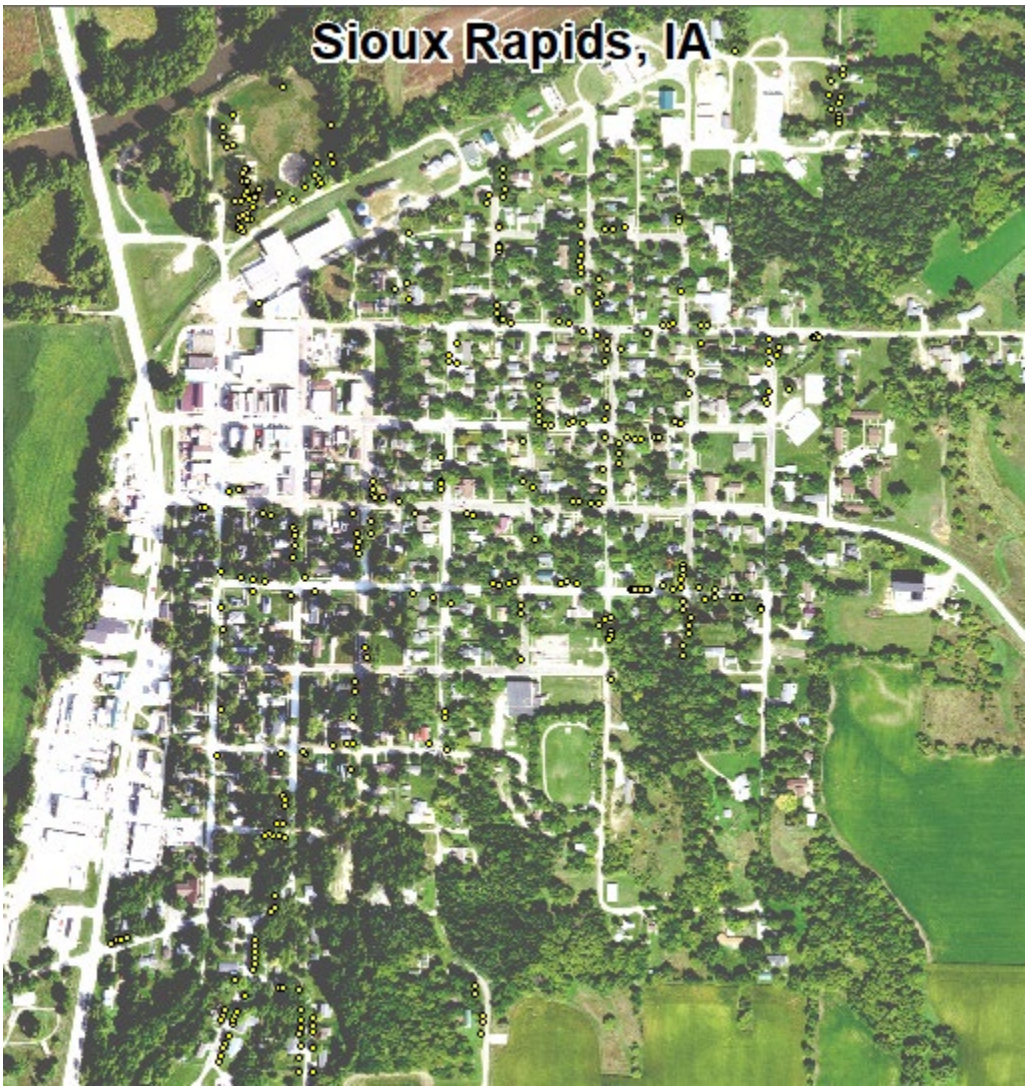
Sioux Rapids, IA



2020 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Sioux Rapids 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 25% of Sioux Rapids's city owned trees (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 2019, 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.

- Sioux Rapids's trees provide $59,003 of benefits annually, an average of $174 a tree
- There are over 31 species of trees
- The top three genera are: Ash 25%, black walnut 14%, and hackberry 9%
- 84% of trees are in need of some type of management
- 16 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 16 trees needing removal, 8 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*
- 36 of the 86 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 with a visual survey yearly
- Sioux Rapids does not have a budget specifically for tree related practice. From information gathered an average cost for a tree removal is around $1,000. – Suggestion: request a budget increase to $7,500 annually and apply for grants to plant replacement trees. With this budget it would take 17 years to remove the 86 ash trees in Sioux Rapids.

Introduction

This plan was developed to assist Sioux Rapids 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 Sioux Rapids, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Sioux Rapids' 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 Sioux Rapids 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 Sioux Rapids's urban forestry goals.

Inventory

In 2019, 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 woodpecker 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. Sioux Rapids's trees reduce energy related costs by approximately $16,600 annually (Appendix A, Table 1). These savings are both in Electricity (80.1 MWh) and in Natural Gas (10,735.4 Therms).

Annual Stormwater Benefits

Sioux Rapids's trees intercept about 733,404 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $19,875 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 Sioux Rapids, it is estimated that trees remove 1,001.1 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 $2,831 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Sioux Rapids, trees sequester about 291,326 lbs of carbon a year with an associated value of $2,185 (Appendix A, Table 5). In addition, the trees store 2,432,251 lbs of carbon, with a yearly benefit of $18,242 (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. Sioux Rapids receives $17,512 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, Sioux Rapids's trees provide $59,003 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 339 trees in Sioux Rapids provide approximately $174 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Sioux Rapids has over 31 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Ash	86	25%
Black walnut	48	14%
hackberry	31	9%
Silver maple	28	8%
Norway maple	25	7%
Broadleaf Deciduous small	19	6%
Black maple	11	3%
Sugar maple	11	3%
Honey locust	10	3%
Blue spruce	10	3%
Other species	60	18%

Age Class

Most of Sioux Rapids's trees (35%) are between 12 and 18 inches 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. Sioux Rapids's size curve is on the medium side, indicating a stand that is trending towards a mature 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 Sioux Rapids indicate that 94% of the trees are in good health, with only 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 79% of Sioux Rapids's trees are in 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 6% of the population. This 6% 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	279	82%
Tree Removal	16	47%
Crown Reduction	5	1%

Canopy Cover

The total canopy with both private and public trees is 31%, 163acres. The canopy cover included in the Sioux Rapids inventory includes approximately 8.5 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 38 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Sioux Rapids'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	86%
Park/vacant/other	14%
Industrial/Large commercial	0%
Small commercial	0%
Multifamily residential	0%

Location	
Front yard	68%
Planting strip	32%

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 a motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

Hazardous trees

Sioux Rapids has 1 critical concern tree that needs immediate removal. This tree can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing immediate maintenance. There are a total of 7 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 16 removals, 7 are ash trees. There are a total of 86 ash trees, and 36 of those have signs and symptoms that have been associated with EAB. In addition, there are 6 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 Sioux Rapids.

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 (22%) and ash (25%) (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: 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 woodpecker damage.

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

Year 1

Removal: 1 large critical concern tree and 6 immediate removal trees
Planting and Replacement: 9 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 5 additional trees needing removal
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 6 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: 4 remaining trees labeled for removal and up to 3 new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 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: 5 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 6 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: 7 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 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: 5 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 6 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: Approximately 25 ash trees removed (approximately 29% of ash). It will take approximately 17 years to remove all ash with the proposed budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
**To remove all ash trees within 6 years, the budget would need to be increased to about $16,000 a year.

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 an 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. Restrictions for tree species could not be found in the city ordinance, but here are suggestions for species not to allow. 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 woodpecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 52.01 states ``The city shall notify the owner of any tree, shmb, bush or other woody vegetation located on private property to remove the tree, bush, shrub or other woody vegetation when such plant constitutes a public nuisance or is a hazard to person or property, or harbors insects, other pests, or disease. The city shall notify in writing the property owner of the property on which such tree, shrub, bush or other woody vegetation is located of the necessity to remove the same. Upon such notice, the owner shall remove the planting at the owner's expense within thirty (30) days. Notice shall either be given by personal sense or by certified mail with return receipt barring the signature of the property owner. In the event the property owner fails to comply with the notice, the city may force compliance by legal process and if granted authority to perform the required action, may thereafter assess the costs against the property for collection in the same manner as a property tax. Code of Iowa, Chapter 364.12(3)(h) allows the City in an emergency to perform any action which may be required to abate the emergency without prior notice, and assess the costs as provided in Chapter 364.12, after notice to the property owner and hearing. ”

Budget

Current Budget

Total $42,000 over 6 years ($7,500/year)

FY 2020 Budget

Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2021 Budget

Removal: $5,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $2,000
Watering & Maintenance: $500

FY 2022 Budget

Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2023 Budget

Removal: $5,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $2,000
Watering & Maintenance: $500

FY 2024 Budget

Removal: $7,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2025 Budget

Removal: $5,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $2,000
Watering & Maintenance: $500

*Reduction of ash over 6 years: approximately 25 ash trees removed (approximately 29% of ash). **It will take approximately 17 years to remove all ash with the proposed budget.**

<u>Purposed Budget Increase</u>

EAB could potentially kill all ash trees in Sioux Rapids within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $16,000 a year.

Additionally, it is recommended that Sioux Rapids 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, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed 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). This would be 8 trees selected for treatment, and Sioux Rapids would still need to find $3,000 for removal for the remaining trees scheduled for removal. Alternatively, if there are 14 treatable trees every other year, it would cost approximately $4,200 a year for treatment and leave $2,800 for additional removals that year. 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 Sioux Rapids. It is suggested to consider increasing the budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Sioux Rapids

Annual Energy Benefits of Public Trees

3/31/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	21.1	1,604	2,822.5	2,766	4,371	(N/A)	25.1	26.3	51.42
Black walnut	12.1	915	1,584.2	1,552	2,468	(N/A)	14.2	14.9	51.42
Northern hackberry	9.9	754	1,361.4	1,334	2,088	(N/A)	9.1	12.6	67.37
Silver maple	8.1	616	1,061.9	1,041	1,656	(N/A)	8.3	10.0	59.15
Norway maple	5.3	406	702.1	688	1,094	(N/A)	7.4	6.6	43.75
Broadleaf Deciduous Small	1.4	107	243.8	239	346	(N/A)	5.6	2.1	18.19
Black maple	2.9	219	350.3	343	562	(N/A)	3.2	3.4	51.08
Sugar maple	2.6	199	340.4	334	533	(N/A)	3.2	3.2	48.44
Honeylocust	3.1	238	428.3	420	657	(N/A)	2.9	4.0	65.74
Blue spruce	0.8	64	125.6	123	187	(N/A)	2.9	1.1	18.74
Basswood	2.2	167	289.3	284	450	(N/A)	2.4	2.7	56.29
Apple	0.8	59	118.0	116	175	(N/A)	2.4	1.1	21.87
American elm	2.6	196	323.1	317	513	(N/A)	2.1	3.1	73.29
Siberian elm	1.1	84	154.3	151	235	(N/A)	1.8	1.4	39.18
Cottonwood	1.2	93	167.6	164	257	(N/A)	1.2	1.5	64.24
Red maple	0.5	38	72.9	71	110	(N/A)	0.9	0.7	36.61
Northern red oak	0.7	54	96.1	94	148	(N/A)	0.9	0.9	49.39
Mulberry	0.4	34	62.2	61	94	(N/A)	0.9	0.6	31.49
Cherry plum	0.2	13	29.5	29	42	(N/A)	0.9	0.3	13.93
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	0.6	0.3	24.57
Pin oak	0.2	16	31.6	31	47	(N/A)	0.6	0.3	23.64
River birch	0.6	44	87.0	85	130	(N/A)	0.6	0.8	64.76
Boxelder	0.3	23	38.8	38	61	(N/A)	0.6	0.4	30.54
Conifer Evergreen Large	0.1	10	14.6	14	24	(N/A)	0.3	0.1	24.14
Hickory	0.2	18	27.0	26	44	(N/A)	0.3	0.3	44.23
Norway spruce	0.1	11	19.7	19	30	(N/A)	0.3	0.2	30.47
White ash	0.1	7	13.3	13	20	(N/A)	0.3	0.1	20.10
Black locust	0.3	24	47.4	46	71	(N/A)	0.3	0.4	70.84
Broadleaf Deciduous Mediu	0.1	8	16.9	17	24	(N/A)	0.3	0.1	24.47
Paper birch	0.1	7	13.7	13	21	(N/A)	0.3	0.1	20.64
Elm	0.4	33	59.0	58	91	(N/A)	0.3	0.5	91.02
Total	80.1	6,079	10,735.4	10,521	16,600	(N/A)	100.0	100.0	48.97

Table 2: Annual Stormwater Benefits

Sioux Rapids

Annual Stormwater Benefits of Public Trees

3/31/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	202,058	5,476	(N/A)	25.1	27.6	64.42
Black walnut	101,901	2,762	(N/A)	14.2	13.9	57.53
Northern hackberry	84,284	2,284	(N/A)	9.1	11.5	73.68
Silver maple	103,709	2,811	(N/A)	8.3	14.1	100.38
Norway maple	34,537	936	(N/A)	7.4	4.7	37.44
Broadleaf Deciduous Small	5,025	136	(N/A)	5.6	0.7	7.17
Black maple	20,169	547	(N/A)	3.2	2.8	49.69
Sugar maple	21,044	570	(N/A)	3.2	2.9	51.84
Honeylocust	30,832	836	(N/A)	2.9	4.2	83.55
Blue spruce	11,457	310	(N/A)	2.9	1.6	31.05
Basswood	24,829	673	(N/A)	2.4	3.4	84.11
Apple	3,242	88	(N/A)	2.4	0.4	10.98
American elm	21,418	580	(N/A)	2.1	2.9	82.92
Siberian elm	10,408	282	(N/A)	1.8	1.4	47.01
Cottonwood	13,294	360	(N/A)	1.2	1.8	90.07
Red maple	4,118	112	(N/A)	0.9	0.6	37.20
Northern red oak	7,254	197	(N/A)	0.9	1.0	65.53
Mulberry	1,598	43	(N/A)	0.9	0.2	14.43
Cherry plum	598	16	(N/A)	0.9	0.1	5.40
Eastern red cedar	3,269	89	(N/A)	0.6	0.4	44.30
Pin oak	1,158	31	(N/A)	0.6	0.2	15.69
River birch	6,244	169	(N/A)	0.6	0.9	84.60
Boxelder	2,176	59	(N/A)	0.6	0.3	29.48
Conifer Evergreen Large	1,539	42	(N/A)	0.3	0.2	41.70
Hickory	1,466	40	(N/A)	0.3	0.2	39.72
Norway spruce	2,969	80	(N/A)	0.3	0.4	80.46
White ash	614	17	(N/A)	0.3	0.1	16.63
Black locust	3,764	102	(N/A)	0.3	0.5	102.01
Broadleaf Deciduous Medium	586	16	(N/A)	0.3	0.1	15.88
Paper birch	608	16	(N/A)	0.3	0.1	16.47
Elm	7,239	196	(N/A)	0.3	1.0	196.17
Citywide total	733,404	19,875	(N/A)	100.0	100.0	58.63

Table 3: Annual Air Quality Benefits

Sioux Rapids

Annual Air Quality Benefits of Public Trees

3/31/2020

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	22.1	3.5	11.1	1.0	119	100.3	14.7	14.0	95.8	626	0.0	0	262.5	746 (N/A)	25.1	8.77
Black walnut	9.8	1.6	5.2	0.4	54	57.0	8.3	8.0	54.7	357	0.0	0	145.0	410 (N/A)	14.2	8.55
Northern hackberry	13.6	2.4	7.0	0.6	75	47.5	6.9	6.6	45.1	296	0.0	0	129.7	371 (N/A)	9.1	11.95
Silver maple	16.9	2.9	8.4	0.7	91	38.2	5.6	5.3	36.7	239	-9.4	-35	105.4	295 (N/A)	8.3	10.55
Norway maple	5.6	1.0	2.9	0.2	31	25.3	3.7	3.5	24.3	158	-1.4	-5	65.1	184 (N/A)	7.4	7.34
Broadleaf Deciduous Small	0.9	0.1	0.5	0.0	5	7.2	1.0	1.0	6.4	44	0.0	0	17.0	48 (N/A)	5.6	2.55
Black maple	4.4	0.7	2.1	0.2	24	13.4	2.0	1.9	13.1	84	-1.6	-6	36.1	102 (N/A)	3.2	9.26
Sugar maple	2.3	0.4	1.3	0.1	13	12.4	1.8	1.7	11.9	77	-1.9	-7	30.0	83 (N/A)	3.2	7.55
Honeylocust	5.9	1.0	2.7	0.3	31	14.9	2.2	2.1	14.2	93	-4.2	-16	39.0	108 (N/A)	2.9	10.84
Blue spruce	1.4	0.3	1.2	0.2	9	4.1	0.6	0.6	3.8	25	-4.0	-15	8.2	20 (N/A)	2.9	1.98
Basswood	3.2	0.5	1.5	0.1	17	10.4	1.5	1.5	10.0	65	0.0	0	28.7	82 (N/A)	2.4	10.24
Apple	1.0	0.2	0.5	0.0	5	3.8	0.6	0.5	3.5	24	0.0	0	10.0	29 (N/A)	2.4	3.59
American elm	6.0	1.0	2.9	0.3	32	12.1	1.8	1.7	11.7	76	0.0	0	37.5	108 (N/A)	2.1	15.47
Siberian elm	1.4	0.2	0.7	0.1	8	5.3	0.8	0.7	5.0	33	0.0	0	14.3	41 (N/A)	1.8	6.79
Cottonwood	1.6	0.3	0.8	0.1	8	5.8	0.8	0.8	5.5	36	0.0	0	15.7	45 (N/A)	1.2	11.21
Red maple	0.9	0.2	0.4	0.0	5	2.4	0.4	0.3	2.3	15	-0.3	-1	6.6	19 (N/A)	0.9	6.27
Northern red oak	1.6	0.3	0.8	0.1	8	3.4	0.5	0.5	3.2	21	-2.2	-8	8.0	21 (N/A)	0.9	7.03
Mulberry	0.5	0.1	0.2	0.0	2	2.1	0.3	0.3	2.0	13	0.0	0	5.5	16 (N/A)	0.9	5.22
Cherry plum	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.0	6 (N/A)	0.9	1.93
Eastern red cedar	0.7	0.1	0.5	0.1	4	1.1	0.2	0.1	1.0	7	-1.8	-7	2.0	4 (N/A)	0.6	2.19
Pin oak	0.1	0.0	0.1	0.0	0	1.0	0.2	0.1	1.0	6	-0.2	-1	2.2	6 (N/A)	0.6	3.05
River birch	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)	0.6	11.87
Boxelder	0.2	0.0	0.1	0.0	1	1.4	0.2	0.2	1.4	9	-0.1	0	3.5	10 (N/A)	0.6	4.82
Conifer Evergreen Large	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
Hickory	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	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1 (N/A)	0.3	1.45
White ash	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	1.0	3 (N/A)	0.3	2.91
Black locust	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	0.3	13.58
Broadleaf Deciduous Medium	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)	0.3	3.47
Paper birch	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)	0.3	2.99
Elm	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19 (N/A)	0.3	19.04
Citywide total	104.2	17.4	53.2	4.9	567	380.3	55.5	53.0	363.0	2,374	-29.6	-111	1,001.9	2,831 (N/A)	100.0	8.35

Table 4: Annual Carbon Stored

Sioux Rapids

Stored CO2 Benefits of Public Trees

3/31/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	723,241	5,424	(N/A)	25.1	29.7	63.82
Black walnut	317,731	2,383	(N/A)	14.2	13.1	49.65
Northern hackberry	209,507	1,571	(N/A)	9.1	8.6	50.69
Silver maple	399,241	2,994	(N/A)	8.3	16.4	106.94
Norway maple	92,964	697	(N/A)	7.4	3.8	27.89
Broadleaf Deciduous	17,250	129	(N/A)	5.6	0.7	6.81
Black maple	48,508	364	(N/A)	3.2	2.0	33.07
Sugar maple	65,283	490	(N/A)	3.2	2.7	44.51
Honeylocust	72,929	547	(N/A)	2.9	3.0	54.70
Blue spruce	8,430	63	(N/A)	2.9	0.3	6.32
Basswood	104,630	785	(N/A)	2.4	4.3	98.09
Apple	15,166	114	(N/A)	2.4	0.6	14.22
American elm	121,484	911	(N/A)	2.1	5.0	130.16
Siberian elm	35,604	267	(N/A)	1.8	1.5	44.51
Cottonwood	50,990	382	(N/A)	1.2	2.1	95.61
Red maple	10,147	76	(N/A)	0.9	0.4	25.37
Northern red oak	34,073	256	(N/A)	0.9	1.4	85.18
Mulberry	6,982	52	(N/A)	0.9	0.3	17.46
Cherry plum	1,994	15	(N/A)	0.9	0.1	4.98
Eastern red cedar	2,204	17	(N/A)	0.6	0.1	8.27
Pin oak	2,049	15	(N/A)	0.6	0.1	7.68
River birch	22,225	167	(N/A)	0.6	0.9	83.35
Boxelder	4,725	35	(N/A)	0.6	0.2	17.72
Conifer Evergreen La	1,170	9	(N/A)	0.3	0.0	8.78
Hickory	3,672	28	(N/A)	0.3	0.2	27.54
Norway spruce	3,343	25	(N/A)	0.3	0.1	25.07
White ash	1,035	8	(N/A)	0.3	0.0	7.76
Black locust	14,280	107	(N/A)	0.3	0.6	107.10
Broadleaf Deciduous	1,101	8	(N/A)	0.3	0.0	8.26
Paper birch	1,035	8	(N/A)	0.3	0.0	7.76
Elm	39,259	294	(N/A)	0.3	1.6	294.44
Citywide total	2,432,251	18,242	(N/A)	100.0	100.0	53.81

Table 5: Annual Carbon Sequestered

Sioux Rapids

Annual CO Benefits of Public Trees

3/31/2020

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	48,293	362	-3,472	-211	-28	35,458	266	80,069	601 (N/A)	25.1	27.5	7.06
Black walnut	27,073	203	-1,525	-115	-12	20,231	152	45,665	342 (N/A)	14.2	15.7	7.14
Northern hackberry	11,113	83	-1,006	-89	-8	16,666	125	26,684	200 (N/A)	9.1	9.2	6.46
Silver maple	31,277	235	-1,916	-87	-15	13,603	102	42,877	322 (N/A)	8.3	14.7	11.48
Norway maple	8,907	67	-446	-47	-4	8,968	67	17,381	130 (N/A)	7.4	6.0	5.21
Broadleaf Deciduous Smal	2,164	16	-83	-22	-1	2,359	18	4,417	33 (N/A)	5.6	1.5	1.74
Black maple	5,272	40	-233	-23	-2	4,832	36	9,848	74 (N/A)	3.2	3.4	6.71
Sugar maple	4,591	34	-313	-25	-3	4,404	33	8,656	65 (N/A)	3.2	3.0	5.90
Honeylocust	9,913	74	-350	-27	-3	5,252	39	14,788	111 (N/A)	2.9	5.1	11.09
Blue spruce	655	5	-40	-16	0	1,421	11	2,020	15 (N/A)	2.9	0.7	1.52
Basswood	5,074	38	-502	-22	-4	3,685	28	8,235	62 (N/A)	2.4	2.8	7.72
Apple	1,355	10	-73	-11	-1	1,312	10	2,583	19 (N/A)	2.4	0.9	2.42
American elm	3,023	23	-583	-25	-5	4,341	33	6,756	51 (N/A)	2.1	2.3	7.24
Siberian elm	2,081	16	-171	-12	-1	1,854	14	3,751	28 (N/A)	1.8	1.3	4.69
Cottonwood	3,016	23	-245	-12	-2	2,050	15	4,808	36 (N/A)	1.2	1.7	9.02
Red maple	331	2	-49	-5	0	848	6	1,125	8 (N/A)	0.9	0.4	2.81
Northern red oak	651	5	-164	-9	-1	1,193	9	1,671	13 (N/A)	0.9	0.6	4.18
Mulberry	649	5	-34	-5	0	741	6	1,352	10 (N/A)	0.9	0.5	3.38
Cherry plum	266	2	-10	-3	0	285	2	539	4 (N/A)	0.9	0.2	1.35
Eastern red cedar	86	1	-11	-4	0	374	3	445	3 (N/A)	0.6	0.2	1.67
Pin oak	327	2	-10	-2	0	360	3	675	5 (N/A)	0.6	0.2	2.53
River birch	470	4	-107	-7	-1	979	7	1,335	10 (N/A)	0.6	0.5	5.01
Boxelder	599	4	-23	-3	0	509	4	1,082	8 (N/A)	0.6	0.4	4.06
Conifer Evergreen Large	116	1	-6	-2	0	216	2	324	2 (N/A)	0.3	0.1	2.43
Hickory	445	3	-18	-2	0	393	3	819	6 (N/A)	0.3	0.3	6.14
Norway spruce	187	1	-16	-3	0	246	2	415	3 (N/A)	0.3	0.1	3.11
White ash	182	1	-5	-1	0	156	1	331	2 (N/A)	0.3	0.1	2.49
Black locust	0	0	-69	-4	-1	539	4	466	3 (N/A)	0.3	0.2	3.49
Broadleaf Deciduous Medi	224	2	-5	-1	0	176	1	393	3 (N/A)	0.3	0.1	2.95
Paper birch	209	2	-5	-1	0	159	1	361	3 (N/A)	0.3	0.1	2.71
Elm	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	0.3	0.5	10.90
Citywide total	169,461	1,271	-11,675	-803	-94	134,343	1,008	291,326	2,185 (N/A)	100.0	100.0	6.45

Table 6: Annual Social and Aesthetic Benefits

Sioux Rapids

Annual Aesthetic/Other Benefits of Public Trees

3/31/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	4,316	(N/A)	25.1	24.6	50.78
Black walnut	2,499	(N/A)	14.2	14.3	52.07
Northern hackberry	1,605	(N/A)	9.1	9.2	51.78
Silver maple	2,540	(N/A)	8.3	14.5	90.70
Norway maple	910	(N/A)	7.4	5.2	36.42
Broadleaf Deciduous Small	122	(N/A)	5.6	0.7	6.40
Black maple	702	(N/A)	3.2	4.0	63.83
Sugar maple	530	(N/A)	3.2	3.0	48.16
Honeylocust	2,140	(N/A)	2.9	12.2	214.03
Blue spruce	213	(N/A)	2.9	1.2	21.28
Basswood	408	(N/A)	2.4	2.3	51.03
Apple	79	(N/A)	2.4	0.4	9.84
American elm	406	(N/A)	2.1	2.3	57.96
Siberian elm	185	(N/A)	1.8	1.1	30.81
Cottonwood	243	(N/A)	1.2	1.4	60.66
Red maple	60	(N/A)	0.9	0.3	19.89
Northern red oak	48	(N/A)	0.9	0.3	15.98
Mulberry	37	(N/A)	0.9	0.2	12.46
Cherry plum	15	(N/A)	0.9	0.1	4.95
Eastern red cedar	27	(N/A)	0.6	0.2	13.68
Pin oak	46	(N/A)	0.6	0.3	23.14
River birch	43	(N/A)	0.6	0.2	21.53
Boxelder	66	(N/A)	0.6	0.4	33.23
Conifer Evergreen Large	32	(N/A)	0.3	0.2	32.32
Hickory	46	(N/A)	0.3	0.3	45.86
Norway spruce	47	(N/A)	0.3	0.3	47.08
White ash	33	(N/A)	0.3	0.2	33.42
Black locust	0	(N/A)	0.3	0.0	0.00
Broadleaf Deciduous Medium	26	(N/A)	0.3	0.1	26.22
Paper birch	29	(N/A)	0.3	0.2	28.56
Elm	58	(N/A)	0.3	0.3	58.34
Citywide total	17,512	(N/A)	100.0	100.0	51.66

Table 7: Summary of Benefits in Dollars

Sioux Rapids

Total Annual Benefits of Public Trees by Species ($)

3/31/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	4,371	601	746	5,476	4,316	15,509	(N/A)	26.3
Black walnut	2,468	342	410	2,762	2,499	8,482	(N/A)	14.4
Northern hackberry	2,088	200	371	2,284	1,605	6,548	(N/A)	11.1
Silver maple	1,656	322	295	2,811	2,540	7,623	(N/A)	12.9
Norway maple	1,094	130	184	936	910	3,254	(N/A)	5.5
Broadleaf Deciduous Sn	346	33	48	136	122	685	(N/A)	1.2
Black maple	562	74	102	547	702	1,986	(N/A)	3.4
Sugar maple	533	65	83	570	530	1,781	(N/A)	3.0
Honeylocust	657	111	108	836	2,140	3,853	(N/A)	6.5
Blue spruce	187	15	20	310	213	746	(N/A)	1.3
Basswood	450	62	82	673	408	1,675	(N/A)	2.8
Apple	175	19	29	88	79	390	(N/A)	0.7
American elm	513	51	108	580	406	1,658	(N/A)	2.8
Siberian elm	235	28	41	282	185	771	(N/A)	1.3
Cottonwood	257	36	45	360	243	941	(N/A)	1.6
Red maple	110	8	19	112	60	308	(N/A)	0.5
Northern red oak	148	13	21	197	48	426	(N/A)	0.7
Mulberry	94	10	16	43	37	201	(N/A)	0.3
Cherry plum	42	4	6	16	15	83	(N/A)	0.1
Eastern red cedar	49	3	4	89	27	173	(N/A)	0.3
Pin oak	47	5	6	31	46	136	(N/A)	0.2
River birch	130	10	24	169	43	376	(N/A)	0.6
Boxelder	61	8	10	59	66	204	(N/A)	0.3
Conifer Evergreen Large	24	2	3	42	32	103	(N/A)	0.2
Hickory	44	6	7	40	46	143	(N/A)	0.2
Norway spruce	30	3	1	80	47	163	(N/A)	0.3
White ash	20	2	3	17	33	76	(N/A)	0.1
Black locust	71	3	14	102	0	190	(N/A)	0.3
Broadleaf Deciduous M	24	3	3	16	26	73	(N/A)	0.1
Paper birch	21	3	3	16	29	71	(N/A)	0.1
Elm	91	11	19	196	58	375	(N/A)	0.6
Citywide Total	16,600	2,185	2,831	19,875	17,512	59,003	(N/A)	100.0

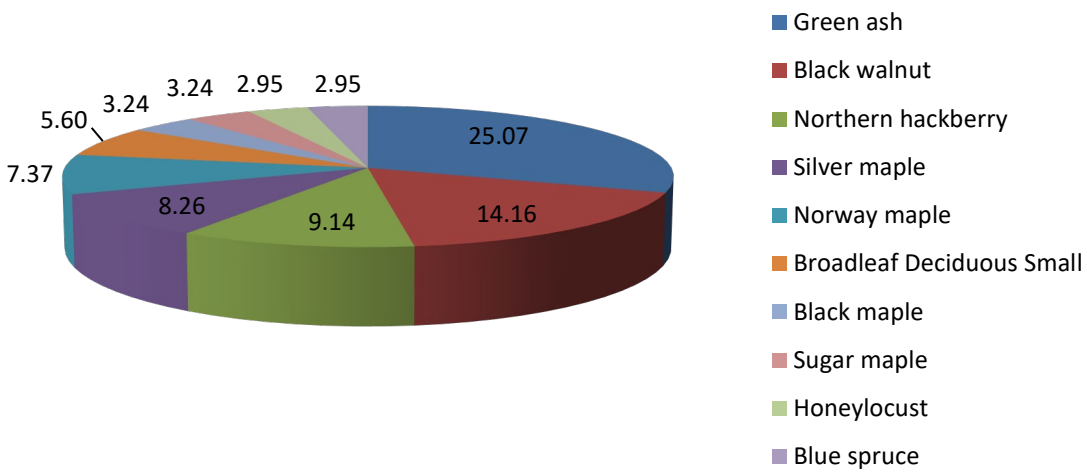

Figure 1: Species Distribution

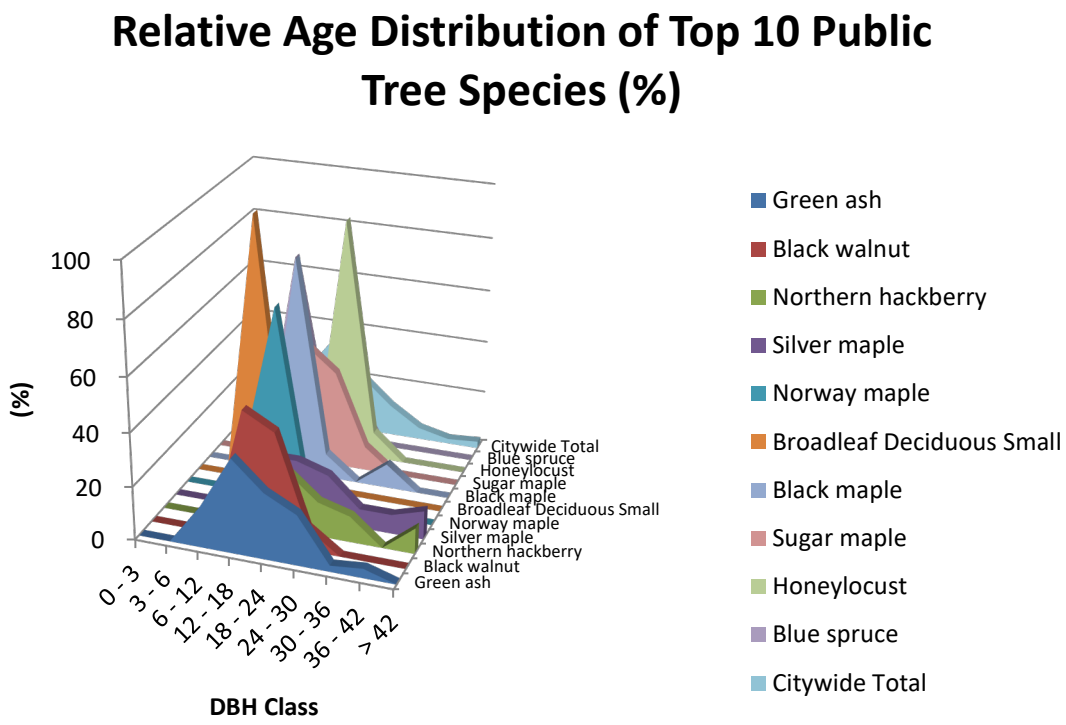

Figure 2: Relative Age Class

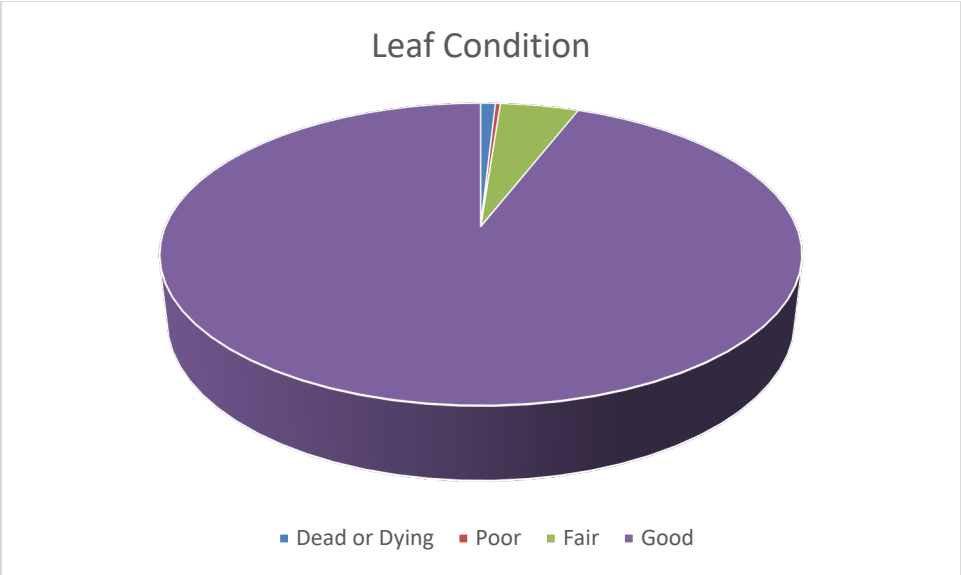

Figure 3: Foliage Condition

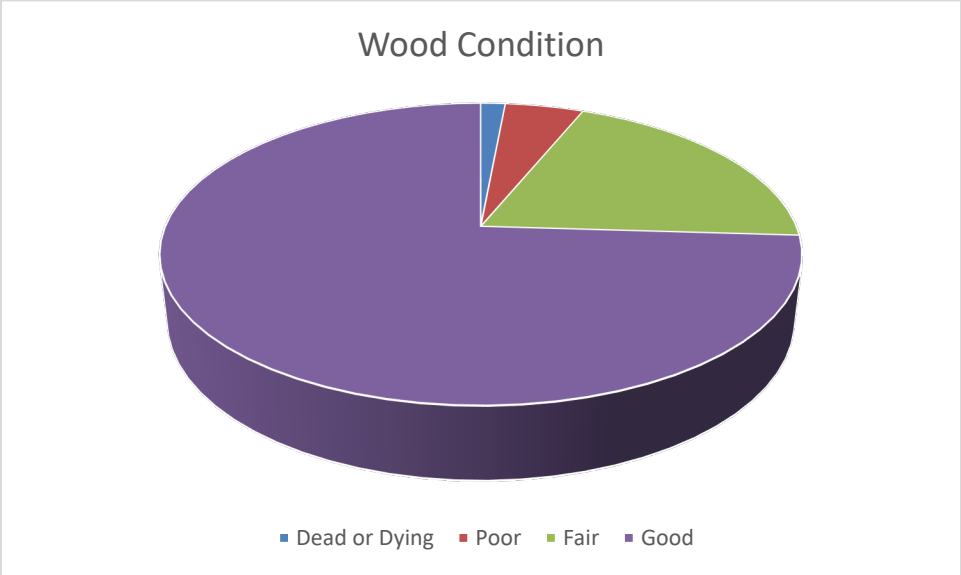

Figure 4: Wood Condition

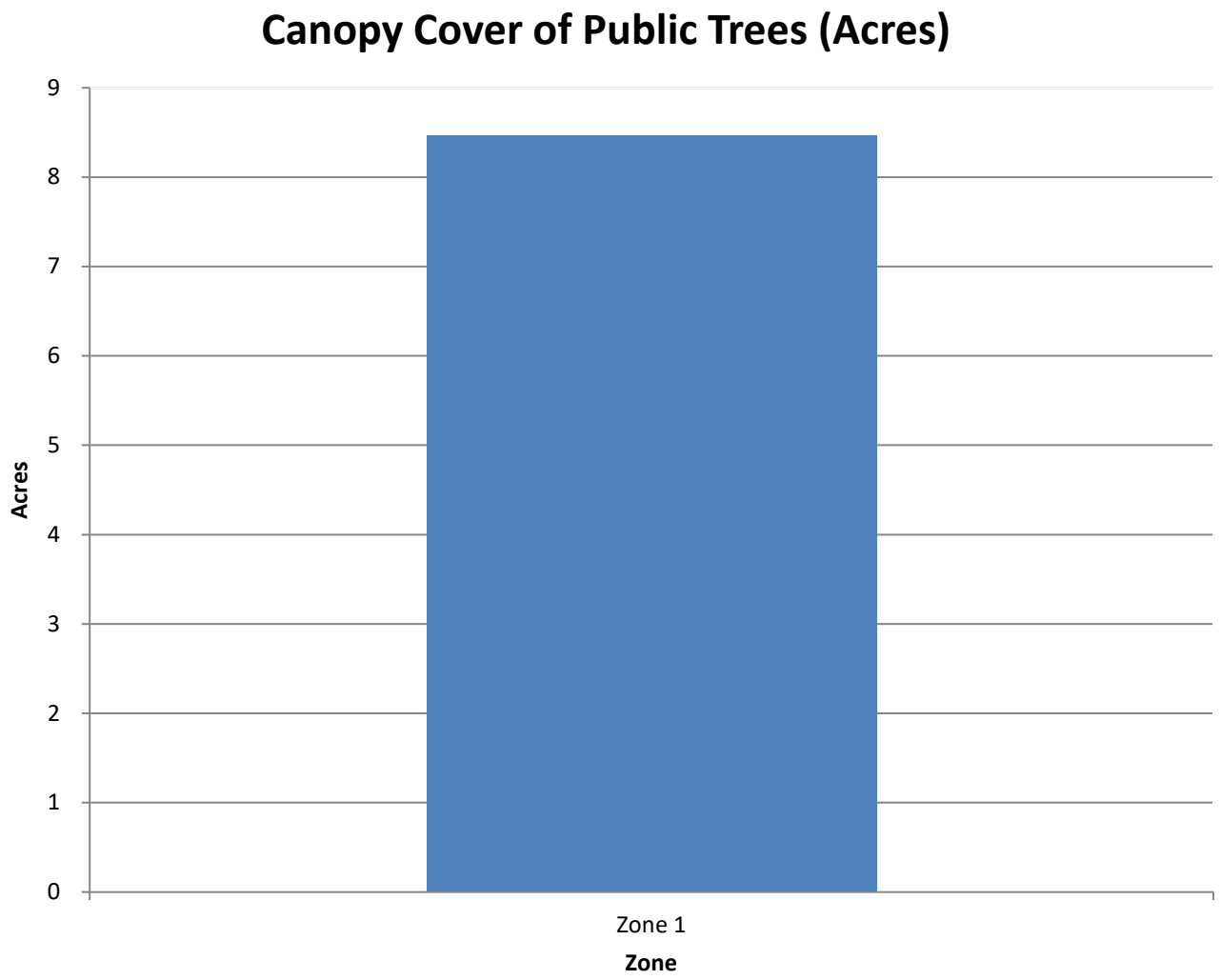

Figure 5: Canopy Cover in Acres

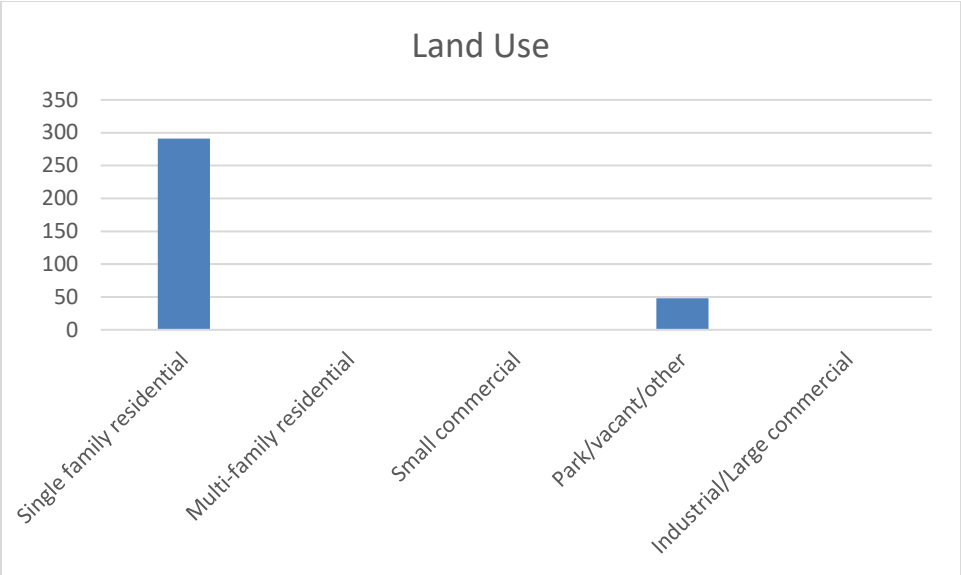

Figure 6: Land Use of city/park trees

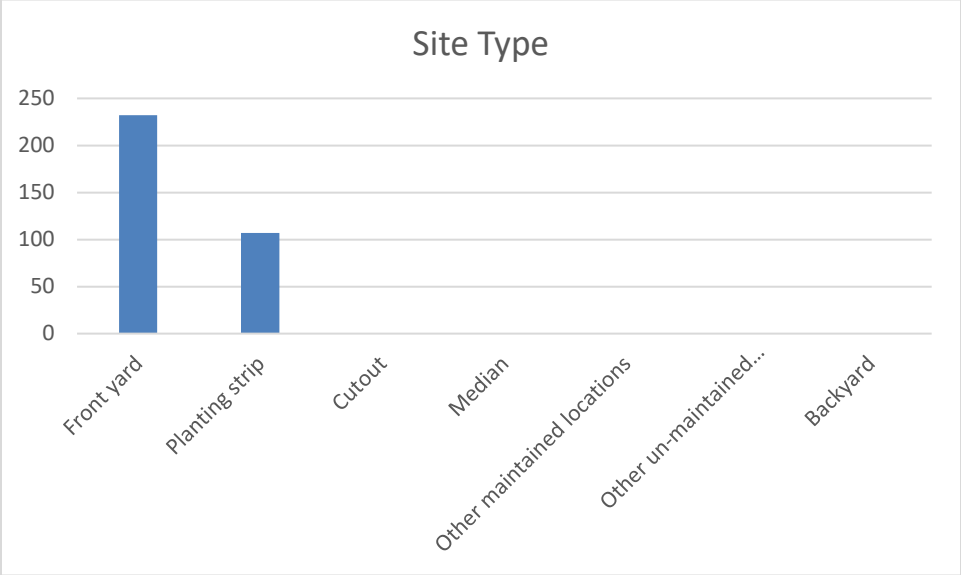

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

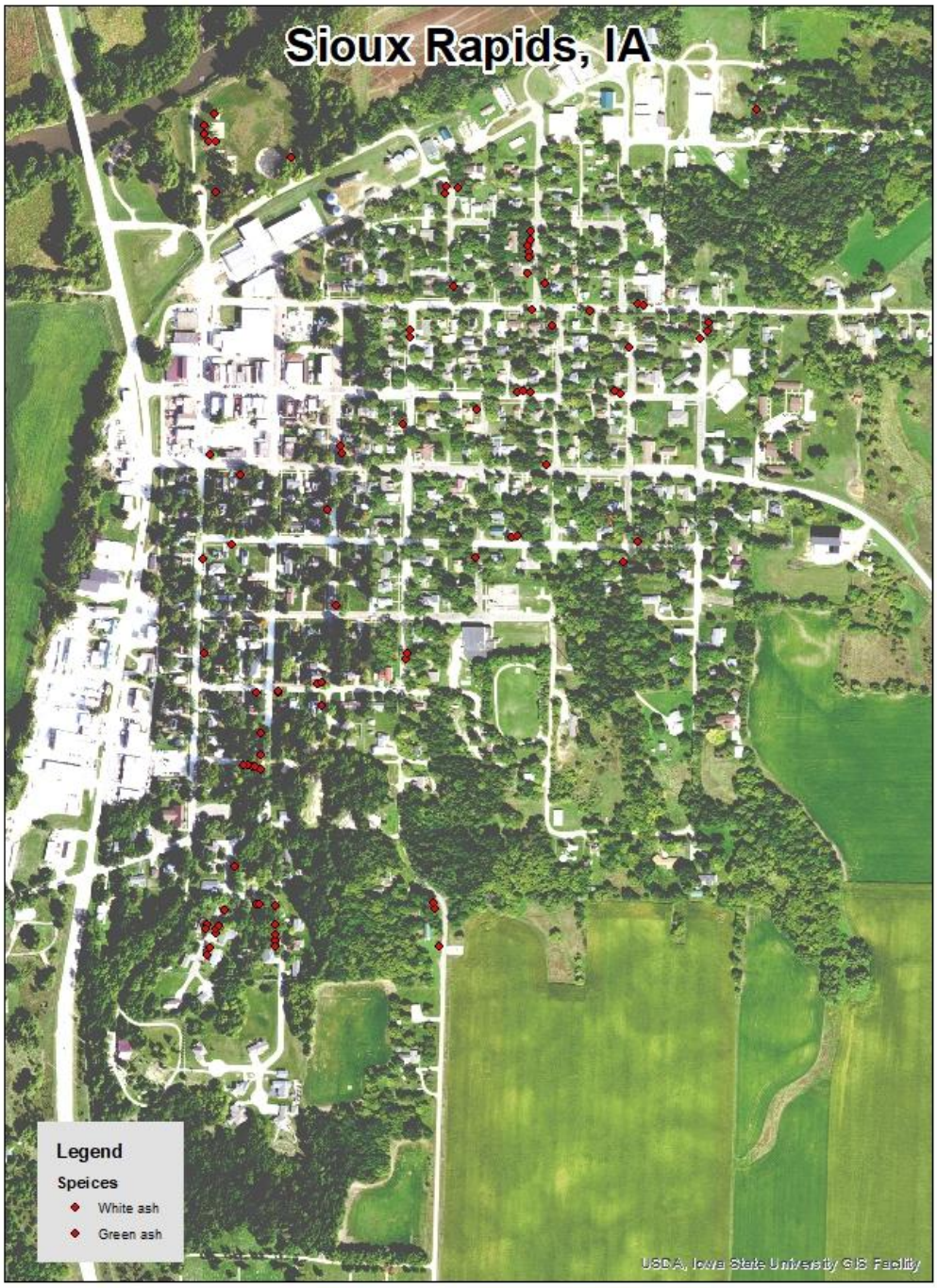

Figure 1: Location of Ash Trees

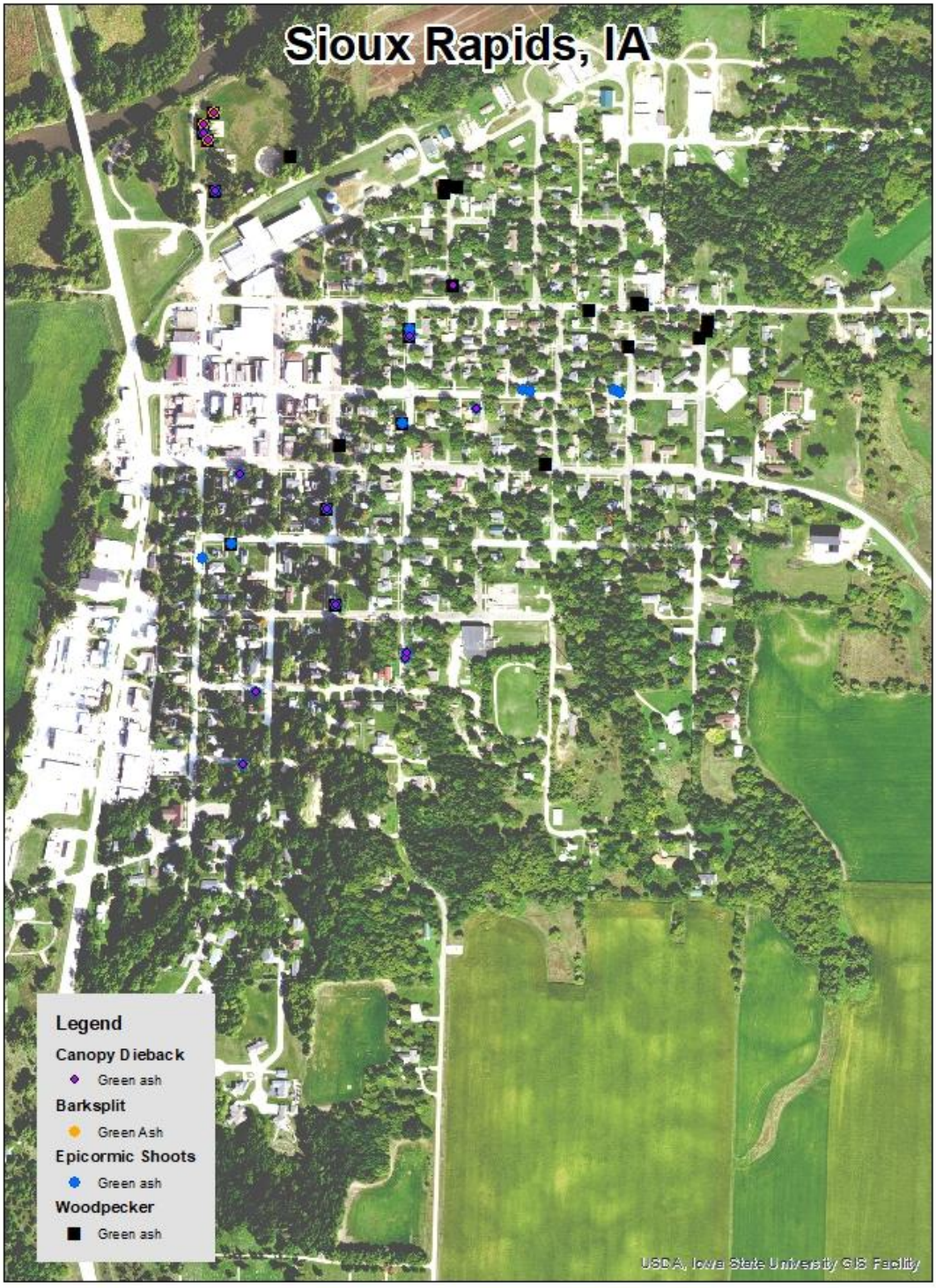

Figure 2: Location of EAB symptoms

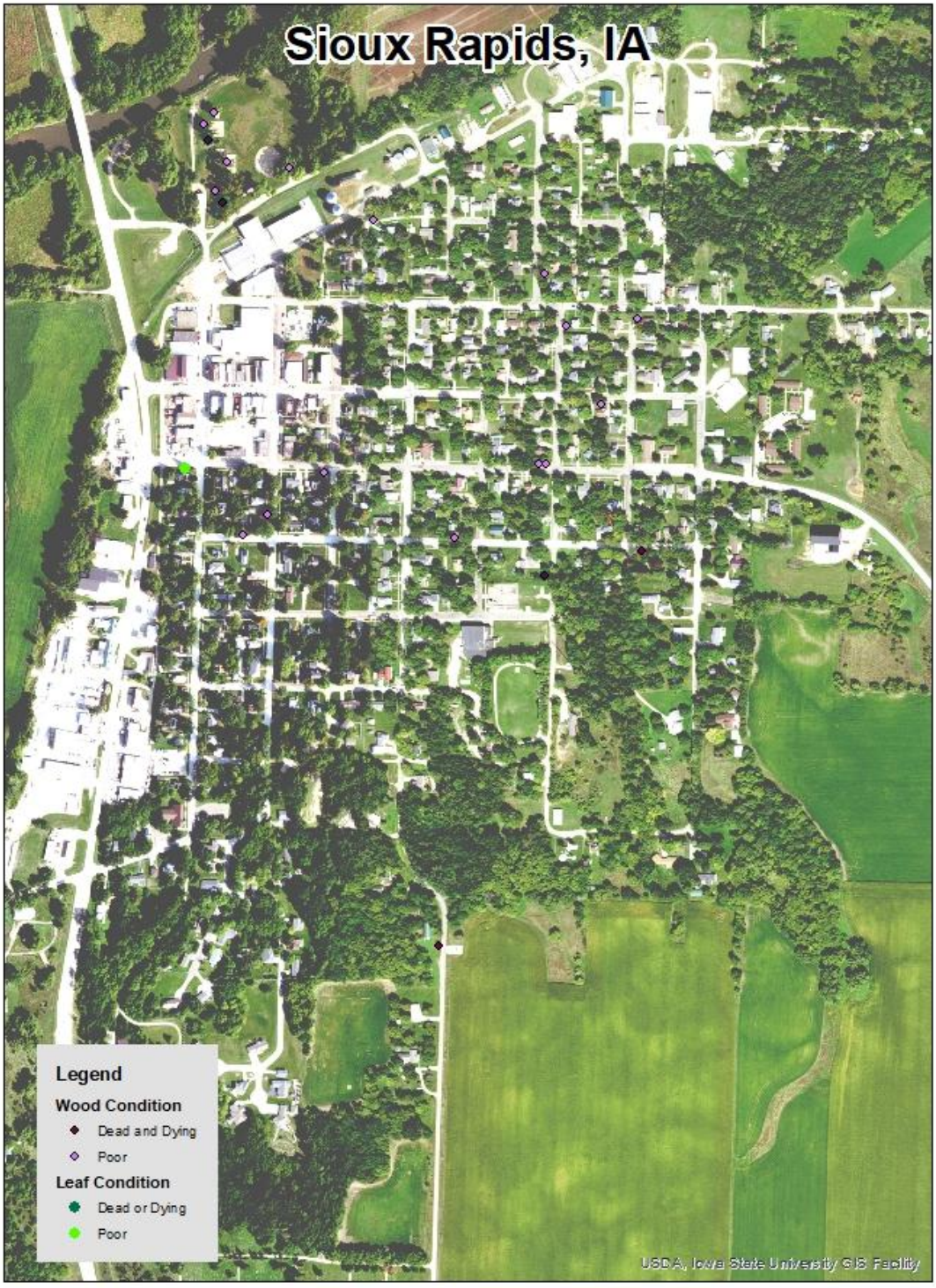

Figure 3: Location of Poor Condition Trees

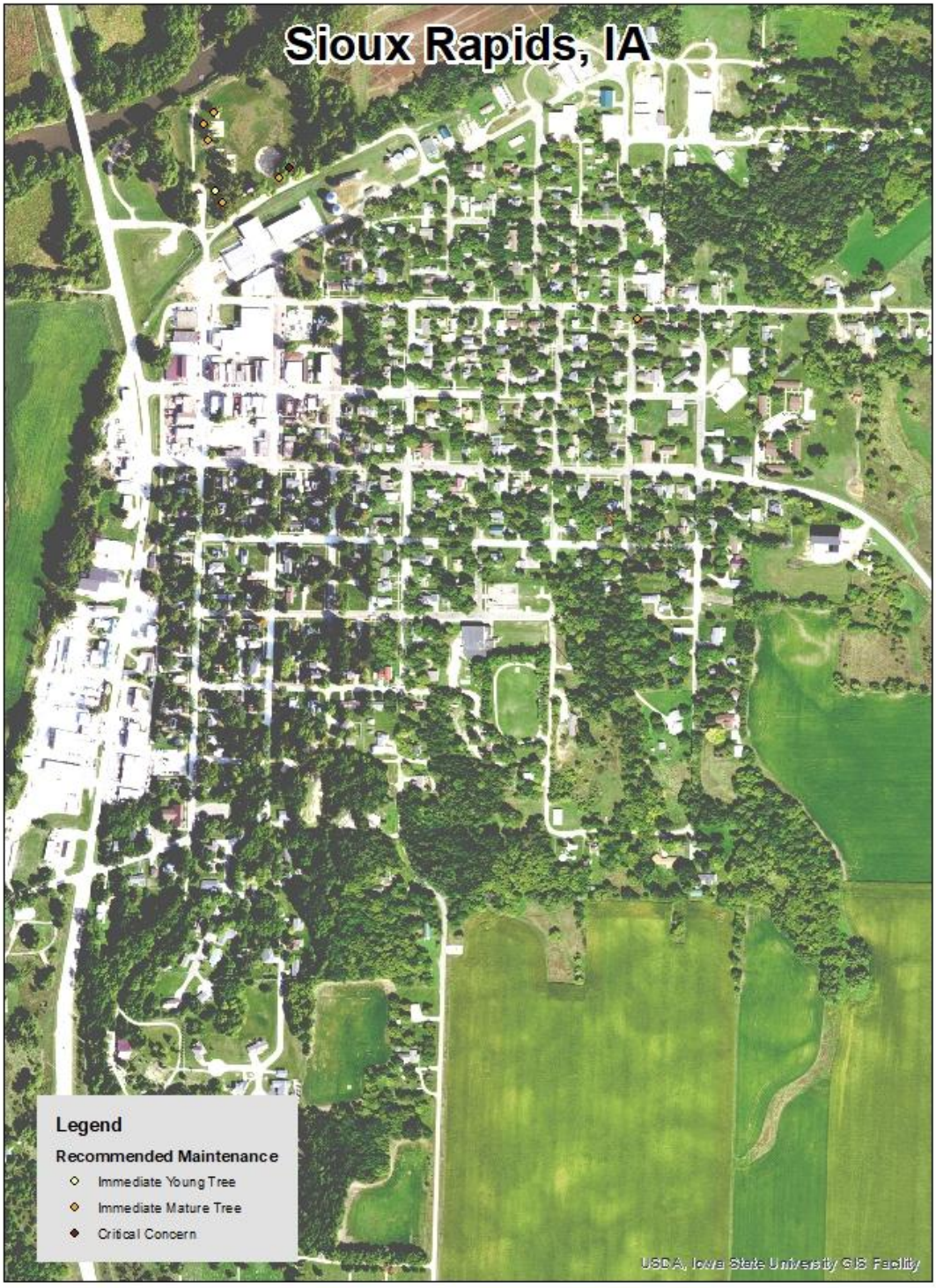

Figure 4: Location of Trees with Recommended Maintenance

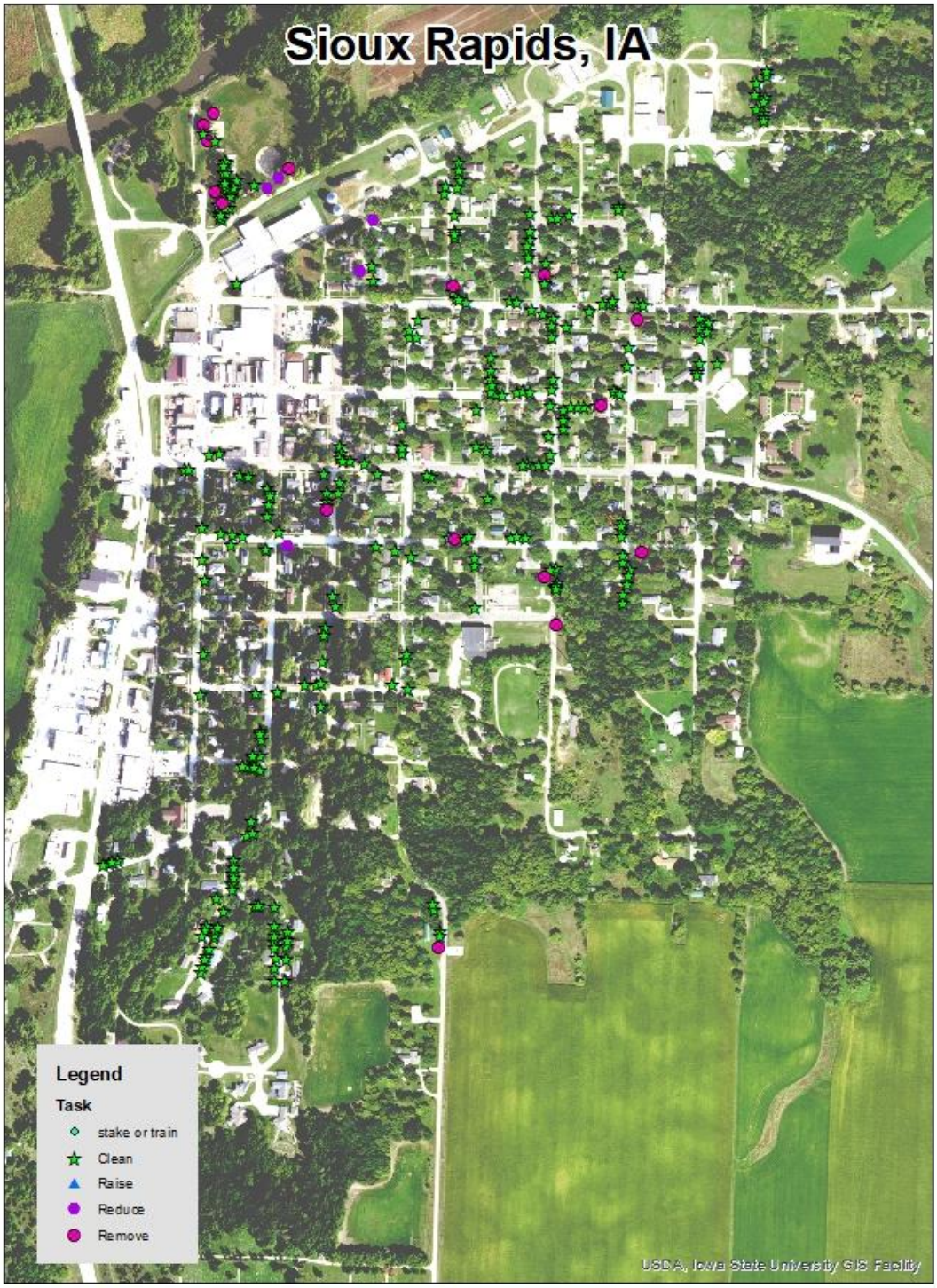

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal*****

Appendix C: Sioux Rapids Tree Ordinances

CHAPTER 52 - DISEASE & DEAD TREE CONTROL

52.01 DEAD OR DISEASED TREE REMOVAL ON PRIVATE PROPERTY.

The city shall notify the owner of any tree, shmb, bush or other woody vegetation located on private property to remove the tree, bush, shrub or other woody vegetation when such plant constitutes a public nuisance or is a hazard to person or property, or harbors insects, other pests, or disease. The city shall notify in writing the property owner of the property on which such tree, shrub, bush or other woody vegetation is located of the necessity to remove the same. Upon such notice, the owner shall remove the planting at the owner's expense within thirty (30) days. Notice shall either be given by personal sense or by certified mail with return receipt barring the signature of the property owner. In the event the property owner fails to comply with the notice, the city may force compliance by legal process and if granted authority to perform the required action, may thereafter assess the costs against the property for collection in the same manner as a property tax. Code of Iowa, Chapter 364.12(3)(h) allows the City in an emergency to perform any action which may be required to abate the emergency without prior notice, and assess the costs as provided in Chapter 364.12, after notice to the property owner and hearing.

52.02 DUTY TO REMOVE.

No person, firm or corporation shall permit any diseased tree, dead wood to remain on the premises owned, controlled or occupied by the person within the City.

(Code of Iowa, Sec, 364.12(3b))

52.03 INSPECTION.

The City shall inspect or cause to be inspected all premises and places within the City to determine whether any condition as defined in Section 52.01 of this Article exists thereon, and shall also inspect or cause to
be inspected any trees reported or suspected to constitute a public nuisance, a hazard to person or property, or harbors insects, other pests, or disease.

52.04 REMOVAL FROM CITY PROPERTY.

If the City, upon inspection or examination, in person or by some qualified person acting for the City, shall determine that any condition as herein defined exists in or upon any public street, alley, park or any public place, including the strip between the curb and the lot line of private property within the City, and that the danger of other trees, shrubs, bushes, or woody vegetation within the City is imminent, the City shall immediately cause the tree, shrub, bush or woody vegetation to be removed and burned or otherwise correct the same in such manner as to destroy or prevent as fully as possible the spread of disease, or insect pests, or vectors known to carry such disease, insects, and/or fungus.

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52.05 REMOVAL FROM PRIVATE PROPERTY.

If the City upon inspection or examination, in person or by some qualified person acting for the City, shall determine with reasonable certainty that any condition as herein defined exists in or upon private premises, and that he danger to other trees within the City is imminent, he/she shall immediately notify by certified mail or personal delivery to the occupant or person in charge of such property, to correct such condition within thirty (30) days of said notification. If such owner, occupant or person in charge of said property fails to comply within thirty (30) days of receipt thereof, the Council may cause the nuisance to be removed and the cost assessed against the property for collection in the same manner as a property tax.

(Code of Iowa, Sec. 364.12(3b&h))

52.06 REASONABLE CERTAINTY.

If the City is unable to determine with reasonable certainty whether or not a tree in or upon private premises is infected, diseased, or harboring insects or pests, a City representative is authorized to remove or cut specimens from said tree, and obtain a diagnosis of such specimens.

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.