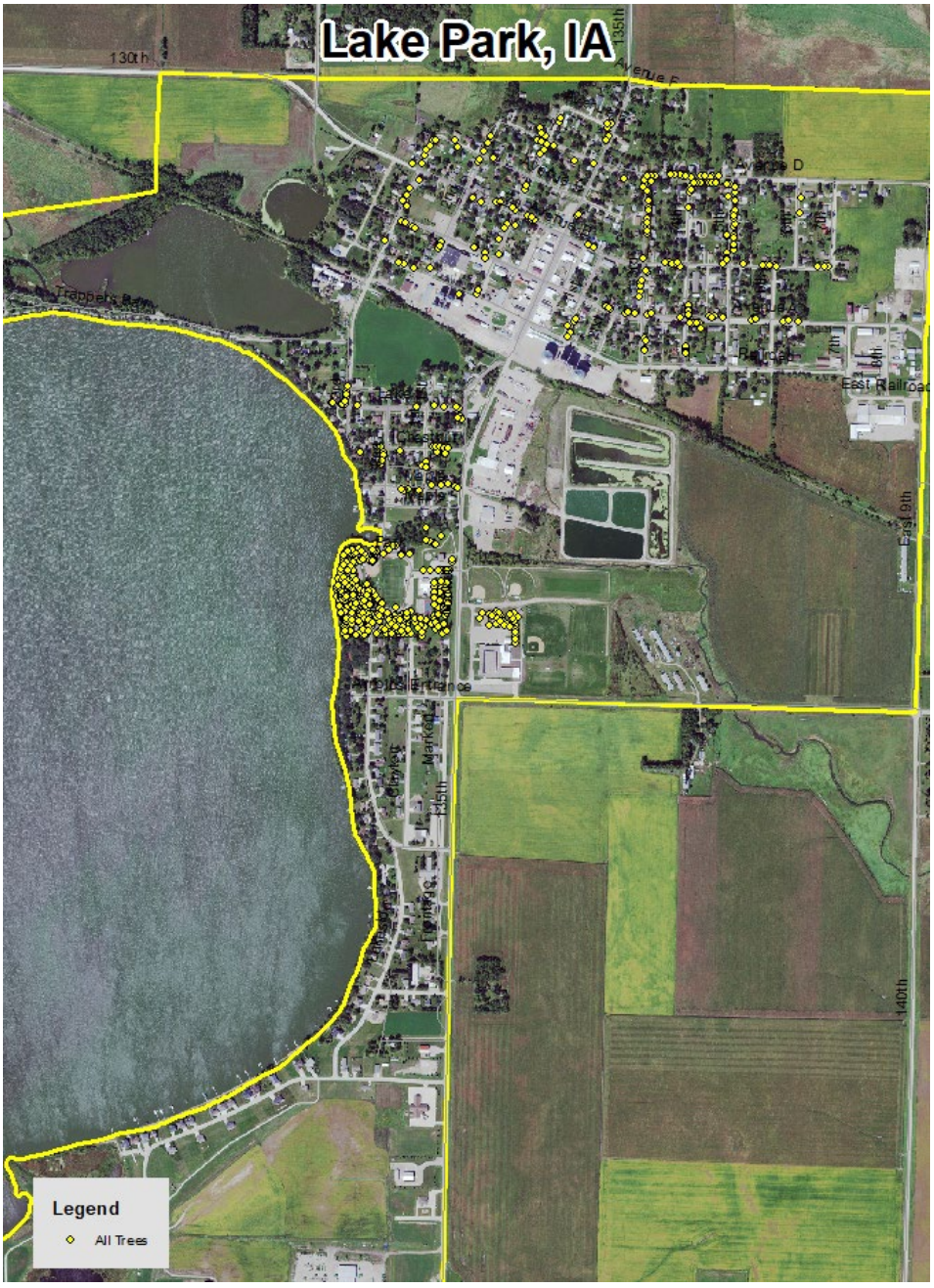
# Lake Park, IA




2018 Urban Forest Management Plan
Prepared by Emma Hanigan
Iowa Department of Natural Resources

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# Executive Summary

## Overview

This plan was developed to assist the City of Lake Park 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 41% of Lake Park'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 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 623 trees inventoried.

- Lake Park's trees provide $125,521 of benefits annually, an average of $201 a tree
- There are over 31 species of trees
- The top three genera are: Ash 41%, Maple 25%, and Oak 14%
- 13% of trees are in need of some type of management
- 42 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 42 trees needing removal, 19 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*
- 26 of the 256 ash trees should be carefully examined, as they have one or more 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, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 84 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 Lake Park 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 Lake Park, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

# Inventory

In 2017, 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 623 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. Lake Park's trees reduce energy related costs by approximately $32,799 annually (Appendix A, Table 1). These savings are both in Electricity (156.4 MWh) and in Natural Gas (21,352.0 Therms).

### Annual Stormwater Benefits

Lake Park's trees intercept about 1,801,808 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $48,829 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 Lake Park, it is estimated that trees remove 1,370 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 $5,758 (Appendix A, Table 3).

### Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Lake Park, trees sequester about 389,702 lbs of carbon a year with an associated value of $4,635 (Appendix A, Table 5). In addition, the trees store 6,766,576 lbs of carbon, with a yearly benefit of $50,749 (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. Lake Park receives $33,499 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, Lake Park's trees provide $125,521 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 623 trees in Lake Park provide approximately $201 annually (Appendix A, Table 7).

# Forest Structure

### Species Distribution

Lake Park has over 31 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

| | | |
|---|---|---|
| Ash | 256 | 41% |
| Maple | 153 | 25% |

| | | |
|---|---|---|
| Oak | 85 | 14% |
| Spruce | 27 | 4% |
| Hackberry | 24 | 4% |
| Walnut | 15 | 2% |
| Cottonwood | 15 | 2% |
| Linden | 12 | 2% |
| Honeylocust | 11 | 2% |
| Cedar | 8 | 1% |
| Buckeye | 3 | <1% |
| Other | 3 | <1% |
| Apple (crabapple) | 3 | <1% |
| Arborvitae | 3 | <1% |
| Birch | 1 | <1% |
| Pine | 1 | <1% |
| Cherry | 1 | <1% |
| Willow | 1 | <1% |
| Elm | 1 | <1% |

## Age Class

Most of Lake Park's trees (39%) are between 24 and 36 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. Lake Park's size curve is on the Larger side, 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 Lake Park indicate that 93% of the trees are in good health, with only 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Also, 22% of Lake Park'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 16% of the population. This 16% is an estimate of trees that need management follow up.

## Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

| | | |
|---|---|---|
| Crown Cleaning | 32 | 5% |
| Crown Raising | 0 | 0% |
| Tree Staking | 0 | 0% |
| Tree Removal | 42 | 7% |
| Crown Reduction | 1 | <1% |

### Canopy Cover

The total canopy with both private and public trees is 12%, 124 acres. The canopy cover included in the Lake Park inventory includes approximately 18 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 75 trees need to be planted annually on public and private lands.

### Land Use and Location

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

| Land Use | |
|---|---|
| Single family residential | 47% |
| Park/vacant/other | 52% |
| Industrial/Large commercial | 0% |
| Small commercial | 0% |
| Multifamily residential | 0% |

| Location | |
|---|---|
| Planting strip | 31% |
| Other maintained locations | 0% |
| Cutout (surrounded by pavement) | 0% |
| Front yard | 69% |

# 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

Lake Park has 8 critical concern trees 6 that need immediate removal and 2 that need trimming. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 18 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 49 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 42 removals, 21 are ash trees. There are a total of 256 ash trees, and 26 of those have signs and symptoms that have been associated with EAB. In

addition, there are 51 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 Lake Park.

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 (25%) (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: 4 largest and critical concern trees
- Planting and Replacement: 5 trees to be planted in open locations
- Young Tree Pruning & Maintenance:
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 3 trees with poor health
- *Or saving for ash tree treatment and/or future ash removal

Planting and Replacement: 5 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: 4 trees - removal of any new critical concern trees in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 5 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: 3 trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 5 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 5
Removal: 4 trees - removal of any new critical concern trees in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 5 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: 3 trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 5 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

*Reduction of ash over 6 years: Approximately 15 ash trees removed (approximately 6% of ash). It will take approximately 84 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 $42,000 a year. If the budget were increased to $10,000 a year all ash could be removed in 18 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. 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. 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 preventative treatments are not being used.

# Budget

**Current Budget**
Total $24,000 over 6 years ($4,000/year)

**FY 2018 Budget**
Removal: $3,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $300

**FY 2019 Budget**
Removal: $2,400
*Or saving for ash tree treatment and/or future ash removal
Planting: $400
Routine trimming: $900
Watering & Maintenance: $300

**FY 2020 Budget**
Removal: $3,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $300

**FY 2021 Budget**
Removal: $2,400
*Or saving for ash tree treatment and/or future ash removal
Planting: $400
Routine trimming: $900
Watering & Maintenance: $300

**FY 2022 Budget**

Removal: $3,200
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $300

**FY 2023 Budget**

Removal: $2,400
*Or saving for ash tree treatment and/or future ash removal
Planting: $400
Routine trimming: $900
Watering & Maintenance: $300

*Reduction of ash over 6 years: approximately 15 ash trees removed (approximately 6% of ash). **It will take approximately 84 years to remove all ash with the current budget.**

Purposed Budget Increase

EAB could potentially kill all ash trees in Lake Park within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $14,000 a year. If the budget were increased to $10,000 a year all ash could be removed within 18 years. Additionally, it is recommended that Lake Park 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 Lake Park would still need to find $198,400 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $192,800 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 Lake Park. It is suggested to consider increasing the budget to plan for this.

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# Appendix A: i-Tree Data

**Table 1: Annual Energy Benefits**

**Lake Park**

**Annual Energy Benefits of Public Trees**

3/29/2018

| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| Green ash | 66.9 | 5,080 | 9,144.3 | 8,961 | 14,042 | (N/A) | 40.8 | 42.8 | 55.28 |
| Bur oak | 22.5 | 1,705 | 3,036.2 | 2,975 | 4,681 | (N/A) | 13.0 | 14.3 | 57.79 |
| Silver maple | 24.7 | 1,875 | 3,261.0 | 3,196 | 5,071 | (N/A) | 11.7 | 15.5 | 69.47 |
| Norway maple | 8.7 | 663 | 1,258.6 | 1,233 | 1,897 | (N/A) | 7.1 | 5.8 | 43.11 |
| Northern hackberry | 8.3 | 629 | 1,176.8 | 1,153 | 1,783 | (N/A) | 3.9 | 5.4 | 74.28 |
| Maple | 0.3 | 26 | 52.9 | 52 | 78 | (N/A) | 3.2 | 0.2 | 3.91 |
| Black walnut | 4.5 | 345 | 629.1 | 617 | 961 | (N/A) | 2.4 | 2.9 | 64.08 |
| Blue spruce | 1.2 | 92 | 163.7 | 160 | 252 | (N/A) | 2.3 | 0.8 | 18.02 |
| Eastern cottonwood | 5.4 | 411 | 750.0 | 735 | 1,146 | (N/A) | 2.3 | 3.5 | 81.87 |
| Honeylocust | 3.8 | 288 | 494.3 | 484 | 773 | (N/A) | 1.8 | 2.4 | 70.25 |
| American basswood | 2.7 | 203 | 363.1 | 356 | 559 | (N/A) | 1.8 | 1.7 | 50.78 |
| Sugar maple | 1.7 | 131 | 230.9 | 226 | 358 | (N/A) | 1.6 | 1.1 | 35.78 |
| Eastern red cedar | 0.9 | 68 | 131.5 | 129 | 197 | (N/A) | 1.3 | 0.6 | 24.57 |
| Spruce | 0.2 | 11 | 18.6 | 18 | 30 | (N/A) | 1.1 | 0.1 | 4.24 |
| Norway spruce | 0.6 | 42 | 72.4 | 71 | 113 | (N/A) | 1.0 | 0.3 | 18.86 |
| Red maple | 0.3 | 20 | 40.5 | 40 | 60 | (N/A) | 1.0 | 0.2 | 10.02 |
| Ohio buckeye | 0.7 | 54 | 88.5 | 87 | 140 | (N/A) | 0.5 | 0.4 | 46.78 |
| Northern red oak | 0.5 | 36 | 68.2 | 67 | 103 | (N/A) | 0.5 | 0.3 | 34.39 |
| Northern white cedar | 0.1 | 5 | 11.9 | 12 | 17 | (N/A) | 0.5 | 0.1 | 5.61 |
| Apple | 0.2 | 17 | 32.3 | 32 | 49 | (N/A) | 0.5 | 0.1 | 16.31 |
| Conifer Evergreen Large | 0.2 | 18 | 34.1 | 33 | 52 | (N/A) | 0.3 | 0.2 | 25.88 |
| White ash | 0.2 | 14 | 26.7 | 26 | 40 | (N/A) | 0.3 | 0.1 | 20.10 |
| Cottonwood | 0.3 | 25 | 46.9 | 46 | 71 | (N/A) | 0.2 | 0.2 | 70.91 |
| Willow | 0.3 | 20 | 39.6 | 39 | 59 | (N/A) | 0.2 | 0.2 | 58.69 |
| Paper birch | 0.1 | 7 | 13.7 | 13 | 21 | (N/A) | 0.2 | 0.1 | 20.64 |
| Black cherry | 0.2 | 15 | 31.6 | 31 | 46 | (N/A) | 0.2 | 0.1 | 46.14 |
| Littleleaf linden | 0.2 | 17 | 33.8 | 33 | 50 | (N/A) | 0.2 | 0.2 | 50.34 |
| Scotch pine | 0.1 | 4 | 9.5 | 9 | 14 | (N/A) | 0.2 | 0.0 | 13.58 |
| American elm | 0.4 | 29 | 52.8 | 52 | 80 | (N/A) | 0.2 | 0.2 | 80.37 |
| Pin oak | 0.3 | 21 | 38.4 | 38 | 58 | (N/A) | 0.2 | 0.2 | 58.37 |
| UNKNOWN | 0.0 | 0 | 0.0 | 0 | 0 | (N/A) | 0.0 | 0.0 | 0.00 |
| Total | 156.4 | 11,874 | 21,352.0 | 20,925 | 32,799 | (N/A) | 100.0 | 100.0 | 52.73 |

**Table 2: Annual Stormwater Benefits**

**Lake Park**

**Annual Stormwater Benefits of Public Trees**

3/29/2018

| Species | Total rainfall interception (Gal) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Green ash | 737,548 | 19,988 | (N/A) | 40.8 | 40.9 | 78.69 |
| Bur oak | 241,840 | 6,554 | (N/A) | 13.0 | 13.4 | 80.91 |
| Silver maple | 372,253 | 10,088 | (N/A) | 11.7 | 20.7 | 138.19 |
| Norway maple | 73,689 | 1,997 | (N/A) | 7.1 | 4.1 | 45.39 |
| Northern hackberry | 79,063 | 2,143 | (N/A) | 3.9 | 4.4 | 89.28 |
| Maple | 1,475 | 40 | (N/A) | 3.2 | 0.1 | 2.00 |
| Black walnut | 53,183 | 1,441 | (N/A) | 2.4 | 3.0 | 96.08 |
| Blue spruce | 14,592 | 395 | (N/A) | 2.3 | 0.8 | 28.25 |
| Eastern cottonwood | 77,068 | 2,089 | (N/A) | 2.3 | 4.3 | 149.18 |
| Honeylocust | 47,475 | 1,287 | (N/A) | 1.8 | 2.6 | 116.96 |
| American basswood | 25,531 | 692 | (N/A) | 1.8 | 1.4 | 62.90 |
| Sugar maple | 20,059 | 544 | (N/A) | 1.6 | 1.1 | 54.36 |
| Eastern red cedar | 13,076 | 354 | (N/A) | 1.3 | 0.7 | 44.30 |
| Spruce | 1,831 | 50 | (N/A) | 1.1 | 0.1 | 7.09 |
| Norway spruce | 6,402 | 174 | (N/A) | 1.0 | 0.4 | 28.92 |
| Red maple | 1,423 | 39 | (N/A) | 1.0 | 0.1 | 6.43 |
| Ohio buckeye | 4,227 | 115 | (N/A) | 0.5 | 0.2 | 38.19 |
| Northern red oak | 5,088 | 138 | (N/A) | 0.5 | 0.3 | 45.96 |
| Northern white cedar | 638 | 17 | (N/A) | 0.5 | 0.0 | 5.77 |
| Apple | 804 | 22 | (N/A) | 0.5 | 0.0 | 7.26 |
| Conifer Evergreen Large | 5,200 | 141 | (N/A) | 0.3 | 0.3 | 70.46 |
| White ash | 1,227 | 33 | (N/A) | 0.3 | 0.1 | 16.63 |
| Cottonwood | 3,943 | 107 | (N/A) | 0.2 | 0.2 | 106.85 |
| Willow | 2,479 | 67 | (N/A) | 0.2 | 0.1 | 67.19 |
| Paper birch | 608 | 16 | (N/A) | 0.2 | 0.0 | 16.47 |
| Black cherry | 1,174 | 32 | (N/A) | 0.2 | 0.1 | 31.82 |
| Littleleaf linden | 2,366 | 64 | (N/A) | 0.2 | 0.1 | 64.13 |
| Scotch pine | 596 | 16 | (N/A) | 0.2 | 0.0 | 16.14 |
| American elm | 4,551 | 123 | (N/A) | 0.2 | 0.3 | 123.33 |
| Pin oak | 2,397 | 65 | (N/A) | 0.2 | 0.1 | 64.95 |
| UNKNOWN | 0 | 0 | (N/A) | 0.0 | 0.0 | 0.00 |
| Citywide total | 1,801,808 | 48,829 | (N/A) | 100.0 | 100.0 | 78.50 |

## Table 3: Annual Air Quality Benefits

**Lake Park**

**Annual Air Quality Benefits of Public Trees**

3/29/2018

| 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 | 90.2 | 14.4 | 43.3 | 4.0 | 481 | 319.4 | 46.5 | 44.4 | 303.3 | 1,990 | 0.0 | 0 | 865.6 | 2,471 (N/A) | 40.8 | 9.73 |
| Bur oak | 29.3 | 4.7 | 14.1 | 1.3 | 156 | 106.9 | 15.6 | 14.9 | 101.8 | 667 | 0.0 | 0 | 288.6 | 823 (N/A) | 13.0 | 10.16 |
| Silver maple | 64.4 | 10.9 | 31.5 | 2.9 | 347 | 116.5 | 17.1 | 16.3 | 111.7 | 729 | -32.4 | -122 | 338.8 | 954 (N/A) | 11.7 | 13.07 |
| Norway maple | 14.0 | 2.4 | 7.0 | 0.6 | 76 | 42.4 | 6.1 | 5.8 | 39.7 | 262 | -3.4 | -13 | 114.7 | 326 (N/A) | 7.1 | 7.41 |
| Northern hackberry | 12.2 | 2.1 | 6.2 | 0.5 | 67 | 40.0 | 5.8 | 5.5 | 37.6 | 248 | 0.0 | 0 | 110.0 | 315 (N/A) | 3.9 | 13.12 |
| Maple | 0.1 | 0.0 | 0.1 | 0.0 | 1 | 1.7 | 0.2 | 0.2 | 1.6 | 10 | -0.1 | 0 | 3.9 | 11 (N/A) | 3.2 | 0.55 |
| Black walnut | 6.8 | 1.1 | 3.2 | 0.3 | 36 | 21.7 | 3.2 | 3.0 | 20.6 | 135 | 0.0 | 0 | 59.8 | 171 (N/A) | 2.4 | 11.41 |
| Blue spruce | 1.6 | 0.3 | 1.5 | 0.2 | 11 | 5.7 | 0.8 | 0.8 | 5.5 | 36 | -5.0 | -19 | 11.5 | 28 (N/A) | 2.3 | 2.02 |
| Eastern cottonwood | 11.2 | 1.8 | 5.0 | 0.5 | 59 | 25.9 | 3.8 | 3.6 | 24.5 | 161 | 0.0 | 0 | 76.4 | 220 (N/A) | 2.3 | 15.72 |
| Honeylocust | 9.5 | 1.6 | 4.3 | 0.4 | 50 | 17.9 | 2.6 | 2.5 | 17.2 | 112 | -7.6 | -29 | 48.2 | 133 (N/A) | 1.8 | 12.09 |
| American basswood | 3.3 | 0.6 | 1.7 | 0.1 | 18 | 12.8 | 1.9 | 1.8 | 12.1 | 79 | -2.9 | -11 | 31.3 | 87 (N/A) | 1.8 | 7.87 |
| Sugar maple | 2.7 | 0.5 | 1.4 | 0.1 | 15 | 8.2 | 1.2 | 1.1 | 7.8 | 51 | -2.2 | -8 | 20.9 | 58 (N/A) | 1.6 | 5.80 |
| Eastern red cedar | 2.7 | 0.5 | 2.2 | 0.3 | 18 | 4.3 | 0.6 | 0.6 | 4.0 | 27 | -7.2 | -27 | 8.1 | 17 (N/A) | 1.3 | 2.19 |
| Spruce | 0.2 | 0.0 | 0.2 | 0.0 | 1 | 0.7 | 0.1 | 0.1 | 0.7 | 4 | -0.7 | -2 | 1.3 | 3 (N/A) | 1.1 | 0.45 |
| Norway spruce | 0.7 | 0.1 | 0.6 | 0.1 | 5 | 2.6 | 0.4 | 0.4 | 2.5 | 16 | -2.1 | -8 | 5.2 | 13 (N/A) | 1.0 | 2.15 |
| Red maple | 0.2 | 0.0 | 0.1 | 0.0 | 1 | 1.3 | 0.2 | 0.2 | 1.2 | 8 | -0.1 | 0 | 3.1 | 9 (N/A) | 1.0 | 1.46 |
| Ohio buckeye | 0.7 | 0.1 | 0.3 | 0.0 | 4 | 3.3 | 0.5 | 0.5 | 3.2 | 21 | -0.2 | -1 | 8.4 | 24 (N/A) | 0.5 | 7.92 |
| Northern red oak | 1.1 | 0.2 | 0.5 | 0.0 | 6 | 2.3 | 0.3 | 0.3 | 2.2 | 14 | -1.6 | -6 | 5.4 | 14 (N/A) | 0.5 | 4.79 |
| Northern white cedar | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.3 | 0.0 | 0.0 | 0.3 | 2 | -0.2 | -1 | 0.6 | 2 (N/A) | 0.5 | 0.56 |
| Apple | 0.2 | 0.0 | 0.1 | 0.0 | 1 | 1.1 | 0.2 | 0.2 | 1.0 | 7 | 0.0 | 0 | 2.8 | 8 (N/A) | 0.5 | 2.66 |
| Conifer Evergreen Large | 0.6 | 0.1 | 0.5 | 0.1 | 4 | 1.2 | 0.2 | 0.2 | 1.1 | 7 | -3.0 | -11 | 0.9 | 0 (N/A) | 0.3 | -0.05 |
| White ash | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.9 | 0.1 | 0.1 | 0.8 | 6 | 0.0 | 0 | 2.1 | 6 (N/A) | 0.3 | 2.91 |
| Cottonwood | 0.5 | 0.1 | 0.2 | 0.0 | 3 | 1.6 | 0.2 | 0.2 | 1.5 | 10 | 0.0 | 0 | 4.4 | 12 (N/A) | 0.2 | 12.48 |
| Willow | 0.5 | 0.1 | 0.2 | 0.0 | 3 | 1.3 | 0.2 | 0.2 | 1.2 | 8 | -0.1 | 0 | 3.6 | 10 (N/A) | 0.2 | 10.16 |
| Paper birch | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.5 | 0.1 | 0.1 | 0.4 | 3 | 0.0 | 0 | 1.1 | 3 (N/A) | 0.2 | 2.99 |
| Black cherry | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 1.0 | 0.1 | 0.1 | 0.9 | 6 | 0.0 | 0 | 2.9 | 8 (N/A) | 0.2 | 8.35 |
| Littleleaf linden | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 1.1 | 0.2 | 0.2 | 1.0 | 7 | -0.2 | -1 | 2.9 | 8 (N/A) | 0.2 | 8.23 |
| Scotch pine | 0.1 | 0.0 | 0.1 | 0.0 | 0 | 0.3 | 0.0 | 0.0 | 0.3 | 2 | -0.2 | -1 | 0.6 | 1 (N/A) | 0.2 | 1.48 |
| American elm | 0.5 | 0.1 | 0.3 | 0.0 | 3 | 1.8 | 0.3 | 0.3 | 1.7 | 11 | 0.0 | 0 | 4.9 | 14 (N/A) | 0.2 | 14.10 |
| Pin oak | 0.3 | 0.1 | 0.2 | 0.0 | 2 | 1.3 | 0.2 | 0.2 | 1.2 | 8 | -0.7 | -3 | 2.9 | 8 (N/A) | 0.2 | 7.54 |
| UNKNOWN | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 (N/A) | 0.0 | 0.00 |
| Citywide total | 254.4 | 42.0 | 125.2 | 11.8 | 1,370 | 746.1 | 108.7 | 103.6 | 708.9 | 4,649 | -69.7 | -261 | 2,031.0 | 5,758 (N/A) | 100.0 | 9.26 |

**Table 4: Annual Carbon Stored**

**Lake Park**

**Stored CO2 Benefits of Public Trees**

3/29/2018

| Species | Total Stored CO2 (lbs) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Green ash | 2,939,508 | 22,046 | (N/A) | 40.8 | 43.4 | 86.80 |
| Bur oak | 951,926 | 7,139 | (N/A) | 13.0 | 14.1 | 88.14 |
| Silver maple | 1,410,420 | 10,578 | (N/A) | 11.7 | 20.8 | 144.91 |
| Norway maple | 233,129 | 1,748 | (N/A) | 7.1 | 3.4 | 39.74 |
| Northern hackberry | 181,846 | 1,364 | (N/A) | 3.9 | 2.7 | 56.83 |
| Maple | 2,429 | 18 | (N/A) | 3.2 | 0.0 | 0.91 |
| Black walnut | 219,243 | 1,644 | (N/A) | 2.4 | 3.2 | 109.62 |
| Blue spruce | 8,701 | 65 | (N/A) | 2.3 | 0.1 | 4.66 |
| Eastern cottonwood | 366,349 | 2,748 | (N/A) | 2.3 | 5.4 | 196.26 |
| Honeylocust | 123,356 | 925 | (N/A) | 1.8 | 1.8 | 84.11 |
| American basswood | 121,943 | 915 | (N/A) | 1.8 | 1.8 | 83.14 |
| Sugar maple | 82,875 | 622 | (N/A) | 1.6 | 1.2 | 62.16 |
| Eastern red cedar | 8,817 | 66 | (N/A) | 1.3 | 0.1 | 8.27 |
| Spruce | 1,185 | 9 | (N/A) | 1.1 | 0.0 | 1.27 |
| Norway spruce | 4,281 | 32 | (N/A) | 1.0 | 0.1 | 5.35 |
| Red maple | 2,470 | 19 | (N/A) | 1.0 | 0.0 | 3.09 |
| Ohio buckeye | 10,872 | 82 | (N/A) | 0.5 | 0.2 | 27.18 |
| Northern red oak | 23,469 | 176 | (N/A) | 0.5 | 0.3 | 58.67 |
| Northern white cedar | 115 | 1 | (N/A) | 0.5 | 0.0 | 0.29 |
| Apple | 3,393 | 25 | (N/A) | 0.5 | 0.1 | 8.48 |
| Conifer Evergreen La | 7,747 | 58 | (N/A) | 0.3 | 0.1 | 29.05 |
| White ash | 2,069 | 16 | (N/A) | 0.3 | 0.0 | 7.76 |
| Cottonwood | 15,773 | 118 | (N/A) | 0.2 | 0.2 | 118.30 |
| Willow | 7,945 | 60 | (N/A) | 0.2 | 0.1 | 59.59 |
| Paper birch | 1,035 | 8 | (N/A) | 0.2 | 0.0 | 7.76 |
| Black cherry | 6,743 | 51 | (N/A) | 0.2 | 0.1 | 50.57 |
| Littleleaf linden | 8,218 | 62 | (N/A) | 0.2 | 0.1 | 61.63 |
| Scotch pine | 257 | 2 | (N/A) | 0.2 | 0.0 | 1.93 |
| American elm | 12,245 | 92 | (N/A) | 0.2 | 0.2 | 91.84 |
| Pin oak | 8,218 | 62 | (N/A) | 0.2 | 0.1 | 61.63 |
| UNKNOWN | 0 | 0 | (N/A) | 0.0 | 0.0 | 0.00 |
| Citywide total | 6,766,576 | 50,749 | (N/A) | 100.0 | 100.0 | 81.59 |

## Table 5: Annual Carbon Sequestered

**Lake Park**

**Annual CO Benefits of Public Trees**

3/29/2018

| Species | Sequestered (lb) | Sequestered ($) | Decomposition Release (lb) | Maintenance Release (lb) | Total Released ($) | Avoided (lb) | Avoided ($) | Net Total (lb) | Total Standard ($) Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green ash | 159,687 | 1,198 | -14,110 | -700 | -111 | 112,270 | 842 | 257,147 | 1,929 (N/A) | 40.8 | 41.6 | 7.59 |
| Bur oak | 53,179 | 399 | -4,569 | -230 | -36 | 37,685 | 283 | 86,064 | 645 (N/A) | 13.0 | 13.9 | 7.97 |
| Silver maple | 104,610 | 785 | -6,771 | -276 | -53 | 41,443 | 311 | 139,006 | 1,043 (N/A) | 11.7 | 22.5 | 14.28 |
| Norway maple | 13,377 | 100 | -1,119 | -90 | -9 | 14,658 | 110 | 26,825 | 201 (N/A) | 7.1 | 4.3 | 4.57 |
| Northern hackberry | 10,402 | 78 | -873 | -77 | -7 | 13,910 | 104 | 23,362 | 175 (N/A) | 3.9 | 3.8 | 7.30 |
| Maple | 398 | 3 | -12 | -7 | 0 | 583 | 4 | 962 | 7 (N/A) | 3.2 | 0.2 | 0.36 |
| Black walnut | 11,107 | 83 | -1,052 | -48 | -8 | 7,617 | 57 | 17,623 | 132 (N/A) | 2.4 | 2.9 | 8.81 |
| Blue spruce | 816 | 6 | -42 | -20 | 0 | 2,031 | 15 | 2,785 | 21 (N/A) | 2.3 | 0.5 | 1.49 |
| Eastern cottonwood | 13,284 | 100 | -1,758 | -60 | -14 | 9,087 | 68 | 20,552 | 154 (N/A) | 2.3 | 3.3 | 11.01 |
| Honeylocust | 3,173 | 24 | -592 | -28 | -5 | 6,371 | 48 | 8,923 | 67 (N/A) | 1.8 | 1.4 | 6.08 |
| American basswood | 7,448 | 56 | -585 | -29 | -5 | 4,478 | 34 | 11,312 | 85 (N/A) | 1.8 | 1.8 | 7.71 |
| Sugar maple | 4,027 | 30 | -400 | -20 | -3 | 2,906 | 22 | 6,513 | 49 (N/A) | 1.6 | 1.1 | 4.88 |
| Eastern red cedar | 0 | 0 | -42 | -16 | 0 | 1,495 | 11 | 1,437 | 11 (N/A) | 1.3 | 0.2 | 1.35 |
| Spruce | 137 | 1 | -6 | -3 | 0 | 253 | 2 | 381 | 3 (N/A) | 1.1 | 0.1 | 0.41 |
| Norway spruce | 505 | 4 | -21 | -9 | 0 | 933 | 7 | 1,407 | 11 (N/A) | 1.0 | 0.2 | 1.76 |
| Red maple | 378 | 3 | -12 | -4 | 0 | 452 | 3 | 814 | 6 (N/A) | 1.0 | 0.1 | 1.02 |
| Ohio buckeye | 1,158 | 9 | -52 | -6 | 0 | 1,185 | 9 | 2,285 | 17 (N/A) | 0.5 | 0.4 | 5.71 |
| Northern red oak | 757 | 6 | -113 | -6 | -1 | 803 | 6 | 1,441 | 11 (N/A) | 0.5 | 0.2 | 3.60 |
| Northern white cedar | 54 | 0 | -1 | -2 | 0 | 113 | 1 | 165 | 1 (N/A) | 0.5 | 0.0 | 0.41 |
| Apple | 344 | 3 | -16 | -3 | 0 | 383 | 3 | 707 | 5 (N/A) | 0.5 | 0.1 | 1.77 |
| Conifer Evergreen Large | 309 | 2 | -37 | -5 | 0 | 405 | 3 | 672 | 5 (N/A) | 0.3 | 0.1 | 2.52 |
| White ash | 364 | 3 | -10 | -2 | 0 | 311 | 2 | 663 | 5 (N/A) | 0.3 | 0.1 | 2.49 |
| Cottonwood | 857 | 6 | -76 | -4 | -1 | 552 | 4 | 1,330 | 10 (N/A) | 0.2 | 0.2 | 9.97 |
| Willow | 470 | 4 | -38 | -3 | 0 | 440 | 3 | 869 | 7 (N/A) | 0.2 | 0.1 | 6.52 |
| Paper birch | 209 | 2 | -5 | -1 | 0 | 159 | 1 | 361 | 3 (N/A) | 0.2 | 0.1 | 2.71 |
| Black cherry | 478 | 4 | -32 | -3 | 0 | 335 | 3 | 778 | 6 (N/A) | 0.2 | 0.1 | 5.84 |
| Littleleaf linden | 789 | 6 | -39 | -3 | 0 | 380 | 3 | 1,127 | 8 (N/A) | 0.2 | 0.2 | 8.45 |
| Scotch pine | 53 | 0 | -1 | -1 | 0 | 94 | 1 | 145 | 1 (N/A) | 0.2 | 0.0 | 1.08 |
| American elm | 454 | 3 | -59 | -4 | 0 | 632 | 5 | 1,023 | 8 (N/A) | 0.2 | 0.2 | 7.68 |
| Pin oak | 880 | 7 | -39 | -3 | 0 | 458 | 3 | 1,296 | 10 (N/A) | 0.2 | 0.2 | 9.72 |
| UNKNOWN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 (N/A) | 0.0 | 0.0 | 0.00 |
| Citywide total | 389,702 | 2,923 | -32,484 | -1,662 | -256 | 262,420 | 1,968 | 617,977 | 4,635 (N/A) | 100.0 | 100.0 | 7.45 |

**Table 6: Annual Social and Aesthetic Benefits**

**Lake Park**

**Annual Aesthetic/Other Benefits of Public Trees**

3/29/2018

| Species | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|
| Green ash | 13,315 | (N/A) | 40.8 | 39.7 | 52.42 |
| Bur oak | 4,424 | (N/A) | 13.0 | 13.2 | 54.62 |
| Silver maple | 8,073 | (N/A) | 11.7 | 24.1 | 110.59 |
| Norway maple | 1,339 | (N/A) | 7.1 | 4.0 | 30.44 |
| Northern hackberry | 1,393 | (N/A) | 3.9 | 4.2 | 58.04 |
| Maple | 67 | (N/A) | 3.2 | 0.2 | 3.34 |
| Black walnut | 881 | (N/A) | 2.4 | 2.6 | 58.72 |
| Blue spruce | 304 | (N/A) | 2.3 | 0.9 | 21.71 |
| Eastern cottonwood | 923 | (N/A) | 2.3 | 2.8 | 65.94 |
| Honeylocust | 809 | (N/A) | 1.8 | 2.4 | 73.57 |
| American basswood | 548 | (N/A) | 1.8 | 1.6 | 49.82 |
| Sugar maple | 417 | (N/A) | 1.6 | 1.2 | 41.66 |
| Eastern red cedar | 0 | (N/A) | 1.3 | 0.0 | 0.00 |
| Spruce | 67 | (N/A) | 1.1 | 0.2 | 9.55 |
| Norway spruce | 143 | (N/A) | 1.0 | 0.4 | 23.87 |
| Red maple | 67 | (N/A) | 1.0 | 0.2 | 11.18 |
| Ohio buckeye | 117 | (N/A) | 0.5 | 0.4 | 39.16 |
| Northern red oak | 53 | (N/A) | 0.5 | 0.2 | 17.62 |
| Northern white cedar | 21 | (N/A) | 0.5 | 0.1 | 6.83 |
| Apple | 20 | (N/A) | 0.5 | 0.1 | 6.53 |
| Conifer Evergreen Large | 42 | (N/A) | 0.3 | 0.1 | 20.84 |
| White ash | 67 | (N/A) | 0.3 | 0.2 | 33.42 |
| Cottonwood | 66 | (N/A) | 0.2 | 0.2 | 65.59 |
| Willow | 43 | (N/A) | 0.2 | 0.1 | 43.05 |
| Paper birch | 29 | (N/A) | 0.2 | 0.1 | 28.56 |
| Black cherry | 29 | (N/A) | 0.2 | 0.1 | 28.80 |
| Littleleaf linden | 81 | (N/A) | 0.2 | 0.2 | 81.48 |
| Scotch pine | 15 | (N/A) | 0.2 | 0.0 | 15.42 |
| American elm | 64 | (N/A) | 0.2 | 0.2 | 64.36 |
| Pin oak | 83 | (N/A) | 0.2 | 0.2 | 83.10 |
| UNKNOWN | 0 | (N/A) | 0.0 | 0.0 | 0.00 |
| Citywide total | 33,499 | (N/A) | 100.0 | 100.0 | 53.86 |

**Table 7: Summary of Benefits in Dollars**

**Lake Park**

**Total Annual Benefits of Public Trees by Species ($)**

3/29/2018

| Species | Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/Other | Total ($) | Standard Error | % of Total $ |
|---|---|---|---|---|---|---|---|---|
| Green ash | 14,042 | 1,929 | 2,471 | 19,988 | 13,315 | 51,743 | (N/A) | 41.2 |
| Bur oak | 4,681 | 645 | 823 | 6,554 | 4,424 | 17,127 | (N/A) | 13.6 |
| Silver maple | 5,071 | 1,043 | 954 | 10,088 | 8,073 | 25,229 | (N/A) | 20.1 |
| Norway maple | 1,897 | 201 | 326 | 1,997 | 1,339 | 5,760 | (N/A) | 4.6 |
| Northern hackberry | 1,783 | 175 | 315 | 2,143 | 1,393 | 5,808 | (N/A) | 4.6 |
| Maple | 78 | 7 | 11 | 40 | 67 | 203 | (N/A) | 0.2 |
| Black walnut | 961 | 132 | 171 | 1,441 | 881 | 3,587 | (N/A) | 2.9 |
| Blue spruce | 252 | 21 | 28 | 395 | 304 | 1,001 | (N/A) | 0.8 |
| Eastern cottonwood | 1,146 | 154 | 220 | 2,089 | 923 | 4,532 | (N/A) | 3.6 |
| Honeylocust | 773 | 67 | 133 | 1,287 | 809 | 3,069 | (N/A) | 2.4 |
| American basswood | 559 | 85 | 87 | 692 | 548 | 1,970 | (N/A) | 1.6 |
| Sugar maple | 358 | 49 | 58 | 544 | 417 | 1,425 | (N/A) | 1.1 |
| Eastern red cedar | 197 | 11 | 17 | 354 | 0 | 579 | (N/A) | 0.5 |
| Spruce | 30 | 3 | 3 | 50 | 67 | 152 | (N/A) | 0.1 |
| Norway spruce | 113 | 11 | 13 | 174 | 143 | 453 | (N/A) | 0.4 |
| Red maple | 60 | 6 | 9 | 39 | 67 | 181 | (N/A) | 0.1 |
| Ohio buckeye | 140 | 17 | 24 | 115 | 117 | 413 | (N/A) | 0.3 |
| Northern red oak | 103 | 11 | 14 | 138 | 53 | 319 | (N/A) | 0.3 |
| Northern white cedar | 17 | 1 | 2 | 17 | 21 | 58 | (N/A) | 0.0 |
| Apple | 49 | 5 | 8 | 22 | 20 | 104 | (N/A) | 0.1 |
| Conifer Evergreen Large | 52 | 5 | 0 | 141 | 42 | 239 | (N/A) | 0.2 |
| White ash | 40 | 5 | 6 | 33 | 67 | 151 | (N/A) | 0.1 |
| Cottonwood | 71 | 10 | 12 | 107 | 66 | 266 | (N/A) | 0.2 |
| Willow | 59 | 7 | 10 | 67 | 43 | 186 | (N/A) | 0.1 |
| Paper birch | 21 | 3 | 3 | 16 | 29 | 71 | (N/A) | 0.1 |
| Black cherry | 46 | 6 | 8 | 32 | 29 | 121 | (N/A) | 0.1 |
| Littleleaf linden | 50 | 8 | 8 | 64 | 81 | 213 | (N/A) | 0.2 |
| Scotch pine | 14 | 1 | 1 | 16 | 15 | 48 | (N/A) | 0.0 |
| American elm | 80 | 8 | 14 | 123 | 64 | 290 | (N/A) | 0.2 |
| Pin oak | 58 | 10 | 8 | 65 | 83 | 224 | (N/A) | 0.2 |
| UNKNOWN | 0 | 0 | 0 | 0 | 0 | 0 | (N/A) | 0.0 |
| Citywide Total | 32,799 | 4,635 | 5,758 | 48,829 | 33,499 | 125,521 | (N/A) | 100.0 |

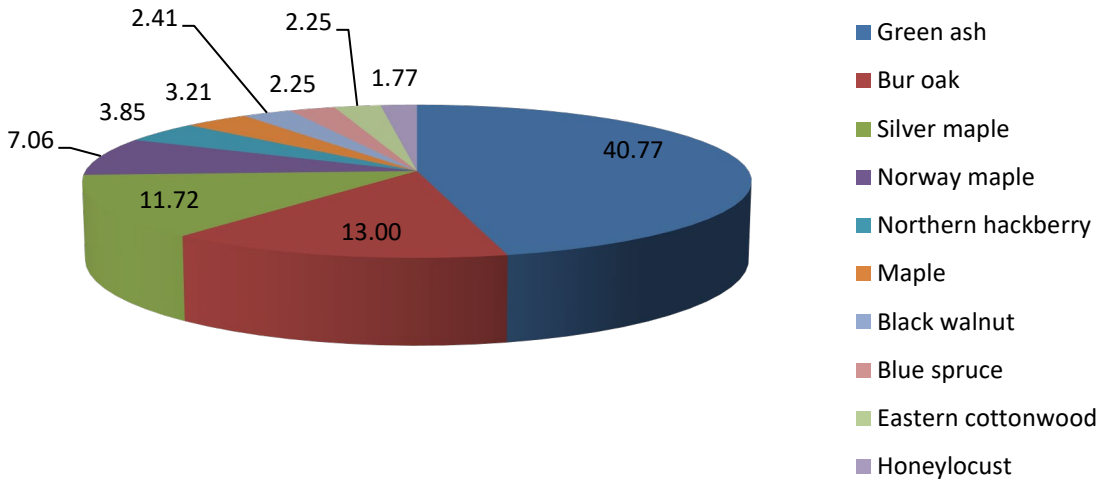


**Figure 1: Species Distribution**

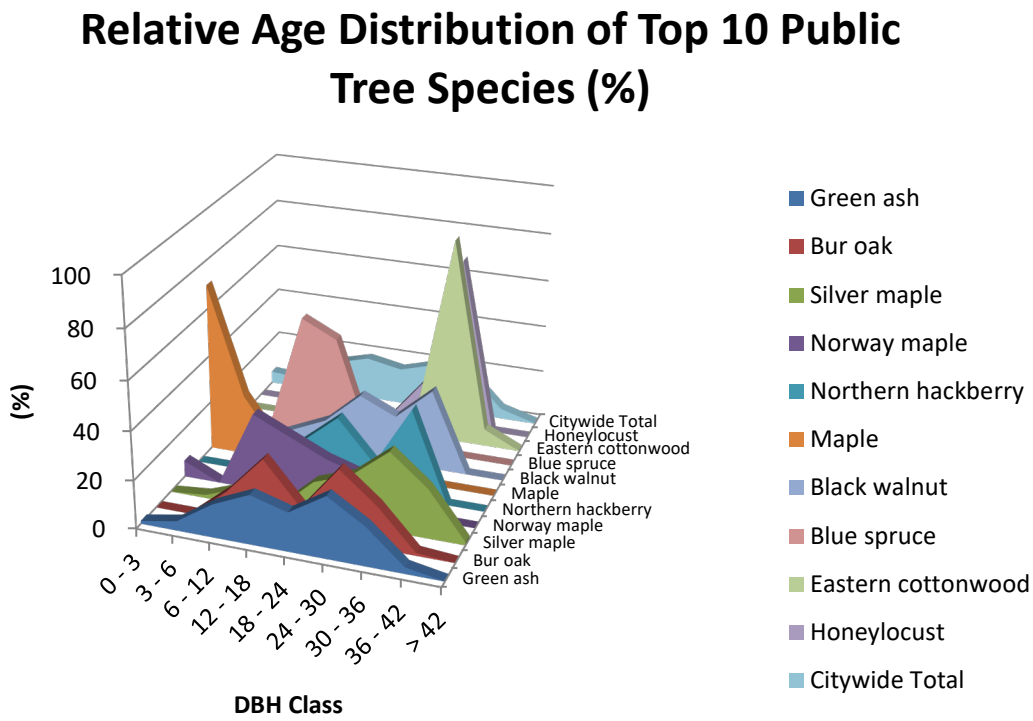


**Figure 2: Relative Age Class**


**Figure 3: Foliage Condition**

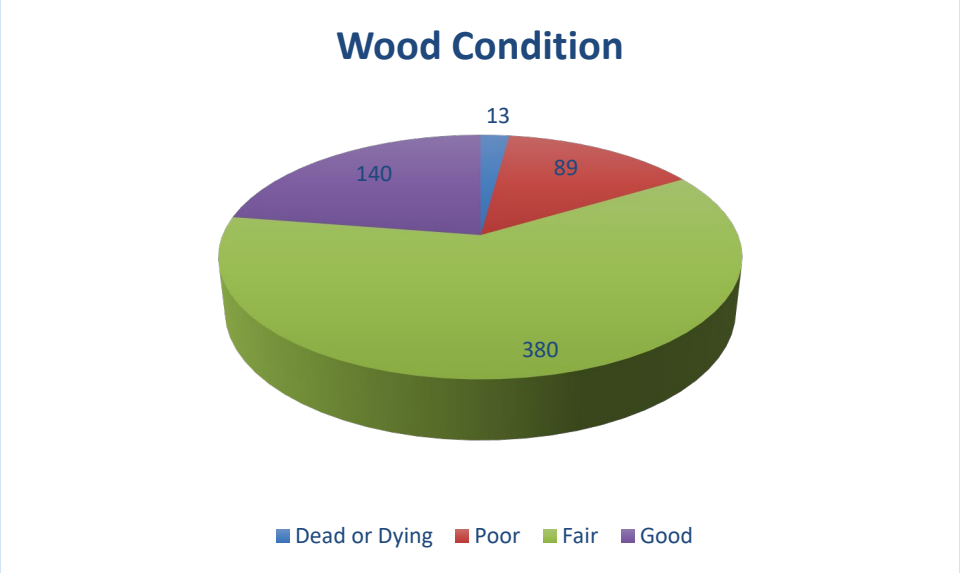


**Figure 4: Wood Condition**

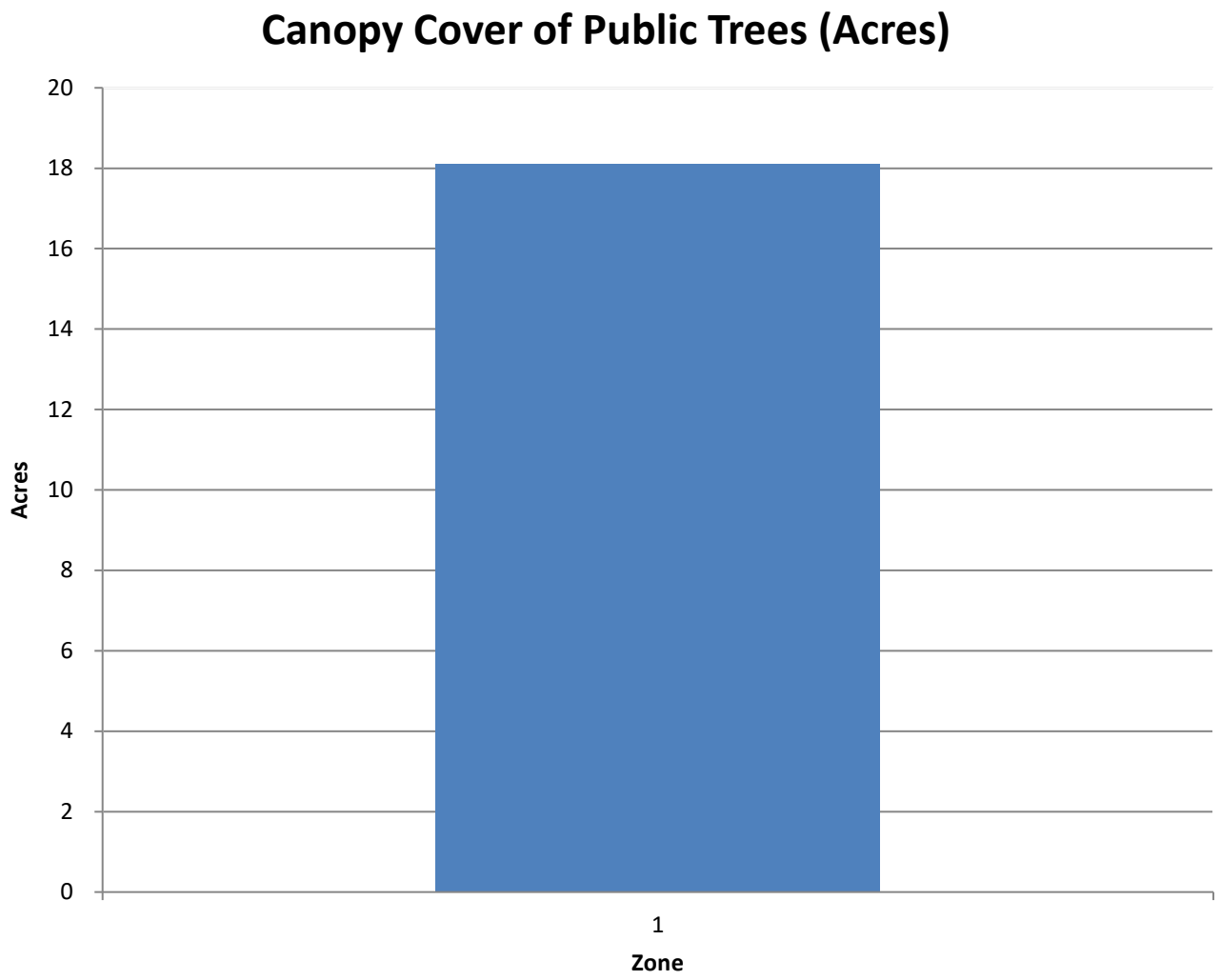


**Figure 5: Canopy Cover in Acres**

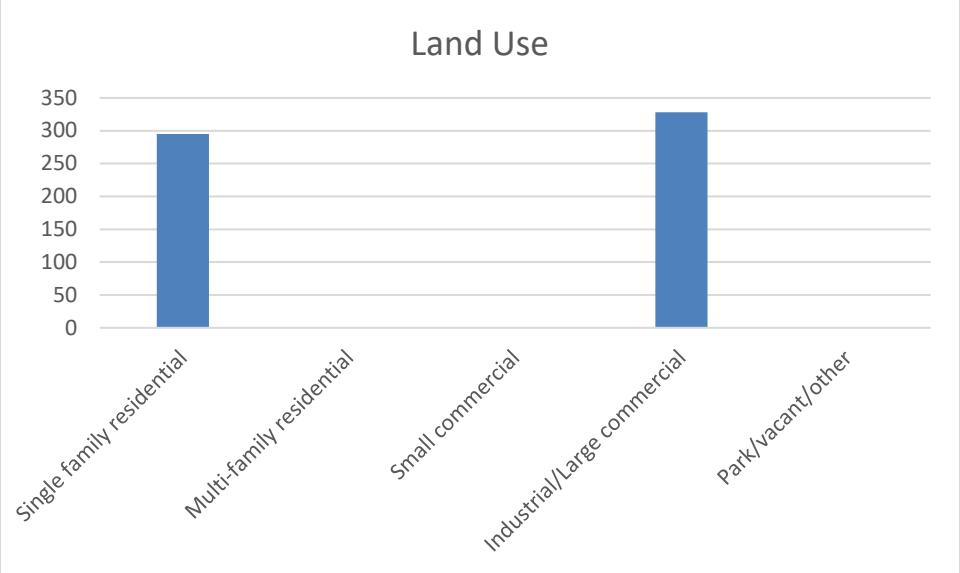


**Figure 6: Land Use of city/park trees**

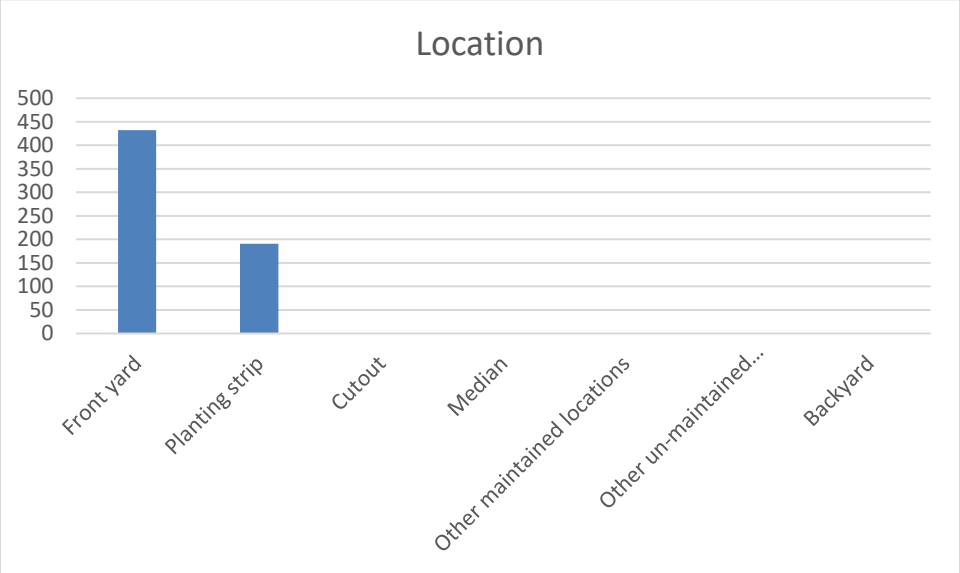


**Figure 7: Location of city/park trees**

# Appendix B: ArcGIS Mapping

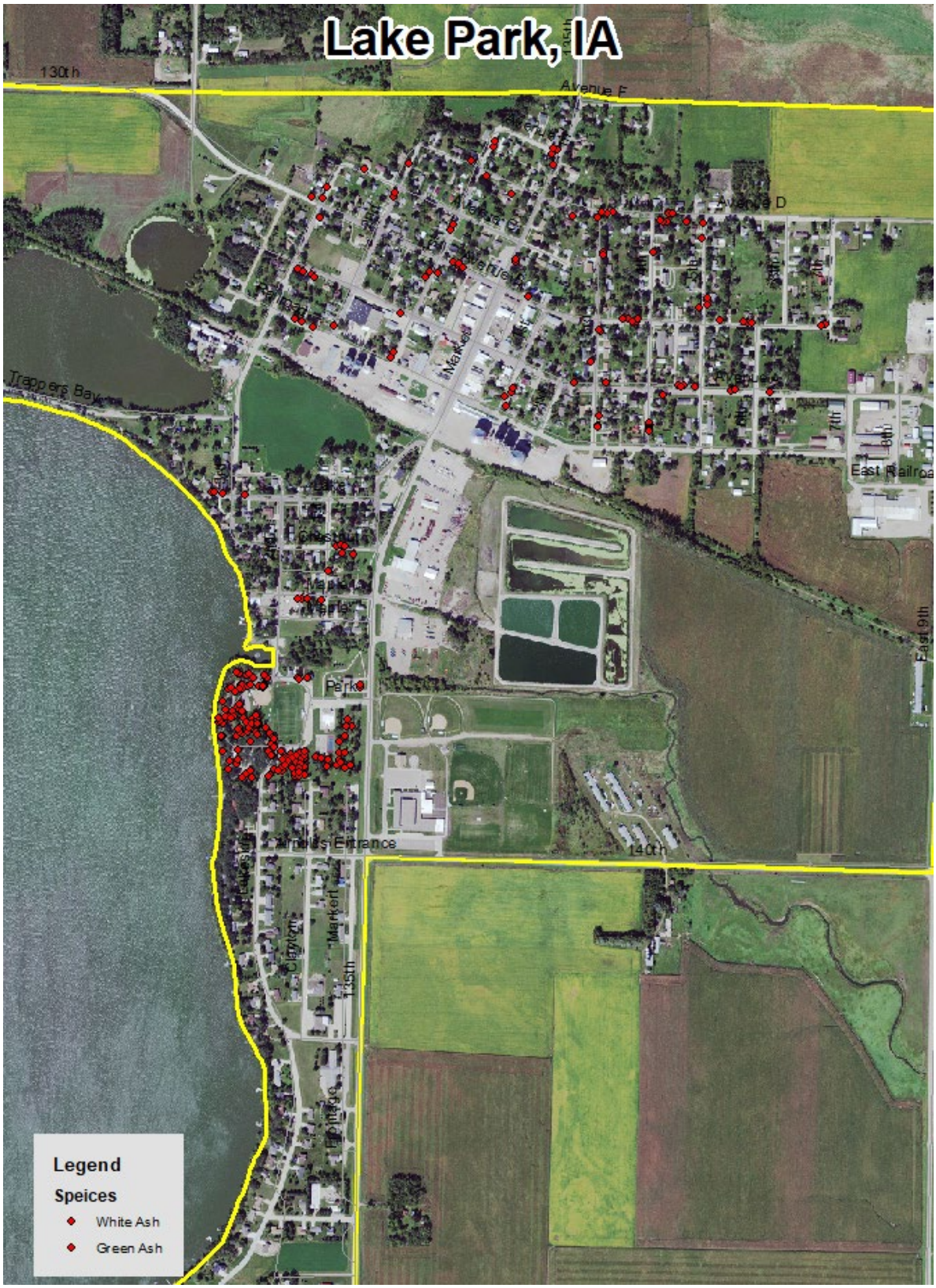


**Figure 1: Location of Ash Trees**


**Figure 2: Location of EAB symptoms**

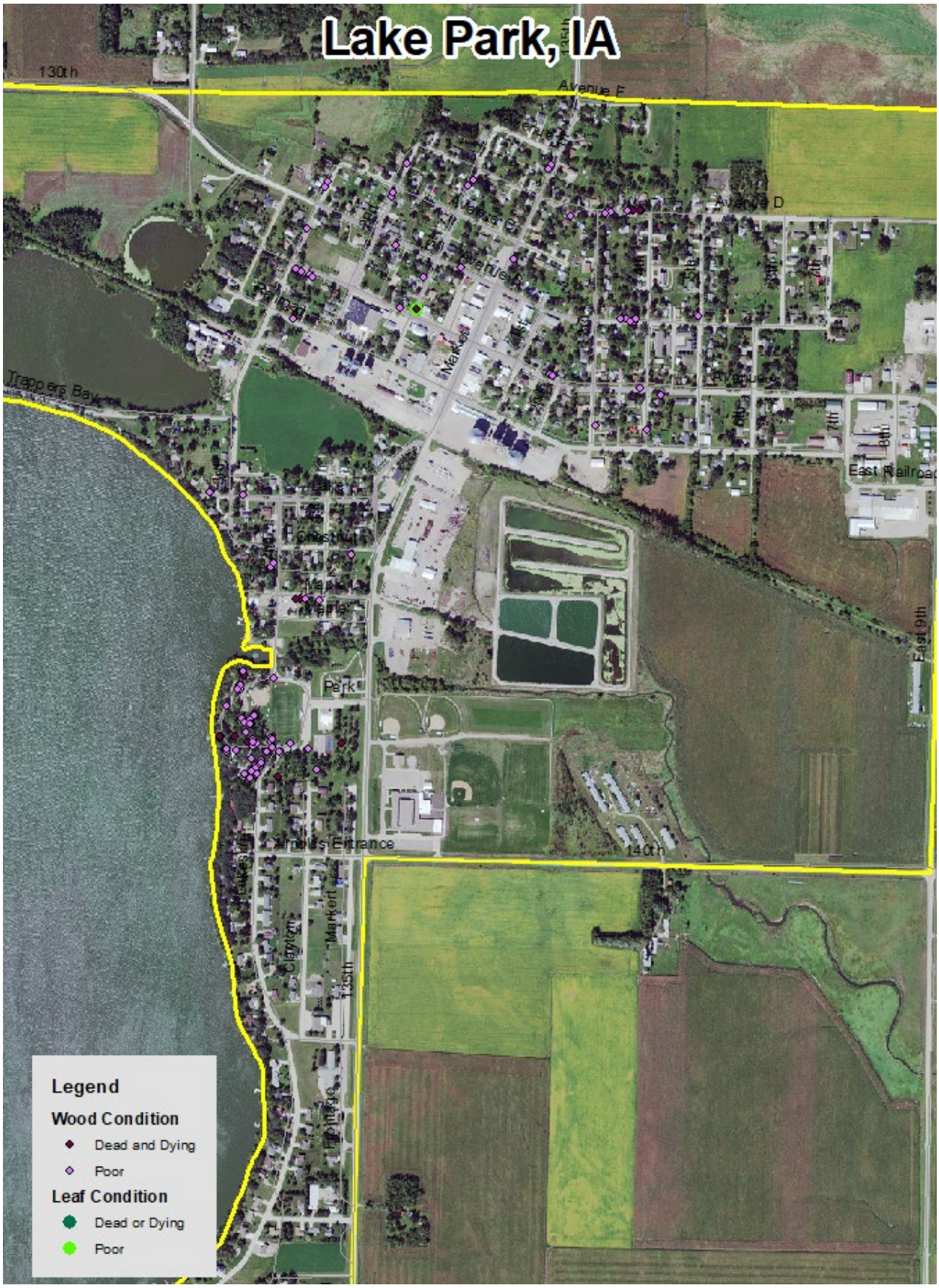


**Figure 3: Location of Poor Condition Trees**


**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***

**142.06 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.

**142.07 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 may additionally remove any trees on the street, not on private property, which are dead or 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[2c] & 372.13[4])*

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TITLE V - BUILDING AND PROPERTY REGULATIONS
MISCELLANEOUS

CHAPTER 143
TREES - DUTCH ELM DISEASE CONTROL



143.01 TREES SUBJECT TO REMOVAL. The Council, having determined that the health of the elm trees within the City is threatened by a fatal disease known as the Dutch Elm Disease, hereby declares the following shall be removed:
(Code of Iowa, Sec. 364.12[3b])

1. Living or Standing Trees. Any living or standing elm tree or part thereof infected with the Dutch Elm Disease fungus or which harbors any of the elm bark beetles, that is scolytus multistriatus (eichb.) or hylurgopinus rufipes (marsh.).

2. Dead Trees. Any dead elm tree or part thereof including logs, branches, stumps, firewood or other elm material from which the bark has not been removed and burned or sprayed with an effective elm bark beetle destroying insecticide.

143.02 DUTY TO REMOVE. No person or entity shall permit any tree or material as defined in Section 143.01 to remain on the premises owned, controlled or occupied by such person or entity within the City.
(Code of Iowa, Sec. 364.12[3b])

143.03 INSPECTION. The superintendent shall inspect or cause to be inspected all premises and places within the City to determine whether any condition as defined in Section 143.01 exists thereon, and also shall inspect or cause to be inspected any elm trees reported or suspected to be infected with the Dutch Elm Disease or any elm bark bearing material reported or suspected to be infected with the elm bark beetles.

143.04 REMOVAL FROM CITY PROPERTY. If the superintendent, upon inspection or examination, determines that any condition as herein defined exists in or upon any public street, alley, park

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.