Roland, 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 Roland 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 18% of Roland'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 301 trees inventoried.

- Roland's trees provide $60,744 of benefits annually, an average of $201.81 per tree
- There are over 39 species of trees
- The top three genera are: Maple 24%, Ash 18%, and Oak 10%
- 33% of trees need some type of management
- 56 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 56 trees needing removal, 36 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*
- 50 of the 53 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 14 years to remove ash. We suggest that city officials request a budget increase to $4,000 annually and apply for grants to plant replacement trees

Introduction

INTRODUCTION

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

Assist Roland 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 301 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. Roland's trees reduce energy-related costs by approximately $15,854 annually (Appendix A, Table 1). These savings are both in electricity (75.1 MWh) and in natural gas (10,361.2 Therms).

Annual Stormwater Benefits

Roland's trees intercept about 847,165 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $22,958 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 Roland, it is estimated that trees remove 947.8 lbs of air pollution (ozone (O3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2)) per year with a net value of $2,648 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Roland, trees sequester about 163,029 lbs of carbon per year with an associated value of $2,057 (Appendix A, Table 5). In addition, the trees store 2,898,834 lbs of carbon, with a yearly benefit of $21,741 (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. Roland receives $17,227 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, Roland's trees provide $60,744 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 301 trees in Roland provide approximately $201.81 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$15,854**	• Intercept **847,165 gallons** • Provides **$22,958** benefit	• Remove **947.8 lbs** of pollution • Net value of **$2,648**	• Sequester **163,029 lbs** • Value of **$2,057** • Store **2,898,834 lbs** • Value of **$21,741**	• **$17,227** in social benefits	• **$60,744** annual benefits • Each tree provides **$201.81** annually

FOREST STRUCTURE

Species Distribution

Roland has over 39 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	73	24%	Ginkgo	3	<1%
Ash	53	18%	Callery Pear	3	<1%
Oak	30	10%	Boxelder	2	<1%
Hackberry	26	9%	Mulberry	1	<1%
Walnut	19	6%	Amur maple	1	<1%
Honey locust	18	6%	Mountain ash	1	<1%
Apple (Crab)	16	5%	Sycamore	1	<1%
Basswood/Linden	13	4%	Kentucky coffee	1	<1%
Pine	10	3%	Catalpa	1	<1%
Spruce	8	2%	Other conifer	9	3%
Elm	5	1.5%	Other Deciduous	3	<1%
Cedar	4	1%			

Age Class

Most of Roland's trees (47%) are between 18 and 30 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. Roland'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 Roland indicate that 51% of the trees are in good health, with only 23% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 32% of Roland's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Twenty-four percent of the tree population's wood condition is in poor health, dead, or dying. This 24% 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	79	26%
Crown Reduction	7	2%
Tree Removal	56	19%
Crown Raising	11	4%
Tree Staking	2	<1%

Canopy Cover

The total canopy with both private and public trees is 105.98 acres or 15%. The canopy cover included in the Roland inventory includes approximately 9 acres (Appendix A, Figure 4). The city's canopy goal is to increase canopy by 20% in 30 years. To achieve this goal it is estimated that 17 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Roland'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	31%
Industrial/Large Commercial	0%
Park/Vacant/Other	69%
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

Roland has 56 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 36 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Proposed Schedule and Budget 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 99 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 56 removals, 49 are ash trees. There are a total of 53 ash trees, and 50 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 Roland.

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 (24%) (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: boxelder, silver maple, tree of heaven, white and red mulberry, catalpa, Russian olive, female ginkgo, all nut and fruit producing trees, poplar, cottonwood, willows, Chinese and Siberian elm, and walnut. All trees planted must meet the restrictions in Roland Arboricultural Specification and Standards of Practice (Appendix C).

Continual Monitoring

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

EMERALD ASH BORER PLAN

Ash Tree Removal

Tree removal will be prioritized by first removing dead, dying, hazardous trees (Appendix B, Figure 4). Next will be all ash in poor condition that display EAB signs and symptoms (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be an effective tool for communities to spread removal costs out over several years while allowing trees to continue providing benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product, or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be normally disposed of if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the guidelines stated in the Arboricultural Specification and Standards of Practice, Part 2, Subsection A-D (Appendix C).

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.

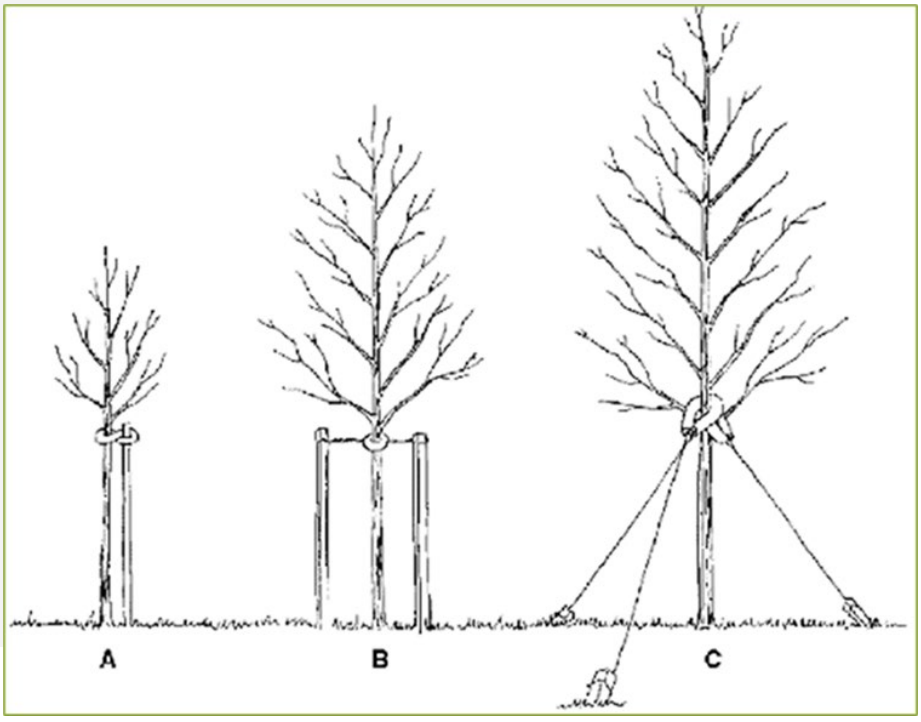
Monitoring

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. The Arboricultural Specification and Standards of Practice, Part 3 Subsection C states: “The property owner is responsible for the maintenance of any tree on their property. Owners are encouraged to contact the local ISU Extension Office for the information on proper planting and care of trees. The Extension Service can help determine which tree species grow best in our area as well as which types of trees are most susceptible to disease.”

Schedule & Budget



PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $2,700/Year – (Based off $2 per Capita Calculation, No Budget Reported)

YEAR 1	Est. Cost
Remove 3 trees recommended for immediate removal	$2,100
Plant 4 trees in open locations	$600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,700**

YEAR 2	Est. Cost
Remove 1 tree recommended for immediate removal	$700
Plant 3 trees in open locations	$450
Prune 1/3 of city owned trees	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,650**

YEAR 3	Est. Cost
Remove 3 trees recommended for immediate removal	$2,100
Plant 4 trees in open locations	$600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,700**

YEAR 4	Est. Cost
Remove 1 tree recommended for immediate removal	$700
Plant 3 trees in open locations	$450
Prune 1/3 of city owned trees	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,650**

YEAR 5	Est. Cost
Remove 3 trees recommended for immediate removal	$2,100
Plant 4 trees in open locations	$600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,700**

YEAR 6	Est. Cost
Remove 1 tree recommended for immediate removal	$700
Plant 3 trees in open locations	$450
Prune 1/3 of city owned trees	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,650**

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 $6,200 a year. If the budget were increased to $4,000 a year all ash could be removed in 9.5 years.*

PROPOSED WORK SCHEDULE WITH INCREASED BUDGET

Budget Allowance of $4,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	Est. Cost
Remove 5 trees recommended for immediate removal	$3,500
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,950**

YEAR 2	Est. Cost
Remove 3 trees recommended for immediate removal	$2,100
Plant 2 trees in open locations	$300
Prune 1/3 of city owned trees	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,900**

YEAR 3	Est. Cost
Remove 5 trees recommended for immediate removal	$3,500
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,950**

YEAR 4	Est. Cost
Remove 3 trees recommended for immediate removal	$2,100
Plant 2 trees in open locations	$300
Prune 1/3 of city owned trees	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,900**

YEAR 5	Est. Cost
Remove 5 trees recommended for immediate removal	$3,500
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,950**

YEAR 6	Est. Cost
Remove 3 trees recommended for immediate removal	$2,100
Plant 2 trees in open locations	$300
Prune 1/3 of city owned trees	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$3,900**

Proposed Budget Increase

EAB could potentially kill all ash trees in Roland within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $6,200 a year. If the budget were increased to $4,000 per year all ash could be removed within 9.5 years. Additionally, we recommend that Roland 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 Roland would still need to find $34,300 for removal. Alternatively, if there are 8 treatable trees, it would cost approximately $2,400 a year for treatment and leave $31,500 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 Roland. We suggest considering an increased budget to plan for this.

WORKS CITED

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

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

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

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

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

Appendices

APPENDIX A: i-TREE DATA

Table 1: Annual Energy Benefits

Roland

Annual Energy Benefits of Public Trees

2/9/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	14.9	1,128	2,042.7	2,002	3,130	(N/A)	15.0	19.7	69.56
Norway maple	7.8	593	1,130.2	1,108	1,700	(N/A)	10.0	10.7	56.68
Northern hackberry	7.9	602	1,129.5	1,107	1,709	(N/A)	8.6	10.8	65.74
Silver maple	7.9	597	1,045.7	1,025	1,622	(N/A)	7.6	10.2	70.50
Northern red oak	2.7	203	350.8	344	547	(N/A)	7.3	3.4	24.85
Black walnut	5.4	408	752.3	737	1,145	(N/A)	6.3	7.2	60.27
Honeylocust	6.3	480	824.0	808	1,288	(N/A)	6.0	8.1	71.56
Sugar maple	4.8	366	662.2	649	1,015	(N/A)	5.3	6.4	63.42
Apple	2.0	150	288.9	283	433	(N/A)	5.3	2.7	27.06
Conifer Evergreen Large	1.3	101	176.8	173	274	(N/A)	3.0	1.7	30.46
Littleleaf linden	1.1	85	162.8	160	244	(N/A)	2.3	1.5	34.93
American basswood	1.1	80	159.4	156	236	(N/A)	1.7	1.5	47.24
Chinese elm	1.7	128	232.2	228	356	(N/A)	1.7	2.2	71.12
Eastern white pine	0.8	59	103.5	101	160	(N/A)	1.7	1.0	32.01
Ash	1.4	106	203.5	199	306	(N/A)	1.7	1.9	61.17
Blue spruce	0.7	56	100.8	99	155	(N/A)	1.7	1.0	30.95
Red maple	0.9	67	106.7	105	171	(N/A)	1.3	1.1	42.86
Swamp white oak	0.2	19	39.9	39	58	(N/A)	1.0	0.4	19.31
Bur oak	0.2	17	31.1	31	47	(N/A)	1.0	0.3	15.70
Austrian pine	0.4	33	58.0	57	90	(N/A)	1.0	0.6	29.88
Callery pear	0.4	34	63.2	62	96	(N/A)	1.0	0.6	31.91
White ash	0.5	38	69.7	68	106	(N/A)	1.0	0.7	35.27
Eastern red cedar	0.3	25	49.3	48	74	(N/A)	1.0	0.5	24.57
Ginkgo	0.6	45	77.4	76	121	(N/A)	1.0	0.8	40.38
Northern pin oak	0.6	44	87.0	85	130	(N/A)	0.7	0.8	64.76
Broadleaf Deciduous Mediu	0.5	38	69.1	68	105	(N/A)	0.7	0.7	52.73
Boxelder	0.4	30	47.8	47	77	(N/A)	0.7	0.5	38.63
Spruce	0.2	15	29.2	29	44	(N/A)	0.7	0.3	22.02
Scotch pine	0.4	28	49.2	48	76	(N/A)	0.7	0.5	38.17
Basswood	0.2	18	27.0	26	44	(N/A)	0.3	0.3	44.23
Amur maple	0.1	6	12.8	13	18	(N/A)	0.3	0.1	18.19
Northern white cedar	0.1	10	14.6	14	24	(N/A)	0.3	0.2	24.14
Catalpa	0.2	18	27.0	26	44	(N/A)	0.3	0.3	44.23
American sycamore	0.3	25	46.9	46	71	(N/A)	0.3	0.4	70.91
Broadleaf Deciduous Small	0.1	6	12.8	13	18	(N/A)	0.3	0.1	18.19
Kentucky coffeetree	0.2	18	27.0	26	44	(N/A)	0.3	0.3	44.23
Norway spruce	0.2	14	24.6	24	38	(N/A)	0.3	0.2	38.17
Mountain ash	0.1	6	12.8	13	18	(N/A)	0.3	0.1	18.19
Mulberry	0.1	6	12.8	13	18	(N/A)	0.3	0.1	18.19
Total	75.1	5,700	10,361.2	10,154	15,854	(N/A)	100.0	100.0	52.67

Table 2: Annual Stormwater Benefits

Roland

Annual Stormwater Benefits of Public Trees

2/9/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	188,906	5,119	(N/A)	15.0	22.3	113.76
Norway maple	72,281	1,959	(N/A)	10.0	8.5	65.29
Northern hackberry	74,144	2,009	(N/A)	8.6	8.8	77.28
Silver maple	110,348	2,990	(N/A)	7.6	13.0	130.02
Northern red oak	17,776	482	(N/A)	7.3	2.1	21.90
Black walnut	59,820	1,621	(N/A)	6.3	7.1	85.32
Honeylocust	75,859	2,056	(N/A)	6.0	9.0	114.21
Sugar maple	54,930	1,489	(N/A)	5.3	6.5	93.04
Apple	7,564	205	(N/A)	5.3	0.9	12.81
Conifer Evergreen Large	27,825	754	(N/A)	3.0	3.3	83.78
Littleleaf linden	9,741	264	(N/A)	2.3	1.1	37.71
American basswood	9,005	244	(N/A)	1.7	1.1	48.81
Chinese elm	24,519	664	(N/A)	1.7	2.9	132.89
Eastern white pine	16,481	447	(N/A)	1.7	1.9	89.33
Ash	13,896	377	(N/A)	1.7	1.6	75.32
Blue spruce	12,018	326	(N/A)	1.7	1.4	65.14
Red maple	5,437	147	(N/A)	1.3	0.6	36.83
Swamp white oak	1,335	36	(N/A)	1.0	0.2	12.06
Bur oak	1,387	38	(N/A)	1.0	0.2	12.53
Austrian pine	6,781	184	(N/A)	1.0	0.8	61.26
Callery pear	2,581	70	(N/A)	1.0	0.3	23.32
White ash	4,453	121	(N/A)	1.0	0.5	40.22
Eastern red cedar	4,904	133	(N/A)	1.0	0.6	44.30
Ginkgo	3,815	103	(N/A)	1.0	0.5	34.46
Northern pin oak	6,244	169	(N/A)	0.7	0.7	84.60
Broadleaf Deciduous Medium	3,888	105	(N/A)	0.7	0.5	52.69
Boxelder	2,912	79	(N/A)	0.7	0.3	39.46
Spruce	3,565	97	(N/A)	0.7	0.4	48.30
Scotch pine	9,209	250	(N/A)	0.7	1.1	124.79
Basswood	1,466	40	(N/A)	0.3	0.2	39.72
Amur maple	264	7	(N/A)	0.3	0.0	7.17
Northern white cedar	1,539	42	(N/A)	0.3	0.2	41.70
Catalpa	1,466	40	(N/A)	0.3	0.2	39.72
American sycamore	3,943	107	(N/A)	0.3	0.5	106.85
Broadleaf Deciduous Small	264	7	(N/A)	0.3	0.0	7.17
Kentucky coffeetree	1,466	40	(N/A)	0.3	0.2	39.72
Norway spruce	4,605	125	(N/A)	0.3	0.5	124.79
Mountain ash	264	7	(N/A)	0.3	0.0	7.17
Mulberry	264	7	(N/A)	0.3	0.0	7.17
Citywide total	847,165	22,958	(N/A)	100.0	100.0	76.27

Table 3: Annual Air Quality Benefits

Roland

Annual Air Quality Benefits of Public Trees

2/9/2022

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								
Green ash	25.7	4.1	11.9	1.2	136	71.1	10.3	9.9	67.4	442	0.0	0	201.5	578	(N/A)	15.0	12.85
Norway maple	14.6	2.5	7.2	0.6	79	37.9	5.5	5.2	35.4	235	-3.4	-13	105.5	301	(N/A)	10.0	10.02
Northern hackberry	11.3	2.0	5.8	0.5	62	38.3	5.6	5.3	36.0	238	0.0	0	104.7	300	(N/A)	8.6	11.52
Silver maple	19.3	3.3	9.5	0.9	104	37.2	5.4	5.2	35.6	232	-10.3	-39	105.9	297	(N/A)	7.6	12.93
Northern red oak	3.1	0.5	1.6	0.1	17	12.6	1.8	1.8	12.1	79	-4.3	-16	29.4	80	(N/A)	7.3	3.63
Black walnut	7.2	1.2	3.5	0.3	38	25.8	3.7	3.6	24.4	160	0.0	0	69.6	199	(N/A)	6.3	10.47
Honeylocust	15.1	2.5	6.8	0.7	79	29.8	4.4	4.2	28.6	186	-11.9	-45	80.0	221	(N/A)	6.0	12.28
Sugar maple	7.2	1.2	3.6	0.3	39	23.0	3.3	3.2	21.8	143	-5.7	-21	58.1	161	(N/A)	5.3	10.08
Apple	2.2	0.4	1.0	0.1	12	9.6	1.4	1.3	9.0	59	0.0	0	24.9	71	(N/A)	5.3	4.43
Conifer Evergreen Large	3.3	0.7	2.7	0.4	22	6.3	0.9	0.9	6.0	39	-14.8	-56	6.3	5	(N/A)	3.0	0.60
Littleleaf linden	1.4	0.2	0.7	0.1	8	5.4	0.8	0.7	5.1	34	-0.7	-3	13.8	39	(N/A)	2.3	5.54
American basswood	1.0	0.2	0.5	0.0	5	5.2	0.7	0.7	4.8	32	-0.9	-3	12.2	34	(N/A)	1.7	6.76
Chinese elm	3.6	0.6	1.6	0.2	19	8.1	1.2	1.1	7.6	50	0.0	0	24.0	69	(N/A)	1.7	13.85
Eastern white pine	1.9	0.4	1.6	0.2	13	3.7	0.5	0.5	3.5	23	-8.4	-31	4.0	4	(N/A)	1.7	0.84
Ash	2.9	0.5	1.4	0.1	16	6.8	1.0	0.9	6.4	42	-0.7	-3	19.4	55	(N/A)	1.7	11.08
Blue spruce	2.0	0.4	1.6	0.2	13	3.5	0.5	0.5	3.3	22	-4.6	-17	7.4	17	(N/A)	1.7	3.48
Red maple	1.0	0.2	0.5	0.0	6	4.1	0.6	0.6	4.0	26	-0.4	-1	10.6	30	(N/A)	1.3	7.47
Swamp white oak	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	8	0.0	0	2.9	8	(N/A)	1.0	2.72
Bur oak	0.1	0.0	0.0	0.0	0	1.1	0.2	0.1	1.0	7	0.0	0	2.4	7	(N/A)	1.0	2.29
Austrian pine	1.1	0.2	0.9	0.1	7	2.0	0.3	0.3	2.0	13	-2.6	-10	4.3	10	(N/A)	1.0	3.38
Callery pear	0.3	0.1	0.2	0.0	2	2.2	0.3	0.3	2.0	13	-0.1	0	5.3	15	(N/A)	1.0	4.95
White ash	0.4	0.1	0.2	0.0	2	2.4	0.3	0.3	2.2	15	0.0	0	6.0	17	(N/A)	1.0	5.67
Eastern red cedar	1.0	0.2	0.8	0.1	7	1.6	0.2	0.2	1.5	10	-2.7	-10	3.1	7	(N/A)	1.0	2.19
Ginkgo	1.0	0.2	0.5	0.0	5	2.8	0.4	0.4	2.7	18	-0.3	-1	7.7	22	(N/A)	1.0	7.22
Northern pin oak	1.4	0.2	0.7	0.1	7	2.9	0.4	0.4	2.6	18	-0.3	-1	8.3	24	(N/A)	0.7	11.87
Broadleaf Deciduous Medium	0.7	0.1	0.4	0.0	4	2.4	0.3	0.3	2.3	15	-0.2	-1	6.4	18	(N/A)	0.7	9.04
Boxelder	0.3	0.0	0.2	0.0	2	1.8	0.3	0.3	1.8	12	-0.1	-1	4.6	13	(N/A)	0.7	6.37
Spruce	0.4	0.1	0.3	0.0	3	1.0	0.1	0.1	0.9	6	-1.5	-6	1.5	3	(N/A)	0.7	1.46
Scotch pine	1.1	0.2	0.9	0.1	7	1.8	0.3	0.2	1.7	11	-5.7	-21	0.6	-3	(N/A)	0.7	-1.58
Basswood	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.3	7.42
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)	0.3	2.55
Northern white cedar	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3	(N/A)	0.3	2.82
Catalpa	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.3	7.42
American sycamore	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12	(N/A)	0.3	12.48
Broadleaf Deciduous Small	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)	0.3	2.55

Roland

Annual Air Quality Benefits of Public Trees

2/9/2022

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								
Kentucky coffeetree	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.3	7.42
Norway spruce	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2	(N/A)	0.3	-1.58
Mountain ash	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)	0.3	2.55
Mulberry	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)	0.3	2.55
Citywide total	132.4	22.5	67.8	6.8	724	359.2	52.2	49.8	340.3	2,236	-83.2	-312	947.8	2,648	(N/A)	100.0	8.80

Table 4: Annual Carbon Stored

Roland

Stored CO2 Benefits of Public Trees

2/9/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	846,185	6,346	(N/A)	15.0	29.2	141.03
Norway maple	238,393	1,788	(N/A)	10.0	8.2	59.60
Northern hackberry	170,188	1,276	(N/A)	8.6	5.9	49.09
Silver maple	455,922	3,419	(N/A)	7.6	15.7	148.67
Northern red oak	55,236	414	(N/A)	7.3	1.9	18.83
Black walnut	232,625	1,745	(N/A)	6.3	8.0	91.83
Honeylocust	194,693	1,460	(N/A)	6.0	6.7	81.12
Sugar maple	205,394	1,540	(N/A)	5.3	7.1	96.28
Apple	33,806	254	(N/A)	5.3	1.2	15.85
Conifer Evergreen La	37,269	280	(N/A)	3.0	1.3	31.06
Littleleaf linden	31,323	235	(N/A)	2.3	1.1	33.56
American basswood	33,897	254	(N/A)	1.7	1.2	50.84
Chinese elm	121,267	910	(N/A)	1.7	4.2	181.90
Eastern white pine	20,861	156	(N/A)	1.7	0.7	31.29
Ash	48,075	361	(N/A)	1.7	1.7	72.11
Blue spruce	16,228	122	(N/A)	1.7	0.6	24.34
Red maple	11,973	90	(N/A)	1.3	0.4	22.45
Swamp white oak	2,420	18	(N/A)	1.0	0.1	6.05
Bur oak	2,255	17	(N/A)	1.0	0.1	5.64
Austrian pine	8,673	65	(N/A)	1.0	0.3	21.68
Callery pear	5,825	44	(N/A)	1.0	0.2	14.56
White ash	10,527	79	(N/A)	1.0	0.4	26.32
Eastern red cedar	3,306	25	(N/A)	1.0	0.1	8.27
Ginkgo	13,790	103	(N/A)	1.0	0.5	34.48
Northern pin oak	22,225	167	(N/A)	0.7	0.8	83.35
Broadleaf Deciduous	11,569	87	(N/A)	0.7	0.4	43.39
Boxelder	7,248	54	(N/A)	0.7	0.3	27.18
Spruce	3,599	27	(N/A)	0.7	0.1	13.50
Scotch pine	14,981	112	(N/A)	0.7	0.5	56.18
Basswood	3,672	28	(N/A)	0.3	0.1	27.54
Amur maple	908	7	(N/A)	0.3	0.0	6.81
Northern white cedar	1,170	9	(N/A)	0.3	0.0	8.78
Catalpa	3,672	28	(N/A)	0.3	0.1	27.54
American sycamore	15,773	118	(N/A)	0.3	0.5	118.30
Broadleaf Deciduous	908	7	(N/A)	0.3	0.0	6.81
Kentucky coffeetree	3,672	28	(N/A)	0.3	0.1	27.54
Norway spruce	7,490	56	(N/A)	0.3	0.3	56.18
Mountain ash	908	7	(N/A)	0.3	0.0	6.81
Mulberry	908	7	(N/A)	0.3	0.0	6.81
Citywide total	2,898,834	21,741	(N/A)	100.0	100.0	72.23

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

Roland

Annual CO $_2$ Benefits of Public Trees

2/9/2022

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
Green ash	35,136	264	-4,062	-160	-32	24,938	187	55,853	419 (N/A)	15.0	20.4	9.31
Norway maple	11,796	88	-1,145	-81	-9	13,101	98	23,672	178 (N/A)	10.0	8.6	5.92
Northern hackberry	9,615	72	-817	-74	-7	13,309	100	22,033	165 (N/A)	8.6	8.0	6.36
Silver maple	33,258	249	-2,188	-87	-17	13,189	99	44,172	331 (N/A)	7.6	16.1	14.40
Northern red oak	4,095	31	-265	-31	-2	4,484	34	8,283	62 (N/A)	7.3	3.0	2.82
Black walnut	13,286	100	-1,117	-57	-9	9,015	68	21,128	158 (N/A)	6.3	7.7	8.34
Honeylocust	15,170	114	-935	-48	-7	10,618	80	24,805	186 (N/A)	6.0	9.0	10.34
Sugar maple	10,982	82	-986	-52	-8	8,083	61	18,026	135 (N/A)	5.3	6.6	8.45
Apple	3,111	23	-162	-25	-1	3,314	25	6,238	47 (N/A)	5.3	2.3	2.92
Conifer Evergreen Large	1,686	13	-179	-25	-2	2,229	17	3,712	28 (N/A)	3.0	1.4	3.09
Littleleaf linden	3,552	27	-150	-14	-1	1,878	14	5,266	39 (N/A)	2.3	1.9	5.64
American basswood	2,509	19	-163	-12	-1	1,768	13	4,102	31 (N/A)	1.7	1.5	6.15
Chinese elm	3,849	29	-582	-19	-5	2,830	21	6,078	46 (N/A)	1.7	2.2	9.12
Eastern white pine	1,006	8	-100	-14	-1	1,296	10	2,187	16 (N/A)	1.7	0.8	3.28
Ash	1,326	10	-231	-16	-2	2,352	18	3,431	26 (N/A)	1.7	1.3	5.15
Blue spruce	762	6	-78	-14	-1	1,238	9	1,907	14 (N/A)	1.7	0.7	2.86
Red maple	1,615	12	-57	-7	0	1,478	11	3,028	23 (N/A)	1.3	1.1	5.68
Swamp white oak	544	4	-12	-3	0	416	3	945	7 (N/A)	1.0	0.3	2.36
Bur oak	492	4	-11	-3	0	366	3	844	6 (N/A)	1.0	0.3	2.11
Austrian pine	426	3	-42	-8	0	725	5	1,102	8 (N/A)	1.0	0.4	2.75
Callery pear	834	6	-28	-4	0	747	6	1,548	12 (N/A)	1.0	0.6	3.87
White ash	1,209	9	-51	-5	0	829	6	1,983	15 (N/A)	1.0	0.7	4.96
Eastern red cedar	43	0	-16	-6	0	561	4	582	4 (N/A)	1.0	0.2	1.45
Ginkgo	679	5	-66	-8	-1	1,000	7	1,604	12 (N/A)	1.0	0.6	4.01
Northern pin oak	840	6	-107	-6	-1	979	7	1,706	13 (N/A)	0.7	0.6	6.40
Broadleaf Deciduous Medi	856	6	-56	-5	0	835	6	1,631	12 (N/A)	0.7	0.6	6.12
Boxelder	837	6	-35	-4	0	673	5	1,471	11 (N/A)	0.7	0.5	5.51
Spruce	240	2	-17	-4	0	341	3	560	4 (N/A)	0.7	0.2	2.10
Scotch pine	256	2	-72	-8	-1	622	5	798	6 (N/A)	0.7	0.3	2.99
Basswood	445	3	-18	-2	0	393	3	819	6 (N/A)	0.3	0.3	6.14
Amur maple	114	1	-4	-1	0	124	1	232	2 (N/A)	0.3	0.1	1.74
Northern white cedar	116	1	-6	-2	0	216	2	324	2 (N/A)	0.3	0.1	2.43

Annual CO 2 Benefits of Public Trees

2/9/2022

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
Catalpa	445	3	-18	-2	0	393	3	819	6 (N/A)	0.3	0.3	6.14
American sycamore	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.3	0.5	9.97
Broadleaf Deciduous Smal	114	1	-4	-1	0	124	1	232	2 (N/A)	0.3	0.1	1.74
Kentucky coffeetree	445	3	-18	-2	0	393	3	819	6 (N/A)	0.3	0.3	6.14
Norway spruce	256	2	-36	-4	0	311	2	528	4 (N/A)	0.3	0.2	3.96
Mountain ash	114	1	-4	-1	0	124	1	232	2 (N/A)	0.3	0.1	1.74
Mulberry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.3	0.1	1.74
Citywide total	163,029	1,223	-13,916	-819	-111	125,969	945	274,263	2,057 (N/A)	100.0	100.0	6.83

Table 6: Annual Social and Aesthetic Benefits

Roland

Annual Aesthetic/Other Benefits of Public Trees

2/9/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	2,677	(N/A)	15.0	15.5	59.49
Norway maple	1,102	(N/A)	10.0	6.4	36.72
Northern hackberry	1,343	(N/A)	8.6	7.8	51.65
Silver maple	2,552	(N/A)	7.6	14.8	110.95
Northern red oak	368	(N/A)	7.3	2.1	16.73
Black walnut	1,088	(N/A)	6.3	6.3	57.28
Honeylocust	3,798	(N/A)	6.0	22.0	210.98
Sugar maple	1,141	(N/A)	5.3	6.6	71.29
Apple	180	(N/A)	5.3	1.0	11.23
Conifer Evergreen Large	315	(N/A)	3.0	1.8	34.98
Littleleaf linden	393	(N/A)	2.3	2.3	56.16
American basswood	203	(N/A)	1.7	1.2	40.64
Chinese elm	277	(N/A)	1.7	1.6	55.48
Eastern white pine	215	(N/A)	1.7	1.2	42.92
Ash	125	(N/A)	1.7	0.7	25.05
Blue spruce	91	(N/A)	1.7	0.5	18.16
Red maple	228	(N/A)	1.3	1.3	56.88
Swamp white oak	65	(N/A)	1.0	0.4	21.78
Bur oak	72	(N/A)	1.0	0.4	23.95
Austrian pine	58	(N/A)	1.0	0.3	19.34
Callery pear	92	(N/A)	1.0	0.5	30.53
White ash	168	(N/A)	1.0	1.0	56.07
Eastern red cedar	14	(N/A)	1.0	0.1	4.56
Ginkgo	52	(N/A)	1.0	0.3	17.49
Northern pin oak	75	(N/A)	0.7	0.4	37.26
Broadleaf Deciduous Medium	82	(N/A)	0.7	0.5	41.11
Boxelder	79	(N/A)	0.7	0.5	39.36
Spruce	63	(N/A)	0.7	0.4	31.25
Scotch pine	26	(N/A)	0.7	0.2	13.13
Basswood	46	(N/A)	0.3	0.3	45.86
Amur maple	6	(N/A)	0.3	0.0	6.40
Northern white cedar	32	(N/A)	0.3	0.2	32.32
Catalpa	46	(N/A)	0.3	0.3	45.86
American sycamore	66	(N/A)	0.3	0.4	65.59
Broadleaf Deciduous Small	6	(N/A)	0.3	0.0	6.40
Kentucky coffeetree	46	(N/A)	0.3	0.3	45.86
Norway spruce	26	(N/A)	0.3	0.2	26.25
Mountain ash	6	(N/A)	0.3	0.0	6.40
Mulberry	6	(N/A)	0.3	0.0	6.40
Citywide total	17,227	(N/A)	100.0	100.0	57.23

Table 7: Summary of Benefits in Dollars

Roland

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

2/9/2022

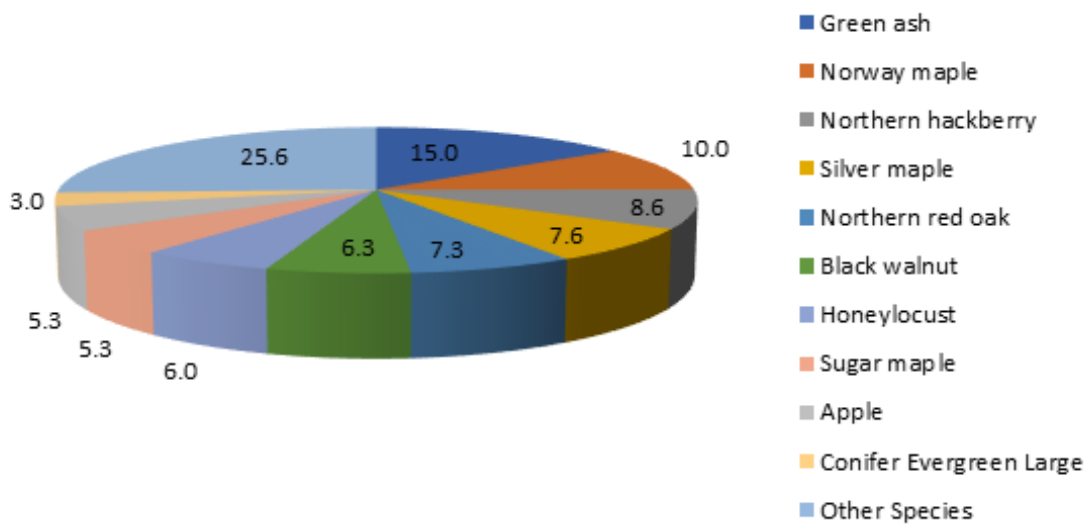
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	15,854	(N/A)	52.67	(N/A)	0.00	(N/A)
CO2	2,057	(N/A)	6.83	(N/A)	0.00	(N/A)
Air Quality	2,648	(N/A)	8.80	(N/A)	0.00	(N/A)
Stormwater	22,958	(N/A)	76.27	(N/A)	0.00	(N/A)
Aesthetic/Other	17,227	(N/A)	57.23	(N/A)	0.00	(N/A)
Total Benefits	60,744	(N/A)	201.81	(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	60,744	(N/A)	201.81	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Roland

Species Distribution of Public Trees

2/9/2022



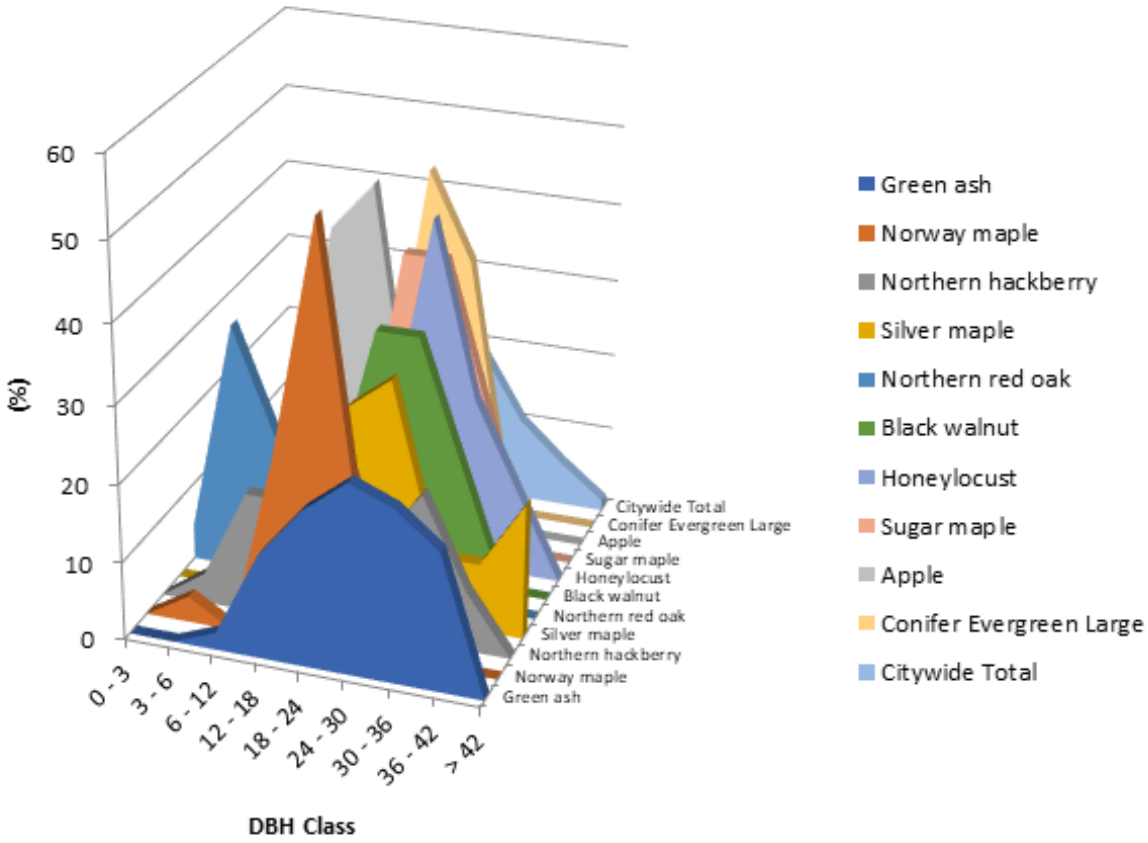
Species	Percent
Green ash	15.0
Norway maple	10.0
Northern hackberry	8.6
Silver maple	7.6
Northern red oak	7.3
Black walnut	6.3
Honeylocust	6.0
Sugar maple	5.3
Apple	5.3
Conifer Evergreen Large	3.0
Other Species	25.6
Total	100.0

Figure 2: Relative Age Class

Roland

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

2/9/2022



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	0.00	0.00	2.22	13.33	20.00	24.44	22.22	17.78	0.00
Norway maple	0.00	3.33	0.00	23.33	53.33	13.33	6.67	0.00	0.00
Northern hackberry	0.00	3.85	15.38	15.38	26.92	11.54	19.23	7.69	0.00
Silver maple	0.00	0.00	0.00	8.70	26.09	30.43	8.70	8.70	17.39
Northern red oak	4.55	31.82	18.18	31.82	13.64	0.00	0.00	0.00	0.00
Black walnut	0.00	0.00	10.53	10.53	31.58	31.58	15.79	0.00	0.00
Honeylocust	0.00	0.00	0.00	5.56	16.67	44.44	22.22	11.11	0.00
Sugar maple	0.00	0.00	0.00	6.25	37.50	37.50	18.75	0.00	0.00
Apple	0.00	12.50	37.50	43.75	6.25	0.00	0.00	0.00	0.00
Conifer Evergreen Large	0.00	0.00	11.11	11.11	44.44	33.33	0.00	0.00	0.00
Citywide Total	0.33	4.32	12.29	18.27	27.57	19.60	10.63	5.65	1.33

Figure 3: Foliage Condition

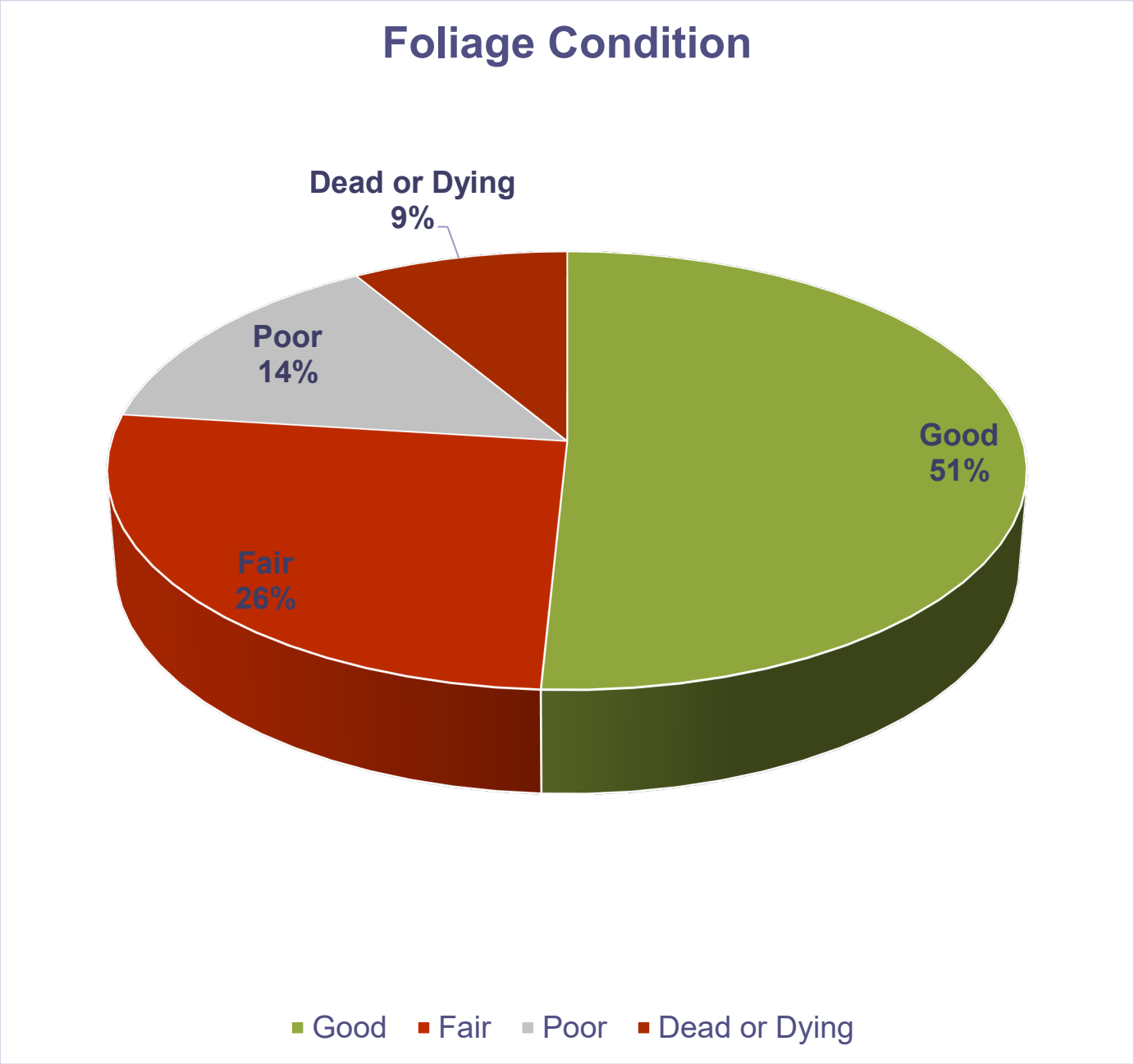


Figure 4: Wood Condition

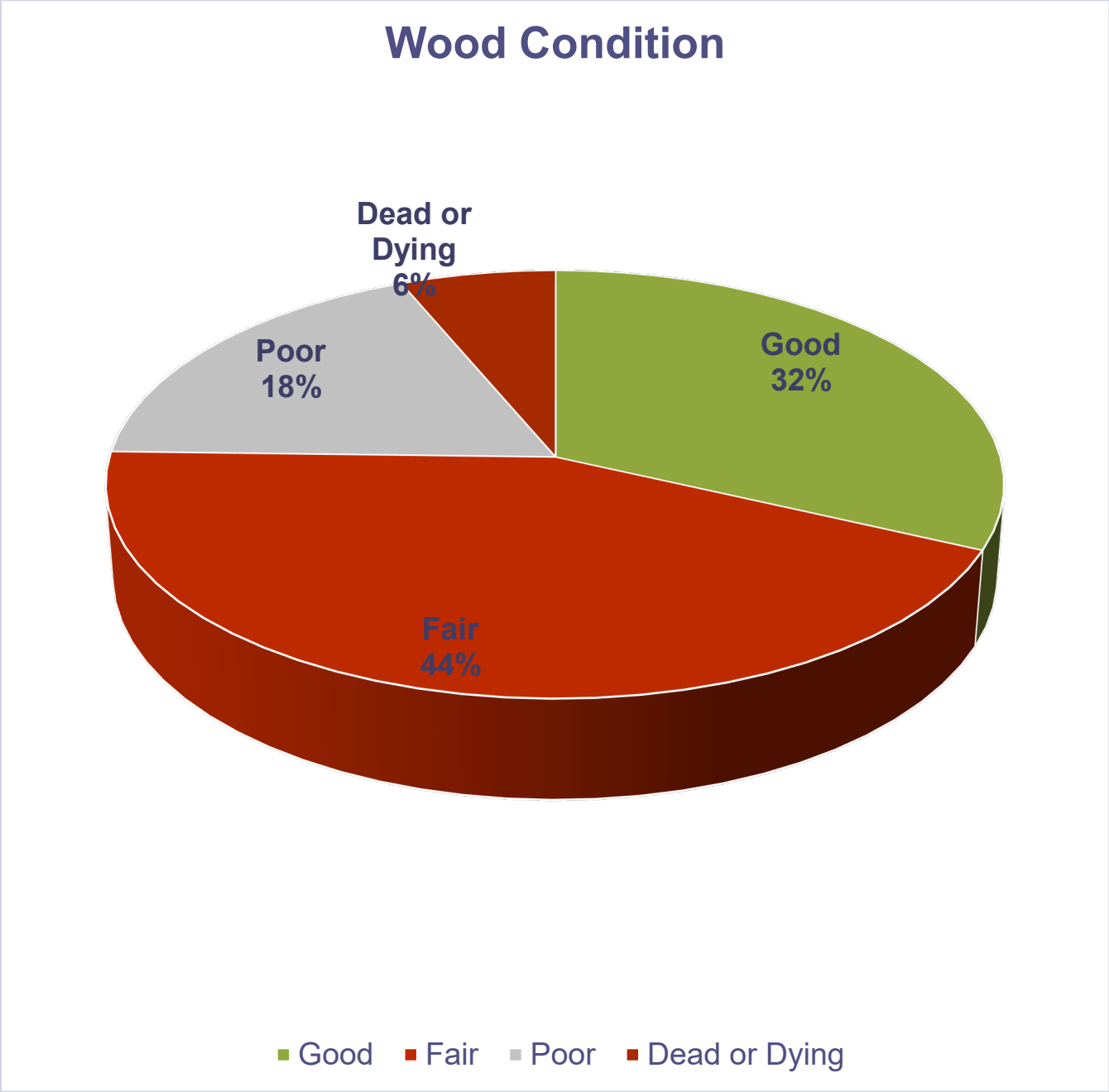
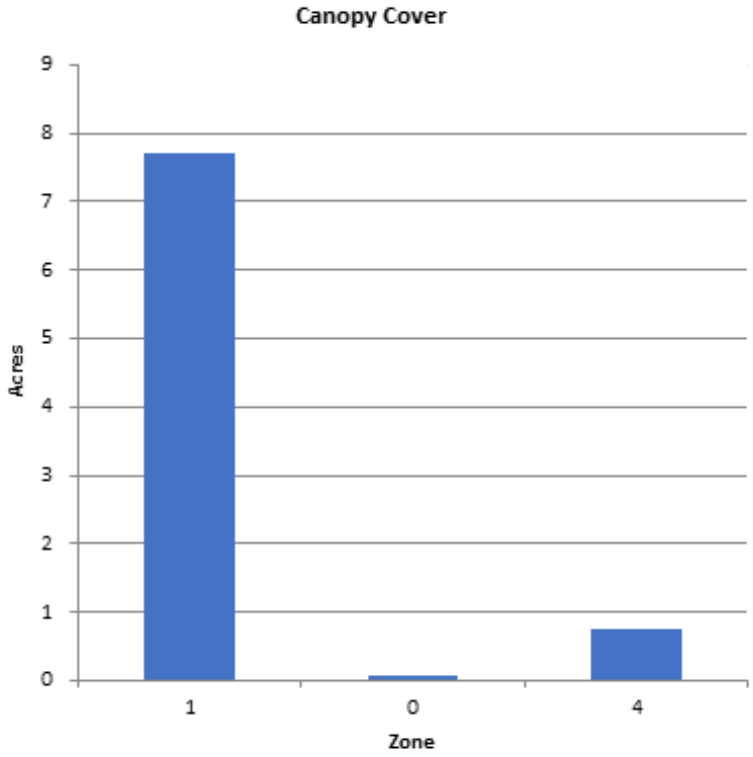


Figure 5: Canopy Cover in Acres

Roland

Canopy Cover of Public Trees (Acres)

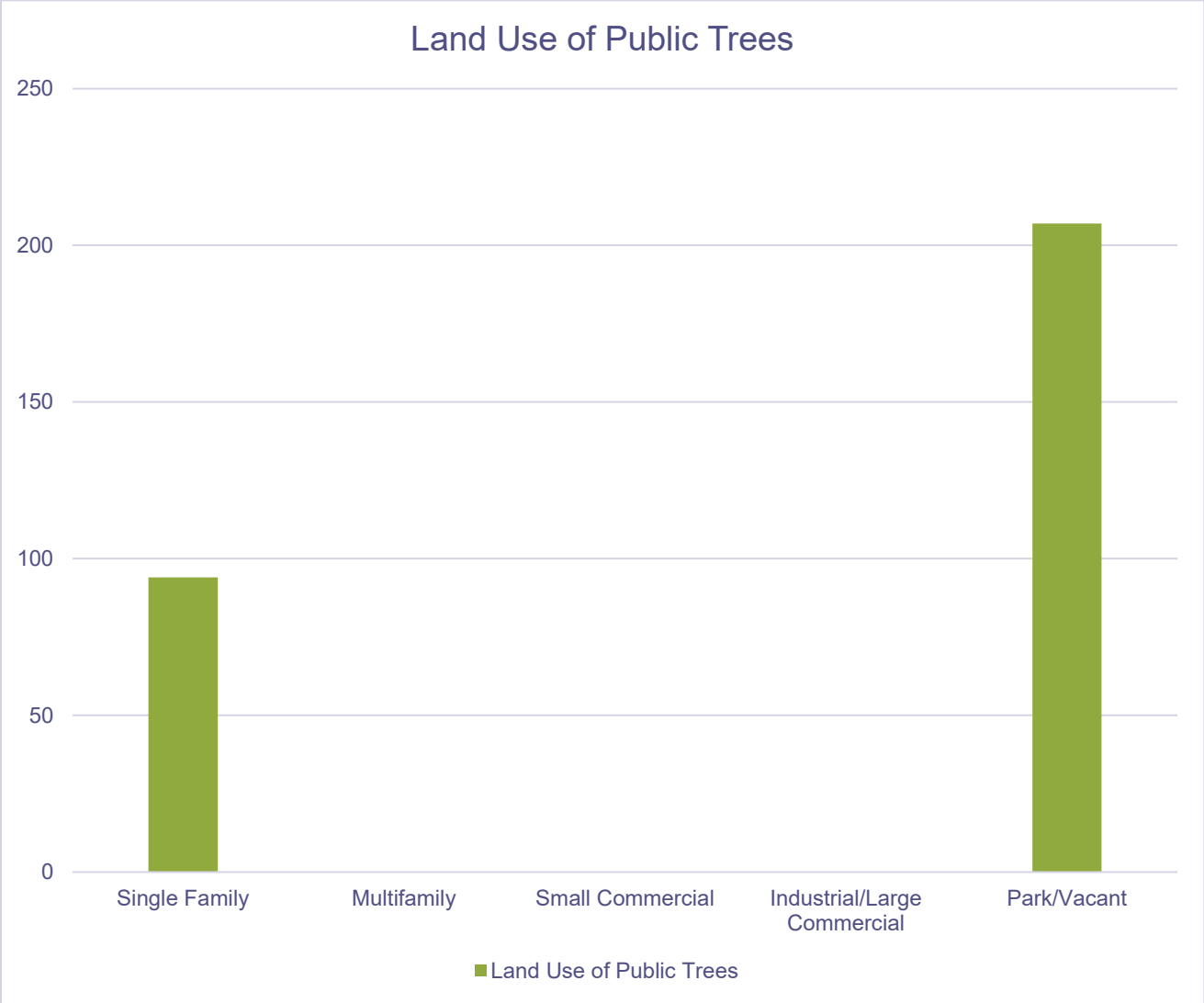
2/9/2022



Zone	Acres	% of Total Canopy Cover
1	8	90.4
0	0	0.7
4	1	8.8
Citywide total	9	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	9	0.00	0.00

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

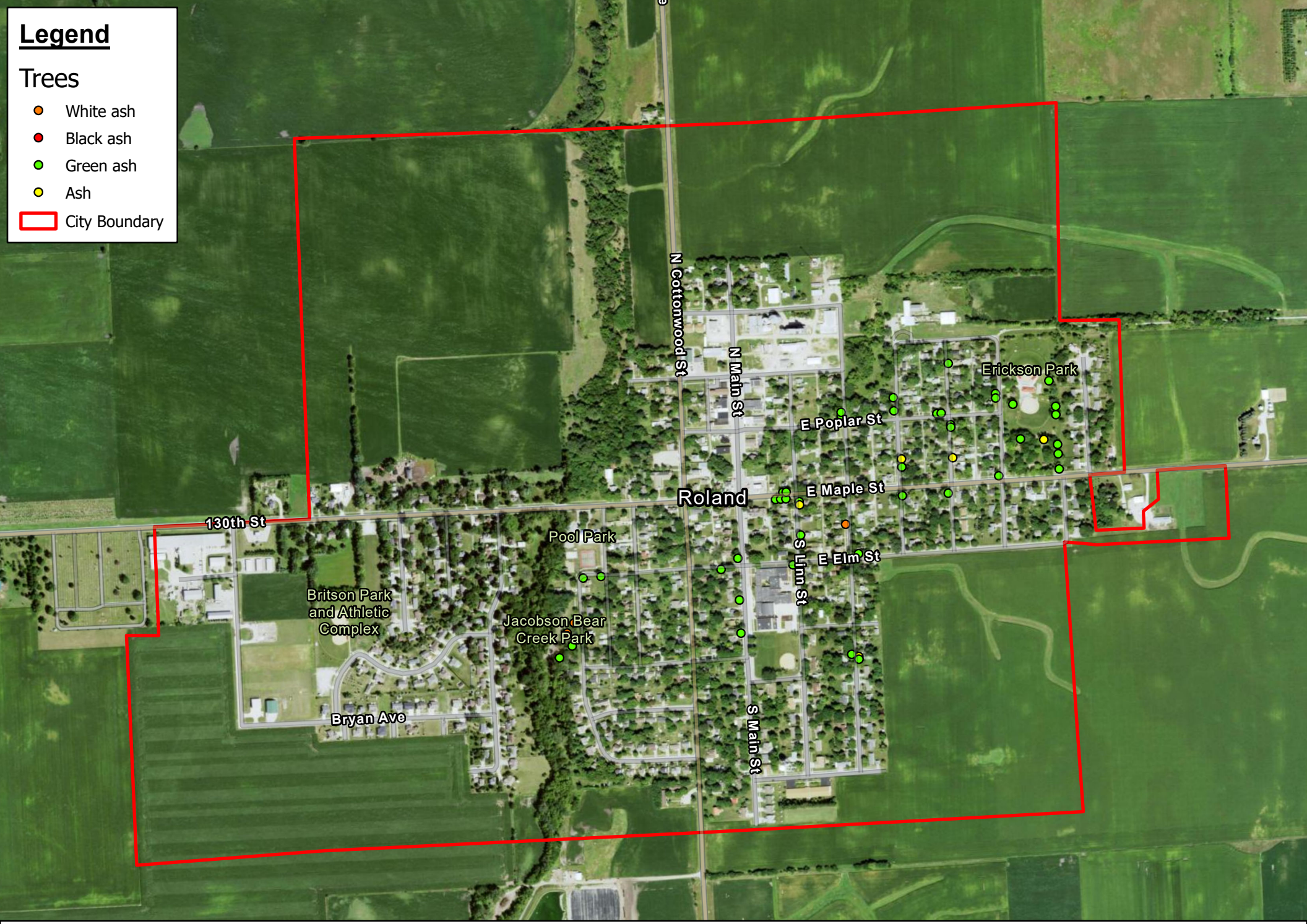
Figure 1: Location of Ash Trees

Figure 2: Location of EAB Symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

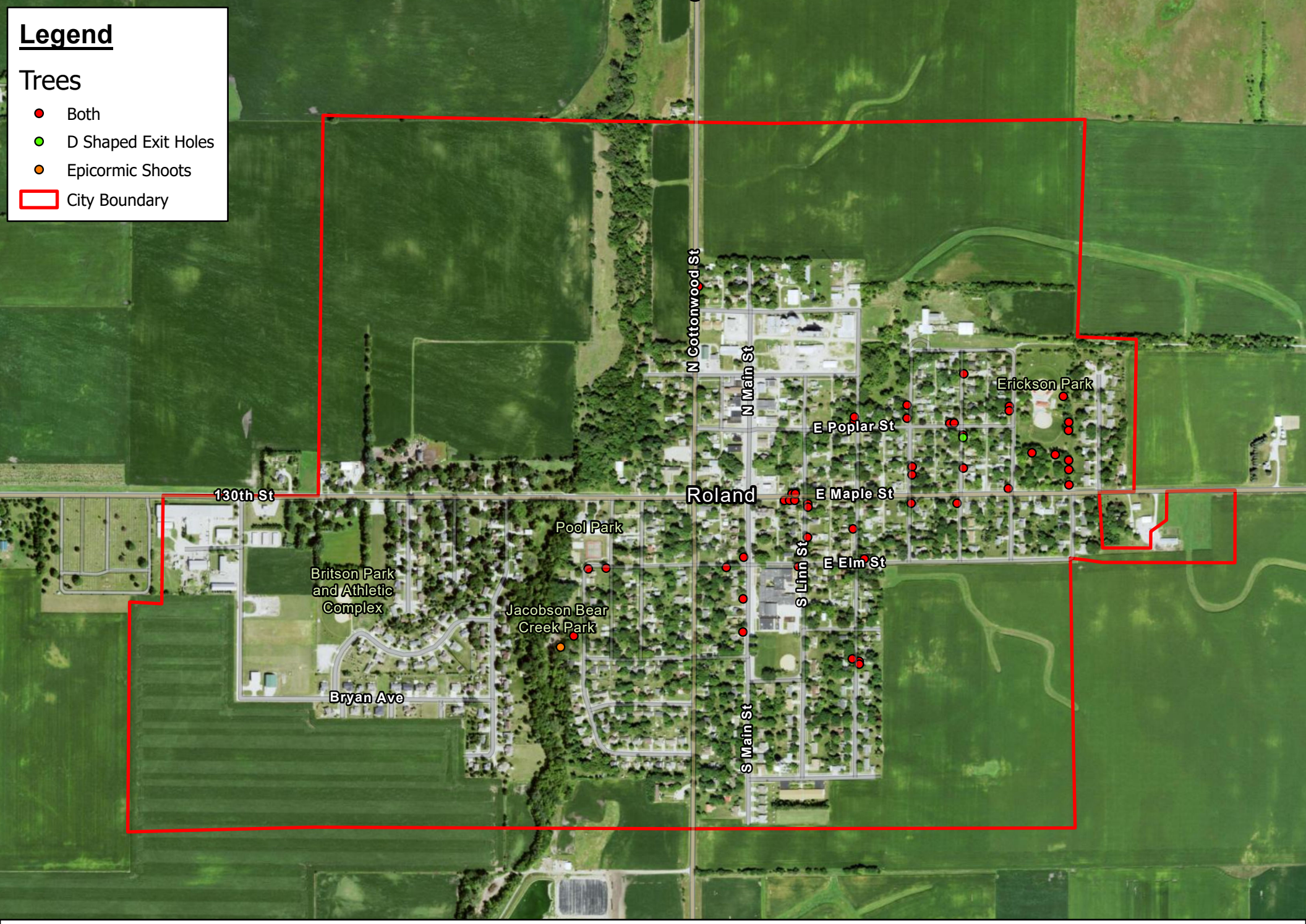
City ownership of the trees recommended for removal should be verified prior to any removal



Ash Tree Location

0 412.5 825 1,650 Feet

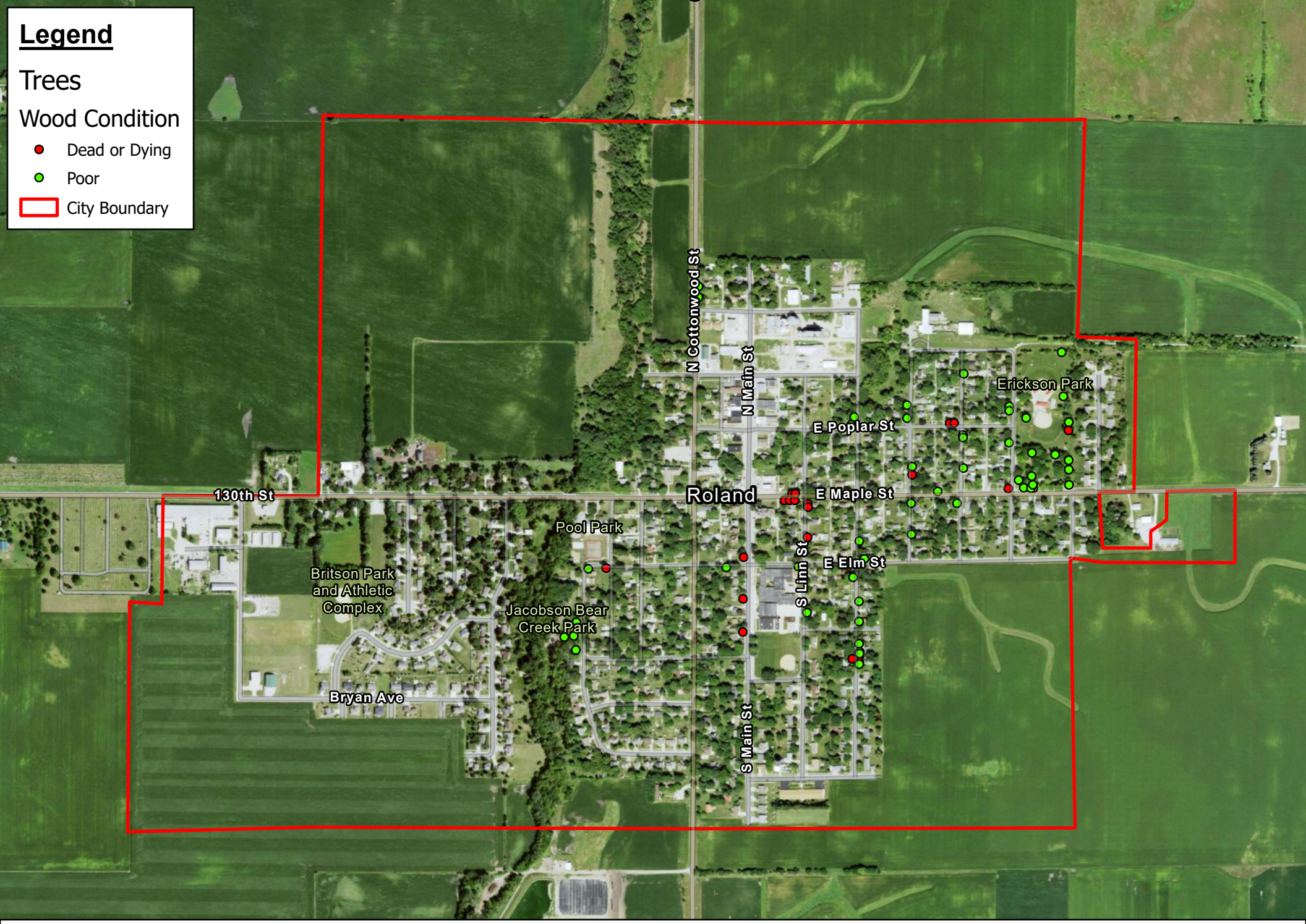
N



EAB Signs/Symptoms

0 412.5 825 1,650 Feet

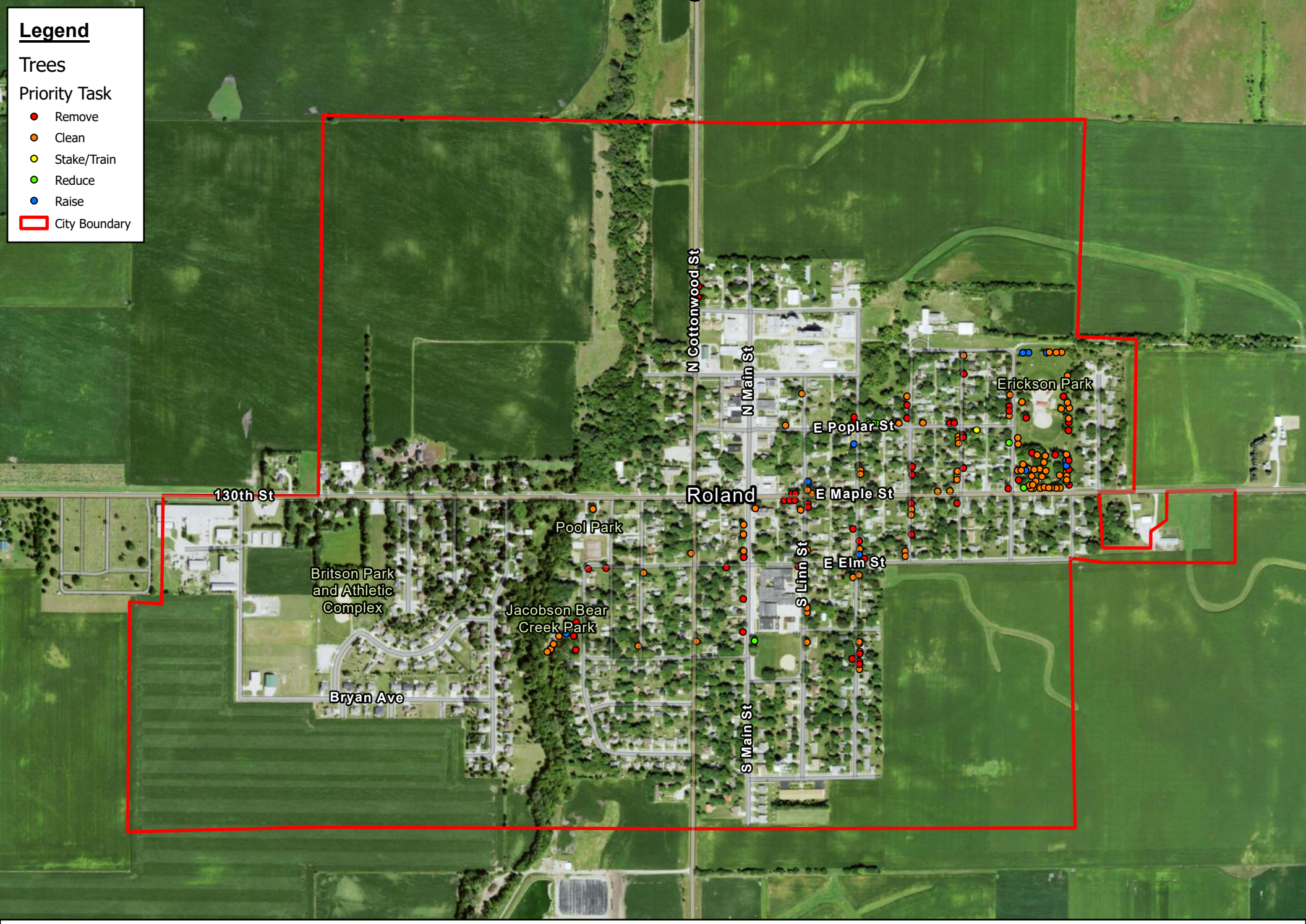
N



Poor Condition Trees

0 412.5 825 1,650 Feet

N



Priority Task

0 412.5 825 1,650 Feet

N

APPENDIX C: ROLAND ARBORICULTURAL SPECIFICATION AND STANDARDS OF PRACTICE

This document has been developed in conjunction with the Tree Ordinance for the City of Roland, Iowa, to detail the specifications and standards of practice concerning trees within the city.

I. PERMITS

Before any street tree can be planted, or removed a permit must be obtained. This permit may be obtained at no cost from the City Hall, 202 E. Ash Street, Roland, Iowa.

A tree permit will only cover the planting or removal of a tree. If the property owner is doing the work, proof of Homeowner Personal Liability Insurance may be required. If the property owner has hired another person or contractor to do the work, the contractor shall provide the City of Roland with a Certificate of Insurance showing the following minimum required limits of coverage before permits will be issued:

Commercial General Liability Insurance with limits of not less than five hundred thousand dollars ($500,000) per occurrence and Workers Compensation Insurance coverage at statutory limits on any and all employees.

Prior to digging or doing any underground work, utilities must be located. Locations can be obtained free of charge by calling Iowa One-Call; 1-800-292-8989.

II. PLANTING

A. Site Evaluation: Not all sites are appropriate for trees. Before planting, thought should be given to how the mature tree will fit the site.

1. Spacing – The spacing of the street trees is dependent upon the species size classes as established for the City of Roland, Iowa. (See Diagram on Exhibit A)

   - Small Trees: no closer than 20 feet
   - Large Trees: no closer than 40 feet

   Exceptions may be made for special plantings designed or approved by a landscape architect.

2. Distances – No tree planting is permitted where the distance between a curb and a detached sidewalk is less than nine (9) feet. In areas without sidewalks, an allowance shall be provided for future construction of sidewalks. (See Diagram on Exhibit B) Small trees shall be planted no closer than four (4) feet from the back of the curb or edge of the travel portion of the street and no closer than four (4) feet to the sidewalk or property line. No large tree shall be planted on right-of-ways that are less than eleven (11) feet. Large trees shall be planted no closer than five (5) feet to the back of the curb or traveled portion and no closer than five (5) feet to the sidewalk or property line. Whenever possible, trees shall be centered between the back of the curb or the traveled portion of the street and the sidewalk or property

line. Trees shall be planted no closer than twenty-five (25) feet from an intersection as measured from the back of the curb of the intersecting street. (See Diagram on Exhibit A) Trees shall be no closer than ten (10) feet from any alley or driveway edge.

3. Utilities

   a. No street trees, other than those classified as "small trees" that do not attain a mature height greater than twenty (20) feet, shall be planted under or within ten (10) lateral feet of any overhead utility wire exclusive of service lines. (See Diagram on Exhibit B)

   b. No street trees shall be planted over or within five (5) lateral feet of any underground line, including the water line and sewer line.

   c. No street trees shall be planted within twenty-five (25) feet of stop signs, utility poles, or fire hydrants.

   d. No street trees shall be planted closer than five (5) feet to a water shut off, manhole, or sewer lateral.

B. Diversity: Due to potential threat from pests or disease it is desirable to plant trees from a variety of tree species. An inventory of trees growing in the area where the new tree is planned should be taken to ensure diversity in the species, genus and family of tree.

C. Procedure: To promote the healthy and continuous growth of any tree, care should be given to its planting. Proper procedures vary according to tree species and type. For detailed instructions consult a local nursery, or the Iowa State University Extension Service.

D. Species: To ensure trees planted in the right-of-way are suitable for urban areas, certain trees are recommended for planting, while certain species cannot be planted on street right-of-way.

Recommended – No list of recommended trees is ever complete or static. New species and cultivators are developed and will prove useful, while old standards will be phased out. The Street Superintendent shall also have the discretion to approve additional types of trees.

In all cases trees to be planted in the street right-of-way will not be less than one (1) inch in diameter at six (6) inches above the soil line on the trunk.

For purposes of this document, allowable tree species are divided into categories based on tree size and available area for planting.

RIGHT-OF-WAY WIDTH: minimum 9′	SMALL TREES

Amur Maple
Tatarian Maple
Ruby Red Horsechestnut
Serviceberry
European Hornbeam
American Hornbeam
Eastern Redbud
Yellowwood
Pagoda Dogwood
Flowering Crabapples
Thornless Cockspur Hawthorn
Washington Hawthorn
Winter King Hawthorn
Hophornbeam
Amur Corktree
Amur Cherry
Mayday Tree
Japanese Pagoda Tree
Japanese Tree Lilac

Only small trees with a maximum height of 20 feet may be planted under utility wires, regardless of street right-of-way width.

RIGHT-OF-WAY WIDTH: minimum 11′	LARGE TREES

Black Maple
Norway Maple
Red Maple
Sugar Maple
Freeman Maple
River Birch – single stem only
Hackberry
White Ash
Gingko – male form only
Thornless Honeylocust
Kentucky Coffeetree
Basswood
American Elm hybrids resistant to Dutch Elm Disease
Cucumbertree Magnolia
Sycamore
Black Cherry
White Oak
Swamp White Oak
Red Oak
Shingle Oak
Bur Oak
Chinkapin Oak
English Oak
Black Oak
Little Leaf Linden
Redmond Linden

This is a list of approved varieties and species that do well in an urban development. As new cultivars are developed, this list will be added to and some may be deleted. This list does not include some varieties that may be approved for planting in certain conditions.

Not Allowed – Due to their susceptibility to storm damage, disease, their limited hardness or because they are considered unusually messy due to dropped fruit and/or limbs, the following tree species will not be allowed to be planted in any street right-of-way within the City of Roland:

Boxelder	All Shrubs
Silver Maple	All Fruit Trees
Tree of Heaven	All Nut Trees
White Birch	White Poplar
Cutleaf Weeping Birch	Bolleana Poplar
White Mulberry	Lombardy Poplar
Red Mulberry	Black Locust
Catalpa	Eurpoean Mountain Ash
Russian Olive	Chinese Elm
Gingko – female form	Siberian Elm
Common Honeylocust	English Walnut
All Conifer trees (Firs, Junipers, Larches, Spruces, Pines, Yews, Arborvitae, and Hemlocks)	Black Walnut
	Willows
	Cottonwood

It is *also not allowed* to do any of the following to street right-of-way trees:

1. Damage, cut, carve, nail, bolt, or set fire
2. Attach any rope, chain, wire, cable for any reason
3. Attach advertising posters or any other contrivance
4. Allow any harmful gaseous, liquid, chemical, or solid substance come in contact
5. Topping (which means the drastic removal of large branches, severely cutting back limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree. (See Diagram on Exhibit C)
6. To patch any tree cavity with concrete or fill material of any kind
7. To place or store any stone, brick, sand, concrete, or other material which shall impede the free passage of water, air, and fertilizer to the roots of any tree

Shrubs – As defined in the City's tree ordinance are not acceptable plantings in the street right-of-way. Any other plantings or ground cover planted in the street right-of-way shall not attain a height of eighteen (18) inches at maturity.

III. MAINTENANCE

A. General: To promote their healthy and vigorous growth, trees should be pruned throughout their life span. Primary care and maintenance of street trees shall be the responsibility of the adjacent property owner. Bulletins and tree pamphlets are available from the Iowa State University Extension Office.

In order to allow the free passage of vehicular traffic and ensure trees will not obstruct or shade traffic control devices or the view of street intersections, all trees shall be trimmed so any overhanging portions shall be fifteen (15) feet over the paved portion of the street or the traveled portion of an alley.

Branches overhanging sidewalks shall be trimmed to a minimum height of eight (8) feet. Good pruning practices should be followed at all times. (See Diagram on Exhibit D)

To ensure the ability of the motorists to see any traffic control device, trees shall be kept trimmed to the specifications listed here: Any traffic light or regulatory sign (as defined in the current edition of the Manual on Uniform Traffic Control Devices (MUTCD)) shall be visible from a distance no less than two hundred (200) feet as measured from the signal or sign to the center of the street. An exception has been made for No Parking Signs; these should be visible from a distance of one hundred (100) feet as measured from the sign to the center of the street.

B. Street Trees: If it becomes necessary in the opinion of the Street Superintendent to trim or remove any street tree or planting, the Street Superintendent shall notify the adjacent property owner. Notification shall be sent by regular U.S. mail.

Before a property owner can plant or remove any street tree, they must first obtain a permit. If the property owner is doing the work, proof of Homeowner Personal liability Insurance may be required. If the property owner has hired another person or contractor to do the work, the contractor shall provide the City of Roland with a Certificate of Insurance showing the following minimum required limits of coverage:

Commercial General Liability Insurance with limits of not less than five hundred thousand dollars ($500,000) per occurrence and Workers Compensation Insurance coverage statutory limits on any and all employees.

Removal of trees shall be complete and the work site shall be cleaned up properly. All tree trunks, limbs, branches, twigs, and brush shall be collected and disposed of in and authorized manner. Stumps and all surface roots shall be ground down to a minimum of four (4) inches below normal ground line, debris cleaned up and the hole shall be backfilled with black dirt.

Whenever the Street Superintendent is notified or becomes aware of a diseased or dead street tree which is in the imminent danger of falling and has the potential of thereby injuring an individual or causing property damage, tree shall be considered a hazard and removed by the City.

Whenever the Street Superintendent is notified or becomes aware of a dead or broken branch or limb in any street tree which is in the imminent danger of falling and has the potential of thereby injuring an individual or causing property damage, the defending branch or limb shall be considered a hazard and be removed by the abutting property owner. Subsequent trimming of the tree which contained the dead or broken branch or limb should occur after notification of the adjacent property owner as outlined above. If the cost of trimming a tree exceeds one-half the cost of tree removal, the Street Superintendent may decide to remove the tree, rather than trim the tree.

C. Private Trees: The property owner is responsible for the maintenance of any tree on their property. Owners are encouraged to contact the local ISU Extension Office for the information on proper planting and care of trees. The Extension Service can help determine which tree species grow best in our area as well as which types of trees are most susceptible to disease.

If it becomes necessary to trim trees and shrubs on private property to comply with the specifications set forth in this document, the Street Superintendent shall notify the owner of the property upon which the tree or shrub is growing. Notification shall be sent by regular U.S. mail.

If the property owner fails to comply with the trimming of the tree or shrub within five (5) days after receipt of the stated above notice, the Street Superintendent shall have the tree or shrub trimmed. The exact cost of the work shall be certified by the City Clerk to the Story County Treasurer to be collected with and in the same manner as property taxes.

Whenever the Street Superintendent is notified or becomes aware of a diseases or dead tree or broken or dead branch or limb in any private tree which has the potential of falling and thereby injuring any individual or causing property damage to adjacent property, the Street Superintendent shall declare the tree, branch, or limb a hazard and order the property owner to remove the hazard within 14 days. Notification shall be sent by certified mail.

If the property owner fails to remove the hazard, the Street Superintendent shall cause the hazard to be removed. For purposes of removing the hazard, City crews or a City agent shall be allowed on private property. Attempts should be made to notify the property owner before entering onto private property. The exact cost of such work shall be certified by the City Clerk to the Story County Treasurer to be collected with and in the same manner as general property taxes.

IV. REMOVAL

Street Trees may be removed only when one or more of the following criteria are met:

A. The tree is infected with an epidemic insect or disease where the recommended control is not applicable and removal is the recommended practice to prevent transmission.

B. The tree poses an extreme public nuisance because of its species, size, location or condition. The nuisance could be caused by fruit or seed drop, harboring of insects or excessive twig or limb breakage.

C. The tree is dead or dying.

D. The tree poses a severe safety hazard that cannot be corrected by pruning, transplanting or other treatments.

E. The tree severely interferes with the growth and development of a more desirable tree.

F. The aesthetic values of the tree are so low or negative that the site is visually enhanced by the tree's removal.

G. Work improvements required to be made around the tree will kill or render it a hazard.

H. Preservation of the tree, when adjacent property is developed, is not cost effective. The monetary value of the tree shall be compared to construction costs necessary to preserve the tree.

I. The tree is causing cracking or raising problems with sidewalks, streets, or curbs and the roots cannot be pruned properly to preserve the tree.

J. Tree roots are causing continual sewer problems that cannot be corrected by alternate methods.

K. The tree is causing intersection sight problems or other public safety problems when it is determined that the branches cannot be pruned properly to eliminate this problem.

V. APPEAL PROCESS

In the event that the property owner receives an order from the Street Superintendent and objects to all or part, the property owner may appeal to the City Council. The property owner must appeal the order in writing to the City Clerk within ten (10) days of the receipt of the order, stating the nature of objection and requesting a hearing. The hearing shall be held before the City Council within twenty (20) days of the notice of appeal being filed with the City Clerk. The City Council shall, within ten (10) days of hearing the appeal, issue a decision. The decision of the City Council shall constitute a final decision.