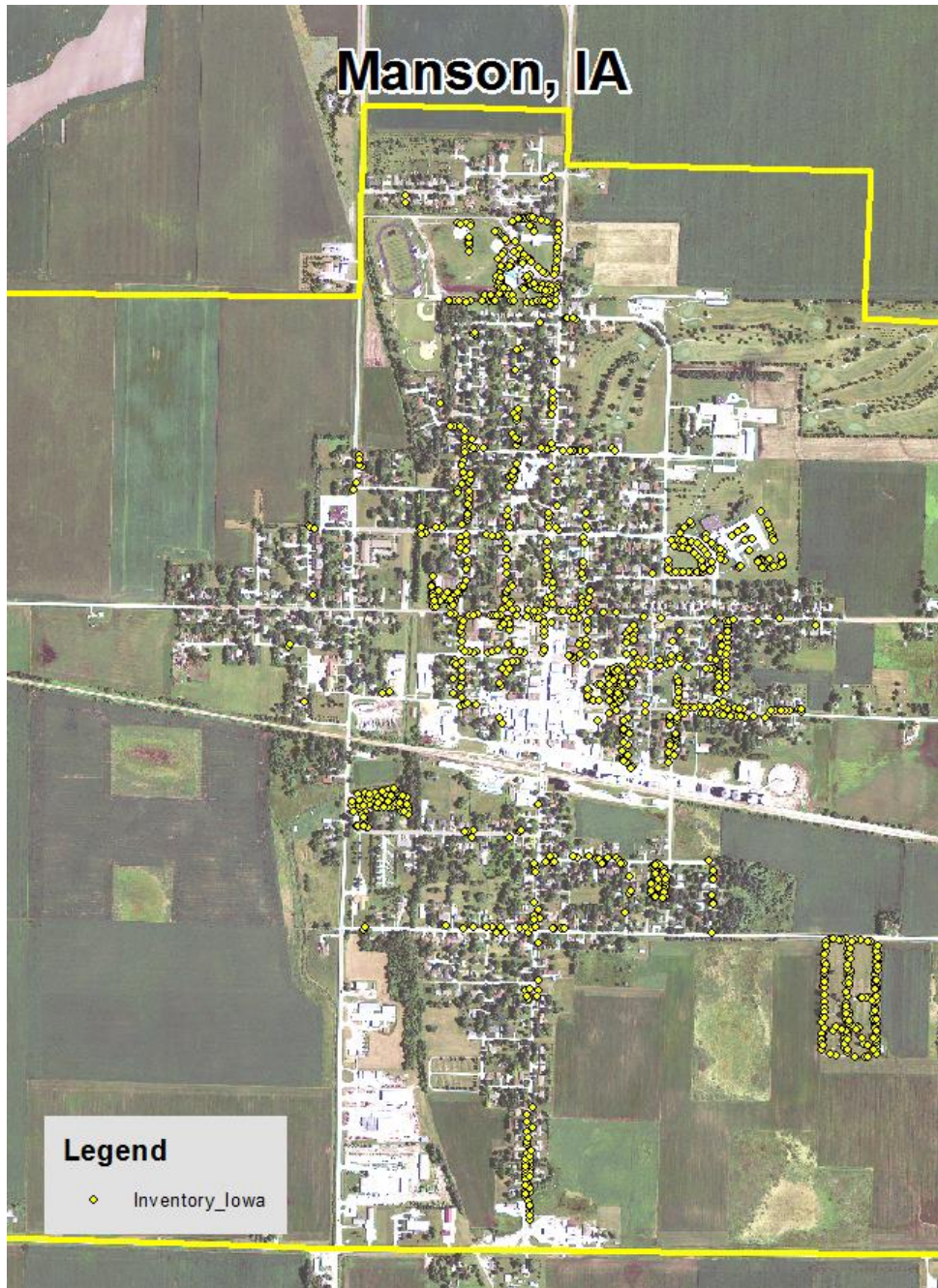# Manson, IA

Manson, IA

Legend
◇ Inventory_Iowa

2016 Urban Forest Management Plan
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Executive Summary_____

Overview

This plan was developed to assist the City of Manson 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 18% of Manson's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2015, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 1,127 trees inventoried.

- Manson's trees provide $178,147 of benefits annually, an average of $158 a tree
- There are over 45 species of trees
- The top three genera are: Maple 34%, Ash 18%, and Spruce 17%
- 3% of trees are in need of some type of management
- 18 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 18 trees needing removal, 10 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*
- 204 of the 4 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 23 years to remove ash – Suggestion: request a budget increase and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2015, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

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

Inventory Results_____

The data collected for the 1,127 city trees were entered into the USDA Forest service program 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. Manson's trees reduce energy related costs by approximately $46,542 annually (Appendix A, Table 1). These savings are both in Electricity (224.1 MWh) and in Natural Gas (30,135.5 Therms).

Annual Stormwater Benefits

Manson's trees intercept about 2,489,621 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $67,469 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 mater (ozone). In Manson, it is estimated that trees remove 2695 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $7,427 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Manson, trees sequester about 473,669 lbs of carbon a year with an associated value of $3,553 (Appendix A, Table 5). In addition, the trees store 7,712,917 lbs of carbon, with a yearly benefit of $57,847 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Manson receives $53,157 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, Manson's trees provide $178,147 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 1,127 trees in Manson provide approximately $158 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Manson has over 45 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	378	34%
Ash	204	18%
Spruce	186	17%
Apple (Crab)	117	10%
Linden/Basswood	60	5%
Honey Locust	49	4%
Hackberry	32	1%
Arborvitae	25	2%
Oak	16	1%
Walnut	10	1%
Cedar	6	<1%
Birch	5	<1%
Willow	5	<1%
Elm	4	<1%
Pear	4	<1%
Buckeye	3	<1%
Mulberry	3	<1%
Hickory	2	<1%
Mountain Ash	2	<1%
Pine	2	<1%
Poplar	2	<1%
Sycamore	2	<1%
Cottonwood	1	<1%
Dogwood	1	<1%
Lilac	1	<1%
Redbud	1	<1%
Tulip Tree	1	<1%
Quaking Aspen	1	<1%

Age Class

Most of Manson's trees (32%) are between 12 and 24 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. Manson's size curve indicates a middle aged stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Manson indicate that 92% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 68% of Manson'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 7% of the population. This 7% 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	19	2%
Tree Removal	18	2%
Tree Staking	1	<1%

Canopy Cover

The total canopy with both private and public trees is 10%, 201 acres. The canopy cover included in the Manson inventory includes approximately 24 acres (Appendix A, Figure 4).

Land Use and Location

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

Land Use
Single family residential	51%
Park/vacant/other	48%
Small commercial	1%
Multifamily residential	1%

Location
Front yard/park	71%
Planting strip	28%
Median	1%

Recommendations

Risk Management

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

Hazardous trees

Manson has 5 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). 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.

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 18 removals, 5 are ash trees. There are a total of 204 ash trees, and 4 of those have signs and symptoms that have been associated with EAB. In addition, there are 22 ash trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Manson.

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 (34%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Continual Monitoring

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

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

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

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash will be prioritized by hazardous or emergency situations only.

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if they are not using a treatment method.

Budget _____

Six Year Maintenance Plan and Estimate Cost

<u>**YEAR 1**</u>   <u>**ESTIMATED COSTS**</u>

Remove 5 Critical Concern trees and 5 immediate trees $7,000
Plant 12 trees in open locations $1,800
Inspect ash trees for signs of Emerald Ash Borer

<u>**YEAR 2**</u>

Remove 9 tree trees $6,300
Plant 10 trees in open locations $1,500
Prune 1/3 of city owned trees $1,000
Inspect ash trees for signs of Emerald Ash Borer

<u>**YEAR 3**</u>
10- removal of any new critical concern trees and ash in poor health
        *Or saving for ash tree treatment and/or future ash removal $7,000
Plant 12 trees in open locations $1,800
Inspect ash trees for signs of EAB

<u>**YEAR 4**</u>

9- removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal $6,300
Plant 13 trees in open locations $1,500
Prune 1/3 of city owned trees $1,000
Inspect ash trees for signs of EAB

<u>**YEAR 5**</u>

10- removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal $7,700
Plant 13 trees in open locations $1,800
Inspect ash trees for signs of EAB

<u>**YEAR 6**</u>

10- removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal $6,300

Plant 14 trees in open locations	$1,500
Prune 1/3 of city owned trees	$1,000

Estimated costs based on average costs of $700/tree for removal, $150/tree for planting and maintenance, and $15/tree for pruning.

Reduction of ash over 6 years: Approximately 43 ash trees removed (approximately 21% of ash). It will take approximately 23 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival. Treatment of ash would alter the cost and timeline. Treatment prices varies greatly by tree size and state location.

Purposed Budget Increase
EAB could potentially kill all ash trees in Manson within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to about $145,000 a year. Additionally, it is recommended that Manson apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Manson would still need $22,800 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $22,000 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Manson. 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

Manson

Annual Energy Benefits of Public Trees

12/22/2015

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	54.3	4,122	7,220.8	7,076	11,198	(N/A)	17.9	24.1	55.71
Silver maple	48.6	3,686	6,325.2	6,199	9,884	(N/A)	13.2	21.2	66.34
Norway maple	26.9	2,041	3,692.1	3,618	5,659	(N/A)	11.6	12.2	43.20
Spruce	17.9	1,359	2,323.6	2,277	3,636	(N/A)	11.2	7.8	28.85
Apple	7.9	599	1,236.3	1,212	1,810	(N/A)	10.4	3.9	15.47
Honeylocust	13.5	1,028	1,785.7	1,750	2,778	(N/A)	4.4	6.0	56.69
Sugar maple	11.7	886	1,520.9	1,491	2,376	(N/A)	4.4	5.1	48.50
Blue spruce	1.2	92	185.7	182	273	(N/A)	4.1	0.6	5.94
Littleleaf linden	5.4	411	744.9	730	1,141	(N/A)	3.0	2.5	33.56
Northern hackberry	10.4	789	1,439.7	1,411	2,200	(N/A)	2.8	4.7	68.75
American basswood	5.0	380	709.9	696	1,075	(N/A)	2.3	2.3	41.36
Northern white cedar	2.6	195	354.5	347	543	(N/A)	2.2	1.2	21.71
Maple	1.6	118	224.1	220	338	(N/A)	2.0	0.7	14.70
Red maple	1.7	131	225.2	221	352	(N/A)	1.1	0.8	29.34
Norway spruce	1.2	92	158.4	155	247	(N/A)	1.1	0.5	20.61
Amur maple	0.8	64	135.2	132	196	(N/A)	1.0	0.4	17.82
Northern red oak	1.5	112	201.6	198	310	(N/A)	1.0	0.7	28.16
Black walnut	2.8	213	383.9	376	590	(N/A)	0.9	1.3	58.95
Eastern red cedar	0.6	46	90.1	88	134	(N/A)	0.5	0.3	22.39
Willow	1.4	104	205.7	202	306	(N/A)	0.4	0.7	61.12
Swamp white oak	0.4	27	48.1	47	74	(N/A)	0.4	0.2	18.43
Pear	0.2	15	33.3	33	47	(N/A)	0.4	0.1	11.80
Conifer Evergreen Large	0.0	1	2.0	2	3	(N/A)	0.3	0.0	0.93
White ash	0.3	25	36.8	36	61	(N/A)	0.3	0.1	20.47
Mulberry	0.6	43	81.0	79	122	(N/A)	0.3	0.3	40.80
Boxelder	0.2	15	26.8	26	41	(N/A)	0.3	0.1	13.67
Paper birch	0.0	3	4.6	5	7	(N/A)	0.3	0.0	2.38
Ohio buckeye	0.3	26	46.3	45	71	(N/A)	0.2	0.2	35.62
River birch	0.0	1	1.6	2	2	(N/A)	0.2	0.0	1.10
American sycamore	0.8	59	107.4	105	164	(N/A)	0.2	0.4	82.02
Elm	0.7	53	97.1	95	148	(N/A)	0.2	0.3	74.17
Black spruce	0.1	10	16.4	16	26	(N/A)	0.2	0.1	13.08
Black poplar	0.7	54	100.5	99	153	(N/A)	0.2	0.3	76.46
Mountain ash	0.4	28	49.3	48	76	(N/A)	0.2	0.2	38.13
Austrian pine	0.2	12	20.0	20	31	(N/A)	0.2	0.1	15.73
Catalpa	0.9	66	118.0	116	182	(N/A)	0.2	0.4	91.02
Dogwood	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Quaking aspen	0.0	0	0.5	0	1	(N/A)	0.1	0.0	0.66
Eastern cottonwood	0.4	29	53.7	53	82	(N/A)	0.1	0.2	82.02
Eastern redbud	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
American elm	0.4	29	52.8	52	80	(N/A)	0.1	0.2	80.37
Japanese tree lilac	0.0	0	0.6	1	1	(N/A)	0.1	0.0	0.87
Siberian elm	0.1	7	13.6	13	20	(N/A)	0.1	0.0	20.49
Bur oak	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Tulip tree	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Total	224.1	17,009	30,135.5	29,533	46,542	(N/A)	100.0	100.0	41.37

Table 2: Annual Stormwater Benefits

Manson

Annual Stormwater Benefits of Public Trees

12/22/2015

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	558,137	15,126	(N/A)	17.9	22.4	75.25
Silver maple	669,933	18,155	(N/A)	13.2	26.9	121.85
Norway maple	201,724	5,467	(N/A)	11.6	8.1	41.73
Spruce	347,777	9,425	(N/A)	11.2	14.0	74.80
Apple	33,139	898	(N/A)	10.4	1.3	7.68
Honeylocust	136,201	3,691	(N/A)	4.4	5.5	75.33
Sugar maple	110,148	2,985	(N/A)	4.4	4.4	60.92
Blue spruce	12,822	347	(N/A)	4.1	0.5	7.55
Littleleaf linden	46,934	1,272	(N/A)	3.0	1.9	37.41
Northern hackberry	88,900	2,409	(N/A)	2.8	3.6	75.29
American basswood	45,626	1,236	(N/A)	2.3	1.8	47.56
Northern white cedar	53,803	1,458	(N/A)	2.2	2.2	58.32
Maple	8,388	227	(N/A)	2.0	0.3	9.88
Red maple	10,316	280	(N/A)	1.1	0.4	23.30
Norway spruce	20,162	546	(N/A)	1.1	0.8	45.53
Amur maple	3,450	93	(N/A)	1.0	0.1	8.50
Northern red oak	13,056	354	(N/A)	1.0	0.5	32.17
Black walnut	32,689	886	(N/A)	0.9	1.3	88.59
Eastern red cedar	8,832	239	(N/A)	0.5	0.4	39.89
Willow	13,681	371	(N/A)	0.4	0.5	74.15
Swamp white oak	1,897	51	(N/A)	0.4	0.1	12.85
Pear	666	18	(N/A)	0.4	0.0	4.51
Conifer Evergreen Large	146	4	(N/A)	0.3	0.0	1.32
White ash	1,989	54	(N/A)	0.3	0.1	17.97
Mulberry	2,507	68	(N/A)	0.3	0.1	22.65
Boxelder	1,274	35	(N/A)	0.3	0.1	11.51
Paper birch	207	6	(N/A)	0.3	0.0	1.87
Ohio buckeye	1,995	54	(N/A)	0.2	0.1	27.03
River birch	24	1	(N/A)	0.2	0.0	0.33
American sycamore	10,981	298	(N/A)	0.2	0.4	148.79
Elm	9,830	266	(N/A)	0.2	0.4	133.19
Black spruce	1,582	43	(N/A)	0.2	0.1	21.44
Black poplar	9,433	256	(N/A)	0.2	0.4	127.82
Mountain ash	1,333	36	(N/A)	0.2	0.1	18.06
Austrian pine	1,801	49	(N/A)	0.2	0.1	24.40
Catalpa	14,478	392	(N/A)	0.2	0.6	196.17
Dogwood	69	2	(N/A)	0.1	0.0	1.86
Quaking aspen	18	0	(N/A)	0.1	0.0	0.48
Eastern cottonwood	5,491	149	(N/A)	0.1	0.2	148.79
Eastern redbud	69	2	(N/A)	0.1	0.0	1.86
American elm	4,551	123	(N/A)	0.1	0.2	123.33
Japanese tree lilac	7	0	(N/A)	0.1	0.0	0.20
Siberian elm	620	17	(N/A)	0.1	0.0	16.81
Bur oak	1,466	40	(N/A)	0.1	0.1	39.72
Tulip tree	1,466	40	(N/A)	0.1	0.1	39.72
Citywide total	2,489,621	67,469	(N/A)	100.0	100.0	59.97

Table 3: Annual Air Quality Benefits

Manson

12/22/2015

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_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Green ash	66.4	10.6	32.3	3.0	355	257.4	37.6	35.9	246.1	1,608	0.0	0	689.4	1,963 (N/A)	17.9	9.77
Silver maple	111.0	18.8	54.9	4.9	600	228.3	33.5	32.0	219.7	1,430	-56.9	-214	646.1	1,816 (N/A)	13.2	12.19
Norway maple	36.2	6.2	18.5	1.6	197	128.8	18.7	17.9	122.0	802	-8.9	-34	341.0	966 (N/A)	11.6	7.37
Spruce	40.7	8.1	33.1	5.0	267	84.1	12.3	11.8	81.1	527	-170.4	-639	105.8	155 (N/A)	11.2	1.23
Apple	9.5	1.6	4.6	0.4	51	39.1	5.6	5.3	35.8	240	-0.1	0	101.7	290 (N/A)	10.4	2.48
Honeylocust	26.0	4.3	12.0	1.2	138	63.9	9.4	8.9	61.3	400	-19.7	-74	167.3	464 (N/A)	4.4	9.46
Sugar maple	13.6	2.3	7.0	0.6	74	55.0	8.1	7.7	52.9	344	-10.9	-41	136.2	378 (N/A)	4.4	7.71
Blue spruce	1.2	0.2	1.2	0.1	8	5.9	0.9	0.8	5.5	37	-4.0	-15	11.8	30 (N/A)	4.1	0.65
Littleleaf linden	7.3	1.3	3.7	0.3	40	25.9	3.8	3.6	24.6	161	-3.7	-14	66.8	188 (N/A)	3.0	5.52
Northern hackberry	12.9	2.2	6.7	0.6	71	49.9	7.2	6.9	47.2	310	0.0	0	133.6	381 (N/A)	2.8	11.91
American basswood	5.5	0.9	2.8	0.2	30	24.2	3.5	3.3	22.7	150	-4.9	-18	58.3	161 (N/A)	2.3	6.21
Northern white cedar	6.3	1.3	5.1	0.8	42	12.3	1.8	1.7	11.7	77	-31.0	-116	9.9	2 (N/A)	2.2	0.07
Maple	1.1	0.2	0.6	0.0	6	7.5	1.1	1.0	7.1	47	-0.5	-2	18.2	51 (N/A)	2.0	2.22
Red maple	1.8	0.3	0.9	0.1	10	8.2	1.2	1.1	7.8	51	-0.7	-3	20.7	58 (N/A)	1.1	4.84
Norway spruce	2.3	0.5	1.9	0.3	15	5.7	0.8	0.8	5.5	36	-9.8	-37	8.0	14 (N/A)	1.1	1.18
Amur maple	0.9	0.2	0.5	0.0	5	4.2	0.6	0.6	3.8	26	0.0	0	10.7	30 (N/A)	1.0	2.77
Northern red oak	2.6	0.4	1.3	0.1	14	7.0	1.0	1.0	6.7	44	-3.7	-14	16.5	44 (N/A)	1.0	4.00
Black walnut	4.2	0.7	2.0	0.2	22	13.4	2.0	1.9	12.7	84	0.0	0	37.0	106 (N/A)	0.9	10.58
Eastern red cedar	1.8	0.4	1.4	0.2	12	2.9	0.4	0.4	2.7	18	-4.9	-18	5.4	12 (N/A)	0.5	1.92
Willow	2.8	0.5	1.4	0.1	15	6.7	1.0	0.9	6.2	41	-0.7	-2	19.0	54 (N/A)	0.4	10.84
Swamp white oak	0.2	0.0	0.1	0.0	1	1.7	0.2	0.2	1.6	10	-0.1	0	4.1	12 (N/A)	0.4	2.89
Pear	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	0.0	0	2.3	7 (N/A)	0.4	1.63
Conifer Evergreen Large	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	-0.1	0	0.1	0 (N/A)	0.3	0.05
White ash	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.5	10	0.0	0	3.7	10 (N/A)	0.3	3.43
Mulberry	0.8	0.1	0.4	0.0	4	2.7	0.4	0.4	2.6	17	0.0	0	7.5	21 (N/A)	0.3	7.15
Boxelder	0.1	0.0	0.1	0.0	0	0.9	0.1	0.1	0.9	6	-0.1	0	2.1	6 (N/A)	0.3	1.99
Paper birch	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	0.3	0.35
Ohio buckeye	0.3	0.0	0.2	0.0	2	1.6	0.2	0.2	1.5	10	-0.1	0	4.0	11 (N/A)	0.2	5.69
River birch	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.2	0.14
American sycamore	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)	0.2	15.71
Elm	1.4	0.2	0.6	0.1	7	3.4	0.5	0.5	3.2	21	0.0	0	9.9	28 (N/A)	0.2	14.19
Black spruce	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.3	3 (N/A)	0.2	1.53
Black poplar	1.3	0.2	0.6	0.1	7	3.4	0.5	0.5	3.2	21	0.0	0	9.8	28 (N/A)	0.2	14.09
Mountain ash	0.4	0.1	0.2	0.0	2	1.7	0.3	0.2	1.7	11	0.0	0	4.6	13 (N/A)	0.2	6.56
Austrian pine	0.2	0.0	0.2	0.0	1	0.7	0.1	0.1	0.7	5	-0.6	-2	1.5	4 (N/A)	0.2	1.82
Catalpa	2.3	0.4	1.0	0.1	12	4.2	0.6	0.6	4.0	26	0.0	0	13.1	38 (N/A)	0.2	19.04
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)	0.1	0.71
Quaking aspen	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)	0.1	0.08
Eastern cottonwood	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	0.1	15.71
Eastern redbud	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)	0.1	0.71
American elm	0.5	0.1	0.3	0.0	3	1.8	0.3	0.3	1.7	11	0.0	0	4.9	14 (N/A)	0.1	14.10
Japanese tree lilac	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)	0.1	0.11
Siberian elm	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)	0.1	2.97
Bur oak	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Tulip tree	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Citywide total	364.6	62.6	197.1	20.4	2,028	1,064.4	155.4	148.2	1,015.3	6,644	-332.1	-1,245	2,695.9	7,427 (N/A)	100.0	6.60

Table 4: Annual Carbon Stored

Manson

Stored CO2 Benefits of Public Trees

12/22/2015

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	2,172,271	16,292	(N/A)	17.9	28.2	81.05
Silver maple	2,391,030	17,933	(N/A)	13.2	31.0	120.35
Norway maple	601,022	4,508	(N/A)	11.6	7.8	34.41
Spruce	419,153	3,144	(N/A)	11.2	5.4	24.95
Apple	153,321	1,150	(N/A)	10.4	2.0	9.83
Honeylocust	331,392	2,485	(N/A)	4.4	4.3	50.72
Sugar maple	389,293	2,920	(N/A)	4.4	5.0	59.59
Blue spruce	5,709	43	(N/A)	4.1	0.1	0.93
Littleleaf linden	159,430	1,196	(N/A)	3.0	2.1	35.17
Northern hackberry	188,257	1,412	(N/A)	2.8	2.4	44.12
American basswood	198,601	1,490	(N/A)	2.3	2.6	57.29
Northern white cedar	78,832	591	(N/A)	2.2	1.0	23.65
Maple	15,362	115	(N/A)	2.0	0.2	5.01
Red maple	21,336	160	(N/A)	1.1	0.3	13.33
Norway spruce	23,632	177	(N/A)	1.1	0.3	14.77
Amur maple	15,269	115	(N/A)	1.0	0.2	10.41
Northern red oak	55,528	416	(N/A)	1.0	0.7	37.86
Black walnut	136,791	1,026	(N/A)	0.9	1.8	102.59
Eastern red cedar	5,787	43	(N/A)	0.5	0.1	7.23
Willow	46,061	345	(N/A)	0.4	0.6	69.09
Swamp white oak	4,280	32	(N/A)	0.4	0.1	8.02
Pear	2,171	16	(N/A)	0.4	0.0	4.07
Conifer Evergreen La	7	0	(N/A)	0.3	0.0	0.02
White ash	4,043	30	(N/A)	0.3	0.1	10.11
Mulberry	12,817	96	(N/A)	0.3	0.2	32.04
Boxelder	1,538	12	(N/A)	0.3	0.0	3.84
Paper birch	210	2	(N/A)	0.3	0.0	0.52
Ohio buckeye	4,725	35	(N/A)	0.2	0.1	17.72
River birch	34	0	(N/A)	0.2	0.0	0.13
American sycamore	51,886	389	(N/A)	0.2	0.7	194.57
Elm	47,716	358	(N/A)	0.2	0.6	178.94
Black spruce	1,120	8	(N/A)	0.2	0.0	4.20
Black poplar	41,716	313	(N/A)	0.2	0.5	156.43
Mountain ash	6,074	46	(N/A)	0.2	0.1	22.78
Austrian pine	1,161	9	(N/A)	0.2	0.0	4.35
Catalpa	78,517	589	(N/A)	0.2	1.0	294.44
Dogwood	178	1	(N/A)	0.1	0.0	1.33
Quaking aspen	12	0	(N/A)	0.1	0.0	0.09
Eastern cottonwood	25,943	195	(N/A)	0.1	0.3	194.57
Eastern redbud	178	1	(N/A)	0.1	0.0	1.33
American elm	12,245	92	(N/A)	0.1	0.2	91.84
Japanese tree lilac	14	0	(N/A)	0.1	0.0	0.10
Siberian elm	908	7	(N/A)	0.1	0.0	6.81
Bur oak	3,672	28	(N/A)	0.1	0.0	27.54
Tulip tree	3,672	28	(N/A)	0.1	0.0	27.54
Citywide total	7,712,917	57,847	(N/A)	100.0	100.0	51.42

Table 5: Annual Carbon Sequestered

Manson

Annual CO₂ Benefits of Public Trees

12/22/2015

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
Green ash	124,308	932	-10,427	-547	-4	0	0	113,334	850 (N/A)	17.9	23.9	4.23
Silver maple	188,553	1,414	-11,477	-517	-4	0	0	176,559	1,324 (N/A)	13.2	37.3	8.89
Norway maple	42,034	315	-2,887	-258	-2	0	0	38,889	292 (N/A)	11.6	8.2	2.23
Spruce	20,278	152	-2,012	-327	-2	0	0	17,939	135 (N/A)	11.2	3.8	1.07
Apple	10,171	76	-738	-121	-1	0	0	9,313	70 (N/A)	10.4	2.0	0.60
Honeylocust	29,830	224	-1,594	-108	-1	0	0	28,129	211 (N/A)	4.4	5.9	4.31
Sugar maple	22,890	172	-1,869	-119	-1	0	0	20,903	157 (N/A)	4.4	4.4	3.20
Blue spruce	677	5	-28	-24	0	0	0	625	5 (N/A)	4.1	0.1	0.10
Littleleaf linden	15,716	118	-767	-64	0	0	0	14,885	112 (N/A)	3.0	3.1	3.28
Northern hackberry	11,913	89	-904	-92	-1	0	0	10,917	82 (N/A)	2.8	2.3	2.56
American basswood	12,824	96	-953	-57	0	0	0	11,813	89 (N/A)	2.3	2.5	3.41
Northern white cedar	2,174	16	-378	-54	0	0	0	1,742	13 (N/A)	2.2	0.4	0.52
Maple	2,295	17	-74	-18	0	0	0	2,202	17 (N/A)	2.0	0.5	0.72
Red maple	2,966	22	-102	-16	0	0	0	2,848	21 (N/A)	1.1	0.6	1.78
Norway spruce	1,065	8	-113	-22	0	0	0	929	7 (N/A)	1.1	0.2	0.58
Amur maple	1,455	11	-73	-12	0	0	0	1,370	10 (N/A)	1.0	0.3	0.93
Northern red oak	1,398	10	-267	-19	0	0	0	1,112	8 (N/A)	1.0	0.2	0.76
Black walnut	6,655	50	-657	-29	0	0	0	5,969	45 (N/A)	0.9	1.3	4.48
Eastern red cedar	211	2	-28	-11	0	0	0	173	1 (N/A)	0.5	0.0	0.22
Willow	2,250	17	-221	-14	0	0	0	2,014	15 (N/A)	0.4	0.4	3.02
Swamp white oak	673	5	-23	-4	0	0	0	646	5 (N/A)	0.4	0.1	1.21
Pear	304	2	-10	-4	0	0	0	290	2 (N/A)	0.4	0.1	0.54
Conifer Evergreen Large	11	0	0	-1	0	0	0	10	0 (N/A)	0.3	0.0	0.02
White ash	624	5	-21	-3	0	0	0	601	5 (N/A)	0.3	0.1	1.50
Mulberry	535	4	-62	-7	0	0	0	466	3 (N/A)	0.3	0.1	1.17
Boxelder	294	2	-9	-2	0	0	0	283	2 (N/A)	0.3	0.1	0.71
Paper birch	79	1	-1	-1	0	0	0	77	1 (N/A)	0.3	0.0	0.19
Ohio buckeye	610	5	-23	-3	0	0	0	584	4 (N/A)	0.2	0.1	2.19
River birch	11	0	0	0	0	0	0	10	0 (N/A)	0.2	0.0	0.04
American sycamore	1,919	14	-249	-9	0	0	0	1,662	12 (N/A)	0.2	0.4	6.23
Elm	1,572	12	-229	-8	0	0	0	1,335	10 (N/A)	0.2	0.3	5.01
Black spruce	92	1	-5	-2	0	0	0	85	1 (N/A)	0.2	0.0	0.32
Black poplar	1,816	14	-200	-8	0	0	0	1,608	12 (N/A)	0.2	0.3	6.03
Mountain ash	535	4	-29	-4	0	0	0	502	4 (N/A)	0.2	0.1	1.88
Austrian pine	103	1	-6	-3	0	0	0	95	1 (N/A)	0.2	0.0	0.35
Catalpa	1,824	14	-377	-10	0	0	0	1,437	11 (N/A)	0.2	0.3	5.39
Dogwood	38	0	-1	-1	0	0	0	37	0 (N/A)	0.1	0.0	0.27
Quaking aspen	3	0	0	0	0	0	0	2	0 (N/A)	0.1	0.0	0.02
Eastern cottonwood	960	7	-125	-4	0	0	0	831	6 (N/A)	0.1	0.2	6.23
Eastern redbud	38	0	-1	-1	0	0	0	37	0 (N/A)	0.1	0.0	0.27
American elm	454	3	-59	-4	0	0	0	392	3 (N/A)	0.1	0.1	2.94
Japanese tree lilac	9	0	0	0	0	0	0	8	0 (N/A)	0.1	0.0	0.06
Siberian elm	161	1	-4	-1	0	0	0	156	1 (N/A)	0.1	0.0	1.17
Bur oak	445	3	-18	-2	0	0	0	426	3 (N/A)	0.1	0.1	3.19
Tulip tree	445	3	-18	-2	0	0	0	426	3 (N/A)	0.1	0.1	3.19
Citywide total	513,219	3,849	-37,037	-2,512	-19	0	0	473,669	3,553 (N/A)	100.0	100.0	3.16

Table 6: Annual Social and Aesthetic Benefits

Manson

Annual Aesthetic/Other Benefits of Public Trees

12/22/2015

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	10,618	(N/A)	17.9	20.0	52.82
Silver maple	15,096	(N/A)	13.2	28.4	101.31
Norway maple	4,250	(N/A)	11.6	8.0	32.44
Spruce	4,719	(N/A)	11.2	8.9	37.45
Apple	561	(N/A)	10.4	1.1	4.79
Honeylocust	6,822	(N/A)	4.4	12.8	139.22
Sugar maple	2,508	(N/A)	4.4	4.7	51.17
Blue spruce	455	(N/A)	4.1	0.9	9.90
Littleleaf linden	1,702	(N/A)	3.0	3.2	50.07
Northern hackberry	1,702	(N/A)	2.8	3.2	53.17
American basswood	1,006	(N/A)	2.3	1.9	38.70
Northern white cedar	354	(N/A)	2.2	0.7	14.16
Maple	393	(N/A)	2.0	0.7	17.08
Red maple	450	(N/A)	1.1	0.8	37.49
Norway spruce	254	(N/A)	1.1	0.5	21.16
Amur maple	83	(N/A)	1.0	0.2	7.53
Northern red oak	128	(N/A)	1.0	0.2	11.61
Black walnut	534	(N/A)	0.9	1.0	53.41
Eastern red cedar	76	(N/A)	0.5	0.1	12.68
Willow	204	(N/A)	0.4	0.4	40.73
Swamp white oak	78	(N/A)	0.4	0.1	19.45
Pear	17	(N/A)	0.4	0.0	4.23
Conifer Evergreen Large	17	(N/A)	0.3	0.0	5.76
White ash	89	(N/A)	0.3	0.2	29.76
Mulberry	31	(N/A)	0.3	0.1	10.32
Boxelder	65	(N/A)	0.3	0.1	21.76
Paper birch	25	(N/A)	0.3	0.0	8.42
Ohio buckeye	65	(N/A)	0.2	0.1	32.69
River birch	5	(N/A)	0.2	0.0	2.74
American sycamore	133	(N/A)	0.2	0.3	66.60
Elm	116	(N/A)	0.2	0.2	58.01
Black spruce	30	(N/A)	0.2	0.1	15.13
Black poplar	132	(N/A)	0.2	0.2	66.10
Mountain ash	31	(N/A)	0.2	0.1	15.48
Austrian pine	38	(N/A)	0.2	0.1	18.77
Catalpa	117	(N/A)	0.2	0.2	58.34
Dogwood	2	(N/A)	0.1	0.0	2.06
Quaking aspen	5	(N/A)	0.1	0.0	5.26
Eastern cottonwood	67	(N/A)	0.1	0.1	66.60
Eastern redbud	2	(N/A)	0.1	0.0	2.06
American elm	64	(N/A)	0.1	0.1	64.36
Japanese tree lilac	0	(N/A)	0.1	0.0	0.03
Siberian elm	22	(N/A)	0.1	0.0	22.05
Bur oak	46	(N/A)	0.1	0.1	45.86
Tulip tree	46	(N/A)	0.1	0.1	45.86
Citywide total	53,157	(N/A)	100.0	100.0	47.25

Table 7: Summary of Benefits in Dollars

Manson

Total Annual Benefits of Public Trees by Species ($)

12/22/201

Species	Energy	CO$_2$	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	11,198	850	1,963	15,126	10,618	39,755	(N/A)	22.3
Silver maple	9,884	1,324	1,816	18,155	15,096	46,275	(N/A)	26.0
Norway maple	5,659	292	966	5,467	4,250	16,633	(N/A)	9.3
Spruce	3,636	135	155	9,425	4,719	18,069	(N/A)	10.1
Apple	1,810	70	290	898	561	3,629	(N/A)	2.0
Honeylocust	2,778	211	464	3,691	6,822	13,965	(N/A)	7.8
Sugar maple	2,376	157	378	2,985	2,508	8,404	(N/A)	4.7
Blue spruce	273	5	30	347	455	1,111	(N/A)	0.6
Littleleaf linden	1,141	112	188	1,272	1,702	4,415	(N/A)	2.5
Northern hackberry	2,200	82	381	2,409	1,702	6,774	(N/A)	3.8
American basswood	1,075	89	161	1,236	1,006	3,568	(N/A)	2.0
Northern white cedar	543	13	2	1,458	354	2,370	(N/A)	1.3
Maple	338	17	51	227	393	1,026	(N/A)	0.6
Red maple	352	21	58	280	450	1,161	(N/A)	0.7
Norway spruce	247	7	14	546	254	1,069	(N/A)	0.6
Amur maple	196	10	30	93	83	413	(N/A)	0.2
Northern red oak	310	8	44	354	128	844	(N/A)	0.5
Black walnut	590	45	106	886	534	2,160	(N/A)	1.2
Eastern red cedar	134	1	12	239	76	463	(N/A)	0.3
Willow	306	15	54	371	204	949	(N/A)	0.5
Swamp white oak	74	5	12	51	78	219	(N/A)	0.1
Pear	47	2	7	18	17	91	(N/A)	0.1
Conifer Evergreen Large	3	0	0	4	17	24	(N/A)	0.0
White ash	61	5	10	54	89	219	(N/A)	0.1
Mulberry	122	3	21	68	31	246	(N/A)	0.1
Boxelder	41	2	6	35	65	149	(N/A)	0.1
Paper birch	7	1	1	6	25	40	(N/A)	0.0
Ohio buckeye	71	4	11	54	65	206	(N/A)	0.1
River birch	2	0	0	1	5	9	(N/A)	0.0
American sycamore	164	12	31	298	133	639	(N/A)	0.4
Elm	148	10	28	266	116	569	(N/A)	0.3
Black spruce	26	1	3	43	30	103	(N/A)	0.1
Black poplar	153	12	28	256	132	581	(N/A)	0.3
Mountain ash	76	4	13	36	31	160	(N/A)	0.1
Austrian pine	31	1	4	49	38	122	(N/A)	0.1
Catalpa	182	11	38	392	117	740	(N/A)	0.4
Dogwood	5	0	1	2	2	10	(N/A)	0.0
Quaking aspen	1	0	0	0	5	7	(N/A)	0.0
Eastern cottonwood	82	6	16	149	67	319	(N/A)	0.2
Eastern redbud	5	0	1	2	2	10	(N/A)	0.0
American elm	80	3	14	123	64	285	(N/A)	0.2
Japanese tree lilac	1	0	0	0	0	1	(N/A)	0.0
Siberian elm	20	1	3	17	22	63	(N/A)	0.0
Bur oak	44	3	7	40	46	140	(N/A)	0.1
Tulip tree	44	3	7	40	46	140	(N/A)	0.1
Citywide Total	46,542	3,553	7,427	67,469	53,157	178,147	(N/A)	100.0

Legend (pie chart):
- Green ash
- Silver maple
- Norway maple
- Spruce
- Apple
- Sugar maple
- Honeylocust
- Blue spruce
- Littleleaf linden
- Northern hackberry
- Other species

Pie chart values: 2.85, 3.02, 4.09, 4.36, 4.36, 10.41, 11.21, 11.65, 13.26, 17.79, 16.99
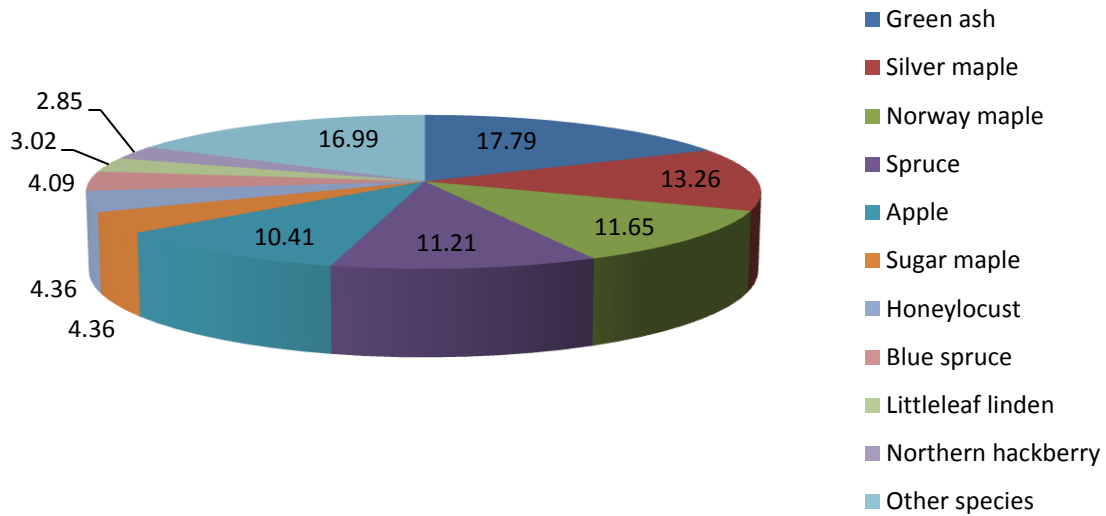
Figure 1: Species Distribution

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

(%) — DBH Class

Axis categories (DBH Class): 0-3, 3-6, 6-12, 12-18, 18-24, 24-30, 30-36, 36-42, >42

Series labels: Green ash, Silver maple, Norway maple, Spruce, Apple, Sugar maple, Honeylocust, Blue spruce, Littleleaf linden, Northern hackberry, Citywide total

Legend:
- Green ash
- Silver maple
- Norway maple
- Spruce
- Apple
- Sugar maple
- Honeylocust
- Blue spruce
- Littleleaf linden
- Northern hackberry
- Citywide total

Figure 2: Relative Age Class

Leaf Condtion

Dead or Dying
0% Poor 1% Fair 7%

Good
92%

Legend:
- Dead or Dying
- Poor
- Fair
- Good
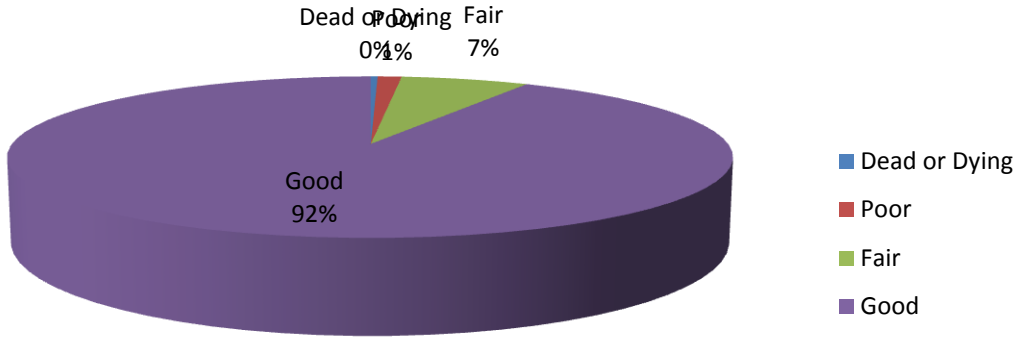
Figure 3: Foliage Condition

Wood Condition

Dead or Dying
1% Poor 7%

Fair
24%

Good
68%

Legend:
- Dead or Dying
- Poor
- Fair
- Good
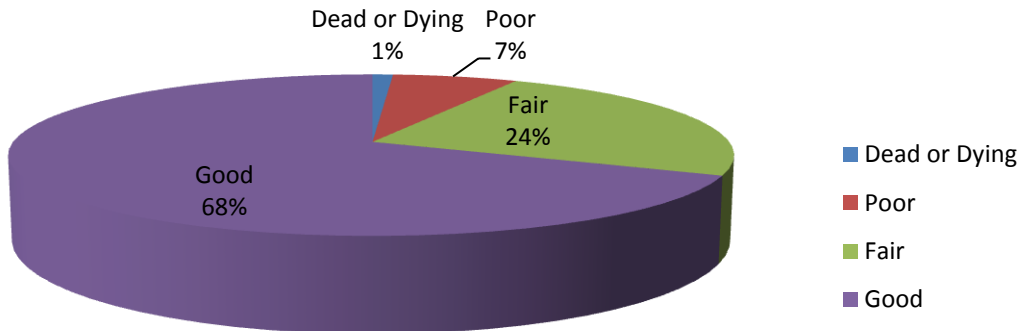
Figure 4: Wood Condition

Canopy Cover
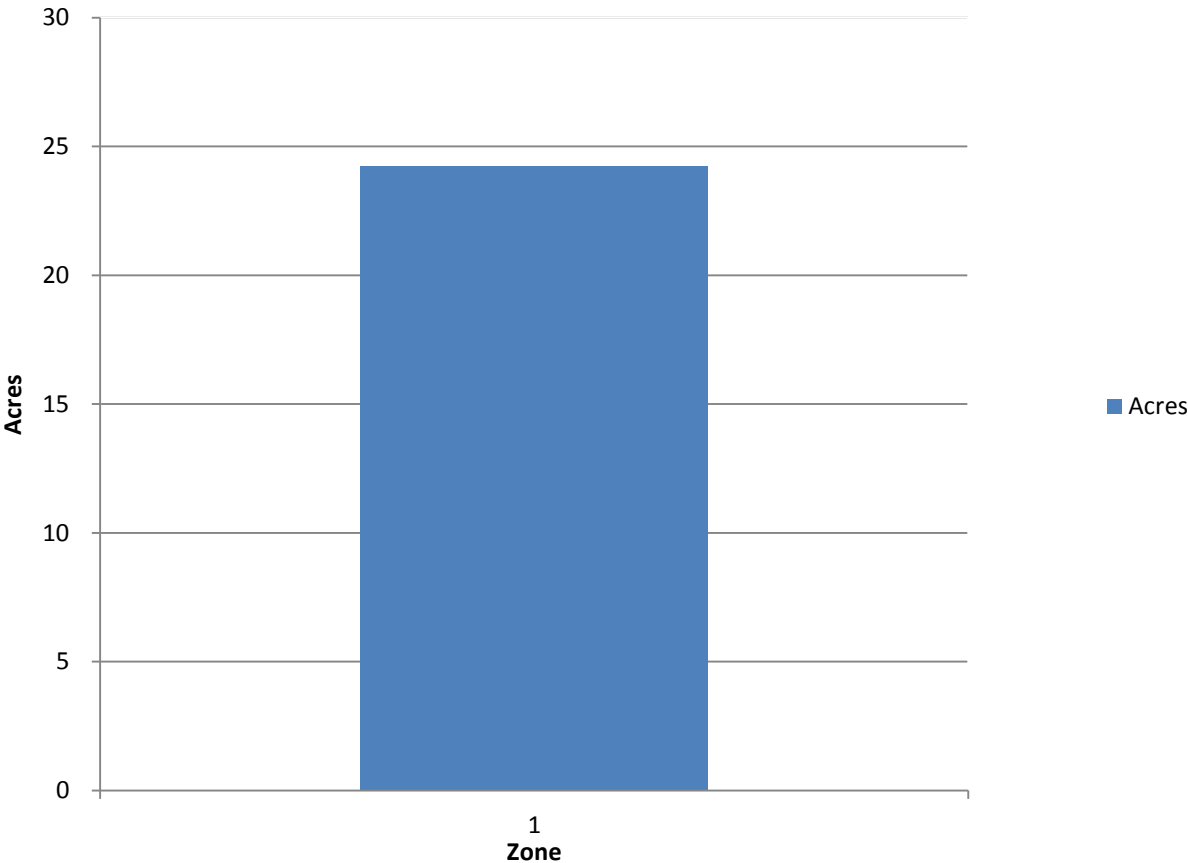
Figure 5: Canopy Cover in Acres

Land use Public Trees by Zone (%)
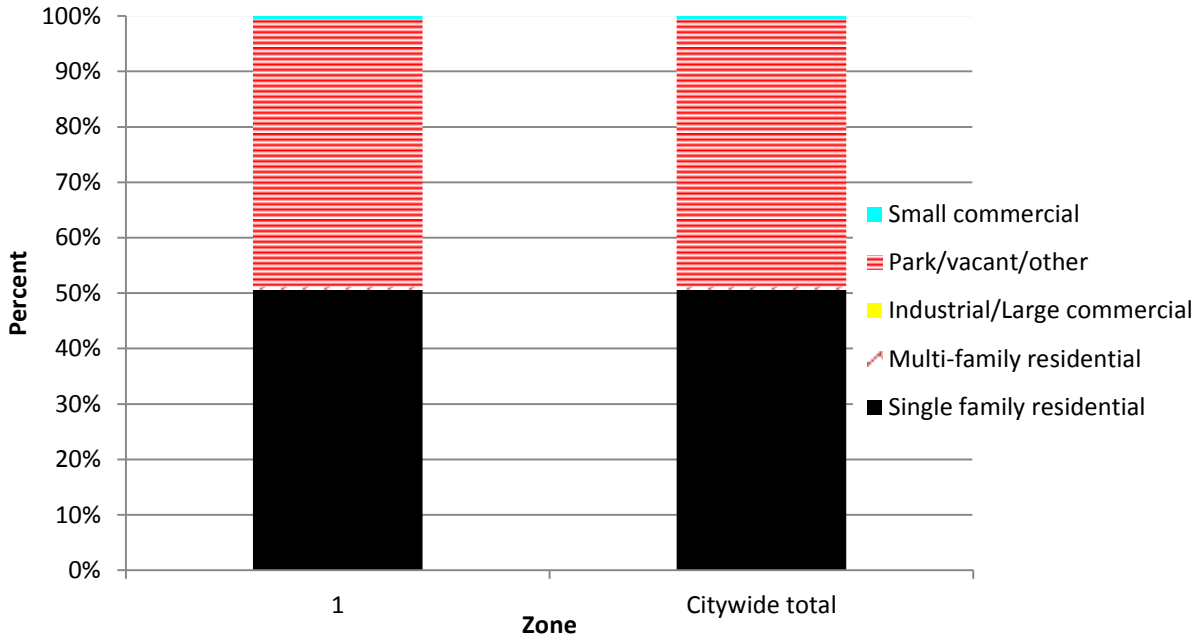
Figure 6: Land Use of city/park trees

Location Public Trees by Zone (%)
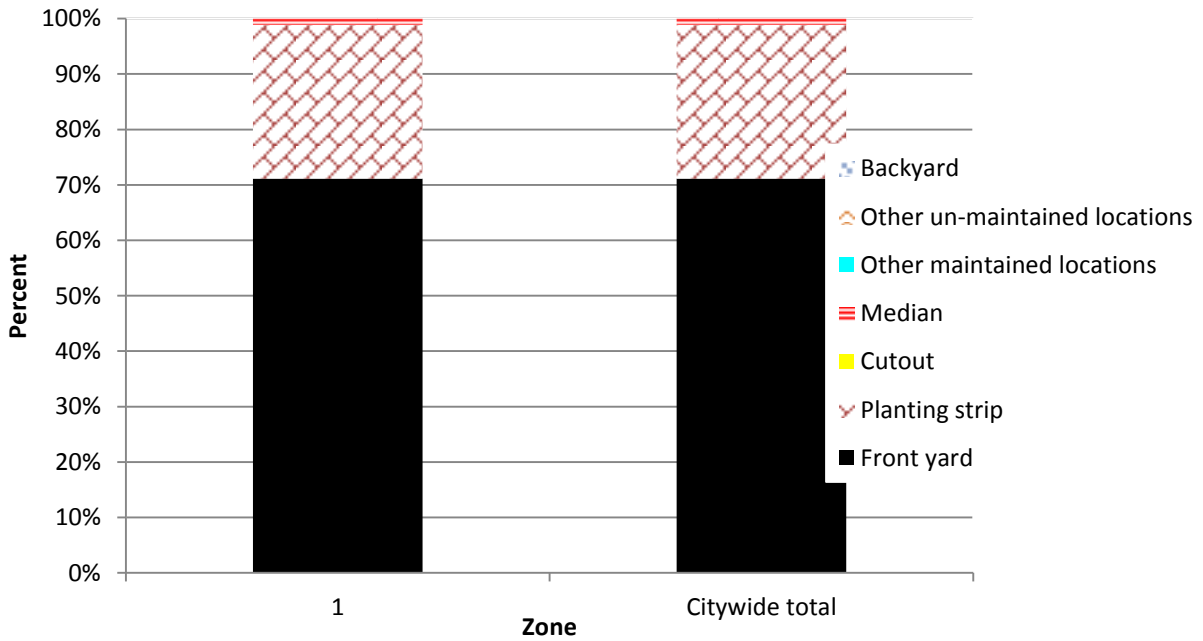
Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping
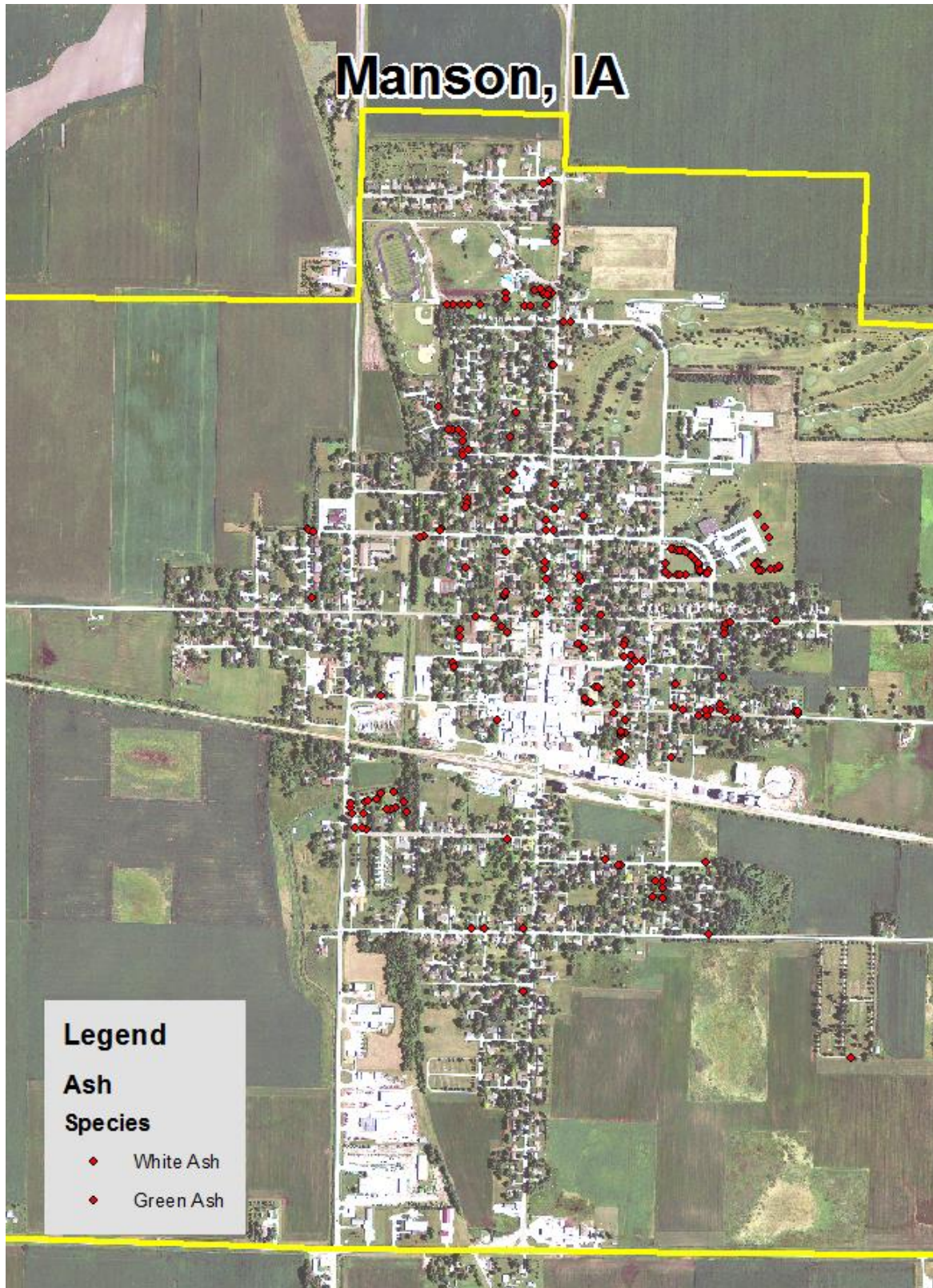
Figure 1: Location of Ash Trees
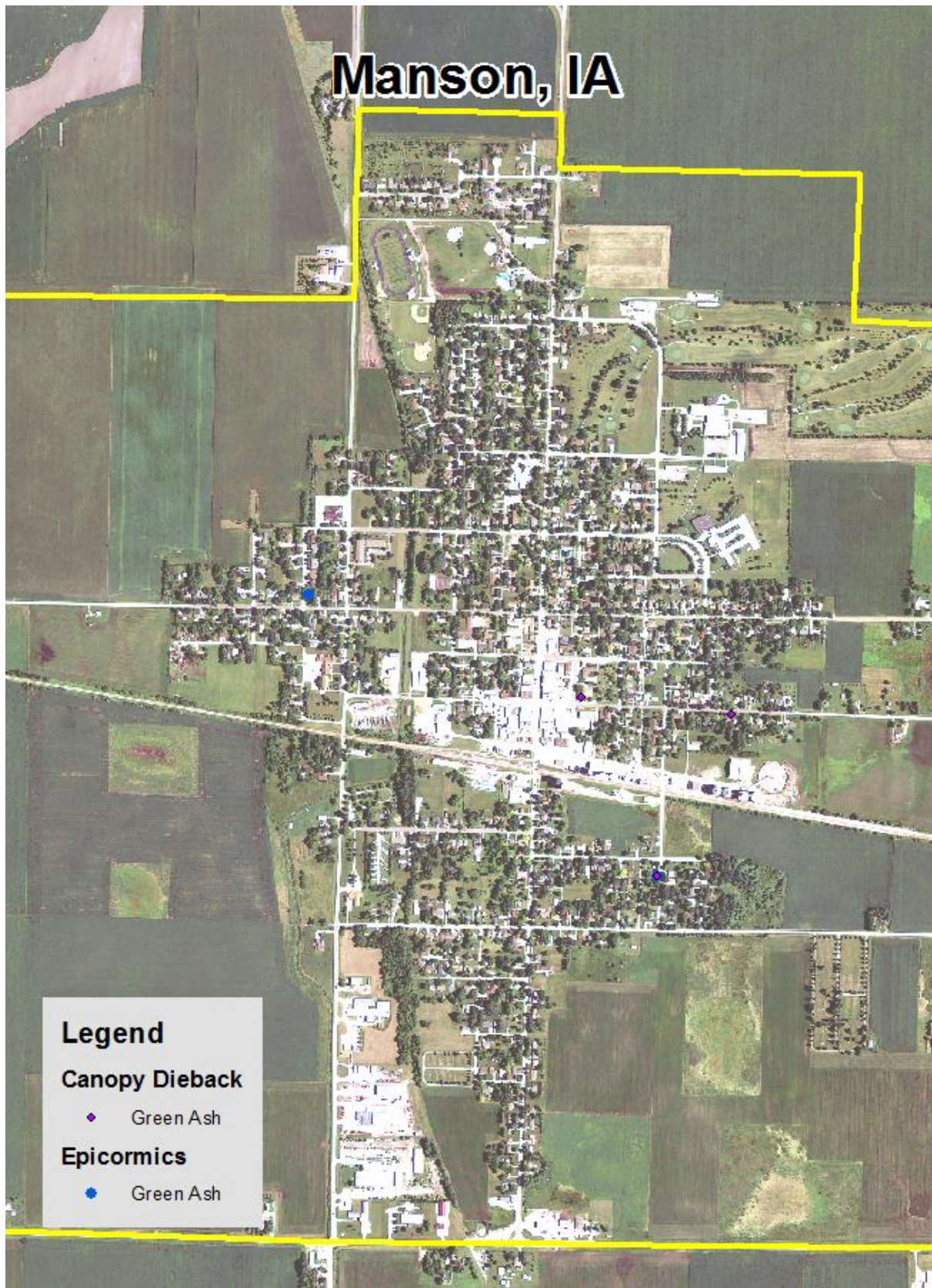
Figure 2: Location of EAB symptoms
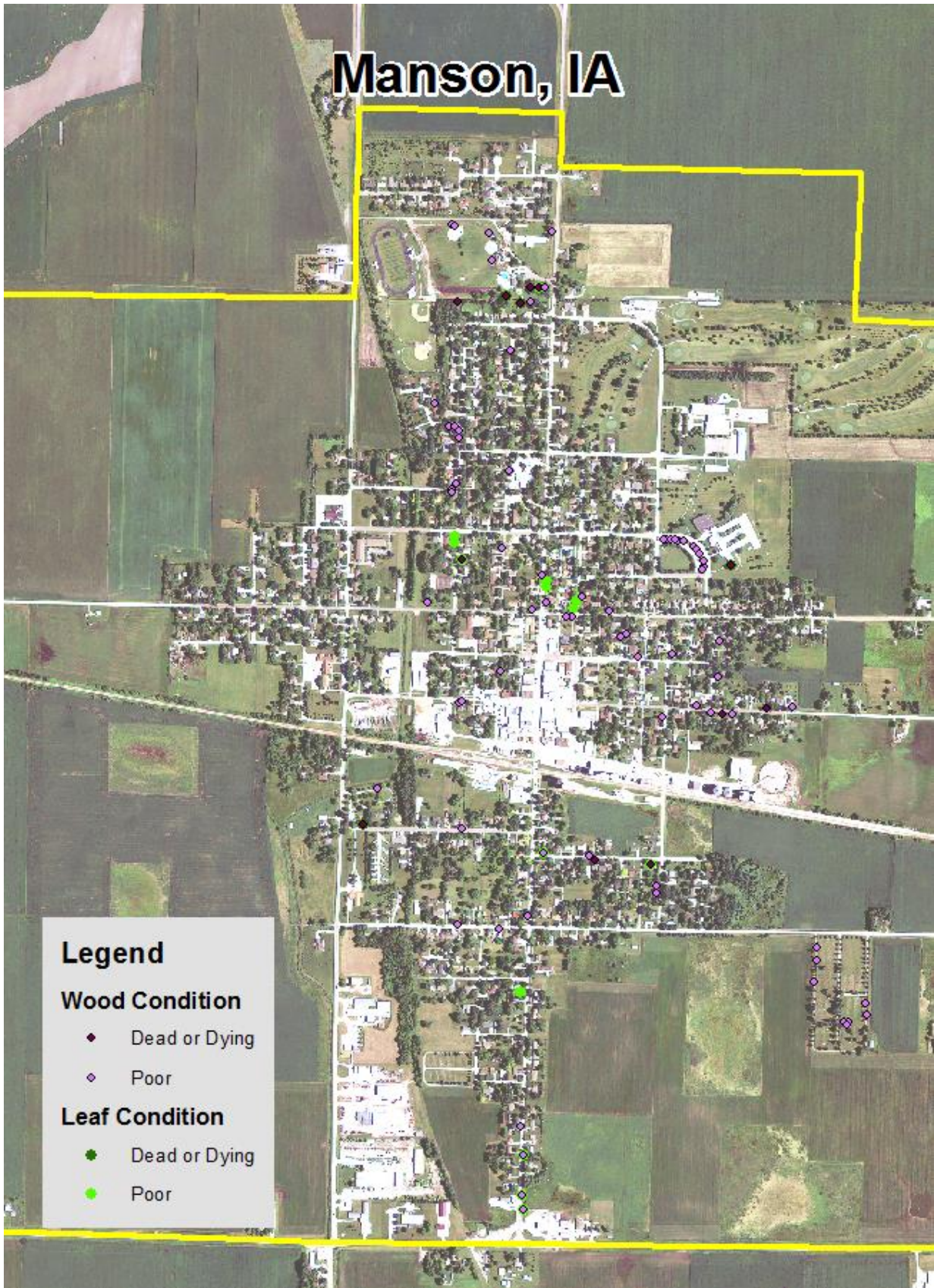
Figure 3: Location of Poor Condition Trees
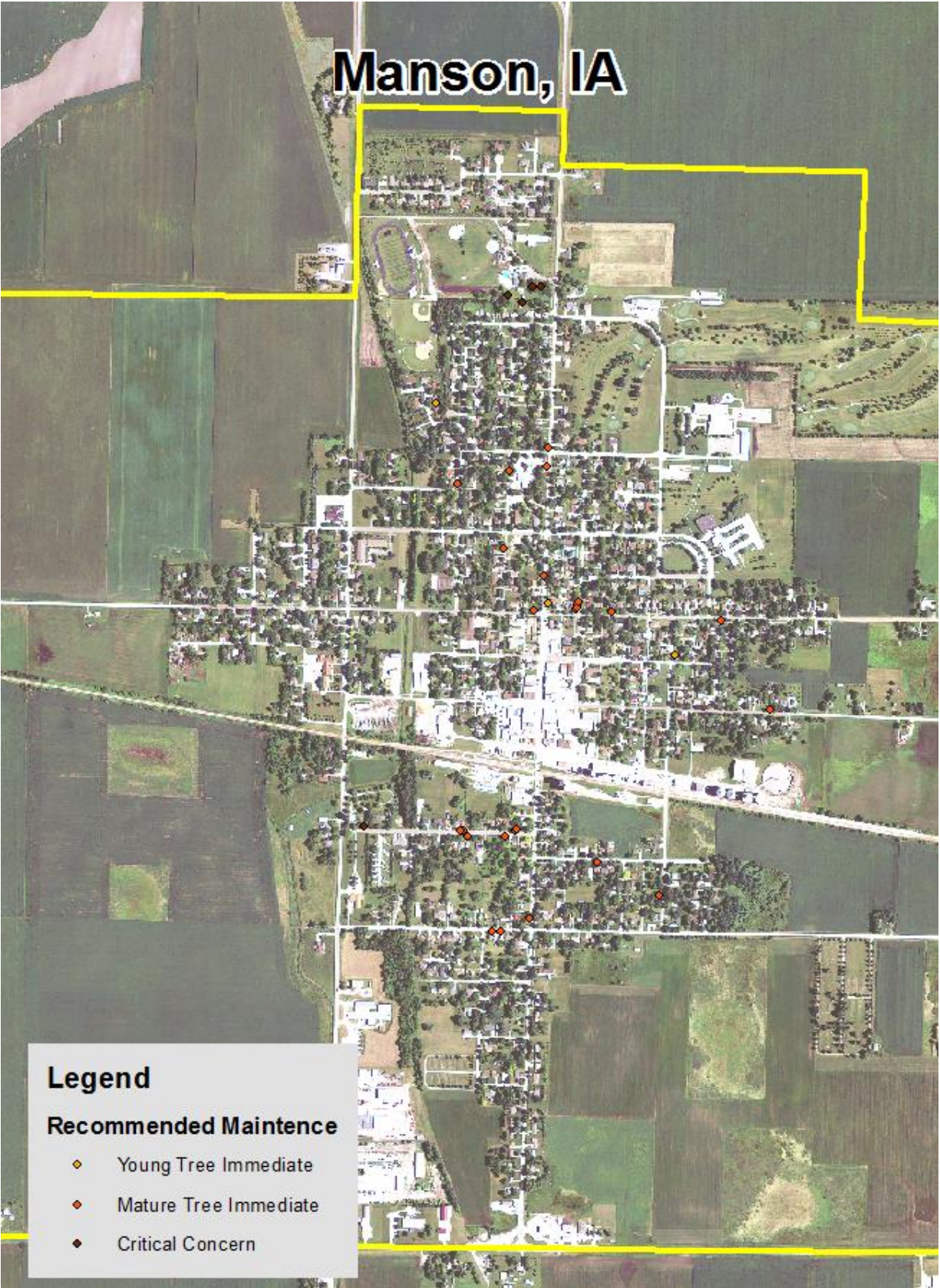
Figure 4: Location of Trees with Recommended Maintenance
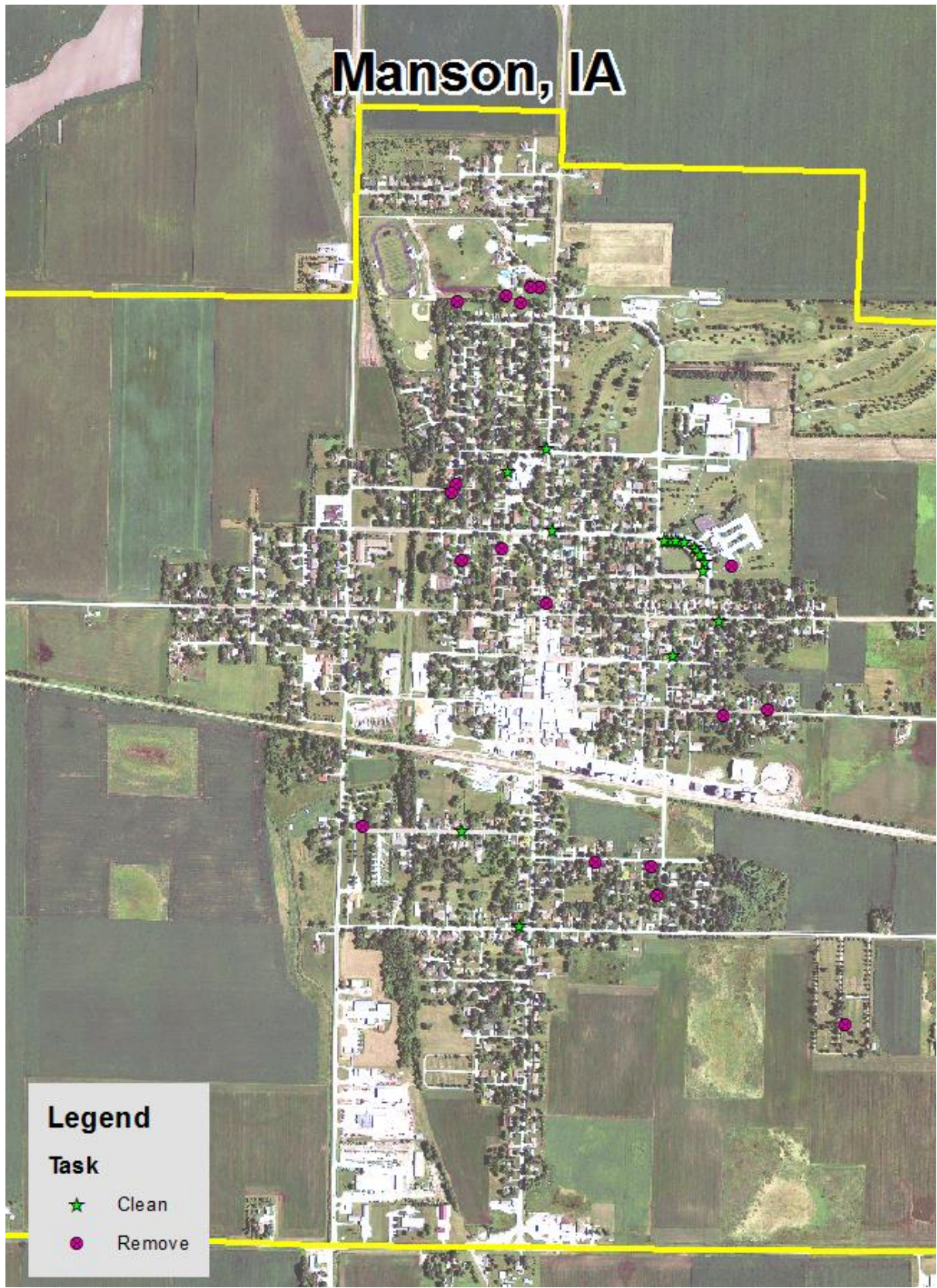
Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*