Runnells, IA:

2020 Urban Forest Management Plan

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Executive Summary

EXECUTIVE SUMMARY

Overview

This plan was developed to assist the City of Runnells 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. With proper planning and management, the costs of removing dead and dying trees can be extended over years, and mitigating public safety issues.

Inventory and Results

In 2020, 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 48 trees inventoried.

- Runnells trees provide $9,164 of benefits annually, an average of $190.92 per tree
- There are over 7 species of trees
- The top three genera are: maple 46%, oak 21%, and spruce 21%
- 31 percent of trees need some type of management
- 1 tree should be removed

Recommendations

Below are some key recommendations, for further details see the Recommendation and Emerald Ash Borer Plan Sections:

- The one tree in need of removal is not over 24 inches in diameter and is therefore not an immediate concern, but should be addressed soon. *City ownership of the trees recommended for removal should be verified prior to any removal*
- All trees should be pruned on a routine schedule: one third of the city at least 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.
- We suggest that city officials request an annual budget of $900 to aid in removal, pruning, planting and maintenance. Apply for grants to help fund these actions.

Introduction

INTRODUCTION

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

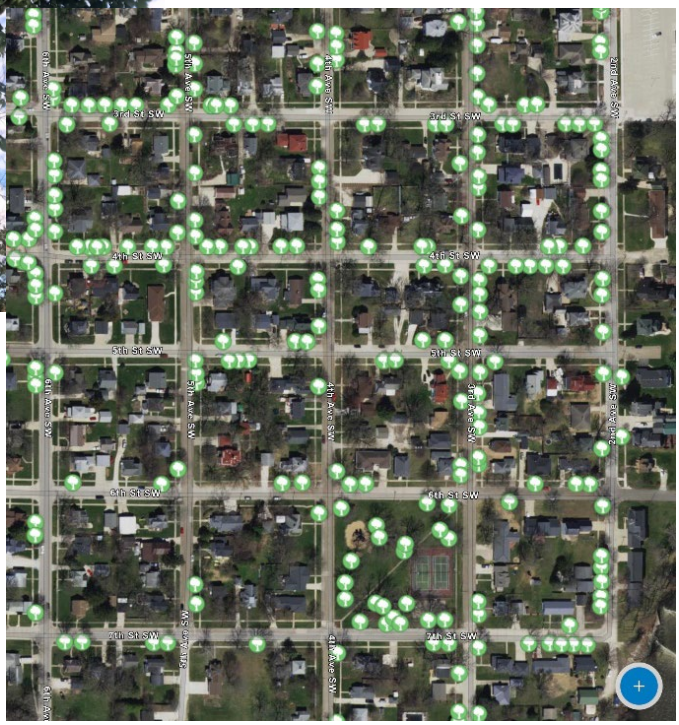
Assist Runnells with Managing its Urban Forest

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



Inventory Results

INVENTORY

In 2020, JEO conducted a tree inventory that included 100 percent 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 feet, recommended maintenance, priority of that maintenance, leaf health, and wood condition.

INVENTORY RESULTS

JEO entered the data collected for the 48 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. Runnells' trees reduce energy-related costs by approximately $2,154 annually (Appendix A, Table 1). These savings are both in electricity (10.2 MWh) and in natural gas (1,409.7 Therms).

Annual Stormwater Benefits

Runnells' trees intercept about 131,164 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $3,555 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 Runnells, it is estimated that trees remove 134.5 pounds of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $374 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Runnells, trees sequester about 32,966 pounds of carbon per year with an associated value of $247 (Appendix A, Table 5). In addition, the trees store 566,999 lbs of carbon, with a yearly benefit of $4,252 (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. Runnells receives $2,727 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, Runnells' trees provide $9,164 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 48 trees in Runnells provide approximately $190.92 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$2,154**	• Intercept **131,164 gallons** • Provides **$3,555** benefit	• Remove **134.5 lbs** of pollution • Net value of **$374**	• Sequester **32,966 lbs** • Value of **$247** • Store **566,999 lbs** • Value of **$4,252**	• **$2,727** in social benefits	• **$9,164** annual benefits • Each tree provides **$190.92** annually

FOREST STRUCTURE

Species Distribution

Runnells has over 7 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	22	46%	Birch	1	2%
Oak	10	21%	Basswood/Linden	1	2%
Spruce	10	21%	Cedar	1	2%
Apple	3	6%	Total Trees:	48	

Age Class

Most of Runnells' trees (42 percent) are between 6 and 18 inches in diameter at 4.5 feet (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. Runnells' size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Runnells indicate that 77 percent of the trees are in good health, with only <1 percent of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 65 percent of Runnells' trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). One percent of the tree population's wood condition is in poor health, dead, or dying. This 1 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	13	27%
Tree Removal	1	2%
Tree Staking	1	2%
Crown Raising	0	0%
Crown Reduction	0	0%

Canopy Cover

The total canopy with both private and public trees is 62.27 acres or around 23 percent. The canopy cover included in the Holstein inventory includes approximately 1 acre (Appendix A, Figure 4). The city's canopy goal is to increase canopy by 7 percent in 30 years. To achieve this goal it is estimated that 30 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Runnells' 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
Park/Vacant/Other	94%
Small Commercial	4%
Single Family Residential	2%
Multifamily Residential	0%
Industrial/Large Commercial	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

Runnells has no failing trees that need immediate removal at this time. For future critical concern trees we recommend starting with the large-diameter trees first. Please refer to the Schedule and Budget at the end of this section for a removal plan. 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 15 trees with maintenance needs.

POOR TREE SPECIES

There is currently one (non-immediate) removal. (Appendix B, Figure 3 & Appendix B, Figure 4). There are no ash in the current city-owned urban canopy. In addition, there are 3 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 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 percent. 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 Runnells.

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 percent of

the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 10 percent of the total urban forest. Presently, the forest is heavily planted with maple (46 percent) (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: crabapple, Japanese Lilac, serviceberry, oak (red, white), hackberry, linden, elm (disease resistant), cork, London plane, ironwood hornbeam 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 avoid adding ash trees to the forest structure. 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. Ash on private property should be carefully examined as well.

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 crabapple, linden, Japanese lilac, elm (Disease Resistant), serviceberry, cork oak (Red, White), London plane, hackberry, ironwood, hornbeam (Ord. 473 – Jun. 18 Supp.)

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Postponed Work

While finances, staffing, and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash will be prioritized by hazardous or emergency situations only.

Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for EAB signs and symptoms including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 151.06 states “A property owner may remove a tree that is on personal property as long as the property owner does the actual work. Otherwise, the property owner must hire a licensed tree surgeon to remove the tree. (Ord. 452 – Jul. 14 Supp.).”

Schedule & Budget

PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $900/Year – (Based off Suggested $2 per capita)

YEAR 1	Est. Cost
Remove 1 tree recommended for immediate removal	$700
Plant 1 tree in an open location	$150
Visual Survey of Pest Signs/Symptoms	n/a
TOTAL	**$850**

YEAR 2	Est. Cost
Prune 1/3 of city owned trees	$240
Plant 4 trees in open locations	$600
Visual Survey of Pesy Signs/Symptoms	n/a
TOTAL	**$840**

YEAR 3	Est. Cost
Prune 1/3 of city owned trees	$240
Plant 3 trees in open locations	$450
Additional removal, planting and maintenance	$210
Visual Survey of Pest Signs/Symptoms	n/a
TOTAL	**$900**

YEAR 4	Est. Cost
Prune 1/3 of city owned trees	$240
Plant 3 trees in open locations	$450
Additional removal, planting and maintenance	$210
Visual Survey of Pest Signs/Symptoms	n/a
TOTAL	**$900**

YEAR 5	Est. Cost
Prune 1/3 of city owned trees	$240
Plant 3 trees in open locations	$450
Additional removal, planting and maintenance	$210
Visual Survey of Pest Signs/Symptoms	n/a
TOTAL	**$900**

YEAR 6	Est. Cost
Prune 1/3 of city owned trees	$240
Plant 3 trees in open locations	$450
Additional removal, planting and maintenance	$210
Visual Survey of Pest Signs/Symptoms	n/a
TOTAL	**$900**

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

Proposed Annual Budget

Our team suggests Runnells apply for Utility Company grants. They 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.

The budget proposed above based off a national average of $2 per capita will allow Runnells to remove all problem trees, and prune 1/3 of the canopy annually after year one. Pruning is important for tree health, and can prevent high rates of costly removals.

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Appendices

APPENDIX A: i-TREE DATA

Annual Energy Benefits of Public Trees

2/1/2021

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	4.1	309	541.9	531	840	(N/A)	20.8	39.0	84.02
Spruce	0.5	34	76.0	74	109	(N/A)	16.7	5.0	13.58
Red maple	1.5	111	187.9	184	295	(N/A)	16.7	13.7	36.86
Swamp white oak	0.9	70	138.9	136	206	(N/A)	10.4	9.6	41.24
Apple	0.2	17	38.5	38	55	(N/A)	6.3	2.5	18.19
Sugar maple	0.6	48	88.4	87	135	(N/A)	4.2	6.3	67.52
Northern red oak	0.3	20	37.6	37	57	(N/A)	4.2	2.6	28.45
Pin oak	0.8	62	108.0	106	168	(N/A)	4.2	7.8	84.11
Blue spruce	0.1	5	10.2	10	15	(N/A)	2.1	0.7	14.80
Littleleaf linden	0.3	22	41.9	41	63	(N/A)	2.1	2.9	62.69
Norway maple	0.1	8	16.9	17	24	(N/A)	2.1	1.1	24.47
River birch	0.3	24	47.4	46	71	(N/A)	2.1	3.3	70.84
White oak	0.1	7	13.7	13	21	(N/A)	2.1	1.0	20.64
Eastern red cedar	0.0	4	7.9	8	11	(N/A)	2.1	0.5	11.47
Maple	0.3	22	39.9	39	61	(N/A)	2.1	2.8	60.68
Norway spruce	0.1	10	14.6	14	24	(N/A)	2.1	1.1	24.14
Total	10.2	773	1,409.7	1,382	2,154	(N/A)	100.0	100.0	44.88

Annual Stormwater Benefits of Public Trees

2/1/2021

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	68,847	1,866	(N/A)	20.8	52.5	186.57
Spruce	4,764	129	(N/A)	16.7	3.6	16.14
Red maple	11,194	303	(N/A)	16.7	8.5	37.92
Swamp white oak	9,048	245	(N/A)	10.4	6.9	49.04
Apple	793	22	(N/A)	6.3	0.6	7.17
Sugar maple	7,592	206	(N/A)	4.2	5.8	102.86
Northern red oak	3,049	83	(N/A)	4.2	2.3	41.32
Pin oak	11,355	308	(N/A)	4.2	8.7	153.86
Blue spruce	755	20	(N/A)	2.1	0.6	20.47
Littleleaf linden	3,744	101	(N/A)	2.1	2.9	101.46
Norway maple	586	16	(N/A)	2.1	0.4	15.88
River birch	3,764	102	(N/A)	2.1	2.9	102.01
White oak	608	16	(N/A)	2.1	0.5	16.47
Eastern red cedar	659	18	(N/A)	2.1	0.5	17.86
Maple	2,867	78	(N/A)	2.1	2.2	77.70
Norway spruce	1,539	42	(N/A)	2.1	1.2	41.70
Citywide total	131,164	3,555	(N/A)	100.0	100.0	74.05

Annual Air Quality Benefits of Public Trees

2/1/2021

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	13.9	2.3	6.6	0.6	74	19.3	2.8	2.7	18.4	120	-7.4	-28	59.3	167	(N/A)	20.8	16.70
Spruce	0.4	0.1	0.4	0.1	3	2.3	0.3	0.3	2.0	14	-1.3	-5	4.6	12	(N/A)	16.7	1.48
Red maple	2.5	0.4	1.2	0.1	14	6.9	1.0	1.0	6.6	43	-0.9	-3	18.8	53	(N/A)	16.7	6.65
Swamp white oak	1.9	0.3	0.9	0.1	10	4.5	0.7	0.6	4.2	28	-0.4	-2	12.7	36	(N/A)	10.4	7.26
Apple	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.0	7	0.0	0	2.7	8	(N/A)	6.3	2.55
Sugar maple	1.0	0.2	0.5	0.0	5	3.1	0.4	0.4	2.9	19	-0.8	-3	7.7	22	(N/A)	4.2	10.75
Northern red oak	0.7	0.1	0.3	0.0	4	1.3	0.2	0.2	1.2	8	-1.0	-4	3.0	8	(N/A)	4.2	3.93
Pin oak	2.3	0.4	1.1	0.1	12	3.9	0.6	0.5	3.7	24	-4.1	-15	8.5	21	(N/A)	4.2	10.58
Blue spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	2.1	1.53
Littleleaf linden	0.7	0.1	0.3	0.0	4	1.4	0.2	0.2	1.3	9	-0.3	-1	4.0	11	(N/A)	2.1	11.21
Norway maple	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	2.1	3.47
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)	2.1	13.58
White oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3	(N/A)	2.1	2.99
Eastern red cedar	0.1	0.0	0.1	0.0	0	0.2	0.0	0.0	0.2	1	-0.3	-1	0.3	1	(N/A)	2.1	0.62
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)	2.1	11.54
Norway spruce	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)	2.1	2.82
Citywide total	25.5	4.4	12.6	1.2	138	48.7	7.1	6.7	46.1	303	-17.8	-67	134.5	374	(N/A)	100.0	7.80

Stored CO_2 Benefits of Public Trees

2/1/2021

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	356,006	2,670	(N/A)	20.8	62.8	267.00
Spruce	2,054	15	(N/A)	16.7	0.4	1.93
Red maple	27,897	209	(N/A)	16.7	4.9	26.15
Swamp white oak	30,608	230	(N/A)	10.4	5.4	45.91
Apple	2,724	20	(N/A)	6.3	0.5	6.81
Sugar maple	28,560	214	(N/A)	4.2	5.0	107.10
Northern red oak	15,251	114	(N/A)	4.2	2.7	57.19
Pin oak	62,568	469	(N/A)	4.2	11.0	234.63
Blue spruce	284	2	(N/A)	2.1	0.1	2.13
Littleleaf linden	15,239	114	(N/A)	2.1	2.7	114.29
Norway maple	1,101	8	(N/A)	2.1	0.2	8.26
River birch	14,280	107	(N/A)	2.1	2.5	107.10
White oak	1,035	8	(N/A)	2.1	0.2	7.76
Eastern red cedar	277	2	(N/A)	2.1	0.0	2.08
Maple	7,945	60	(N/A)	2.1	1.4	59.59
Norway spruce	1,170	9	(N/A)	2.1	0.2	8.78
Citywide total	566,999	4,252	(N/A)	100.0	100.0	88.59

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.

Runnells

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

2/1/2021

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	21,958	165	-1,709	-51	-13	6,832	51	27,030	203 (N/A)	20.8	57.3	20.27
Spruce	421	3	-10	-9	0	755	6	1,157	9 (N/A)	16.7	2.5	1.08
Red maple	2,544	19	-134	-13	-1	2,446	18	4,843	36 (N/A)	16.7	10.3	4.54
Swamp white oak	1,501	11	-148	-10	-1	1,548	12	2,890	22 (N/A)	10.4	6.1	4.34
Apple	342	3	-13	-4	0	372	3	697	5 (N/A)	6.3	1.5	1.74
Sugar maple	1,515	11	-137	-7	-1	1,070	8	2,441	18 (N/A)	4.2	5.2	9.15
Northern red oak	375	3	-73	-4	-1	443	3	741	6 (N/A)	4.2	1.6	2.78
Pin oak	2,196	16	-300	-9	-2	1,380	10	3,265	24 (N/A)	4.2	6.9	12.25
Blue spruce	39	0	-1	-1	0	106	1	142	1 (N/A)	2.1	0.3	1.07
Littleleaf linden	1,118	8	-73	-4	-1	478	4	1,519	11 (N/A)	2.1	3.2	11.39
Norway maple	224	2	-5	-1	0	176	1	393	3 (N/A)	2.1	0.8	2.95
River birch	370	3	-69	-4	-1	539	4	837	6 (N/A)	2.1	1.8	6.27
White oak	209	2	-5	-1	0	159	1	361	3 (N/A)	2.1	0.8	2.71
Eastern red cedar	40	0	-1	-1	0	82	1	119	1 (N/A)	2.1	0.3	0.89
Maple	0	0	-38	-3	0	477	4	436	3 (N/A)	2.1	0.9	3.27
Norway spruce	116	1	-6	-2	0	216	2	324	2 (N/A)	2.1	0.7	2.43
Citywide total	32,966	247	-2,723	-123	-21	17,078	128	47,198	354 (N/A)	100.0	100.0	7.37

Annual Aesthetic/Other Benefits of Public Trees

2/1/2021

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,502	(N/A)	20.8	55.1	150.23
Spruce	123	(N/A)	16.7	4.5	15.42
Red maple	337	(N/A)	16.7	12.3	42.08
Swamp white oak	143	(N/A)	10.4	5.3	28.67
Apple	19	(N/A)	6.3	0.7	6.40
Sugar maple	153	(N/A)	4.2	5.6	76.42
Northern red oak	25	(N/A)	4.2	0.9	12.69
Pin oak	157	(N/A)	4.2	5.8	78.51
Blue spruce	21	(N/A)	2.1	0.8	21.08
Littleleaf linden	106	(N/A)	2.1	3.9	106.03
Norway maple	26	(N/A)	2.1	1.0	26.22
River birch	31	(N/A)	2.1	1.2	31.46
White oak	29	(N/A)	2.1	1.0	28.56
Eastern red cedar	21	(N/A)	2.1	0.8	21.34
Maple	0	(N/A)	2.1	0.0	0.00
Norway spruce	32	(N/A)	2.1	1.2	32.32
Citywide total	2,727	(N/A)	100.0	100.0	56.81

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

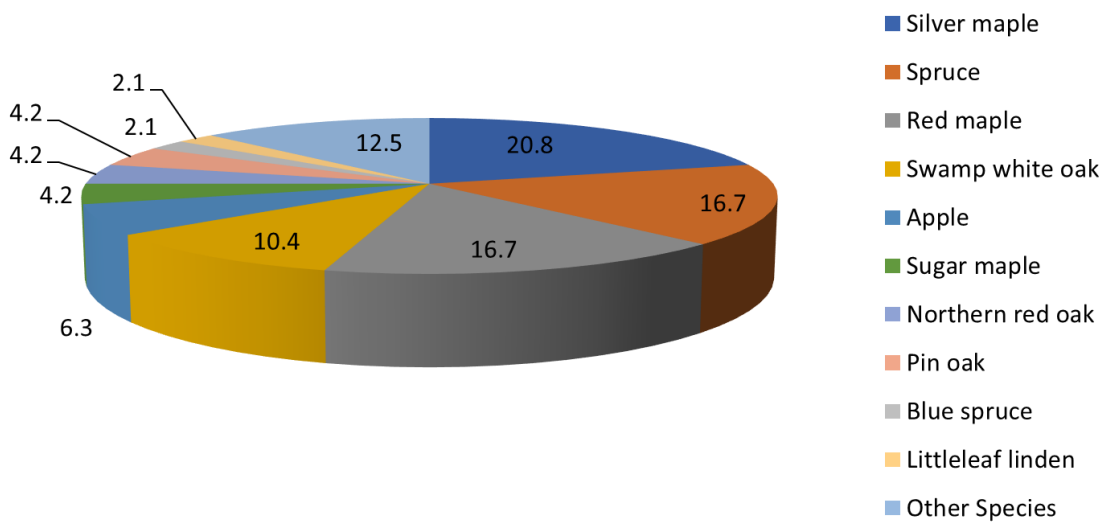
2/1/2021

Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	2,154	(N/A)	44.88	(N/A)	0.00	(N/A)
CO2	354	(N/A)	7.37	(N/A)	0.00	(N/A)
Air Quality	374	(N/A)	7.80	(N/A)	0.00	(N/A)
Stormwater	3,555	(N/A)	74.05	(N/A)	0.00	(N/A)
Aesthetic/Other	2,727	(N/A)	56.81	(N/A)	0.00	(N/A)
Total Benefits	9,164	(N/A)	190.92	(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	9,164	(N/A)	190.92	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Species Distribution of Public Trees

2/1/2021

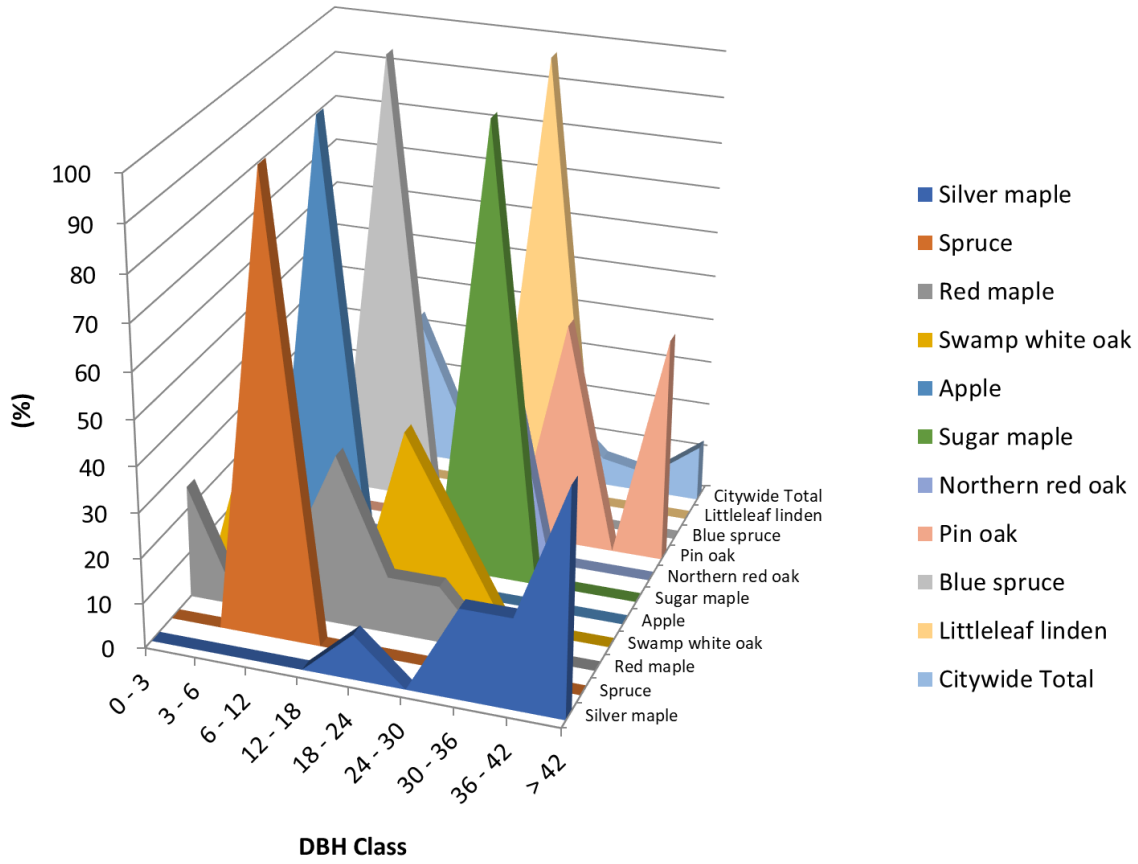


Species	Percent
Silver maple	20.8
Spruce	16.7
Red maple	16.7
Swamp white oak	10.4
Apple	6.3
Sugar maple	4.2
Northern red oak	4.2
Pin oak	4.2
Blue spruce	2.1
Littleleaf linden	2.1
Other Species	12.5
Total	100.0

Figure 2: Relative Age Class

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

2/1/2021



	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	0.00	0.00	0.00	10.00	0.00	20.00	20.00	50.00
Spruce	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Red maple	25.00	0.00	12.50	37.50	12.50	12.50	0.00	0.00	0.00
Swamp white oak	0.00	40.00	0.00	0.00	40.00	20.00	0.00	0.00	0.00
Apple	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugar maple	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Northern red oak	50.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00
Pin oak	0.00	0.00	0.00	0.00	0.00	0.00	50.00	0.00	50.00
Blue spruce	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Littleleaf linden	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Citywide Total	6.25	4.17	33.33	8.33	8.33	16.67	6.25	4.17	12.50

Figure 3: Foliage Condition

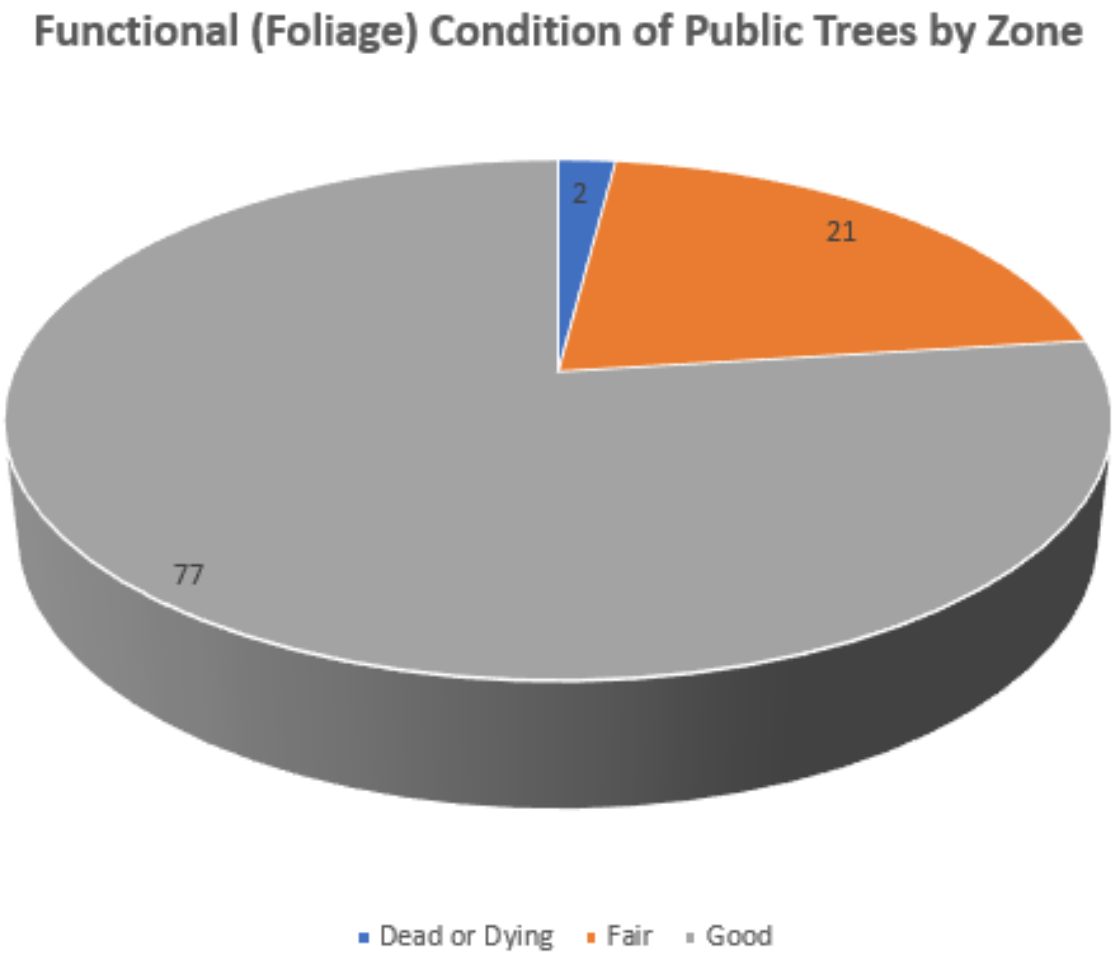
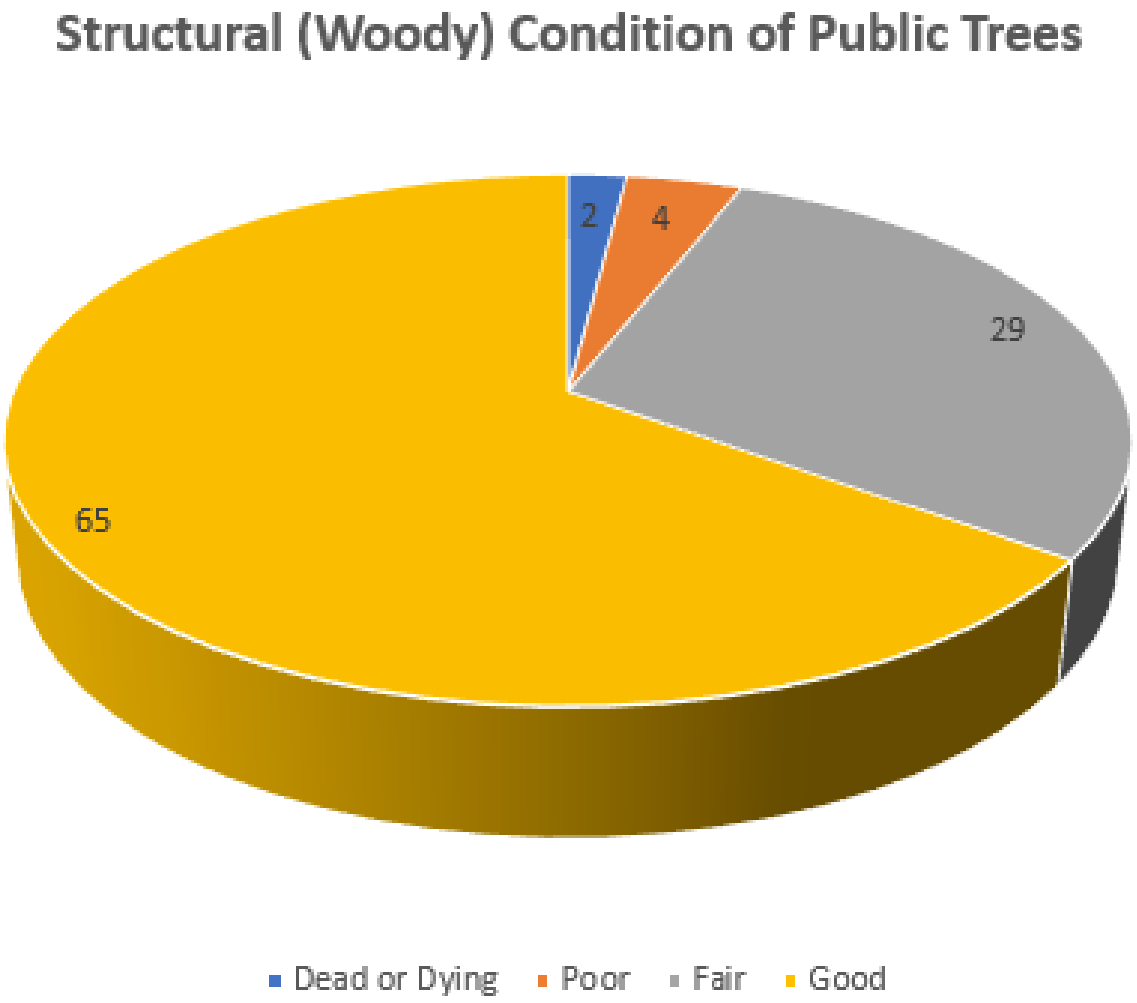


Figure 4: Wood Condition

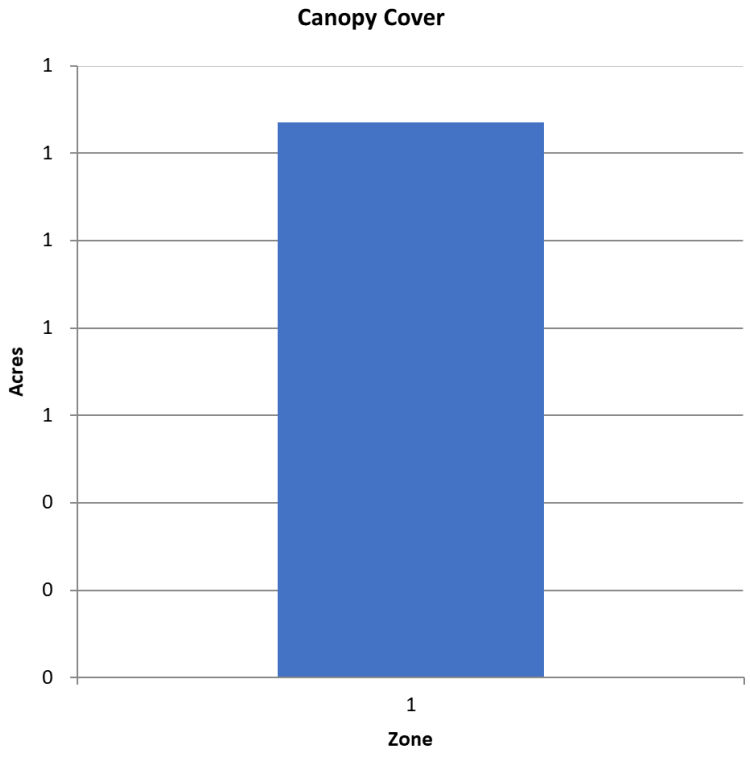


Runnells

Figure 5: Canopy Cover in Acres

Canopy Cover of Public Trees (Acres)

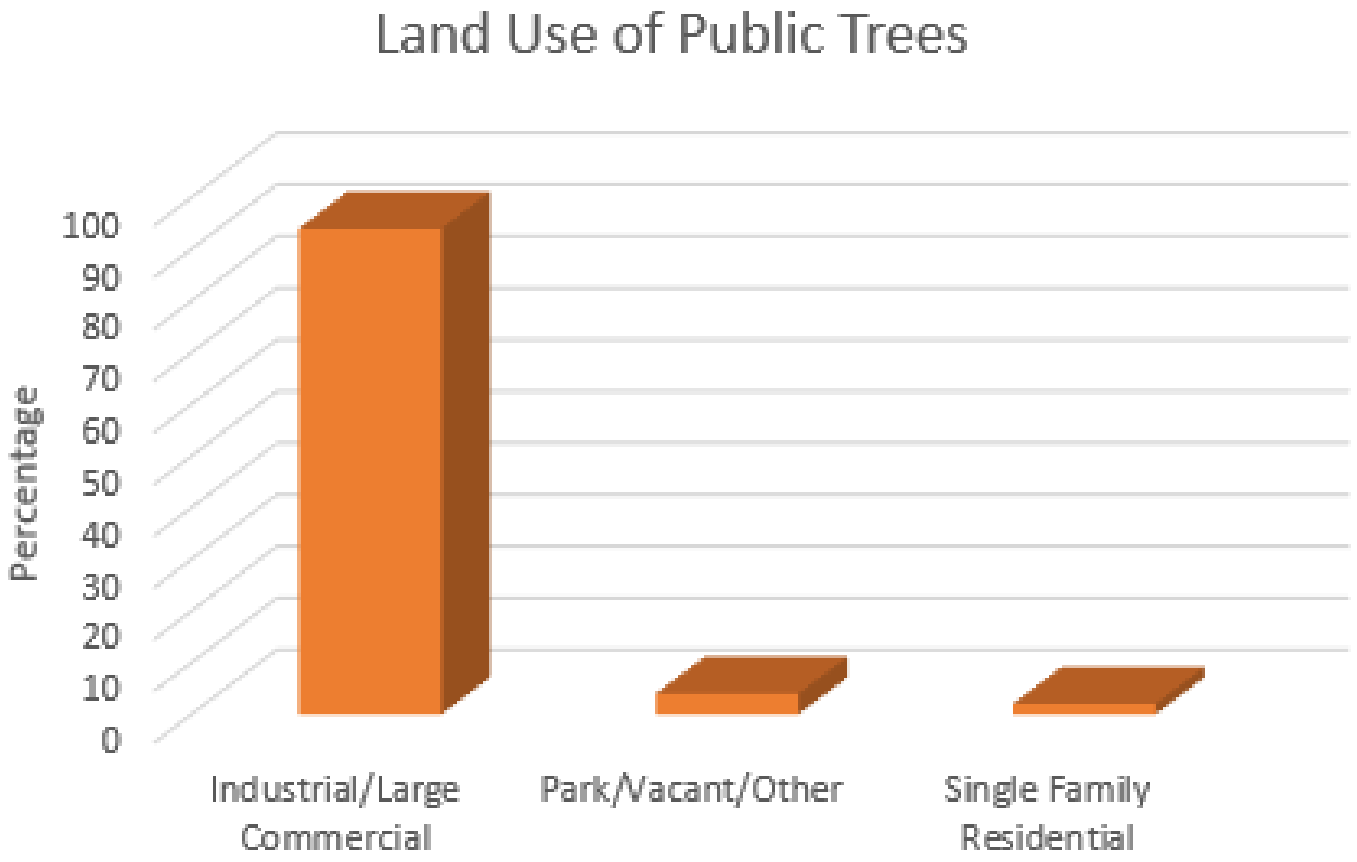
2/1/2021



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

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide Total	0	0	1	0.00	0.00

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

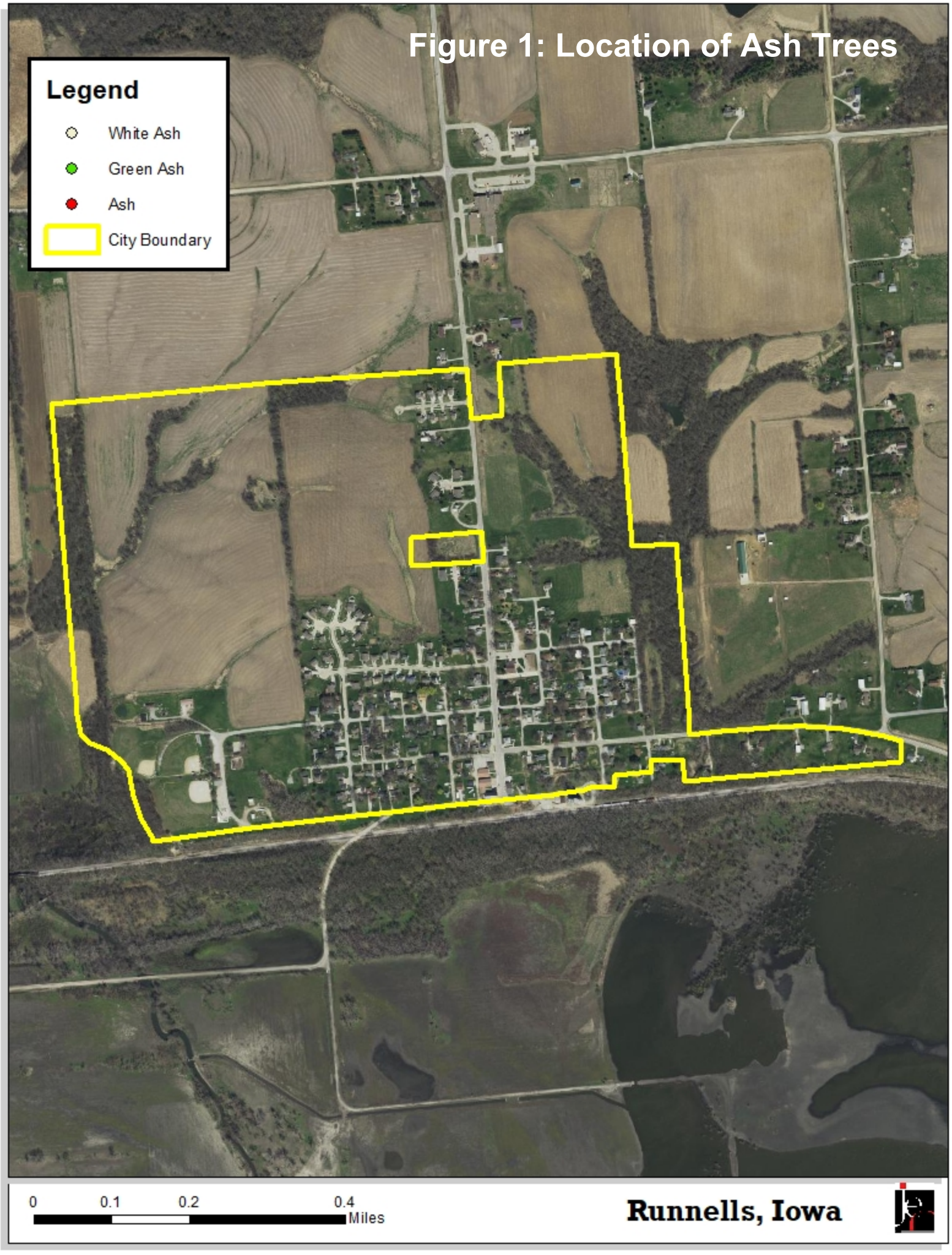


Figure 1: Location of Ash Trees
Legend
White Ash
Green Ash
Ash
City Boundary
0
0.1
0.2
0.4
Miles
Runnells, Iowa

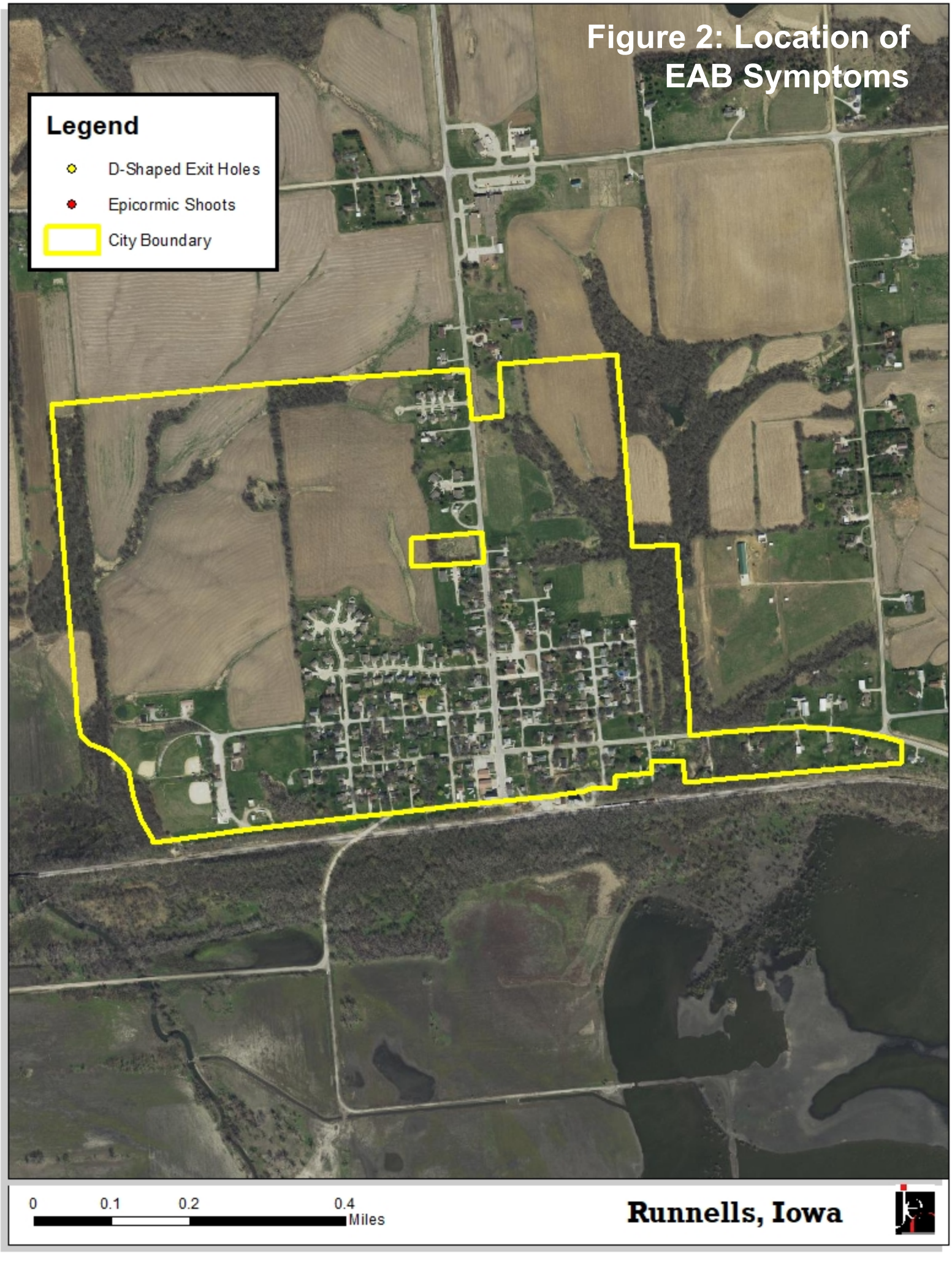


Figure 2: Location of EAB Symptoms
Legend
D-Shaped Exit Holes
Epicormic Shoots
City Boundary
0
0.1
0.2
0.4
Miles
Runnells, Iowa

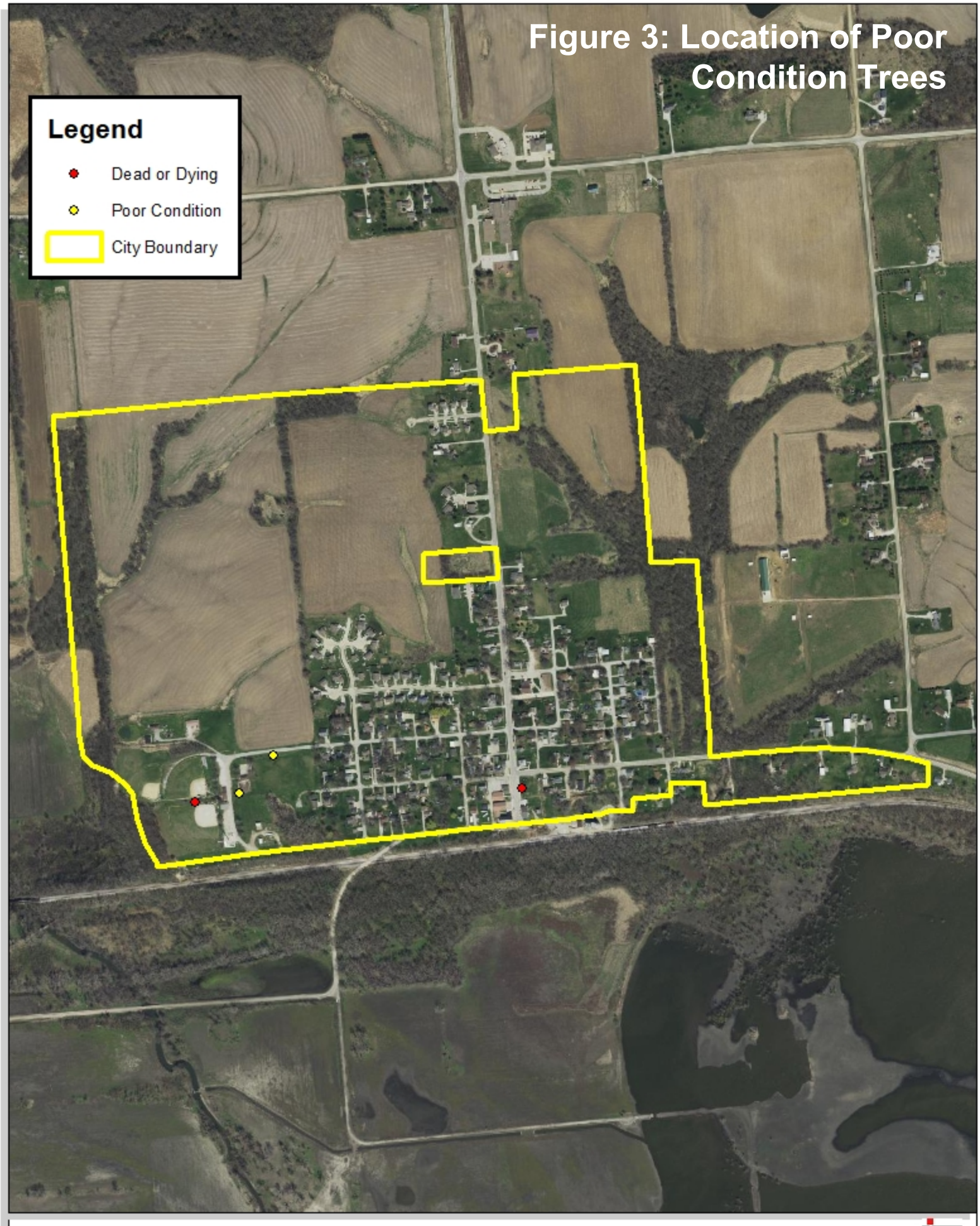
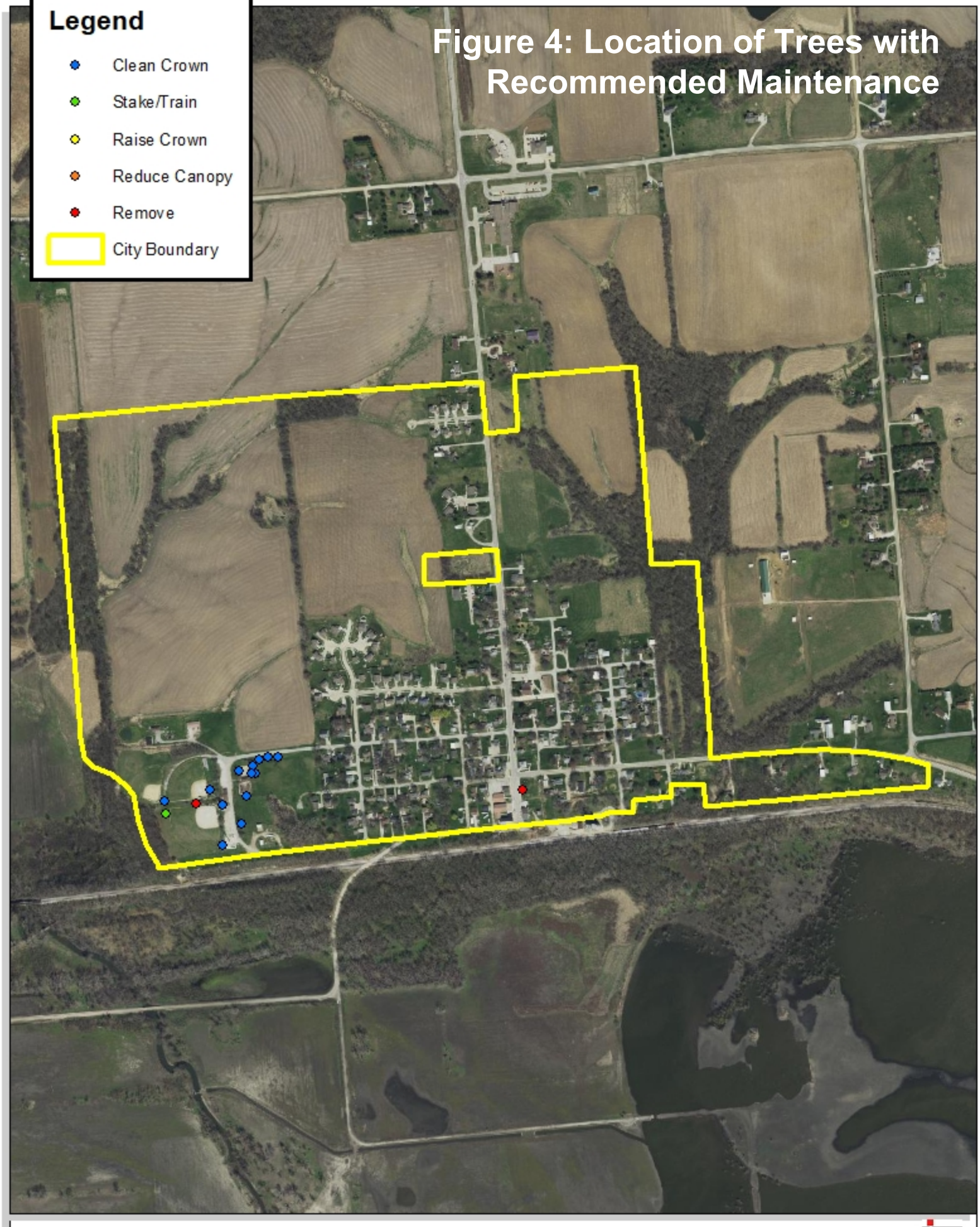


Figure 3: Location of Poor Condition Trees
Legend
Dead or Dying
Poor Condition
City Boundary
0
0.1
0.2
0.4
Miles
Runnells, Iowa


Legend
Clean Crown
Stake/Train
Raise Crown
Reduce Canopy
Remove
City Boundary
Figure 4: Location of Trees with Recommended Maintenance
0
0.1
0.2
0.4
Miles
Runnells, Iowa

APPENDIX C: RUNNELLS TREE ORDINANCES

151.01 DEFINITIONS.
For use in this chapter, the following terms are defined:

1. "Boulevard" means the area given between the proposed or existing sidewalk and curb on a public street.
2. "Director of Public Works" means the Director of Public Works of the City or a duly appointed representative.

151.02 PERMITS FOR PLANTING TREES IN BOULEVARDS.
A permit must be secured at the office of the Director of Public Works before planting any tree in any boulevard within the corporate limits of the City. Trees are to be purchased and planted by the property owner of the land abutting the boulevard, or by a person retained by the property owner. Varieties of trees approved are those trees of the hard wood variety, having good appearance, adaptability to the climate, being long lived and generally free from injurious insects and diseases. Following are listed the approved varieties: Crabapple Linden Japanese Lilac Elm (Disease Resistant) Serviceberry Cork Oak (Red, White) London Plane Hackberry Ironwood Hornbeam (Ord. 473 – Jun. 18 Supp.)

151.03 TREE TRIMMING.
All property owners shall trim boulevard trees to a ground clearance of eight (8) feet. The City or City's agent will perform trimming of boulevard trees as deemed necessary. Public utilities may do such trimming as necessary to protect their utilities.

151.04 REGULATIONS FOR PLANTING TREES IN BOULEVARDS.

1. Trees must be of an approved variety and of nursery stock with a straight trunk.
2. No trees shall be placed so as to cause a traffic hazard, in the opinion of the Director of Public Works.
3. Trees shall be planted at least twenty-five (25) feet apart.
4. Trees shall not be planted closer than 25 feet from future or existing curb returns at intersections.
5. Trees shall be planted at least five (5) feet from driveways, visible or identifiable underground utility or light poles.
6. Except where a special permit is obtained from the Director of Public Works, no tree shall be planted on any boulevard where the distance between the nearest edge of the sidewalk and curb is less than four (4) feet.
7. All trees shall be planted equidistant from the nearest edge of the proposed or existing sidewalk and curb, except when the Director of Public Works directs otherwise.
8. The Director of Public Works may assist in staking out the location of the tree planting.
9. Trees shall be planted at least ten (10) feet from fire hydrants.

151.05 REMOVAL OF BOULEVARD TREES.

1. The City will remove trees that are determined by the Director of Public Works to be diseased, dangerous or a public nuisance.
2. Ordinary removal by the City will leave the stump in the ground, cut off at about boulevard level, then ground to below the surface of the boulevard.
3. Removal of any boulevard tree is to be approved by the Director of Public Works before starting removal.
4. Upon approval to remove a nuisance tree from the boulevard, the property owner may hire a licensed tree surgeon to remove this tree if the property owner takes full responsibility for the hauling, chipping, stump removal, replacement of the tree, and replacement of the lawn. Any income from the sale of the tree would then go to the property owner instead of the City. (Ord. 452 – Jul. 14 Supp.)

151.06 REMOVAL OF TREES ON PRIVATE PROPERTY.

1. A property owner may remove a tree that is on personal property as long as the property owner does the actual work. Otherwise, the property owner must hire a licensed tree surgeon to remove the tree. (Ord. 452 – Jul. 14 Supp.)

151.07 ABUSE OR MUTILATION OF TREES.
No person shall willfully damage, injure, mar, deface or destroy any tree on any boulevard in the City. (Ord. 452 – Jul. 14 Supp.)

151.08 DISEASE CONTROL.
Any dead, diseased, or damaged tree or shrub that may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance. (Ord. 452 – Jul. 14 Supp.)