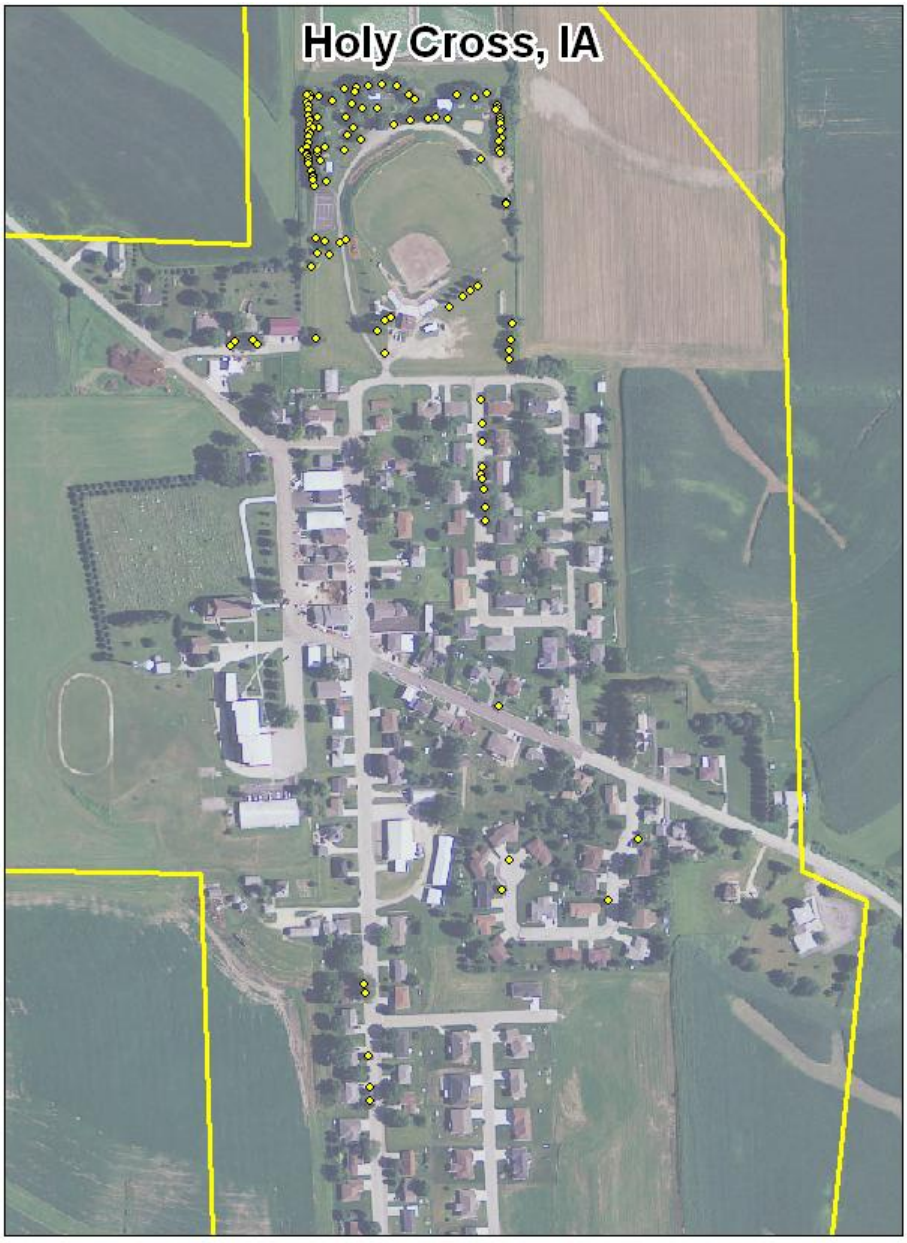
# HOLY CROSS, IA




## 2012 Management Plan

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# Executive Summary

**Overview:**

This plan was developed to assist the City of Holy Cross with help in managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows communities 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 that kills all species of native ash trees. There is a strong possibility that over 10% of Holy Cross's city-managed ash trees could die once EAB becomes established in the community. With proper planning and management, the costs of removing dead and dying trees can be extended over several years mitigating public safety issues.

**Inventory and Results:**

In the summer of 2011, a street tree inventory was conducted using an integrated Global Positioning System (GPS) data collector. This involved a complete inventory of street trees within the City's Right-of-Way and some parkland. Below are some key findings of the 119 trees inventoried.

- Holy Cross street trees provide roughly $14,261 of annual benefits, an average of $120 per tree.
- The top three species groups are: Pine (33%), Maples (23%) and Ash (17%).
- Approximately 9% of trees are in need of some type of management.
- For various reasons, 3 trees are recommended for removal.

**Recommendations:**

The core recommendations are described in detail in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations, as well. Below are some key recommendations.

- One of the 20 ash trees inventoried one is in need of follow up checking because it displays some signs and symptoms associated with EAB.
- All trees should be pruned on a routine schedule- one third of the city every other year.
- Plant a diverse mix of trees that *does not include*: ash, soft maple, autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar and tree-of-heaven.
- Check ash trees with a visual survey yearly.

# Introduction

This plan was developed to assist Holy Cross with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with a great proportion 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 Holy Cross, these costs can be extended over several years and public safety issues from dead and dying ash trees can be mitigated.

Trees are an important component of Holy Cross's infrastructure and are one of the greatest assets to the community. Through research, it has been shown that trees provide a community with numerous public benefits including: improved air quality, storm water runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and creating a desirable place to live. It is essential that these benefits be maintained for the people of Holy Cross and future generations through sound urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential start to developing management strategies is to have a comprehensive public tree inventory. This inventory supplies information that can be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Holy Cross's urban forestry goals.

# Inventory

In the summer of 2011, a tree inventory was conducted that included the city-owned street trees and some park trees. The tree data was collected using a handheld Global Positioning System (GPS) receiver/data logger. This devise records Geographic Information System (GIS) coordinates with an accuracy of 3 meters. The data can then 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 collector was written to be compatible with a state-of-the-art software suite called i-Tree. This software was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. This software is in the public domain and can be accessed for free.

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

# Inventory Results

The data collected by the data loggers was downloaded and analyzed by software developed by the USDA Forest service called *Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM)*. This is software is also part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis of Holy Cross's inventory data.

## ***Annual Benefits***

**Annual Energy Benefits:**

Trees conserve energy by shading buildings and blocking winds. Holy Cross's trees reduce energy related costs by approximately $3,623 annually (Appendix A, Table 1). These savings are both in Electricity (17.9 MWh) and in Natural Gas (2,314 Therms).

**Annual Storm water Benefits:**

Holy Cross's trees intercept about 172,040 gallons of rainfall and snow melt per year (Appendix A, Table 2). This interception provides $4,663 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 that emit volatile organic matter (ozone). In Holy Cross, it is estimated that trees remove 200 lbs. of air pollution (ozone ($O_3$), particulate matter less than 10 microns ($PM_{10}$), carbon monoxide (CO), nitrogen dioxide ($NO_2$), and sulfur dioxide ($SO_2$)) per year with a net value of $543 (Appendix A, Table 3).

**Annual Carbon Benefits:**

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. Of the 119 trees inventoried, the amount of carbon stored amounts to approximately 362,624 total lbs of $CO_2$ (Appendix A, Table 4). Those trees are sequestering about 34,833 lbs of carbon per year (Appendix A, Table 5). The benefits these trees provide from summer shading and from reductions in household wind infiltration in the winter result in approximately 29,962 fewer lbs of $CO_2$ being released into the atmosphere (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. Holy Cross receives approximately $4,947 in annual social benefits from its street trees (Appendix A, Table 6).

**Financial Summary of all Benefits:**

According to the USDA Forest Service i-Tree STRATUM analysis, Holy Cross's trees provide $14,261 of benefits annually. Benefits of individual trees vary based on size, species, health and location. On average, each of the 119 trees in Holy Cross's inventory provides approximately $120 annually (Appendix A, Table 7).

## ***Forest Structure***

**Species Distribution:**

There were at the very lease 21 different tree species surveyed. The distribution of trees by genus is as follows:

| Genus | # of trees | % of total |
|---|---|---|
| Pine (*Pinus*) | 39 | 32.8% |
| Maple (*acer*) | 27 | 22.7% |
| Ash (*fraxius*) | 20 | 16.8% |
| Spruce (*picea*) | 11 | 9.2% |
| Walnut (*juglans*) | 5 | 4.2% |
| Honeylocust (*gleditsia*) | 4 | 3.4% |
| Cherry (*prunus*) | 4 | 3.4% |
| Linden (*tilia*) | 3 | 2.5% |
| Oak (*quercus*) | 3 | 2.5% |
| Arborvitae (*Thuja*) | 3 | 2.5% |
| | 119 | 100.0% |

**Size Distribution:**

The table below summarizes distribution of surveyed trees by their diameter in inches when measured at 4.5 above the ground. The abundance of many trees in the 6 to 18 inch range reflects the many trees that were planted all at once in the City Park. See Appendix A, Figure 2 for a breakdown of size distributions by species.

| Size Classes (inches of diameter at 4.5 feet) | # of trees | % of trees |
|---|---|---|
| 0 - 3 | 4 | 3.4% |
| 3 - 6 | 7 | 5.9% |
| 6 - 12 | 36 | 30.3% |
| 12 - 18 | 53 | 44.5% |
| 18 - 24 | 12 | 10.1% |
| 24 - 30 | 4 | 3.4% |
| 30 - 36 | 3 | 2.5% |
| | 119 | 100.0% |

**Condition: Foliage and Wood:**

Leaf condition is a good indicator of the overall health of urban trees. The foliage condition results for Holy Cross indicated that 83% of the trees were in good health, 15% in fair health, 2% in poor health and <1% dead or dying. (Appendix A, Figure 3). Leaf health is largely a function of climatic factors during the growing season which affect the ability of diseases to take hold. This year was not too cool or too wet, therefore, leaf diseases were not so much an issue.

The condition of the wood in urban trees is another important indicator of tree health. The wood forms the structural support system for the leaves and branches. Extensive decay in the main stem makes a tree structurally unsafe which leads to a tree becoming a safety hazard. In Holy Cross, 83% of the surveyed trees were in good health, 12% in fair health, 5% in poor health and <1% dead or dying. (Appendix A, Figure 4). The 5% in poor condition should be assessed more carefully. Some of these trees with poor wood condition are being recommended for removal due to public safety concerns.

**Management Needs:**

Each surveyed tree was assessed for recommended maintenance needs. The following tables list the specific management needs and recommendations. (See Appendix B, figure 5).

| Priority Task | # of trees | % of trees |
|---|---|---|
| none | 108 | 90.8% |
| stake/train | 2 | 1.7% |
| clean | 2 | 1.7% |
| raise | 4 | 3.4% |
| remove | 3 | 2.5% |
| | 119 | 100.0% |

| Maintenance Recommendation | # of trees | % of trees |
|---|---|---|
| None | 107 | 89.9% |
| young tree (routine) | 4 | 3.4% |
| mature tree (routine) | 8 | 6.7% |
| | 119 | 100.0% |

**Land Use and Location**:

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

| Land Use | |
|---|---|
| Park/vacant/other | 80% |
| Single family residential | 20% |

| Location | |
|---|---|
| Other maintained locations (e.g. parks) | 80% |
| Planting strip | 1% |
| Front yard | 16% |
| Back yard | 1% |
| Other unmaintained locations | 2% |

# Recommendations

**Risk Management:**

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have 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**:

A total of 3 trees are recommended for removal for one reason or another. All 3 had poor wood condition or showed signs of severe decay. These trees could break off or topple over in storms or under ice and snow loads.

**Pruning Cycle:**

Proper pruning can extend the life and improve the overall health of trees, and can reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning (stake/train), crown cleaning (clean), crown raising (raise), and crown reduction (reduce). 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. Staking and training is recommended for younger trees so they can develop good architecture. It is recommended that all trees be pruned on a routine schedule every five to seven years.

| Priority Task | # of trees | % of trees |
|---|---|---|
| none | 108 | 90.8% |
| stake/train | 2 | 1.7% |
| clean | 2 | 1.7% |
| raise | 4 | 3.4% |
| remove | 3 | 2.5% |
| | 119 | 100.0% |

**Planting:**

Most of the planting over the next six years should replace the trees that are recommended for removal. It is recommended to plant two trees for every tree removed since survival rates will not be 100%. It is not essential that the new trees be planted in the same location as the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Holy Cross.

Since most insects and diseases target a particular genus (e.g. ash) or species (e.g. green ash) of trees, it is important to always plant a diverse mix of species. Current diversity recommendations advise that any genus (e.g. maple, oak or ash) not make up more than 20% of the urban forest. Any single species (e.g. silver maple, sugar maple, white oak or bur oak) not make up more than 10% of the total urban forest. Presently, the forest is heavily planted with Pine 33% and Maple at 23% (Appendix A, Figure 1). These two species groups should not be planted until these percentages fall below 20%. 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: Autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, and willow.

**Continual Monitoring:**

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

# Emerald Ash Borer (EAB) Plan

**EAB Quarantines:**

EAB is an extremely destructive plant pest and it is responsible for the death and decline of many millions ash trees throughout the Eastern United States and Canada. Ash in both forestlands and urban settings constitutes a very significant portion of the canopy cover. 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 its spread beyond its known locations by regulating articles.

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

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

**Wood Disposal:**

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

**Canopy Replacement:**

As your budget permits, all removed ash trees should be replaced. All trees should meet the restrictions in your city's ordinance (Appendix C). The new plantings should be a diverse mix and should not include ash, Autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, or willow.

**Private Ash Trees:**

It is strongly recommended that private property owners start removing ash trees on their property as trees are infested with Emerald Ash Borer. Trees that are on private property are part of Holy Cross's urban forest. Private property owners should be given direction to the proper species to plant, spacing, and location. Holy Cross has a city ordinance for trees.

## Budget Recommendations

EAB could potentially kill all of the ash trees in Holy Cross within a decade after its arrival. It is recommended that the City apply for grants to fund replacement tree planting. 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. Most of the 20 ash trees surveyed were located in the City Park. We recommend that about 1/3 (7 trees) of them be removed and replaced over the next 6 years. You should replant 2 trees for everyone removed. Remove ash trees where they occur in groups throughout the park (Appendix B, Figure 1). We also recommend that the City adopt a policy of allocating somewhere between $2 to $4 per capita per year into a forestry budget to be used for planting, removals and maintenance of Holy Cross's urban forest.

**Recommended Budget: $5,850 over six years.**

**FY 2011 Budget**

Removal: $1000
Planting: $400
Routine trimming: $100
Watering & Maintenance: $100

**FY 2012 Budget**

Removal: $500
Planting: $200
Routine trimming: $100
Watering & Maintenance: $50

**FY 2013 Budget**

Removal: $500
Planting: $200
Routine trimming: $100
Watering & Maintenance: $50

**FY 2014 Budget**

Removal: $500
Planting: $200
Routine trimming: $100
Watering & Maintenance: $50

**FY 2015 Budget**

Removal: $500
Planting: $200
Routine trimming: $100
Watering & Maintenance: $50

**FY 2016 Budget**

Removal: $500
Planting: $200
Routine trimming: $100
Watering & Maintenance: $50

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# Appendix A: i-Tree Data

**Table 1: Annual Energy Benefits**

## Annual Energy Benefits of Public Trees by Species

1/19/2012

| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| Scotch pine | 4.0 | 305 | 498.8 | 489 | 793 | (N/A) | 32.8 | 21.9 | 20.35 |
| Green ash | 4.2 | 318 | 546.9 | 536 | 854 | (N/A) | 15.1 | 23.6 | 47.45 |
| Silver maple | 4.1 | 314 | 521.9 | 511 | 826 | (N/A) | 14.3 | 22.8 | 48.58 |
| Norway maple | 0.8 | 58 | 105.1 | 103 | 160 | (N/A) | 5.0 | 4.4 | 26.74 |
| Blue spruce | 0.5 | 38 | 71.2 | 70 | 108 | (N/A) | 5.0 | 3.0 | 18.04 |
| Honeylocust | 1.3 | 96 | 165.4 | 162 | 258 | (N/A) | 3.4 | 7.1 | 64.41 |
| Black walnut | 0.8 | 63 | 105.8 | 104 | 166 | (N/A) | 3.4 | 4.6 | 41.60 |
| Norway spruce | 0.5 | 41 | 63.6 | 62 | 103 | (N/A) | 3.4 | 2.8 | 25.72 |
| Northern white cedar | 0.0 | 2 | 5.3 | 5 | 7 | (N/A) | 2.5 | 0.2 | 2.49 |
| Littleleaf linden | 0.4 | 27 | 48.9 | 48 | 75 | (N/A) | 2.5 | 2.1 | 25.07 |
| Boxelder | 0.4 | 30 | 47.8 | 47 | 77 | (N/A) | 1.7 | 2.1 | 38.63 |
| Cherry plum | 0.1 | 11 | 25.7 | 25 | 36 | (N/A) | 1.7 | 1.0 | 18.19 |
| Black cherry | 0.1 | 7 | 16.6 | 16 | 24 | (N/A) | 1.7 | 0.7 | 11.80 |
| Other street trees | 0.6 | 45 | 91.1 | 89 | 135 | (N/A) | 7.6 | 3.7 | 14.95 |
| Citywide total | 17.9 | 1,356 | 2,314.0 | 2,268 | 3,623 | (N/A) | 100.0 | 100.0 | 30.45 |

**Table 2: Annual Stormwater Benefits**

## Annual Stormwater Benefits of Public Trees by Species

1/19/2012

| Species | Total rainfall interception (Gal) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Scotch pine | 46,800 | 1,268 | (N/A) | 32.8 | 27.2 | 32.52 |
| Green ash | 36,848 | 999 | (N/A) | 15.1 | 21.4 | 55.48 |
| Silver maple | 42,109 | 1,141 | (N/A) | 14.3 | 24.5 | 67.13 |
| Norway maple | 4,315 | 117 | (N/A) | 5.0 | 2.5 | 19.49 |
| Blue spruce | 6,110 | 166 | (N/A) | 5.0 | 3.6 | 27.60 |
| Honeylocust | 12,051 | 327 | (N/A) | 3.4 | 7.0 | 81.65 |
| Black walnut | 6,129 | 166 | (N/A) | 3.4 | 3.6 | 41.53 |
| Norway spruce | 7,585 | 206 | (N/A) | 3.4 | 4.4 | 51.39 |
| Northern white cedar | 310 | 8 | (N/A) | 2.5 | 0.2 | 2.80 |
| Littleleaf linden | 2,181 | 59 | (N/A) | 2.5 | 1.3 | 19.70 |
| Boxelder | 2,912 | 79 | (N/A) | 1.7 | 1.7 | 39.46 |
| Cherry plum | 529 | 14 | (N/A) | 1.7 | 0.3 | 7.17 |
| Black cherry | 333 | 9 | (N/A) | 1.7 | 0.2 | 4.51 |
| Other street trees | 3,828 | 104 | (N/A) | 7.6 | 2.2 | 11.53 |
| Citywide total | 172,040 | 4,663 | (N/A) | 100.0 | 100.0 | 39.18 |

**Table 3: Annual Air Quality Benefits**

## Annual Air Quality Benefits of Public Trees by Species

1/19/2012

| Species | Deposition (lb) $O_3$ | $NO_2$ | $PM_{10}$ | $SO_2$ | Total Depos. ($) | Avoided (lb) $NO_2$ | $PM_{10}$ | VOC | $SO_2$ | Total Avoided ($) | BVOC Emissions (lb) | BVOC Emissions ($) | Total (lb) | Total ($) | Standard Error | % of Total Trees | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotch pine | 4.9 | 1.0 | 4.4 | 0.6 | 34 | 18.7 | 2.8 | 2.6 | 18.2 | 118 | -16.0 | -60 | 37.2 | 91 | (N/A) | 32.8 | 2.34 |
| Green ash | 3.8 | 0.6 | 1.9 | 0.2 | 20 | 19.8 | 2.9 | 2.8 | 19.0 | 124 | 0.0 | 0 | 50.9 | 144 | (N/A) | 15.1 | 8.01 |
| Silver maple | 5.4 | 0.9 | 2.9 | 0.2 | 30 | 19.3 | 2.8 | 2.7 | 18.8 | 122 | -3.3 | -12 | 49.9 | 139 | (N/A) | 14.3 | 8.18 |
| Norway maple | 0.6 | 0.1 | 0.3 | 0.0 | 3 | 3.6 | 0.5 | 0.5 | 3.4 | 23 | -0.2 | -1 | 9.0 | 25 | (N/A) | 5.0 | 4.20 |
| Blue spruce | 0.7 | 0.1 | 0.6 | 0.1 | 5 | 2.4 | 0.4 | 0.3 | 2.3 | 15 | -2.1 | -8 | 4.8 | 12 | (N/A) | 5.0 | 1.99 |
| Honeylocust | 2.3 | 0.4 | 1.1 | 0.1 | 12 | 5.9 | 0.9 | 0.8 | 5.7 | 37 | -1.7 | -6 | 15.5 | 43 | (N/A) | 3.4 | 10.75 |
| Black walnut | 0.5 | 0.1 | 0.3 | 0.0 | 3 | 3.9 | 0.6 | 0.5 | 3.7 | 24 | 0.0 | 0 | 9.6 | 27 | (N/A) | 3.4 | 6.79 |
| Norway spruce | 0.9 | 0.2 | 0.7 | 0.1 | 6 | 2.5 | 0.4 | 0.3 | 2.4 | 16 | -3.0 | -11 | 4.4 | 10 | (N/A) | 3.4 | 2.48 |
| Northern white cedar | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.2 | 0.0 | 0.0 | 0.1 | 1 | -0.1 | 0 | 0.3 | 1 | (N/A) | 2.5 | 0.22 |
| Littleleaf linden | 0.2 | 0.0 | 0.1 | 0.0 | 1 | 1.7 | 0.3 | 0.2 | 1.6 | 11 | -0.1 | -1 | 4.1 | 12 | (N/A) | 2.5 | 3.84 |
| Boxelder | 0.3 | 0.0 | 0.2 | 0.0 | 2 | 1.8 | 0.3 | 0.3 | 1.8 | 12 | -0.1 | -1 | 4.6 | 13 | (N/A) | 1.7 | 6.37 |
| Cherry plum | 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) | 1.7 | 2.55 |
| Black cherry | 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) | 1.7 | 1.63 |
| Other street trees | 0.3 | 0.0 | 0.2 | 0.0 | 2 | 2.9 | 0.4 | 0.4 | 2.7 | 18 | -0.5 | -2 | 6.5 | 18 | (N/A) | 7.6 | 1.98 |
| Citywide total | 20.0 | 3.5 | 12.9 | 1.4 | 118 | 84.0 | 12.3 | 11.8 | 80.9 | 526 | -27.1 | -102 | 199.7 | 543 | (N/A) | 100.0 | 4.56 |

**Table 4: Annual Carbon Stored**

## Stored CO2 Benefits of Public Trees by Species

1/19/2012

| Species | Total Stored CO2 (lbs) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Scotch pine | 32,850 | 246 | (N/A) | 32.8 | 9.1 | 6.32 |
| Green ash | 122,949 | 922 | (N/A) | 15.1 | 33.9 | 51.23 |
| Silver maple | 119,462 | 896 | (N/A) | 14.3 | 32.9 | 52.70 |
| Norway maple | 9,887 | 74 | (N/A) | 5.0 | 2.7 | 12.36 |
| Blue spruce | 3,373 | 25 | (N/A) | 5.0 | 0.9 | 4.22 |
| Honeylocust | 28,767 | 216 | (N/A) | 3.4 | 7.9 | 53.94 |
| Black walnut | 16,836 | 126 | (N/A) | 3.4 | 4.6 | 31.57 |
| Norway spruce | 6,853 | 51 | (N/A) | 3.4 | 1.9 | 12.85 |
| Northern white | 43 | 0 | (N/A) | 2.5 | 0.0 | 0.11 |
| Littleleaf linden | 5,644 | 42 | (N/A) | 2.5 | 1.6 | 14.11 |
| Boxelder | 7,248 | 54 | (N/A) | 1.7 | 2.0 | 27.18 |
| Cherry plum | 1,816 | 14 | (N/A) | 1.7 | 0.5 | 6.81 |
| Black cherry | 1,086 | 8 | (N/A) | 1.7 | 0.3 | 4.07 |
| Other street trees | 2,635 | 44 | (N/A) | 7.6 | 1.6 | 4.84 |
| Citywide total | 362,624 | 2,720 | (N/A) | 100.0 | 100.0 | 22.85 |

**Table 5: Annual Carbon Sequestered**

## Annual $CO_2$ Benefits of Public Trees by Species

1/19/2012

| Species | Sequestered (lb) | Sequestered ($) | Decomposition Release (lb) | Maintenance Release (lb) | Total Released ($) | Avoided (lb) | Avoided ($) | Net Total (lb) | Total ($) | Standar d Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scotch pine | 3,625 | 27 | -158 | -8 | -1 | 6,734 | 51 | 10,194 | 76 | (N/A) | 32.8 | 15.7 | 1.96 |
| Green ash | 9,367 | 70 | -590 | -4 | -4 | 7,029 | 53 | 15,802 | 119 | (N/A) | 15.1 | 24.4 | 6.58 |
| Silver maple | 12,427 | 93 | -573 | -3 | -4 | 6,948 | 52 | 18,797 | 141 | (N/A) | 14.3 | 29.0 | 8.29 |
| Norway maple | 1,411 | 11 | -47 | -1 | 0 | 1,271 | 10 | 2,633 | 20 | (N/A) | 5.0 | 4.1 | 3.29 |
| Blue spruce | 336 | 3 | -16 | -1 | 0 | 850 | 6 | 1,169 | 9 | (N/A) | 5.0 | 1.8 | 1.46 |
| Honeylocust | 3,833 | 29 | -138 | -1 | -1 | 2,111 | 16 | 5,805 | 44 | (N/A) | 3.4 | 9.0 | 10.88 |
| Black walnut | 1,759 | 13 | -81 | -1 | -1 | 1,386 | 10 | 3,063 | 23 | (N/A) | 3.4 | 4.7 | 5.74 |
| Norway spruce | 534 | 4 | -33 | -1 | 0 | 896 | 7 | 1,396 | 10 | (N/A) | 3.4 | 2.2 | 2.62 |
| Northern white cedar | 25 | 0 | 0 | -1 | 0 | 50 | 0 | 74 | 1 | (N/A) | 2.5 | 0.1 | 0.19 |
| Littleleaf linden | 961 | 7 | -27 | -1 | 0 | 604 | 5 | 1,537 | 12 | (N/A) | 2.5 | 2.4 | 3.84 |
| Boxelder | 837 | 6 | -35 | 0 | 0 | 673 | 5 | 1,474 | 11 | (N/A) | 1.7 | 2.3 | 5.53 |
| Cherry plum | 228 | 2 | -9 | 0 | 0 | 248 | 2 | 467 | 4 | (N/A) | 1.7 | 0.7 | 1.75 |
| Black cherry | 152 | 1 | -5 | 0 | 0 | 161 | 1 | 308 | 2 | (N/A) | 1.7 | 0.5 | 1.15 |
| Other street trees | 1,103 | 8 | -28 | -2 | 0 | 1,001 | 8 | 2,075 | 16 | (N/A) | 7.6 | 3.2 | 1.73 |
| Citywide total | 36,596 | 274 | -1,741 | -23 | -13 | 29,962 | 225 | 64,795 | 486 | (N/A) | 100.0 | 100.0 | 4.08 |

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

## Annual Aesthetic/Other Benefits of Public Trees by Species

1/19/2012

| Species | Total ($) | Standar d Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|
| Scotch pine | 1,024 | (N/A) | 32.8 | 20.7 | 26.25 |
| Green ash | 867 | (N/A) | 15.1 | 17.5 | 48.18 |
| Silver maple | 1,153 | (N/A) | 14.3 | 23.3 | 67.84 |
| Norway maple | 157 | (N/A) | 5.0 | 3.2 | 26.09 |
| Blue spruce | 135 | (N/A) | 5.0 | 2.7 | 22.47 |
| Honeylocust | 881 | (N/A) | 3.4 | 17.8 | 220.20 |
| Black walnut | 178 | (N/A) | 3.4 | 3.6 | 44.49 |
| Norway spruce | 144 | (N/A) | 3.4 | 2.9 | 36.01 |
| Northern white cedar | 18 | (N/A) | 2.5 | 0.4 | 6.12 |
| Littleleaf linden | 117 | (N/A) | 2.5 | 2.4 | 39.16 |
| Boxelder | 79 | (N/A) | 1.7 | 1.6 | 39.36 |
| Cherry plum | 13 | (N/A) | 1.7 | 0.3 | 6.40 |
| Black cherry | 8 | (N/A) | 1.7 | 0.2 | 4.23 |
| Other street trees | 172 | (N/A) | 7.6 | 3.5 | 19.16 |
| Citywide total | 4,947 | (N/A) | 100.0 | 100.0 | 41.57 |

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

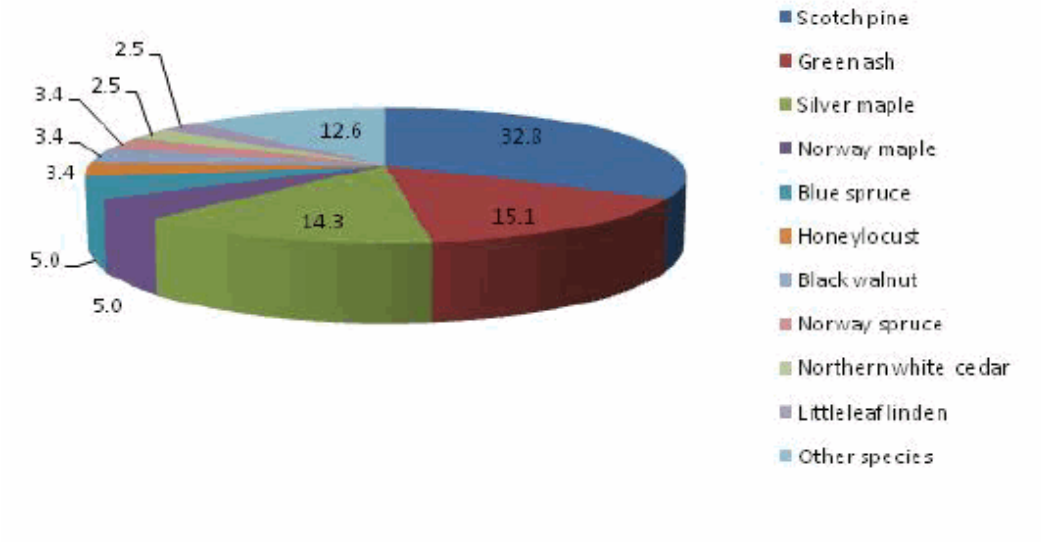
## Total Annual Benefits of Public Trees by Species ($)

1/19/201

| Species | Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/Other | Total ($) | Standard Error | % of Total $ |
|---|---|---|---|---|---|---|---|---|
| Scotch pine | 793 | 76 | 91 | 1,268 | 1,024 | 3,253 | (±0) | 22.8 |
| Green ash | 854 | 119 | 144 | 999 | 867 | 2,983 | (±0) | 20.9 |
| Silver maple | 826 | 141 | 139 | 1,141 | 1,153 | 3,400 | (±0) | 23.8 |
| Norway maple | 160 | 20 | 25 | 117 | 157 | 479 | (±0) | 3.4 |
| Blue spruce | 108 | 9 | 12 | 166 | 135 | 429 | (±0) | 3.0 |
| Honeylocust | 258 | 44 | 43 | 327 | 881 | 1,552 | (±0) | 10.9 |
| Black walnut | 166 | 23 | 27 | 166 | 178 | 561 | (±0) | 3.9 |
| Norway spruce | 103 | 10 | 10 | 206 | 144 | 473 | (±0) | 3.3 |
| Northern white cedar | 7 | 1 | 1 | 8 | 18 | 35 | (±0) | 0.2 |
| Littleleaf linden | 75 | 12 | 12 | 59 | 117 | 275 | (±0) | 1.9 |
| Boxelder | 77 | 11 | 13 | 79 | 79 | 259 | (±0) | 1.8 |
| Cherry plum | 36 | 4 | 5 | 14 | 13 | 72 | (±0) | 0.5 |
| Black cherry | 24 | 2 | 3 | 9 | 8 | 47 | (±0) | 0.3 |
| Other street trees | 135 | 16 | 18 | 104 | 172 | 444 | (±0) | 3.1 |
| Citywide Total | 3,623 | 486 | 543 | 4,663 | 4,947 | 14,261 | (±0) | 100.0 |

## Species Distribution of Public Trees (%)

1/19/2012

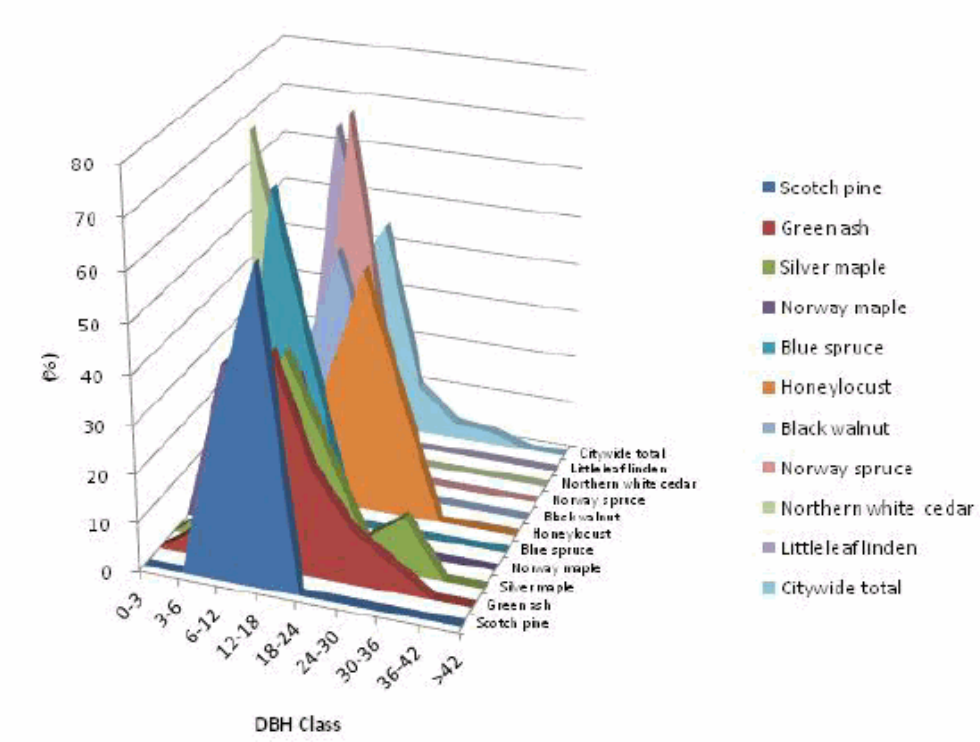



| Species | Percent |
|---|---|
| Scotch pine | 32.8 |
| Green ash | 15.1 |
| Silver maple | 14.3 |
| Norway maple | 5.0 |
| Blue spruce | 5.0 |
| Honeylocust | 3.4 |
| Black walnut | 3.4 |
| Norway spruce | 3.4 |
| Northern white cedar | 2.5 |
| Littleleaf linden | 2.5 |
| Other species | 12.6 |
| Total | 100.0 |

**Figure 1: Species Distribution**

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

1/19/2012




| | DBH class (in) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | 0-3 | 3-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 | 36-42 | >42 |
| Scotch pine | 0.0 | 0.0 | 35.9 | 64.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Green ash | 0.0 | 5.6 | 11.1 | 44.4 | 22.2 | 11.1 | 5.6 | 0.0 | 0.0 |
| Silver maple | 0.0 | 5.9 | 11.8 | 41.2 | 23.5 | 5.9 | 11.8 | 0.0 | 0.0 |
| Norway maple | 0.0 | 33.3 | 33.3 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Blue spruce | 0.0 | 0.0 | 66.7 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Honeylocust | 0.0 | 0.0 | 0.0 | 25.0 | 50.0 | 25.0 | 0.0 | 0.0 | 0.0 |
| Black walnut | 0.0 | 0.0 | 25.0 | 50.0 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Norway spruce | 0.0 | 0.0 | 0.0 | 75.0 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Northern white cedar | 66.7 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Littleleaf linden | 0.0 | 0.0 | 66.7 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Citywide total | 3.4 | 5.9 | 30.3 | 44.5 | 10.1 | 3.4 | 2.5 | 0.0 | 0.0 |

**Figure 2: Relative Age Class**

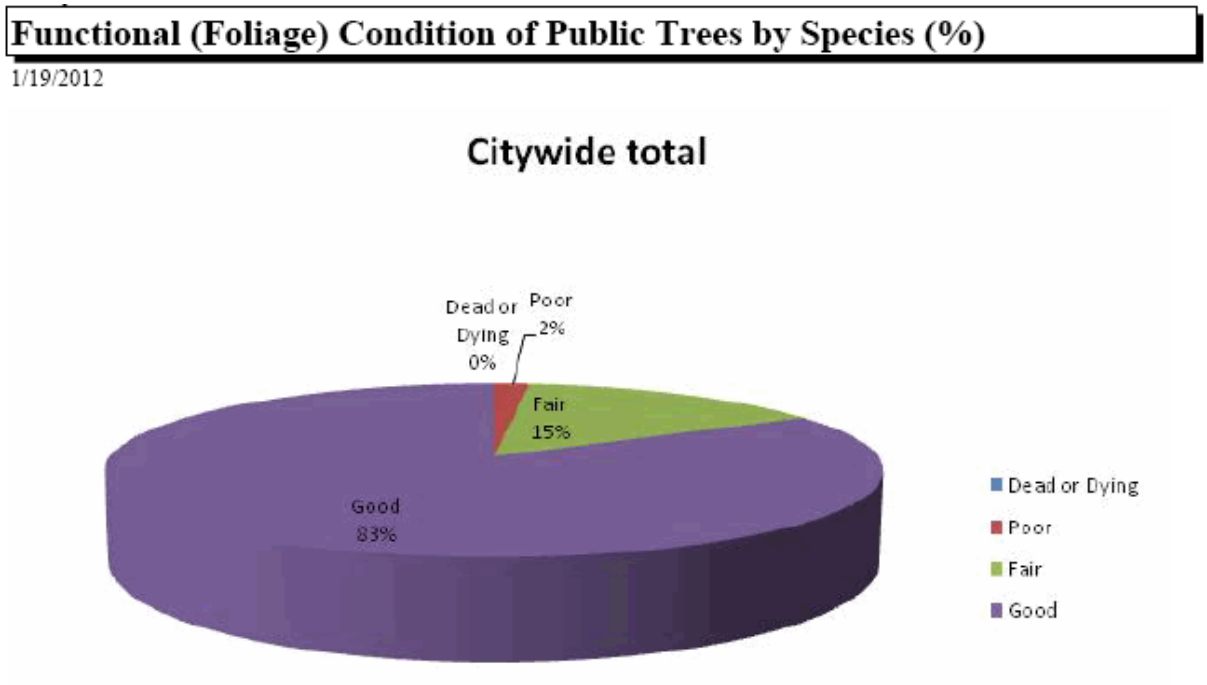



**Figure 3: Foliage Condition**

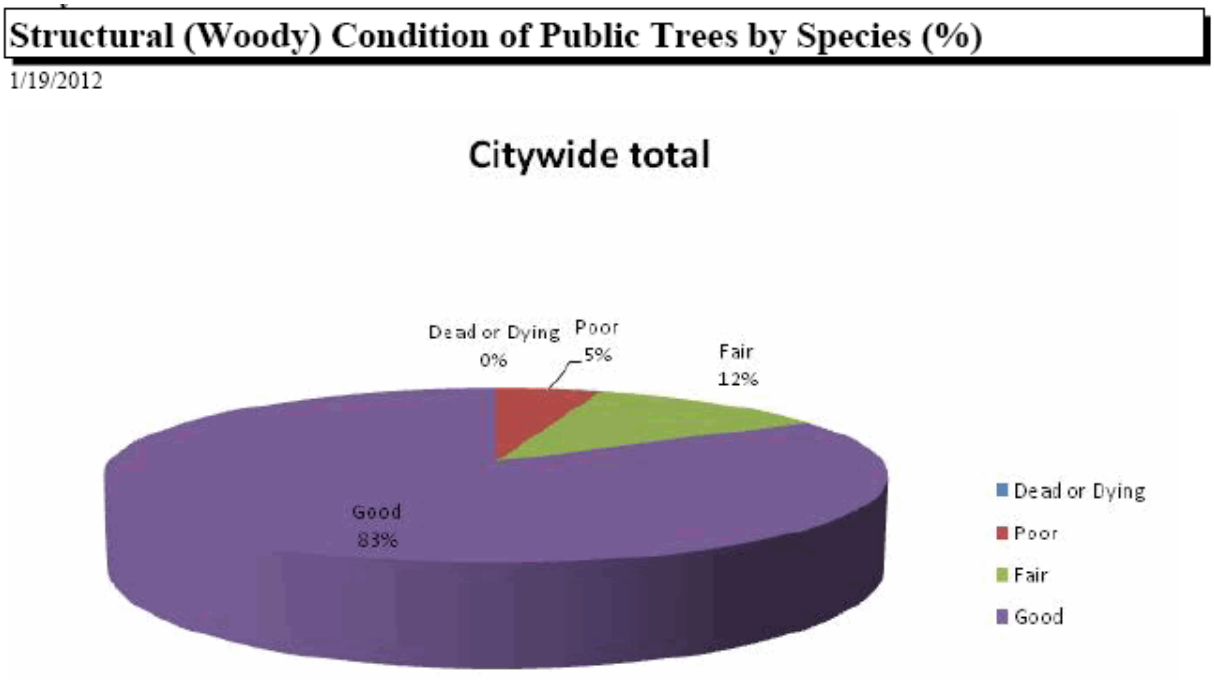
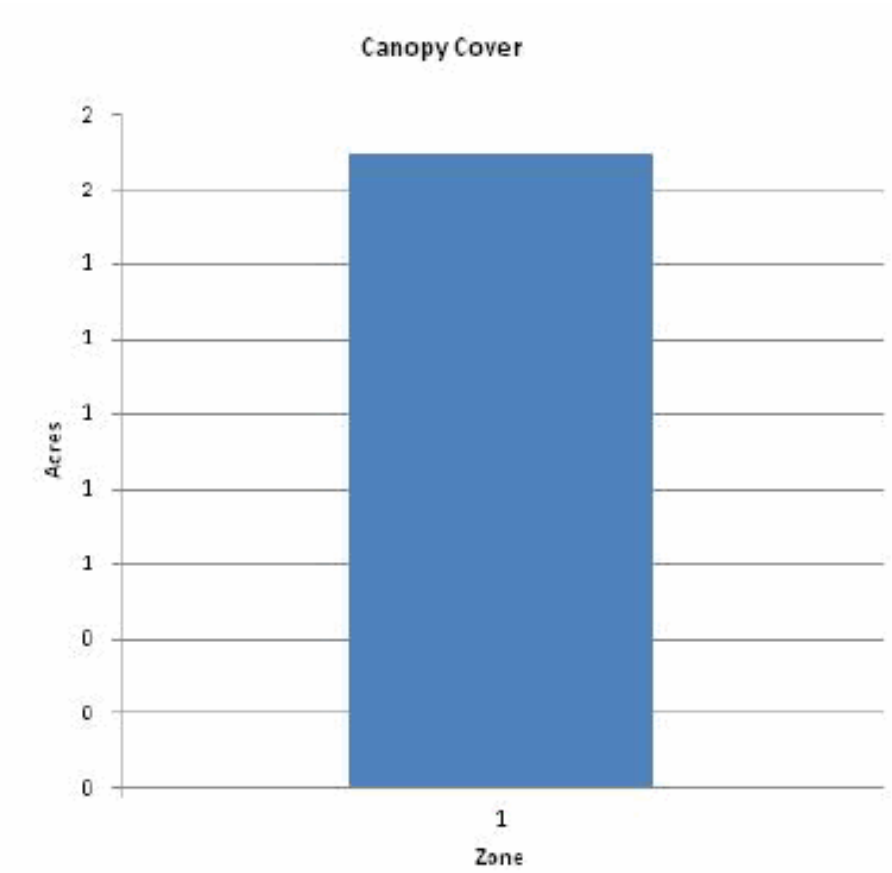



**Figure 4: Wood Condition**

# Canopy Cover of Public Trees (Acres)

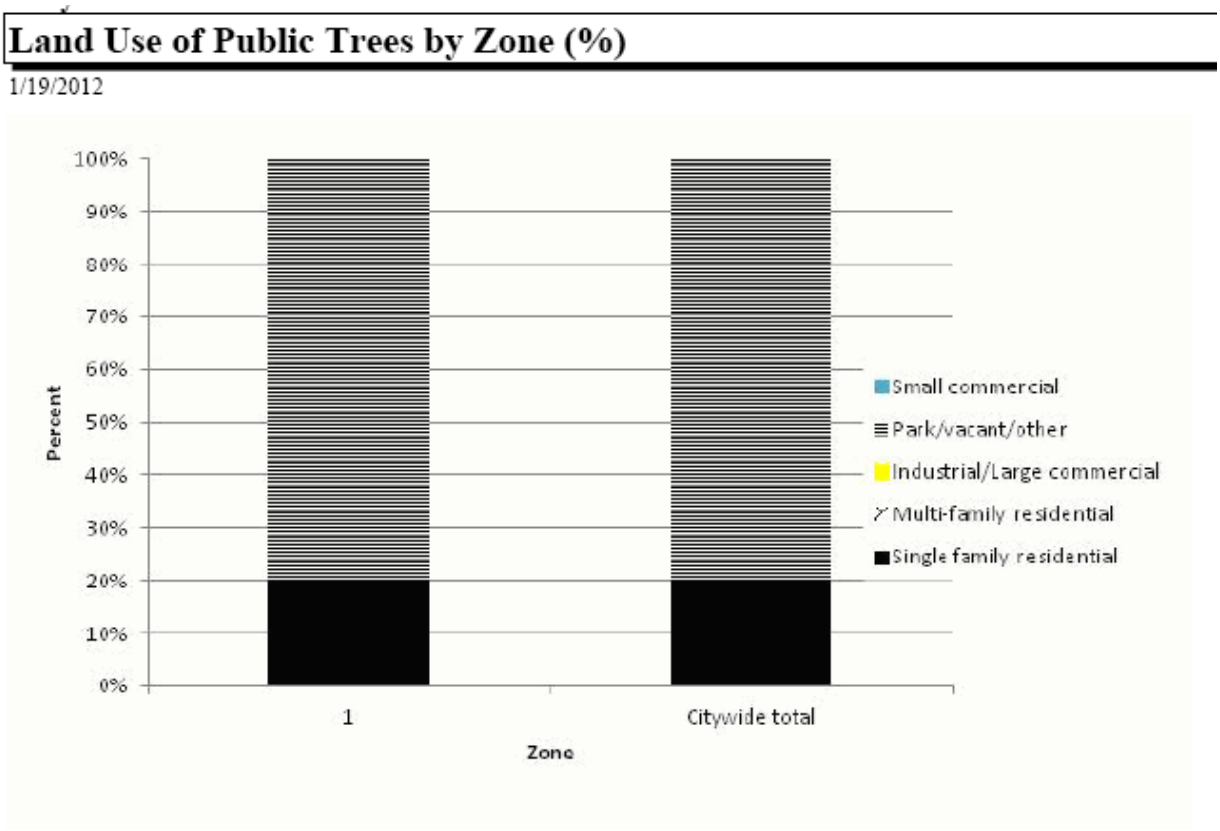
1/19/2012




| Zone | Acres | % of Total Canopy Cover |
|---|---|---|
| 1 | 2 | 100.0 |
| Citywide total | 2 | 100.0 |

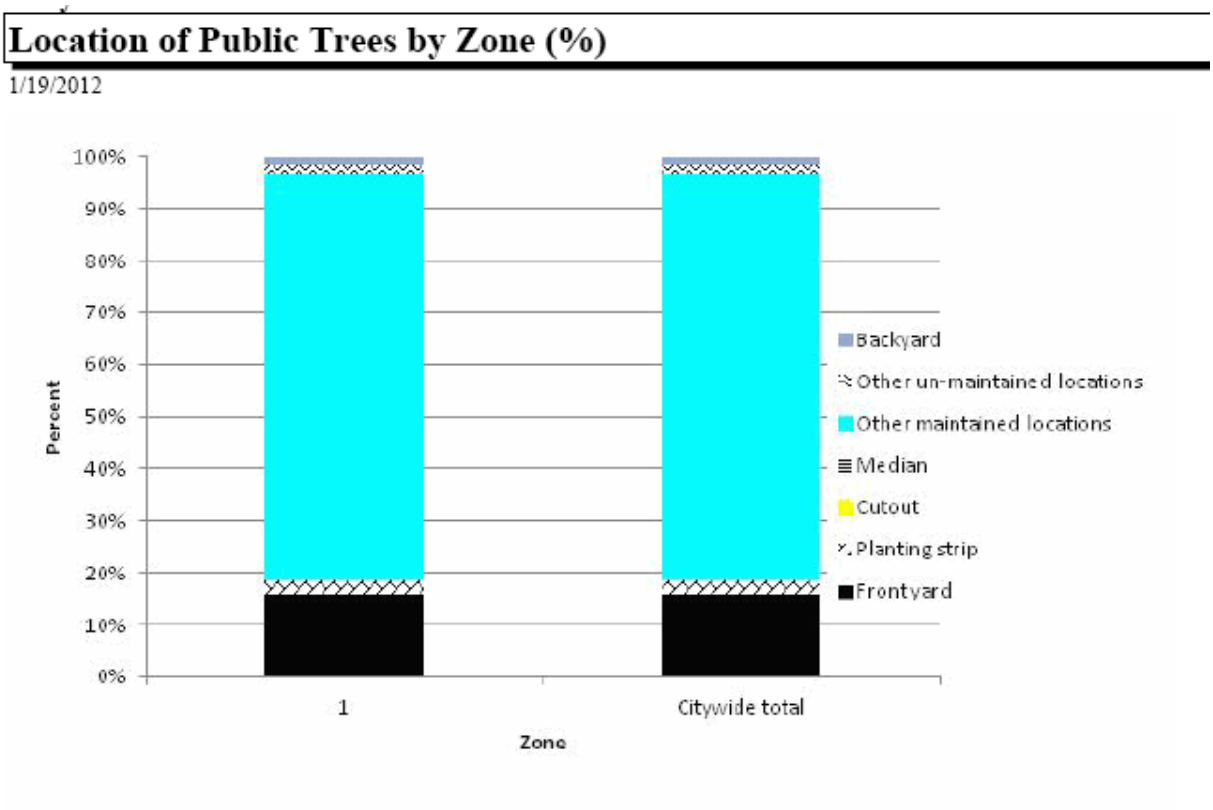
| | Total Land Area | Total Street and Sidewalk Area | Total Canopy Cover | Canopy Cover as % of Total Land Area | Canopy Cover as % of Total Streets and Sidewalks |
|---|---|---|---|---|---|
| Citywide | 0 | 0 | 2 | | |

**Figure 5: Canopy Cover in Acres**




| Zone | Single family residential | Multi-family residential | Industrial/ Large commercial | Park/vacant/ other | Small commercial |
|---|---|---|---|---|---|
| 1 | 20.2 | 0.0 | 0.0 | 79.8 | 0.0 |
| Citywide total | 20.2 | 0.0 | 0.0 | 79.8 | 0.0 |

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




| Zone | Front yard | Planting strip | Cutout | Median | Other maintained locations | Other un-maintained locations | Backyard |
|---|---|---|---|---|---|---|---|
| 1 | 16.0 | 2.5 | 0.0 | 0.0 | 78.2 | 1.7 | 1.7 |
| Citywide total | 16.0 | 2.5 | 0.0 | 0.0 | 78.2 | 1.7 | 1.7 |

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

# Appendix B: ArcGIS Mapping

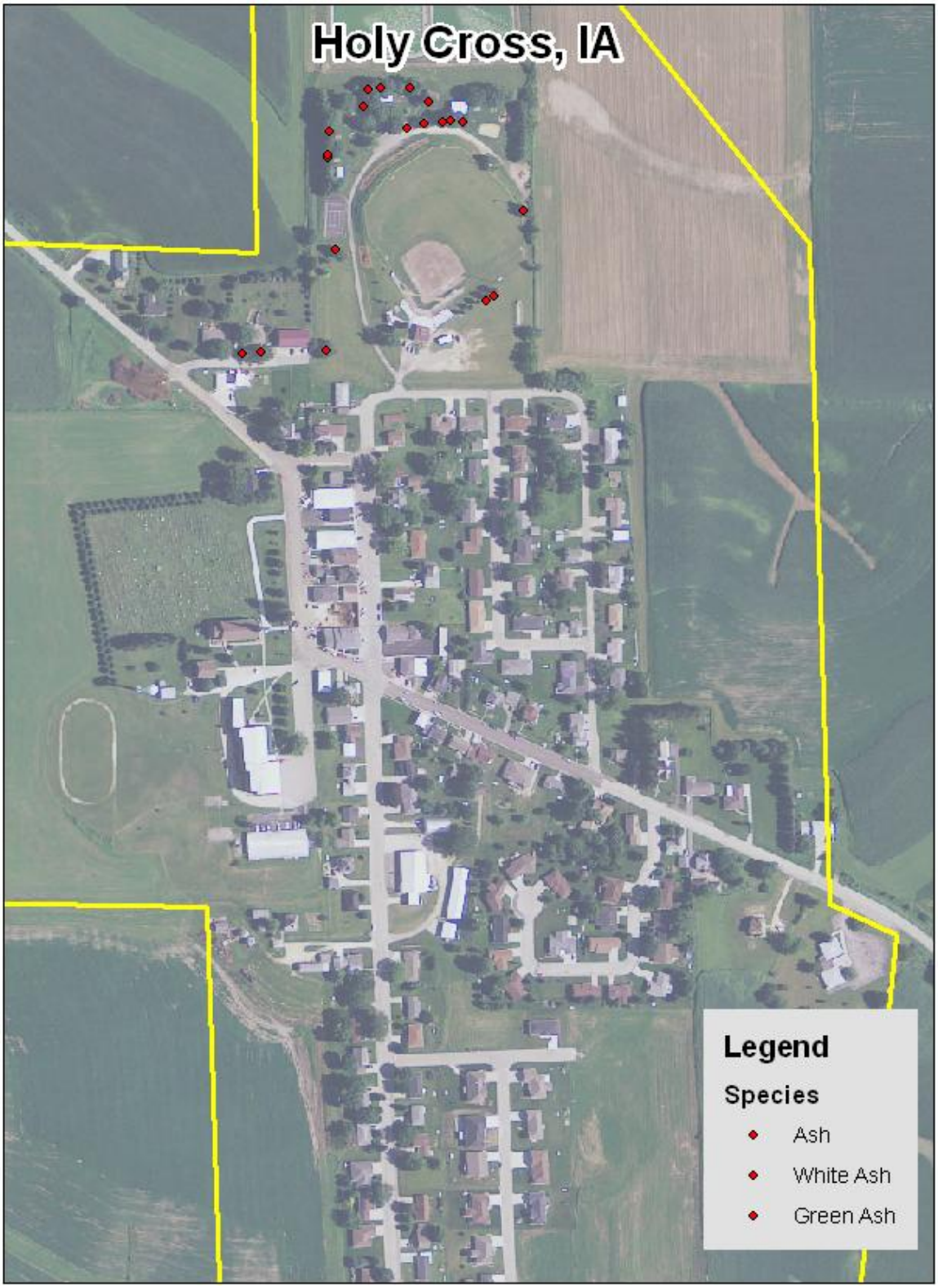



**Figure 1: Location of Ash Trees**

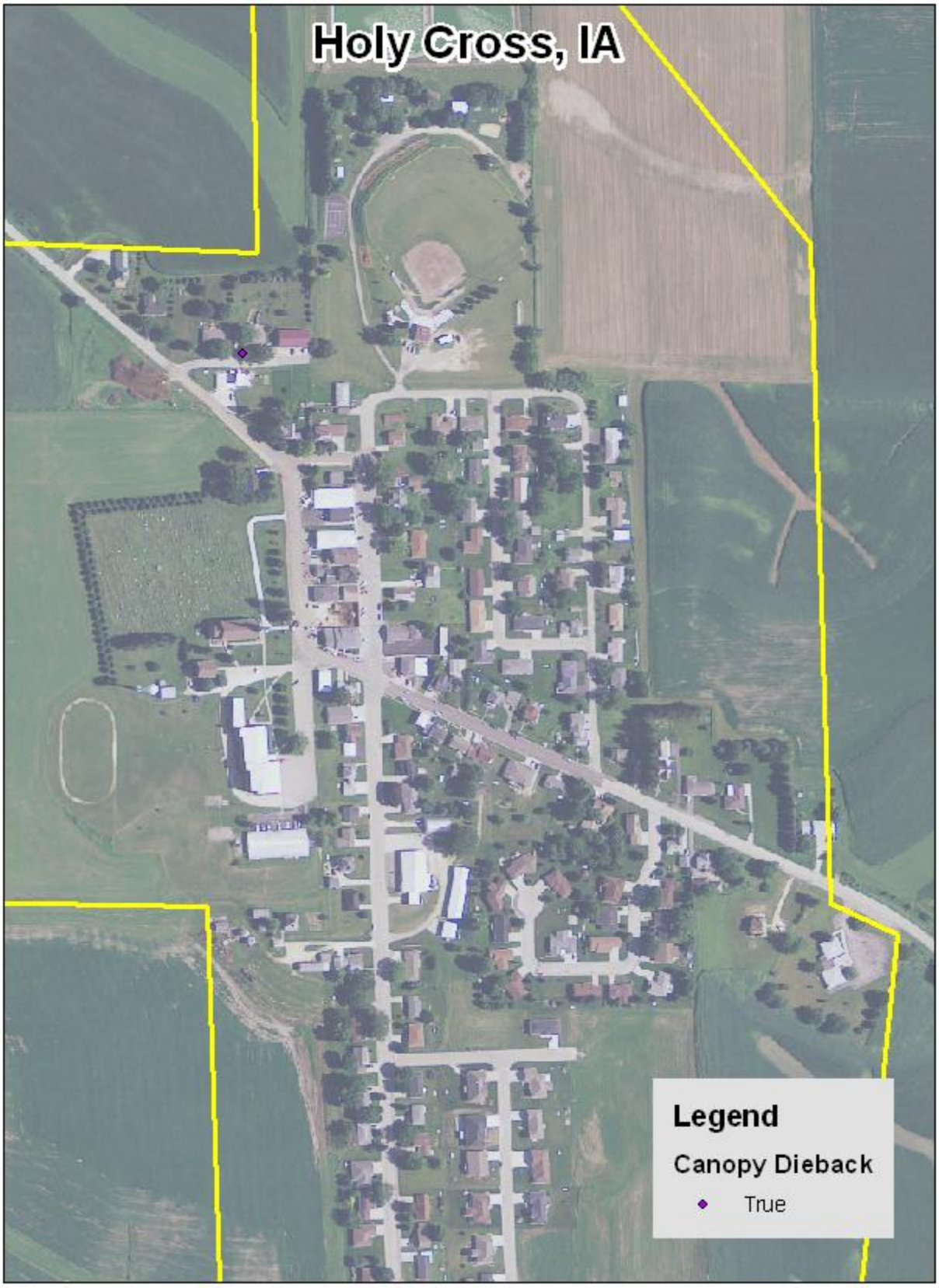



**Figure 2: Location of EAB symptoms**

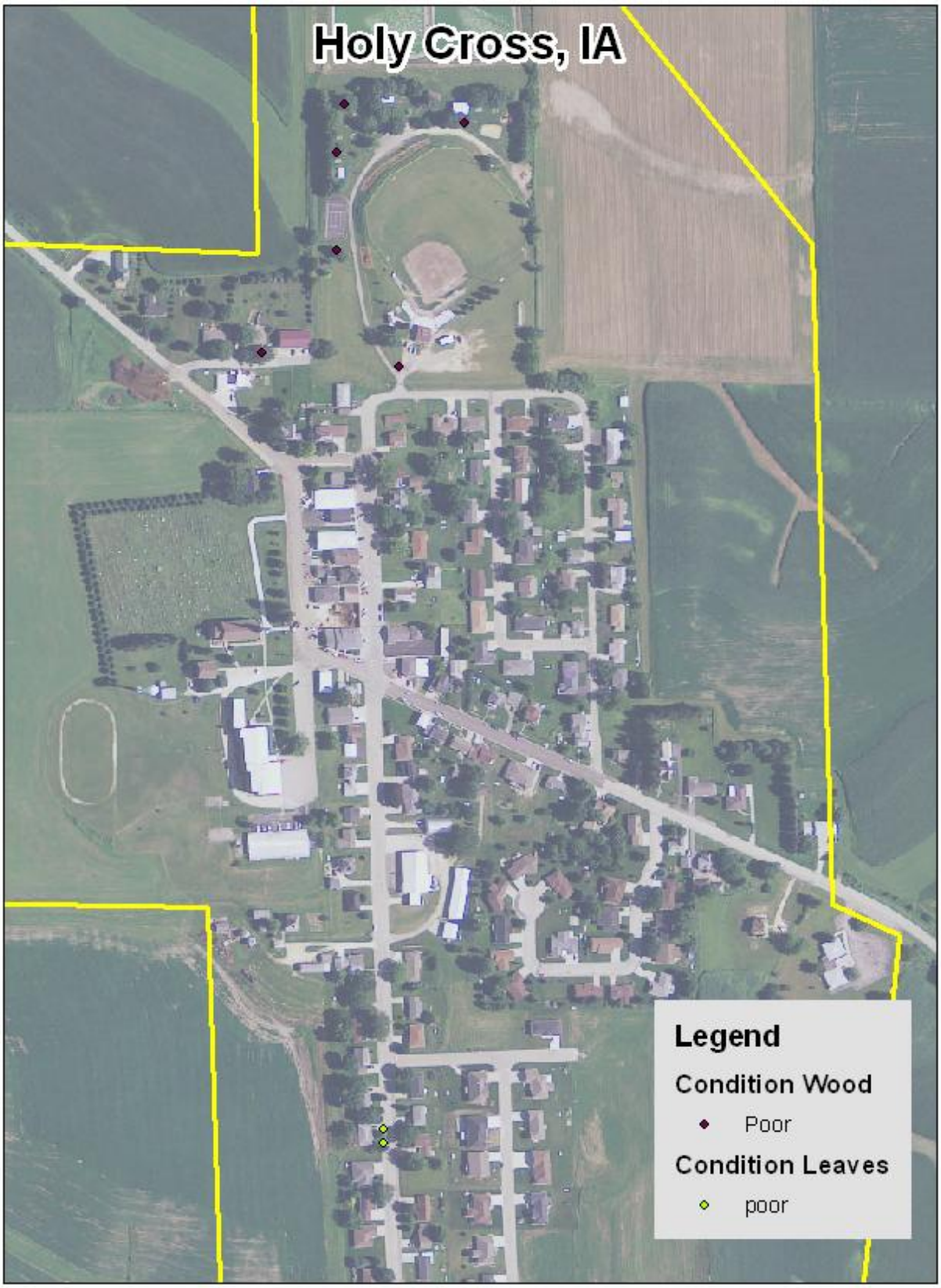



**Figure 3: Location of Poor Condition Trees**

**NO IMMEDIATE MAINTENANCE RECOMMENDED**

**Figure 4: Location of Trees with Recommended Maintenance**

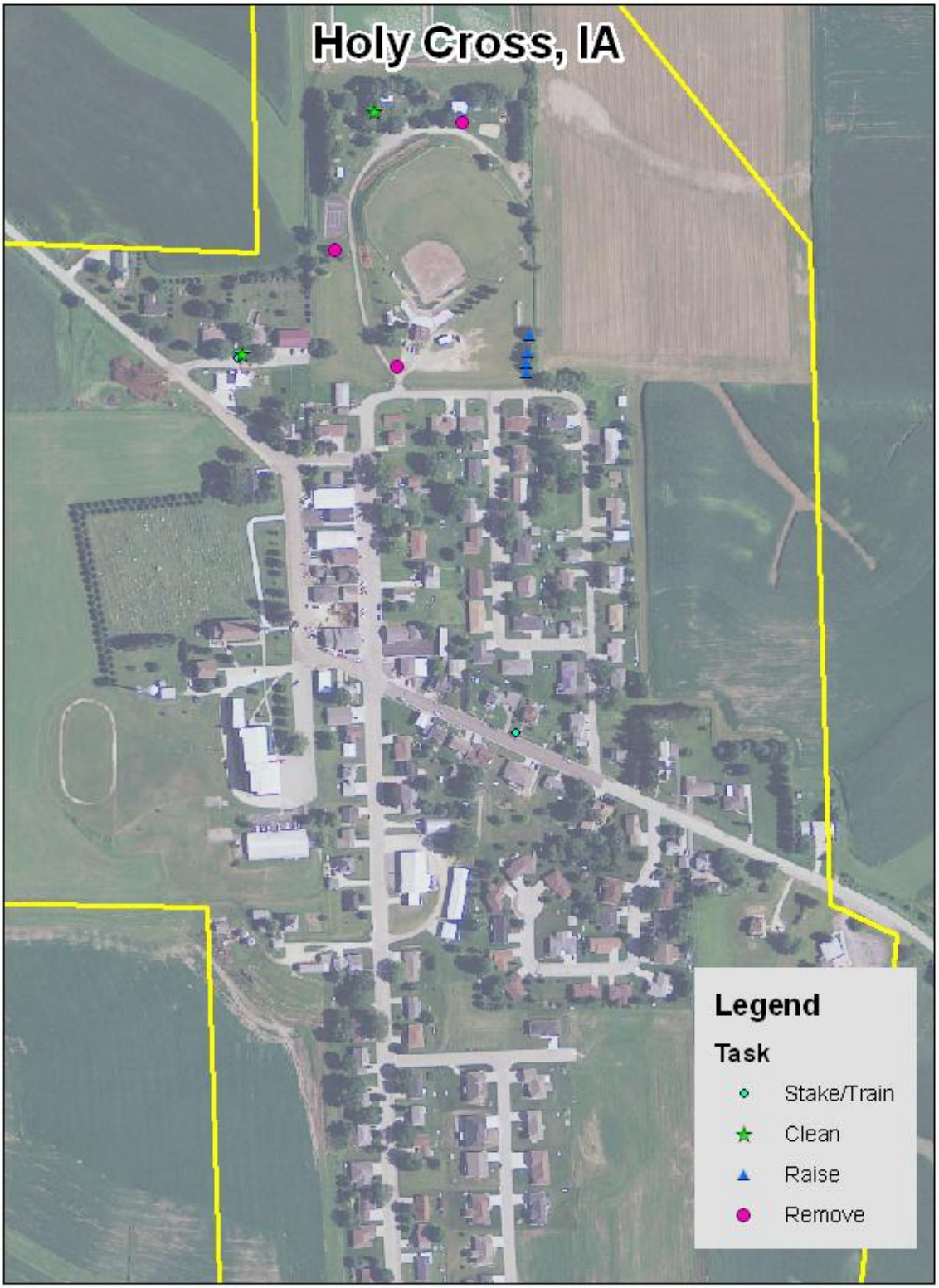



**Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal***

# Appendix C: Holy Cross Tree Ordinances

**TITLE III COMMUNITY PROTECTION**
**CHAPTER 2 NUISANCES**



3-2-1 DEFINITIONS. For use in this Ordinance, the following terms are defined:

1. The term "nuisance" means whatever is injurious to health, indecent, or unreasonably offensive to the senses or an obstacle to the free use of property, so as essentially to unreasonably interfere with the comfortable enjoyment of life or property. The following are declared to be nuisances:

(Code of Iowa, Sec. 657.1)

h. Cotton-bearing cottonwood trees and all other cotton-bearing poplar trees in the City.

m. Trees infected with Dutch elm disease.

(Code of Iowa, Sec. 657.2(12))

**TITLE VI PHYSICAL ENVIRONMENT**
**CHAPTER 9 TREE BOARD, REGULATIONS**



6-9-1 CREATION AND ESTABLISHMENT. There is hereby created and established a City Tree Board for the city of Holy Cross, Iowa, which shall consist of five members and one City Council representative chosen by the Mayor and confirmed by the City Council.

6-9-2 COMPENSATION. Members of the Board shall serve without compensation.

6-9-3 DUTIES AND RESPONSIBILITIES. It shall be the responsibility of the Board to study, investigate, counsel and develop a written plan for the care, preservation, trimming, planting, replanting, removal, or disposition of trees and shrubs in public areas. Such a plan will be presented to the City Council and upon its acceptance and approval shall constitute the official comprehensive tree plan for the city of Holy Cross, Iowa. The Board shall review annually and update if needed the comprehensive city tree plan. The Board, when requested by the City

Council, shall consider, investigate, make findings, report, and recommend upon any special matter of question within the scope of its work.

6-9-4 OPERATION. The Board shall choose its own officers, make its own rules and regulations and keep a journal of its proceedings. A majority of the members shall be a quorum for the transaction of business.

(Ord. 92-1, Passed June 3, 1992)

6-9-5 TREE TOPPING. It shall be unlawful as a normal practice for any person, firm or City Department to top any street tree, park tree, or other tree on public property. Topping is defined as the severe cutting back of limbs to stubs larger that three inches in diameter within the trees' crown to such a degree so as to remove the normal canopy and disfigure the tree. Trees severely damaged by storms or other causes, or certain trees under utility wires or other obstructions where other pruning practices are impractical may be exempted from this Chapter at the determination of the City Tree Board.

(Ord. 96-1, Passed June 4, 1996)