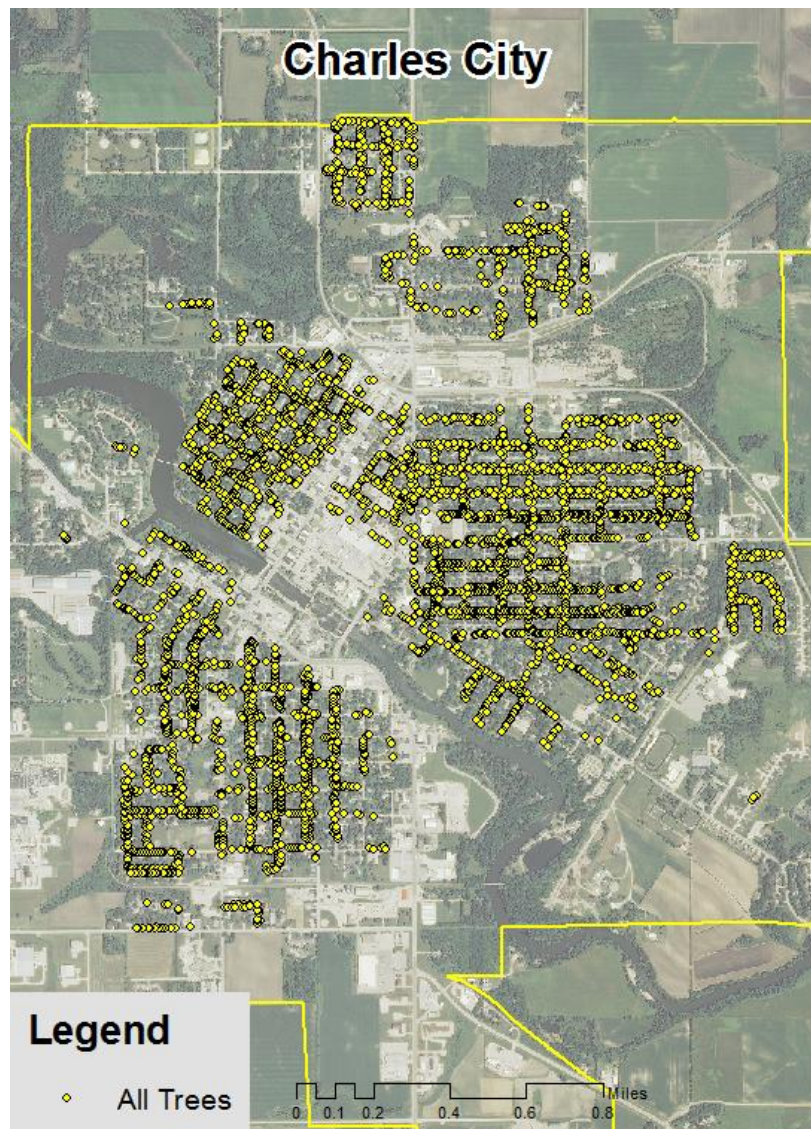


# Charles City, IA



2015 Urban Forest Management Plan  
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# Executive Summary

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## Overview

This plan was developed to assist the City of Charles City 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 21% of Charles City'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

A tree inventory was conducted by Emma Hanigan, Iowa DNR, 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 7,006 trees inventoried.

- Charles City's trees provide \$1,159,125 of benefits annually, an average of \$165 a tree
- There are over 64 species of trees
- The top three genera are: Maple 49%, Ash 21%, and Hackberry 9%
- 4% of trees are in need of some type of management
- 62 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 62 trees needing removal, 14 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\\*](#)
- 116 of the 1,448 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, any fruit-bearing tree or any tree of the kinds commonly known as 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 15 years to remove ash – Suggestion: request a budget increase and apply for grants to plant replacement trees

## Introduction

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

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

## Inventory

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A tree inventory was conducted by Emma Hanigan, Iowa DNR, 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**

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The data collected for the 7,006 city trees was entered into the USDA Forest Service program i-Tree Streets, 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. Charles City's trees reduce energy related costs by approximately \$327,297 annually (Appendix A, Table 1). These savings are both in Electricity (1,582.9 MWh) and in Natural Gas (211,386.6 Therms).

#### **Annual Stormwater Benefits**

Charles City's trees intercept about 14,090,418 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$381,850 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 Charles City, it is estimated that trees remove 19,436.7 lbs of air pollution (ozone (O<sub>3</sub>), particulate matter less than 10 microns (PM<sub>10</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>)) per year with a net value of \$54,628 (Appendix A, Table 3).

#### **Annual Carbon Benefits**

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Charles City, trees sequester about 3,408,975 lbs of carbon a year with an associated value of \$25,567 (Appendix A, Table 4). In addition, the trees store 43,732,976 lbs of carbon, with a yearly benefit of \$327,997 (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. Charles City receives \$351,561 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, Charles City's trees provide \$1,159,125 of benefits annually. Benefits of individual trees vary based on size, species, health

and location, but on average each of the 7,006 trees in Charles City provide approximately \$165 annually (Appendix A, Table 7).

## **Forest Structure**

### **Species Distribution**

Charles City has over 64 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

|                         |       |     |
|-------------------------|-------|-----|
| Maple                   | 3,464 | 49% |
| Ash                     | 1,448 | 21% |
| Hackberry               | 663   | 9%  |
| Oak                     | 402   | 6%  |
| Linden/Basswood         | 343   | 5%  |
| Honeylocust             | 144   | 2%  |
| Apple/Crabapple         | 132   | 2%  |
| Black Walnut            | 118   | 2%  |
| Elm                     | 43    | 1%  |
| Spruce                  | 40    | 1%  |
| Aspen/Cottonwood/Poplar | 30    | <1% |
| Catalpa                 | 26    | <1% |
| Mountain Ash            | 17    | <1% |
| Cherry/Plum             | 16    | <1% |
| Eastern Red Cedar       | 15    | <1% |
| Ohio Buckeye            | 13    | <1% |
| Black Locust            | 12    | <1% |
| Pine                    | 10    | <1% |
| Mulberry                | 9     | <1% |
| Pear                    | 8     | <1% |
| Southern Magnolia       | 7     | <1% |
| Hickory                 | 6     | <1% |
| Eastern Redbud          | 6     | <1% |
| Ginkgo                  | 6     | <1% |
| Willow                  | 4     | <1% |
| Northern White Cedar    | 4     | <1% |
| Birch                   | 3     | <1% |
| American Chestnut       | 2     | <1% |
| Kentucky Coffeetree     | 2     | <1% |
| Amur Corktree           | 2     | <1% |
| American Sycamore       | 2     | <1% |
| Mimosa                  | 1     | <1% |
| Dogwood                 | 1     | <1% |

|                        |   |     |
|------------------------|---|-----|
| Eastern Hophornbeam    | 1 | <1% |
| Other Medium Deciduous | 2 | <1% |
| Other Small Deciduous  | 2 | <1% |
| Other Medium Evergreen | 2 | <1% |

### Age Class

Most of Charles City's trees (87%) are between 6 and 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. Charles City's size curve includes a significant amount of trees that are in the middle stage of life, and consideration should be given to planting in order to provide the next generation of trees.

### 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 Charles City indicate that 86% 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). Additionally, 38% of Charles City'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 4% of the population. This 4% 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  | 210 | 3%  |
| Tree Removal    | 62  | <1% |
| Crown Reduction | 18  | <1% |
| Tree Staking    | 3   | <1% |
| Crown Raising   | 1   | <1% |

### Canopy Cover

The total canopy with both private and public trees is 26%, 1,055 acres. The canopy cover included in the Charles City inventory includes approximately 163 acres (Appendix A, Figure 4).

### Land Use and Location

The majority of Charles City's city and park trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure 7). The following describes the land use and locations for the street and park trees.

### Land Use

|                             |     |
|-----------------------------|-----|
| Single family residential   | 98% |
| Small commercial            | 1%  |
| Industrial/Large commercial | <1% |
| Multifamily residential     | <1% |
| Park/vacant/other           | <1% |

### Location

|                                 |     |
|---------------------------------|-----|
| Planting strip                  | 83% |
| Front yard                      | 17% |
| Median                          | <1% |
| Cutout (surrounded by pavement) | <1% |

## Recommendations

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### **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

Charles City has 11 critical concern trees that need immediate removal, 2 that need crown reduction, and 15 that need crown cleaning. 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 13 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 266 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 62 removals, 6 are ash trees. There are a total of 1,448 ash trees, and 116 of those have signs and symptoms that have been associated with EAB. In addition, there are 323 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 at least 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 or greater number of trees helps ensure continuation of the benefits of the existing forest in Charles City.

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 (49%) (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: any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

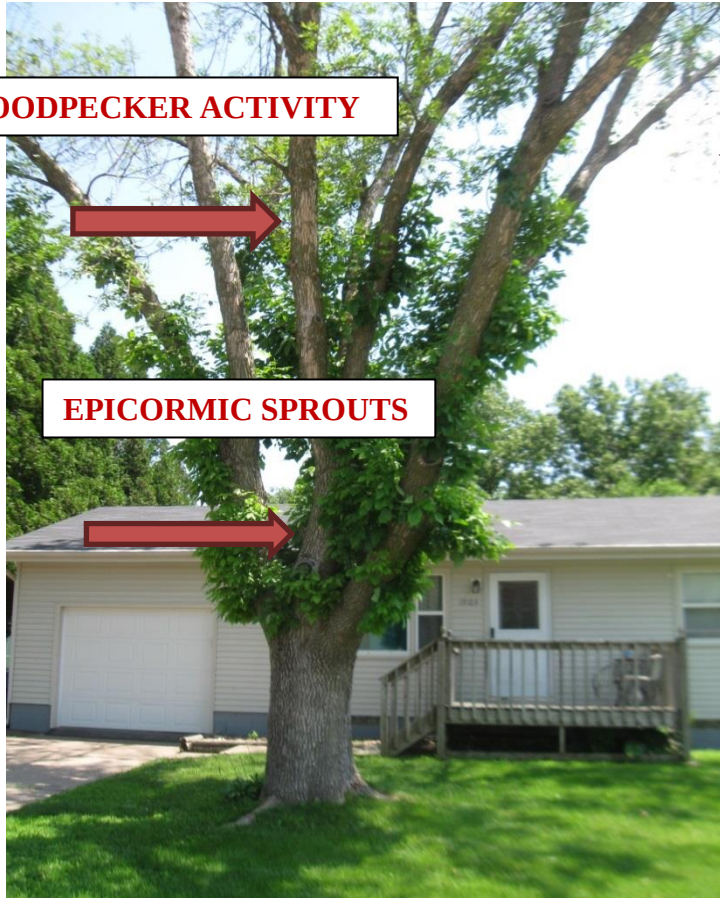
## **Continual Monitoring For EAB**

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 (See examples below). **Once EAB arrives in Charles City, it could potentially kill all ash within 4 to 10 years of its arrival.**



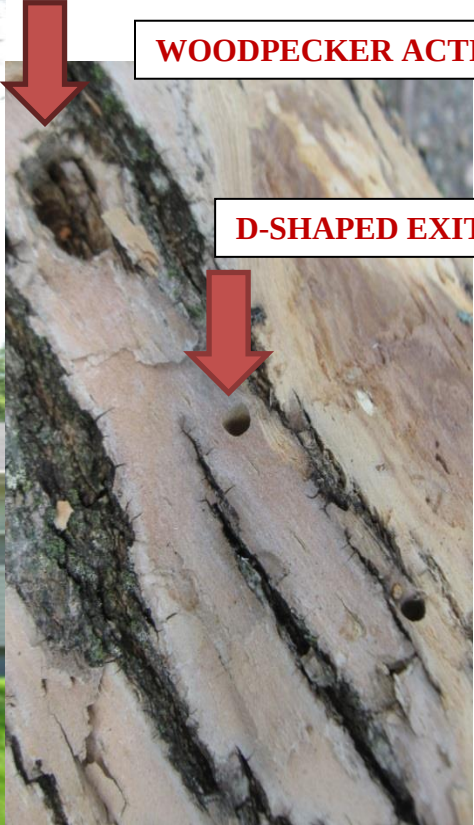
**EAB infested tree in Muscatine with top thinning and many new green epicormic sprouts**

**WOODPECKER ACTIVITY**



**EPICORMIC SPROUTS**

**WOODPECKER ACTIVITY**



**D-SHAPED EXIT HOLE**

**EAB infested tree in Muscatine with sprouting, wood pecker activity, and D-shaped exit holes**

# Emerald Ash Borer Plan

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## 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 an 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.

## 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? The entire state of Iowa is under quarantine, so regulated articles may not be moved into non-quarantined states. For more information, please visit <http://www.emeraldashborer.info/>.

## **Canopy Replacement**

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, any fruit-bearing tree or any tree of the kinds commonly known as 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. City Code 151.06 states “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.”.

## **Six Year Maintenance Plan and Cost Estimates**

### **Year 1 (FY 2016)**

|                                                                                                                                    |                 |
|------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Remove 11 critical concern trees that need immediate attention                                                                     | \$4,400         |
| Maintain 17 critical concern trees that need immediate attention (2 reduction, 15 cleaning)                                        | \$5,100         |
| Remove 51 trees (marked for removal)                                                                                               | \$20,400        |
| Plant and Maintain 75 trees in open locations (pursue grants)                                                                      | \$7,500         |
| Ash tree treatment (if elected), 736 trees in good condition, average 12–18”<br>- \$15 per inch, treated every two years, see note | avg. \$225/tree |
| Visual Survey for signs and symptoms of EAB                                                                                        |                 |

### **Year 2 (FY 2017)**

|                                                                            |            |
|----------------------------------------------------------------------------|------------|
| Remove any new critical concern trees and ash in poor health               | \$400/tree |
| Plant and Maintain 75 trees in open locations (pursue grants)              | \$7,500    |
| Ash tree treatment (if elected)                                            |            |
| Routine trimming: Contract to trim 1/3 of the city trees (~\$300 per tree) |            |
| Visual Survey for signs and symptoms of EAB                                |            |

### **Year 3 (FY 2018)**

|                                                               |            |
|---------------------------------------------------------------|------------|
| Remove any new critical concern trees and ash in poor health  | \$400/tree |
| Plant and Maintain 75 trees in open locations (pursue grants) | \$7,500    |
| Ash tree treatment (if elected)                               |            |
| Visual Survey for signs and symptoms of EAB                   |            |

### **Year 4 (FY 2019)**

|                                                                            |            |
|----------------------------------------------------------------------------|------------|
| Remove any new critical concern trees and ash in poor health               | \$400/tree |
| Plant and Maintain 75 trees in open locations (pursue grants)              | \$7,500    |
| Ash tree treatment (if elected)                                            |            |
| Routine trimming: Contract to trim 1/3 of the city trees (~\$300 per tree) |            |
| Visual Survey for signs and symptoms of EAB                                |            |

### **Year 5 (FY 2020)**

|                                                               |            |
|---------------------------------------------------------------|------------|
| Remove any new critical concern trees and ash in poor health  | \$400/tree |
| Plant and Maintain 75 trees in open locations (pursue grants) | \$7,500    |
| Ash tree treatment (if elected)                               |            |
| Visual Survey for signs and symptoms of EAB                   |            |

## **Year 6 (FY 2021)**

|                                                                            |            |
|----------------------------------------------------------------------------|------------|
| Remove any new critical concern trees and ash in poor health               | \$400/tree |
| Plant and Maintain 75 trees in open locations (pursue grants)              | \$7,500    |
| Ash tree treatment (if elected)                                            |            |
| Routine trimming: Contract to trim 1/3 of the city trees (~\$300 per tree) |            |
| Visual Survey for signs and symptoms of EAB                                |            |

\*Reduction of ash in poor health will reduce exposure to Emerald Ash Borer over time. EAB could potentially kill all ash within 4 years of its arrival.

\*\*Assuming a cost of \$400 per tree for removal, the budget would need to be increased to \$96,500 a year to remove all ash trees within 6 years.

\*\*\*Suggest a future (post ash removal and replacement) budget of at least \$40,000. Currently, this amount would cover about 41% of what would be needed to remove EAB infested trees over a six year period. Suggest setting aside additional funds to prepare for the expected arrival of EAB. Planting could be at least partially dependent on receiving grant funds annually.

### **Proposed Budget Increase**

EAB could potentially kill all ash trees in Charles City within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to \$96,500 a year. If the budget were increased to \$44,600 a year all ash could be removed within 13 years. Additionally, it is recommended that Charles City 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 an example, if the average ash diameter is 20 inches and treatment costs \$15 per inch, then treating 10 trees would cost about \$3,000 (every other year treatment). This would be 10 trees selected for treatment, and Charles City would still need to find \$400 per tree for removal. Alternatively, if there are 15 treatable trees, it would cost approximately \$4,500 every two years for treatment and leave five less trees for removal (for at least two more years). 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 Charles City. 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

Charles City

## Annual Energy Benefits of Public Trees

3/20/2015

| Species                    | Total Electricity<br>(MWh) | Electricity<br>(\$) | Total Natural<br>Gas (Therms) | Natural<br>Gas (\$) | Total<br>(\$) | Standard<br>Error | % of Total<br>Trees | % of<br>Total \$ | Avg.<br>\$/tree |
|----------------------------|----------------------------|---------------------|-------------------------------|---------------------|---------------|-------------------|---------------------|------------------|-----------------|
| Norway maple               | 327.5                      | 24,855              | 44,667.0                      | 43,774              | 68,628        | (N/A)             | 23.6                | 21.0             | 41.67           |
| Green ash                  | 293.4                      | 22,270              | 37,748.7                      | 36,994              | 59,264        | (N/A)             | 19.7                | 18.1             | 43.04           |
| Silver maple               | 236.1                      | 17,919              | 30,732.7                      | 30,118              | 48,037        | (N/A)             | 11.7                | 14.7             | 58.72           |
| Sugar maple                | 177.9                      | 13,501              | 23,007.1                      | 22,547              | 36,048        | (N/A)             | 10.7                | 11.0             | 48.06           |
| Northern hackberry         | 218.0                      | 16,546              | 30,627.2                      | 30,015              | 46,561        | (N/A)             | 9.5                 | 14.2             | 70.23           |
| Pin oak                    | 54.9                       | 4,167               | 7,361.1                       | 7,214               | 11,380        | (N/A)             | 3.0                 | 3.5              | 55.25           |
| Littleleaf linden          | 34.4                       | 2,610               | 4,656.0                       | 4,563               | 7,173         | (N/A)             | 2.8                 | 2.2              | 37.36           |
| American basswood          | 34.6                       | 2,629               | 4,814.9                       | 4,719               | 7,348         | (N/A)             | 2.1                 | 2.2              | 48.99           |
| Honeylocust                | 41.2                       | 3,127               | 5,300.2                       | 5,194               | 8,321         | (N/A)             | 2.1                 | 2.5              | 57.79           |
| Apple                      | 7.7                        | 581                 | 1,213.7                       | 1,189               | 1,771         | (N/A)             | 1.9                 | 0.5              | 13.42           |
| Black walnut               | 25.9                       | 1,969               | 3,442.9                       | 3,374               | 5,343         | (N/A)             | 1.7                 | 1.6              | 45.28           |
| Northern red oak           | 21.2                       | 1,609               | 2,832.3                       | 2,776               | 4,384         | (N/A)             | 1.6                 | 1.3              | 39.86           |
| Black maple                | 22.4                       | 1,698               | 2,901.8                       | 2,844               | 4,542         | (N/A)             | 1.4                 | 1.4              | 47.81           |
| Maple                      | 2.3                        | 175                 | 345.6                         | 339                 | 514           | (N/A)             | 1.0                 | 0.2              | 7.44            |
| Red maple                  | 8.4                        | 635                 | 1,109.4                       | 1,087               | 1,722         | (N/A)             | 1.0                 | 0.5              | 24.96           |
| Bur oak                    | 20.7                       | 1,573               | 2,864.1                       | 2,807               | 4,379         | (N/A)             | 0.9                 | 1.3              | 67.38           |
| White ash                  | 5.9                        | 444                 | 743.8                         | 729                 | 1,173         | (N/A)             | 0.7                 | 0.4              | 24.96           |
| Catalpa                    | 5.8                        | 442                 | 790.8                         | 775                 | 1,217         | (N/A)             | 0.4                 | 0.4              | 46.79           |
| Spruce                     | 2.3                        | 177                 | 301.8                         | 296                 | 473           | (N/A)             | 0.3                 | 0.1              | 20.56           |
| Mountain ash               | 1.4                        | 104                 | 195.1                         | 191                 | 296           | (N/A)             | 0.2                 | 0.1              | 17.39           |
| Black poplar               | 4.6                        | 346                 | 651.5                         | 639                 | 984           | (N/A)             | 0.2                 | 0.3              | 57.90           |
| Eastern red cedar          | 1.4                        | 103                 | 204.1                         | 200                 | 303           | (N/A)             | 0.2                 | 0.1              | 20.20           |
| American elm               | 2.1                        | 157                 | 277.6                         | 272                 | 429           | (N/A)             | 0.2                 | 0.1              | 30.65           |
| Northern pin oak           | 3.1                        | 237                 | 443.3                         | 434                 | 672           | (N/A)             | 0.2                 | 0.2              | 47.97           |
| Ohio buckeye               | 1.6                        | 123                 | 235.7                         | 231                 | 354           | (N/A)             | 0.2                 | 0.1              | 27.24           |
| Elm                        | 2.7                        | 205                 | 351.6                         | 345                 | 549           | (N/A)             | 0.2                 | 0.2              | 45.78           |
| Black locust               | 3.3                        | 250                 | 479.0                         | 469                 | 719           | (N/A)             | 0.2                 | 0.2              | 59.93           |
| Blue spruce                | 0.6                        | 47                  | 92.3                          | 90                  | 137           | (N/A)             | 0.2                 | 0.0              | 11.44           |
| Amur maple                 | 0.6                        | 45                  | 95.0                          | 93                  | 138           | (N/A)             | 0.1                 | 0.0              | 13.79           |
| Chinese elm                | 1.8                        | 140                 | 244.4                         | 240                 | 380           | (N/A)             | 0.1                 | 0.1              | 37.96           |
| Eastern white pine         | 0.9                        | 67                  | 116.2                         | 114                 | 181           | (N/A)             | 0.1                 | 0.1              | 20.15           |
| Mulberry                   | 1.1                        | 83                  | 178.4                         | 175                 | 258           | (N/A)             | 0.1                 | 0.1              | 28.69           |
| Cherry plum                | 0.5                        | 40                  | 75.9                          | 74                  | 114           | (N/A)             | 0.1                 | 0.0              | 12.68           |
| Cottonwood                 | 2.8                        | 213                 | 389.5                         | 382                 | 595           | (N/A)             | 0.1                 | 0.2              | 74.35           |
| Pear                       | 0.2                        | 17                  | 38.9                          | 38                  | 55            | (N/A)             | 0.1                 | 0.0              | 6.90            |
| Siberian elm               | 1.5                        | 113                 | 194.3                         | 190                 | 303           | (N/A)             | 0.1                 | 0.1              | 43.31           |
| Southern magnolia          | 0.2                        | 13                  | 29.8                          | 29                  | 42            | (N/A)             | 0.1                 | 0.0              | 6.07            |
| Eastern redbud             | 0.3                        | 24                  | 55.7                          | 55                  | 79            | (N/A)             | 0.1                 | 0.0              | 13.17           |
| Ginkgo                     | 1.3                        | 98                  | 165.8                         | 163                 | 260           | (N/A)             | 0.1                 | 0.1              | 43.34           |
| Hickory                    | 0.7                        | 54                  | 95.6                          | 94                  | 147           | (N/A)             | 0.1                 | 0.0              | 24.57           |
| Swamp white oak            | 0.6                        | 47                  | 83.6                          | 82                  | 129           | (N/A)             | 0.1                 | 0.0              | 21.54           |
| Black cherry               | 0.3                        | 21                  | 39.8                          | 39                  | 60            | (N/A)             | 0.1                 | 0.0              | 11.95           |
| Quaking aspen              | 0.9                        | 68                  | 108.4                         | 106                 | 174           | (N/A)             | 0.1                 | 0.1              | 34.79           |
| Northern white cedar       | 0.1                        | 9                   | 20.3                          | 20                  | 29            | (N/A)             | 0.1                 | 0.0              | 7.25            |
| Boxelder                   | 0.7                        | 56                  | 100.4                         | 98                  | 155           | (N/A)             | 0.1                 | 0.0              | 38.65           |
| Willow                     | 1.2                        | 89                  | 174.0                         | 170                 | 259           | (N/A)             | 0.1                 | 0.1              | 64.76           |
| Black spruce               | 0.3                        | 25                  | 47.6                          | 47                  | 72            | (N/A)             | 0.0                 | 0.0              | 24.02           |
| River birch                | 0.9                        | 67                  | 124.3                         | 122                 | 188           | (N/A)             | 0.0                 | 0.1              | 62.82           |
| Broadleaf Deciduous Small  | 0.1                        | 7                   | 16.6                          | 16                  | 24            | (N/A)             | 0.0                 | 0.0              | 11.80           |
| Norway spruce              | 0.2                        | 16                  | 28.6                          | 28                  | 44            | (N/A)             | 0.0                 | 0.0              | 21.89           |
| Kentucky coffeetree        | 0.5                        | 38                  | 65.1                          | 64                  | 102           | (N/A)             | 0.0                 | 0.0              | 50.77           |
| American sycamore          | 0.9                        | 70                  | 122.1                         | 120                 | 190           | (N/A)             | 0.0                 | 0.1              | 94.83           |
| Amur corktree              | 0.3                        | 21                  | 35.7                          | 35                  | 56            | (N/A)             | 0.0                 | 0.0              | 27.88           |
| Broadleaf Evergreen Medium | 0.5                        | 35                  | 48.4                          | 47                  | 83            | (N/A)             | 0.0                 | 0.0              | 41.29           |
| Broadleaf Deciduous Medium | 0.5                        | 36                  | 59.0                          | 58                  | 94            | (N/A)             | 0.0                 | 0.0              | 46.78           |
| American chestnut          | 0.8                        | 59                  | 107.4                         | 105                 | 164           | (N/A)             | 0.0                 | 0.1              | 82.02           |
| Kwanzaan cherry            | 0.1                        | 11                  | 25.7                          | 25                  | 36            | (N/A)             | 0.0                 | 0.0              | 18.19           |
| Mimosa                     | 0.0                        | 2                   | 3.8                           | 4                   | 5             | (N/A)             | 0.0                 | 0.0              | 5.40            |
| Scotch pine                | 0.1                        | 10                  | 14.6                          | 14                  | 24            | (N/A)             | 0.0                 | 0.0              | 24.14           |
| White oak                  | 0.0                        | 0                   | 0.5                           | 0                   | 1             | (N/A)             | 0.0                 | 0.0              | 0.66            |
| Basswood                   | 0.1                        | 7                   | 13.7                          | 13                  | 21            | (N/A)             | 0.0                 | 0.0              | 20.64           |
| Eastern hophornbeam        | 0.2                        | 14                  | 24.7                          | 24                  | 38            | (N/A)             | 0.0                 | 0.0              | 38.13           |
| Ash                        | 0.3                        | 24                  | 47.4                          | 46                  | 71            | (N/A)             | 0.0                 | 0.0              | 70.84           |
| Dogwood                    | 0.0                        | 2                   | 3.8                           | 4                   | 5             | (N/A)             | 0.0                 | 0.0              | 5.40            |
| Total                      | 1,582.9                    | 120,138             | 211,386.6                     | 207,159             | 327,297       | (N/A)             | 100.0               | 100.0            | 46.88           |

**Table 2: Annual Stormwater Benefits**  
Charles City

| <b>Annual Stormwater Benefits of Public Trees</b> |                                   |            |                |                  |               |              |
|---------------------------------------------------|-----------------------------------|------------|----------------|------------------|---------------|--------------|
| 3/20/2015                                         |                                   |            |                |                  |               |              |
| Species                                           | Total rainfall interception (Gal) | Total (\$) | Standard Error | % of Total Trees | % of Total \$ | Avg. \$/tree |
| Norway maple                                      | 2,330,205                         | 63,149     | (N/A)          | 23.6             | 16.5          | 38.34        |
| Green ash                                         | 2,400,850                         | 65,063     | (N/A)          | 19.7             | 17.0          | 47.25        |
| Silver maple                                      | 2,912,953                         | 78,941     | (N/A)          | 11.7             | 20.7          | 96.50        |
| Sugar maple                                       | 1,572,780                         | 42,622     | (N/A)          | 10.7             | 11.2          | 56.83        |
| Northern hackberry                                | 1,930,103                         | 52,306     | (N/A)          | 9.5              | 13.7          | 78.89        |
| Pin oak                                           | 510,971                           | 13,847     | (N/A)          | 3.0              | 3.6           | 67.22        |
| Littleleaf linden                                 | 287,813                           | 7,800      | (N/A)          | 2.8              | 2.0           | 40.62        |
| American basswood                                 | 298,884                           | 8,100      | (N/A)          | 2.1              | 2.1           | 54.00        |
| Honeylocust                                       | 351,128                           | 9,516      | (N/A)          | 2.1              | 2.5           | 66.08        |
| Apple                                             | 27,952                            | 758        | (N/A)          | 1.9              | 0.2           | 5.74         |
| Black walnut                                      | 233,022                           | 6,315      | (N/A)          | 1.7              | 1.7           | 53.52        |
| Northern red oak                                  | 186,487                           | 5,054      | (N/A)          | 1.6              | 1.3           | 45.94        |
| Black maple                                       | 176,759                           | 4,790      | (N/A)          | 1.4              | 1.3           | 50.42        |
| Maple                                             | 11,294                            | 306        | (N/A)          | 1.0              | 0.1           | 4.44         |
| Red maple                                         | 50,945                            | 1,381      | (N/A)          | 1.0              | 0.4           | 20.01        |
| Bur oak                                           | 281,910                           | 7,640      | (N/A)          | 0.9              | 2.0           | 117.53       |
| White ash                                         | 39,998                            | 1,084      | (N/A)          | 0.7              | 0.3           | 23.06        |
| Catalpa                                           | 63,095                            | 1,710      | (N/A)          | 0.4              | 0.4           | 65.76        |
| Spruce                                            | 32,076                            | 869        | (N/A)          | 0.3              | 0.2           | 37.79        |
| Mountain ash                                      | 4,901                             | 133        | (N/A)          | 0.2              | 0.0           | 7.81         |
| Black poplar                                      | 50,459                            | 1,367      | (N/A)          | 0.2              | 0.4           | 80.44        |
| Eastern red cedar                                 | 19,641                            | 532        | (N/A)          | 0.2              | 0.1           | 35.49        |
| American elm                                      | 16,208                            | 439        | (N/A)          | 0.2              | 0.1           | 31.37        |
| Northern pin oak                                  | 24,964                            | 677        | (N/A)          | 0.2              | 0.2           | 48.32        |
| Ohio buckeye                                      | 9,240                             | 250        | (N/A)          | 0.2              | 0.1           | 19.26        |
| Elm                                               | 24,682                            | 669        | (N/A)          | 0.2              | 0.2           | 55.74        |
| Black locust                                      | 33,428                            | 906        | (N/A)          | 0.2              | 0.2           | 75.49        |
| Blue spruce                                       | 7,533                             | 204        | (N/A)          | 0.2              | 0.1           | 17.01        |
| Amur maple                                        | 2,068                             | 56         | (N/A)          | 0.1              | 0.0           | 5.60         |
| Chinese elm                                       | 16,278                            | 441        | (N/A)          | 0.1              | 0.1           | 44.11        |
| Eastern white pine                                | 11,506                            | 312        | (N/A)          | 0.1              | 0.1           | 34.65        |
| Mulberry                                          | 5,762                             | 156        | (N/A)          | 0.1              | 0.0           | 17.35        |
| Cherry plum                                       | 1,814                             | 49         | (N/A)          | 0.1              | 0.0           | 5.46         |
| Cottonwood                                        | 39,042                            | 1,058      | (N/A)          | 0.1              | 0.3           | 132.25       |
| Pear                                              | 757                               | 21         | (N/A)          | 0.1              | 0.0           | 2.57         |
| Siberian elm                                      | 12,529                            | 340        | (N/A)          | 0.1              | 0.1           | 48.50        |
| Southern magnolia                                 | 1,015                             | 27         | (N/A)          | 0.1              | 0.0           | 3.93         |
| Eastern redbud                                    | 1,134                             | 31         | (N/A)          | 0.1              | 0.0           | 5.12         |
| Ginkgo                                            | 8,865                             | 240        | (N/A)          | 0.1              | 0.1           | 40.04        |
| Hickory                                           | 4,505                             | 122        | (N/A)          | 0.1              | 0.0           | 20.35        |
| Swamp white oak                                   | 3,591                             | 97         | (N/A)          | 0.1              | 0.0           | 16.22        |
| Black cherry                                      | 941                               | 26         | (N/A)          | 0.1              | 0.0           | 5.10         |
| Quaking aspen                                     | 5,612                             | 152        | (N/A)          | 0.1              | 0.0           | 30.42        |
| Northern white cedar                              | 1,289                             | 35         | (N/A)          | 0.1              | 0.0           | 8.73         |
| Boxelder                                          | 6,642                             | 180        | (N/A)          | 0.1              | 0.0           | 45.00        |
| Willow                                            | 12,487                            | 338        | (N/A)          | 0.1              | 0.1           | 84.60        |
| Black spruce                                      | 5,493                             | 149        | (N/A)          | 0.0              | 0.0           | 49.62        |
| River birch                                       | 8,938                             | 242        | (N/A)          | 0.0              | 0.1           | 80.74        |
| Broadleaf Deciduous Small                         | 333                               | 9          | (N/A)          | 0.0              | 0.0           | 4.51         |
| Norway spruce                                     | 4,817                             | 131        | (N/A)          | 0.0              | 0.0           | 65.28        |
| Kentucky coffeetree                               | 4,056                             | 110        | (N/A)          | 0.0              | 0.0           | 54.96        |
| American sycamore                                 | 14,478                            | 392        | (N/A)          | 0.0              | 0.1           | 196.17       |
| Amur corktree                                     | 1,572                             | 43         | (N/A)          | 0.0              | 0.0           | 21.30        |
| Broadleaf Evergreen Medium                        | 3,551                             | 96         | (N/A)          | 0.0              | 0.0           | 48.11        |
| Broadleaf Deciduous Medium                        | 2,818                             | 76         | (N/A)          | 0.0              | 0.0           | 38.19        |
| American chestnut                                 | 10,981                            | 298        | (N/A)          | 0.0              | 0.1           | 148.79       |
| Kwanzan cherry                                    | 529                               | 14         | (N/A)          | 0.0              | 0.0           | 7.17         |
| Mimosa                                            | 69                                | 2          | (N/A)          | 0.0              | 0.0           | 1.86         |
| Scotch pine                                       | 1,539                             | 42         | (N/A)          | 0.0              | 0.0           | 41.70        |
| White oak                                         | 18                                | 0          | (N/A)          | 0.0              | 0.0           | 0.48         |
| Basswood                                          | 608                               | 16         | (N/A)          | 0.0              | 0.0           | 16.47        |
| Eastern hophornbeam                               | 667                               | 18         | (N/A)          | 0.0              | 0.0           | 18.06        |
| Ash                                               | 3,764                             | 102        | (N/A)          | 0.0              | 0.0           | 102.01       |
| Dogwood                                           | 69                                | 2          | (N/A)          | 0.0              | 0.0           | 1.86         |
| Citywide total                                    | 14,090,418                        | 381,850    | (N/A)          | 100.0            | 100.0         | 54.70        |

**Table 3: Annual Air Quality Benefits**  
Charles City

**Annual Air Quality Benefits of Public Trees**

3/20/2015

| 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 <sub>3</sub>  | NO <sub>2</sub> | PM <sub>10</sub> | SO <sub>2</sub> |                   | NO <sub>2</sub> | PM <sub>10</sub> | VOC     | SO <sub>2</sub> |                    |                     |                     |            |              |                |                  |              |
| Norway maple               | 400.7           | 69.1            | 207.5            | 17.7            | 2,195             | 1,565.3         | 227.9            | 217.3   | 1,486.1         | 9,752              | -100.8              | -378                | 4,091.0    | 11,569 (N/A) |                | 23.6             | 7.02         |
| Green ash                  | 228.9           | 36.6            | 122.1            | 10.3            | 1,255             | 1,379.3         | 202.4            | 193.4   | 1,330.0         | 8,647              | 0.0                 | 0                   | 3,503.0    | 9,901 (N/A)  |                | 19.7             | 7.19         |
| Silver maple               | 447.7           | 75.9            | 226.5            | 19.8            | 2,433             | 1,110.3         | 162.8            | 155.4   | 1,068.4         | 6,954              | -242.6              | -910                | 3,024.3    | 8,478 (N/A)  |                | 11.7             | 10.36        |
| Sugar maple                | 187.3           | 31.9            | 98.8             | 8.3             | 1,030             | 836.4           | 122.7            | 117.2   | 805.8           | 5,242              | -151.6              | -568                | 2,056.9    | 5,703 (N/A)  |                | 10.7             | 7.60         |
| Northern hackberry         | 285.3           | 49.4            | 148.2            | 12.8            | 1,565             | 1,049.6         | 152.2            | 145.0   | 988.8           | 6,519              | 0.0                 | 0                   | 2,831.2    | 8,083 (N/A)  |                | 9.5              | 12.19        |
| Pin oak                    | 80.2            | 14.1            | 42.7             | 3.6             | 444               | 260.4           | 38.0             | 36.3    | 248.7           | 1,626              | -153.6              | -576                | 570.4      | 1,494 (N/A)  |                | 3.0              | 7.25         |
| Littleleaf linden          | 43.7            | 7.5             | 22.4             | 1.9             | 239               | 164.1           | 23.9             | 22.8    | 156.1           | 1,023              | -22.1               | -83                 | 420.3      | 1,179 (N/A)  |                | 2.8              | 6.14         |
| American basswood          | 34.8            | 5.9             | 18.3             | 1.5             | 191               | 166.4           | 24.2             | 23.0    | 157.2           | 1,035              | -31.6               | -119                | 399.7      | 1,107 (N/A)  |                | 2.1              | 7.38         |
| Honeylocust                | 64.7            | 10.7            | 30.3             | 2.9             | 344               | 193.4           | 28.4             | 27.1    | 186.6           | 1,213              | -46.8               | -176                | 497.3      | 1,381 (N/A)  |                | 2.1              | 9.59         |
| Apple                      | 6.4             | 1.1             | 3.3              | 0.3             | 35                | 38.0            | 5.4              | 5.2     | 34.7            | 233                | 0.0                 | 0                   | 94.3       | 268 (N/A)    |                | 1.9              | 2.03         |
| Black walnut               | 24.0            | 3.8             | 12.4             | 1.1             | 130               | 122.9           | 18.0             | 17.1    | 117.6           | 768                | 0.0                 | 0                   | 316.8      | 898 (N/A)    |                | 1.7              | 7.61         |
| Northern red oak           | 37.8            | 6.5             | 18.6             | 1.7             | 205               | 100.5           | 14.7             | 14.0    | 96.0            | 628                | -53.6               | -201                | 236.2      | 631 (N/A)    |                | 1.6              | 5.74         |
| Black maple                | 40.9            | 7.0             | 19.2             | 1.8             | 218               | 105.3           | 15.4             | 14.7    | 101.3           | 660                | -14.0               | -52                 | 291.6      | 825 (N/A)    |                | 1.4              | 8.68         |
| Maple                      | 1.2             | 0.2             | 0.8              | 0.1             | 7                 | 11.2            | 1.6              | 1.5     | 10.4            | 69                 | -0.5                | -2                  | 26.5       | 74 (N/A)     |                | 1.0              | 1.08         |
| Red maple                  | 8.9             | 1.5             | 4.6              | 0.4             | 49                | 39.6            | 5.8              | 5.5     | 37.9            | 247                | -3.4                | -13                 | 100.8      | 283 (N/A)    |                | 1.0              | 4.11         |
| Bur oak                    | 39.9            | 6.4             | 18.2             | 1.8             | 210               | 99.2            | 14.4             | 13.7    | 93.9            | 617                | 0.0                 | 0                   | 287.5      | 827 (N/A)    |                | 0.9              | 12.72        |
| White ash                  | 2.5             | 0.4             | 1.7              | 0.1             | 15                | 27.4            | 4.0              | 3.8     | 26.5            | 172                | 0.0                 | 0                   | 66.5       | 187 (N/A)    |                | 0.7              | 3.97         |
| Catalpa                    | 7.6             | 1.2             | 3.7              | 0.3             | 41                | 27.7            | 4.0              | 3.9     | 26.4            | 173                | 0.0                 | 0                   | 74.9       | 214 (N/A)    |                | 0.4              | 8.22         |
| Spruce                     | 3.5             | 0.7             | 3.0              | 0.4             | 23                | 11.0            | 1.6              | 1.5     | 10.6            | 69                 | -12.3               | -46                 | 20.0       | 46 (N/A)     |                | 0.3              | 1.99         |
| Mountain ash               | 1.4             | 0.2             | 0.7              | 0.1             | 7                 | 6.6             | 1.0              | 0.9     | 6.2             | 41                 | 0.0                 | 0                   | 17.0       | 48 (N/A)     |                | 0.2              | 2.85         |
| Black poplar               | 5.9             | 0.9             | 2.9              | 0.3             | 32                | 22.0            | 3.2              | 3.0     | 20.6            | 136                | 0.0                 | 0                   | 58.9       | 168 (N/A)    |                | 0.2              | 9.89         |
| Eastern red cedar          | 3.7             | 0.7             | 3.0              | 0.5             | 24                | 6.6             | 1.0              | 0.9     | 6.1             | 41                 | -10.8               | -40                 | 11.8       | 25 (N/A)     |                | 0.2              | 1.66         |
| American elm               | 1.3             | 0.2             | 0.8              | 0.1             | 8                 | 9.8             | 1.4              | 1.4     | 9.4             | 61                 | 0.0                 | 0                   | 24.4       | 69 (N/A)     |                | 0.2              | 4.93         |
| Northern pin oak           | 4.6             | 0.8             | 2.3              | 0.2             | 25                | 15.1            | 2.2              | 2.1     | 14.2            | 94                 | -1.1                | -4                  | 40.3       | 114 (N/A)    |                | 0.2              | 8.17         |
| Ohio buckeye               | 1.1             | 0.2             | 0.7              | 0.0             | 6                 | 7.9             | 1.1              | 1.1     | 7.4             | 49                 | -0.3                | -1                  | 19.2       | 54 (N/A)     |                | 0.2              | 4.15         |
| Elm                        | 2.6             | 0.4             | 1.3              | 0.1             | 14                | 12.7            | 1.9              | 1.8     | 12.2            | 80                 | 0.0                 | 0                   | 33.1       | 94 (N/A)     |                | 0.2              | 7.83         |
| Black locust               | 7.2             | 1.2             | 3.5              | 0.3             | 39                | 16.0            | 2.3              | 2.2     | 14.9            | 99                 | -1.6                | -6                  | 45.9       | 131 (N/A)    |                | 0.2              | 10.94        |
| Blue spruce                | 0.9             | 0.2             | 0.8              | 0.1             | 6                 | 3.0             | 0.4              | 0.4     | 2.8             | 19                 | -2.5                | -9                  | 6.2        | 15 (N/A)     |                | 0.2              | 1.28         |
| Amur maple                 | 0.4             | 0.1             | 0.2              | 0.0             | 2                 | 2.9             | 0.4              | 0.4     | 2.7             | 18                 | 0.0                 | 0                   | 7.2        | 20 (N/A)     |                | 0.1              | 2.03         |
| Chinese elm                | 1.6             | 0.3             | 0.8              | 0.1             | 9                 | 8.7             | 1.3              | 1.2     | 8.4             | 55                 | 0.0                 | 0                   | 22.4       | 63 (N/A)     |                | 0.1              | 6.35         |
| Eastern white pine         | 1.2             | 0.2             | 1.1              | 0.2             | 8                 | 4.2             | 0.6              | 0.6     | 4.0             | 26                 | -4.2                | -16                 | 7.9        | 19 (N/A)     |                | 0.1              | 2.07         |
| Mulberry                   | 1.9             | 0.3             | 0.9              | 0.1             | 10                | 5.5             | 0.8              | 0.7     | 5.0             | 34                 | 0.0                 | 0                   | 15.2       | 44 (N/A)     |                | 0.1              | 4.85         |
| Cherry plum                | 0.4             | 0.1             | 0.2              | 0.0             | 2                 | 2.5             | 0.4              | 0.3     | 2.4             | 16                 | 0.0                 | 0                   | 6.4        | 18 (N/A)     |                | 0.1              | 2.01         |
| Cottonwood                 | 5.6             | 0.9             | 2.5              | 0.2             | 29                | 13.5            | 2.0              | 1.9     | 12.7            | 84                 | 0.0                 | 0                   | 39.2       | 113 (N/A)    |                | 0.1              | 14.12        |
| Pear                       | 0.1             | 0.0             | 0.1              | 0.0             | 1                 | 1.1             | 0.2              | 0.2     | 1.0             | 7                  | 0.0                 | 0                   | 2.7        | 8 (N/A)      |                | 0.1              | 0.94         |
| Siberian elm               | 1.6             | 0.3             | 0.9              | 0.1             | 9                 | 7.0             | 1.0              | 1.0     | 6.7             | 44                 | 0.0                 | 0                   | 18.6       | 53 (N/A)     |                | 0.1              | 7.54         |
| Southern magnolia          | 0.0             | 0.0             | 0.1              | 0.0             | 0                 | 0.9             | 0.1              | 0.1     | 0.8             | 5                  | -0.2                | -1                  | 1.8        | 5 (N/A)      |                | 0.1              | 0.71         |
| Eastern redbud             | 0.2             | 0.0             | 0.1              | 0.0             | 1                 | 1.6             | 0.2              | 0.2     | 1.5             | 10                 | 0.0                 | 0                   | 3.9        | 11 (N/A)     |                | 0.1              | 1.83         |
| Ginkgo                     | 2.4             | 0.4             | 1.2              | 0.1             | 13                | 6.0             | 0.9              | 0.8     | 5.8             | 38                 | -0.8                | -3                  | 17.0       | 48 (N/A)     |                | 0.1              | 8.01         |
| Hickory                    | 0.2             | 0.0             | 0.2              | 0.0             | 1                 | 3.4             | 0.5              | 0.5     | 3.2             | 21                 | 0.0                 | 0                   | 8.0        | 22 (N/A)     |                | 0.1              | 3.73         |
| Swamp white oak            | 0.5             | 0.1             | 0.3              | 0.0             | 3                 | 3.0             | 0.4              | 0.4     | 2.8             | 19                 | -0.1                | -1                  | 7.4        | 21 (N/A)     |                | 0.1              | 3.46         |
| Black cherry               | 0.2             | 0.0             | 0.1              | 0.0             | 1                 | 1.3             | 0.2              | 0.2     | 1.2             | 8                  | 0.0                 | 0                   | 3.3        | 9 (N/A)      |                | 0.1              | 1.88         |
| Quaking aspen              | 0.4             | 0.1             | 0.2              | 0.0             | 2                 | 4.1             | 0.6              | 0.6     | 4.0             | 26                 | 0.0                 | 0                   | 10.1       | 28 (N/A)     |                | 0.1              | 5.65         |
| Northern white cedar       | 0.1             | 0.0             | 0.1              | 0.0             | 1                 | 0.6             | 0.1              | 0.1     | 0.5             | 4                  | -0.4                | -1                  | 1.2        | 3 (N/A)      |                | 0.1              | 0.76         |
| Boxelder                   | 0.7             | 0.1             | 0.4              | 0.0             | 4                 | 3.5             | 0.5              | 0.5     | 3.4             | 22                 | -0.3                | -1                  | 8.8        | 25 (N/A)     |                | 0.1              | 6.18         |
| Willow                     | 2.7             | 0.5             | 1.3              | 0.1             | 15                | 5.7             | 0.8              | 0.8     | 5.3             | 35                 | -0.6                | -2                  | 16.6       | 47 (N/A)     |                | 0.1              | 11.87        |
| Black spruce               | 0.9             | 0.2             | 0.7              | 0.1             | 6                 | 1.6             | 0.2              | 0.2     | 1.5             | 10                 | -2.1                | -8                  | 3.4        | 8 (N/A)      |                | 0.0              | 2.67         |
| River birch                | 1.9             | 0.3             | 0.9              | 0.1             | 10                | 4.2             | 0.6              | 0.6     | 4.0             | 26                 | -0.4                | -2                  | 12.3       | 35 (N/A)     |                | 0.0              | 11.69        |
| Broadleaf Deciduous Small  | 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)      |                | 0.0              | 1.63         |
| Norway spruce              | 0.6             | 0.1             | 0.5              | 0.1             | 4                 | 1.0             | 0.1              | 0.1     | 0.9             | 6                  | -2.9                | -11                 | 0.5        | -1 (N/A)     |                | 0.0              | -0.51        |
| Kentucky coffeetree        | 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)     |                | 0.0              | 8.38         |
| American sycamore          | 2.7             | 0.4             | 1.2              | 0.1             | 14                | 4.4             | 0.6              | 0.6     | 4.2             | 27                 | 0.0                 | 0                   | 14.3       | 42 (N/A)     |                | 0.0              | 20.79        |
| Amur corktree              | 0.2             | 0.0             | 0.1              | 0.0             | 1                 | 1.3             | 0.2              | 0.2     | 1.2             | 8                  | -0.1                | 0                   | 3.2        | 9 (N/A)      |                | 0.0              | 4.56         |
| Broadleaf Evergreen Medium | 0.2             | 0.0             | 0.3              | 0.0             | 2                 | 2.1             | 0.3              | 0.3     | 2.1             | 13                 | -1.0                | -4                  | 4.3        | 11 (N/A)     |                | 0.0              | 5.49         |
| Broadleaf Deciduous Medium | 0.4             | 0.1             | 0.2              | 0.0             | 2                 | 2.2             | 0.3              | 0.3     | 2.1             | 14                 | -0.1                | 0                   | 5.6        | 16 (N/A)     |                | 0.0              | 7.92         |
| American chestnut          | 1.6             | 0.3             | 0.7              | 0.1             | 8                 | 3.7             | 0.5              | 0.5     | 3.5             | 23                 | 0.0                 | 0                   | 10.9       | 31 (N/A)     |                | 0.0              | 15.71        |
| Kwanzan cherry             | 0.1             | 0.0             | 0.1              | 0.0             | 1                 | 0.8             | 0.1              | 0.1     | 0.7             | 5                  | 0.0                 | 0                   | 1.8        | 5 (N/A)      |                | 0.0              | 2.55         |
| Mimosa                     | 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)      |                | 0.0              | 0.71         |
| Scotch pine                | 0.2             | 0.0             | 0.1              | 0.0             | 1                 | 0.6             | 0.1              | 0.1     | 0.6             | 4                  | -0.5                | -2                  | 1.2        | 3 (N/A)      |                | 0.0              | 2.82         |
| 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)      |                | 0.0              | 0.08         |
| Basswood                   | 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)      |                | 0.0              | 2.99         |
| Eastern hophornbeam        | 0.2             | 0.0             | 0.1              | 0.0             | 1                 | 0.9             | 0.1              | 0.1     | 0.8             | 5                  | 0.0                 | 0                   | 2.3        | 7 (N/A)      |                | 0.0              | 6.56         |
| Ash                        | 0.9             | 0.1             | 0.4              | 0.0             | 5                 | 1.6             | 0.2              | 0.2     | 1.5             | 10                 | -0.2                | -1                  | 4.7        | 14 (N/A)     |                | 0.0              | 13.58        |
| Dogwood                    | 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)      |                | 0.0              | 0.71         |
| Citywide total             | 2,005.5         | 340.0           | 1,034.5          | 90.2            | 10,958            | 7,511.1         | 1,097.1          | 1,046.8 | 7,174.9         | 46,908             | -863.5              | -3,238              | 19,436.7   | 54,628 (N/A) |                | 100.0            | 7.83         |

**Table 4: Annual Carbon Stored  
Charles City**

| <b>Stored CO2 Benefits of Public Trees</b> |                           |               |                   |                     |                  |                 |
|--------------------------------------------|---------------------------|---------------|-------------------|---------------------|------------------|-----------------|
| 3/20/2015                                  |                           |               |                   |                     |                  |                 |
| Species                                    | Total Stored<br>CO2 (lbs) | Total<br>(\$) | Standard<br>Error | % of Total<br>Trees | % of<br>Total \$ | Avg.<br>\$/tree |
| Norway maple                               | 6,682,174                 | 50,116        | (N/A)             | 23.6                | 15.3             | 30.43           |
| Green ash                                  | 7,532,347                 | 56,493        | (N/A)             | 19.7                | 17.2             | 41.03           |
| Silver maple                               | 9,708,987                 | 72,817        | (N/A)             | 11.7                | 22.2             | 89.02           |
| Sugar maple                                | 5,356,637                 | 40,175        | (N/A)             | 10.7                | 12.2             | 53.57           |
| Northern hackberry                         | 4,180,618                 | 31,355        | (N/A)             | 9.5                 | 9.6              | 47.29           |
| Pin oak                                    | 2,028,826                 | 15,216        | (N/A)             | 3.0                 | 4.6              | 73.87           |
| Littleleaf linden                          | 955,747                   | 7,168         | (N/A)             | 2.8                 | 2.2              | 37.33           |
| American basswood                          | 1,268,142                 | 9,511         | (N/A)             | 2.1                 | 2.9              | 63.41           |
| Honeylocust                                | 814,044                   | 6,105         | (N/A)             | 2.1                 | 1.9              | 42.40           |
| Apple                                      | 110,418                   | 828           | (N/A)             | 1.9                 | 0.3              | 6.27            |
| Black walnut                               | 784,286                   | 5,882         | (N/A)             | 1.7                 | 1.8              | 49.85           |
| Northern red oak                           | 782,324                   | 5,867         | (N/A)             | 1.6                 | 1.8              | 53.34           |
| Black maple                                | 446,180                   | 3,346         | (N/A)             | 1.4                 | 1.0              | 35.22           |
| Maple                                      | 19,284                    | 145           | (N/A)             | 1.0                 | 0.0              | 2.10            |
| Red maple                                  | 107,830                   | 809           | (N/A)             | 1.0                 | 0.2              | 11.72           |
| Bur oak                                    | 1,310,298                 | 9,827         | (N/A)             | 0.9                 | 3.0              | 151.19          |
| White ash                                  | 81,656                    | 612           | (N/A)             | 0.7                 | 0.2              | 13.03           |
| Catalpa                                    | 249,422                   | 1,871         | (N/A)             | 0.4                 | 0.6              | 71.95           |
| Spruce                                     | 27,129                    | 203           | (N/A)             | 0.3                 | 0.1              | 8.85            |
| Mountain ash                               | 20,983                    | 157           | (N/A)             | 0.2                 | 0.0              | 9.26            |
| Black poplar                               | 190,202                   | 1,427         | (N/A)             | 0.2                 | 0.4              | 83.91           |
| Eastern red cedar                          | 12,406                    | 93            | (N/A)             | 0.2                 | 0.0              | 6.20            |
| American elm                               | 39,643                    | 297           | (N/A)             | 0.2                 | 0.1              | 21.24           |
| Northern pin oak                           | 75,429                    | 566           | (N/A)             | 0.2                 | 0.2              | 40.41           |
| Ohio buckeye                               | 20,115                    | 151           | (N/A)             | 0.2                 | 0.0              | 11.60           |
| Elm                                        | 86,560                    | 649           | (N/A)             | 0.2                 | 0.2              | 54.10           |
| Black locust                               | 117,866                   | 884           | (N/A)             | 0.2                 | 0.3              | 73.67           |
| Blue spruce                                | 6,682                     | 50            | (N/A)             | 0.2                 | 0.0              | 4.18            |
| Amur maple                                 | 7,558                     | 57            | (N/A)             | 0.1                 | 0.0              | 5.67            |
| Chinese elm                                | 53,285                    | 400           | (N/A)             | 0.1                 | 0.1              | 39.96           |
| Eastern white pine                         | 9,050                     | 68            | (N/A)             | 0.1                 | 0.0              | 7.54            |
| Mulberry                                   | 30,616                    | 230           | (N/A)             | 0.1                 | 0.1              | 25.51           |
| Cherry plum                                | 7,319                     | 55            | (N/A)             | 0.1                 | 0.0              | 6.10            |
| Cottonwood                                 | 182,637                   | 1,370         | (N/A)             | 0.1                 | 0.4              | 171.22          |
| Pear                                       | 2,391                     | 18            | (N/A)             | 0.1                 | 0.0              | 2.24            |
| Siberian elm                               | 40,771                    | 306           | (N/A)             | 0.1                 | 0.1              | 43.68           |
| Southern magnolia                          | 502                       | 4             | (N/A)             | 0.1                 | 0.0              | 0.54            |
| Eastern redbud                             | 3,823                     | 29            | (N/A)             | 0.1                 | 0.0              | 4.78            |
| Ginkgo                                     | 34,775                    | 261           | (N/A)             | 0.1                 | 0.1              | 43.47           |
| Hickory                                    | 8,844                     | 66            | (N/A)             | 0.1                 | 0.0              | 11.06           |
| Swamp white oak                            | 8,601                     | 65            | (N/A)             | 0.1                 | 0.0              | 10.75           |
| Black cherry                               | 3,748                     | 28            | (N/A)             | 0.1                 | 0.0              | 5.62            |
| Quaking aspen                              | 13,085                    | 98            | (N/A)             | 0.1                 | 0.0              | 19.63           |
| Northern white cedar                       | 518                       | 4             | (N/A)             | 0.1                 | 0.0              | 0.97            |
| Boxelder                                   | 20,615                    | 155           | (N/A)             | 0.1                 | 0.0              | 38.65           |
| Willow                                     | 44,451                    | 333           | (N/A)             | 0.1                 | 0.1              | 83.35           |
| Black spruce                               | 7,598                     | 57            | (N/A)             | 0.0                 | 0.0              | 18.99           |
| River birch                                | 32,184                    | 241           | (N/A)             | 0.0                 | 0.1              | 80.46           |
| Broadleaf Deciduous                        | 1,086                     | 8             | (N/A)             | 0.0                 | 0.0              | 4.07            |
| Norway spruce                              | 7,528                     | 56            | (N/A)             | 0.0                 | 0.0              | 28.23           |
| Kentucky coffeetree                        | 12,130                    | 91            | (N/A)             | 0.0                 | 0.0              | 45.49           |
| American sycamore                          | 95,241                    | 714           | (N/A)             | 0.0                 | 0.2              | 357.15          |
| Amur corktree                              | 3,843                     | 29            | (N/A)             | 0.0                 | 0.0              | 14.41           |
| Broadleaf Evergreen                        | 3,701                     | 28            | (N/A)             | 0.0                 | 0.0              | 13.88           |
| Broadleaf Deciduous                        | 7,248                     | 54            | (N/A)             | 0.0                 | 0.0              | 27.18           |
| American chestnut                          | 51,886                    | 389           | (N/A)             | 0.0                 | 0.1              | 194.57          |
| Kwanzan cherry                             | 1,816                     | 14            | (N/A)             | 0.0                 | 0.0              | 6.81            |
| Mimosa                                     | 178                       | 1             | (N/A)             | 0.0                 | 0.0              | 1.33            |
| Scotch pine                                | 1,170                     | 9             | (N/A)             | 0.0                 | 0.0              | 8.78            |
| White oak                                  | 12                        | 0             | (N/A)             | 0.0                 | 0.0              | 0.09            |
| Basswood                                   | 1,035                     | 8             | (N/A)             | 0.0                 | 0.0              | 7.76            |
| Eastern hophornbeam                        | 3,037                     | 23            | (N/A)             | 0.0                 | 0.0              | 22.78           |
| Ash                                        | 14,280                    | 107           | (N/A)             | 0.0                 | 0.0              | 107.10          |
| Dogwood                                    | 178                       | 1             | (N/A)             | 0.0                 | 0.0              | 1.33            |
| Citywide total                             | 43,732,976                | 327,997       | (N/A)             | 100.0               | 100.0            | 46.98           |

**Table 5: Annual Carbon Sequestered**

**Charles City**

**Annual CO<sub>2</sub> Benefits of Public Trees**

3/20/2015

| 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 |
|--------------------------|------------------|------------------|----------------------------|--------------------------|---------------------|--------------|--------------|----------------|---------------------------|------------------|---------------|--------------|
| Norway maple             | 535,611          | 4,017            | -32,120                    | -3,082                   | -264                | 549,280      | 4,120        | 1,049,688      | 7,873 (N/A)               | 23.6             | 18.0          | 4.78         |
| Green ash                | 638,108          | 4,786            | -36,155                    | -2,828                   | -292                | 492,159      | 3,691        | 1,091,283      | 8,185 (N/A)               | 19.7             | 18.7          | 5.94         |
| Silver maple             | 835,012          | 6,263            | -46,610                    | -2,424                   | -368                | 396,004      | 2,970        | 1,181,982      | 8,865 (N/A)               | 11.7             | 20.2          | 10.84        |
| Sugar maple              | 333,706          | 2,503            | -25,723                    | -1,769                   | -206                | 298,362      | 2,238        | 604,575        | 4,534 (N/A)               | 10.7             | 10.4          | 6.05         |
| Northern hackberry       | 259,517          | 1,946            | -20,067                    | -1,971                   | -165                | 365,666      | 2,742        | 603,144        | 4,524 (N/A)               | 9.5              | 10.3          | 6.82         |
| Pin oak                  | 203,599          | 1,527            | -9,738                     | -551                     | -77                 | 92,082       | 691          | 285,392        | 2,140 (N/A)               | 3.0              | 4.9           | 10.39        |
| Littleleaf linden        | 104,531          | 784              | -4,589                     | -390                     | -37                 | 57,690       | 433          | 157,243        | 1,179 (N/A)               | 2.8              | 2.7           | 6.14         |
| American basswood        | 84,084           | 631              | -6,087                     | -375                     | -48                 | 58,109       | 436          | 135,730        | 1,018 (N/A)               | 2.1              | 2.3           | 6.79         |
| Honeylocust              | 110,626          | 830              | -3,907                     | -316                     | -32                 | 69,112       | 518          | 175,514        | 1,316 (N/A)               | 2.1              | 3.0           | 9.14         |
| Apple                    | 12,137           | 91               | -532                       | -118                     | -5                  | 12,848       | 96           | 24,335         | 183 (N/A)                 | 1.9              | 0.4           | 1.38         |
| Black walnut             | 58,804           | 441              | -3,765                     | -259                     | -30                 | 43,512       | 326          | 98,292         | 737 (N/A)                 | 1.7              | 1.7           | 6.25         |
| Northern red oak         | 29,035           | 218              | -3,755                     | -255                     | -30                 | 35,553       | 267          | 60,578         | 454 (N/A)                 | 1.6              | 1.0           | 4.13         |
| Black maple              | 38,388           | 288              | -2,142                     | -195                     | -18                 | 37,522       | 281          | 73,573         | 552 (N/A)                 | 1.4              | 1.3           | 5.81         |
| Maple                    | 3,024            | 23               | -95                        | -34                      | -1                  | 3,865        | 29           | 6,761          | 51 (N/A)                  | 1.0              | 0.1           | 0.73         |
| Red maple                | 12,943           | 97               | -518                       | -80                      | -4                  | 14,039       | 105          | 26,384         | 198 (N/A)                 | 1.0              | 0.5           | 2.87         |
| Bur oak                  | 49,960           | 375              | -6,290                     | -228                     | -49                 | 34,755       | 261          | 78,197         | 586 (N/A)                 | 0.9              | 1.3           | 9.02         |
| White ash                | 11,676           | 88               | -394                       | -60                      | -3                  | 9,820        | 74           | 21,041         | 158 (N/A)                 | 0.7              | 0.4           | 3.36         |
| Catalpa                  | 13,826           | 104              | -1,197                     | -62                      | -9                  | 9,758        | 73           | 22,325         | 167 (N/A)                 | 0.4              | 0.4           | 6.44         |
| Spruce                   | 2,330            | 17               | -130                       | -40                      | -1                  | 3,912        | 29           | 6,071          | 46 (N/A)                  | 0.3              | 0.1           | 1.98         |
| Mountain ash             | 2,058            | 15               | -101                       | -18                      | -1                  | 2,308        | 17           | 4,247          | 32 (N/A)                  | 0.2              | 0.1           | 1.87         |
| Black poplar             | 11,542           | 87               | -913                       | -49                      | -7                  | 7,640        | 57           | 18,221         | 137 (N/A)                 | 0.2              | 0.3           | 8.04         |
| Eastern red cedar        | 499              | 4                | -60                        | -25                      | -1                  | 2,278        | 17           | 2,693          | 20 (N/A)                  | 0.2              | 0.0           | 1.35         |
| American elm             | 2,460            | 18               | -190                       | -23                      | -2                  | 3,470        | 26           | 5,717          | 43 (N/A)                  | 0.2              | 0.1           | 3.06         |
| Northern pin oak         | 5,321            | 40               | -362                       | -30                      | -3                  | 5,241        | 39           | 10,170         | 76 (N/A)                  | 0.2              | 0.2           | 5.45         |
| Ohio buckeye             | 3,141            | 24               | -98                        | -16                      | -1                  | 2,721        | 20           | 5,747          | 43 (N/A)                  | 0.2              | 0.1           | 3.32         |
| Elm                      | 6,051            | 45               | -415                       | -27                      | -3                  | 4,526        | 34           | 10,136         | 76 (N/A)                  | 0.2              | 0.2           | 6.33         |
| Black locust             | 4,626            | 35               | -566                       | -34                      | -5                  | 5,517        | 41           | 9,543          | 72 (N/A)                  | 0.2              | 0.2           | 5.96         |
| Blue spruce              | 426              | 3                | -32                        | -12                      | 0                   | 1,034        | 8            | 1,417          | 11 (N/A)                  | 0.2              | 0.0           | 0.89         |
| Amur maple               | 913              | 7                | -36                        | -10                      | 0                   | 991          | 7            | 1,858          | 14 (N/A)                  | 0.1              | 0.0           | 1.39         |
| Chinese elm              | 4,204            | 32               | -256                       | -19                      | -2                  | 3,095        | 23           | 7,024          | 53 (N/A)                  | 0.1              | 0.1           | 5.27         |
| Eastern white pine       | 860              | 6                | -43                        | -15                      | 0                   | 1,490        | 11           | 2,291          | 17 (N/A)                  | 0.1              | 0.0           | 1.91         |
| Mulberry                 | 464              | 3                | -147                       | -19                      | -1                  | 1,841        | 14           | 2,140          | 16 (N/A)                  | 0.1              | 0.0           | 1.78         |
| Cherry plum              | 801              | 6                | -35                        | -8                       | 0                   | 877          | 7            | 1,635          | 12 (N/A)                  | 0.1              | 0.0           | 1.36         |
| Cottonwood               | 6,926            | 52               | -877                       | -31                      | -7                  | 4,709        | 35           | 10,727         | 80 (N/A)                  | 0.1              | 0.2           | 10.06        |
| Pear                     | 368              | 3                | -12                        | -5                       | 0                   | 377          | 3            | 728            | 5 (N/A)                   | 0.1              | 0.0           | 0.68         |
| Siberian elm             | 2,548            | 19               | -196                       | -15                      | -2                  | 2,491        | 19           | 4,828          | 36 (N/A)                  | 0.1              | 0.1           | 5.17         |
| Southern magnolia        | 65               | 0                | -2                         | -2                       | 0                   | 294          | 2            | 354            | 3 (N/A)                   | 0.1              | 0.0           | 0.38         |
| Eastern redbud           | 502              | 4                | -18                        | -5                       | 0                   | 539          | 4            | 1,018          | 8 (N/A)                   | 0.1              | 0.0           | 1.27         |
| Ginkgo                   | 1,545            | 12               | -167                       | -18                      | -1                  | 2,155        | 16           | 3,515          | 26 (N/A)                  | 0.1              | 0.1           | 4.39         |
| Hickory                  | 1,489            | 11               | -42                        | -8                       | 0                   | 1,187        | 9            | 2,626          | 20 (N/A)                  | 0.1              | 0.0           | 3.28         |
| Swamp white oak          | 1,102            | 8                | -42                        | -6                       | 0                   | 1,045        | 8            | 2,099          | 16 (N/A)                  | 0.1              | 0.0           | 2.62         |
| Black cherry             | 419              | 3                | -18                        | -4                       | 0                   | 457          | 3            | 854            | 6 (N/A)                   | 0.1              | 0.0           | 1.28         |
| Quaking aspen            | 1,754            | 13               | -63                        | -8                       | -1                  | 1,496        | 11           | 3,179          | 24 (N/A)                  | 0.1              | 0.1           | 4.77         |
| Northern white cedar     | 112              | 1                | -3                         | -3                       | 0                   | 201          | 2            | 308            | 2 (N/A)                   | 0.1              | 0.0           | 0.58         |
| Boxelder                 | 1,988            | 15               | -99                        | -9                       | -1                  | 1,241        | 9            | 3,122          | 23 (N/A)                  | 0.1              | 0.1           | 5.85         |
| Willow                   | 940              | 7                | -213                       | -14                      | -2                  | 1,957        | 15           | 2,670          | 20 (N/A)                  | 0.1              | 0.0           | 5.01         |
| Black spruce             | 159              | 1                | -36                        | -7                       | 0                   | 561          | 4            | 677            | 5 (N/A)                   | 0.0              | 0.0           | 1.69         |
| River birch              | 1,126            | 8                | -154                       | -9                       | -1                  | 1,472        | 11           | 2,435          | 18 (N/A)                  | 0.0              | 0.0           | 6.09         |
| Broadleaf Deciduous Smal | 152              | 1                | -5                         | -2                       | 0                   | 161          | 1            | 306            | 2 (N/A)                   | 0.0              | 0.0           | 1.15         |
| Norway spruce            | 274              | 2                | -36                        | -4                       | 0                   | 349          | 3            | 583            | 4 (N/A)                   | 0.0              | 0.0           | 2.18         |
| Kentucky coffeetree      | 1,105            | 8                | -58                        | -5                       | 0                   | 834          | 6            | 1,876          | 14 (N/A)                  | 0.0              | 0.0           | 7.04         |
| American sycamore        | 1,391            | 10               | -457                       | -11                      | -4                  | 1,547        | 12           | 2,470          | 19 (N/A)                  | 0.0              | 0.0           | 9.26         |
| Amur corktree            | 482              | 4                | -19                        | -3                       | 0                   | 460          | 3            | 919            | 7 (N/A)                   | 0.0              | 0.0           | 3.45         |
| Broadleaf Evergreen Medi | 286              | 2                | -18                        | -4                       | 0                   | 776          | 6            | 1,040          | 8 (N/A)                   | 0.0              | 0.0           | 3.90         |
| Broadleaf Deciduous Medi | 772              | 6                | -35                        | -4                       | 0                   | 790          | 6            | 1,523          | 11 (N/A)                  | 0.0              | 0.0           | 5.71         |
| American chestnut        | 1,919            | 14               | -249                       | -9                       | -2                  | 1,300        | 10           | 2,962          | 22 (N/A)                  | 0.0              | 0.1           | 11.11        |
| Kwanzan cherry           | 228              | 2                | -9                         | -2                       | 0                   | 248          | 2            | 465            | 3 (N/A)                   | 0.0              | 0.0           | 1.74         |
| Mimosa                   | 38               | 0                | -1                         | -1                       | 0                   | 37           | 0            | 74             | 1 (N/A)                   | 0.0              | 0.0           | 0.55         |
| Scotch pine              | 116              | 1                | -6                         | -2                       | 0                   | 216          | 2            | 324            | 2 (N/A)                   | 0.0              | 0.0           | 2.43         |
| White oak                | 3                | 0                | 0                          | 0                        | 0                   | 4            | 0            | 7              | 0 (N/A)                   | 0.0              | 0.0           | 0.05         |
| Basswood                 | 209              | 2                | -5                         | -1                       | 0                   | 159          | 1            | 361            | 3 (N/A)                   | 0.0              | 0.0           | 2.71         |
| Eastern hophornbeam      | 268              | 2                | -15                        | -2                       | 0                   | 308          | 2            | 560            | 4 (N/A)                   | 0.0              | 0.0           | 4.20         |
| Ash                      | 370              | 3                | -69                        | -4                       | -1                  | 539          | 4            | 837            | 6 (N/A)                   | 0.0              | 0.0           | 6.27         |
| Dogwood                  | 38               | 0                | -1                         | -1                       | 0                   | 37           | 0            | 74             | 1 (N/A)                   | 0.0              | 0.0           | 0.55         |
| Citywide total           | 3,408,975        | 25,567           | -209,994                   | -15,540                  | -1,692              | 2,655,027    | 19,913       | 5,838,468      | 43,789 (N/A)              | 100.0            | 100.0         | 6.27         |

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

| <b>Annual Aesthetic/Other Benefits of Public Trees</b> |            |                |                  |               |              |
|--------------------------------------------------------|------------|----------------|------------------|---------------|--------------|
| 3/20/2015                                              |            |                |                  |               |              |
| Species                                                | Total (\$) | Standard Error | % of Total Trees | % of Total \$ | Avg. \$/tree |
| Norway maple                                           | 54,681     | (N/A)          | 23.6             | 15.6          | 33.20        |
| Green ash                                              | 61,920     | (N/A)          | 19.7             | 17.6          | 44.97        |
| Silver maple                                           | 70,796     | (N/A)          | 11.7             | 20.1          | 86.55        |
| Sugar maple                                            | 37,122     | (N/A)          | 10.7             | 10.6          | 49.50        |
| Northern hackberry                                     | 36,199     | (N/A)          | 9.5              | 10.3          | 54.60        |
| Pin oak                                                | 17,000     | (N/A)          | 3.0              | 4.8           | 82.52        |
| Littleleaf linden                                      | 11,188     | (N/A)          | 2.8              | 3.2           | 58.27        |
| American basswood                                      | 6,607      | (N/A)          | 2.1              | 1.9           | 44.05        |
| Honeylocust                                            | 25,709     | (N/A)          | 2.1              | 7.3           | 178.53       |
| Apple                                                  | 675        | (N/A)          | 1.9              | 0.2           | 5.11         |
| Black walnut                                           | 5,500      | (N/A)          | 1.7              | 1.6           | 46.61        |
| Northern red oak                                       | 2,278      | (N/A)          | 1.6              | 0.6           | 20.71        |
| Black maple                                            | 5,054      | (N/A)          | 1.4              | 1.4           | 53.20        |
| Maple                                                  | 535        | (N/A)          | 1.0              | 0.2           | 7.75         |
| Red maple                                              | 1,998      | (N/A)          | 1.0              | 0.6           | 28.96        |
| Bur oak                                                | 3,653      | (N/A)          | 0.9              | 1.0           | 56.20        |
| White ash                                              | 1,790      | (N/A)          | 0.7              | 0.5           | 38.09        |
| Catalpa                                                | 1,188      | (N/A)          | 0.4              | 0.3           | 45.71        |
| Spruce                                                 | 641        | (N/A)          | 0.3              | 0.2           | 27.85        |
| Mountain ash                                           | 116        | (N/A)          | 0.2              | 0.0           | 6.83         |
| Black poplar                                           | 958        | (N/A)          | 0.2              | 0.3           | 56.33        |
| Eastern red cedar                                      | 202        | (N/A)          | 0.2              | 0.1           | 13.50        |
| American elm                                           | 401        | (N/A)          | 0.2              | 0.1           | 28.66        |
| Northern pin oak                                       | 521        | (N/A)          | 0.2              | 0.1           | 37.23        |
| Ohio buckeye                                           | 353        | (N/A)          | 0.2              | 0.1           | 27.16        |
| Elm                                                    | 557        | (N/A)          | 0.2              | 0.2           | 46.38        |
| Black locust                                           | 422        | (N/A)          | 0.2              | 0.1           | 35.20        |
| Blue spruce                                            | 170        | (N/A)          | 0.2              | 0.0           | 14.16        |
| Amur maple                                             | 51         | (N/A)          | 0.1              | 0.0           | 5.14         |
| Chinese elm                                            | 404        | (N/A)          | 0.1              | 0.1           | 40.35        |
| Eastern white pine                                     | 238        | (N/A)          | 0.1              | 0.1           | 26.45        |
| Mulberry                                               | 26         | (N/A)          | 0.1              | 0.0           | 2.85         |
| Cherry plum                                            | 45         | (N/A)          | 0.1              | 0.0           | 5.04         |
| Cottonwood                                             | 495        | (N/A)          | 0.1              | 0.1           | 61.84        |
| Pear                                                   | 19         | (N/A)          | 0.1              | 0.0           | 2.38         |
| Siberian elm                                           | 227        | (N/A)          | 0.1              | 0.1           | 32.40        |
| Southern magnolia                                      | 22         | (N/A)          | 0.1              | 0.0           | 3.14         |
| Eastern redbud                                         | 28         | (N/A)          | 0.1              | 0.0           | 4.62         |
| Ginkgo                                                 | 116        | (N/A)          | 0.1              | 0.0           | 19.32        |
| Hickory                                                | 189        | (N/A)          | 0.1              | 0.1           | 31.44        |
| Swamp white oak                                        | 123        | (N/A)          | 0.1              | 0.0           | 20.48        |
| Black cherry                                           | 24         | (N/A)          | 0.1              | 0.0           | 4.74         |
| Quaking aspen                                          | 195        | (N/A)          | 0.1              | 0.1           | 38.94        |
| Northern white cedar                                   | 42         | (N/A)          | 0.1              | 0.0           | 10.59        |
| Boxelder                                               | 170        | (N/A)          | 0.1              | 0.0           | 42.43        |
| Willow                                                 | 86         | (N/A)          | 0.1              | 0.0           | 21.53        |
| Black spruce                                           | 32         | (N/A)          | 0.0              | 0.0           | 10.76        |
| River birch                                            | 102        | (N/A)          | 0.0              | 0.0           | 34.03        |
| Broadleaf Deciduous Small                              | 8          | (N/A)          | 0.0              | 0.0           | 4.23         |
| Norway spruce                                          | 33         | (N/A)          | 0.0              | 0.0           | 16.54        |
| Kentucky coffeetree                                    | 104        | (N/A)          | 0.0              | 0.0           | 51.77        |
| American sycamore                                      | 87         | (N/A)          | 0.0              | 0.0           | 43.45        |
| Amur corktree                                          | 52         | (N/A)          | 0.0              | 0.0           | 26.02        |
| Broadleaf Evergreen Medium                             | 70         | (N/A)          | 0.0              | 0.0           | 34.98        |
| Broadleaf Deciduous Medium                             | 78         | (N/A)          | 0.0              | 0.0           | 39.16        |
| American chestnut                                      | 133        | (N/A)          | 0.0              | 0.0           | 66.60        |
| Kwanzan cherry                                         | 13         | (N/A)          | 0.0              | 0.0           | 6.40         |
| Mimosa                                                 | 2          | (N/A)          | 0.0              | 0.0           | 2.06         |
| Scotch pine                                            | 32         | (N/A)          | 0.0              | 0.0           | 32.32        |
| White oak                                              | 5          | (N/A)          | 0.0              | 0.0           | 5.26         |
| Basswood                                               | 29         | (N/A)          | 0.0              | 0.0           | 28.56        |
| Eastern hophornbeam                                    | 15         | (N/A)          | 0.0              | 0.0           | 15.48        |
| Ash                                                    | 31         | (N/A)          | 0.0              | 0.0           | 31.46        |
| Dogwood                                                | 2          | (N/A)          | 0.0              | 0.0           | 2.06         |
| Citywide total                                         | 351,561    | (N/A)          | 100.0            | 100.0         | 50.36        |

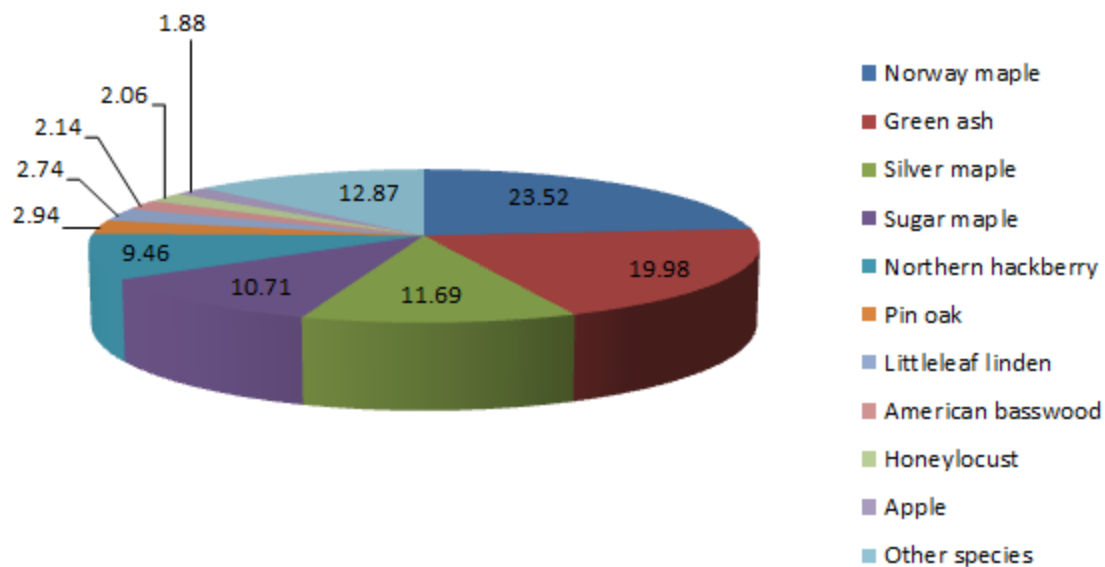
**Table 7: Summary of Benefits in Dollars**

Charles City

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

3/20/2015

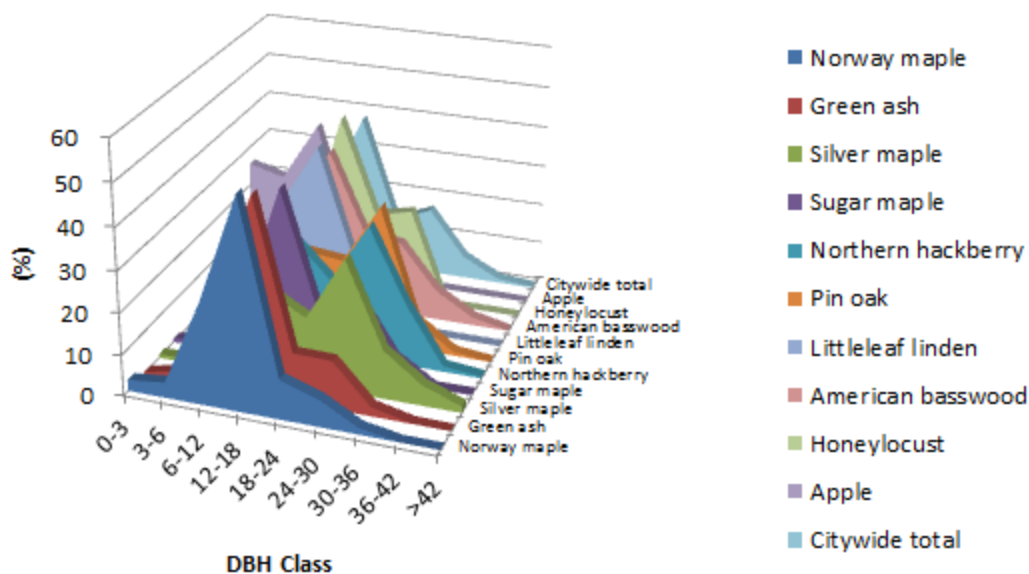
| Species                | Energy  | CO <sub>2</sub> | Air Quality | Stormwater | Aesthetic/Other | Total (\$)      | Standard Error | % of Total \$ |
|------------------------|---------|-----------------|-------------|------------|-----------------|-----------------|----------------|---------------|
| Norway maple           | 68,628  | 7,873           | 11,569      | 63,149     | 54,681          | 205,899 (N/A)   |                | 17.8          |
| Green ash              | 59,264  | 8,185           | 9,901       | 65,063     | 61,920          | 204,332 (N/A)   |                | 17.6          |
| Silver maple           | 48,037  | 8,865           | 8,478       | 78,941     | 70,796          | 215,116 (N/A)   |                | 18.6          |
| Sugar maple            | 36,048  | 4,534           | 5,703       | 42,622     | 37,122          | 126,029 (N/A)   |                | 10.9          |
| Northern hackberry     | 46,561  | 4,524           | 8,083       | 52,306     | 36,199          | 147,672 (N/A)   |                | 12.7          |
| Pin oak                | 11,380  | 2,140           | 1,494       | 13,847     | 17,000          | 45,861 (N/A)    |                | 4.0           |
| Littleleaf linden      | 7,173   | 1,179           | 1,179       | 7,800      | 11,188          | 28,519 (N/A)    |                | 2.5           |
| American basswood      | 7,348   | 1,018           | 1,107       | 8,100      | 6,607           | 24,180 (N/A)    |                | 2.1           |
| Honeylocust            | 8,321   | 1,316           | 1,381       | 9,516      | 25,709          | 46,243 (N/A)    |                | 4.0           |
| Apple                  | 1,771   | 183             | 268         | 758        | 675             | 3,654 (N/A)     |                | 0.3           |
| Black walnut           | 5,343   | 737             | 898         | 6,315      | 5,500           | 18,793 (N/A)    |                | 1.6           |
| Northern red oak       | 4,384   | 454             | 631         | 5,054      | 2,278           | 12,802 (N/A)    |                | 1.1           |
| Black maple            | 4,542   | 552             | 825         | 4,790      | 5,054           | 15,763 (N/A)    |                | 1.4           |
| Maple                  | 514     | 51              | 74          | 306        | 535             | 1,480 (N/A)     |                | 0.1           |
| Red maple              | 1,722   | 198             | 283         | 1,381      | 1,998           | 5,583 (N/A)     |                | 0.5           |
| Bur oak                | 4,379   | 586             | 827         | 7,640      | 3,653           | 17,086 (N/A)    |                | 1.5           |
| White ash              | 1,173   | 158             | 187         | 1,084      | 1,790           | 4,392 (N/A)     |                | 0.4           |
| Catalpa                | 1,217   | 167             | 214         | 1,710      | 1,188           | 4,496 (N/A)     |                | 0.4           |
| Spruce                 | 473     | 46              | 46          | 869        | 641             | 2,074 (N/A)     |                | 0.2           |
| Mountain ash           | 296     | 32              | 48          | 133        | 116             | 625 (N/A)       |                | 0.1           |
| Black poplar           | 984     | 137             | 168         | 1,367      | 958             | 3,614 (N/A)     |                | 0.3           |
| Eastern red cedar      | 303     | 20              | 25          | 532        | 202             | 1,083 (N/A)     |                | 0.1           |
| American elm           | 429     | 43              | 69          | 439        | 401             | 1,381 (N/A)     |                | 0.1           |
| Northern pin oak       | 672     | 76              | 114         | 677        | 521             | 2,060 (N/A)     |                | 0.2           |
| Ohio buckeye           | 354     | 43              | 54          | 250        | 353             | 1,055 (N/A)     |                | 0.1           |
| Elm                    | 549     | 76              | 94          | 669        | 557             | 1,945 (N/A)     |                | 0.2           |
| Black locust           | 719     | 72              | 131         | 906        | 422             | 2,250 (N/A)     |                | 0.2           |
| Blue spruce            | 137     | 11              | 15          | 204        | 170             | 537 (N/A)       |                | 0.0           |
| Amur maple             | 138     | 14              | 20          | 56         | 51              | 280 (N/A)       |                | 0.0           |
| Chinese elm            | 380     | 53              | 63          | 441        | 404             | 1,340 (N/A)     |                | 0.1           |
| Eastern white pine     | 181     | 17              | 19          | 312        | 238             | 767 (N/A)       |                | 0.1           |
| Mulberry               | 258     | 16              | 44          | 156        | 26              | 500 (N/A)       |                | 0.0           |
| Cherry plum            | 114     | 12              | 18          | 49         | 45              | 239 (N/A)       |                | 0.0           |
| Cottonwood             | 595     | 80              | 113         | 1,058      | 495             | 2,341 (N/A)     |                | 0.2           |
| Pear                   | 55      | 5               | 8           | 21         | 19              | 108 (N/A)       |                | 0.0           |
| Siberian elm           | 303     | 36              | 53          | 340        | 227             | 958 (N/A)       |                | 0.1           |
| Southern magnolia      | 42      | 3               | 5           | 27         | 22              | 100 (N/A)       |                | 0.0           |
| Eastern redbud         | 79      | 8               | 11          | 31         | 28              | 156 (N/A)       |                | 0.0           |
| Ginkgo                 | 260     | 26              | 48          | 240        | 116             | 691 (N/A)       |                | 0.1           |
| Hickory                | 147     | 20              | 22          | 122        | 189             | 500 (N/A)       |                | 0.0           |
| Swamp white oak        | 129     | 16              | 21          | 97         | 123             | 386 (N/A)       |                | 0.0           |
| Black cherry           | 60      | 6               | 9           | 26         | 24              | 125 (N/A)       |                | 0.0           |
| Quaking aspen          | 174     | 24              | 28          | 152        | 195             | 573 (N/A)       |                | 0.0           |
| Northern white cedar   | 29      | 2               | 3           | 35         | 42              | 112 (N/A)       |                | 0.0           |
| Boxelder               | 155     | 23              | 25          | 180        | 170             | 552 (N/A)       |                | 0.0           |
| Willow                 | 259     | 20              | 47          | 338        | 86              | 751 (N/A)       |                | 0.1           |
| Black spruce           | 72      | 5               | 8           | 149        | 32              | 266 (N/A)       |                | 0.0           |
| River birch            | 188     | 18              | 35          | 242        | 102             | 586 (N/A)       |                | 0.1           |
| Broadleaf Deciduous Sn | 24      | 2               | 3           | 9          | 8               | 47 (N/A)        |                | 0.0           |
| Norway spruce          | 44      | 4               | -1          | 131        | 33              | 211 (N/A)       |                | 0.0           |
| Kentucky coffeetree    | 102     | 14              | 17          | 110        | 104             | 346 (N/A)       |                | 0.0           |
| American sycamore      | 190     | 19              | 42          | 392        | 87              | 729 (N/A)       |                | 0.1           |
| Amur corktree          | 56      | 7               | 9           | 43         | 52              | 166 (N/A)       |                | 0.0           |
| Broadleaf Evergreen Me | 83      | 8               | 11          | 96         | 70              | 268 (N/A)       |                | 0.0           |
| Broadleaf Deciduous Mi | 94      | 11              | 16          | 76         | 78              | 276 (N/A)       |                | 0.0           |
| American chestnut      | 164     | 22              | 31          | 298        | 133             | 648 (N/A)       |                | 0.1           |
| Kwanzan cherry         | 36      | 3               | 5           | 14         | 13              | 72 (N/A)        |                | 0.0           |
| Mimosa                 | 5       | 1               | 1           | 2          | 2               | 11 (N/A)        |                | 0.0           |
| Scotch pine            | 24      | 2               | 3           | 42         | 32              | 103 (N/A)       |                | 0.0           |
| White oak              | 1       | 0               | 0           | 0          | 5               | 7 (N/A)         |                | 0.0           |
| Basswood               | 21      | 3               | 3           | 16         | 29              | 71 (N/A)        |                | 0.0           |
| Eastern hophornbeam    | 38      | 4               | 7           | 18         | 15              | 82 (N/A)        |                | 0.0           |
| Ash                    | 71      | 6               | 14          | 102        | 31              | 224 (N/A)       |                | 0.0           |
| Dogwood                | 5       | 1               | 1           | 2          | 2               | 11 (N/A)        |                | 0.0           |
| Citywide Total         | 327,297 | 43,789          | 54,628      | 381,850    | 351,561         | 1,159,125 (N/A) |                | 100.0         |



| <b>Charles City</b>                             |               |
|-------------------------------------------------|---------------|
| <b>Species Distribution of Public Trees (%)</b> |               |
| <b>3/6/2015</b>                                 |               |
| Species                                         | Percent       |
| Norway maple                                    | 23.52         |
| Green ash                                       | 19.98         |
| Silver maple                                    | 11.69         |
| Sugar maple                                     | 10.71         |
| Northern hackberry                              | 9.46          |
| Pin oak                                         | 2.94          |
| Littleleaf linden                               | 2.74          |
| American basswood                               | 2.14          |
| Honeylocust                                     | 2.06          |
| Apple                                           | 1.88          |
| Other species                                   | 12.87         |
| <b>Total</b>                                    | <b>100.00</b> |

**Figure 1: Species Distribution**

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



|                                                             |                |       |       |       |       |       |       |       |      |
|-------------------------------------------------------------|----------------|-------|-------|-------|-------|-------|-------|-------|------|
| Charles City                                                |                |       |       |       |       |       |       |       |      |
| Relative Age Distribution of Top 10 Public Tree Species (%) |                |       |       |       |       |       |       |       |      |
| 3/6/2015                                                    |                |       |       |       |       |       |       |       |      |
|                                                             | DBH class (in) |       |       |       |       |       |       |       |      |
| Species                                                     | 0-3            | 3-6   | 6-12  | 12-18 | 18-24 | 24-30 | 30-36 | 36-42 | >42  |
| Norway maple                                                | 2.73           | 3.76  | 24.88 | 50.79 | 9.65  | 6.61  | 1.58  | 0.00  | 0.00 |
| Green ash                                                   | 0.43           | 2.50  | 23.71 | 47.43 | 11.86 | 11.71 | 2.21  | 0.14  | 0.00 |
| Silver maple                                                | 0.85           | 1.10  | 9.77  | 21.49 | 16.48 | 31.99 | 11.72 | 5.01  | 1.59 |
| Sugar maple                                                 | 0.93           | 2.13  | 14.67 | 42.40 | 13.87 | 19.60 | 6.00  | 0.13  | 0.27 |
| Northern hackberry                                          | 0.00           | 0.15  | 5.13  | 27.00 | 18.10 | 32.73 | 15.08 | 1.36  | 0.45 |
| Pin oak                                                     | 0.00           | 2.91  | 15.05 | 20.39 | 19.42 | 33.98 | 7.28  | 0.97  | 0.00 |
| Littleleaf linden                                           | 0.00           | 1.04  | 28.13 | 42.71 | 16.15 | 11.98 | 0.00  | 0.00  | 0.00 |
| American basswood                                           | 0.00           | 0.00  | 14.67 | 38.67 | 19.33 | 18.00 | 7.33  | 2.00  | 0.00 |
| Honeylocust                                                 | 0.00           | 0.00  | 12.50 | 43.75 | 20.83 | 22.92 | 0.00  | 0.00  | 0.00 |
| Apple                                                       | 25.76          | 23.48 | 37.88 | 11.36 | 1.52  | 0.00  | 0.00  | 0.00  | 0.00 |
| Citywide total                                              | 2.54           | 3.70  | 19.47 | 38.01 | 12.85 | 16.67 | 5.51  | 0.98  | 0.27 |

Figure 2: Relative Age Class

### Citywide total

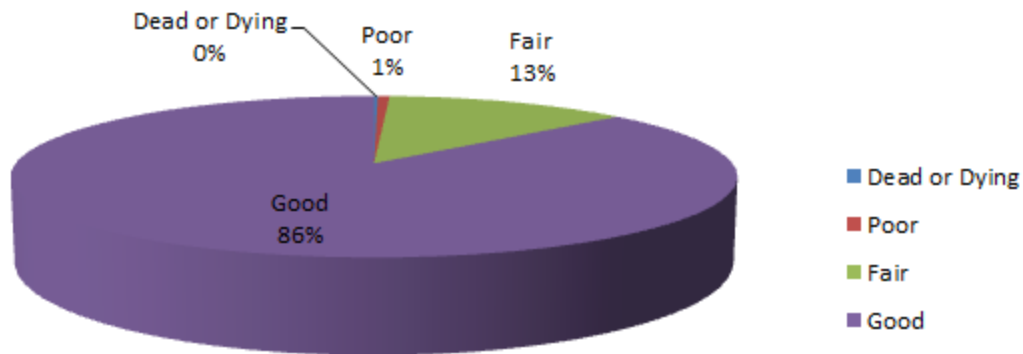


Figure 3: Foliage Condition

### Citywide total

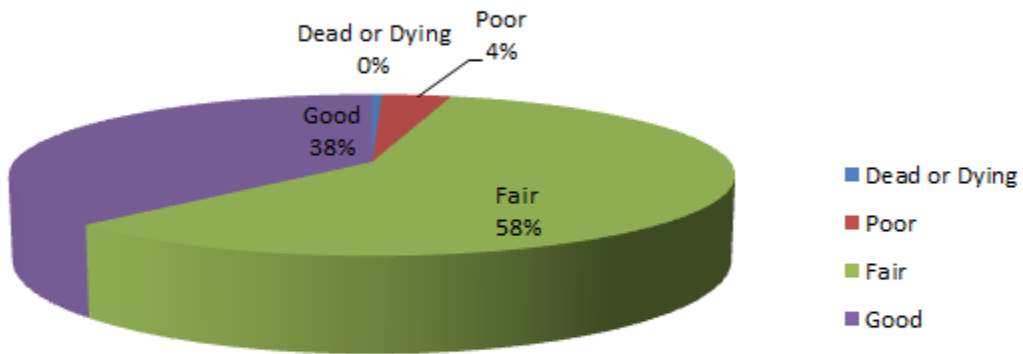
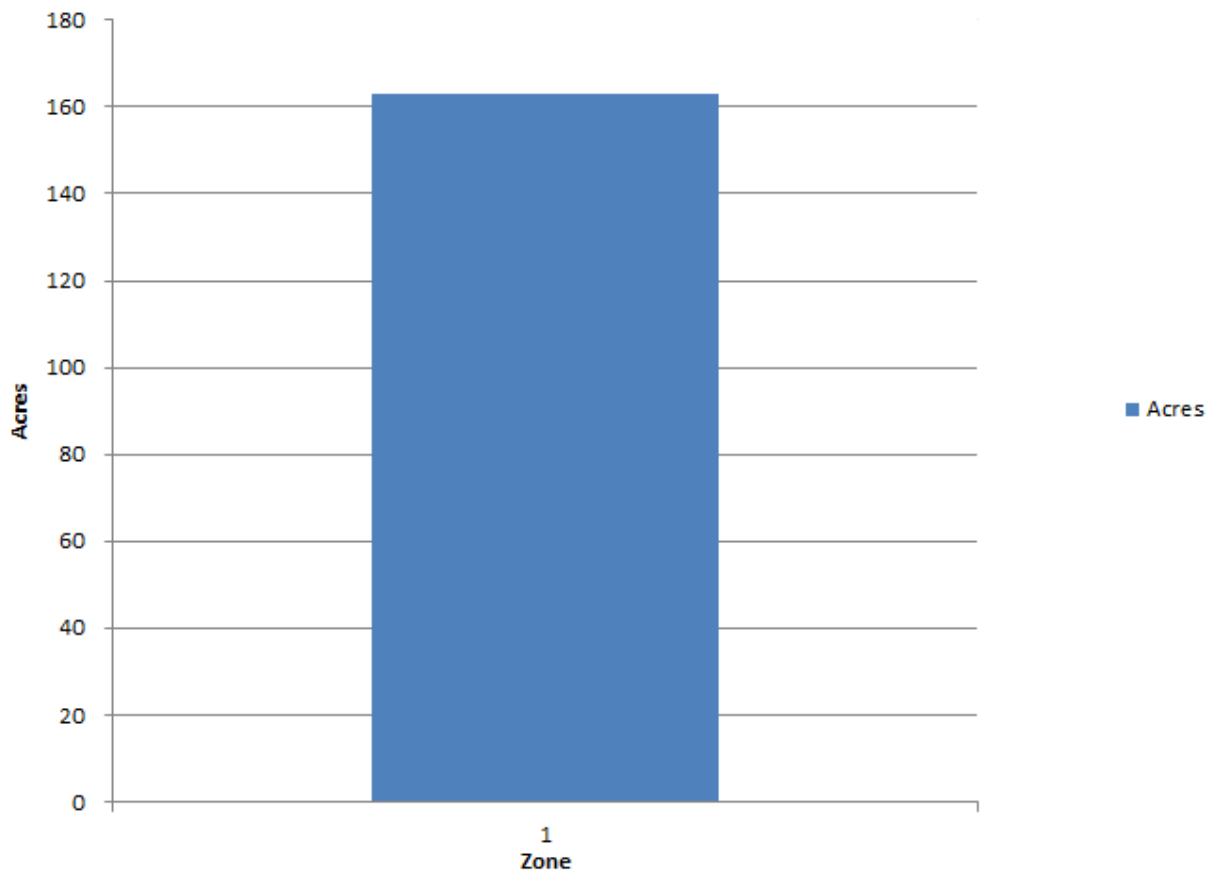


Figure 4: Wood Condition



| Zone           | Acres  | % of<br>Total<br>Canopy |
|----------------|--------|-------------------------|
| 1              | 163.15 | 100.00                  |
| Citywide total | 163.15 | 100.00                  |

**Figure 5: Canopy Cover in Acres**

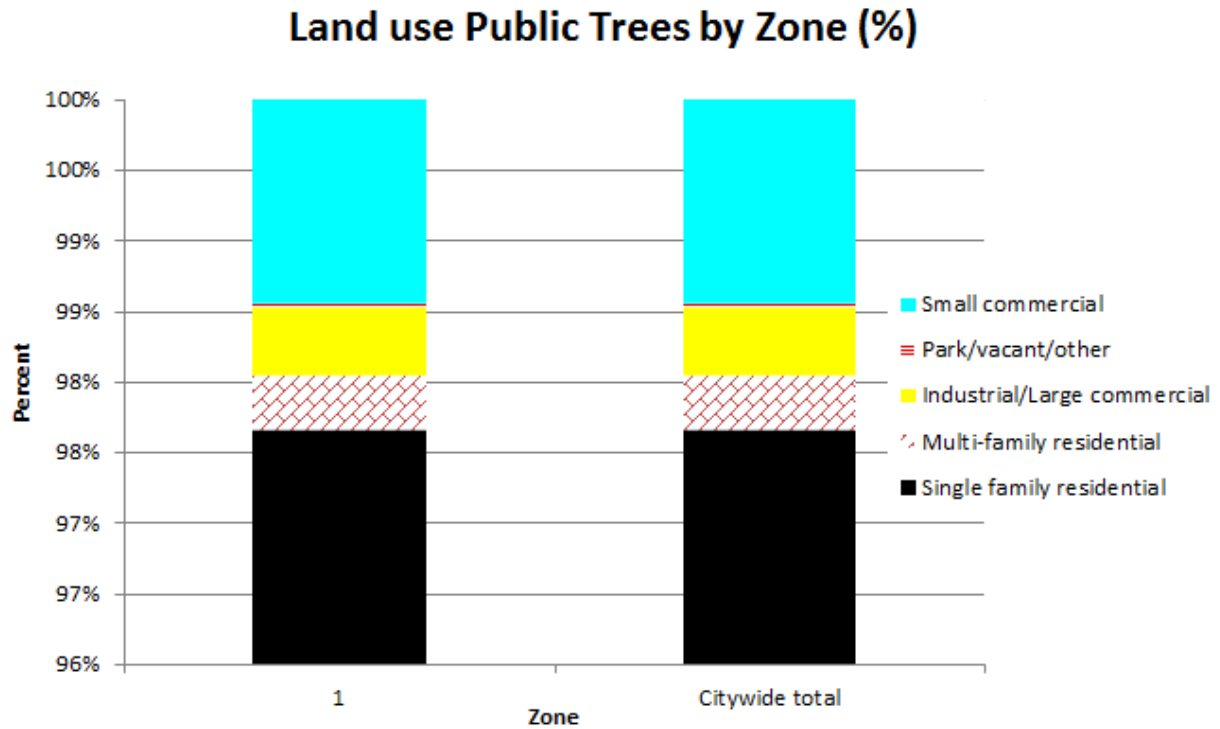


Figure 6: Land Use of city/park trees

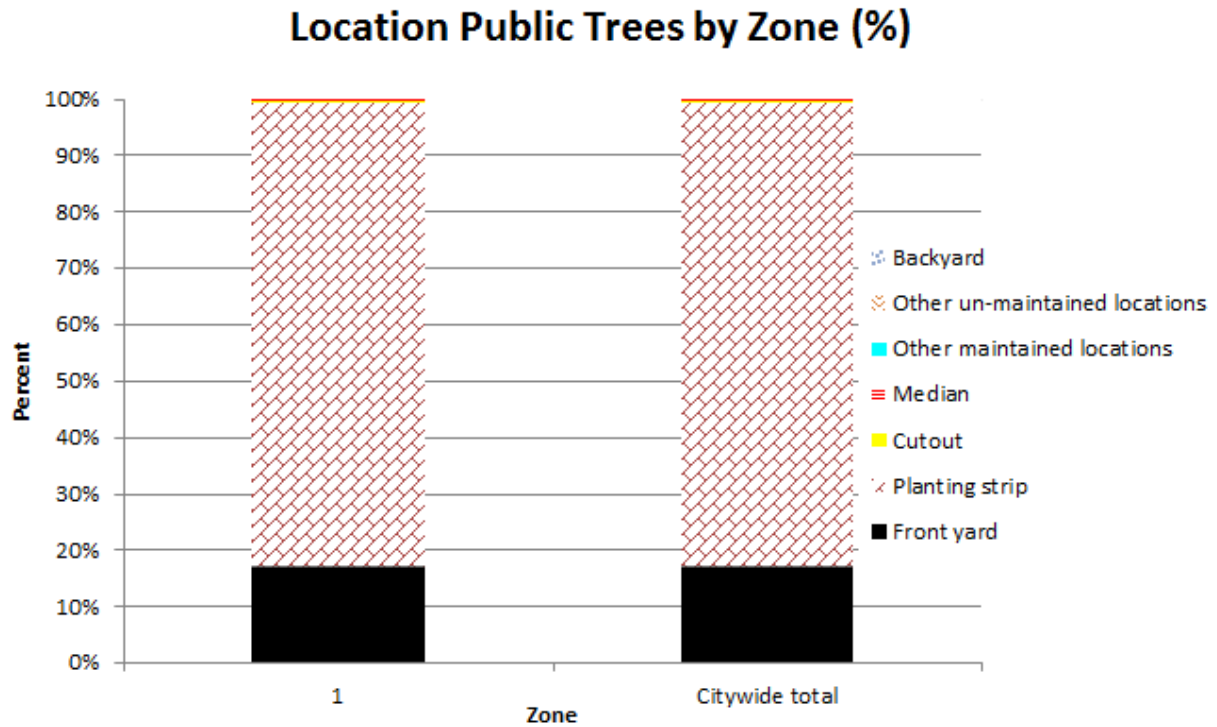


Figure 7: Location of city/park trees

## Appendix B: ArcGIS Mapping

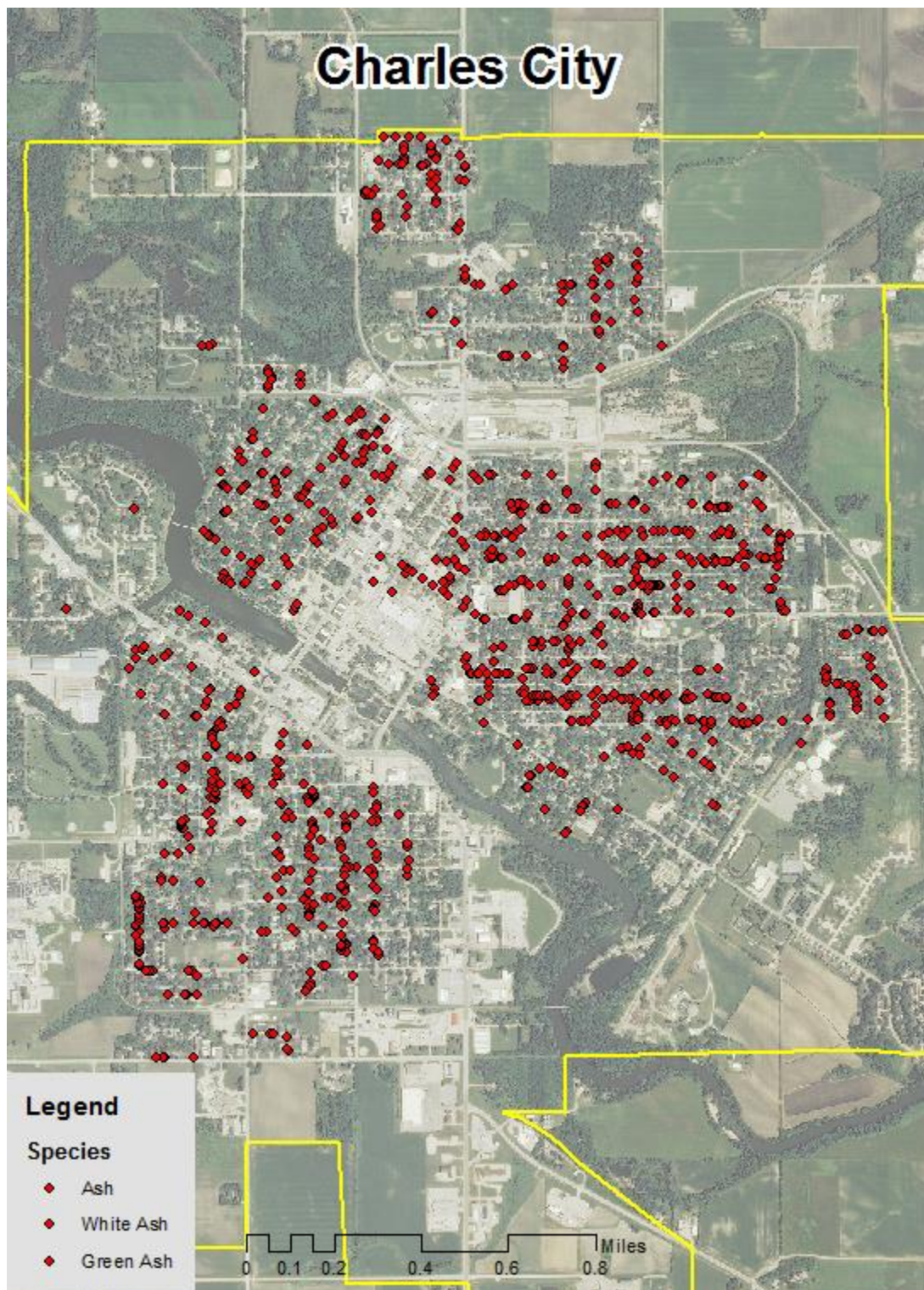


Figure 1: Location of Ash Trees

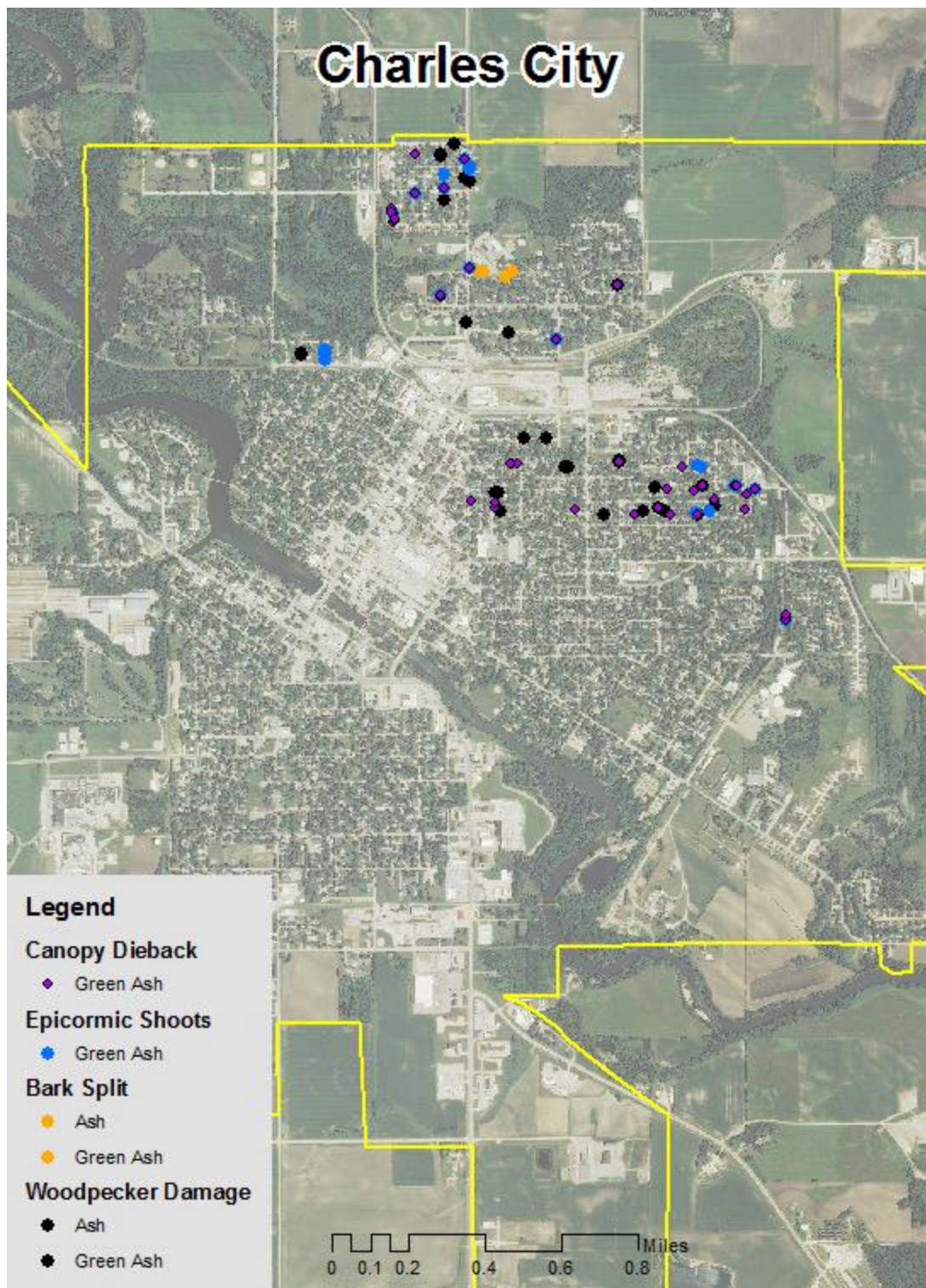


Figure 2: Location of EAB symptoms

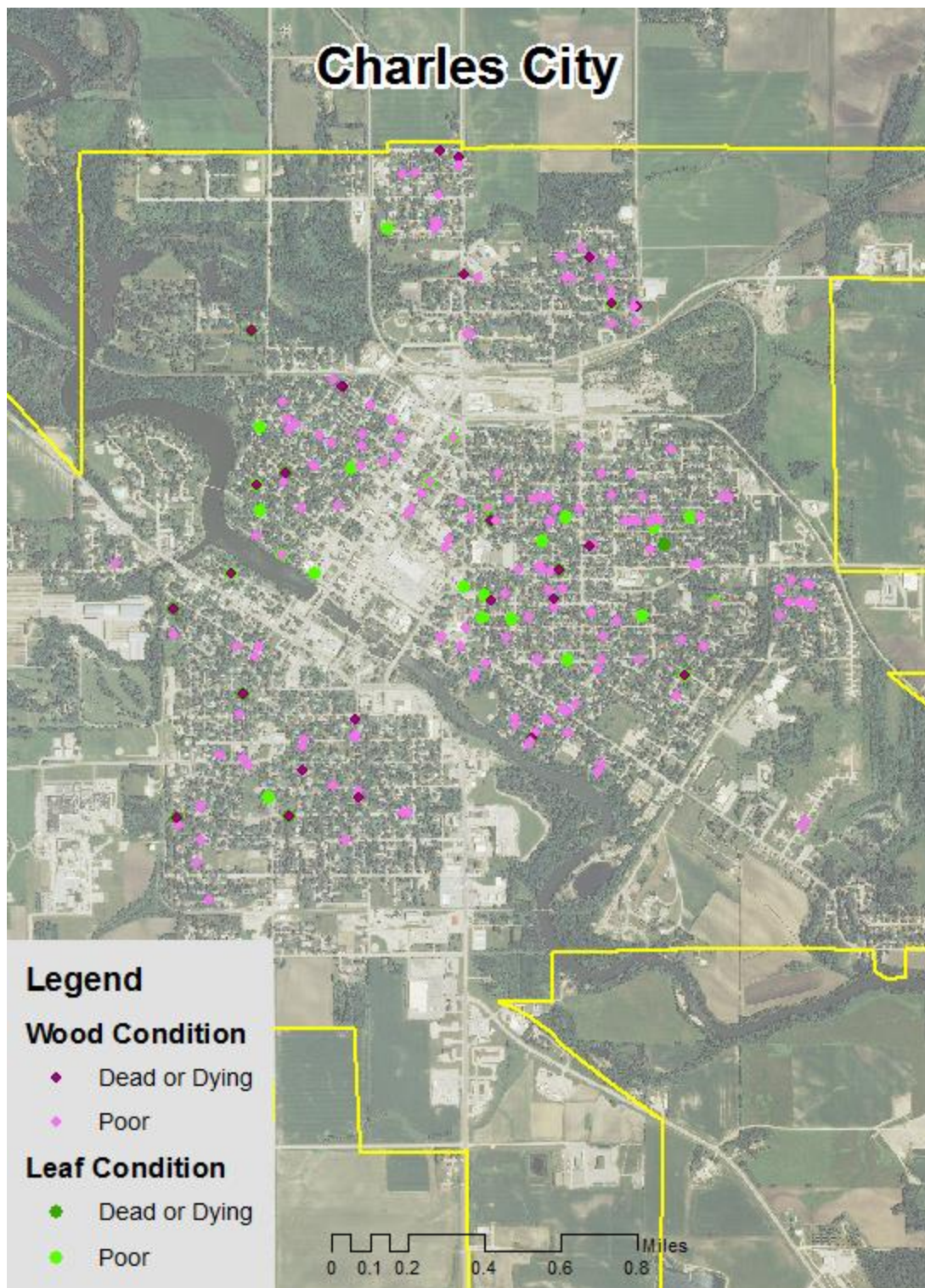


Figure 3: Location of Poor Condition Trees

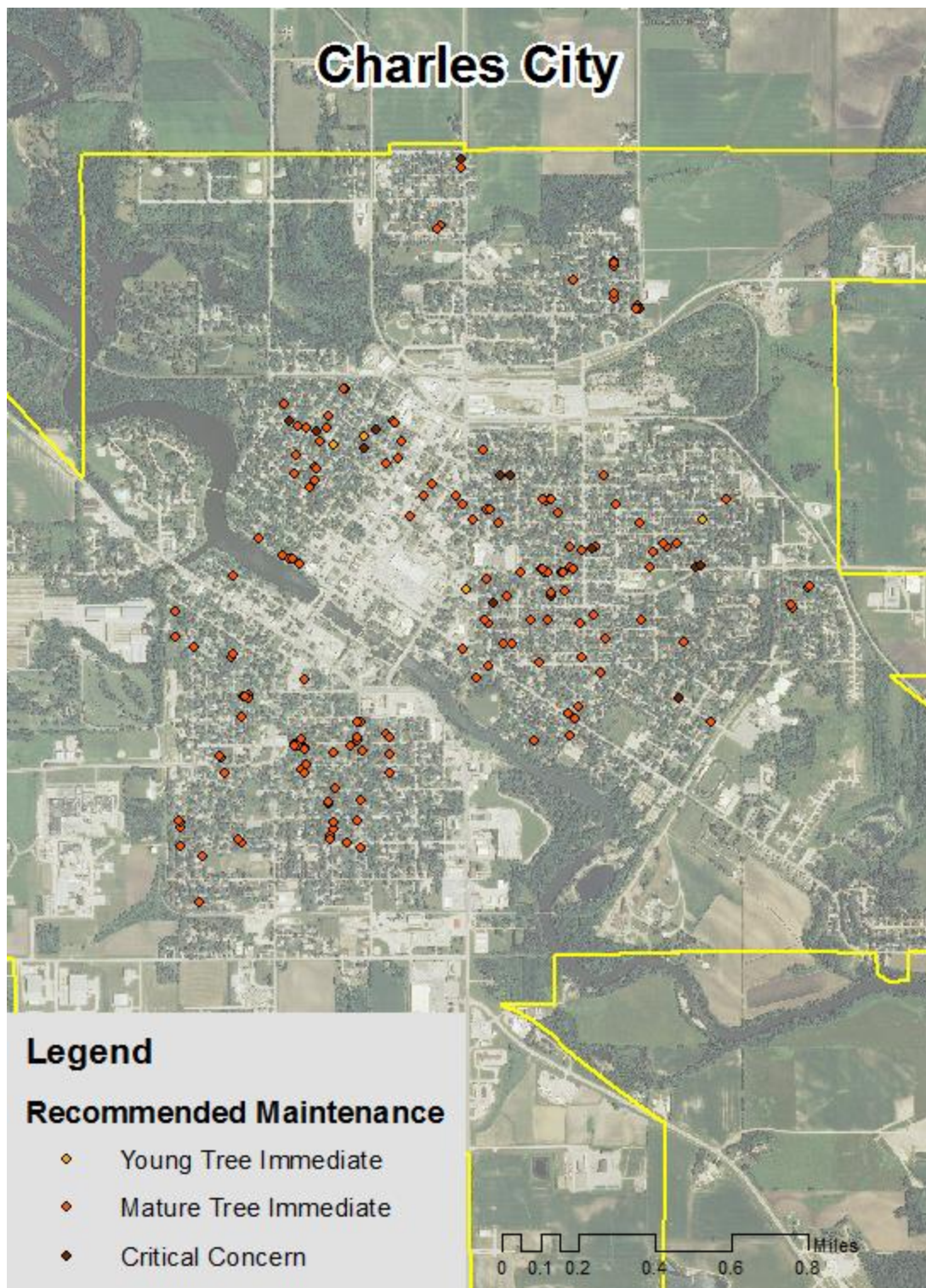


Figure 4: Location of Trees with Recommended Maintenance

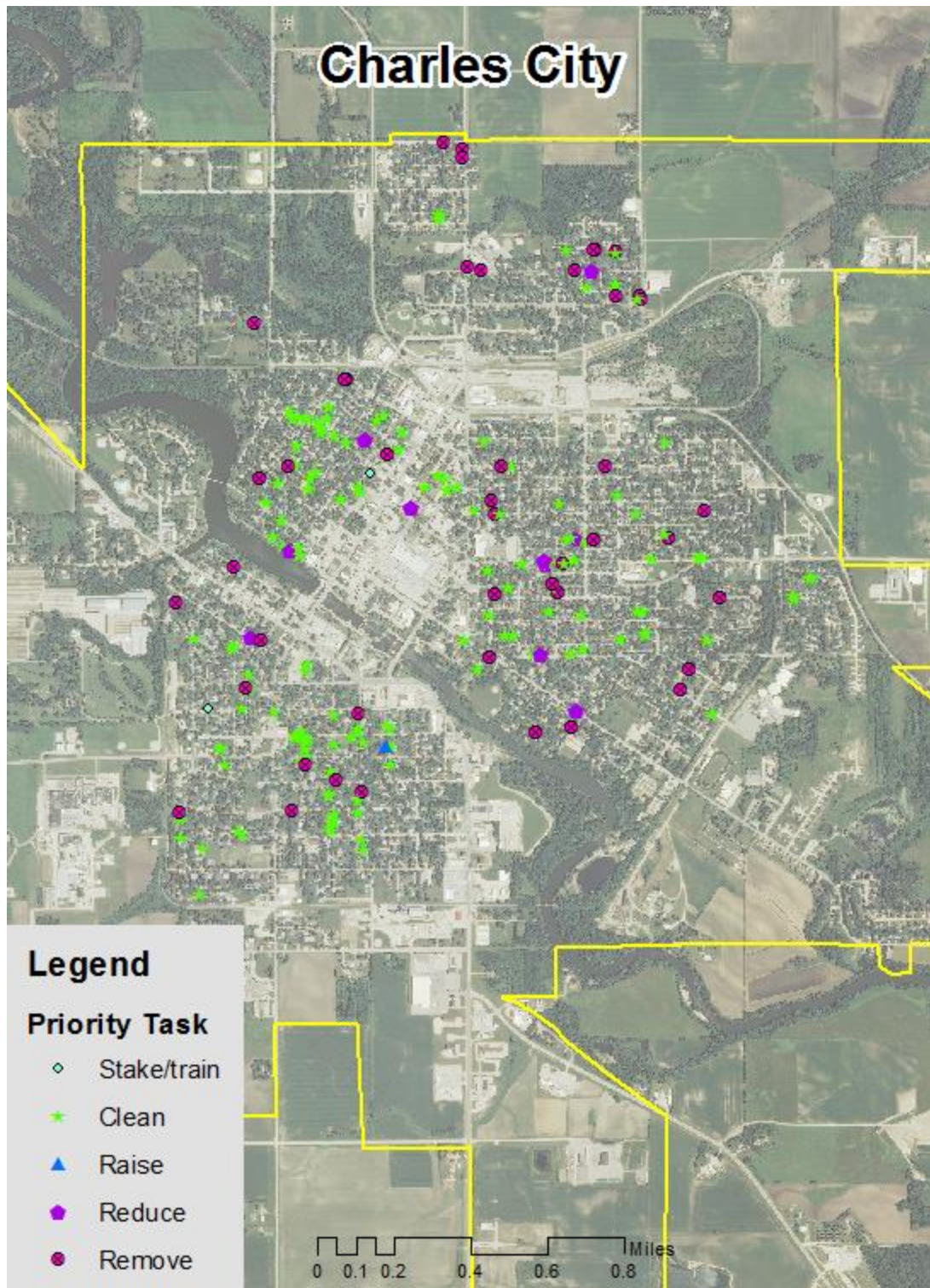


Figure 5: Maintenance Tasks \*City ownership of the trees recommended for removal should be verified prior to any removal\*

## Appendix C: Charles City Tree Ordinances

### CHAPTER 151

#### TREES

151.01 Definition  
151.02 Planting Restrictions  
151.03 Duty to Trim Trees

151.04 Trimming Trees for Safety  
151.05 Disease Control  
151.06 Inspection and Removal

**151.01 DEFINITION.** For use in this chapter, “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.

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

1. **Alignment.** All trees 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 nine (9) 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 thirty (30) 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, box elder, Chinese elm, evergreen, willow or black walnut.

**151.03 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. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

*(Code of Iowa, Sec. 364.12[2c, d & e])*

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**151.04 TRIMMING TREES FOR SAFETY.** The City may trim any tree located on the parking if the tree is creating a public hazard.

**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])*

[The next page is 791]

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