Fairfax, IA

Urban Forestry Management Plan

SUMMER 2021

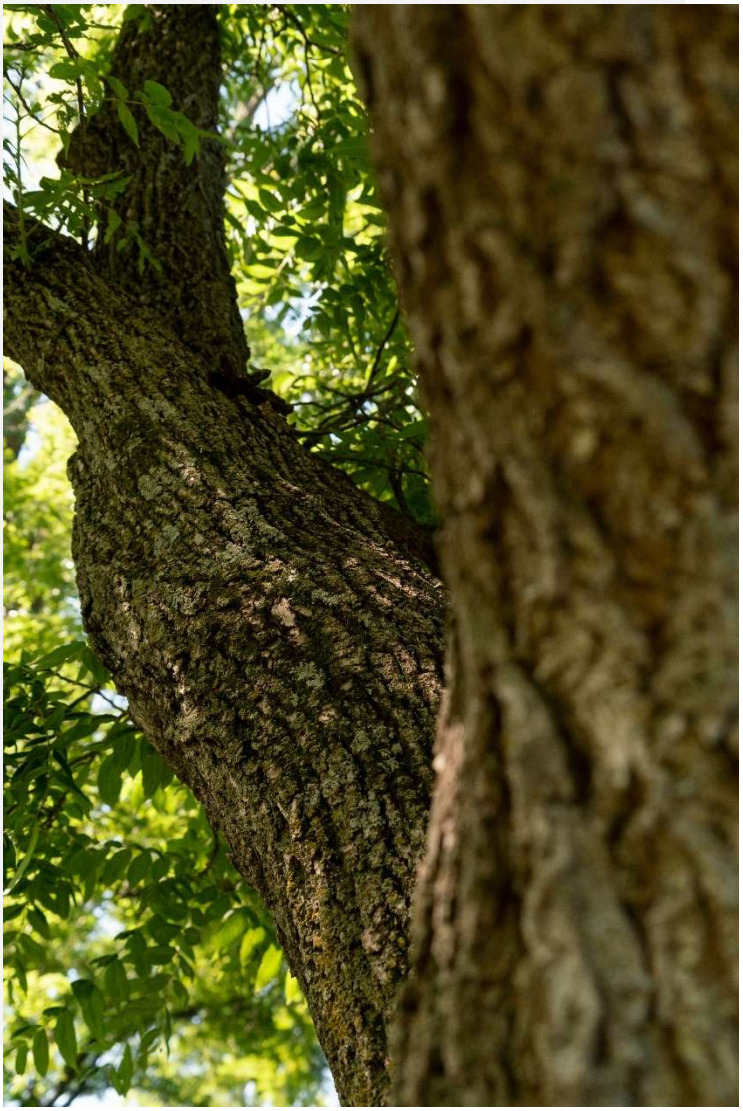
JEO CONSULTING GROUP

Table of Contents

Table of Contents

Table of Contents

Executive Summary



EXECUTIVE SUMMARY

Overview

This plan was developed to assist the City of Fairfax in managing its urban forest, including budgeting and future planning. Trees bring numerous benefits to a community, and sound management helps leaders take advantage of these benefits. Management is especially important now considering the serious threats posed by forest pests like 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 except mountain ash. There is a strong possibility that 8% of Fairfax's city-owned trees will die once EAB becomes established in the community, unless local leaders begin preventative treatment. 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 2021, JEO conducted a tree inventory 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 644 trees inventoried.

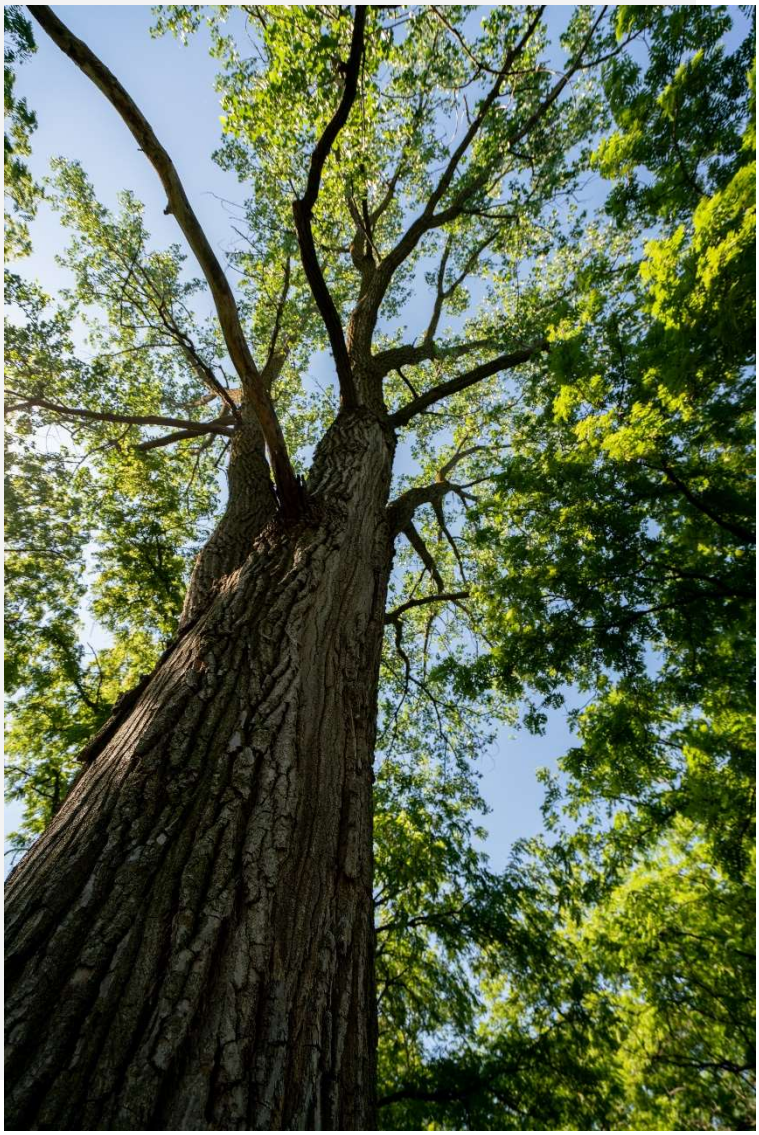
- Fairfax's trees provide $46,241 of benefits annually, an average of $72 per tree
- There are over 47 species of trees
- The top three genera are: Maple 31%, Apple 19%, and Oak 10%
- 46% of trees need some type of management
- 27 trees should be removed

Recommendations

We detail our core recommendations in the Recommendations Section. In the Emerald Ash Borer Plan, we include management recommendations. Below are some key recommendations.

- Out of the 27 trees needing removal, 5 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately. *City ownership of the trees recommended for removal should be verified prior to any removal*
- 29 of the 49 ash trees should be carefully examined, as they have 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 yearly with a visual survey.
- With the current budget, Fairfax should be able to remove all ash within five years. However, with the loss of trees due to EAB as well as the 2020 Derecho, we suggest that city officials request a budget increase to at least $11,500 annually and apply for grants to plant replacement trees.

Introduction



INTRODUCTION

This plan was developed to assist Fairfax with managing, budgeting, and future planning of their urban forest. Across the state, forestry budgets continue to decrease as a higher percentage of the budgets are devoted to 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, treatment, and replacement planting. With proper planning and management of the current canopy in Fairfax, these costs can be spread out over the years and public safety issues from dead and dying ash trees can be mitigated.

Trees are an important part of Fairfax's infrastructure and one of the city's greatest assets. The benefits of trees are immense. Trees improve air quality, intercept stormwater runoff, conserve energy, lower traffic speeds, increase property values, reduce crime, improve mental health, and create a desirable place to live, to name just a few. Good urban forestry management will maintain these important benefits for the people of Fairfax and future generations.

Urban forestry management sets goals and develops management strategies to achieve them. To develop management strategies, a comprehensive public tree inventory must be conducted. The inventory informs maintenance, removal schedules, tree planting, and budgeting. Aligning management actions with the tree inventory results will help meet Fairfax's urban forestry goals.

Assist Fairfax with Managing its Urban Forest

Inform on the Benefits of a Healthy Urban Forest

Establish Preventative Treatment for Emerald Ash Borer

Develop Efficient City Tree Management Techniques

Mitigate Public Safety Issues

Findings

INVENTORY

In 2021, JEO conducted a tree inventory that included 100% of the city-owned trees on both streets and parks. The team collected tree data 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 data collectors' programming 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, for all ash trees, the team notes signs and symptoms associated with EAB including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and woodpecker damage.

INVENTORY RESULTS

JEO entered the data collected for the 644 city trees into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Following are results from the i-Tree STREETS analysis.

ANNUAL BENEFITS

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Fairfax's trees reduce energy-related costs by approximately $13,775 annually (Appendix A, Table 1). These savings are both in electricity (64.7 MWh) and in natural gas (9,048.5 Therms).

Annual Stormwater Benefits

Fairfax's trees intercept about 465,547 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $12,616 in benefit 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 lessens emissions of volatile organic matter (ozone). In Fairfax, it is estimated that trees remove 761.8 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 $2,127 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Fairfax, trees sequester about 127,716 lbs of carbon per year with an associated value of $958 (Appendix A, Table 5). In addition, the trees store 1,159,090 lbs of carbon, with a yearly benefit of $8,693 (Appendix A, Table 4).

Annual Aesthetics Benefits

The social benefits of trees are hard to capture. The i-Tree 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. Fairfax receives $16,027 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, Fairfax's trees provide $46,269 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 644 trees in Fairfax provide approximately $71.85 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$13,775**	• Intercept **465,547 gallons** • Provides **$12,616** benefit	• Remove **761.8 lbs** of pollution • Net value of **$2,127**	• Sequester **127,716 lbs** • Value of **$958** • Store **1,159,090 lbs** • Value of **$8,693**	• **$16,027** in social benefits	• **$46,269** annual benefits • Each tree provides **$71.85** annually

FOREST STRUCTURE

Species Distribution

Fairfax has over 47 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	200	31%
Apple	122	19%
Oak	63	10%
Ash	49	8%
Locust	32	5%
Pear	29	5%
Spruce	21	3%
Other Evergreen	18	3%
Eastern hophornbeam	15	2%
Birch	14	2%
Hackberry	14	2%
Basswood/Linden	10	2%
Elm	10	2%
Cedar	9	1%
Coffee Tree	6	<1%
Lilac	4	<1%
Pine	4	<1%
Other Deciduous	3	<1%
Catalpa	2	<1%
Ginkgo	2	<1%
Mulberry	2	<1%
Redbud	2	<1%
Sycamore	2	<1%
Tulip Tree	2	<1%
Willow	2	<1%
Cherry	1	<1%
Cottonwood	1	<1%
Magnolia	1	<1%
Poplar	1	<1%

Age Class

Most of Fairfax's trees (63%) are between 3 and 12 inches in diameter at 4.5 ft (Appendix A, Figure 2).

To prepare for natural mortality and to maintain canopy cover, most trees should be in the smallest size category (a downward slope), indicating youth. Fairfax's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Fairfax indicate that 54% of the trees are in good health, with only 7% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 56% of Fairfax's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Eight percent of the tree population's wood condition is in poor health, dead, or dying. This 8% is an estimate of trees that need management follow up.

Management Needs

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

Action	Number of Trees	Percentage
Crown Cleaning	194	30%
Crown Reduction	1	0%
Tree Removal	27	4%
Crown Raising	59	9%
Tree Staking	8	1%

Canopy Cover

The total canopy with both private and public trees is 126 acres or 10% cover. The canopy cover included in the Fairfax inventory includes approximately 6 acres (Appendix A, Figure 4). The city's canopy goal is to increase canopy by 20% in 30 years. To achieve this goal it is estimated that 30 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Fairfax'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	Percentage
Single Family Residential	51%
Industrial/Large Commercial	35%
Park/Vacant/Other	12%
Small Commercial	1%
Multifamily Residential	0%

Recommendations

RECOMMENDATIONS

Risk Management

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

HAZARDOUS TREES

Fairfax has 27 trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter, critical concern trees first. There are 5 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Six-Year Maintenance Plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 295 trees with maintenance needs.

POOR TREE SPECIES

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 27 removals, 8 are ash trees. There are a total of 49 ash trees, and 29 of those have signs and symptoms that have been associated with EAB. *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 removes lower branches that are two inches in diameter or larger to provide clearance for pedestrians or vehicles. Crown reduction removes individual limbs from structures or utility wires. We recommend 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 five years will replace the trees that are removed. We recommend planting 1.2 trees for every tree removed, since survival rates will not be 100%. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Fairfax.

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 (31%) (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: Black Walnut, Boxelder, Catalpa, Chinese Elm, Cottonwood, Evergreens, Fruit and Nut bearing over one (1) inch, Mulberry, Pin Oak, Poplar, Siberian Elm, Silver Maple, Tree of Heaven, Willow and Magnolia as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. We recommend 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 by first removing dead, dying, hazardous trees (Appendix B, Figure 4). Next will be all ash in poor condition that display EAB signs and symptoms (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 an effective tool for communities to spread removal costs out over several years while allowing trees to continue providing 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 normally disposed of if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include: Black Walnut, Boxelder, Catalpa, Chinese Elm, Cottonwood, Evergreens, Fruit and Nut bearing over one (1) inch, Mulberry, Pin Oak, Poplar, Siberian Elm, Silver Maple, Tree of Heaven, Willow and Magnolia

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.

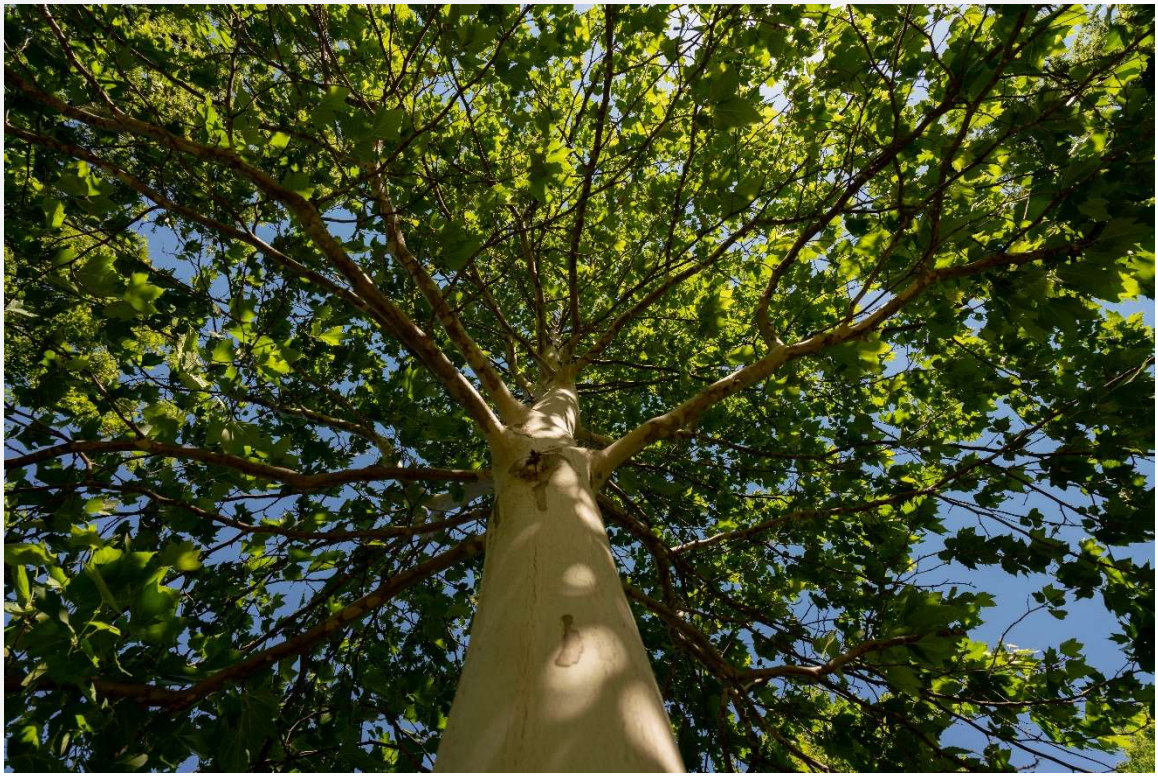
Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for EAB signs and symptoms including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and woodpecker 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. City Code 151.06 states that if it is determined with reasonable certainty that any such condition (dead, diseased, or damaged trees) exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

Schedule & Budget



PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $10,250/Year – (Based off Reported Yearly Tree Budget)

YEAR 1	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,110**

YEAR 2	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,110**

YEAR 3	Est. Cost
Remove 10 trees recommended for immediate removal (or ash)	$7,000
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,110**

YEAR 4	Est. Cost
Remove 10 trees recommended for immediate removal (or ash)	$7,000
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,110**

YEAR 5	Est. Cost
Remove 10 trees recommended for immediate removal (or ash)	$7,000
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,110**

YEAR 6	Est. Cost
Remove 10 trees recommended for immediate removal (or ash)	$7,000
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,110**

Estimated costs based on average costs of $700/tree for removal, $150/tree for planting and maintenance, and $15/tree for pruning.

***To remove all ash trees within 6 years alone, the budget would need to be more than $5,750 annually. If the budget were increased to $11,500 a year all ash could be removed in 3 years.*

PROPOSED WORK SCHEDULE WITH INCREASED BUDGET

Budget Allowance of $11,500/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	Est. Cost
Remove 11 trees recommended for immediate removal	$7,700
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,810**

YEAR 2	Est. Cost
Remove 11 trees recommended for immediate removal	$7,700
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,810**

YEAR 3	Est. Cost
Remove 11 trees recommended for immediate removal (or ash)	$7,700
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,810**

YEAR 4	Est. Cost
Remove 11 trees recommended for immediate removal (or ash)	$7,700
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,810**

YEAR 5	Est. Cost
Remove 11 trees recommended for immediate removal (or ash)	$7,700
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,810**

YEAR 6	Est. Cost
Remove 11 trees recommended for immediate removal (or ash)	$7,700
Plant 10 trees in open locations	$1,500
Prune 1/6 of city owned trees	$1,610
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,810**

Proposed Budget Increase

EAB could potentially kill all ash trees in Fairfax within four years of its arrival. To remove all ash trees within six years, the budget would need to be about $5,750, but to remove them in three years, the budget could be raised to $11,500. Additionally, we recommend that Fairfax 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 considered by many communities is treating 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 removal 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). Four trees would be selected for treatment, and Fairfax would still need to find $31,500 for removal. Alternatively, if there are 8 treatable trees, it would cost approximately $2,400 a year for treatment and leave $28,700 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 Fairfax. We suggest considering an increased 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

Appendices

APPENDIX A: i-TREE DATA

Table 1: Annual Energy Benefits

Fairfax

Annual Energy Benefits of All Trees

4/7/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	8.2	625	1,229.8	1,205	1,830	(N/A)	18.9	13.3	15.00
Red maple	7.3	551	1,028.3	1,008	1,559	(N/A)	15.5	11.3	15.59
Silver maple	7.0	528	920.5	902	1,431	(N/A)	6.5	10.4	34.06
Swamp white oak	1.7	128	272.3	267	395	(N/A)	6.1	2.9	10.12
Norway maple	2.3	174	336.7	330	504	(N/A)	5.6	3.7	14.01
Green ash	8.0	608	1,033.1	1,012	1,621	(N/A)	5.3	11.8	47.67
Honeylocust	6.4	487	835.5	819	1,306	(N/A)	5.0	9.5	40.80
Callery pear	3.0	230	445.3	436	666	(N/A)	4.5	4.8	22.98
Northern red oak	1.6	119	219.9	216	334	(N/A)	2.6	2.4	19.65
White ash	3.9	295	494.4	485	780	(N/A)	2.3	5.7	51.99
Sugar maple	1.5	115	211.5	207	322	(N/A)	2.3	2.3	21.48
Eastern hophornbeam	0.6	49	111.2	109	158	(N/A)	2.3	1.1	10.52
River birch	2.6	199	377.4	370	569	(N/A)	2.2	4.1	40.62
Northern hackberry	1.4	103	218.1	214	317	(N/A)	2.2	2.3	22.61
Conifer Evergreen Small	0.2	13	28.4	28	41	(N/A)	1.6	0.3	4.09
Conifer Evergreen Medium	0.5	41	86.4	85	125	(N/A)	1.4	0.9	13.93
Northern white cedar	1.2	88	141.6	139	227	(N/A)	1.4	1.6	25.23
Littleleaf linden	1.3	95	177.4	174	269	(N/A)	1.4	2.0	29.92
Black spruce	0.6	48	96.8	95	143	(N/A)	1.4	1.0	15.88
Kentucky coffeetree	0.2	13	22.1	22	35	(N/A)	0.9	0.3	5.82
Norway spruce	0.1	11	25.0	24	36	(N/A)	0.9	0.3	5.92
Northern pin oak	0.6	44	88.1	86	130	(N/A)	0.8	0.9	25.97
Amur maple	0.2	12	28.0	27	40	(N/A)	0.8	0.3	7.96
Spruce	0.0	3	6.6	7	9	(N/A)	0.8	0.1	1.86
Japanese tree lilac	0.1	11	24.2	24	34	(N/A)	0.6	0.2	8.60
Siberian elm	0.8	58	100.7	99	156	(N/A)	0.6	1.1	39.07
Eastern white pine	0.4	32	58.2	57	89	(N/A)	0.6	0.6	22.37
Elm	0.7	52	92.6	91	143	(N/A)	0.6	1.0	35.71
Conifer Evergreen Large	0.1	6	13.5	13	19	(N/A)	0.3	0.1	9.59
Willow	0.1	6	12.4	12	18	(N/A)	0.3	0.1	8.99
Broadleaf Deciduous Mediu	0.0	3	7.0	7	10	(N/A)	0.3	0.1	5.04
Eastern redbud	0.1	7	16.6	16	24	(N/A)	0.3	0.2	11.80
American elm	0.1	8	13.6	13	21	(N/A)	0.3	0.2	10.48
Ginkgo	0.0	0	0.8	1	1	(N/A)	0.3	0.0	0.57
Mulberry	0.3	21	44.5	44	64	(N/A)	0.3	0.5	32.17
Maple	0.5	41	70.0	69	110	(N/A)	0.3	0.8	54.82
Oak	0.2	14	27.5	27	41	(N/A)	0.3	0.3	20.64
Tulip tree	0.1	9	17.4	17	26	(N/A)	0.3	0.2	13.23
Northern catalpa	0.0	0	0.9	1	1	(N/A)	0.3	0.0	0.66
American sycamore	0.0	0	0.9	1	1	(N/A)	0.3	0.0	0.66
Common chokecherry	0.1	6	12.8	13	18	(N/A)	0.2	0.1	18.19
Cottonwood	0.3	25	46.9	46	71	(N/A)	0.2	0.5	70.91
Southern magnolia	0.0	1	2.8	3	4	(N/A)	0.2	0.0	3.94
Broadleaf Deciduous Large	0.1	7	13.7	13	21	(N/A)	0.2	0.1	20.64
American basswood	0.1	7	13.8	14	20	(N/A)	0.2	0.1	20.27
Quaking aspen	0.0	2	3.7	4	6	(N/A)	0.2	0.0	5.82
Blue spruce	0.1	11	19.5	19	30	(N/A)	0.2	0.2	29.65
Total	64.7	4,907	9,048.5	8,868	13,775	(N/A)	100.0	100.0	21.39

Table 2: Annual Stormwater Benefits

Fairfax

Annual Stormwater Benefits of All Trees

4/7/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	28,998	786	(N/A)	18.9	6.2	6.44
Red maple	38,714	1,049	(N/A)	15.5	8.3	10.49
Silver maple	76,953	2,085	(N/A)	6.5	16.5	49.65
Swamp white oak	8,593	233	(N/A)	6.1	1.8	5.97
Norway maple	12,301	333	(N/A)	5.6	2.6	9.26
Green ash	65,309	1,770	(N/A)	5.3	14.0	52.05
Honeylocust	47,241	1,280	(N/A)	5.0	10.1	40.01
Callery pear	16,876	457	(N/A)	4.5	3.6	15.77
Northern red oak	8,723	236	(N/A)	2.6	1.9	13.91
White ash	34,804	943	(N/A)	2.3	7.5	62.88
Sugar maple	9,183	249	(N/A)	2.3	2.0	16.59
Eastern hophornbeam	2,205	60	(N/A)	2.3	0.5	3.98
River birch	19,069	517	(N/A)	2.2	4.1	36.91
Northern hackberry	6,899	187	(N/A)	2.2	1.5	13.35
Conifer Evergreen Small	2,149	58	(N/A)	1.6	0.5	5.82
Conifer Evergreen Medium	6,300	171	(N/A)	1.4	1.4	18.97
Northern white cedar	17,401	472	(N/A)	1.4	3.7	52.40
Littleleaf linden	10,566	286	(N/A)	1.4	2.3	31.81
Black spruce	7,588	206	(N/A)	1.4	1.6	22.85
Kentucky coffeetree	1,030	28	(N/A)	0.9	0.2	4.65
Norway spruce	1,550	42	(N/A)	0.9	0.3	7.00
Northern pin oak	5,111	139	(N/A)	0.8	1.1	27.70
Amur maple	539	15	(N/A)	0.8	0.1	2.92
Spruce	408	11	(N/A)	0.8	0.1	2.21
Japanese tree lilac	470	13	(N/A)	0.6	0.1	3.19
Siberian elm	5,970	162	(N/A)	0.6	1.3	40.45
Eastern white pine	7,334	199	(N/A)	0.6	1.6	49.69
Elm	5,272	143	(N/A)	0.6	1.1	35.72
Conifer Evergreen Large	808	22	(N/A)	0.3	0.2	10.95
Willow	325	9	(N/A)	0.3	0.1	4.41
Broadleaf Deciduous Medium	175	5	(N/A)	0.3	0.0	2.37
Eastern redbud	333	9	(N/A)	0.3	0.1	4.51
American elm	530	14	(N/A)	0.3	0.1	7.18
Ginkgo	14	0	(N/A)	0.3	0.0	0.19
Mulberry	1,439	39	(N/A)	0.3	0.3	19.49
Maple	4,471	121	(N/A)	0.3	1.0	60.58
Oak	1,216	33	(N/A)	0.3	0.3	16.47
Tulip tree	779	21	(N/A)	0.3	0.2	10.56
Northern catalpa	36	1	(N/A)	0.3	0.0	0.48
American sycamore	36	1	(N/A)	0.3	0.0	0.48
Common chokecherry	264	7	(N/A)	0.2	0.1	7.17
Cottonwood	3,943	107	(N/A)	0.2	0.8	106.85
Southern magnolia	56	2	(N/A)	0.2	0.0	1.53
Broadleaf Deciduous Large	608	16	(N/A)	0.2	0.1	16.47
American basswood	474	13	(N/A)	0.2	0.1	12.83
Quaking aspen	172	5	(N/A)	0.2	0.0	4.65
Blue spruce	2,312	63	(N/A)	0.2	0.5	62.66

Annual Stormwater Benefits of All Trees

4/7/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Citywide total	465,547	12,616	(N/A)	100.0	100.0	19.59

Table 3: Annual Air Quality Benefits

Fairfax

Annual Air Quality Benefits of All Trees

4/7/2022

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								
Apple	7.0	1.2	3.6	0.3	38	40.2	5.8	5.5	37.3	248	0.0	0	100.8	286	(N/A)	18.9	2.35
Red maple	5.1	0.9	3.0	0.2	29	34.9	5.1	4.8	32.9	217	-2.1	-8	84.7	238	(N/A)	15.5	2.38
Silver maple	10.2	1.7	5.4	0.5	56	32.9	4.8	4.6	31.5	206	-6.2	-23	85.4	238	(N/A)	6.5	5.68
Swamp white oak	0.7	0.1	0.5	0.0	4	8.4	1.2	1.1	7.6	52	-0.3	-1	19.5	55	(N/A)	6.1	1.41
Norway maple	1.4	0.2	0.9	0.1	8	11.2	1.6	1.5	10.4	69	-0.4	-2	26.9	75	(N/A)	5.6	2.10
Green ash	6.2	1.0	3.3	0.3	34	37.7	5.5	5.3	36.3	236	0.0	0	95.6	270	(N/A)	5.3	7.95
Honeylocust	8.2	1.4	4.0	0.4	44	30.2	4.4	4.2	29.1	189	-5.7	-21	76.1	212	(N/A)	5.0	6.62
Callery pear	1.9	0.3	1.2	0.1	11	14.8	2.1	2.0	13.8	91	-0.6	-2	35.6	100	(N/A)	4.5	3.46
Northern red oak	1.2	0.2	0.7	0.1	7	7.5	1.1	1.0	7.1	47	-1.7	-6	17.2	47	(N/A)	2.6	2.77
White ash	3.7	0.6	1.9	0.2	20	18.2	2.7	2.6	17.6	114	0.0	0	47.5	135	(N/A)	2.3	8.97
Sugar maple	0.7	0.1	0.5	0.0	4	7.2	1.1	1.0	6.9	45	-0.7	-3	16.8	47	(N/A)	2.3	3.12
Eastern hophornbeam	0.3	0.1	0.2	0.0	2	3.3	0.5	0.4	2.9	20	0.0	0	7.7	22	(N/A)	2.3	1.44
River birch	3.2	0.5	1.7	0.1	17	12.7	1.8	1.7	11.9	79	-0.8	-3	32.9	93	(N/A)	2.2	6.65
Northern hackberry	0.3	0.1	0.3	0.0	2	6.8	1.0	0.9	6.1	41	0.0	0	15.5	44	(N/A)	2.2	3.12
Conifer Evergreen Small	0.2	0.0	0.2	0.0	1	0.9	0.1	0.1	0.8	5	-1.1	-4	1.2	2	(N/A)	1.6	0.25
Conifer Evergreen Medium	0.6	0.1	0.6	0.1	4	2.7	0.4	0.4	2.4	16	-2.0	-7	5.2	13	(N/A)	1.4	1.45
Northern white cedar	2.0	0.4	1.7	0.2	13	5.4	0.8	0.8	5.3	34	-7.7	-29	8.8	18	(N/A)	1.4	2.03
Littleleaf linden	1.6	0.3	0.8	0.1	9	6.1	0.9	0.8	5.7	38	-0.8	-3	15.4	43	(N/A)	1.4	4.81
Black spruce	0.7	0.1	0.7	0.1	5	3.1	0.4	0.4	2.9	19	-2.4	-9	6.1	15	(N/A)	1.4	1.69
Kentucky coffeetree	0.0	0.0	0.0	0.0	0	0.8	0.1	0.1	0.8	5	0.0	0	1.9	5	(N/A)	0.9	0.87
Norway spruce	0.1	0.0	0.1	0.0	1	0.7	0.1	0.1	0.7	5	-0.4	-2	1.4	4	(N/A)	0.9	0.61
Northern pin oak	1.0	0.2	0.5	0.0	5	2.8	0.4	0.4	2.6	17	-0.2	-1	7.7	22	(N/A)	0.8	4.37
Amur maple	0.1	0.0	0.0	0.0	0	0.8	0.1	0.1	0.7	5	0.0	0	1.9	5	(N/A)	0.8	1.08
Spruce	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.1	0	0.3	1	(N/A)	0.8	0.15
Japanese tree lilac	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.6	4	0.0	0	1.7	5	(N/A)	0.6	1.17
Siberian elm	0.7	0.1	0.4	0.0	4	3.6	0.5	0.5	3.4	22	0.0	0	9.2	26	(N/A)	0.6	6.54
Eastern white pine	0.8	0.2	0.7	0.1	6	2.0	0.3	0.3	1.9	13	-3.7	-14	2.6	4	(N/A)	0.6	1.05
Elm	0.4	0.1	0.2	0.0	2	3.3	0.5	0.5	3.1	20	0.0	0	8.1	23	(N/A)	0.6	5.69
Conifer Evergreen Large	0.1	0.0	0.1	0.0	0	0.4	0.1	0.1	0.4	2	-0.2	-1	0.8	2	(N/A)	0.3	1.02
Willow	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	2	(N/A)	0.3	1.21
Broadleaf Deciduous Medium	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	0.3	0.67
Eastern redbud	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)	0.3	1.63
American elm	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.1	3	(N/A)	0.3	1.54
Ginkgo	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)	0.3	0.07

Fairfax

Annual Air Quality Benefits of All Trees

4/7/2022

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								
Mulberry	0.5	0.1	0.2	0.0	3	1.4	0.2	0.2	1.2	8	0.0	0	3.8	11	(N/A)	0.3	5.45
Maple	1.1	0.2	0.5	0.0	6	2.5	0.4	0.4	2.5	16	-0.4	-1	7.2	20	(N/A)	0.3	10.15
Oak	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6	(N/A)	0.3	2.99
Tulip tree	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4	(N/A)	0.3	1.93
Northern catalpa	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)	0.3	0.08
American sycamore	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)	0.3	0.08
Common chokecherry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.2	2.55
Cottonwood	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12	(N/A)	0.2	12.48
Southern magnolia	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.2	0	(N/A)	0.2	0.47
Broadleaf Deciduous Large	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)	0.2	2.99
American basswood	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)	0.2	2.71
Quaking aspen	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)	0.2	0.87
Blue spruce	0.4	0.1	0.3	0.0	2	0.7	0.1	0.1	0.6	4	-0.9	-3	1.3	3	(N/A)	0.2	3.10
Citywide total	61.1	10.4	34.6	3.1	343	310.2	45.1	42.9	293.0	1,929	-38.6	-145	761.8	2,127	(N/A)	100.0	3.30

Table 4: Annual Carbon Stored

Fairfax

Stored CO2 Benefits of All Trees

4/7/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	116,236	872	(N/A)	18.9	10.0	7.15
Red maple	71,822	539	(N/A)	15.5	6.2	5.39
Silver maple	228,276	1,712	(N/A)	6.5	19.7	40.76
Swamp white oak	14,998	112	(N/A)	6.1	1.3	2.88
Norway maple	25,647	192	(N/A)	5.6	2.2	5.34
Green ash	200,984	1,507	(N/A)	5.3	17.3	44.33
Honeylocust	102,926	772	(N/A)	5.0	8.9	24.12
Callery pear	35,715	268	(N/A)	4.5	3.1	9.24
Northern red oak	19,033	143	(N/A)	2.6	1.6	8.40
White ash	87,982	660	(N/A)	2.3	7.6	43.99
Sugar maple	22,148	166	(N/A)	2.3	1.9	11.07
Eastern hophornbeam	7,048	53	(N/A)	2.3	0.6	3.52
River birch	52,882	397	(N/A)	2.2	4.6	28.33
Northern hackberry	4,533	34	(N/A)	2.2	0.4	2.43
Conifer Evergreen Sn	849	6	(N/A)	1.6	0.1	0.64
Conifer Evergreen M	2,316	17	(N/A)	1.4	0.2	1.93
Northern white cedar	18,111	136	(N/A)	1.4	1.6	15.09
Littleleaf linden	34,932	262	(N/A)	1.4	3.0	29.11
Black spruce	3,392	25	(N/A)	1.4	0.3	2.83
Kentucky coffeetree	1,113	8	(N/A)	0.9	0.1	1.39
Norway spruce	559	4	(N/A)	0.9	0.0	0.70
Northern pin oak	16,717	125	(N/A)	0.8	1.4	25.08
Amur maple	1,619	12	(N/A)	0.8	0.1	2.43
Spruce	48	0	(N/A)	0.8	0.0	0.07
Japanese tree lilac	1,441	11	(N/A)	0.6	0.1	2.70
Siberian elm	17,098	128	(N/A)	0.6	1.5	32.06
Eastern white pine	9,174	69	(N/A)	0.6	0.8	17.20
Elm	14,199	106	(N/A)	0.6	1.2	26.62
Conifer Evergreen La	295	2	(N/A)	0.3	0.0	1.11
Willow	437	3	(N/A)	0.3	0.0	1.64
Broadleaf Deciduous	235	2	(N/A)	0.3	0.0	0.88
Eastern redbud	1,086	8	(N/A)	0.3	0.1	4.07
American elm	1,086	8	(N/A)	0.3	0.1	4.07
Ginkgo	9	0	(N/A)	0.3	0.0	0.03
Mulberry	7,651	57	(N/A)	0.3	0.7	28.69
Maple	11,569	87	(N/A)	0.3	1.0	43.39
Oak	2,069	16	(N/A)	0.3	0.2	7.76
Tulip tree	1,220	9	(N/A)	0.3	0.1	4.57
Northern catalpa	24	0	(N/A)	0.3	0.0	0.09
American sycamore	24	0	(N/A)	0.3	0.0	0.09
Common chokecherry	908	7	(N/A)	0.2	0.1	6.81
Cottonwood	15,773	118	(N/A)	0.2	1.4	118.30
Southern magnolia	3	0	(N/A)	0.2	0.0	0.02
Broadleaf Deciduous	1,035	8	(N/A)	0.2	0.1	7.76
American basswood	1,025	8	(N/A)	0.2	0.1	7.68
Quaking aspen	185	1	(N/A)	0.2	0.0	1.39
Blue spruce	2,661	20	(N/A)	0.2	0.2	19.96
Citywide total	1,159,090	8,693	(N/A)	100.0	100.0	13.50

The value of stored carbon dioxide is calculated as the total amount of carbon dioxide sequestered annually over the life of each tree, summed for the population. This value should not be added to the Replacement Value or double-counting of the carbon dioxide storage benefit will occur.

Table 5: Annual Carbon Sequestered

Fairfax

Annual CO Benefits of All Trees

4/7/2022

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
Apple	12,512	94	-558	-120	-5	13,808	104	25,642	192 (N/A)	18.9	11.2	1.58
Red maple	10,700	80	-345	-83	-3	12,178	91	22,449	168 (N/A)	15.5	9.8	1.68
Silver maple	22,420	168	-1,103	-74	-9	11,677	88	32,921	247 (N/A)	6.5	14.3	5.88
Swamp white oak	3,697	28	-81	-23	-1	2,824	21	6,417	48 (N/A)	6.1	2.8	1.23
Norway maple	4,600	34	-134	-27	-1	3,851	29	8,290	62 (N/A)	5.6	3.6	1.73
Green ash	17,556	132	-965	-76	-8	13,447	101	29,963	225 (N/A)	5.3	13.0	6.61
Honeylocust	13,276	100	-498	-51	-4	10,759	81	23,486	176 (N/A)	5.0	10.2	5.50
Callery pear	6,021	45	-178	-32	-2	5,082	38	10,893	82 (N/A)	4.5	4.7	2.82
Northern red oak	2,354	18	-91	-19	-1	2,620	20	4,864	36 (N/A)	2.6	2.1	2.15
White ash	9,399	70	-422	-33	-3	6,525	49	15,469	116 (N/A)	2.3	6.7	7.73
Sugar maple	2,376	18	-108	-17	-1	2,539	19	4,789	36 (N/A)	2.3	2.1	2.39
Eastern hophornbeam	1,025	8	-34	-12	0	1,080	8	2,058	15 (N/A)	2.3	0.9	1.03
River birch	4,767	36	-254	-26	-2	4,395	33	8,883	67 (N/A)	2.2	3.9	4.76
Northern hackberry	884	7	-23	-14	0	2,272	17	3,119	23 (N/A)	2.2	1.4	1.67
Conifer Evergreen Small	124	1	-4	-5	0	289	2	403	3 (N/A)	1.6	0.2	0.30
Conifer Evergreen Mediun	321	2	-11	-10	0	898	7	1,198	9 (N/A)	1.4	0.5	1.00
Northern white cedar	1,189	9	-87	-19	-1	1,951	15	3,034	23 (N/A)	1.4	1.3	2.53
Littleleaf linden	3,889	29	-168	-15	-1	2,109	16	5,814	44 (N/A)	1.4	2.5	4.85
Black spruce	400	3	-16	-11	0	1,062	8	1,434	11 (N/A)	1.4	0.6	1.20
Kentucky coffeetree	445	3	-5	-4	0	292	2	728	5 (N/A)	0.9	0.3	0.91
Norway spruce	134	1	-3	-4	0	245	2	372	3 (N/A)	0.9	0.2	0.47
Northern pin oak	919	7	-81	-7	-1	962	7	1,793	13 (N/A)	0.8	0.8	2.69
Amur maple	266	2	-8	-4	0	273	2	527	4 (N/A)	0.8	0.2	0.79
Spruce	32	0	0	-1	0	62	0	93	1 (N/A)	0.8	0.0	0.14
Japanese tree lilac	228	2	-7	-3	0	236	2	454	3 (N/A)	0.6	0.2	0.85
Siberian elm	1,276	10	-82	-8	-1	1,274	10	2,460	18 (N/A)	0.6	1.1	4.61
Eastern white pine	477	4	-44	-8	0	716	5	1,141	9 (N/A)	0.6	0.5	2.14
Elm	1,523	11	-68	-7	-1	1,152	9	2,599	19 (N/A)	0.6	1.1	4.87
Conifer Evergreen Large	71	1	-1	-2	0	132	1	200	1 (N/A)	0.3	0.1	0.75
Willow	191	1	-3	-1	0	129	1	316	2 (N/A)	0.3	0.1	1.18
Broadleaf Deciduous Medi	101	1	-2	-1	0	72	1	170	1 (N/A)	0.3	0.1	0.64

Annual CO Benefits of All Trees

4/7/2022

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
Eastern redbud	152	1	-5	-2	0	161	1	306	2 (N/A)	0.3	0.1	1.15
American elm	156	1	-6	-2	0	168	1	316	2 (N/A)	0.3	0.1	1.18
Ginkgo	4	0	0	0	0	7	0	11	0 (N/A)	0.3	0.0	0.04
Mulberry	592	4	-37	-4	0	459	3	1,011	8 (N/A)	0.3	0.4	3.79
Maple	1,407	11	-56	-5	0	908	7	2,254	17 (N/A)	0.3	1.0	8.45
Oak	418	3	-10	-2	0	318	2	723	5 (N/A)	0.3	0.3	2.71
Tulip tree	283	2	-6	-2	0	207	2	483	4 (N/A)	0.3	0.2	1.81
Northern catalpa	5	0	0	0	0	9	0	13	0 (N/A)	0.3	0.0	0.05
American sycamore	5	0	0	0	0	9	0	13	0 (N/A)	0.3	0.0	0.05
Common chokecherry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.2	0.1	1.74
Cottonwood	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.2	0.6	9.97
Southern magnolia	1	0	0	0	0	26	0	27	0 (N/A)	0.2	0.0	0.20
Broadleaf Deciduous Large	209	2	-5	-1	0	159	1	361	3 (N/A)	0.2	0.2	2.71
American basswood	120	1	-5	-1	0	148	1	262	2 (N/A)	0.2	0.1	1.96
Quaking aspen	74	1	-1	-1	0	49	0	121	1 (N/A)	0.2	0.1	0.91
Blue spruce	147	1	-13	-3	0	233	2	364	3 (N/A)	0.2	0.2	2.73
Citywide total	127,716	958	-5,611	-742	-48	108,445	813	229,808	1,724 (N/A)	100.0	100.0	2.68

Table 6: Annual Social and Aesthetic Benefits

Fairfax

Annual Aesthetic/Other Benefits of All Trees

4/7/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	706	(N/A)	18.9	4.4	5.79
Red maple	1,812	(N/A)	15.5	11.3	18.12
Silver maple	2,228	(N/A)	6.5	13.9	53.05
Swamp white oak	487	(N/A)	6.1	3.0	12.48
Norway maple	561	(N/A)	5.6	3.5	15.58
Green ash	1,663	(N/A)	5.3	10.4	48.93
Honeylocust	2,898	(N/A)	5.0	18.1	90.55
Callery pear	692	(N/A)	4.5	4.3	23.85
Northern red oak	250	(N/A)	2.6	1.6	14.71
White ash	1,153	(N/A)	2.3	7.2	76.90
Sugar maple	312	(N/A)	2.3	1.9	20.82
Eastern hophornbeam	57	(N/A)	2.3	0.4	3.80
River birch	486	(N/A)	2.2	3.0	34.73
Northern hackberry	286	(N/A)	2.2	1.8	20.45
Conifer Evergreen Small	94	(N/A)	1.6	0.6	9.39
Conifer Evergreen Medium	181	(N/A)	1.4	1.1	20.11
Northern white cedar	283	(N/A)	1.4	1.8	31.41
Littleleaf linden	433	(N/A)	1.4	2.7	48.11
Black spruce	194	(N/A)	1.4	1.2	21.54
Kentucky coffeetree	88	(N/A)	0.9	0.6	14.73
Norway spruce	55	(N/A)	0.9	0.3	9.16
Northern pin oak	100	(N/A)	0.8	0.6	19.91
Amur maple	15	(N/A)	0.8	0.1	2.93
Spruce	30	(N/A)	0.8	0.2	5.97
Japanese tree lilac	13	(N/A)	0.6	0.1	3.14
Siberian elm	122	(N/A)	0.6	0.8	30.53
Eastern white pine	89	(N/A)	0.6	0.6	22.35
Elm	161	(N/A)	0.6	1.0	40.16
Conifer Evergreen Large	22	(N/A)	0.3	0.1	11.13
Willow	26	(N/A)	0.3	0.2	12.89
Broadleaf Deciduous Medium	16	(N/A)	0.3	0.1	7.81
Eastern redbud	8	(N/A)	0.3	0.1	4.23
American elm	25	(N/A)	0.3	0.2	12.63
Ginkgo	1	(N/A)	0.3	0.0	0.37
Mulberry	35	(N/A)	0.3	0.2	17.60
Maple	175	(N/A)	0.3	1.1	87.48
Oak	57	(N/A)	0.3	0.4	28.56
Tulip tree	43	(N/A)	0.3	0.3	21.64
Northern catalpa	11	(N/A)	0.3	0.1	5.26
American sycamore	11	(N/A)	0.3	0.1	5.26
Common chokecherry	6	(N/A)	0.2	0.0	6.40
Cottonwood	66	(N/A)	0.2	0.4	65.59
Southern magnolia	0	(N/A)	0.2	0.0	0.01
Broadleaf Deciduous Large	29	(N/A)	0.2	0.2	28.56
American basswood	13	(N/A)	0.2	0.1	13.08
Quaking aspen	15	(N/A)	0.2	0.1	14.73
Blue spruce	20	(N/A)	0.2	0.1	19.97

Annual Aesthetic/Other Benefits of All Trees

4/7/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Citywide total	16,027	(N/A)	100.0	100.0	24.89

Table 7: Summary of Benefits in Dollars

Fairfax

Total Annual Benefits, Net Benefits, and Costs for All Trees

4/7/2022

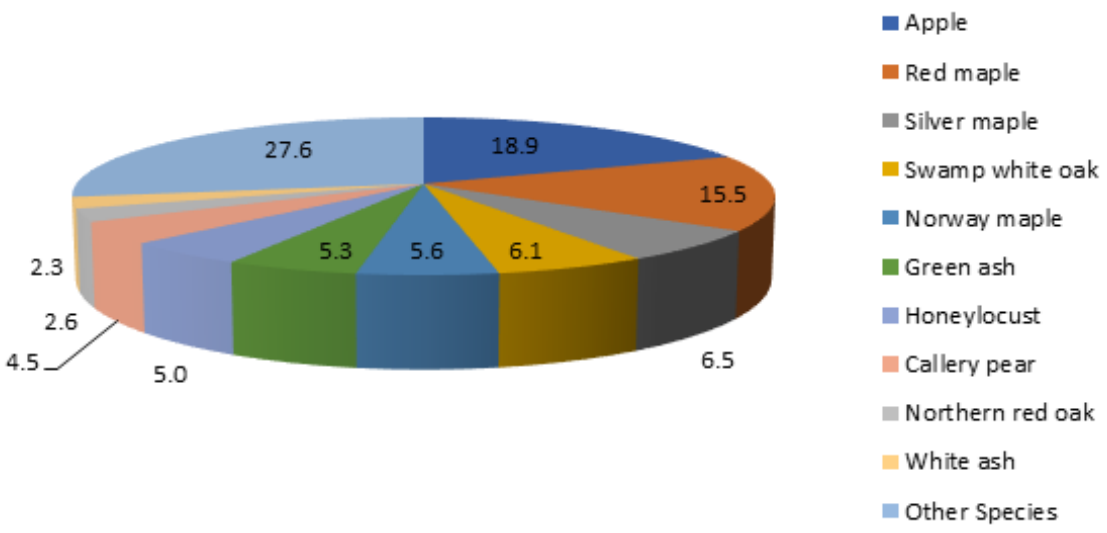
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	13,775	(N/A)	21.39	(N/A)	0.49	(N/A)
CO2	1,724	(N/A)	2.68	(N/A)	0.06	(N/A)
Air Quality	2,127	(N/A)	3.30	(N/A)	0.08	(N/A)
Stormwater	12,616	(N/A)	19.59	(N/A)	0.45	(N/A)
Aesthetic/Other	16,027	(N/A)	24.89	(N/A)	0.57	(N/A)
Total Benefits	46,269	(N/A)	71.85	(N/A)	1.64	(N/A)
Costs						
Planting	0		0.00		0.00	
Contract Pruning	0		0.00		0.00	
Pest Management	0		0.00		0.00	
Irrigation	0		0.00		0.00	
Removal	0		0.00		0.00	
Administration	0		0.00		0.00	
Inspection/Service	0		0.00		0.00	
Infrastructure Repairs	0		0.00		0.00	
Litter Clean-up	0		0.00		0.00	
Liability/Claims	0		0.00		0.00	
Other Costs	0		0.00		0.00	
Total Costs	0		0.00		0.00	
Net Benefits	46,269	(N/A)	71.85	(N/A)	1.64	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Fairfax

Species Distribution of All Trees

4/7/2022



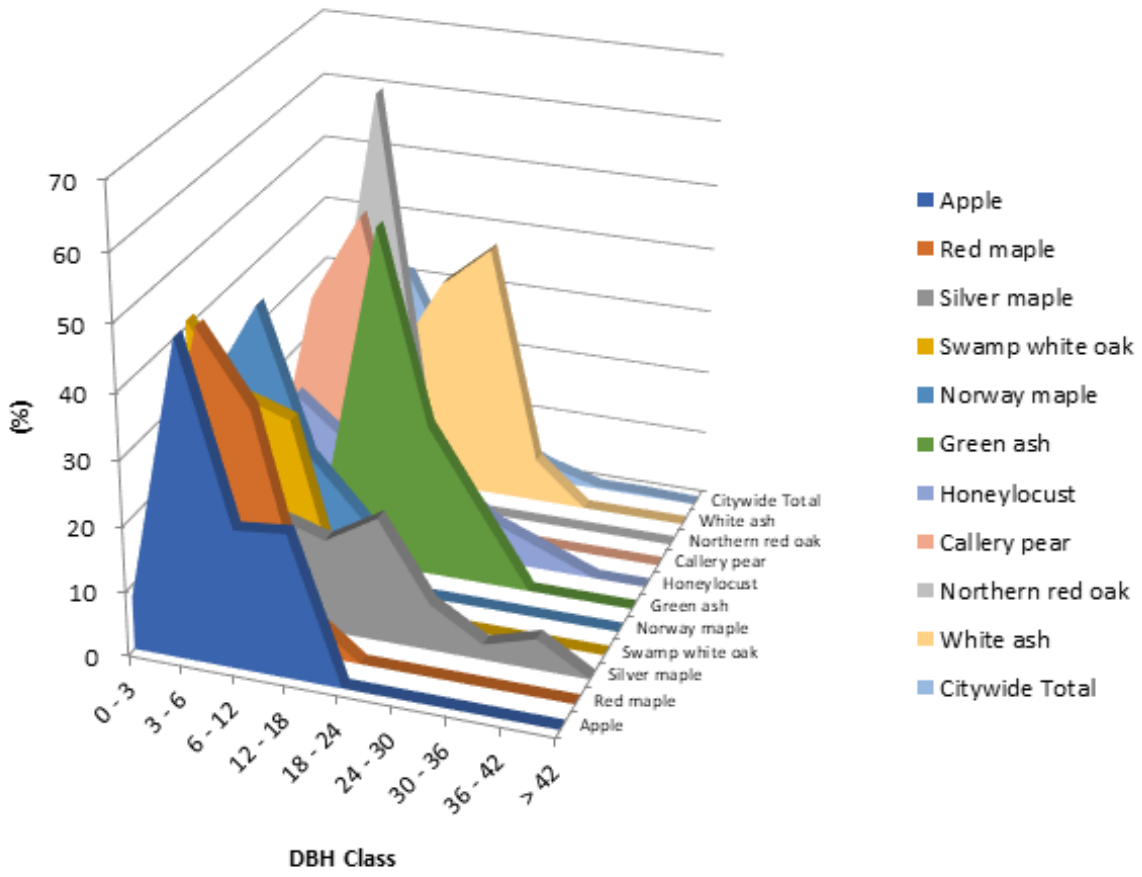
Species	Percent
Apple	18.9
Red maple	15.5
Silver maple	6.5
Swamp white oak	6.1
Norway maple	5.6
Green ash	5.3
Honeylocust	5.0
Callery pear	4.5
Northern red oak	2.6
White ash	2.3
Other Species	27.6
Total	100.0

Figure 2: Relative Age Class

Fairfax

Relative Age Distribution of Top 10 All Tree Species for All Zones (%)

4/7/2022



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Apple	8.20	48.36	21.31	22.13	0.00	0.00	0.00	0.00	0.00
Red maple	11.00	47.00	36.00	6.00	0.00	0.00	0.00	0.00	0.00
Silver maple	11.90	23.81	16.67	14.29	19.05	7.14	2.38	4.76	0.00
Swamp white oak	41.03	30.77	28.21	0.00	0.00	0.00	0.00	0.00	0.00
Norway maple	27.78	41.67	19.44	11.11	0.00	0.00	0.00	0.00	0.00
Green ash	0.00	0.00	11.76	52.94	23.53	11.76	0.00	0.00	0.00
Honeylocust	6.25	21.88	15.63	34.38	12.50	6.25	3.13	0.00	0.00
Callery pear	0.00	34.48	48.28	17.24	0.00	0.00	0.00	0.00	0.00
Northern red oak	5.88	17.65	64.71	11.76	0.00	0.00	0.00	0.00	0.00
White ash	0.00	0.00	20.00	33.33	40.00	6.67	0.00	0.00	0.00
Citywide Total	12.27	31.83	31.21	15.84	5.75	2.48	0.31	0.31	0.00

Figure 3: Foliage Condition

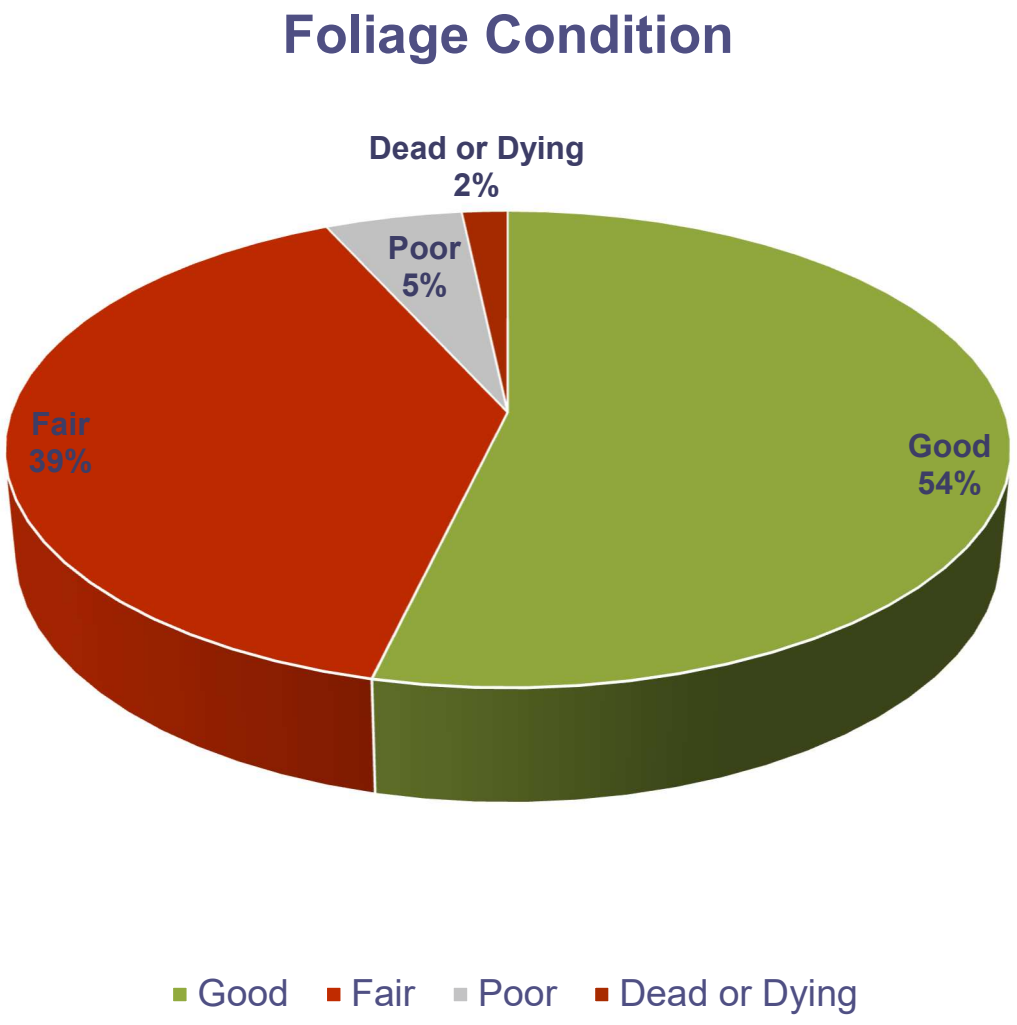


Figure 4: Wood Condition

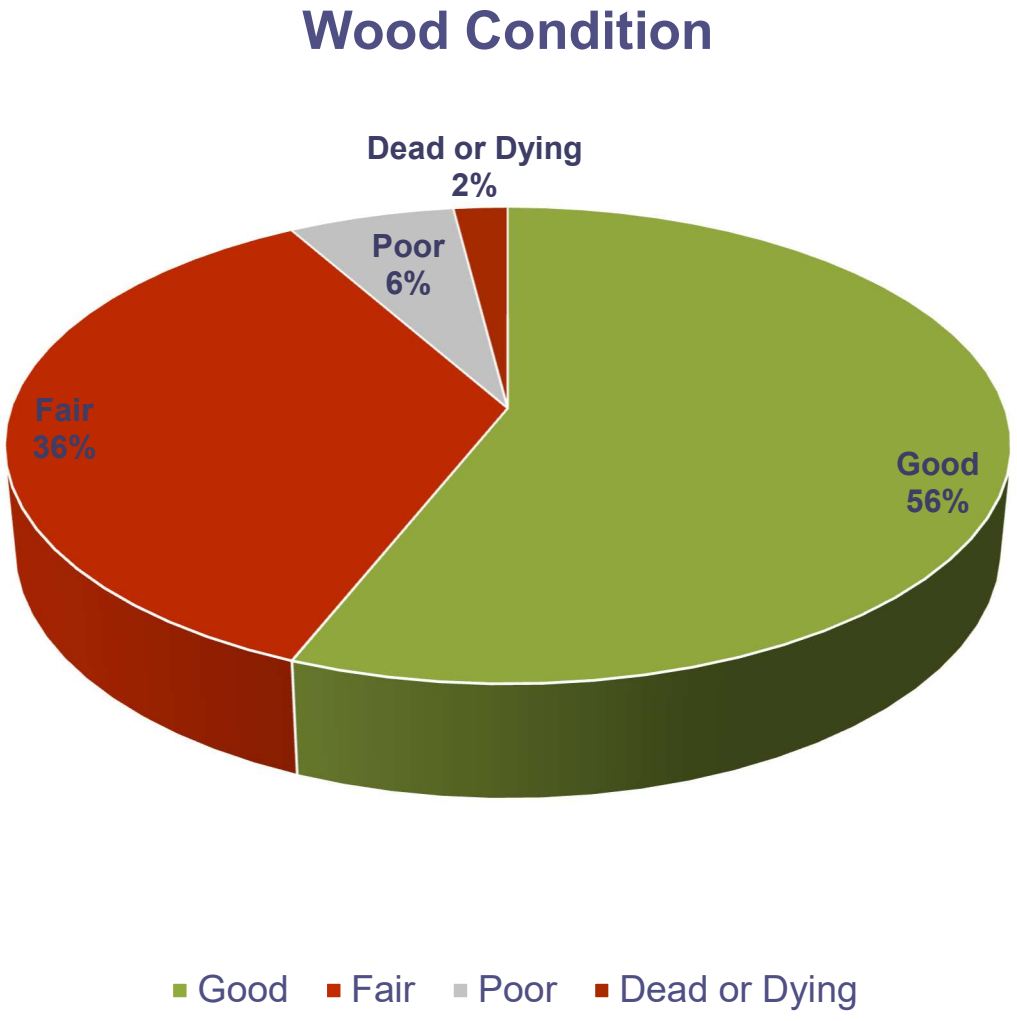
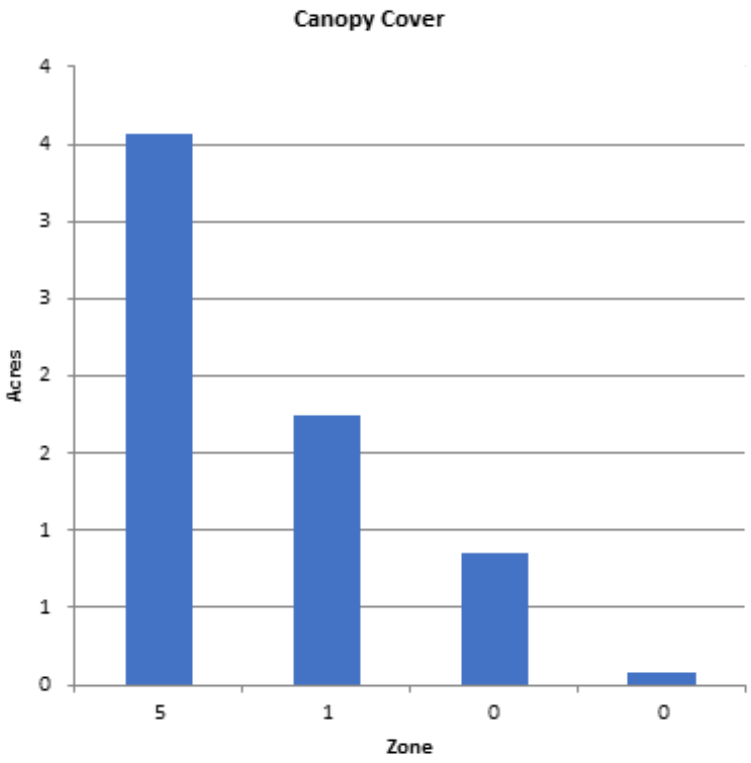


Figure 5: Canopy Cover in Acres

Fairfax

Canopy Cover of All Trees (Acres)

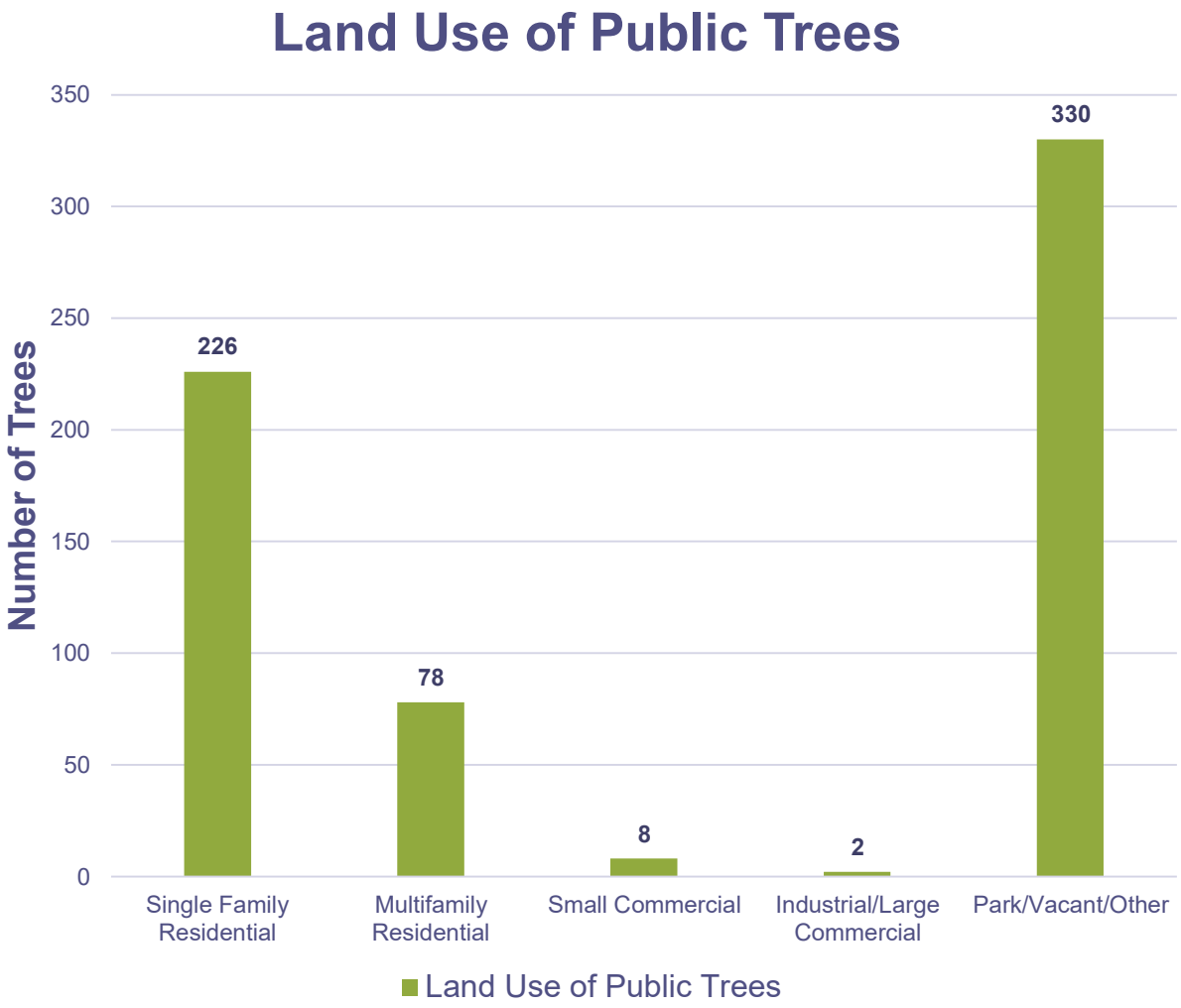
4/7/2022



Zone	Acres	% of Total Canopy Cover
5	4	57.2
1	2	27.9
0	1	13.6
0	0	1.2
Citywide total	6	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 Total	0	0	6	0.00	0.00

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

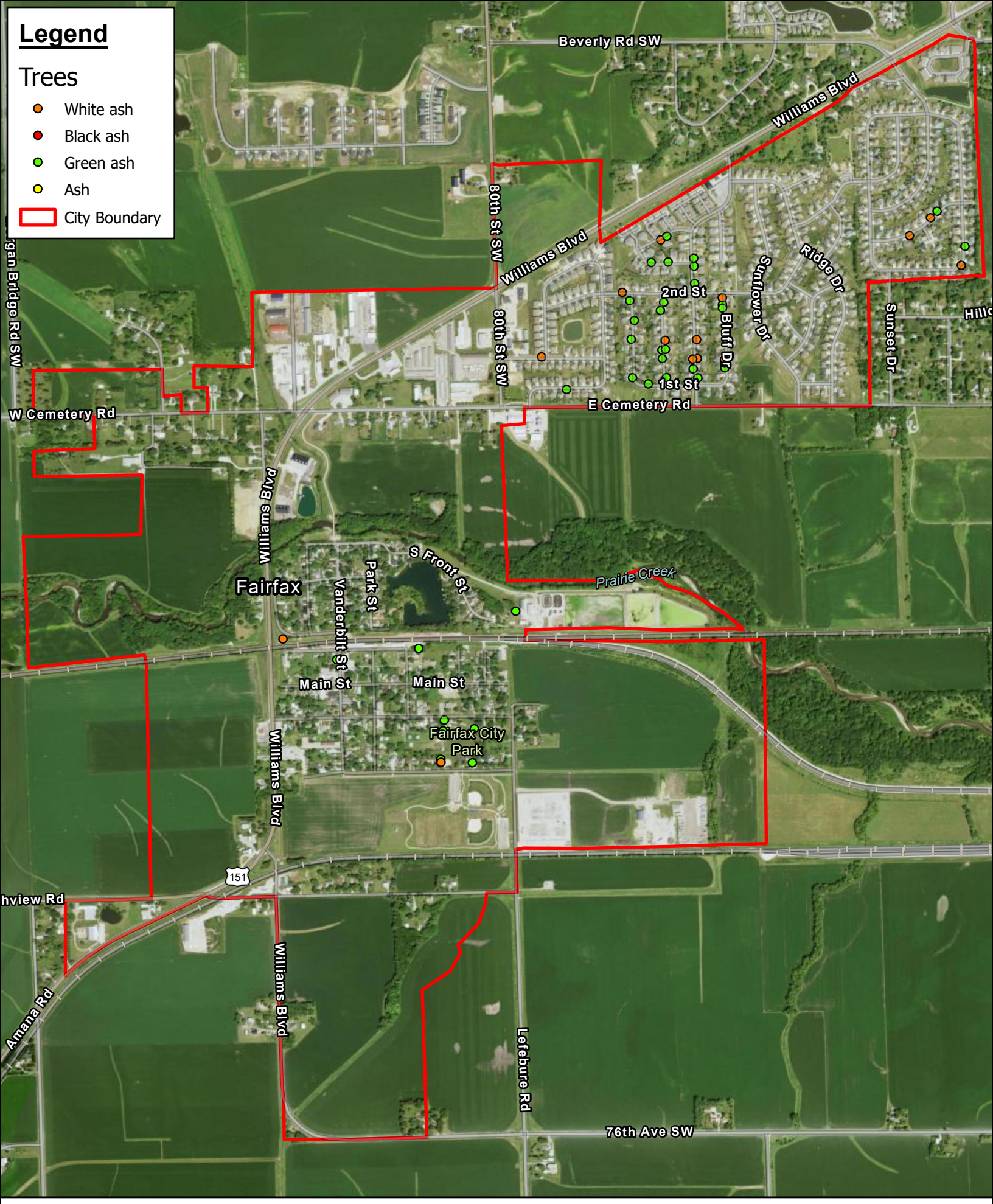
Figure 1: Location of Ash Trees

Figure 2: Location of EAB Symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

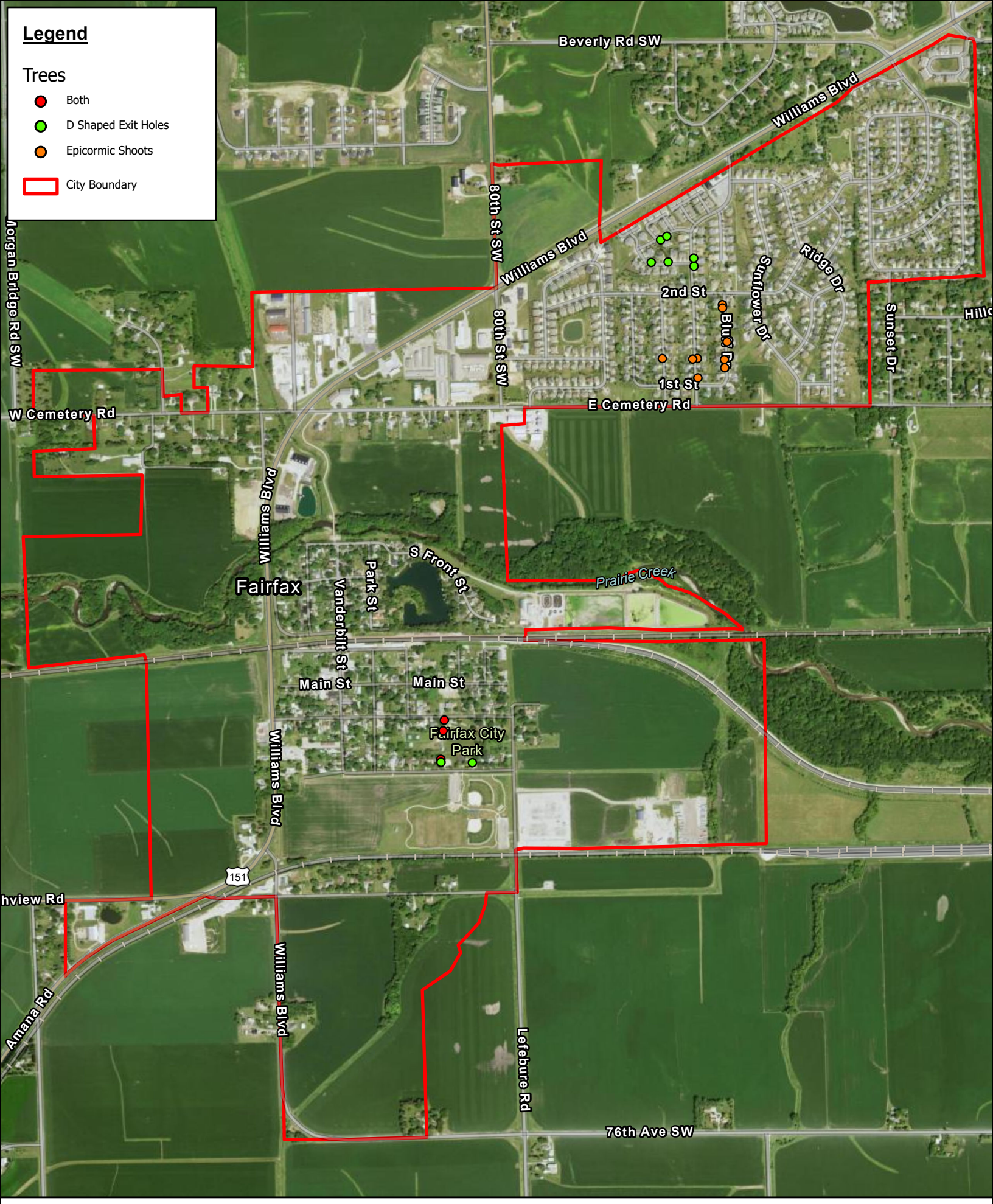
City ownership of the trees recommended for removal should be verified prior to any removal



Ash Tree Location

0 500 1,000 2,000 Feet

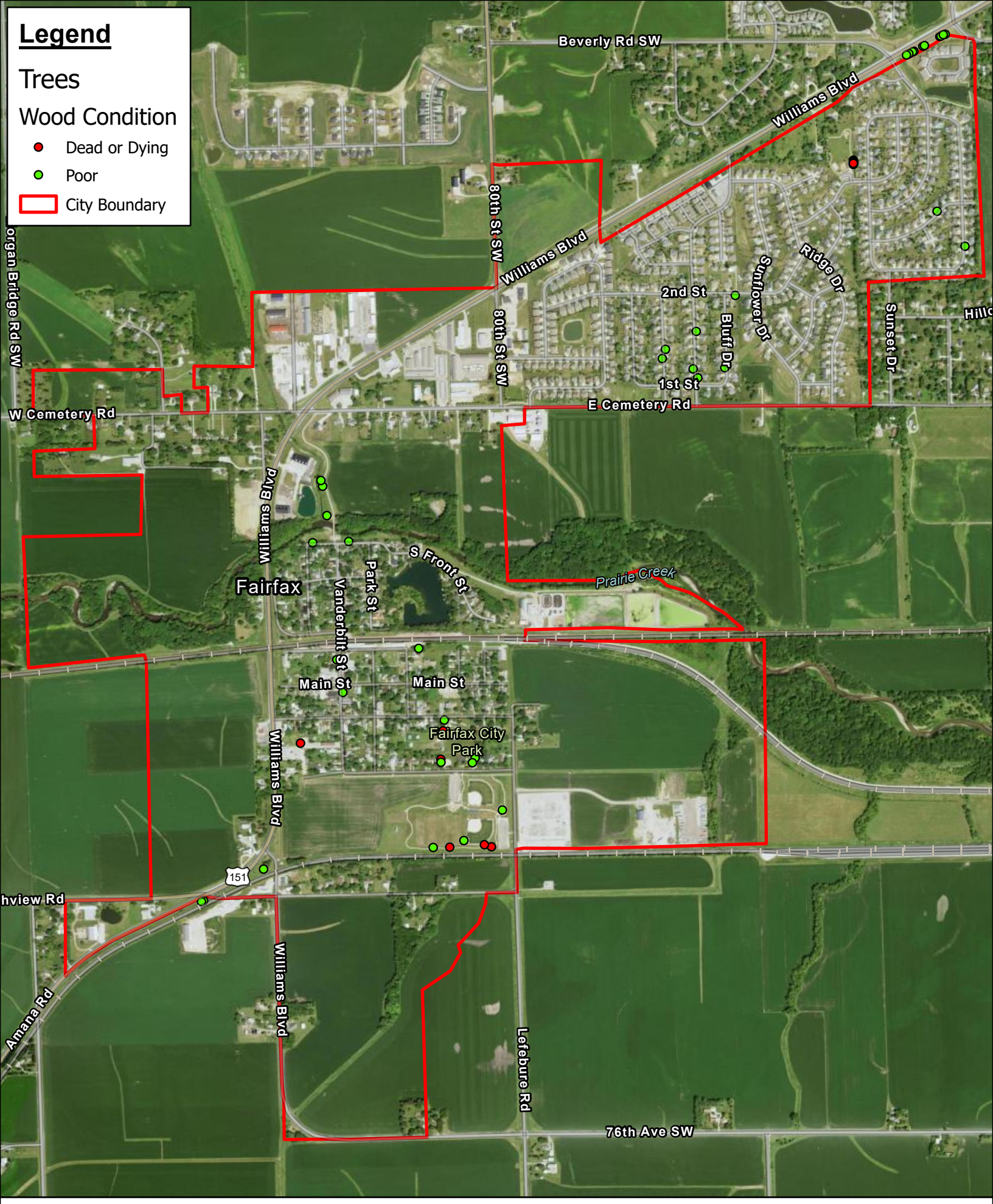
N

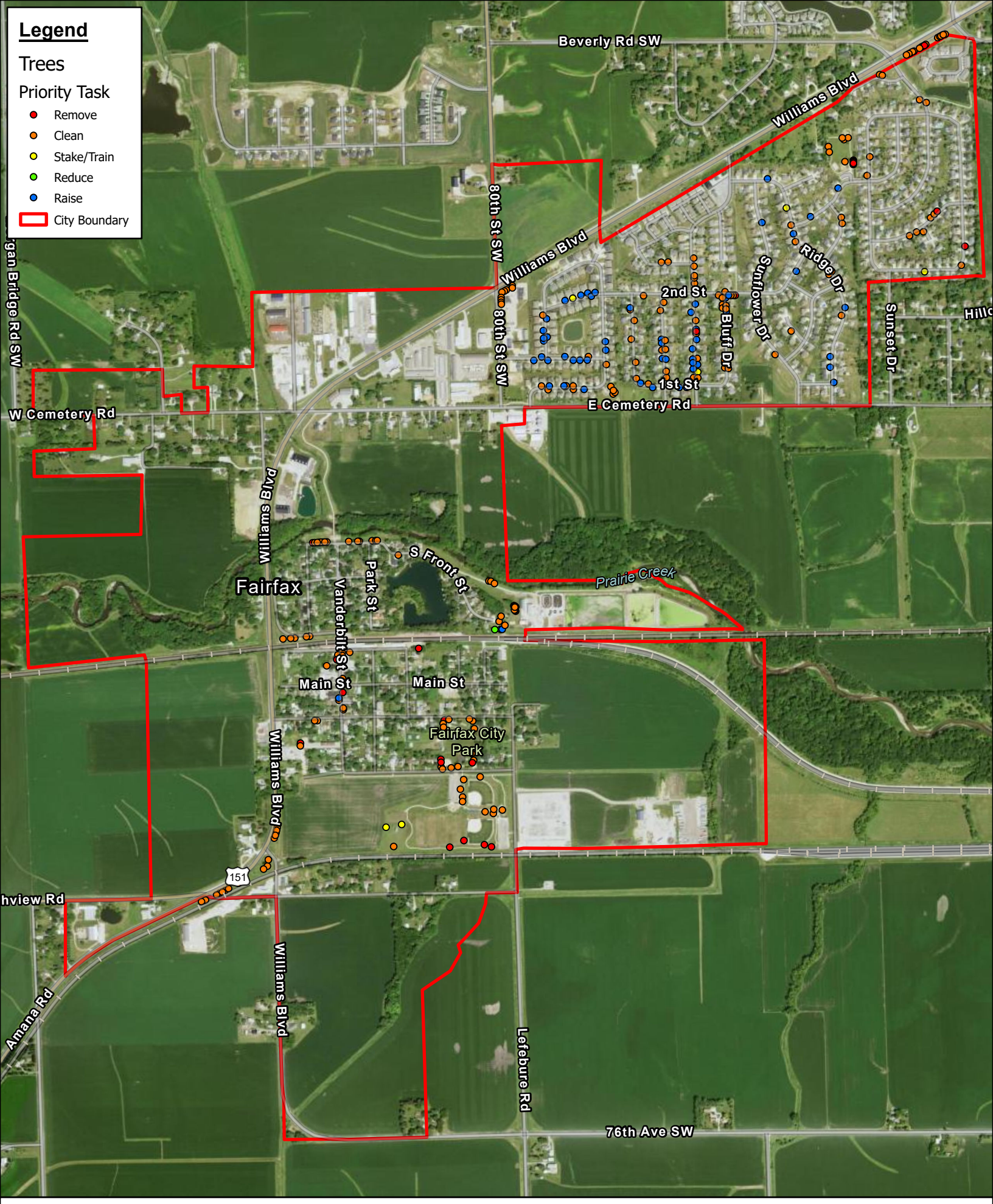


EAB Signs/Symptoms

0 500 1,000 2,000 Feet

N


Legend
Trees
Wood Condition
Dead or Dying
Poor
City Boundary
Beverly Rd SW
Williams Blvd
80th St SW
Williams Blvd
80th St SW
Organ Bridge Rd SW
W Cemetery Rd
E Cemetery Rd
2nd St
1st St
Bluff Dr
Sunflower Dr
Ridge Dr
Sunset Dr
Williams Blvd
Fairfax
Park St
Vanderbilt St
S Front St
Prairie Creek
Main St
Main St
Fairfax City Park
Williams Blvd
151
hview Rd
Amana Rd
Williams Blvd
Lefebure Rd
76th Ave SW
Poor Condition Trees
0 500 1,000 2,000
Feet
N


Legend
Trees
Priority Task
Remove
Clean
Stake/Train
Reduce
Raise
City Boundary
Beverly Rd SW
Williams Blvd
80th St SW
Williams Blvd
80th St SW
2nd St
Sunflower Dr
Bluff Dr
Ridge Dr
Sunset Dr
1st St
E Cemetery Rd
W Cemetery Rd
Williams Blvd
Fairfax
Park St
S Front St
Prairie Creek
Vanderbilt St
Main St
Main St
Fairfax City Park
Williams Blvd
151
Williams Blvd
Lefebure Rd
76th Ave SW
Amana Rd
Priority Task
0 500 1,000 2,000
Feet
N

APPENDIX C: FAIRFAX TREE ORDINANCES

151.01 DEFINITION.

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

151.02 PLANTING RESTRICTIONS.

No tree shall be planted in any parking or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.

2. Spacing. Trees shall not be planted on any parking which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.

3. Prohibited Trees. No person shall plant in any street any fruitbearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

4. Permit to Plant, Treat or Remove Trees. No person shall plant, move, spray, fertilize, brace, trim, cut or otherwise disturb any tree or shrub in any street, park, or public place without first obtaining a written permit from the City Building Inspector. The City Building Inspector shall issue the permit if in his or her judgment the desired work is necessary, and the proposed method and workmanship thereof are of a satisfactory nature. Such work shall be done under the supervision of the City Building Inspector. A permit is not required for the trimming or maintaining of shrubbery growing on any street, park, or public place if such shrubbery does not constitute a public nuisance. Every permit shall describe the work to be done, the species, sizes and locations of trees or shrubs concerned, and the date of expiration. Any permit may be declared void if its terms are violated.

5. Fastening Materials to Trees. No person shall place or maintain upon any street, park or public place any material which will impede the free passage of water, air and fertilizer to the roots of any tree or shrub growing therein, except by permission of the City Building Inspector, or when such materials are designed for the construction of sidewalks, paving, gutters or other public improvements, and have been placed under a permit granted by the City.

6. Damaging Trees. No person shall break, deface, injure or destroy any tree or shrub in any street, park or public place. No person shall knowingly permit any leak to exist in any gas pipe or main within the root zone of any such tree or shrub. No person shall knowingly permit any

wire designed to carry electronic current to come in contact with any such tree or shrub unless protected by approved methods. Whenever the City Building Inspector determines it to be necessary, in order to prune or remove any tree or shrub to protect, move or cut off the electricity from any service wire, he or she shall serve written notice on the owner of such wire, to protect such wire and the owner shall comply with such order within twenty four (24) hours after service of the notice.

7. Street Tree Planting Guide. All trees planted in a street, park or public place shall be of a species that is clean, strong and long-lived. The purpose of this guide is to promote improved and healthy tree growth conditions while avoiding site obstruction and conflicts with utilities.

A. The following are recommended trees species:

(1) Trees (over 40') Planted on 40' Spacing:

(a) Ash - White, Green, or Purple

(b) Ginkgo - Columnar varieties particularly desirable

(c) Hackberry

(d) Honey locust - Skyline

(e) Linden - Silver, Redmond

(f) Maple - Black, Schedler Norway, (Norway, Red and Sugar - Columnar varieties particularly desirable)

(g) Oak - White, Northern Red, Swamp White, Bur

(h) Tulip Tree

(i) Sycamore

(2) Trees (12' - 30') Planted on 20' Spacing

(a) Amur/Hedge Maple

(b) Crabapple varieties - Columnar varieties particularly desirable

(c) Eastern Redbud

(d) Hop Hornbeam

(e) Littleleaf Linden

(f) Ornamental Pear

(g) Sargent Cherry

(h) Serviceberry

B. Short lived tree species, trees with weak wood, trees which create a site obstruction or have excessive mess are prohibited. The following is a non-exhaustive list of prohibited tree species: Boxelder, Catalpa, Cottonwood, Evergreens, Fruit and Nut bearing over one (1) inch, Mulberry, Pin Oak, Siberian Elm, Silver Maple, Tree of Heaven, Willow and Magnolia (site objection)

C. Tree Spacing. All trees planted in a street, park or public place shall be in accordance with the following spacing requirements.

(1) 40' between large trees and 20' between small trees

(2) 20' from all intersection

(3) 10' from all driveways and alleys

(4) 8' minimum height

(5) 4' minimum areas between street and sidewalk

(Ord. 50 – Jan. 06 Supp.)

151.03 DUTY TO TRIM TREES.

The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax. (Code of Iowa, Sec. 364.12[2c, d & e])

151.04 TRIMMING TREES TO BE SUPERVISED.

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

151.05 DISEASE CONTROL.

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

151.06 INSPECTION AND REMOVAL.

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

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

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