Glenwood, 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 Glenwood 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 13% of Glenwood'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 718 trees inventoried.

- Glenwood's trees provide $169,096 of benefits annually, an average of $236 per tree
- There are over 52 species of trees
- The top three genera are: Maple 33%, Ash 13%, and Walnut 8%
- 70% of trees need some type of management
- 65 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 65 trees needing removal, 41 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*
- 44 of the 94 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 could take 6.5 years to remove ash. We suggest that city officials request a budget increase to $15,000 annually and apply for grants to plant replacement trees

Introduction

INTRODUCTION

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

Assist Glenwood with Managing its Urban Forest

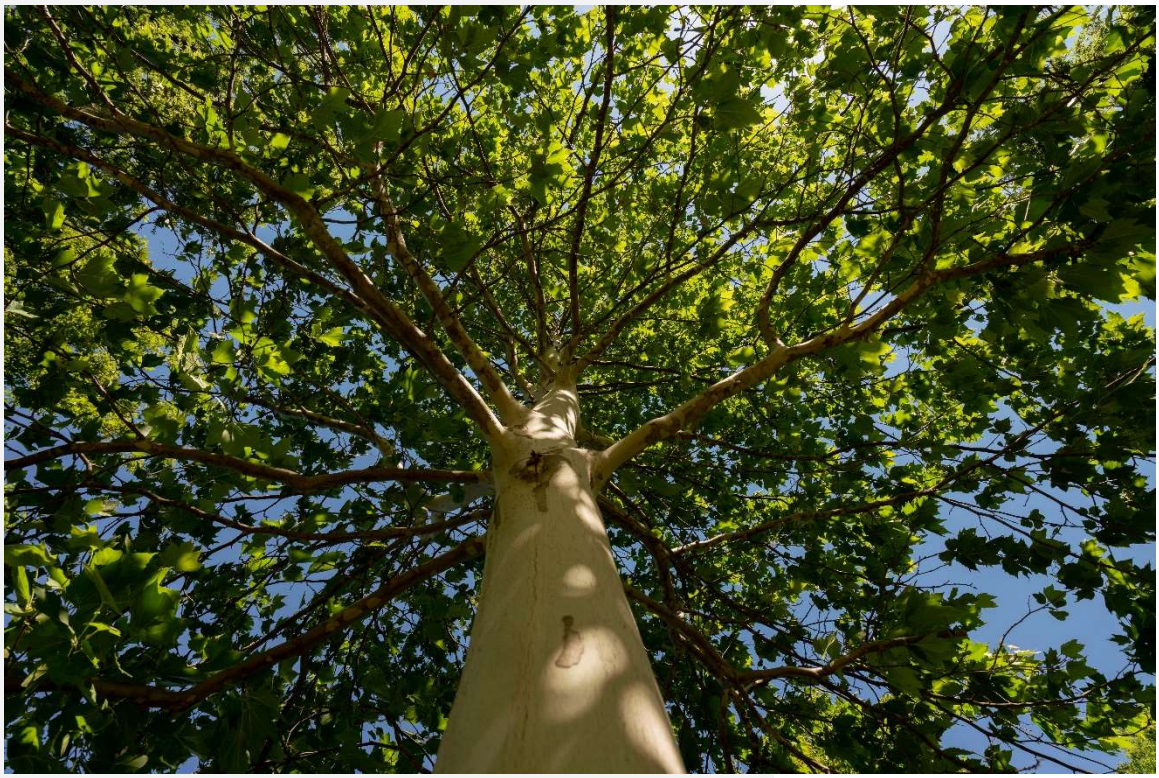
Inform on the Benefits of a Healthy Urban Forest

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 ArcGIS 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 718 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. Glenwood's trees reduce energy-related costs by approximately $45,530 annually (Appendix A, Table 1). These savings are both in electricity (202.9 MWh) and in natural gas (27,683 Therms).

Annual Stormwater Benefits

Glenwood's trees intercept about 2,475,980 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $67,099 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 Glenwood, it is estimated that trees remove 2,724 lb. 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 $7,697 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Glenwood, trees sequester about 513,515 lb. of carbon per year with an associated value of $3,851 (Appendix A, Table 5). In addition, the trees store 10,709,136 lb. of carbon, with a yearly benefit of $80,319 (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. Glenwood receives $45,768 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, Glenwood's trees provide $169,096 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 718 trees in Glenwood provide approximately $236 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$45,530**	• Intercept **2,475,980 gallons** • Provides **$67,099** benefit	• Remove **2,724 lbs** of pollution • Net value of **$7,697**	• Sequester **513,515 lb.** • Value of **$3,851** • Store **10,709,136 lb.** • Value of **$80,319**	• **$45,768** in social benefits	• **$169,096** annual benefits • Each tree provides **$236** annually

FOREST STRUCTURE

Species Distribution

Glenwood has over 52 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	236	33%
Ash	94	13%
Oak	55	8%
Walnut	61	8%
Hackberry	44	6%
Apple	38	5%
Locust	30	4%
Basswood/Linden	22	3%
Spruce	18	3%
Elm	17	2%
Pine	11	2%
Cottonwood	10	1%
Sycamore	6	<1%
Coffee Tree	5	<1%
Eastern Redbud	5	<1%

Mulberry	5	<1%
Buckeye	4	<1%
Cherry	3	<1%
Plum	3	<1%
Poplar	3	<1%
Catalpa	2	<1%
Cedar	2	<1%
Hickory	2	<1%
Birch	1	<1%
Buckthorn	1	<1%
Lilac	1	<1%
Pear	1	<1%
Tulip Tree	1	<1%
Willow	1	<1%
Other Conifers	22	3%

Age Class

Most of Glenwood's trees (37%) are between 12 and 28 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. Glenwood's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Glenwood indicate that 92% of the trees are in good health, with only 8% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 88% of Glenwood's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Twelve percent of the tree population's wood condition is in poor health, dead, or dying. This 12% 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	383	53%
Crown Reduction	18	3%
Tree Removal	65	9%
Crown Raising	40	6%
Tree Staking	0	0%

Canopy Cover

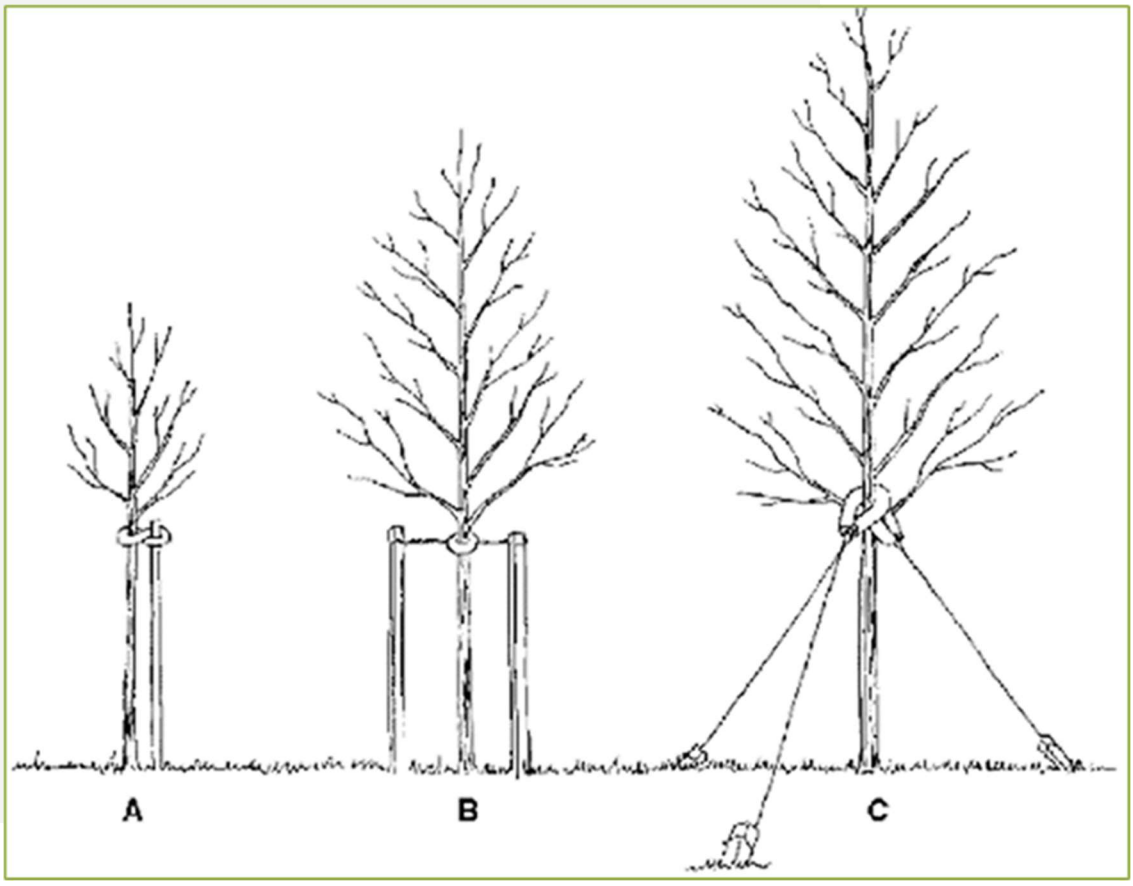
The total canopy with both private and public trees is 483 acres or 25% cover. The canopy cover included in the Glenwood inventory includes approximately 25 acres (Appendix A, Figure 4). The city's canopy goal is to increase canopy by 6% in 30 years. To achieve this goal, it is estimated that 9 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Glenwood'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	57%
Industrial/Large Commercial	42%
Park/Vacant/Other	0%
Small Commercial	0%
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

Glenwood has 65 critical concern 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 41 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 506 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 65 removals, 37 are ash trees. There are a total of 94 ash trees, and 44 of those have signs and symptoms that have been associated with EAB. In addition, there are 48 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising 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 Glenwood.

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 (33%) (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 planting along streets because they are public nuisances include: fruit-bearing trees or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, or evergreens 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 woodpecker 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 any fruit-bearing trees or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, or evergreens

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.

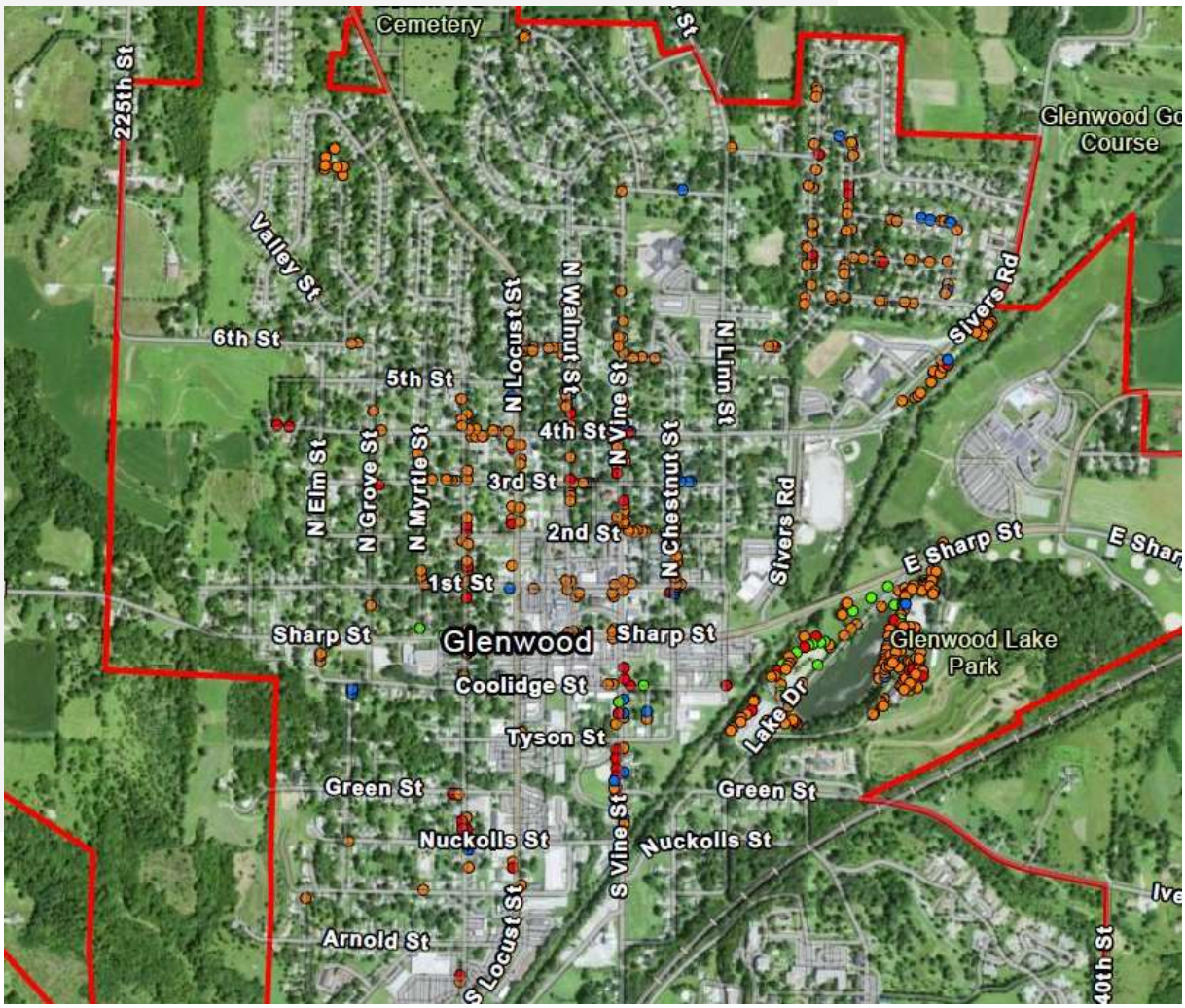
Monitoring

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, “If the Council upon inspection or examination in person or by some qualified person, shall determine with reasonable certainty that any condition as defined in Section 151.05 exists in or upon private property, including the strip between the curb and the lot line of private property, and he/she shall immediately notify by certified mail the owner, occupant or person in charge of such property, to correct such condition within fourteen (14) days of such 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 nuisance to be removed and the costs shall be assessed against the property.”

Schedule & Budget



PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $10,150/Year – (No budget provided, based off $2/resident estimation)

YEAR 1	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 9 trees in open locations	$1,350
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,145**

YEAR 2	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 9 trees in open locations	$1,350
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,145**

YEAR 3	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 9 trees in open locations	$1,350
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,145**

YEAR 4	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 9 trees in open locations	$1,350
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,145**

YEAR 5	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 9 trees in open locations	$1,350
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,145**

YEAR 6	Est. Cost
Remove 10 trees recommended for immediate removal	$7,000
Plant 9 trees in open locations	$1,350
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,145**

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 $11,000 a year. If the budget were increased to $15,000 a year all ash could be removed in 4.5 years.*

PROPOSED WORK SCHEDULE WITH INCREASED BUDGET

Budget Allowance of $15,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	Est. Cost
Remove 16 trees recommended for immediate removal	$11,200
Plant 13 trees in open locations	$1,950
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,945**

YEAR 2	Est. Cost
Remove 16 trees recommended for immediate removal	$11,200
Plant 13 trees in open locations	$1,950
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,945**

YEAR 3	Est. Cost
Remove 16 trees recommended for immediate removal	$11,200
Plant 13 trees in open locations	$1,950
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,945**

YEAR 4	Est. Cost
Remove 16 trees recommended for immediate removal	$11,200
Plant 13 trees in open locations	$1,950
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,945**

YEAR 5	Est. Cost
Remove 16 trees recommended for immediate removal	$11,200
Plant 13 trees in open locations	$1,950
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,945**

YEAR 6	Est. Cost
Remove 16 trees recommended for immediate removal	$11,200
Plant 13 trees in open locations	$1,950
Prune 1/6 of city owned trees	$1,795
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,945**

Purposed Budget Increase

EAB could potentially kill all ash trees in Glenwood within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $11,000 a year. If the

budget were increased to $15,000 per year all ash could be removed within 4.5 years. Additionally, we recommend that Glenwood 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 Glenwood would still need to find $63,000 for removal. Alternatively, if there are 8 treatable trees, it would cost approximately $2,400 a year for treatment and leave $60,200 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 Glenwood. 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

Glenwood

Annual Energy Benefits of Public Trees

4/1/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	41.0	3,110	5,424.2	5,316	8,426	(N/A)	15.5	19.8	75.91
Green ash	24.5	1,858	3,384.9	3,317	5,175	(N/A)	10.4	12.2	69.01
Red maple	12.5	945	1,589.5	1,558	2,503	(N/A)	8.5	5.9	41.03
Black walnut	18.8	1,426	2,592.6	2,541	3,966	(N/A)	8.5	9.3	65.02
Norway maple	11.4	866	1,625.1	1,593	2,458	(N/A)	6.8	5.8	50.16
Northern hackberry	18.3	1,387	2,532.9	2,482	3,869	(N/A)	6.1	9.1	87.93
Apple	5.7	432	838.0	821	1,253	(N/A)	5.3	2.9	32.97
Honeylocust	9.3	704	1,244.2	1,219	1,923	(N/A)	4.0	4.5	66.31
Bur oak	7.7	582	1,042.9	1,022	1,604	(N/A)	3.8	3.8	59.42
Conifer Evergreen Large	2.9	222	384.0	376	598	(N/A)	2.8	1.4	29.91
American basswood	5.8	442	827.4	811	1,253	(N/A)	2.6	2.9	65.92
White ash	5.5	415	740.0	725	1,140	(N/A)	2.6	2.7	60.01
Northern red oak	3.9	293	541.3	530	823	(N/A)	2.2	1.9	51.44
Pear	2.6	200	384.9	377	578	(N/A)	2.2	1.4	36.10
Blue spruce	1.8	140	246.3	241	381	(N/A)	2.1	0.9	25.40
Sugar maple	2.8	210	380.7	373	583	(N/A)	1.8	1.4	44.88
Cottonwood	4.8	364	626.9	614	979	(N/A)	1.4	2.3	97.87
Swamp white oak	2.1	157	283.0	277	434	(N/A)	1.3	1.0	48.27
Chinese elm	3.0	224	399.5	392	616	(N/A)	1.0	1.4	87.95
American sycamore	2.1	161	279.6	274	435	(N/A)	0.8	1.0	72.53
Siberian elm	2.7	202	344.7	338	540	(N/A)	0.8	1.3	89.94
Kentucky coffeetree	1.5	114	197.9	194	308	(N/A)	0.7	0.7	61.54
Eastern white pine	0.9	67	118.1	116	183	(N/A)	0.7	0.4	36.63
Mulberry	0.7	57	120.5	118	175	(N/A)	0.7	0.4	34.96
Red pine	0.3	23	43.1	42	65	(N/A)	0.6	0.2	16.22
Ohio buckeye	0.7	54	102.8	101	154	(N/A)	0.6	0.4	38.60
Littleleaf linden	0.9	65	125.7	123	188	(N/A)	0.4	0.4	62.69
Black poplar	1.4	103	179.9	176	279	(N/A)	0.4	0.7	93.09
Spruce	0.3	20	38.7	38	58	(N/A)	0.4	0.1	19.21
Eastern redbud	0.5	35	69.1	68	102	(N/A)	0.4	0.2	34.15
Cherry plum	0.3	25	50.3	49	75	(N/A)	0.4	0.2	24.84
Hickory	0.6	47	80.7	79	126	(N/A)	0.3	0.3	63.12
Scotch pine	0.3	25	44.3	43	69	(N/A)	0.3	0.2	34.32
Eastern cottonwood	0.9	66	118.0	116	182	(N/A)	0.3	0.4	91.02
Eastern red cedar	0.2	12	24.4	24	36	(N/A)	0.3	0.1	18.02
Catalpa	0.8	58	105.8	104	162	(N/A)	0.3	0.4	80.97
Conifer Evergreen Medium	0.2	14	25.4	25	39	(N/A)	0.3	0.1	19.66
Kwanzan cherry	0.0	1	1.2	1	2	(N/A)	0.3	0.0	0.87
Northern pin oak	0.6	49	94.8	93	142	(N/A)	0.3	0.3	70.84
Black cherry	0.2	15	31.6	31	46	(N/A)	0.1	0.1	46.14
Birch	0.3	20	39.6	39	59	(N/A)	0.1	0.1	58.69
Callery pear	0.0	3	6.2	6	9	(N/A)	0.1	0.0	8.99
Pin oak	0.1	8	15.8	15	24	(N/A)	0.1	0.1	23.64
Black locust	0.3	24	47.4	46	71	(N/A)	0.1	0.2	70.84
Black maple	0.3	22	39.9	39	61	(N/A)	0.1	0.1	60.68
American elm	0.6	45	71.2	70	114	(N/A)	0.1	0.3	114.45
Tulip tree	0.4	29	53.7	53	82	(N/A)	0.1	0.2	82.02
Japanese tree lilac	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
River birch	0.3	24	47.4	46	71	(N/A)	0.1	0.2	70.84
Amur maple	0.1	6	12.8	13	18	(N/A)	0.1	0.0	18.19
Willow	0.3	24	47.4	46	71	(N/A)	0.1	0.2	70.84
Buckthorn	0.1	6	12.8	13	18	(N/A)	0.1	0.0	18.19
Total	202.9	15,401	27,683.0	27,129	42,530	(N/A)	100.0	100.0	59.23

Table 2: Annual Stormwater Benefits

Glenwood

Annual Stormwater Benefits of Public Trees

4/1/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	652,714	17,689	(N/A)	15.5	26.4	159.36
Green ash	316,182	8,569	(N/A)	10.4	12.8	114.25
Red maple	88,252	2,392	(N/A)	8.5	3.6	39.21
Black walnut	218,277	5,915	(N/A)	8.5	8.8	96.97
Norway maple	106,390	2,883	(N/A)	6.8	4.3	58.84
Northern hackberry	208,063	5,639	(N/A)	6.1	8.4	128.15
Apple	25,521	692	(N/A)	5.3	1.0	18.20
Honeylocust	101,050	2,738	(N/A)	4.0	4.1	94.43
Bur oak	94,816	2,570	(N/A)	3.8	3.8	95.17
Conifer Evergreen Large	56,728	1,537	(N/A)	2.8	2.3	76.87
American basswood	71,033	1,925	(N/A)	2.6	2.9	101.32
White ash	55,004	1,491	(N/A)	2.6	2.2	78.45
Northern red oak	43,155	1,169	(N/A)	2.2	1.7	73.09
Pear	11,800	320	(N/A)	2.2	0.5	19.99
Blue spruce	26,631	722	(N/A)	2.1	1.1	48.11
Sugar maple	31,404	851	(N/A)	1.8	1.3	65.46
Cottonwood	72,389	1,962	(N/A)	1.4	2.9	196.17
Swamp white oak	15,069	408	(N/A)	1.3	0.6	45.38
Chinese elm	45,628	1,237	(N/A)	1.0	1.8	176.65
American sycamore	29,281	794	(N/A)	0.8	1.2	132.25
Siberian elm	35,884	972	(N/A)	0.8	1.4	162.08
Kentucky coffeetree	16,704	453	(N/A)	0.7	0.7	90.53
Eastern white pine	21,388	580	(N/A)	0.7	0.9	115.92
Mulberry	4,051	110	(N/A)	0.7	0.2	21.96
Red pine	3,325	90	(N/A)	0.6	0.1	22.53
Ohio buckeye	5,060	137	(N/A)	0.6	0.2	34.28
Littleleaf linden	11,232	304	(N/A)	0.4	0.5	101.46
Black poplar	19,968	541	(N/A)	0.4	0.8	180.38
Spruce	4,160	113	(N/A)	0.4	0.2	37.58
Eastern redbud	2,105	57	(N/A)	0.4	0.1	19.02
Cherry plum	1,196	32	(N/A)	0.4	0.0	10.80
Hickory	6,956	189	(N/A)	0.3	0.3	94.25
Scotch pine	7,574	205	(N/A)	0.3	0.3	102.63
Eastern cottonwood	14,478	392	(N/A)	0.3	0.6	196.17
Eastern red cedar	2,294	62	(N/A)	0.3	0.1	31.08
Catalpa	11,182	303	(N/A)	0.3	0.5	151.51
Conifer Evergreen Medium	2,300	62	(N/A)	0.3	0.1	31.16
Kwanzan cherry	15	0	(N/A)	0.3	0.0	0.20
Northern pin oak	7,529	204	(N/A)	0.3	0.3	102.01
Black cherry	1,174	32	(N/A)	0.1	0.0	31.82
Birch	2,479	67	(N/A)	0.1	0.1	67.19
Callery pear	163	4	(N/A)	0.1	0.0	4.41
Pin oak	579	16	(N/A)	0.1	0.0	15.69
Black locust	3,764	102	(N/A)	0.1	0.2	102.01
Black maple	2,867	78	(N/A)	0.1	0.1	77.70
American elm	4,551	123	(N/A)	0.1	0.2	123.33
Tulip tree	5,491	149	(N/A)	0.1	0.2	148.79
Japanese tree lilac	69	2	(N/A)	0.1	0.0	1.86

Annual Stormwater Benefits of Public Trees

4/1/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
River birch	3,764	102	(N/A)	0.1	0.2	102.01
Amur maple	264	7	(N/A)	0.1	0.0	7.17
Willow	3,764	102	(N/A)	0.1	0.2	102.01
Buckthorn	264	7	(N/A)	0.1	0.0	7.17
Citywide total	2,475,980	67,099	(N/A)	100.0	100.0	93.45

Table 3: Annual Air Quality Benefits

Glenwood

Annual Air Quality Benefits of Public Trees

4/1/2022

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								
Silver maple	127.8	21.7	61.4	5.7	685	193.5	28.3	27.0	185.3	1,210	-68.8	-258	582.0	1,637	(N/A)	15.5	14.75
Green ash	45.6	7.3	20.9	2.0	240	117.2	17.0	16.2	110.9	729	0.0	0	337.3	970	(N/A)	10.4	12.93
Red maple	18.8	3.2	9.0	0.8	101	58.4	8.6	8.2	56.4	366	-6.7	-25	156.8	442	(N/A)	8.5	7.25
Black walnut	27.7	4.4	13.1	1.2	147	89.9	13.1	12.5	85.1	559	0.0	0	247.0	706	(N/A)	8.5	11.58
Norway maple	21.9	3.8	10.8	1.0	118	55.1	8.0	7.6	51.7	342	-5.1	-19	154.7	441	(N/A)	6.8	9.00
Northern hackberry	39.5	6.8	19.3	1.8	213	87.7	12.7	12.1	82.8	545	0.0	0	262.7	758	(N/A)	6.1	17.23
Apple	8.4	1.4	3.9	0.4	45	27.7	4.0	3.8	25.8	171	0.0	0	75.3	216	(N/A)	5.3	5.67
Honeylocust	19.6	3.2	9.0	0.9	104	43.9	6.4	6.1	42.0	274	-14.9	-56	116.3	322	(N/A)	4.0	11.11
Bur oak	14.6	2.3	6.7	0.7	77	36.6	5.3	5.1	34.8	228	0.0	0	106.0	305	(N/A)	3.8	11.29
Conifer Evergreen Large	6.6	1.3	5.4	0.8	43	13.8	2.0	1.9	13.2	86	-26.5	-100	18.5	30	(N/A)	2.8	1.50
American basswood	10.3	1.8	5.0	0.5	55	28.1	4.1	3.9	26.4	174	-8.6	-32	71.4	198	(N/A)	2.6	10.40
White ash	6.3	1.0	3.2	0.3	34	26.0	3.8	3.6	24.8	162	0.0	0	68.9	196	(N/A)	2.6	10.33
Northern red oak	9.4	1.6	4.5	0.4	51	18.5	2.7	2.6	17.5	115	-13.6	-51	43.6	115	(N/A)	2.2	7.16
Pear	3.9	0.6	1.8	0.2	21	12.8	1.8	1.8	12.0	79	0.0	0	34.9	100	(N/A)	2.2	6.25
Blue spruce	3.8	0.8	3.1	0.5	25	8.7	1.3	1.2	8.3	54	-9.9	-37	17.9	43	(N/A)	2.1	2.84
Sugar maple	4.6	0.8	2.3	0.2	25	13.2	1.9	1.8	12.6	82	-3.6	-13	33.7	94	(N/A)	1.8	7.20
Cottonwood	15.4	2.5	6.7	0.7	80	22.7	3.3	3.2	21.7	142	0.0	0	76.2	222	(N/A)	1.4	22.20
Swamp white oak	2.6	0.5	1.3	0.1	14	9.9	1.4	1.4	9.4	62	-0.7	-2	26.0	74	(N/A)	1.3	8.17
Chinese elm	7.5	1.2	3.3	0.3	39	14.1	2.0	2.0	13.4	88	0.0	0	43.8	127	(N/A)	1.0	18.13
American sycamore	5.3	0.8	2.3	0.2	27	10.0	1.5	1.4	9.6	63	0.0	0	31.2	90	(N/A)	0.8	15.04
Siberian elm	7.6	1.3	3.5	0.3	40	12.5	1.8	1.8	12.0	78	0.0	0	40.8	119	(N/A)	0.8	19.76
Kentucky coffeetree	2.1	0.3	1.0	0.1	11	7.1	1.0	1.0	6.8	44	0.0	0	19.5	56	(N/A)	0.7	11.14
Eastern white pine	2.6	0.5	2.1	0.3	17	4.2	0.6	0.6	4.0	26	-12.8	-48	2.1	-5	(N/A)	0.7	-0.97
Mulberry	1.4	0.2	0.6	0.1	7	3.7	0.5	0.5	3.4	23	0.0	0	10.5	30	(N/A)	0.7	6.03
Red pine	0.3	0.1	0.3	0.0	2	1.4	0.2	0.2	1.3	9	-1.0	-4	2.9	7	(N/A)	0.6	1.81
Ohio buckeye	0.8	0.1	0.4	0.0	5	3.4	0.5	0.5	3.2	21	-0.2	-1	8.8	25	(N/A)	0.6	6.25
Littleleaf linden	2.2	0.4	1.0	0.1	12	4.2	0.6	0.6	3.9	26	-1.0	-4	11.9	34	(N/A)	0.4	11.21
Black poplar	4.0	0.6	1.7	0.2	21	6.4	0.9	0.9	6.1	40	0.0	0	20.9	61	(N/A)	0.4	20.27
Spruce	0.4	0.1	0.4	0.1	3	1.3	0.2	0.2	1.2	8	-1.7	-6	2.1	4	(N/A)	0.4	1.47
Eastern redbud	0.7	0.1	0.3	0.0	4	2.2	0.3	0.3	2.1	14	0.0	0	6.1	17	(N/A)	0.4	5.82
Cherry plum	0.3	0.0	0.2	0.0	2	1.6	0.2	0.2	1.5	10	0.0	0	4.1	12	(N/A)	0.4	3.88
Hickory	0.9	0.1	0.4	0.0	5	2.9	0.4	0.4	2.8	18	0.0	0	8.1	23	(N/A)	0.3	11.57
Scotch pine	0.9	0.2	0.7	0.1	6	1.6	0.2	0.2	1.5	10	-4.2	-16	1.2	0	(N/A)	0.3	-0.06
Eastern cottonwood	2.3	0.4	1.0	0.1	12	4.2	0.6	0.6	4.0	26	0.0	0	13.1	38	(N/A)	0.3	19.04

Glenwood

Annual Air Quality Benefits of Public Trees

4/1/2022

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 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)	0.3	1.40
Catalpa	1.7	0.3	0.7	0.1	9	3.7	0.5	0.5	3.5	23	0.0	0	10.9	32	(N/A)	0.3	15.76
Conifer Evergreen Medium	0.3	0.1	0.2	0.0	2	0.9	0.1	0.1	0.9	6	-0.8	-3	1.8	4	(N/A)	0.3	2.21
Kwanzan cherry	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	0.11
Northern pin oak	1.7	0.3	0.8	0.1	9	3.1	0.5	0.4	2.9	19	-0.4	-1	9.5	27	(N/A)	0.3	13.58
Black cherry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8	(N/A)	0.1	8.35
Birch	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	0.1	10.16
Callery pear	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	0.1	1.21
Pin oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	-0.1	0	1.1	3	(N/A)	0.1	3.05
Black locust	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.1	13.58
Black maple	0.7	0.1	0.3	0.0	4	1.4	0.2	0.2	1.3	8	-0.2	-1	4.0	12	(N/A)	0.1	11.54
American elm	2.2	0.4	1.0	0.1	12	2.7	0.4	0.4	2.7	17	0.0	0	9.9	29	(N/A)	0.1	28.89
Tulip tree	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16	(N/A)	0.1	15.71
Japanese tree lilac	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)	0.1	0.71
River birch	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.1	13.58
Amur maple	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)	0.1	2.55
Willow	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.1	13.58
Buckthorn	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)	0.1	2.55
Citywide total	437.8	73.5	212.4	20.7	2,354	967.5	140.9	134.4	919.2	6,029	-183.0	-686	2,723.6	7,697	(N/A)	100.0	10.72

Table 4: Annual Carbon Stored

Glenwood

Stored CO2 Benefits of Public Trees

4/1/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	3,276,563	24,574	(N/A)	15.5	30.6	221.39
Green ash	1,517,145	11,379	(N/A)	10.4	14.2	151.71
Red maple	210,320	1,577	(N/A)	8.5	2.0	25.86
Black walnut	900,537	6,754	(N/A)	8.5	8.4	110.72
Norway maple	362,746	2,721	(N/A)	6.8	3.4	55.52
Northern hackberry	643,382	4,825	(N/A)	6.1	6.0	109.67
Apple	129,339	970	(N/A)	5.3	1.2	25.53
Honeylocust	249,895	1,874	(N/A)	4.0	2.3	64.63
Bur oak	494,156	3,706	(N/A)	3.8	4.6	137.27
Conifer Evergreen La	64,485	484	(N/A)	2.8	0.6	24.18
American basswood	388,374	2,913	(N/A)	2.6	3.6	153.31
White ash	143,593	1,077	(N/A)	2.6	1.3	56.68
Northern red oak	210,944	1,582	(N/A)	2.2	2.0	98.88
Pear	60,004	450	(N/A)	2.2	0.6	28.13
Blue spruce	27,994	210	(N/A)	2.1	0.3	14.00
Sugar maple	135,587	1,017	(N/A)	1.8	1.3	78.22
Cottonwood	543,096	4,073	(N/A)	1.4	5.1	407.32
Swamp white oak	43,057	323	(N/A)	1.3	0.4	35.88
Chinese elm	254,732	1,910	(N/A)	1.0	2.4	272.93
American sycamore	181,872	1,364	(N/A)	0.8	1.7	227.34
Siberian elm	185,120	1,388	(N/A)	0.8	1.7	231.40
Kentucky coffeetree	70,833	531	(N/A)	0.7	0.7	106.25
Eastern white pine	33,304	250	(N/A)	0.7	0.3	49.96
Mulberry	22,044	165	(N/A)	0.7	0.2	33.07
Red pine	1,940	15	(N/A)	0.6	0.0	3.64
Ohio buckeye	13,771	103	(N/A)	0.6	0.1	25.82
Littleleaf linden	45,717	343	(N/A)	0.4	0.4	114.29
Black poplar	137,907	1,034	(N/A)	0.4	1.3	344.77
Spruce	3,856	29	(N/A)	0.4	0.0	9.64
Eastern redbud	10,688	80	(N/A)	0.4	0.1	26.72
Cherry plum	4,853	36	(N/A)	0.4	0.0	12.13
Hickory	29,615	222	(N/A)	0.3	0.3	111.06
Scotch pine	10,833	81	(N/A)	0.3	0.1	40.62
Eastern cottonwood	78,517	589	(N/A)	0.3	0.7	294.44
Eastern red cedar	1,379	10	(N/A)	0.3	0.0	5.17
Catalpa	55,031	413	(N/A)	0.3	0.5	206.37
Conifer Evergreen M	1,402	11	(N/A)	0.3	0.0	5.26
Kwanzan cherry	28	0	(N/A)	0.3	0.0	0.10
Northern pin oak	28,560	214	(N/A)	0.3	0.3	107.10
Black cherry	6,743	51	(N/A)	0.1	0.1	50.57
Birch	7,945	60	(N/A)	0.1	0.1	59.59
Callery pear	218	2	(N/A)	0.1	0.0	1.64
Pin oak	1,025	8	(N/A)	0.1	0.0	7.68
Black locust	14,280	107	(N/A)	0.1	0.1	107.10
Black maple	7,945	60	(N/A)	0.1	0.1	59.59
American elm	41,265	309	(N/A)	0.1	0.4	309.48
Tulip tree	25,943	195	(N/A)	0.1	0.2	194.57
Japanese tree lilac	178	1	(N/A)	0.1	0.0	1.33
River birch	14,280	107	(N/A)	0.1	0.1	107.10
Amur maple	908	7	(N/A)	0.1	0.0	6.81
Willow	14,280	107	(N/A)	0.1	0.1	107.10
Buckthorn	908	7	(N/A)	0.1	0.0	6.81
Citywide total	10,709,136	80,319	(N/A)	100.0	100.0	111.86

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

Glenwood

Annual CO Benefits of Public Trees

4/1/2022

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
Silver maple	208,191	1,561	-15,729	-495	-122	68,726	515	260,693	1,955 (N/A)	15.5	32.6	17.61
Green ash	55,581	417	-7,282	-269	-57	41,066	308	89,096	668 (N/A)	10.4	11.1	8.91
Red maple	22,264	167	-1,010	-108	-8	20,887	157	42,034	315 (N/A)	8.5	5.3	5.17
Black walnut	45,307	340	-4,323	-197	-34	31,508	236	72,296	542 (N/A)	8.5	9.0	8.89
Norway maple	14,305	107	-1,743	-121	-14	19,128	143	31,569	237 (N/A)	6.8	3.9	4.83
Northern hackberry	24,956	187	-3,088	-184	-25	30,642	230	52,326	392 (N/A)	6.1	6.5	8.92
Apple	7,536	57	-621	-75	-5	9,541	72	16,381	123 (N/A)	5.3	2.0	3.23
Honeylocust	23,364	175	-1,199	-76	-10	15,552	117	37,640	282 (N/A)	4.0	4.7	9.73
Bur oak	15,702	118	-2,372	-85	-18	12,870	97	26,115	196 (N/A)	3.8	3.3	7.25
Conifer Evergreen Large	3,601	27	-310	-53	-3	4,903	37	8,141	61 (N/A)	2.8	1.0	3.05
American basswood	21,617	162	-1,864	-69	-14	9,762	73	29,447	221 (N/A)	2.6	3.7	11.62
White ash	14,496	109	-689	-48	-6	9,170	69	22,929	172 (N/A)	2.6	2.9	9.05
Northern red oak	1,550	12	-1,013	-51	-8	6,466	48	6,952	52 (N/A)	2.2	0.9	3.26
Pear	4,321	32	-288	-33	-2	4,427	33	8,427	63 (N/A)	2.2	1.1	3.95
Blue spruce	1,437	11	-134	-33	-1	3,086	23	4,355	33 (N/A)	2.1	0.5	2.18
Sugar maple	6,593	49	-652	-32	-5	4,649	35	10,558	79 (N/A)	1.8	1.3	6.09
Cottonwood	5,222	39	-2,607	-58	-20	8,051	60	10,608	80 (N/A)	1.4	1.3	7.96
Swamp white oak	3,563	27	-207	-19	-2	3,471	26	6,809	51 (N/A)	1.3	0.9	5.67
Chinese elm	5,944	45	-1,223	-34	-9	4,953	37	9,640	72 (N/A)	1.0	1.2	10.33
American sycamore	3,484	26	-873	-24	-7	3,562	27	6,148	46 (N/A)	0.8	0.8	7.69
Siberian elm	5,296	40	-889	-30	-7	4,460	33	8,837	66 (N/A)	0.8	1.1	11.05
Kentucky coffeetree	3,319	25	-340	-15	-3	2,514	19	5,478	41 (N/A)	0.7	0.7	8.22
Eastern white pine	956	7	-160	-18	-1	1,490	11	2,268	17 (N/A)	0.7	0.3	3.40
Mulberry	228	2	-106	-13	-1	1,253	9	1,362	10 (N/A)	0.7	0.2	2.04
Red pine	273	2	-9	-5	0	500	4	758	6 (N/A)	0.6	0.1	1.42
Ohio buckeye	1,304	10	-66	-7	-1	1,187	9	2,417	18 (N/A)	0.6	0.3	4.53
Littleleaf linden	1,118	8	-219	-12	-2	1,433	11	2,320	17 (N/A)	0.4	0.3	5.80
Black poplar	1,917	14	-662	-16	-5	2,276	17	3,515	26 (N/A)	0.4	0.4	8.79
Spruce	293	2	-19	-5	0	435	3	704	5 (N/A)	0.4	0.1	1.76
Eastern redbud	860	6	-51	-6	0	767	6	1,570	12 (N/A)	0.4	0.2	3.93
Cherry plum	495	4	-23	-4	0	557	4	1,025	8 (N/A)	0.4	0.1	2.56

Annual CO Benefits of Public Trees

4/1/2022

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
Hickory	1,405	11	-142	-6	-1	1,043	8	2,299	17 (N/A)	0.3	0.3	8.62
Scotch pine	187	1	-52	-7	0	557	4	686	5 (N/A)	0.3	0.1	2.57
Eastern cottonwood	1,824	14	-377	-10	-3	1,469	11	2,906	22 (N/A)	0.3	0.4	10.90
Eastern red cedar	40	0	-7	-3	0	269	2	299	2 (N/A)	0.3	0.0	1.12
Catalpa	1,769	13	-264	-9	-2	1,287	10	2,783	21 (N/A)	0.3	0.3	10.44
Conifer Evergreen Mediun	129	1	-7	-3	0	319	2	439	3 (N/A)	0.3	0.1	1.64
Kwanzan cherry	17	0	0	0	0	11	0	28	0 (N/A)	0.3	0.0	0.10
Northern pin oak	0	0	-137	-9	-1	1,077	8	932	7 (N/A)	0.3	0.1	3.49
Black cherry	0	0	-32	-4	0	335	3	299	2 (N/A)	0.1	0.0	2.24
Birch	470	4	-38	-3	0	440	3	869	7 (N/A)	0.1	0.1	6.52
Callery pear	96	1	-2	-1	0	65	0	158	1 (N/A)	0.1	0.0	1.18
Pin oak	163	1	-5	-1	0	180	1	337	3 (N/A)	0.1	0.0	2.53
Black locust	0	0	-69	-4	-1	539	4	466	3 (N/A)	0.1	0.1	3.49
Black maple	0	0	-38	-3	0	477	4	436	3 (N/A)	0.1	0.1	3.27
American elm	724	5	-198	-6	-2	987	7	1,507	11 (N/A)	0.1	0.2	11.31
Tulip tree	960	7	-125	-4	-1	650	5	1,481	11 (N/A)	0.1	0.2	11.11
Japanese tree lilac	38	0	-1	-1	0	37	0	74	1 (N/A)	0.1	0.0	0.55
River birch	0	0	-69	-4	-1	539	4	466	3 (N/A)	0.1	0.1	3.49
Amur maple	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Willow	370	3	-69	-4	-1	539	4	837	6 (N/A)	0.1	0.1	6.27
Buckthorn	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Citywide total	513,515	3,851	-51,410	-2,279	-403	340,358	2,553	800,184	6,001 (N/A)	100.0	100.0	8.36

Table 6: Annual Social and Aesthetic Benefits

Glenwood

Annual Aesthetic/Other Benefits of Public Trees

4/1/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	14,671	(N/A)	15.5	32.1	132.17
Green ash	4,230	(N/A)	10.4	9.2	56.40
Red maple	3,056	(N/A)	8.5	6.7	50.11
Black walnut	3,606	(N/A)	8.5	7.9	59.12
Norway maple	1,386	(N/A)	6.8	3.0	28.28
Northern hackberry	2,992	(N/A)	6.1	6.5	68.01
Apple	439	(N/A)	5.3	1.0	11.54
Honeylocust	5,315	(N/A)	4.0	11.6	183.29
Bur oak	1,256	(N/A)	3.8	2.7	46.51
Conifer Evergreen Large	876	(N/A)	2.8	1.9	43.82
American basswood	1,453	(N/A)	2.6	3.2	76.47
White ash	1,740	(N/A)	2.6	3.8	91.56
Northern red oak	116	(N/A)	2.2	0.3	7.22
Pear	254	(N/A)	2.2	0.6	15.87
Blue spruce	307	(N/A)	2.1	0.7	20.49
Sugar maple	682	(N/A)	1.8	1.5	52.49
Cottonwood	315	(N/A)	1.4	0.7	31.55
Swamp white oak	351	(N/A)	1.3	0.8	39.02
Chinese elm	394	(N/A)	1.0	0.9	56.30
American sycamore	256	(N/A)	0.8	0.6	42.75
Siberian elm	312	(N/A)	0.8	0.7	52.04
Kentucky coffeetree	273	(N/A)	0.7	0.6	54.67
Eastern white pine	126	(N/A)	0.7	0.3	25.17
Mulberry	13	(N/A)	0.7	0.0	2.56
Red pine	79	(N/A)	0.6	0.2	19.65
Ohio buckeye	135	(N/A)	0.6	0.3	33.66
Littleleaf linden	106	(N/A)	0.4	0.2	35.34
Black poplar	124	(N/A)	0.4	0.3	41.25
Spruce	78	(N/A)	0.4	0.2	25.97
Eastern redbud	51	(N/A)	0.4	0.1	16.89
Cherry plum	28	(N/A)	0.4	0.1	9.43
Hickory	112	(N/A)	0.3	0.2	56.23
Scotch pine	47	(N/A)	0.3	0.1	23.54
Eastern cottonwood	117	(N/A)	0.3	0.3	58.34
Eastern red cedar	21	(N/A)	0.3	0.0	10.67
Catalpa	124	(N/A)	0.3	0.3	61.96
Conifer Evergreen Medium	46	(N/A)	0.3	0.1	23.16
Kwanzan cherry	0	(N/A)	0.3	0.0	0.03
Northern pin oak	0	(N/A)	0.3	0.0	0.00
Black cherry	0	(N/A)	0.1	0.0	0.00
Birch	43	(N/A)	0.1	0.1	43.05
Callery pear	13	(N/A)	0.1	0.0	12.89
Pin oak	23	(N/A)	0.1	0.1	23.14
Black locust	0	(N/A)	0.1	0.0	0.00
Black maple	0	(N/A)	0.1	0.0	0.00
American elm	87	(N/A)	0.1	0.2	86.69
Tulip tree	67	(N/A)	0.1	0.1	66.60

Annual Aesthetic/Other Benefits of Public Trees

4/1/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Japanese tree lilac	2	(N/A)	0.1	0.0	2.06
River birch	0	(N/A)	0.1	0.0	0.00
Amur maple	6	(N/A)	0.1	0.0	6.40
Willow	31	(N/A)	0.1	0.1	31.46
Buckthorn	6	(N/A)	0.1	0.0	6.40
Citywide total	45,768	(N/A)	100.0	100.0	63.74

Table 7: Summary of Benefits in Dollars

Glenwood

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

4/1/2022

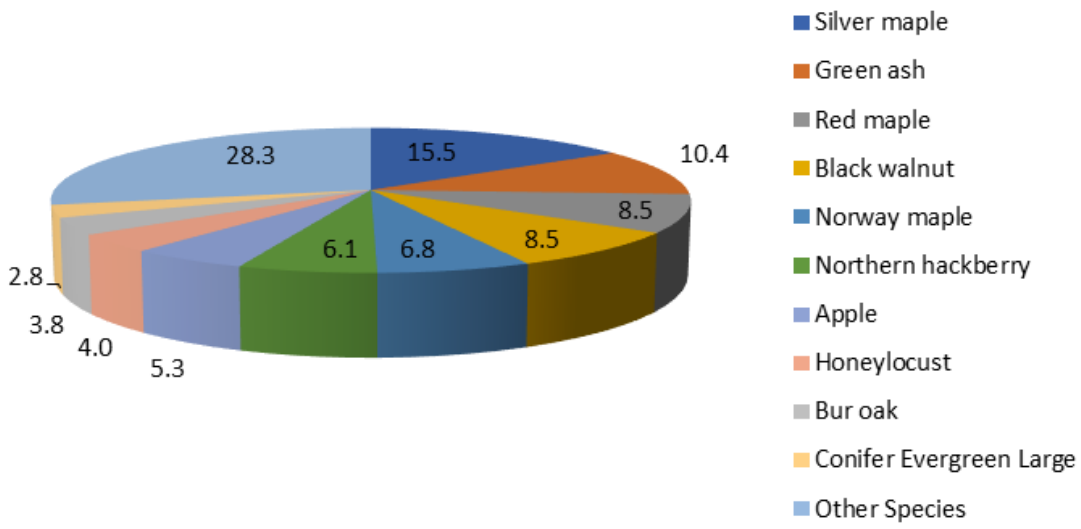
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	42,530	(N/A)	59.23	(N/A)	0.00	(N/A)
CO2	6,001	(N/A)	8.36	(N/A)	0.00	(N/A)
Air Quality	7,697	(N/A)	10.72	(N/A)	0.00	(N/A)
Stormwater	67,099	(N/A)	93.45	(N/A)	0.00	(N/A)
Aesthetic/Other	45,768	(N/A)	63.74	(N/A)	0.00	(N/A)
Total Benefits	169,096	(N/A)	235.51	(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	169,096	(N/A)	235.51	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Glenwood

Species Distribution of Public Trees

4/1/2022



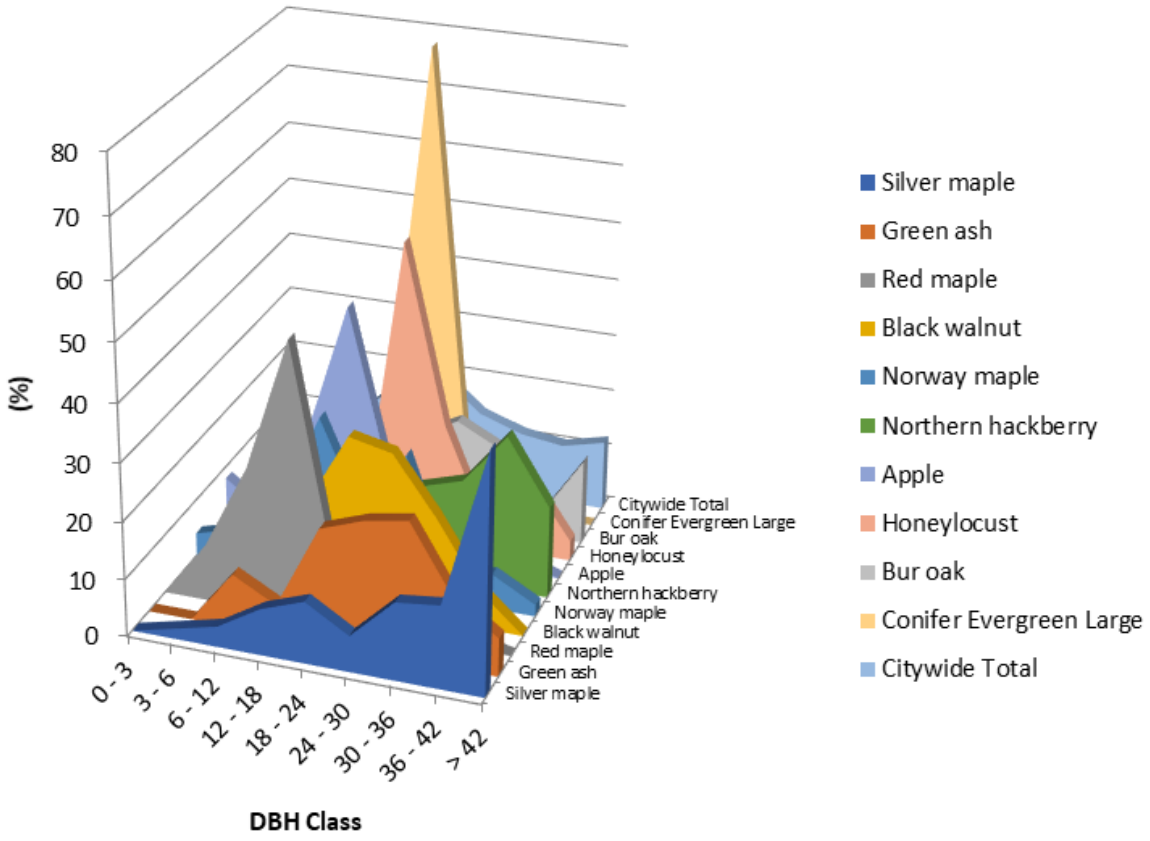
Species	Percent
Silver maple	15.5
Green ash	10.4
Red maple	8.5
Black walnut	8.5
Norway maple	6.8
Northern hackberry	6.1
Apple	5.3
Honeylocust	4.0
Bur oak	3.8
Conifer Evergreen Large	2.8
Other Species	28.3
Total	100.0

Figure 2: Relative Age Class

Glenwood

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

4/1/2022



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Silver maple	0.00	1.80	3.60	8.11	10.81	6.31	13.51	14.41	41.44
Green ash	0.00	0.00	9.33	5.33	20.00	22.67	24.00	12.00	6.67
Red maple	0.00	9.84	24.59	47.54	9.84	4.92	1.64	1.64	0.00
Black walnut	0.00	0.00	1.64	16.39	29.51	27.87	18.03	6.56	0.00
Norway maple	4.08	6.12	12.24	28.57	12.24	24.49	4.08	6.12	2.04
Northern hackberry	0.00	0.00	2.27	6.82	13.64	15.91	18.18	27.27	15.91
Apple	7.89	2.63	18.42	42.11	13.16	10.53	2.63	2.63	0.00
Honeylocust	0.00	0.00	6.90	0.00	51.72	20.69	3.45	13.79	3.45
Bur oak	3.70	7.41	11.11	11.11	14.81	18.52	14.81	3.70	14.81
Conifer Evergreen Large	0.00	0.00	0.00	15.00	80.00	5.00	0.00	0.00	0.00
Citywide Total	1.11	2.65	10.86	17.41	19.92	13.93	11.42	10.45	12.26

Figure 3: Foliage Condition

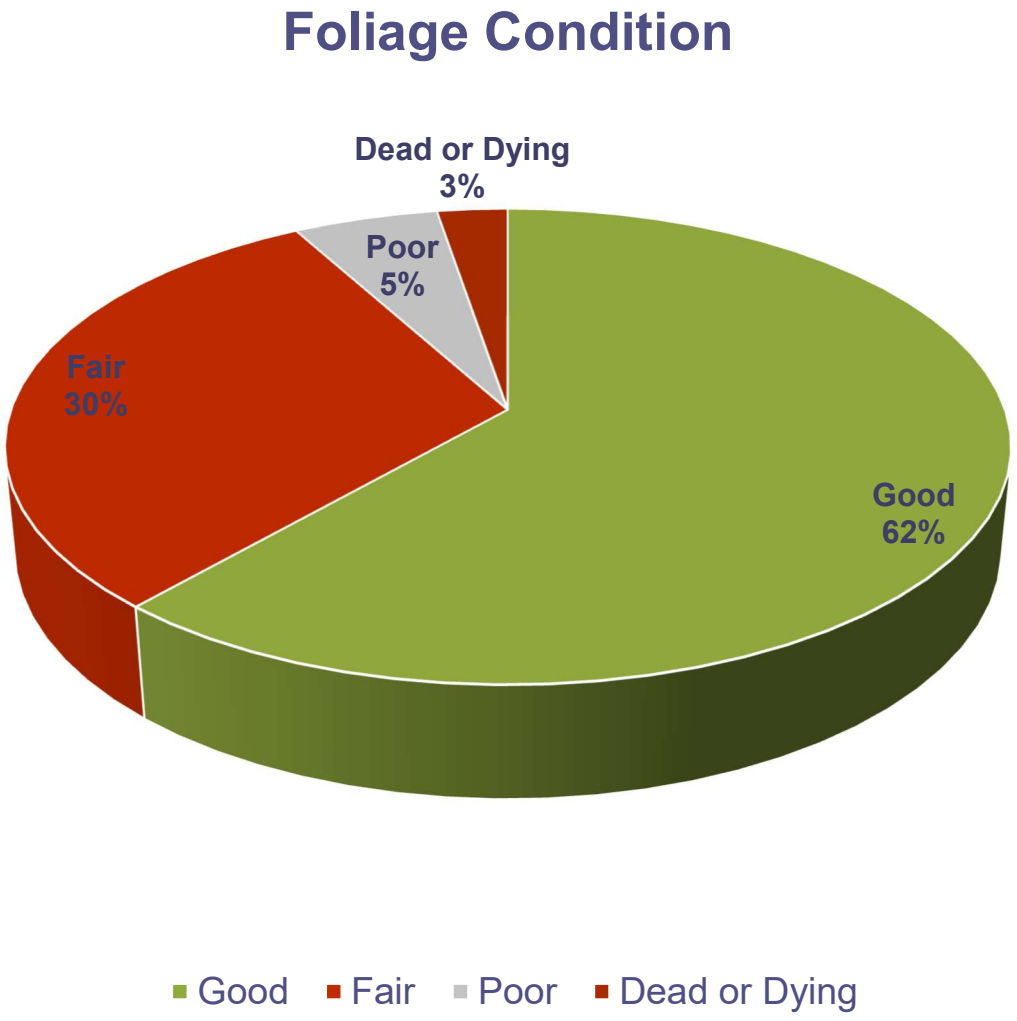


Figure 4: Wood Condition

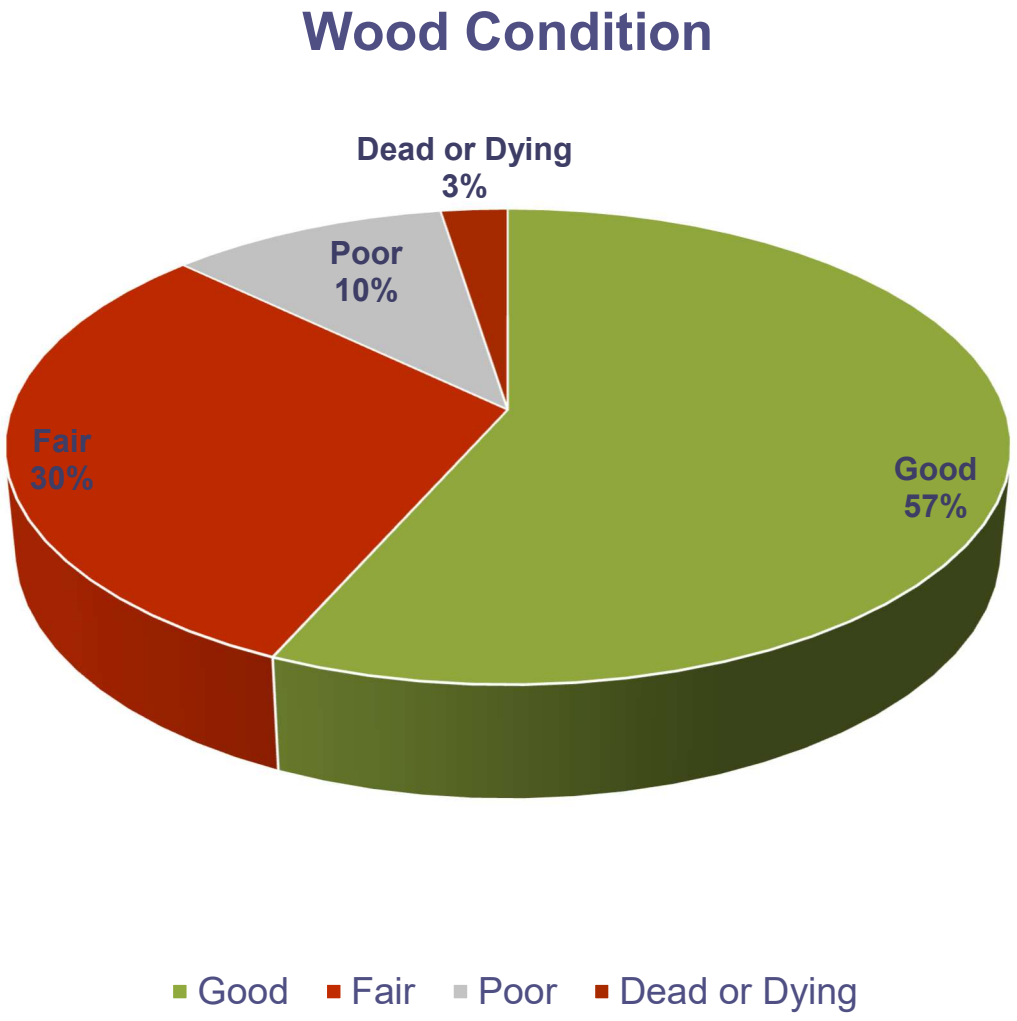
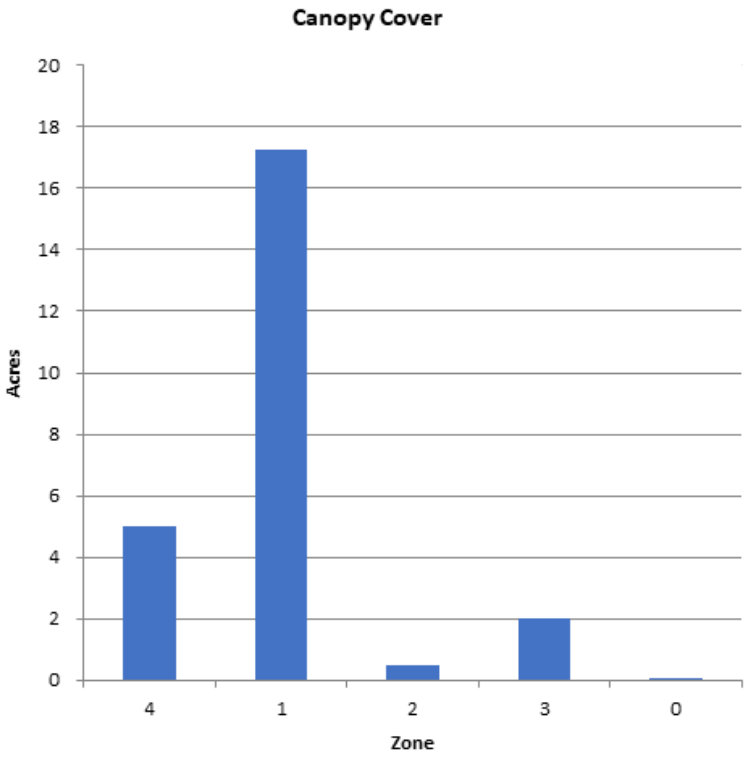


Figure 5: Canopy Cover in Acres

Glenwood

Canopy Cover of Public Trees (Acres)

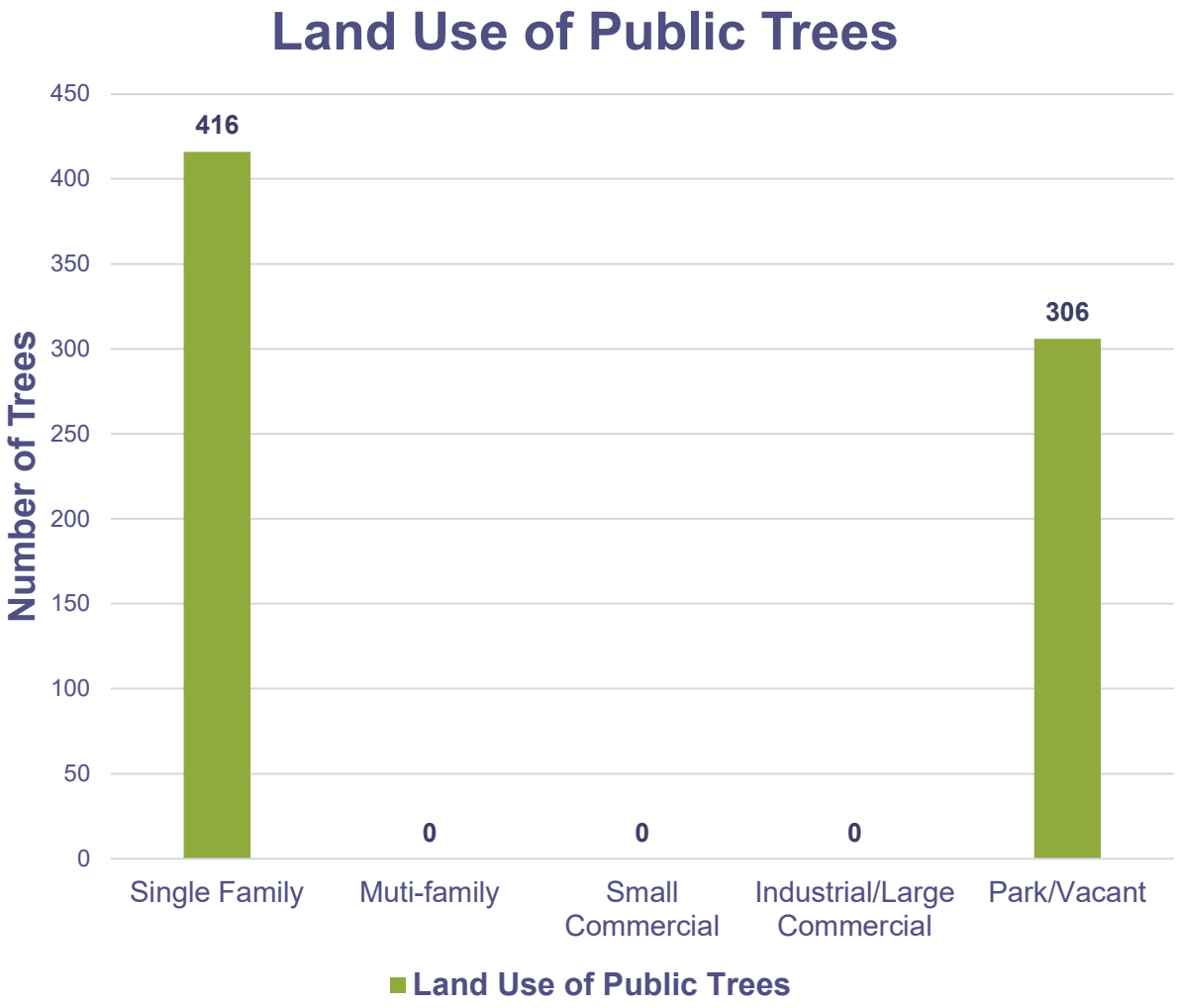
4/1/2022



Zone	Acres	% of Total Canopy Cover
4	5	20.1
1	17	69.7
2	1	2.0
3	2	8.0
0	0	0.1
Citywide total	25	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	25	0.00	0.00

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

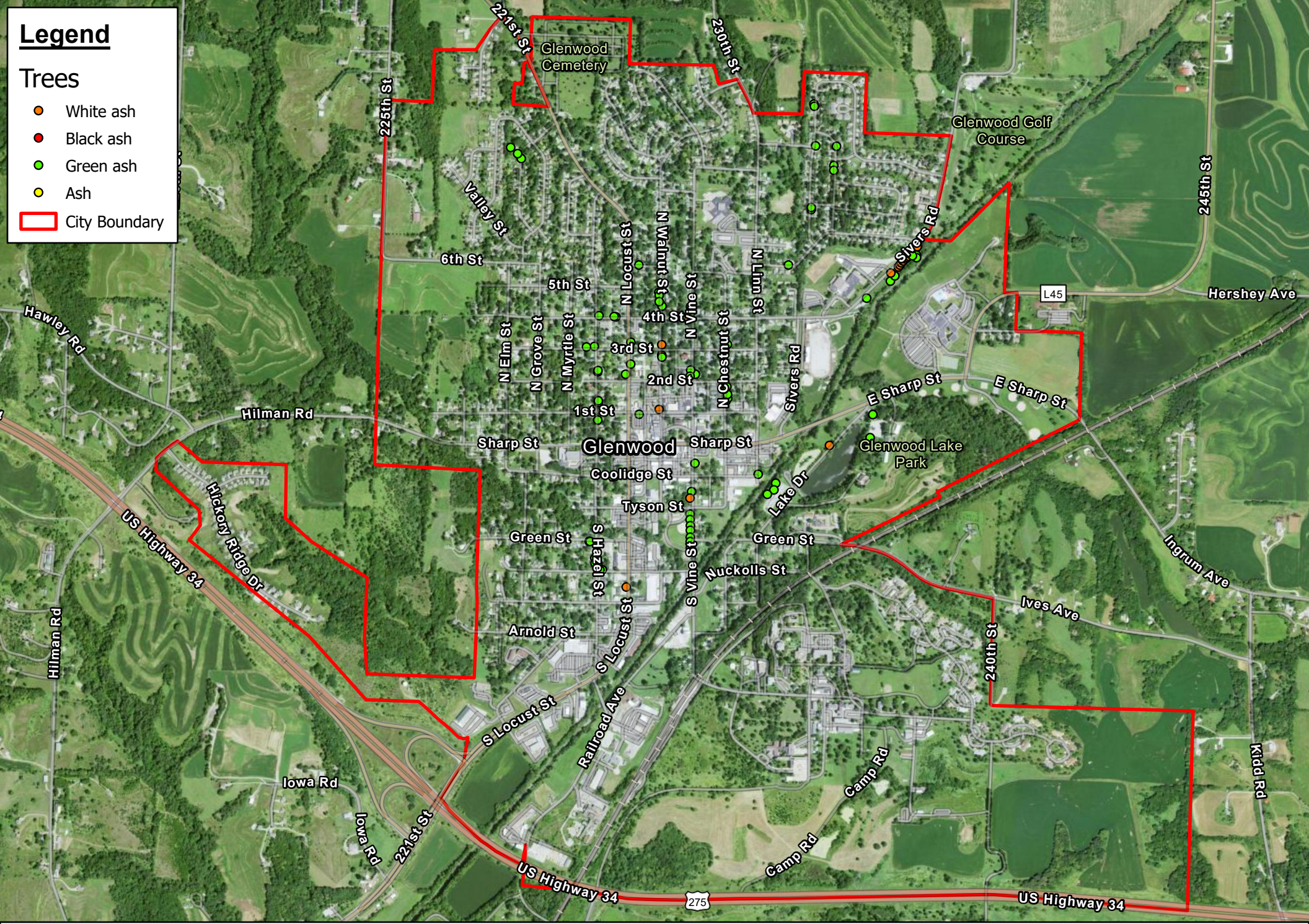
Figure 1: Location of Ash Trees

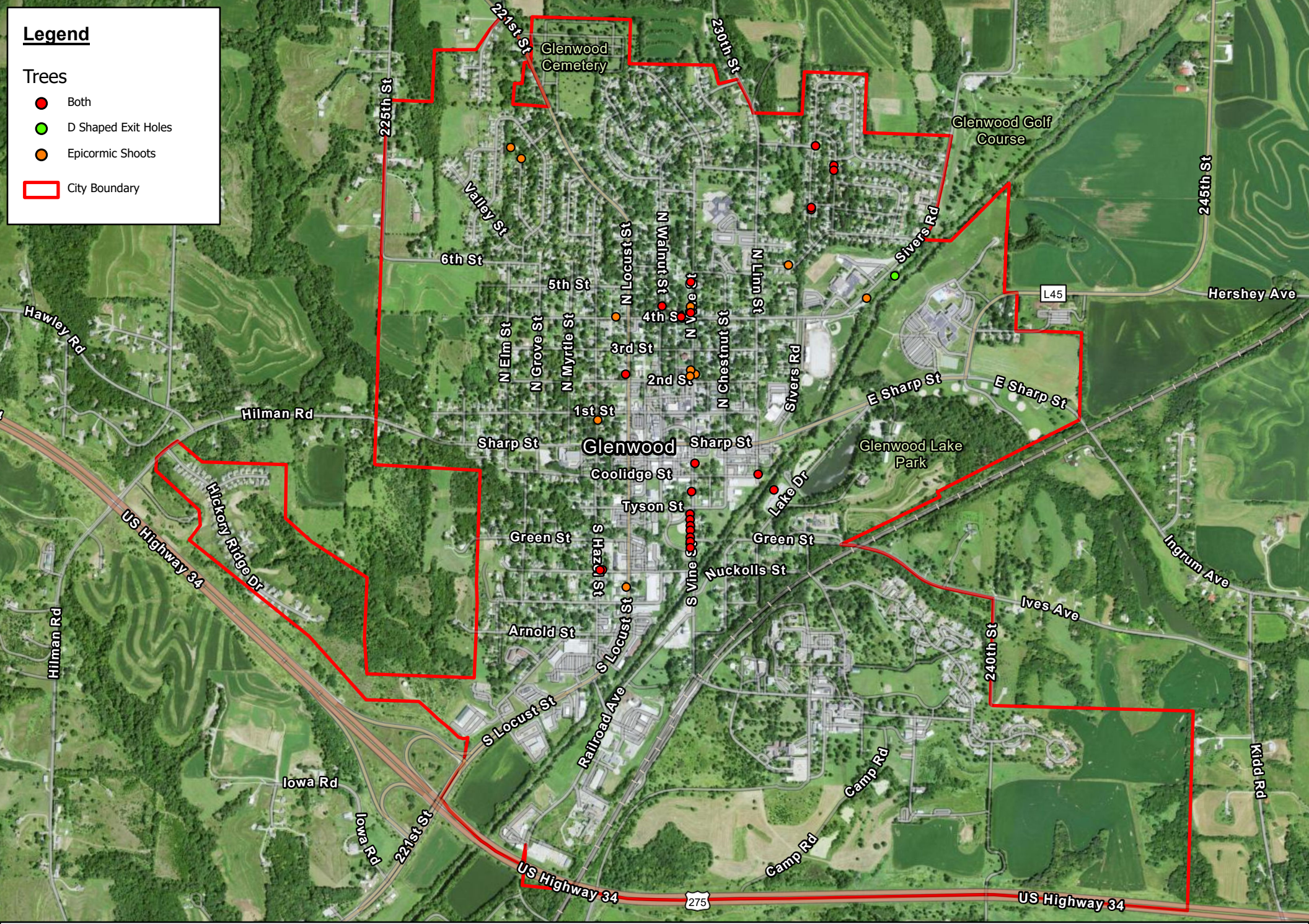
Figure 2: Location of EAB Symptoms

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

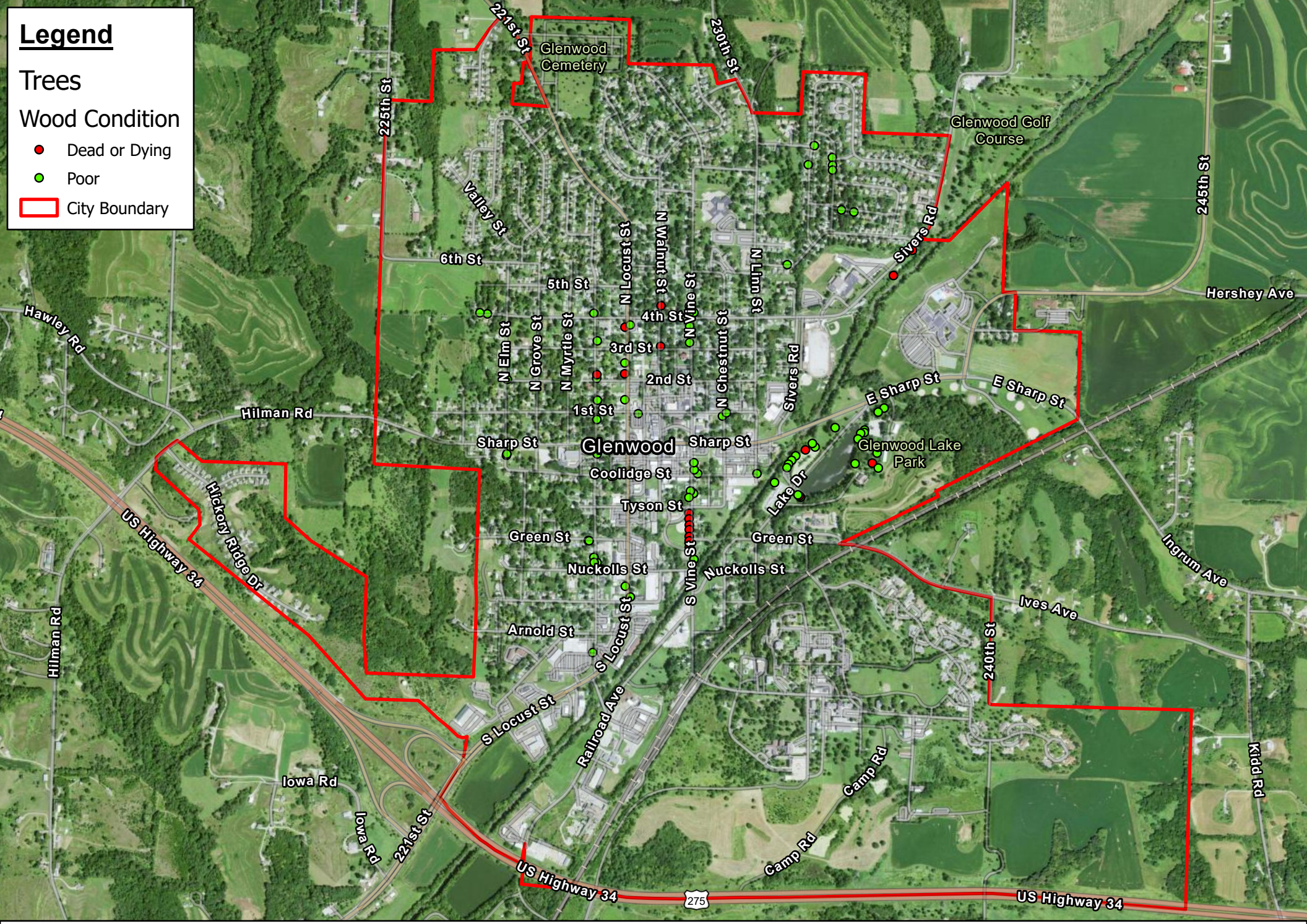

Legend
Trees
White ash
Black ash
Green ash
Ash
City Boundary
Glenwood
Glenwood Cemetery
Glenwood Golf Course
Glenwood Lake Park
221st St
225th St
230th St
245th St
240th St
Valley St
6th St
5th St
4th St
3rd St
2nd St
1st St
N Locust St
N Walnut St
N Vine St
N Linn St
N Chestnut St
N Elm St
N Grove St
N Myrtle St
Sivers Rd
Hershey Ave
L45
Hawley Rd
Hilman Rd
Sharp St
E Sharp St
Coolidge St
Tyson St
Green St
Nuckolls St
Lake Dr
Ingrum Ave
Ives Ave
Hickory Ridge Dr
US Highway 34
S Hazel St
S Vine St
S Locust St
Arnold St
Railroad Ave
Camp Rd
Iowa Rd
Kidd Rd
275
N
0 5001,000 2,000
Feet
Ash Tree Location

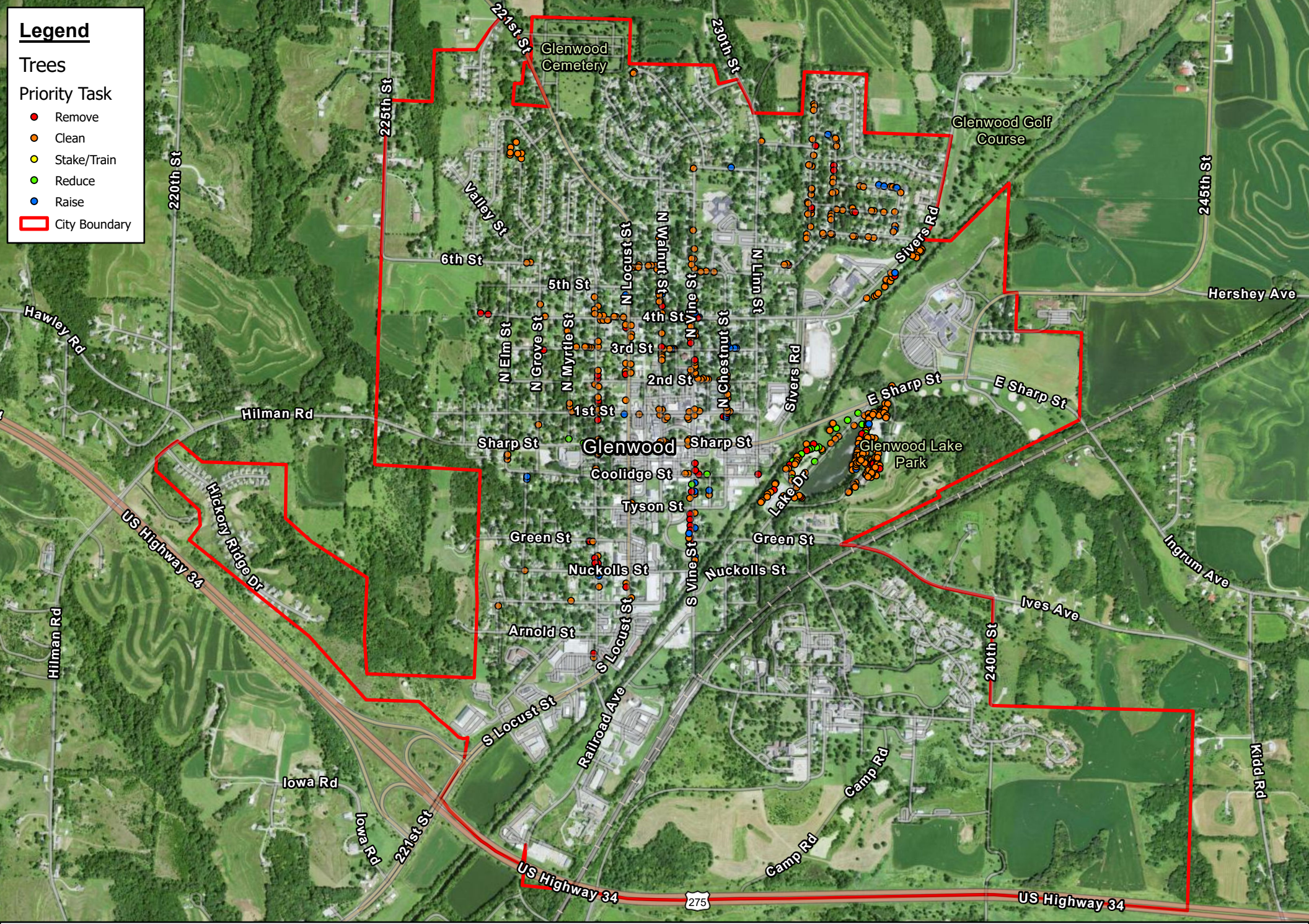


EAB Signs/Symptoms

0 5001,000 2,000 Feet

N


Legend
Trees
Wood Condition
Dead or Dying
Poor
City Boundary
Glenwood
Glenwood Cemetery
Glenwood Golf Course
Glenwood Lake Park
221st St
225th St
230th St
245th St
Valley St
6th St
5th St
4th St
3rd St
2nd St
1st St
N Locust St
N Walnut St
N Vine St
N Linn St
N Chestnut St
N Elm St
N Grove St
N Myrtle St
Sivers Rd
Hershey Ave
Hawley Rd
Hilman Rd
Sharp St
E Sharp St
Coolidge St
Tyson St
Green St
Nuckolls St
Arnold St
S Locust St
S Vine St
Lake Dr
Hickory Ridge Dr
US Highway 34
Ingrum Ave
Ives Ave
240th St
Railroad Ave
Camp Rd
Iowa Rd
Kidd Rd
275
0 5001,000 2,000
Feet
N
Poor Condition Trees



Priority Task

APPENDIX C: GLENWOOD 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 hereafter 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, or evergreens.

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])

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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 TREES SUBJECT TO REMOVAL.

The Council having determined that the health of any tree, shrub, or part thereof within the City is threatened by serious insects, or disease pests, or disease, or shows evidence of deterioration to the extent that is appears to be hazardous to the public or property of another is hereby declared a nuisance. The following shall be treated or removed:

1. Any dead or damaged tree, shrub, or part thereof.

2. Any tree, shrub, or part thereof infected with serious insects, or disease pests, or a disease.

3. Any tree, shrub, or part thereof showing evidence of deterioration to the extent that it appears to be hazardous to the public property of property of another. (Amended by ordinance No. 592)

151.06 INSPECTION AND REMOVAL.

The Council shall inspect or cause to be inspected, all premises and places within the City to determine whether any condition as defined in Section 151.05 of this chapter exists thereon. Such trees, shrubs, or parts thereof shall be subject to removal as follows:

1. Removal from City Property. If the Council upon inspection or examination, in person or by some qualified person, shall determine that any condition as defined in Section 151.05 exists in or upon any public property, other than the strip between the curb and the lot line of private property, within the City and that the danger to other trees, shrubs, or parts thereof within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the insects, disease pests, disease, or evidence of deterioration. The Council may also order the removal of any trees, shrubs or parts thereof on the streets of the City which interfere with the making of improvement or with travel thereon.

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2. Removal from Private Property. If the Council upon inspection or examination in person or by some qualified person, shall determine with reasonable certainty that any condition as defined in Section 151.05 exists in or upon private property, including the strip between the curb and the lot line of private property, and he/she shall immediately notify by certified mail the owner, occupant or person in charge of such property, to correct such condition within fourteen (14) days of such 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 nuisance to be removed and the costs shall be assessed against the property.

(Amended by Ordinance No. 592)

151.07 COMMUNITY TREE BOARD

1. Purpose. It is the purpose of this section to promote and protect the public health, safety and general welfare of the City of Glenwood, Iowa by establishing a legal community tree board to oversee tree planting and tree maintenance needs of City property, and to promote citizen involvement and education to enhance Glenwood 's community tree resources.

2. 2. Establishment. There is hereby created and established a City Tree Board of the City of Glenwood, Iowa, which shall consist of five members, who shall be appointed by the Mayor with the approval of the City Council.

   Members of the City Tree Board shall serve without compensation.

3. Term of Office. The term of the five persons to be appointed by the Mayor shall be three years, except that the term of two of the members appointed to the first board shall be only 2 years. In the event that a vacancy shall occur during the term of any member, his or her successor shall be appointed for the unexpired portion of the term.

4. Duties and Responsibilities. It shall be the responsibility of the board to study, investigate, counsel, and develop a written plan for the care, preservation, trimming, planting, replanting, removal or disposition of tress in public areas. Such a plan will be presented to the City Council and upon its acceptance and approval shall constitute the official comprehensive tree plan for the City of Glenwood, Iowa. The board shall review annually and update if needed the comprehensive tree plan. The board, when requested by the City Council, shall consider, investigate, make findings, report and recommend upon any special matter of question within the scope of its work.

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5. Operation. The board shall choose its own officers, make rules and regulations, and keep a journal of its proceedings. A majority of the members shall be a quorum for the transaction of business.

(Section 151.07 added by Ordinance No. 599)