

2014 Urban Forest Management Plan

Luana, Iowa

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3
Table of Contents

Executive Summary	4
Overview	4
Inventory and Results	4
Recommendations	4
Inventory Results	5
Annual Benefits	5
Annual Energy Benefits	5
Annual Stormwater Benefits	5
Annual Air Quality Benefits.....	5
Annual Carbon Benefits.....	5
Annual Aesthetics Benefits.....	5
Financial Summary of all Benefits.....	5
Forest Structure	6
Species Distribution	7
Age Class	7
Condition: Wood and Foliage.....	7
Management Needs.....	8
Canopy Cover	8
Land Use and Location.....	8
Recommendations	8
Risk Management	8
Pruning Cycle	9
Planting	9
Continual Monitoring	9
Proposed Six Year Maintenance Plan	10
Emerald Ash Borer	11
Ash Tree Removal	11
EAB Quarantines	11
Wood Disposal	11
Canopy Replacement	11
Postponed Work	11
Monitoring.....	12
Private Ash Trees	12
Budget	12
Works Cited	13
Appendix A: i-Tree Data	14
Appendix B: ArcGIS Mapping	20
Appendix C: Suitable Shade Tree Lists	24

Community Tree Inventory

Luana, Iowa

Summary

This plan was developed to assist the City of Luana with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows communities 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 (does not include mountain ash). There is a strong possibility that 8.7% of Luana's city owned trees (ash) will die once EAB becomes established in the community. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory & Results

In 2014, a tree inventory was conducted using Global Positioning System (GPS) data collectors. --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. The inventory was a complete inventory of street and park trees. Below are some key findings of the **46 trees inventoried**.

Inventory Overview

- ◆ Luana's trees provide \$9,324.64 of benefits annually, an average of \$203 a tree
- ◆ There are over 11 species of trees
- ◆ The top three genus are: Maple 69.6%, Ash 8.7%, Apple 6.5%
- ◆ 52.17% of trees are in need of some type of management
- ◆ 5 trees are recommended for removal.

General Recommendations

The following are key recommendations from the inventory:

- ◆ Of the 5 trees needing removal, all 5 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*
- ◆ After the removal of the 5 critical concern trees, ash trees should be assessed for removal.
- ◆ The 4 ash trees should be re-evaluated annually for signs and symptoms associated with EAB.
- ◆ All trees should be pruned on a routine schedule - one third of the city every other year.
- ◆ Plant a diverse mix of trees that does NOT include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.
- ◆ Check ash trees with a visual survey yearly

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.

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 of 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.

Detailed Inventory Results

The data collected for the 46 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

1. Annual Energy Benefits: Trees conserve energy by shading buildings and blocking winds. Luana's trees reduce energy related costs by approximately \$2,427.94 annually. These savings are both in Electricity (11.52 MWh) and in Natural Gas (1,585.01 Therms).

2. Annual Stormwater Benefits: Luana's trees intercept about 132,915.87 gallons of rainfall or snowmelt a year. This interception provides \$3,602.02 of benefits to the city.

3. 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 Luana, it is estimated that trees remove 149.95 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$421.84.

4. Annual Carbon Benefits: Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Luana trees sequester about 43,894.68 lbs of carbon dioxide (CO₂) a year with an associated value of \$329.21. In addition, the trees store 519,347.50 lbs of carbon, with a yearly benefit of \$3,895.11.

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. Luana receives \$2,543.63 in annual social benefits from trees.

Financial Summary of all Benefits: According to the USDA Forest Service i-Tree STRATUM analysis, Luana's trees provide **\$9,324.64 of benefits annually**. Benefits of individual trees vary based on size, species, health and location, but **on average each of the 85 trees in Luana provide approximately \$203 annually**.

Table 1: Annual Benefits of Public Trees

Benefits	Per Tree	Cumulative
Energy	\$52.78	\$2,427.94
CO ₂	\$7.16	\$329.21
Air Quality	\$9.17	\$421.84
Stormwater	\$78.30	\$3,602.02
Aesthetic/Other	\$55.30	\$9,324.64
Total (\$)	\$202.71	\$9,324.64

Community Tree Inventory

Luana, Iowa

Forest Structure

1. Species & Genus Distribution: Luana has over 11 different tree species along city streets and parks. The following figures and tables show the distribution of the trees by genus and the most common species. 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, and it is recommended that they should not be planted until this percentage can be lowered.

Figure 1: Common Tree Genus by Percentage

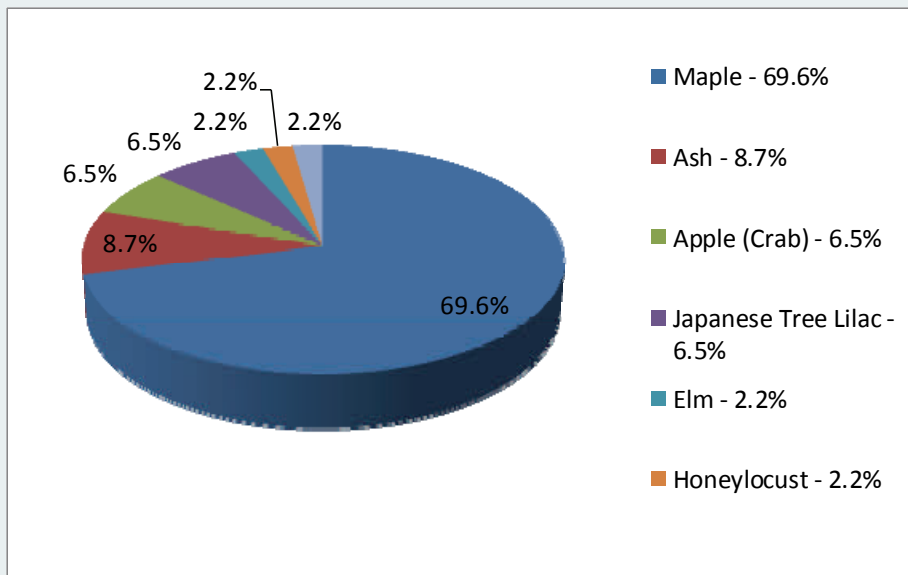
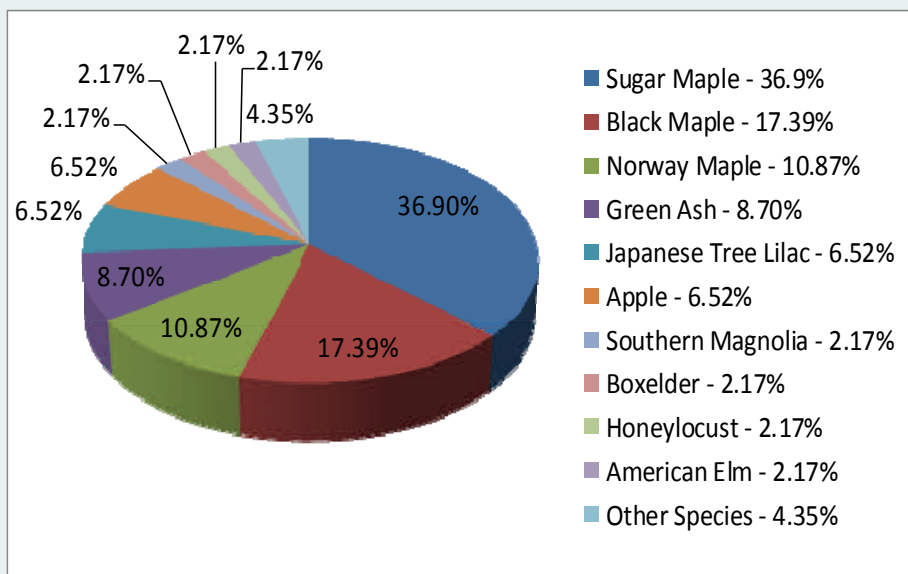


Table 2: Tree Genus

Genus	No. of Trees
Maple	32
Ash	4
Apple (Crab)	3
Japanese Tree Lilac	3
Elm	1
Honeylocust	1
Magnolia	1

Figure 2: Common Tree Species by Percentage



2. Age Class: Luana has a good balance of age classes. 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. Luana's size curve is on the smaller side, indicating a younger than average stand. However, the most abundant genus, maple is older than average.

Figure 3: Age Distribution of Top 10 Public Tree Species (by Percentage)

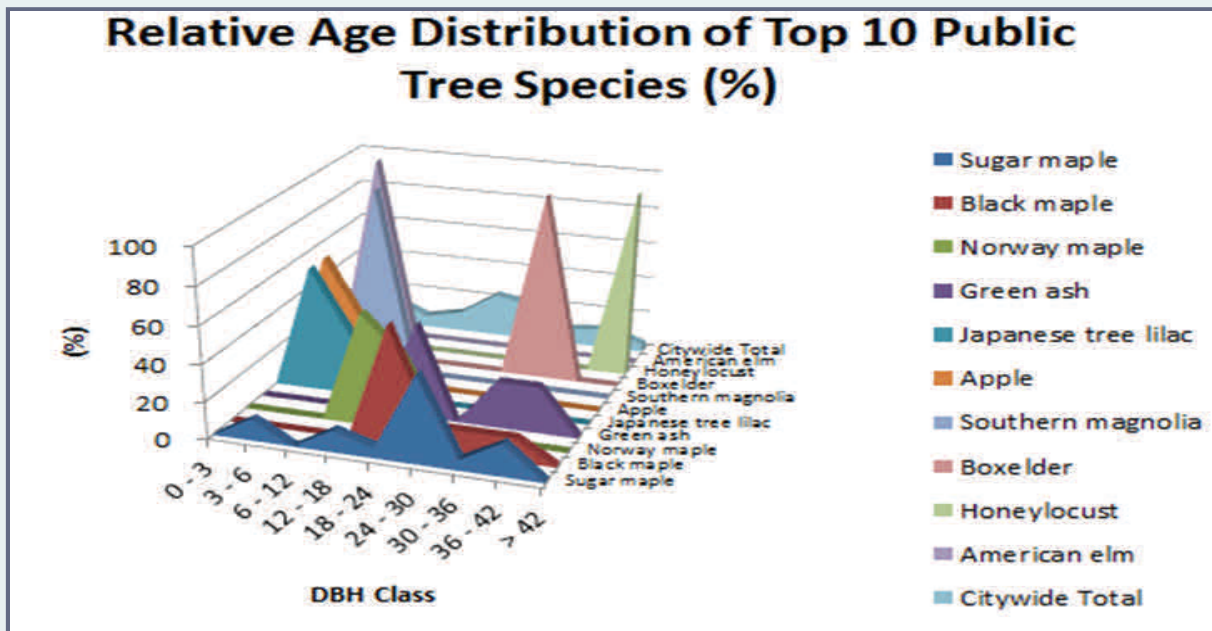


Table 3: Relative Age Distribution

Species	DBH class (in)								
	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Sugar maple	0.00	11.76	0.00	11.76	5.88	47.06	5.88	17.65	0.00
Black maple	0.00	0.00	0.00	0.00	62.50	12.50	12.50	12.50	0.00
Norway maple	0.00	0.00	0.00	60.00	40.00	0.00	0.00	0.00	0.00
Green ash	0.00	0.00	0.00	0.00	50.00	0.00	25.00	25.00	0.00
Japanese tree lilac	0.00	66.67	33.33	0.00	0.00	0.00	0.00	0.00	0.00
Apple	0.00	66.67	33.33	0.00	0.00	0.00	0.00	0.00	0.00
Southern magnolia	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Boxelder	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00
Honeylocust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
American elm	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	0.00	15.22	6.52	10.87	23.91	19.57	8.70	10.87	4.35

3. 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 Luana indicate that 100% of the trees are in fair-good health, with only none of the foliage in poor health, dead or dying. Similarly, 73.9% of Luana's trees are in fair-good health for wood condition. Wood condition that is in poor health, dead or dying is about 26.1% of the population. This 26.1% is an estimate of trees that need management follow up soon.

Community Tree Inventory

Luana, Iowa

4. Management Needs: The following management needs for Luana’s urban trees are outlined in Table 4. The table outlines the specific management needs of the street and park trees by number of trees and percent of the canopy.

- ◆ 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.
- ◆ Tree staking includes staking, training, mulching, etc.

Table 4: Management Needs

Technique	No of Trees	Percentage
Crown Cleaning	14	30.43%
Crown Raising	1	2.17%
Tree Staking	0	0%
Tree Removal	5	10.87%
Crown Reduction	4	8.7%

Table 5: Land Use

Single Family Residential	52.17%
Park/Vacant/Other	47.83%
Industrial/Large Commercial	0%
Small Commercial	0%
Multifamily Residential	0%

Table 6: Location Type

Planting Strip	54.35%
Other Maintained Location (Park)	41.30%
Front Yard	4.35%
Cutout (Surrounded by Pavement)	0%

5. Canopy Cover: Luana occupies 672 acres. The tree canopy cover of Luana is approximately 1.36 acres, about .20%.

6. Land Use and Location: The majority of Luana’s city and park trees are in planting strips in single family neighborhoods. Table 5 & Table 6 describe the land use and locations for the street and park trees.

Recommendations

1. 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.

2. Hazardous Trees: Luana has 5 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Image 4 & Image 5). It is recommended to start with the large diameter critical concern trees first. All 5 trees are 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.

3. Poor Tree Species: After the removal of the critical concern trees, ash trees should be assessed for removal (Appendix B, Image 3 & Appendix B, Image 4). There are a total of 4 ash trees that currently have no signs or symptoms that have been associated with EAB. *City ownership of the trees recommended for removal should be verified prior to any removal.

4. 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.

5. 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%. 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 Luana.

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 (69.6%). Maple 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 the city tree ordinance.

The importance of species diversity was brought to the forefront with the loss of the American elm from Dutch elm disease. When one genus (Maple) makes up a majority of the species (Norway Maple, Silver Maple, Sugar Maple) in a planting it is an unbalanced population. These unbalanced populations leave the population open to destruction from diseases and pests. Unfortunately, the lessons of the American elm are only recently being heeded. Communities typically replaced lost elms with a small but reliable selection of ash and Norway and silver maple. This left cities in the predicament they are finding themselves in now as they stand to lose a large percentage of their ash trees to the emerald ash borer.

6. Continual Monitoring: It is important to continuously check the health of all trees. Due to the imminent threat of Emerald Ash Borer to ash trees, it is recommended that 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. For a list of forest health threats, please visit the Iowa DNR's website at <http://www.iowadnr.gov/Environment/Forestry/ForestHealth>

Proposed Six Year Maintenance Plan

Year 1: Removal: 5 critical concern trees or saving for ash tree treatment

Planting and Replacement: 6 trees to be planted in open locations

Visual Survey for signs and symptoms of EAB

Year 2: Removal: 4 ash or saving for ash tree treatment

Planting and Replacement: 5 trees in open locations from year one removals

Routine pruning: 1/3 of trees (12)

Visual Survey for signs and symptoms of EAB

Year 3: Removal: any new critical concern trees or saving for ash tree treatment

Planting and Replacement: 5 trees to be planted in open locations

Year 4: Removal: any new critical concern trees or saving for ash tree treatment

Planting and Replacement: 5 trees in open locations

Routine pruning: 1/3 of trees (12)

Year 5: Removal: any new critical concern trees and/or 3 ash or saving for ash tree treatment

Planting and Replacement: 5 trees to be planted in open locations and locations from previous removals

Year 6: Removal: any new critical concern trees and/or 2 ash or saving for ash tree treatment

Planting and Replacement: 5 trees in open locations from previous removals

Routine pruning: 1/3 of trees (12)

Reduction of ash over 6 years: Four ash trees removed (100% of ash). EAB could potentially kill all ash within 4 years of its arrival.

Emerald Ash Borer Plan

1. Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first. Next will be all ash in poor condition and displaying signs and symptoms of EAB. ***City ownership of the tree recommended for removal should be verified prior to any removal.**

2. Treatment of Ash Trees

Chemical treatment can be effective, spreading 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/>

3. EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million 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.

4. 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.

5. Canopy Replacement

As budget permits, all removed ash trees will be replaced. All trees will meet the restrictions in the city ordinance. 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.

6. Postponed Work

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



Emerald Ash Borer Beetle next to D-shaped exit holes.

Community Tree Inventory

Luana, Iowa

7. Monitoring (repeated)

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 die-back, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

8. Private Ash Trees

It is strongly recommended that private property owners start removing ash trees or treating healthy trees they desire to preserve on their property upon arrival of EAB or confirmed within 15 miles. Refer to City Ordinance for more information.

Proposed Budget

Total \$11,220 over 6 years (\$1,870/year)

FY 2015 Budget

Removal @ \$700/tree: \$3,500 *Or saving for ash tree treatment

Planting @ \$100/tree: \$600

Watering & Maintenance @ \$50/tree: \$300

FY 2016 Budget

Removal: \$2,800 *Or saving for ash tree treatment

Planting: \$500

Watering & Maintenance: \$250

Routine Pruning: @ \$9/tree: \$110

FY 2017 Budget

Removal: \$0

Planting: \$500

Watering & Maintenance: \$250

FY 2018 Budget

Removal: \$0

Planting: \$500

Watering & Maintenance: \$250

Routine Pruning: \$110

FY 2019 Budget

Removal: \$0

Planting: \$500

Watering & Maintenance: \$250

FY 2020 Budget

Removal: \$0

Planting: \$500

Watering & Maintenance: \$250

Routine Pruning: \$110

*Reduction of ash over 6 years: 4 ash trees removed (100% of ash).

Proposed Budget Increase

EAB could potentially kill all ash trees in Luana within 4 years of its arrival. To remove all ash trees within 6 years the budget would average \$470 a year. Additionally, it is recommended that Luana 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	% of Total Trees	% of Total \$	Avg. \$/tree	
Sugar maple	4.97	376.87	666.88	653.55	1,030.42	36.96	42.44	60.61	
Black maple	2.27	172.66	319.20	312.81	485.47	17.39	20.00	60.68	
Norway maple	1.23	93.44	167.61	164.26	257.70	10.87	10.61	51.54	
Green ash	1.35	102.59	188.88	185.10	287.68	8.70	11.85	71.92	
Japanese tree lilac	0.12	8.98	20.42	20.02	29.00	6.52	1.19	9.67	
Apple	0.12	8.98	20.42	20.02	29.00	6.52	1.19	9.67	
Southern magnolia	0.08	6.37	12.70	12.44	18.82	2.17	0.78	18.82	
Boxelder	0.29	22.16	40.66	39.85	62.01	2.17	2.55	62.01	
Honeylocust	0.37	27.82	47.41	46.46	74.28	2.17	3.06	74.28	
American elm	0.02	1.40	1.94	1.90	3.29	2.17	0.14	3.29	
Silver maple	0.44	33.45	59.32	58.14	91.59	2.17	3.77	91.59	
Other city trees	0.26	19.91	39.57	38.78	58.69	2.17	2.42	58.69	
Total	11.52	874.63	1,585.01	1,553.31	2,427.94	100.00	100.00	52.78	

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species						
Species	Total Rainfall Interception (Gal)	Total (\$)	% of Total Trees	% of Total \$	Avg. \$/tree	
Sugar maple	62,425.84	1,691.74	36.96	46.97	99.51	
Black maple	22,935.84	621.56	17.39	17.26	77.70	
Norway maple	9,185.84	248.94	10.87	6.91	49.79	
Green ash	17,910.81	485.38	8.70	13.48	121.35	
Japanese tree lilac	401.81	10.89	6.52	0.30	3.63	
Apple	401.81	10.89	6.52	0.30	3.63	
Southern magnolia	676.81	18.34	2.17	0.51	18.34	
Boxelder	4,023.71	109.04	2.17	3.03	109.04	
Honeylocust	4,684.77	126.96	2.17	3.52	126.96	
American elm	97.61	2.65	2.17	0.07	2.65	
Silver maple	7,691.74	208.45	2.17	5.79	208.45	
Other City Trees	2,479.28	67.19	2.17	1.87	67.19	
Citywide total	132,915.87	3,602.02	100.00	100.00	78.30	

Table 3: Annual Air Quality Benefits & Table 4: Annual Carbon Sequestered

Annual Air Quality Benefits of Public Trees by Species																							
Species	Deposition O3		Deposition PM10		Deposition SO2		Total Deposition		Avoided NO2		Avoided VOC		Avoided SO2		Total Avoided		BVOC		% of Total		Avg. \$/tree		
	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)		(lb)	(lb)
Sugar maple	8.73	1.49	4.24	0.39	46.98	23.56	3.44	3.28	22.49	147.10	- 6.78	- 25.42	60.84	168.66	36.96	9.92							
Black maple	5.99	1.02	2.74	0.27	31.76	10.91	1.58	1.51	10.30	67.84	- 1.94	- 7.28	32.39	92.32	17.39	11.54							
Norway maple	1.64	0.28	0.83	0.07	8.93	5.88	0.86	0.82	5.59	36.65	- 0.40	- 1.51	15.57	44.07	10.87	8.81							
Green ash	2.48	0.40	1.14	0.11	13.10	6.49	0.94	0.90	6.13	40.33	0.00	0.00	18.59	53.43	8.70	13.36							
Japanese tree lilac	0.05	0.01	0.03	0.00	0.31	0.60	0.08	0.08	0.54	3.66	0.00	0.00	1.40	3.97	6.52	1.32							
Apple	0.05	0.01	0.03	0.00	0.31	0.60	0.08	0.08	0.54	3.66	0.00	0.00	1.40	3.97	6.52	1.32							
Southern magnolia	0.02	0.00	0.04	0.00	0.21	0.41	0.06	0.06	0.38	2.52	- 0.17	- 0.63	0.80	2.10	2.17	2.10							
Boxelder	0.60	0.10	0.27	0.03	3.16	1.40	0.20	0.19	1.32	10.78	- 0.18	- 0.66	3.94	11.20	2.17	11.20							
Honeylocust	0.94	0.15	0.42	0.04	4.94	1.72	0.25	0.24	1.66	10.78	- 0.76	- 2.85	4.67	12.87	2.17	12.87							
American elm	0.00	0.00	0.00	0.00	0.01	0.08	0.01	0.01	0.08	0.52	0.00	0.00	0.19	0.53	2.17	0.53							
Silver maple	1.69	0.29	0.80	0.07	9.01	2.09	0.31	0.29	1.99	13.05	- 0.93	- 3.50	6.59	18.56	2.17	18.56							
Other City Trees	0.49	0.08	0.24	0.02	2.66	1.29	0.18	0.18	1.19	7.94	- 0.12	- 0.43	3.56	10.16	2.17	10.16							
Citywide Total	22.70	3.83	10.81	1.01	121.40	55.04	8.01	7.64	52.20	342.73	- 11.28	- 42.29	149.95	421.84	100.00	9.17							

Annual CO2 Benefits of Public Trees by Species																
Species	Sequestered		Sequestered Decomposition		Maint. Release		Total Release		Avoided		Net Total		% of Total		Avg. \$/tree	
	(lb)	(\$)	(lb)	(\$)	(lb)	(\$)	(lb)	(\$)	(lb)	(\$)	(lb)	(\$)	(lb)	(\$)		(lb)
Sugar maple	12,178.77	91.34	- 1,219.16	- 55.38	- 0.42	8,328.83	62.47	19,233.06	144.25	36.96	43.82	8.49				
Black maple	4,616.73	34.63	- 305.10	- 21.84	- 0.16	3,815.71	28.62	8,105.50	60.79	17.39	18.47	7.60				
Norway maple	2,097.67	15.73	- 128.46	- 11.31	- 0.08	2,065.07	15.49	4,022.97	30.17	10.87	9.17	6.03				
Green ash	3,191.09	23.93	- 394.16	- 14.82	- 0.11	2,267.12	17.00	5,049.23	37.87	8.70	11.50	9.47				
Japanese tree lilac	189.75	1.42	- 6.06	- 2.34	- 0.02	198.53	1.49	379.88	2.85	6.52	0.87	0.95				
Apple	189.75	1.42	- 6.06	- 2.34	- 0.02	198.53	1.49	379.88	2.85	6.52	0.87	0.95				
Southern magnolia	56.29	0.42	- 2.32	- 1.17	- 0.01	140.81	1.06	193.61	1.45	2.17	0.44	1.45				
Boxelder	1,454.17	10.91	- 109.47	- 4.29	- 0.03	489.72	3.67	1,830.12	13.73	2.17	4.17	13.73				
Honeylocust	0.00	0.00	- 58.78	- 2.73	- 0.02	614.75	4.61	553.25	4.15	2.17	1.26	4.15				
American elm	44.66	0.33	- 1.42	- 0.59	0.00	30.84	0.23	73.49	0.55	2.17	0.17	0.55				
Silver maple	2,696.90	20.23	- 225.70	- 5.85	- 0.04	739.25	5.54	3,204.61	24.03	2.17	7.30	24.03				
Other City Trees	469.91	3.52	- 38.14	- 2.73	- 0.02	440.02	3.30	869.07	6.52	2.17	1.98	6.52				
Citywide Total	27,185.71	203.89	- 2,494.84	- 125.39	- 0.94	19,329.19	144.97	43,894.68	329.21	100.00	100.00	7.16				

Table 5: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species					
Species	Total stored CO2 (lbs)	Total (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Sugar maple	253,700.46	1,902.75	36.96	48.85	111.93
Black maple	63,562.29	476.72	17.39	12.24	59.59
Norway maple	26,763.05	200.72	10.87	5.15	40.14
Green ash	82,117.03	615.88	8.70	15.81	153.97
Japanese tree lilac	1,263.49	9.48	6.52	0.24	3.16
Apple	1,263.49	9.48	6.52	0.24	3.16
Southern magnolia	483.86	3.63	2.17	0.09	3.63
Boxelder	22,805.80	171.04	2.17	4.39	171.04
Honeylocust	12,244.84	91.84	2.17	2.36	91.84
American elm	177.79	1.33	2.17	0.03	1.33
Silver maple	47,020.11	352.65	2.17	9.05	352.65
Other City Trees	7,945.29	59.59	2.17	1.53	59.59
Citywide total	519,347.50	3,895.11	100.00	100.00	84.68

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefit of Public Trees by Species				
Species	Total (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Sugar maple	1,209.64	36.96	47.56	71.16
Black maple	545.38	17.39	21.44	68.17
Norway maple	203.58	10.87	8.00	40.72
Green ash	240.31	8.70	9.45	60.08
Japanese tree lilac	10.52	6.52	0.41	3.51
Apple	10.52	6.52	0.41	3.51
Southern magnolia	21.93	2.17	0.86	21.93
Boxelder	78.52	2.17	3.09	78.52
Honeylocust	0.00	2.17	0.00	0.00
American elm	5.36	2.17	0.21	5.36
Silver maple	174.80	2.17	6.87	174.80
Other City Trees	43.05	2.17	1.69	43.05
Citywide Total	2,543.63	100.00	100.00	55.30

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species							
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	% of Total \$
Sugar maple	1,030.42	144.25	168.66	1,691.74	1,209.64	4,244.72	45.52
Black maple	485.47	60.79	92.32	621.56	545.38	1,805.53	19.36
Norway maple	257.70	30.17	44.07	248.94	203.58	784.46	8.41
Green ash	287.68	37.87	53.43	485.38	240.31	1,104.68	11.85
Japanese tree lilac	29.00	2.85	3.97	10.89	10.52	57.22	0.61
Apple	29.00	2.85	3.97	10.89	10.52	57.22	0.61
Southern magnolia	18.82	1.45	2.10	18.34	21.93	62.64	0.67
Boxelder	62.01	13.73	11.20	109.04	78.52	274.49	2.94
Honeylocust	74.28	4.15	12.87	126.96	0.00	218.26	2.34
American elm	3.29	0.55	0.53	2.65	5.36	12.39	0.13
Silver maple	91.59	24.03	18.56	208.45	174.80	517.43	5.55
Other City Trees	58.69	6.52	10.16	67.19	43.05	185.60	1.99
Citywide Total	2,427.94	329.21	421.84	3,602.02	2,543.63	9,324.64	100.00

Figure 1: Species Distribution

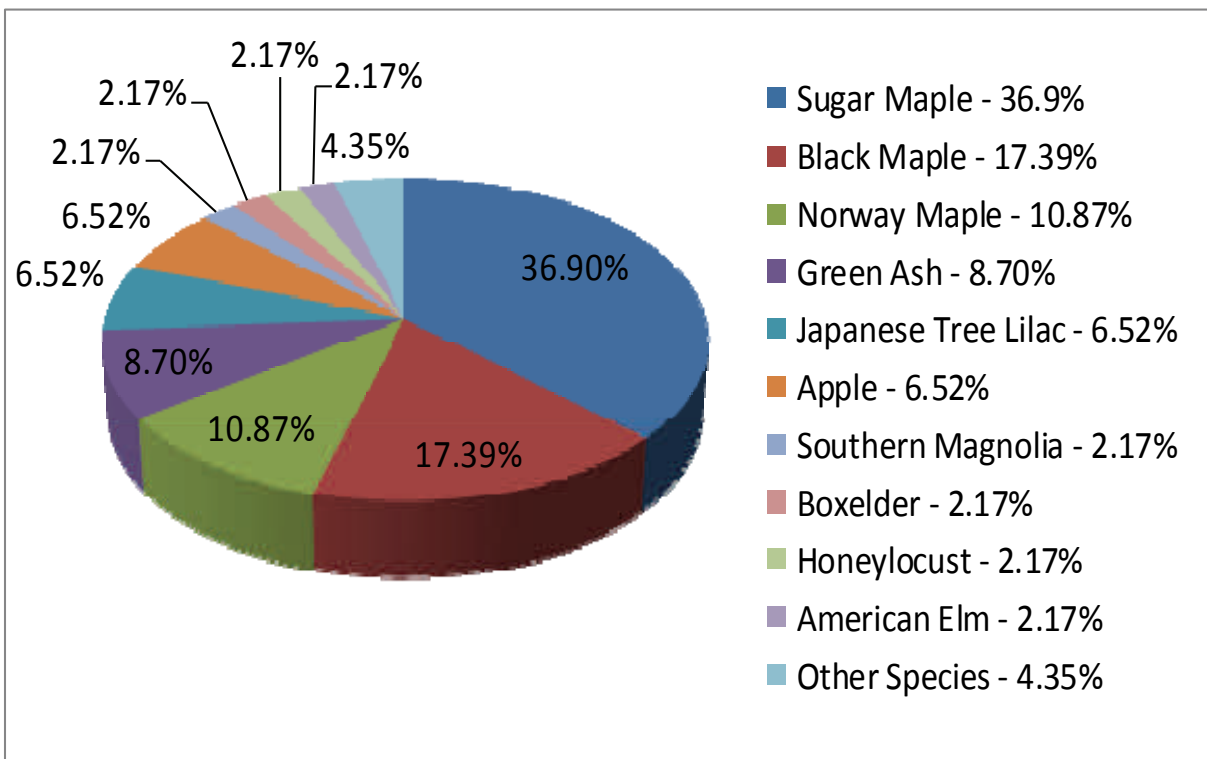


Figure 2: Relative Age Class

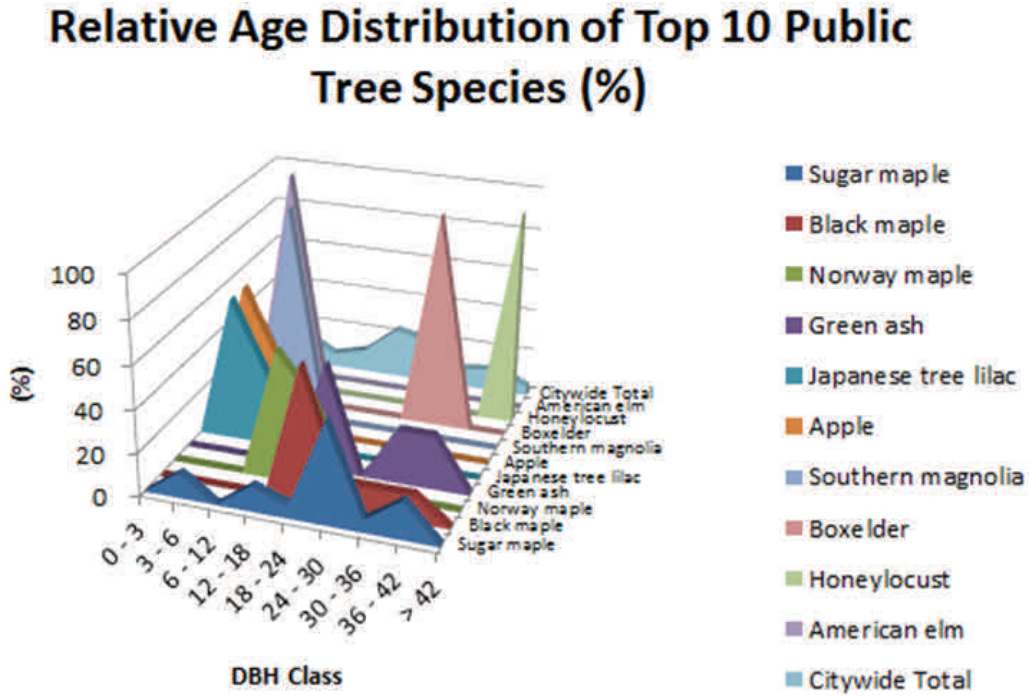


Table 8: Relative Age Class

Species	DBH class (in)									
	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42	
Sugar maple	0.00	11.76	0.00	11.76	5.88	47.06	5.88	17.65	0.00	
Black maple	0.00	0.00	0.00	0.00	62.50	12.50	12.50	12.50	0.00	
Norway maple	0.00	0.00	0.00	60.00	40.00	0.00	0.00	0.00	0.00	
Green ash	0.00	0.00	0.00	0.00	50.00	0.00	25.00	25.00	0.00	
Japanese tree lilac	0.00	66.67	33.33	0.00	0.00	0.00	0.00	0.00	0.00	
Apple	0.00	66.67	33.33	0.00	0.00	0.00	0.00	0.00	0.00	
Southern magnolia	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
Boxelder	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	
Honeylocust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
American elm	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Citywide Total	0.00	15.22	6.52	10.87	23.91	19.57	8.70	10.87	4.35	

Figure 3: Foliage Condition

Functional (Foliage) Condition of Public Trees

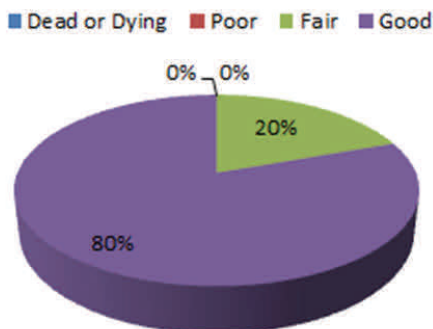


Figure 4: Wood Condition

Structural (Woody) Condition of Public Trees

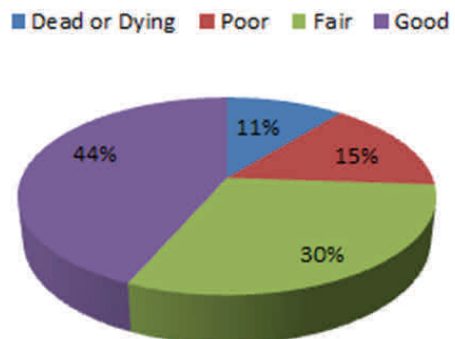


Figure 5: Land Use of City/Park Trees

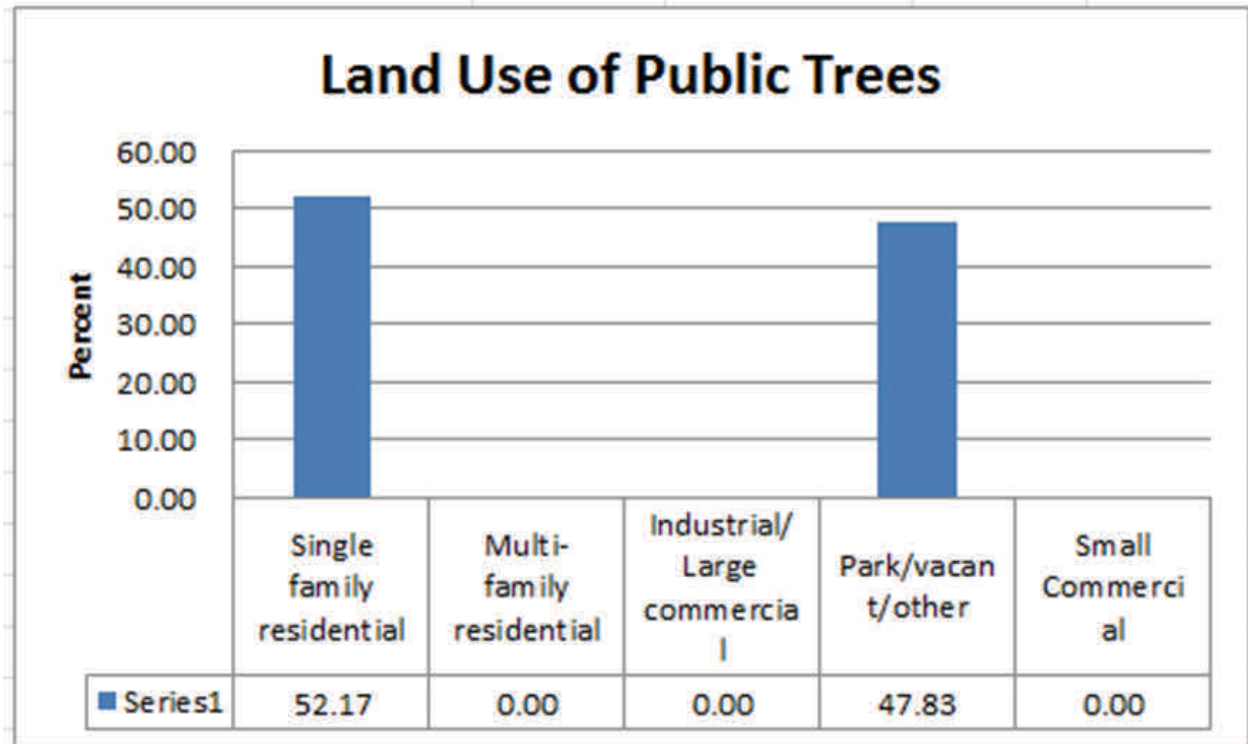
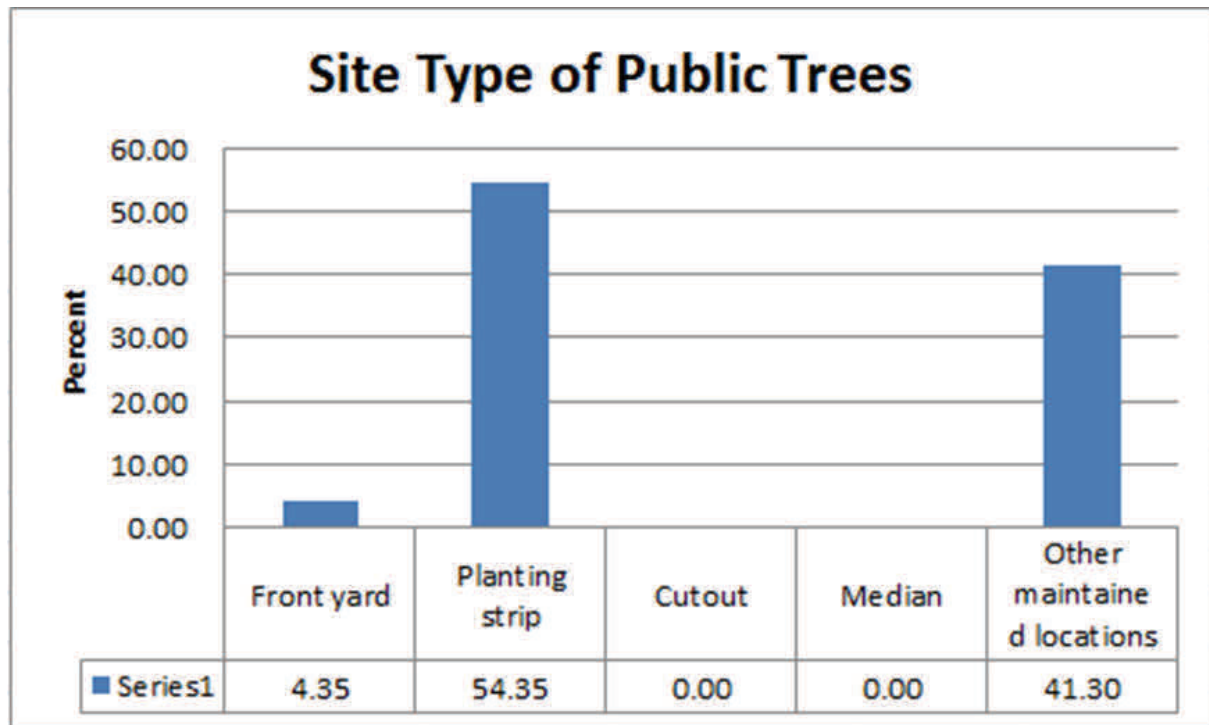


Figure 6: Location of City/Park Trees



Appendix B: ArcGIS Mapping

Image 1: Location of Ash Trees

Image 2: Location of Trees with Recommended Maintenance

Image 3: Maintenance Tasks



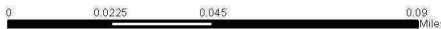
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, IGN, IGP, swisstopo, and the GIS User Community, and Northeast Iowa RC&D

Image 1. Location of Ash Trees

Legend

-  Green ash
-  Ash
-  White ash
-  Black ash

Luana, Iowa



Map created by Northeast Iowa RC&D
11/13/2014



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, ICP, swisstopo, and the GIS User Community, and Northeast Iowa RC&D

Image 2. Location of Trees with Recommended Maintenance

Luana, Iowa

<p>Legend</p> <p> Critical Concern</p>	<p> Mature Tree Immediate</p>	<p> Mature Tree Routine</p>	<p> Young Tree Immediate</p>	<p> Young Tree Routine</p>	<p style="text-align: center;">N</p> <p style="text-align: center;">0 0.0175 0.035 0.07 Miles</p> <p style="text-align: center;">Map created by Northeast Iowa RC&D 11/13/2014</p>
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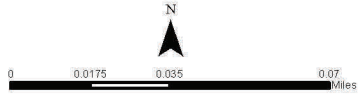
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, and Northeast Iowa RC&D

Image 3. Location of Maintenance Tasks

Luana, Iowa

Legend

-  Clean
-  Raise
-  Reduce
-  Remove*
-  Stake/Train
-  Treat pest/disease



Map created by Northeast Iowa RC&D
11/20/2014

*City owned trees recommended for removal should be verified prior to any removal

Appendix C: Suitable Shade Tree Lists

Shade Trees for Iowa

This document lists several shade tree selections suitable for the Iowa landscape. Nursery and landscape professionals have eliminated green, white, black, pumpkin, and blue ash from their inventories and designs since they are susceptible to the emerald ash borer, which kills ash trees. This destructive pest has been found in several states in the upper Midwest.

While not all-inclusive, this list does describe many useful species, many which are also pest-resistant. Not all trees appearing on this list will “work” in every landscape situation. Great care must be taken to carefully match trees to sites (including above- and below-ground spatial and environmental constraints) and to complement species existing nearby so that a diverse tree canopy will be maintained. *A healthy and diverse tree population is the best defense against current and future tree pests.*

<u>Deciduous Shade Trees</u>	<u>Height/Width</u>	<u>Growth Habit</u>
Alder		
<u>Manchurian alder</u> – <i>Alnus hirsuta</i> 'Harbin' (Prairie Horizon [®])	40'/30'	Upright
Amur maackia – <i>Maackia amurensis</i>	25'/25'	Upright-spreading
Baldcypresses		
<u>Baldcypress</u> – <i>Taxodium distichum</i> 'Mickelson' (Shawnee Brave [®]) 'JFS-SGPN' (Green Whisper [™])	55'/20' 55'/30'	Narrow-pyramid Pyramidal
Birches		
<u>Asian white birch</u> – <i>Betula platyphylla</i> 'VerDale' (Prairie Vision [®])	35'/30'	Upright-oval
<u>Gray birch</u> – <i>Betula populifolia</i> 'Whitespire Sr.'	40'/25'	Pyramidal-oval
<u>Hybrid birch</u> – <i>Betula</i> × 'Penci-2' (Royal Frost [®])	40'/25'	Pyramidal
<u>River birch</u> – <i>Betula nigra</i> 'Cully' (Heritage [®])	45'/30'	Oval
<u>Whitebarked Himalayan birch</u> – <i>Betula utilis</i> 'Madison' (White Satin [™])	35'/20'	Broadly-pyramidal

	<u>Height/Width</u>	<u>Growth Habit</u>
Coffeetree		
<u>Kentucky coffeetree</u> – <i>Gymnocladus dioica</i>		
'Espresso'	50'/35'	Oval
Cork trees		
<u>Cork tree</u> – <i>Phellodendron</i> species		
'Longenecker' (Eye Stopper™)	40'/35'	Rounded
'His Majesty'	40'/35'	Vase-shaped
Elms		
<u>American elm</u> – <i>Ulmus americana</i>		
'Jefferson'	70'/50'	Vase-shaped
'Princeton'	60'/40'	Vase-shaped
'Lewis & Clark' (Prairie Expedition™)	60'/50'	Umbrella-shaped
'New Harmony'	70'/70'	Vase-shaped
'Valley Forge'	70'/70'	Vase-shaped
<u>Asian Elm Cultivars and Hybrids</u>		
'Morton' (Accolade™)	70'/60'	Vase-shaped
'Morton Glossy' (Triumph™)	55'/45'	Vase-shaped
'New Horizon'	55'/40'	Upright-oval
'Prospector'	40'/30'	Vase-shaped
'Discovery'	50'/40'	Vase-shaped
<u>European and Eurasian Hybrid Elm Cultivars</u>		
'Patriot'	50'/40'	Stiff vase-shaped
Filbert		
Turkish filbert – <i>Corylus colurna</i>	40'/30'	Pyramidal
Gingkoes		
<u>Ginkgo</u> – <i>Ginkgo biloba</i>		
'Autumn Gold'	45'/35'	Broadly-pyramidal
'Halka'	45'/40'	Oval
'Magyar'	60'/40'	Upright-oval
'PNI 2720' (Princeton Sentry®)	40'/15'	Narrow-pyramidal
'JFS-UGA2' (Golden Colonnade®)	45'/25'	Narrow-oval
'The President' (Presidential Gold®)	50'/40'	Broadly-pyramidal

	<u>Height/Width</u>	<u>Growth Habit</u>
Hackberries		
<u>Hackberry – <i>Celtis occidentalis</i></u>		
'JFS-KSU1' (Prairie Sentinel™)	45'/12'	Columnar
'Chicagoland'	50'/40'	Broadly-pyramidal
'Prairie Pride'	50'/40'	Oval
Honeylocusts		
<u>Honeylocust – <i>Gleditsia triacanthos</i> var. <i>inermis</i></u>		
'Draves' (Street Keeper™)	45'/20'	Narrow-upright
'Harve' (Northern Acclaim™)	45'/35'	Upright-spreading
'Skycole' (Skyline®)	50'/35'	Pyramidal
Hornbeams		
<u>European hornbeam – <i>Carpinus betulus</i></u>		
'JFS-KW1CB' (Emerald Avenue®)	40'/30'	Broadly-pyramidal
'Windy City'	45'/40'	Upright-spreading
Hophornbeam		
American hophornbeam – <i>Ostrya virginiana</i>		
	40'/25'	Upright-oval
Horsechestnuts		
<u>Common horsechestnut – <i>Aesculus hippocastanum</i></u>		
'Baumannii'	50'/40'	Broadly-oval
<u>Red horsechestnut – <i>Aesculus × carnea</i></u>		
'Briotii'	30'/35'	Round
'Fort McNair'	30'/30'	Round
Lindens		
<u>American linden – <i>Tilia americana</i></u>		
'Boulevard'	60'/30'	Pyramidal
'Continental Appeal'	50'/30'	Narrow-oval
'Wandell' (Legend®)	40'/30'	Broad-pyramidal
'McKSentry' (American Sentry®)	45'/30'	Pyramidal
'Lincoln'	35'/25'	Pyramidal
'Redmond'	50'/35'	Pyramidal
<u>Hybrid Linden – <i>Tilia × flavescens</i> (<i>americana</i> × <i>cordata</i>)</u>		
'Glenleven'	50'/30'	Pyramidal

	<u>Height/Width</u>	<u>Growth Habit</u>
<u>Littleleaf linden</u> – <i>Tilia cordata</i>		
'Bailey' (Shamrock [®])	40'/30'	Pyramidal
'Corzam' (Corinthian [®])	45'/15'	Narrow-pyramid
'Ronald' (Norlin [™])	40'/30'	Pyramidal
<u>Mongolian linden</u> – <i>Tilia mongolica</i>		
'Harvest Gold'	30-40'/25-30'	Upright-oval
<u>Silver linden</u> – <i>Tilia tomentosa</i>		
'PNI 6051' (Green Mountain [®])	45'/35'	Broad-pyramidal
'Sterling'	45'/35'	Broad-pyramidal
Magnolias		
Cucumbertree – <i>Magnolia acuminata</i>	50-80'/40-60'	Upright-oval
Maples		
<u>Black maple</u> – <i>Acer nigrum</i>		
	60'/60'	Round-spreading
<u>Freeman maple</u> – <i>Acer × freemanii</i>		
'Jeffersred' (Autumn Blaze [®])	50'/45'	Broadly-oval
'DTR 102' (Autumn Fantasy [®])	40'/30'	Broadly-oval
'Marmo'	50'/30'	Upright-oval
'Bailston' (Matador [™])	40'/30'	Upright-oval
'Morgan' ('Indian Summer')	45'/40'	Rounded
'Sienna' (Sienna Glen [®])	45'/35'	Pyramidal
'UMNAF#1' (Firefall [™])	50'/30'	Upright-oval
<u>Hybrid maple</u> – <i>Acer truncatum</i> × <i>platanoides</i>		
'Warrenred' (Pacific Sunset [®])	30'/25'	Upright-spreading
'JFS-KW202' (Crimson Sunset [™])	35'/25'	Upright-oval
<u>Miyabe maple</u> – <i>Acer miyabei</i>		
'Morton' (State Street [™])	45'/30'	Upright-oval
'JFS-KW3AMI' (Rugged Ridge [™])	55'/40'	Upright-oval
<u>Norway maple</u> – <i>Acer platanoides</i>		
'Columnarbrood' (Parkway [®])	40'/25'	Oval
'Deborah'	45'/40'	Rounded
'Emerald Queen'	50'/40'	Oval-upright
'Ezestre' (Easy Street [™])	40'/20'	Narrow-pyramidal
'Fairview'	45'/35'	Upright-oval

	<u>Height/Width</u>	<u>Growth Habit</u>
'Pond' (Emerald Lustre [™])	45'/40'	Rounded
'Princeton Gold'	35'/30'	Oval
<u>Red maple – <i>Acer rubrum</i></u>		
'Bailcraig' (Scarlet Jewell [™])	50'/30'	Upright
'Franksred' (Red Sunset [®])	45'/35'	Upright-oval
'Magnificent Magenta' (Burgundy Belle [®])	50'/40'	Oval
'Frank Jr.' (Redpointe [™])	45'/30'	Pyramidal
'New World'	40'/20'	Narrow-oval
'Polara' (Rubyfrost [™])	45'/40'	Broadly-oval
'Somerset'	45'/35'	Broadly-oval
<u>Sugar maple – <i>Acer saccharum</i></u>		
'Autumn Splendor'	45'/40'	Broadly-oval
'JFS-KW8' (Autumn Fest [™])	50'/35'	Upright-oval
'JFS-Caddo2' (Flashfire [™])	45'/40'	Broadly-oval
'Bailsta' (Fall Fiesta [™])	50'/50'	Upright-rounded
'Commemoration'	50'/35'	Oval-rounded
'Endowment'	50'/20'	Columnar
'Legacy'	50'/35'	Oval
'Morton' (Crescendo [™])	40'/30'	Broadly-oval
'Green Mountain'	45'/35'	Broadly-oval
Planetrees		
<u>London planetree – <i>Platanus × acerifolia</i></u>		
'Bloodgood'	50'/40'	Broadly-pyramidal
'Morton Circle' (Exclamation [™])	55'/35'	Upright-pyramidal
Oaks		
<u>Bur oak – <i>Quercus macrocarpa</i></u>		
'JFS-KW3' (Urban Pinnacle [™])	50-80'/40-80'	Spreading
	55'/25'	Narrow-pyramidal
<u>Chinkapin oak – <i>Quercus muehlenbergii</i></u>		
	45'/45'	Round
<u>English/white oak – <i>Quercus bimundorum</i></u>		
'Crimschmidt' (Crimson Spire [™])	45'/15'	Columnar
'Midwest' (Prairie Stature [™])	50'/40'	Broadly-pyramidal
<u>Hybrid oak – <i>Quercus</i> ×</u>		
'Clemons' (Heritage [®])	40-50'/40-50'	Broadly-pyramidal
'Long' (Regal Prince [®])	45'/18'	Narrow-oval

	<u>Height/Width</u>	<u>Growth Habit</u>
Red oak – <i>Quercus rubra</i>	60-75'/60'	Spreading
Shingle oak – <i>Quercus imbricaria</i>	50'/40'	Broadly-oval
Swamp white oak – <i>Quercus bicolor</i>	60'/60'	Round
White oak – <i>Quercus alba</i>	50-70'/40-80'	Spreading
Sweetgums		
<u>Sweetgum – <i>Liquidambar styraciflua</i></u>		
'Clydesform' (Emerald Sentinel®)	30'/12'	Narrow-pyramid
'Moraine'	40'/25'	Pyramidal

Compiled by Jeff Iles, Department of Horticulture, Iowa State University
10-January-2013

Small-stature Trees for Iowa

This document lists several small-stature tree selections suitable for the Iowa landscape. Nursery and landscape professionals have eliminated green, white, black, pumpkin, and blue ash from their inventories and designs since they are susceptible to the emerald ash borer, which kills ash trees. This destructive pest has been found in several states in the upper Midwest.

While not all-inclusive, this list does describe many useful species, many which are also pest-resistant. Not all trees appearing on this list will “work” in every landscape situation. Great care must be taken to carefully match trees to sites (including above- and below-ground spatial and environmental constraints) and to complement species existing nearby so that a diverse tree canopy will be maintained. *A healthy and diverse tree population is the best defense against current and future tree pests.*

<u>Deciduous Small-stature Trees</u>	<u>Height/Width</u>	<u>Growth Habit</u>
Amur maackia – <i>Maackia amurensis</i>	20'/20'	Upright-spreading
Cherries		
<u>Sargent cherry</u> – <i>Prunus sargentii</i>		
'JFS-KW58' (Pink Flair [®])	25'/15'	Upright
'Hokkaido Normandale' (Spring Wonder [™])	25'/20'	Upright-spreading
Crabapples – <i>Malus</i> species		
'Adirondack'	18'/12'	Vase-shaped
'Beeson' (May's Delight [®])	8'/8'	Upright-spreading
'Hub Tures' (Spring Sensation [™])	10'/12'	Wide-spreading
'JFS-KW5' (Royal Raindrops [®])	20'/15'	Upright-spreading
'Malusquest' (Pink Sparkles [®])	15'/12'	Upright
'Orange Crush'	15'/15'	Round-spreading
Dogwoods		
Corneliancherry dogwood – <i>Cornus mas</i>	20'/20'	Round-spreading
<u>Gray dogwood</u> – <i>Cornus racemosa</i>		
'Jade' (Snow Mantle [™])	15'/8'	Upright-spreading
Pagoda dogwood – <i>Cornus alternifolia</i>	20'/20'	Spreading

	<u>Height/Width</u>	<u>Growth Habit</u>
Hophornbeams		
American hophornbeam – <i>Ostrya virginiana</i>	25'/20'	Upright-spreading
Hornbeams		
<u>American hornbeam</u> – <i>Carpinus caroliniana</i>		
'J.N. Strain'	25'/25'	Spreading
'J.N. Upright' (Firespire™)	20'/10'	Upright
Lilacs		
<u>Japanese tree lilac</u> – <i>Syringa reticulata</i>		
'Bailnce' (Snowdance™)	18'/20'	Round-spreading
'Ivory Silk'	25'/15'	Upright
<u>Pekin lilac</u> – <i>Syringa reticulata</i> subsp. <i>pekinensis</i>		
'Morton' (China Snow®)	20'/20'	Upright-spreading
'SunDak' (Copper Curls®)	20'/15'	Upright-spreading
Magnolias		
<u>Loebner magnolia</u> – <i>Magnolia × loebneri</i>		
'Merrill'	25'/25'	Upright-spreading
'Ruth' (Spring Welcome®)	20'/20'	Round-spreading
Maples		
<u>Tatarian maple</u> – <i>Acer tataricum</i>		
'GarAnn' (Hot Wings®)	20'/25'	Round-spreading
Three-flower maple – <i>Acer triflorum</i>	25'/25'	Upright-spreading
Pears		
<u>Callery pear</u> – <i>Pyrus calleryana</i>		
'Glen's Form' (Chanticleer®)	40'/15'	Narrow-pyramid
<u>Ussurian pear</u> – <i>Pyrus ussuriensis</i>		
'MorDak' (Prairie Gem®)	25'/20'	Oval
'Bailfrost' (Mountain Frost®)	20'/15'	Upright-oval
Redbud		
<u>American redbud</u> – <i>Cercis canadensis</i>		
'Pink Trim' (Northern Herald™)	25'/25'	Spreading

Serviceberries

Allegheny serviceberry – *Amelanchier laevis*

'Cumulus'

20'/15'

Upright-spreading

'JFS-Arb' (**Spring Flurry**[®])

28'/20'

Upright-oval

Apple serviceberry – *Amelanchier* × *grandiflora*

'Autumn Brilliance'

20'/15'

Upright-spreading

'Strata'

20'/20'

Horizontal

Compiled by Jeff Iles, Department of Horticulture, Iowa State University
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