Kellogg, IA

2016 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Kellogg 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 14% of Kellogg'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 2015, a tree inventory was conducted by Matt Brewer, Iowa DNR, 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 118 trees inventoried.

- Kellogg's trees provide $29,985 of benefits annually, an average of $254 a tree
- There are over 23 species of trees
- The top three genera are: Maple 30%, Black Walnut 26%, and Ash 14%
- 25% of trees are in need of some type of management
- 5 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 5 trees needing removal, 4 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*
- 5 of the 17 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
- Budget impacts from ash removal – Suggestion: request a budget increase to at least $1,200-$2,550 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Kellogg 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 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 and replacement planting. With proper planning and management of the current canopy in Kellogg, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2015, a tree inventory was conducted by Matt Brewer, Iowa DNR, 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 118 city trees was entered into the USDA Forest Service program i-Tree Streets, 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. Kellogg's trees reduce energy related costs by approximately $7,121 annually (Appendix A, Table 1). These savings are both in Electricity (33.8 MWh) and in Natural Gas (4,645.9 Therms).

Annual Stormwater Benefits

Kellogg's trees intercept about 425,716 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $11,537 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 Kellogg, it is estimated that trees remove 439.5 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 $1,237 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Kellogg, trees sequester about 97,479 lbs of carbon a year with an associated value of $731 (Appendix A, Table 4). In addition, the trees store 1,664,151 lbs of carbon, with a yearly benefit of $12,481 (Appendix A, Table 5).

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. Kellogg receives $8,997 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, Kellogg's trees provide $29,985 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 118 trees in Kellogg provides approximately $254 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Kellogg has over 23 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	35	30%
Black Walnut	31	26%
Ash	17	14%
Spruce	8	7%
Honeylocust	5	4%
Hackberry	4	3%
Elm	4	3%
Eastern Red Cedar	3	3%
Mulberry	2	2%
American Sycamore	2	2%
Oak	2	2%
Pine	1	1%
Aspen/Cottonwood	1	1%
Pear	1	1%
Linden/Basswood	1	1%
Other Medium Deciduous	1	1%

Age Class

Over half of Kellogg's trees (64%) are between 18 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that a large number of trees are in the smallest size categories (a downward slope) to prepare for natural mortality and to maintain canopy cover. Kellogg will have an aging tree population as this 64% matures, and should consider new plantings (currently only 1% are under 6 inches in diameter) to develop the next generation of trees.

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 Kellogg indicate that 81% of the trees are in good health, with only 6% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, 70% of Kellogg'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 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	25	21%
Tree Removal	5	4%

Canopy Cover

The total canopy with both private and public trees is 27% (62 acres). The canopy cover included in the Kellogg inventory includes approximately 4 acres (Appendix A, Figure 4).

Land Use and Location

The majority of Kellogg's city and park trees are in yard settings in parks (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use	
Park/vacant/other	70%
Single family residential	29%
Small commercial	1%

Location	
Front yard	92%
Planting strip	8%

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

Kellogg has 2 critical concern trees, both of which 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 critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 30 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 5 removals, 4 are ash trees. There are a total of 17 ash trees, and 5 of those have signs and symptoms that have been associated with EAB. In addition, there are 5 ash 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.

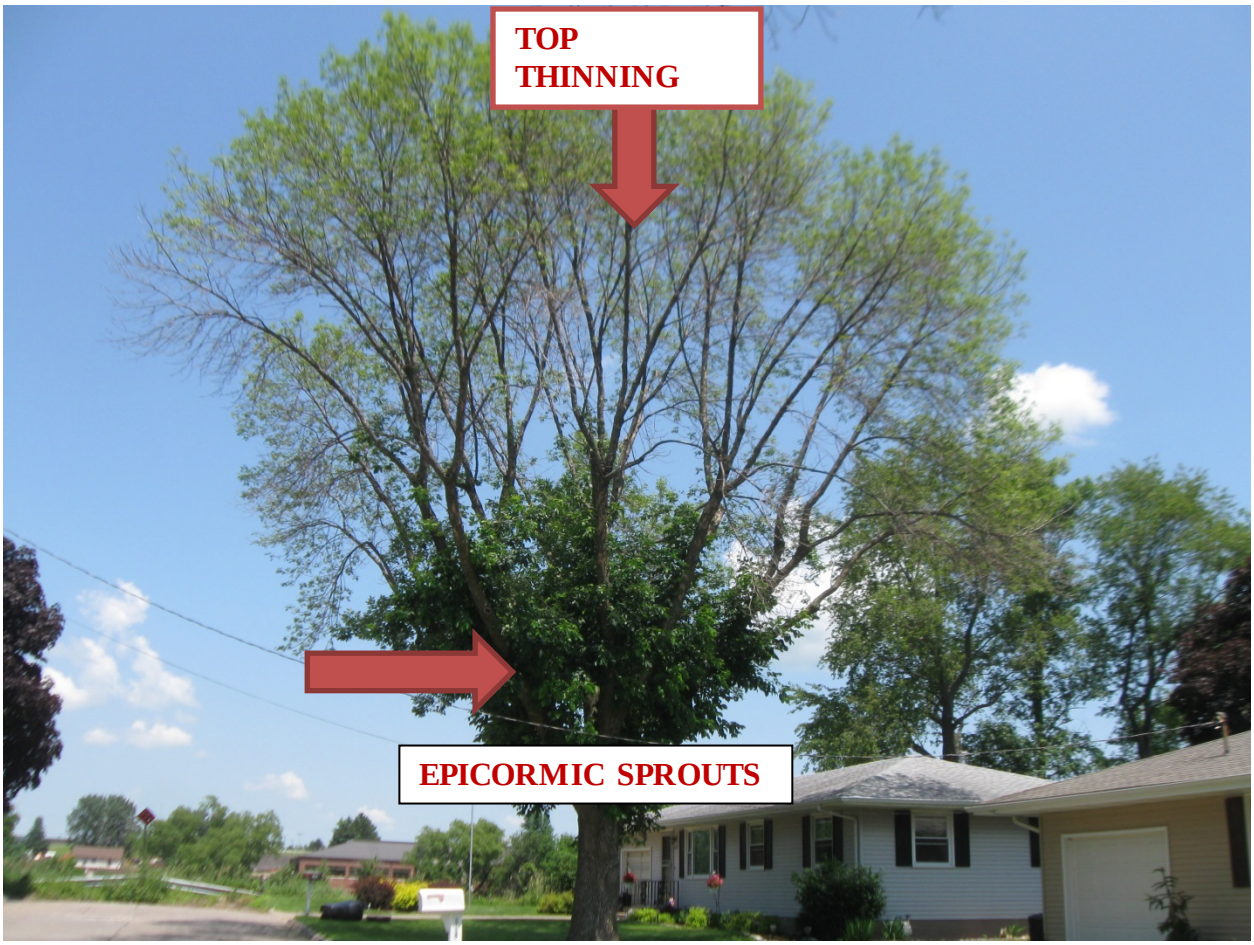
Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant at least 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 or greater number of trees helps ensure continuation of the benefits of the existing forest in Kellogg.

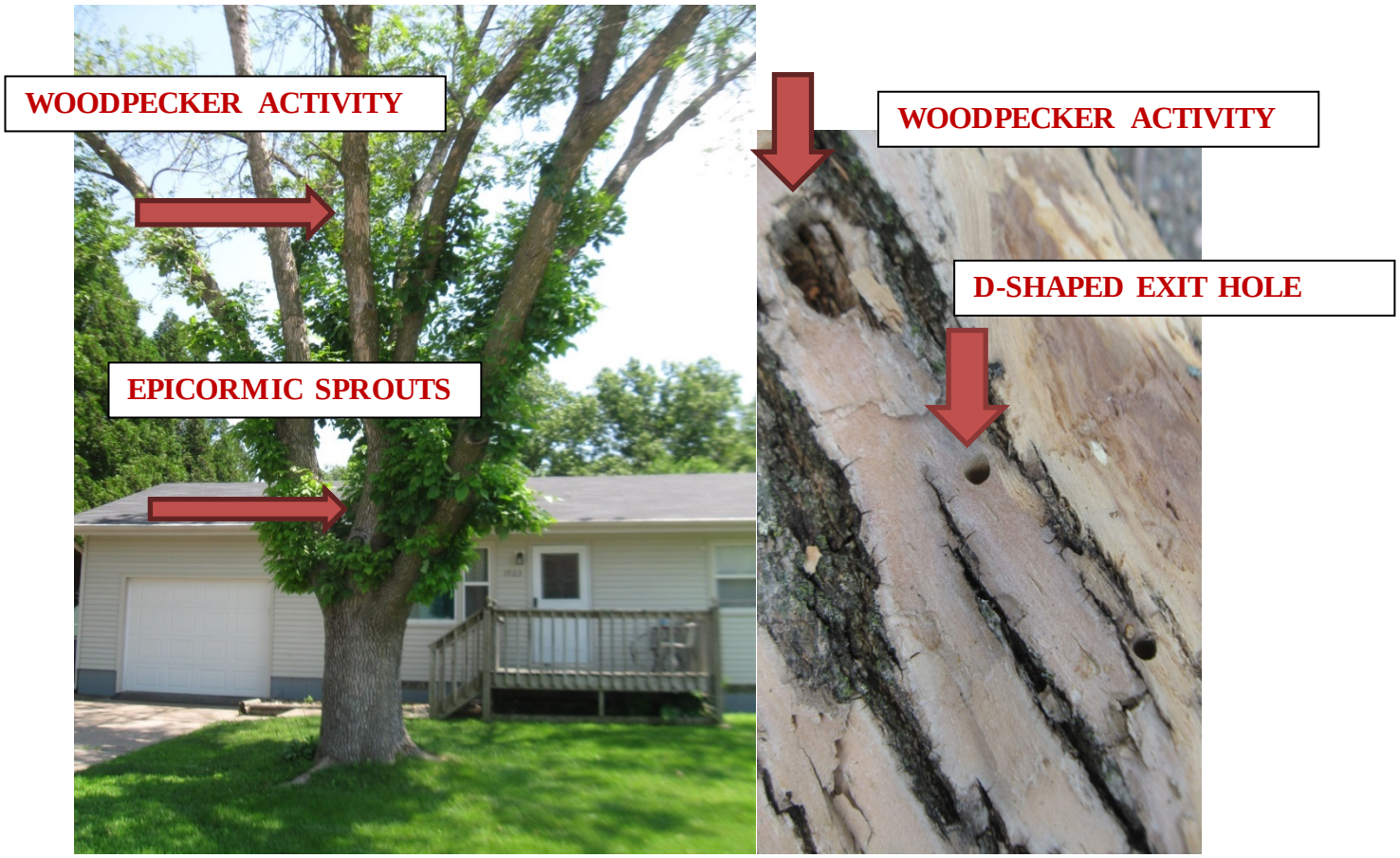
It is important to plant a diverse mix of species in the urban forest to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 10% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 5-10% of the total urban forest. Presently, the forest is heavily planted with maple (30%) (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. All trees planted must meet the restrictions in city ordinance 150.02 (Appendix C).

Continual Monitoring For EAB

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 (See examples below). Once EAB arrives in Kellogg, it could potentially kill all ash within 4 to 10 years of its arrival.



EAB infested tree in Muscatine with top thinning and many new green epicormic sprouts



EAB infested tree in Muscatine with sprouting, wood pecker activity, and D-shaped exit holes

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.

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? The entire state of Iowa is under quarantine, so regulated articles may not be moved into non-quarantined states. For more information, please visit http://www.emeraldashborer.info/.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 150.02 (Appendix C). 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. City Code 150.05 states "Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance. A property owner is responsible for the removal of any dead or otherwise dangerous trees, shrubs or branches which are on said owner's property. The property owner is liable for all damages to any person or property resulting from the removal of shrubs, trees or branches from the property owner's property. Without in any way limiting the liability of such owner, this liability shall specifically include damages to public sidewalks, curbing, pavement and public utility equipment. The failure to remove any tree or branch by the owner for the period of fourteen (14) days after either written or oral notice from the Mayor shall result in the tree or branch being regarded as a nuisance and the same shall be abated accordingly.".

Six Year Maintenance Plan and Cost Estimates

Year 1 (FY 2016)

Remove 2 critical concern trees that need immediate attention	$1,800
Remove 1 tree (marked for removal)	$900
Plant and Maintain 10 trees in open locations (pursue grants)	$1,000
Ash tree treatment (if elected), 7 trees in good condition, average 24–30"	avg. $405/tree
-$15 per inch, treated every two years, see note	
*Or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

Year 2 (FY 2017)

Remove 2 trees (marked for removal)	$1,800
Plant and Maintain 10 trees in open locations (pursue grants)	$1,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
Visual Survey for signs and symptoms of EAB	

Year 3 (FY 2018)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

Year 4 (FY 2019)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
Visual Survey for signs and symptoms of EAB	

Year 5 (FY 2020)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

Year 6 (FY 2021)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
Visual Survey for signs and symptoms of EAB	

*****Reduction of ash in poor health will reduce exposure to Emerald Ash Borer over time. EAB could potentially kill all ash within 4-15 years of its arrival.
******Assuming a cost of $900 per tree for removal, the budget would need to be increased to $2,550 a year to remove all ash trees within 6 years.
*******Suggest a future (post ash removal and replacement) budget of at least $2 per capita (population 599). Currently, this amount would cover about 47% of what would be needed to remove EAB infested trees over a six year period. Suggest setting aside additional funds to prepare for the expected arrival of EAB. Planting would be at least partially dependent on receiving grant funds annually.

Proposed Budget Increase

EAB could potentially kill all ash trees in Kellogg within 4-15 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $2,550 a year. If the budget were increased to $1,200 a year all ash could be removed within 13 years. Additionally, it is recommended that Kellogg 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 an example, if the average ash diameter is 20 inches and treatment costs $15 per inch, then treating 10 trees would cost about $3,000 (every other year treatment). This would be 10 trees selected for treatment, and Kellogg would still need to find $900 per tree for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $4,500 every two years for treatment and leave five less trees for removal (for at least two more years). 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 Kellogg. 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

Annual Energy Benefits of Public Trees

1/15/2016

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	9.3	707	1,310.4	1,284	1,991	(N/A)	26.3	28.0	64.22
Silver maple	7.7	583	1,024.7	1,004	1,587	(N/A)	18.6	22.3	72.13
Green ash	4.8	365	675.3	662	1,027	(N/A)	13.6	14.4	64.19
Spruce	0.9	69	121.1	119	188	(N/A)	6.8	2.6	23.48
Sugar maple	2.8	211	369.8	362	573	(N/A)	6.8	8.0	71.62
Honeylocust	1.7	128	217.9	214	341	(N/A)	4.2	4.8	68.28
Northern hackberry	1.5	116	220.6	216	333	(N/A)	3.4	4.7	83.15
Siberian elm	0.6	48	85.6	84	132	(N/A)	2.5	1.9	44.01
Eastern red cedar	0.3	21	40.8	40	61	(N/A)	2.5	0.9	20.20
Red maple	0.2	17	33.0	32	49	(N/A)	1.7	0.7	24.58
American sycamore	0.9	66	118.0	116	182	(N/A)	1.7	2.6	91.02
Mulberry	0.3	20	37.5	37	56	(N/A)	1.7	0.8	28.16
Norway maple	0.4	32	64.3	63	95	(N/A)	1.7	1.3	47.66
Eastern white pine	0.1	10	14.6	14	24	(N/A)	0.8	0.3	24.14
Littleleaf linden	0.2	17	33.8	33	50	(N/A)	0.8	0.7	50.34
Pear	0.1	6	12.8	13	18	(N/A)	0.8	0.3	18.19
Boxelder	0.3	22	40.7	40	62	(N/A)	0.8	0.9	62.01
Broadleaf Deciduous Mediu	0.1	8	16.9	17	24	(N/A)	0.8	0.3	24.47
Eastern cottonwood	0.4	33	59.0	58	91	(N/A)	0.8	1.3	91.02
Pin oak	0.3	21	38.4	38	58	(N/A)	0.8	0.8	58.37
Elm	0.4	33	59.0	58	91	(N/A)	0.8	1.3	91.02
White ash	0.3	20	28.4	28	48	(N/A)	0.8	0.7	48.12
Northern red oak	0.2	15	23.3	23	38	(N/A)	0.8	0.5	37.72
Total	33.8	2,568	4,645.9	4,553	7,121	(N/A)	100.0	100.0	60.34

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

1/15/2016

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	103,020	2,792	(N/A)	26.3	24.2	90.06
Silver maple	116,317	3,152	(N/A)	18.6	27.3	143.28
Green ash	57,230	1,551	(N/A)	13.6	13.4	96.93
Spruce	16,660	451	(N/A)	6.8	3.9	56.43
Sugar maple	37,361	1,012	(N/A)	6.8	8.8	126.56
Honeylocust	18,516	502	(N/A)	4.2	4.3	100.36
Northern hackberry	16,020	434	(N/A)	3.4	3.8	108.54
Siberian elm	7,145	194	(N/A)	2.5	1.7	64.54
Eastern red cedar	3,928	106	(N/A)	2.5	0.9	35.49
Red maple	1,251	34	(N/A)	1.7	0.3	16.95
American sycamore	14,478	392	(N/A)	1.7	3.4	196.17
Mulberry	931	25	(N/A)	1.7	0.2	12.62
Norway maple	4,350	118	(N/A)	1.7	1.0	58.95
Eastern white pine	1,539	42	(N/A)	0.8	0.4	41.70
Littleleaf linden	2,366	64	(N/A)	0.8	0.6	64.13
Pear	264	7	(N/A)	0.8	0.1	7.17
Boxelder	4,024	109	(N/A)	0.8	0.9	109.04
Broadleaf Deciduous Medium	586	16	(N/A)	0.8	0.1	15.88
Eastern cottonwood	7,239	196	(N/A)	0.8	1.7	196.17
Pin oak	2,397	65	(N/A)	0.8	0.6	64.95
Elm	7,239	196	(N/A)	0.8	1.7	196.17
White ash	1,663	45	(N/A)	0.8	0.4	45.05
Northern red oak	1,193	32	(N/A)	0.8	0.3	32.34
Citywide total	425,716	11,537	(N/A)	100.0	100.0	97.77

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

1/15/2016

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								
Black walnut	12.3	2.0	5.9	0.6	65	44.8	6.5	6.2	42.2	278	0.0	0	120.3	344	(N/A)	26.3	11.08
Silver maple	21.4	3.6	10.4	0.9	115	36.3	5.3	5.1	34.7	227	-11.3	-42	106.5	300	(N/A)	18.6	13.63
Green ash	7.3	1.2	3.4	0.3	38	23.1	3.4	3.2	21.8	144	0.0	0	63.6	182	(N/A)	13.6	11.39
Spruce	1.9	0.4	1.6	0.2	13	4.3	0.6	0.6	4.1	27	-8.6	-32	5.2	7	(N/A)	6.8	0.93
Sugar maple	5.4	0.9	2.6	0.2	29	13.1	1.9	1.8	12.6	82	-4.2	-16	34.4	95	(N/A)	6.8	11.93
Honeylocust	3.6	0.6	1.6	0.2	19	7.9	1.2	1.1	7.6	50	-2.8	-11	21.0	58	(N/A)	4.2	11.63
Northern hackberry	2.6	0.4	1.3	0.1	14	7.4	1.1	1.0	7.0	46	0.0	0	20.9	60	(N/A)	3.4	15.04
Siberian elm	1.3	0.2	0.6	0.1	7	3.0	0.4	0.4	2.9	19	0.0	0	8.9	26	(N/A)	2.5	8.53
Eastern red cedar	0.7	0.1	0.6	0.1	5	1.3	0.2	0.2	1.2	8	-2.2	-8	2.4	5	(N/A)	2.5	1.66
Red maple	0.2	0.0	0.1	0.0	1	1.1	0.2	0.1	1.0	7	-0.1	0	2.6	7	(N/A)	1.7	3.64
American sycamore	2.3	0.4	1.0	0.1	12	4.2	0.6	0.6	4.0	26	0.0	0	13.1	38	(N/A)	1.7	19.04
Mulberry	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.2	9	(N/A)	1.7	4.55
Norway maple	0.9	0.2	0.5	0.0	5	2.1	0.3	0.3	1.9	13	-0.2	-1	6.0	17	(N/A)	1.7	8.52
Eastern white pine	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)	0.8	2.82
Littleleaf linden	0.4	0.1	0.2	0.0	2	1.1	0.2	0.2	1.0	7	-0.2	-1	2.9	8	(N/A)	0.8	8.23
Pear	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.8	2.55
Boxelder	0.6	0.1	0.3	0.0	3	1.4	0.2	0.2	1.3	9	-0.2	-1	3.9	11	(N/A)	0.8	11.20
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)	0.8	3.47
Eastern cottonwood	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)	0.8	19.04
Pin oak	0.3	0.1	0.2	0.0	2	1.3	0.2	0.2	1.2	8	-0.7	-3	2.9	8	(N/A)	0.8	7.54
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)	0.8	19.04
White ash	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.2	8	0.0	0	3.0	8	(N/A)	0.8	8.32
Northern red oak	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.3	-1	2.1	6	(N/A)	0.8	5.79
Citywide total	64.4	10.8	31.8	3.1	348	161.5	23.5	22.4	153.2	1,006	-31.1	-117	439.5	1,237	(N/A)	100.0	10.48

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

1/15/2016

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	392,528	2,944	(N/A)	26.3	23.6	94.97
Silver maple	511,725	3,838	(N/A)	18.6	30.7	174.45
Green ash	233,983	1,755	(N/A)	13.6	14.1	109.68
Spruce	21,215	159	(N/A)	6.8	1.3	19.89
Sugar maple	157,082	1,178	(N/A)	6.8	9.4	147.26
Honeylocust	46,514	349	(N/A)	4.2	2.8	69.77
Northern hackberry	39,204	294	(N/A)	3.4	2.4	73.51
Siberian elm	31,169	234	(N/A)	2.5	1.9	77.92
Eastern red cedar	2,481	19	(N/A)	2.5	0.1	6.20
Red maple	2,201	17	(N/A)	1.7	0.1	8.26
American sycamore	78,517	589	(N/A)	1.7	4.7	294.44
Mulberry	3,945	30	(N/A)	1.7	0.2	14.79
Norway maple	15,381	115	(N/A)	1.7	0.9	57.68
Eastern white pine	1,170	9	(N/A)	0.8	0.1	8.78
Littleleaf linden	8,218	62	(N/A)	0.8	0.5	61.63
Pear	908	7	(N/A)	0.8	0.1	6.81
Boxelder	22,806	171	(N/A)	0.8	1.4	171.04
Broadleaf Deciduous	1,101	8	(N/A)	0.8	0.1	8.26
Eastern cottonwood	39,259	294	(N/A)	0.8	2.4	294.44
Pin oak	8,218	62	(N/A)	0.8	0.5	61.63
Elm	39,259	294	(N/A)	0.8	2.4	294.44
White ash	3,672	28	(N/A)	0.8	0.2	27.54
Northern red oak	3,595	27	(N/A)	0.8	0.2	26.96
Citywide total	1,664,151	12,481	(N/A)	100.0	100.0	105.77

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

1/15/2016

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
Black walnut	23,365	175	-1,884	-97	-15	15,618	117	37,001	278 (N/A)	26.3	25.4	8.95
Silver maple	35,234	264	-2,456	-89	-19	12,876	97	45,565	342 (N/A)	18.6	31.2	15.53
Green ash	12,113	91	-1,123	-51	-9	8,072	61	19,011	143 (N/A)	13.6	13.0	8.91
Spruce	1,054	8	-102	-17	-1	1,528	11	2,463	18 (N/A)	6.8	1.7	2.31
Sugar maple	7,094	53	-754	-31	-6	4,653	35	10,961	82 (N/A)	6.8	7.5	10.28
Honeylocust	5,868	44	-223	-13	-2	2,825	21	8,457	63 (N/A)	4.2	5.8	12.69
Northern hackberry	2,086	16	-188	-15	-2	2,573	19	4,457	33 (N/A)	3.4	3.1	8.36
Siberian elm	1,233	9	-150	-7	-1	1,065	8	2,141	16 (N/A)	2.5	1.5	5.35
Eastern red cedar	126	1	-12	-5	0	456	3	564	4 (N/A)	2.5	0.4	1.41
Red maple	331	2	-11	-2	0	371	3	689	5 (N/A)	1.7	0.5	2.58
American sycamore	1,824	14	-377	-10	-3	1,469	11	2,906	22 (N/A)	1.7	2.0	10.90
Mulberry	382	3	-19	-3	0	433	3	792	6 (N/A)	1.7	0.5	2.97
Norway maple	594	4	-74	-5	-1	714	5	1,230	9 (N/A)	1.7	0.8	4.61
Eastern white pine	116	1	-6	-2	0	216	2	324	2 (N/A)	0.8	0.2	2.43
Littleleaf linden	789	6	-39	-3	0	380	3	1,127	8 (N/A)	0.8	0.8	8.45
Pear	114	1	-4	-1	0	124	1	232	2 (N/A)	0.8	0.2	1.74
Boxelder	1,454	11	-109	-4	-1	490	4	1,830	14 (N/A)	0.8	1.3	13.73
Broadleaf Deciduous Medi	224	2	-5	-1	0	176	1	393	3 (N/A)	0.8	0.3	2.95
Eastern cottonwood	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	0.8	1.0	10.90
Pin oak	880	7	-39	-3	0	458	3	1,296	10 (N/A)	0.8	0.9	9.72
Elm	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	0.8	1.0	10.90
White ash	494	4	-18	-2	0	449	3	923	7 (N/A)	0.8	0.6	6.92
Northern red oak	281	2	-17	-2	0	329	2	591	4 (N/A)	0.8	0.4	4.43
Citywide total	97,479	731	-7,988	-374	-63	56,743	426	145,860	1,094 (N/A)	100.0	100.0	9.27

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

1/15/2016

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	1,889	(N/A)	26.3	21.0	60.94
Silver maple	2,618	(N/A)	18.6	29.1	119.01
Green ash	951	(N/A)	13.6	10.6	59.42
Spruce	202	(N/A)	6.8	2.2	25.24
Sugar maple	697	(N/A)	6.8	7.7	87.11
Honeylocust	1,464	(N/A)	4.2	16.3	292.80
Northern hackberry	261	(N/A)	3.4	2.9	65.29
Siberian elm	98	(N/A)	2.5	1.1	32.54
Eastern red cedar	49	(N/A)	2.5	0.5	16.24
Red maple	60	(N/A)	1.7	0.7	29.84
American sycamore	117	(N/A)	1.7	1.3	58.34
Mulberry	22	(N/A)	1.7	0.2	10.94
Norway maple	58	(N/A)	1.7	0.6	28.84
Eastern white pine	32	(N/A)	0.8	0.4	32.32
Littleleaf linden	81	(N/A)	0.8	0.9	81.48
Pear	6	(N/A)	0.8	0.1	6.40
Boxelder	79	(N/A)	0.8	0.9	78.52
Broadleaf Deciduous Medium	26	(N/A)	0.8	0.3	26.22
Eastern cottonwood	58	(N/A)	0.8	0.6	58.34
Pin oak	83	(N/A)	0.8	0.9	83.10
Elm	58	(N/A)	0.8	0.6	58.34
White ash	64	(N/A)	0.8	0.7	63.74
Northern red oak	24	(N/A)	0.8	0.3	24.08
Citywide total	8,997	(N/A)	100.0	100.0	76.24

Table 7: Summary of Benefits in Dollars

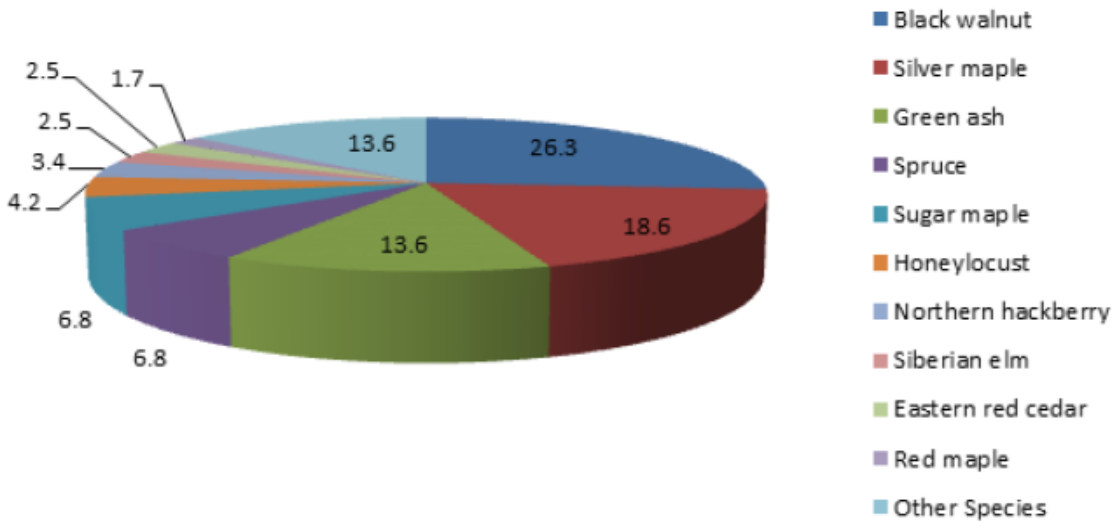
Total Annual Benefits of Public Trees by Species ($)

1/15/2016

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Black walnut	1,991	278	344	2,792	1,889	7,293	(N/A)	24.3
Silver maple	1,587	342	300	3,152	2,618	7,999	(N/A)	26.7
Green ash	1,027	143	182	1,551	951	3,854	(N/A)	12.9
Spruce	188	18	7	451	202	867	(N/A)	2.9
Sugar maple	573	82	95	1,012	697	2,460	(N/A)	8.2
Honeylocust	341	63	58	502	1,464	2,429	(N/A)	8.1
Northern hackberry	333	33	60	434	261	1,121	(N/A)	3.7
Siberian elm	132	16	26	194	98	465	(N/A)	1.6
Eastern red cedar	61	4	5	106	49	225	(N/A)	0.8
Red maple	49	5	7	34	60	155	(N/A)	0.5
American sycamore	182	22	38	392	117	751	(N/A)	2.5
Mulberry	56	6	9	25	22	118	(N/A)	0.4
Norway maple	95	9	17	118	58	297	(N/A)	1.0
Eastern white pine	24	2	3	42	32	103	(N/A)	0.3
Littleleaf linden	50	8	8	64	81	213	(N/A)	0.7
Pear	18	2	3	7	6	36	(N/A)	0.1
Boxelder	62	14	11	109	79	274	(N/A)	0.9
Broadleaf Deciduous M	24	3	3	16	26	73	(N/A)	0.2
Eastern cottonwood	91	11	19	196	58	375	(N/A)	1.3
Pin oak	58	10	8	65	83	224	(N/A)	0.7
Elm	91	11	19	196	58	375	(N/A)	1.3
White ash	48	7	8	45	64	172	(N/A)	0.6
Northern red oak	38	4	6	32	24	104	(N/A)	0.3
Citywide Total	7,121	1,094	1,237	11,537	8,997	29,985	(N/A)	100.0

Species Distribution of Public Trees

1/15/2016

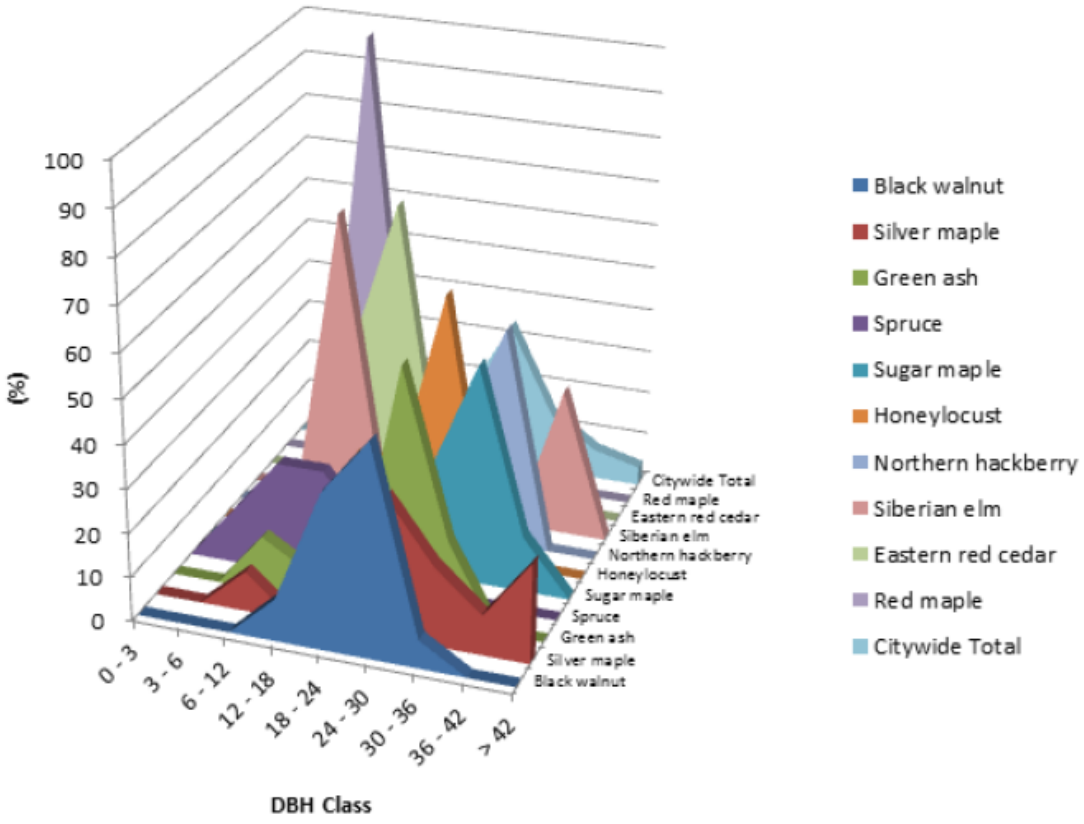


Species	Percent
Black walnut	26.3
Silver maple	18.6
Green ash	13.6
Spruce	6.8
Sugar maple	6.8
Honeylocust	4.2
Northern hackberry	3.4
Siberian elm	2.5
Eastern red cedar	2.5
Red maple	1.7
Other Species	13.6
Total	100.0

Figure 1: Species Distribution

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

1/15/2016



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Black walnut	0.00	0.00	0.00	9.68	35.48	48.39	6.45	0.00	0.00
Silver maple	0.00	0.00	9.09	0.00	9.09	31.82	18.18	9.09	22.73
Green ash	0.00	0.00	12.50	6.25	6.25	56.25	18.75	0.00	0.00
Spruce	0.00	12.50	25.00	25.00	12.50	25.00	0.00	0.00	0.00
Sugar maple	0.00	0.00	0.00	12.50	0.00	25.00	50.00	12.50	0.00
Honeylocust	0.00	0.00	0.00	20.00	20.00	60.00	0.00	0.00	0.00
Northern hackberry	0.00	0.00	0.00	0.00	25.00	25.00	50.00	0.00	0.00
Siberian elm	0.00	0.00	66.67	0.00	0.00	0.00	0.00	33.33	0.00
Eastern red cedar	0.00	0.00	33.33	66.67	0.00	0.00	0.00	0.00	0.00
Red maple	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	0.00	0.85	12.71	11.86	16.10	33.90	13.56	6.78	4.24

Figure 2: Relative Age Class

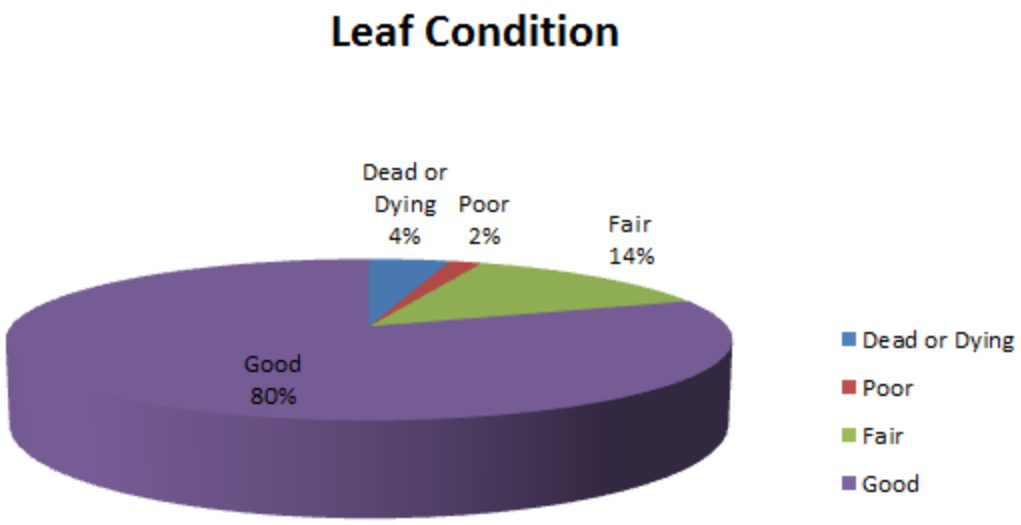


Figure 3: Foliage Condition

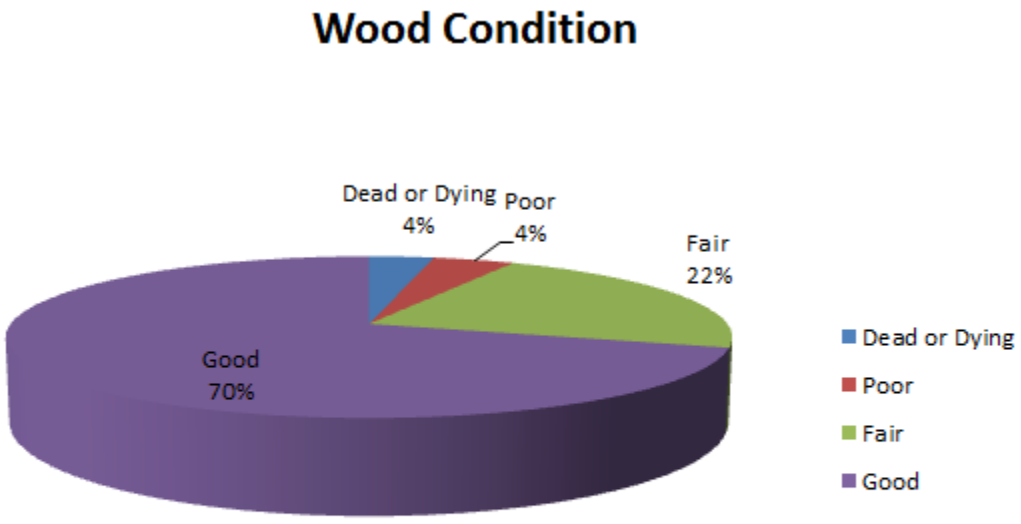
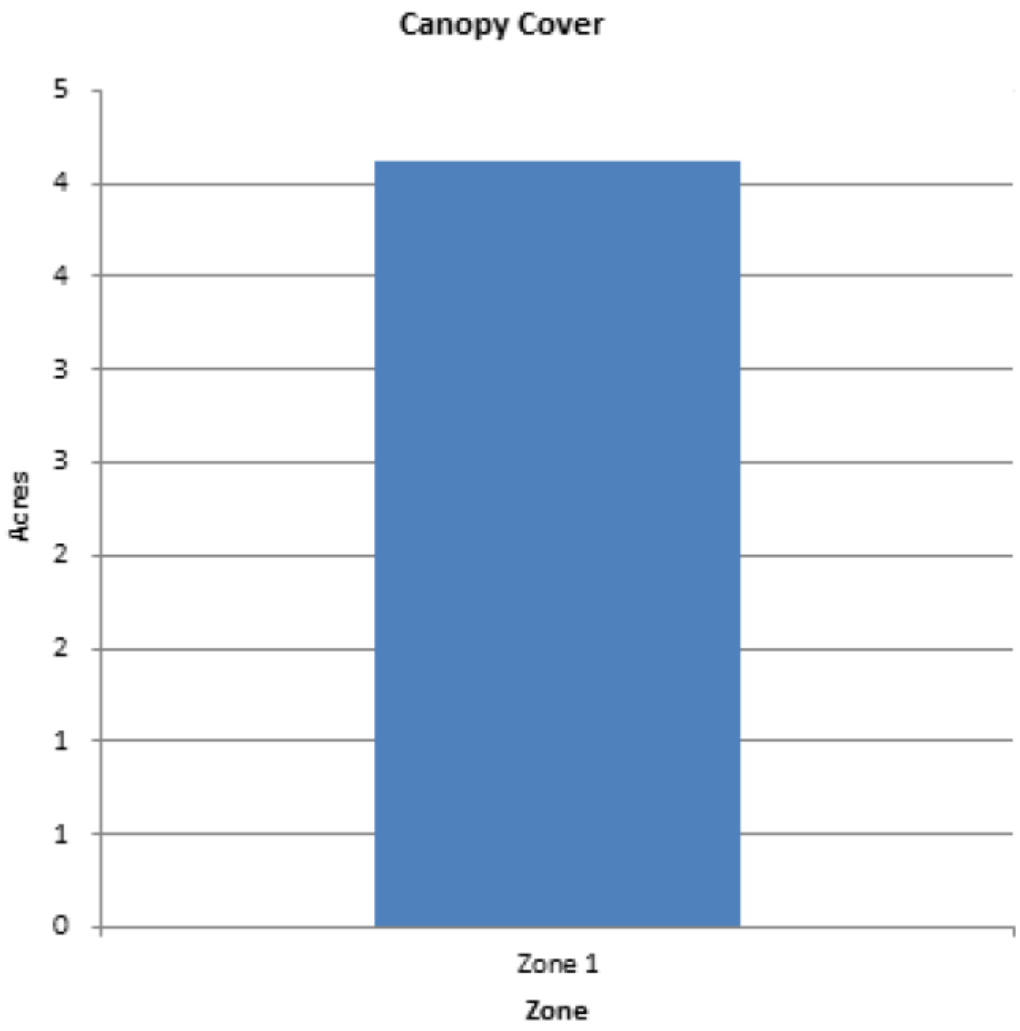


Figure 4: Wood Condition

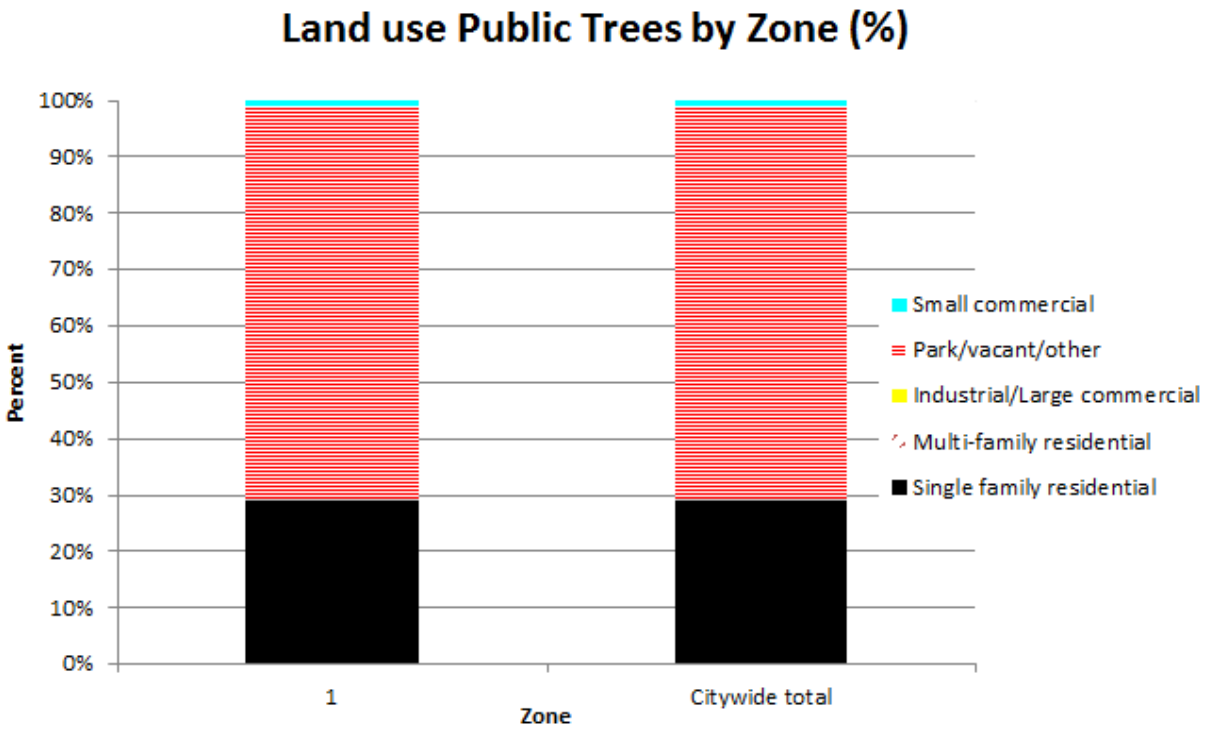
Canopy Cover of Public Trees (Acres)

1/15/2016



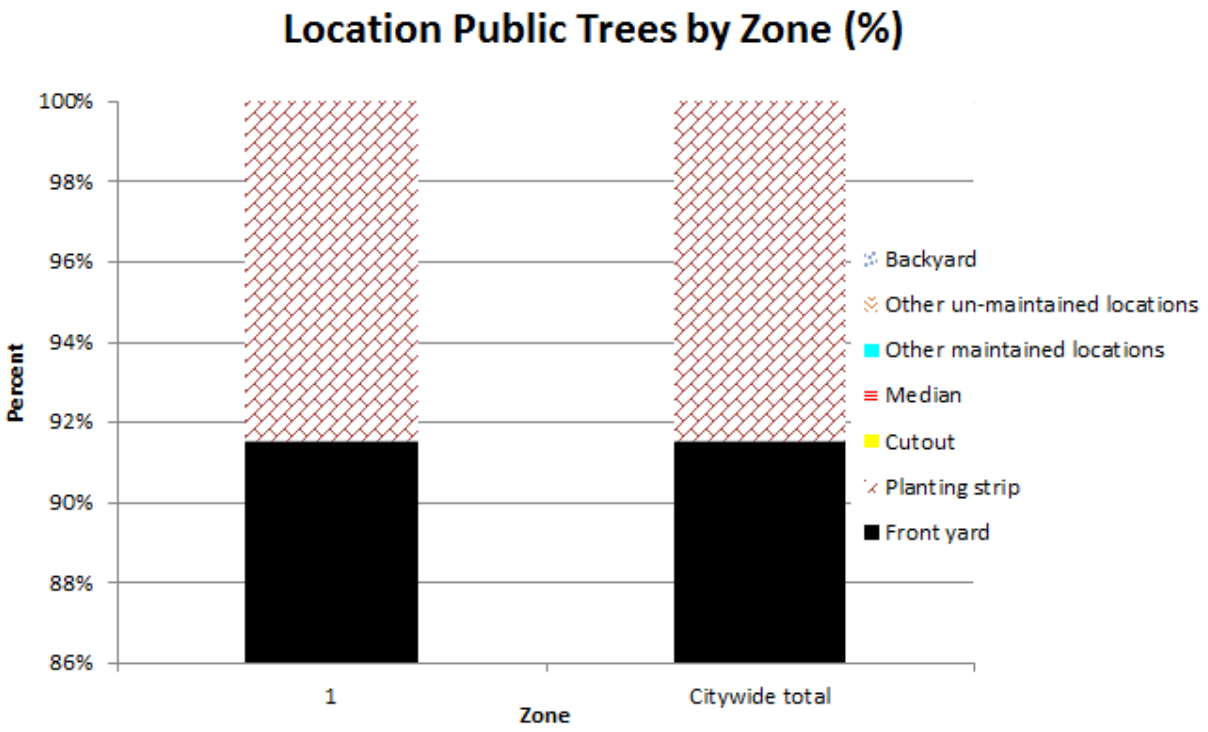
Zone	Acres	% of Total Canopy Cover
Zone 1	4	100.0
Citywide total	4	100.0

Figure 5: Canopy Cover in Acres



Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant /other	Small commercial
1	28.81	0.00	0.00	70.34	0.85
Citywide total	28.81	0.00	0.00	70.34	0.85

Figure 6: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	91.53	8.47	0.00	0.00	0.00	0.00	0.00
Citywide total	91.53	8.47	0.00	0.00	0.00	0.00	0.00

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

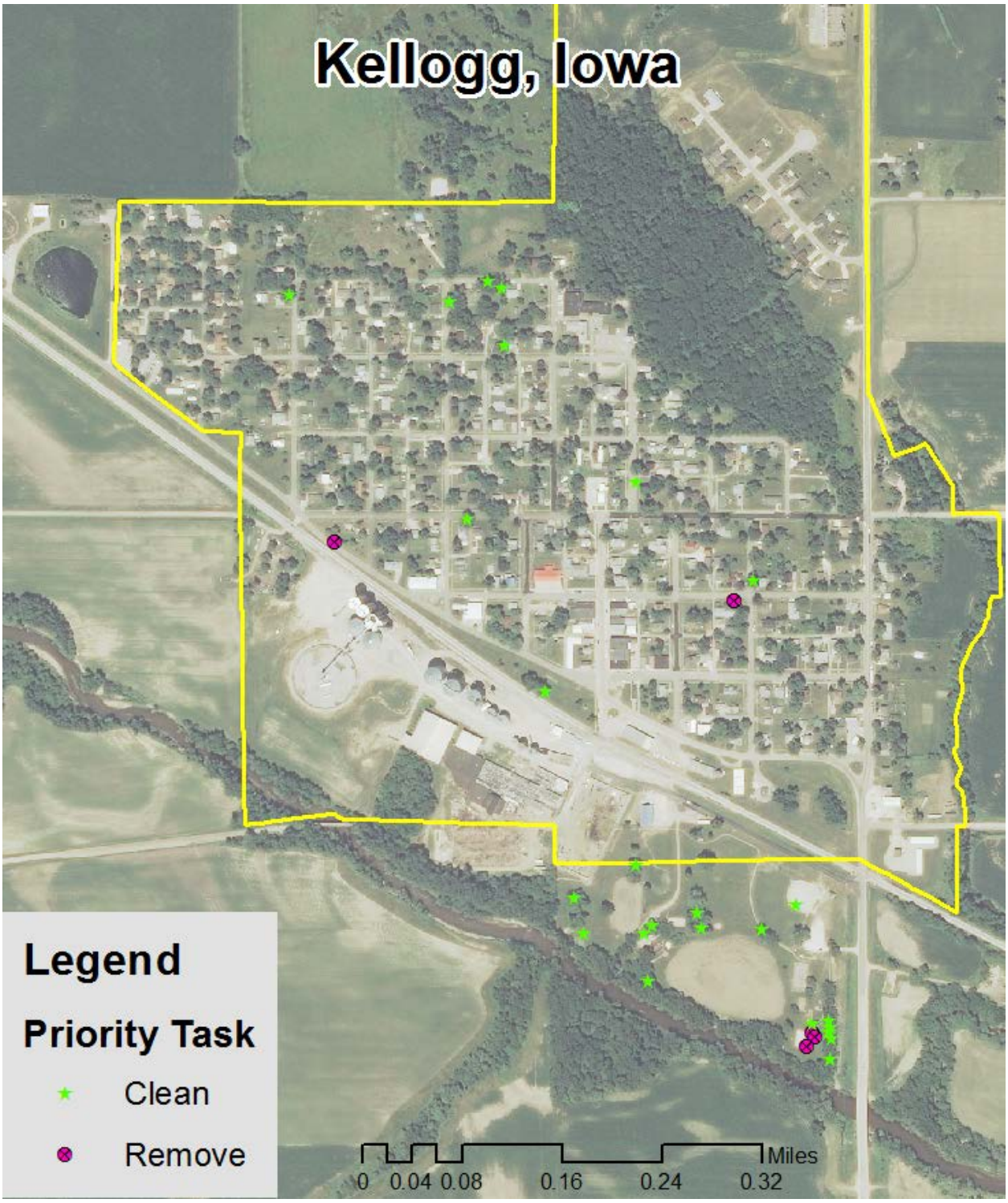


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: Kellogg Tree Ordinances

CHAPTER 150

TREES

150.01 DEFINITION. For use in this chapter, "parking" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

150.02 PLANTING RESTRICTIONS. No tree shall be planted in any parking or street.

150.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

(Code of Iowa, Sec. 364.12[2c, d & e])

150.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 150.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

150.05 DEAD AND DANGEROUS TREES. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance. A property owner is responsible for the removal of any dead or otherwise dangerous trees, shrubs or branches which are on said owner's property. The property owner is liable for all damages to any person or property resulting from the removal of shrubs, trees or branches from the property owner's property. Without in any way limiting the liability of such owner, this liability shall specifically include damages to public sidewalks, curbing, pavement and public utility equipment. The failure to remove any tree or branch by the owner for the period of fourteen (14) days after either written or oral notice from the Mayor shall result in the tree or branch being regarded as a nuisance and the same shall be abated accordingly.

150.06 PERMIT REQUIRED. A property owner wanting to cut down or otherwise remove a tree or branch of a tree located in the publicly owned property or right-of-way abutting the owner's property where there is a possibility the cutting of such tree or branch will fall on a sidewalk, alley, street or any other public right-of-way shall first obtain a permit from the Mayor.

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.