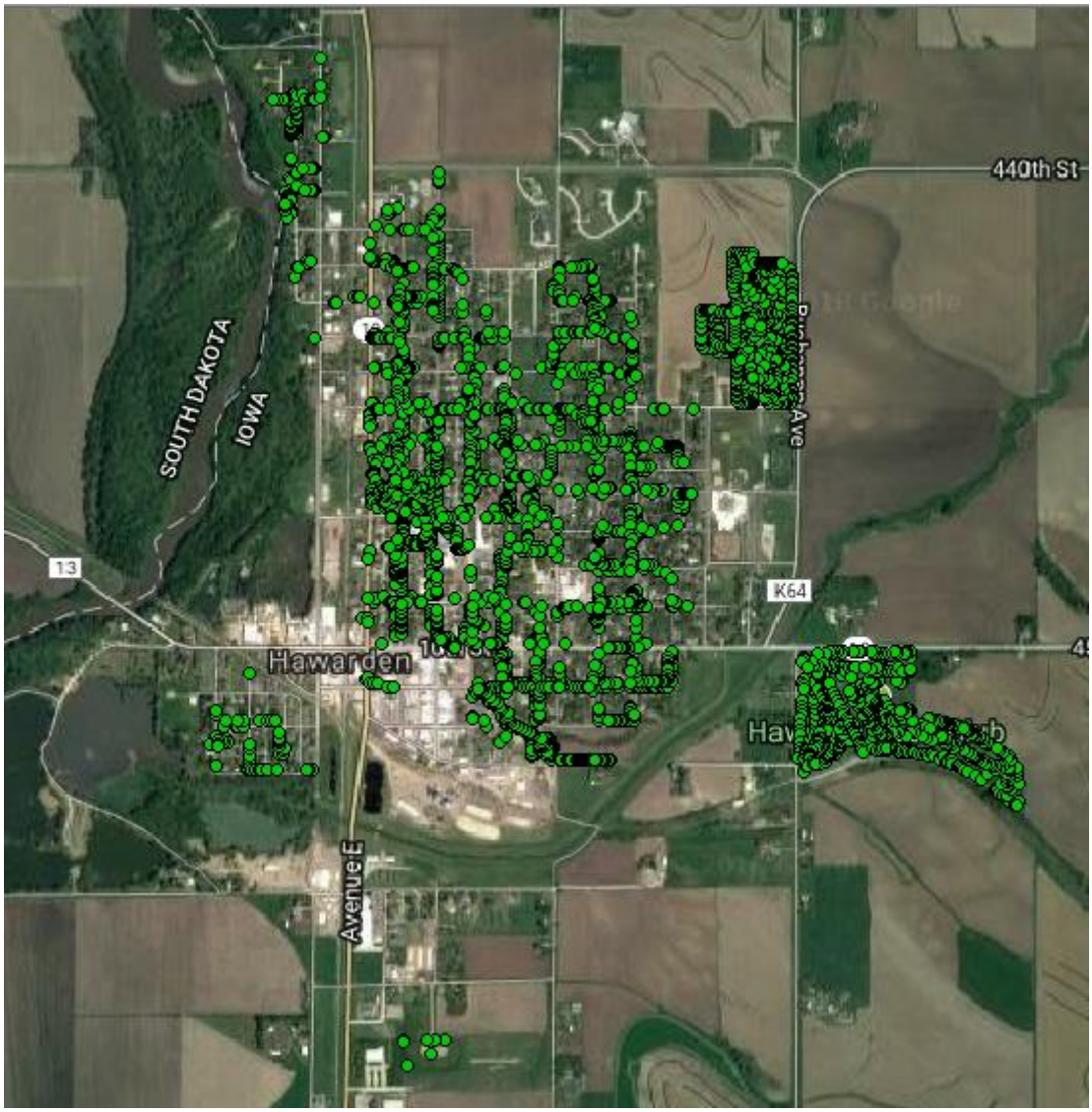
Community Tree Management Plan for Hawarden, IA



2017 Urban Forest Management Plan
Prepared by ArborPro, Inc.
In Partnership with the Iowa DNR

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Executive Summary

Overview

This plan was developed to assist the City of Hawarden with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 25.57% of Hawarden's community, unless preventative treatment is used, will become infested and 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 2017, 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 2674 trees inventoried.

- Hawarden's trees provide $437,579 of benefits annually, an average of $169 a tree
- There are over 51 species of trees
- The top three genera are: Ash 25.57%, Maple 19.96%, and Spruce 15.09%
- 81% of trees need some type of management or mitigation.
- 88 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 88 trees needing removal, 40 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*
- 66 of the 671 ash trees should be carefully examined, as they present with some of the symptoms that could be related to an EAB infestation.
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: Ash, Maple, Cottonwood, Poplar, Box Elder, Bradford Pear, female Ginko, Chinese Elm, Scot's Pine, Austrian Pine, Willow or Black Walnut.
- Check ash trees with a visual survey yearly
- With the current budget it could take 40 years to remove ash – Suggestion: request a budget increase to $15,000 annually and apply for grants to plant replacement trees

Introduction

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

Trees are an important component of Hawarden'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, storm water 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 Hawarden 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 Hawarden's urban forestry goals.

Inventory

In 2017, a tree inventory was conducted that included 100% of the city owned street trees and park trees. The tree data was collected using a hand held Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 2624 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. Hawarden's trees reduce energy related costs by approximately $113,915.20 annually (Appendix A, Table 1). These savings are both in Electricity (547 MWh) and in Natural Gas (73,865 Therms).

Annual Stormwater Benefits

Hawarden's trees intercept about 5,910,783.79 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $ 160,182.24 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 Hawarden it is estimated that trees remove 877.65 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $ 18,958.01 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Hawarden, trees sequester about 1,232,688.67 lbs of carbon a year with an associated value of $ 9,245.16 (Appendix A, Table 4). In addition, the trees store 19,356,444.24 lbs of carbon, with a yearly benefit of $145,133.33 (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. Hawarden receives $129,137.57 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, Hawarden's trees provide $437,539.02 of benefits annually. Benefits of individual trees vary based on size, species, health

and location, but on average each of the 2624 trees in Hawarden provide approximately $169 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Hawarden has over 51 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Green ash	655	24.96
Silver maple	293	11.16
Northern hackberry	204	7.77
Red maple	96	3.65
American basswood	71	2.7
Eastern cottonwood	68	2.59
Cottonwood	46	1.75
Black walnut	41	1.56
Northern red oak	23	0.87
American elm	22	0.83
Sugar maple	20	0.76
White ash	16	0.6
Quaking aspen	11	0.41
American sycamore	4	0.15
Kentucky coffeetree	2	0.07
Hickory	2	0.07
Black maple	2	0.07
Catalpa	1	0.03
Norway maple	91	3.46
Honeylocust	90	3.42
Siberian elm	58	2.21
Littleleaf linden	17	0.64
Willow	8	0.3
Birch	5	0.19
Callery pear	4	0.15
Black locust	2	0.07
Swamp white oak	1	0.03
Ohio buckeye	1	0.03
River birch	1	0.03
Ginkgo	1	0.03
Apple	147	5.6
Amur maple	22	0.83
White mulberry	14	0.53
Plum	7	0.26
Cherry plum	3	0.11

Eastern redbud	3	0.11
Mountain ash	3	0.11
Japanese tree lilac	2	0.07
Broadleaf Evergreen Large	2	0.07
Broadleaf Evergreen Medium	9	0.34
Spruce	70	2.66
Northern white cedar	24	0.91
Scotch pine	22	0.83
Norway spruce	18	0.68
Conifer Evergreen Large	17	0.64
Ponderosa pine	5	0.19
Eastern white pine	3	0.11
Blue spruce	308	11.73
Austrian pine	22	0.83
Conifer Evergreen Medium	2	0.07
Eastern red cedar	35	1.33

Age Class

Approximately one half (53.88%) of Hawarden's trees are between 0 and 18 inches in diameter at 4.5 ft. (Appendix A, Figure 2). It is preferred that the highest number of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Hawarden's size curve is on the downward side, indicating a young-mature forest stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Hawarden indicate that 9.79% of the trees are in fair health, with 89.29% of the trees in good health, and only .46% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 46.45% of Hawarden's trees are in fair health for wood condition, with 49.34% in good wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 4.22% of the population. This 4.22% 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).

Priority Tasks for All Trees by Zone (None)				
Zone	DBH Class	Tree Coun	Standard I	% of Zone	% of All Tr
	Total	161	(N/A)	6.21	6.21
Priority Tasks for All Trees by Zone (Stake/Train)				
	Total	237	(N/A)	9.14	9.14
Priority Tasks for All Trees by Zone (Crown cleaning)				
	Total	1079	(N/A)	41.60	41.60
Priority Tasks for All Trees by Zone (Crown Raising)				
	Total	548	(N/A)	21.13	21.13
Priority Tasks for All Trees by Zone (Remove)				
	Total	88	(N/A)	3.39	3.39
Priority Tasks for All Trees by Zone (Treat pest/disease)				
	Total	0	(N/A)	0.00	0.00
Priority Tasks for All Trees by Zone (Crown reduction/thinning)				
	Total	548	(N/A)	21.13	21.13

Canopy Cover

The total canopy with both private and public trees is 3.28%, 1849 acres. The canopy cover included in the Hawarden inventory includes approximately 55 acres (Appendix A, Figure 4). The City's Canopy goal is 20%, in 30 years. To achieve this goal, it is estimated that 7-12 trees need to be planted annually.

Land Use and Location

The majority of Hawarden's city and park trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use			
Single family residential	1284	(N/A)	49.50	49.50
Multi-family residential	6	(N/A)	0.23	0.23
Small commercial	5	(N/A)	0.19	0.19
Industrial/Large commercial	0	(N/A)	0.00	0.00
Park/vacant/other	1299	(N/A)	50.08	50.08
Total	2594	(N/A)	100.00	100.00
Location				
Front yard	822	(N/A)	31.34	31.34
Planting strip	567	(N/A)	21.60	21.60
Cutout	0	(N/A)	0.00	0.00
Median	0	(N/A)	0.00	0.00
Other maintained locations	1235	(N/A)	47.06	47.06
Other un-maintained locations	0	(N/A)	0.00	0.00
Backyard	0	(N/A)	0.00	0.00
Total	2634	(N/A)	100.00	100.00

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

Hawarden has 1 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 39 trees over 25 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 the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There is a total of 2374 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 88 removals, only 47 are ash trees. There is a total of 671 ash trees, and 66 of those have signs and symptoms that have been associated with EAB. In addition, there are 11 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six-year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six-year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Hawarden.

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 (52.43%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance.

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

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

Year 1

Removal: 8 largest critical concern trees
Planting and Replacement: 9 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 critical concern trees and 4 additional ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 6 trees in open locations from year one removals
Young Tree Pruning & Maintenance:
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 8 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 6 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 8 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 6 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: 24 ash trees removed (approximately 61.53% of ash). It will take approximately 10 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
** To remove all ash trees within 6 years, the budget would need to be increased to $19,500 a year. If the budget were increased to $15,000 a year all ash could be removed in 13 years.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. To stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:
• emerald ash borer
• firewood of all hardwood species (for example ash, oak, maple and hickory)
• nursery stock and green lumber of ash
• any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

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

Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. An example of City Code could state "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

Current Budget
Total $29,172 over 6 years ($4,862/year)

FY 2018 Budget
Removal: $3400
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2019 Budget
Removal: $2000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

FY 2020 Budget
Removal: $3400
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2021 Budget
Removal: $2000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

FY 2022 Budget
Removal: $3400
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2023 Budget
Removal: $2000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

*Reduction of ash over 6 years: approximately 24 ash trees removed (approximately 3.5% of ash). **It will take approximately 70 years to remove all ash with the current budget.**

Purposed Budget Increase
EAB could potentially kill all ash trees in Hawarden within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $19,500 a year. If the budget

were increased to $10,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Hawarden apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Hawarden would still need to find $8,000 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $1,800 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Hawarden. It is suggested to consider increasing the budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Hawarden

3/12/2018

Annual Energy Benefits of Public Trees by Species

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	155.35	11,791.09	20,499.23	20,089.25	31,880.34	(N/A)	25.25	27.99	48.67
Blue spruce	31.65	2,402.31	4,293.94	4,208.06	6,610.37	(N/A)	11.87	5.80	21.46
Silver maple	97.06	7,366.51	12,802.45	12,546.40	19,912.91	(N/A)	11.30	17.48	67.96
Northern hackberry	62.39	4,735.09	8,903.61	8,725.54	13,460.63	(N/A)	7.86	11.82	65.98
Apple	8.61	653.74	1,361.38	1,334.16	1,987.90	(N/A)	5.67	1.75	13.52
Red maple	14.37	1,091.04	1,933.03	1,894.37	2,985.41	(N/A)	3.70	2.62	31.10
Norway maple	18.79	1,426.48	2,635.01	2,582.31	4,008.79	(N/A)	3.51	3.52	44.05
Honeylocust	27.39	2,078.74	3,607.19	3,535.05	5,613.78	(N/A)	3.47	4.93	62.38
American basswood	12.86	975.74	1,887.14	1,849.40	2,825.14	(N/A)	2.74	2.48	39.79
Spruce	6.00	455.37	825.22	808.71	1,264.09	(N/A)	2.70	1.11	18.06
Eastern cottonwood	24.60	1,867.41	3,286.92	3,221.18	5,088.59	(N/A)	2.62	4.47	74.83
Siberian elm	15.16	1,150.72	1,987.02	1,947.28	3,098.00	(N/A)	2.24	2.72	53.41
Cottonwood	13.14	997.49	1,770.92	1,735.50	2,732.98	(N/A)	1.77	2.40	59.41
Black walnut	10.09	765.83	1,343.26	1,316.39	2,082.23	(N/A)	1.58	1.83	50.79
Eastern red cedar	2.70	204.88	406.51	398.38	603.26	(N/A)	1.35	0.53	17.24
Northern white cedar	3.84	291.38	501.65	491.62	782.99	(N/A)	0.93	0.69	32.62
Northern red oak	1.52	115.72	199.35	195.36	311.08	(N/A)	0.89	0.27	13.53
Austrian pine	1.99	150.81	283.13	277.47	428.28	(N/A)	0.85	0.38	19.47
American elm	9.59	727.57	1,246.83	1,221.89	1,949.46	(N/A)	0.85	1.71	88.61
Amur maple	0.78	59.32	127.84	125.28	184.61	(N/A)	0.85	0.16	8.39
Scotch pine	3.03	230.18	386.00	378.28	608.46	(N/A)	0.85	0.53	27.66
Sugar maple	3.18	240.99	435.62	426.91	667.89	(N/A)	0.77	0.59	33.39
Norway spruce	3.11	235.96	408.16	399.99	635.95	(N/A)	0.69	0.56	35.33
Littleleaf linden	2.77	210.14	367.28	359.94	570.08	(N/A)	0.66	0.50	33.53
Conifer Evergreen Large	1.93	146.44	241.94	237.10	383.54	(N/A)	0.66	0.34	22.56
White ash	2.83	214.59	350.26	343.26	557.85	(N/A)	0.62	0.49	34.87
White mulberry	1.53	116.05	242.95	238.09	354.14	(N/A)	0.54	0.31	25.30
Quaking aspen	1.39	105.82	180.76	177.14	282.96	(N/A)	0.42	0.25	25.72
Broadleaf Evergreen Medi	0.46	35.08	71.43	70.00	105.09	(N/A)	0.35	0.09	11.68
Willow	1.79	136.09	267.93	262.57	398.66	(N/A)	0.31	0.35	49.83
Plum	0.15	11.43	26.09	25.57	37.00	(N/A)	0.27	0.03	5.29
Ponderosa pine	0.65	49.23	87.72	85.97	135.19	(N/A)	0.19	0.12	27.04
Birch	0.61	46.39	87.50	85.75	132.14	(N/A)	0.19	0.12	26.43
American sycamore	1.12	84.94	145.77	142.86	227.80	(N/A)	0.15	0.20	56.95
Callery pear	0.34	26.08	52.74	51.68	77.76	(N/A)	0.15	0.07	19.44
Eastern redbud	0.21	15.90	29.09	28.51	44.40	(N/A)	0.12	0.04	14.80
Cherry plum	0.10	7.55	17.25	16.91	24.46	(N/A)	0.12	0.02	8.15
Mountain ash	0.26	19.83	38.12	37.36	57.19	(N/A)	0.12	0.05	19.06
Eastern white pine	0.42	32.09	54.07	52.98	85.08	(N/A)	0.12	0.07	28.36
Broadleaf Evergreen Large	0.34	25.94	42.38	41.53	67.47	(N/A)	0.08	0.06	33.73
Conifer Evergreen Medium	0.09	6.99	15.05	14.75	21.74	(N/A)	0.08	0.02	10.87
Kentucky coffeetree	0.65	49.39	91.79	89.95	139.34	(N/A)	0.08	0.12	69.67
Hickory	0.12	9.38	17.42	17.07	26.45	(N/A)	0.08	0.02	13.23
Black maple	0.37	27.89	46.56	45.63	73.53	(N/A)	0.08	0.06	36.76
Black locust	0.56	42.24	76.91	75.37	117.62	(N/A)	0.08	0.10	58.81
Japanese tree lilac	0.15	11.24	25.66	25.15	36.39	(N/A)	0.08	0.03	18.19
Catalpa	0.26	19.97	38.11	37.35	57.32	(N/A)	0.04	0.05	57.32
Swamp white oak	0.24	17.87	29.49	28.90	46.78	(N/A)	0.04	0.04	46.78
Ginkgo	0.07	5.04	9.88	9.68	14.72	(N/A)	0.04	0.01	14.72
River birch	0.26	19.91	39.57	38.78	58.69	(N/A)	0.04	0.05	58.69
Ohio buckeye	0.26	19.91	39.57	38.78	58.69	(N/A)	0.04	0.05	58.69
Total	547.14	41,527.79	73,864.70	72,387.41	113,915.20	(N/A)	100.00	100.00	43.91

Table 2: Annual Storm Water Benefits

Hawarden

3/12/2018

Annual Stormwater Benefits of Public Trees by Species

Species	Total Rainfall Interception (Gal)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	1,414,869.10	38,342.95	(N/A)	25.25	23.94	58.54
Blue spruce	439,909.14	11,921.54	(N/A)	11.87	7.44	38.71
Silver maple	1,378,065.04	37,345.56	(N/A)	11.30	23.31	127.46
Northern hackberry	550,817.58	14,927.16	(N/A)	7.86	9.32	73.17
Apple	35,596.76	964.67	(N/A)	5.67	0.60	6.56
Red maple	110,911.18	3,005.69	(N/A)	3.70	1.88	31.31
Norway maple	151,086.61	4,094.45	(N/A)	3.51	2.56	44.99
Honeylocust	289,575.67	7,847.50	(N/A)	3.47	4.90	87.19
American basswood	125,572.00	3,403.00	(N/A)	2.74	2.12	47.93
Spruce	81,764.89	2,215.83	(N/A)	2.70	1.38	31.65
Eastern cottonwood	326,125.76	8,838.01	(N/A)	2.62	5.52	129.97
Siberian elm	155,192.63	4,205.72	(N/A)	2.24	2.63	72.51
Cottonwood	169,888.34	4,603.97	(N/A)	1.77	2.87	100.09
Black walnut	94,848.60	2,570.40	(N/A)	1.58	1.60	62.69
Eastern red cedar	38,748.86	1,050.09	(N/A)	1.35	0.66	30.00
Northern white cedar	81,892.85	2,219.30	(N/A)	0.93	1.39	92.47
Northern red oak	10,338.98	280.19	(N/A)	0.89	0.17	12.18
Austrian pine	26,572.35	720.11	(N/A)	0.85	0.45	32.73
American elm	86,716.16	2,350.01	(N/A)	0.85	1.47	106.82
Amur maple	2,646.85	71.73	(N/A)	0.85	0.04	3.26
Scotch pine	56,542.03	1,532.29	(N/A)	0.85	0.96	69.65
Sugar maple	27,912.89	756.44	(N/A)	0.77	0.47	37.82
Norway spruce	71,845.26	1,947.01	(N/A)	0.69	1.22	108.17
Littleleaf linden	20,950.08	567.75	(N/A)	0.66	0.35	33.40
Conifer Evergreen Large	30,024.16	813.65	(N/A)	0.66	0.51	47.86
White ash	21,546.45	583.91	(N/A)	0.62	0.36	36.49
White mulberry	7,746.87	209.94	(N/A)	0.54	0.13	15.00
Quaking aspen	8,823.29	239.11	(N/A)	0.42	0.15	21.74
Broadleaf Evergreen Mediu	2,962.27	80.28	(N/A)	0.35	0.05	8.92
Willow	18,905.79	512.35	(N/A)	0.31	0.32	64.04
Plum	492.81	13.36	(N/A)	0.27	0.01	1.91
Ponderosa pine	13,724.98	371.95	(N/A)	0.19	0.23	74.39
Birch	4,498.74	121.92	(N/A)	0.19	0.08	24.38
American sycamore	11,012.30	298.43	(N/A)	0.15	0.19	74.61
Callery pear	2,816.89	76.34	(N/A)	0.15	0.05	19.08
Eastern redbud	742.64	20.13	(N/A)	0.12	0.01	6.71
Cherry plum	340.60	9.23	(N/A)	0.12	0.01	3.08
Mountain ash	938.47	25.43	(N/A)	0.12	0.02	8.48
Eastern white pine	7,476.99	202.63	(N/A)	0.12	0.13	67.54
Broadleaf Evergreen Large	3,276.98	88.81	(N/A)	0.08	0.06	44.40
Conifer Evergreen Medium	1,011.91	27.42	(N/A)	0.08	0.02	13.71
Kentucky coffeetree	8,081.21	219.00	(N/A)	0.08	0.14	109.50
Hickory	779.49	21.12	(N/A)	0.08	0.01	10.56
Black maple	2,229.16	60.41	(N/A)	0.08	0.04	30.21
Black locust	5,173.44	140.20	(N/A)	0.08	0.09	70.10
Japanese tree lilac	528.98	14.34	(N/A)	0.08	0.01	7.17
Catalpa	2,590.68	70.21	(N/A)	0.04	0.04	70.21
Swamp white oak	1,409.09	38.19	(N/A)	0.04	0.02	38.19
Ginkgo	301.39	8.17	(N/A)	0.04	0.01	8.17
River birch	2,479.28	67.19	(N/A)	0.04	0.04	67.19
Ohio buckeye	2,479.28	67.19	(N/A)	0.04	0.04	67.19
Citywide total	5,910,783.79	160,182.24	(N/A)	100.00	100.00	61.75

Table 3: Annual Air Quality Benefits

Hawarden

3/12/2018

Annual Air Quality Benefits of Public Trees by Species

Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Tree Numbers	Avg. $/tree
Green ash	149.12	23.85	76.18	6.69	807.82	734.90	107.51	102.62	704.18	4,595.30	0.00	0.00	1,905.03	5,403.12	(N/A)	25.25	8.25
Blue spruce	58.86	11.67	49.35	7.24	390.63	150.30	21.93	20.92	143.28	937.88	- 160.02	- 600.08	303.52	728.43	(N/A)	11.87	2.37
Silver maple	237.68	40.29	116.88	10.54	1,282.07	457.82	67.00	63.96	439.06	2,863.73	- 124.50	- 466.87	1,308.74	3,678.93	(N/A)	11.30	12.56
Northern hackberry	80.83	13.99	42.22	3.62	444.08	301.59	43.66	41.56	282.97	1,870.08	0.00	0.00	810.45	2,314.15	(N/A)	7.86	11.34
Apple	9.55	1.57	4.70	0.44	51.39	42.70	6.10	5.79	39.02	262.04	- 0.05	- 0.20	109.81	313.23	(N/A)	5.67	2.13
Red maple	24.64	4.20	11.74	1.09	131.93	68.23	9.96	9.50	65.12	425.96	- 8.51	- 31.92	185.98	525.97	(N/A)	3.70	5.48
Norway maple	28.17	4.86	14.19	1.25	153.20	90.47	13.13	12.50	85.28	562.01	- 6.83	- 25.63	243.02	689.58	(N/A)	3.51	7.58
Honeylocust	55.94	9.22	25.61	2.55	295.62	129.21	18.91	18.06	123.97	808.38	- 42.90	- 160.88	340.57	943.12	(N/A)	3.47	10.48
American basswood	15.49	2.64	7.94	0.69	84.48	62.63	9.03	8.59	58.34	387.24	- 13.71	- 51.42	151.63	420.30	(N/A)	2.74	5.92
Spruce	8.65	1.71	7.65	1.06	58.51	28.62	4.17	3.97	27.17	178.29	- 32.61	- 122.29	50.39	114.51	(N/A)	2.70	1.64
Eastern cottonwood	54.01	8.64	24.25	2.42	283.09	116.77	17.05	16.27	111.49	729.12	0.00	0.00	350.90	1,012.21	(N/A)	2.62	14.89
Siberian elm	25.77	4.39	12.64	1.14	138.97	71.54	10.48	10.00	68.68	447.67	0.00	0.00	204.63	586.64	(N/A)	2.24	10.11
Cottonwood	29.35	4.69	13.19	1.31	153.86	62.49	9.12	8.70	59.55	389.90	0.00	0.00	188.40	543.76	(N/A)	1.77	11.82
Black walnut	10.26	1.64	5.19	0.46	55.44	47.84	6.99	6.67	45.74	298.86	0.00	0.00	124.79	354.30	(N/A)	1.58	8.64
Eastern red cedar	7.19	1.42	5.79	0.88	47.04	13.17	1.90	1.80	12.22	81.31	- 21.19	- 79.47	23.18	48.87	(N/A)	1.35	1.40
Northern white cedar	9.81	1.94	7.86	1.21	64.05	18.07	2.65	2.53	17.39	113.18	- 44.60	- 167.24	16.85	9.99	(N/A)	0.93	0.42
Northern red oak	1.87	0.32	0.97	0.08	10.23	7.19	1.05	1.01	6.91	45.01	- 2.61	- 9.78	16.79	45.46	(N/A)	0.89	1.98
Austrian pine	3.48	0.69	2.98	0.43	23.26	9.56	1.39	1.32	8.99	59.33	- 9.32	- 34.95	19.51	47.64	(N/A)	0.85	2.17
American elm	22.61	3.85	10.77	1.00	121.06	45.21	6.62	6.32	43.44	283.01	0.00	0.00	139.84	404.08	(N/A)	0.85	18.37
Amur maple	0.44	0.07	0.26	0.02	2.50	3.91	0.56	0.53	3.54	23.91	0.00	- 0.01	9.33	26.40	(N/A)	0.85	1.20
Scotch pine	6.62	1.31	5.39	0.81	43.50	14.18	2.09	1.99	13.74	89.07	- 28.44	- 106.65	17.70	25.92	(N/A)	0.85	1.18
Sugar maple	3.18	0.54	1.72	0.14	17.58	15.14	2.21	2.10	14.38	94.36	- 2.60	- 9.75	36.81	102.18	(N/A)	0.77	5.11
Norway spruce	8.76	1.73	6.95	1.08	57.00	14.65	2.15	2.05	14.08	91.73	- 42.46	- 159.23	8.99	- 10.50	(N/A)	0.69	- 0.58
Littleleaf linden	2.96	0.51	1.56	0.13	16.27	13.14	1.92	1.83	12.57	82.11	- 1.54	- 5.79	33.07	92.59	(N/A)	0.66	5.45
Conifer Evergreen Large	3.38	0.67	2.83	0.41	22.40	8.99	1.32	1.27	8.74	56.54	- 13.07	- 49.02	14.53	29.91	(N/A)	0.66	1.76
White ash	1.76	0.28	1.02	0.08	9.85	13.15	1.94	1.86	12.81	82.79	0.00	0.00	32.89	92.64	(N/A)	0.62	5.79
White mulberry	2.57	0.42	1.19	0.12	13.60	7.59	1.08	1.03	6.93	46.56	- 0.01	- 0.05	20.91	60.11	(N/A)	0.54	4.29
Quaking aspen	0.50	0.08	0.35	0.02	2.98	6.56	0.96	0.92	6.32	41.10	0.00	0.00	15.71	44.09	(N/A)	0.42	4.01
Broadleaf Evergreen Mediu	0.08	0.02	0.22	0.01	0.97	2.26	0.32	0.31	2.07	13.91	- 0.61	- 2.29	4.69	12.59	(N/A)	0.35	1.40
Willow	4.07	0.70	1.97	0.18	21.92	8.78	1.26	1.20	8.13	54.15	- 0.93	- 3.51	25.36	72.56	(N/A)	0.31	9.07
Plum	0.06	0.01	0.04	0.00	0.34	0.77	0.11	0.10	0.68	4.65	0.00	0.00	1.77	5.00	(N/A)	0.27	0.71
Ponderosa pine	1.61	0.32	1.30	0.20	10.55	3.08	0.45	0.43	2.94	19.22	- 7.05	- 26.44	3.27	3.32	(N/A)	0.19	0.66
Birch	0.77	0.13	0.40	0.03	4.20	2.96	0.43	0.41	2.77	18.34	- 0.19	- 0.72	7.71	21.82	(N/A)	0.19	4.36
American sycamore	1.28	0.20	0.63	0.06	6.85	5.28	0.77	0.74	5.07	33.04	0.00	0.00	14.03	39.89	(N/A)	0.15	9.97
Callery pear	0.50	0.09	0.26	0.02	2.75	1.69	0.24	0.23	1.56	10.43	- 0.12	- 0.46	4.48	12.72	(N/A)	0.15	3.18
Eastern redbud	0.21	0.03	0.10	0.01	1.13	1.00	0.15	0.14	0.95	6.24	0.00	0.00	2.59	7.37	(N/A)	0.12	2.46
Cherry plum	0.05	0.01	0.03	0.00	0.29	0.51	0.07	0.07	0.45	3.08	0.00	0.00	1.19	3.36	(N/A)	0.12	1.12
Mountain ash	0.25	0.04	0.12	0.01	1.36	1.27	0.18	0.17	1.18	7.85	0.00	0.00	3.24	9.21	(N/A)	0.12	3.07
Eastern white pine	0.86	0.17	0.71	0.11	5.66	1.98	0.29	0.28	1.91	12.42	- 3.30	- 12.37	3.00	5.71	(N/A)	0.12	1.90
Broadleaf Evergreen Large	0.25	0.05	0.26	0.03	1.79	1.59	0.23	0.22	1.54	9.99	- 1.29	- 4.85	2.88	6.93	(N/A)	0.08	3.47
Conifer Evergreen Medium	0.08	0.02	0.09	0.01	0.60	0.46	0.07	0.06	0.42	2.82	- 0.30	- 1.13	0.90	2.29	(N/A)	0.08	1.14
Kentucky coffeetree	1.06	0.17	0.50	0.05	5.61	3.13	0.45	0.43	2.95	19.44	0.00	0.00	8.74	25.05	(N/A)	0.08	12.53
Hickory	0.03	0.00	0.03	0.00	0.18	0.59	0.09	0.08	0.56	3.69	0.00	0.00	1.38	3.86	(N/A)	0.08	1.93
Black maple	0.40	0.07	0.20	0.02	2.17	1.72	0.25	0.24	1.67	10.80	- 0.15	- 0.58	4.41	12.39	(N/A)	0.08	6.20
Black locust	1.08	0.19	0.53	0.05	5.84	2.67	0.39	0.37	2.53	16.60	- 0.25	- 0.94	7.55	21.50	(N/A)	0.08	10.75
Japanese tree lilac	0.09	0.01	0.05	0.00	0.51	0.75	0.11	0.10	0.67	4.58	0.00	0.00	1.79	5.09	(N/A)	0.08	2.55
Catalpa	0.27	0.04	0.14	0.01	1.44	1.27	0.18	0.18	1.19	7.90	0.00	0.00	3.28	9.34	(N/A)	0.04	9.34
Swamp white oak	0.22	0.04	0.12	0.01	1.21	1.10	0.16	0.16	1.07	6.93	- 0.06	- 0.22	2.81	7.92	(N/A)	0.04	7.92
Ginkgo	0.03	0.01	0.02	0.00	0.18	0.32	0.05	0.04	0.30	2.00	- 0.01	- 0.06	0.76	2.12	(N/A)	0.04	2.12
River birch	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	(N/A)	0.04	10.16
Ohio buckeye	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	(N/A)	0.04	10.16
Citywide Total	877.65	149.70	469.55	47.76	4,863.28	2,601.39	379.50	361.99	2,478.91	16,230.41	- 569.52	- 2,135.68	6,796.94	18,958.01	(N/A)	100.00	7.31

Table 4: Annual Carbon Stored

Hawarden

3/12/2018

Stored CO2 Benefits of Public Trees by Species

Species	Total stored CO2 (lbs)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	4,873,559.94	36,551.70	(N/A)	25.25	25.18	55.80
Blue spruce	399,538.64	2,996.54	(N/A)	11.87	2.06	9.73
Silver maple	5,421,583.99	40,661.88	(N/A)	11.30	28.01	138.78
Northern hackberry	1,183,462.20	8,875.97	(N/A)	7.86	6.11	43.51
Apple	160,217.45	1,201.63	(N/A)	5.67	0.83	8.17
Red maple	273,895.12	2,054.21	(N/A)	3.70	1.42	21.40
Norway maple	463,969.81	3,479.77	(N/A)	3.51	2.40	38.24
Honeylocust	715,756.77	5,368.18	(N/A)	3.47	3.70	59.65
American basswood	566,133.22	4,246.00	(N/A)	2.74	2.92	59.80
Spruce	71,840.72	538.81	(N/A)	2.70	0.37	7.70
Eastern cottonwood	1,840,904.20	13,806.78	(N/A)	2.62	9.51	203.04
Siberian elm	635,324.20	4,764.93	(N/A)	2.24	3.28	82.15
Cottonwood	1,014,082.18	7,605.62	(N/A)	1.77	5.24	165.34
Black walnut	335,640.80	2,517.31	(N/A)	1.58	1.73	61.40
Eastern red cedar	23,968.51	179.76	(N/A)	1.35	0.12	5.14
Northern white cedar	113,011.36	847.59	(N/A)	0.93	0.58	35.32
Northern red oak	35,451.43	265.89	(N/A)	0.89	0.18	11.56
Austrian pine	24,008.76	180.07	(N/A)	0.85	0.12	8.18
American elm	458,373.77	3,437.80	(N/A)	0.85	2.37	156.26
Amur maple	9,035.21	67.76	(N/A)	0.85	0.05	3.08
Scotch pine	70,288.92	527.17	(N/A)	0.85	0.36	23.96
Sugar maple	91,353.78	685.15	(N/A)	0.77	0.47	34.26
Norway spruce	109,742.56	823.07	(N/A)	0.69	0.57	45.73
Littleleaf linden	65,744.73	493.09	(N/A)	0.66	0.34	29.01
Conifer Evergreen Large	30,594.36	229.46	(N/A)	0.66	0.16	13.50
White ash	49,461.23	370.96	(N/A)	0.62	0.26	23.18
White mulberry	40,765.50	305.74	(N/A)	0.54	0.21	21.84
Quaking aspen	18,442.66	138.32	(N/A)	0.42	0.10	12.57
Broadleaf Evergreen Medi	1,892.09	14.19	(N/A)	0.35	0.01	1.58
Willow	66,911.60	501.84	(N/A)	0.31	0.35	62.73
Plum	1,482.63	11.12	(N/A)	0.27	0.01	1.59
Ponderosa pine	17,556.71	131.68	(N/A)	0.19	0.09	26.34
Birch	12,703.79	95.28	(N/A)	0.19	0.07	19.06
American sycamore	41,744.50	313.08	(N/A)	0.15	0.22	78.27
Callery pear	8,399.06	62.99	(N/A)	0.15	0.04	15.75
Eastern redbud	3,228.73	24.22	(N/A)	0.12	0.02	8.07
Cherry plum	1,099.48	8.25	(N/A)	0.12	0.01	2.75
Mountain ash	3,958.85	29.69	(N/A)	0.12	0.02	9.90
Eastern white pine	7,855.72	58.92	(N/A)	0.12	0.04	19.64
Broadleaf Evergreen Large	4,619.65	34.65	(N/A)	0.08	0.02	17.32
Conifer Evergreen Medium	327.06	2.45	(N/A)	0.08	0.00	1.23
Kentucky coffeetree	34,400.83	258.01	(N/A)	0.08	0.18	129.00
Hickory	1,219.99	9.15	(N/A)	0.08	0.01	4.57
Black maple	4,724.83	35.44	(N/A)	0.08	0.02	17.72
Black locust	17,904.31	134.28	(N/A)	0.08	0.09	67.14
Japanese tree lilac	1,815.81	13.62	(N/A)	0.08	0.01	6.81
Catalpa	8,457.68	63.43	(N/A)	0.04	0.04	63.43
Swamp white oak	3,624.16	27.18	(N/A)	0.04	0.02	27.18
Ginkgo	474.14	3.56	(N/A)	0.04	0.00	3.56
River birch	7,945.29	59.59	(N/A)	0.04	0.04	59.59
Ohio buckeye	7,945.29	59.59	(N/A)	0.04	0.04	59.59
Citywide total	19,356,444.24	145,173.33	(N/A)	100.00	100.00	55.97

Table 5: Annual Carbon Sequestered

Hawarden

3/12/2018

Annual CO2 Benefits of Public Trees by Species

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	349,786.47	2,623.40	- 23,393.28	- 1,530.37	- 186.93	260,579.88	1,954.35	585,442.70	4,390.82	(N/A)	25.25	28.54	6.70
Blue spruce	26,416.46	198.12	- 1,917.80	- 563.75	- 18.61	53,090.33	398.18	77,025.24	577.69	(N/A)	11.87	3.75	1.88
Silver maple	403,533.36	3,026.50	- 26,023.93	- 1,067.05	- 203.18	162,797.98	1,220.98	539,240.36	4,044.30	(N/A)	11.30	26.29	13.80
Northern hackberry	74,401.88	558.01	- 5,682.62	- 572.53	- 46.91	104,644.33	784.83	172,791.07	1,295.93	(N/A)	7.86	8.42	6.35
Apple	14,019.14	105.14	- 770.06	- 140.40	- 6.83	14,447.52	108.36	27,556.20	206.67	(N/A)	5.67	1.34	1.41
Red maple	27,642.17	207.32	- 1,315.72	- 136.50	- 10.89	24,111.71	180.84	50,301.66	377.26	(N/A)	3.70	2.45	3.93
Norway maple	30,667.65	230.01	- 2,228.29	- 183.50	- 18.09	31,524.82	236.44	59,780.68	448.36	(N/A)	3.51	2.91	4.93
Honeylocust	75,621.56	567.16	- 3,437.34	- 215.87	- 27.40	45,939.55	344.55	117,907.90	884.31	(N/A)	3.47	5.75	9.83
American basswood	36,037.99	270.28	- 2,717.76	- 152.49	- 21.53	21,563.70	161.73	54,731.44	410.49	(N/A)	2.74	2.67	5.78
Spruce	5,983.82	44.88	- 344.84	- 108.23	- 3.40	10,063.64	75.48	15,594.40	116.96	(N/A)	2.70	0.76	1.67
Eastern cottonwood	46,634.09	349.76	- 8,836.34	- 272.22	- 68.31	41,269.18	309.52	78,794.70	590.96	(N/A)	2.62	3.84	8.69
Siberian elm	27,752.25	208.14	- 3,052.40	- 161.66	- 24.11	25,430.50	190.73	49,968.69	374.77	(N/A)	2.24	2.44	6.46
Cottonwood	22,842.73	171.32	- 4,867.59	- 150.74	- 37.64	22,044.16	165.33	39,868.56	299.01	(N/A)	1.77	1.94	6.50
Black walnut	22,870.31	171.53	- 1,611.08	- 100.23	- 12.83	16,924.72	126.94	38,083.73	285.63	(N/A)	1.58	1.86	6.97
Eastern red cedar	950.09	7.13	- 115.05	- 52.26	- 1.25	4,527.69	33.96	5,310.47	39.83	(N/A)	1.35	0.26	1.14
Northern white cedar	3,872.25	29.04	- 542.45	- 74.88	- 4.63	6,439.37	48.30	9,694.29	72.71	(N/A)	0.93	0.47	3.03
Northern red oak	2,144.71	16.09	- 170.77	- 18.53	- 1.42	2,557.30	19.18	4,512.72	33.85	(N/A)	0.89	0.22	1.47
Austrian pine	1,533.15	11.50	- 115.24	- 36.08	- 1.13	3,332.95	25.00	4,714.78	35.36	(N/A)	0.85	0.23	1.61
American elm	11,633.24	87.25	- 2,200.19	- 91.26	- 17.19	16,079.08	120.59	25,420.86	190.66	(N/A)	0.85	1.24	8.67
Amur maple	1,251.08	9.38	- 43.55	- 15.02	- 0.44	1,311.03	9.83	2,503.55	18.78	(N/A)	0.85	0.12	0.85
Scotch pine	2,784.11	20.88	- 337.39	- 56.55	- 2.95	5,087.02	38.15	7,477.18	56.08	(N/A)	0.85	0.36	2.55
Sugar maple	6,106.65	45.80	- 440.70	- 34.52	- 3.56	5,325.76	39.94	10,957.19	82.18	(N/A)	0.77	0.53	4.11
Norway spruce	2,585.57	19.39	- 526.76	- 63.96	- 4.43	5,214.56	39.11	7,209.40	54.07	(N/A)	0.69	0.35	3.00
Littleleaf linden	7,986.79	59.90	- 316.17	- 31.01	- 2.60	4,643.95	34.83	12,283.57	92.13	(N/A)	0.66	0.60	5.42
Conifer Evergreen Large	2,036.55	15.27	- 146.85	- 32.96	- 1.35	3,236.25	24.27	5,092.99	38.20	(N/A)	0.66	0.25	2.25
White ash	6,109.57	45.82	- 239.19	- 25.55	- 1.99	4,742.49	35.57	10,587.32	79.40	(N/A)	0.62	0.52	4.96
White mulberry	2,251.74	16.89	- 195.76	- 23.40	- 1.64	2,564.59	19.23	4,597.17	34.48	(N/A)	0.54	0.22	2.46
Quaking aspen	2,871.76	21.54	- 88.52	- 14.63	- 0.77	2,338.50	17.54	5,107.11	38.30	(N/A)	0.42	0.25	3.48
Broadleaf Evergreen Mediu	264.36	1.98	- 9.08	- 7.02	- 0.12	775.36	5.82	1,023.62	7.68	(N/A)	0.35	0.05	0.85
Willow	1,510.77	11.33	- 321.93	- 21.84	- 2.58	3,007.54	22.56	4,174.55	31.31	(N/A)	0.31	0.20	3.91
Plum	253.74	1.90	- 7.25	- 3.51	- 0.08	252.56	1.89	495.55	3.72	(N/A)	0.27	0.02	0.53
Ponderosa pine	836.18	6.27	- 84.27	- 12.29	- 0.72	1,087.91	8.16	1,827.53	13.71	(N/A)	0.19	0.09	2.74
Birch	1,090.65	8.18	- 61.09	- 6.24	- 0.50	1,025.27	7.69	2,048.59	15.36	(N/A)	0.19	0.10	3.07
American sycamore	2,509.95	18.82	- 200.37	- 10.92	- 1.58	1,877.15	14.08	4,175.81	31.32	(N/A)	0.15	0.20	7.83
Callery pear	666.56	5.00	- 41.77	- 4.10	- 0.34	576.25	4.32	1,196.95	8.98	(N/A)	0.15	0.06	2.24
Eastern redbud	314.26	2.36	- 15.54	- 2.73	- 0.14	351.29	2.63	647.28	4.85	(N/A)	0.12	0.03	1.62
Cherry plum	160.50	1.20	- 5.32	- 1.95	- 0.05	166.96	1.25	320.18	2.40	(N/A)	0.12	0.02	0.80
Mountain ash	390.20	2.93	- 19.05	- 3.32	- 0.17	438.26	3.29	806.09	6.05	(N/A)	0.12	0.04	2.02
Eastern white pine	490.30	3.68	- 37.71	- 7.41	- 0.34	709.26	5.32	1,154.44	8.66	(N/A)	0.12	0.06	2.89
Broadleaf Evergreen Large	615.95	4.62	- 22.17	- 3.12	- 0.19	573.19	4.30	1,163.85	8.73	(N/A)	0.08	0.06	4.36
Conifer Evergreen Medium	50.67	0.38	- 1.57	- 1.76	- 0.02	154.58	1.16	201.92	1.51	(N/A)	0.08	0.01	0.76
Kentucky coffeetree	1,619.28	12.14	- 165.12	- 7.02	- 1.29	1,091.41	8.19	2,538.55	19.04	(N/A)	0.08	0.12	9.52
Hickory	282.98	2.12	- 5.86	- 1.76	- 0.06	207.39	1.56	482.76	3.62	(N/A)	0.08	0.02	1.81
Black maple	648.47	4.86	- 22.68	- 3.12	- 0.19	616.41	4.62	1,239.08	9.29	(N/A)	0.08	0.06	4.65
Black locust	385.95	2.89	- 85.94	- 6.24	- 0.69	933.60	7.00	1,227.36	9.21	(N/A)	0.08	0.06	4.60
Japanese tree lilac	227.75	1.71	- 8.72	- 2.34	- 0.08	248.31	1.86	465.00	3.49	(N/A)	0.08	0.02	1.74
Catalpa	659.69	4.95	- 40.60	- 2.73	- 0.32	441.38	3.31	1,057.75	7.93	(N/A)	0.04	0.05	7.93
Swamp white oak	385.95	2.89	- 17.40	- 1.95	- 0.15	395.01	2.96	761.61	5.71	(N/A)	0.04	0.04	5.71
Ginkgo	57.58	0.43	- 2.28	- 1.17	- 0.03	111.34	0.84	165.47	1.24	(N/A)	0.04	0.01	1.24
River birch	469.91	3.52	- 38.14	- 2.73	- 0.31	440.02	3.30	869.07	6.52	(N/A)	0.04	0.04	6.52
Ohio buckeye	469.91	3.52	- 38.14	- 2.73	- 0.31	440.02	3.30	869.07	6.52	(N/A)	0.04	0.04	6.52
Citywide Total	1,232,688.67	9,245.16	- 92,929.65	- 6,044.08	- 742.30	917,753.07	6,883.15	2,051,468.01	15,386.01	(N/A)	100.00	100.00	5.93

Table 6: Annual Social and Aesthetic Benefits

Hawarden

3/12/2018

Average Annual Benefits of Public Trees by Species ($/tree)

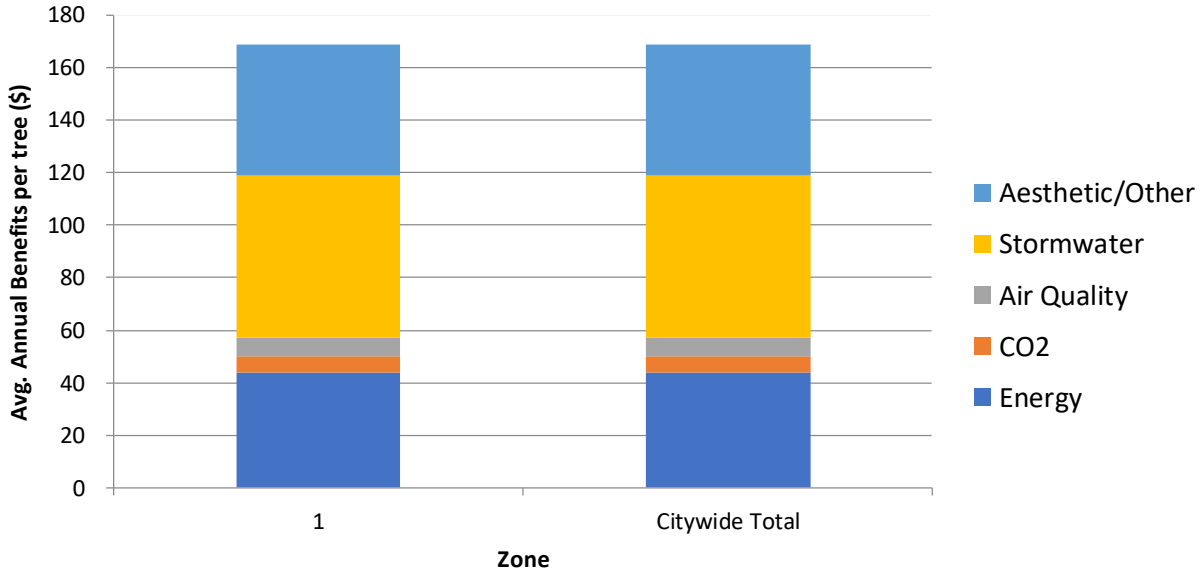
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total	Standard Error
Green ash	48.67	6.70	8.25	58.54	48.90	171.06	(N/A)
Blue spruce	21.46	1.88	2.37	38.71	20.60	85.01	(N/A)
Silver maple	67.96	13.80	12.56	127.46	106.63	328.41	(N/A)
Northern hackberry	65.98	6.35	11.34	73.17	51.62	208.47	(N/A)
Apple	13.52	1.41	2.13	6.56	5.41	29.03	(N/A)
Red maple	31.10	3.93	5.48	31.31	38.70	110.51	(N/A)
Norway maple	44.05	4.93	7.58	44.99	33.12	134.68	(N/A)
Honeylocust	62.38	9.83	10.48	87.19	200.79	370.66	(N/A)
American basswood	39.79	5.78	5.92	47.93	38.65	138.07	(N/A)
Spruce	18.06	1.67	1.64	31.65	22.12	75.14	(N/A)
Eastern cottonwood	74.83	8.69	14.89	129.97	50.84	279.22	(N/A)
Siberian elm	53.41	6.46	10.11	72.51	36.76	179.26	(N/A)
Cottonwood	59.41	6.50	11.82	100.09	40.06	217.88	(N/A)
Black walnut	50.79	6.97	8.64	62.69	50.34	179.43	(N/A)
Eastern red cedar	17.24	1.14	1.40	30.00	12.69	62.46	(N/A)
Northern white cedar	32.62	3.03	0.42	92.47	31.57	160.11	(N/A)
Northern red oak	13.53	1.47	1.98	12.18	8.69	37.84	(N/A)
Austrian pine	19.47	1.61	2.17	32.73	20.50	76.47	(N/A)
American elm	88.61	8.67	18.37	106.82	69.51	291.97	(N/A)
Amur maple	8.39	0.85	1.20	3.26	3.09	16.80	(N/A)
Scotch pine	27.66	2.55	1.18	69.65	29.74	130.77	(N/A)
Sugar maple	33.39	4.11	5.11	37.82	34.81	115.25	(N/A)
Norway spruce	35.33	3.00	- 0.58	108.17	21.65	167.57	(N/A)
Littleleaf linden	33.53	5.42	5.45	33.40	51.54	129.34	(N/A)
Conifer Evergreen Large	22.56	2.25	1.76	47.86	29.94	104.37	(N/A)
White ash	34.87	4.96	5.79	36.49	51.76	133.87	(N/A)
White mulberry	25.30	2.46	4.29	15.00	9.41	56.45	(N/A)
Quaking aspen	25.72	3.48	4.01	21.74	32.02	86.97	(N/A)
Broadleaf Evergreen Mediu	11.68	0.85	1.40	8.92	13.62	36.47	(N/A)
Willow	49.83	3.91	9.07	64.04	18.10	144.96	(N/A)
Plum	5.29	0.53	0.71	1.91	1.81	10.25	(N/A)
Ponderosa pine	27.04	2.74	0.66	74.39	34.87	139.70	(N/A)
Birch	26.43	3.07	4.36	24.38	22.78	81.03	(N/A)
American sycamore	56.95	7.83	9.97	74.61	54.00	203.36	(N/A)
Callery pear	19.44	2.24	3.18	19.08	17.89	61.84	(N/A)
Eastern redbud	14.80	1.62	2.46	6.71	5.86	31.44	(N/A)
Cherry plum	8.15	0.80	1.12	3.08	2.83	15.98	(N/A)
Mountain ash	19.06	2.02	3.07	8.48	7.31	39.93	(N/A)
Eastern white pine	28.36	2.89	1.90	67.54	42.16	142.85	(N/A)
Broadleaf Evergreen Large	33.73	4.36	3.47	44.40	77.75	163.72	(N/A)
Conifer Evergreen Medium	10.87	0.76	1.14	13.71	16.70	43.18	(N/A)
Kentucky coffeetree	69.67	9.52	12.53	109.50	62.14	263.36	(N/A)
Hickory	13.23	1.81	1.93	10.56	21.64	49.18	(N/A)
Black maple	36.76	4.65	6.20	30.21	47.86	125.67	(N/A)
Black locust	58.81	4.60	10.75	70.10	19.58	163.84	(N/A)
Japanese tree lilac	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Catalpa	57.32	7.93	9.34	70.21	57.69	202.49	(N/A)
Swamp white oak	46.78	5.71	7.92	38.19	39.16	137.75	(N/A)
Ginkgo	14.72	1.24	2.12	8.17	6.77	33.03	(N/A)
River birch	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)
Ohio buckeye	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)
Citywide Total	43.91	5.93	7.31	61.75	49.78	168.69	(N/A)

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	31,880.34	4,390.82	5,403.12	38,342.95	32,026.60	112,043.83	(N/A)	25.61
Blue spruce	6,610.37	577.69	728.43	11,921.54	6,344.35	26,182.37	(N/A)	5.98
Silver maple	19,912.91	4,044.30	3,678.93	37,345.56	31,241.69	96,223.40	(N/A)	21.99
Northern hackberry	13,460.63	1,295.93	2,314.15	14,927.16	10,529.64	42,527.51	(N/A)	9.72
Apple	1,987.90	206.67	313.23	964.67	795.33	4,267.80	(N/A)	0.98
Red maple	2,985.41	377.26	525.97	3,005.69	3,714.76	10,609.09	(N/A)	2.42
Norway maple	4,008.79	448.36	689.58	4,094.45	3,014.31	12,255.48	(N/A)	2.80
Honeylocust	5,613.78	884.31	943.12	7,847.50	18,070.75	33,359.46	(N/A)	7.62
American basswood	2,825.14	410.49	420.30	3,403.00	2,744.38	9,803.31	(N/A)	2.24
Spruce	1,264.09	116.96	114.51	2,215.83	1,548.10	5,259.48	(N/A)	1.20
Eastern cottonwood	5,088.59	590.96	1,012.21	8,838.01	3,457.39	18,987.16	(N/A)	4.34
Siberian elm	3,098.00	374.77	586.64	4,205.72	2,132.00	10,397.12	(N/A)	2.38
Cottonwood	2,732.98	299.01	543.76	4,603.97	1,842.81	10,022.55	(N/A)	2.29
Black walnut	2,082.23	285.63	354.30	2,570.40	2,064.02	7,356.57	(N/A)	1.68
Eastern red cedar	603.26	39.83	48.87	1,050.09	444.18	2,186.24	(N/A)	0.50
Northern white cedar	782.99	72.71	9.99	2,219.30	757.61	3,842.59	(N/A)	0.88
Northern red oak	311.08	33.85	45.46	280.19	199.80	870.37	(N/A)	0.20
Austrian pine	428.28	35.36	47.64	720.11	450.97	1,682.37	(N/A)	0.38
American elm	1,949.46	190.66	404.08	2,350.01	1,529.21	6,423.42	(N/A)	1.47
Amur maple	184.61	18.78	26.40	71.73	67.98	369.49	(N/A)	0.08
Scotch pine	608.46	56.08	25.92	1,532.29	654.28	2,877.03	(N/A)	0.66
Sugar maple	667.89	82.18	102.18	756.44	696.22	2,304.91	(N/A)	0.53
Norway spruce	635.95	54.07	- 10.50	1,947.01	389.67	3,016.19	(N/A)	0.69
Littleleaf linden	570.08	92.13	92.59	567.75	876.25	2,198.79	(N/A)	0.50
Conifer Evergreen Large	383.54	38.20	29.91	813.65	509.04	1,774.34	(N/A)	0.41
White ash	557.85	79.40	92.64	583.91	828.16	2,141.97	(N/A)	0.49
White mulberry	354.14	34.48	60.11	209.94	131.68	790.35	(N/A)	0.18
Quaking aspen	282.96	38.30	44.09	239.11	352.19	956.66	(N/A)	0.22
Broadleaf Evergreen Medi	105.09	7.68	12.59	80.28	122.57	328.21	(N/A)	0.08
Willow	398.66	31.31	72.56	512.35	144.79	1,159.67	(N/A)	0.27
Plum	37.00	3.72	5.00	13.36	12.68	71.75	(N/A)	0.02
Ponderosa pine	135.19	13.71	3.32	371.95	174.33	698.50	(N/A)	0.16
Birch	132.14	15.36	21.82	121.92	113.91	405.14	(N/A)	0.09
American sycamore	227.80	31.32	39.89	298.43	216.00	813.44	(N/A)	0.19
Callery pear	77.76	8.98	12.72	76.34	71.56	247.35	(N/A)	0.06
Eastern redbud	44.40	4.85	7.37	20.13	17.57	94.33	(N/A)	0.02
Cherry plum	24.46	2.40	3.36	9.23	8.49	47.95	(N/A)	0.01
Mountain ash	57.19	6.05	9.21	25.43	21.92	119.80	(N/A)	0.03
Eastern white pine	85.08	8.66	5.71	202.63	126.48	428.55	(N/A)	0.10
Broadleaf Evergreen Large	67.47	8.73	6.93	88.81	155.50	327.43	(N/A)	0.07
Conifer Evergreen Medium	21.74	1.51	2.29	27.42	33.40	86.37	(N/A)	0.02
Kentucky coffeetree	139.34	19.04	25.05	219.00	124.29	526.72	(N/A)	0.12
Hickory	26.45	3.62	3.86	21.12	43.29	98.35	(N/A)	0.02
Black maple	73.53	9.29	12.39	60.41	95.73	251.35	(N/A)	0.06
Black locust	117.62	9.21	21.50	140.20	39.16	327.68	(N/A)	0.07
Japanese tree lilac	36.39	3.49	5.09	14.34	12.80	72.10	(N/A)	0.02
Catalpa	57.32	7.93	9.34	70.21	57.69	202.49	(N/A)	0.05
Swamp white oak	46.78	5.71	7.92	38.19	39.16	137.75	(N/A)	0.03
Ginkgo	14.72	1.24	2.12	8.17	6.77	33.03	(N/A)	0.01
River birch	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)	0.04
Ohio buckeye	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)	0.04
Citywide Total	113,915.20	15,386.01	18,958.01	160,182.24	129,137.57	437,579.02	(N/A)	100.00

Average Annual Benefits of Public Trees by Zone ($/tree)



Total Annual Benefits of Public Trees by Zone ($)

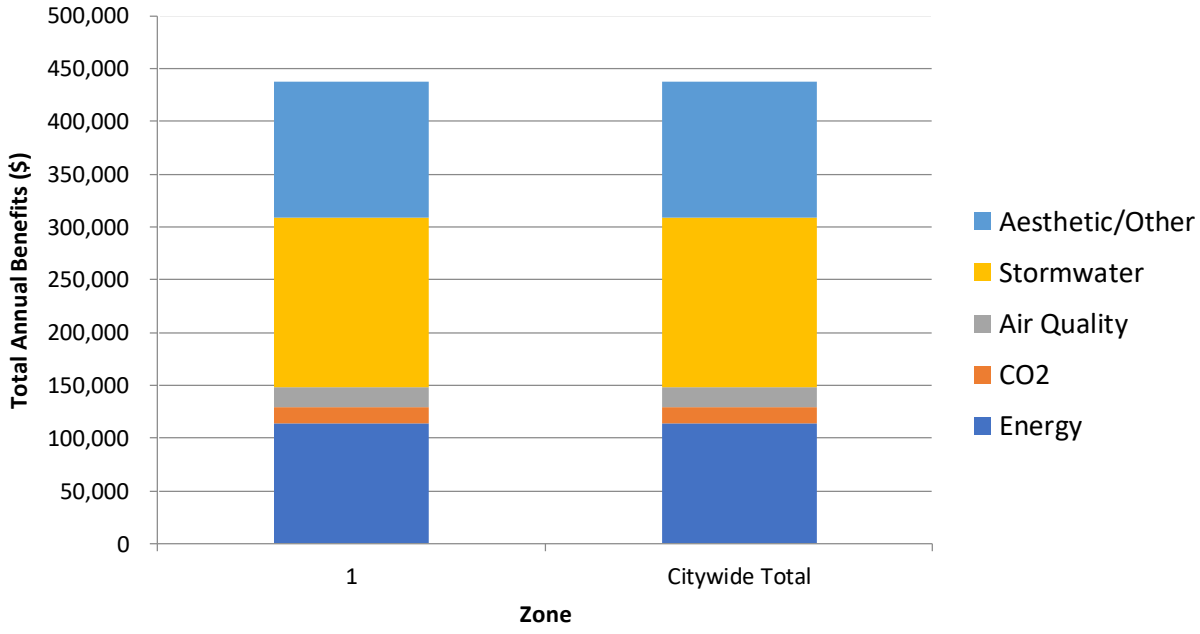
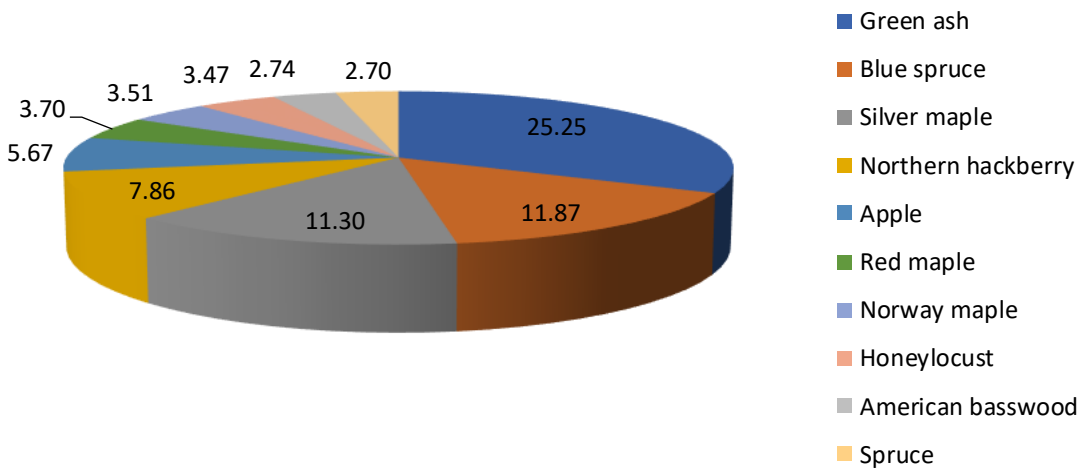


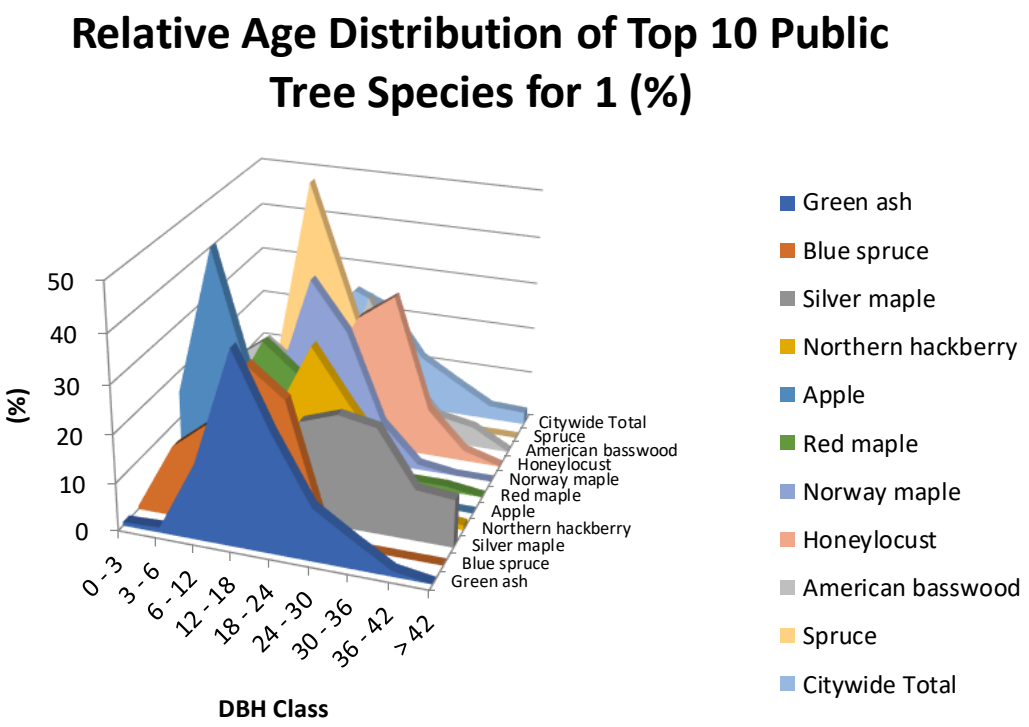
Figure 1: Species Distribution



Hawarden
Species Distribution of Public Trees for 1
3/12/2018

Species	Percent
Green ash	25.25
Blue spruce	11.87
Silver maple	11.30
Northern hackberry	7.86
Apple	5.67
Red maple	3.70
Norway maple	3.51
Honeylocust	3.47
American basswood	2.74
Spruce	2.70
Other Species	21.94

Figure 2: Relative Age Distribution



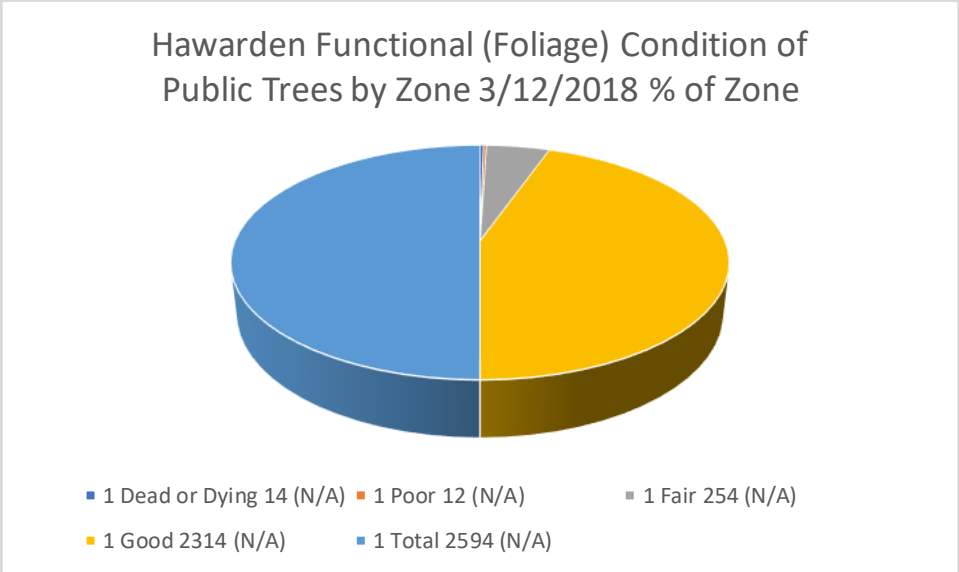
Relative Age Distribution of Top 10 Public Tree Species for 1 (%)

DBH class (in)

Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Green ash	0.76	1.07	15.88	39.85	24.27	10.99	5.95	1.22	0.00
Blue spruce	0.65	14.61	20.78	33.77	27.92	2.27	0.00	0.00	0.00
Silver maple	2.05	0.00	2.73	9.22	20.48	23.21	21.84	10.58	9.90
Northern hackberry	0.49	4.41	7.84	17.16	32.84	22.06	12.25	1.96	0.98
Apple	15.65	46.94	20.41	8.84	6.12	2.04	0.00	0.00	0.00
Red maple	19.79	11.46	26.04	19.79	15.63	5.21	1.04	1.04	0.00
Norway maple	10.99	1.10	13.19	37.36	27.47	8.79	1.10	0.00	0.00
Honeylocust	0.00	3.33	10.00	13.33	27.78	33.33	10.00	2.22	0.00
American basswood	11.27	16.90	11.27	7.04	29.58	14.08	5.63	4.23	0.00
Spruce	0.00	10.00	50.00	28.57	7.14	4.29	0.00	0.00	0.00
Citywide Total	4.12	8.71	15.84	24.94	21.78	11.76	7.25	2.97	2.62

Figure 2: Relative Age Class

Figure 3: Functional Condition of all Trees

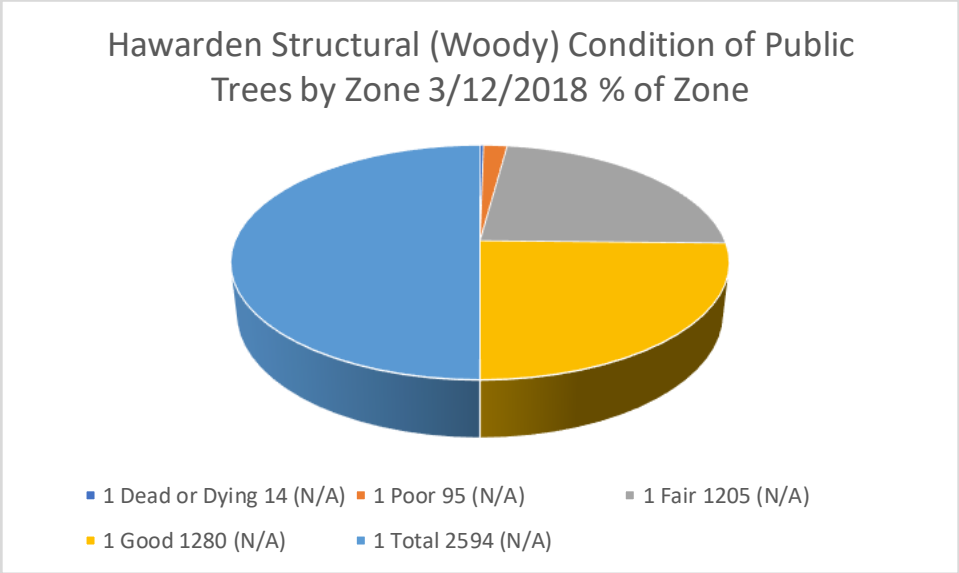


Hawarden
Functional (Foliage) Condition of Public Trees by Zone
3/12/2018

Zone	Condition	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Dead or Dying	14	(N/A)	0.54	0.54
	Poor	12	(N/A)	0.46	0.46
	Fair	254	(N/A)	9.79	9.79
	Good	2314	(N/A)	89.21	89.21
	Total	2594	(N/A)	100.00	100.00

Figure 3: Foliage Condition

Figure 4: Structural Condition of all Trees

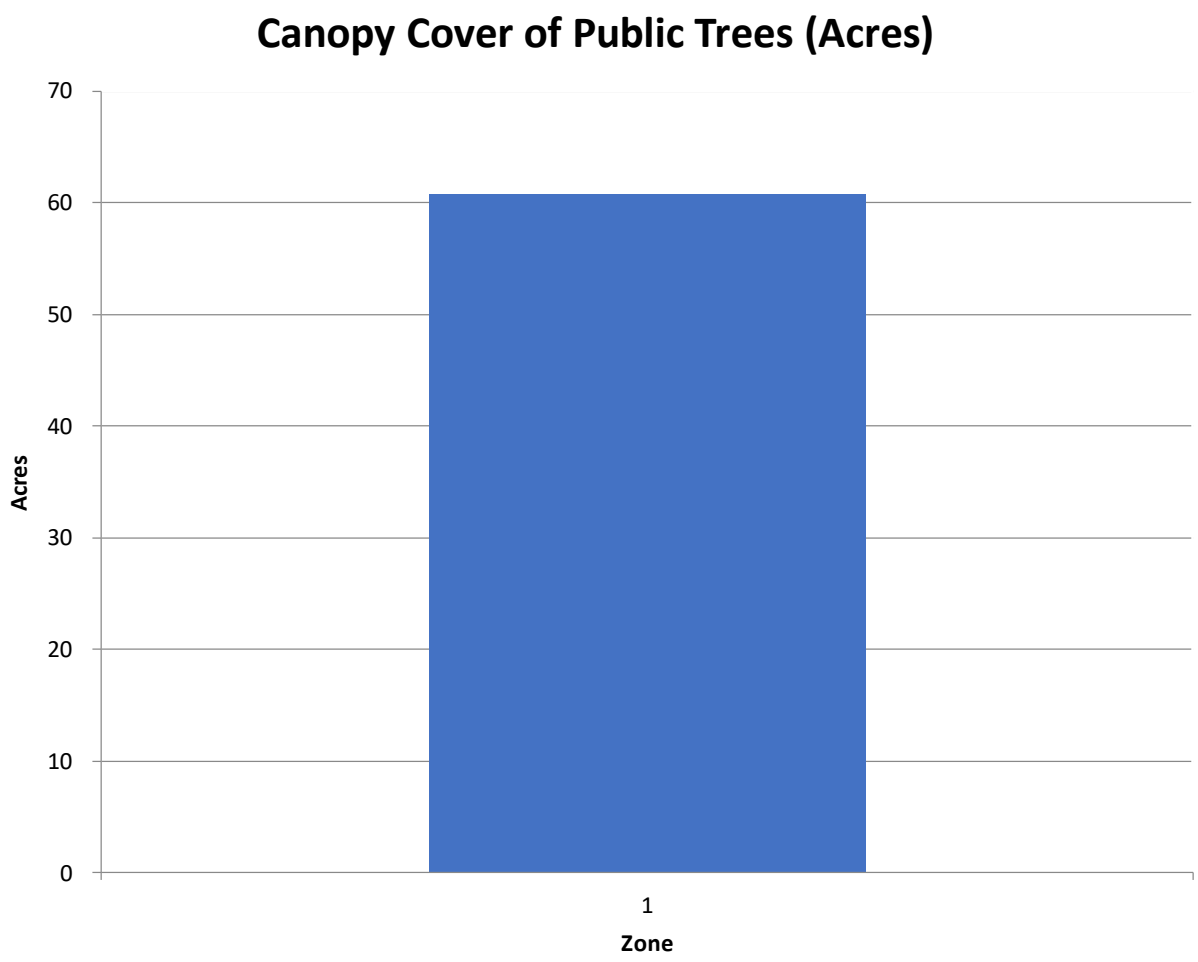


Hawarden
Structural (Woody) Condition of Public Trees by Zone
3/12/2018

Zone	Condition	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Dead or Dying	14	(N/A)	0.54	0.54
	Poor	95	(N/A)	3.66	3.66
	Fair	1205	(N/A)	46.45	46.45
	Good	1280	(N/A)	49.34	49.34
	Total	2594	(N/A)	100.00	100.00

Figure 4: Wood Condition

Figure 5: Canopy Cover in Acres

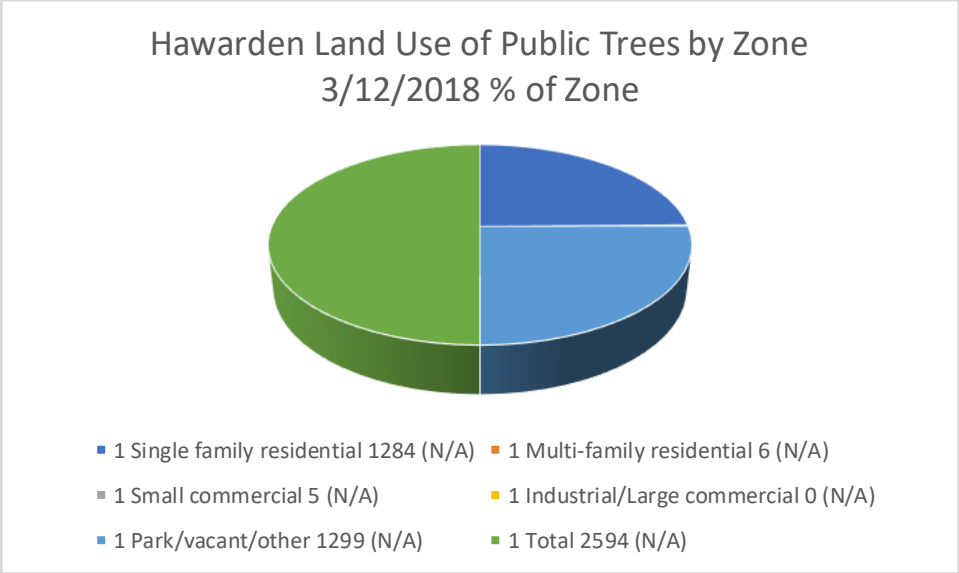

Canopy Cover of Public Trees (Acres)
70
60
50
40
30
20
10
0
Acres
1
Zone

Hawarden
Canopy Cover of Public Trees (Acres)
3/12/2018

Zone	Acres	% of Total Canopy
1	60.75	100.00
Citywide Total	60.75	100.00

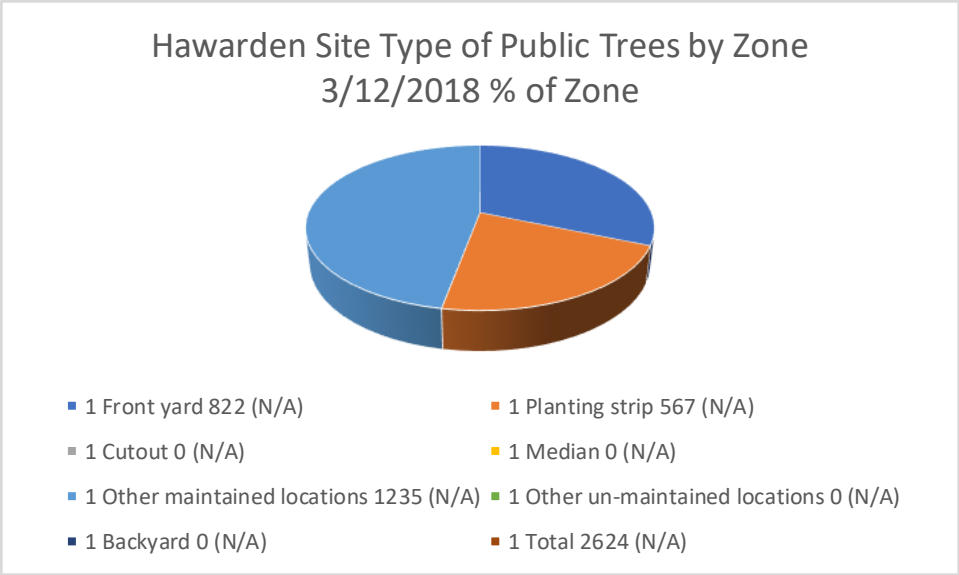
	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide Total	1,849.60	55.15	60.75	3.28	110.14

Figure 6: Land Use of city/park trees



Hawarden
Land Use of Public Trees by Zone
3/12/2018

Zone	Land Use	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Single family residential	1284	(N/A)	49.50	49.50
	Multi-family residential	6	(N/A)	0.23	0.23
	Small commercial	5	(N/A)	0.19	0.19
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	1299	(N/A)	50.08	50.08
	Total	2594	(N/A)	100.00	100.00



Hawarden
Site Type of Public Trees by Zone
3/12/2018

Zone	Site Type	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Front yard	822	(N/A)	31.32	31.32
	Planting strip	567	(N/A)	21.60	22.06
	Cutout	0	(N/A)	0.00	0.00
	Median	0	(N/A)	0.00	0.00
	Other maintained locations	1235	(N/A)	47.06	47.06
	Other un-maintained locations	0	(N/A)	0.00	0.00
	Backyard	0	(N/A)	0.00	0.00
	Total	2624	(N/A)	0.00	0.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

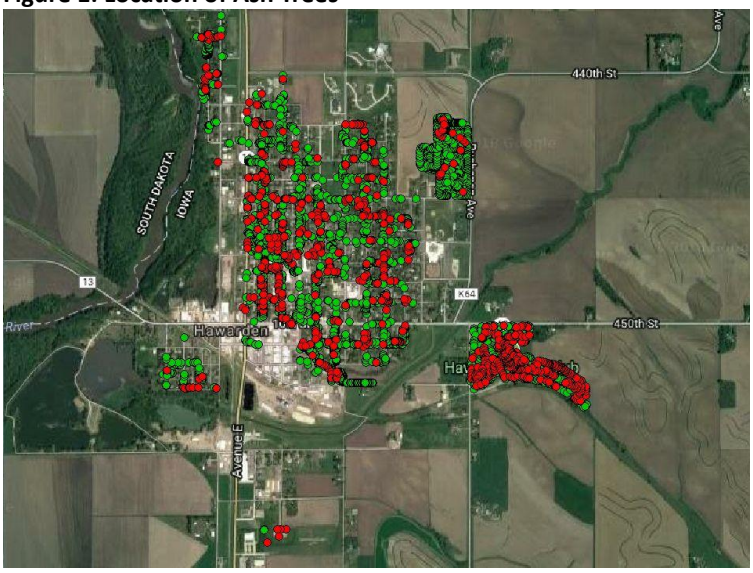


Figure 2: Location of EAB symptoms

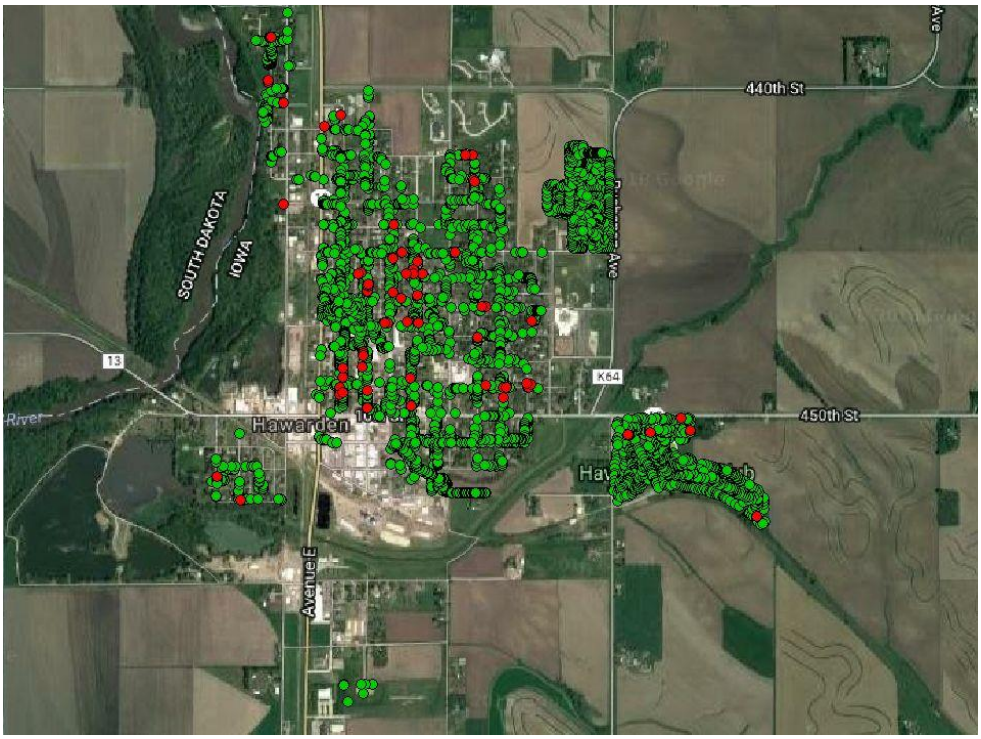


Figure 3: Location of Poor Condition Trees

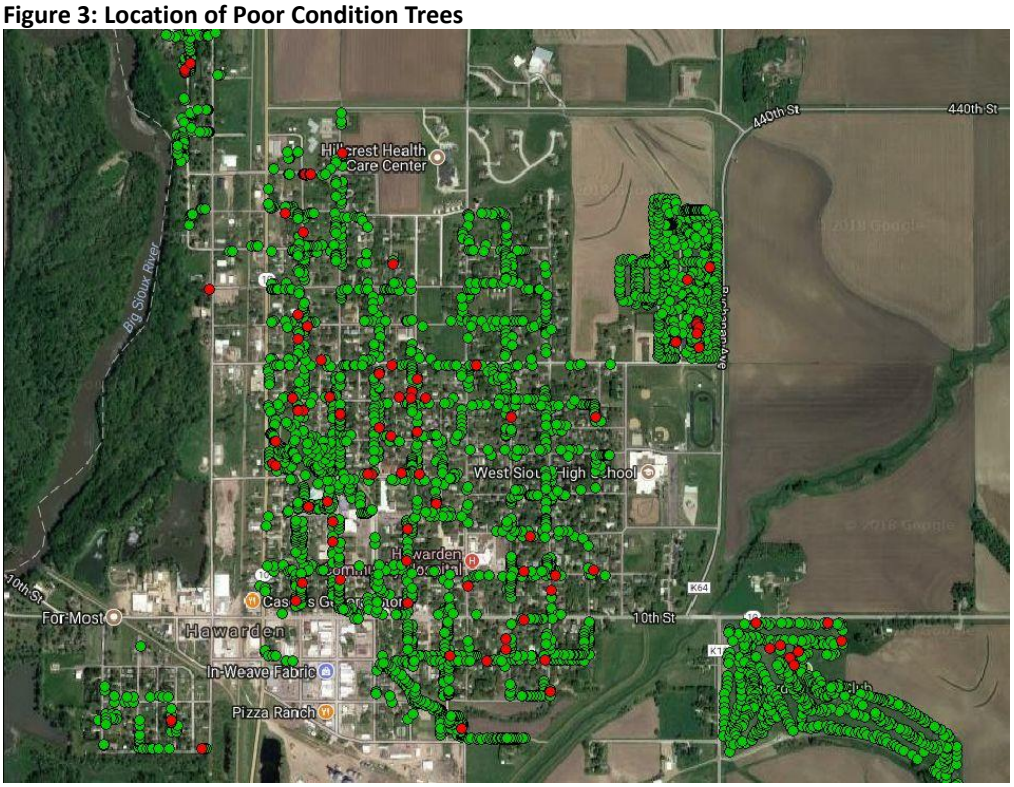


Figure 4: Location of Trees with Recommended Maintenance

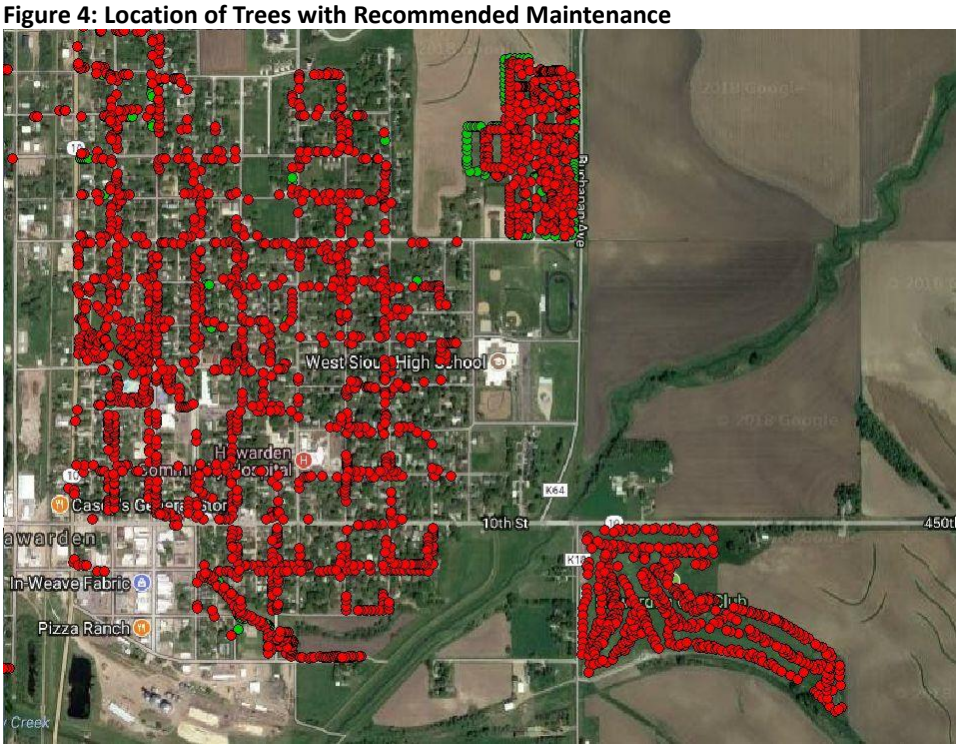


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Hawarden Tree Ordinances

URBAN FORESTRY ORDINANCE (example)

Sections:

01. Title.

The ordinance codified in this chapter shall be known as The City of Hawarden Urban Forestry Ordinance.

02. Purpose.

The City of Hawarden Urban Forestry Ordinance is enacted to further the following public purposes:

(a) To realize the optimum benefits of trees on the City's streets and public places, including favorable modification of microclimates, mitigation of air, water and noise pollution, reduction of soil erosion and runoff, enhancement of the visual environment, and promotion of community pride;

(b) To provide habitat for wildlife and green space;

(c) To integrate street planting and maintenance with other urban elements and amenities, including but not limited to utilities, vehicular and pedestrian traffic;

(d) To promote efficient, cost-effective management of the City's urban forest by coordinating public and private efforts within a comprehensive and professional management system;

(e) To promote the attractiveness of the City to residents and visitors and enhance property values and the quality of life within the City;

(f) To reduce the public hazard, nuisance, and expense occasioned by improper tree selection, planting, and maintenance;

(g) To create and maintain a unified urban-forest resource, enhancing the City's overall character and sense of place; and

(h) To provide a mechanism by which a "street tree" may be removed, as well as the imposition of penalties for any unauthorized removal or violations of the Urban Forestry Ordinance.

03. Definitions.

Unless the context otherwise clearly indicates, the words and phrases used in this chapter shall be defined as follows:

(a) "Cumulative diameter" shall refer to the sum diameter of the trunks of multi-stemmed trees, or to the sum diameter of the trunks of several trees, when measured at four and one-half feet (4-1/2') feet above natural grade.

(b) "Department" shall mean the Department of Public Works or the Department's designee.

(c) "Director" shall mean the Director of the Department of Public Works or the Director's designee.

(d) "Drip line" shall mean the outermost limit of the canopy of a tree as determined by the perimeter of its branches which, extended perpendicularly to the ground, encloses the tree.

(e) "Injure" or "injury" shall mean any act which harms or damages a tree, including but not limited to impact, cutting, carving, transplanting, or knocking over, and includes but is not limited to the following: injurious attachment of any rope, wire, nail, advertising poster, or other contrivance to any street tree; intentionally or negligently allowing any gaseous liquid or solid substance that is harmful to a tree to come into contact with a tree; setting fire or intentionally or negligently permitting any fire to burn when such fire

or the heat therefrom will injure any part of any tree; pruning which in and of itself will kill or cause a tree to decline; or severing of all or part of a tree.

(f) “Landscape material” shall mean any tree, shrub, groundcover or other plant.

(g) “Maintenance” shall mean those actions necessary to promote the life, growth, health, or beauty of a tree. Maintenance includes both routine and major activities. “Routine maintenance” shall include adequate watering to ensure the tree’s growth and sustainability; weed control; removal of tree-well trash; staking; fertilizing; routine adjustment and timely removal of stakes, ties, tree guards, and tree grates; bracing; and sidewalk repairs related to the tree’s growth or root system. “Major maintenance” shall include structural pruning as necessary to maintain public safety and to sustain the health, safety, and natural growth habit of the tree; pest- and disease-management procedures as needed and, in a manner, consistent with public health and ecological diversity; replacement of dead or damaged trees.

(h) “Nuisance tree” shall mean any tree that poses a hazard to person or property. A tree may be deemed a nuisance if it or any part of it: (1) appears dead, dangerous, or likely to fall; (2) obstructs or damages a street or sidewalk; (3) harbors a serious disease or infestation threatening the health of other trees; (4) interferes with vehicular or pedestrian traffic; (5) obstructs official street cleaning activities; or (6) poses any other significant hazard or potential hazard, as determined by the Department.

(i) “Parking strip” or “parkway” shall mean the area between the property line and roadway, except sidewalk and curb, if any.

(j) “Replacement value fee” shall mean a fee equal to the value of the tree as determined by an appraisal prepared by a certified arborist by using the most current edition of the “Guide for Plant Appraisal” published by the Council of Tree and Landscape Appraisers. All trees four inches (4") and greater in diameter at four and one-half feet (4-1/2') above natural grade level shall be evaluated using the trunk formula method of appraisal. All other trees shall be evaluated using the replacement cost method of appraisal.

(k) “Street tree” shall mean any tree growing within the public right-of-way, including unimproved public streets and sidewalks, and any tree growing on land under the jurisdiction of the City of Hawarden.

04 Maintenance of Street Trees.

(a) Responsibilities of Property Owners. It shall be the duty of all public agencies and property owners whose lots or portions of lots abut, front or are adjacent to any street tree to maintain such street tree. This duty shall include both routine and major maintenance of the street tree. This duty shall be extended to any property owner where the conditions of development approval require maintenance.

(b) Responsibilities of the Department. The Department shall maintain all street trees and landscapes on properties wholly owned by the City and those landscapes that are not the responsibility of any other entity under subsection (a) of this section. In addition, the Department may, at the Department's discretion, determine to undertake the regular routine and/or major maintenance of certain street trees or corridors of street trees to promote consistency in the maintenance of trees or when in the public interest.

(c) Liability. Nothing in this chapter shall be deemed to impose any liability upon the City of Hawarden or upon any of its officers or employees or agents, or to relieve the owner and occupant of any private property from the duty to keep trees upon such property or under his or her control in a safe condition.

(d) Department Street Tree Inventory and Documentation. The Department shall use its best efforts to maintain an inventory of all trees under its jurisdiction; such information shall be made available to the public upon request.

05 Planting and Removal of Street Trees.

(a) Encroachment Permit Required – Planting. It shall be unlawful for any person to plant a street tree without a valid encroachment permit for such work issued by the Department.

(b) Encroachment Permit Required – Removal. It shall be unlawful for any person to remove any street tree without a valid tree removal permit for such work issued in accordance with this chapter and a valid encroachment permit for such work issued by the Department.

(c) Planting. An abutting property owner who desires a permit to plant a street tree shall apply to the Department as part of the encroachment permit process. The details of the planting, such as the species of street tree, soil testing, soil amending, staking, location and other details shall be approved by the Department. If approved, a permit to plant the specified species of tree(s) shall be issued to the applicant. The Department may elect to plant the street tree or permit the applicant to do so and condition any permits on the abutting property owner's agreement to water or otherwise maintain the street tree or upon such other conditions as may be appropriate. In order to encourage the planting of street trees, the Department may, in its discretion, waive the permit fee for the planting of a street tree.

(d) Tree Removal Permit. An abutting property owner who desires to remove a street tree shall apply to the Department for a tree removal permit. Such application must be accompanied by payment of the encroachment permit fee in accordance with the Master Fee Schedule adopted by the City.

(e) Removal Application. An applicant requesting a tree removal permit to remove a street tree shall be required to submit a plan showing (1) the location, species, trunk diameter at four and one-half feet (4-

1/2') above natural grade, canopy size, and drip line (as defined in Section 03) of all street trees to be removed, (2) a red “X” over each street tree to be removed, (3) an appraisal of the replacement value fee (as defined in Section 03) of all street trees identified in the plan to be removed, (4) a tree report prepared by a certified arborist providing accurate information and opinion regarding the location, species, trunk diameter measured at four and one half feet (4-1/2') above natural grade, canopy size, and condition of all street trees identified in the plan to be removed, and (5) such other information or details as the Department may require. Further, applicants for a street tree removal permit shall also comply with the submittal requirements for an encroachment permit as set forth in Section 04.

(f) Decision to Grant Permit. The Department shall present the application to remove a street tree to the Planning Commission at a noticed public hearing. The Planning Commission may grant or deny the tree removal permit for removal of a street tree as determined in its sole discretion. If the Planning Commission grants a permit for tree removal, the Planning Commission shall require the planting of replacement trees of equal or cumulative diameter to the trees approved for removal and payment of the replacement value fee of the street tree(s) to be removed. When replacement of a tree of equal diameter is not feasible, for reasons related to site-specific conditions, replacement at the largest practicable diameter, as determined by the Planning Commission, shall be required. When the replacement tree cannot match the diameter of the tree to be removed, due to site-specific conditions, the Planning Commission shall require replacement planting of several trees of equal cumulative diameter to the tree being removed. In cases where the need for street tree removal is without fault of the property owner and the property owner is not otherwise responsible for maintenance of the street tree, or for other good cause shown, the Planning Commission may waive the requirement to plant a replacement tree of equal or cumulative value or payment of a replacement value fee.

(g) Notice Required. Upon receipt of an application for a tree removal permit for street tree removal, the Department shall post notice of the public hearing on such application on the affected street tree(s), in a manner not injurious to the tree(s); at the locations designated in Section 01.

(h) Appeals.

(1) Any person aggrieved by the decision of the Planning Commission may appeal to the City Council within fifteen (15) days after final action by the Planning Commission. The decision of the City Council shall be final.

(2) All appeals under this section shall be governed by the City Council and Planning Commission procedures.

(i) Compliance with Landscaping Provisions of Zoning Ordinance. In all cases, tree planting and landscaping undertaken pursuant to this chapter shall comply with all except when, in the discretion of the Public Works Department or the Planning Department, site conditions are such that modification is warranted.

06 Protection of Trees and Landscape Material.

(a) Injury to or Destruction of Trees Prohibited. It shall be unlawful for any person to intentionally, maliciously or through negligence injure or destroy a street tree.

(b) Injury to or Destruction of Landscape Materials Prohibited. It shall be unlawful for any person to intentionally, maliciously or through negligence injure or destroy any landscape material in any street median, center strip, or other landscaped portion of a public right-of-way under the City's jurisdiction, except as authorized by the Department.

(c) Construction Work – Protection of Trees Required. It shall be unlawful for any person to engage in any construction work on private or public property without first taking steps to protect all street trees from damage, including damage caused by soil compaction or contamination.

07 Nuisance Trees; Abatement.

(a) Notice to Property Owner(s). Upon a finding by the Department that any tree on private property or a street tree for which a property owner is responsible is a "nuisance tree" as defined herein, the Department shall send notice to the property owner(s) which describes the condition creating the nuisance, the actions required to be taken to abate the nuisance, and the date by which compliance must be completed. Required action may include replacement or removal of the tree. In cases of extreme danger, as determined by the Department, the Department may require immediate compliance.

(b) Department of Public Works to Abate Nuisance If Owner Fails to Do So. If the responsible property owner does not undertake in a timely manner the abatement action, as required by said notice, the Department may perform necessary work to abate the nuisance. The cost of such abatement, including labor, equipment, materials, inspection services, and administrative costs, shall be an obligation owing by the responsible property owner(s) to the City.

(c) Method of Enforcement and Collection of Lien. The City Manager or his or her designee shall calculate all costs of abatement. The property owner shall be billed by the City Manager or his or her designee for the total costs and payment shall be due and payable within fifteen (15) days of the billing date. If the property owner fails timely to remit payment, the costs for abating such nuisance shall constitute a special

assessment against the property to which it relates, and upon recordation in the office of the County Recorder of a notice of lien, as so made and confirmed, shall constitute a lien on said property for the amount of such assessment.

08 Materials Deleterious to Plant Growth Prohibited.

Except where approved by the Department, it shall be unlawful for any person to place or allow to be placed in or upon any parking strip, parking area or public plat any salt, oil, herbicide, or any other material deleterious to the growth of plants, or in such close proximity to such public squares, parking areas, or public plats, that such deleterious material will permeate the soil thereof.

09 Paving Prohibited on Parkway.

It is unlawful for any person to pave any parking strip or parkway in any manner or with any material whatsoever without first securing the written permission of the Department. Such permission shall be given in accordance with rules and regulations adopted by the Department.

10 Exemptions.

The City of Hawarden is not subject to the requirements of this chapter.

11 Urban Forestry Account.

All replacement value fees and penalties collected under this chapter shall be deposited in an Urban Forestry Account for use by the Department in tree planting and landscape maintenance.

12 Penalties for Violation of Ordinance.

It shall be unlawful for any person to violate any provisions or to fail to comply with any requirement of this chapter.

(a) Criminal Penalties. Any person violating any provisions of this chapter shall be punishable as set forth in appropriate City legislation.

(b) Civil Penalties. Any person, including but not limited to the property owner, the person performing the work, and/or any other responsible person who violates any provision of this chapter or any condition established as part of any permit issued hereunder, may be required to replace any removed or damaged street tree or landscaping and shall become liable to the City for a civil penalty three (3) times the replacement value fee of the street tree or landscaping plus the City's incurred appraisal costs, if any. The replacement value fee shall be determined by a City-selected certified arborist qualified to perform plant and tree appraisals, if the replacement value fee has not already been determined.

(c) Cumulative. The remedies set forth in this section are not exclusive, but cumulative, and may be used in addition to those set forth elsewhere in this Municipal Code or by law.

(d) The imposition of any fine or civil penalty for violation of this chapter shall be determined by the City Manager or his designee and may be appealed to the City Council in accordance with the appeal procedures set forth in appropriate City legislation.

(e) A decision of the City Manager not to impose a fine or civil penalty for an alleged violation of this chapter shall be presented to the City Council at its next regularly scheduled meeting, and if in the opinion of the City Council good cause appears for imposition of a fine or civil penalty, the City Council shall set a time for the hearing and shall cause no less than ten (10) calendar days' notice thereof to be given to the alleged violator(s) and such other persons who may have an interest in the matter.

Works Cited

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The City of Emeryville, http://www.ci.emeryville.ca.us, City Telephone: (510)596-4300
City Clerk's Office has the official version of the Emeryville Municipal Code, The Emeryville Municipal Code is current through 01/01/18

https://www.codebook.com/