

GREELEY, IA



2012 Management Plan

Prepared by: Bruce Blaire
Bureau of Forestry, Iowa DNR



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Executive Summary

Overview:

This plan was developed to assist the City of Greeley with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows communities 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 that kills all species of our native ash trees. There is a strong possibility that over 5% of Greeley's city-managed ash trees could 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 several years mitigating public safety issues.

Inventory and Results:

In the summer of 2011, a street tree inventory was conducted using an integrated Global Positioning System (GPS) data collector. This involved a complete inventory of street trees within the City's Right-of-Way and some parkland. Below are some key findings of the 49 trees inventoried.

- Greeley street trees provide roughly \$11,060 of benefits, an average of \$226 per tree.
- The top three species groups are: Maples (39%), Ash (37%) and Spruce (4%).
- Approximately 39% of trees are in need of some type of management.
- For various reasons, 7 trees are recommended for removal.

Recommendations:

The core recommendations are described in detail in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations, as well. Below are some key recommendations.

- Of the 18 ash trees surveyed, 2 showed signs and symptoms consistent with a potential EAB infestation (e.g. canopy dieback, epicormic branching, bark splitting, D-shaped exit holes and woodpecker damage.)
- All trees should be pruned on a routine schedule- one third of the city every other year.
- Plant a diverse mix of trees that *does not include*: ash, soft maple, autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar and tree-of-heaven.
- Check ash trees with a visual survey yearly.

Introduction

This plan was developed to assist Greeley with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with a great proportion 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 Greeley, these costs can be extended over several years and public safety issues from dead and dying ash trees can be mitigated.

Trees are an important component of Greeley's infrastructure and are one of the greatest assets to the community. Through research, it has been shown that trees provide a community with numerous public benefits including: improved air quality, storm water runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and creating a desirable place to live. It is essential that these benefits be maintained for the people of Greeley and future generations through sound urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential start to developing management strategies is to have a comprehensive public tree inventory. This inventory supplies information that can be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Greeley's urban forestry goals.

Inventory

In the summer of 2011, a tree inventory was conducted that included the city-owned street trees and some park trees. The tree data was collected using a handheld Global Positioning System (GPS) receiver/data logger. This device records Geographic Information System (GIS) coordinates with an accuracy of 3 meters. The data can then 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 collector was written to be compatible with a state-of-the-art software suite called i-Tree. This software was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. This software is in the public domain and can be accessed for free.

To quantify the urban forest structure and its benefits, specific data is collected for each tree. This data includes: location, land use, tree species, diameter at 4.5 ft (DBH), 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 by the data loggers was downloaded and analyzed by software developed by the USDA Forest service called *Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM)*. This software is also part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis of Greeley's inventory data.

Annual Benefits

Annual Energy Benefits:

Trees conserve energy by shading buildings and blocking winds. Greeley's trees reduce energy related costs by approximately \$2,728 annually (Appendix A, Table 1). These savings are both in Electricity (13.2 MWh) and in Natural Gas (1,764 Therms).

Annual Storm water Benefits:

Greeley's trees intercept about 162,271 gallons of rainfall and snow melt per year (Appendix A, Table 2). This interception provides \$4,398 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 that emit volatile organic matter (ozone). In Greeley, it is estimated that trees remove 174 lbs. of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$493 (Appendix A, Table 3).

Annual Carbon Benefits:

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. Of the 49 trees inventoried, the amount of carbon stored amounts to approximately 744,071 total lbs of CO₂ (Appendix A, Table 4). Those trees are sequestering about 32,591 lbs of carbon per year (Appendix A, Table 5). The benefits these trees provide from summer shading and from reductions in household wind infiltration in the winter result in approximately 22,086 fewer lbs of CO₂ being released into the atmosphere (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. Greeley receives approximately \$3,031 in annual social benefits from its street trees (Appendix A, Table 6).

Financial Summary of all Benefits:

According to the USDA Forest Service i-Tree STRATUM analysis, Greeley's trees provide \$11,060 of benefits annually. Benefits of individual trees vary based on size, species, health and location. On average, each of the 49 trees in Greeley's inventory provides approximately \$226/tree.

Forest Structure

Species Distribution:

There were over 13 different tree species surveyed. The distribution of trees by genus is as follows:

Genus	# of trees	% of total
Maple (<i>acer</i>)	19	38.8%
Ash (<i>fraxius</i>)	18	36.7%
Spruce (<i>picea</i>)	2	4.1%
Arborvitae (<i>Thuja</i>)	2	4.1%
Other evergreens	2	4.1%
Willow (<i>Salix</i>)	2	4.1%
Honeylocust (<i>gleditsia</i>)	1	2.0%
Linden (<i>tilia</i>)	1	2.0%
Walnut (<i>juglans</i>)	1	2.0%
Pine (<i>Pinus</i>)	1	2.0%
	49	100.0%

Size Distribution:

The table below summarizes distribution of surveyed trees by their diameter in inches when measured at 4.5 above the ground. Trees between 12 to 18 inches in diameter were most abundant (24.5%). See Appendix A, Figure 2 for a breakdown of size distributions by species.

Size Classes (inches of diameter at 4.5 feet)	# of trees	% of trees
0 - 3	4	8.2%
3 - 6	0	0.0%
6 - 12	5	10.2%
12 - 18	12	24.5%
18 - 24	8	16.3%
24 - 30	5	10.2%
30 - 36	4	8.2%
36 - 42	4	8.2%
42+	7	14.3%
	49	100.0%

Condition: Foliage and Wood:

Leaf condition is a good indicator of the overall health of urban trees. The foliage condition results for Greeley indicated that 86% of the trees were in good health, 10% in fair health, 2% in poor health and 2% dead or dying. (Appendix A, Figure 3). Leaf health is largely a function of climatic factors during the growing season. This year was not too cool or too wet, therefore, leaf diseases were not as much an issue.

The condition of the wood in urban trees is another important indicator of tree health. The wood forms the structural support system for the leaves and branches. Extensive decay in the main stem makes a tree structurally unsafe which leads to a tree becoming a safety hazard. In Greeley, 55% of the surveyed trees were in good health, 25% in fair health, 18% in poor health and 2% dead or dying. (Appendix A, Figure 4). The 20% in poor, or dead or dying, condition should be assessed more carefully. Many of these are ash trees with a lot of stem rot. One of the trees with poor wood condition is being recommended for removal due to public safety concerns. The 25% in fair health is to a large extent a reflection of having many maple trees which tend to have problems with decay or cracking in their main stem. The City already has too many maple trees, so please encourage less planting of this species group.

Management Needs:

Each surveyed tree was assessed for recommended maintenance needs. The following tables list the specific management needs and recommendations. (See Appendix B, figures 3 & 5).

Priority Task	# of trees	% of trees
none	30	61.2%
clean	7	14.3%
remove	7	14.3%
raise	2	4.1%
reduce	2	4.1%
stake/train	1	2.0%
	49	100.0%

Maintenance Recommendation	# of trees	% of trees
None	30	61.2%
mature tree (routine)	17	34.7%
mature tree (immediate)	1	2.0%
critical concern (public safety)	1	2.0%
	49	100.0%

Land Use and Location:

The majority of Greeley's surveyed trees are 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	80%
Park/vacant/other	20%

Location

Front yard	16%
Planting strip	60%
Back yard	4%
Other maintained locations (e.g. parks)	20%

Recommendations

Risk Management:

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have 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:

A total of 7 trees are recommended for removal for one reason or another. All 7 of these trees had poor wood condition and showed signs of severe decay. Five were ash trees that had been improperly pruned (e.g. "topped") many years ago which has lead to their early demise. These trees with severe decay could easily break off or topple over in storms or under ice and snow loads. Two of these trees are old sugar maple. These tree's locations are shown on the map in Appendix B, Figure 5.

Pruning Cycle:

Proper pruning can extend the life and improve the overall health of trees, and can reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning (stake/train), crown cleaning (clean), crown raising (raise), and crown reduction (reduce). 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. Staking and training is recommended for younger trees so they can develop good architecture. It is recommended that all trees be pruned on a routine schedule every five to seven years.

Priority Task	# of trees	% of trees
none	30	61.2%
clean	7	14.3%
remove	7	14.3%
raise	2	4.1%
reduce	2	4.1%
stake/train	1	2.0%
	49	100.0%

Planting:

Most of the planting over the next six years should replace the trees that are recommended for removal. It is recommended to plant two 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 as the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Greeley.

Since most insects and diseases target a particular genus (e.g. ash) or species (e.g. green ash) of trees, it is important to always plant a diverse mix of species. Current diversity recommendations advise that any genus (e.g. maple, oak or ash) not make up more than 20% of the urban forest. Any single species (e.g. silver maple, sugar maple, white oak or bur oak) not make up more than 10% of the total urban forest. Presently, the forest is heavily planted with Maple (39%) and Ash (37%) (Appendix A, Figure 1). Maples should not be planted until this percentage is dramatically lowered. Ash trees have not been recommended for planting since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: Autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, and willow. I noticed that white poplar was recommended in your City Tree Ordinance. This tree can become invasive so should probably be taken off of your list.

Continual Monitoring:

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

Emerald Ash Borer (EAB) Plan

Ash Tree Removal:

Ash trees in poor condition and displaying signs and symptoms of EAB should be considered for removal (Appendix B, Figure 2). [**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 many millions ash trees throughout the Eastern United States and Canada. Ash in both forestlands and urban settings constitutes a very significant portion of the canopy cover. 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 its spread beyond its known locations 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 urban 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 your budget permits, all removed ash trees should be replaced. All trees should meet the restrictions in your city's ordinance (Appendix C). The new plantings should be a diverse mix and should not include ash, Autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, or willow.

Postponed Work:

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genus's other than ash will be prioritized by hazardous or emergency situations only.

Private Ash Trees:

It is strongly recommended that private property owners start removing ash trees on their property as trees are infested with Emerald Ash Borer. Trees that are on private property are part of Greeley's urban forest. Private property owners should be given direction to the proper species to plant, spacing, and location. Greeley has a city ordinance for trees.

Budget

Purposed Budget Increase:

EAB could potentially kill all of the ash trees in Greeley within a decade after its arrival. It is recommended that the City apply for grants to fund replacement tree planting. 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. We recommend removing the 5 ash trees with severe decay (Appendix B, Figure 1 & Figure 3). You should remove the one additional ash tree showing signs and symptoms consistent with EAB (Appendix B, Figure 2). Additionally, remove the dead sugar maple if it hasn't already been removed. Finally, we recommend that the City adopt a policy of allocating somewhere between \$2 to \$4 per capita per year into a forestry budget to be used for planting, removals and maintenance of Greeley's urban forest.

Recommended Budget for the next 5 years: \$5,850.

FY 2011 Budget

Removal: \$1500
Planting: \$300
Routine trimming: \$100
Watering & Maintenance: \$75

FY 2012 Budget

Removal: \$1500
Planting: \$300
Routine trimming: \$100
Watering & Maintenance: \$75

FY 2013 Budget

Removal: \$500
Planting: \$300
Routine trimming: \$100
Watering & Maintenance: \$75

FY 2014 Budget

Planting: \$300
Routine trimming: \$100
Watering & Maintenance: \$75

FY 2015 Budget

Planting: \$200
Routine trimming: \$100
Watering & Maintenance: \$50

Works Cited

Census Bureau. 2000. <http://censtats.census.gov/data/IA/1601964290.pdf> (April, 2010)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J.; McPherson, E. Gregory; Simpson, James R.; Vargas, Kelaine E.; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species

10/18/2011

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	5.8	439	784.2	768	1,207	(N/A)	36.7	44.3	67.06
Silver maple	3.3	249	436.0	427	676	(N/A)	18.4	24.8	75.11
Sugar maple	1.9	147	263.7	258	405	(N/A)	14.3	14.9	57.87
Norway maple	0.7	50	93.8	92	142	(N/A)	6.1	5.2	47.36
Conifer Evergreen Small	0.0	1	1.3	1	2	(N/A)	4.1	0.1	0.93
Willow	0.5	36	59.0	58	94	(N/A)	4.1	3.4	46.78
Northern white cedar	0.0	1	1.3	1	2	(N/A)	4.1	0.1	0.93
Honeylocust	0.3	21	33.4	33	54	(N/A)	2.0	2.0	53.77
Black walnut	0.2	18	27.0	26	44	(N/A)	2.0	1.6	44.23
Black spruce	0.1	5	10.2	10	15	(N/A)	2.0	0.5	14.80
Blue spruce	0.1	10	15.2	15	25	(N/A)	2.0	0.9	24.51
Scotch pine	0.1	10	14.6	14	24	(N/A)	2.0	0.9	24.14
Littleleaf linden	0.2	15	23.9	23	39	(N/A)	2.0	1.4	38.70
Other street trees	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	13.2	999	1,763.6	1,728	2,728	(N/A)	100.0	100.0	55.67

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

10/18/2011

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	71,266	1,931	(N/A)	36.7	43.9	107.30
Silver maple	48,847	1,324	(N/A)	18.4	30.1	147.09
Sugar maple	25,314	686	(N/A)	14.3	15.6	98.01
Norway maple	5,759	156	(N/A)	6.1	3.6	52.03
Conifer Evergreen Small	49	1	(N/A)	4.1	0.0	0.66
Willow	2,818	76	(N/A)	4.1	1.7	38.19
Northern white cedar	97	3	(N/A)	4.1	0.1	1.32
Honeylocust	1,557	42	(N/A)	2.0	1.0	42.19
Black walnut	1,465	40	(N/A)	2.0	0.9	39.72
Black spruce	755	20	(N/A)	2.0	0.5	20.47
Blue spruce	1,544	42	(N/A)	2.0	1.0	41.85
Scotch pine	1,539	42	(N/A)	2.0	1.0	41.70
Littleleaf linden	1,260	34	(N/A)	2.0	0.8	34.14
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	162,271	4,398	(N/A)	100.0	100.0	89.75

Table 3: Annual Air Quality Benefits**Annual Air Quality Benefits of Public Trees by Species**

10/18/2011

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total (\$)	Standard % of Total Error	Avg. Trees \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂							
Green ash	10.5	1.7	4.8	0.5	56	27.5	4.0	3.8	26.2	172	0.0	0	79.1	227 (N/A)	36.7	12.62
Silver maple	9.4	1.6	4.6	0.4	51	15.5	2.3	2.2	14.8	97	-5.2	-19	45.6	128 (N/A)	18.4	14.23
Sugar maple	3.6	0.6	1.7	0.2	19	9.2	1.3	1.3	8.7	57	-2.8	-10	23.9	66 (N/A)	14.3	9.46
Norway maple	1.1	0.2	0.6	0.1	6	3.2	0.5	0.4	3.0	20	-0.3	-1	8.8	25 (N/A)	6.1	8.32
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	4.1	0.09
Willow	0.4	0.1	0.2	0.0	2	2.2	0.3	0.3	2.1	14	-0.1	0	5.6	16 (N/A)	4.1	7.92
Northern white cedar	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	4.1	0.05
Honeylocust	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.3	8	-0.2	-1	3.2	9 (N/A)	2.0	8.90
Black walnut	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	2.0	7.42
Black spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2 (N/A)	2.0	1.53
Blue spruce	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3 (N/A)	2.0	2.89
Scotch pine	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3 (N/A)	2.0	2.82
Littleleaf linden	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6 (N/A)	2.0	6.42
Other street trees	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.0	0.00
Citywide total	26.1	4.3	12.6	1.2	140	62.5	9.1	8.7	59.6	390	-10.0	-38	174.2	493 (N/A)	100.0	10.05

Table 4: Annual Carbon Stored**Stored CO2 Benefits of Public Trees by Species**

10/18/2011

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	354,194	2,656	(N/A)	36.7	47.6	147.58
Silver maple	244,681	1,835	(N/A)	18.4	32.9	203.90
Sugar maple	106,056	795	(N/A)	14.3	14.3	113.63
Norway maple	19,005	143	(N/A)	6.1	2.6	47.51
Conifer Evergreen	5	0	(N/A)	4.1	0.0	0.02
Willow	7,248	54	(N/A)	4.1	1.0	27.18
Northern white	5	0	(N/A)	4.1	0.0	0.02
Honeylocust	3,037	23	(N/A)	2.0	0.4	22.78
Black walnut	3,672	28	(N/A)	2.0	0.5	27.54
Black spruce	284	2	(N/A)	2.0	0.0	2.13
Blue spruce	1,118	8	(N/A)	2.0	0.2	8.39
Scotch pine	1,170	9	(N/A)	2.0	0.2	8.78
Littleleaf linden	3,595	27	(N/A)	2.0	0.5	26.96
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	744,071	5,581	(N/A)	100.0	100.0	113.89

Table 5: Annual Carbon Sequestered

Annual CO₂ Benefits of Public Trees by Species

10/18/2011

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
Green ash	12,218	92	-1,700	-4	-13	9,693	73	20,208	152 (N/A)	36.7	37.0	8.42
Silver maple	15,982	120	-1,174	-2	-9	5,497	41	20,302	152 (N/A)	18.4	37.1	16.92
Sugar maple	4,904	37	-509	-1	-4	3,241	24	7,635	57 (N/A)	14.3	14.0	8.18
Norway maple	610	5	-91	-1	-1	1,109	8	1,628	12 (N/A)	6.1	3.0	4.07
Conifer Evergreen	1	0	0	0	0	12	0	13	0 (N/A)	4.1	0.0	0.05
Willow	772	6	-35	0	0	790	6	1,527	11 (N/A)	4.1	2.8	5.73
Northern white cedar	7	0	0	0	0	12	0	19	0 (N/A)	4.1	0.0	0.07
Honeylocust	474	4	-15	0	0	466	3	925	7 (N/A)	2.0	1.7	6.94
Black walnut	445	3	-18	0	0	393	3	820	6 (N/A)	2.0	1.5	6.15
Black spruce	39	0	-1	0	0	106	1	143	1 (N/A)	2.0	0.3	1.07
Blue spruce	91	1	-5	0	0	213	2	298	2 (N/A)	2.0	0.5	2.23
Scotch pine	116	1	-6	0	0	216	2	326	2 (N/A)	2.0	0.6	2.45
Littleleaf linden	514	4	-17	0	0	337	3	834	6 (N/A)	2.0	1.5	6.25
Other street trees	0	0	0	0	0	0	0	0	0 (N/A)	0.0	0.0	0.00
Citywide total	36,173	271	-3,572	-10	-27	22,086	166	54,677	410 (N/A)	100.0	100.0	8.37

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

10/18/2011

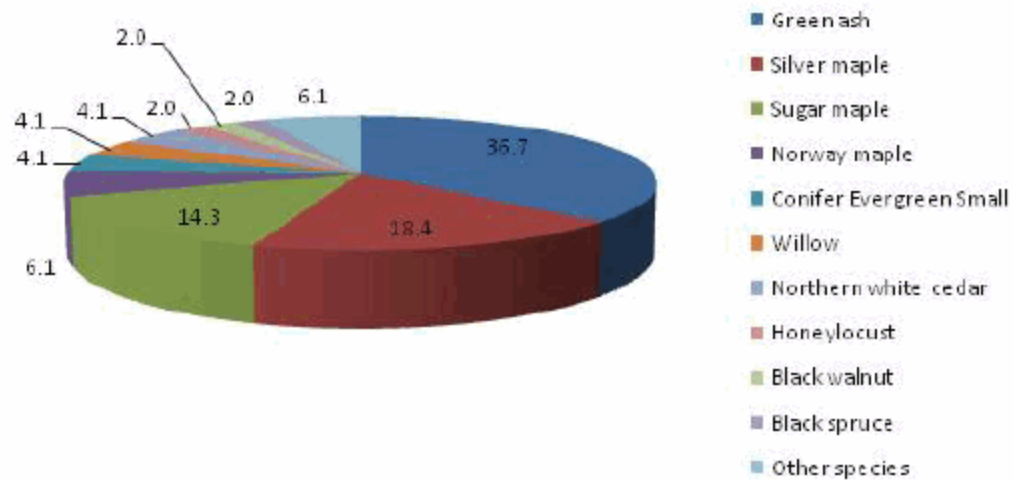
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	959	(N/A)	36.7	31.7	53.30
Silver maple	1,139	(N/A)	18.4	37.6	126.60
Sugar maple	487	(N/A)	14.3	16.1	69.53
Norway maple	65	(N/A)	6.1	2.2	21.79
Conifer Evergreen Small	9	(N/A)	4.1	0.3	4.27
Willow	78	(N/A)	4.1	2.6	39.16
Northern white cedar	12	(N/A)	4.1	0.4	5.76
Honeylocust	103	(N/A)	2.0	3.4	102.70
Black walnut	46	(N/A)	2.0	1.5	45.86
Black spruce	21	(N/A)	2.0	0.7	21.08
Blue spruce	25	(N/A)	2.0	0.8	25.23
Scotch pine	32	(N/A)	2.0	1.1	32.32
Littleleaf linden	55	(N/A)	2.0	1.8	55.09
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	3,031	(N/A)	100.0	100.0	61.87

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species (\$)								
10/18/20								
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Green ash	1,207	152	227	1,931	959	4,477 (±0)		40.5
Silver maple	676	152	128	1,324	1,139	3,419 (±0)		30.9
Sugar maple	405	57	66	686	487	1,701 (±0)		15.4
Norway maple	142	12	25	156	65	401 (±0)		3.6
Conifer Evergreen	2	0	0	1	9	12 (±0)		0.1
Willow	94	11	16	76	78	276 (±0)		2.5
Northern white cedar	2	0	0	3	12	16 (±0)		0.1
Honeylocust	54	7	9	42	103	215 (±0)		1.9
Black walnut	44	6	7	40	46	143 (±0)		1.3
Black spruce	15	1	2	20	21	59 (±0)		0.5
Blue spruce	25	2	3	42	25	97 (±0)		0.9
Scotch pine	24	2	3	42	32	103 (±0)		0.9
Littleleaf linden	39	6	6	34	55	141 (±0)		1.3
Other street trees	0	0	0	0	0	0 (±0)		0.0
Citywide Total	2,728	410	493	4,398	3,031	11,060 (±0)		100.0

Species Distribution of Public Trees (%)

10/18/2011

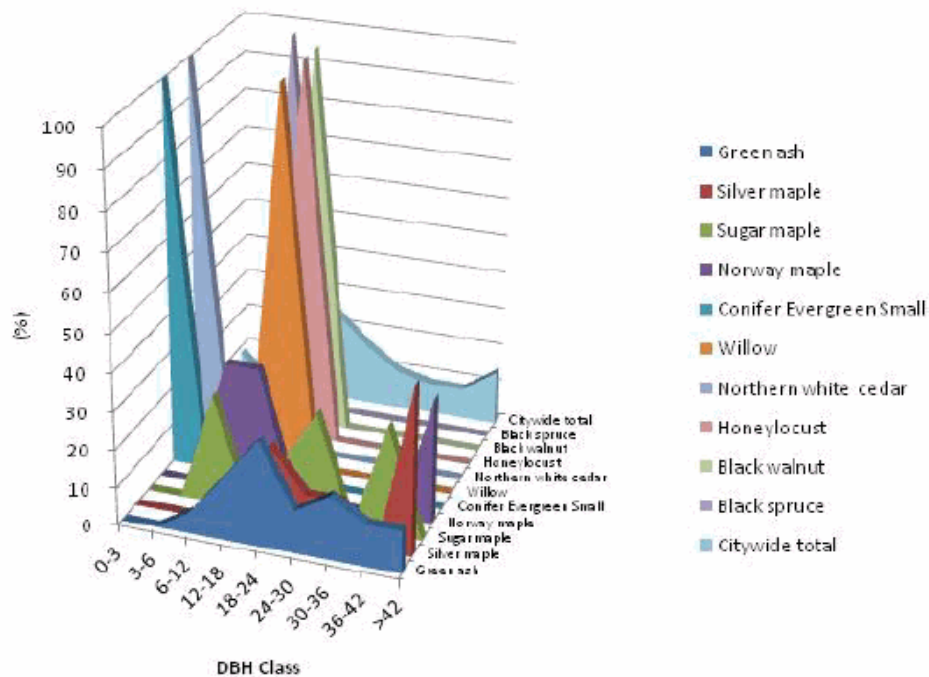


Species	Percent
Green ash	36.7
Silver maple	18.4
Sugar maple	14.3
Norway maple	6.1
Conifer Evergreen	4.1
Willow	4.1
Northern white cedar	4.1
Honeylocust	2.0
Black walnut	2.0
Black spruce	2.0
Other species	6.1
Total	100.0

Figure 1: Species Distribution

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

10/18/2011



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Green ash	0.0	0.0	5.6	16.7	27.8	11.1	16.7	11.1	11.1
Silver maple	0.0	0.0	0.0	11.1	22.2	11.1	11.1	0.0	44.4
Sugar maple	0.0	0.0	28.6	0.0	14.3	28.6	0.0	28.6	0.0
Norway maple	0.0	0.0	33.3	33.3	0.0	0.0	0.0	0.0	33.3
Conifer Evergreen	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Willow	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Northern white cedar	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Honeylocust	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Black walnut	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Black spruce	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Citywide total	8.2	0.0	10.2	24.5	16.3	10.2	8.2	8.2	14.3

Figure 2: Relative Age Class

Functional (Foliage) Condition of Public Trees by Species (%)

10/18/2011

Citywide total

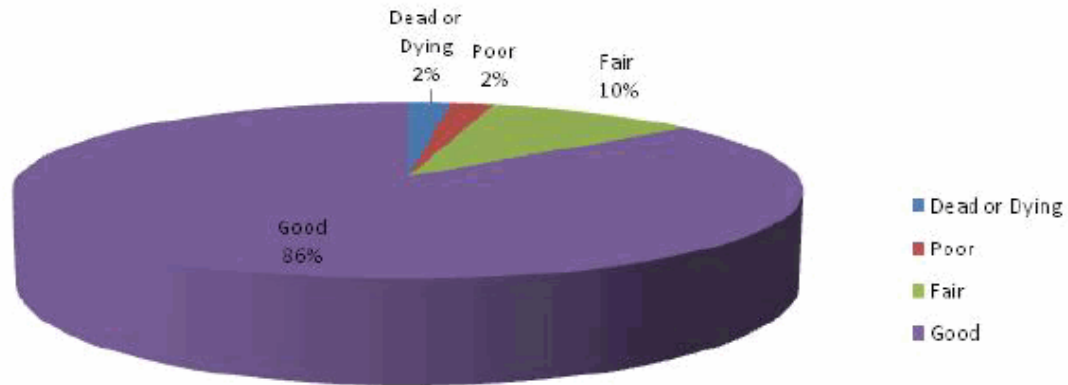


Figure 3: Foliage Condition

Structural (Woody) Condition of Public Trees by Species (%)

10/18/2011

Citywide total

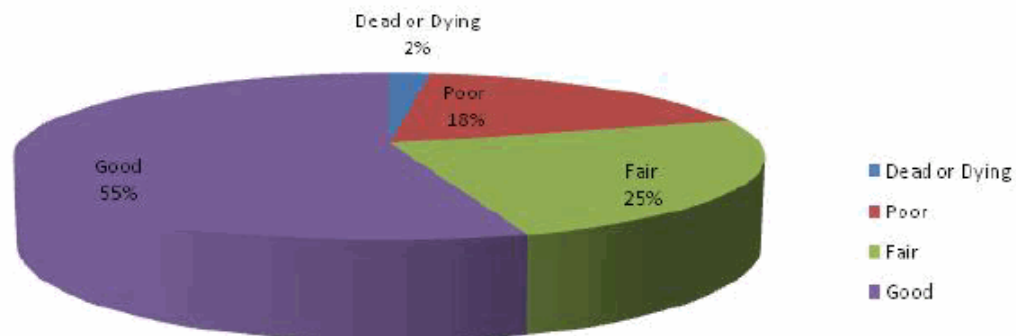
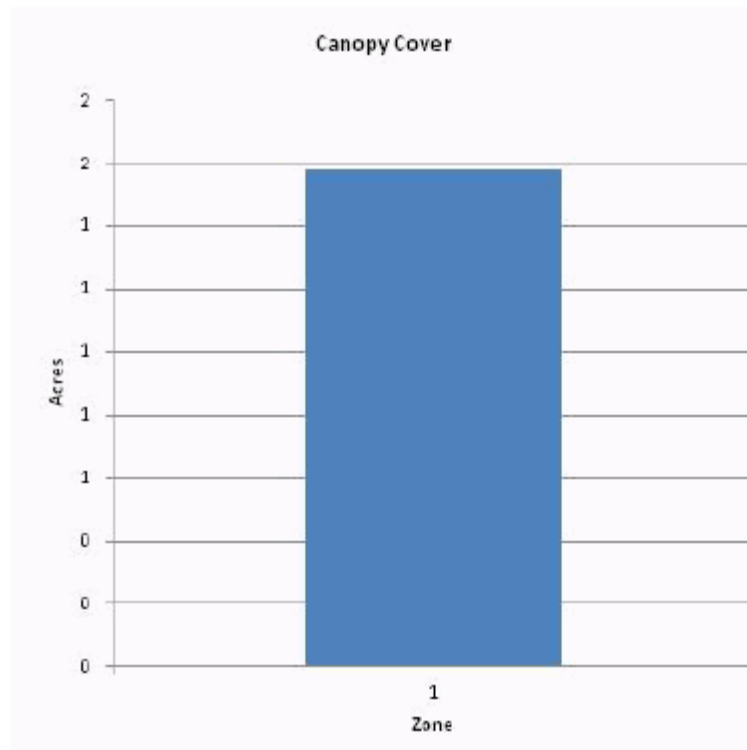


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

10/18/2011



Zone	Acres	% of Total Canopy Cover
1	2	100.0
Citywide total	2	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	2		

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

10/18/2011

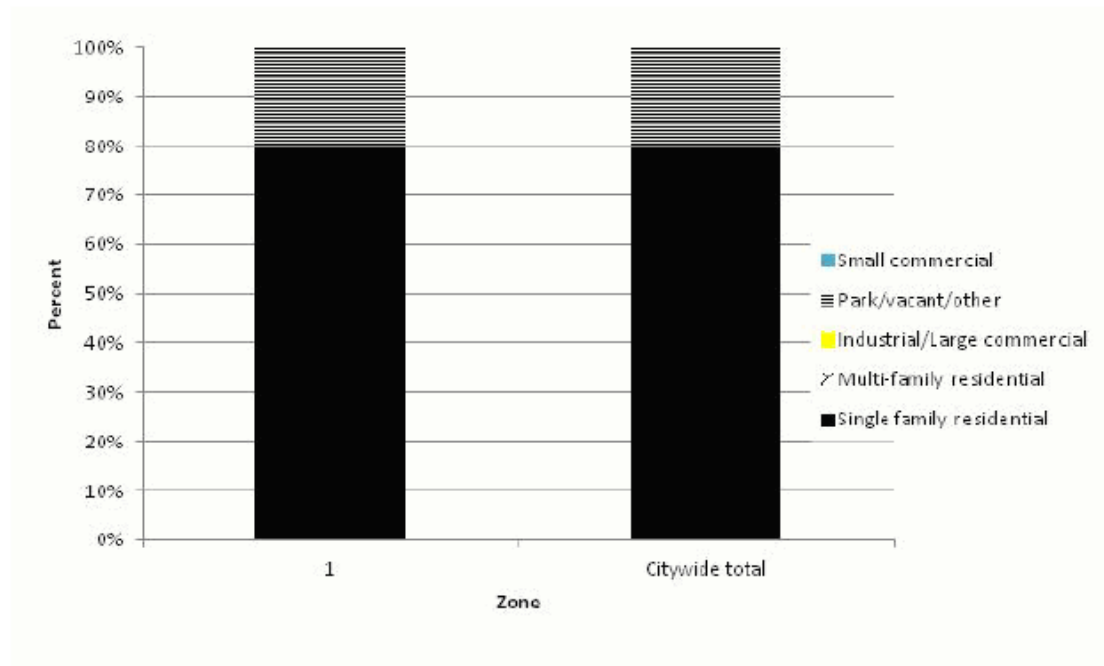
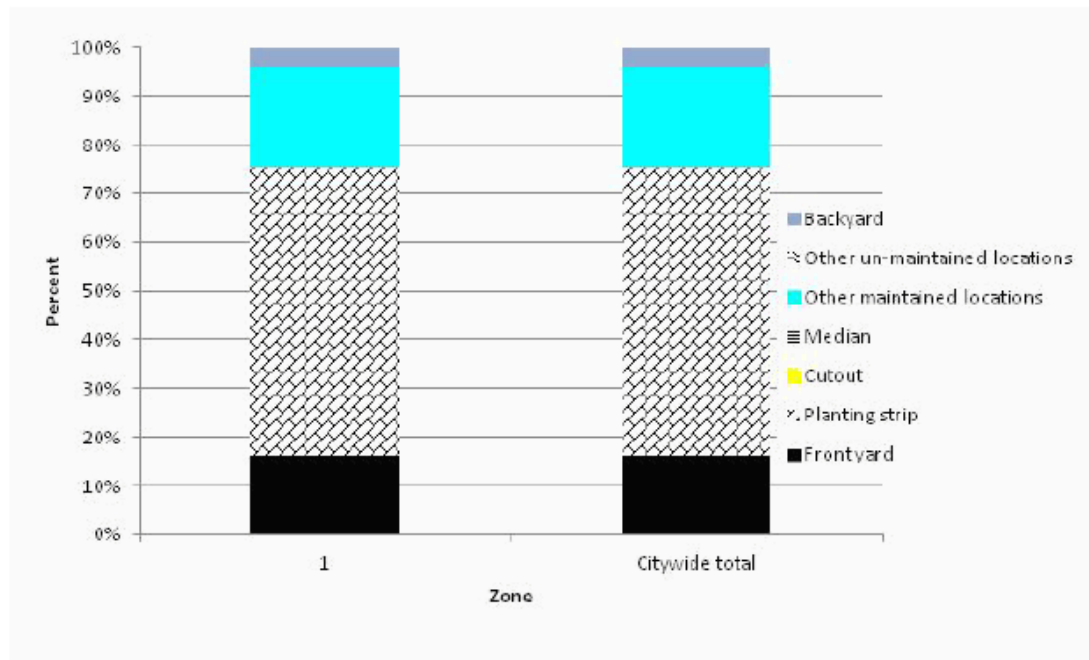


Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

10/18/2011



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	16.3	59.2	0.0	0.0	20.4	0.0	4.1
Citywide total	16.3	59.2	0.0	0.0	20.4	0.0	4.1

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

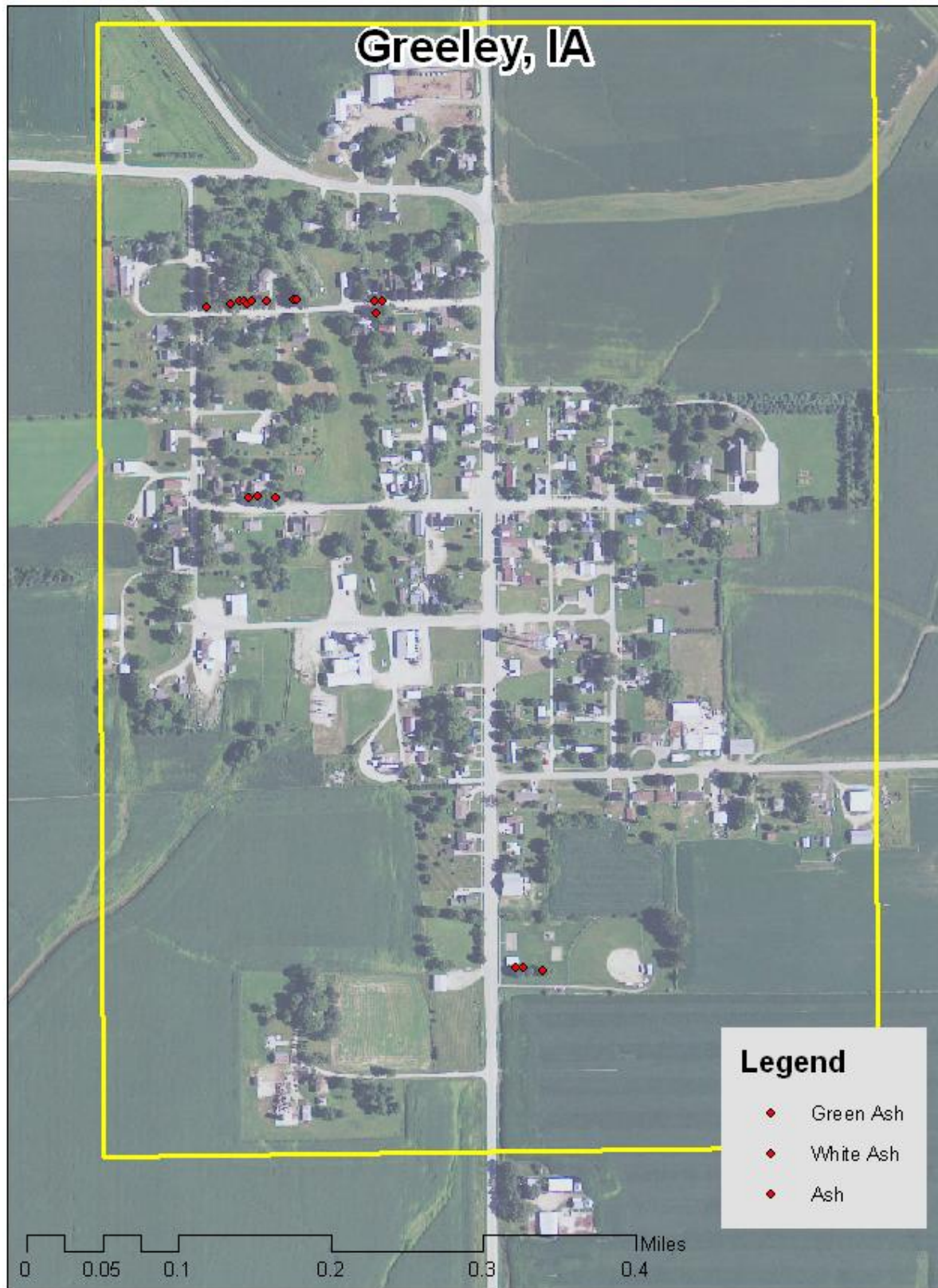


Figure 1: Location of Ash Trees

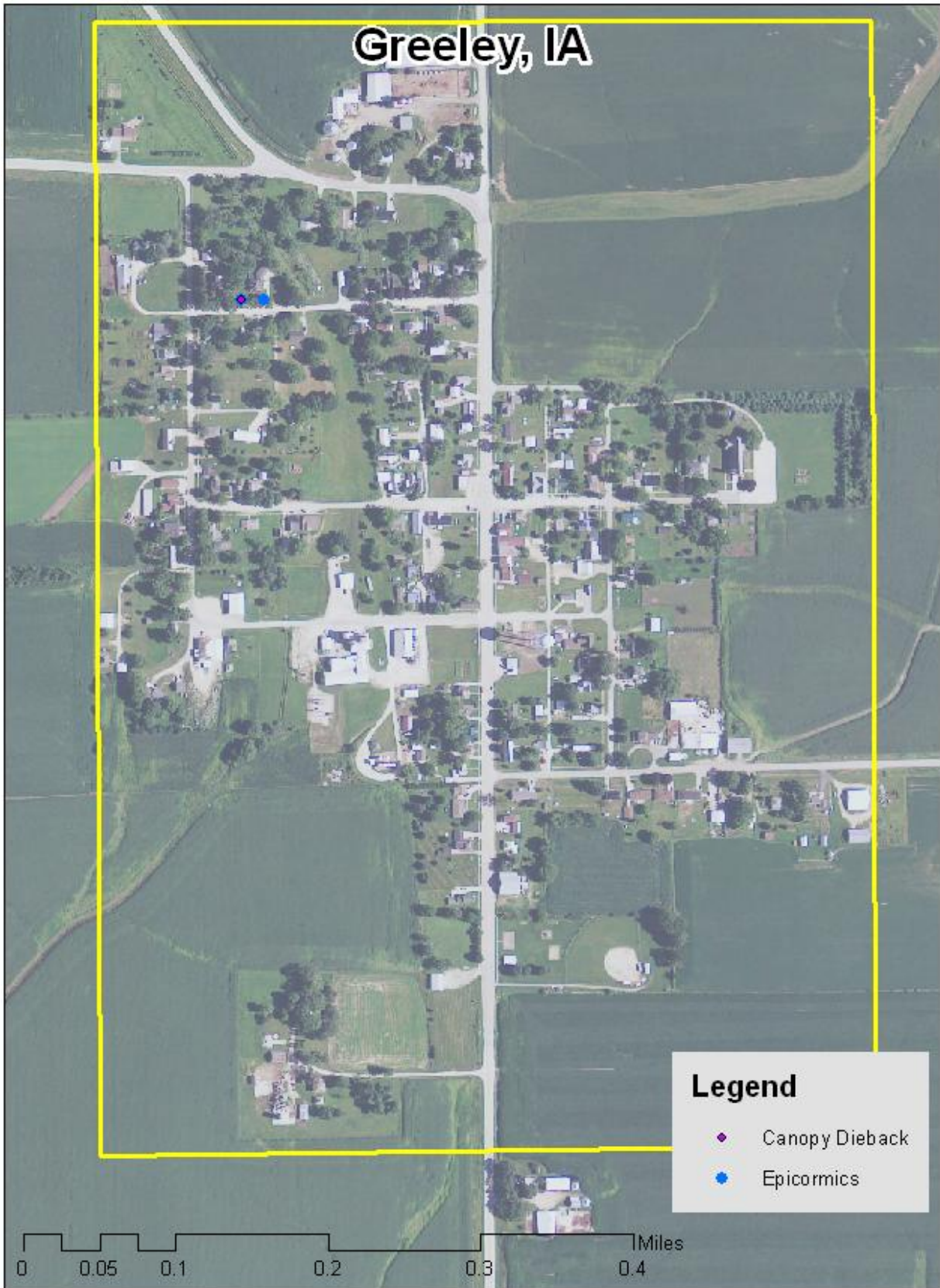


Figure 2: Location of EAB symptoms

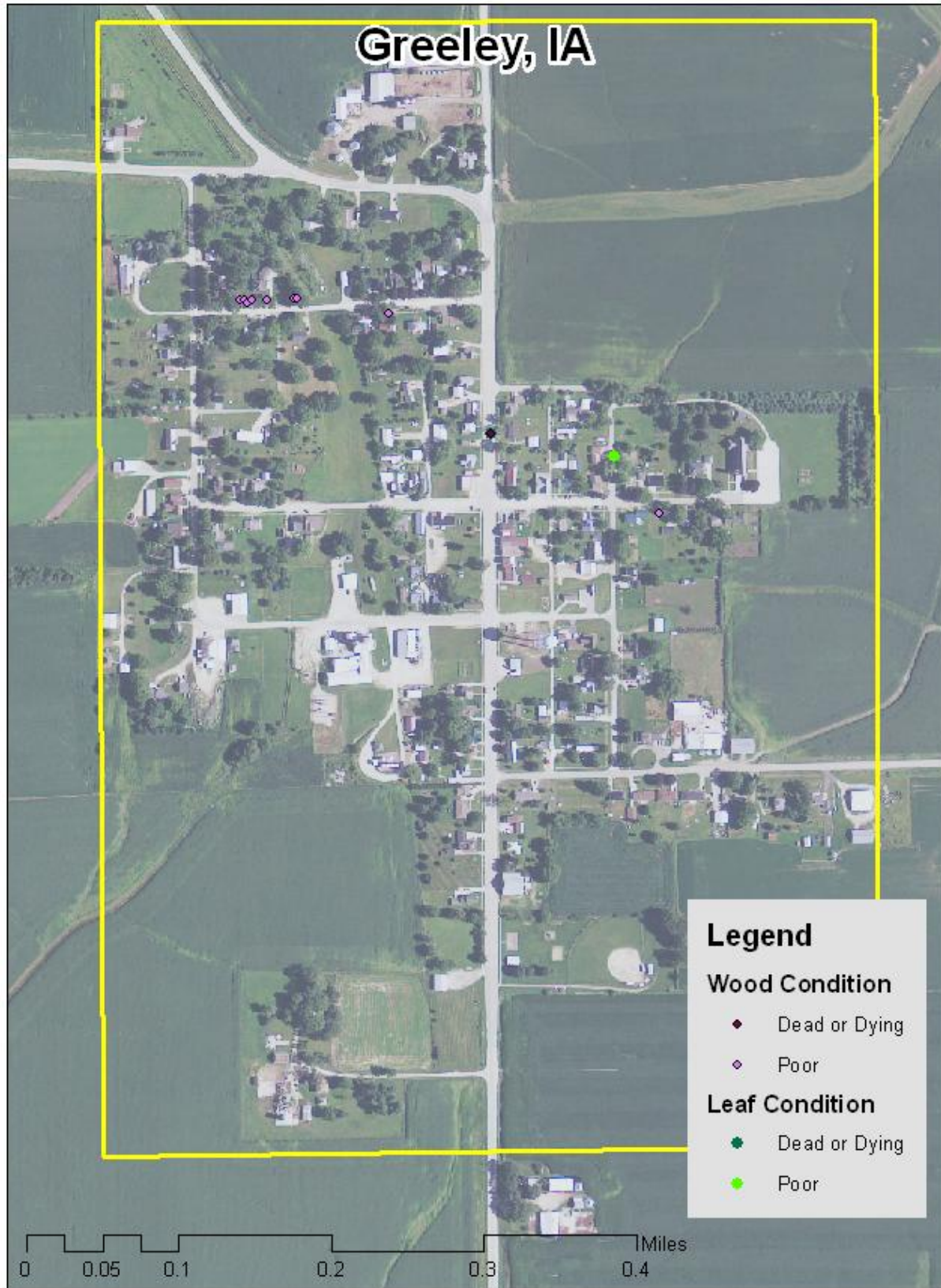


Figure 3: Location of Poor Condition Trees



Figure 4: Location of Trees with Recommended Maintenance

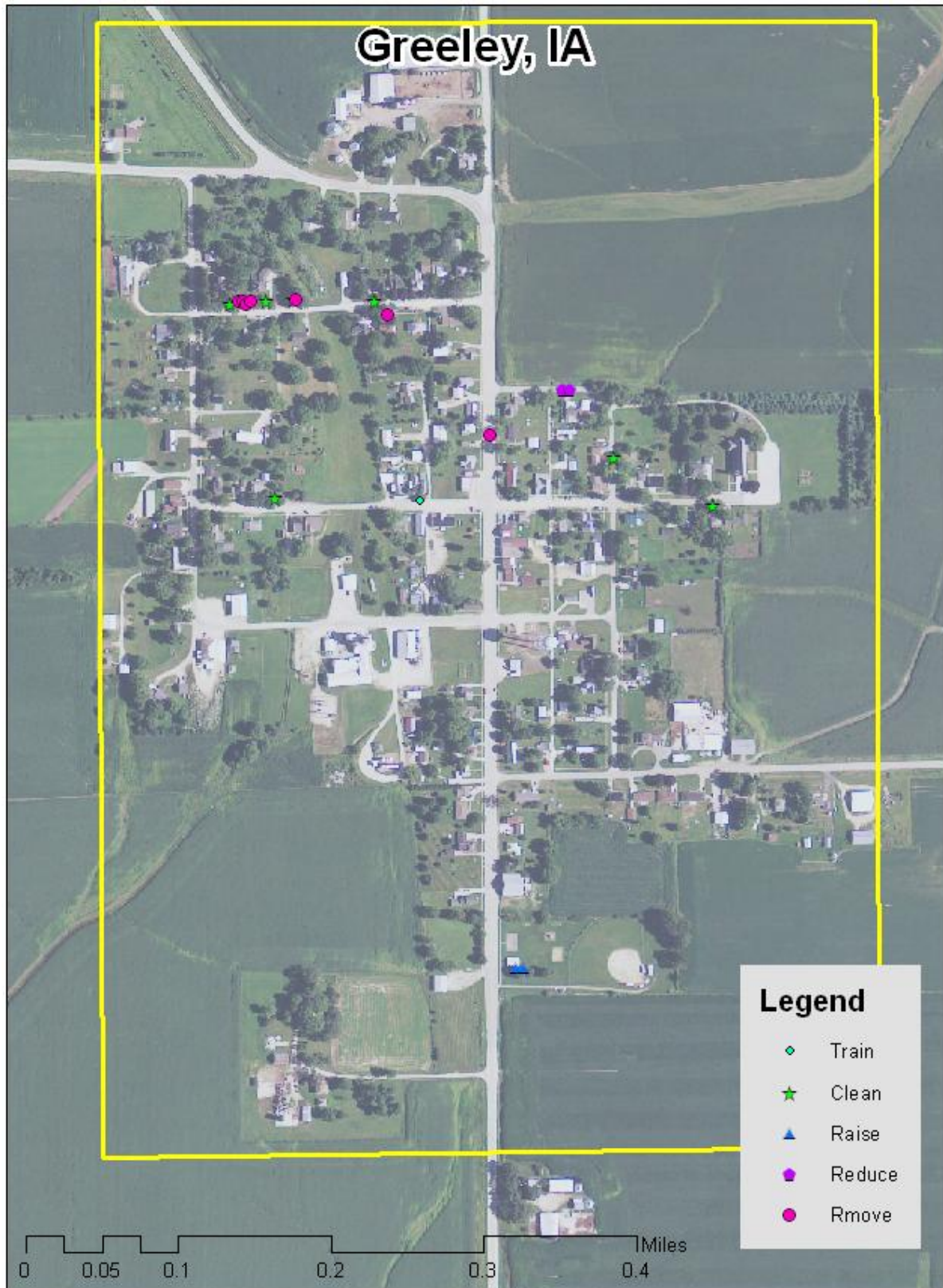


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Greeley's Tree Ordinances

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 the Director at 515-281-5918.