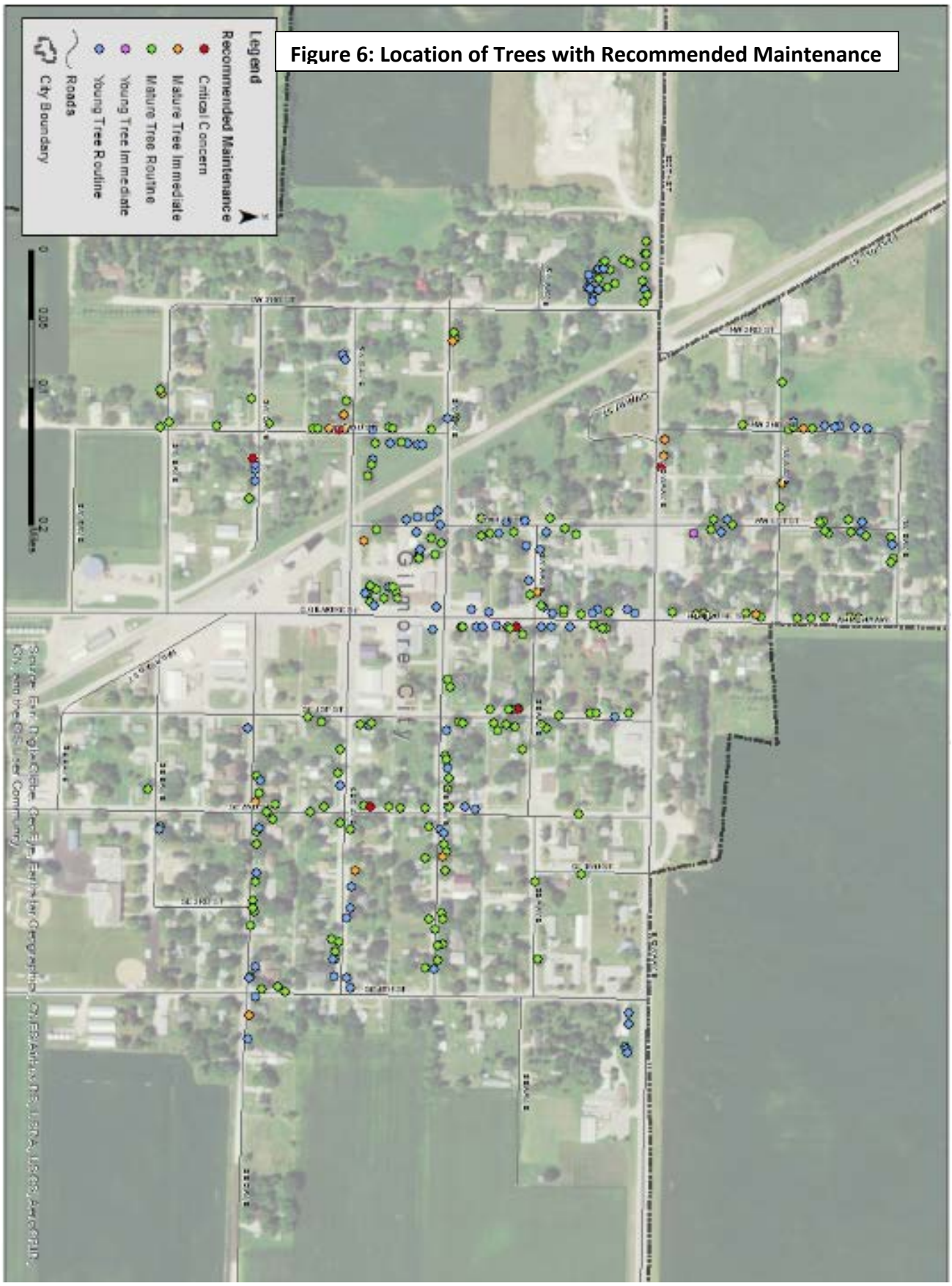


Figure 6: Location of Trees with Recommended Maintenance

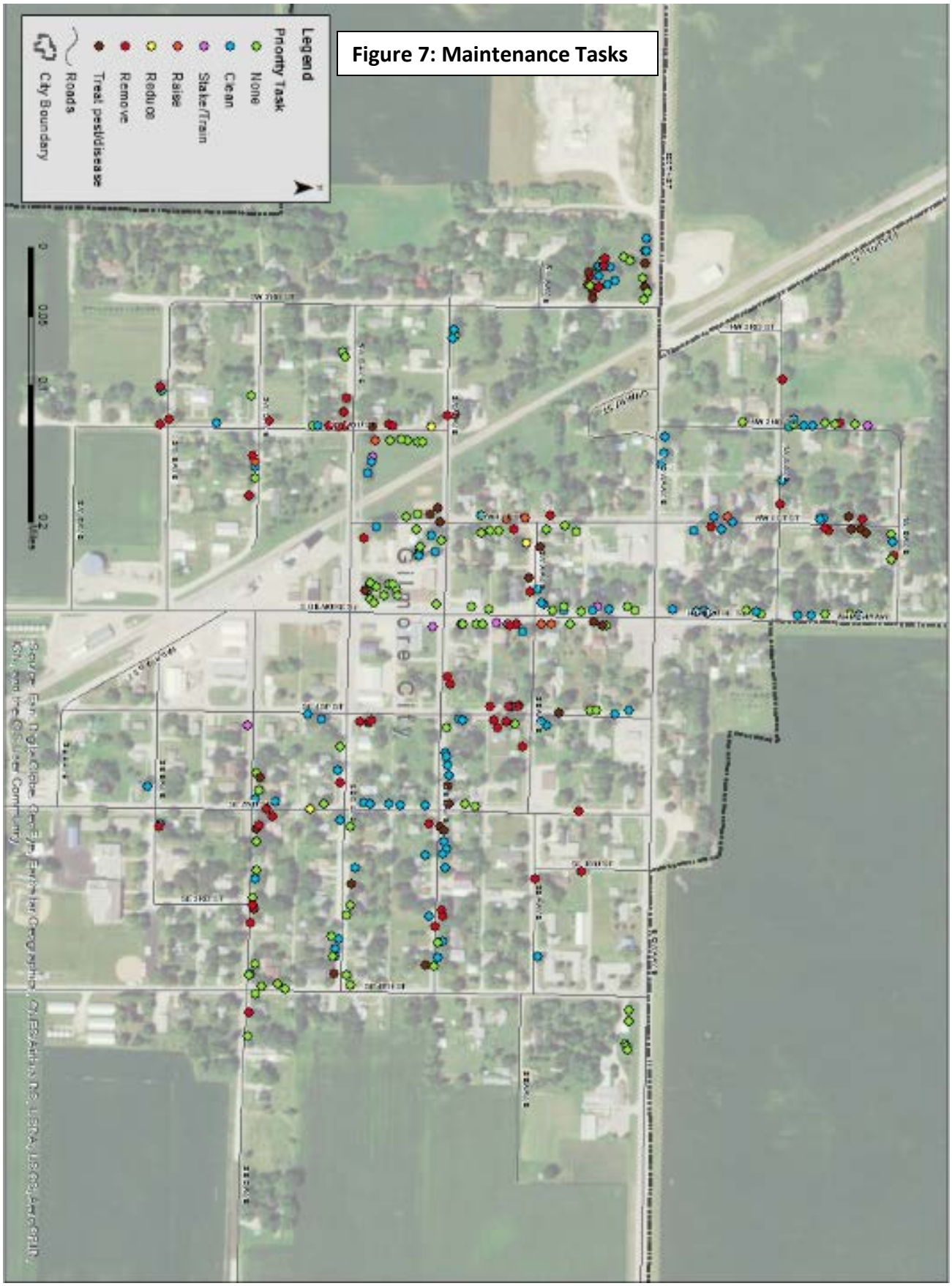


Figure 7: Maintenance Tasks

Appendix C Gilmore City Tree Ordinances

CODE OF ORDINANCES, GILMORE CITY, IOWA
- 625 -
CHAPTER 150
TREES
150.01 Definition 150.04 Trimming Trees to be Supervised
150.02 Planting Restrictions 150.05 Disease Control
150.03 Duty to Trim Trees 150.06 Inspection and Removal
150.01 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.
150.02 PLANTING RESTRICTIONS. No tree shall be planted in any parking or street except in accordance with the following:
1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any parking that is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow, or black walnut.
150.03 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])
150.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 150.03, 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.
150.05 DISEASE CONTROL. Any dead, diseased, or damaged tree or shrub that may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to

be a nuisance.

150.06 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:

CHAPTER 150 TREES

- 626 -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 ORDINANCES, GILMORE CITY, IOWA

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

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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.