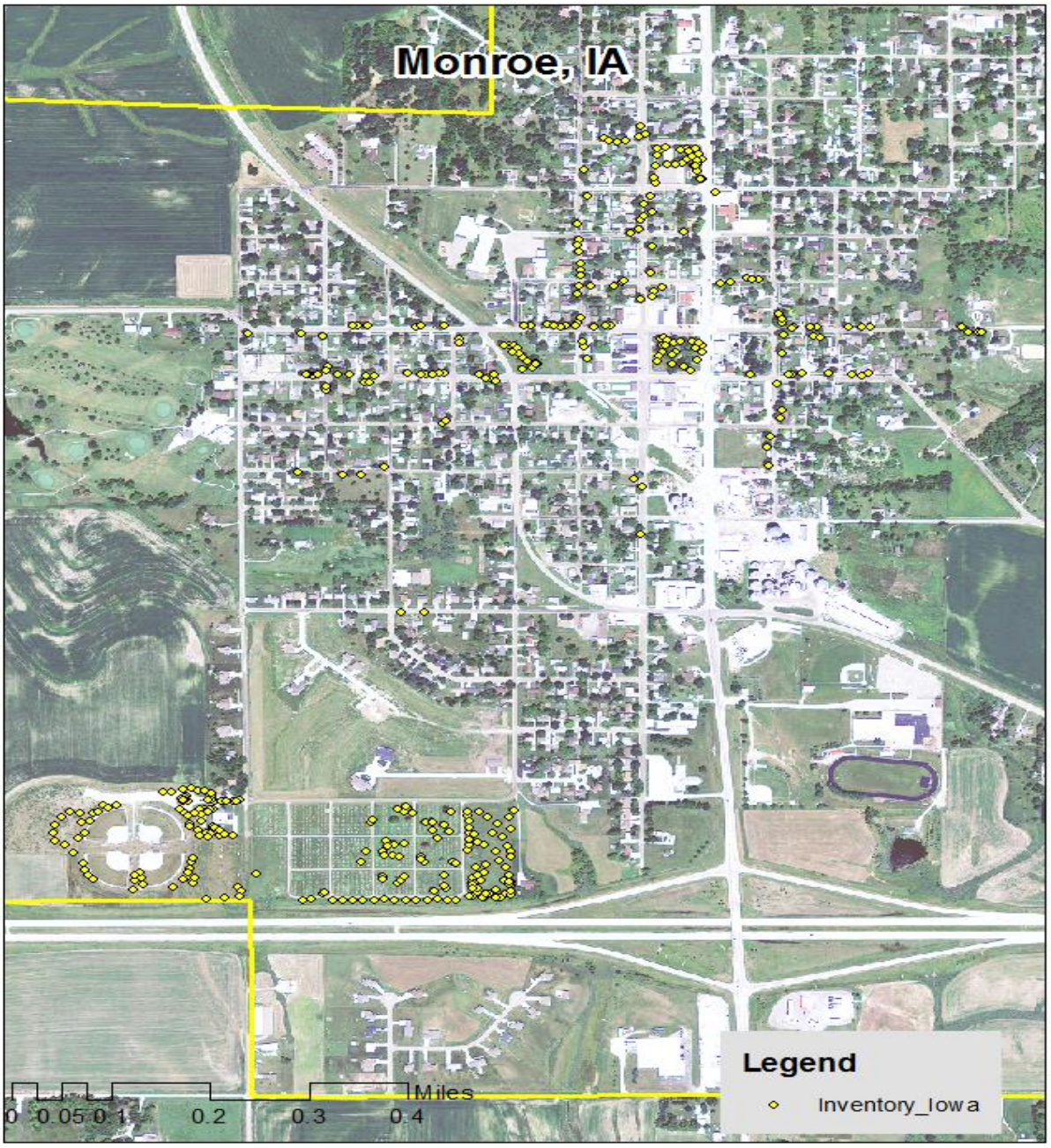

2013 Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Monroe 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 6% of Monroe'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 576 trees inventoried.

- Monroe's trees provide $76,225 of benefits annually, an average of $132 a tree
- There are over 42 species of trees
- The top three genus are: Maple 29%, Spruce 10%, and Redbud & Oak 8% each
- 24% of trees are in need of some type of management
- 30 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 30 trees needing removal, 17 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*
- 6 of the 33 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB
- 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, evergreens, redbud, cottonwood, poplar, box elder, Siberian elm, willow, or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take several years to take out the ash and other trees identified as needing to be removed – Suggestion: request a budget increase to $8,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2013, a tree inventory was conducted that included 100% of the city owned trees in parking strips along city streets. 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 576 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Monroe's trees reduce energy related costs by approximately $19,623 annually (Appendix A, Table 1). These savings are both in Electricity (92.9 MWh) and in Natural Gas (12,831.8 Therms).

Annual Stormwater Benefits

Monroe's trees intercept about 1,167,804 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $31,650 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 Monroe, it is estimated that trees remove 1,126 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 $3,069 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Monroe, trees sequester about 343,597 lbs of carbon a year with an associated value of $2,577 (Appendix A, Table 5). In addition, the trees store 3,720,705 lbs of carbon, with a yearly benefit of $27,905 (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. Monroe receives $19,308 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, Monroe's trees provide $88,470 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 576 trees in Monroe provide approximately $132 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Monroe has over 42 different tree species along city streets (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Silver Maple	46	8%
E. Redbud	46	8%
Maple	43	7%
N. Hackberry	35	6%
Sugar Maple	34	6%
E. Red Cedar	32	6%
Norway Spruce	29	5%
Red Maple	23	4%
Blue Spruce	22	4%
Apple (Crab)	21	4%
All other deciduous	210	36%
All other conifers	35	6%

Age Class

The majority of Monroe's trees (52%) are between 0 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 24 inches in diameter at 4.5 ft. Monroe's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Monroe indicate that 88% 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, 72% of Monroe'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 8% of the population. This 8% 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	94	16%
Tree Removal	30	5%
Crown Raising	13	2%
Crown Reduction	2	<1%

Canopy Cover

The canopy cover of Monroe is approximately 11 acres (Appendix A, Figure 4). According to the 2000 census, Monroe occupies 1,082 acres. Thus the canopy cover on city land is about 1%.

Land Use and Location

The majority of Monroe's city street trees are in planting strips in by a park, vacant lot, or other location (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use	
Park/vacant/other	67%
Single family residential	33%

Location	
Planting strip	67%
Front yard	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

Monroe has 9 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 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming. There are 36 additional 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 30 removals, 2 are ash trees. There are a total of 33 ash trees, and 6 of those have signs and symptoms that have been associated with EAB. There is one ash tree that is 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 Monroe.

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 (29%) (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, Siberian elm, evergreen, willow, or black walnut, as outlined in section 151.02 of the Sample city ordinance (Appendix C). All trees planted must meet the restrictions in the sample 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 death 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: 11 trees - 5 largest critical concern trees, plus 6 others recommended for removal
Planting and Replacement: 12 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Years 2 through 6

Removal: 10 trees/year - critical concern trees, those recommended for removal, and additional ash trees with poor health

Planting and Replacement: 12 trees each year in open locations

Routine trimming: Contract to trim 1/3 of the city trees in Years 2, 4, and 6

Visual Survey for signs and symptoms of EAB

EAB could potentially kill all ash within 4 years of its arrival. Estimated cost for tree removal is $500 per tree (multiplied by 61 = $30,500). Estimated cost for replacement plantings is $150 per tree (multiplied by 72 = $10,800). Estimated trimming cost is $1,800 in years 2,4, and 6 ($5,400 total) and watering and maintenance cost is estimated at $500 annually ($3,000 total). Grand total of estimated urban forestry costs equals $49,700. To remove all ash trees within 6 years, plant replacement trees, do the recommended trimming, plus routine watering and maintenance each year, the budget would need to be increased to about $8,300 a year. As stated earlier, the city is encouraged to apply for grants to help with the cost of replacement plantings.

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, spreading 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 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 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 ash trees will be replaced. All trees should meet the restrictions in the sample city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Siberian 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 genus 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. Sample 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."

Budget

Current Budget
Total $49,700 over 6 years (about $8,300/year)

FY 2014 Budget

Removal: $5,500
Planting: $1,800
Watering & Maintenance: $500

FY 2015-2019 Budget

Removal: $5,000 annually
Planting: $1,800 annually
Routine trimming: $1,800 in 2015, 2017, and 2019
Watering & Maintenance: $500 each year

Purposed Budget Increase

EAB could potentially kill all ash trees in Monroe within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $8,300 a year Additionally, it is recommended that Monroe 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Monroe

Annual Energy Benefits of Public Trees by Species

3/5/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	15.8	1,201	2,092.7	2,051	3,252	(N/A)	8.0	16.6	70.69
Eastern redbud	0.6	42	97.1	95	137	(N/A)	8.0	0.7	2.98
Maple	2.9	217	407.9	400	616	(N/A)	7.5	3.1	14.33
Northern hackberry	13.8	1,049	1,971.8	1,932	2,982	(N/A)	6.1	15.2	85.19
Sugar maple	8.9	673	1,196.1	1,172	1,845	(N/A)	5.9	9.4	54.26
Eastern red cedar	3.3	252	492.1	482	734	(N/A)	5.6	3.7	22.93
Norway spruce	4.2	316	544.0	533	849	(N/A)	5.0	4.3	29.28
Red maple	0.7	55	98.9	97	152	(N/A)	4.0	0.8	6.60
Blue spruce	1.9	146	250.1	245	391	(N/A)	3.8	2.0	17.78
Apple	1.0	77	162.0	159	236	(N/A)	3.7	1.2	11.23
Pin oak	6.3	479	853.4	836	1,315	(N/A)	3.7	6.7	62.61
Northern red oak	0.9	67	128.1	126	193	(N/A)	3.5	1.0	9.63
Green ash	5.1	389	716.1	702	1,090	(N/A)	3.0	5.6	64.14
Ash	4.7	356	684.4	671	1,027	(N/A)	2.8	5.2	64.17
Broadleaf Deciduous	0.1	8	18.9	19	27	(N/A)	2.6	0.1	1.77
Northern white cedar	1.6	122	209.2	205	327	(N/A)	2.4	1.7	23.33
Amur maple	0.0	3	7.5	7	10	(N/A)	2.1	0.1	0.87
American sycamore	4.8	368	663.8	651	1,018	(N/A)	2.1	5.2	84.85
Eastern white pine	1.0	80	140.5	138	217	(N/A)	1.7	1.1	21.73
Siberian elm	3.3	248	455.0	446	694	(N/A)	1.7	3.5	69.41
Honeylocust	2.6	195	335.6	329	523	(N/A)	1.6	2.7	58.16
Broadleaf Deciduous	0.1	5	10.9	11	16	(N/A)	1.2	0.1	2.23
Tulip tree	0.4	31	56.5	55	86	(N/A)	1.2	0.4	12.28
Kentucky coffeetree	0.0	1	2.8	3	4	(N/A)	1.0	0.0	0.66
Spruce	0.2	14	24.6	24	38	(N/A)	1.0	0.2	6.35
Other street trees	8.7	657	1,211.8	1,188	1,844	(N/A)	10.9	9.4	29.27
Citywide total	92.9	7,048	12,831.8	12,575	19,623	(N/A)	100.0	100.0	34.07

Table 2: Annual Stormwater Benefits

Monroe

Annual Stormwater Benefits of Public Trees by Species

3/5/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	223,651	6,061	(N/A)	8.0	19.2	131.77
Eastern redbud	1,726	47	(N/A)	8.0	0.2	1.02
Maple	25,449	690	(N/A)	7.5	2.2	16.04
Northern hackberry	149,104	4,041	(N/A)	6.1	12.8	115.46
Sugar maple	104,096	2,821	(N/A)	5.9	8.9	82.98
Eastern red cedar	48,401	1,312	(N/A)	5.6	4.1	40.99
Norway spruce	95,214	2,580	(N/A)	5.0	8.2	88.98
Red maple	5,092	138	(N/A)	4.0	0.4	6.00
Blue spruce	24,811	672	(N/A)	3.8	2.1	30.57
Apple	3,592	97	(N/A)	3.7	0.3	4.64
Pin oak	70,037	1,898	(N/A)	3.7	6.0	90.39
Northern red oak	4,760	129	(N/A)	3.5	0.4	6.45
Green ash	57,248	1,552	(N/A)	3.0	4.9	91.27
Ash	51,052	1,384	(N/A)	2.8	4.4	86.48
Broadleaf Deciduous	295	8	(N/A)	2.6	0.0	0.53
Northern white cedar	33,565	910	(N/A)	2.4	2.9	64.98
Amur maple	89	2	(N/A)	2.1	0.0	0.20
American sycamore	73,076	1,980	(N/A)	2.1	6.3	165.04
Eastern white pine	24,550	665	(N/A)	1.7	2.1	66.54
Siberian elm	32,659	885	(N/A)	1.7	2.8	88.51
Honeylocust	31,212	846	(N/A)	1.6	2.7	93.99
Broadleaf Deciduous	236	6	(N/A)	1.2	0.0	0.91
Tulip tree	5,597	152	(N/A)	1.2	0.5	21.67
Kentucky coffeetree	107	3	(N/A)	1.0	0.0	0.48
Spruce	2,110	57	(N/A)	1.0	0.2	9.53
Other street trees	100,073	2,712	(N/A)	10.9	8.6	43.05
Citywide total	1,167,804	31,650	(N/A)	100.0	100.0	54.95

Table 3: Annual Air Quality Benefits

Monroe

Annual Air Quality Benefits of Public Trees by Species

3/5/2014

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
Silver maple	37.6	6.4	18.5	1.7	203	74.7	10.9	10.4	71.6	467	-19.2	-72	212.6	598	(N/A)	8.0	13.00
Eastern redbud	0.2	0.0	0.1	0.0	1	2.8	0.4	0.4	2.5	17	0.0	0	6.5	18	(N/A)	8.0	0.40
Maple	6.2	1.1	2.9	0.3	33	13.8	2.0	1.9	12.9	85	-2.0	-8	39.0	111	(N/A)	7.5	2.58
Northern hackberry	25.2	4.4	12.5	1.1	137	66.8	9.7	9.2	62.7	414	0.0	0	191.7	551	(N/A)	6.1	15.75
Sugar maple	14.1	2.4	7.0	0.6	76	42.1	6.1	5.9	40.1	263	-11.1	-41	107.4	298	(N/A)	5.9	8.76
Eastern red cedar	9.9	2.0	7.8	1.2	64	16.1	2.3	2.2	15.0	100	-26.7	-100	29.8	64	(N/A)	5.6	1.99
Norway spruce	11.6	2.3	9.2	1.4	75	19.6	2.9	2.7	18.9	123	-56.6	-212	12.0	-14	(N/A)	5.0	-0.48
Red maple	1.1	0.2	0.5	0.0	6	3.4	0.5	0.5	3.3	21	-0.4	-1	9.2	26	(N/A)	4.0	1.13
Blue spruce	3.1	0.6	2.7	0.4	21	9.0	1.3	1.3	8.7	57	-8.9	-33	18.3	44	(N/A)	3.8	2.01
Apple	0.8	0.1	0.4	0.0	4	5.1	0.7	0.7	4.6	31	0.0	0	12.4	35	(N/A)	3.6	1.68
Pin oak	12.2	2.1	6.3	0.6	67	30.0	4.4	4.2	28.6	187	-22.7	-85	65.6	169	(N/A)	3.6	8.04
Northern red oak	0.6	0.1	0.4	0.0	4	4.3	0.6	0.6	4.0	26	-0.9	-3	9.7	27	(N/A)	3.5	1.34
Green ash	6.9	1.1	3.3	0.3	37	24.6	3.6	3.4	23.2	153	0.0	0	66.4	190	(N/A)	3.0	11.16
Ash	11.4	2.0	5.5	0.5	61	22.8	3.3	3.1	21.3	141	-2.6	-10	67.2	192	(N/A)	2.8	12.03
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	2.6	0.23
Northern white cedar	4.0	0.8	3.2	0.5	26	7.5	1.1	1.1	7.3	47	-18.1	-68	7.3	5	(N/A)	2.4	0.38
Amur maple	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	2.1	0.11
American sycamore	11.0	1.8	4.9	0.5	58	23.1	3.4	3.2	21.9	144	0.0	0	69.9	202	(N/A)	2.1	16.83
Eastern white pine	3.0	0.6	2.4	0.4	19	5.0	0.7	0.7	4.8	31	-14.3	-54	3.1	-3	(N/A)	1.7	-0.32
Siberian elm	4.9	0.8	2.5	0.2	27	15.7	2.3	2.2	14.8	97	0.0	0	43.4	124	(N/A)	1.7	12.41
Honeylocust	6.2	1.0	2.8	0.3	33	12.1	1.8	1.7	11.6	76	-4.9	-19	32.5	90	(N/A)	1.6	9.96
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)	1.2	0.29
Tulip tree	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.6	16	(N/A)	1.2	2.32
Kentucky coffeetree	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.2	0	(N/A)	1.0	0.08
Spruce	0.2	0.0	0.2	0.0	1	0.9	0.1	0.1	0.8	5	-0.7	-3	1.7	4	(N/A)	1.0	0.68
Other street trees	16.7	2.8	8.4	0.9	91	41.5	6.0	5.7	39.2	258	-9.2	-35	112.1	314	(N/A)	10.9	4.99
Citywide total	187.8	32.7	101.9	11.0	1,049	444.0	64.6	61.6	420.6	2,764	-198.3	-744	1,125.8	3,069	(N/A)	100.0	5.33

Table 4: Annual Carbon Stored

Monroe

Stored CO2 Benefits of Public Trees by Species

3/5/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	810,580	6,079	(N/A)	8.0	21.8	132.16
Eastern redbud	4,957	37	(N/A)	8.0	0.1	0.81
Maple	67,731	508	(N/A)	7.5	1.8	11.81
Northern	390,585	2,929	(N/A)	6.1	10.5	83.70
Sugar maple	410,988	3,082	(N/A)	5.9	11.1	90.66
Eastern red cedar	31,966	240	(N/A)	5.6	0.9	7.49
Norway spruce	146,204	1,097	(N/A)	5.0	3.9	37.81
Red maple	12,528	94	(N/A)	4.0	0.3	4.09
Blue spruce	19,872	149	(N/A)	3.8	0.5	6.77
Apple	13,653	102	(N/A)	3.7	0.4	4.88
Pin oak	318,494	2,389	(N/A)	3.7	8.6	113.75
Northern red oak	10,080	76	(N/A)	3.5	0.3	3.78
Green ash	223,241	1,674	(N/A)	3.0	6.0	98.49
Ash	187,656	1,407	(N/A)	2.8	5.0	87.96
Broadleaf	699	5	(N/A)	2.6	0.0	0.35
Northern white	45,683	343	(N/A)	2.4	1.2	24.47
Amur maple	165	1	(N/A)	2.1	0.0	0.10
American	367,724	2,758	(N/A)	2.1	9.9	229.83
Eastern white pine	36,657	275	(N/A)	1.7	1.0	27.49
Siberian elm	118,927	892	(N/A)	1.7	3.2	89.20
Honeylocust	80,403	603	(N/A)	1.6	2.2	67.00
Broadleaf	319	2	(N/A)	1.2	0.0	0.34
Tulip tree	26,016	195	(N/A)	1.2	0.7	27.87
Kentucky	73	1	(N/A)	1.0	0.0	0.09
Spruce	1,254	9	(N/A)	1.0	0.0	1.57
Other street trees	178,829	2,957	(N/A)	10.9	10.6	46.93
Citywide total	3,720,705	27,905	(N/A)	100.0	100.0	48.45

Table 5: Annual Carbon Sequestered

Monroe

Annual CO_2 Benefits of Public Trees by Species

3/5/2014

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
Silver maple	63,145	474	-3,891	-9	-29	26,540	199	85,785	643	(N/A)	8.0	25.0	13.99
Eastern redbud	1,008	8	-24	-9	0	930	7	1,904	14	(N/A)	8.0	0.6	0.31
Maple	2,522	19	-325	-8	-3	4,786	36	6,974	52	(N/A)	7.5	2.0	1.22
Northern hackberry	18,950	142	-1,875	-7	-14	23,189	174	40,257	302	(N/A)	6.1	11.7	8.63
Sugar maple	20,601	155	-1,973	-7	-15	14,869	112	33,491	251	(N/A)	5.9	9.8	7.39
Eastern red cedar	159	1	-153	-6	-1	5,560	42	5,559	42	(N/A)	5.6	1.6	1.30
Norway spruce	2,903	22	-702	-6	-5	6,986	52	9,182	69	(N/A)	5.0	2.7	2.37
Red maple	650	5	-60	-4	0	1,211	9	1,797	13	(N/A)	4.0	0.5	0.59
Blue spruce	1,468	11	-95	-4	-1	3,225	24	4,594	34	(N/A)	3.8	1.3	1.57
Apple	1,571	12	-66	-4	-1	1,704	13	3,205	24	(N/A)	3.7	0.9	1.14
Pin oak	29,764	223	-1,529	-4	-11	10,578	79	38,809	291	(N/A)	3.7	11.3	13.86
Northern red oak	1,279	10	-48	-4	0	1,482	11	2,710	20	(N/A)	3.5	0.8	1.02
Green ash	12,672	95	-1,072	-3	-8	8,587	64	20,184	151	(N/A)	3.0	5.9	8.90
Ash	3,686	28	-901	-3	-7	7,869	59	10,651	80	(N/A)	2.8	3.1	4.99
Broadleaf Deciduous	218	2	-3	-3	0	179	1	391	3	(N/A)	2.6	0.1	0.20
Northern white cedar	2,019	15	-219	-3	-2	2,687	20	4,484	34	(N/A)	2.4	1.3	2.40
Amur maple	104	1	-1	-2	0	67	1	168	1	(N/A)	2.1	0.1	0.11
American sycamore	11,175	84	-1,765	-2	-13	8,124	61	17,532	131	(N/A)	2.1	5.1	10.96
Eastern white pine	901	7	-176	-2	-1	1,761	13	2,484	19	(N/A)	1.7	0.7	1.86
Siberian elm	6,243	47	-571	-2	-4	5,485	41	11,155	84	(N/A)	1.7	3.3	8.37
Honeylocust	3,963	30	-386	-2	-3	4,299	32	7,875	59	(N/A)	1.6	2.3	6.56
Broadleaf Deciduous	128	1	-2	-1	0	108	1	233	2	(N/A)	1.2	0.1	0.25
Tulip tree	975	7	-125	-1	-1	676	5	1,525	11	(N/A)	1.2	0.4	1.63
Kentucky coffeetree	16	0	0	-1	0	26	0	40	0	(N/A)	1.0	0.0	0.05
Spruce	162	1	-6	-1	0	310	2	465	3	(N/A)	1.0	0.1	0.58
Other street trees	19,537	147	-1,892	-12	-14	14,511	109	32,142	241	(N/A)	10.9	9.4	3.83
Citywide total	205,820	1,544	-17,859	-112	-135	155,748	1,168	343,597	2,577	(N/A)	100.0	100.0	4.47

Table 6: Annual Social and Aesthetic Benefits

Monroe

Annual Aesthetic/Other Benefits of Public Trees by Species

3/5/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	4,981	(N/A)	8.0	25.8	108.28
Eastern redbud	41	(N/A)	8.0	0.2	0.89
Maple	330	(N/A)	7.5	1.7	7.67
Northern hackberry	2,332	(N/A)	6.1	12.1	66.62
Sugar maple	2,118	(N/A)	5.9	11.0	62.30
Eastern red cedar	85	(N/A)	5.6	0.4	2.67
Norway spruce	462	(N/A)	5.0	2.4	15.94
Red maple	88	(N/A)	4.0	0.5	3.84
Blue spruce	411	(N/A)	3.8	2.1	18.70
Apple	85	(N/A)	3.7	0.4	4.03
Pin oak	2,264	(N/A)	3.7	11.7	107.82
Northern red oak	147	(N/A)	3.5	0.8	7.36
Green ash	1,023	(N/A)	3.0	5.3	60.19
Ash	336	(N/A)	2.8	1.7	21.02
Broadleaf Deciduous	7	(N/A)	2.6	0.0	0.44
Northern white cedar	381	(N/A)	2.4	2.0	27.22
Amur maple	0	(N/A)	2.1	0.0	0.03
American sycamore	757	(N/A)	2.1	3.9	63.07
Eastern white pine	170	(N/A)	1.7	0.9	16.97
Siberian elm	453	(N/A)	1.7	2.3	45.26
Honeylocust	980	(N/A)	1.6	5.1	108.93
Broadleaf Deciduous	29	(N/A)	1.2	0.2	4.19
Tulip tree	98	(N/A)	1.2	0.5	14.02
Kentucky coffeetree	32	(N/A)	1.0	0.2	5.26
Spruce	63	(N/A)	1.0	0.3	10.54
Other street trees	1,633	(N/A)	10.9	8.5	25.92
Citywide total	19,308	(N/A)	100.0	100.0	33.52

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 $
Silver maple	3,252	643	598	6,061	4,981	$15,535.53	(±0)	20.38
Eastern redbud	137	14	18	47	41	$257.41	(±0)	0.34
Maple	616	52	111	690	330	$1,798.93	(±0)	2.36
Northern hackberry	2,982	302	551	4,041	2,332	$10,207.51	(±0)	13.39
Sugar maple	1,845	251	298	2,821	2,118	$7,333.37	(±0)	9.62
Eastern red cedar	734	42	64	1,312	85	$2,236.40	(±0)	2.93
Norway spruce	849	69	-14	2,580	462	$3,946.94	(±0)	5.18
Red maple	152	13	26	138	88	$417.57	(±0)	0.55
Blue spruce	391	34	44	672	411	$1,553.61	(±0)	2.04
Apple	236	24	35	97	85	$477.09	(±0)	0.63
Pin oak	1,315	291	169	1,898	2,264	$5,937.26	(±0)	7.79
Northern red oak	193	20	27	129	147	$515.95	(±0)	0.68
Green ash	1,090	151	190	1,552	1,023	$4,006.25	(±0)	5.26
Ash	1,027	80	192	1,384	336	$3,019.07	(±0)	3.96
Broadleaf Deciduous Small	27	3	3	8	7	$47.53	(±0)	0.06
Northern white cedar	327	34	5	910	381	$1,656.20	(±0)	2.17
Amur maple	10	1	1	2	0	$15.77	(±0)	0.02
American sycamore	1,018	131	202	1,980	757	$4,088.93	(±0)	5.36
Eastern white pine	217	19	-3	665	170	$1,067.84	(±0)	1.40
Siberian elm	694	84	124	885	453	$2,239.61	(±0)	2.94
Honeylocust	523	59	90	846	980	$2,498.43	(±0)	3.28
Broadleaf Deciduous Medium	16	2	2	6	29	$55.07	(±0)	0.07
Tulip tree	86	11	16	152	98	$363.47	(±0)	0.48
Kentucky coffeetree	4	0	0	3	32	$39.21	(±0)	0.05
Spruce	38	3	4	57	63	$166.15	(±0)	0.22
Other street trees	1,844	241	314	2,712	1,633	$6,744.51	(±0)	8.85
Citywide total	19,623	2,577	3,069	31,650	19,308	$76,225.59	(±0)	100.00

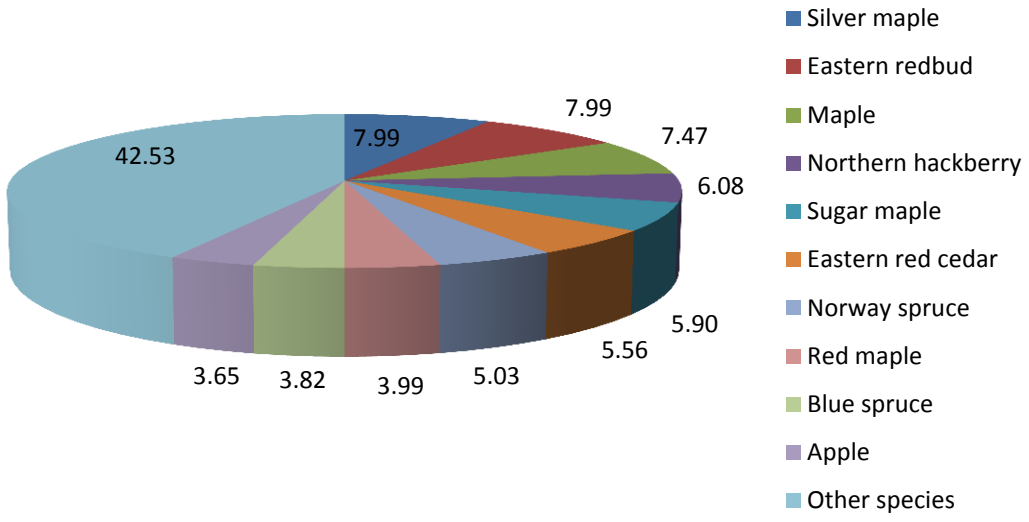

Figure 1: Species Distribution

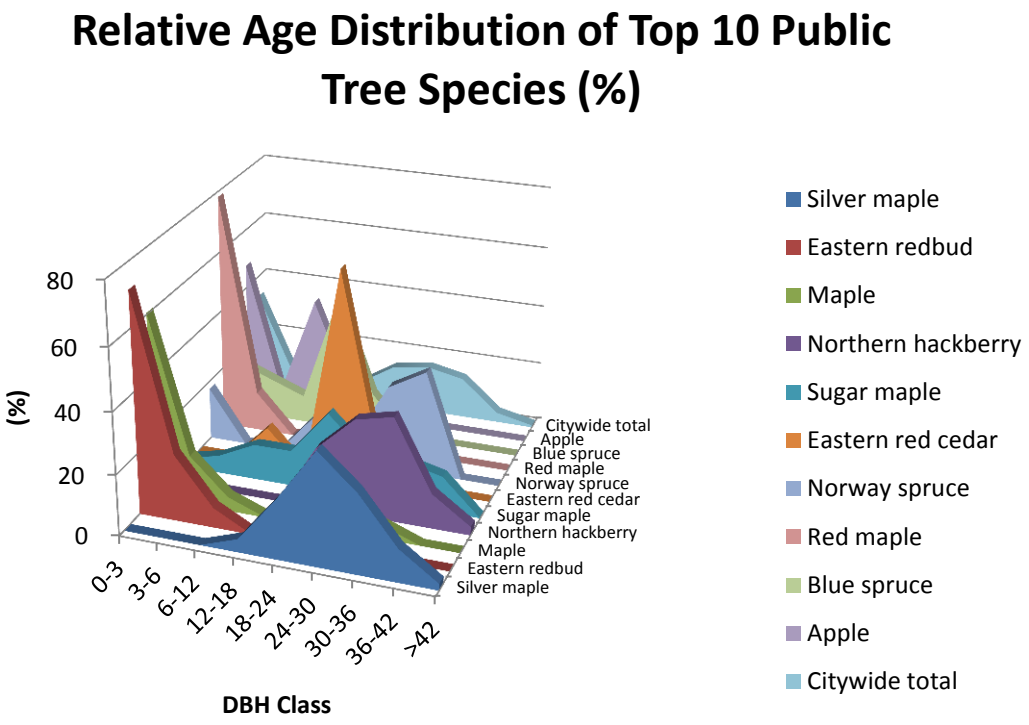

Figure 2: Relative Age Class

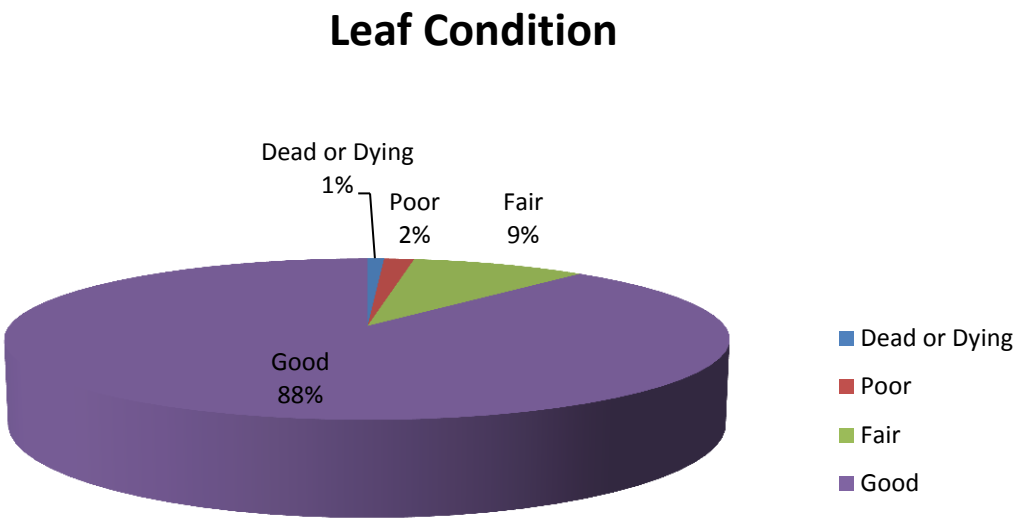

Figure 3: Foliage Condition

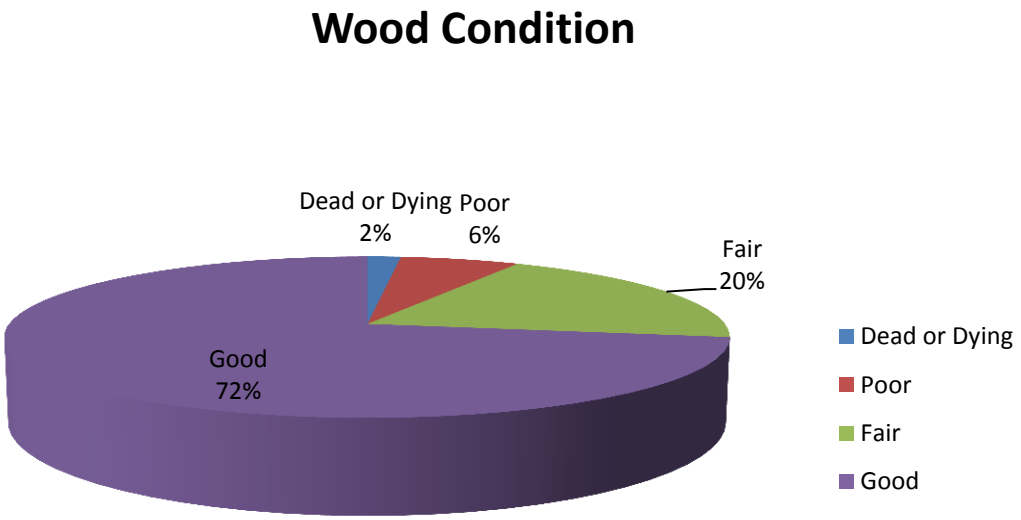

Figure 4: Wood Condition

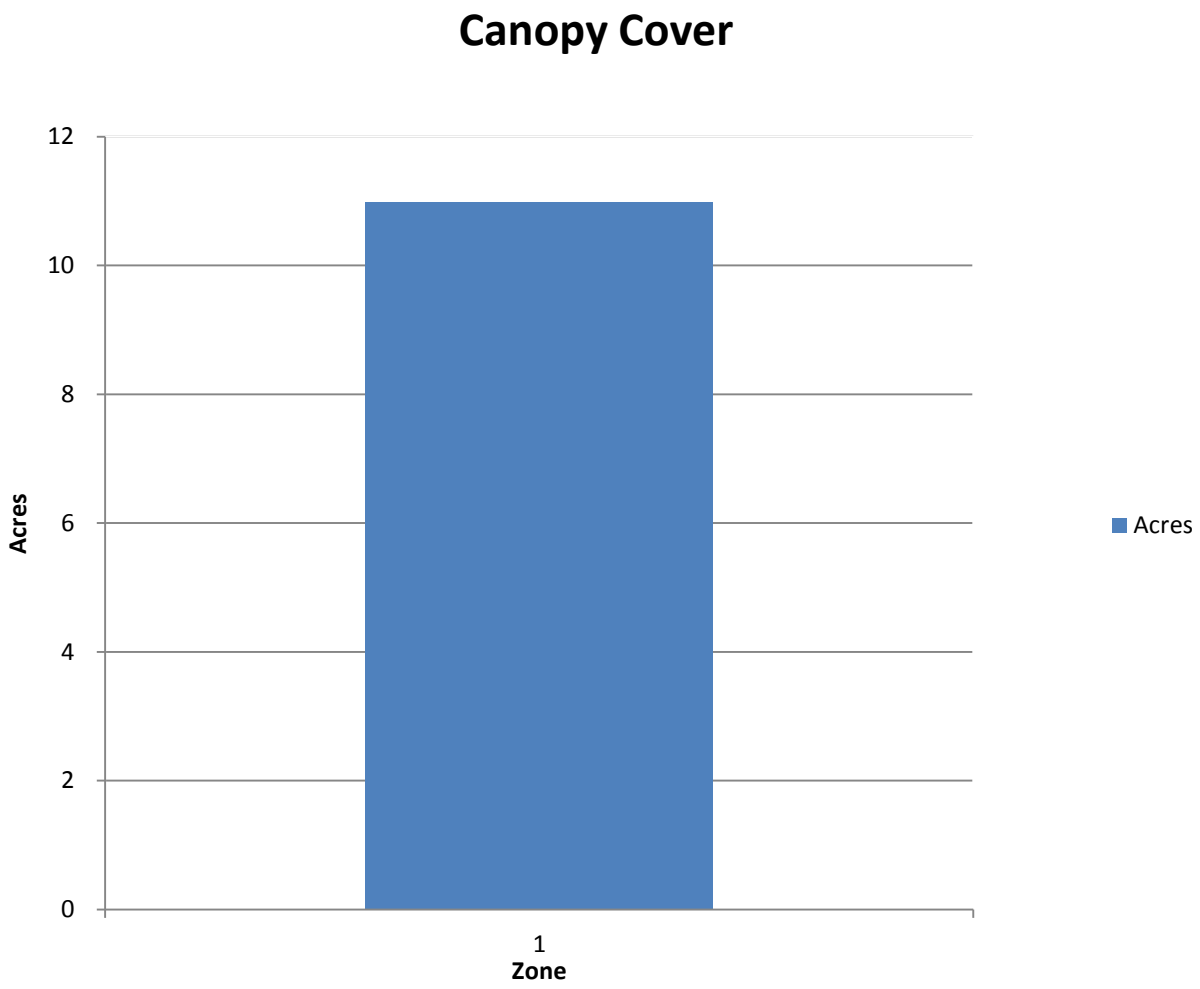

Figure 5: Canopy Cover in Acres

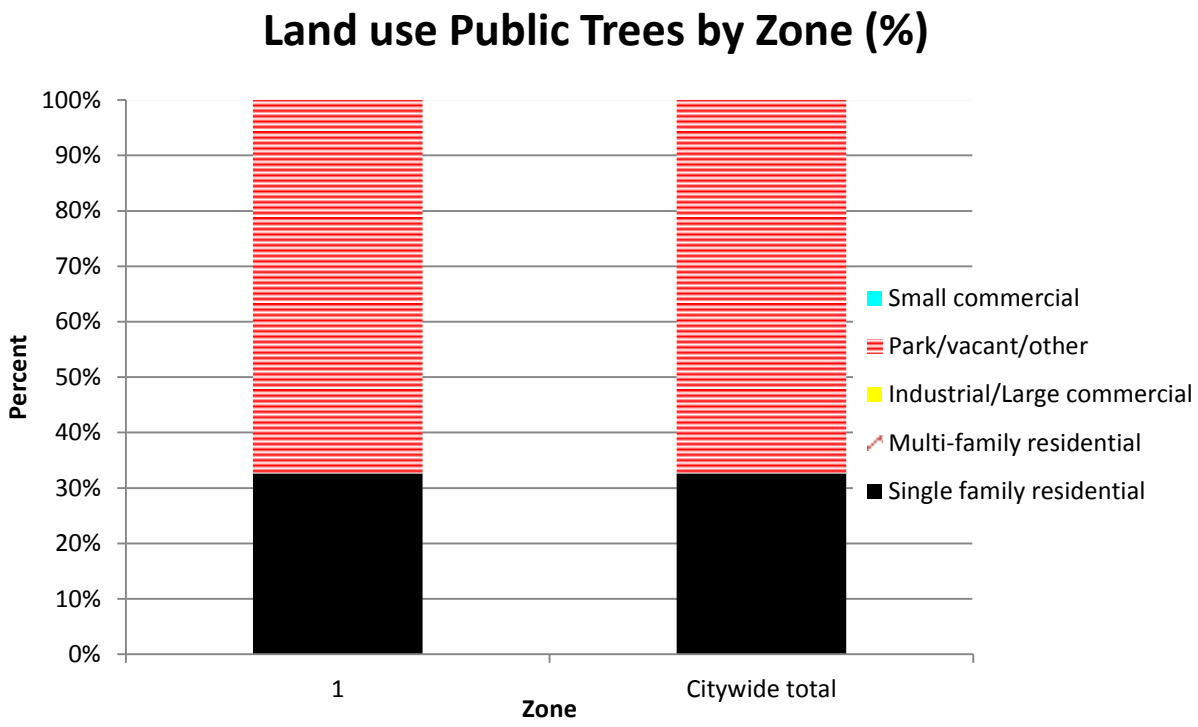

Figure 6: Land Use of city/park trees

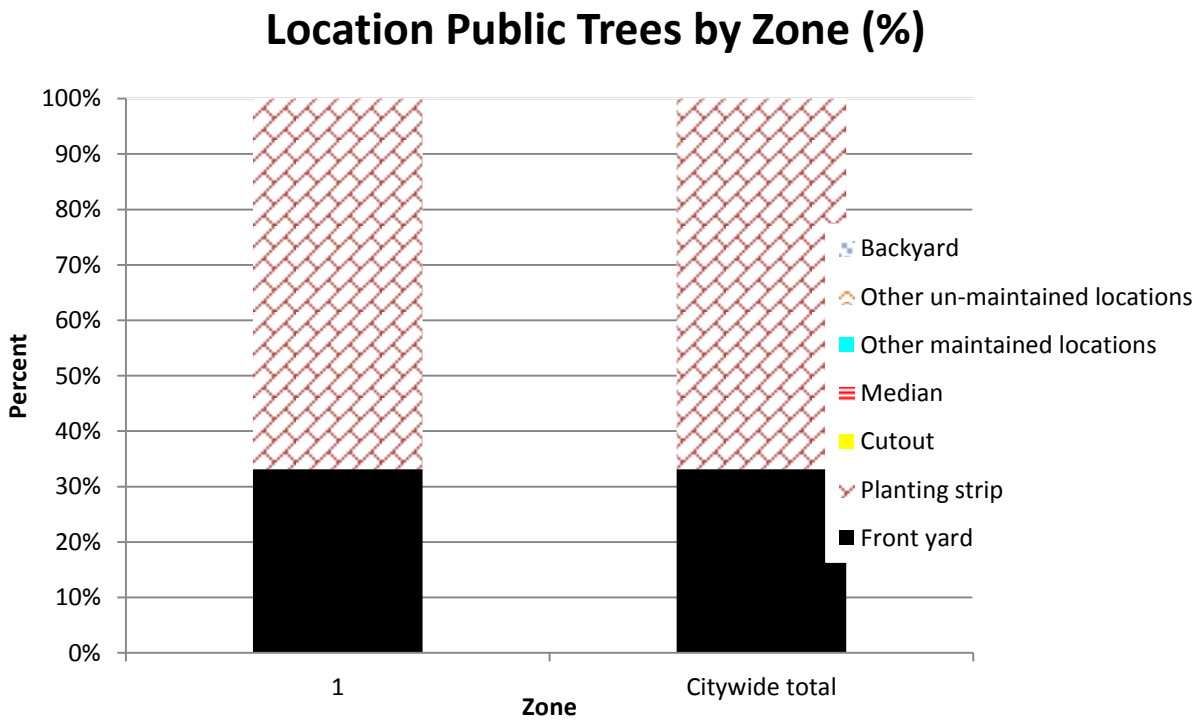

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

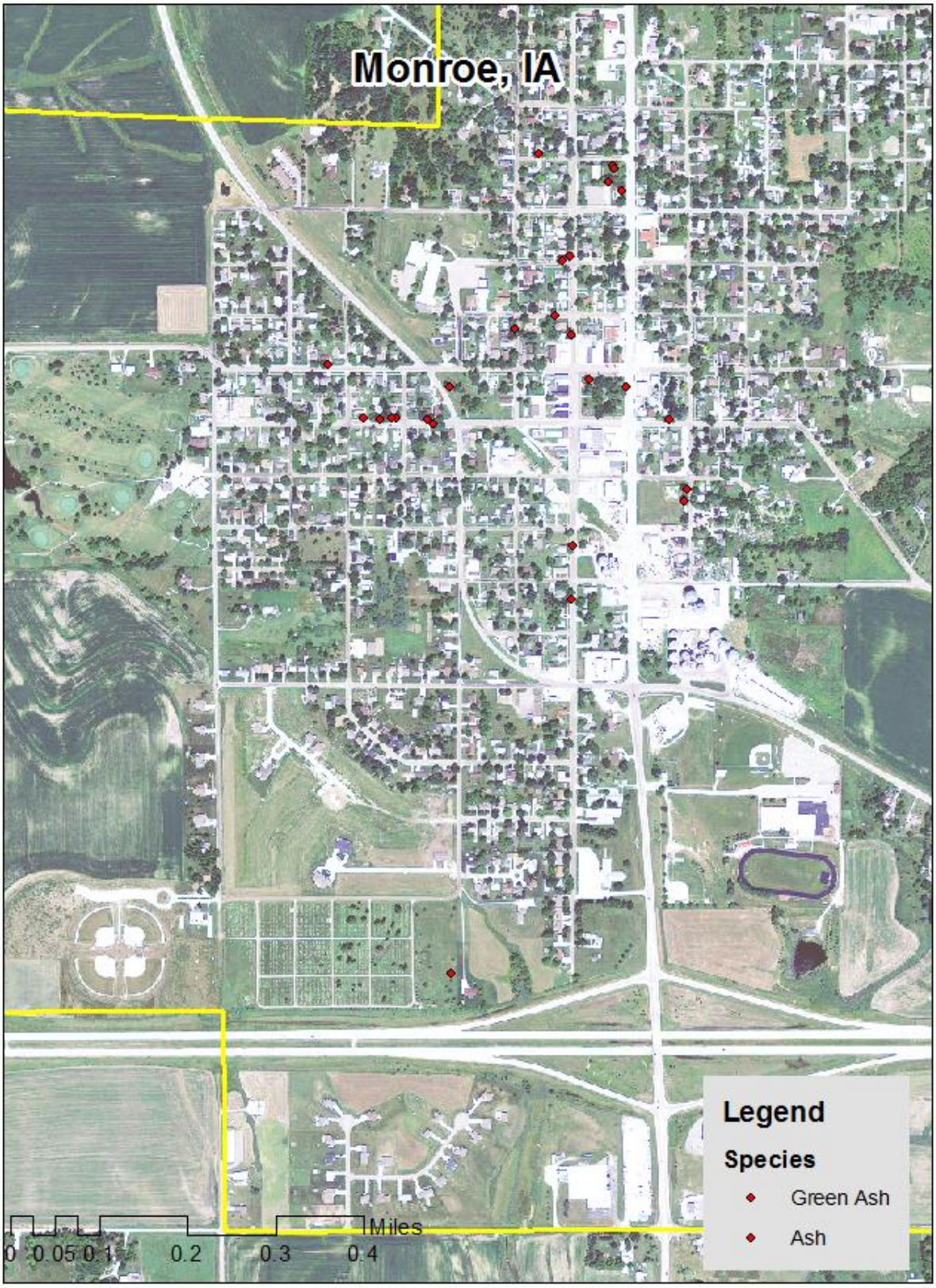

Figure 1: Location of Ash Trees

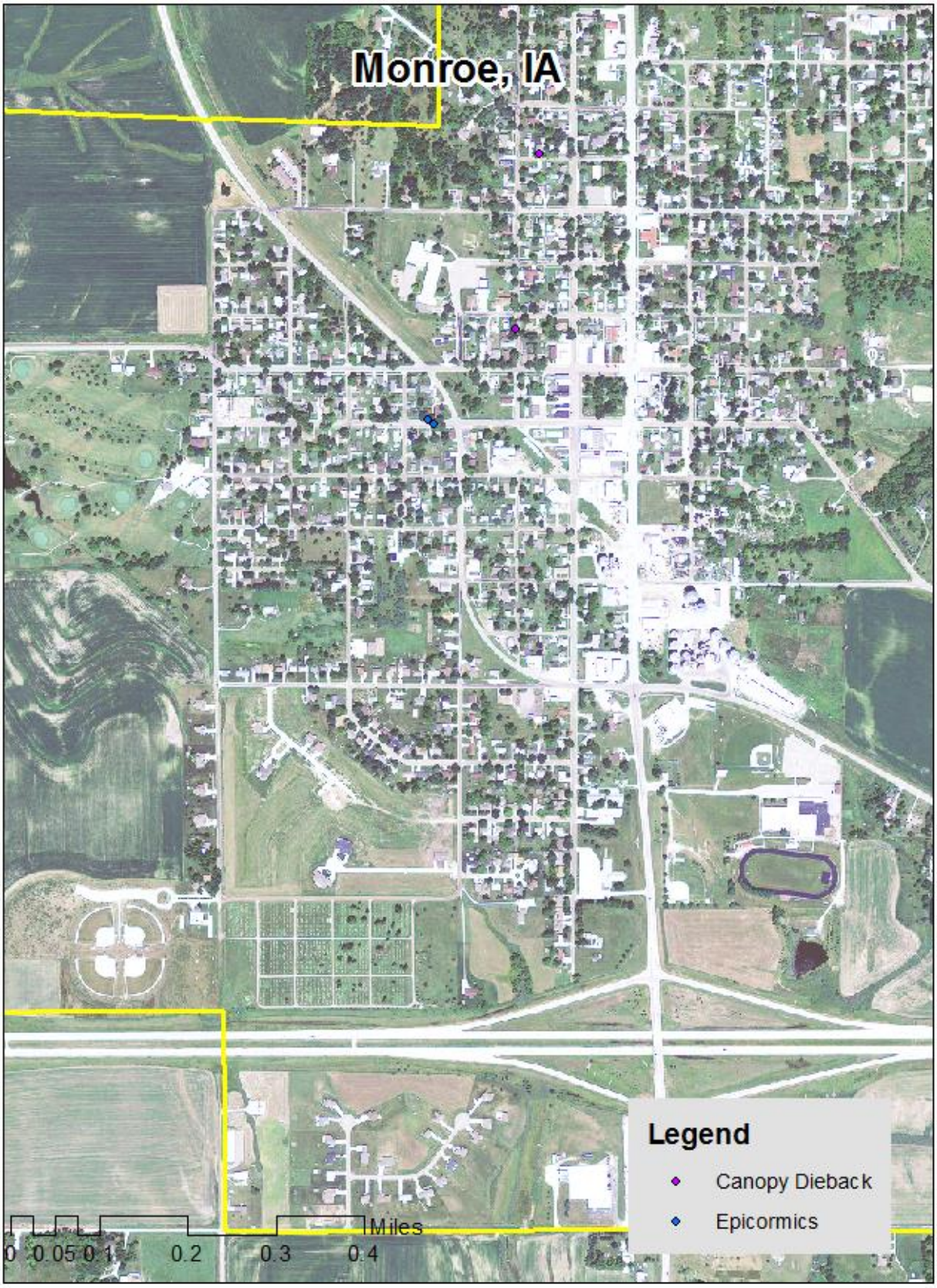

Figure 2: Location of EAB symptoms

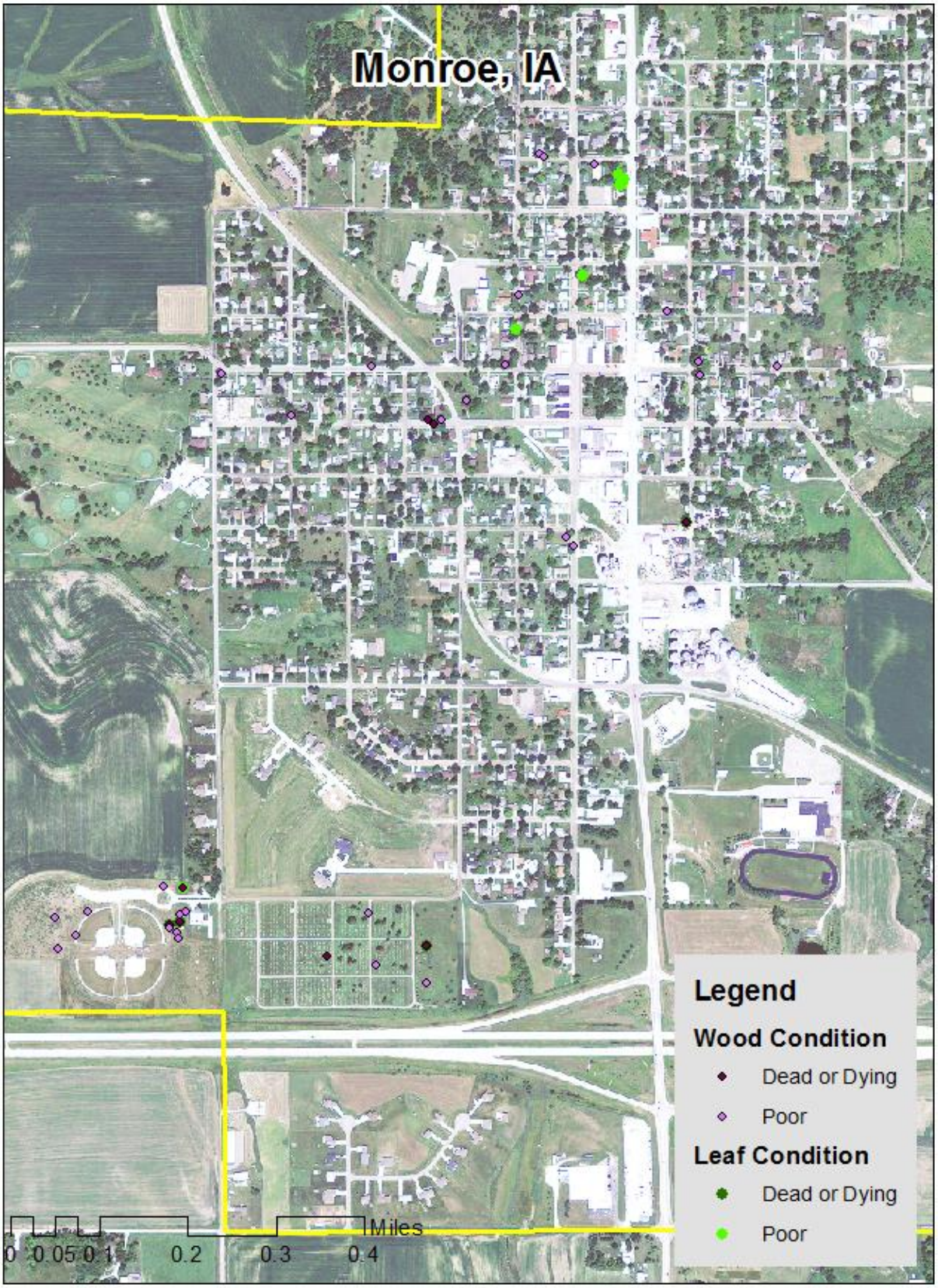

Figure 3: Location of Poor Condition Trees

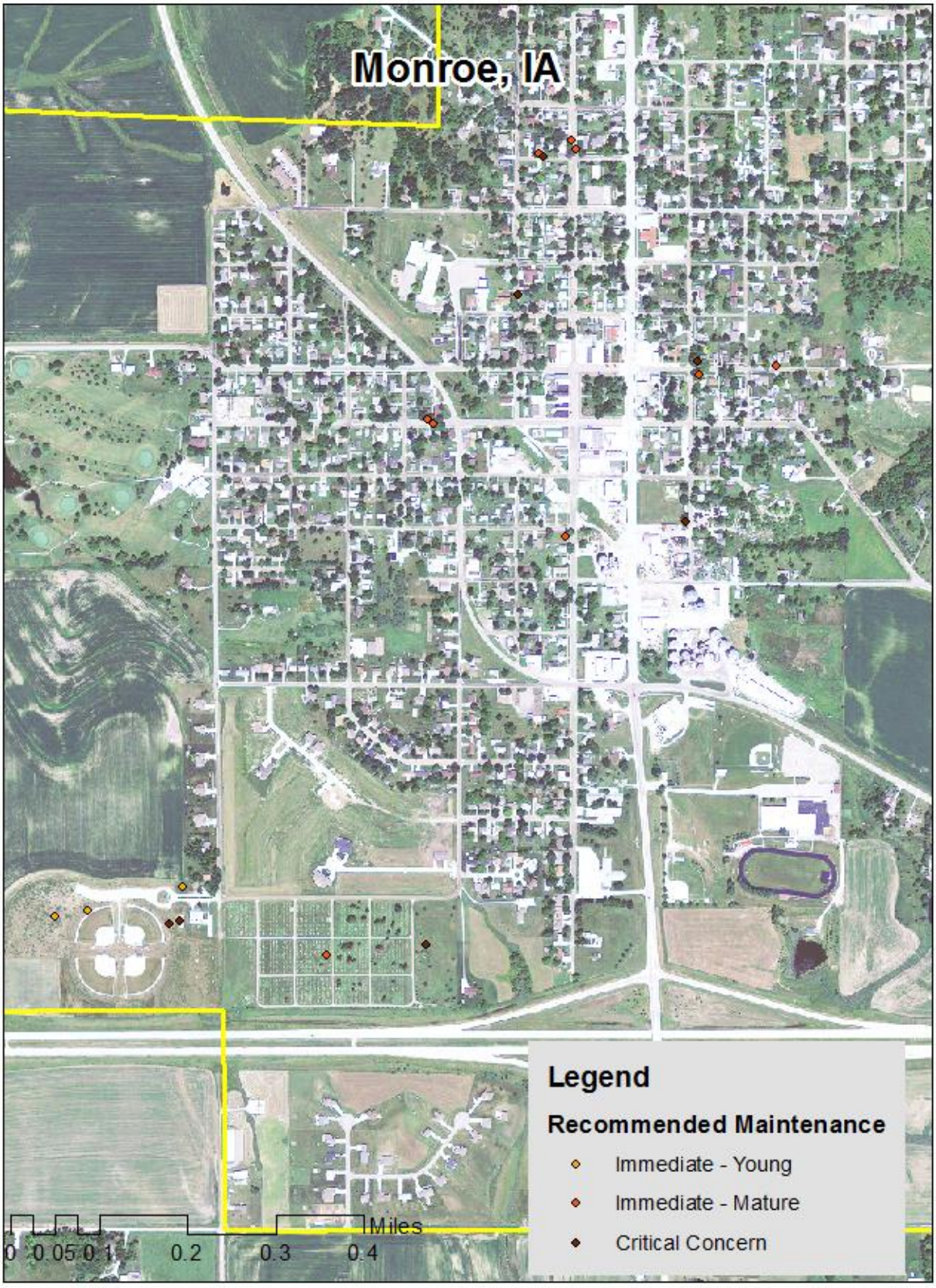

Figure 4: Location of Trees with Recommended Maintenance

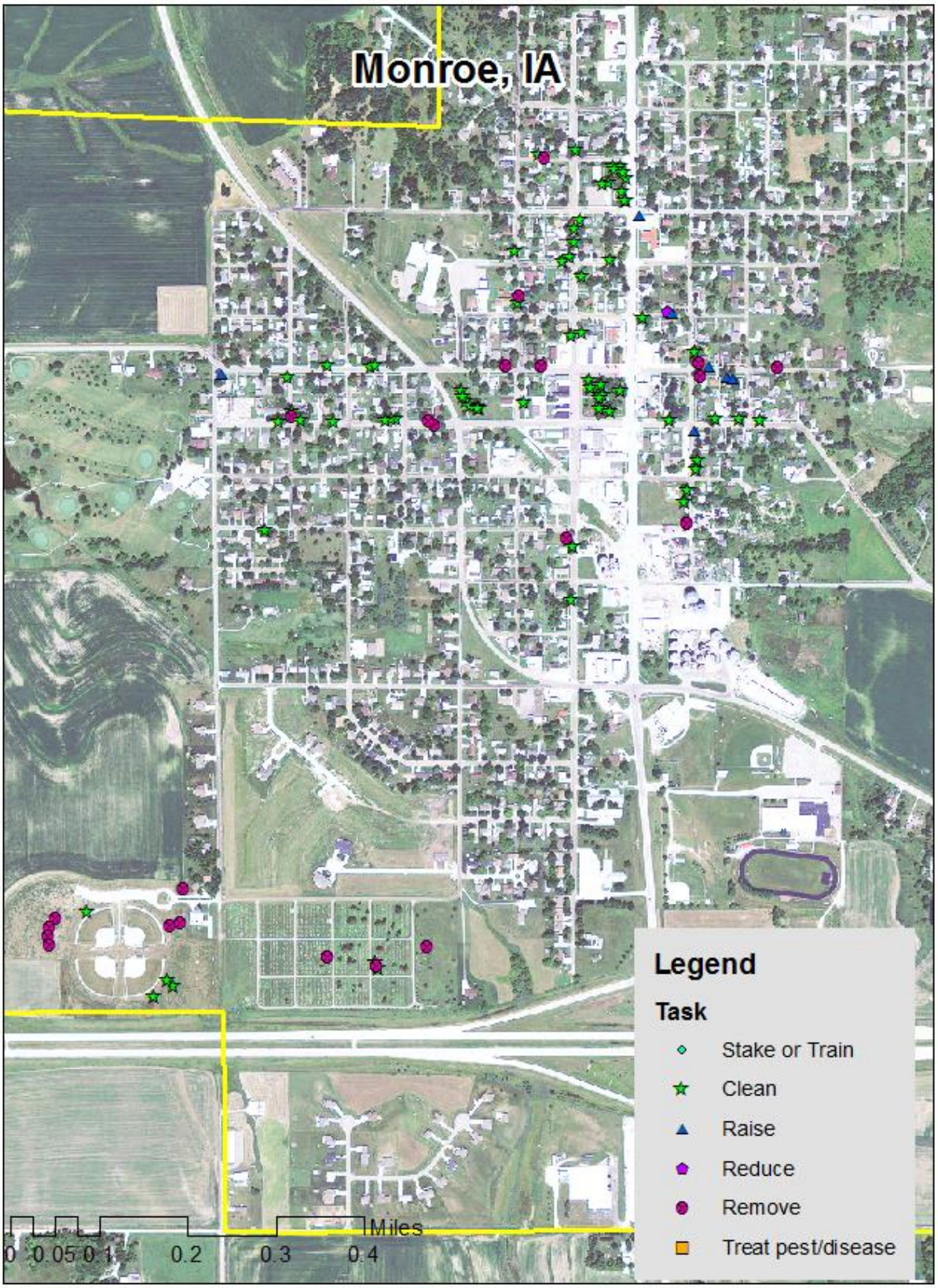

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: Sample Tree Ordinances

CHAPTER 151
TREES AND GRASS

151.01 DEFINITION. For use in this chapter, "boulevard" 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 RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard 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 boulevard 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.

151.03 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 eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, 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 infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:
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 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.
(Code of Iowa, Sec. 364.12[3b & h])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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 Director Chuck Gipp at 515-281-5918.