

Gladbrook, IA



2020 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Gladbrook 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 20% of Gladbrook's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2018, 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 518 trees inventoried.

- Gladbrook's trees provide \$100,968.56 of benefits annually, an average of \$194.92 a tree
- There were over 42 species of trees found in the inventory, with 25 genera of trees found.
- The top three genera are: Maple 46%, Ash 20%, and Oak 9%.
- 7 trees inventoried were in need of some type of management other than routine maintenance.
- No data was collected for which trees are recommended for removal or where they are located. Additionally, no data was collected as to the maintenance priority of any given tree.

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.

- EAB was not recorded when the inventory was conducted. There are 104 ash trees within Gladbrook and it is likely that some are currently displaying symptoms of EAB. It is recommended that a visual inspection of all ash trees be conducted annually.
- All trees should be pruned on a routine schedule- one sixth of the city every year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

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

Trees are an important component of Gladbrook's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Gladbrook 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 Gladbrook's urban forestry goals.

Inventory

In 2018, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

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

Inventory Results

The data collected for the 518 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Gladbrook's trees reduce energy related costs by approximately \$26,524 annually (Appendix A, Table 1). These savings are both in Electricity (127 MWh) and in Natural Gas (17,231.9 Therms).

Annual Stormwater Benefits

Gladbrook's trees intercept about 1,450,192 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$39,300 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 Gladbrook, it is estimated that trees remove 1,638.4 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$4,597 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Gladbrook, trees sequester about 294,413 lbs of carbon a year with an associated value of \$2,208 (Appendix A, Table 5). In addition, the trees store 5,679,123 lbs of carbon, with a yearly benefit of \$42,593 (Appendix A, Table 4).

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. Gladbrook receives \$26,956 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, Gladbrook's trees provide \$100,968.56 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 519 trees in Gladbrook provide approximately \$194.92 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Gladbrook has over 25 different tree genera along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Genus	Count	Percent
Maple	239	46%
Ash	104	20%
Oak	48	9%
Basswood	27	5%
Spruce	18	3%
Honeylocust	12	2%
Lilac	10	2%
Apple	8	2%
Hackberry	8	2%
Elm	7	1%
Walnut	6	1%
Broadleaf deciduous S/M/L	5	1%
Birch	5	1%
Acer	3	1%
Carya	3	1%
Pear	3	1%
Abies	2	<1%
Ca	2	<1%
Aspen	2	<1%
Cherry	1	<1%
Cottonwood	1	<1%
Cedar	1	<1%
Pine	1	<1%
Mulberry	1	<1%
Magnolia	1	<1%

Age Class

The size of Gladbrook's trees is distributed bi-modally peaking at 12-18 inches and 24 to 30 inches in diameter at 4.5 ft. In total, 33% of Gladbrook's trees are between 6 and 18 inches in diameter at 4.5 ft, and another 33% of Gladbrook's trees are between 18-30 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Gladbrook's size curve is on the larger side, with only 6% of Gladbrook's trees between 0 and 3 inches in diameter at 4.5 feet, indicating an older than average 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 Gladbrook indicate that 65% of the trees are in good health, with only 6% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 65% of Gladbrook's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B,

Figure 3). Wood condition that is in poor health, dead or dying is about 6% of the population. This 6% is an estimate of trees that need management follow up.

Management Needs

There were no specific management needs recorded for Gladbrook's trees. It is recommended that the trees that were listed as in need of immediate maintenance be prioritized.

Canopy Cover

The total canopy with both private and public trees is 22%, 98.83 acres. The canopy cover included in the Gladbrook inventory includes approximately 14.35 acres, which is 3% of Gladbrook's total land acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 33 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Gladbrook'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	Count	Percent
Single Family Res.	480	93%
Park/Vacant/Other	31	6%
Small Commercial	7	1%

Location	Count	Percent
Planting Strip	486	94%
Other		
Maintained	31	6%
Front Yard	1	0%

Recommendations

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

Hazardous trees

Detailed information was not collected on which trees are potentially hazardous or where they might be located.

Poor tree species

The data collectors did not collect appropriate data on this, however it was noted that 104 trees in Gladbrook are ash trees, which is 20% of the total trees inventoried. While the collectors did not gather data on EAB, it is common though out the region and very likely affecting many of the ash trees in Gladbrook. Visual inspections of ash trees should be conducted annually in order track their conditions. Treatment for EAB is an effective preventative measure that can be taken to prevent the

death of healthy ash trees. It is not recommended to be used on ash trees already displaying two or more symptoms of EAB. Since data for EAB was not collected, we will present two separate scenarios regarding ash management versus removal. If all 104 ash trees in Gladbrook are healthy and could be treated, it would cost an estimated \$38,160 every two years, which is an average of \$366.92 per tree. If all 104 ash trees in Gladbrook are suffering from EAB, it would cost an estimated \$83,200 to remove them, which is an average of \$800 per tree. These scenarios represent two different extremes and while it is likely that many ash trees within Gladbrook are displaying signs of EAB, it is also likely that many are not and would therefore be eligible for treatment. It is recommended that Gladbrook treat many of its larger, healthier ash trees and begin removing dead or dying ash trees, as well as those found to be displaying 2 or more symptoms of EAB.

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 Gladbrook.

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 (46%) (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, as outlined in section 140.03 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 140.03 (Appendix C).

Continual Monitoring

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

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. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. 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 planted must meet the restrictions in city ordinance 140.03 (Appendix C). The new plantings should be a diverse mix and will not include any fruit bearing trees, cottonwood, poplar, boxelder, Chinese elm, or evergreens. Additionally, no ash or

maple should be planted.

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 preventative treatments are not being used. City Ordinance 140.07 states “The superintendent shall remove, on order of the Council, any tree on the streets of the City which interferes with the making of improvements or with travel thereon. The superintendent shall additionally remove any 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.”

Works Cited

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Gladbrook

Annual Energy Benefits of Public Trees

12/10/2019

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Stand- ard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	30.3	2,297	4,079.4	3,998	6,295 (N/A)	19.1	23.7	63.58
Silver maple	21.6	1,638	2,838.3	2,782	4,420 (N/A)	13.7	16.7	62.25
Black maple	14.7	1,115	2,010.4	1,970	3,085 (N/A)	11.4	11.6	52.29
Norway maple	13.3	1,012	1,916.8	1,878	2,891 (N/A)	11.0	10.9	50.71
Red maple	6.3	475	786.3	771	1,246 (N/A)	5.0	4.7	47.91
Sugar maple	5.8	441	767.0	752	1,192 (N/A)	3.7	4.5	62.75
American basswood	5.5	417	782.2	767	1,184 (N/A)	3.7	4.5	62.31
Bur oak	4.3	326	599.4	587	913 (N/A)	2.9	3.4	60.90
Pin oak	4.2	321	568.2	557	878 (N/A)	2.9	3.3	58.51
Norway spruce	2.6	199	349.4	342	542 (N/A)	2.9	2.0	36.12
Northern red oak	1.8	139	254.1	249	388 (N/A)	2.9	1.5	25.84
Honeylocust	4.2	316	535.7	525	841 (N/A)	2.3	3.2	70.07
Amur maple	0.3	21	48.2	47	69 (N/A)	2.3	0.3	5.71
Japanese tree lilac	0.0	3	6.2	6	9 (N/A)	1.9	0.0	0.87
Northern hackberry	1.4	104	198.0	194	298 (N/A)	1.5	1.1	37.21
Littleleaf linden	0.9	71	141.9	139	210 (N/A)	1.5	0.8	26.26
Apple	0.6	43	94.3	92	135 (N/A)	1.5	0.5	16.89
American elm	1.9	141	239.6	235	376 (N/A)	1.4	1.4	53.72
Black walnut	1.9	147	266.2	261	407 (N/A)	1.2	1.5	67.90
Catalpa	1.5	111	194.6	191	301 (N/A)	1.0	1.1	60.24
Broadleaf Deciduous Medium	0.0	1	3.2	3	4 (N/A)	0.8	0.0	1.10
Pear	0.3	25	50.3	49	75 (N/A)	0.6	0.3	24.84
White ash	0.3	21	40.0	39	60 (N/A)	0.6	0.2	20.10
Blue spruce	0.3	25	44.9	44	69 (N/A)	0.6	0.3	22.99
River birch	0.3	23	46.5	46	69 (N/A)	0.6	0.3	22.92
Paper birch	0.5	38	65.1	64	102 (N/A)	0.4	0.4	50.77
Quaking aspen	0.5	36	54.0	53	88 (N/A)	0.4	0.3	44.23
Ash	0.5	40	79.1	78	117 (N/A)	0.4	0.4	58.69
White oak	0.0	0	0.5	0	1 (N/A)	0.2	0.0	0.66
Swamp white oak	0.0	3	6.2	6	9 (N/A)	0.2	0.0	8.99
Common chokecherry	0.1	6	12.8	13	18 (N/A)	0.2	0.1	18.19
Southern magnolia	0.0	1	2.8	3	4 (N/A)	0.2	0.0	3.94
Eastern red cedar	0.0	4	7.9	8	11 (N/A)	0.2	0.0	11.47
Eastern white pine	0.1	11	19.7	19	30 (N/A)	0.2	0.1	30.47
Mulberry	0.0	2	3.8	4	5 (N/A)	0.2	0.0	5.40
Cottonwood	0.4	33	59.0	58	91 (N/A)	0.2	0.3	91.02
Broadleaf Deciduous Large	0.4	33	59.0	58	91 (N/A)	0.2	0.3	91.02
Oak	0.0	0	0.5	0	1 (N/A)	0.2	0.0	0.66
Total	127.0	9,637	17,231.9	16,887	26,524 (N/A)	100.0	100.0	51.21

Table 2: Annual Stormwater Benefits

Gladbrook

Annual Stormwater Benefits of Public Trees

12/10/2019

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	365,446	9,904	(N/A)	19.1	25.2	100.04
Silver maple	296,841	8,044	(N/A)	13.7	20.5	113.30
Black maple	133,616	3,621	(N/A)	11.4	9.2	61.37
Norway maple	121,468	3,292	(N/A)	11.0	8.4	57.75
Red maple	45,365	1,229	(N/A)	5.0	3.1	47.28
Sugar maple	77,684	2,105	(N/A)	3.7	5.4	110.80
American basswood	61,490	1,666	(N/A)	3.7	4.2	87.70
Bur oak	57,801	1,566	(N/A)	2.9	4.0	104.43
Pin oak	47,422	1,285	(N/A)	2.9	3.3	85.68
Norway spruce	62,528	1,695	(N/A)	2.9	4.3	112.97
Northern red oak	15,022	407	(N/A)	2.9	1.0	27.14
Honeylocust	48,182	1,306	(N/A)	2.3	3.3	108.81
Amur maple	897	24	(N/A)	2.3	0.1	2.03
Japanese tree lilac	74	2	(N/A)	1.9	0.0	0.20
Northern hackberry	10,730	291	(N/A)	1.5	0.7	36.35
Littleleaf linden	8,507	231	(N/A)	1.5	0.6	28.82
Apple	2,438	66	(N/A)	1.5	0.2	8.26
American elm	16,007	434	(N/A)	1.4	1.1	61.97
Black walnut	22,923	621	(N/A)	1.2	1.6	103.54
Catalpa	14,760	400	(N/A)	1.0	1.0	80.00
Broadleaf Deciduous Medium	49	1	(N/A)	0.8	0.0	0.33
Pear	1,196	32	(N/A)	0.6	0.1	10.80
White ash	1,841	50	(N/A)	0.6	0.1	16.63
Blue spruce	4,612	125	(N/A)	0.6	0.3	41.66
River birch	2,654	72	(N/A)	0.6	0.2	23.98
Paper birch	4,056	110	(N/A)	0.4	0.3	54.96
Quaking aspen	2,931	79	(N/A)	0.4	0.2	39.72
Ash	4,959	134	(N/A)	0.4	0.3	67.19
White oak	18	0	(N/A)	0.2	0.0	0.48
Swamp white oak	163	4	(N/A)	0.2	0.0	4.41
Common chokecherry	264	7	(N/A)	0.2	0.0	7.17
Southern magnolia	56	2	(N/A)	0.2	0.0	1.53
Eastern red cedar	659	18	(N/A)	0.2	0.0	17.86
Eastern white pine	2,969	80	(N/A)	0.2	0.2	80.46
Mulberry	69	2	(N/A)	0.2	0.0	1.86
Cottonwood	7,239	196	(N/A)	0.2	0.5	196.17
Broadleaf Deciduous Large	7,239	196	(N/A)	0.2	0.5	196.17
Oak	18	0	(N/A)	0.2	0.0	0.48
Citywide total	1,450,192	39,300	(N/A)	100.0	100.0	75.87

Table 3: Annual Air Quality Benefits

Gladbrook

Annual Air Quality Benefits of Public Trees

12/10/2019

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard (\$ Error)	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂							
Green ash	52.9	8.5	24.4	2.4	279	143.9	21.0	20.0	137.2	898	0.0	0	410.3	1,177 (N/A)	19.1	11.89
Silver maple	50.1	8.5	24.8	2.2	271	101.7	14.9	14.2	97.6	637	-26.6	-100	287.5	807 (N/A)	13.7	11.37
Black maple	33.1	5.7	15.3	1.5	176	70.0	10.2	9.7	66.5	436	-11.0	-41	201.1	571 (N/A)	11.4	9.69
Norway maple	24.5	4.2	12.1	1.1	132	64.6	9.3	8.9	60.5	400	-5.8	-22	179.5	511 (N/A)	11.0	8.97
Red maple	10.0	1.7	4.7	0.4	53	29.2	4.3	4.1	28.4	184	-3.5	-13	79.3	224 (N/A)	5.0	8.61
Sugar maple	12.5	2.1	5.9	0.6	67	27.4	4.0	3.8	26.3	172	-9.7	-36	73.0	202 (N/A)	3.7	10.63
American basswood	8.5	1.4	4.1	0.4	46	26.6	3.8	3.7	24.9	165	-7.2	-27	66.3	183 (N/A)	3.7	9.66
Bur oak	8.1	1.3	3.7	0.4	42	20.6	3.0	2.9	19.5	128	0.0	0	59.3	171 (N/A)	2.9	11.38
Pin oak	8.4	1.5	4.3	0.4	46	20.1	2.9	2.8	19.1	125	-15.6	-59	43.9	113 (N/A)	2.9	7.51
Norway spruce	7.6	1.5	6.0	0.9	50	12.4	1.8	1.7	11.9	78	-37.0	-139	7.0	-12 (N/A)	2.9	-0.77
Northern red oak	2.9	0.5	1.5	0.1	16	8.7	1.3	1.2	8.3	54	-4.1	-15	20.3	55 (N/A)	2.9	3.64
Honeylocust	9.5	1.6	4.3	0.4	50	19.5	2.9	2.7	18.8	122	-7.5	-28	52.2	144 (N/A)	2.3	12.02
Amur maple	0.1	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	9	0.0	0	3.2	9 (N/A)	2.3	0.76
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	1.9	0.11
Northern hackberry	1.4	0.2	0.8	0.1	8	6.6	1.0	0.9	6.2	41	0.0	0	17.2	49 (N/A)	1.5	6.11
Littleleaf linden	1.3	0.2	0.7	0.1	7	4.6	0.7	0.6	4.2	28	-0.7	-2	11.7	33 (N/A)	1.5	4.12
Apple	0.6	0.1	0.3	0.0	3	2.8	0.4	0.4	2.5	17	0.0	0	7.2	21 (N/A)	1.5	2.58
American elm	3.6	0.6	1.8	0.2	19	8.8	1.3	1.2	8.4	55	0.0	0	25.9	74 (N/A)	1.4	10.62
Black walnut	3.0	0.5	1.4	0.1	16	9.2	1.3	1.3	8.8	57	0.0	0	25.6	73 (N/A)	1.2	12.19
Catalpa	1.7	0.3	0.8	0.1	9	6.9	1.0	1.0	6.6	43	0.0	0	18.4	52 (N/A)	1.0	10.45
Broadleaf Deciduous Medium	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	1 (N/A)	0.8	0.14
Pear	0.3	0.0	0.2	0.0	2	1.6	0.2	0.2	1.5	10	0.0	0	4.1	12 (N/A)	0.6	3.88
White ash	0.1	0.0	0.1	0.0	0	1.3	0.2	0.2	1.3	8	0.0	0	3.1	9 (N/A)	0.6	2.91
Blue spruce	0.6	0.1	0.5	0.1	4	1.6	0.2	0.2	1.5	10	-1.7	-6	3.1	8 (N/A)	0.6	2.51
River birch	0.5	0.1	0.3	0.0	3	1.5	0.2	0.2	1.4	9	-0.1	0	4.0	12 (N/A)	0.6	3.84
Paper birch	0.4	0.1	0.2	0.0	2	2.3	0.3	0.3	2.3	15	0.0	0	5.9	17 (N/A)	0.4	8.38
Quaking aspen	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	14	0.0	0	5.3	15 (N/A)	0.4	7.42
Ash	1.0	0.2	0.5	0.0	5	2.6	0.4	0.4	2.4	16	-0.2	-1	7.1	20 (N/A)	0.4	10.16
White oak	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.08
Swamp white oak	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	0.2	1.21
Common chokecherry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.2	2.55
Southern magnolia	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.2	0 (N/A)	0.2	0.47
Eastern red cedar	0.1	0.0	0.1	0.0	0	0.2	0.0	0.0	0.2	1	-0.3	-1	0.3	1 (N/A)	0.2	0.62
Eastern white pine	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1 (N/A)	0.2	1.45
Mulberry	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.2	0.71
Cottonwood	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19 (N/A)	0.2	19.04
Broadleaf Deciduous Large	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19 (N/A)	0.2	19.04
Oak	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.08
Citywide total	245.6	41.4	120.3	11.6	1,324	604.5	88.1	84.0	575.3	3,770	-132.4	-497	1,638.4	4,597 (N/A)	100.0	8.87

**Table 4: Annual Carbon Stored
Gladbrook**

Stored CO2 Benefits of Public Trees

12/10/2019

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	1,775,755	13,318	(N/A)	19.1	31.3	134.53
Silver maple	1,145,402	8,591	(N/A)	13.7	20.2	120.99
Black maple	356,232	2,672	(N/A)	11.4	6.3	45.28
Norway maple	405,385	3,040	(N/A)	11.0	7.1	53.34
Red maple	110,061	825	(N/A)	5.0	1.9	31.75
Sugar maple	377,471	2,831	(N/A)	3.7	6.6	149.00
American basswood	313,669	2,353	(N/A)	3.7	5.5	123.82
Bur oak	265,651	1,992	(N/A)	2.9	4.7	132.83
Pin oak	222,991	1,672	(N/A)	2.9	3.9	111.50
Norway spruce	95,764	718	(N/A)	2.9	1.7	47.88
Northern red oak	59,453	446	(N/A)	2.9	1.0	29.73
Honeylocust	123,021	923	(N/A)	2.3	2.2	76.89
Amur maple	2,536	19	(N/A)	2.3	0.0	1.58
Japanese tree lilac	138	1	(N/A)	1.9	0.0	0.10
Northern hackberry	20,615	155	(N/A)	1.5	0.4	19.33
Littleleaf linden	28,767	216	(N/A)	1.5	0.5	26.97
Apple	10,908	82	(N/A)	1.5	0.2	10.23
American elm	75,982	570	(N/A)	1.4	1.3	81.41
Black walnut	95,561	717	(N/A)	1.2	1.7	119.45
Catalpa	54,662	410	(N/A)	1.0	1.0	81.99
Broadleaf Deciduous	67	1	(N/A)	0.8	0.0	0.13
Pear	4,853	36	(N/A)	0.6	0.1	12.13
White ash	3,104	23	(N/A)	0.6	0.1	7.76
Blue spruce	4,064	30	(N/A)	0.6	0.1	10.16
River birch	8,181	61	(N/A)	0.6	0.1	20.45
Paper birch	12,130	91	(N/A)	0.4	0.2	45.49
Quaking aspen	7,344	55	(N/A)	0.4	0.1	27.54
Ash	15,891	119	(N/A)	0.4	0.3	59.59
White oak	12	0	(N/A)	0.2	0.0	0.09
Swamp white oak	218	2	(N/A)	0.2	0.0	1.64
Common chokecherry	908	7	(N/A)	0.2	0.0	6.81
Southern magnolia	3	0	(N/A)	0.2	0.0	0.02
Eastern red cedar	277	2	(N/A)	0.2	0.0	2.08
Eastern white pine	3,343	25	(N/A)	0.2	0.1	25.07
Mulberry	178	1	(N/A)	0.2	0.0	1.33
Cottonwood	39,259	294	(N/A)	0.2	0.7	294.44
Broadleaf Deciduous	39,259	294	(N/A)	0.2	0.7	294.44
Oak	12	0	(N/A)	0.2	0.0	0.09
Citywide total	5,679,123	42,593	(N/A)	100.0	100.0	82.23

Table 5: Annual Carbon Sequestered

Gladbrook

Annual CO₂ Benefits of Public Trees

12/10/2019

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	64,508	484	-8,524	-324	-66	50,765	381	106,425	798 (N/A)	19.1	22.2	8.06
Silver maple	87,004	653	-5,499	-235	-43	36,200	271	117,469	881 (N/A)	13.7	24.5	12.41
Black maple	16,515	124	-1,710	-137	-14	24,641	185	39,308	295 (N/A)	11.4	8.2	5.00
Norway maple	16,826	126	-1,947	-143	-16	22,371	168	37,107	278 (N/A)	11.0	7.8	4.88
Red maple	11,162	84	-528	-52	-4	10,498	79	21,079	158 (N/A)	5.0	4.4	6.08
Sugar maple	15,625	117	-1,812	-67	-14	9,735	73	23,481	176 (N/A)	3.7	4.9	9.27
American basswood	18,154	136	-1,506	-64	-12	9,223	69	25,808	194 (N/A)	3.7	5.4	10.19
Bur oak	10,339	78	-1,275	-48	-10	7,205	54	16,220	122 (N/A)	2.9	3.4	8.11
Pin oak	20,217	152	-1,070	-45	-8	7,089	53	26,191	196 (N/A)	2.9	5.5	13.10
Norway spruce	3,566	27	-460	-50	-4	4,406	33	7,463	56 (N/A)	2.9	1.6	3.73
Northern red oak	1,567	12	-285	-23	-2	3,063	23	4,322	32 (N/A)	2.9	0.9	2.16
Honeylocust	6,342	48	-590	-31	-5	6,980	52	12,700	95 (N/A)	2.3	2.7	7.94
Amur maple	473	4	-12	-7	0	470	4	924	7 (N/A)	2.3	0.2	0.58
Japanese tree lilac	87	1	-1	-2	0	56	0	140	1 (N/A)	1.9	0.0	0.10
Northern hackberry	1,413	11	-99	-13	-1	2,291	17	3,592	27 (N/A)	1.5	0.8	3.37
Littleleaf linden	1,965	15	-139	-13	-1	1,569	12	3,382	25 (N/A)	1.5	0.7	3.17
Apple	1,048	8	-52	-9	0	943	7	1,929	14 (N/A)	1.5	0.4	1.81
American elm	2,252	17	-365	-19	-3	3,121	23	4,989	37 (N/A)	1.4	1.0	5.35
Black walnut	4,738	36	-459	-20	-4	3,239	24	7,498	56 (N/A)	1.2	1.6	9.37
Catalpa	3,461	26	-262	-14	-2	2,443	18	5,627	42 (N/A)	1.0	1.2	8.44
Broadleaf Deciduous Medi	22	0	-1	-1	0	29	0	49	0 (N/A)	0.8	0.0	0.09
Pear	495	4	-23	-4	0	557	4	1,025	8 (N/A)	0.6	0.2	2.56
White ash	546	4	-15	-4	0	467	3	994	7 (N/A)	0.6	0.2	2.49
Blue spruce	276	2	-20	-6	0	552	4	803	6 (N/A)	0.6	0.2	2.01
River birch	571	4	-40	-4	0	512	4	1,039	8 (N/A)	0.6	0.2	2.60
Paper birch	1,105	8	-58	-5	0	834	6	1,876	14 (N/A)	0.4	0.4	7.04
Quaking aspen	891	7	-35	-4	0	786	6	1,637	12 (N/A)	0.4	0.3	6.14
Ash	940	7	-76	-5	-1	880	7	1,738	13 (N/A)	0.4	0.4	6.52
White oak	3	0	0	0	0	4	0	7	0 (N/A)	0.2	0.0	0.05
Swamp white oak	96	1	-2	-1	0	65	0	158	1 (N/A)	0.2	0.0	1.18
Common chokecherry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.2	0.0	1.74
Southern magnolia	1	0	0	0	0	26	0	27	0 (N/A)	0.2	0.0	0.20
Eastern red cedar	40	0	-1	-1	0	82	1	119	1 (N/A)	0.2	0.0	0.89
Eastern white pine	187	1	-16	-3	0	246	2	415	3 (N/A)	0.2	0.1	3.11
Mulberry	38	0	-1	-1	0	37	0	74	1 (N/A)	0.2	0.0	0.55
Cottonwood	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	0.2	0.3	10.90
Broadleaf Deciduous Large	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	0.2	0.3	10.90
Oak	3	0	0	0	0	4	0	7	0 (N/A)	0.2	0.0	0.05
Citywide total	294,413	2,208	-27,266	-1,366	-215	212,979	1,597	478,760	3,591 (N/A)	100.0	100.0	6.93

Table 6: Annual Social and Aesthetic Benefit**Gladbrook****Annual Aesthetic/Other Benefits of Public Trees**

12/10/2019

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	5,139	(N/A)	19.1	19.1	51.91
Silver maple	6,907	(N/A)	13.7	25.6	97.29
Black maple	2,135	(N/A)	11.4	7.9	36.18
Norway maple	1,655	(N/A)	11.0	6.1	29.03
Red maple	1,501	(N/A)	5.0	5.6	57.72
Sugar maple	1,503	(N/A)	3.7	5.6	79.08
American basswood	1,284	(N/A)	3.7	4.8	67.59
Bur oak	777	(N/A)	2.9	2.9	51.79
Pin oak	1,541	(N/A)	2.9	5.7	102.72
Norway spruce	477	(N/A)	2.9	1.8	31.81
Northern red oak	163	(N/A)	2.9	0.6	10.87
Honeylocust	1,567	(N/A)	2.3	5.8	130.56
Amur maple	25	(N/A)	2.3	0.1	2.08
Japanese tree lilac	0	(N/A)	1.9	0.0	0.03
Northern hackberry	245	(N/A)	1.5	0.9	30.58
Littleleaf linden	248	(N/A)	1.5	0.9	31.00
Apple	61	(N/A)	1.5	0.2	7.57
American elm	311	(N/A)	1.4	1.2	44.42
Black walnut	368	(N/A)	1.2	1.4	61.32
Catalpa	288	(N/A)	1.0	1.1	57.70
Broadleaf Deciduous Medium	11	(N/A)	0.8	0.0	2.74
Pear	28	(N/A)	0.6	0.1	9.43

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White ash	100 (N/A)	0.6	0.4	33.42
Blue spruce	66 (N/A)	0.6	0.2	22.09
River birch	59 (N/A)	0.6	0.2	19.56
Paper birch	104 (N/A)	0.4	0.4	51.77
Quaking aspen	92 (N/A)	0.4	0.3	45.86
Ash	86 (N/A)	0.4	0.3	43.05
White oak	5 (N/A)	0.2	0.0	5.26
Swamp white oak	13 (N/A)	0.2	0.0	12.89
Common chokecherry	6 (N/A)	0.2	0.0	6.40
Southern magnolia	0 (N/A)	0.2	0.0	0.01
Eastern red cedar	21 (N/A)	0.2	0.1	21.34
Eastern white pine	47 (N/A)	0.2	0.2	47.08
Mulberry	2 (N/A)	0.2	0.0	2.06
Cottonwood	58 (N/A)	0.2	0.2	58.34
Broadleaf Deciduous Large	58 (N/A)	0.2	0.2	58.34
Oak	5 (N/A)	0.2	0.0	5.26
Citywide total	26,956 (N/A)	100.0	100.0	52.04

Table 7: Summary of Benefits in Dollars

Gladbrook

Annual Benefits of Public Trees by Species (\$/tree)							
12/10/2019							
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard E
Green ash	63.58	8.06	11.89	100.04	51.91	235.48	(N/A)
Silver maple	62.25	12.41	11.37	113.30	97.29	296.62	(N/A)
Black maple	52.29	5.00	9.69	61.37	36.18	164.53	(N/A)
Norway maple	50.71	4.88	8.97	57.75	29.03	151.35	(N/A)
Red maple	47.91	6.08	8.61	47.28	57.72	167.60	(N/A)
Sugar maple	62.75	9.27	10.63	110.80	79.08	272.53	(N/A)
American basswood	62.31	10.19	9.66	87.70	67.59	237.45	(N/A)
Bur oak	60.90	8.11	11.38	104.43	51.79	236.60	(N/A)
Pin oak	58.51	13.10	7.51	85.68	102.72	267.51	(N/A)
Norway spruce	36.12	3.73	-0.77	112.97	31.81	183.86	(N/A)
Northern red oak	25.84	2.16	3.64	27.14	10.87	69.66	(N/A)
Honeylocust	70.07	7.94	12.02	108.81	130.56	329.40	(N/A)
Amur maple	5.71	0.58	0.76	2.03	2.08	11.16	(N/A)
Japanese tree lilac	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)
Northern hackberry	37.21	3.37	6.11	36.35	30.58	113.62	(N/A)
Littleleaf linden	26.26	3.17	4.12	28.82	31.00	93.37	(N/A)
Apple	16.89	1.81	2.58	8.26	7.57	37.11	(N/A)
American elm	53.72	5.35	10.62	61.97	44.42	176.07	(N/A)
Black walnut	67.90	9.37	12.19	103.54	61.32	254.32	(N/A)
Catalpa	60.24	8.44	10.45	80.00	57.70	216.83	(N/A)
Broadleaf Deciduous 1	1.10	0.09	0.14	0.33	2.74	4.40	(N/A)
Pear	24.84	2.56	3.88	10.80	9.43	51.51	(N/A)
White ash	20.10	2.49	2.91	16.63	33.42	75.55	(N/A)
Blue spruce	22.99	2.01	2.51	41.66	22.09	91.26	(N/A)
River birch	22.92	2.60	3.84	23.98	19.56	72.89	(N/A)
Paper birch	50.77	7.04	8.38	54.96	51.77	172.93	(N/A)
Quaking aspen	44.23	6.14	7.42	39.72	45.86	143.36	(N/A)
Ash	58.69	6.52	10.16	67.19	43.05	185.60	(N/A)
White oak	0.66	0.05	0.08	0.48	5.26	6.53	(N/A)
Swamp white oak	8.99	1.18	1.21	4.41	12.89	28.68	(N/A)
Common chokecherry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Southern magnolia	3.94	0.20	0.47	1.53	0.01	6.15	(N/A)
Eastern red cedar	11.47	0.89	0.62	17.86	21.34	52.19	(N/A)
Eastern white pine	30.47	3.11	1.45	80.46	47.08	162.58	(N/A)
Mulberry	5.40	0.55	0.71	1.86	2.06	10.58	(N/A)
Cottonwood	91.02	10.90	19.04	196.17	58.34	375.47	(N/A)
Broadleaf Deciduous I	91.02	10.90	19.04	196.17	58.34	375.47	(N/A)
Oak	0.66	0.05	0.08	0.48	5.26	6.53	(N/A)
Citywide Total	51.21	6.93	8.87	75.87	52.04	194.92	(N/A)

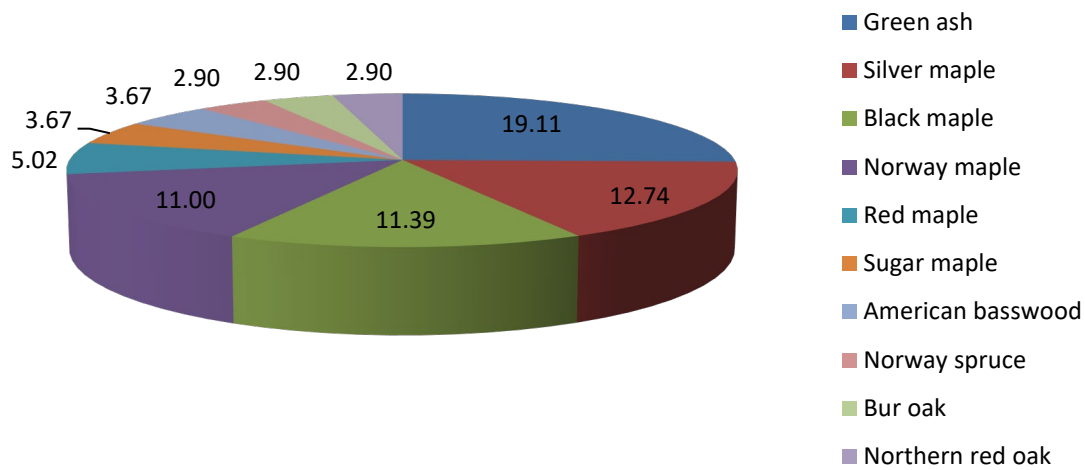


Figure 1: Species Distribution

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

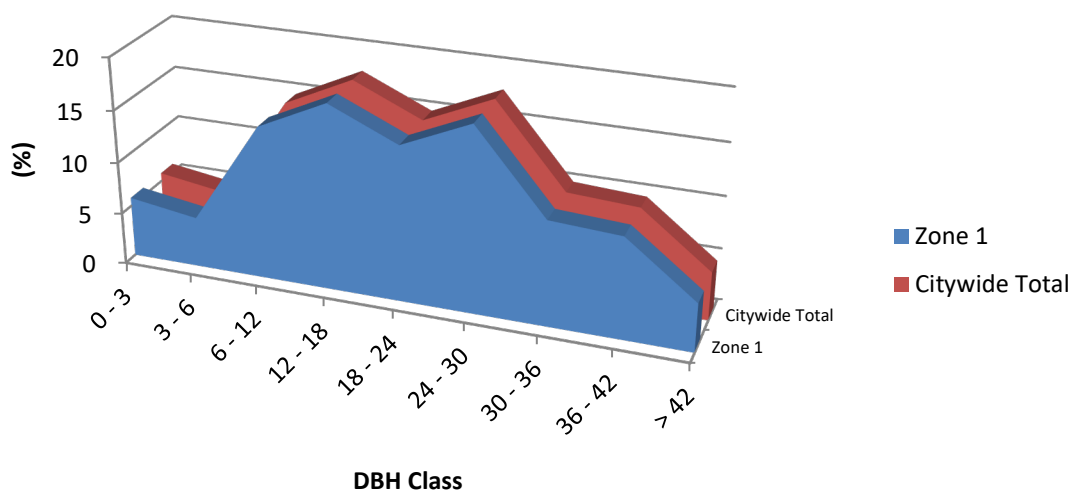


Figure 2: Relative Age Class

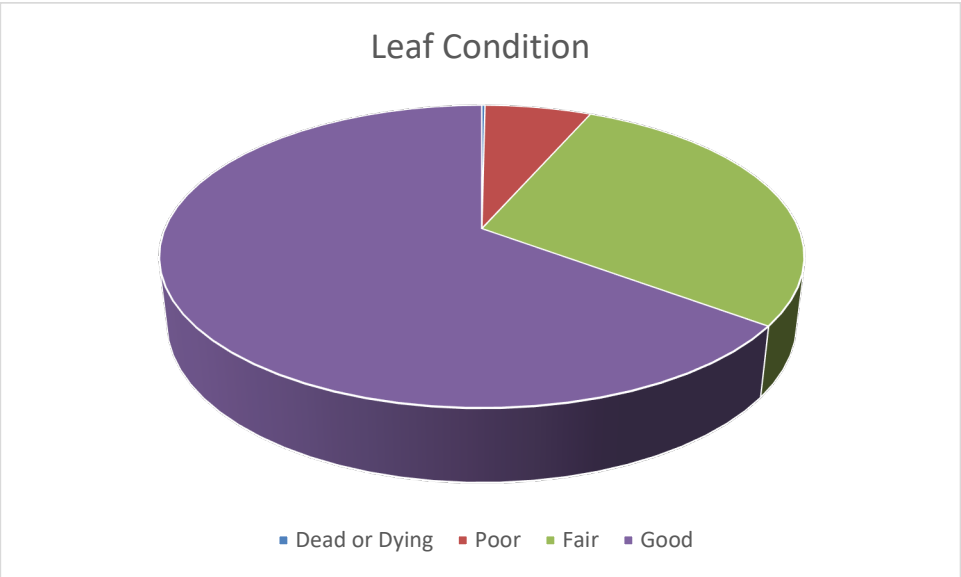


Figure 3: Foliage Condition

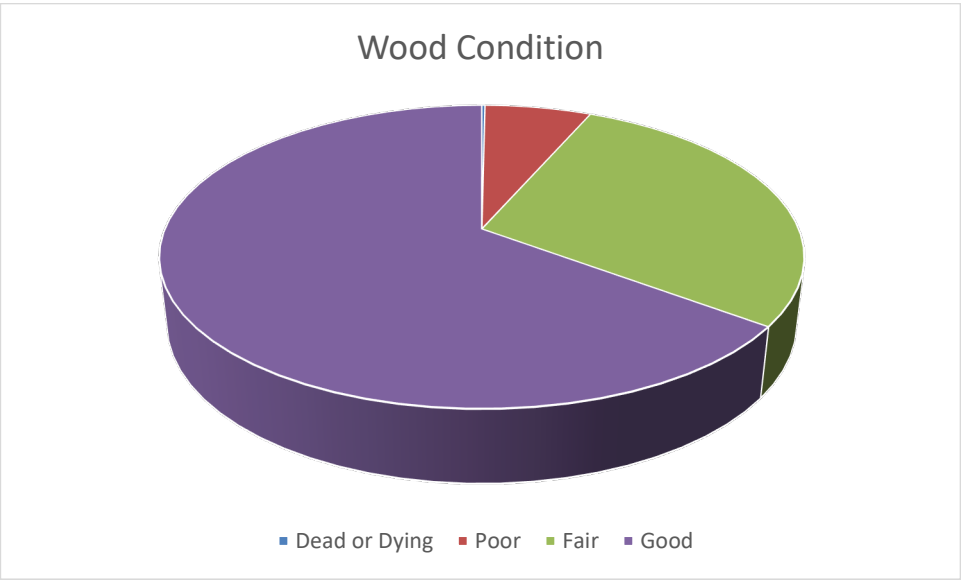


Figure 4: Wood Condition

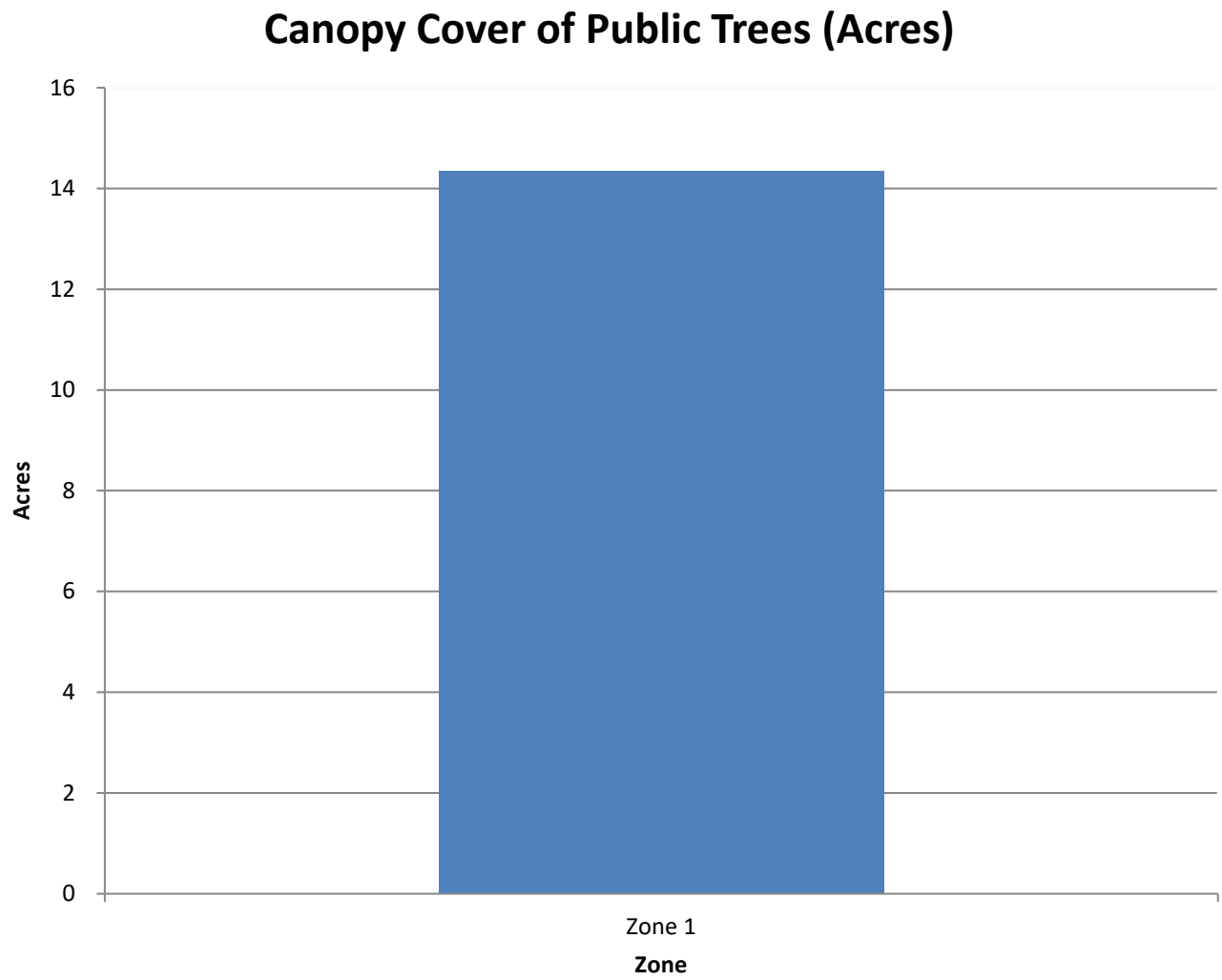


Figure 5: Canopy Cover in Acres

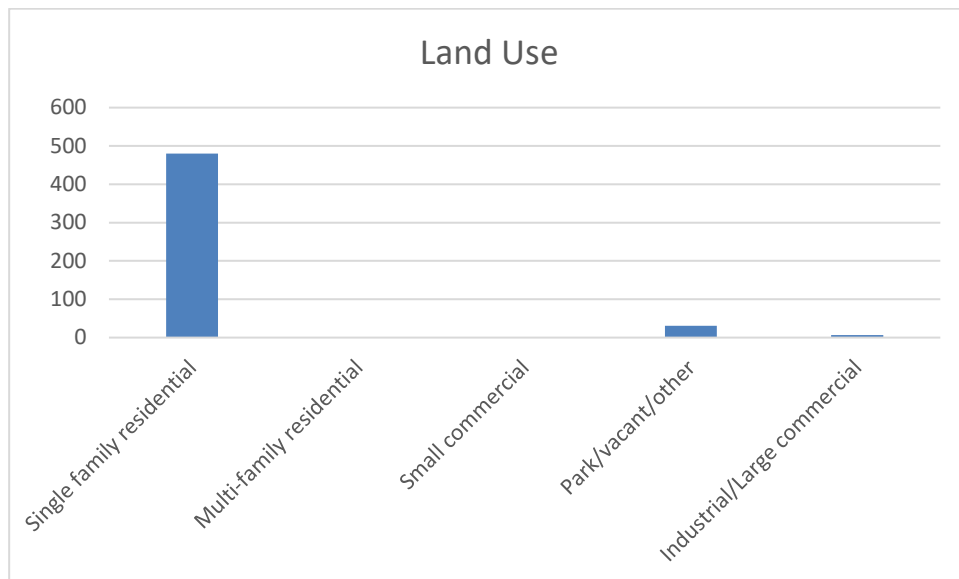


Figure 6: Land Use of city/park trees

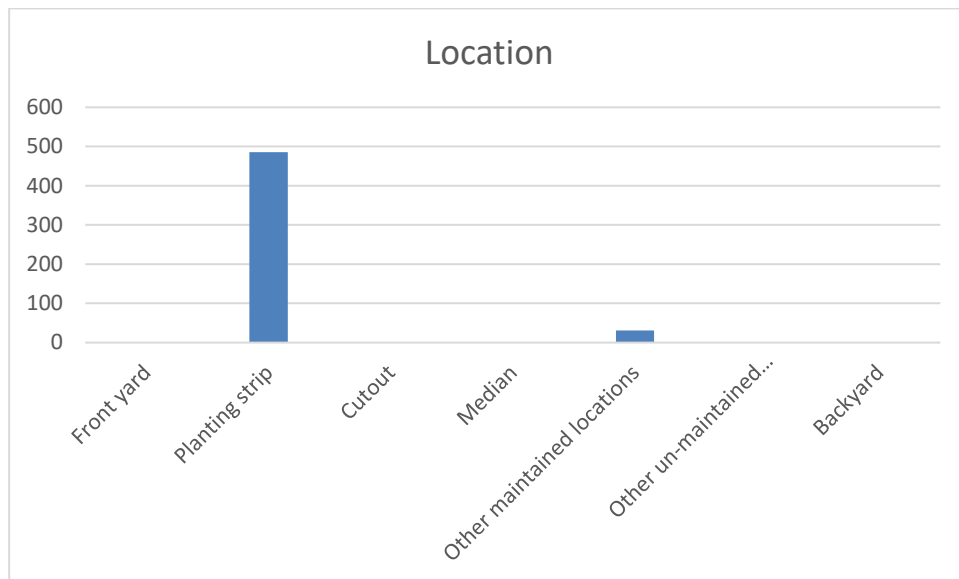


Figure 7: Location of city/park trees



Figure 1: Location of Ash Trees



Figure 3: Location of Poor Condition Trees



Figure 4: Location of Trees with Recommended Maintenance

Appendix C: Gladbrook Tree Ordinances

140.01 PURPOSE. The purpose of the chapters in this Code of Ordinances pertaining to Trees is to beautify and preserve the appearance of the City by regulating and providing for the planting, care and removal of trees.

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

1. "Parking": means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.
2. "Superintendent": means the superintendent of public works or such other person as may be designated by the Council.

140.03 PLANTING RESTRICTIONS. No tree shall be planted in any street or parking except in accordance with the following:

1. Alignment. All trees hereafter planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any parking which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.

3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, boxelder, Chinese elm, or evergreens.

140.04 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks.
(Code of Iowa, Sec. 364.1212c])

140.05 ASSESSMENT. If the abutting property owner fails to trim the trees as required in this chapter, the City may serve 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[2d & e])

140.06 TRIMMING TREES TO BE SUPERVISED. It shall be unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

140.07 REMOVAL OF TREES. The superintendent shall remove, on order of the Council, any tree on the streets of the City which interferes with the making of improvements or with travel thereon. The superintendent shall additionally remove any 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.
(Code of Iowa, Sec. 364.12 [2cl & 372.13 [4])

The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E 9th St, Des Moines IA 50319.

If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-725-8200.