Hills, IA

Urban Forestry Management Plan

SUMMER 2021

JEO CONSULTING GROUP

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Executive Summary

EXECUTIVE SUMMARY

Overview

This plan was developed to assist the City of Hills 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 10% of Hills' 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 67 trees inventoried.

- Hills' trees provide $8,384 of benefits annually, an average of $125.13 per tree
- There are over 25 species of trees
- The top three genera are: Maple 22%, Ash 10%, and Eastern hophornbeam 10%
- 25% of trees need some type of management
- 4 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 4 trees needing removal, 3 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*
- 5 of the 7 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 it will take 1-2 years to remove ash. We suggest that city officials keep the budget set at $6,000 annually and apply for grants to plant replacement trees.

Introduction

INTRODUCTION

This plan was developed to assist Hills 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 Hills, 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 Hills' 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 Hills 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 Hills' urban forestry goals.

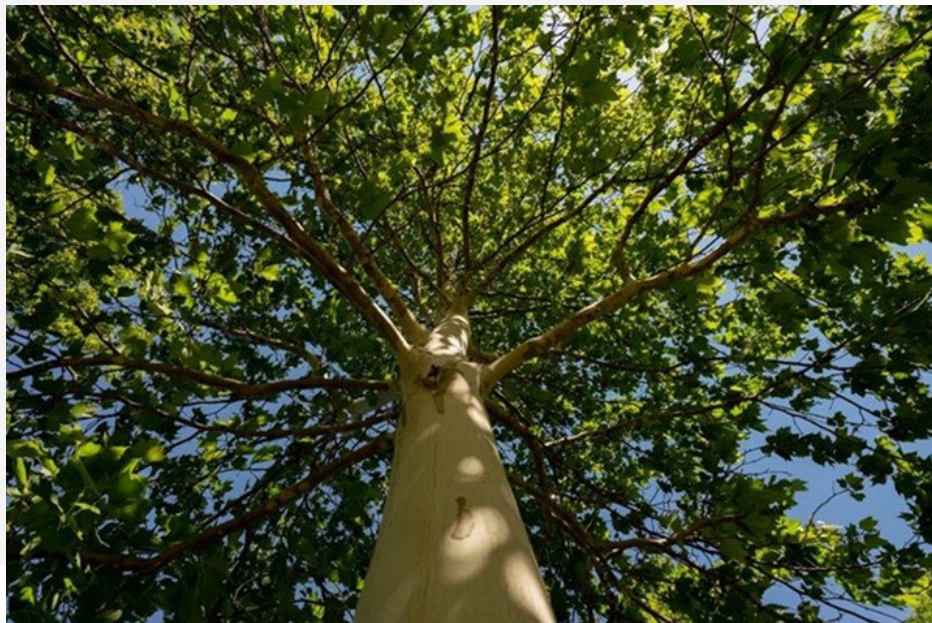| Assist Hills with Managing its Urban Forest | Inform on the Benefits of a Healthy Urban Forest | Establish Preventative Treatment for Emerald Ash Borer | Develop Efficient City Tree Management Techniques | Mitigate Public Safety Issues |

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 wood pecker damage.

INVENTORY RESULTS

JEO entered the data collected for the 67 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. Hills' trees reduce energy-related costs by approximately $2,136 annually (Appendix A, Table 1). These savings are both in electricity (10.3 MWh) and in natural gas (1,383.1 Therms).

Annual Stormwater Benefits

Hills' trees intercept about 128,665 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $3,487 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 Hills, it is estimated that trees remove 143.3 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 $409 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Hills, trees sequester about 23,536 lbs of carbon per year with an associated value of $177 (Appendix A, Table 5). In addition, the trees store 655,890 lbs of carbon, with a yearly benefit of $4,919 (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. Hills receives $2,071 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, Hills' trees provide $8,384 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 67 trees in Hills provide approximately $125.13 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$2,136**	• Intercept **128,665 gallons** • Provides **$3,487** benefit	• Remove **143.3 lbs** of pollution • Net value of **$409**	• Sequester **23,536 lbs** • Value of **$177** • Store **655,890 lbs** • Value of **$4,919**	• **$2,071** in social benefits	• **$8,384** annual benefits • Each tree provides **$125.13** annually

FOREST STRUCTURE

Species Distribution

Hills has over 25 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	15	22%		Sweetgum	2	3%
Ash	7	10%		Basswood/Linden	1	1.5%
Eastern hophornbeam	7	10%		Siberian elm	1	1.5%
Eastern redbud	6	9%		Honeylocust	1	1.5%
Cottonwood	6	9%		Ginkgo	1	1.5%
Oak	3	4.5%		Ohio buckeye	1	1.5%
Spruce	3	4.5%		Black cherry	1	1.5%
Pine	3	4.5%		Lilac	1	1.5%
Eastern red cedar	2	3%		Pear (Callery)	1	1.5%
				Other deciduous	5	7%

Age Class

Most of Hills' trees (49.25%) are between 0 and 6 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. Hills' 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 Hills indicate that 97% of the trees are in good or fair health, with only 3% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 97% of Hills' trees are in good or fair health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Three percent of the tree population's wood condition is in poor health, dead, or dying. This 3% 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	14	21%
Crown Reduction	0	0%
Tree Removal	4	6%
Crown Raising	3	4.5%
Tree Staking	0	0%

Canopy Cover

The total canopy with both private and public trees is 72.5 acres or 18% cover. The canopy cover included in the Hills inventory includes approximately 1 acre (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 10 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Hills' 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	16.5%
Industrial/Large Commercial	4.5%
Park/Vacant/Other	77.5%
Small Commercial	1.5%
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

Hills has 4 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 3 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Schedule and Budget at the end of this section. After all the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 17 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 4 removals, 2 are ash trees. There are a total of 7 ash trees, and 5 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 Proposed Schedule and Budget 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 Hills.

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 (55%) (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: any fruit-bearing tree or any tree of the kinds commonly known as 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. 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). No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. Instead we recommend species such as Honeylocust, Kentucky coffeetree, ginkgo, swamp white oak, and eastern redbud.

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 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. City Code 151.06 states "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."

Schedule & Budget

PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $6,000/Year – (Based off Reported Yearly Tree Budget)

YEAR 1	Est. Cost
Remove 4 trees recommended for immediate removal	$3,200
Remove 2 ash trees	$1,600
Plant 5 trees in open locations	$750
Prune 1/3 of city owned trees	$335
TOTAL	**$5,885**

YEAR 4	Est. Cost
Removal funds (if necessary)	$2,400
Plant 5 trees in open locations	$750
Prune 1/3 of city owned trees	$335
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,485**

YEAR 2	Est. Cost
Remove 3 remaining ash	$2,400
Plant 10 trees in open locations	$1,500
Prune 1/3 of city owned trees	$335
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,235**

YEAR 5	Est. Cost
Removal funds (if necessary)	$2,400
Plant 5 trees in open locations	$750
Prune 1/3 of city owned trees	$335
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,485**

YEAR 3	Est. Cost
Removal funds (if necessary)	$2,400
Plant 5 trees in open locations	$750
Prune 1/3 of city owned trees	$335
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,485**

YEAR 6	Est. Cost
Removal funds (if necessary)	$2,400
Plant 5 trees in open locations	$750
Prune 1/3 of city owned trees	$335
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,485**

Estimated costs based on average costs of $800/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 $1,000 a year. If the budget were to remain at $6,000 a year all ash could be removed in 1 year.*

Proposed Budget Arrangements

EAB could potentially kill all ash trees in Hills within four years of its arrival. To remove all ash trees within six years, the budget would need to be at least $1,000 a year. If the budget were to remain at $6,000 per year all ash could be removed within 1 year. Additionally, we recommend that Hills 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 2 trees could be treated per year (every other year treatment). Two trees would be selected for treatment, and Hills would still need to find $4,000 for removal of ash. Alternatively, if there are 4 treatable trees, it would cost approximately $1,200 a year for treatment and leave $2,400 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 Hills. We suggest considering an increased budget to plan for this.

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Appendices

APPENDIX A: i-TREE DATA

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

2/18/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern hophornbeam	0.1	9	20.2	20	29	(N/A)	10.4	1.3	4.11
Eastern redbud	0.0	2	3.7	4	5	(N/A)	9.0	0.2	0.87
Silver maple	2.0	148	254.2	249	397	(N/A)	9.0	18.6	66.20
Cottonwood	2.9	221	378.6	371	592	(N/A)	9.0	27.7	98.63
Black maple	0.1	11	21.6	21	32	(N/A)	7.5	1.5	6.49
Green ash	1.6	118	214.4	210	328	(N/A)	7.5	15.3	65.57
Broadleaf Deciduous Small	0.0	1	3.1	3	4	(N/A)	7.5	0.2	0.87
Norway spruce	0.0	1	2.0	2	3	(N/A)	4.5	0.1	0.93
Eastern white pine	0.2	13	28.5	28	41	(N/A)	4.5	1.9	13.58
Norway maple	0.7	52	103.8	102	154	(N/A)	4.5	7.2	51.33
Eastern red cedar	0.2	12	24.4	24	36	(N/A)	3.0	1.7	18.02
Sweetgum	0.0	0	0.9	1	1	(N/A)	3.0	0.1	0.66
White ash	0.8	64	109.0	107	171	(N/A)	3.0	8.0	85.27
Oak	0.0	0	0.5	0	1	(N/A)	1.5	0.0	0.66
Lilac	0.0	0	0.6	1	1	(N/A)	1.5	0.0	0.87
American basswood	0.0	0	0.5	0	1	(N/A)	1.5	0.0	0.69
Bur oak	0.1	7	13.7	13	21	(N/A)	1.5	1.0	20.64
Black cherry	0.1	6	12.8	13	18	(N/A)	1.5	0.9	18.19
Ohio buckeye	0.2	18	29.5	29	47	(N/A)	1.5	2.2	46.78
Sugar maple	0.2	18	26.9	26	44	(N/A)	1.5	2.1	44.11
Ginkgo	0.0	0	0.4	0	1	(N/A)	1.5	0.0	0.57
Pin oak	0.2	19	28.4	28	46	(N/A)	1.5	2.2	46.43
Pear	0.0	0	0.6	1	1	(N/A)	1.5	0.0	0.87
Honeylocust	0.3	23	42.3	41	65	(N/A)	1.5	3.0	64.79
Siberian elm	0.5	38	62.2	61	98	(N/A)	1.5	4.6	98.48
Total	10.3	781	1,383.1	1,355	2,136	(N/A)	100.0	100.0	31.88

Table 2: Annual Stormwater Benefits

Hills

Annual Stormwater Benefits of Public Trees

2/18/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern hophornbeam	358	10	(N/A)	10.4	0.3	1.39
Eastern redbud	45	1	(N/A)	9.0	0.0	0.20
Silver maple	29,971	812	(N/A)	9.0	23.3	135.37
Cottonwood	43,434	1,177	(N/A)	9.0	33.8	196.17
Black maple	561	15	(N/A)	7.5	0.4	3.04
Green ash	17,237	467	(N/A)	7.5	13.4	93.43
Broadleaf Deciduous Small	37	1	(N/A)	7.5	0.0	0.20
Norway spruce	146	4	(N/A)	4.5	0.1	1.32
Eastern white pine	1,787	48	(N/A)	4.5	1.4	16.14
Norway maple	6,830	185	(N/A)	4.5	5.3	61.69
Eastern red cedar	2,294	62	(N/A)	3.0	1.8	31.08
Sweetgum	36	1	(N/A)	3.0	0.0	0.48
White ash	10,599	287	(N/A)	3.0	8.2	143.62
Oak	18	0	(N/A)	1.5	0.0	0.48
Lilac	7	0	(N/A)	1.5	0.0	0.20
American basswood	8	0	(N/A)	1.5	0.0	0.22
Bur oak	608	16	(N/A)	1.5	0.5	16.47
Black cherry	264	7	(N/A)	1.5	0.2	7.17
Ohio buckeye	1,409	38	(N/A)	1.5	1.1	38.19
Sugar maple	1,367	37	(N/A)	1.5	1.1	37.05
Ginkgo	7	0	(N/A)	1.5	0.0	0.19
Pin oak	1,378	37	(N/A)	1.5	1.1	37.35
Pear	7	0	(N/A)	1.5	0.0	0.20
Honeylocust	2,905	79	(N/A)	1.5	2.3	78.73
Siberian elm	7,351	199	(N/A)	1.5	5.7	199.22
Citywide total	128,665	3,487	(N/A)	100.0	100.0	52.04

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

2/18/2022

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								
Eastern hophornbeam	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	4	0.0	0	1.3	4	(N/A)	10.4	0.54
Eastern redbud	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	1	(N/A)	9.0	0.11
Silver maple	5.5	0.9	2.6	0.2	29	9.2	1.3	1.3	8.8	57	-2.9	-11	27.0	76	(N/A)	9.0	12.65
Cottonwood	9.5	1.5	4.1	0.4	49	13.7	2.0	1.9	13.2	86	0.0	0	46.4	135	(N/A)	9.0	22.55
Black maple	0.0	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	4	0.0	0	1.6	5	(N/A)	7.5	0.92
Green ash	2.1	0.3	1.0	0.1	11	7.4	1.1	1.0	7.0	46	0.0	0	20.1	57	(N/A)	7.5	11.46
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	1	(N/A)	7.5	0.11
Norway spruce	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	-0.1	0	0.1	0	(N/A)	4.5	0.05
Eastern white pine	0.2	0.0	0.2	0.0	1	0.9	0.1	0.1	0.8	5	-0.5	-2	1.7	4	(N/A)	4.5	1.48
Norway maple	1.4	0.2	0.7	0.1	8	3.4	0.5	0.5	3.1	21	-0.3	-1	9.5	27	(N/A)	4.5	9.07
Eastern red cedar	0.4	0.1	0.3	0.0	3	0.8	0.1	0.1	0.7	5	-1.3	-5	1.3	3	(N/A)	3.0	1.40
Sweetgum	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)	3.0	0.08
White ash	1.8	0.3	0.8	0.1	10	3.9	0.6	0.6	3.8	25	0.0	0	11.9	34	(N/A)	3.0	17.19
Oak	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)	1.5	0.08
Lilac	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)	1.5	0.11
American basswood	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)	1.5	0.08
Bur oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3	(N/A)	1.5	2.99
Black cherry	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)	1.5	2.55
Ohio buckeye	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)	1.5	7.92
Sugar maple	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.6	7	(N/A)	1.5	7.08
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)	1.5	0.07
Pin oak	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.3	-1	2.5	7	(N/A)	1.5	6.75
Pear	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)	1.5	0.11
Honeylocust	0.5	0.1	0.3	0.0	3	1.5	0.2	0.2	1.4	9	-0.4	-1	3.8	11	(N/A)	1.5	10.61
Siberian elm	1.7	0.3	0.8	0.1	9	2.3	0.3	0.3	2.2	15	0.0	0	8.0	23	(N/A)	1.5	23.37
Citywide total	23.7	3.9	11.2	1.1	126	48.8	7.1	6.8	46.6	305	-5.9	-22	143.3	409	(N/A)	100.0	6.10

Table 4: Annual Carbon Stored

Hills

Stored CO2 Benefits of Public Trees

2/18/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern hophornbeam	917	7	(N/A)	10.4	0.1	0.98
Eastern redbud	83	1	(N/A)	9.0	0.0	0.10
Silver maple	133,374	1,000	(N/A)	9.0	20.3	166.72
Cottonwood	335,892	2,519	(N/A)	9.0	51.2	419.86
Black maple	891	7	(N/A)	7.5	0.1	1.34
Green ash	66,763	501	(N/A)	7.5	10.2	100.14
Broadleaf Deciduous	69	1	(N/A)	7.5	0.0	0.10
Norway spruce	7	0	(N/A)	4.5	0.0	0.02
Eastern white pine	770	6	(N/A)	4.5	0.1	1.93
Norway maple	23,326	175	(N/A)	4.5	3.6	58.32
Eastern red cedar	1,379	10	(N/A)	3.0	0.2	5.17
Sweetgum	24	0	(N/A)	3.0	0.0	0.09
White ash	31,546	237	(N/A)	3.0	4.8	118.30
Oak	12	0	(N/A)	1.5	0.0	0.09
Lilac	14	0	(N/A)	1.5	0.0	0.10
American basswood	13	0	(N/A)	1.5	0.0	0.09
Bur oak	1,035	8	(N/A)	1.5	0.2	7.76
Black cherry	908	7	(N/A)	1.5	0.1	6.81
Ohio buckeye	3,624	27	(N/A)	1.5	0.6	27.18
Sugar maple	3,624	27	(N/A)	1.5	0.6	27.18
Ginkgo	5	0	(N/A)	1.5	0.0	0.03
Pin oak	3,595	27	(N/A)	1.5	0.5	26.96
Pear	14	0	(N/A)	1.5	0.0	0.10
Honeylocust	6,743	51	(N/A)	1.5	1.0	50.57
Siberian elm	41,265	309	(N/A)	1.5	6.3	309.48
Citywide total	655,890	4,919	(N/A)	100.0	100.0	73.42

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

Hills

Annual CO ₂ Benefits of Public Trees

2/18/2022

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 hophornbeam	207	2	-4	-3	0	197	1	396	3 (N/A)	10.4	1.1	0.42
Eastern redbud	52	0	-1	-1	0	34	0	84	1 (N/A)	9.0	0.2	0.10
Silver maple	8,934	67	-640	-23	-5	3,273	25	11,544	87 (N/A)	9.0	30.8	14.43
Cottonwood	2,873	22	-1,612	-35	-12	4,878	37	6,103	46 (N/A)	9.0	16.3	7.63
Black maple	158	1	-4	-3	0	248	2	399	3 (N/A)	7.5	1.1	0.60
Green ash	3,873	29	-320	-16	-3	2,602	20	6,138	46 (N/A)	7.5	16.4	9.21
Broadleaf Deciduous Smal	43	0	-1	-1	0	28	0	70	1 (N/A)	7.5	0.2	0.10
Norway spruce	11	0	0	-1	0	18	0	28	0 (N/A)	4.5	0.1	0.07
Eastern white pine	158	1	-4	-4	0	283	2	434	3 (N/A)	4.5	1.2	1.08
Norway maple	1,064	8	-112	-7	-1	1,154	9	2,099	16 (N/A)	4.5	5.6	5.25
Eastern red cedar	83	1	-7	-3	0	269	2	342	3 (N/A)	3.0	0.9	1.28
Sweetgum	5	0	0	0	0	9	0	13	0 (N/A)	3.0	0.0	0.05
White ash	2,630	20	-151	-7	-1	1,409	11	3,881	29 (N/A)	3.0	10.3	14.55
Oak	3	0	0	0	0	4	0	7	0 (N/A)	1.5	0.0	0.05
Lilac	9	0	0	0	0	6	0	14	0 (N/A)	1.5	0.0	0.10
American basswood	3	0	0	0	0	4	0	8	0 (N/A)	1.5	0.0	0.06
Bur oak	209	2	-5	-1	0	159	1	361	3 (N/A)	1.5	1.0	2.71
Black cherry	114	1	-4	-1	0	124	1	232	2 (N/A)	1.5	0.6	1.74
Ohio buckeye	386	3	-17	-2	0	395	3	762	6 (N/A)	1.5	2.0	5.71
Sugar maple	319	2	-17	-2	0	391	3	691	5 (N/A)	1.5	1.8	5.18
Ginkgo	2	0	0	0	0	4	0	6	0 (N/A)	1.5	0.0	0.04
Pin oak	473	4	-17	-2	0	411	3	865	6 (N/A)	1.5	2.3	6.49
Pear	9	0	0	0	0	6	0	14	0 (N/A)	1.5	0.0	0.10
Honeylocust	936	7	-32	-3	0	515	4	1,417	11 (N/A)	1.5	3.8	10.62
Siberian elm	983	7	-198	-6	-2	829	6	1,608	12 (N/A)	1.5	4.3	12.06
Citywide total	23,536	177	-3,149	-121	-25	17,250	129	37,516	281 (N/A)	100.0	100.0	4.20

Table 6: Annual Social and Aesthetic Benefits

Hills

Annual Aesthetic/Other Benefits of Public Trees

2/18/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern hophornbeam	10	(N/A)	10.4	0.5	1.48
Eastern redbud	0	(N/A)	9.0	0.0	0.03
Silver maple	671	(N/A)	9.0	32.4	111.87
Cottonwood	171	(N/A)	9.0	8.3	28.57
Black maple	29	(N/A)	7.5	1.4	5.83
Green ash	308	(N/A)	7.5	14.9	61.64
Broadleaf Deciduous Small	0	(N/A)	7.5	0.0	0.03
Norway spruce	17	(N/A)	4.5	0.8	5.76
Eastern white pine	46	(N/A)	4.5	2.2	15.42
Norway maple	101	(N/A)	4.5	4.9	33.58
Eastern red cedar	35	(N/A)	3.0	1.7	17.51
Sweetgum	11	(N/A)	3.0	0.5	5.26
White ash	253	(N/A)	3.0	12.2	126.36
Oak	5	(N/A)	1.5	0.3	5.26
Lilac	0	(N/A)	1.5	0.0	0.03
American basswood	2	(N/A)	1.5	0.1	1.78
Bur oak	29	(N/A)	1.5	1.4	28.56
Black cherry	6	(N/A)	1.5	0.3	6.40
Ohio buckeye	39	(N/A)	1.5	1.9	39.16
Sugar maple	40	(N/A)	1.5	1.9	39.54
Ginkgo	0	(N/A)	1.5	0.0	0.37
Pin oak	48	(N/A)	1.5	2.3	47.55
Pear	0	(N/A)	1.5	0.0	0.03
Honeylocust	195	(N/A)	1.5	9.4	194.60
Siberian elm	54	(N/A)	1.5	2.6	54.03
Citywide total	2,071	(N/A)	100.0	100.0	30.90

Table 7: Summary of Benefits in Dollars

Hills

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

2/18/2022

Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	2,136	(N/A)	31.88	(N/A)	0.00	(N/A)
CO2	281	(N/A)	4.20	(N/A)	0.00	(N/A)
Air Quality	409	(N/A)	6.10	(N/A)	0.00	(N/A)
Stormwater	3,487	(N/A)	52.04	(N/A)	0.00	(N/A)
Aesthetic/Other	2,071	(N/A)	30.90	(N/A)	0.00	(N/A)
Total Benefits	8,384	(N/A)	125.13	(N/A)	0.00	(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	8,384	(N/A)	125.13	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Species Distribution of Public Trees

2/18/2022
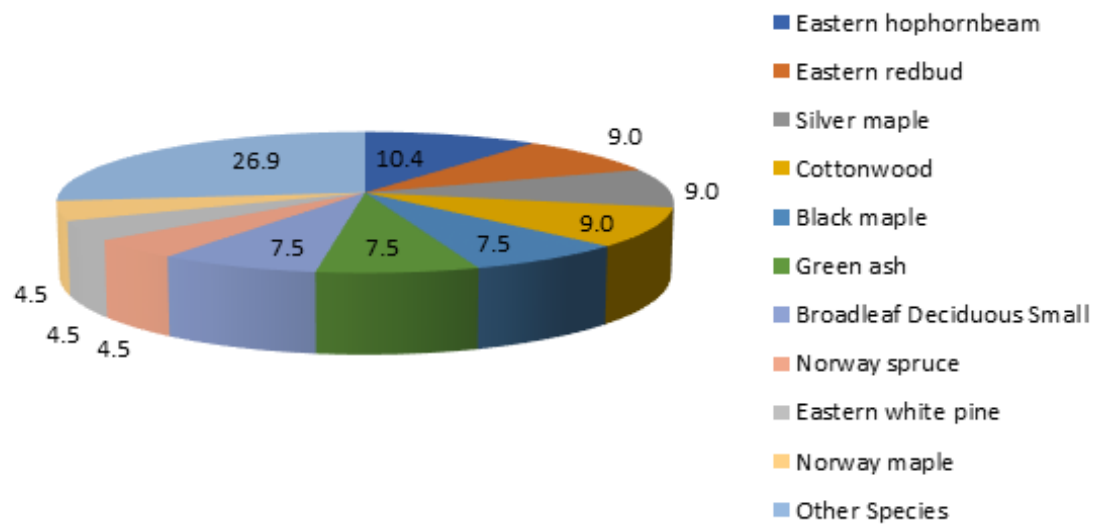
Species	Percent
Eastern hophornbeam	10.4
Eastern redbud	9.0
Silver maple	9.0
Cottonwood	9.0
Black maple	7.5
Green ash	7.5
Broadleaf Deciduous Small	7.5
Norway spruce	4.5
Eastern white pine	4.5
Norway maple	4.5
Other Species	26.9
Total	100.0

Figure 2: Relative Age Class

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

2/18/2022
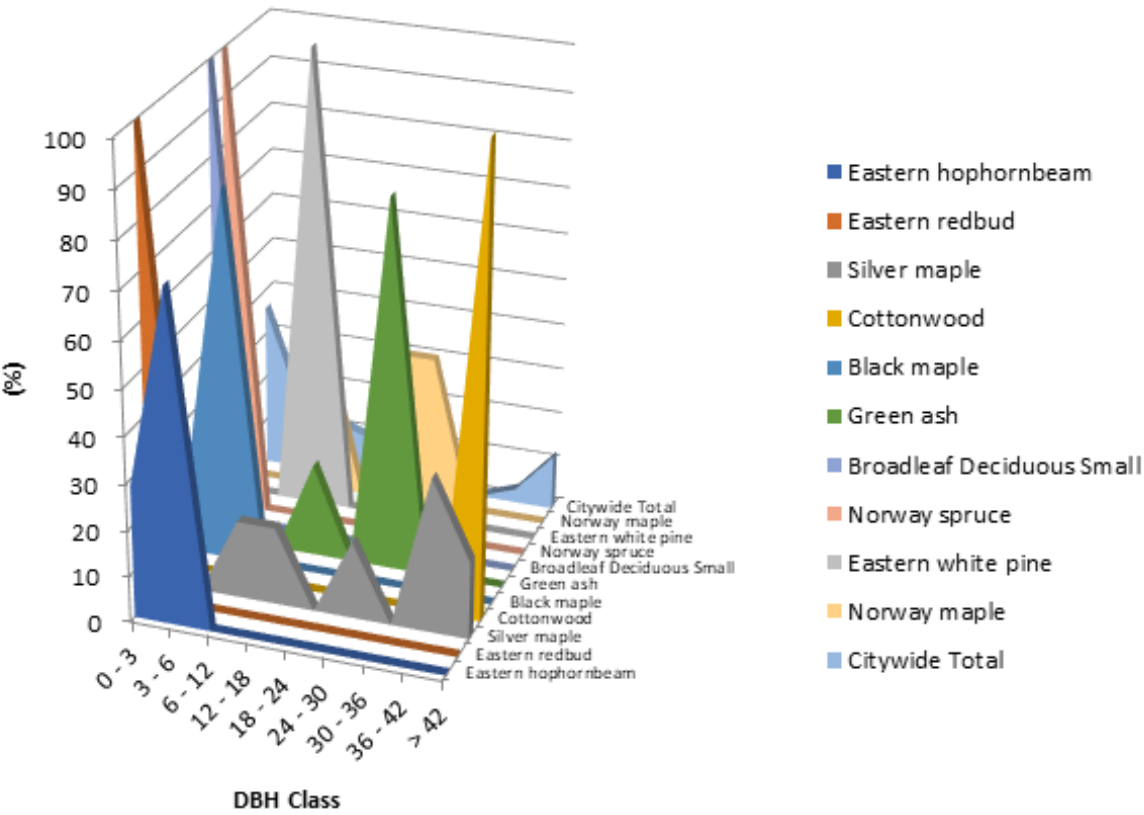
Species	DBH class	(in)							
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Eastern hophornbeam	28.57	71.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eastern redbud	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silver maple	0.00	0.00	16.67	16.67	0.00	16.67	0.00	33.33	16.67
Cottonwood	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Black maple	20.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Green ash	0.00	0.00	0.00	20.00	0.00	80.00	0.00	0.00	0.00
Broadleaf Deciduous Sm	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Norway spruce	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eastern white pine	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Norway maple	0.00	0.00	33.33	0.00	33.33	33.33	0.00	0.00	0.00
Citywide Total	35.82	13.43	11.94	8.96	2.99	11.94	0.00	2.99	11.94

Figure 3: Foliage Condition

Foliage Condition

Poor
3%

Dead or Dying
0%

Fair
29%

Good
68%

■ Good ■ Fair ■ Poor ■ Dead or Dying

Figure 4: Wood Condition

Wood Condition

Legend: Good · Fair · Poor · Dead or Dying
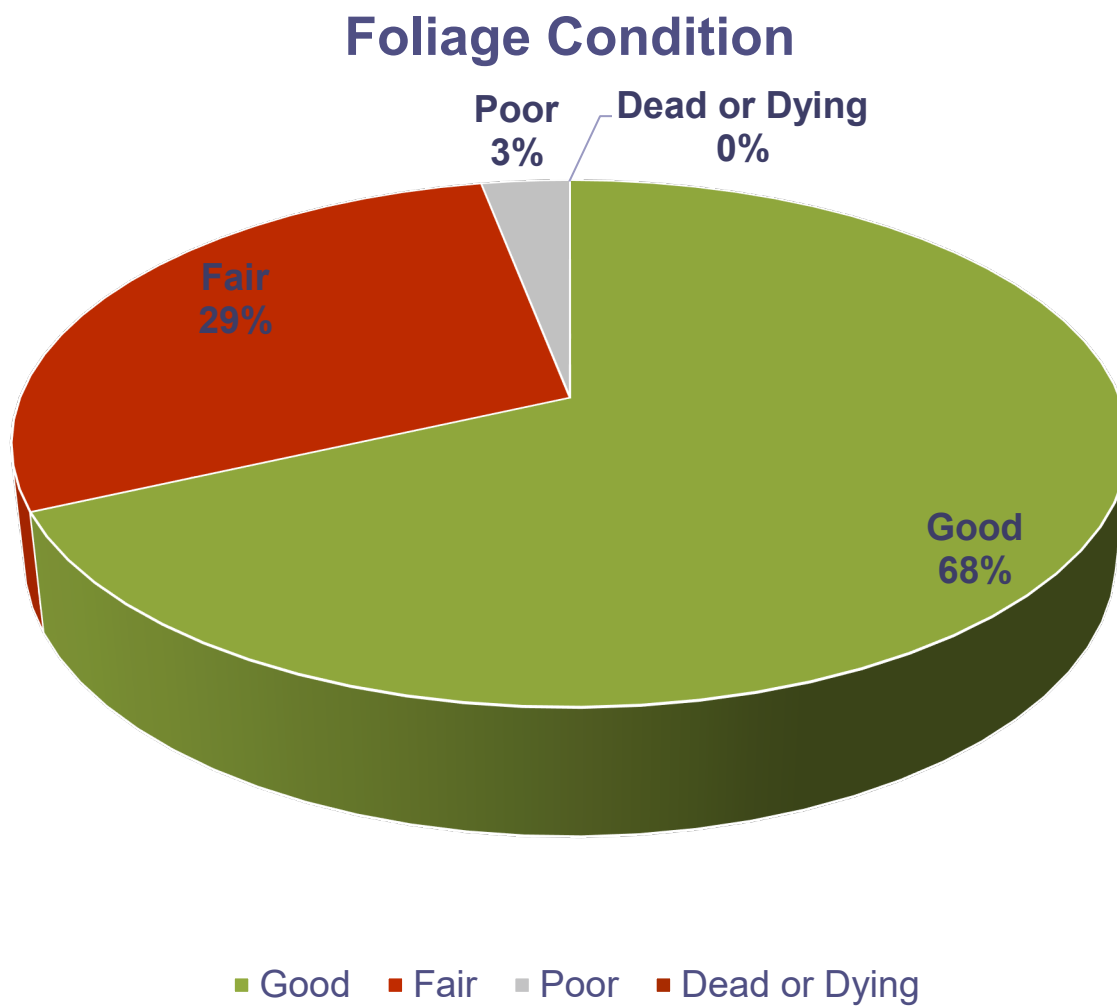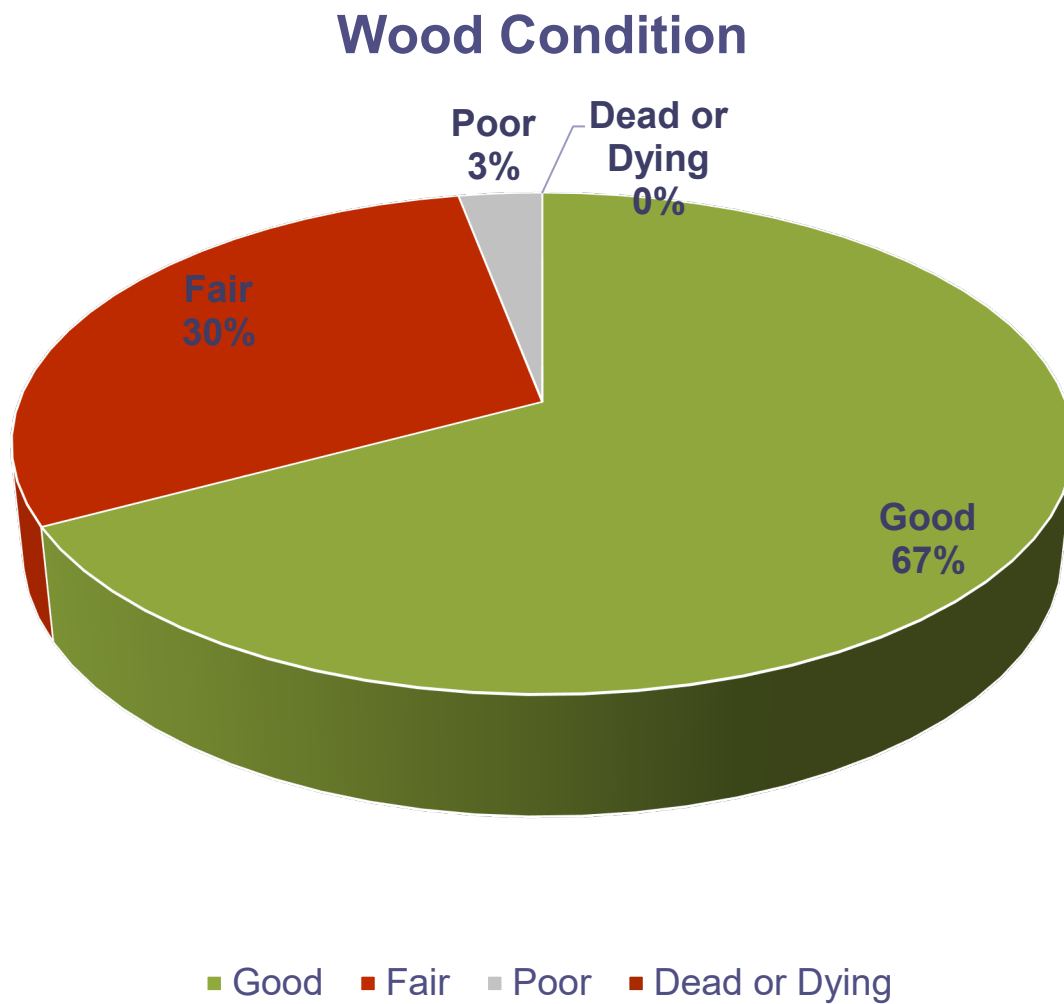
Figure 5: Canopy Cover in Acres

Hills

Canopy Cover of Public Trees (Acres)

2/18/2022
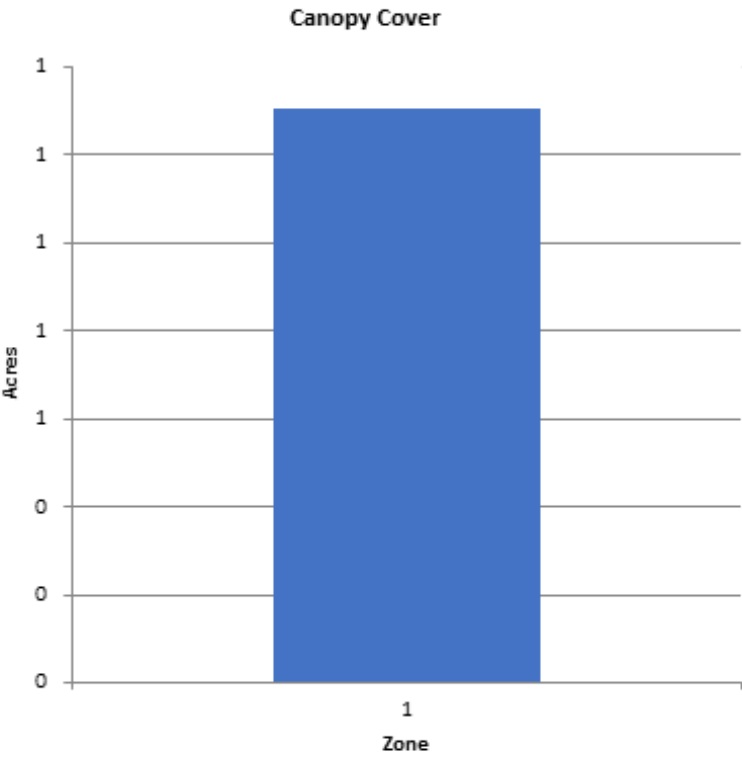
Canopy Cover

Zone	Acres	% of Total Canopy Cover
1	1	100.0
Citywide total	1	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	1	0.00	0.00

Figure 6: Land Use of City/Park Trees

Land Use of Public Trees
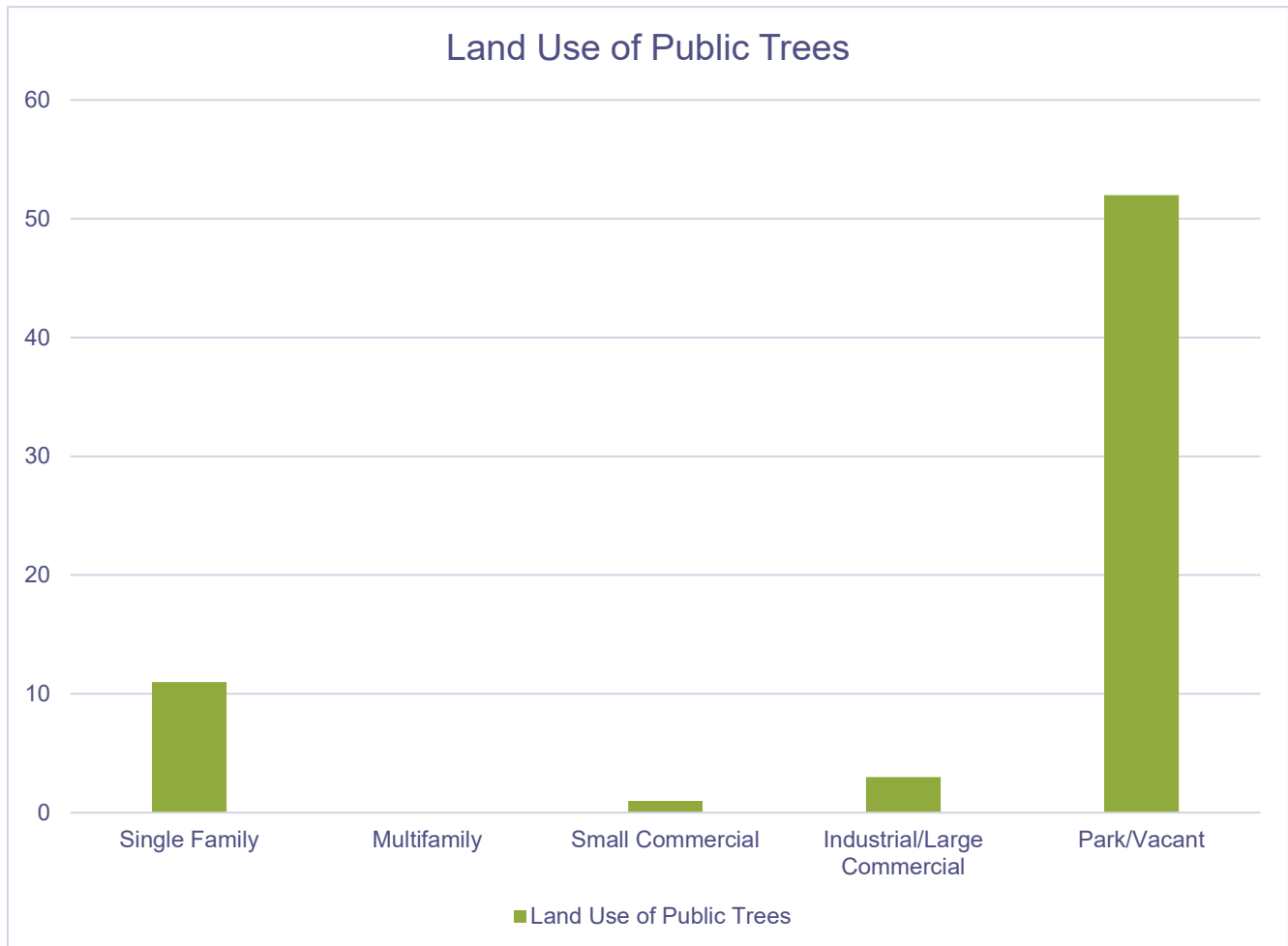
APPENDIX B: ArcGIS MAPPING

Figure 1: Location of Ash Trees

Figure 2: Location of EAB Symptoms

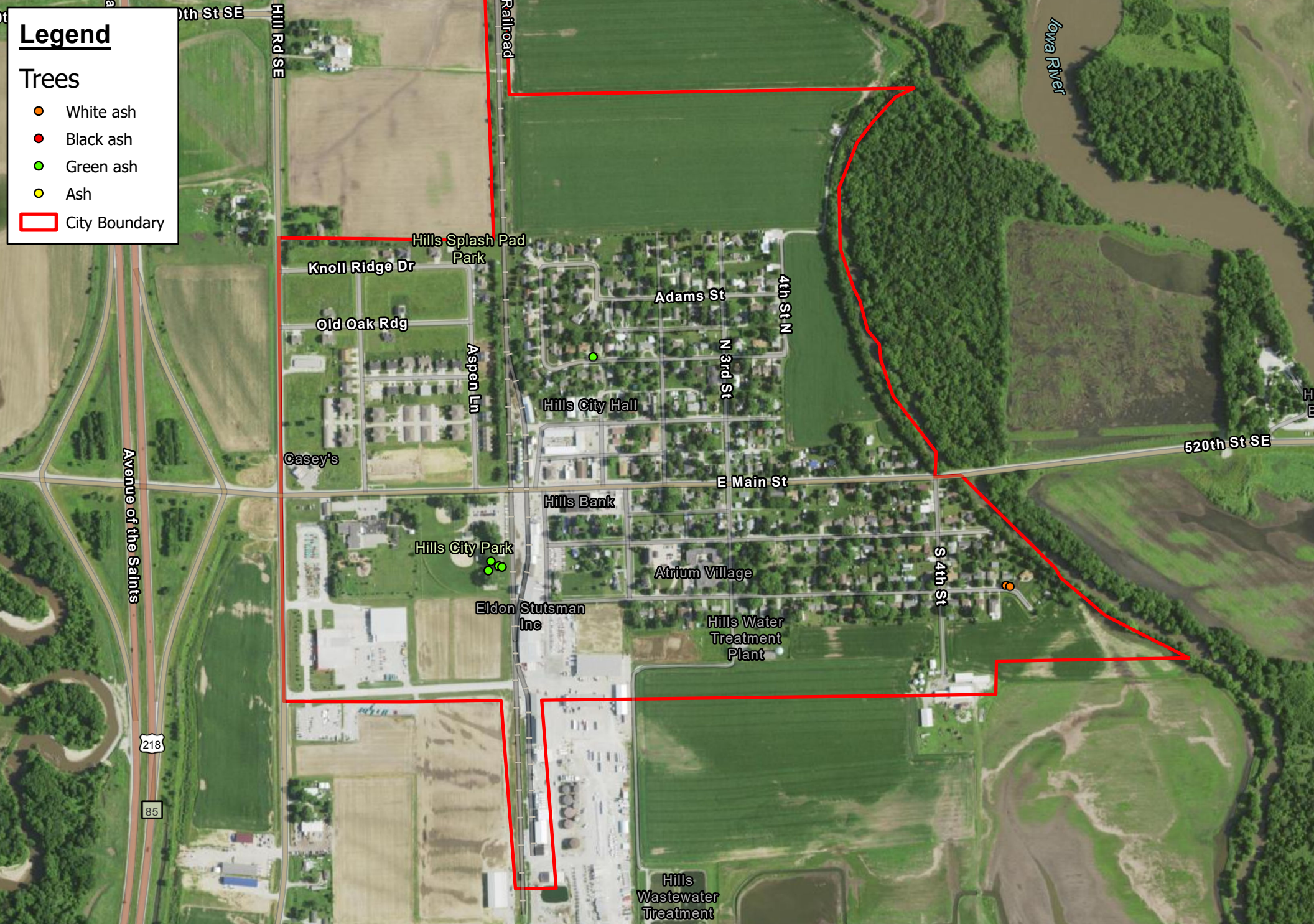**Figure 3: Location of Poor Condition Trees**

Figure 4: Location of Trees with Recommended Maintenance

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

Legend

Trees
- ● White ash
- ● Black ash
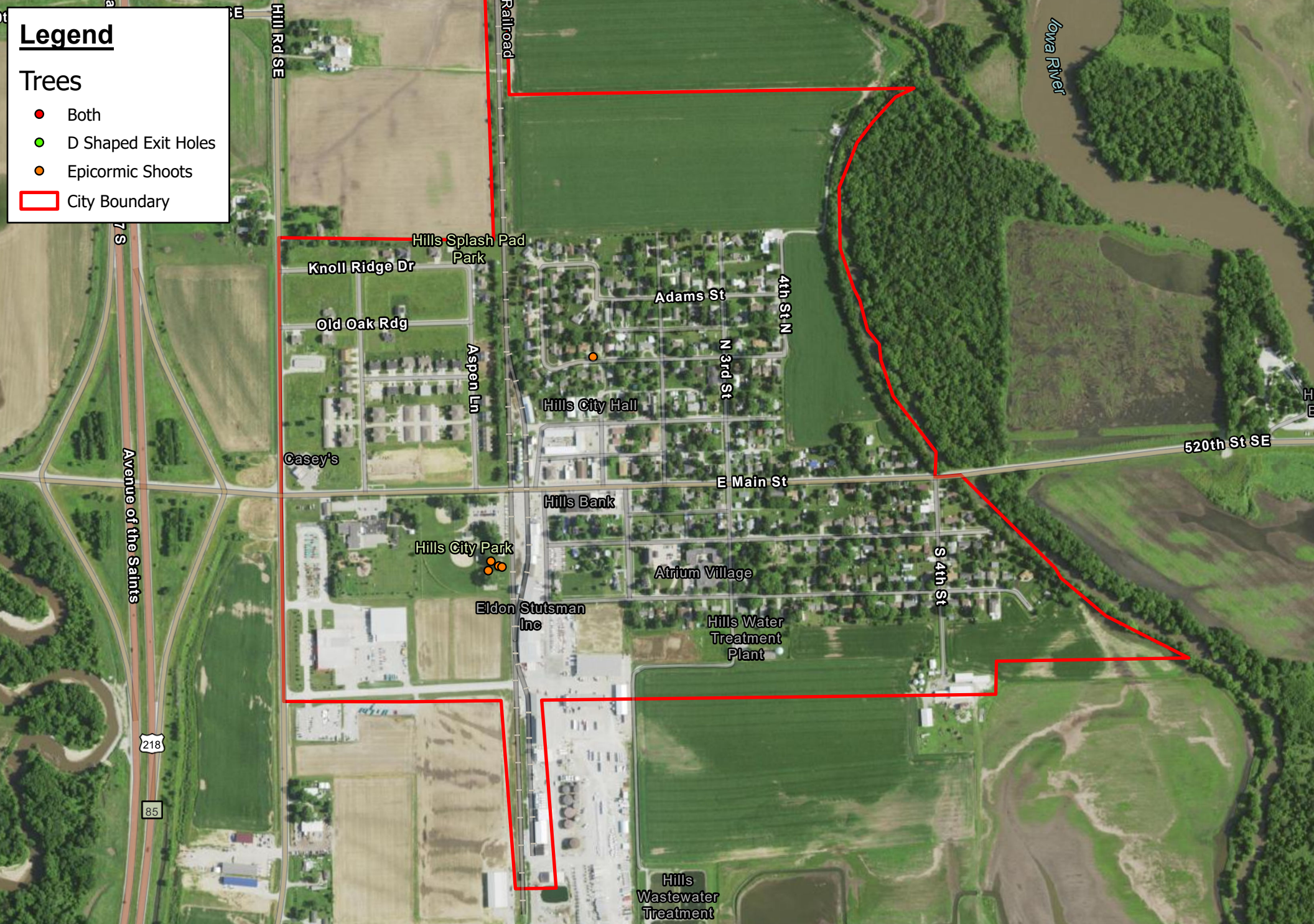- ● Green ash
- ● Ash
- ▭ City Boundary

Ash Tree Location

0 360 720 1,440 Feet

Legend

Trees

- 🔴 Both
- 🟢 D Shaped Exit Holes
- 🟠 Epicormic Shoots
- ⬜ City Boundary

EAB Signs/Symptoms

0   360   720   1,440 Feet

Legend

Trees
Wood Condition
- 🔴 Dead or Dying
- 🟢 Poor
- ▭ City Boundary

Iowa River

Hill Rd SE

Railroad

Hills Splash Pad Park

Knoll Ridge Dr

Adams St

4th St N

Old Oak Rdg

Aspen Ln

N 3rd St

Hills City Hall

520th St SE

Casey's

E Main St

Hills Bank

Hills City Park

Atrium Village

S 4th St

Eldon Stutsman Inc

Hills Water Treatment Plant

Avenue of the Saints

218

85

Hills Wastewater Treatment

Poor Condition Trees

N

0   360   720   1,440
Feet

500th St SE

Hill Rd SE

Railroad

Iowa River

Hills Splash Pad Park

Knoll Ridge Dr

Old Oak Rdg

Aspen Ln

Adams St

4th St N

N 3rd St

Hills City Hall

Casey's

E Main St

520th St SE

Hills Bank

Hills City Park

Atrium Village

S 4th St

Eldon Stutsman Inc

Hills Water Treatment Plant

218

85

Avenue of the Saints

Hills Wastewater Treatment

Priority Task

0   360   720   1,440
Feet

N

APPENDIX C: HILLS TREE ORDINANCES

151.01 DEFINITIONS

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 fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

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.

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.

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 515-725-8200.