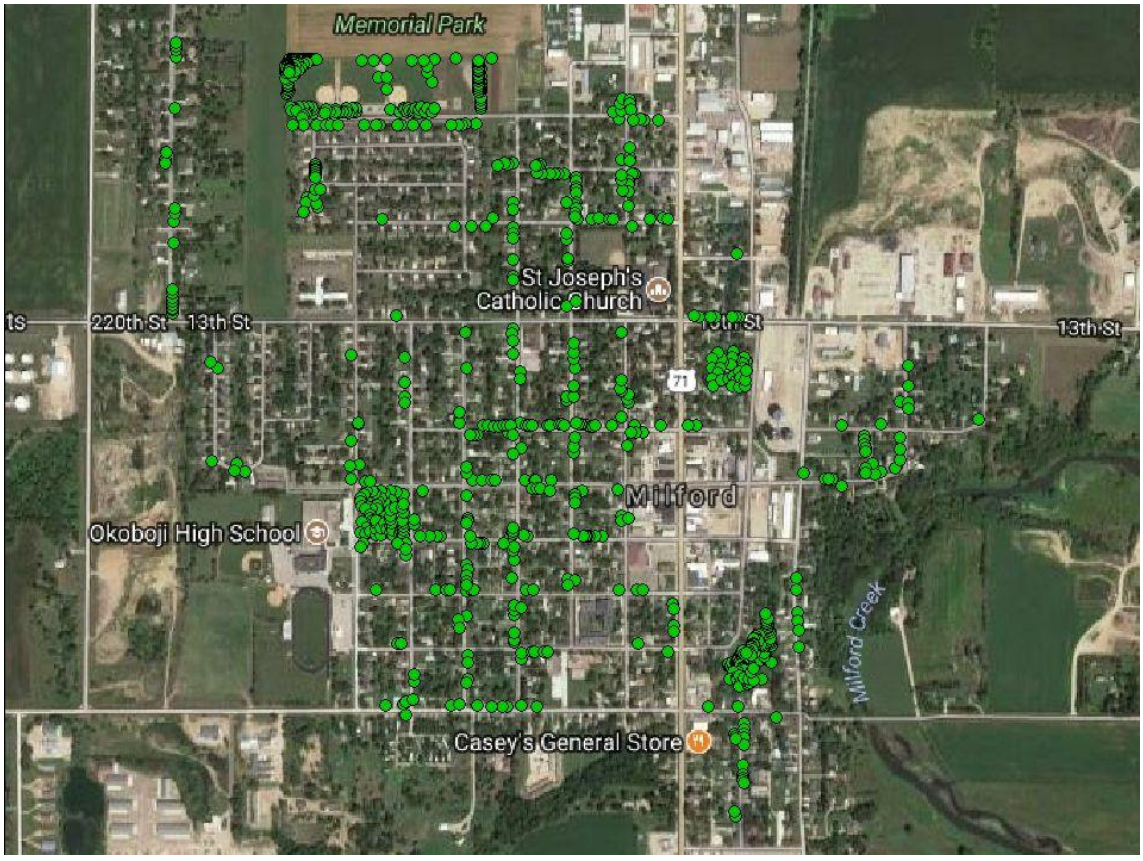
Community Tree Management Plan for Milford, IA



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

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Milford 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 38.80% of Milford'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 736 trees inventoried.

- Milford's trees provide $117,464.44of benefits annually, an average of $160 a tree
- There are over 35 species of trees
- The top three genera are: Ash 38.98%, Maple 20.31%, and Spruce 9.89%
- 86% of trees need some type of management or mitigation.
- 40 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 40 trees needing removal, 0 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*
- 68 of the 298 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 35 years to remove ash – Suggestion: request a budget increase to $10,000 annually and apply for grants to plant replacement trees

Introduction

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

Trees are an important component of Milford'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 Milford 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 Milford'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 736 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. Milfords trees reduce energy related costs by approximately $31,872.44 annually (Appendix A, Table 1). These savings are both in Electricity (153.45 MWh) and in Natural Gas (20,638.14Therms).

Annual Stormwater Benefits

Milford's trees intercept about 1,488,060.15gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $40,326.43 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 Milford it is estimated that trees remove 191.78 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 $5184.77 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Milford, trees sequester about 350,996.55 lbs of carbon a year with an associated value of $4387.35 (Appendix A, Table 4). In addition, the trees store 4,538,427.39 lbs of carbon, with a yearly benefit of $34,038.20 (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. Milford receives $35,693.43 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, Milford's trees provide $117,464.44 of benefits annually. Benefits of individual trees vary based on size, species, health

and location, but on average each of the 736 trees in Milford provide approximately $160 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Milford has over 35 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Green ash	294	38.28%
Silver maple	57	7.42%
Red maple	30	3.90%
Sugar maple	18	2.34%
Black walnut	18	2.34%
Pin oak	15	1.90%
American basswood	9	1.17%
American elm	8	1.04%
Bur oak	8	1.04%
Catalpa	6	0.78%
Northern hackberry	5	0.65%
White ash	4	0.52%
Eastern cottonwood	4	0.52%
Broadleaf Deciduous Large	3	0.39%
Northern red oak	3	0.39%
Paper birch	3	0.39%
Elm	1	0.13%
Norway maple	51	6.64%
Honeylocust	18	2.34%
Siberian elm	16	2.08%
Littleleaf linden	12	1.56%
Birch	3	0.39%
River birch	3	0.39%
Boxelder	3	0.39%
Ohio buckeye	1	0.13%
Apple	15	1.95%
Japanese tree lilac	3	0.39%
White mulberry	1	0.18%
Amur maple	1	0.18%
Cherry plum	1	0.18%
Conifer Evergreen Large	17	2.21%
Spruce	13	1.69%
Eastern white pine	3	0.39%
Blue spruce	63	8.20%
Austrian pine	25	3.25%

Age Class

Approximately one third (54%) of Milford'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. Milford's size curve is on the downward side, indicating a young 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 Milford indicate that 12.11% of the trees are in fair health, with 84.49% of the trees in good health, and only .82% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 41.22% of Milford's trees are in fair health for wood condition, with 52.65% in good wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 3.54% of the population. This 6.13% 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 Public Trees by Zone (None)

Zone	DBH Class	Tree Coun	Standard E	% of Zone	% of Public Trees
	Total	36	(N/A)	4.90	4.90

Priority Tasks for Public Trees by Zone (Stake/Train)

Zone	DBH Class	Tree Coun	Standard E	% of Zone	% of Public Trees
	Total	29	(N/A)	3.95	3.95

Priority Tasks for Public Trees by Zone (Crown cleaning)

Zone	DBH Class	Tree Coun	Standard E	% of Zone	% of Public Trees
	Total	421	(N/A)	57.28	57.28

Priority Tasks for Public Trees by Zone (Crown Raising)

Zone	DBH Class	Tree Coun	Standard E	% of Zone	% of Public Trees
	Total	133	(N/A)	18.10	18.10

Priority Tasks for Public Trees by Zone (Crown reduction/thinning)

Zone	DBH Class	Tree Coun	Standard E	% of Zone	% of Public Trees
	Total	76	(N/A)	10.34	10.34

Priority Tasks for Public Trees by Zone (Remove)

Zone	DBH Class	Tree Coun	Standard E	% of Zone	% of Public Trees
	Total	40	(N/A)	5.44	5.44

Canopy Cover

The total canopy with both private and public trees is 1.09%, 1,459 acres. The canopy cover included in the Milford inventory includes approximately 16 acres (Appendix A, Figure 4). The City's Canopy goal is 30%, in 30 years. To achieve this goal, it is estimated that 107 public and private trees need to be planted annually.

Single family residential	368 (N/A)	50.07
Multi-family residential	8 (N/A)	1.09
Small commercial	6 (N/A)	0.82
Industrial/Large commercial	0 (N/A)	0.00
Park/vacant/other	353 (N/A)	48.03

Land Use and Location

The majority of Milford'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.

Front yard	226 (N/A)	0.00	0.29
Planting strip	154 (N/A)	0.00	20.05
Cutout	0 (N/A)	0.00	0.00
Median	0 (N/A)	0.00	0.00
Other maintained locations	356 (N/A)	0.00	46.35
Other un-maintained locations	0 (N/A)	0.00	0.00
Backyard	0 (N/A)	0.00	0.00

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

Milford has 0 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). 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 660 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 40 removals, only 12 are ash trees. There is a total of 298 ash trees, and 68 of those have signs and symptoms that have been associated with EAB. In addition, there are 40 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 Milford.

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: 1 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: 2 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: 2 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: 2 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: 2 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: 12 ash trees removed (approximately 4.02% of ash). It will take approximately 30 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 $10,000 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 if tree is not being treated. 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 $13,322 over 6 years ($2222/year)

FY 2018 Budget
Removal: $1500
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $200

FY 2019 Budget
Removal: $1000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $500
Watering & Maintenance: $100

FY 2020 Budget
Removal: $1500
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $200

FY 2021 Budget
Removal: $1000
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Routine trimming: $500
Watering & Maintenance: $200

FY 2022 Budget
Removal: $1000
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $500

FY 2023 Budget
Removal: $1000
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Routine trimming: $500
Watering & Maintenance: $200

*Reduction of ash over 6 years: approximately 24 ash trees removed (approximately 4.02% of ash). **It will take approximately 30 years to remove all ash with the current budget.**

Purposed Budget Increase
EAB could potentially kill all ash trees in Milford 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 Milford 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 Milford 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 Milford. It is suggested to consider increasing the budget to plan for this.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J.; McPherson, E. Gregory; Simpson, James R.; Vargas, Kelaine E.; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Milford

3/28/2018

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	67.33	5,110.57	9,043.38	8,862.52	13,973.09	(N/A)	40.00	43.84	47.53
Blue spruce	5.44	412.78	714.93	700.63	1,113.41	(N/A)	8.57	3.49	17.67
Silver maple	17.03	1,292.64	2,227.14	2,182.60	3,475.24	(N/A)	7.76	10.90	60.97
Norway maple	11.30	858.00	1,618.80	1,586.42	2,444.42	(N/A)	6.94	7.67	47.93
Red maple	5.28	400.96	709.31	695.13	1,096.08	(N/A)	4.08	3.44	36.54
Austrian pine	2.94	223.26	368.33	360.97	584.22	(N/A)	3.40	1.83	23.37
Sugar maple	4.23	321.18	555.87	544.75	865.93	(N/A)	2.45	2.72	48.11
Black walnut	5.27	399.71	725.14	710.64	1,110.34	(N/A)	2.45	3.48	61.69
Honeylocust	5.12	388.83	674.05	660.57	1,049.40	(N/A)	2.45	3.29	58.30
Conifer Evergreen Large	2.28	173.40	284.08	278.40	451.80	(N/A)	2.31	1.42	26.58
Siberian elm	4.79	363.50	643.86	630.98	994.49	(N/A)	2.18	3.12	62.16
Pin oak	4.53	344.16	608.30	596.13	940.29	(N/A)	2.04	2.95	62.69
Apple	0.33	24.89	56.46	55.33	80.22	(N/A)	2.04	0.25	5.35
Spruce	1.35	102.84	168.80	165.42	268.26	(N/A)	1.77	0.84	20.64
Littleleaf linden	2.48	187.89	333.30	326.63	514.52	(N/A)	1.63	1.61	42.88
American basswood	2.41	183.10	360.92	353.70	536.80	(N/A)	1.22	1.68	59.64
Bur oak	0.96	72.91	138.67	135.90	208.81	(N/A)	1.09	0.66	26.10
American elm	1.71	129.66	224.94	220.44	350.10	(N/A)	1.09	1.10	43.76
Catalpa	1.65	124.88	221.99	217.55	342.44	(N/A)	0.82	1.07	57.07
Northern hackberry	1.69	127.99	240.30	235.50	363.49	(N/A)	0.68	1.14	72.70
White ash	0.90	67.96	98.46	96.49	164.45	(N/A)	0.54	0.52	41.11
Eastern cottonwood	1.21	92.15	165.64	162.33	254.48	(N/A)	0.54	0.80	63.62
Boxelder	0.56	42.64	75.08	73.57	116.22	(N/A)	0.41	0.36	38.74
Eastern white pine	0.08	6.26	14.14	13.85	20.11	(N/A)	0.41	0.06	6.70
Northern red oak	0.29	21.69	42.50	41.65	63.34	(N/A)	0.41	0.20	21.11
Japanese tree lilac	0.05	3.62	8.22	8.05	11.67	(N/A)	0.41	0.04	3.89
Broadleaf Deciduous Large	0.69	52.15	98.70	96.72	148.87	(N/A)	0.41	0.47	49.62
Paper birch	0.73	55.53	92.09	90.25	145.78	(N/A)	0.41	0.46	48.59
River birch	0.28	21.12	36.47	35.74	56.86	(N/A)	0.41	0.18	18.95
Birch	0.18	13.80	29.23	28.65	42.44	(N/A)	0.41	0.13	14.15
Ohio buckeye	0.10	7.96	16.85	16.52	24.47	(N/A)	0.14	0.08	24.47
White mulberry	0.07	5.62	12.83	12.58	18.19	(N/A)	0.14	0.06	18.19
Elm	0.03	2.20	3.69	3.62	5.82	(N/A)	0.14	0.02	5.82
Amur maple	0.07	5.62	12.83	12.58	18.19	(N/A)	0.14	0.06	18.19
Cherry plum	0.07	5.62	12.83	12.58	18.19	(N/A)	0.14	0.06	18.19
Total	153.45	11,647.07	20,638.14	20,225.38	31,872.44	(N/A)	100.00	100.00	43.36

Table 2: Annual Storm Water

Milford

3/28/2018

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	610,028.79	16,531.78	(N/A)	40.00	40.99	56.23
Blue spruce	71,124.28	1,927.47	(N/A)	8.57	4.78	30.59
Silver maple	208,167.57	5,641.34	(N/A)	7.76	13.99	98.97
Norway maple	94,569.06	2,562.82	(N/A)	6.94	6.36	50.25
Red maple	37,307.83	1,011.04	(N/A)	4.08	2.51	33.70
Austrian pine	36,988.55	1,002.39	(N/A)	3.40	2.49	40.10
Sugar maple	34,189.96	926.55	(N/A)	2.45	2.30	51.47
Black walnut	56,045.06	1,518.82	(N/A)	2.45	3.77	84.38
Honeylocust	43,206.97	1,170.91	(N/A)	2.45	2.90	65.05
Conifer Evergreen Large	36,862.86	998.98	(N/A)	2.31	2.48	58.76
Siberian elm	49,108.42	1,330.84	(N/A)	2.18	3.30	83.18
Pin oak	47,841.40	1,296.50	(N/A)	2.04	3.22	86.43
Apple	1,042.08	28.24	(N/A)	2.04	0.07	1.88
Spruce	18,325.27	496.61	(N/A)	1.77	1.23	38.20
Littleleaf linden	21,227.54	575.27	(N/A)	1.63	1.43	47.94
American basswood	23,802.96	645.06	(N/A)	1.22	1.60	71.67
Bur oak	9,803.72	265.68	(N/A)	1.09	0.66	33.21
American elm	13,853.58	375.43	(N/A)	1.09	0.93	46.93
Catalpa	16,193.67	438.85	(N/A)	0.82	1.09	73.14
Northern hackberry	14,716.71	398.82	(N/A)	0.68	0.99	79.76
White ash	5,601.21	151.79	(N/A)	0.54	0.38	37.95
Eastern cottonwood	13,489.71	365.57	(N/A)	0.54	0.91	91.39
Boxelder	5,265.48	142.69	(N/A)	0.41	0.35	47.56
Eastern white pine	857.03	23.23	(N/A)	0.41	0.06	7.74
Northern red oak	1,585.98	42.98	(N/A)	0.41	0.11	14.33
Japanese tree lilac	144.77	3.92	(N/A)	0.41	0.01	1.31
Broadleaf Deciduous Large	7,141.50	193.53	(N/A)	0.41	0.48	64.51
Paper birch	5,521.78	149.64	(N/A)	0.41	0.37	49.88
River birch	1,584.00	42.93	(N/A)	0.41	0.11	14.31
Birch	911.37	24.70	(N/A)	0.41	0.06	8.23
Ohio buckeye	585.96	15.88	(N/A)	0.14	0.04	15.88
White mulberry	264.49	7.17	(N/A)	0.14	0.02	7.17
Elm	171.63	4.65	(N/A)	0.14	0.01	4.65
Amur maple	264.49	7.17	(N/A)	0.14	0.02	7.17
Cherry plum	264.49	7.17	(N/A)	0.14	0.02	7.17
Citywide total	1,488,060.15	40,326.43	(N/A)	100.00	100.00	54.87

Benefits

Table 3: Annual Air Quality Benefits

Milford

3/28/2018

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	62.89	10.05	32.46	2.82	341.63	319.91	46.70	44.55	305.21	1,996.89	0.00	0.00	824.58	2,338.53	(N/A)	40.00	7.95
Blue spruce	9.19	1.82	7.77	1.13	61.14	25.63	3.75	3.58	24.62	160.42	- 25.58	- 95.92	51.91	125.64	(N/A)	8.57	1.99
Silver maple	31.55	5.35	16.03	1.40	171.62	80.18	11.75	11.22	77.07	502.01	- 16.96	- 63.62	217.57	610.01	(N/A)	7.76	10.70
Norway maple	17.88	3.09	8.97	0.79	97.15	54.71	7.92	7.54	51.30	339.15	- 4.31	- 16.17	147.88	420.13	(N/A)	6.94	8.24
Red maple	7.58	1.29	3.70	0.34	40.83	25.06	3.66	3.49	23.93	156.50	- 2.73	- 10.24	66.32	187.09	(N/A)	4.08	6.24
Austrian pine	4.62	0.92	3.91	0.57	30.75	13.70	2.02	1.93	13.32	86.16	- 13.25	- 49.67	27.73	67.23	(N/A)	3.40	2.69
Sugar maple	3.74	0.64	2.06	0.17	20.82	19.97	2.92	2.79	19.17	124.99	- 3.09	- 11.60	48.38	134.20	(N/A)	2.45	7.46
Black walnut	6.59	1.05	3.20	0.30	35.22	25.18	3.66	3.49	23.87	156.79	0.00	0.00	67.35	192.01	(N/A)	2.45	10.67
Honeylocust	7.94	1.31	3.72	0.36	42.19	24.18	3.54	3.38	23.20	151.27	- 5.56	- 20.87	62.06	172.59	(N/A)	2.45	9.59
Conifer Evergreen Large	4.21	0.83	3.50	0.52	27.85	10.62	1.57	1.50	10.35	66.87	- 16.20	- 60.76	16.89	33.95	(N/A)	2.31	2.00
Siberian elm	7.99	1.36	3.94	0.35	43.13	22.74	3.32	3.17	21.70	141.96	0.00	0.00	64.57	185.10	(N/A)	2.18	11.57
Pin oak	8.15	1.43	4.22	0.37	44.75	21.52	3.14	3.00	20.54	134.34	- 15.25	- 57.18	47.12	121.91	(N/A)	2.04	8.13
Apple	0.09	0.01	0.07	0.00	0.57	1.66	0.23	0.22	1.48	10.11	0.00	0.00	3.79	10.68	(N/A)	2.04	0.71
Spruce	1.99	0.39	1.72	0.24	13.35	6.30	0.93	0.89	6.14	39.67	- 7.02	- 26.32	11.59	26.70	(N/A)	1.77	2.05
Littleleaf linden	3.27	0.56	1.66	0.14	17.82	11.79	1.72	1.64	11.24	73.57	- 1.65	- 6.18	30.38	85.22	(N/A)	1.63	7.10
American basswood	2.87	0.49	1.47	0.13	15.66	11.81	1.70	1.62	10.95	72.89	- 2.56	- 9.59	28.47	78.95	(N/A)	1.22	8.77
Bur oak	1.05	0.17	0.53	0.05	5.67	4.65	0.67	0.64	4.35	28.81	0.00	0.00	12.11	34.48	(N/A)	1.09	4.31
American elm	1.61	0.27	0.89	0.07	8.97	8.08	1.18	1.13	7.74	50.52	0.00	0.00	20.98	59.48	(N/A)	1.09	7.44
Catalpa	1.81	0.29	0.90	0.08	9.74	7.83	1.14	1.09	7.46	48.84	0.00	0.00	20.60	58.58	(N/A)	0.82	9.76
Northern hackberry	2.11	0.37	1.10	0.09	11.59	8.15	1.18	1.12	7.65	50.54	0.00	0.00	21.77	62.13	(N/A)	0.68	12.43
White ash	0.35	0.06	0.23	0.02	2.04	4.06	0.61	0.58	4.06	25.82	0.00	0.00	9.96	27.86	(N/A)	0.54	6.97
Eastern cottonwood	1.66	0.27	0.79	0.07	8.85	5.79	0.84	0.80	5.50	36.10	0.00	0.00	15.74	44.95	(N/A)	0.54	11.24
Boxelder	0.63	0.10	0.31	0.03	3.36	2.66	0.39	0.37	2.54	16.63	- 0.28	- 1.04	6.75	18.94	(N/A)	0.41	6.31
Eastern white pine	0.06	0.01	0.07	0.01	0.44	0.42	0.06	0.06	0.37	2.54	- 0.24	- 0.90	0.81	2.08	(N/A)	0.41	0.69
Northern red oak	0.20	0.03	0.13	0.01	1.16	1.39	0.20	0.19	1.29	8.60	- 0.29	- 1.09	3.16	8.67	(N/A)	0.41	2.89
Japanese tree lilac	0.01	0.00	0.01	0.00	0.06	0.24	0.03	0.03	0.22	1.47	0.00	0.00	0.54	1.53	(N/A)	0.41	0.51
Broadleaf Deciduous Large	0.78	0.13	0.39	0.04	4.22	3.32	0.48	0.46	3.11	20.59	0.00	0.00	8.71	24.81	(N/A)	0.41	8.27
Paper birch	0.48	0.08	0.27	0.02	2.69	3.42	0.50	0.48	3.32	21.50	0.00	0.00	8.58	24.18	(N/A)	0.41	8.06
River birch	0.23	0.04	0.12	0.01	1.26	1.32	0.19	0.18	1.26	8.24	- 0.06	- 0.23	3.29	9.27	(N/A)	0.41	3.09
Birch	0.07	0.01	0.05	0.00	0.43	0.91	0.13	0.12	0.83	5.56	- 0.03	- 0.10	2.10	5.89	(N/A)	0.41	1.96
Ohio buckeye	0.06	0.01	0.04	0.00	0.33	0.52	0.07	0.07	0.48	3.21	- 0.02	- 0.07	1.23	3.47	(N/A)	0.14	3.47
White mulberry	0.05	0.01	0.03	0.00	0.26	0.38	0.05	0.05	0.34	2.29	0.00	0.00	0.90	2.55	(N/A)	0.14	2.55
Elm	0.00	0.00	0.00	0.00	0.02	0.13	0.02	0.02	0.13	0.85	0.00	0.00	0.31	0.87	(N/A)	0.14	0.87
Amur maple	0.05	0.01	0.03	0.00	0.26	0.38	0.05	0.05	0.34	2.29	0.00	0.00	0.90	2.55	(N/A)	0.14	2.55
Cherry plum	0.05	0.01	0.03	0.00	0.26	0.38	0.05	0.05	0.34	2.29	0.00	0.00	0.90	2.55	(N/A)	0.14	2.55
Citywide Total	191.78	32.45	104.32	10.13	1,066.07	729.02	106.40	101.51	695.39	4,550.26	- 115.08	- 431.56	1,855.92	5,184.78	(N/A)	100.00	7.05

Table 4: Annual Carbon Stored

Milford

3/28/2018

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	2,049,875.52	15,374.07	(N/A)	40.00	45.17	52.29
Blue spruce	59,876.63	449.07	(N/A)	8.57	1.32	7.13
Silver maple	665,959.68	4,994.70	(N/A)	7.76	14.67	87.63
Norway maple	293,927.98	2,204.46	(N/A)	6.94	6.48	43.22
Red maple	86,548.88	649.12	(N/A)	4.08	1.91	21.64
Austrian pine	27,705.65	207.79	(N/A)	3.40	0.61	8.31
Sugar maple	105,412.90	790.60	(N/A)	2.45	2.32	43.92
Black walnut	211,956.30	1,589.67	(N/A)	2.45	4.67	88.32
Honeylocust	98,470.15	738.53	(N/A)	2.45	2.17	41.03
Conifer Evergreen Large	38,335.56	287.52	(N/A)	2.31	0.84	16.91
Siberian elm	195,895.07	1,469.21	(N/A)	2.18	4.32	91.83
Pin oak	210,549.85	1,579.12	(N/A)	2.04	4.64	105.27
Apple	2,904.96	21.79	(N/A)	2.04	0.06	1.45
Spruce	15,466.86	116.00	(N/A)	1.77	0.34	8.92
Littleleaf linden	70,705.53	530.29	(N/A)	1.63	1.56	44.19
American basswood	102,045.68	765.34	(N/A)	1.22	2.25	85.04
Bur oak	33,771.31	253.28	(N/A)	1.09	0.74	31.66
American elm	41,281.32	309.61	(N/A)	1.09	0.91	38.70
Catalpa	58,659.86	439.95	(N/A)	0.82	1.29	73.32
Northern hackberry	29,963.41	224.73	(N/A)	0.68	0.66	44.95
White ash	12,050.03	90.38	(N/A)	0.54	0.27	22.59
Eastern cottonwood	53,845.43	403.84	(N/A)	0.54	1.19	100.96
Boxelder	19,004.98	142.54	(N/A)	0.41	0.42	47.51
Eastern white pine	297.34	2.23	(N/A)	0.41	0.01	0.74
Northern red oak	3,073.93	23.05	(N/A)	0.41	0.07	7.68
Japanese tree lilac	369.37	2.77	(N/A)	0.41	0.01	0.92
Broadleaf Deciduous Large	25,264.97	189.49	(N/A)	0.41	0.56	63.16
Paper birch	15,801.35	118.51	(N/A)	0.41	0.35	39.50
River birch	3,859.47	28.95	(N/A)	0.41	0.09	9.65
Birch	1,537.60	11.53	(N/A)	0.41	0.03	3.84
Ohio buckeye	1,100.67	8.26	(N/A)	0.14	0.02	8.26
White mulberry	907.91	6.81	(N/A)	0.14	0.02	6.81
Elm	185.46	1.39	(N/A)	0.14	0.00	1.39
Amur maple	907.91	6.81	(N/A)	0.14	0.02	6.81
Cherry plum	907.91	6.81	(N/A)	0.14	0.02	6.81
Citywide total	4,538,427.40	34,038.21	(N/A)	100.00	100.00	46.31

Table 5: Annual Carbon Sequestered

Milford

3/28/2018

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	154,171.47	1,156.29	- 9,839.40	- 673.54	- 78.85	112,942.21	847.07	256,600.74	1,924.51	(N/A)	40.00	43.86	6.55
Blue spruce	4,225.24	31.69	- 287.48	- 93.60	- 2.86	9,122.36	68.42	12,966.52	97.25	(N/A)	8.57	2.22	1.54
Silver maple	59,300.27	444.75	- 3,197.31	- 172.97	- 25.28	28,566.99	214.25	84,496.99	633.73	(N/A)	7.76	14.44	11.12
Norway maple	19,025.96	142.69	- 1,412.31	- 112.13	- 11.43	18,961.59	142.21	36,463.12	273.47	(N/A)	6.94	6.23	5.36
Red maple	10,241.95	76.81	- 415.43	- 48.56	- 3.48	8,861.02	66.46	18,638.98	139.79	(N/A)	4.08	3.19	4.66
Austrian pine	2,171.97	16.29	- 132.99	- 47.19	- 1.35	4,933.88	37.00	6,925.67	51.94	(N/A)	3.40	1.18	2.08
Sugar maple	7,468.71	56.02	- 505.98	- 41.34	- 4.10	7,098.01	53.24	14,019.41	105.15	(N/A)	2.45	2.40	5.84
Black walnut	12,799.92	96.00	- 1,017.39	- 53.82	- 8.03	8,833.39	66.25	20,562.10	154.22	(N/A)	2.45	3.52	8.57
Honeylocust	12,225.32	91.69	- 472.66	- 41.34	- 3.85	8,593.10	64.45	20,304.42	152.28	(N/A)	2.45	3.47	8.46
Conifer Evergreen Large	2,472.86	18.55	- 184.01	- 38.61	- 1.67	3,832.10	28.74	6,082.34	45.62	(N/A)	2.31	1.04	2.68
Siberian elm	8,937.54	67.03	- 940.30	- 50.70	- 7.43	8,033.30	60.25	15,979.84	119.85	(N/A)	2.18	2.73	7.49
Pin oak	19,929.28	149.47	- 1,010.68	- 47.00	- 7.93	7,605.78	57.04	26,477.39	198.58	(N/A)	2.04	4.53	13.24
Apple	557.26	4.18	- 14.08	- 8.19	- 0.17	550.09	4.13	1,085.08	8.14	(N/A)	2.04	0.19	0.54
Spruce	1,324.82	9.94	- 74.24	- 22.62	- 0.73	2,272.64	17.04	3,500.61	26.25	(N/A)	1.77	0.60	2.02
Littleleaf linden	7,584.15	56.88	- 339.39	- 27.30	- 2.75	4,152.24	31.14	11,369.71	85.27	(N/A)	1.63	1.94	7.11
American basswood	6,683.89	50.13	- 489.82	- 27.69	- 3.88	4,046.49	30.35	10,212.87	76.60	(N/A)	1.22	1.75	8.51
Bur oak	2,395.43	17.97	- 162.26	- 10.92	- 1.30	1,611.36	12.09	3,833.61	28.75	(N/A)	1.09	0.66	3.59
American elm	1,959.73	14.70	- 198.72	- 16.58	- 1.61	2,865.46	21.49	4,609.90	34.57	(N/A)	1.09	0.79	4.32
Catalpa	3,829.34	28.72	- 281.57	- 16.38	- 2.23	2,759.92	20.70	6,291.31	47.18	(N/A)	0.82	1.08	7.86
Northern hackberry	2,051.43	15.39	- 143.82	- 15.21	- 1.19	2,828.60	21.21	4,721.00	35.41	(N/A)	0.68	0.81	7.08
White ash	1,663.00	12.47	- 57.84	- 7.02	- 0.49	1,501.95	11.26	3,100.09	23.25	(N/A)	0.54	0.53	5.81
Eastern cottonwood	2,921.49	21.91	- 258.46	- 12.48	- 2.03	2,036.54	15.27	4,687.09	35.15	(N/A)	0.54	0.80	8.79
Boxelder	1,637.11	12.28	- 91.22	- 6.63	- 0.73	942.36	7.07	2,481.61	18.61	(N/A)	0.41	0.42	6.20
Eastern white pine	74.16	0.56	- 1.44	- 1.95	- 0.03	138.29	1.04	209.06	1.57	(N/A)	0.41	0.04	0.52
Northern red oak	442.07	3.32	- 14.75	- 3.51	- 0.14	479.29	3.59	903.09	6.77	(N/A)	0.41	0.15	2.26
Japanese tree lilac	84.56	0.63	- 1.82	- 1.37	- 0.02	79.99	0.60	161.37	1.21	(N/A)	0.41	0.03	0.40
Broadleaf Deciduous Large	1,725.36	12.94	- 121.27	- 7.41	- 0.97	1,152.39	8.64	2,749.07	20.62	(N/A)	0.41	0.47	6.87
Paper birch	1,550.36	11.63	- 75.85	- 6.63	- 0.62	1,227.12	9.20	2,695.01	20.21	(N/A)	0.41	0.46	6.74
River birch	486.98	3.65	- 19.28	- 2.73	- 0.17	466.72	3.50	931.69	6.99	(N/A)	0.41	0.16	2.33
Birch	415.18	3.11	- 8.78	- 2.34	- 0.08	304.90	2.29	708.96	5.32	(N/A)	0.41	0.12	1.77
Ohio buckeye	223.95	1.68	- 5.28	- 1.17	- 0.05	175.86	1.32	393.35	2.95	(N/A)	0.14	0.07	2.95
White mulberry	113.87	0.85	- 4.36	- 1.17	- 0.04	124.15	0.93	232.50	1.74	(N/A)	0.14	0.04	1.74
Elm	74.18	0.56	- 0.89	- 0.59	- 0.01	48.64	0.36	121.35	0.91	(N/A)	0.14	0.02	0.91
Amur maple	113.87	0.85	- 4.36	- 1.17	- 0.04	124.15	0.93	232.50	1.74	(N/A)	0.14	0.04	1.74
Cherry plum	113.87	0.85	- 4.36	- 1.17	- 0.04	124.15	0.93	232.50	1.74	(N/A)	0.14	0.04	1.74
Citywide Total	350,996.56	2,632.47	- 21,789.77	- 1,623.00	- 175.60	257,397.05	1,930.48	584,980.84	4,387.36	(N/A)	100.00	100.00	5.97

Table 6: Annual Social and Aesthetic Benefits

Milford

3/28/2018

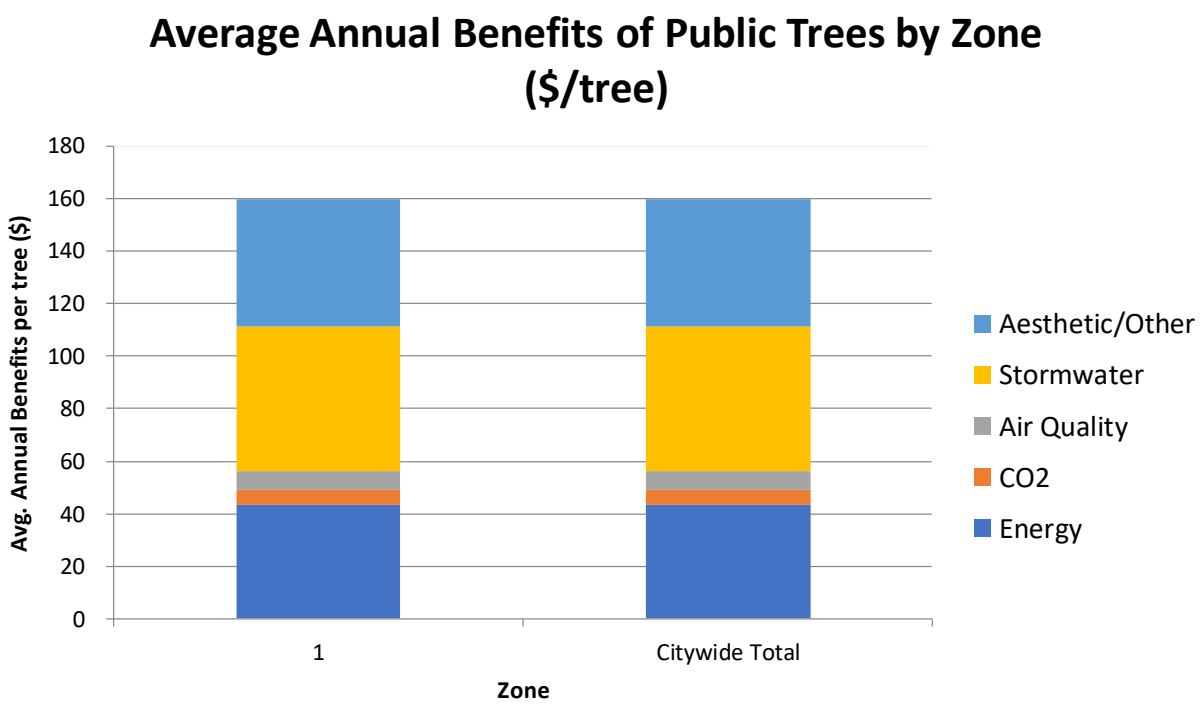
Average Annual Benefits of Public Trees by Species ($/tree)

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/ Other	Total	Standard Error
Green ash	47.53	6.55	7.95	56.23	48.47	166.73	(N/A)
Blue spruce	17.67	1.54	1.99	30.59	18.28	70.09	(N/A)
Silver maple	60.97	11.12	10.70	98.97	88.21	269.97	(N/A)
Norway maple	47.93	5.36	8.24	50.25	36.16	147.94	(N/A)
Red maple	36.54	4.66	6.24	33.70	48.27	129.40	(N/A)
Austrian pine	23.37	2.08	2.69	40.10	24.14	92.38	(N/A)
Sugar maple	48.11	5.84	7.46	51.47	48.03	160.91	(N/A)
Black walnut	61.69	8.57	10.67	84.38	58.68	223.98	(N/A)
Honeylocust	58.30	8.46	9.59	65.05	145.83	287.23	(N/A)
Conifer Evergreen Large	26.58	2.68	2.00	58.76	36.18	126.20	(N/A)
Siberian elm	62.16	7.49	11.57	83.18	41.21	205.60	(N/A)
Pin oak	62.69	13.24	8.13	86.43	104.17	274.65	(N/A)
Apple	5.35	0.54	0.71	1.88	1.94	10.43	(N/A)
Spruce	20.64	2.02	2.05	38.20	28.07	90.98	(N/A)
Littleleaf linden	42.88	7.11	7.10	47.94	66.14	171.17	(N/A)
American basswood	59.64	8.51	8.77	71.67	57.40	206.00	(N/A)
Bur oak	26.10	3.59	4.31	33.21	28.82	96.04	(N/A)
American elm	43.76	4.32	7.44	46.93	36.90	139.35	(N/A)
Catalpa	57.07	7.86	9.76	73.14	55.23	203.07	(N/A)
Northern hackberry	72.70	7.08	12.43	79.76	56.50	228.47	(N/A)
White ash	41.11	5.81	6.97	37.95	56.16	148.00	(N/A)
Eastern cottonwood	63.62	8.79	11.24	91.39	58.93	233.97	(N/A)
Boxelder	38.74	6.20	6.31	47.56	43.96	142.79	(N/A)
Eastern white pine	6.70	0.52	0.69	7.74	9.34	25.00	(N/A)
Northern red oak	21.11	2.26	2.89	14.33	16.24	56.83	(N/A)
Japanese tree lilac	3.89	0.40	0.51	1.31	1.38	7.49	(N/A)
Broadleaf Deciduous Large	49.62	6.87	8.27	64.51	50.61	179.89	(N/A)
Paper birch	48.59	6.74	8.06	49.88	49.80	163.07	(N/A)
River birch	18.95	2.33	3.09	14.31	18.26	56.94	(N/A)
Birch	14.15	1.77	1.96	8.23	17.33	43.45	(N/A)
Ohio buckeye	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
White mulberry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Elm	5.82	0.91	0.87	4.65	14.73	26.98	(N/A)
Amur maple	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Cherry plum	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Citywide Total	43.36	5.97	7.05	54.87	48.56	159.82	(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	13,973.09	1,924.51	2,338.53	16,531.78	14,250.07	49,017.97	(N/A)	41.73
Blue spruce	1,113.41	97.25	125.64	1,927.47	1,151.94	4,415.71	(N/A)	3.76
Silver maple	3,475.24	633.73	610.01	5,641.34	5,027.74	15,388.06	(N/A)	13.10
Norway maple	2,444.42	273.47	420.13	2,562.82	1,844.02	7,544.86	(N/A)	6.42
Red maple	1,096.08	139.79	187.09	1,011.04	1,448.09	3,882.10	(N/A)	3.30
Austrian pine	584.22	51.94	67.23	1,002.39	603.60	2,309.38	(N/A)	1.97
Sugar maple	865.93	105.15	134.20	926.55	864.53	2,896.35	(N/A)	2.47
Black walnut	1,110.34	154.22	192.01	1,518.82	1,056.30	4,031.68	(N/A)	3.43
Honeylocust	1,049.40	152.28	172.59	1,170.91	2,624.92	5,170.10	(N/A)	4.40
Conifer Evergreen Large	451.80	45.62	33.95	998.98	615.01	2,145.37	(N/A)	1.83
Siberian elm	994.49	119.85	185.10	1,330.84	659.39	3,289.67	(N/A)	2.80
Pin oak	940.29	198.58	121.91	1,296.50	1,562.52	4,119.81	(N/A)	3.51
Apple	80.22	8.14	10.68	28.24	29.14	156.42	(N/A)	0.13
Spruce	268.26	26.25	26.70	496.61	364.89	1,182.72	(N/A)	1.01
Littleleaf linden	514.52	85.27	85.22	575.27	793.71	2,053.98	(N/A)	1.75
American basswood	536.80	76.60	78.95	645.06	516.58	1,853.99	(N/A)	1.58
Bur oak	208.81	28.75	34.48	265.68	230.57	768.30	(N/A)	0.65
American elm	350.10	34.57	59.48	375.43	295.20	1,114.79	(N/A)	0.95
Catalpa	342.44	47.18	58.58	438.85	331.37	1,218.42	(N/A)	1.04
Northern hackberry	363.49	35.41	62.13	398.82	282.51	1,142.36	(N/A)	0.97
White ash	164.45	23.25	27.86	151.79	224.65	592.00	(N/A)	0.50
Eastern cottonwood	254.48	35.15	44.95	365.57	235.73	935.89	(N/A)	0.80
Boxelder	116.22	18.61	18.94	142.69	131.89	428.36	(N/A)	0.36
Eastern white pine	20.11	1.57	2.08	23.23	28.02	75.00	(N/A)	0.06
Northern red oak	63.34	6.77	8.67	42.98	48.73	170.49	(N/A)	0.15
Japanese tree lilac	11.67	1.21	1.53	3.92	4.15	22.48	(N/A)	0.02
Broadleaf Deciduous Large	148.87	20.62	24.81	193.53	151.84	539.67	(N/A)	0.46
Paper birch	145.78	20.21	24.18	149.64	149.40	489.21	(N/A)	0.42
River birch	56.86	6.99	9.27	42.93	54.78	170.83	(N/A)	0.15
Birch	42.44	5.32	5.89	24.70	51.99	130.34	(N/A)	0.11
Ohio buckeye	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)	0.06
White mulberry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)	0.03
Elm	5.82	0.91	0.87	4.65	14.73	26.98	(N/A)	0.02
Amur maple	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)	0.03
Cherry plum	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)	0.03
Citywide Total	31,872.44	4,387.36	5,184.78	40,326.43	35,693.44	117,464.44	(N/A)	100.00


Average Annual Benefits of Public Trees by Zone ($/tree)
Avg. Annual Benefits per tree ($)
180
160
140
120
100
80
60
40
20
0
1
Citywide Total
Zone
Aesthetic/Other
Stormwater
Air Quality
CO2
Energy

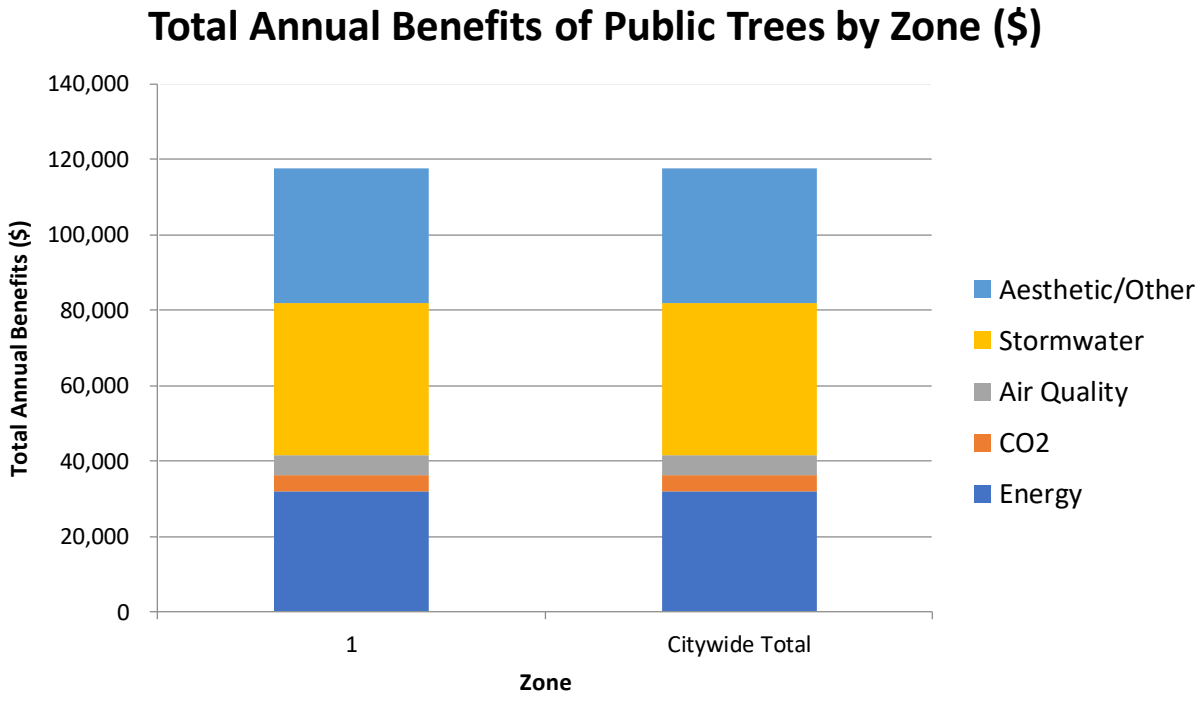

Total Annual Benefits of Public Trees by Zone ($)
Total Annual Benefits ($)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1
Citywide Total
Zone
Aesthetic/Other
Stormwater
Air Quality
CO2
Energy

Figure 1: Species Distribution

Milford
Species Distribution of Public Trees
3/28/2018

Species	Percent
Green ash	40.00
Blue spruce	8.57
Silver maple	7.76
Norway maple	6.94
Red maple	4.08
Austrian pine	3.40
Sugar maple	2.45
Black walnut	2.45
Honeylocust	2.45
Conifer Evergreen Large	2.31
Other Species	19.59

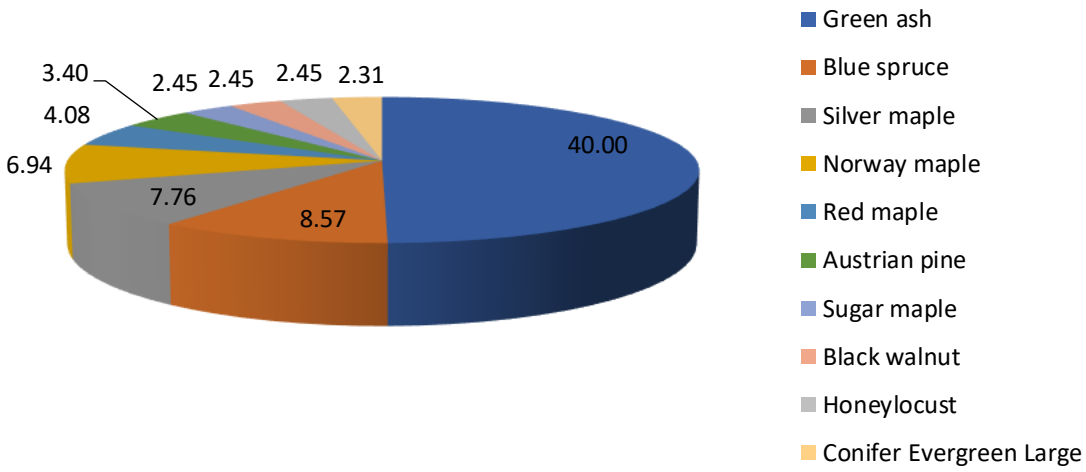
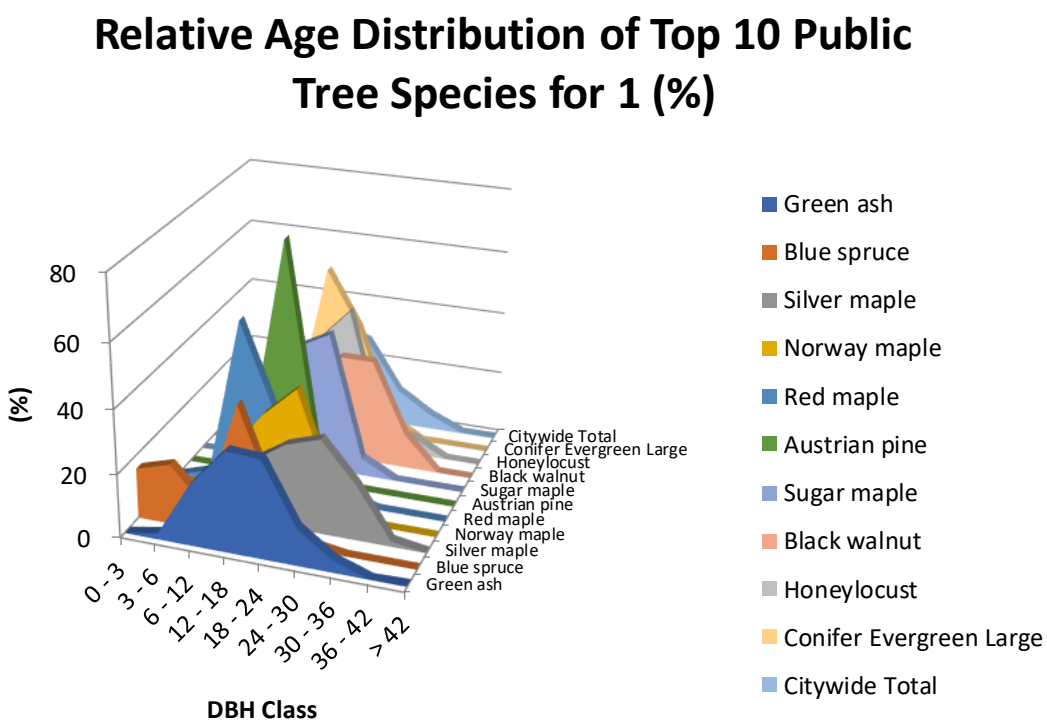


Figure 2: Relative Age Distribution



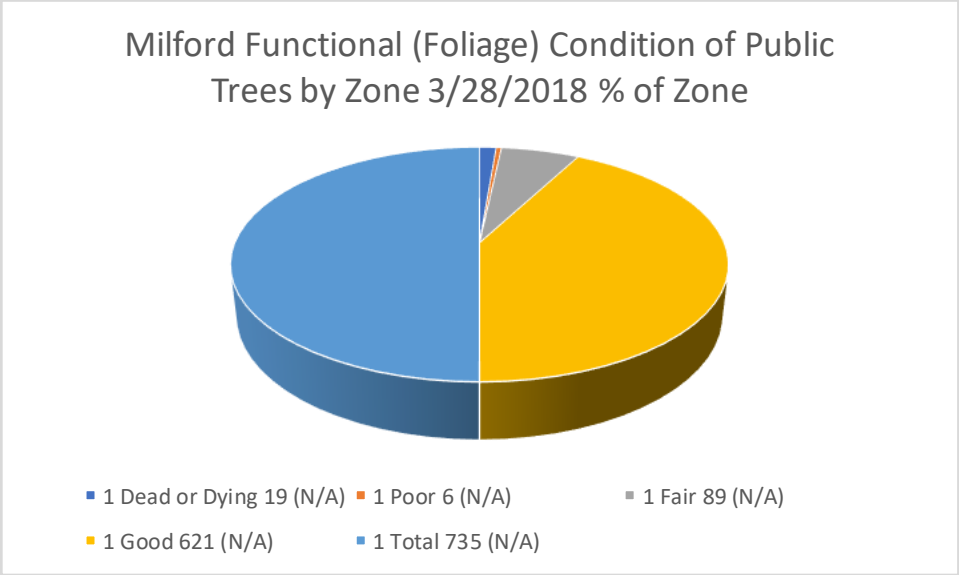
Relative Age Distribution of Top 10 Public Tree Species for 1 (%)

DBH class (in)

Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Green ash	0.00	2.04	19.73	31.63	30.95	11.56	3.74	0.00	0.34
Blue spruce	15.87	19.05	7.94	41.27	14.29	1.59	0.00	0.00	0.00
Silver maple	0.00	1.75	3.51	19.30	26.32	29.82	17.54	1.75	0.00
Norway maple	1.96	3.92	15.69	29.41	39.22	9.80	0.00	0.00	0.00
Red maple	0.00	3.33	53.33	26.67	13.33	3.33	0.00	0.00	0.00
Austrian pine	0.00	0.00	16.00	76.00	8.00	0.00	0.00	0.00	0.00
Sugar maple	0.00	0.00	11.11	38.89	44.44	5.56	0.00	0.00	0.00
Black walnut	0.00	0.00	0.00	22.22	33.33	33.33	11.11	0.00	0.00
Honeylocust	0.00	0.00	11.11	33.33	44.44	5.56	5.56	0.00	0.00
Conifer Evergreen Large	0.00	0.00	5.88	52.94	35.29	5.88	0.00	0.00	0.00
Citywide Total	2.99	5.85	16.19	31.02	27.21	11.43	4.76	0.27	0.27

Figure 2: Relative Age Class

Figure 3: Functional Condition of all Trees

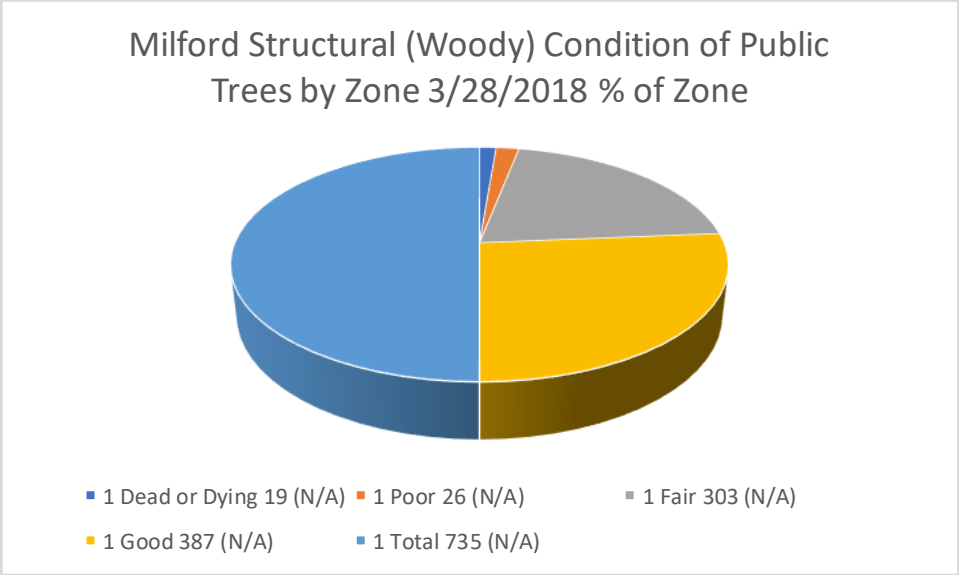


Milford
Functional (Foliage) Condition of Public Trees by Zone
3/28/2018

Zone	Condition	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Dead or Dying	19	(N/A)	2.59	2.59
	Poor	6	(N/A)	0.82	0.82
	Fair	89	(N/A)	12.11	12.11
	Good	621	(N/A)	84.49	84.49
	Total	735	(N/A)	100.00	100.00

Figure 3: Foliage Condition

Figure 4: Structural Condition of all Trees



Milford
Structural (Woody) Condition of Public Trees by Zone
3/28/2018

Zone	Condition	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Dead or Dying	19	(N/A)	2.59	2.59
	Poor	26	(N/A)	3.54	3.54
	Fair	303	(N/A)	41.22	41.22
	Good	387	(N/A)	52.65	52.65
	Total	735	(N/A)	100.00	100.00

Figure 4: Wood Condition

Milford
Canopy Cover of Public Trees (Acres)
3/28/2018

Zone	Acres	% of Total Canopy
1	15.93	100.00
Citywide Total	15.93	100.00

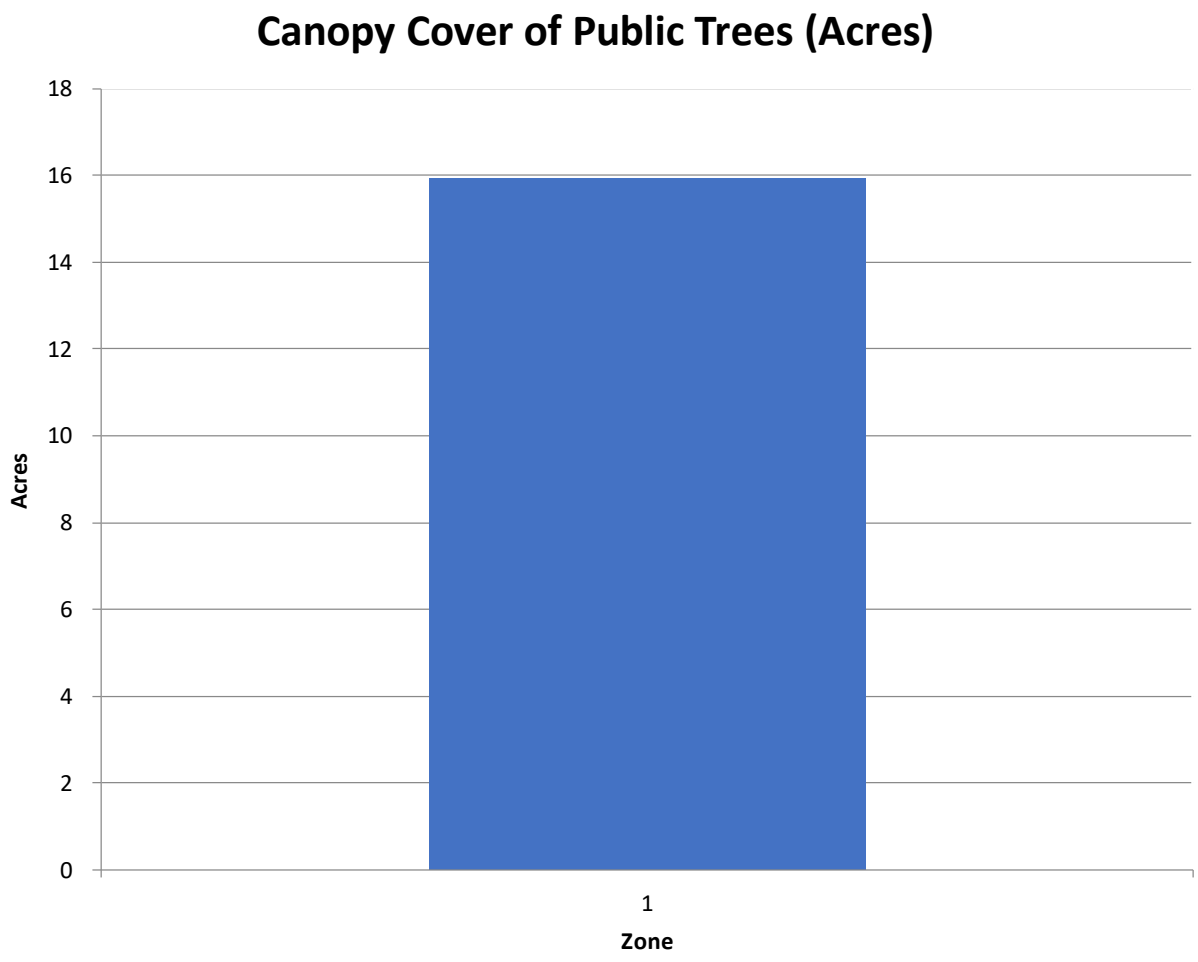
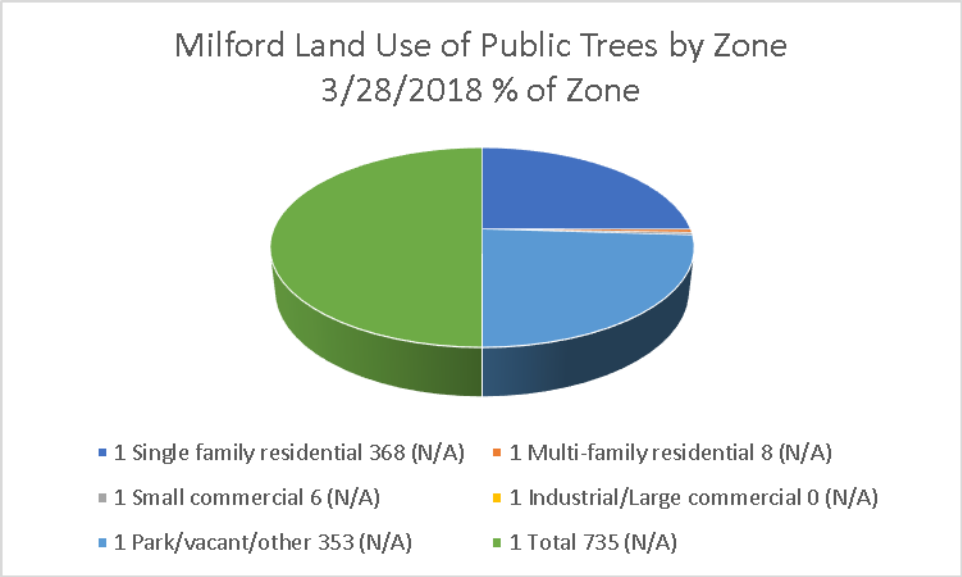


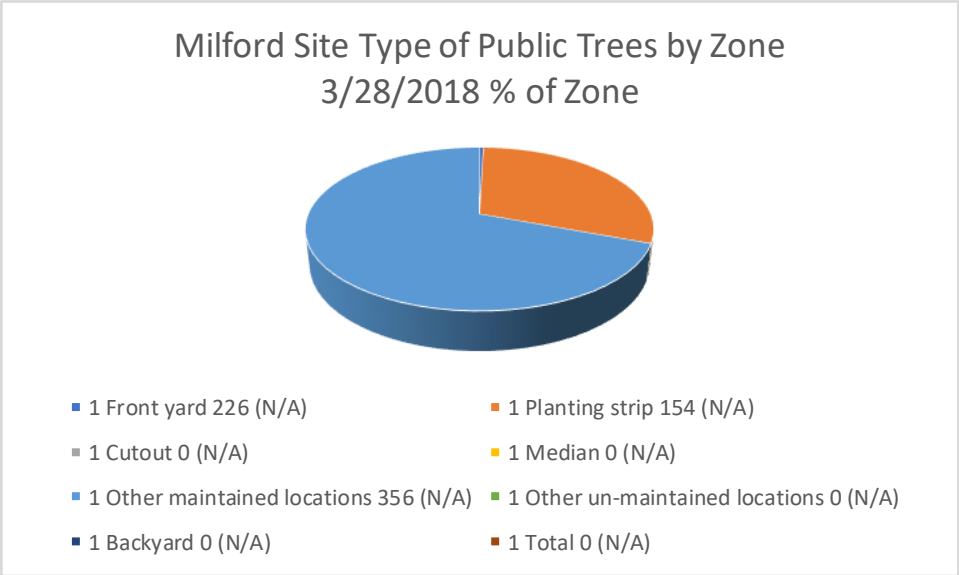
Figure 5: Canopy Cover in Acres

Figure 6: Land Use of city/park trees



Milford
Land Use of Public Trees by Zone
3/28/2018

Zone	Land Use	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Single family residential	368	(N/A)	50.07	50.07
	Multi-family residential	8	(N/A)	1.09	1.09
	Small commercial	6	(N/A)	0.82	0.82
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	353	(N/A)	48.03	48.03
	Total	735	(N/A)	100.00	100.00



Milford
Site Type of Public Trees by Zone
3/28/2018

Zone	Site Type	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Front yard	226	(N/A)	0.29	0.29
	Planting strip	154	(N/A)	20.25	20.05
	Cutout	0	(N/A)	0.00	0.00
	Median	0	(N/A)	0.00	0.00
	Other maintained locations	356	(N/A)	46.35	46.35
	Other un-maintained locations	0	(N/A)	0.00	0.00
	Backyard	0	(N/A)	0.00	0.00
	Total	0	(N/A)	0.00	0.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

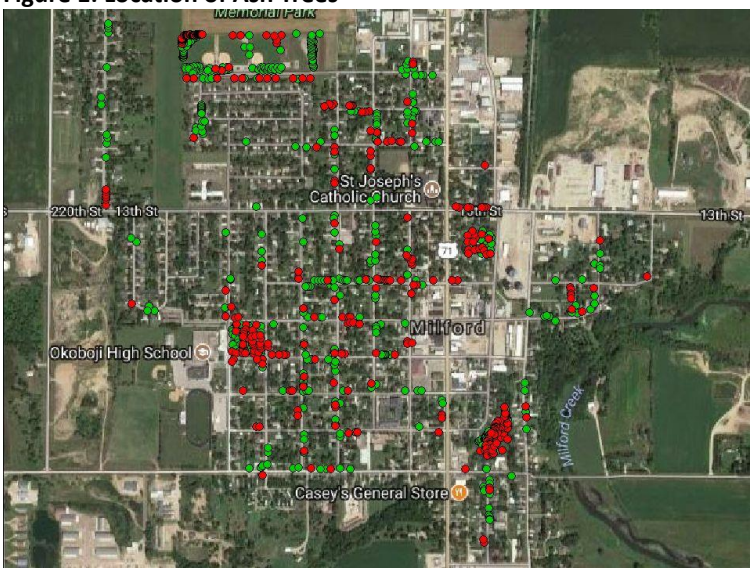


Figure 2: Location of EAB symptoms

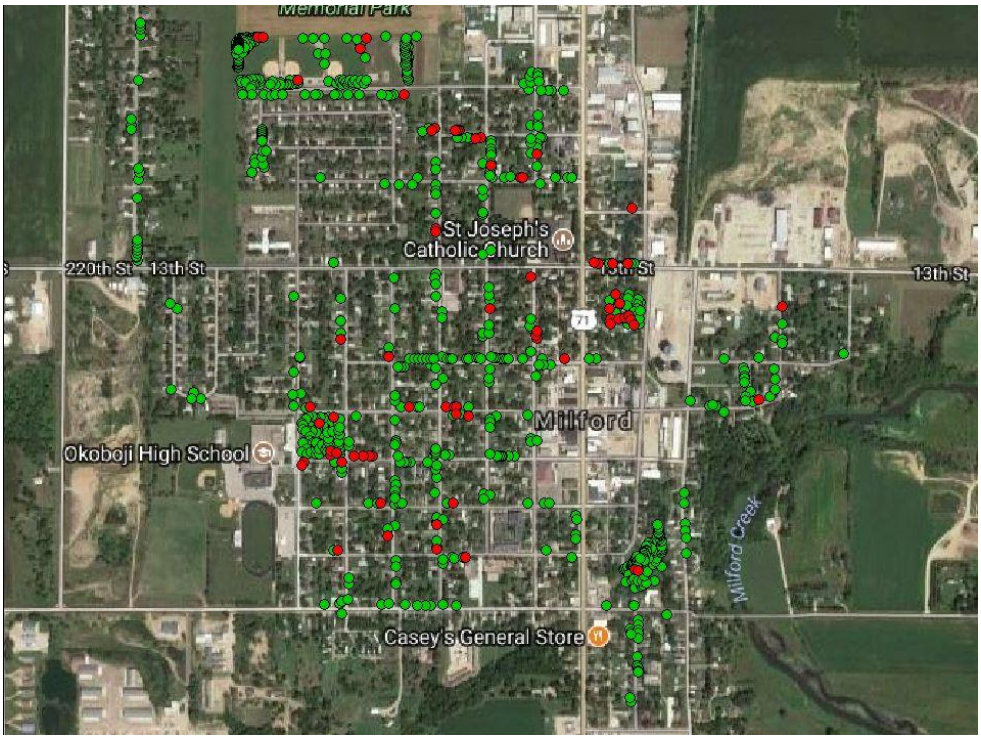


Figure 3: Location of Poor Condition Trees

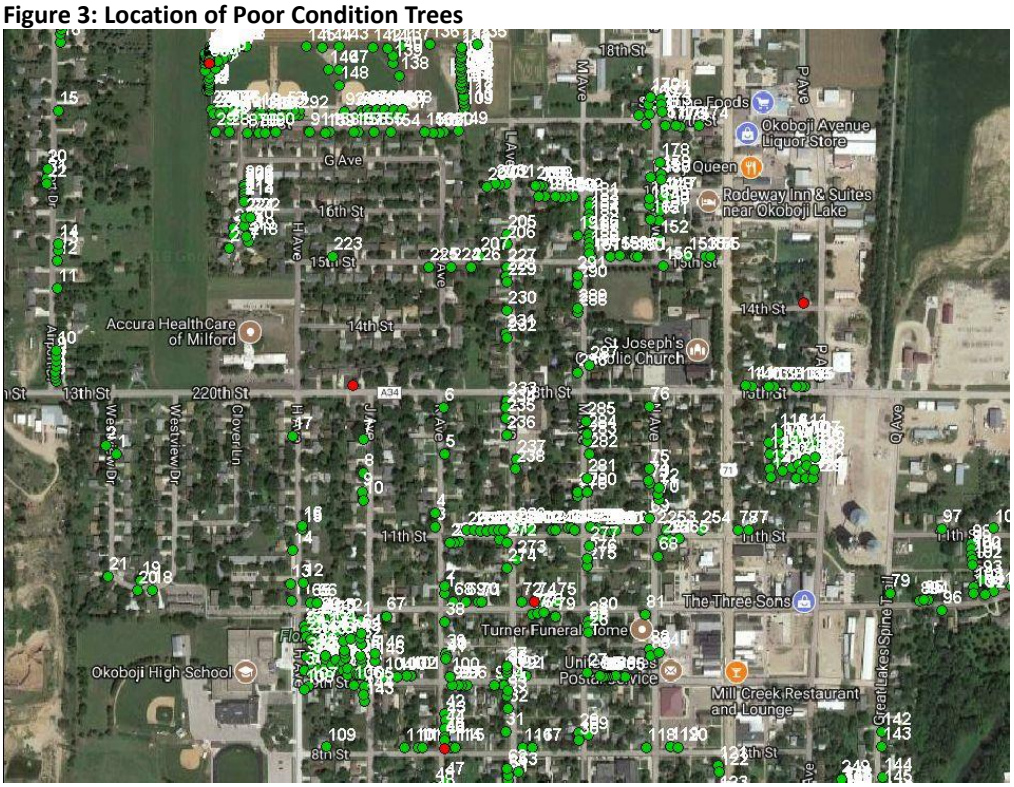
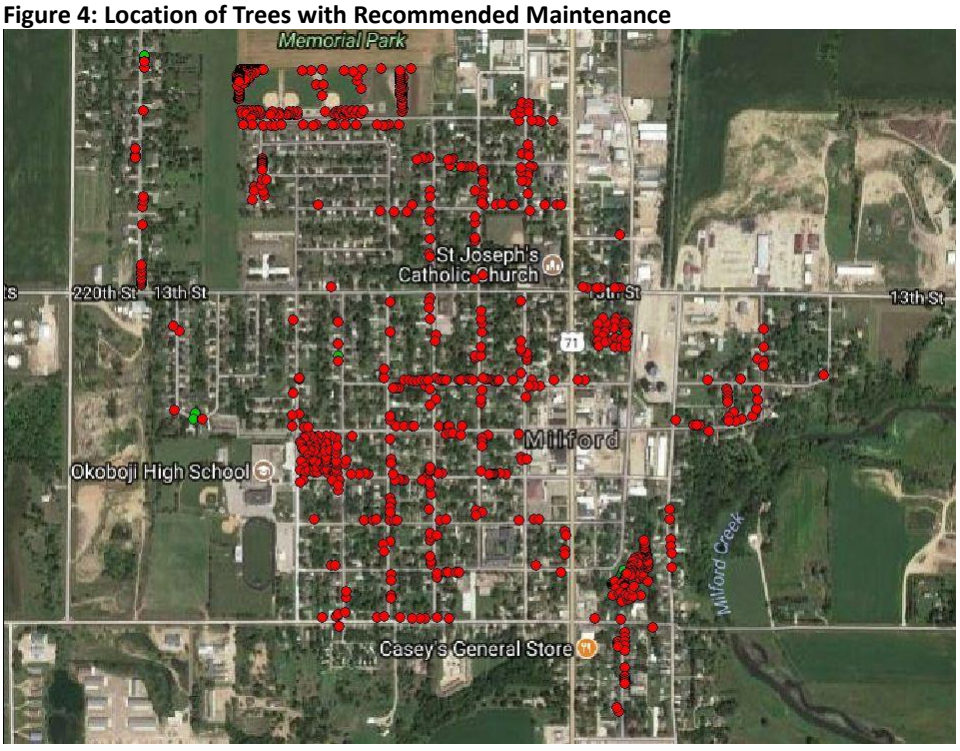


Figure 4: Location of Trees with Recommended Maintenance



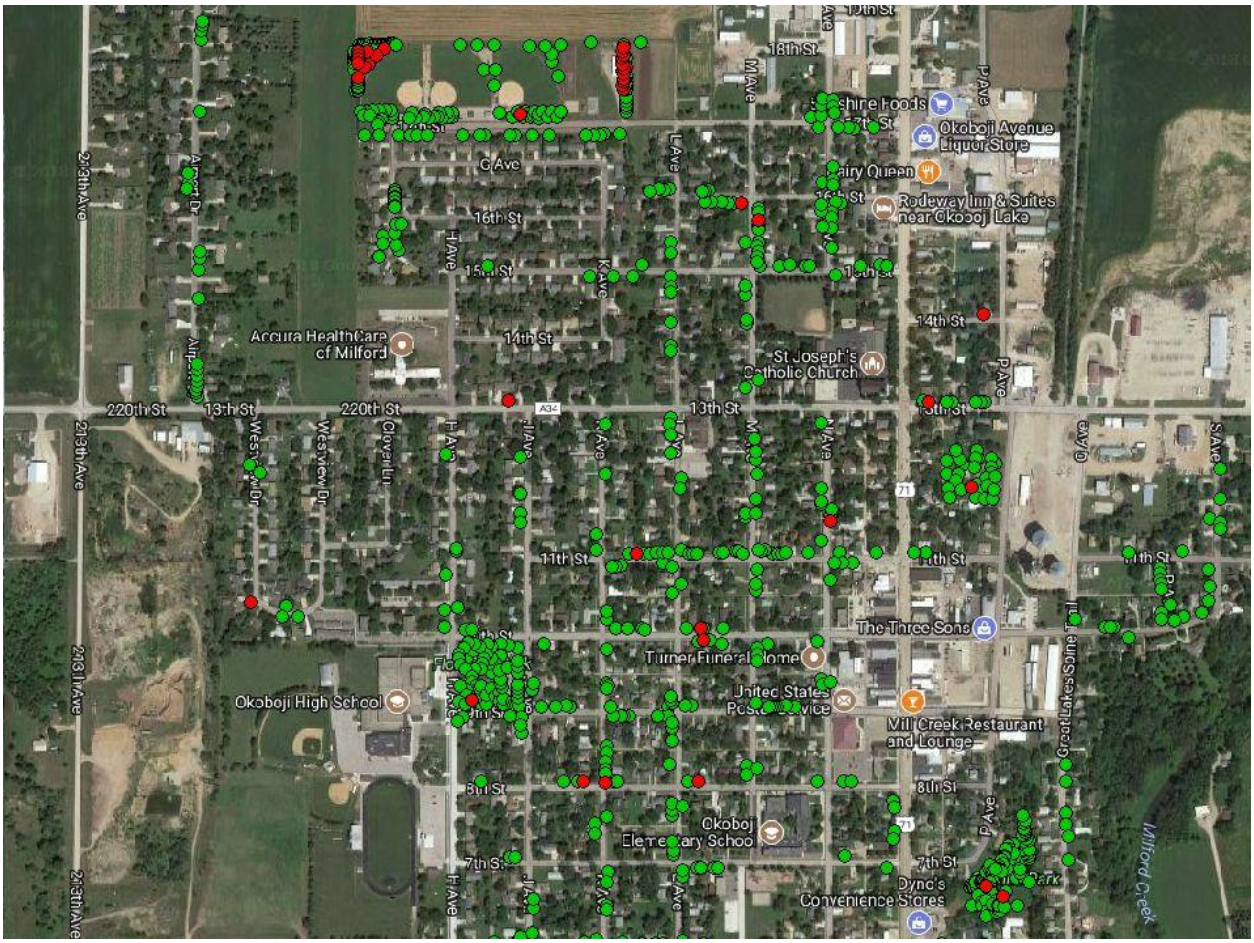


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: Milford Tree Ordinances

URBAN FORESTRY ORDINANCE

CHAPTER 151
TREES

151.01 PLANTING RESTRICTIONS. All trees planted in any street shall be planted fifteen (15) feet from the curb.

151.02 REMOVAL OF TREES. The City shall have removed, on the order of the Council, any existing tree on the streets of the City which interferes with the making of improvements or with travel thereon, and additionally shall remove any existing trees on the street, not on private property, which have become diseased or which constitute a danger to the public or which may otherwise be declared a nuisance.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the existing trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the existing trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax. *(Code of Iowa, Sec. 364.12[2c, d & e])*

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any existing tree in a street or public place unless the work is done under the supervision of the City.

151.05 DISEASE CONTROL. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that 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.

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