Tiffin, IA

2014 Community Tree Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Tiffin 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 3% (7 trees) of Tiffin's city owned trees (ash) will die once EAB becomes established in the community. 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 2013, 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 205 trees inventoried.

- There are currently 7 ash trees on public property
- 5 of the 7 ash trees are 12 inches or less in diameter
- Tiffin's trees provide $10,812.20 of benefits annually, an average of $52 a tree
- There are approximately 34 species of trees
- 85% of the trees surveyed are 12 inches in diameter or less, which means the tree cover on public property is generally young
- The top three genus are: oak 37%, Maple 20%, and elm 10%
- 26 % of trees are in need of some type of management
- 5 trees are recommended to be considered for removal
- Just over 50% of the trees surveyed are in the parks

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 5 trees needing to be evaluated for removal, none of them are over 24 inches in diameter at 4.5 ft. Three of the trees are 6 inches or less. *City ownership of the trees recommended for removal should be verified prior to any removal*
- None of the 7 ash trees are in need of an immediate follow up because they are not currently displaying signs and symptoms associated with EAB. Check ash trees with a visual survey yearly.
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that does not include ash and minimizes oak and maple
- At this point based on the smaller size of ash trees the removal of these trees is estimated at $2,200 to $3,500

Introduction

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

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

Inventory

In 2013, a tree inventory was conducted that included 100% of the city owned trees on the streets and the 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 of 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 205 city trees was entered into the USDA Forest Service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Tiffin's trees reduce energy related costs by approximately $3,250 annually (Appendix A, Table 1). These savings are both in Electricity (15.1 MWh) and in Natural Gas (2,149 Therms).

Annual Stormwater Benefits

Tiffin's trees intercept about 111,956 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $3,034 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 Tiffin, it is estimated that trees remove 177 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 $496 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Tiffin, trees sequester about 32,765 lbs of carbon a year with an associated value of $424 (Appendix A, Table 5). In addition, the trees store 316,607 lbs of carbon, with a yearly benefit of $2,375 (Appendix A, Table 4).

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. Tiffin receives $3,608 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Tiffin's trees provide $10,812.20 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 205 trees in Tiffin provide approximately $52 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Tiffin has over 34 different tree species along city streets and in the parks (Appendix A, Figure 1). The distribution of the most common trees by genus is as follows:

Oak	75	37%
Maple	42	20%
Elm	20	10%
Crabapple/Apple	11	5%
Callery Pear	10	5%

Age Class

Over 3/4 of Tiffin's public trees (85%) are between 1 and 12 inches in diameter at 4.5 ft (Appendix A, Figure 2). Only 9% of the trees have a diameter greater than 18 inches.

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 Tiffin indicate that 83% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 58% of Tiffin'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 11% of the population.

Management Needs

The following outlines the specific management needs of the inventoried street and park trees by number of trees (Appendix B, Figure 5).

Crown Raising	43
Crown Cleaning	5
Tree Removal	5

Canopy Cover

The canopy cover of Tiffin is approximately 1 acre (Appendix A, Figure 5).

Land Use and Location

Just over 50% of Tiffin's public trees are located in the parks (Appendix A, Figure 6 & Appendix A, Figure7).

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

Tiffin has 5 trees that should be considered for removal. In the fall of 2013 you were sent a letter listing a number of trees that need to be evaluated for removal or pruning. *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. It is critical that any oak species are only pruned during the dormant season (November 1 through March 1).

Planting

If any trees are removed in the future it is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Tiffin.

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 community tree cover has significant oak (37%) and maple (20%) (Appendix A, Figure 1), **so the amount of new oak and maple should be significantly limited.**

Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are prohibited include: cottonwood, poplar, boxelder, Chinese elm, evergreen (along streets), willow, and black walnut as outlined in section 151.02 of the city ordinance (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 death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all trees in poor condition (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 is one option that some communities are considering to potentially help spread removal costs out over several years while allowing trees to continue to provide benefits. Treatment is not recommended if EAB is more than 15 miles away from the community. **There are a lot of factors that need to be considered before the community decides if it wants to utilize chemical treatments on public trees including environmental concerns related to the use of insecticides for this pest.** 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 over 25 million 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 Iowa Department of Agriculture and Land Stewardship (IDALS) is attempting to contain the beetle before it spreads beyond its known positions by regulating articles. Currently the entire State of Iowa is under a state and federal quarantine. See http://iowatreepests.com/eab_regulations.html for specifics on current quarantines.

The regulated articles under the quarantine include EAB at any living state; entire ash trees; firewood of any hardwood species; any cut or fallen material of the ash; non-heat treated ash lumber with either bark or sapwood attached; and hardwood wood or bark chips larger than one inch in two dimension.

The quarantine orders that the regulated articles cannot be moved out of the State of Iowa unless a permit the USDA Animal and Plant Health Inspection Service (APHIS) or if the article has been treated to exterminate any pests under the supervision of USDA and the Iowa Department of Agriculture and Land Stewardship.

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? The good news at this point is 71% of your ash trees are 12 inches in diameter or less.

Canopy Replacement

As budget permits, all removed ash trees will hopefully be replaced. The new plantings will be a diverse mix and will minimize oak and maple, and not include ash and cottonwood, poplar, boxelder, Chinese elm, evergreen (along streets), willow, and black walnut as outlined in section 151.02 of the city ordinance (Appendix C).

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. The good news there is only 7 public trees to monitor.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if the trees die and become hazardous. There is a statement in the current city tree ordinance that would allow the city to encourage the removal of trees of concern. In a 2000 Iowa DNR study it was estimated that there was at least 51 private ash trees in the community, but private trees were not estimated in the most recent study.

Budget

At this point based on the smaller size of ash trees the removal of these trees is estimated at $2,200 to $3,500. EAB could potentially kill all untreated ash within 4 to 8 years of its arrival to your community. This pest is in Mechanicsville. Based on recent findings in Iowa there is significant potential that this pest is in this area, but just has not been found yet. The good news for Tiffin at this point is 71% (5) of the ash trees on public property are 12 inches in diameter or less. If some of these trees have to be removed in the next 5 years the average cost could be $500/tree or less. There are only 2 ash trees on public property greater than 12 inches in diameter.

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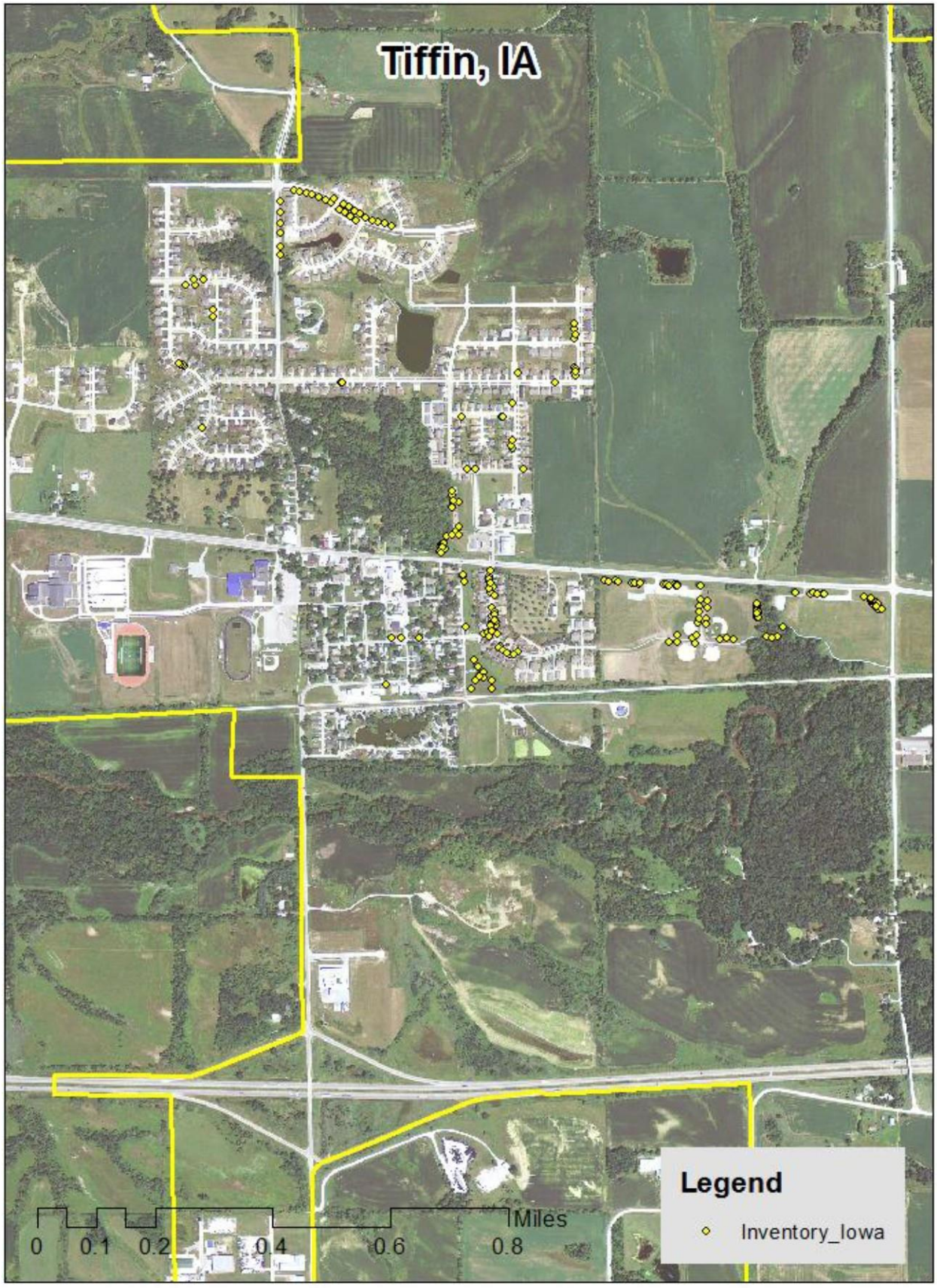
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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Tiffin

Annual Energy Benefits of Public Trees by Species

1/25/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pin oak	1.2	94	177.1	174	268	(N/A)	13.2	8.2	9.91
Northern red oak	0.9	65	120.9	118	183	(N/A)	8.8	5.6	10.18
Elm	3.2	239	436.9	428	667	(N/A)	8.3	20.5	39.25
Swamp white oak	0.4	28	59.4	58	86	(N/A)	6.8	2.6	6.13
Sugar maple	0.6	42	79.8	78	120	(N/A)	5.4	3.7	10.94
Apple	0.2	16	37.6	37	53	(N/A)	5.4	1.6	4.84
Callery pear	0.7	57	111.7	109	166	(N/A)	4.9	5.1	16.59
Bur oak	0.3	23	40.5	40	63	(N/A)	4.9	1.9	6.27
Red maple	0.4	28	53.8	53	81	(N/A)	4.4	2.5	8.95
Broadleaf Deciduous	0.1	5	11.3	11	16	(N/A)	3.9	0.5	2.00
Silver maple	1.2	90	157.8	155	245	(N/A)	3.4	7.5	34.96
Maple	0.5	37	65.3	64	101	(N/A)	2.9	3.1	16.86
Boxelder	1.0	75	135.7	133	208	(N/A)	2.9	6.4	34.65
Spruce	0.2	13	28.3	28	40	(N/A)	2.9	1.2	6.70
Oak	0.5	36	69.1	68	104	(N/A)	2.9	3.2	17.31
Green ash	0.5	34	58.1	57	91	(N/A)	2.0	2.8	22.83
Norway maple	0.2	19	39.9	39	58	(N/A)	1.5	1.8	19.31
Black cherry	0.3	21	45.1	44	65	(N/A)	1.5	2.0	21.73
American basswood	0.1	11	22.9	22	34	(N/A)	1.5	1.0	11.20
Littleleaf linden	0.1	10	20.3	20	30	(N/A)	1.5	0.9	9.96
Siberian elm	0.8	61	113.8	112	172	(N/A)	1.5	5.3	57.41
Other street trees	1.9	141	263.6	258	399	(N/A)	9.8	12.3	19.97
Citywide total	15.1	1,144	2,149.0	2,106	3,250	(N/A)	100.0	100.0	15.86

Table 2: Annual Stormwater Benefits

Tiffin

Annual Stormwater Benefits of Public Trees by Species

1/25/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pin oak	9,817	266	(N/A)	13.2	8.8	9.85
Northern red oak	4,446	120	(N/A)	8.8	4.0	6.69
Elm	30,901	837	(N/A)	8.3	27.6	49.26
Swamp white oak	1,770	48	(N/A)	6.8	1.6	3.43
Sugar maple	2,779	75	(N/A)	5.4	2.5	6.85
Apple	718	19	(N/A)	5.4	0.6	1.77
Callery pear	4,115	112	(N/A)	4.9	3.7	11.15
Bur oak	1,845	50	(N/A)	4.9	1.7	5.00
Red maple	1,598	43	(N/A)	4.4	1.4	4.81
Broadleaf Deciduous	182	5	(N/A)	3.9	0.2	0.62
Silver maple	12,460	338	(N/A)	3.4	11.1	48.24
Maple	2,889	78	(N/A)	2.9	2.6	13.05
Boxelder	8,938	242	(N/A)	2.9	8.0	40.37
Spruce	1,714	46	(N/A)	2.9	1.5	7.74
Oak	3,057	83	(N/A)	2.9	2.7	13.81
Green ash	2,853	77	(N/A)	2.0	2.6	19.33
Norway maple	1,335	36	(N/A)	1.5	1.2	12.06
Black cherry	1,446	39	(N/A)	1.5	1.3	13.06
American basswood	709	19	(N/A)	1.5	0.6	6.41
Littleleaf linden	648	18	(N/A)	1.5	0.6	5.85
Siberian elm	6,870	186	(N/A)	1.5	6.1	62.07
Other street trees	10,867	295	(N/A)	9.8	9.7	14.73
Citywide total	111,956	3,034	(N/A)	100.0	100.0	14.80

Table 3: Annual Air Quality Benefits

Tiffin

Annual Air Quality Benefits of Public Trees by Species

1/25/2014

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Pin oak	1.3	0.2	0.8	0.1	7	6.0	0.9	0.8	5.6	37	-2.7	-10	13.0	35	(N/A)	13.2	1.28
Northern red oak	0.5	0.1	0.3	0.0	3	4.1	0.6	0.6	3.9	25	-0.8	-3	9.4	26	(N/A)	8.8	1.43
Elm	3.3	0.5	1.7	0.1	18	15.1	2.2	2.1	14.3	94	0.0	0	39.4	112	(N/A)	8.3	6.59
Swamp white oak	0.1	0.0	0.1	0.0	1	1.8	0.3	0.2	1.7	11	-0.1	0	4.2	12	(N/A)	6.8	0.84
Sugar maple	0.1	0.0	0.1	0.0	1	2.7	0.4	0.4	2.5	17	-0.2	-1	6.1	17	(N/A)	5.4	1.54
Apple	0.1	0.0	0.1	0.0	1	1.1	0.2	0.1	1.0	7	0.0	0	2.6	7	(N/A)	5.4	0.66
Callery pear	0.5	0.1	0.3	0.0	3	3.6	0.5	0.5	3.4	23	-0.1	-1	8.8	25	(N/A)	4.9	2.46
Bur oak	0.0	0.0	0.1	0.0	0	1.4	0.2	0.2	1.4	9	0.0	0	3.3	9	(N/A)	4.9	0.92
Red maple	0.1	0.0	0.1	0.0	1	1.8	0.3	0.2	1.7	11	-0.1	0	4.1	12	(N/A)	4.4	1.29
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.7	2	(N/A)	3.9	0.26
Silver maple	1.6	0.3	0.9	0.1	9	5.6	0.8	0.8	5.4	35	-1.0	-4	14.4	40	(N/A)	3.4	5.75
Maple	0.5	0.1	0.2	0.0	3	2.3	0.3	0.3	2.2	15	-0.2	-1	5.8	16	(N/A)	2.9	2.74
Boxelder	1.0	0.2	0.5	0.0	5	4.7	0.7	0.7	4.5	29	-0.5	-2	11.8	33	(N/A)	2.9	5.50
Spruce	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	-0.5	-2	1.6	4	(N/A)	2.9	0.69
Oak	0.1	0.0	0.1	0.0	1	2.3	0.3	0.3	2.2	14	0.0	0	5.4	15	(N/A)	2.9	2.51
Green ash	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	13	0.0	0	5.1	14	(N/A)	2.0	3.57
Norway maple	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	8	0.0	0	2.9	8	(N/A)	1.5	2.72
Black cherry	0.5	0.1	0.2	0.0	3	1.4	0.2	0.2	1.3	8	0.0	0	3.8	11	(N/A)	1.5	3.67
American basswood	0.0	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	4	0.0	0	1.6	4	(N/A)	1.5	1.49
Littleleaf linden	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.5	4	(N/A)	1.5	1.38
Siberian elm	0.8	0.1	0.4	0.0	4	3.9	0.6	0.5	3.6	24	0.0	0	10.0	28	(N/A)	1.5	9.47
Other street trees	1.3	0.2	0.8	0.1	7	9.0	1.3	1.2	8.4	56	-0.5	-2	21.8	61	(N/A)	9.8	3.05
Citywide total	12.4	2.1	7.1	0.6	70	72.7	10.5	10.0	68.3	451	-6.5	-24	177.2	496	(N/A)	100.0	2.42

Table 4: Annual Carbon Stored

Tiffin

Stored CO2 Benefits of Public Trees by Species

1/25/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pin oak	34,208	257	(N/A)	13.2	10.8	9.50
Northern red oak	8,901	67	(N/A)	8.8	2.8	3.71
Elm	111,068	833	(N/A)	8.3	35.1	49.00
Swamp white oak	3,008	23	(N/A)	6.8	1.0	1.61
Sugar maple	5,327	40	(N/A)	5.4	1.7	3.63
Apple	2,268	17	(N/A)	5.4	0.7	1.55
Callery pear	8,514	64	(N/A)	4.9	2.7	6.39
Bur oak	2,357	18	(N/A)	4.9	0.7	1.77
Red maple	2,647	20	(N/A)	4.4	0.8	2.21
Broadleaf	438	3	(N/A)	3.9	0.1	0.41
Silver maple	34,047	255	(N/A)	3.4	10.8	36.48
Maple	5,876	44	(N/A)	2.9	1.9	7.35
Boxelder	29,152	219	(N/A)	2.9	9.2	36.44
Spruce	595	4	(N/A)	2.9	0.2	0.74
Oak	5,185	39	(N/A)	2.9	1.6	6.48
Green ash	5,926	44	(N/A)	2.0	1.9	11.11
Norway maple	2,420	18	(N/A)	1.5	0.8	6.05
Black cherry	7,664	57	(N/A)	1.5	2.4	19.16
American	1,398	10	(N/A)	1.5	0.4	3.49
Littleleaf linden	1,398	10	(N/A)	1.5	0.4	3.49
Siberian elm	20,228	152	(N/A)	1.5	6.4	50.57
Other street trees	10,878	180	(N/A)	9.8	7.6	8.99
Citywide total	316,607	2,375	(N/A)	100.0	100.0	11.58

Table 5: Annual Carbon Sequestered

Tiffin

Annual CO_2 Benefits of Public Trees by Species

1/25/2014

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pin oak	3,886	29	-164	-5	-1	2,079	16	5,796	43	(N/A)	13.2	10.3	1.61
Northern red oak	1,236	9	-43	-4	0	1,433	11	2,623	20	(N/A)	8.8	4.6	1.09
Elm	7,288	55	-533	-3	-4	5,285	40	12,036	90	(N/A)	8.3	21.3	5.31
Swamp white oak	784	6	-14	-3	0	610	5	1,376	10	(N/A)	6.8	2.4	0.74
Sugar maple	881	7	-26	-2	0	932	7	1,785	13	(N/A)	5.4	3.2	1.22
Apple	364	3	-11	-2	0	362	3	713	5	(N/A)	5.4	1.3	0.49
Callery pear	1,489	11	-41	-2	0	1,249	9	2,695	20	(N/A)	4.9	4.8	2.02
Bur oak	733	5	-11	-2	0	508	4	1,228	9	(N/A)	4.9	2.2	0.92
Red maple	439	3	-13	-2	0	615	5	1,040	8	(N/A)	4.4	1.8	0.87
Broadleaf Deciduous	128	1	-2	-2	0	108	1	232	2	(N/A)	3.9	0.4	0.22
Silver maple	3,609	27	-163	-1	-1	1,991	15	5,435	41	(N/A)	3.4	9.6	5.82
Maple	822	6	-28	-1	0	822	6	1,615	12	(N/A)	2.9	2.9	2.02
Boxelder	2,693	20	-140	-1	-1	1,654	12	4,206	32	(N/A)	2.9	7.5	5.26
Spruce	148	1	-3	-1	0	277	2	421	3	(N/A)	2.9	0.7	0.53
Oak	1,047	8	-25	-1	0	798	6	1,819	14	(N/A)	2.9	3.2	2.27
Green ash	937	7	-28	-1	0	759	6	1,667	13	(N/A)	2.0	3.0	3.13
Norway maple	544	4	-12	-1	0	416	3	948	7	(N/A)	1.5	1.7	2.37
Black cherry	601	5	-37	-1	0	465	3	1,028	8	(N/A)	1.5	1.8	2.57
American basswood	187	1	-7	-1	0	246	2	426	3	(N/A)	1.5	0.8	1.06
Littleleaf linden	343	3	-7	-1	0	221	2	556	4	(N/A)	1.5	1.0	1.39
Siberian elm	1,454	11	-97	-1	-1	1,342	10	2,699	20	(N/A)	1.5	4.8	6.75
Other street trees	3,151	24	-115	-4	-1	3,117	23	6,149	46	(N/A)	9.8	10.9	2.31
Citywide total	32,765	246	-1,520	-40	-12	25,288	190	56,493	424	(N/A)	100.0	100.0	2.07

Table 6: Annual Social and Aesthetic Benefits

Tiffin

Annual Aesthetic/Other Benefits of Public Trees by Species

1/25/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pin oak	354	(N/A)	13.2	9.8	13.10
Northern red oak	143	(N/A)	8.8	4.0	7.95
Elm	695	(N/A)	8.3	19.3	40.91
Swamp white oak	116	(N/A)	6.8	3.2	8.27
Sugar maple	116	(N/A)	5.4	3.2	10.54
Apple	17	(N/A)	5.4	0.5	1.56
Callery pear	178	(N/A)	4.9	4.9	17.80
Bur oak	142	(N/A)	4.9	3.9	14.22
Red maple	81	(N/A)	4.4	2.2	8.98
Broadleaf Deciduous	4	(N/A)	3.9	0.1	0.54
Silver maple	360	(N/A)	3.4	10.0	51.37
Maple	126	(N/A)	2.9	3.5	20.95
Boxelder	238	(N/A)	2.9	6.6	39.62
Spruce	56	(N/A)	2.9	1.6	9.34
Oak	148	(N/A)	2.9	4.1	24.67
Green ash	118	(N/A)	2.0	3.3	29.43
Norway maple	65	(N/A)	1.5	1.8	21.78
Black cherry	35	(N/A)	1.5	1.0	11.75
American basswood	22	(N/A)	1.5	0.6	7.23
Littleleaf linden	52	(N/A)	1.5	1.5	17.42
Siberian elm	120	(N/A)	1.5	3.3	39.94
Other street trees	422	(N/A)	9.8	11.7	21.11
Citywide total	3,608	(N/A)	100.0	100.0	17.60

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species								
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Pin oak	268	43	35	266	354	$965.51	(±0)	8.93
Northern red oak	183	20	26	120	143	$492.23	(±0)	4.55
Elm	667	90	112	837	695	$2,402.42	(±0)	22.22
Swamp white oak	86	10	12	48	116	$271.63	(±0)	2.51
Sugar maple	120	13	17	75	116	$341.94	(±0)	3.16
Apple	53	5	7	19	17	$102.49	(±0)	0.95
Callery pear	166	20	25	112	178	$500.32	(±0)	4.63
Bur oak	63	9	9	50	142	$273.35	(±0)	2.53
Red maple	81	8	12	43	81	$224.13	(±0)	2.07
Broadleaf Deciduous Small	16	2	2	5	4	$29.06	(±0)	0.27
Silver maple	245	41	40	338	360	$1,023.06	(±0)	9.46
Maple	101	12	16	78	126	$333.70	(±0)	3.09
Boxelder	208	32	33	242	238	$752.40	(±0)	6.96
Spruce	40	3	4	46	56	$150.03	(±0)	1.39
Oak	104	14	15	83	148	$363.42	(±0)	3.36
Green ash	91	13	14	77	118	$313.11	(±0)	2.90
Norway maple	58	7	8	36	65	$174.68	(±0)	1.62
Black cherry	65	8	11	39	35	$158.33	(±0)	1.46
American basswood	34	3	4	19	22	$82.19	(±0)	0.76
Littleleaf linden	30	4	4	18	52	$108.01	(±0)	1.00
Siberian elm	172	20	28	186	120	$526.93	(±0)	4.87
Other street trees	399	46	61	295	422	$1,223.26	(±0)	11.31
Citywide total	3,250	424	496	3,034	3,608	$10,812.20	(±0)	100.00

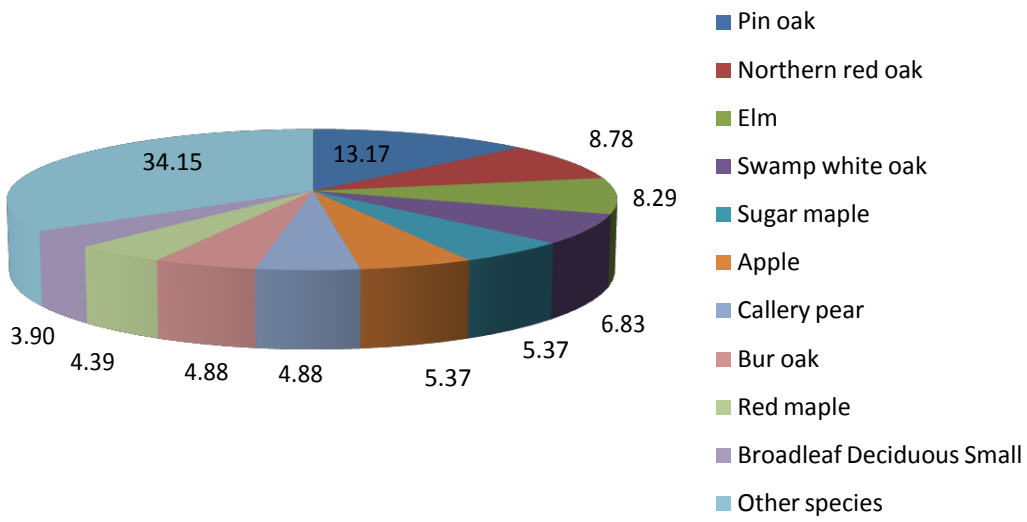

Figure 1: Species Distribution

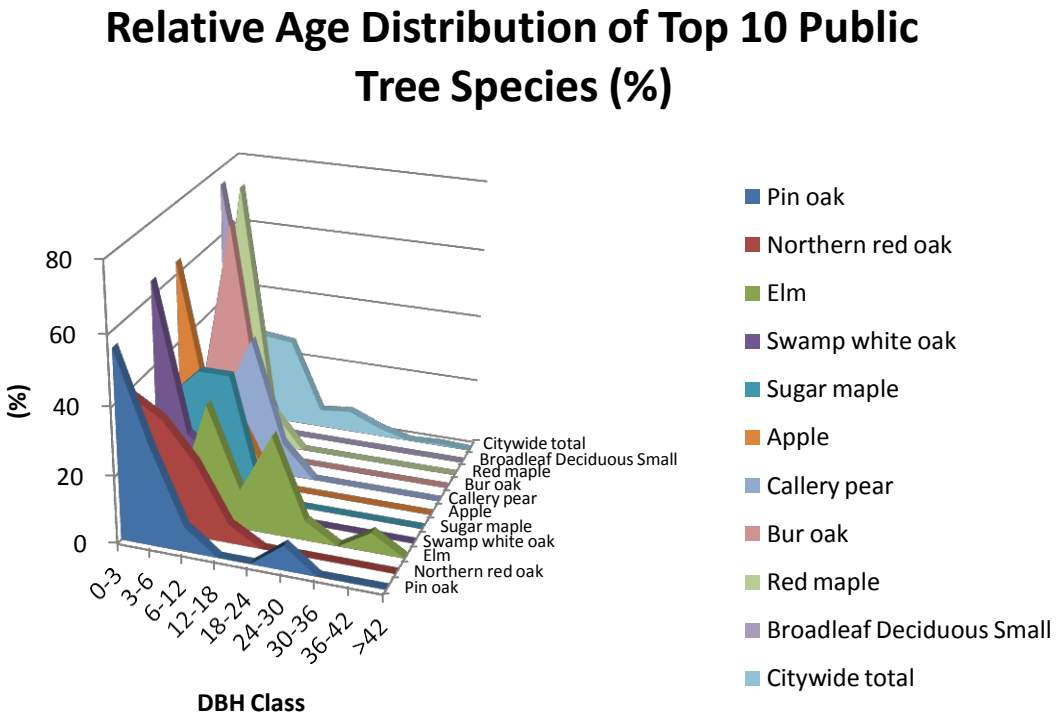

Figure 2: Relative Age Class

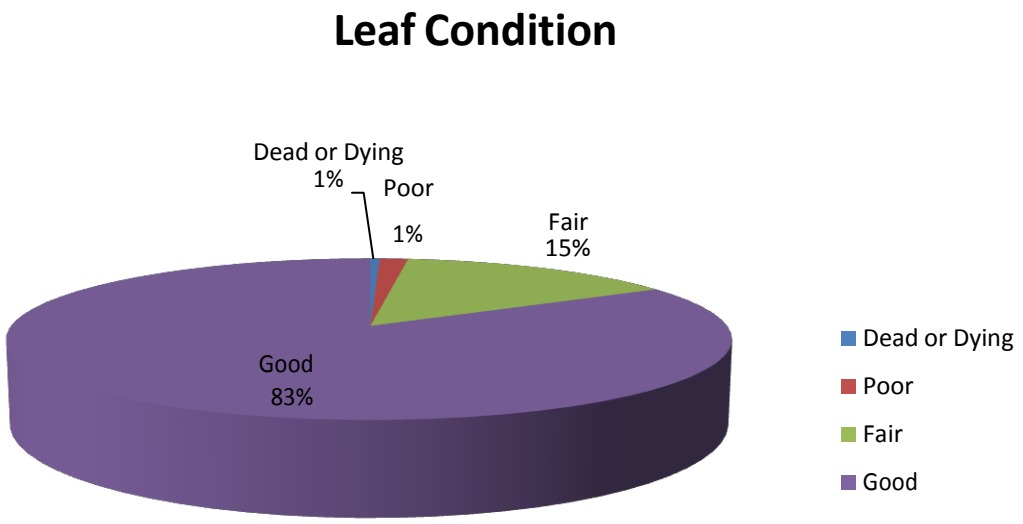

Figure 3: Foliage Condition

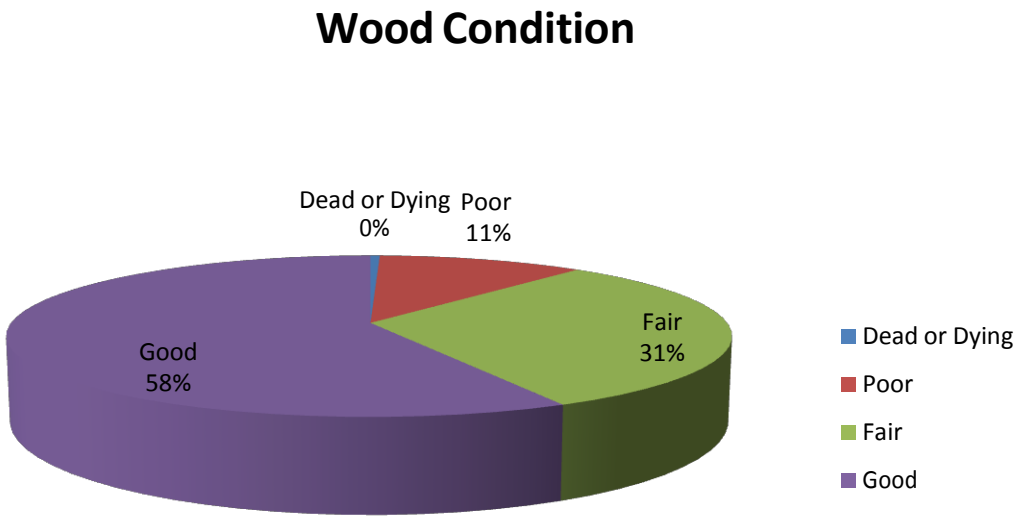

Figure 4: Wood Condition

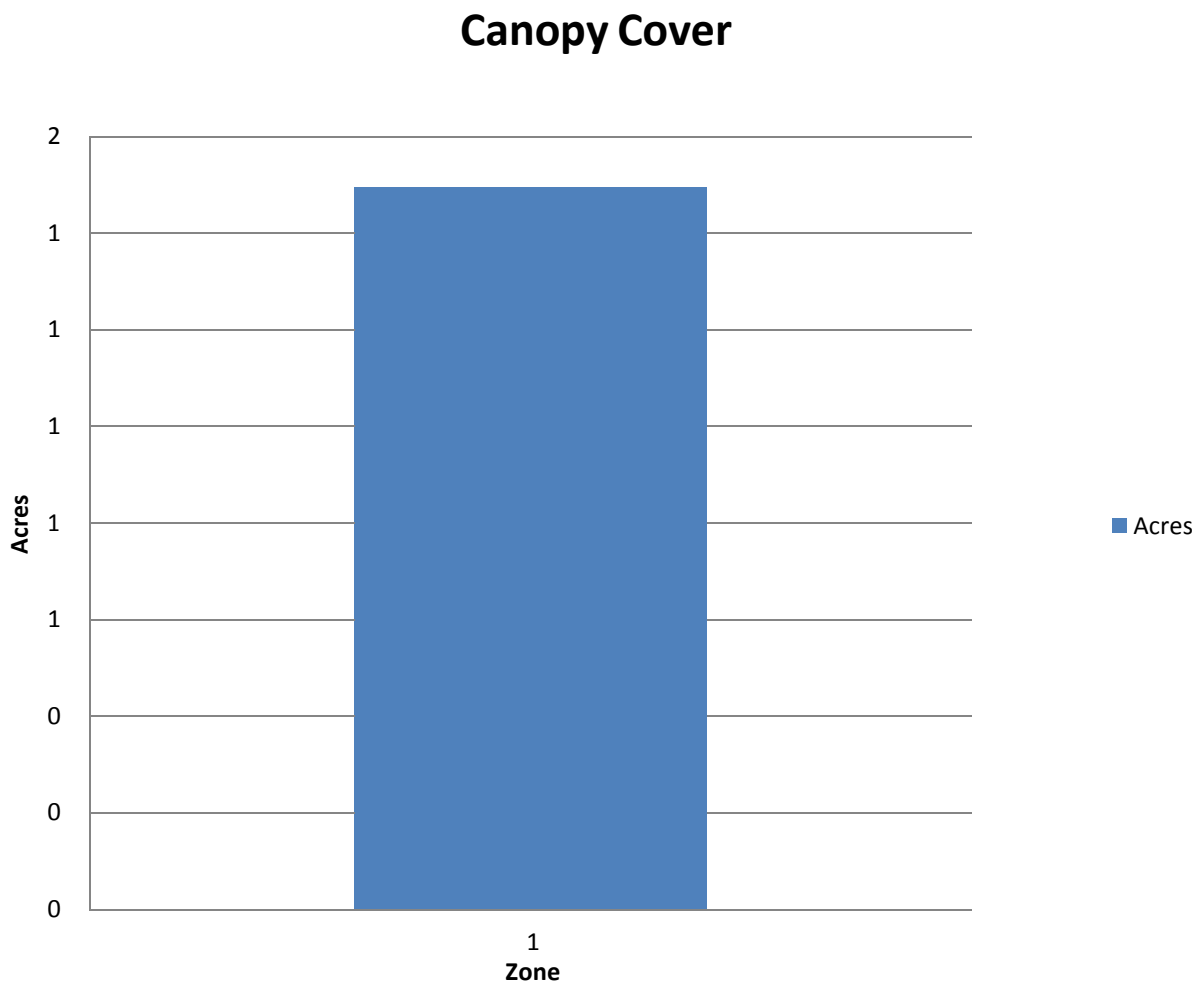

Figure 5: Canopy Cover in Acres

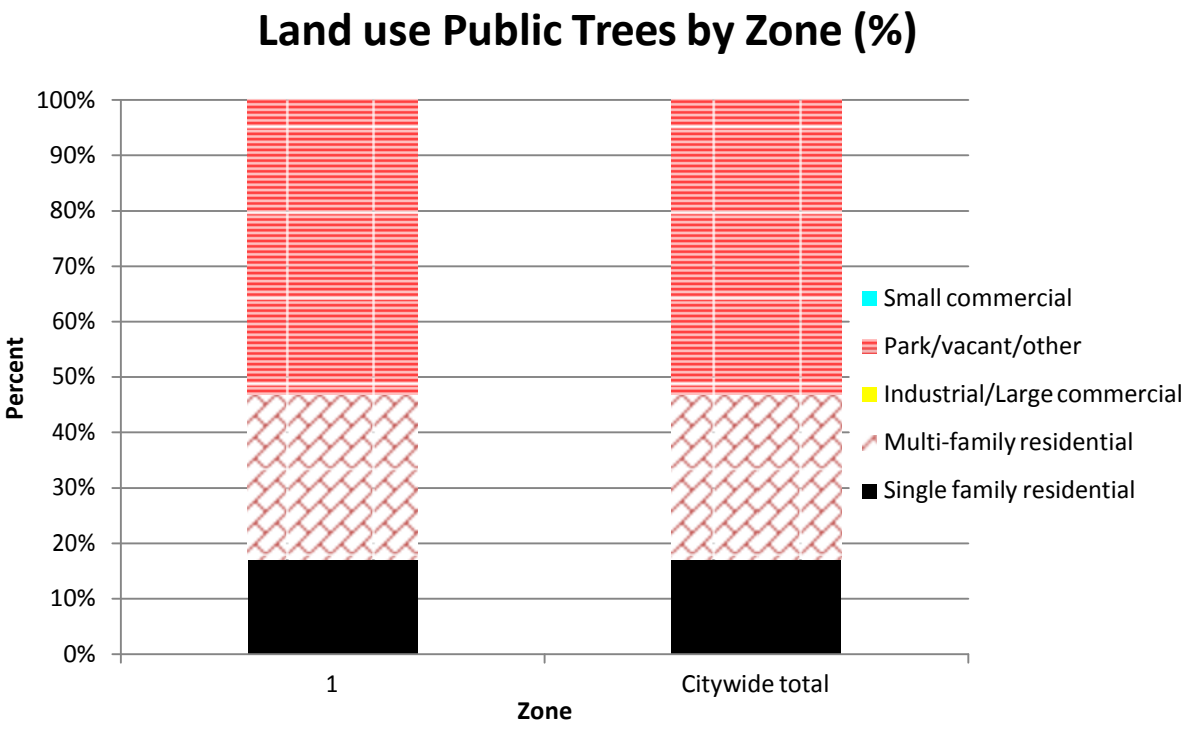

Figure 6: Land Use of city/park trees

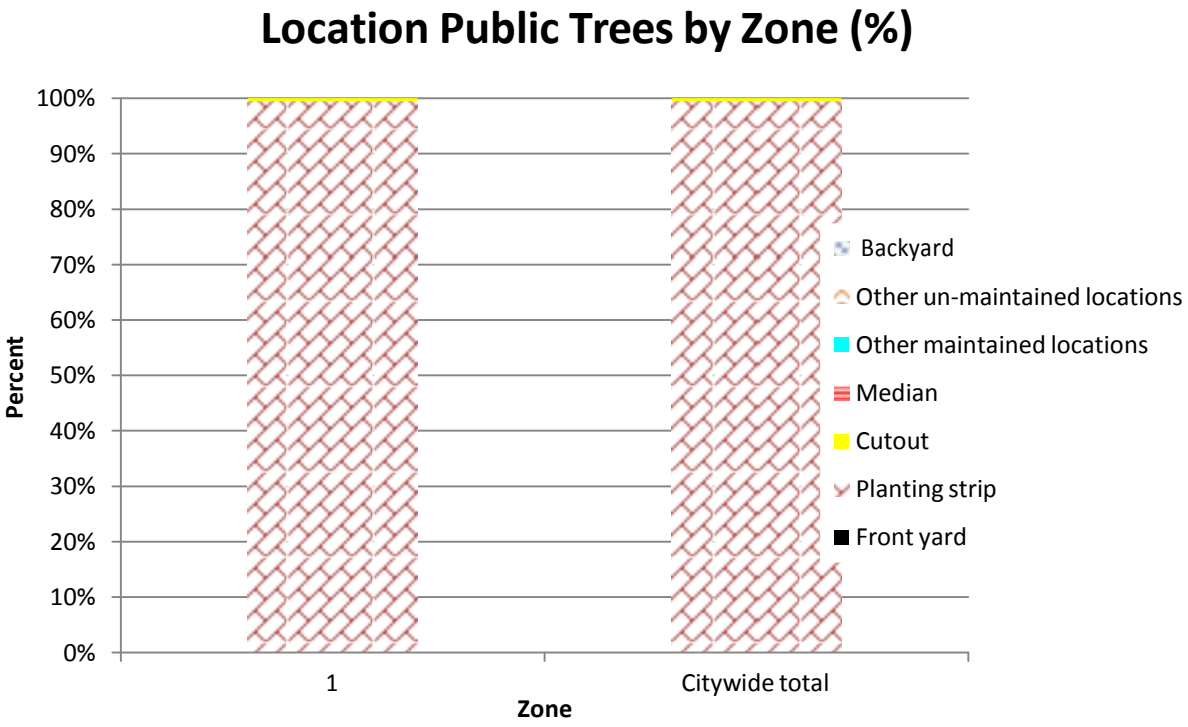

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

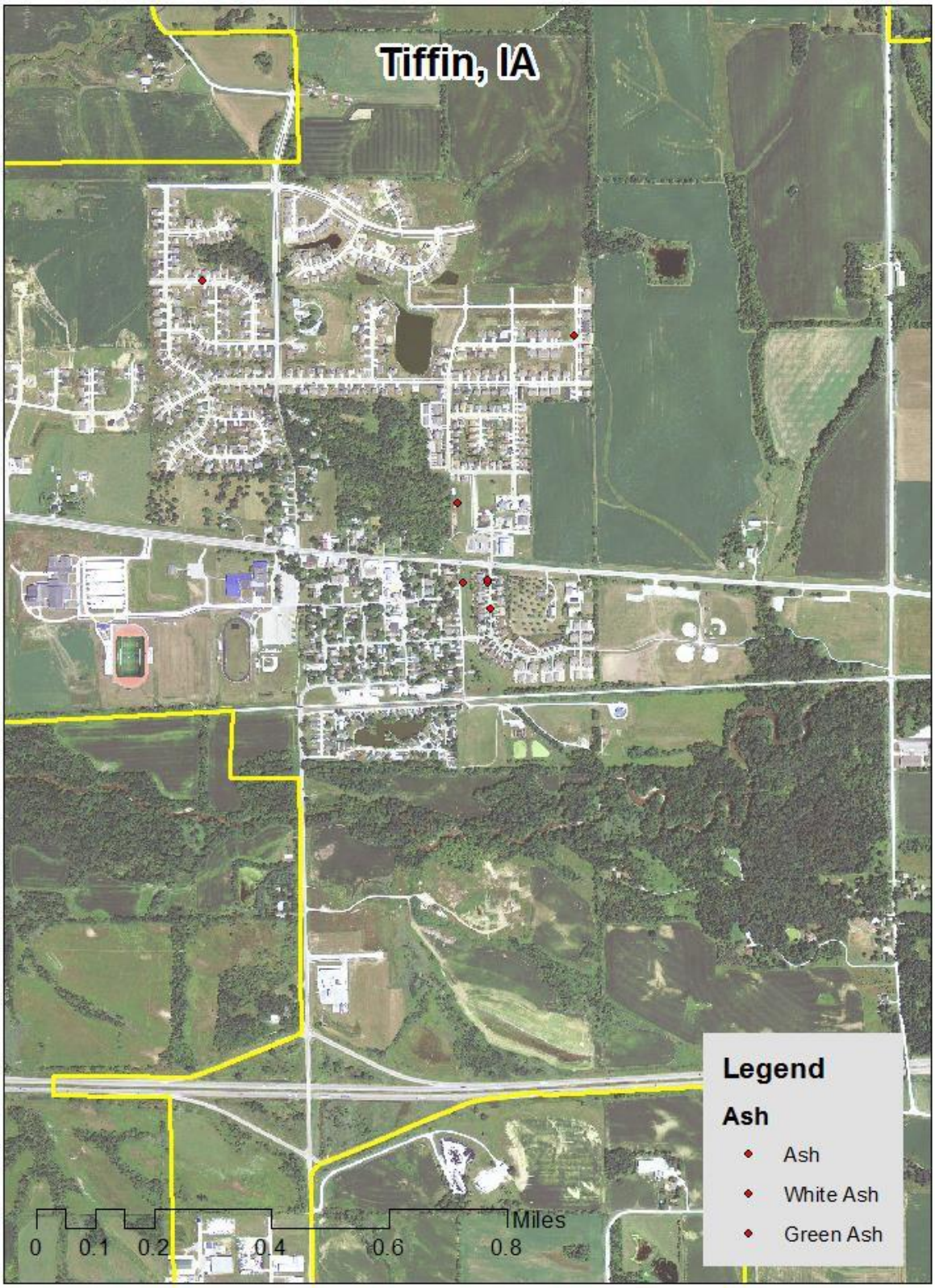

Figure 1: Location of Ash Trees

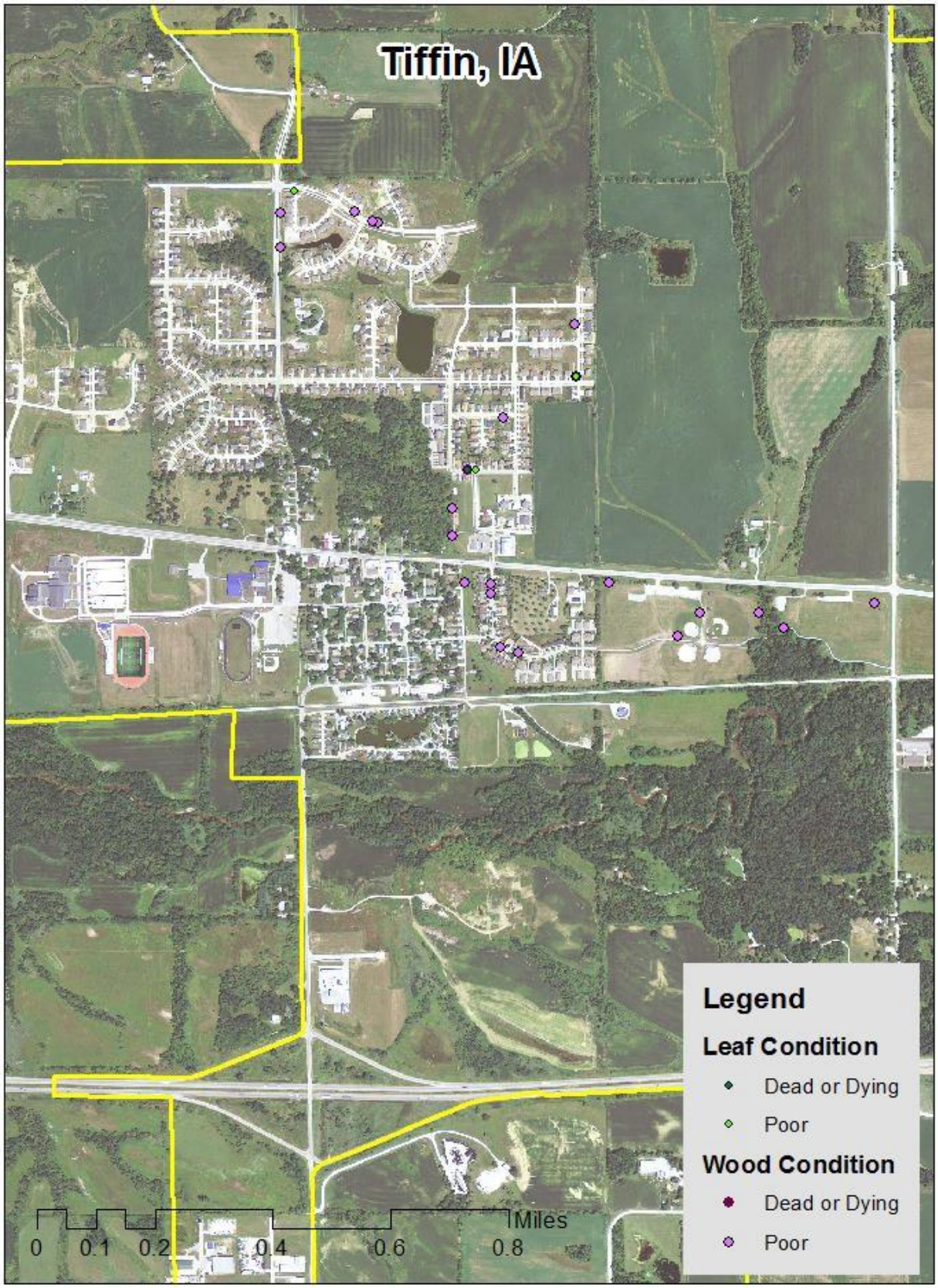

Figure 3: Location of Poor Condition Trees

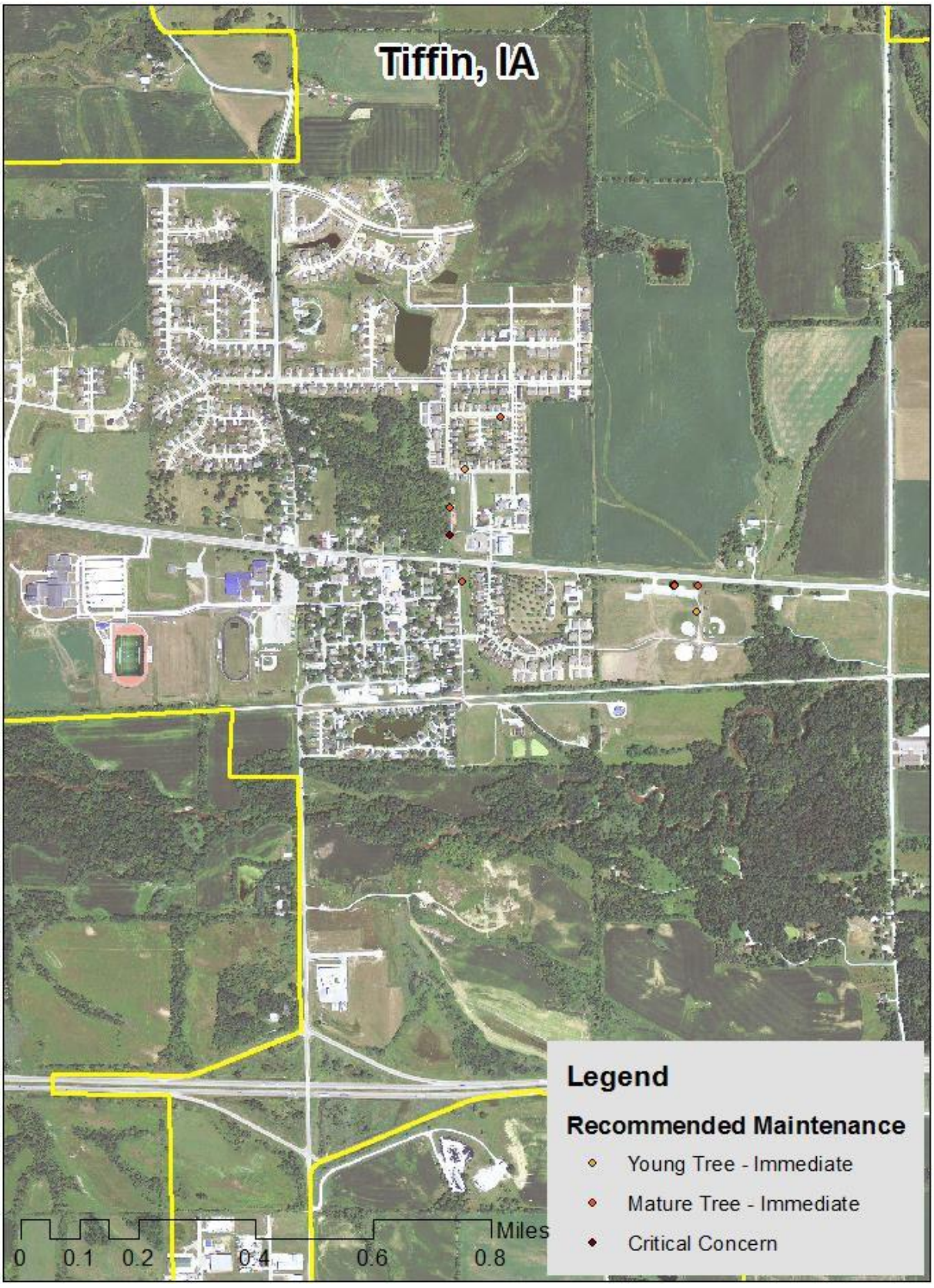

Figure 4: Location of Trees with Recommended Maintenance

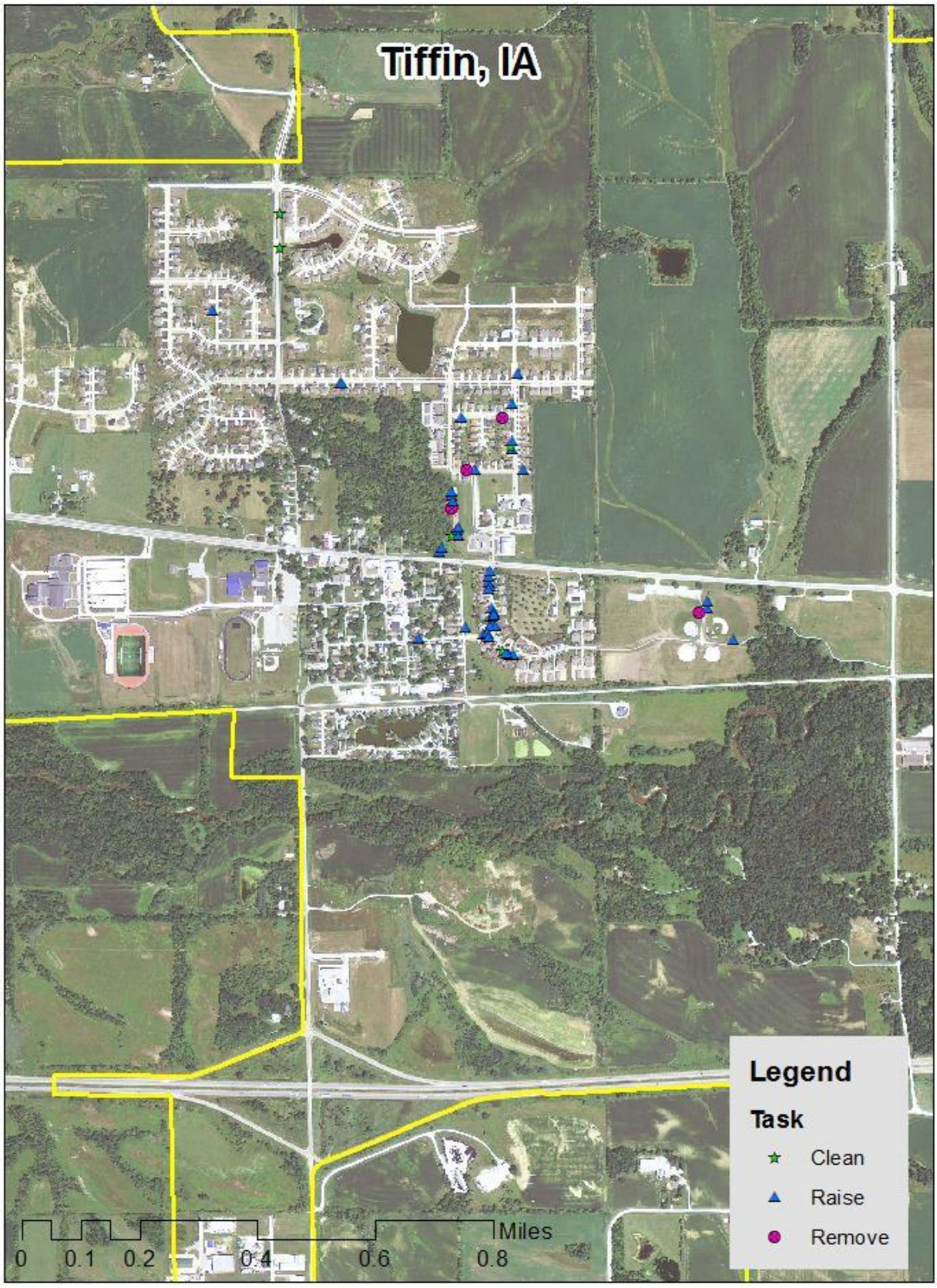

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Tiffin Tree Ordinances

CHAPTER 151 TREES

151.1 Definition 151.04 Trimming Trees to be Supervised

151.2 Planting Restrictions 151.05 Disease Control

151.3 Duty to Trim Trees 151.06 Inspection and Removal

151.1 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.

151.2 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 which 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.

151.3 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])

151.4 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.

151.5 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.

151.6 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)