

2012 Management Plan
 Prepared by George Warford
 Bureau of Forestry, Iowa DNR



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Executive Summary

Overview

This plan was developed to assist the City of Bayard 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 18% of Bayard'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 and Results

In 2012, 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 71 trees inventoried.

- Bayard's trees provide \$16,117 of benefits annually, an average of \$227 a tree
- There are over 14 species of trees
- The top three genus are: Maple 45%, Ash 18%, and Conifers/Evergreens 7%
- 58% of trees are in need of some type of management
- 3 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 3 trees needing removal, 2 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 2 of the 13 ash trees are in need of follow up because they are displaying 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 do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take several years to remove ash – Suggestion: request a budget increase to \$2,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2012, a tree inventory was conducted that included 100% of the city owned right of way trees. 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 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 wood pecker damage.

Inventory Results

The data collected for the 71 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

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Bayard's trees reduce energy related costs by approximately \$4,036 annually (Appendix A, Table 1). These savings are both in Electricity (19.4 MWh) and in Natural Gas (2,617.3 Therms).

Annual Stormwater Benefits

Bayard's trees intercept about 213,143 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$5,777 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 Bayard, it is estimated that trees remove 242.8 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 \$680 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon storage and sequestration reduce the amount of carbon in the atmosphere, mitigating climate change. In Bayard, trees store 800,877 lbs of carbon, with a yearly benefit of \$6,007 (Appendix A, Table 4). In addition, the trees sequester about 77,997 lbs of carbon a year with an associated value of \$585 (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. Bayard receives \$5,039 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Bayard's trees provide \$16,117 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 71 trees in Bayard provide approximately \$227 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Bayard has over 14 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple	32	45%
Ash	13	18%
Conifer/Evergreen	5	7%
Hackberry	4	6%
Honeylocust	3	4%
Walnut	3	4%
Linden/Basswood	3	4%
Broadleaf Deciduous	2	3%
Sycamore	2	3%
Elm	2	3%
Poplar	1	1%
Oak	1	1%

Age Class

Most of Bayard's trees (56%) are between 12 and 24 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 18 inches in diameter at 4.5 ft. Bayard's size curve fits the preferred age class.

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 Bayard indicate that 89% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 69% of Bayard'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 11% of the population. This 11% 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	38	53.5%
Crown Raising	0	0%
Tree Staking	0	0%
Tree Removal	3	4.2%
Crown Reduction	0	0%

Canopy Cover

The canopy cover of Bayard is approximately 2 acres (Appendix A, Figure 4). According to the 2000 census, Bayard occupies 320 acres. Thus the canopy cover on city land is <1%.

Land Use

Single family residential	90.1%
Park/vacant/other	9.9%
Industrial/Large commercial	0%
Small commercial	0%
Multifamily residential	0%

Location

Planting strip	100%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%
Front yard	0%

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

Bayard has 2 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 2 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming. Since there are no trees with these needs, keep an eye on ash, larger diameter trees, and trees that may interfere with power lines.

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 3 removals, 2 are ash trees. There are a total of 13 ash trees, and 2 of those have signs and symptoms that have been associated with EAB. The remaining trees are in fair to good 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 Bayard.

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 (45%) (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, evergreens, willow, or black walnut. Species recommendations are outlined in the Sample City Ordinance (Appendix C). All trees planted should meet the restrictions in the Sample City Ordinance (Appendix C).

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 death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Six Year Maintenance Plan with No Additional Funding

Year 1

Removal: 3 critical concern trees

Planting and Replacement: 2 or 3 trees to be planted in open locations

Visual Survey for signs and symptoms of EAB

Years 2 through 6

Removal: Any new trees that become a critical concern and any ash trees in poor health

Planting and Replacement: 2 to 3 trees each year in open locations

Routine trimming: Contract to trim 1/3 of the city trees in Years 2, 4, and 6

Visual Survey for signs and symptoms of EAB

EAB could potentially kill all ash within 4 years of its arrival. To remove all ash trees within 6 years, plus plant replacement trees, and do the recommended trimming, the budget would need to be increased to about \$2,000 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 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 Bayard. 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 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.

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.

Canopy Replacement

As budget permits, all removed ash trees will be replaced. All trees will meet the restrictions in sample city ordinance (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, willow, tree of heaven, 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 genus 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. The Sample Tree Ordinance, Code 151.09 states "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in

charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.”

Budget

Suggested Budget

Total \$12,000 over 6 years (\$2,000/year)

FY 2014 Budget

Removal: \$1,500

Planting: \$300

Watering & Maintenance: \$200

FY 2015 Budget

Removal: \$1,000

Planting: \$450

Routine trimming: \$350

Watering & Maintenance: \$200

FY 2016 Budget

Removal: \$1,500

Planting: \$300

Watering & Maintenance: \$200

FY 2017 Budget

Removal: \$1,000

Planting: \$450

Routine trimming: \$350

Watering & Maintenance: \$200

FY 2018 Budget

Removal: \$1,500

Planting: \$300

Watering & Maintenance: \$200

FY 2019 Budget

Removal: \$1,000

Planting: \$450

Routine trimming: \$350

Watering & Maintenance: \$200

Purposed Budget Increase

EAB could potentially kill all ash trees in Bayard within 4 years of its arrival. The suggested budget estimates \$500 per tree for removal (15 trees = \$7,500), \$150 replacement trees (15 = \$2,250), a conservative amount of about \$15 per tree for routine pruning (\$1,050), and \$200 per year for watering and maintenance (\$1,200), for a total of \$12,000 over six years. Additionally, it is recommended that Bayard 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.

Works Cited

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Bayard

Annual Energy Benefits of Public Trees by Species

1/12/2013

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	3.0	230	415.2	407	637	(N/A)	18.3	15.8	48.97
Silver maple	3.5	262	447.6	439	701	(N/A)	16.9	17.4	58.42
Sugar maple	3.5	267	467.8	458	725	(N/A)	15.5	18.0	65.92
Norway maple	2.2	166	311.0	305	470	(N/A)	12.7	11.7	52.27
Conifer Evergreen Large	0.7	52	83.3	82	133	(N/A)	7.0	3.3	26.67
Northern hackberry	1.3	100	186.3	183	282	(N/A)	5.6	7.0	70.59
Honeylocust	1.0	77	128.2	126	202	(N/A)	4.2	5.0	67.44
Black walnut	0.8	63	112.0	110	172	(N/A)	4.2	4.3	57.49
American basswood	1.1	82	154.3	151	234	(N/A)	4.2	5.8	77.86
American sycamore	0.9	66	118.0	116	182	(N/A)	2.8	4.5	91.02
Siberian elm	0.3	25	40.5	40	65	(N/A)	2.8	1.6	32.39
Broadleaf Deciduous	0.3	20	38.1	37	57	(N/A)	1.4	1.4	57.32
Broadleaf Deciduous	0.2	18	29.5	29	47	(N/A)	1.4	1.2	46.78
Black poplar	0.3	20	38.1	37	57	(N/A)	1.4	1.4	57.32
Northern pin oak	0.3	24	47.4	46	71	(N/A)	1.4	1.8	70.84
Other street trees	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	19.4	1,471	2,617.3	2,565	4,036	(N/A)	100.0	100.0	56.85

Table 2: Annual Stormwater Benefits

Bayard

Annual Stormwater Benefits of Public Trees by Species

1/12/2013

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	28,410	770	(N/A)	18.3	13.3	59.23
Silver maple	40,734	1,104	(N/A)	16.9	19.1	92.00
Sugar maple	42,124	1,142	(N/A)	15.5	19.8	103.79
Norway maple	18,493	501	(N/A)	12.7	8.7	55.69
Conifer Evergreen Large	10,554	286	(N/A)	7.0	5.0	57.20
Northern hackberry	11,096	301	(N/A)	5.6	5.2	75.18
Honeylocust	10,926	296	(N/A)	4.2	5.1	98.70
Black walnut	7,999	217	(N/A)	4.2	3.8	72.26
American basswood	15,985	433	(N/A)	4.2	7.5	144.41
American sycamore	14,477	392	(N/A)	2.8	6.8	196.17
Siberian elm	1,991	54	(N/A)	2.8	0.9	26.98
Broadleaf Deciduous	2,591	70	(N/A)	1.4	1.2	70.21
Broadleaf Deciduous	1,409	38	(N/A)	1.4	0.7	38.19
Black poplar	2,591	70	(N/A)	1.4	1.2	70.21
Northern pin oak	3,764	102	(N/A)	1.4	1.8	102.01
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	213,143	5,777	(N/A)	100.0	100.0	81.36

Table 3: Annual Air Quality Benefits
Bayard

Annual Air Quality Benefits of Public Trees by Species

1/12/2013

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	2.9	0.5	1.5	0.1	16	14.5	2.1	2.0	13.7	90	0.0	0	37.3	106 (N/A)	18.3	8.16	
Silver maple	6.5	1.1	3.3	0.3	35	16.2	2.4	2.3	15.6	102	-3.8	-14	43.9	123 (N/A)	16.9	10.24	
Sugar maple	6.2	1.1	3.0	0.3	33	16.6	2.4	2.3	15.9	104	-4.8	-18	43.0	119 (N/A)	15.5	10.84	
Norway maple	3.5	0.6	1.8	0.2	19	10.5	1.5	1.5	9.9	65	-0.8	-3	28.7	81 (N/A)	12.7	9.05	
Conifer Evergreen Large	1.2	0.2	1.0	0.1	8	3.2	0.5	0.4	3.1	20	-4.4	-16	5.3	11 (N/A)	7.0	2.27	
Northern hackberry	1.6	0.3	0.8	0.1	9	6.3	0.9	0.9	6.0	39	0.0	0	16.8	48 (N/A)	5.6	11.98	
Honeylocust	2.1	0.4	1.0	0.1	11	4.7	0.7	0.7	4.6	30	-1.7	-6	12.5	35 (N/A)	4.2	11.55	
Black walnut	0.9	0.1	0.4	0.0	5	3.9	0.6	0.5	3.7	25	0.0	0	10.3	29 (N/A)	4.2	9.75	
American basswood	2.5	0.4	1.2	0.1	14	5.2	0.8	0.7	4.9	33	-2.1	-8	13.9	38 (N/A)	4.2	12.78	
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)	2.8	19.04	
Siberian elm	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.5	10	0.0	0	3.7	10 (N/A)	2.8	5.23	
Broadleaf Deciduous	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9 (N/A)	1.4	9.34	
Broadleaf Deciduous	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	1.4	7.92	
Black poplar	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9 (N/A)	1.4	9.34	
Northern pin oak	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)	1.4	13.58	
Other street trees	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.0	0.00	
Citywide total	31.6	5.3	15.9	1.5	172	92.2	13.4	12.8	87.8	575	-17.9	-67	242.8	680 (N/A)	100.0	9.57	

Table 4: Annual Carbon Stored
Bayard

Stored CO2 Benefits of Public Trees by Species

1/12/2013

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	95,268	715	(N/A)	18.3	11.9	54.96
Silver maple	162,034	1,215	(N/A)	16.9	20.2	101.27
Sugar maple	181,417	1,361	(N/A)	15.5	22.7	123.69
Norway maple	58,034	435	(N/A)	12.7	7.3	48.36
Conifer Evergreen	10,196	76	(N/A)	7.0	1.3	15.29
Northern	21,916	164	(N/A)	5.6	2.7	41.09
Honeylocust	27,527	206	(N/A)	4.2	3.4	68.82
Black walnut	27,902	209	(N/A)	4.2	3.5	69.76
American	99,300	745	(N/A)	4.2	12.4	248.25
American	78,517	589	(N/A)	2.8	9.8	294.44
Siberian elm	3,945	30	(N/A)	2.8	0.5	14.79
Broadleaf	8,458	63	(N/A)	1.4	1.1	63.43
Broadleaf	3,624	27	(N/A)	1.4	0.5	27.18
Black poplar	8,458	63	(N/A)	1.4	1.1	63.43
Northern pin oak	14,280	107	(N/A)	1.4	1.8	107.10
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	800,877	6,007	(N/A)	100.0	100.0	84.60

Table 5: Annual Carbon Sequestered**Bayard****Annual CO₂ Benefits of Public Trees by Species**

1/12/2013

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Total Avoided (lb)	Avoided (\$)	Net Total (lb)	Total (\$)	Standard % of Total Trees	% of Total \$	Avg. \$/tree
Green ash	7,172	54	-457	-3	-3	5,077	38	11,789	88 (N/A)	18.3	15.1	6.80
Silver maple	12,862	96	-778	-2	-6	5,798	43	17,880	134 (N/A)	16.9	22.9	11.17
Sugar maple	8,506	64	-871	-2	-7	5,893	44	13,526	101 (N/A)	15.5	17.3	9.22
Norway maple	3,631	27	-279	-2	-2	3,660	27	7,011	53 (N/A)	12.7	9.0	5.84
Conifer Evergreen	721	5	-49	-1	0	1,142	9	1,814	14 (N/A)	7.0	2.3	2.72
Northern hackberry	1,552	12	-105	-1	-1	2,205	17	3,651	27 (N/A)	5.6	4.7	6.85
Honeylocust	3,446	26	-132	-1	-1	1,695	13	5,008	38 (N/A)	4.2	6.4	12.52
Black walnut	1,962	15	-134	-1	-1	1,387	10	3,214	24 (N/A)	4.2	4.1	8.03
American basswood	5,111	38	-477	-1	-4	1,820	14	6,454	48 (N/A)	4.2	8.3	16.13
American sycamore	1,824	14	-377	0	-3	1,469	11	2,916	22 (N/A)	2.8	3.7	10.93
Siberian elm	475	4	-19	0	0	555	4	1,011	8 (N/A)	2.8	1.3	3.79
Broadleaf Deciduous	660	5	-41	0	0	441	3	1,060	8 (N/A)	1.4	1.4	7.95
Broadleaf Deciduous	386	3	-17	0	0	395	3	763	6 (N/A)	1.4	1.0	5.73
Black poplar	660	5	-41	0	0	441	3	1,060	8 (N/A)	1.4	1.4	7.95
Northern pin oak	370	3	-69	0	-1	539	4	840	6 (N/A)	1.4	1.1	6.30
Other street trees	0	0	0	0	0	0	0	0	0 (N/A)	0.0	0.0	0.00
Citywide total	49,338	370	-3,844	-14	-29	32,517	244	77,997	585 (N/A)	100.0	100.0	8.24

Table 6: Annual Social and Aesthetic Benefits**Bayard****Annual Aesthetic/Other Benefits of Public Trees by Species**

1/12/2013

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	651	(N/A)	18.3	12.9	50.06
Silver maple	1,052	(N/A)	16.9	20.9	87.65
Sugar maple	853	(N/A)	15.5	16.9	77.54
Norway maple	347	(N/A)	12.7	6.9	38.60
Conifer Evergreen Large	191	(N/A)	7.0	3.8	38.22
Northern hackberry	219	(N/A)	5.6	4.3	54.74
Honeylocust	881	(N/A)	4.2	17.5	293.50
Black walnut	169	(N/A)	4.2	3.4	56.38
American basswood	320	(N/A)	4.2	6.4	106.73
American sycamore	117	(N/A)	2.8	2.3	58.34
Siberian elm	54	(N/A)	2.8	1.1	27.03
Broadleaf Deciduous	58	(N/A)	1.4	1.1	57.69
Broadleaf Deciduous	39	(N/A)	1.4	0.8	39.16
Black poplar	58	(N/A)	1.4	1.1	57.69
Northern pin oak	31	(N/A)	1.4	0.6	31.46
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	5,039	(N/A)	100.0	100.0	70.98

Table 7: Summary of Benefits in Dollars**Bayard****Total Annual Benefits of Public Trees by Species (\$)**

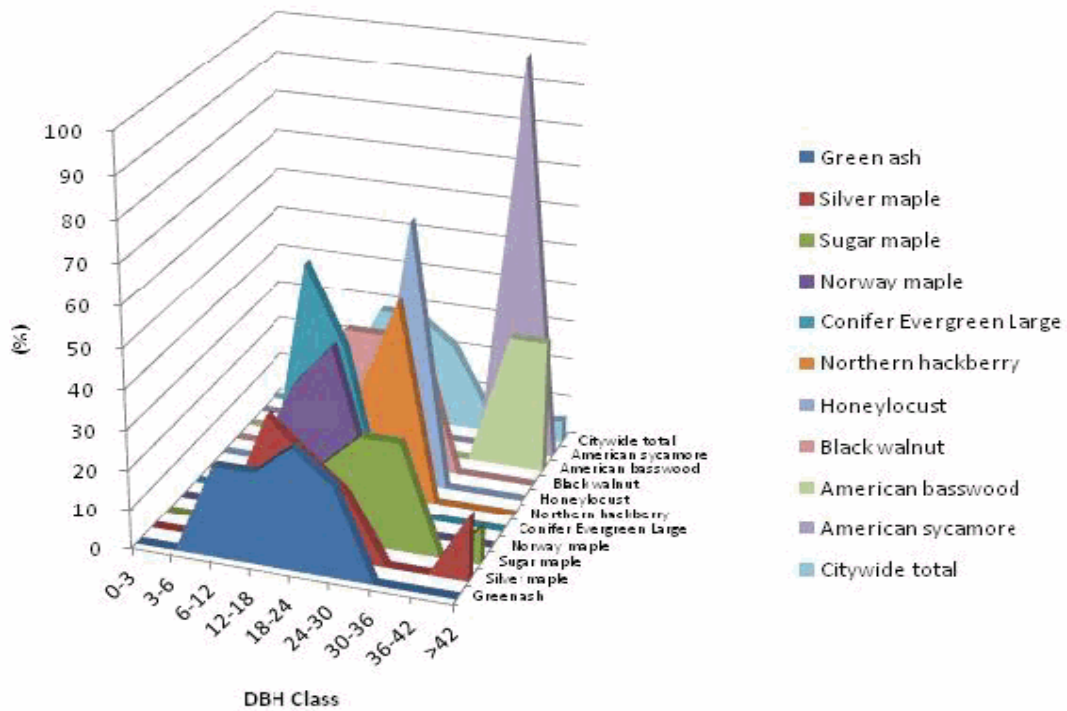
1/12/201

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total Standard (\$)	Error	% of Total \$
Green ash	637	88	106	770	651	2,252	(±0)	14.0
Silver maple	701	134	123	1,104	1,052	3,114	(±0)	19.3
Sugar maple	725	101	119	1,142	853	2,940	(±0)	18.2
Norway maple	470	53	81	501	347	1,453	(±0)	9.0
Conifer Evergreen	133	14	11	286	191	635	(±0)	3.9
Northern hackberry	282	27	48	301	219	877	(±0)	5.4
Honeylocust	202	38	35	296	881	1,451	(±0)	9.0
Black walnut	172	24	29	217	169	612	(±0)	3.8
American basswood	234	48	38	433	320	1,074	(±0)	6.7
American sycamore	182	22	38	392	117	751	(±0)	4.7
Siberian elm	65	8	10	54	54	191	(±0)	1.2
Broadleaf Deciduous	57	8	9	70	58	203	(±0)	1.3
Broadleaf Deciduous	47	6	8	38	39	138	(±0)	0.9
Black poplar	57	8	9	70	58	203	(±0)	1.3
Northern pin oak	71	6	14	102	31	224	(±0)	1.4
Other street trees	0	0	0	0	0	0	(±0)	0.0
Citywide Total	4,036	585	680	5,777	5,039	16,117	(±0)	100.0

Bayard

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

1/12/2013



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Green ash	0.0	0.0	23.1	23.1	30.8	23.1	0.0	0.0	0.0
Silver maple	0.0	0.0	8.3	33.3	25.0	16.7	0.0	0.0	16.7
Sugar maple	0.0	0.0	0.0	18.2	18.2	27.3	27.3	0.0	9.1
Norway maple	0.0	0.0	11.1	33.3	44.4	11.1	0.0	0.0	0.0
Conifer Evergreen	0.0	0.0	0.0	60.0	40.0	0.0	0.0	0.0	0.0
Northern hackberry	0.0	0.0	0.0	25.0	25.0	50.0	0.0	0.0	0.0
Honeylocust	0.0	0.0	0.0	33.3	0.0	66.7	0.0	0.0	0.0
Black walnut	0.0	0.0	0.0	33.3	33.3	33.3	0.0	0.0	0.0
American basswood	0.0	0.0	0.0	0.0	33.3	0.0	0.0	33.3	33.3
American sycamore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
Citywide total	0.0	0.0	8.5	28.2	28.2	21.1	4.2	4.2	5.6

Figure 2: Relative Age Class

Functional (Foliage) Condition of Public Trees by Species (%)

1/12/2013

Citywide total

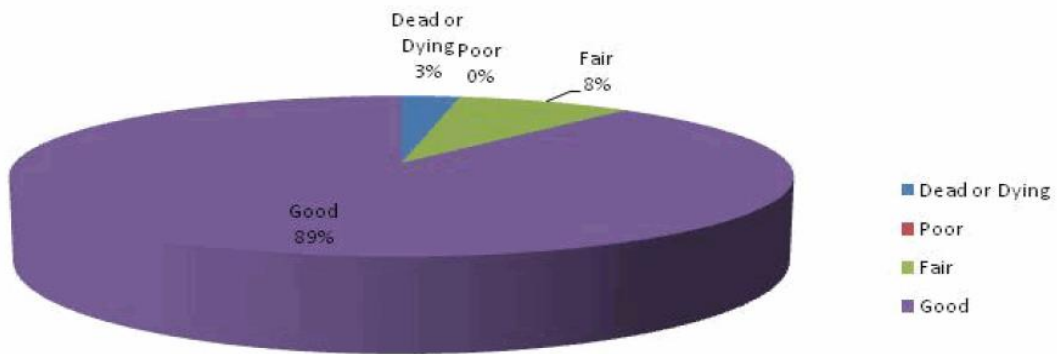


Figure 3: Foliage Condition

Structural (Woody) Condition of Public Trees by Species (%)

1/12/2013

Citywide total

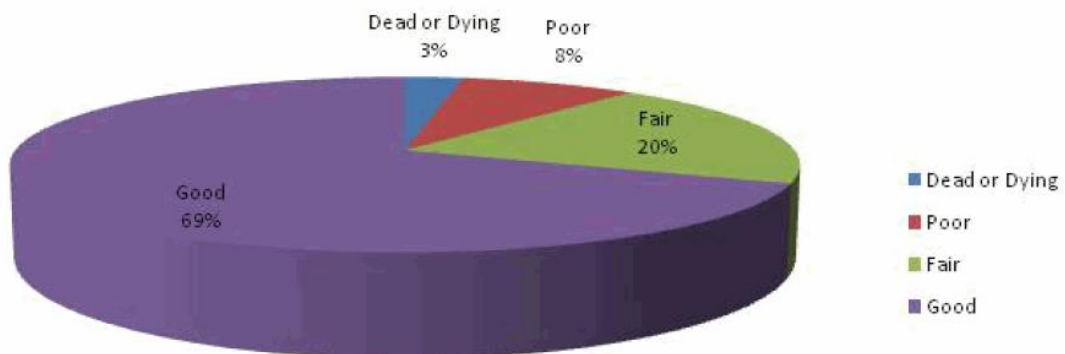
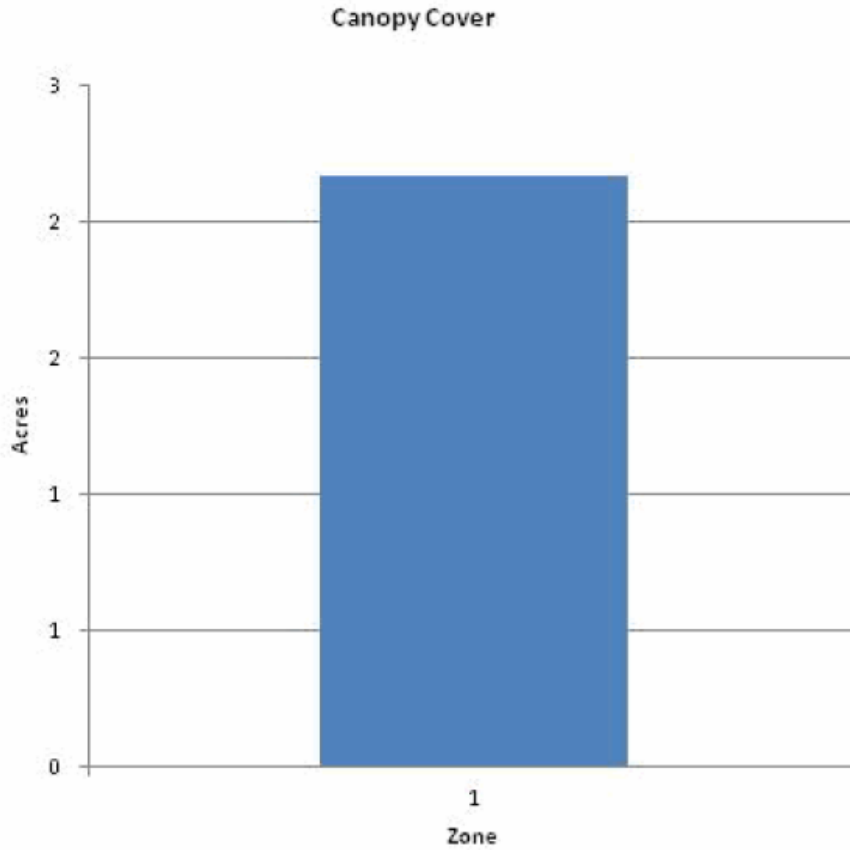


Figure 4: Wood Condition

Bayard

Canopy Cover of Public Trees (Acres)

1/12/2013



Zone	Acres	% of Total Canopy Cover
1	2	100.0
Citywide total	2	100.0

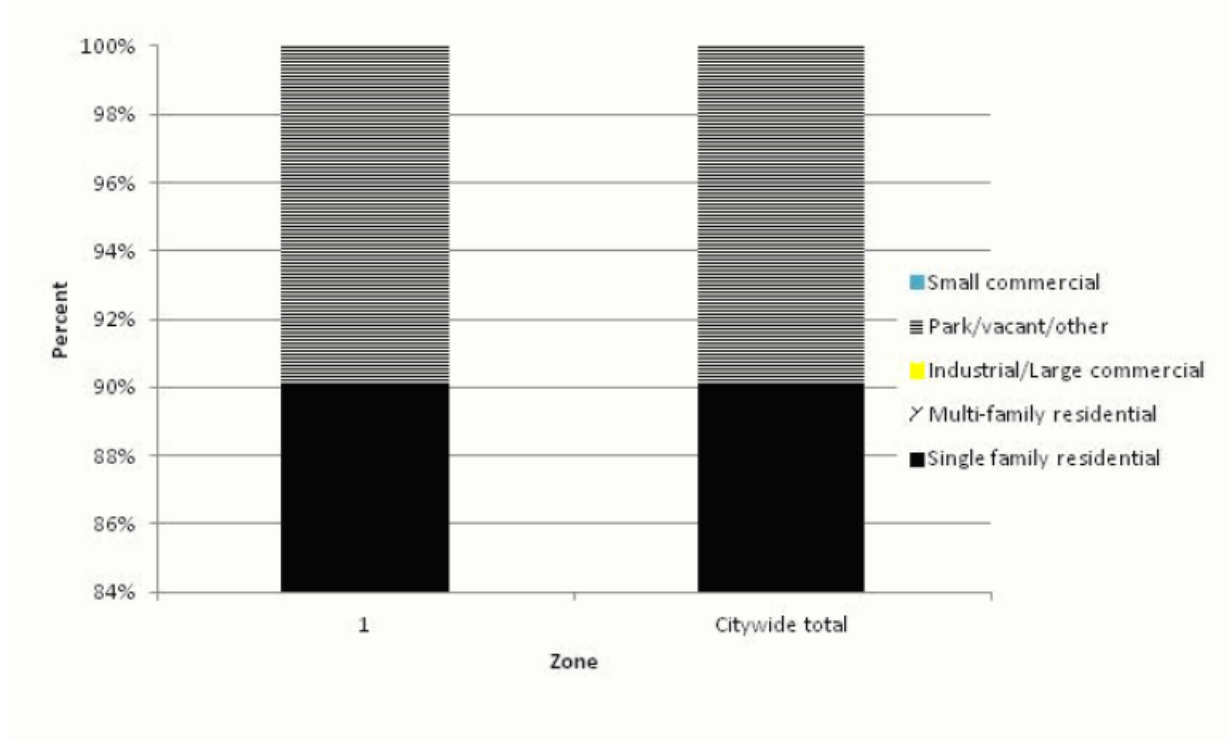
	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	2		

Figure 5: Canopy Cover in Acres

Bayard

Land Use of Public Trees by Zone (%)

1/12/2013



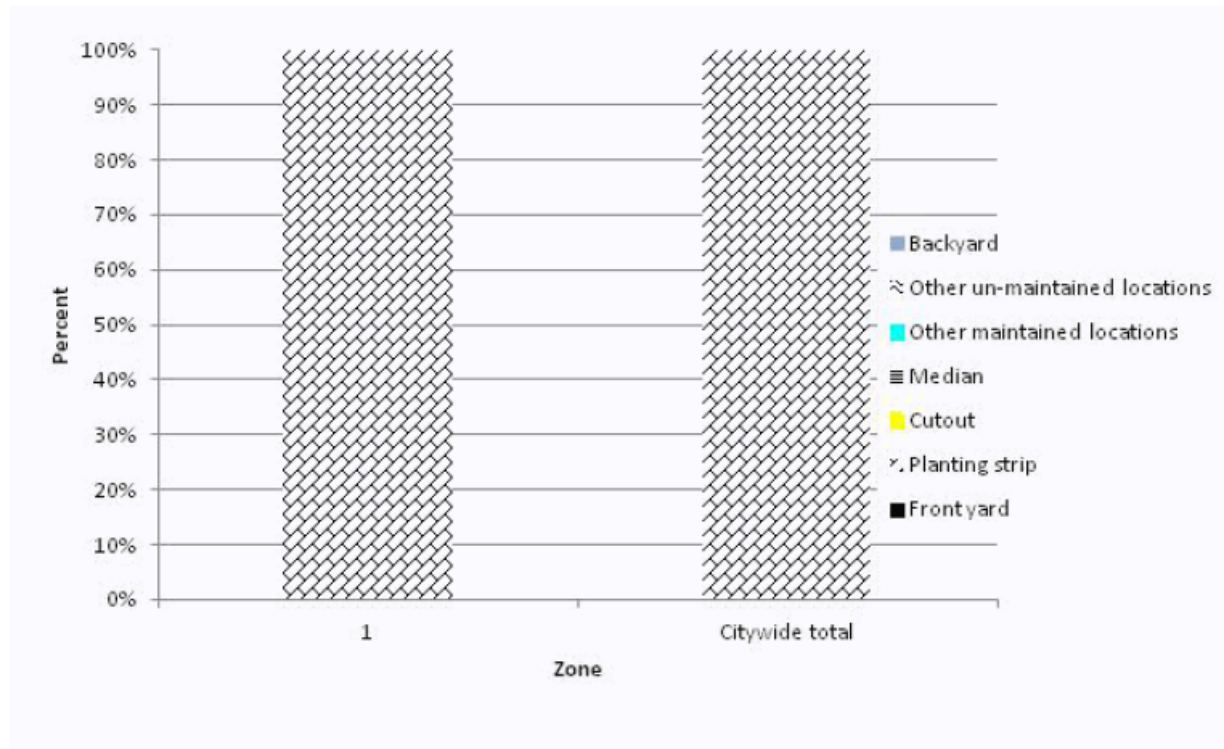
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	90.1	0.0	0.0	9.9	0.0
Citywide total	90.1	0.0	0.0	9.9	0.0

Figure 6: Land Use of city/park trees

Bayard

Location of Public Trees by Zone (%)

1/12/2013



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Citywide total	0.0	100.0	0.0	0.0	0.0	0.0	0.0

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

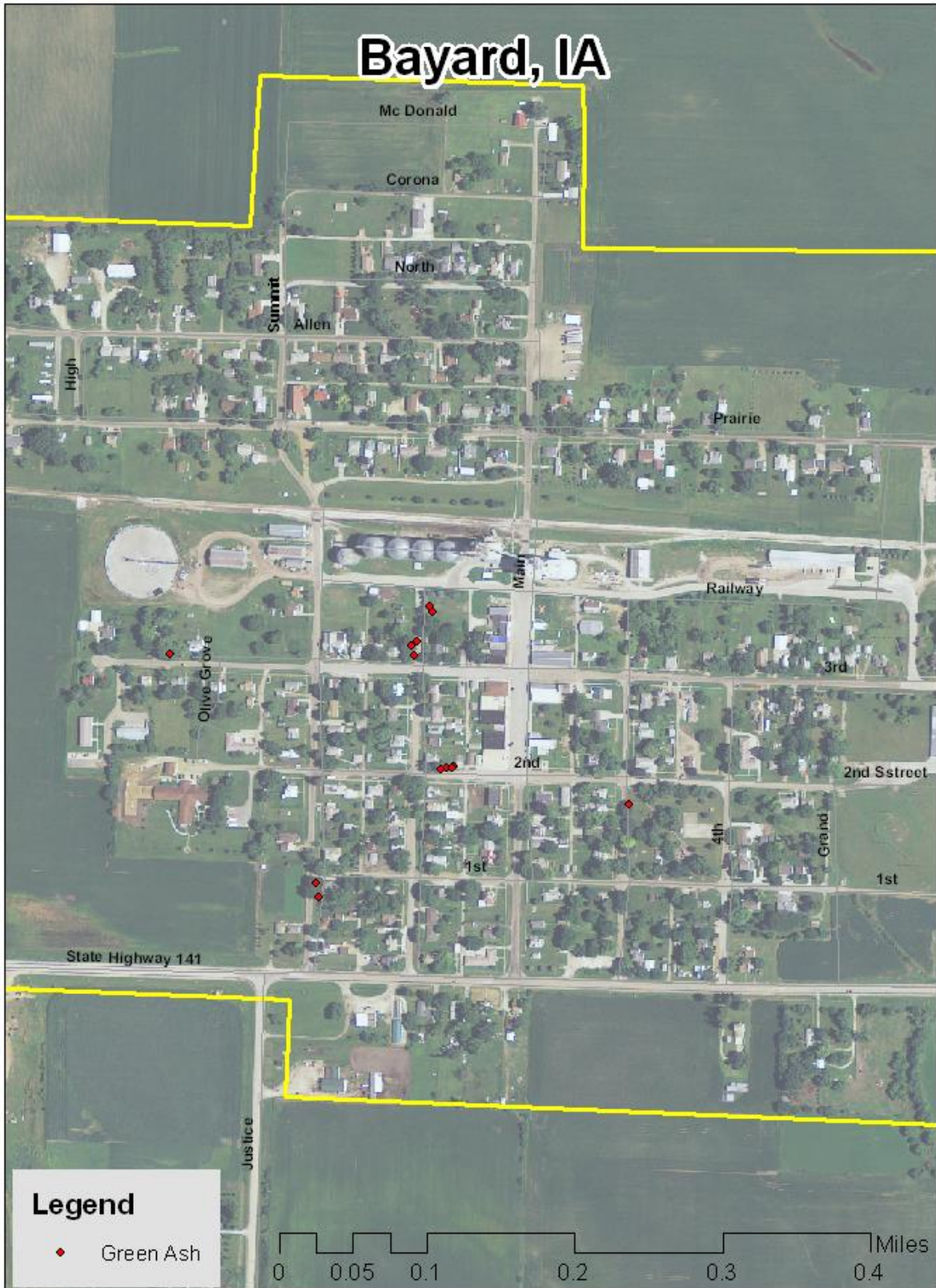


Figure 1: Location of Ash Trees



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: Sample Tree Ordinance

CHAPTER 151

TREES

151.01 Purpose

151.02 Definitions

151.03 Authority of City Generally

151.04 Trimming or Removal

151.05 Supervisory Authority of Street Superintendent

151.06 Planting Restrictions

151.07 Arboricultural Specifications and Standards
of Practice

151.08 Trees on Public Property

151.09 Trees on Private Property

151.10 Enforcement

151.01 PURPOSE. The purpose of this chapter is to beautify and preserve the appearance of the City by requiring street trees to be uniformly located and maintained. The primary responsibility for maintaining street trees is placed upon the abutting property owner or his agent, and the Street Superintendent shall supervise any extensive trimming or cutting of said trees.

151.02 DEFINITIONS. For use in these chapters the following terms are defined:

1. “City Arboricultural Specifications and Standards of Practice” means the document containing the detailed performance standards and specifications to be used in carrying out the provisions of this chapter.
2. “City property” means and includes the property owned by or leased to the City.
3. “Contractor” means any person, business who receives compensation for the performance of work done.
4. “Forestry Improvement Committee” means the duly established committee responsible to study, investigate, counsel and develop a written plan for the care, preservation, trimming, planting, replanting, removal or disposition of trees and shrubs within the City.
5. “In the City streets” means the property included in that area located within any area platted as a City or public street.
6. “Maintain” or “maintenance,” when used in reference to trees, means and includes pruning, spraying, mulching, fertilizing, cultivating, supporting, treating for disease or injury or any other similar act which promotes the life, growth, health or beauty of trees.
7. “Parkway” means that portion of the public right-of way between the curb or the edge of the traveled portion of the street and the adjacent property line used for the purpose of planting and maintaining City street trees.
8. “Private tree” means any and all trees growing on private property.
9. “Property owner” means a person owning private property in the City, as shown by the County Auditor’s Plat of Manchester.
10. “Public property” means any and all property located within the confines of the City and owned by the City or held in the name of the City by any of the departments, commissions or agencies within the City Government.
11. “Public tree” means any and all trees growing on the public property including but not limited to street right-of-ways.

12. "Right-of-way" means a parcel of land intended to be occupied for streets, sidewalks, utilities and other public purposes.
13. "Shrubs" means woody vegetation usually growing with multiple stems and a height less than ten (10) feet.
14. "Topping" means heading, stubbing, rounding, tipping or "dehorning" which means the drastic removal of large branches, severely cutting back limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree.
15. "Trees" means woody vegetation usually growing with a single stem and a height over ten (10) feet.

151.03 AUTHORITY OF CITY GENERALLY. The City shall have jurisdiction over all trees and other planting on the streets, highways, alleys, parkways and City grounds within the City in order to provide orderly tree trimming and removal, to protect the health of all trees from disease and to require trees and planting to be maintained in a manner not dangerous to public safety.

151.04 TRIMMING OR REMOVAL. Nothing in this chapter shall be construed so as to give or recognize any property or vested rights in and to any trees heretofore or hereafter planted on any street or avenue in the City; the City expressly reserves and asserts its rights at any time to trim or remove or cause to be trimmed or removed any tree now or hereafter planted on any street or avenue parkway whenever the Street Superintendent deems such trimming or removal advisable for the purpose of street improvements, or to eliminate hazardous situations or for the needs of travel of traffic without compensation to the abutting property owners.

151.05 SUPERVISORY AUTHORITY OF STREET SUPERINTENDENT. The Street Superintendent shall be responsible for the enforcement of provisions of this chapter and the supervision of all work by City employees or contractors in the trimming, removal, maintenance, or planting of trees and other plantings on the streets, highways, alleys, parkways, and other City property. No person shall interfere or cause any person to interfere with any work being done under the provisions of this chapter by any employee of the City or by any person doing work for the City.

151.06 PLANTING RESTRICTIONS. No tree shall be planted in any parking or public right-of-way except in accordance with the following: No person shall plant a tree within the parking or public right-of-way without first obtaining a permit therefore, which shall show the type of tree to be planted and the placement of the tree. The application form for such permit is available at City Hall. The application for a permit shall not be considered by the Street Superintendent unless and until the applicant has staked the exact location for the proposed street tree and has obtained permission to dig in such exact location from all concerned utilities. The approval of the permit shall be at the discretion of the Street Superintendent, taking into account the provisions of this chapter, the City Tree Plan and the best interests of the community. The permit shall expire six months from date of issue. The tree planting must comply with the City Arboricultural Specifications and Standards of Practice. There will be no fee for this permit.

151.07 ARBORICULTURAL SPECIFICATIONS AND STANDARDS OF PRACTICE.

1. Establishment. There is hereby established an Arboricultural Specifications and Standards of Practice document of and for the City. This document includes but is not limited to: (i) species of street trees allowed and banned; (ii) the spacing between street trees and distances from fixed objects; (iii) proximity of street trees to utility lines; and (iv) topping.

2. Authority. The performance standards and specifications contained within the City Arboricultural Specifications and Standards of Practice shall be considered a part of this chapter and made subject to all its provisions.

151.08 TREES ON PUBLIC PROPERTY.

1. Permits. No person except the City or a person hired by the City shall plant or remove any tree on City property without first filing an application and obtaining a permit from the City. The person receiving the permit shall abide by the Arboricultural Specifications and Standards of Practice as adopted by the City. The City shall have the authority to require any permit holder to show adequate insurance coverage to cover potential damages that occur during the execution of the work. In the case of the property owner doing the work, proof of homeowner personal liability insurance may be required. If the property owner has hired another person or contractor to do the work, the contractor shall provide the City with a certificate of insurance. The certificates shall show the following minimum required limits of coverage of Commercial General Liability Insurance with limits of not less than \$500,000 per occurrence and Worker's Compensation Insurance coverage at statutory limits on any and all employees. A public utility shall also be required to obtain a permit to trim or remove any tree on any street or other public place. The work shall be limited to the actual necessities of the service of the company in the area specified on the permit. This work shall be done in accordance with the Arboricultural Specifications and Standards of Practice as established for the City. The City may assign an inspector to supervise the provisions of the permit. The cost of the service shall be charged to the public utility. In the event severe weather has caused a tree to damage utility lines, the utility company or the City (or authorized agent) may trim or remove trees necessary to repair the damaged utility lines without first obtaining a permit. A permit should be obtained before any additional trimming not required for repair of the utility line is done.

2. Planting.

A. Tree Species. The City Forestry Improvement Committee shall develop and maintain a list of desirable trees for planting in the right-of-way as part of the City's Arboricultural Specifications and Standards of Practice. The Forestry Improvement Committee shall also establish and maintain a list of trees not suitable for planting.

B. Spacing. In order to promote the healthy and vigorous growth of street trees, their spacing shall be in accordance with the City's Arboricultural Specifications and Standards of Practice.

C. Utilities. In order to minimize obstructions and conflicts, the placement of street trees under, over, adjacent to or near utility lines shall be limited as specified in the City's Arboricultural Specifications and Standards of Practice.

D. Distance from Curb and Sidewalk. In order to promote the healthy and vigorous growth of street trees, certain distances as specified in the City's Arboricultural Specifications and Standards of Practice from curbs, sidewalks, driveways and intersections shall be maintained.

E. Excavation and Construction. In order to promote and ensure the healthy and vigorous growth of street trees, any excavation, filling or construction occurring within an area specified in the City's Arboricultural Specifications and Standards of Practice of a street tree is prohibited unless a permit is obtained from the City.

F. Storage. The depositing, placement, storage or maintenance of any stone, brick, sand, concrete or other material within the drip line of a tree which may impede the free

passage of water, air or fertilizer to the roots of any street tree is prohibited without obtaining a permit.

3. Maintenance. Due to the existence of City street trees, the resulting tree-lined streets provide both aesthetic and monetary value to the property owner; therefore, the primary care and maintenance of street and parkway trees shall be the responsibility of the adjacent homeowner. Persons shall maintain trees and plants in the parkway on which their property abuts at the same standard of care imposed on persons growing trees and plants on private property. It shall be the duty of any person growing a tree or other plant on private property abutting a street or public place:

A. To keep all private trees and planting extending over any street or alley trimmed up to a height of not less than fourteen (14) feet except that a height of not less than seven (7) feet shall be permitted over the sidewalk area, and also to keep said space clear of debris. 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.

B. Not to plant any tree or other plant which would cause a public danger or a nuisance.

C. To treat in an accepted manner or remove any tree or plant diseased or insect-ridden as to constitute a hazard to other trees or plants or to constitute a nuisance to the health, welfare and safety of the community.

D. Removal. If in the opinion of the City, removal of a street tree becomes necessary, the adjacent property shall be notified as specified in the City's Arboricultural Specifications and Standards of Practice. In the event the adjacent property requests the removal of a street tree or shrub the City does not consider the removal necessary, the property owner may appeal the Street Superintendent's decision to the Forestry Improvement Committee as outlined in Section 151.10 of this chapter.

E. Traffic Control. In the event the planting, maintenance or removal of any tree requires equipment or material to be located on or fall onto the street right-of-way, the permit holder shall provide for traffic control. All traffic control shall conform to the requirements and specifications of the current edition of the *Manual of Uniform Traffic Control Devices* (MUTCD). In all cases, the disruption of smooth traffic flow shall be kept to a minimum. Additional warning devices or precautionary measures may be necessary to control pedestrian traffic.

F. Protection. No person shall:

- (1) Damage, cut, carve, nail, bolt or set fire to any street tree;
- (2) Attach any rope, chain or wire cable to any street tree;
- (3) Attach advertising posters or any other contrivance to any street tree; or
- (4) Allow any harmful gaseous, liquid, chemical or solid substance to come in contact with any street tree.

G. Tree Topping. It is unlawful as a normal practice for any person or City department to top any street tree, park tree or other tree on public property. Trees severely damaged by storms or other causes or certain trees under utility wires or other

obstructions where other pruning practices are impractical may be exempted from this section at the determination of the Street Superintendent.

151.09 TREES ON PRIVATE PROPERTY.

1. Maintenance. The property owner is responsible for the maintenance and care of any tree located on private property. Certain regulations apply to trees whose branches, limbs, roots or other parts extend into or over the street right-of-way. The property owner is responsible for ensuring private trees are trimmed to sufficient height to allow free passage of pedestrians and vehicular travel and so they will not obstruct or shade streetlights, traffic lights, signs or any traffic control devices or the view of any street intersection. Detailed information is contained in the City's Arboricultural Specifications and Standards of Practice. Whenever the City is notified or becomes aware of a dead tree or broken or dead branch or limb in any private tree which is in imminent danger of falling and thereby injuring any individual or causing property damage to adjacent property, the Street Superintendent may declare the tree, branch or limb a hazard and order the property owner to remove the hazard in an expedient manner. If the property owner fails to remove the hazard, the Street Superintendent may cause the hazard to be removed. For purposes of removing the hazard, City crews or City agents shall be allowed on private property. Attempts should be made to notify the property owner before entering onto private property.

2. Traffic Control. In the event the planting, maintenance or removal of any private tree requires equipment or material to be located on or fall onto the street right-of-way, the homeowner or the homeowner's agent shall provide for traffic control. All traffic control shall conform to the requirements and specifications of the current edition of the *Manual of Uniform Traffic Control Devices* (MUTCD). In all cases the disruption of smooth traffic flow shall be kept to a minimum. Additional warning devices or precautionary measures may be necessary to control pedestrian traffic.

151.10 ENFORCEMENT.

1. Appeals. A person may appeal the issuance or denial of a permit authorized by this chapter or an order of the Street Superintendent providing for the non-emergency removal of a tree or shrub pursuant to the following procedure:

A. Within 10 days of receiving the decision the Street Superintendent, notice of appeal shall be given to the Street Superintendent and Forestry Improvement Committee in writing. The notice of appeal shall state the nature of the objection and request a hearing. Hearing shall be held before the Forestry Improvement Committee within 20 days of the filing of the notice of appeal. Following hearing, the Forestry Improvement Committee shall, within ten (10) days, provide a written decision concerning the issues raised by the notice of appeal.

B. A person may appeal the decision of the Forestry Improvement Committee to the City Council by filing a written notice with the City Clerk within seven (7) days after issuance of the decision of the Forestry Improvement Committee. The notice of appeal shall specify the nature of the objection to the decision of the Forestry Improvement Committee, and shall include a summary of the factual basis supporting the appeal, as well as a request for hearing before the City Council. The hearing shall be held before the City Council within 20 days after the notice of appeal being filed with the City Clerk. The City Council shall, within 10 days after hearing the appeal, issue a decision. The decision of the City Council shall constitute a final decision.

2. Interference. No person shall hinder, prevent, delay or otherwise interfere with the City or any assistants in the execution or enforcement of this chapter.

3. Penalties. Any person violating or failing to comply with the provisions of this chapter shall be considered in violation, and provisions for the City to abate the nuisance shall be made as specified in Chapter 50 of this Code of Ordinances.

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 515-281-5918.