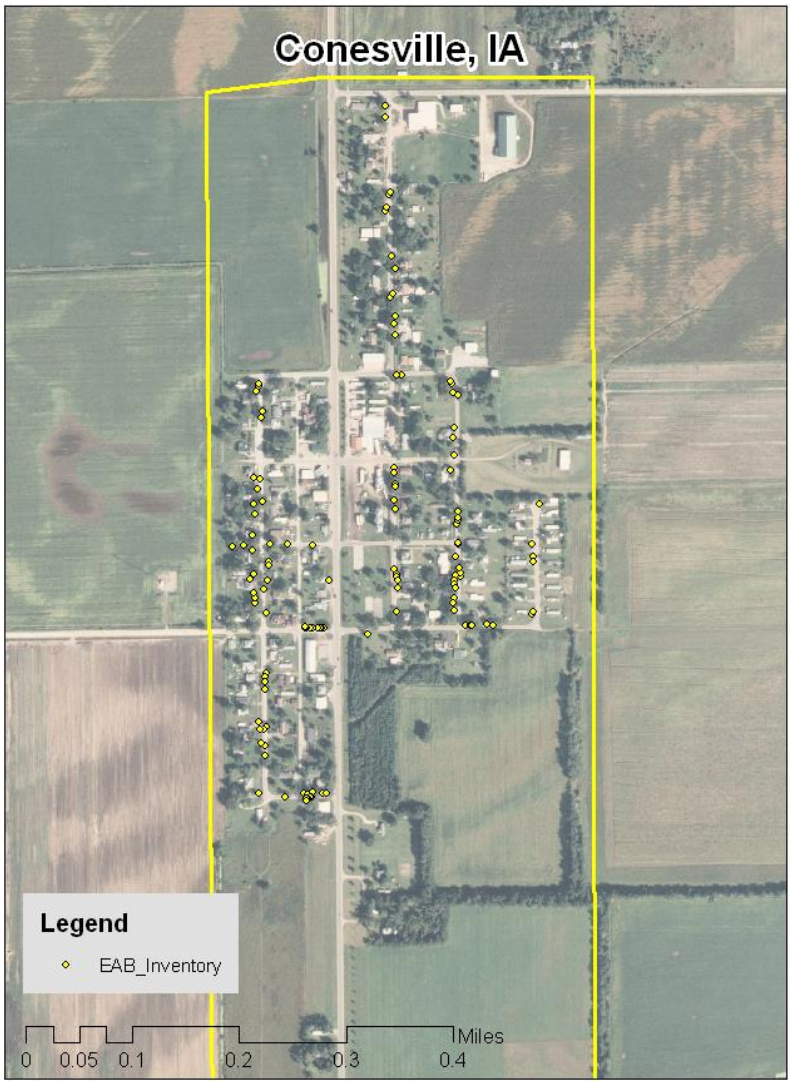
Conesville, IA



2010 Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Conesville 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 8% of Conesville'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 2010, 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 125 trees inventoried.

- Conesville's trees provide $19,427 of benefits annually, an average of $155 a tree
- There are over 23 species of trees
- The top three genus are: Maple 32%, Elm 23%, and Ash 8%
- 40% of trees are in need of some type of management
- 2 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 2 trees needing removal, 1 tree is 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*
- 2 of the 11 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, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 11 years to remove ash – Suggestion: request a budget increase to $2,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2010, a tree inventory was conducted that included 100% of the city owned street trees. 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 125 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. Conesville's trees reduce energy related costs by approximately $5,002 annually (Appendix A, Table 1). These savings are both in Electricity (24 MWh) and in Natural Gas (3,247.7 Therms).

Annual Stormwater Benefits

Conesville's trees intercept about 265,836 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $7,205 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic mater (ozone). In Conesville, it is estimated that trees remove 307.2 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 $869 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Conesville, trees sequester about 98,266 lbs of carbon a year with an associated value of $737 (Appendix A, Table 4). In addition, the trees store 923,785 lbs of carbon, with a yearly benefit of $6,928 (Appendix A, Table 5).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Conesville receives $5,615 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, Conesville's trees provide $19,427 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 125 trees in Conesville provide approximately $155 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Conesville has over 23 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple	40	32%
Elm	29	23%
Ash	11	8%
Cedar	7	5.5%
Hackberry	5	4%
Oak	4	3%
Spruce	4	3%
Catalpa	4	3%
Redbud	3	2%
Walnut	3	2%
Sycamore	3	2%
Cottonwood	3	2%
Pear	3	2%
Apple	2	1.5%
Mulberry	2	1.5%
Plum	1	<1%
Pine	1	<1%

Age Class

Most of Conesville's trees (43%) are between 6 and 24 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 18 inches in diameter at 4.5 ft. Conesville's size curve is on the smaller side, indicating a slightly 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 Conesville indicate that 53% of the trees are in good health, with 7% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 49% of Conesville'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. This 18% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	21	17%
Crown Raising	16	13%
Tree Staking	0	0%
Tree Removal	11	9%
Crown Reduction	1	<1%

Canopy Cover

The canopy cover of Conesville is approximately 3 acres (Appendix A, Figure 4). According to the 2000 census, Conesville occupies 256 acres. Thus the canopy cover on city land is about 1%.

Land Use and Location

The majority of Conesville'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	100%
Park/vacant/other	0%
Industrial/Large commercial	0%
Small commercial	0%
Multifamily residential	0%

Location	
Front yard	87.2%
Back yard	12.8%
Other maintained locations	0%
Cutout (surrounded by pavement)	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

Conesville has 1 critical concern tree that needs immediate removal. This tree 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 6 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 a total of 11 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 2 removals, 1 is an ash tree. There are a total of 11 ash trees, and 2 of those have signs and symptoms that have been associated with EAB. In addition, there are 6 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Conesville.

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 (32%) and Elm (23%) (Appendix A, Figure 1). Maple and Elm 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, as outlined in the city ordinance (Appendix C). All trees planted must meet the restrictions in 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.

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

Year 1

Removal: largest critical concern trees
Planting and Replacement: 5 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: young critical concern tree, check largest mature immediate concern tree and ash trees with poor health
Planting and Replacement: 5 trees in open locations from year one removals
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3

Removal: largest immediate concern tree, check for ash in poor health
Planting and Replacement: 5 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 4

Removal: largest immediate concern tree, check ash in poor health
Planting and Replacement: 5 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 5

Removal: largest immediate concern tree, check ash in poor health
Planting and Replacement: 5 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 6

Removal: removal of any new critical concern trees, largest immediate concern tree, check ash in poor health
Planting and Replacement: 5 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 2 ash trees removed (approximately 18% of ash). It will take approximately 11 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.

** To remove all ash trees within 6 years, the budget would need to be increased to $2,000 a year.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

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 will meet the restrictions in city ordinance (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on 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. City Code 135.10 Maintenance of Parking or Terrace states: "It shall be the responsibility of the abutting property owner to maintain all property outside the lot and property lines and inside the curb lines upon the public streets, except that the abutting property owner shall not be required to remove diseased trees or dead wood on the publicly owned property or right-of-way. Maintenance includes timely mowing, trimming trees and shrubs and picking up litter."
City code also gives the city the right to remove the tree and charge the landowner if the disease tree/hazard is not removed in timely manner.

Budget

Current Budget
Total $6,000 over 6 years ($1,000/year)

FY 2011 Budget
Removal: $1,000
Planting: possible grants
Watering & Maintenance:

FY 2012 Budget
Removal: $1,000
Planting:
Routine trimming:
Watering & Maintenance:

FY 2013 Budget
Removal: $750
Planting: $250
Watering & Maintenance:

FY 2014 Budget
Removal: $1,000
Planting:
Routine trimming:
Watering & Maintenance:

FY 2015 Budget
Removal: $1,000
Planting:
Watering & Maintenance:

FY 2016 Budget
Removal:
Planting: $500
Routine trimming: $500
Watering & Maintenance:

It will take approximately 11 years to remove all ash with the current budget.

Purposed Budget Increase

EAB could potentially kill all ash trees in Conesville within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $2,000 a year. If the budget were increased to $3,000 a year all ash could be removed within 4 years. Additionally, it is recommended that Conesville 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

Annual Energy Benefits of Public Trees by Species

11/22/2010

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	9.5	723	1,245.1	1,220	1,943	(N/A)	28.8	38.9	53.97
Siberian elm	4.7	355	632.0	619	975	(N/A)	18.4	19.5	42.37
Green ash	1.7	126	229.1	225	350	(N/A)	8.8	7.0	31.86
Eastern red cedar	0.1	8	17.3	17	25	(N/A)	5.6	0.5	3.62
Northern hackberry	1.0	78	152.9	150	228	(N/A)	4.0	4.6	45.50
Elm	1.0	74	137.3	135	208	(N/A)	4.0	4.2	41.66
Sugar maple	0.9	66	108.5	106	173	(N/A)	3.2	3.5	43.14
Catalpa	1.1	86	157.9	155	241	(N/A)	3.2	4.8	60.19
Eastern redbud	0.1	8	17.3	17	24	(N/A)	2.4	0.5	8.15
Black walnut	1.0	74	138.6	136	210	(N/A)	2.4	4.2	70.08
Blue spruce	0.2	14	30.6	30	44	(N/A)	2.4	0.9	14.80
American sycamore	0.5	34	65.6	64	99	(N/A)	2.4	2.0	32.86
Cottonwood	1.1	86	156.1	153	239	(N/A)	2.4	4.8	79.79
Pear	0.1	6	14.1	14	20	(N/A)	2.4	0.4	6.64
Apple	0.0	2	4.4	4	6	(N/A)	1.6	0.1	3.13
White mulberry	0.1	7	16.6	16	24	(N/A)	1.6	0.5	11.80
Other street trees	0.9	71	124.4	122	192	(N/A)	6.4	3.9	24.05
Citywide total	24.0	1,819	3,247.7	3,183	5,002	(N/A)	100.0	100.0	40.01

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

11/22/2010

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	119,117	3,228	(N/A)	28.8	44.8	89.68
Siberian elm	42,713	1,158	(N/A)	18.4	16.1	50.33
Green ash	15,998	434	(N/A)	8.8	6.0	39.42
Eastern red cedar	1,284	35	(N/A)	5.6	0.5	4.97
Northern hackberry	8,655	235	(N/A)	4.0	3.3	46.91
Elm	11,014	299	(N/A)	4.0	4.1	59.70
Sugar maple	8,204	222	(N/A)	3.2	3.1	55.59
Catalpa	15,095	409	(N/A)	3.2	5.7	102.27
Eastern redbud	341	9	(N/A)	2.4	0.1	3.08
Black walnut	12,023	326	(N/A)	2.4	4.5	108.62
Blue spruce	2,266	61	(N/A)	2.4	0.9	20.47
American sycamore	3,806	103	(N/A)	2.4	1.4	34.38
Cottonwood	17,067	463	(N/A)	2.4	6.4	154.19
Pear	279	8	(N/A)	2.4	0.1	2.52
Apple	76	2	(N/A)	1.6	0.0	1.03
White mulberry	333	9	(N/A)	1.6	0.1	4.51
Other street trees	7,565	205	(N/A)	6.4	2.9	25.63
Citywide total	265,836	7,205	(N/A)	100.0	100.0	57.64

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

11/22/2010

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Silver maple	18.3	3.1	9.3	0.8	100	44.8	6.6	6.3	43.1	281	-9.8	-37	122.5	343	(N/A)	28.8	9.54
Siberian elm	5.9	1.0	3.1	0.3	32	22.2	3.2	3.1	21.2	139	0.0	0	60.0	171	(N/A)	18.4	7.44
Green ash	1.7	0.3	0.9	0.1	9	7.9	1.2	1.1	7.5	49	0.0	0	20.6	58	(N/A)	8.8	5.31
Eastern red cedar	0.0	0.0	0.1	0.0	0	0.5	0.1	0.1	0.5	3	-0.6	-2	0.7	1	(N/A)	5.6	0.20
Northern hackberry	1.2	0.2	0.6	0.1	7	5.0	0.7	0.7	4.6	31	0.0	0	13.1	37	(N/A)	4.0	7.48
Elm	1.3	0.2	0.6	0.1	7	4.7	0.7	0.6	4.4	29	0.0	0	12.6	36	(N/A)	4.0	7.23
Sugar maple	1.0	0.2	0.5	0.0	6	4.1	0.6	0.6	4.0	26	-0.8	-3	10.2	28	(N/A)	3.2	7.04
Catalpa	2.1	0.3	1.0	0.1	11	5.4	0.8	0.8	5.1	34	0.0	0	15.6	45	(N/A)	3.2	11.19
Eastern redbud	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)	2.4	1.12
Black walnut	1.6	0.2	0.7	0.1	8	4.7	0.7	0.7	4.4	29	0.0	0	13.1	38	(N/A)	2.4	12.51
Blue spruce	0.2	0.0	0.2	0.0	1	0.9	0.1	0.1	0.9	6	-0.7	-3	1.8	5	(N/A)	2.4	1.53
American sycamore	0.3	0.1	0.2	0.0	2	2.2	0.3	0.3	2.1	14	0.0	0	5.4	15	(N/A)	2.4	5.11
Cottonwood	2.6	0.4	1.2	0.1	14	5.4	0.8	0.8	5.2	34	0.0	0	16.4	47	(N/A)	2.4	15.80
Pear	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	1.0	3	(N/A)	2.4	0.92
Apple	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	1.6	0.41
White mulberry	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3	(N/A)	1.6	1.63
Other street trees	1.2	0.2	0.7	0.1	7	4.4	0.6	0.6	4.2	28	-0.5	-2	11.6	33	(N/A)	6.4	4.07
Citywide total	37.6	6.3	19.0	1.7	204	114.0	16.6	15.9	108.5	711	-12.5	-47	307.2	869	(N/A)	100.0	6.95

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species

11/22/2010

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	390,680	2,930	(N/A)	28.8	42.3	81.39
Siberian elm	147,059	1,103	(N/A)	18.4	15.9	47.95
Green ash	54,095	406	(N/A)	8.8	5.9	36.88
Eastern red cedar	301	2	(N/A)	5.6	0.0	0.32
Northern	17,015	128	(N/A)	4.0	1.8	25.52
Elm	43,229	324	(N/A)	4.0	4.7	64.84
Sugar maple	30,273	227	(N/A)	3.2	3.3	56.76
Catalpa	67,845	509	(N/A)	3.2	7.3	127.21
Eastern redbud	1,099	8	(N/A)	2.4	0.1	2.75
Black walnut	50,174	376	(N/A)	2.4	5.4	125.43
Blue spruce	853	6	(N/A)	2.4	0.1	2.13
American	10,527	79	(N/A)	2.4	1.1	26.32
Cottonwood	86,975	652	(N/A)	2.4	9.4	217.44
Pear	935	7	(N/A)	2.4	0.1	2.34
Apple	192	1	(N/A)	1.6	0.0	0.72
White mulberry	1,086	8	(N/A)	1.6	0.1	4.07
Other street trees	9,729	161	(N/A)	6.4	2.3	20.11
Citywide total	923,785	6,928	(N/A)	100.0	100.0	55.43

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees by Species

11/22/2010

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	33,986	255	-1,875	-7	-14	15,976	120	48,080	361	(N/A)	28.8	48.9	10.02
Siberian elm	8,482	64	-706	-4	-5	7,851	59	15,622	117	(N/A)	18.4	15.9	5.09
Green ash	4,058	30	-260	-2	-2	2,782	21	6,578	49	(N/A)	8.8	6.7	4.49
Eastern red cedar	93	1	-1	-1	0	185	1	275	2	(N/A)	5.6	0.3	0.29
Northern hackberry	1,180	9	-82	-1	-1	1,716	13	2,814	21	(N/A)	4.0	2.9	4.22
Elm	2,427	18	-208	-1	-2	1,630	12	3,849	29	(N/A)	4.0	3.9	5.77
Sugar maple	1,688	13	-145	-1	-1	1,464	11	3,006	23	(N/A)	3.2	3.1	5.64
Catalpa	2,850	21	-326	-1	-2	1,901	14	4,425	33	(N/A)	3.2	4.5	8.30
Eastern redbud	160	1	-5	-1	0	167	1	322	2	(N/A)	2.4	0.3	0.80
Black walnut	2,476	19	-241	-1	-2	1,644	12	3,878	29	(N/A)	2.4	4.0	9.70
Blue spruce	116	1	-4	-1	0	319	2	430	3	(N/A)	2.4	0.4	1.07
American sycamore	1,077	8	-51	-1	0	759	6	1,785	13	(N/A)	2.4	1.8	4.46
Cottonwood	2,484	19	-417	-1	-3	1,910	14	3,976	30	(N/A)	2.4	4.1	9.94
Pear	131	1	-4	-1	0	135	1	262	2	(N/A)	2.4	0.3	0.65
Apple	47	0	-1	0	0	43	0	88	1	(N/A)	1.6	0.1	0.33
White mulberry	152	1	-5	0	0	161	1	308	2	(N/A)	1.6	0.3	1.15
Other street trees	1,115	8	-103	-2	-1	1,558	12	2,569	19	(N/A)	6.4	2.6	2.41
Citywide total	62,524	469	-4,434	-24	-33	40,201	302	98,266	737	(N/A)	100.0	100.0	5.90

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

11/22/2010

Species	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	2,885	(N/A)	28.8	51.4	80.15
Siberian elm	736	(N/A)	18.4	13.1	32.01
Green ash	395	(N/A)	8.8	7.0	35.88
Eastern red cedar	94	(N/A)	5.6	1.7	13.37
Northern hackberry	187	(N/A)	4.0	3.3	37.31
Elm	211	(N/A)	4.0	3.8	42.29
Sugar maple	183	(N/A)	3.2	3.3	45.86
Catalpa	214	(N/A)	3.2	3.8	53.38
Eastern redbud	8	(N/A)	2.4	0.2	2.83
Black walnut	190	(N/A)	2.4	3.4	63.29
Blue spruce	63	(N/A)	2.4	1.1	21.08
American sycamore	115	(N/A)	2.4	2.0	38.27
Cottonwood	174	(N/A)	2.4	3.1	58.12
Pear	6	(N/A)	2.4	0.1	2.16
Apple	2	(N/A)	1.6	0.0	1.05
White mulberry	8	(N/A)	1.6	0.2	4.23
Other street trees	142	(N/A)	6.4	2.5	17.77
Citywide total	5,615	(N/A)	100.0	100.0	44.92

Table 7: Summary of Benefits in Dollars

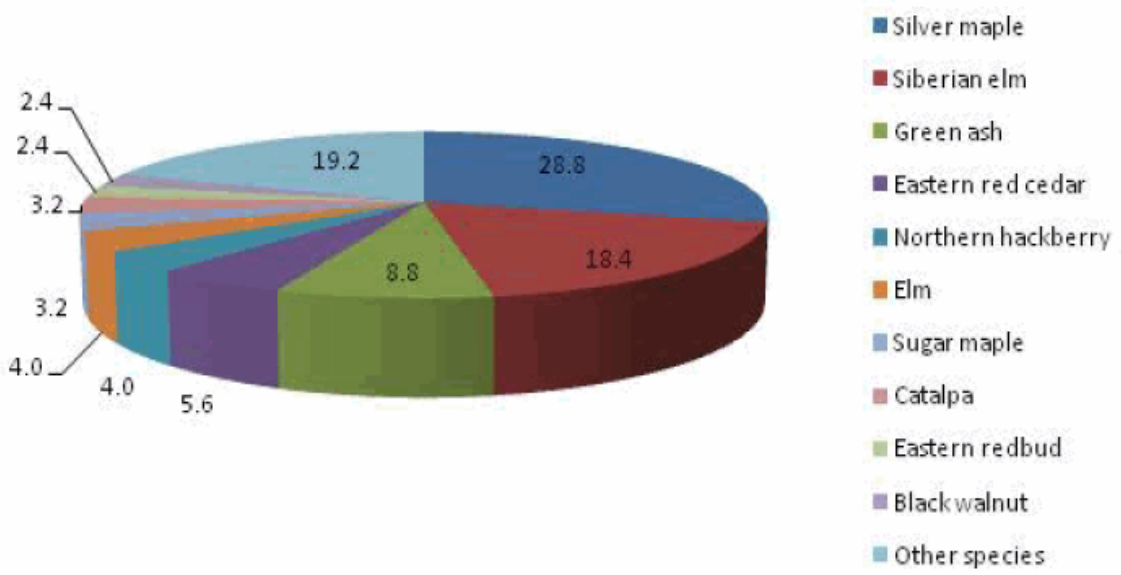
Total Annual Benefits of Public Trees by Species ($)

11/30/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	1,943	361	343	3,228	2,885	8,761	(±0)	45.1
Siberian elm	975	117	171	1,158	736	3,157	(±0)	16.2
Green ash	350	49	58	434	395	1,286	(±0)	6.6
Eastern red cedar	25	2	1	35	94	157	(±0)	0.8
Northern hackberry	228	21	37	235	187	707	(±0)	3.6
Elm	208	29	36	299	211	783	(±0)	4.0
Sugar maple	173	23	28	222	183	629	(±0)	3.2
Catalpa	241	33	45	409	214	941	(±0)	4.8
Eastern redbud	24	2	3	9	8	48	(±0)	0.2
Black walnut	210	29	38	326	190	793	(±0)	4.1
Blue spruce	44	3	5	61	63	177	(±0)	0.9
American sycamore	99	13	15	103	115	345	(±0)	1.8
Cottonwood	239	30	47	463	174	954	(±0)	4.9
Pear	20	2	3	8	6	39	(±0)	0.2
Apple	6	1	1	2	2	12	(±0)	0.1
White mulberry	24	2	3	9	8	47	(±0)	0.2
Other street trees	192	19	33	205	142	591	(±0)	3.0
Citywide Total	5,002	737	869	7,205	5,615	19,427	(±0)	100.0

Species Distribution of Public Trees (%)

11/22/2010

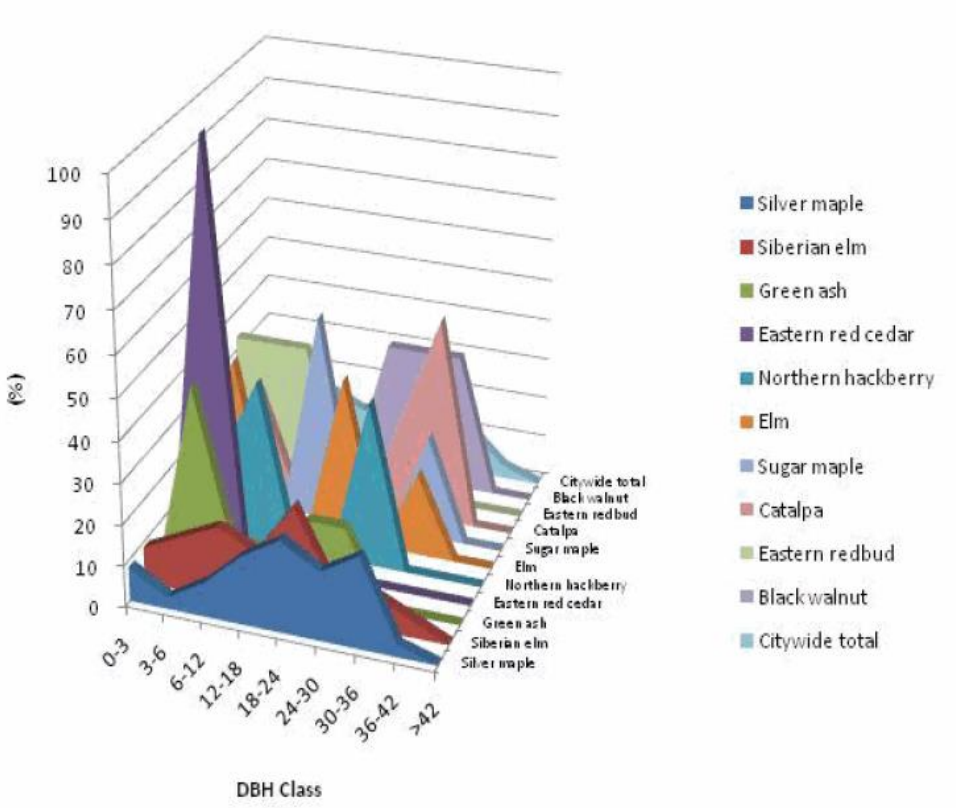


Species	Percent
Silver maple	28.8
Siberian elm	18.4
Green ash	8.8
Eastern red cedar	5.6
Northern hackberry	4.0
Elm	4.0
Sugar maple	3.2
Catalpa	3.2
Eastern redbud	2.4
Black walnut	2.4
Other species	19.2
Total	100.0

Figure 1: Species Distribution

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

11/22/2010



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Silver maple	8.3	2.8	8.3	16.7	22.2	16.7	22.2	2.8	0.0
Siberian elm	8.7	13.0	17.4	13.0	26.1	8.7	8.7	4.3	0.0
Green ash	0.0	45.5	9.1	9.1	18.2	18.2	0.0	0.0	0.0
Eastern red cedar	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern hackberry	0.0	20.0	40.0	0.0	0.0	40.0	0.0	0.0	0.0
Elm	0.0	40.0	0.0	0.0	40.0	0.0	20.0	0.0	0.0
Sugar maple	0.0	25.0	0.0	50.0	0.0	0.0	25.0	0.0	0.0
Catalpa	0.0	25.0	0.0	0.0	0.0	25.0	50.0	0.0	0.0
Eastern redbud	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0
Black walnut	0.0	0.0	0.0	0.0	33.3	33.3	33.3	0.0	0.0
Citywide total	8.8	20.8	15.2	11.2	16.8	12.0	12.0	3.2	0.0

Figure 2: Relative Age Class

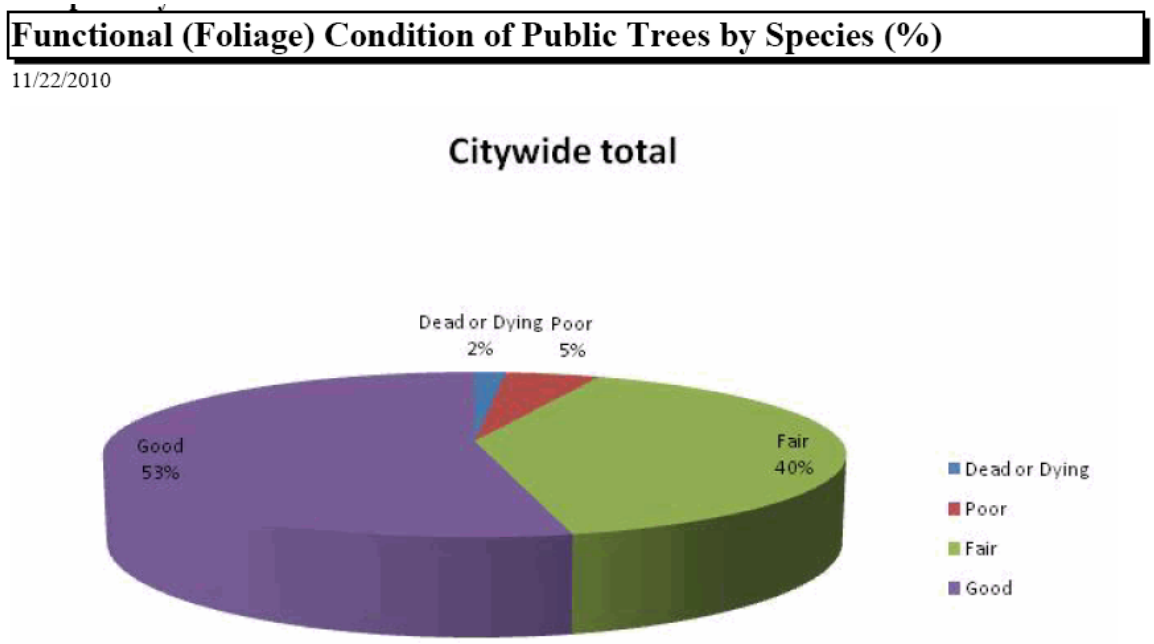


Figure 3: Foliage Condition

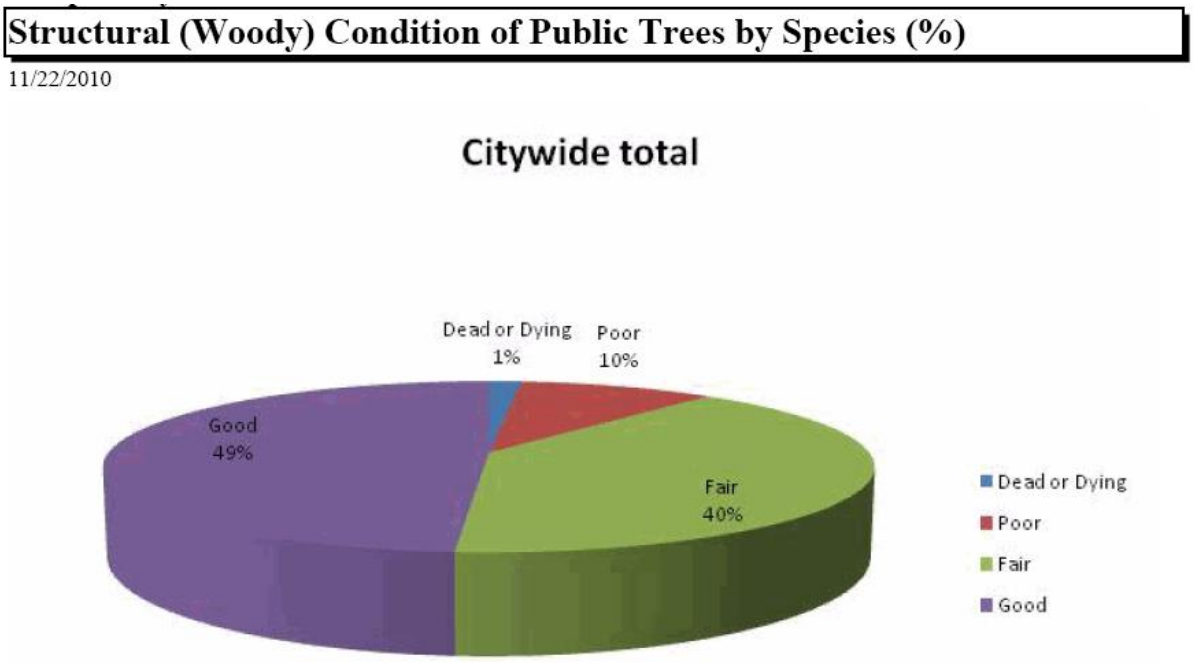
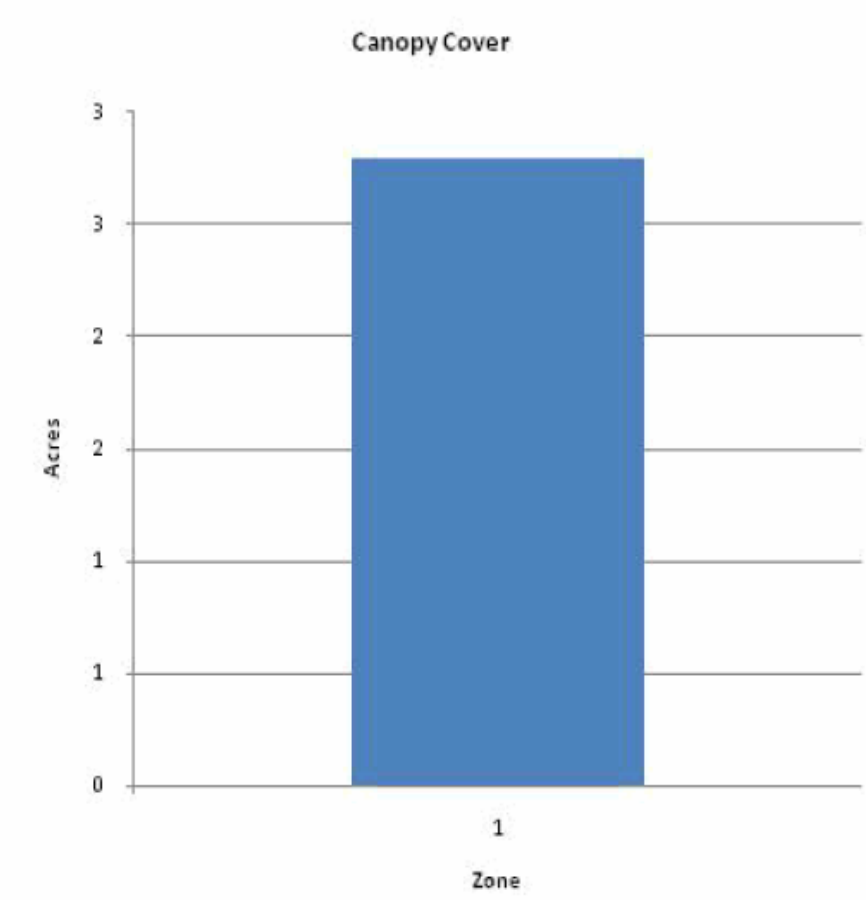


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

11/22/2010



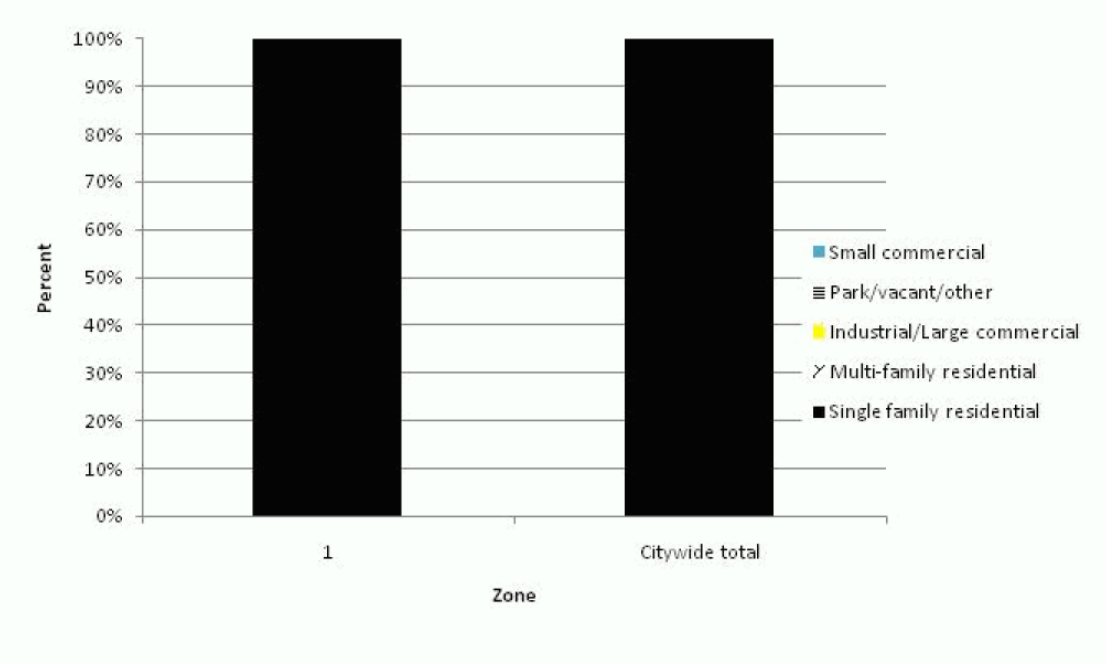
Zone	Acres	% of Total Canopy Cover
1	3	100.0
Citywide total	3	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	3		

Figure 5: Canopy Cover in Acres

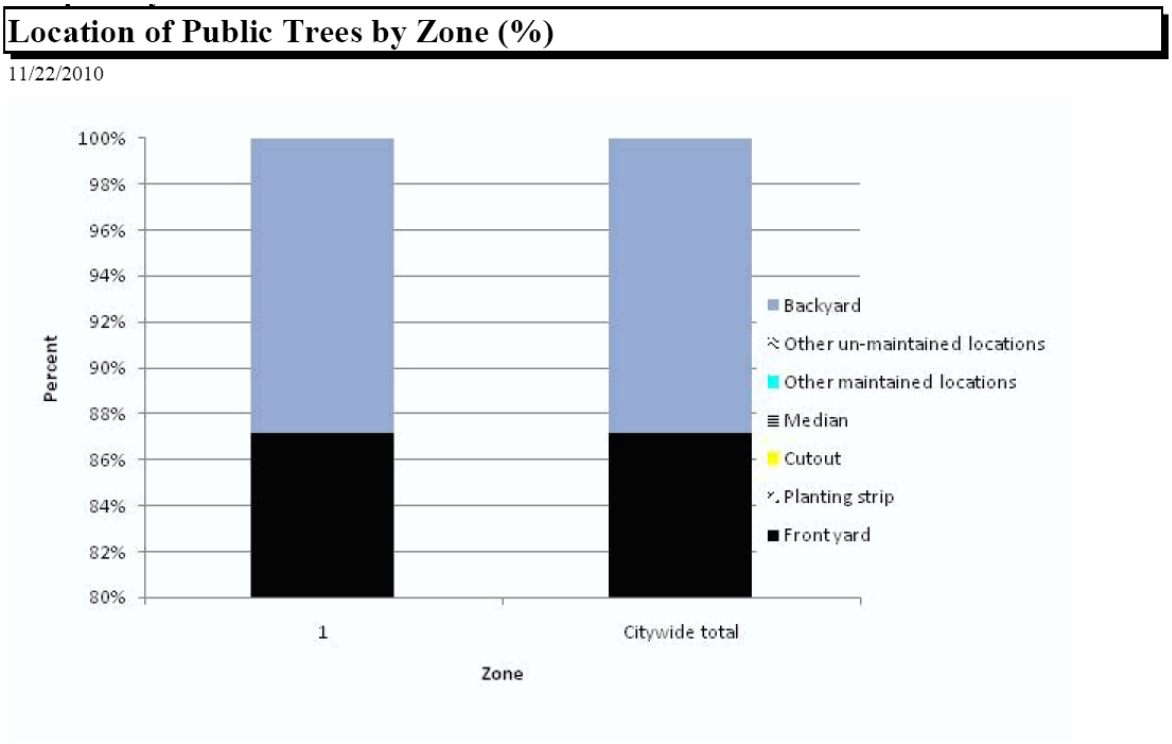
Land Use of Public Trees by Zone (%)

11/22/2010



Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	100.0	0.0	0.0	0.0	0.0
Citywide total	100.0	0.0	0.0	0.0	0.0

Figure 6: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	87.2	0.0	0.0	0.0	0.0	0.0	12.8
Citywide total	87.2	0.0	0.0	0.0	0.0	0.0	12.8

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

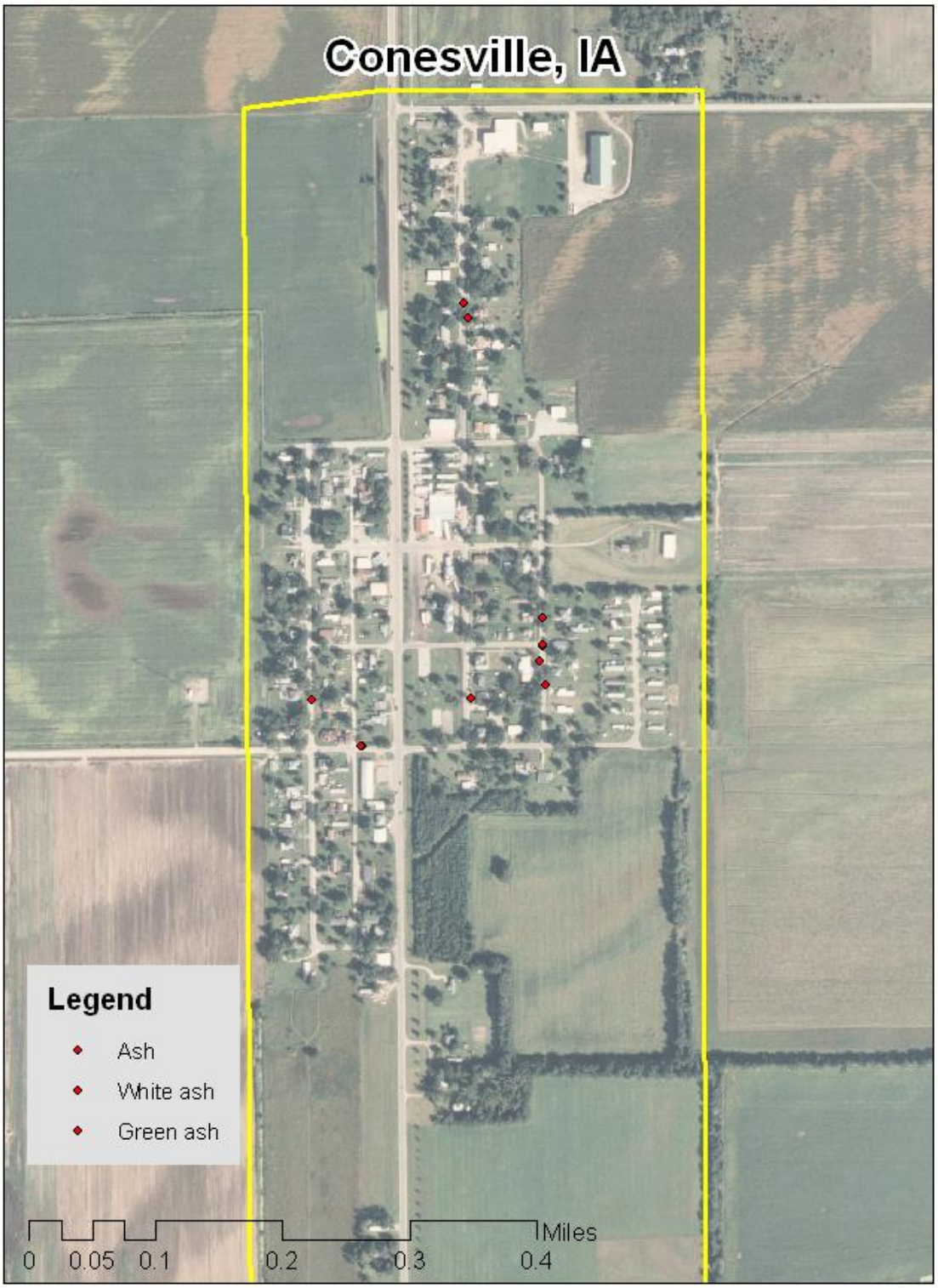


Figure 1: Location of Ash Trees

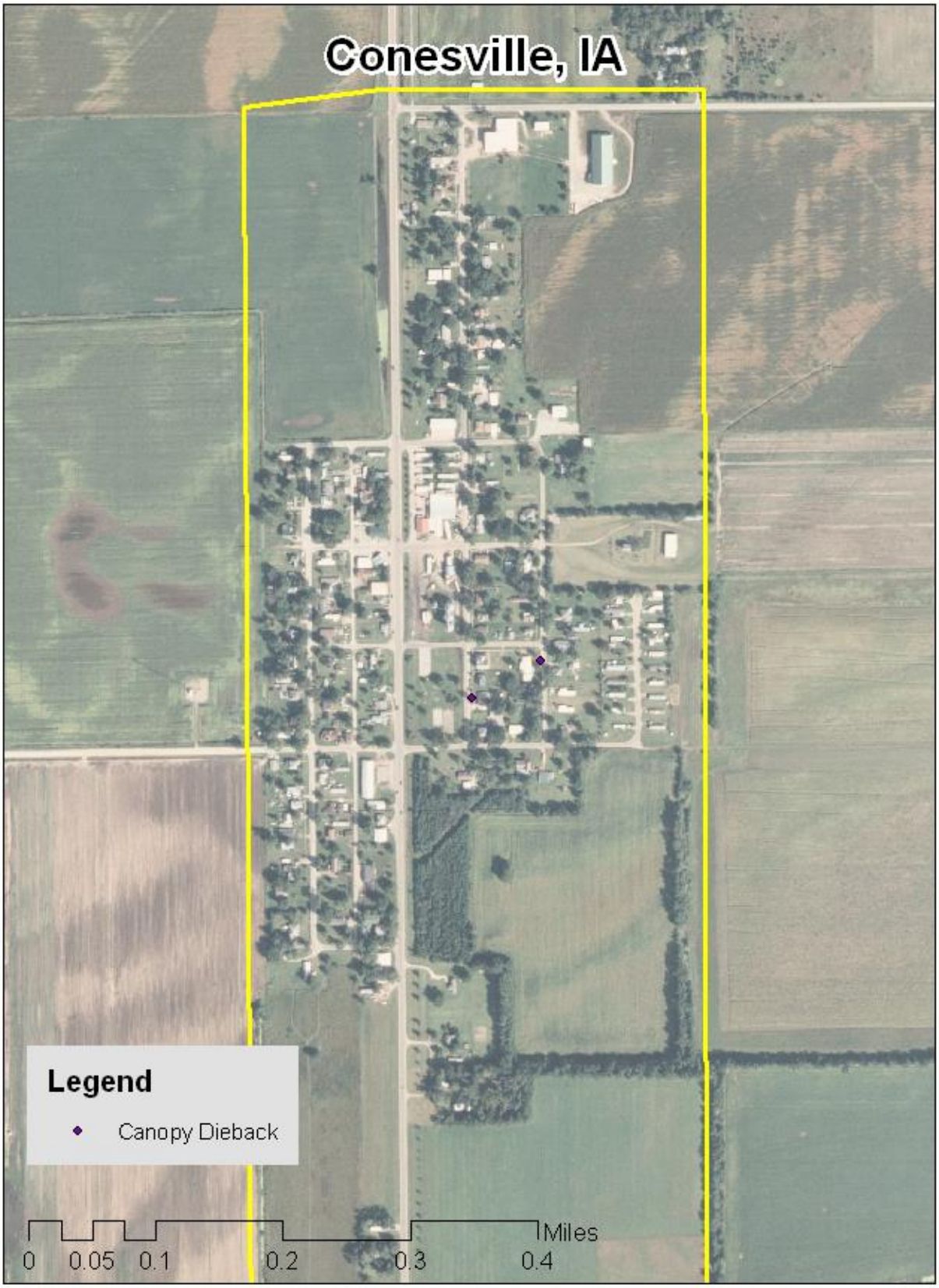


Figure 2: Location of EAB symptoms

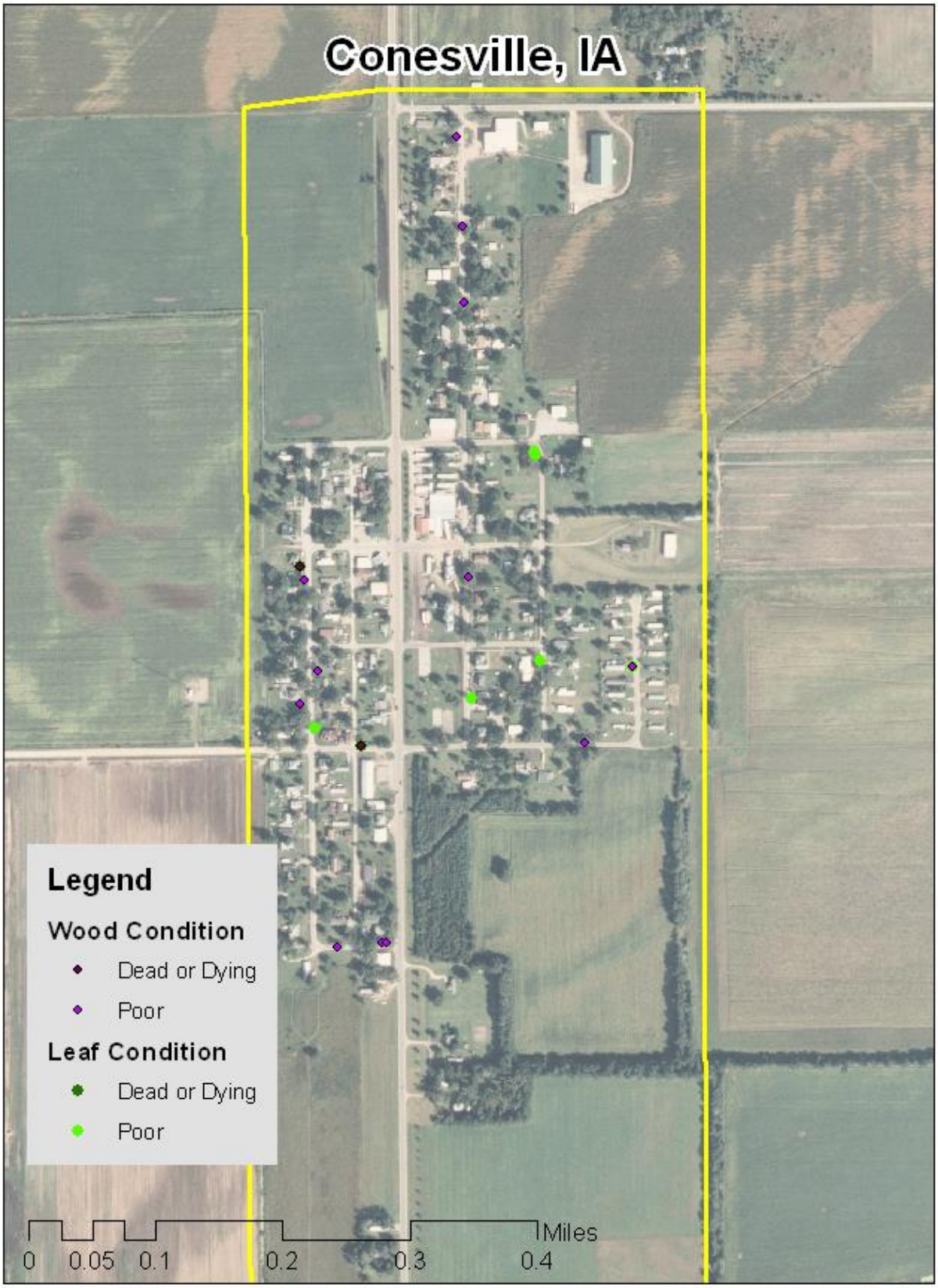


Figure 3: Location of Poor Condition Trees

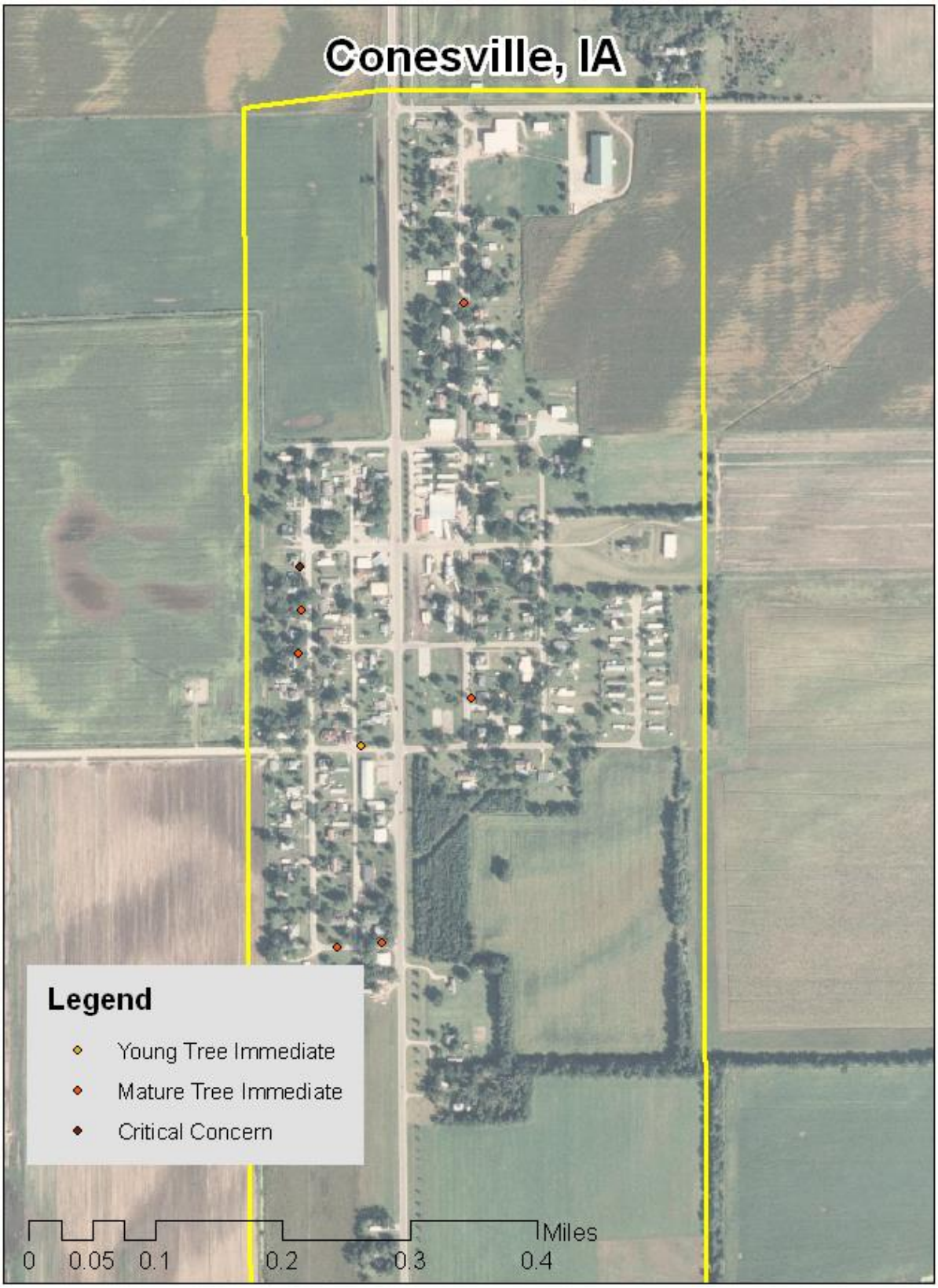


Figure 4: Location of Trees with Recommended Maintenance*City ownership of the trees recommended for removal should be verified prior to any removal*

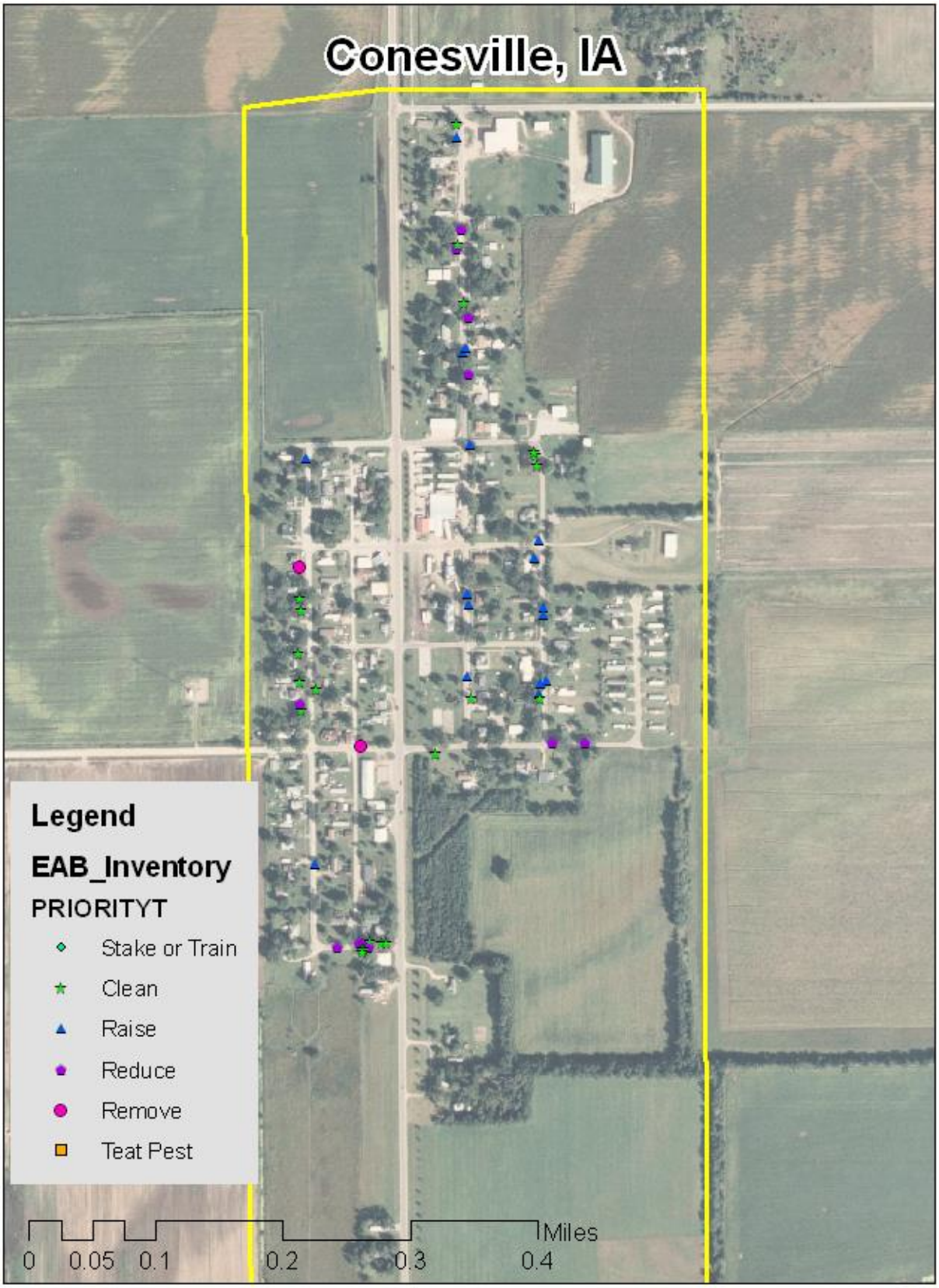


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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