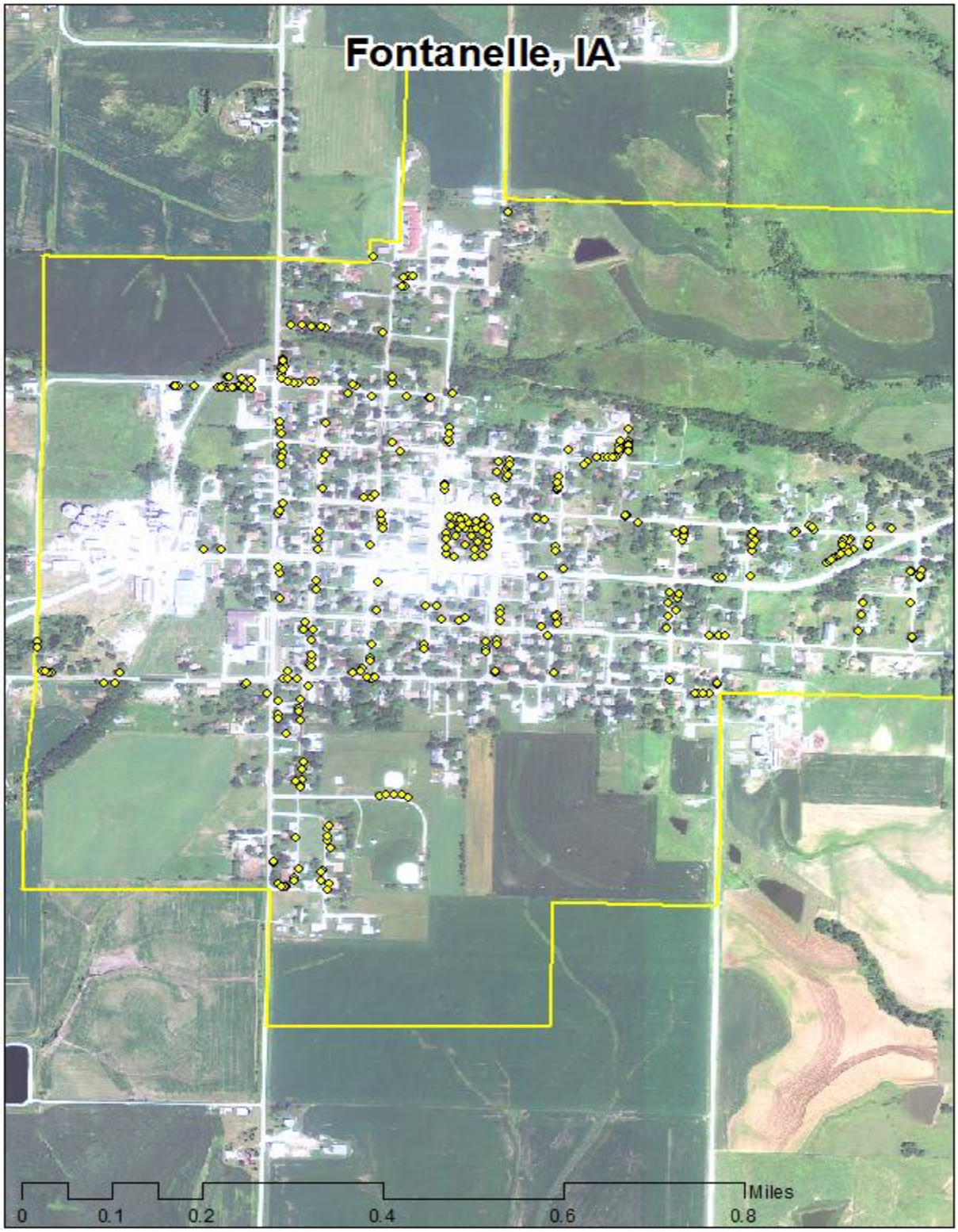

2013 Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Fontanelle 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 16% of Fontanelle'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 344 trees inventoried.

- Fontanelle's trees provide $91,404 of benefits annually, an average of $265.71 a tree
- There are over 33 species of trees
- The top three genus are: Maple 29%, Ash 16 %, and Spruce 7%
- 34% of trees (116) are in need of some type of maintenance (See Fig. 5, Append. B)
- 52 trees are recommended for evaluation for removal or 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 52 trees recommended for removal evaluation for removal, 15 are "critical concern" trees and should be removed immediately (See Fig. 4, Append. B, and attached listing and map). *City ownership of the trees recommended for removal should be verified prior to any removal*
- 24 of the 54 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB (Fig. 2, Append. B) All ash trees (Fig. 1, Append. B)
- 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 an estimated removal cost of $ 900 per tree (contracted), it could take $48,600 or more to remove the 54 ash trees if EAB damage occurs. Suggestion: begin by requesting a budget increase to $10,000 annually for tree removal and apply for grants to help plant replacement trees, or treat ash like any other tree and remove when tree health declines or infestations occur and replace trees as needed.

Introduction

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

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

Inventory

In 2013, a tree inventory was conducted that included 100% of the city owned trees, mostly on 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 344 city owned 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. Fontanelle's trees reduce energy related costs by approximately $17,462 annually (Appendix A, Table 1). These savings are both in Electricity (82.7 MWh) and in Natural Gas (11,412.9 Therms).

Annual Stormwater Benefits

Fontanelle's trees intercept about 920,334 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $24,943 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 Fontanelle, it is estimated that trees remove 1,083.7 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 $3,058 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Fontanelle, trees sequester about 181,676 lbs of carbon a year with an associated value of $2,274 (Appendix A, Table 5). In addition, the trees store 3,584,428 lbs of carbon, with a yearly benefit of $26,883 (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. Fontanelle receives $16,784 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, Fontanelle's trees provide $91,404 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 344 trees in Greenfield provide approximately $265.71 annually.

Forest Structure

Species Distribution

Fontanelle has over 33 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple	99	28.8%
Ash	54	15.6%
Blue Spruce	23	6.6%
Black Walnut	18	5.2%
Apple	18	5.2%
Oak	17	4.9%
Hackberry	15	4.3%
Other Species	100	29.4%

Other species include: buckeye, pine, Norway spruce, catalpa, Ginko, mulberry, black cherry, elm, sycamore, linden, basswood, lilac, and E. cottonwood.

Age Class

Most of Fontanelle's trees (23%) are between 18 and 24 inches in diameter at 4.5 ft (Appendix A, Figure 2). Approximately 34% of the trees are in the 24" and over diameter class. For age, it is preferred that smaller size classes (43%) have the highest amount of trees to prepare for natural mortality and to maintain canopy cover. Fontanelle's size curve is about average for age distribution.

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 Fontanelle indicate that 89% 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 Fontanelle'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 13% of the tree population. This 13% is an estimate of trees that need management follow up for possible removal.

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, Figures 4 & 5).

Crown Cleaning	61	18%
Crown Raising	2	<1%
Tree Staking	1	<1%

Tree Removal	52	15%
Crown Reduction	0	0%

Canopy Cover

The city owned canopy cover of Fontanelle is approximately 9.5 acres (Appendix A, Figure 5). According to the 2010 census, Fontanelle occupies 614.4 acres. Thus the canopy cover on city land is about 1.5%.

Land Use and Location

The majority of Fontanelle'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	90%
Park/vacant/other	10%
Industrial/Large commercial	0%
Small commercial	0%
Multifamily residential	0%

Location	
Planting strip	100%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%
Front yard	0%

Recommendations

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

Hazardous trees

Fontanelle has 15 "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) and in a detailed listing provided with this plan. It is recommended to start with the large diameter critical concern trees first. After the removal of the critical concern trees, there are 37 trees that are recommended for removal/evaluation for removal within the next 3-5 years (locations listed on the map, Append. B, Figure 5).

Poor tree species

After the removal of the 15 critical concern trees (7 are ash), 37 other trees in poor health should be assessed for removal (Appendix B, Figures 3, 4, & 5). Nine of these "other trees" are ash. After that, ash trees in poor health should be assessed for removal. Fontanelle has a total of 54 city owned ash trees, and 24 of those have signs and symptoms that have been associated with EAB. Ash trees should be inspected on a yearly basis for decline. *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. There are approximately 63 trees in Fontanelle in need of some kind of pruning, mostly foliage cleaning.

Planting

Most of the planting should be done annually to 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%. 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 Greenfield.

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 (28.8%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut or any tree species restricted by city ordinance.

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 (bark flecking).

Six Year Maintenance Plan – Proposed

Remove all "critical concern" trees first (15 total, there are 7 ash in this group). Then, concentrate on the other poor condition trees recommended for removal evaluation/removal and remove them before they become critical concern trees (there are 9 ash in this group of 37). Treat ash like any other tree species, removing the trees in poor health first. Replanting should be done yearly and ash trees should be inspected yearly for signs and symptoms of EAB.

Year 1
- Removal: 8 largest critical concern trees
- Planting and Replacement: none
- Visual Survey for signs and symptoms of EAB

Year 2
- Removal: 7 remaining critical concern trees
- Planting and Replacement: 10 trees in open locations from year one removals
- Routine trimming: trim 21 of the city trees needing pruning of some type
- Visual Survey for signs and symptoms of EAB

Year 3
- Removal: 10 trees in poor health/removal recommended
- Planting and Replacement: 8 trees to be planted in open locations and locations from previous removals
- Visual Survey for signs and symptoms of EAB

Year 4
- Removal: 9 trees in poor health/removal recommended
- Planting and Replacement: 12 trees in open locations from previous removals
- Routine trimming: trim 21 of the city trees needing pruning of some type
- Visual Survey for signs and symptoms of EAB

Year 5
- Removal: 9 trees in poor health/removal recommended
- Planting and Replacement: 11 trees to be planted in open locations and locations from previous removals
- Visual Survey for signs and symptoms of EAB

Year 6
- Removal: 9 trees in poor health/removal recommended
- Planting and Replacement: 11 trees in open locations from previous removals
- Routine trimming: trim 21 of the city trees needing pruning of some type
- Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years will probably be minimal. EAB could potentially kill all ash within 4 years of infestation. After the 6 year recommended period to remove and trim everything with designated needs, concentrate on removing ash trees if needed, those in poor condition first. Any new critical concern trees and trees evaluated as needing removal are always top candidates for priority management.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal should 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/ For information about available treatments, visit http://extension.iastate.edu/Publications/PM2084.pdf

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 should be replaced with a suitable diversity of non-ash tree species. All trees must meet the species restrictions in any existing city ordinance. In lieu of ordinance restrictions, it is recommended that new plantings should be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. Fontanelle's City Tree Ordinance Chapter 151, paragraphs 151.01 through 151.06 is attached with this plan.

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 should 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. If you suspect that you may have EAB damage, the first step is to contact the ISU Plant and Insect Diagnostic Clinic at 515-294-0581.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB in accordance with Fontanelle's City Tree Ordinance.

Budget

Assuming that the budget for tree maintenance will remain minimal, the following are some estimated costs associated with the recommended maintenance work.

If a budget increase may be possible, a recommendation would be to increase the $2 per capita, which is a requirement for becoming a Tree City USA.

Tree removal costs average around $500-$900 per tree, depending on the size and numbers of trees. The estimated range would be $350-$1,500.

Trimming (including cleaning, raising, reducing) averages $75 per tree and can range from $70 to $200 per tree.

New planting averages about $150 per tree (5' trees in 10 gallon containers are about $75-$100 plus the cost of watering).

Purposed Budget Increase

EAB could potentially kill all ash trees in Fontanelle within 4 years of its arrival. Realistically, it may take $8,100 of additional funding per year for 6 years to remove all of the ash trees in the city.

It is recommended that Fontanelle apply for grants to fund replacement trees and/or to work with organizations like Trees Forever. 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. For more information about grants please contact Emma Hanigan, DNR State Urban Forester, at 515-281-5600 or by e-mail at Emma.Hanigan@dnr.iowa.gov

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Fontanelle

Annual Energy Benefits of Public Trees by Species

2/10/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	17.0	1,294	2,349.7	2,303	3,596	(N/A)	15.7	20.6	66.60
Norway maple	11.4	869	1,611.1	1,579	2,448	(N/A)	13.7	14.0	52.08
Silver maple	13.0	988	1,727.6	1,693	2,681	(N/A)	11.3	15.4	68.75
Blue spruce	2.2	169	293.5	288	457	(N/A)	6.4	2.6	20.77
Black walnut	4.3	325	590.0	578	903	(N/A)	5.2	5.2	50.19
Apple	2.1	161	314.5	308	469	(N/A)	5.2	2.7	26.08
Northern hackberry	5.8	438	818.4	802	1,240	(N/A)	4.4	7.1	82.67
Broadleaf Deciduous	1.1	86	187.0	183	269	(N/A)	3.8	1.5	20.71
Eastern white pine	1.1	85	146.2	143	229	(N/A)	2.9	1.3	22.87
Northern pin oak	3.2	239	466.3	457	696	(N/A)	2.9	4.0	69.62
Sugar maple	2.7	206	356.3	349	555	(N/A)	2.6	3.2	61.64
Broadleaf Deciduous	1.7	125	235.0	230	356	(N/A)	2.6	2.0	39.51
Conifer Evergreen Large	1.0	78	117.1	115	193	(N/A)	2.3	1.1	24.14
Eastern red cedar	0.8	63	123.0	121	183	(N/A)	2.3	1.1	22.93
Siberian elm	3.4	262	451.1	442	704	(N/A)	2.3	4.0	87.97
Bur oak	1.4	106	199.2	195	301	(N/A)	2.0	1.7	43.01
Honeylocust	1.8	135	232.0	227	362	(N/A)	1.5	2.1	72.38
Black cherry	0.4	32	70.7	69	102	(N/A)	1.5	0.6	20.32
Maple	0.5	37	63.8	63	99	(N/A)	1.2	0.6	24.78
Lilac	0.8	61	126.5	124	185	(N/A)	1.2	1.1	46.14
Other street trees	6.8	519	933.8	915	1,434	(N/A)	9.0	8.2	46.26
Citywide total	82.7	6,278	11,412.9	11,185	17,462	(N/A)	100.0	100.0	50.76

Table 2: Annual Stormwater Benefits

Fontanelle

Annual Stormwater Benefits of Public Trees by Species

2/10/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	204,632	5,546	(N/A)	15.7	22.2	102.70
Norway maple	99,493	2,696	(N/A)	13.7	10.8	57.37
Silver maple	183,499	4,973	(N/A)	11.3	19.9	127.52
Blue spruce	27,641	749	(N/A)	6.4	3.0	34.05
Black walnut	45,270	1,227	(N/A)	5.2	4.9	68.16
Apple	8,092	219	(N/A)	5.2	0.9	12.18
Northern hackberry	61,247	1,660	(N/A)	4.4	6.7	110.66
Broadleaf Deciduous	5,383	146	(N/A)	3.8	0.6	11.22
Eastern white pine	16,847	457	(N/A)	2.9	1.8	45.66
Northern pin oak	36,356	985	(N/A)	2.9	4.0	98.53
Sugar maple	32,832	890	(N/A)	2.6	3.6	98.87
Broadleaf Deciduous	11,529	312	(N/A)	2.6	1.3	34.72
Conifer Evergreen Large	12,308	334	(N/A)	2.3	1.3	41.70
Eastern red cedar	12,100	328	(N/A)	2.3	1.3	40.99
Siberian elm	45,016	1,220	(N/A)	2.3	4.9	152.50
Bur oak	14,649	397	(N/A)	2.0	1.6	56.72
Honeylocust	21,643	587	(N/A)	1.5	2.4	117.31
Black cherry	1,975	54	(N/A)	1.5	0.2	10.70
Maple	2,866	78	(N/A)	1.2	0.3	19.42
Lilac	4,696	127	(N/A)	1.2	0.5	31.82
Other street trees	72,260	1,958	(N/A)	9.0	7.9	63.17
Citywide total	920,334	24,943	(N/A)	100.0	100.0	72.51

Table 3: Annual Air Quality Benefits

Fontanelle

Annual Air Quality Benefits of Public Trees by Species

2/10/2014

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
Green ash	29.0	4.6	13.5	1.3	153	81.5	11.9	11.3	77.2	508	0.0	0	230.4	661	(N/A)	15.7	12.24
Norway maple	19.6	3.4	9.7	0.9	106	55.1	8.0	7.6	51.9	342	-4.7	-17	151.6	431	(N/A)	13.7	9.17
Silver maple	32.7	5.5	16.0	1.4	176	61.5	9.0	8.6	58.9	385	-17.9	-67	175.9	494	(N/A)	11.3	12.66
Blue spruce	3.3	0.6	2.8	0.4	22	10.5	1.5	1.5	10.1	66	-9.7	-36	21.1	52	(N/A)	6.4	2.34
Black walnut	5.3	0.8	2.6	0.2	28	20.5	3.0	2.8	19.4	128	0.0	0	54.7	156	(N/A)	5.2	8.66
Apple	2.3	0.4	1.1	0.1	12	10.4	1.5	1.4	9.6	64	0.0	0	26.7	76	(N/A)	5.2	4.22
Northern hackberry	10.1	1.8	5.1	0.5	55	27.9	4.0	3.8	26.2	173	0.0	0	79.3	228	(N/A)	4.4	15.19
Broadleaf Deciduous	1.6	0.3	0.8	0.1	8	5.7	0.8	0.8	5.1	35	0.0	0	15.1	43	(N/A)	3.8	3.32
Eastern white pine	1.9	0.4	1.6	0.2	12	5.3	0.8	0.7	5.1	33	-6.8	-26	9.1	20	(N/A)	2.9	2.00
Northern pin oak	8.3	1.4	4.0	0.4	44	15.4	2.2	2.1	14.3	95	-1.9	-7	46.2	132	(N/A)	2.9	13.24
Sugar maple	5.0	0.8	2.4	0.2	27	12.8	1.9	1.8	12.3	80	-3.9	-15	33.3	92	(N/A)	2.6	10.24
Broadleaf Deciduous	1.9	0.3	1.0	0.1	10	8.0	1.2	1.1	7.5	49	-0.5	-2	20.5	58	(N/A)	2.6	6.44
Conifer Evergreen Large	1.4	0.3	1.2	0.2	9	4.7	0.7	0.7	4.7	30	-4.4	-16	9.3	23	(N/A)	2.3	2.82
Eastern red cedar	2.5	0.5	2.0	0.3	16	4.0	0.6	0.6	3.8	25	-6.7	-25	7.5	16	(N/A)	2.3	1.99
Siberian elm	9.2	1.6	4.3	0.4	49	16.3	2.4	2.3	15.6	102	0.0	0	52.0	151	(N/A)	2.3	18.85
Bur oak	1.6	0.3	0.8	0.1	9	6.7	1.0	0.9	6.3	42	0.0	0	17.8	51	(N/A)	2.0	7.23
Honeylocust	4.3	0.7	1.9	0.2	23	8.3	1.2	1.2	8.0	52	-3.4	-13	22.5	62	(N/A)	1.5	12.42
Black cherry	0.6	0.1	0.3	0.0	3	2.1	0.3	0.3	1.9	13	0.0	0	5.6	16	(N/A)	1.5	3.22
Maple	0.5	0.1	0.2	0.0	3	2.3	0.3	0.3	2.2	14	-0.2	-1	5.8	16	(N/A)	1.2	4.04
Lilac	1.7	0.3	0.8	0.1	9	4.0	0.6	0.5	3.6	24	0.0	0	11.5	33	(N/A)	1.2	8.35
Other street trees	12.0	2.0	5.9	0.6	64	32.6	4.8	4.5	31.0	203	-5.4	-20	87.9	247	(N/A)	9.0	7.98
Citywide total	154.5	26.1	77.9	7.6	840	395.6	57.5	54.9	374.8	2,463	-65.3	-245	1,083.7	3,058	(N/A)	100.0	8.89

Table 4: Annual Carbon Stored

Fontanelle

Stored CO2 Benefits of Public Trees by Species

2/10/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	966,962	7,252	(N/A)	15.7	27.0	134.30
Norway maple	322,606	2,420	(N/A)	13.7	9.0	51.48
Silver maple	803,584	6,027	(N/A)	11.3	22.4	154.54
Blue spruce	18,638	140	(N/A)	6.4	0.5	6.35
Black walnut	172,203	1,292	(N/A)	5.2	4.8	71.75
Apple	35,622	267	(N/A)	5.2	1.0	14.84
Northern	156,402	1,173	(N/A)	4.4	4.4	78.20
Broadleaf	26,387	198	(N/A)	3.8	0.7	15.22
Eastern white pine	15,479	116	(N/A)	2.9	0.4	11.61
Northern pin oak	136,467	1,024	(N/A)	2.9	3.8	102.35
Sugar maple	148,355	1,113	(N/A)	2.6	4.1	123.63
Broadleaf	31,166	234	(N/A)	2.6	0.9	25.97
Conifer Evergreen	9,362	70	(N/A)	2.3	0.3	8.78
Eastern red cedar	7,992	60	(N/A)	2.3	0.2	7.49
Siberian elm	224,576	1,684	(N/A)	2.3	6.3	210.54
Bur oak	53,571	402	(N/A)	2.0	1.5	57.40
Honeylocust	55,722	418	(N/A)	1.5	1.6	83.58
Black cherry	9,480	71	(N/A)	1.5	0.3	14.22
Maple	5,842	44	(N/A)	1.2	0.2	10.95
Lilac	26,971	202	(N/A)	1.2	0.8	50.57
Other street trees	161,953	2,678	(N/A)	9.0	10.0	86.38
Citywide total	3,584,428	26,883	(N/A)	100.0	100.0	78.15

Table 5: Annual Carbon Sequestered

Fontanelle

Annual CO_2 Benefits of Public Trees by Species

2/10/2014

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($) Error	Standard	% of Total Trees	% of Total $	Avg. $/tree
Green ash	37,651	282	-4,641	-11	-35	28,590	214	61,589	462	(N/A)	15.7	20.3	8.55
Norway maple	16,059	120	-1,549	-9	-12	19,198	144	33,699	253	(N/A)	13.7	11.1	5.38
Silver maple	57,049	428	-3,857	-8	-29	21,843	164	75,027	563	(N/A)	11.3	24.8	14.43
Blue spruce	1,583	12	-89	-4	-1	3,742	28	5,232	39	(N/A)	6.4	1.7	1.78
Black walnut	10,309	77	-827	-4	-6	7,186	54	16,665	125	(N/A)	5.2	5.5	6.94
Apple	3,339	25	-171	-4	-1	3,562	27	6,726	50	(N/A)	5.2	2.2	2.80
Northern hackberry	7,736	58	-751	-3	-6	9,680	73	16,662	125	(N/A)	4.4	5.5	8.33
Broadleaf Deciduous	1,313	10	-127	-3	-1	1,898	14	3,082	23	(N/A)	3.8	1.0	1.78
Eastern white pine	1,182	9	-74	-2	-1	1,888	14	2,994	22	(N/A)	2.9	1.0	2.25
Northern pin oak	1,950	15	-655	-2	-5	5,287	40	6,580	49	(N/A)	2.9	2.2	4.94
Sugar maple	6,671	50	-712	-2	-5	4,544	34	10,501	79	(N/A)	2.6	3.5	8.75
Broadleaf Deciduous	2,993	22	-150	-2	-1	2,768	21	5,611	42	(N/A)	2.6	1.9	4.68
Conifer Evergreen	924	7	-45	-2	0	1,732	13	2,610	20	(N/A)	2.3	0.9	2.45
Eastern red cedar	83	1	-38	-2	0	1,390	10	1,433	11	(N/A)	2.3	0.5	1.34
Siberian elm	6,890	52	-1,078	-2	-8	5,784	43	11,594	87	(N/A)	2.3	3.8	10.87
Bur oak	3,430	26	-257	-1	-2	2,340	18	5,512	41	(N/A)	2.0	1.8	5.91
Honeylocust	5,394	40	-267	-1	-2	2,974	22	8,100	61	(N/A)	1.5	2.7	12.15
Black cherry	829	6	-46	-1	0	713	5	1,495	11	(N/A)	1.5	0.5	2.24
Maple	817	6	-28	-1	0	809	6	1,596	12	(N/A)	1.2	0.5	2.99
Lilac	1,435	11	-129	-1	-1	1,339	10	2,644	20	(N/A)	1.2	0.9	4.96
Other street trees	14,039	105	-1,714	-6	-13	11,467	86	23,786	178	(N/A)	9.0	7.9	5.75
Citywide total	181,676	1,363	-17,205	-67	-130	138,735	1,041	303,139	2,274	(N/A)	100.0	100.0	6.61

Table 6: Annual Social and Aesthetic Benefits

Fontanelle

Annual Aesthetic/Other Benefits of Public Trees by Species

2/10/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	2,989	(N/A)	15.7	17.8	55.35
Norway maple	1,549	(N/A)	13.7	9.2	32.96
Silver maple	4,293	(N/A)	11.3	25.6	110.08
Blue spruce	512	(N/A)	6.4	3.1	23.29
Black walnut	893	(N/A)	5.2	5.3	49.63
Apple	193	(N/A)	5.2	1.2	10.69
Northern hackberry	967	(N/A)	4.4	5.8	64.49
Broadleaf Deciduous	75	(N/A)	3.8	0.5	5.80
Eastern white pine	317	(N/A)	2.9	1.9	31.68
Northern pin oak	169	(N/A)	2.9	1.0	16.89
Sugar maple	661	(N/A)	2.6	3.9	73.50
Broadleaf Deciduous	308	(N/A)	2.6	1.8	34.27
Conifer Evergreen Large	259	(N/A)	2.3	1.5	32.32
Eastern red cedar	35	(N/A)	2.3	0.2	4.38
Siberian elm	414	(N/A)	2.3	2.5	51.70
Bur oak	312	(N/A)	2.0	1.9	44.50
Honeylocust	1,361	(N/A)	1.5	8.1	272.26
Black cherry	48	(N/A)	1.5	0.3	9.61
Maple	126	(N/A)	1.2	0.8	31.40
Lilac	86	(N/A)	1.2	0.5	21.60
Other street trees	1,217	(N/A)	9.0	7.3	39.24
Citywide total	16,784	(N/A)	100.0	100.0	48.79

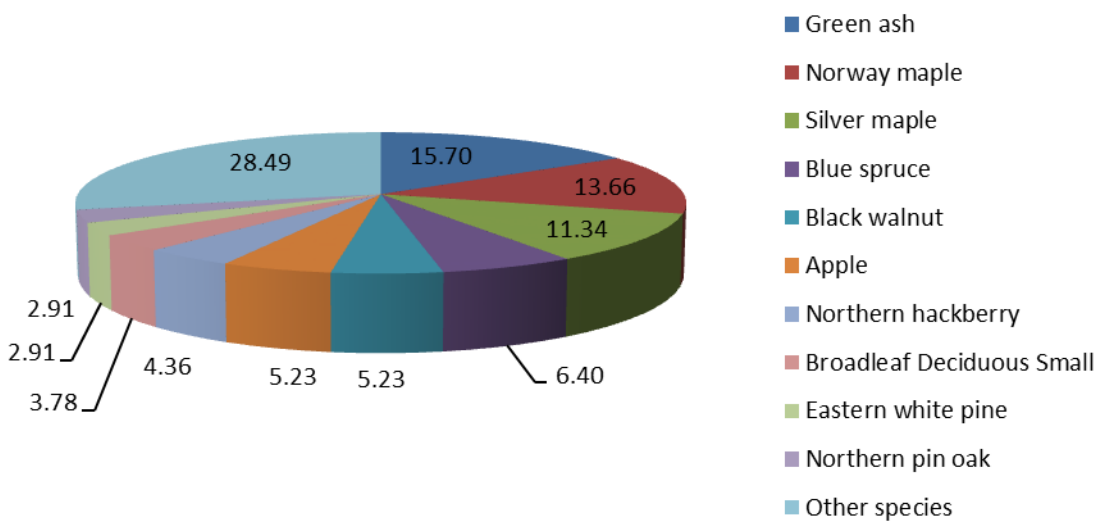

Figure 1: Species Distribution

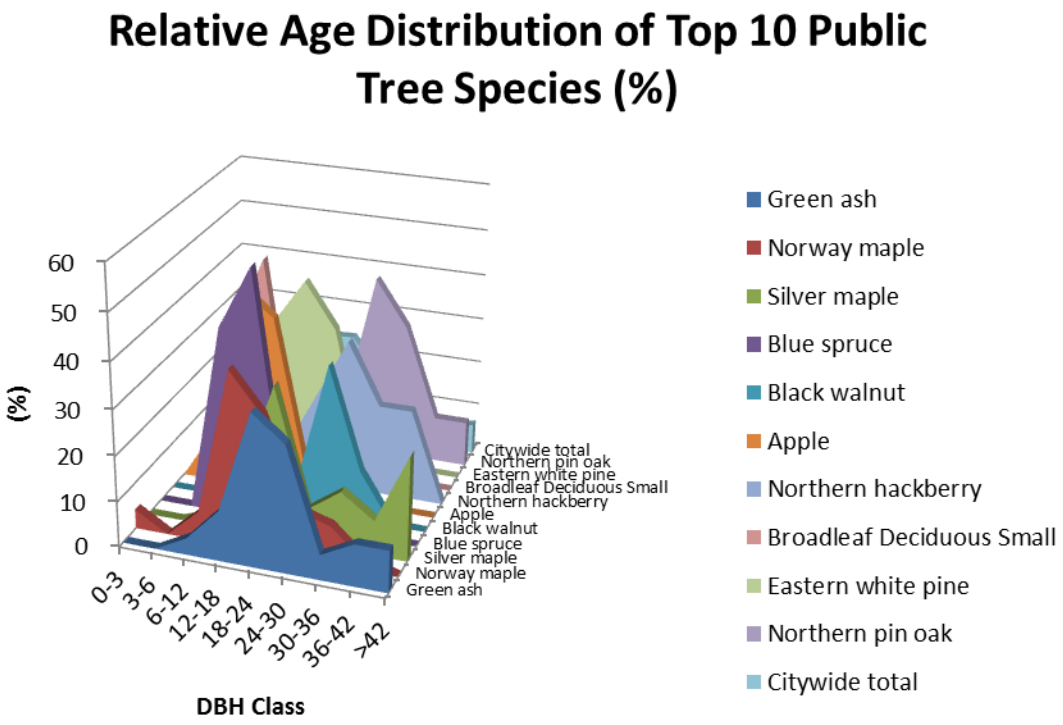

Figure 2: Relative Age Class

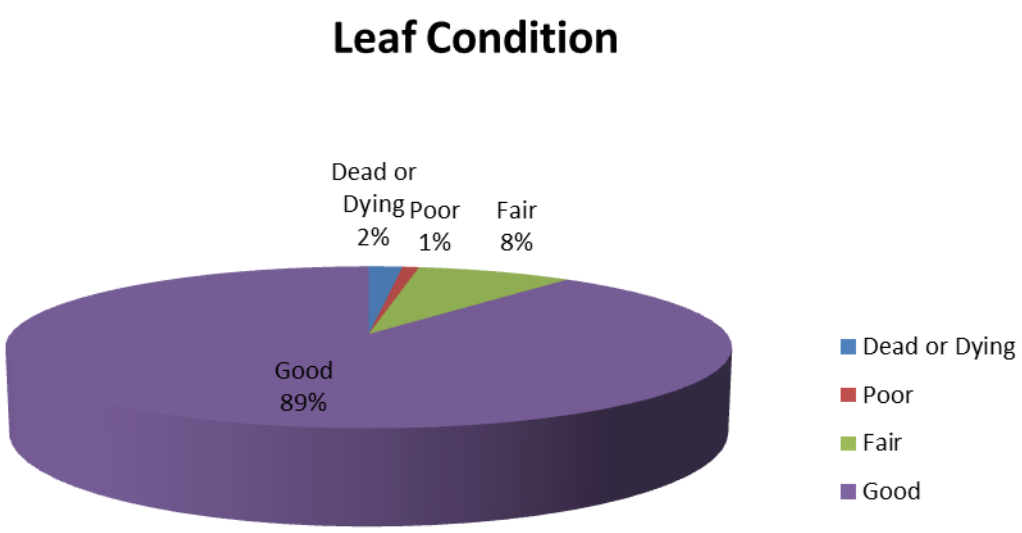

Figure 3: Foliage Condition

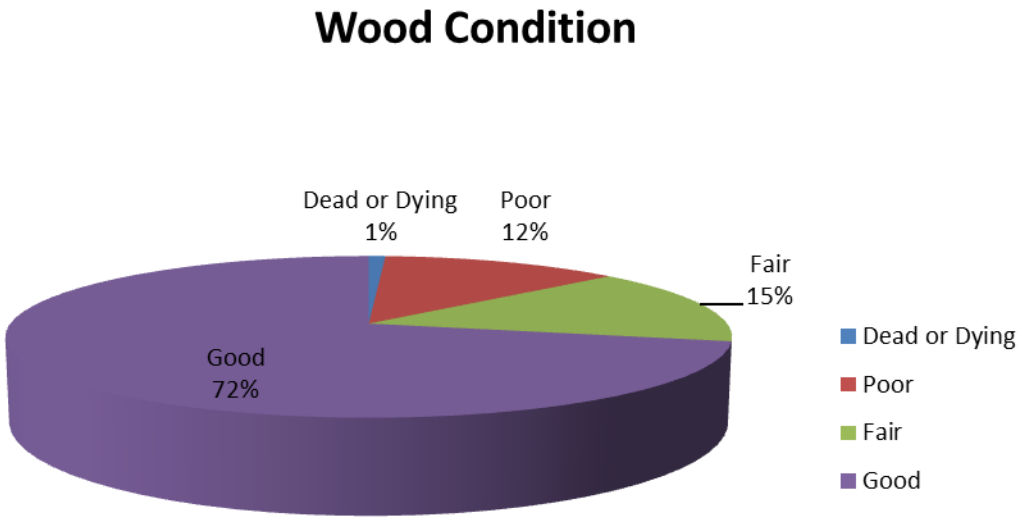

Figure 4: Wood Condition

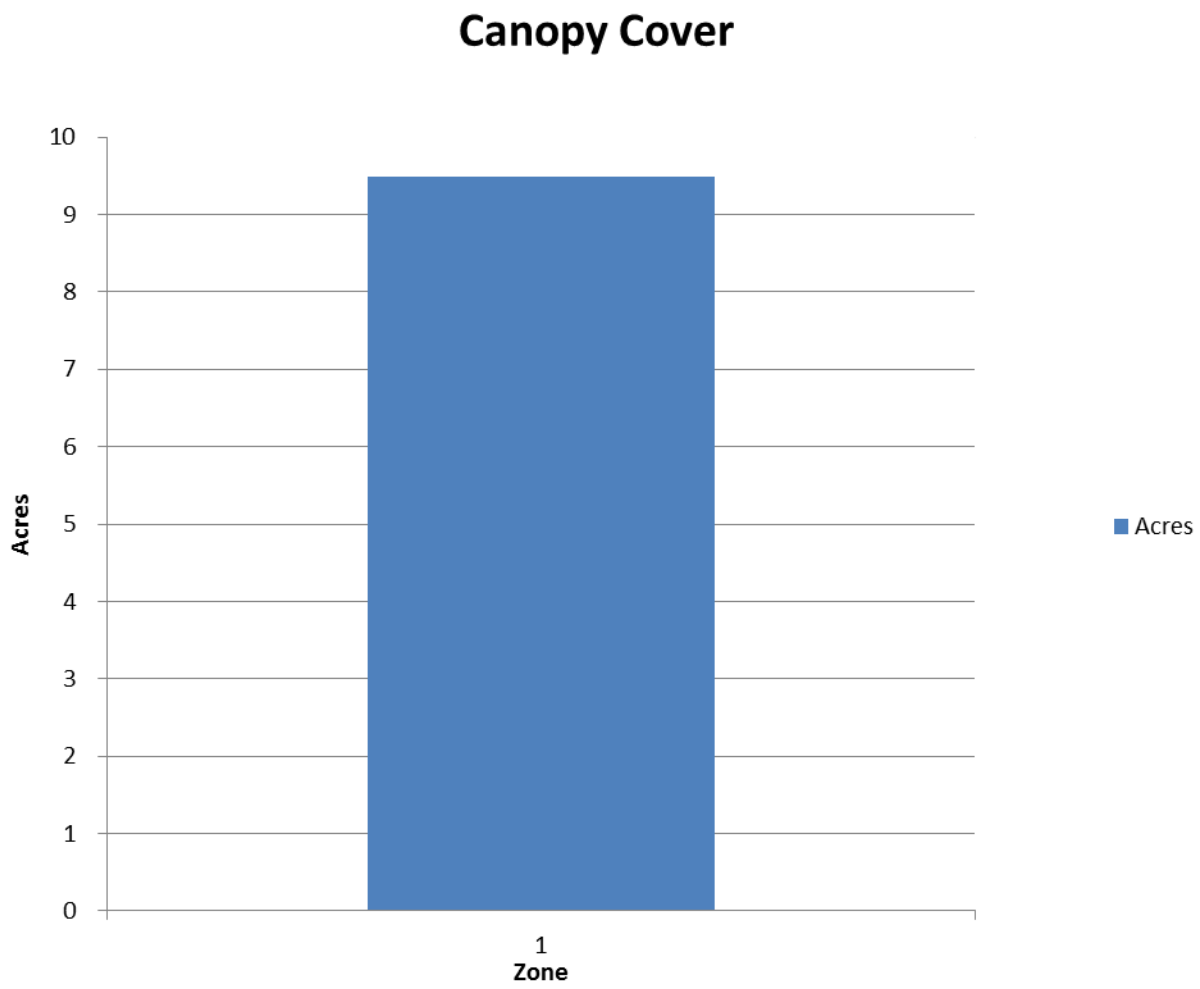

Figure 5: Canopy Cover in Acres

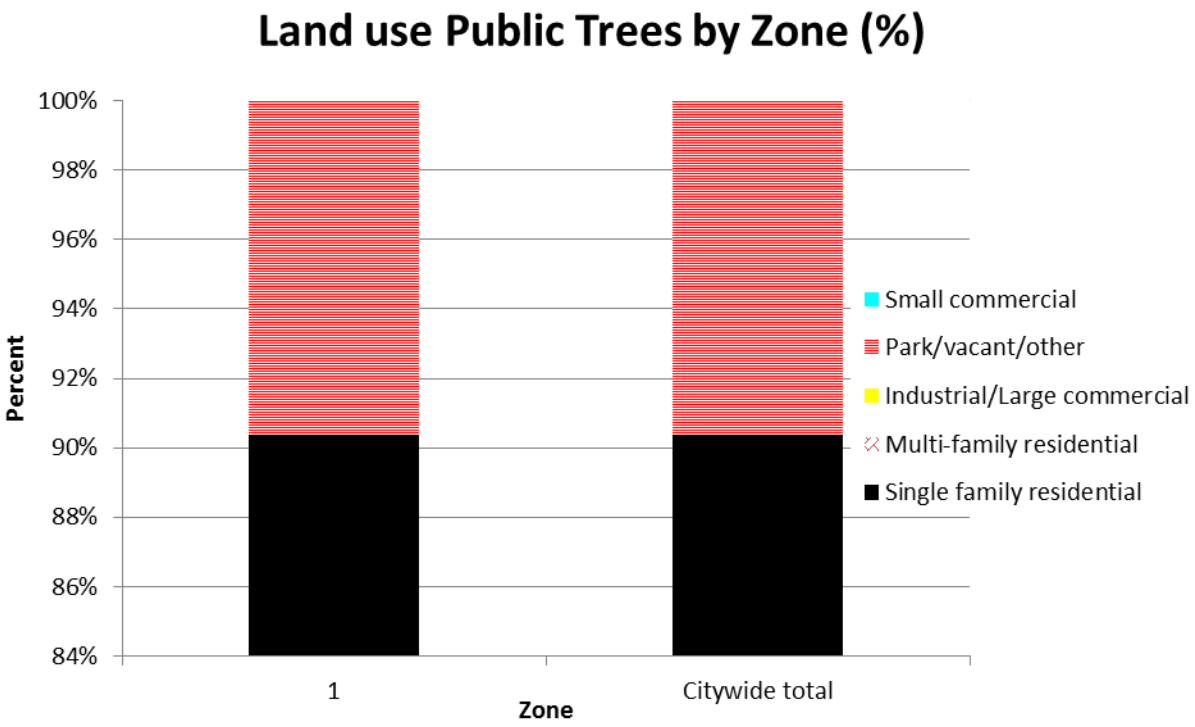

Figure 6: Land Use of city/park trees

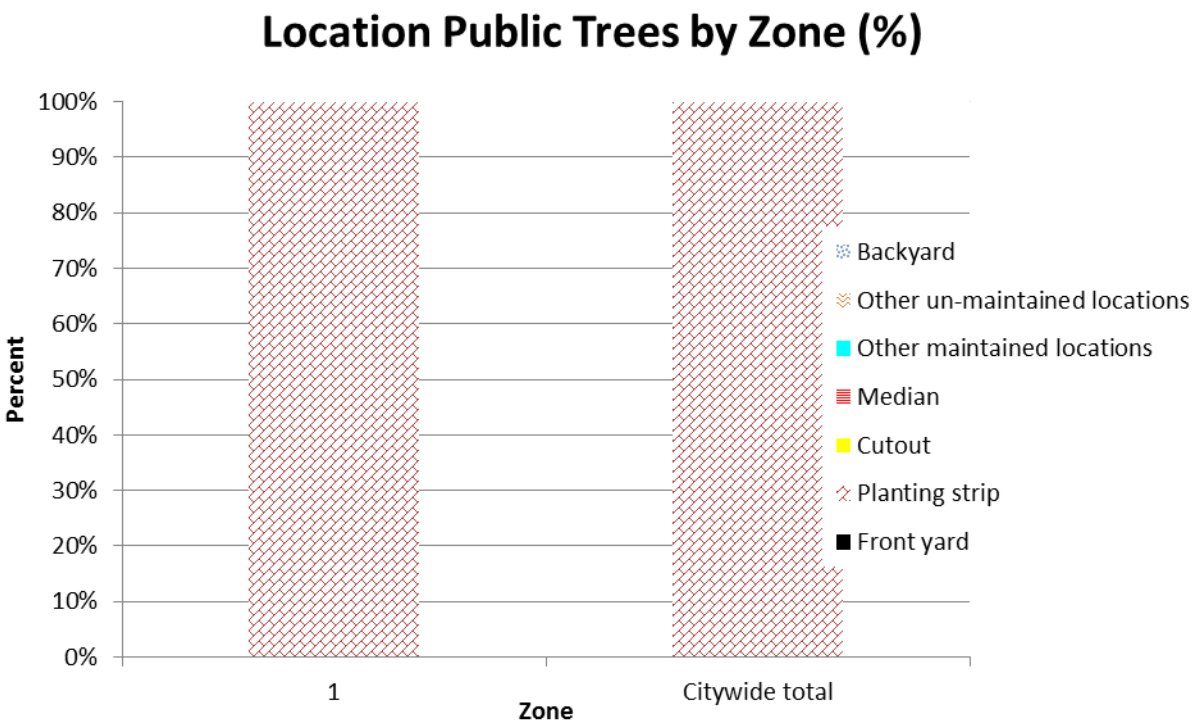

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

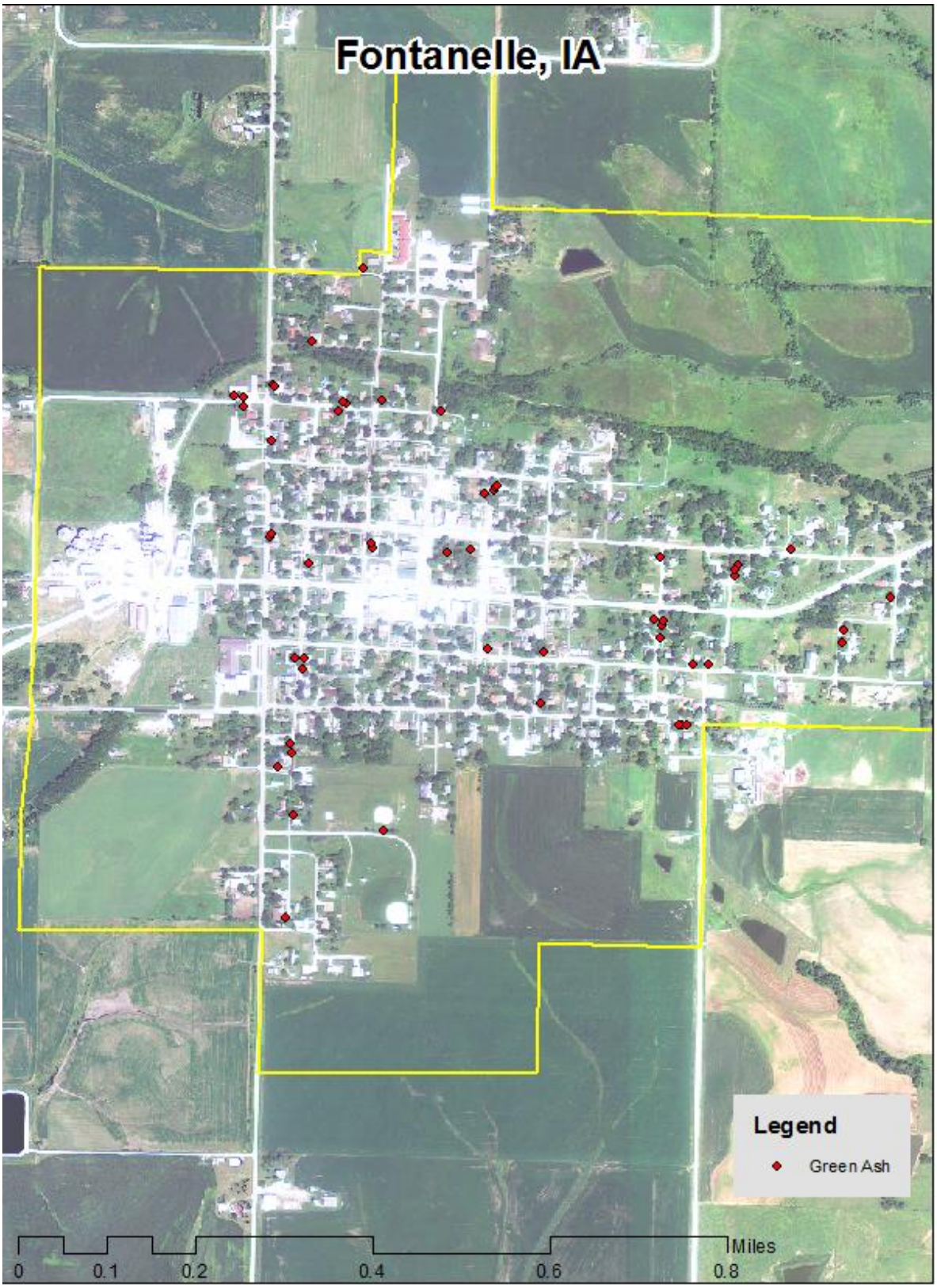

Figure 1: Location of Ash Trees

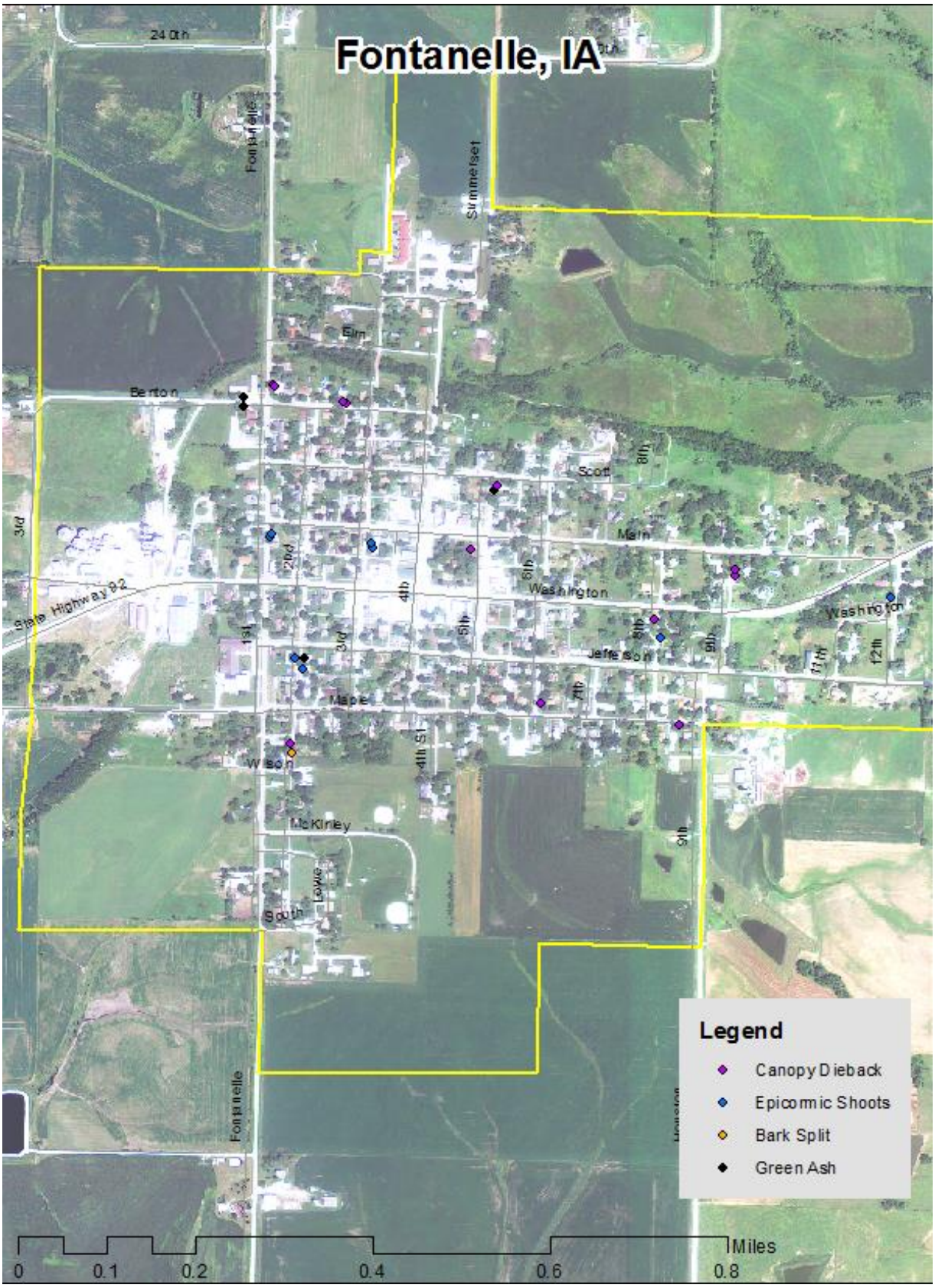

Figure 2: Location of EAB symptoms

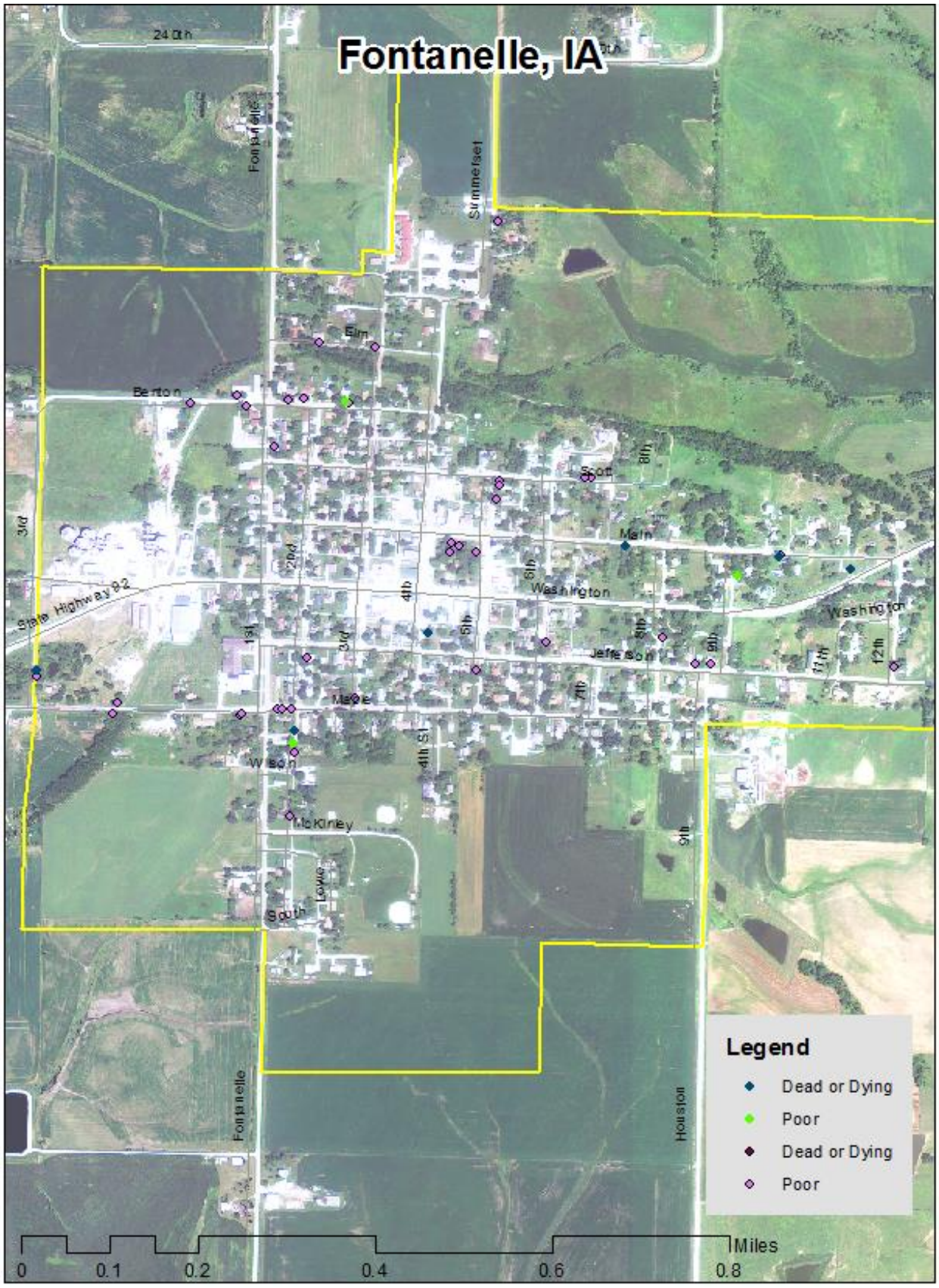

Figure 3: Location of Poor Condition Trees

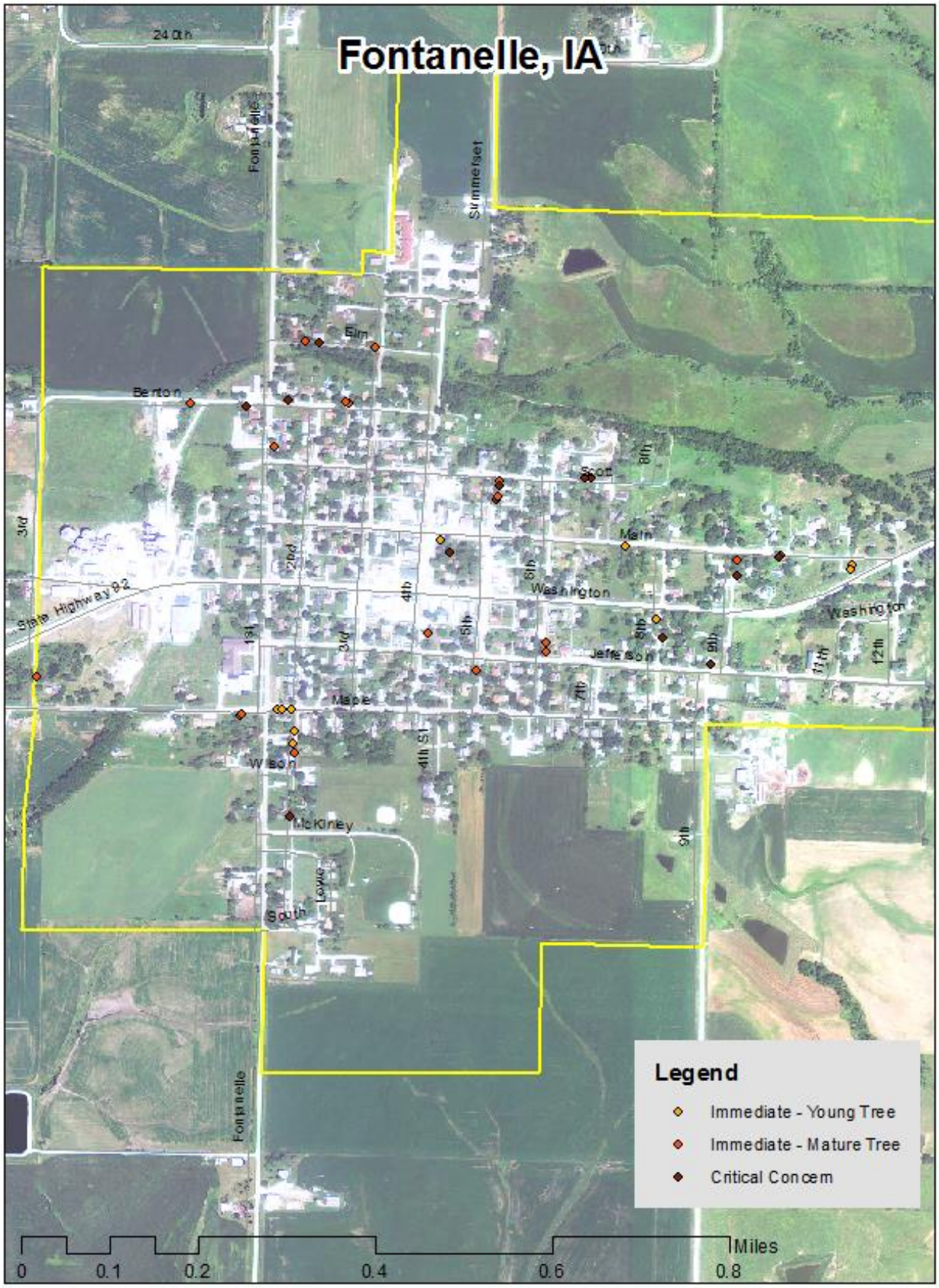

Figure 4: Location of Trees with Recommended Maintenance

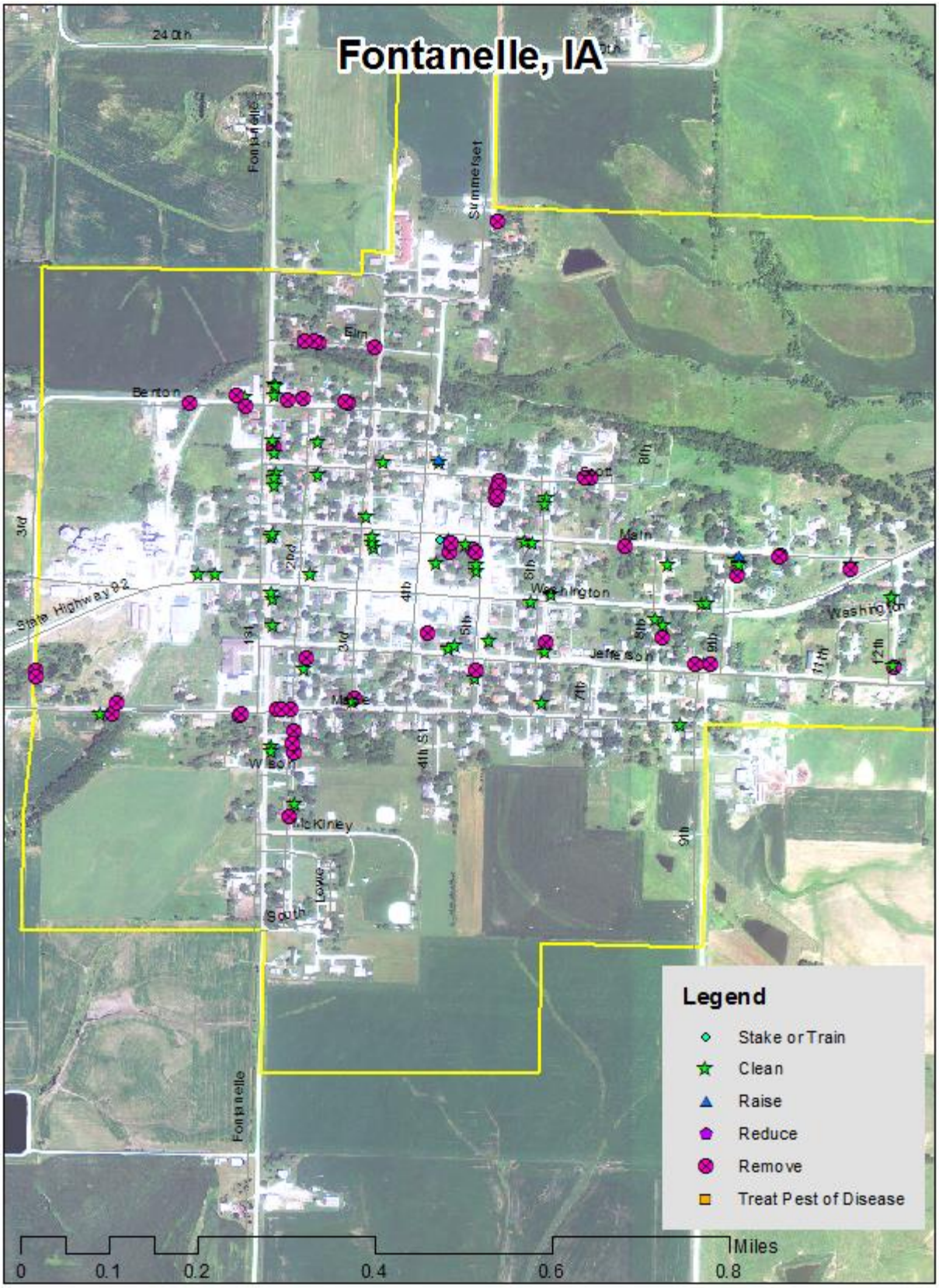

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Sample Tree Ordinances

CHAPTER 151

TREES

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

151.02 PLANTING 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. Utility Lines. Trees planted in the parking must not be planted over utility line easements.

3. 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. Where parkings are inadequate in size for the planting of trees, trees should be planted inside the property lines.

4. Prohibited Trees. Trees planted in the parking must be of the type listed as appropriate for City parkings by the *Iowa State University Extension Community Trees, Street Trees for Iowa* or *Trees Forever*.

151.03 DUTY TO TRIM TREES. Property owners of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least twelve (12) feet above the surface of the street and nine (9) feet above the surface of sidewalks and lawns. Trees with double leaders shall be pruned in a timely manner so as to avoid loss as a result of wind and/or ice. 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. The City may at any time, through its Public Works Department or by its agents, maintain and prune trees planted on parkings.

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

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

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

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

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

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

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

[The next page is 675]

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If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-281-5918.