Woolstock, IA

2019 Urban Forest Management Plan
Prepared by Gabriele Edwards
Iowa Department of Natural Resources

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Executive Summary

Overview

This plan was developed to assist the City of Woolstock 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 48% of Woolstock's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. 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 2018, 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 58 trees inventoried.

- Woolstock's trees provide $15,214 of benefits annually, an average of $262 a tree
- There are 15 species of trees
- The top three genera are: Ash 48%, Maple 17%, and Hackberry 8%
- 29% of trees are in need of some type of management
- 3 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 3 trees needing removal, all are over 12 inches in diameter at 4.5 ft and should be addressed in the next few years *City ownership of the trees recommended for removal should be verified prior to any removal*
- 1 of the 28 ash trees should be carefully examined, as it has one or more symptoms that could be related to an EAB infestation
- 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
- In order to cover the cost of ash tree removal, pruning, and planting and maintenance of new trees, it is recommended that the annual budget be increased to $3,175.
- Create a community tree ordinance

Introduction

This plan was developed to assist Woolstock 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 or treatment and replacement planting. With proper planning and management of the current canopy in Woolstock, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2018, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with 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 58 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits
Trees conserve energy by shading buildings and blocking winds. Woolstock's trees reduce energy related costs by approximately $3,789 annually (Appendix A, Table 1). These savings are both in Electricity (18.8 MWh) and in Natural Gas (2,412.1 Therms).

Annual Stormwater Benefits
Woolstock's trees intercept about 227,573 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $6,167 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 Woolstock, it is estimated that trees remove 252.2 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 $713 (Appendix A, Table 3).

Annual Carbon Benefits
Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Woolstock, trees sequester about 41,582 lbs of carbon a year with an associated value of $512 (Appendix A, Table 5). In addition, the trees store 769,304 lbs of carbon, with a yearly benefit of $5,770 (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. Woolstock receives $4,026 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits
According to the USDA Forest Service i-Tree STREETS analysis, Woolstock's trees provide $15,214 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 58 trees in Woolstock provide approximately $262 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Woolstock has 15 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Ash	28	48%
Maple	10	17%
Hackberry	5	8%
Cedar	3	5%
Oak	3	5%
Spruce	3	5%
Pine	2	3%
Locust	1	1%
Apple (Crab)	1	1%
Elm	1	1%
Linden/Basswood	1	1%

Age Class

Most of Woolstock's trees (44%) are between 24 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Woolstock's size curve is on the larger side, indicating an older 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 Woolstock indicate that 100% of the trees are in good health (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 87% of Woolstock'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 5% of the population. This 5% is an estimate of trees that need management follow up.

Management Needs

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

Crown Reduction	14	24%
Tree Removal	3	5%

Canopy Cover

The total canopy with both private and public trees is 13% and 90 acres. The canopy cover included in the Woolstock inventory includes approximately 2.4 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 49 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Woolstock'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.

<u>Land Use</u>

Park/vacant/other	63%
Single family residential	27%
Industrial/Large commercial	6%
Small commercial	1%

<u>Location</u>

Front yard	81%
Planting strip	18%

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.

<u>Hazardous trees</u>

Woolstock has 1 critical concern tree that needs immediate crown reduction. This tree can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). 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 and immediate concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 10 additional trees with these needs.

<u>Poor tree species</u>

After the maintenance 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 3 removals, all are ash trees. There are a total of 28 ash trees, and 1 of those has signs and symptoms that have been associated with EAB. In addition, there is 1 tree that is in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

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

be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

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

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 (17%) (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.

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 decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Emerald Ash Borer Plan

Ash Tree Removal
Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all 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 tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines
EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of 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 trees will be replaced. 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 genera 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 if preventative treatments are not being used.

PROPOSED WORK SCHEDULE AND ESTIMATED COSTS

YEAR 1   **ESTIMATED COSTS**

Prune 1 critical and 6 immediate concern trees $210
Remove 3 ash trees $2,100
Plant 5 trees in open locations $500
Water & Maintenance $250
Inspect ash trees for signs of Emerald Ash Borer

YEAR 2

Remove 3 ash trees $2,100
Plant 5 trees in open locations $500
Water & Maintenance $250
Prune 1/3 of city owned trees (19) $570
Inspect ash trees for signs of Emerald Ash Borer

YEAR 3

Remove 3 ash trees $2,100
Plant 5 trees in open locations $500
Water & Maintenance $250
Inspect ash trees for signs of EAB

YEAR 4

Remove 3 ash trees $2,100
Plant 5 trees in open locations $500
Water & Maintenance $250
Prune 1/3 of city owned trees (19) $570
Inspect ash trees for signs of EAB

YEAR 5

Remove 3 ash trees $2,100
Plant 5 trees in open locations $500
Water & Maintenance $250
Inspect ash trees for signs of EAB

YEAR 6

Remove 3 ash trees $2,100
Plant 5 trees in open locations $500

Water & Maintenance	$250
Prune 1/3 of city owned trees (20)	$600

Average annual budget: $3,175

Estimated costs based on average costs of $700/tree for removal, $100/tree for planting, $50/tree for water and maintenance, and $30/tree for pruning.

This plan removes 18 ash trees, or 64% of all ash trees in the city.

Purposed Budget Increase

EAB could potentially kill all ash trees in Woolstock within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $7,375 a year. Additionally, it is recommended that Woolstock 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.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Woolstock would still need to find $14,000 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $9,100 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Woolstock. It is suggested to consider increasing the budget to plan for this.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

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, DJ and JF 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

Woolstock

Annual Energy Benefits of Public Trees

1/25/2019

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
White ash	8.6	656	1,049.7	1,029	1,684	(N/A)	37.9	44.4	76.56
Silver maple	2.4	179	298.0	292	471	(N/A)	12.1	12.4	67.31
Green ash	2.1	163	289.2	283	446	(N/A)	10.3	11.8	74.37
Northern hackberry	1.7	132	247.1	242	375	(N/A)	8.6	9.9	74.92
Eastern red cedar	0.3	25	49.3	48	74	(N/A)	5.2	1.9	24.57
Northern red oak	0.7	52	97.6	96	148	(N/A)	5.2	3.9	49.26
Norway spruce	0.3	25	44.3	43	69	(N/A)	3.4	1.8	34.32
Sugar maple	0.7	52	94.2	92	145	(N/A)	3.4	3.8	72.36
Eastern white pine	0.2	16	28.6	28	44	(N/A)	3.4	1.2	21.89
Honeylocust	0.4	28	47.4	46	74	(N/A)	1.7	2.0	74.28
Blue spruce	0.0	2	4.9	5	7	(N/A)	1.7	0.2	6.94
Apple	0.2	14	24.7	24	38	(N/A)	1.7	1.0	38.13
American elm	0.6	45	71.2	70	114	(N/A)	1.7	3.0	114.45
American basswood	0.2	18	36.4	36	54	(N/A)	1.7	1.4	53.99
Norway maple	0.2	18	29.5	29	47	(N/A)	1.7	1.2	46.78
Total	18.8	1,426	2,412.1	2,364	3,789	(N/A)	100.0	100.0	65.34

Table 2: Annual Stormwater Benefits

Woolstock

Annual Stormwater Benefits of Public Trees

1/25/2019

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
White ash	104,551	2,833	(N/A)	37.9	45.9	128.79
Silver maple	31,944	866	(N/A)	12.1	14.0	123.67
Green ash	27,767	752	(N/A)	10.3	12.2	125.41
Northern hackberry	16,082	436	(N/A)	8.6	7.1	87.16
Eastern red cedar	4,904	133	(N/A)	5.2	2.2	44.30
Northern red oak	7,108	193	(N/A)	5.2	3.1	64.21
Norway spruce	7,574	205	(N/A)	3.4	3.3	102.63
Sugar maple	9,126	247	(N/A)	3.4	4.0	123.65
Eastern white pine	4,817	131	(N/A)	3.4	2.1	65.28
Honeylocust	4,685	127	(N/A)	1.7	2.1	126.96
Blue spruce	256	7	(N/A)	1.7	0.1	6.95
Apple	667	18	(N/A)	1.7	0.3	18.06
American elm	4,551	123	(N/A)	1.7	2.0	123.33
American basswood	2,133	58	(N/A)	1.7	0.9	57.80
Norway maple	1,409	38	(N/A)	1.7	0.6	38.19
Citywide total	227,573	6,167	(N/A)	100.0	100.0	106.33

Table 3: Annual Air Quality Benefits

Woolstock

Annual Air Quality Benefits of Public Trees

1/25/2019

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							
White ash	20.2	3.2	9.1	0.9	106	40.0	5.9	5.7	39.1	252	0.0	0	124.2	358 (N/A)	37.9	16.29
Silver maple	5.3	0.9	2.6	0.2	29	11.0	1.6	1.5	10.7	69	-2.7	-10	31.3	88 (N/A)	12.1	12.56
Green ash	4.3	0.7	2.0	0.2	23	10.2	1.5	1.4	9.7	64	0.0	0	30.0	86 (N/A)	10.3	14.41
Northern hackberry	2.4	0.4	1.2	0.1	13	8.4	1.2	1.2	7.9	52	0.0	0	22.9	65 (N/A)	8.6	13.09
Eastern red cedar	1.0	0.2	0.8	0.1	7	1.6	0.2	0.2	1.5	10	-2.7	-10	3.1	7 (N/A)	5.2	2.19
Northern red oak	1.5	0.3	0.7	0.1	8	3.3	0.5	0.5	3.1	21	-2.1	-8	7.8	21 (N/A)	5.2	6.88
Norway spruce	0.9	0.2	0.7	0.1	6	1.6	0.2	0.2	1.5	10	-4.2	-16	1.2	0 (N/A)	3.4	-0.06
Sugar maple	1.3	0.2	0.6	0.1	7	3.3	0.5	0.5	3.1	21	-1.0	-4	8.6	24 (N/A)	3.4	11.86
Eastern white pine	0.6	0.1	0.5	0.1	4	1.0	0.1	0.1	0.9	6	-2.9	-11	0.5	-1 (N/A)	3.4	-0.51
Honeylocust	0.9	0.2	0.4	0.0	5	1.7	0.3	0.2	1.7	11	-0.8	-3	4.7	13 (N/A)	1.7	12.87
Blue spruce	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.3	1 (N/A)	1.7	0.75
Apple	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	1.7	6.56
American elm	2.2	0.4	1.0	0.1	12	2.7	0.4	0.4	2.7	17	0.0	0	9.9	29 (N/A)	1.7	28.89
American basswood	0.2	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	7	-0.2	-1	2.8	8 (N/A)	1.7	7.78
Norway maple	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	1.7	7.92
Citywide total	41.5	6.9	20.1	2.1	223	88.2	12.9	12.4	85.1	553	-16.8	-63	252.2	713 (N/A)	100.0	12.29

Table 4: Annual Carbon Stored

Woolstock

Stored CO2 Benefits of Public Trees

1/25/2019

Species	Total Stored CO_2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
White ash	316,328	2,372	(N/A)	37.9	41.1	107.84
Silver maple	112,752	846	(N/A)	12.1	14.7	120.81
Green ash	145,941	1,095	(N/A)	10.3	19.0	182.43
Northern hackberry	35,423	266	(N/A)	8.6	4.6	53.14
Eastern red cedar	3,306	25	(N/A)	5.2	0.4	8.27
Northern red oak	31,675	238	(N/A)	5.2	4.1	79.19
Norway spruce	10,833	81	(N/A)	3.4	1.4	40.62
Sugar maple	37,086	278	(N/A)	3.4	4.8	139.07
Eastern white pine	7,528	56	(N/A)	3.4	1.0	28.23
Honeylocust	12,245	92	(N/A)	1.7	1.6	91.84
Blue spruce	43	0	(N/A)	1.7	0.0	0.32
Apple	3,037	23	(N/A)	1.7	0.4	22.78
American elm	41,265	309	(N/A)	1.7	5.4	309.48
American basswood	8,218	62	(N/A)	1.7	1.1	61.63
Norway maple	3,624	27	(N/A)	1.7	0.5	27.18
Citywide total	769,304	5,770	(N/A)	100.0	100.0	99.48

Table 5: Annual Carbon Sequestered

Woolstock

Annual CO₂ Benefits of Public Trees

1/25/2019

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
White ash	20,608	155	-1,518	-73	-12	14,489	109	33,506	251 (N/A)	37.9	48.4	11.42
Silver maple	9,010	68	-541	-25	-4	3,958	30	12,402	93 (N/A)	12.1	17.9	13.29
Green ash	4,463	33	-701	-23	-5	3,597	27	7,336	55 (N/A)	10.3	10.6	9.17
Northern hackberry	2,169	16	-170	-16	-1	2,926	22	4,909	37 (N/A)	8.6	7.1	7.36
Eastern red cedar	0	0	-16	-6	0	561	4	539	4 (N/A)	5.2	0.8	1.35
Northern red oak	1,134	9	-152	-9	-1	1,152	9	2,125	16 (N/A)	5.2	3.1	5.31
Norway spruce	187	1	-52	-8	0	557	4	685	5 (N/A)	3.4	1.0	2.57
Sugar maple	1,752	13	-178	-8	-1	1,158	9	2,724	20 (N/A)	3.4	3.9	10.22
Eastern white pine	274	2	-36	-4	0	349	3	583	4 (N/A)	3.4	0.8	2.18
Honeylocust	0	0	-59	-3	0	615	5	553	4 (N/A)	1.7	0.8	4.15
Blue spruce	12	0	0	-1	0	48	0	60	0 (N/A)	1.7	0.1	0.45
Apple	268	2	-15	-2	0	308	2	560	4 (N/A)	1.7	0.8	4.20
American elm	724	5	-198	-6	-2	987	7	1,507	11 (N/A)	1.7	2.2	11.31
American basswood	597	4	-39	-3	0	405	3	960	7 (N/A)	1.7	1.4	7.20
Norway maple	386	3	-17	-2	0	395	3	762	6 (N/A)	1.7	1.1	5.71
Citywide total	41,582	312	-3,693	-187	-29	31,507	236	69,209	519 (N/A)	100.0	100.0	8.95

Table 6: Annual Social and Aesthetic Benefits

Woolstock

Annual Aesthetic/Other Benefits of Public Trees

1/25/2019

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
White ash	2,158	(N/A)	37.9	53.6	98.09
Silver maple	711	(N/A)	12.1	17.7	101.54
Green ash	332	(N/A)	10.3	8.2	55.32
Northern hackberry	292	(N/A)	8.6	7.2	58.32
Eastern red cedar	0	(N/A)	5.2	0.0	0.00
Northern red oak	79	(N/A)	5.2	2.0	26.26
Norway spruce	47	(N/A)	3.4	1.2	23.54
Sugar maple	173	(N/A)	3.4	4.3	86.73
Eastern white pine	33	(N/A)	3.4	0.8	16.54
Honeylocust	0	(N/A)	1.7	0.0	0.00
Blue spruce	12	(N/A)	1.7	0.3	12.31
Apple	15	(N/A)	1.7	0.4	15.48
American elm	87	(N/A)	1.7	2.2	86.69
American basswood	48	(N/A)	1.7	1.2	47.53
Norway maple	39	(N/A)	1.7	1.0	39.16
Citywide total	4,026	(N/A)	100.0	100.0	69.41

Table 7: Summary of Benefits in Dollars

Woolstock

Total Annual Benefits of Public Trees by Species ($)

1/25/2019

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
White ash	1,684	251	358	2,833	2,158	7,285	(N/A)	47.9
Silver maple	471	93	88	866	711	2,229	(N/A)	14.6
Green ash	446	55	86	752	332	1,672	(N/A)	11.0
Northern hackberry	375	37	65	436	292	1,204	(N/A)	7.9
Eastern red cedar	74	4	7	133	0	217	(N/A)	1.4
Northern red oak	148	16	21	193	79	456	(N/A)	3.0
Norway spruce	69	5	0	205	47	326	(N/A)	2.1
Sugar maple	145	20	24	247	173	610	(N/A)	4.0
Eastern white pine	44	4	-1	131	33	211	(N/A)	1.4
Honeylocust	74	4	13	127	0	218	(N/A)	1.4
Blue spruce	7	0	1	7	12	27	(N/A)	0.2
Apple	38	4	7	18	15	82	(N/A)	0.5
American elm	114	11	29	123	87	365	(N/A)	2.4
American basswood	54	7	8	58	48	174	(N/A)	1.1
Norway maple	47	6	8	38	39	138	(N/A)	0.9
Citywide Total	3,789	519	713	6,167	4,026	15,214	(N/A)	100.0
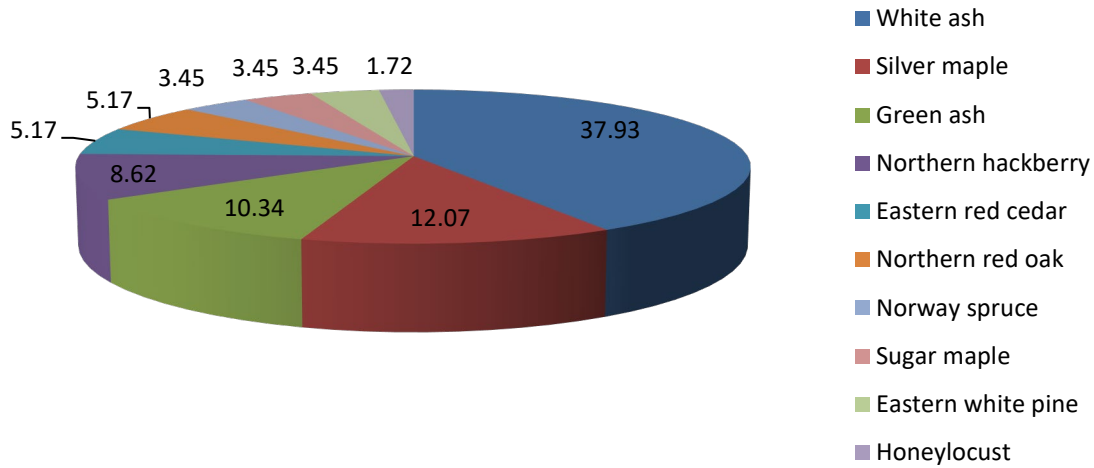
Figure 1: Species Distribution

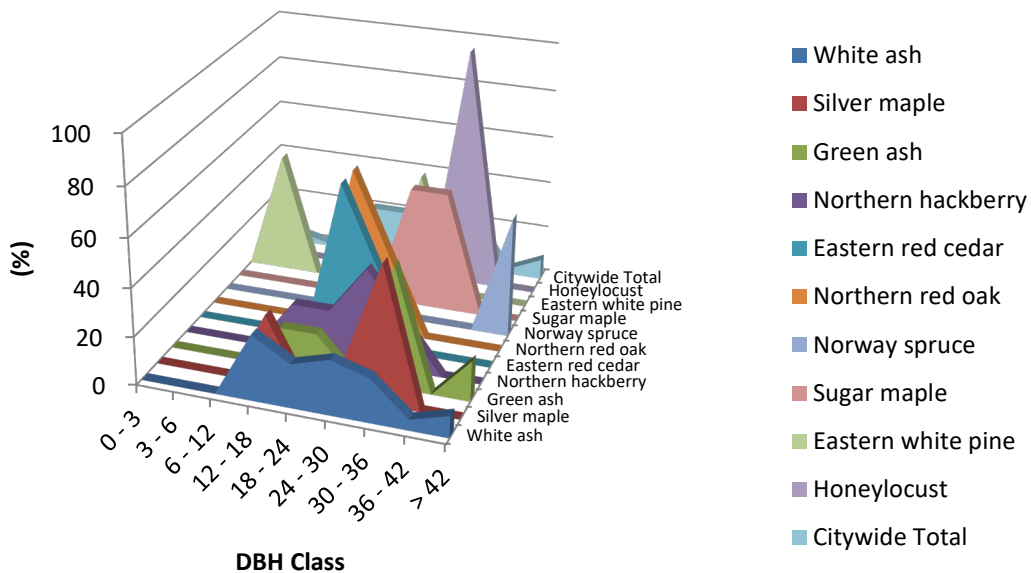## Relative Age Distribution of Top 10 Public Tree Species (%)
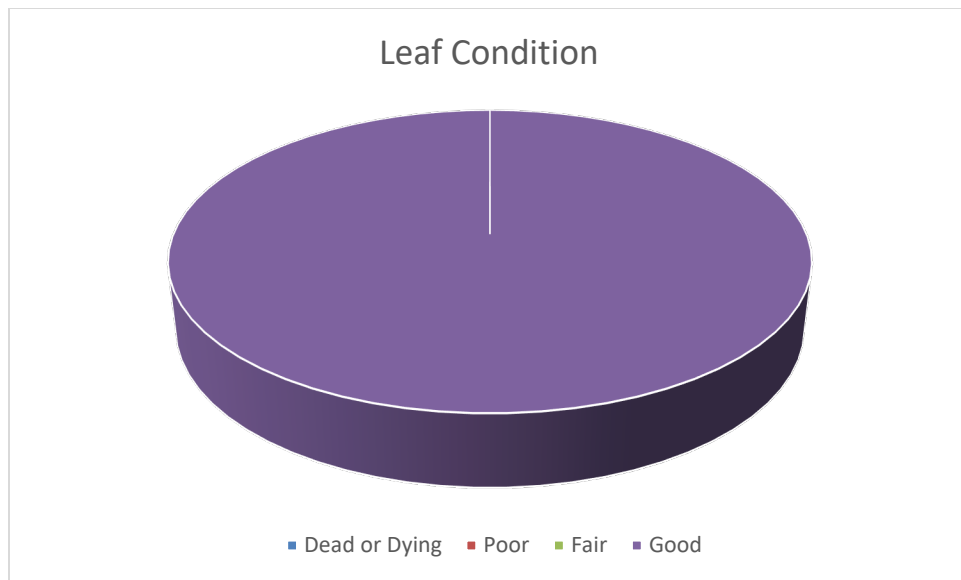

Figure 2: Relative Age Class
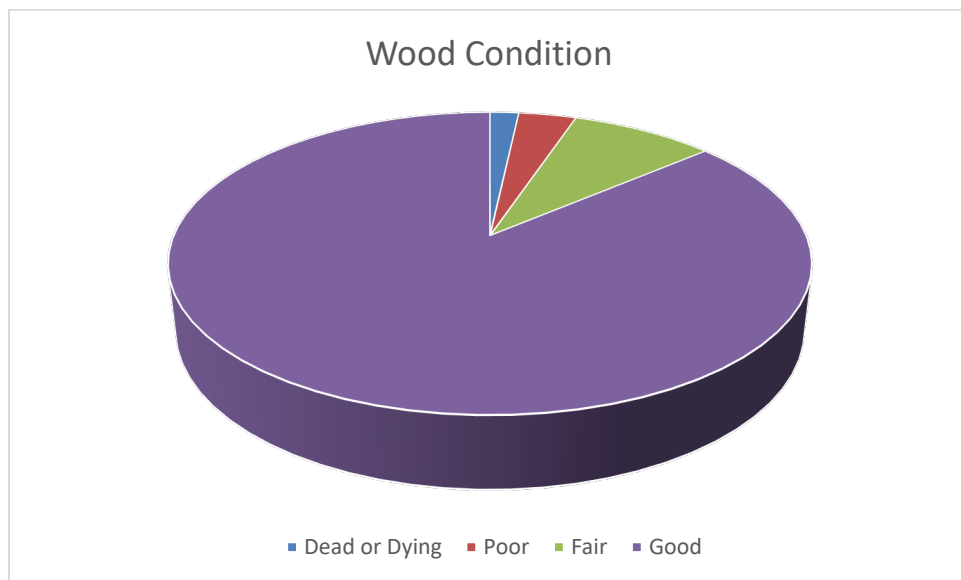
Figure 3: Foliage Condition

Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

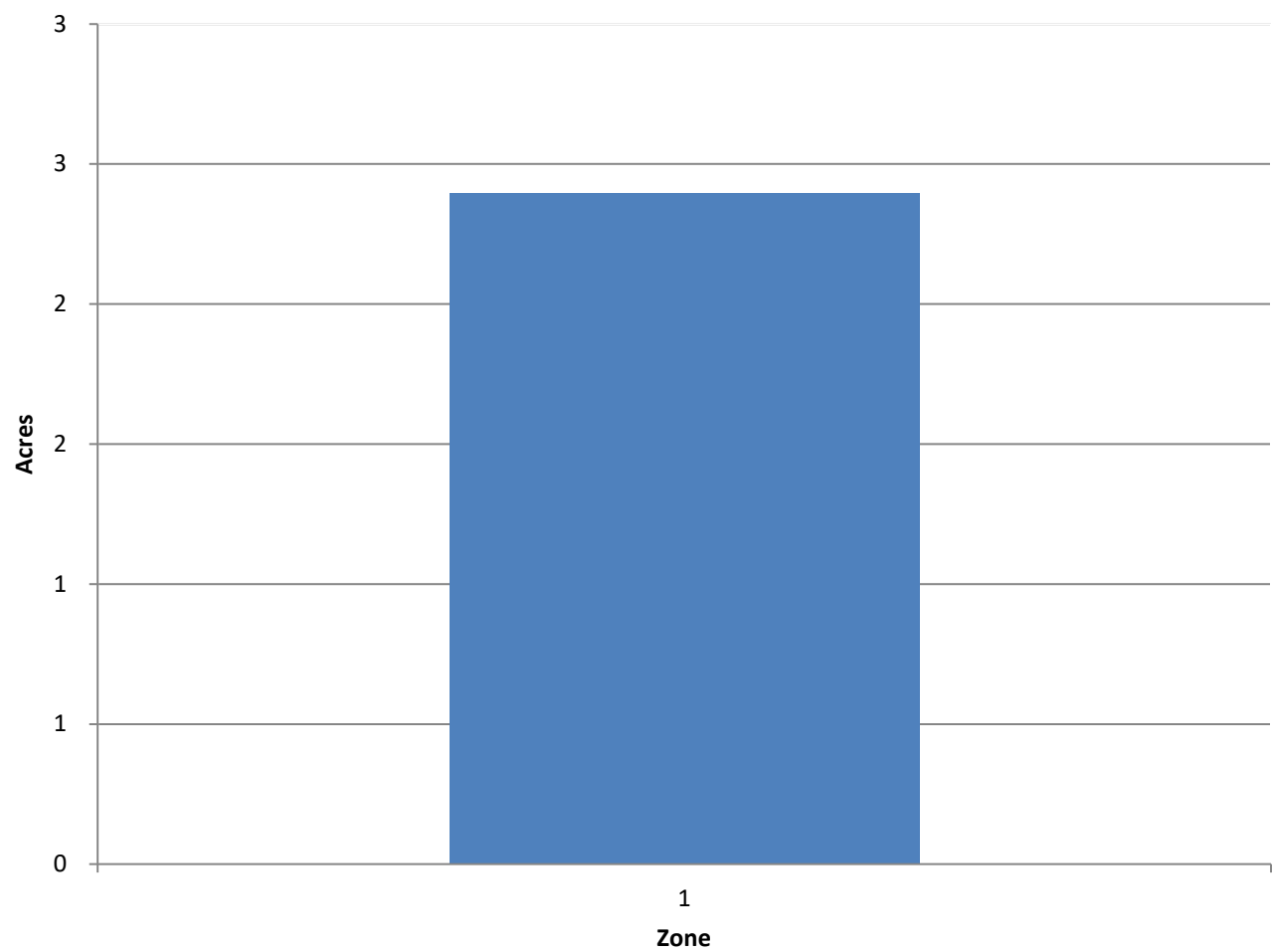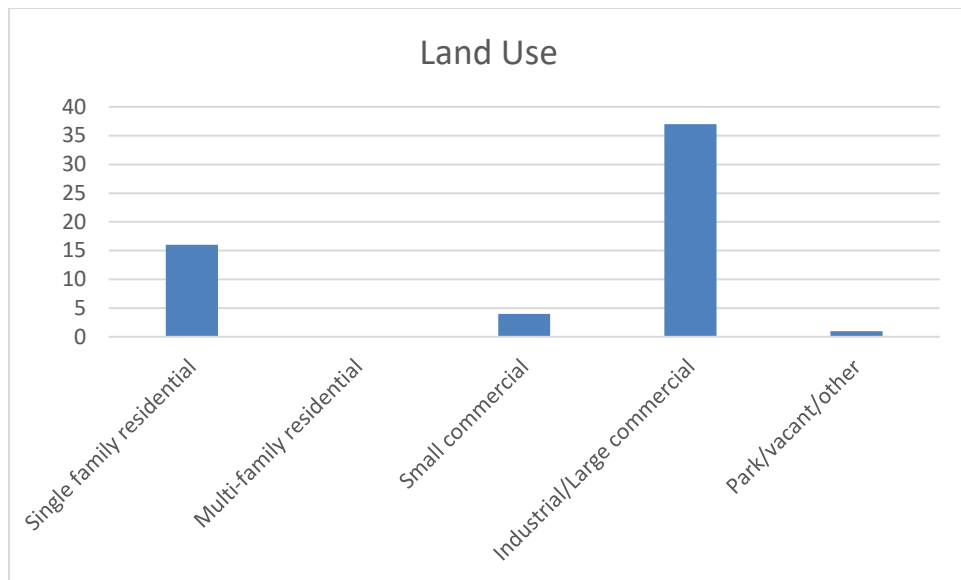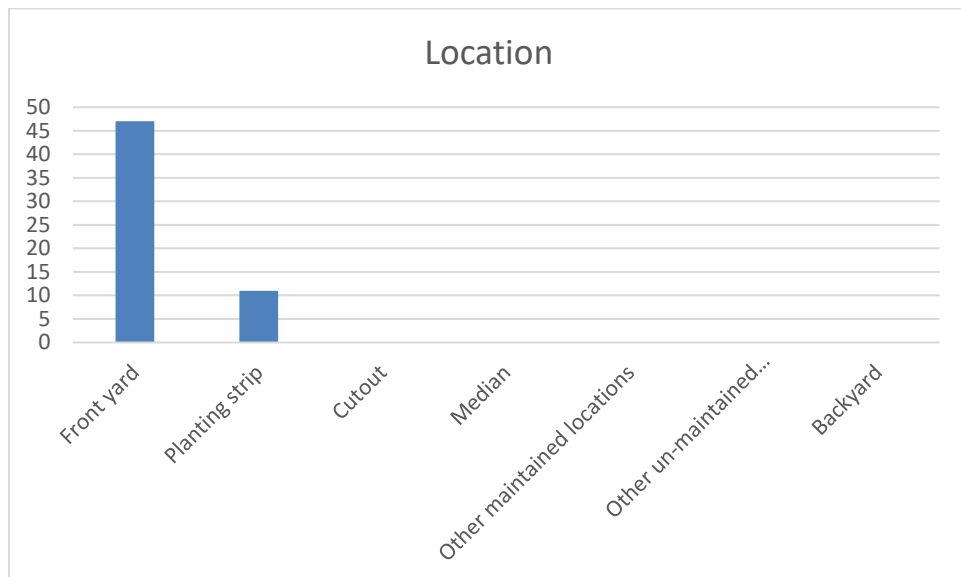**Figure 5: Canopy Cover in Acres**

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

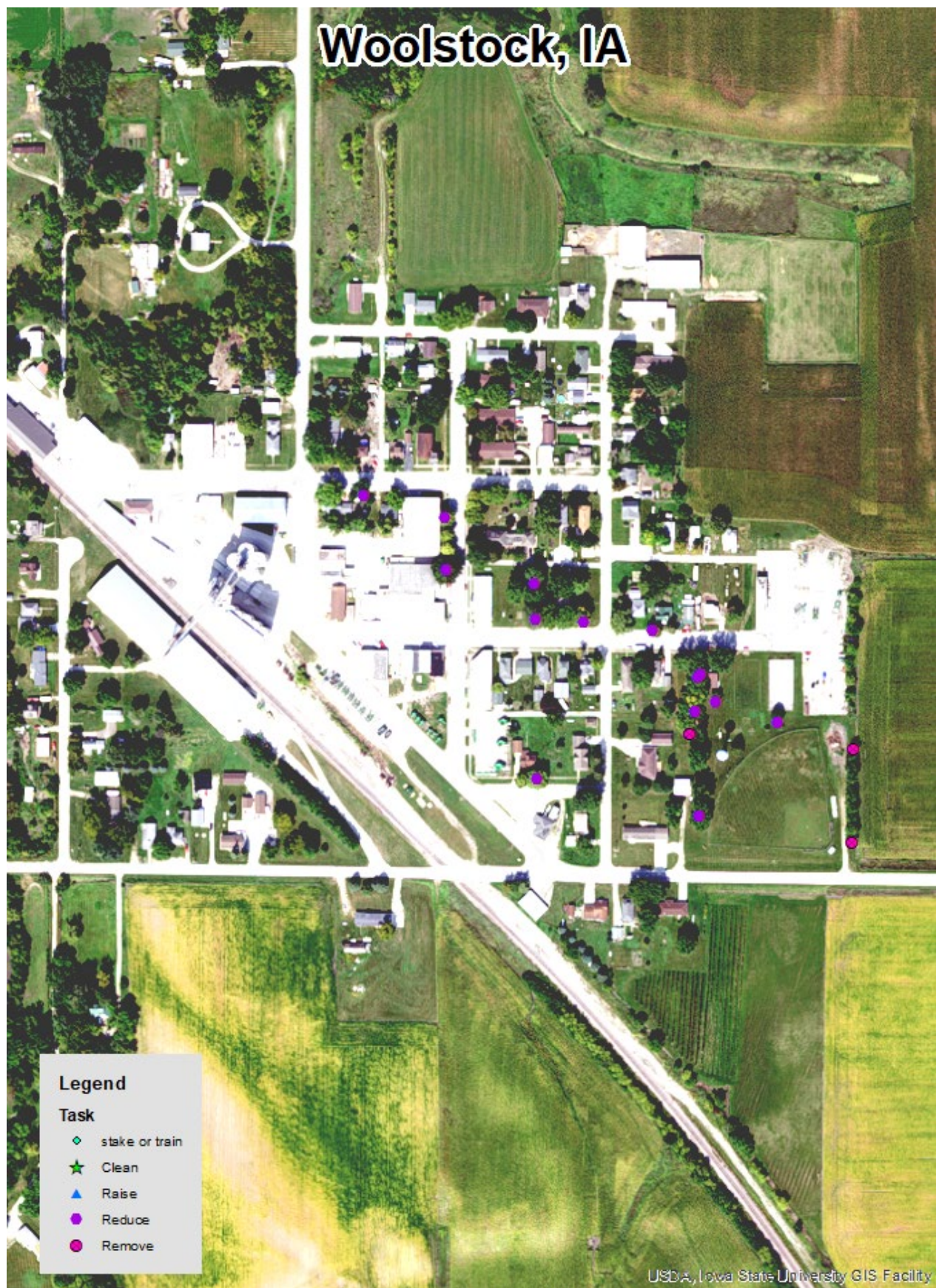**Figure 4: Location of Trees with Recommended Maintenance**

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

Appendix C: Woolstock Tree Ordinances

None

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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 515-725-8200.