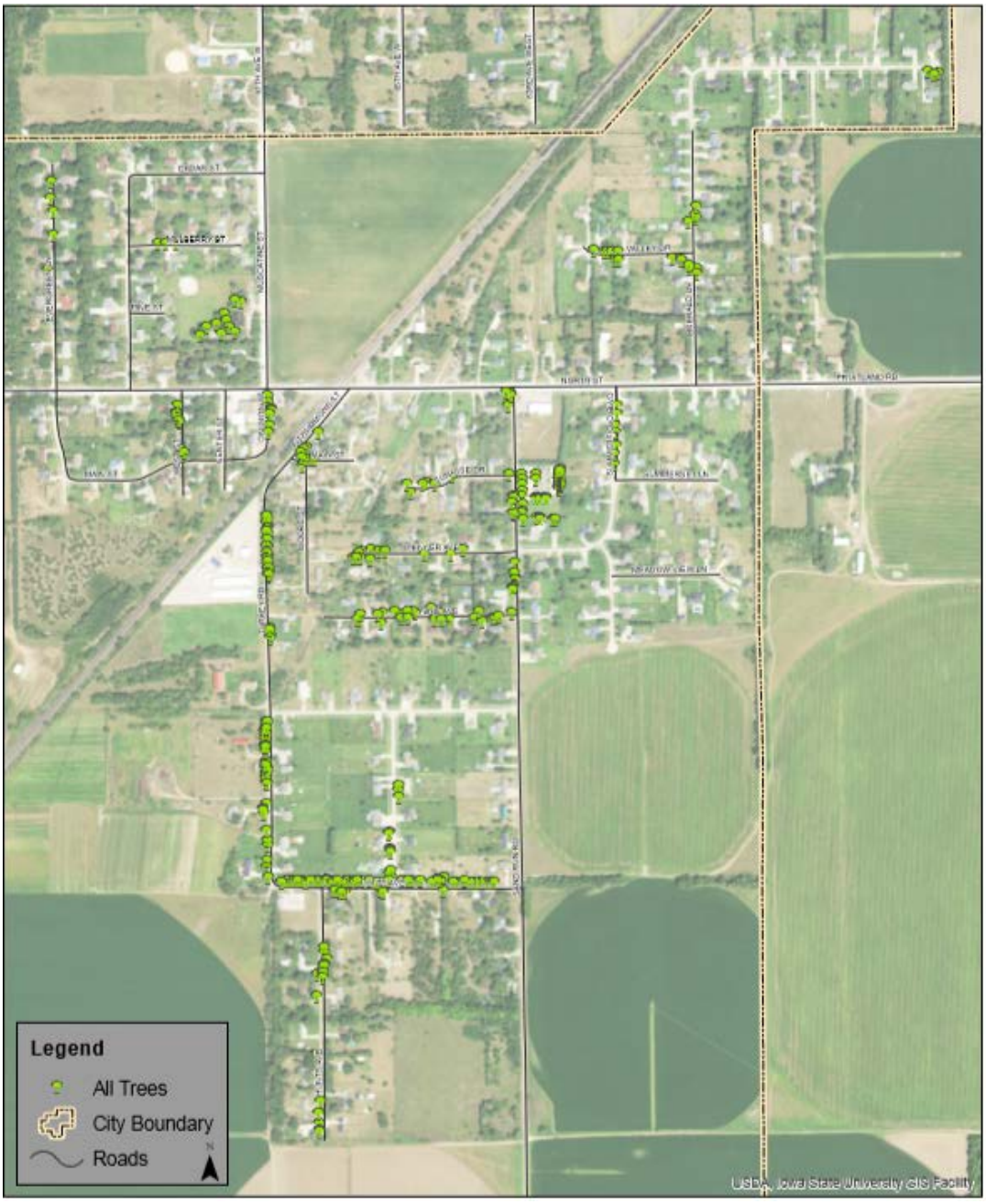
Fruitland, IA



2018 Urban Forest Management Plan
Prepared by Richard Kittelson
Iowa Department of Natural Resources

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Fruitland with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as 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 (this does not include mountain ash). There is a strong possibility that Fruitland's 1 city owned ash will die once EAB becomes established in the community, unless preventative treatment is used. 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 2018, a tree inventory was conducted 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 339 trees inventoried.

- Fruitland's trees provide $24,467.17 of benefits annually, an average of $72.17 a tree
- There are over 25 species of trees
- The top three genera are: Cedars 43.7%, Elm 12.4%, and Oak 6.2%
- 23% of trees are in need of some type of management
- 21 trees are recommended for removal

Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.

- Of the 21 trees needing removal, 2 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*
- The 1 ash tree should be annually examined for 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 with a visual survey yearly
- With the current budget it will take 1 year to remove ash – Suggestion: request a budget increase to $1,500 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Fruitland with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on 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 or treatment and replacement planting. With proper planning and management of the current canopy in Fruitland these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Fruitland's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Fruitland and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Fruitland's urban forestry goals.

Inventory

In 2018, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected 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 programming used to collect tree information on the data collectors 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, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 339 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Fruitland's trees reduce energy related costs by approximately $7,279.23 annually (Appendix A, Table 1). These savings are both in Electricity (33.58 MWh) and in Natural Gas (4,827.28 Therms).

Annual Stormwater Benefits

Fruitland's trees intercept about 326,510.81 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $8,848.44 of benefits 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 emitting volatile organic matter (ozone). In Fruitland it is estimated that trees remove 372.68 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $992.05 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Fruitland, trees sequester about 44,021.96 lbs of carbon a year with an associated value of $330.16 (Appendix A, Table 5). In addition, the trees store 604,213.25 lbs of carbon, with a yearly benefit of $4,532.60 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The 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. Fruitland receives $6,620.27 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, Fruitland's trees provide $24,467.17 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 339 trees in Fruitland provide approximately $72.17 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Fruitland has over 25 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Cedar	148	43.7%
Elm	42	12.4%
Oak	21	6.2%%
Maple	21	6.2%
Apple	18	5.3%
Spruce	14	4.1%
Mulberry	12	3.5%
Japanese Tree Lilac	7	2.1%
Plum	5	1.5%
Others	51	15%

Age Class

Most of Fruitland's trees (85%) are 18 inches or less in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Fruitland's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Fruitland indicate that 97% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 92% of Fruitland's trees are in fair to good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 8% of the population. This 8% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	40	11.8%
Crown Raising	3	.88%
Tree Staking	3	.88%
Tree Removal	21	6.9%
Crown Reduction	11	3.24%

Canopy Cover

The total canopy with both private and public trees is 8%, 97 acres. The canopy cover included in the Fruitland inventory includes approximately 3.32 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 84 trees need to be planted annually.

Land Use and Location

The majority of Fruitland'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	
Single family residential	85.25%
Park/vacant/other	2.95%
Industrial/Large commercial	0.0%
Small commercial	11.8%
Multifamily residential	0.0%

Location	
Planting strip	15.63%
Other maintained locations	12.69%
Median	2.06%
Front yard	69.62%

Recommendations

Risk Management

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

Hazardous trees

Fruitland has 0 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 2 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the immediate concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There is a total of 57 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 21 removals, 0 are ash trees. There is 1 ash tree that currently does not have signs and symptoms that have been associated with EAB. In addition,

there are 27 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 is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. 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 Fruitland.

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 cedars (44%) (Appendix A, Figure 1). Cedars 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: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended 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.

Six Year Maintenance Plan with <u>No Additional Funding</u>

Year 1

- Removal: one ash and 1 largest critical concern tree
- Planting and Replacement: 2 trees to be planted in open locations
- Young Tree Pruning & Maintenance:
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 2 critical concern trees
- *Or saving for ash tree treatment and/or future ash removal
- Planting and Replacement: 0 trees in open locations from year one removals
- Young Tree Pruning & Maintenance:

Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3
Removal: 2 trees - removal of any new critical concern trees
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 2 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4
Removal: 2 trees - removal of any new critical concern trees
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 0 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 5
Removal: 2 trees - removal of any new critical concern trees
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 2 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6
Removal: 2 trees - removal of any new critical concern trees
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 0 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: One ash and 11 additional recommended removals. **It will take 1 year to remove the ash with the current budget.**

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (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 effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide 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 disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

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 the following signs and symptoms: 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.

Budget

Current Budget
Total $9,000 over 6 years ($1,500/year)

FY 2019 Budget
Removal: $1,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $200
Watering & Maintenance: $100

FY 2020 Budget
Removal: $1,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $00
Routine trimming: $200
Watering & Maintenance: $100

FY 2021 Budget
Removal: $1,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $200
Watering & Maintenance: $100

FY 2022 Budget
Removal: $1,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $00
Routine trimming: $200
Watering & Maintenance: $100

FY 2023 Budget
Removal: $1,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $200
Watering & Maintenance: $100

FY 2024 Budget

Removal: $1,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $00
Routine trimming: $200
Watering & Maintenance: $100

*Reduction of ash over 6 years: One ash and 11 additional recommended removals. **It will take 1 year to remove the ash with the current budget.**

Purposed Budget Increase

EAB could potentially kill all ash trees in Fruitland within 4 years of its arrival. To remove the ash tree and 11 additional recommended removals within 6 years the budget would need to be increased to $1,500 a year. Additionally, it is recommended that Fruitland 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 being considered by many communities is treating a number of selected trees. 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, Fruitland's one ash tree's diameter is 12-18 inches and at $12 per inch, the tree could be treated for $144-$216 every other year. Fruitland would still need to find $1000 for removal.

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

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of All Trees by Species			12/20/2018						
Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern red cedar	8.36	634.69	1,289.18	1,263.40	1,898.08	(N/A)	37.76	26.08	14.83
Siberian elm	5.68	431.11	749.63	734.63	1,165.74	(N/A)	10.62	16.01	32.38
Northern white cedar	1.75	132.60	230.63	226.02	358.61	(N/A)	5.90	4.93	17.93
Apple	0.64	48.54	110.33	108.13	156.67	(N/A)	5.31	2.15	8.70
Silver maple	2.93	222.52	395.22	387.32	609.84	(N/A)	4.13	8.38	43.56
White mulberry	0.81	61.78	119.27	116.88	178.66	(N/A)	3.24	2.45	16.24
Northern pin oak	2.99	227.29	443.60	434.73	662.02	(N/A)	2.95	9.09	66.20
Callery pear	0.90	68.54	136.80	134.06	202.60	(N/A)	2.36	2.78	25.32
Pin oak	0.68	51.87	93.28	91.41	143.28	(N/A)	2.06	1.97	20.47
Blue spruce	0.56	42.88	75.65	74.14	117.02	(N/A)	2.06	1.61	16.72
Japanese tree lilac	0.02	1.78	4.37	4.29	6.06	(N/A)	2.06	0.08	0.87
Chinese elm	0.78	59.50	106.75	104.62	164.12	(N/A)	1.77	2.25	27.35
Conifer Evergreen Medium	0.21	15.75	34.46	33.77	49.52	(N/A)	1.77	0.68	8.25
Plum	0.52	39.41	75.62	74.11	113.52	(N/A)	1.47	1.56	22.70
Black spruce	0.42	31.95	59.95	58.75	90.70	(N/A)	1.47	1.25	18.14
Lilac	0.60	45.70	95.50	93.59	139.28	(N/A)	1.18	1.91	34.82
Red pine	0.16	11.97	26.94	26.40	38.37	(N/A)	1.18	0.53	9.59
Red maple	0.96	73.14	136.21	133.48	206.63	(N/A)	1.18	2.84	51.66
Broadleaf Deciduous Small	0.61	45.94	91.71	89.87	135.81	(N/A)	1.18	1.87	33.95
Basswood	0.22	16.57	31.15	30.52	47.09	(N/A)	0.88	0.65	15.70
Others	3.75	284.99	521.04	510.62	795.60		9.44	10.93	25.10
Total	33.58	2,548.50	4,827.28	4,730.73	7,279.23	(N/A)	100.00	100.00	21.47

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of All Trees by Species				12/20/2018		
Species	Total Rainfall Interception (Gal)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern red cedar	117,864.51	3,194.13	(N/A)	37.76	36.10	24.95
Siberian elm	42,300.31	1,146.34	(N/A)	10.62	12.96	31.84
Northern white cedar	20,015.55	542.42	(N/A)	5.90	6.13	27.12
Apple	2,153.79	58.37	(N/A)	5.31	0.66	3.24
Silver maple	30,176.06	817.77	(N/A)	4.13	9.24	58.41
White mulberry	2,879.32	78.03	(N/A)	3.24	0.88	7.09
Northern pin oak	34,465.07	934.00	(N/A)	2.95	10.56	93.40
Callery pear	5,087.56	137.87	(N/A)	2.36	1.56	17.23
Pin oak	3,718.62	100.77	(N/A)	2.06	1.14	14.40
Blue spruce	6,656.79	180.40	(N/A)	2.06	2.04	25.77
Japanese tree lilac	52.15	1.41	(N/A)	2.06	0.02	0.20
Chinese elm	5,897.69	159.83	(N/A)	1.77	1.81	26.64
Conifer Evergreen Medium	2,037.85	55.23	(N/A)	1.77	0.62	9.20
Plum	1,869.49	50.66	(N/A)	1.47	0.57	10.13
Black spruce	5,624.01	152.41	(N/A)	1.47	1.72	30.48
Lilac	3,529.55	95.65	(N/A)	1.18	1.08	23.91
Red pine	1,616.57	43.81	(N/A)	1.18	0.50	10.95
Red maple	9,226.23	250.03	(N/A)	1.18	2.83	62.51
Broadleaf Deciduous Small	3,083.26	83.56	(N/A)	1.18	0.94	20.89
Basswood	1,387.35	37.60	(N/A)	0.88	0.42	12.53
Others	26,869.07	728.15		9.44	8.23	23.13
Citywide total	326,510.81	8,848.44	(N/A)	100.00	100.00	26.10

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of All Trees by Species					12/20/2018												
Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Stand. Error	% of Total Trees	Avg. $/tree
Eastern red cedar	18.81	3.73	15.55	2.31	124.21	41.07	5.89	5.60	37.85	252.88	- 63.89	- 239.58	66.93	137.51	(N/A)	37.76	1.07
Siberian elm	4.13	0.70	2.42	0.18	23.39	26.84	3.93	3.75	25.73	167.85	0.00	0.00	67.68	191.24	(N/A)	10.62	5.31
Northern white cedar	2.04	0.40	1.87	0.25	13.98	8.25	1.21	1.15	7.91	51.59	- 6.63	- 24.87	16.45	40.71	(N/A)	5.90	2.04
Apple	0.28	0.05	0.18	0.01	1.62	3.25	0.46	0.43	2.90	19.75	0.00	- 0.01	7.55	21.36	(N/A)	5.31	1.19
Silver maple	3.69	0.62	2.01	0.16	20.43	13.91	2.03	1.94	13.27	86.85	- 2.33	- 8.72	35.31	98.56	(N/A)	4.13	7.04
White mulberry	0.73	0.12	0.37	0.03	3.96	3.96	0.57	0.54	3.69	24.47	0.00	- 0.01	10.01	28.42	(N/A)	3.24	2.58
Northern pin oak	7.83	1.35	3.75	0.35	42.03	14.62	2.11	2.00	13.58	90.31	- 1.77	- 6.64	43.82	125.70	(N/A)	2.95	12.57
Callery pear	0.56	0.10	0.35	0.02	3.25	4.44	0.64	0.61	4.10	27.35	- 0.18	- 0.66	10.64	29.93	(N/A)	2.36	3.74
Pin oak	0.30	0.05	0.22	0.01	1.85	3.25	0.47	0.45	3.10	20.29	- 0.77	- 2.90	7.10	19.24	(N/A)	2.06	2.75
Blue spruce	0.74	0.15	0.66	0.09	5.03	2.67	0.39	0.37	2.56	16.71	- 2.26	- 8.49	5.37	13.25	(N/A)	2.06	1.89
Japanese tree lilac	0.00	0.00	0.00	0.00	0.01	0.12	0.02	0.02	0.11	0.74	0.00	0.00	0.27	0.75	(N/A)	2.06	0.11
Chinese elm	0.45	0.07	0.27	0.02	2.54	3.74	0.54	0.52	3.55	23.29	0.00	0.00	9.16	25.82	(N/A)	1.77	4.30
Conifer Evergreen Medium	0.14	0.03	0.17	0.02	1.06	1.04	0.15	0.14	0.94	6.36	- 0.56	- 2.11	2.05	5.30	(N/A)	1.77	0.88
Plum	0.51	0.08	0.25	0.02	2.72	2.52	0.36	0.35	2.35	15.60	0.00	- 0.01	6.44	18.31	(N/A)	1.47	3.66
Black spruce	0.69	0.14	0.60	0.09	4.66	2.02	0.29	0.28	1.91	12.57	- 1.98	- 7.42	4.04	9.81	(N/A)	1.47	1.96
Lilac	1.30	0.21	0.59	0.06	6.85	2.99	0.43	0.40	2.73	18.32	- 0.01	- 0.03	8.70	25.15	(N/A)	1.18	6.29
Red pine	0.12	0.02	0.13	0.01	0.88	0.80	0.11	0.11	0.71	4.86	- 0.45	- 1.67	1.58	4.07	(N/A)	1.18	1.02
Red maple	2.33	0.40	1.07	0.10	12.35	4.63	0.67	0.64	4.36	28.77	- 0.76	- 2.86	13.44	38.26	(N/A)	1.18	9.57
Broadleaf Deciduous Small	1.08	0.18	0.49	0.05	5.70	2.97	0.43	0.41	2.74	18.28	- 0.01	- 0.02	8.33	23.96	(N/A)	1.18	5.99
Basswood	0.05	0.01	0.05	0.00	0.34	1.05	0.15	0.15	0.99	6.52	0.00	0.00	2.44	6.86	(N/A)	0.88	2.29
Others	3.54	0.60	1.95	0.17	19.72	17.99	2.62	2.49	17.02	111.94	- 1.02	- 3.82	45.37	127.84		9.44	4.08
Citywide Total	49.31	9.01	32.95	3.97	296.57	162.14	23.47	22.34	152.11	1,005.32	- 82.62	- 309.84	372.68	992.05	(N/A)	100.00	2.93

Table 4: Annual Carbon Stored

Stored CO2 Benefits of All Trees by Species				12/20/2018		
Species	Total stored CO2 (lbs)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern red cedar	66,169.48	496.27	(N/A)	37.76	10.95	3.88
Siberian elm	109,376.25	820.32	(N/A)	10.62	18.10	22.79
Northern white cedar	13,137.19	98.53	(N/A)	5.90	2.17	4.93
Apple	6,686.81	50.15	(N/A)	5.31	1.11	2.79
Silver maple	79,954.56	599.66	(N/A)	4.13	13.23	42.83
White mulberry	11,830.03	88.73	(N/A)	3.24	1.96	8.07
Northern pin oak	129,621.99	972.16	(N/A)	2.95	21.45	97.22
Callery pear	10,446.64	78.35	(N/A)	2.36	1.73	9.79
Pin oak	7,718.67	57.89	(N/A)	2.06	1.28	8.27
Blue spruce	4,008.82	30.07	(N/A)	2.06	0.66	4.30
Japanese tree lilac	96.49	0.72	(N/A)	2.06	0.02	0.10
Chinese elm	15,245.26	114.34	(N/A)	1.77	2.52	19.06
Conifer Evergreen Medium	498.58	3.74	(N/A)	1.77	0.08	0.62
Plum	7,903.91	59.28	(N/A)	1.47	1.31	11.86
Black spruce	4,390.71	32.93	(N/A)	1.47	0.73	6.59
Lilac	20,241.92	151.81	(N/A)	1.18	3.35	37.95
Red pine	589.74	4.42	(N/A)	1.18	0.10	1.11
Red maple	24,936.53	187.02	(N/A)	1.18	4.13	46.76
Broadleaf Deciduous Small	16,700.38	125.25	(N/A)	1.18	2.76	31.31
Basswood	2,254.52	16.91	(N/A)	0.88	0.37	5.64
Others	72,404.78	543.04		9.44	11.98	17.28
Citywide total	604,213.25	4,531.60	(N/A)	100.00	100.00	13.37

Table 5: Annual Carbon Sequestered

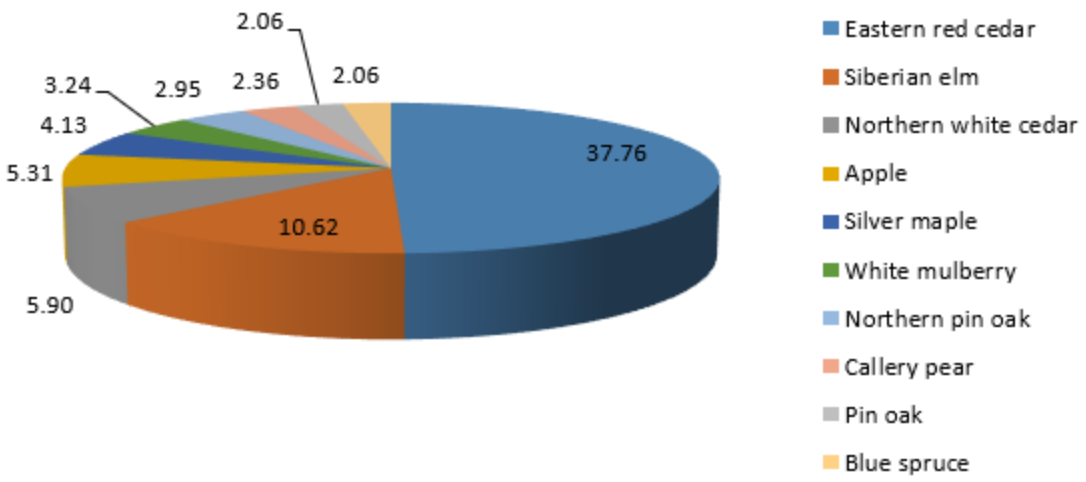
Annual CO2 Benefits of All Trees by Species				12/20/2018									
Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern red cedar	4,426.31	33.20	- 317.63	- 173.36	- 3.68	14,026.42	105.20	17,961.75	134.71	(N/A)	37.76	18.53	1.05
Siberian elm	9,423.15	70.67	- 529.56	- 59.28	- 4.42	9,527.37	71.46	18,361.68	137.71	(N/A)	10.62	18.94	3.83
Northern white cedar	1,584.17	11.88	- 63.06	- 29.84	- 0.70	2,930.34	21.98	4,421.61	33.16	(N/A)	5.90	4.56	1.66
Apple	1,033.32	7.75	- 32.14	- 13.07	- 0.34	1,072.67	8.05	2,060.79	15.46	(N/A)	5.31	2.13	0.86
Silver maple	8,931.40	66.99	- 383.84	- 29.45	- 3.10	4,917.63	36.88	13,435.75	100.77	(N/A)	4.13	13.86	7.20
White mulberry	1,229.05	9.22	- 56.83	- 11.31	- 0.51	1,365.34	10.24	2,526.25	18.95	(N/A)	3.24	2.61	1.72
Northern pin oak	2,444.22	18.33	- 622.19	- 35.10	- 4.93	5,023.15	37.67	6,810.09	51.08	(N/A)	2.95	7.02	5.11
Callery pear	1,825.25	13.69	- 50.84	- 9.56	- 0.45	1,514.67	11.36	3,279.52	24.60	(N/A)	2.36	3.38	3.07
Pin oak	1,147.85	8.61	- 37.13	- 7.02	- 0.33	1,146.23	8.60	2,249.93	16.87	(N/A)	2.06	2.32	2.41
Blue spruce	373.46	2.80	- 19.24	- 9.36	- 0.21	947.67	7.11	1,292.53	9.69	(N/A)	2.06	1.33	1.38
Japanese tree lilac	60.78	0.46	- 0.77	- 1.37	- 0.02	39.29	0.29	97.94	0.73	(N/A)	2.06	0.10	0.10
Chinese elm	1,734.01	13.01	- 73.22	- 8.39	- 0.61	1,314.90	9.86	2,967.31	22.25	(N/A)	1.77	3.06	3.71
Conifer Evergreen Medium	98.91	0.74	- 2.39	- 4.10	- 0.05	348.06	2.61	440.48	3.30	(N/A)	1.77	0.45	0.55
Plum	771.71	5.79	- 37.98	- 6.44	- 0.33	870.90	6.53	1,598.19	11.99	(N/A)	1.47	1.65	2.40
Black spruce	327.04	2.45	- 21.08	- 7.61	- 0.22	706.19	5.30	1,004.55	7.53	(N/A)	1.47	1.04	1.51
Lilac	487.14	3.65	- 97.21	- 9.95	- 0.80	1,009.94	7.57	1,389.93	10.42	(N/A)	1.18	1.43	2.61
Red pine	141.24	1.06	- 2.83	- 3.51	- 0.05	264.43	1.98	399.33	3.00	(N/A)	1.18	0.41	0.75
Red maple	165.26	1.24	- 119.70	- 9.36	- 0.97	1,616.45	12.12	1,652.66	12.39	(N/A)	1.18	1.70	3.10
Broadleaf Deciduous Small	1,262.48	9.47	- 80.16	- 8.00	- 0.66	1,015.23	7.61	2,189.56	16.42	(N/A)	1.18	2.26	4.11
Basswood	491.77	3.69	- 10.82	- 2.93	- 0.10	366.14	2.75	844.17	6.33	(N/A)	0.88	0.87	2.11
Others	6,063.43	45.48	- 347.69	- 42.51	- 2.93	6,298.13	47.24	11,971.36	89.79		9.44	12.35	2.73
Citywide Total	44,021.96	330.16	- 2,906.30	- 481.46	- 25.41	56,321.17	422.41	96,955.37	727.17	(N/A)	100.00	100.00	2.15

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefit of All Trees by Species					12/20/2018
Species	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Eastern red cedar	2,159.09	(N/A)	37.76	32.61	16.87
Siberian elm	982.72	(N/A)	10.62	14.84	27.30
Northern white cedar	451.90	(N/A)	5.90	6.83	22.60
Apple	56.74	(N/A)	5.31	0.86	3.15
Silver maple	863.99	(N/A)	4.13	13.05	61.71
White mulberry	69.57	(N/A)	3.24	1.05	6.32
Northern pin oak	214.99	(N/A)	2.95	3.25	21.50
Callery pear	209.38	(N/A)	2.36	3.16	26.17
Pin oak	141.62	(N/A)	2.06	2.14	20.23
Blue spruce	142.48	(N/A)	2.06	2.15	20.35
Japanese tree lilac	0.24	(N/A)	2.06	0.00	0.03
Chinese elm	194.47	(N/A)	1.77	2.94	32.41
Conifer Evergreen Medium	82.65	(N/A)	1.77	1.25	13.78
Plum	43.80	(N/A)	1.47	0.66	8.76
Black spruce	99.68	(N/A)	1.47	1.51	19.94
Lilac	28.84	(N/A)	1.18	0.44	7.21
Red pine	44.51	(N/A)	1.18	0.67	11.13
Red maple	29.84	(N/A)	1.18	0.45	7.46
Broadleaf Deciduous Small	75.14	(N/A)	1.18	1.14	18.79
Basswood	71.85	(N/A)	0.88	1.09	23.95
Others	656.77		9.44	9.92	19.71
Citywide Total	6,620.27	(N/A)	100.00	100.00	19.53

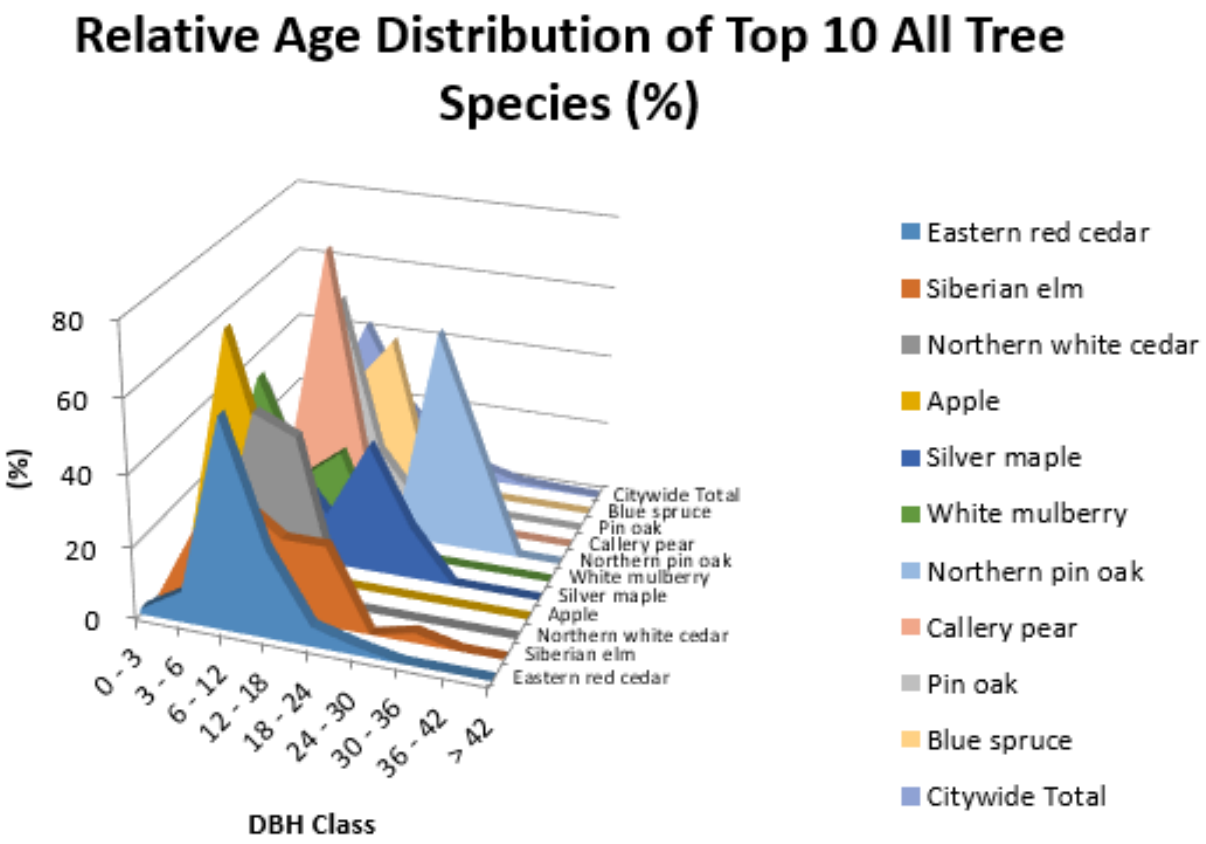
Table 7: Summary of Benefits in Dollars

Average Annual Benefits of All Tree by Species ($/tree)					12/20/2018		
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total	Stand. Error
Eastern red cedar	14.83	1.05	1.07	24.95	16.87	58.78	(N/A)
Siberian elm	32.38	3.83	5.31	31.84	27.30	100.66	(N/A)
Northern white cedar	17.93	1.66	2.04	27.12	22.60	71.34	(N/A)
Apple	8.70	0.86	1.19	3.24	3.15	17.14	(N/A)
Silver maple	43.56	7.20	7.04	58.41	61.71	177.92	(N/A)
White mulberry	16.24	1.72	2.58	7.09	6.32	33.97	(N/A)
Northern pin oak	66.20	5.11	12.57	93.40	21.50	198.78	(N/A)
Callery pear	25.32	3.07	3.74	17.23	26.17	75.55	(N/A)
Pin oak	20.47	2.41	2.75	14.40	20.23	60.25	(N/A)
Blue spruce	16.72	1.38	1.89	25.77	20.35	66.12	(N/A)
Japanese tree lilac	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)
Chinese elm	27.35	3.71	4.30	26.64	32.41	94.42	(N/A)
Conifer Evergreen Medium	8.25	0.55	0.88	9.20	13.78	32.67	(N/A)
Plum	22.70	2.40	3.66	10.13	8.76	47.66	(N/A)
Black spruce	18.14	1.51	1.96	30.48	19.94	72.03	(N/A)
Lilac	34.82	2.61	6.29	23.91	7.21	74.84	(N/A)
Red pine	9.59	0.75	1.02	10.95	11.13	33.44	(N/A)
Red maple	51.66	3.10	9.57	62.51	7.46	134.29	(N/A)
Broadleaf Deciduous Small	33.95	4.11	5.99	20.89	18.79	83.72	(N/A)
Basswood	15.70	2.11	2.29	12.53	23.95	56.57	(N/A)
Others	502.06	54.59	81.54	462.54	394.15	1,494.87	
Citywide Total	21.47	2.15	2.93	26.10	19.53	72.17	(N/A)



12/20/2018	
Species	Percent
Eastern red cedar	37.76
Siberian elm	10.62
Northern white cedar	5.90
Apple	5.31
Silver maple	4.13
White mulberry	3.24
Northern pin oak	2.95
Callery pear	2.36
Pin oak	2.06
Blue spruce	2.06
Other Species	23.60

Figure 1: Species Distribution



12/20/2018	DBH class (in)								
Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	>42
Eastern red cedar	1.56	8.59	57.81	24.22	5.47	2.34	0.00	0.00	0.00
Siberian elm	0.00	22.22	30.56	22.22	22.22	0.00	2.78	0.00	0.00
Northern white cedar	0.00	5.00	50.00	45.00	0.00	0.00	0.00	0.00	0.00
Apple	5.56	66.67	27.78	0.00	0.00	0.00	0.00	0.00	0.00
Silver maple	7.14	0.00	28.57	14.29	35.71	14.29	0.00	0.00	0.00
White mulberry	9.09	45.45	18.18	27.27	0.00	0.00	0.00	0.00	0.00
Northern pin oak	0.00	0.00	10.00	0.00	0.00	60.00	30.00	0.00	0.00
Callery pear	0.00	12.50	75.00	12.50	0.00	0.00	0.00	0.00	0.00
Pin oak	28.57	0.00	57.14	14.29	0.00	0.00	0.00	0.00	0.00
Blue spruce	0.00	28.57	28.57	42.86	0.00	0.00	0.00	0.00	0.00
Citywide Total	5.90	16.22	42.18	21.24	8.26	4.13	1.18	0.59	0.29

Figure 2: Relative Age Class

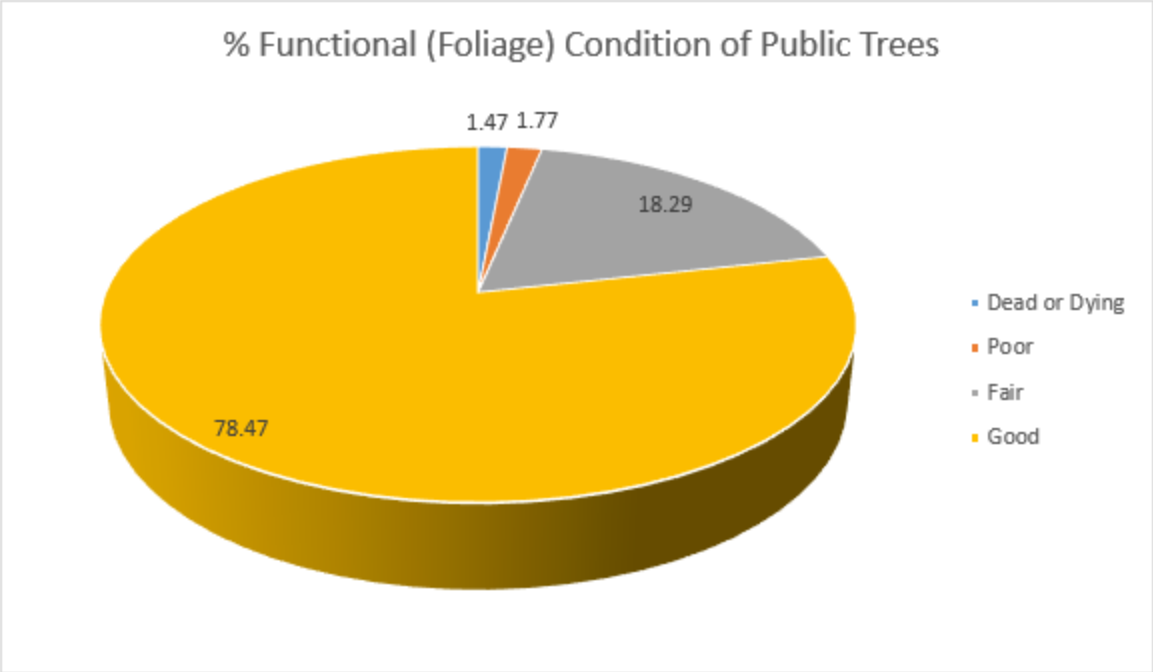


Figure 3: Foliage Condition

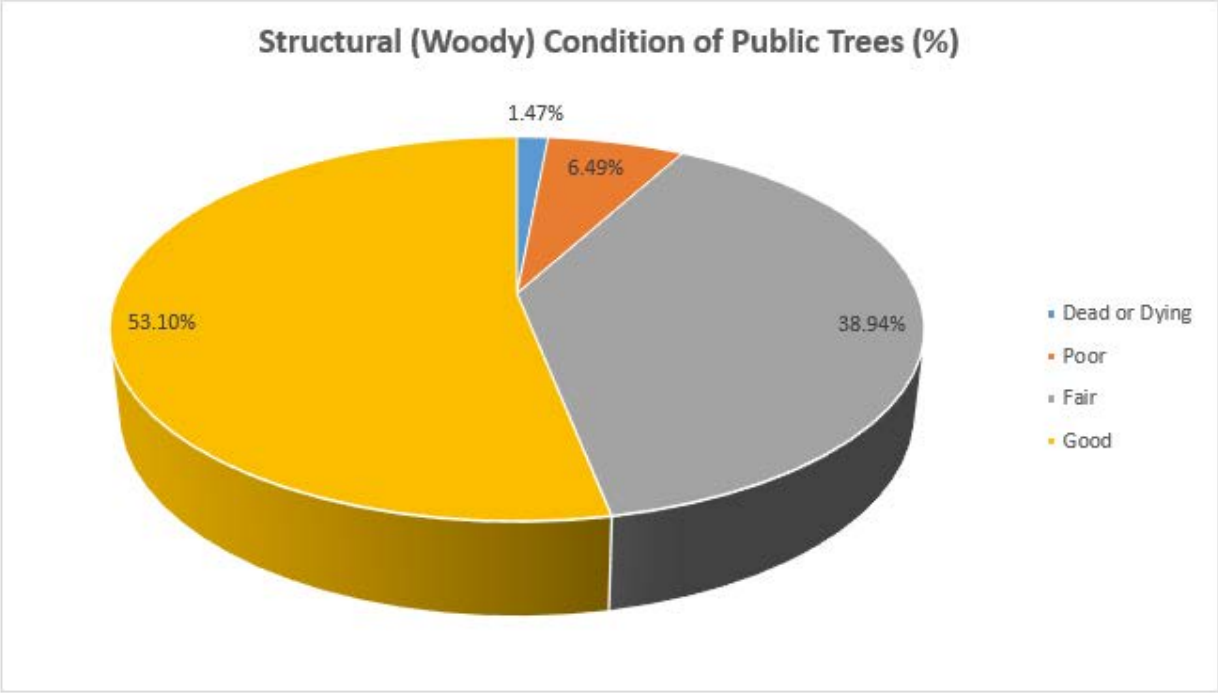
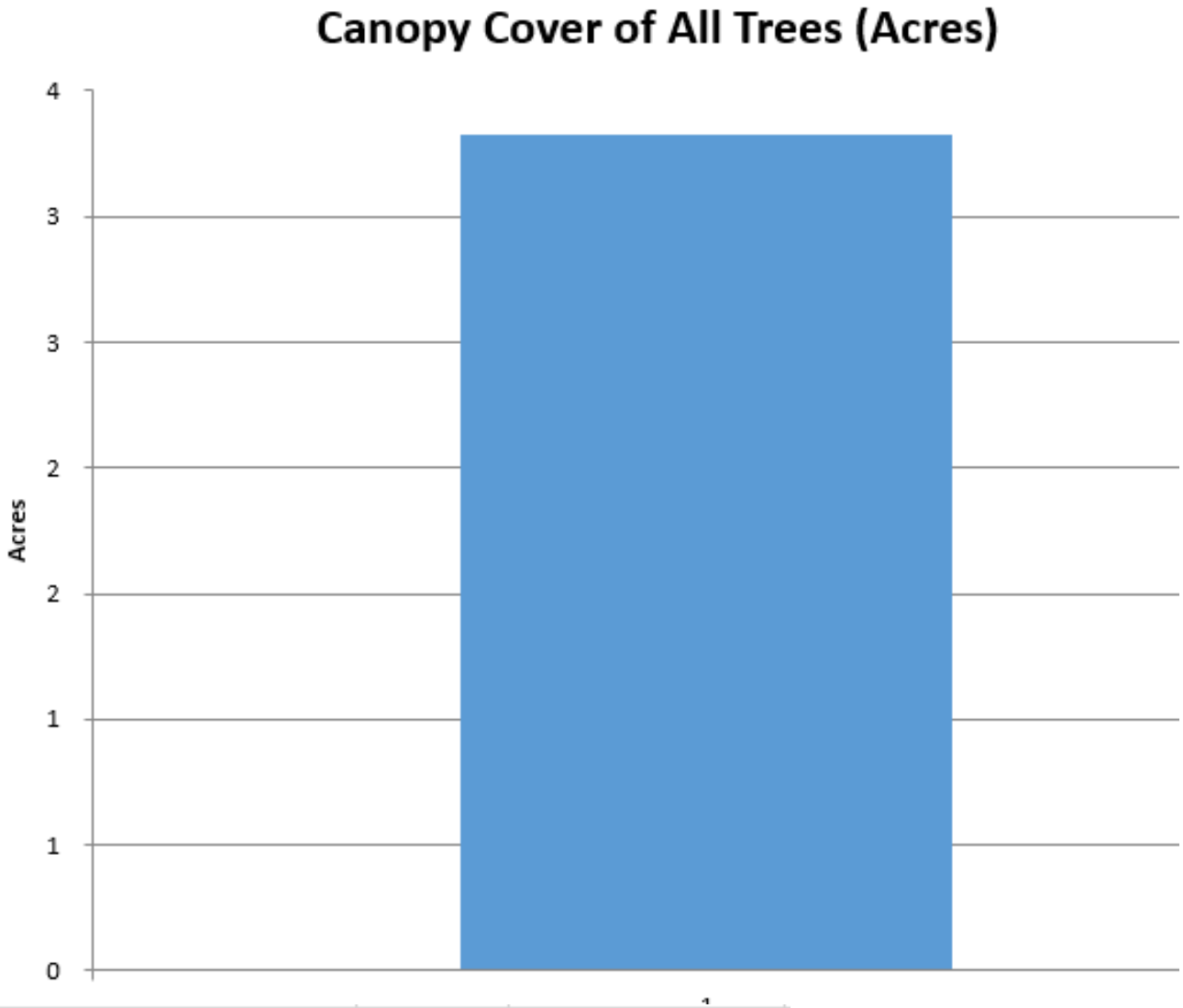
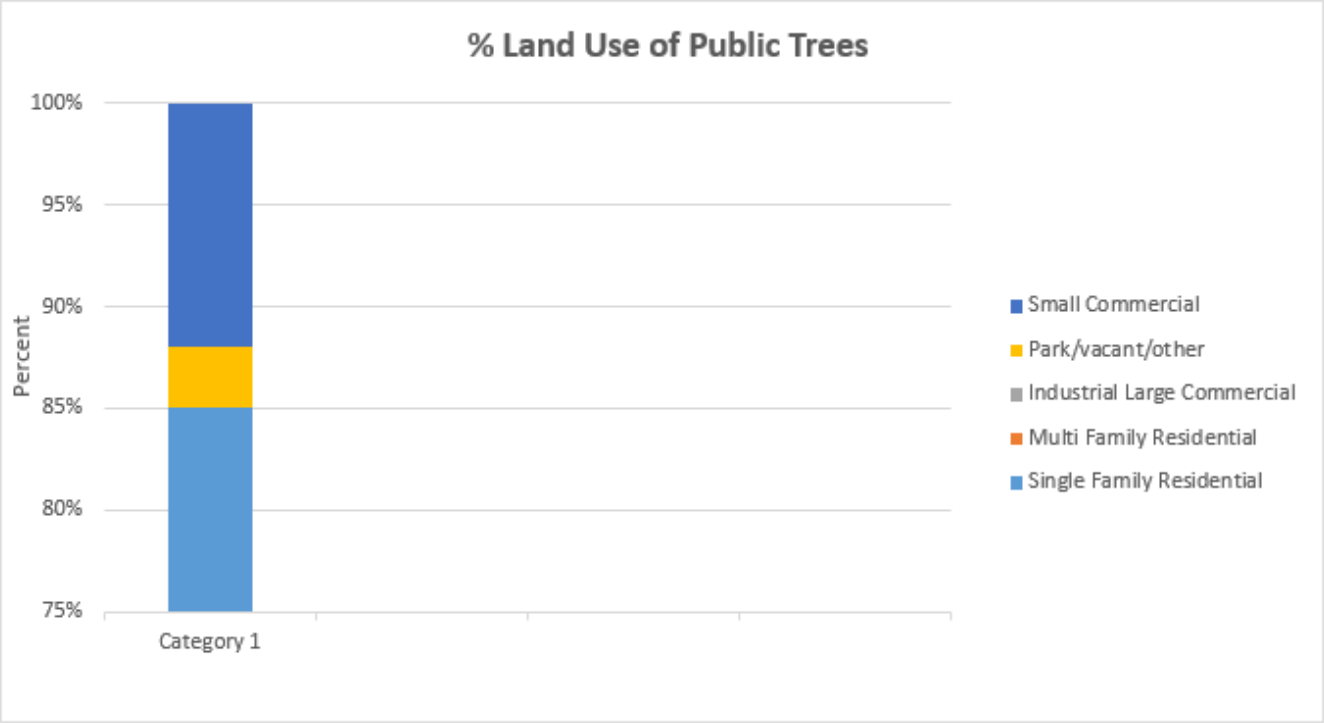


Figure 4: Wood Condition



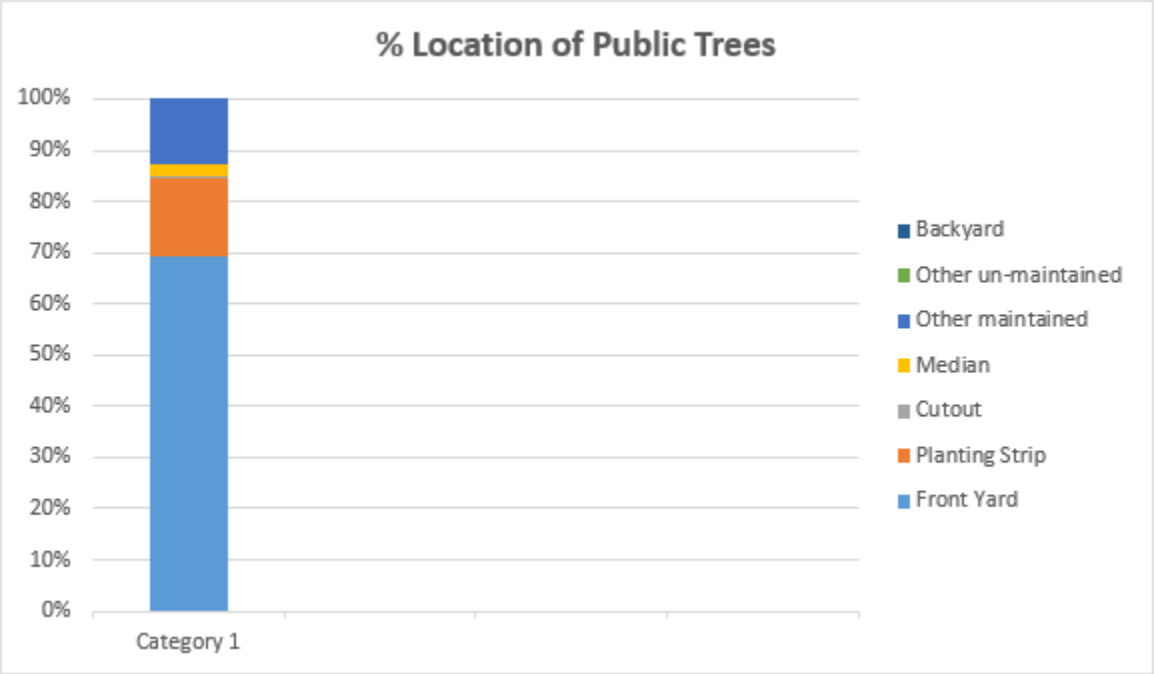
Canopy Cover of All Trees (Acres)		12/20/2018
Zone	Acres	% of Total Canopy
1	3.32	41.50
Citywide Total	8.00	100.00

Figure 5: Canopy Cover in Acres



12/20/2018	Land Use of All Trees by Zone			
Citywide	Single family residential	289	(N/A)	85.25
	Multi-family residential	0	(N/A)	0.00
	Industrial/Large commercial	0	(N/A)	0.00
	Park/vacant/other	10	(N/A)	2.95
	Small commercial	40	(N/A)	11.80
	Total	339	(N/A)	100.00

Figure 6: Land Use of city/park trees



Citywide	Front yard	236	(N/A)	69.62
	Planting strip	53	(N/A)	15.63
	Cutout	0	(N/A)	0.00
	Median	7	(N/A)	2.06
	Other maintained locations	43	(N/A)	12.69
	Other un-maintained locations	0	(N/A)	0.00
	Backyard	0	(N/A)	0.00
	Total	339	(N/A)	100.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1:

Location of Ash Trees
2018 Community Tree Inventory
Fruitland, IA

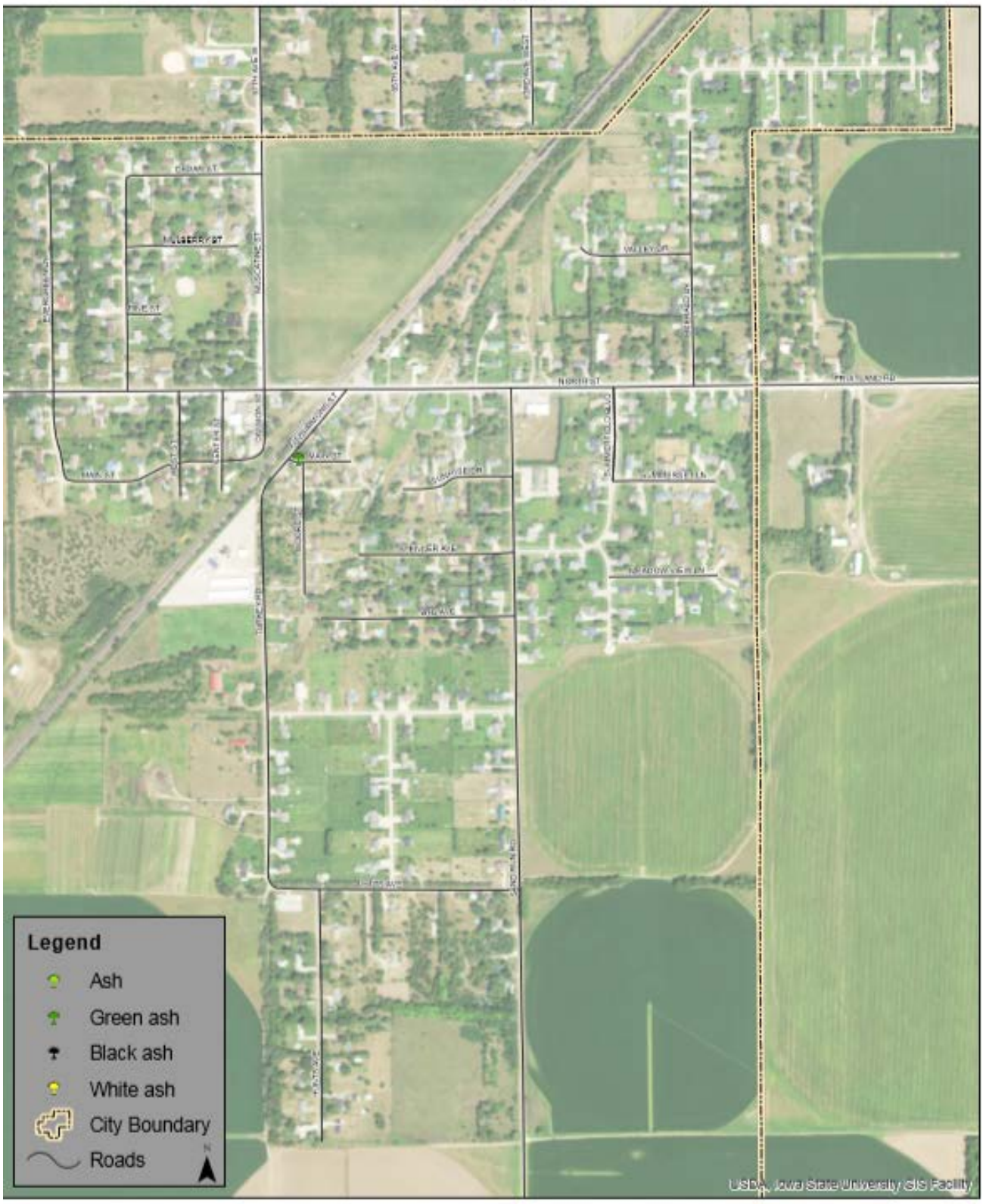


Figure 2:

Location of Poor Condition Trees
2018 Community Tree Inventory
Fruitland, IA

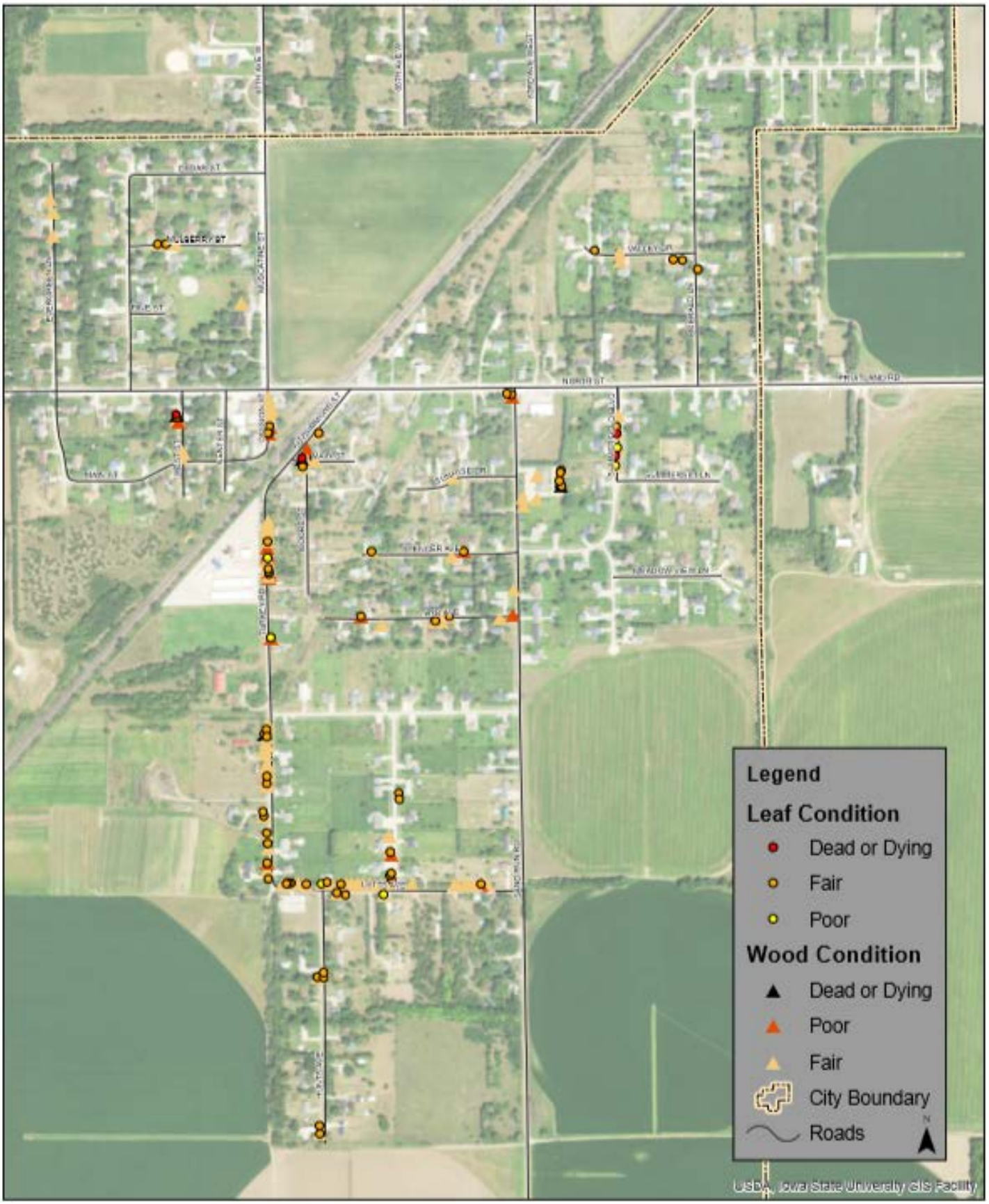


Figure 3:

Location of Trees with Recommended Maintenance
2018 Community Tree Inventory
Fruitland, IA

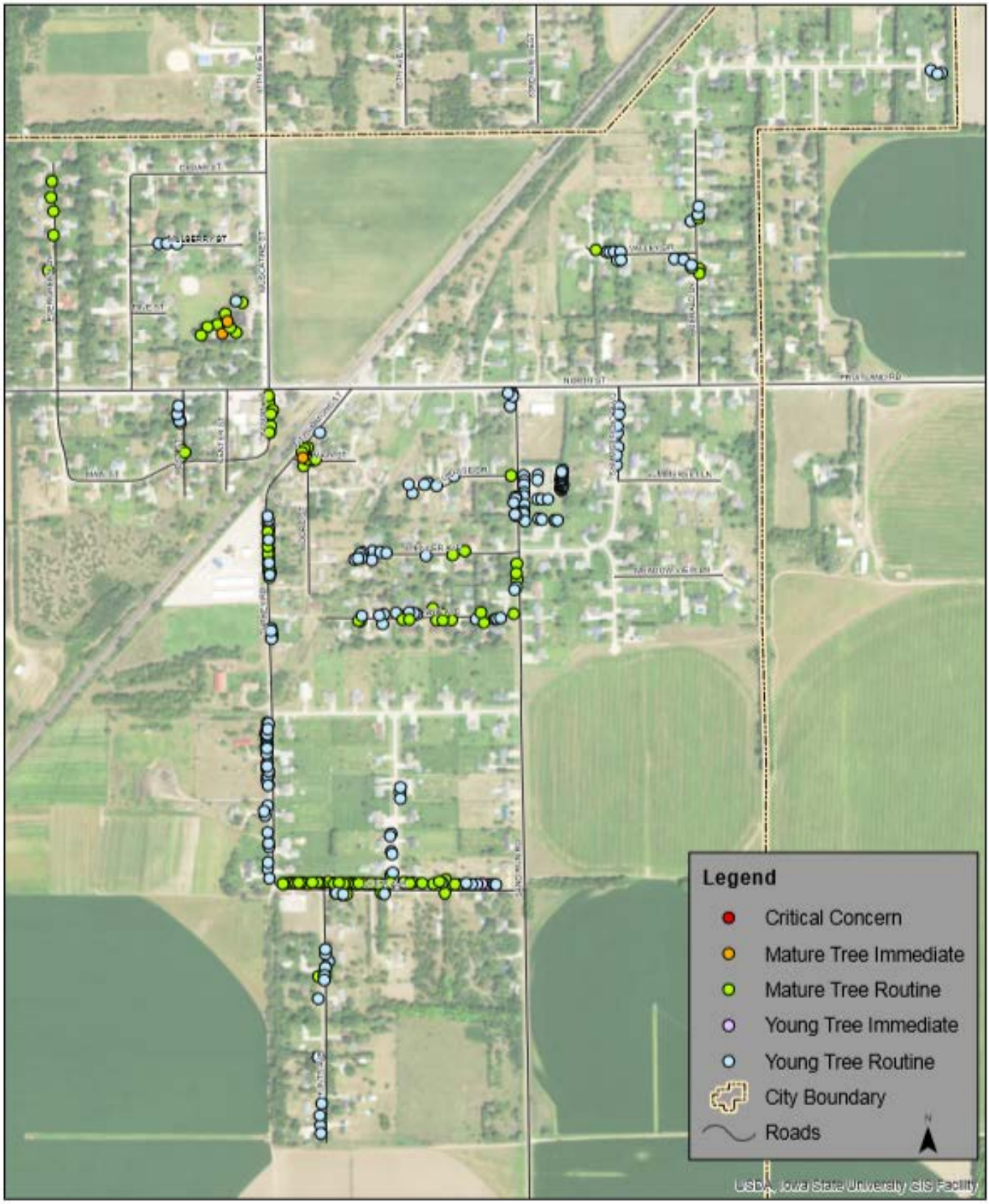


Figure 4:

Maintenance Tasks
2018 Community Tree Inventory
Fruitland, IA

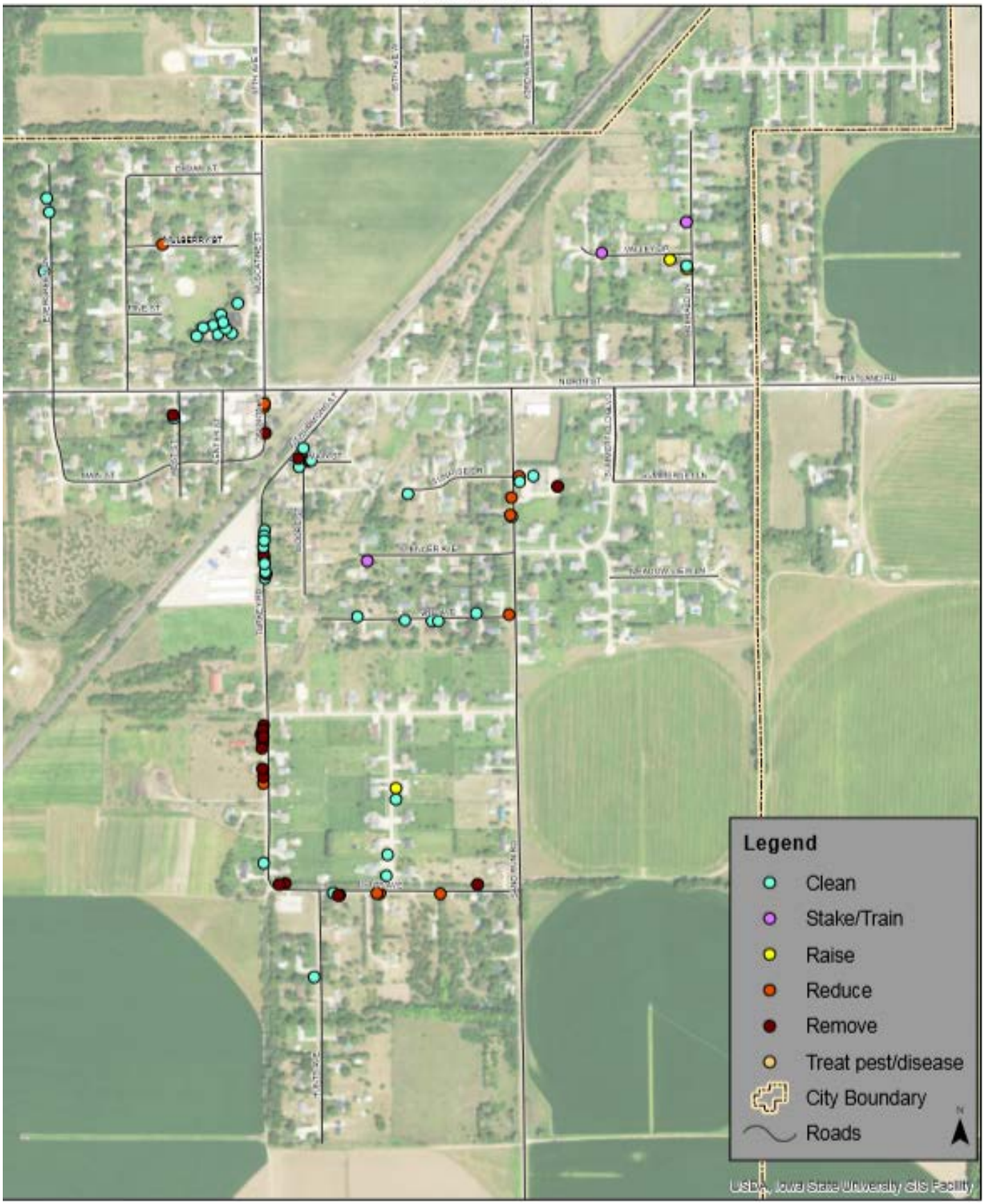
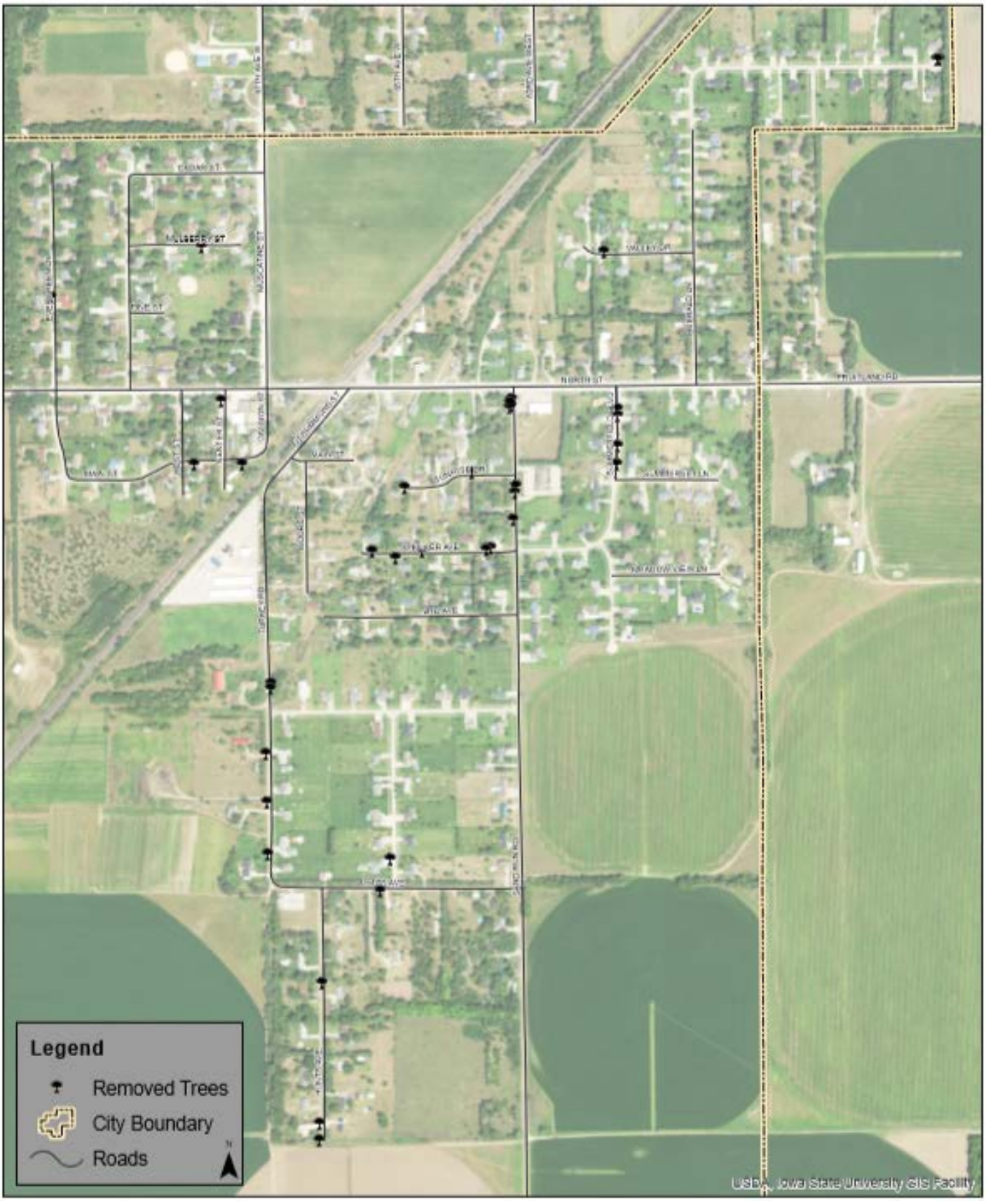


Figure 5:

Removed Trees
2018 Community Tree Inventory
Fruitland, IA



The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E 9th St, Des Moines IA 50319.

If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-725-8200.