

2013 COMMUNITY TREE MANAGEMENT PLAN

Prepared by: LINDSEY BARNEY
Bureau of Forestry, Iowa DNR

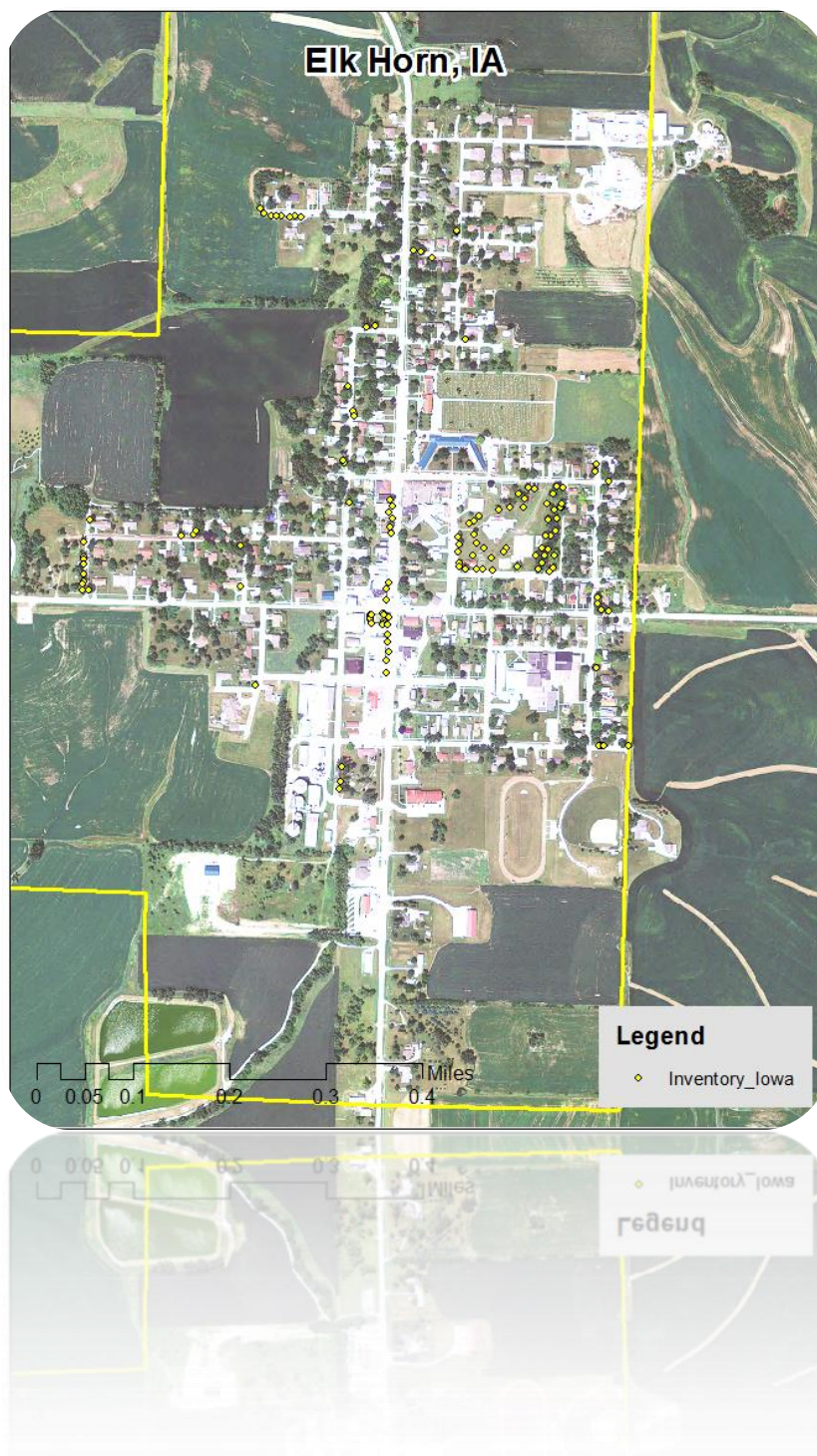


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Executive Summary

Overview

This plan was developed to assist the City of Elk Horn 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 14.3% of Elk Horn's inventoried right of way trees (ash) will die once EAB becomes established in the community. Your District Forester can help your community members understand the cause and effects of EAB in addition to planning for removal trees and suitable replacements.

Inventory and Results

In 2013, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street right of way and park trees. Below are some key findings of the 133 trees inventoried.

- Elk Horn's trees provide \$20,457 of benefits annually, an average of \$154 a tree
- There are over 27 species of trees
- The top three genus are: Maple 27.8%, Ash 14.3%, and Cedar 9.8%
- 6% of trees are in need of some type of management
- 5 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 5 trees needing removal, 1 tree is over 24 inches in diameter at 4.5 ft and must be addressed immediately **Private or public ownership should be established prior to any tree removals.**
- 6 of the 19 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB
- All city managed 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, maple, cottonwood, poplar, box elder, Chinese or Siberian elm, elm, evergreen, willow, black walnut, tree of heaven, exotic mulberry trees (white mulberry is very common), and Bradford/Callery Pear. Please also be careful not to plant the following shrubs, as they are considered invasive species: autumn olive, honeysuckles, salt cedar, rhododendron, multiflora rose, buckthorn, Japanese Barberry, Burning Bush, and Oriental bittersweet (a vine).
- Check ash trees with a visual survey yearly

- The community as a whole should be aware that if every right of way inventoried ash were to die of EAB, the replanting and replacement costs would total an estimated \$12,300. Over 10 years, the community of Elk Horn should budget at least \$1200 to cover these potential future expenses.

Introduction

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

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

Inventory

In 2013, a tree inventory was conducted that included 100% of the city owned street right of way and park trees. 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 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 for the 133 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Elk Horn's trees reduce energy related costs by approximately \$5,192 annually (Appendix A, Table 1). These savings are both in Electricity (24.6 MWh) and in Natural Gas (3,390.1 Therms).

Annual Stormwater Benefits

Elk Horn's trees intercept about 291,609 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$7,903 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 Elk Horn, it is estimated that trees remove 309 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$862 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Elk Horn, trees sequester about 59,507 lbs of carbon a year with an associated value of \$446 (Appendix A, Table 5). In addition, the trees store 1,065,138 lbs of carbon, with a yearly benefit of \$7,989 (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. Elk Horn receives \$5,782 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Elk Horn's trees provide \$20,457 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 133 trees in Elk Horn provide approximately \$154 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Elk Horn has over 27 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Genus	Count	Percentage
Maple	37	27.8%
Ash	19	14.3%
Cedar	13	9.8%
Elm	10	7.5%
Apple	8	6.0%
Spruce	8	6.0%
Birch	5	3.8%
Honeylocust	5	3.8%
Poplar	4	3.0%
Walnut	4	3.0%
Oak	3	2.3%
Pine	3	2.3%
Broadleaf Deciduous	2	1.5%
Conifer Evergreen	2	1.5%
Japanese Tree Lilac	2	1.5%
Pear	2	1.5%
Sycamore	2	1.5%
Dogwood	1	0.8%
Hackberry	1	0.8%
Linden	1	0.8%
Ohio Buckeye	1	0.8%
	133	

Age Class

Most of Elk Horn's trees (23%) are between 24 and 30 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 18 inches in diameter at 4.5 ft. Elk Horn's size curve is on the slightly larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Elk Horn indicate that 94% of the trees are in good or fair health, with only 6% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 94% of Elk Horn's trees are in good or fair health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 6% of the population. This 6% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	14	10.5%
Tree Removal	5	3.8%
Treat Pest/Disease	4	3.0%
Tree Staking	1	<1%

Canopy Cover

The right of way and park canopy cover of Elk Horn is approximately 2.87 acres (Appendix A, Figure 4). According to the 2010 census, Elk Horn occupies 512 acres. Thus the canopy cover on city parks and right of way areas is about 0.5%.

Land Use and Location

The majority of Elk Horn's city managed trees are found on park land and planting strips. Planting strips are most common in single family residential areas (Appendix A, Figure 6 & Appendix A, Figure 7). The following describes the land use and locations for the street and park trees.

Land Use

Park/vacant/other	53.38%
Single family residential	31.58%
Small commercial	12.03%
Industrial/Large Commercial	3.01%

Location

Front yard	84.21%
Cutout	12.03%
Planting strip	3.76%

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

Elk Horn has 2 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 is 1 tree over 24 inches in diameter at 4.5 ft that should be addressed immediately. After the 5 critical concern trees are addressed, there should be follow up on immediate concern trees (both mature and young). There are a total of 15 trees with these needs.

PRIORITY TASK	# BY TASK UNDER CRITICAL CONCERN	# BY TASK UNDER MATURE TREE IMMEDIATE	# BY TASK UNDER MATURE TREE ROUTINE	# BY TASK UNDER YOUNG TREE IMMEDIATE	# BY TASK UNDER YOUNG TREE ROUTINE	NONE	TOTAL
NONE: For immediate and critical concern activities, this means the tree needs follow-up by an arborist, for routine activities this means to treat the trees via routine maintenance	1	1	66		41		109
STAKE/TRAIN					1		1
CLEAN		10	4				14
RAISE							
REDUCE							
REMOVE	2	3					5
TREAT PEST/DISEASE (For most this means address carpenter ant activity)	2	1	1				4
TOTAL	5	15	71	0	42	0	133

Poor tree species

After the removal of the critical concern and immediate concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 5 removals, none are ash trees. There are a total of 19 ash trees, and 6 of those have signs and symptoms that have been associated with EAB. In addition, there are 3 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 five main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, crown reduction, and treat pest/disease. 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. Treat pest/disease trees showed indications of foliar or structural decline due to insect, disease, or rot. These trees should be investigated further by a certified arborist who can look into the integrity of the tree. It is recommended that all trees be pruned on a routine schedule every five to seven years.

Planting

It is recommended to plant 1.2 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 of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Elk Horn.

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 (28%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Recommended Species to plant in Western Iowa:

COMMON NAME	SCIENTIFIC NAME	CULTIVARS/SELECTIONS
LARGE SHADE TREES – Plant 35 feet apart and away from overhead power lines.		
Swamp White Oak	<i>Quercus bicolor</i>	
White Oak	<i>Quercus alba</i>	
Bur Oak	<i>Quercus macrocarpa</i>	

Red Oak	<i>Quercus rubra</i>	
Black Oak	<i>Quercus velutina</i>	
Chinkapin Oak	<i>Quercus muehlenbergii</i>	
American Basswood (Linden)	<i>Tilia Americana</i>	Boulevard, Front Yard, Legend, Redmond
Thornless Honeylocust	<i>Gleditsia triacanthos var. inermis</i>	Shademaster, Skyline
American elm	<i>Ulmus Americana</i>	Independence, New harmony, Valley Forge
Cottonwood (seedless) - ***Not recommended for planting near any homes or structures	<i>Populus deltoides</i>	Siouxland
Sycamore	<i>Plantanus occidentalis</i>	
Yellowwood	<i>Cladrastis lutea</i>	
Kentucky coffeetree	<i>Gymnocladus dioicus</i>	Expresso
Black Cherry	<i>Prunus serotina</i>	
Hackberry	<i>Celtis occidentalis</i>	Chicagoland, Prairie Pride, Windy City
LOW GROWING TREES (less than 30 feet tall) planted as close as 12 feet.		
Eastern redbud	<i>Cercis Canadensis</i>	
Thornless cockspur hawthorn or other native hawthorns	<i>Crataegus crusgalli var. inermis</i>	
Ironwood (hop hornbeam)	<i>Ostrya virginiana</i>	
American hornbeam	<i>Carpinus caroliniana</i>	
Serviceberry	<i>Amalanchier arborea</i>	Autumn brilliance, Cumulus, Princess Diana
Flowering crabapple	<i>Malus</i>	Prairiefire, Adams, Sentinel, Snowdrift
Red mulberry	<i>Morus rubra</i>	
American (wild) plum	<i>Prunus americana</i>	
EVERGREEN TREES – planted 25 feet apart and away from overhead power lines.		
Eastern White Pine	<i>Pinus strobes</i>	
Jack pine	<i>Pinus banksiana</i>	
Junipers (Eastern red cedar)	<i>Juniperus virginiana</i>	
Norway spruce	<i>Picea abies</i>	
Concolor fir	<i>Abies concolor</i>	
Bald cypress	<i>Taxodium distichum</i>	
Arborvitae (Northern White cedar)	<i>Thuja occidentalis</i>	Techny, Brandon, Holmstrup

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 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**

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million 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 ash trees should be replaced. All trees need to meet the restrictions in city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and

will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genus 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 (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the 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.”

Treating for EAB

Many landowners will want to treat their ash trees with insecticides to prolong the life of their ash trees. This is only recommended when EAB has been found within 15 miles of the tree in question. Insecticidal injections or drenches can have serious environmental side effects (on birds, bees, non-target insects, and can enter groundwater sources). Some insecticides have application limits – like only treating 3 trees per acre, for instance. Within a city scenario – it is likely that these chemicals will be over applied. Please contact me if you have any questions. I would be more than happy to host an informational meeting on EAB and its effects on community ash trees.

My suggestion would be to start increasing the city tree budget for removals and replacements now. I would place all efforts and finances on replanting trees – and removing tree casualties as they arise. Insecticidal treatments are expensive, environmentally hazardous, and are not a good solution to the potential issue across an entire community.

Maintenance Plan and Budget

The following tasks are placed in order of yearly priority. These tasks should be fulfilled as your budget or personnel time allows. Critical concern trees should be addressed immediately, and

immediate mature tree tasks should be addressed within 2-3 years (which is their expected lifetime before they become critical concern trees). If you are interested in creating a scheduled maintenance and replanting plan, based on a set budget, please contact me. For now, a priority list looks like this:

2014: Address 5 critical concern trees. These trees fall on both private and publically managed land.

2014-2015: Complete any remaining immediate or routine tasks on public and right of way spaces. There are 15 immediate concern trees that need to be addressed, and a total of 5 mature tree routine tasks to complete. Finally, there is 1 young tree that should be staked or trained.

Determine how the city of Elk Horn would like to proceed with EAB planning, outreach, and public assistance (if possible).

Monitor for suspicious ash trees.

2015-2017: Consider promoting routine trimming of the remaining city trees. Ideally, routine trimming should be done to 1/3 of the city's trees every 2 years. In other words, all public and right of way trees should be trimmed once every 6 years.

Also – consider evaluating Elk Horn's street trees again for hazards by 2017 (if not before).

Monitor for tree health issues – all species.

Proposed Budget Increase

Planning and budgeting finances and/or city employee time for forest health threats will be a critical matter for your community to consider. Emerald Ash Borer is one of these threats, and could potentially kill all ash trees in Elk Horn within 4 years of its arrival. To remove and replace all 19 ash trees, Elk Horn would need to budget an estimated \$12,300. Additionally, it is recommended that Elk Horn 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. The Trees for Kids Grant will continue to be a great option for your community to use for tree planting projects on public lands.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Elk Horn

Annual Energy Benefits of Public Trees by Species

1/27/2014

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	5.3	399	723.5	709	1,108	(N/A)	14.3	21.3	58.32
Northern white cedar	0.0	4	8.6	8	12	(N/A)	9.8	0.2	0.93
Silver maple	3.6	274	466.0	457	731	(N/A)	8.3	14.1	66.45
Siberian elm	3.1	233	419.7	411	644	(N/A)	7.5	12.4	64.41
Red maple	0.4	30	51.0	50	80	(N/A)	6.0	1.5	9.96
Apple	0.2	18	42.1	41	60	(N/A)	6.0	1.2	7.47
Norway maple	2.0	153	300.5	295	447	(N/A)	5.3	8.6	63.89
Sugar maple	1.2	95	166.0	163	257	(N/A)	3.8	5.0	51.47
Birch	0.6	46	87.5	86	132	(N/A)	3.8	2.5	26.43
Honeylocust	1.4	108	194.6	191	299	(N/A)	3.8	5.8	59.72
Black walnut	1.3	97	174.4	171	268	(N/A)	3.0	5.2	67.02
Blue spruce	0.3	19	40.8	40	59	(N/A)	3.0	1.1	14.80
Eastern cottonwood	1.7	129	229.4	225	354	(N/A)	3.0	6.8	88.42
Maple	0.1	9	18.0	18	27	(N/A)	2.3	0.5	8.88
Amur maple	0.0	2	5.0	5	7	(N/A)	2.3	0.1	2.38
Norway spruce	0.5	35	58.9	58	93	(N/A)	2.3	1.8	30.93
Eastern white pine	0.6	42	73.8	72	115	(N/A)	2.3	2.2	38.17
Pin oak	1.0	76	138.1	135	212	(N/A)	2.3	4.1	70.52
Broadleaf Deciduous	0.0	1	1.2	1	2	(N/A)	1.5	0.0	0.87
Conifer Evergreen Large	0.3	22	39.4	39	61	(N/A)	1.5	1.2	30.47
American sycamore	0.3	25	47.3	46	72	(N/A)	1.5	1.4	35.78
Pear	0.0	1	1.2	1	2	(N/A)	1.5	0.0	0.87
Japanese tree lilac	0.0	1	1.2	1	2	(N/A)	1.5	0.0	0.87
Other street trees	0.7	51	101.6	100	151	(N/A)	3.8	2.9	30.18
Citywide total	24.6	1,870	3,390.1	3,322	5,192	(N/A)	100.0	100.0	39.04

Table 2: Annual Stormwater Benefits

Elk Horn

Annual Stormwater Benefits of Public Trees by Species

1/27/2014

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	60,525	1,640	(N/A)	14.3	20.8	86.33
Northern white cedar	634	17	(N/A)	9.8	0.2	1.32
Silver maple	49,012	1,328	(N/A)	8.3	16.8	120.76
Siberian elm	30,069	815	(N/A)	7.5	10.3	81.49
Red maple	2,299	62	(N/A)	6.0	0.8	7.79
Apple	818	22	(N/A)	6.0	0.3	2.77
Norway maple	21,209	575	(N/A)	5.3	7.3	82.11
Sugar maple	14,299	388	(N/A)	3.8	4.9	77.50
Birch	4,498	122	(N/A)	3.8	1.5	24.38
Honeylocust	14,027	380	(N/A)	3.8	4.8	76.03
Black walnut	14,841	402	(N/A)	3.0	5.1	100.55
Blue spruce	3,021	82	(N/A)	3.0	1.0	20.47
Eastern cottonwood	25,457	690	(N/A)	3.0	8.7	172.48
Maple	649	18	(N/A)	2.3	0.2	5.86
Amur maple	84	2	(N/A)	2.3	0.0	0.75
Norway spruce	9,112	247	(N/A)	2.3	3.1	82.32
Eastern white pine	13,813	374	(N/A)	2.3	4.7	124.79
Pin oak	10,771	292	(N/A)	2.3	3.7	97.30
Broadleaf Deciduous	15	0	(N/A)	1.5	0.0	0.20
Conifer Evergreen Large	5,938	161	(N/A)	1.5	2.0	80.47
American sycamore	3,961	107	(N/A)	1.5	1.4	53.67
Pear	15	0	(N/A)	1.5	0.0	0.20
Japanese tree lilac	15	0	(N/A)	1.5	0.0	0.20
Other street trees	6,529	177	(N/A)	3.8	2.2	35.39
Citywide total	291,609	7,903	(N/A)	100.0	100.0	59.42

Table 3: Annual Air Quality Benefits**Elk Horn****Annual Air Quality Benefits of Public Trees by Species**

1/27/2014

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	7.6	1.2	3.6	0.3	40	25.1	3.7	3.5	23.8	156	0.0	0	68.9	197 (N/A)		14.3	10.37
Northern white cedar	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.2	-1	0.3	1 (N/A)		9.8	0.05
Silver maple	8.2	1.4	4.1	0.4	45	17.0	2.5	2.4	16.4	106	-4.4	-17	47.8	134 (N/A)		8.3	12.20
Siberian elm	4.5	0.8	2.3	0.2	24	14.6	2.1	2.0	13.9	91	0.0	0	40.4	116 (N/A)		7.5	11.56
Red maple	0.4	0.1	0.2	0.0	2	1.8	0.3	0.3	1.8	12	-0.2	-1	4.7	13 (N/A)		6.0	1.65
Apple	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	8	0.0	0	2.9	8 (N/A)		6.0	1.02
Norway maple	4.6	0.8	2.2	0.2	25	9.8	1.4	1.3	9.1	61	-1.0	-4	28.4	81 (N/A)		5.3	11.62
Sugar maple	1.9	0.3	0.9	0.1	10	5.9	0.9	0.8	5.6	37	-1.5	-6	15.0	42 (N/A)		3.8	8.33
Birch	0.8	0.1	0.4	0.0	4	3.0	0.4	0.4	2.8	18	-0.2	-1	7.7	22 (N/A)		3.8	4.36
Honeylocust	2.7	0.4	1.2	0.1	14	6.8	1.0	0.9	6.4	42	-1.9	-7	17.6	49 (N/A)		3.8	9.80
Black walnut	1.9	0.3	0.9	0.1	10	6.1	0.9	0.8	5.8	38	0.0	0	16.8	48 (N/A)		3.0	12.02
Blue spruce	0.3	0.1	0.3	0.0	2	1.3	0.2	0.2	1.1	8	-0.9	-4	2.5	6 (N/A)		3.0	1.53
Eastern cottonwood	4.3	0.7	1.9	0.2	23	8.1	1.2	1.1	7.7	50	0.0	0	25.2	73 (N/A)		3.0	18.25
Maple	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	4	0.0	0	1.4	4 (N/A)		2.3	1.30
Amur maple	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)		2.3	0.31
Norway spruce	1.1	0.2	0.9	0.1	7	2.2	0.3	0.3	2.1	14	-4.8	-18	2.4	3 (N/A)		2.3	0.90
Eastern white pine	1.7	0.3	1.3	0.2	11	2.6	0.4	0.4	2.5	16	-8.6	-32	0.9	-5 (N/A)		2.3	-1.58
Pin oak	1.8	0.3	0.9	0.1	10	4.8	0.7	0.7	4.5	30	-3.4	-13	10.5	27 (N/A)		2.3	9.04
Broadleaf Deciduous	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)		1.5	0.11
Conifer Evergreen Large	0.7	0.1	0.6	0.1	5	1.4	0.2	0.2	1.3	9	-2.8	-10	1.8	3 (N/A)		1.5	1.45
American sycamore	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	13 (N/A)		1.5	6.28
Pear	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)		1.5	0.11
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)		1.5	0.11
Other street trees	1.2	0.2	0.6	0.1	7	3.3	0.5	0.5	3.1	20	-0.3	-1	9.1	26 (N/A)		3.8	5.19
Citywide total	44.4	7.5	22.7	2.3	242	117.7	17.1	16.3	111.6	733	-30.3	-113	309.4	862 (N/A)		100.0	6.48

Table 4: Annual Carbon Stored**Elk Horn****Stored CO2 Benefits of Public Trees by Species**

1/27/2014

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	247,964	1,860	(N/A)	14.3	23.3	97.88
Northern white	32	0	(N/A)	9.8	0.0	0.02
Silver maple	192,498	1,444	(N/A)	8.3	18.1	131.25
Siberian elm	109,387	820	(N/A)	7.5	10.3	82.04
Red maple	4,826	36	(N/A)	6.0	0.5	4.52
Apple	2,555	19	(N/A)	6.0	0.2	2.39
Norway maple	74,622	560	(N/A)	5.3	7.0	79.95
Sugar maple	55,007	413	(N/A)	3.8	5.2	82.51
Birch	12,704	95	(N/A)	3.8	1.2	19.06
Honeylocust	33,381	250	(N/A)	3.8	3.1	50.07
Black walnut	61,161	459	(N/A)	3.0	5.7	114.68
Blue spruce	1,137	9	(N/A)	3.0	0.1	2.13
Eastern	147,127	1,103	(N/A)	3.0	13.8	275.86
Maple	1,134	9	(N/A)	2.3	0.1	2.84
Amur maple	205	2	(N/A)	2.3	0.0	0.51
Norway spruce	12,003	90	(N/A)	2.3	1.1	30.01
Eastern white pine	22,471	169	(N/A)	2.3	2.1	56.18
Pin oak	45,717	343	(N/A)	2.3	4.3	114.29
Broadleaf	28	0	(N/A)	1.5	0.0	0.10
Conifer Evergreen	6,685	50	(N/A)	1.5	0.6	25.07
American	15,785	118	(N/A)	1.5	1.5	59.19
Pear	28	0	(N/A)	1.5	0.0	0.10
Japanese tree lilac	28	0	(N/A)	1.5	0.0	0.10
Other street trees	8,462	140	(N/A)	3.8	1.8	27.98
Citywide total	1,065,138	7,989	(N/A)	100.0	100.0	60.06

Table 5: Annual Carbon Sequestered**Elk Horn****Annual CO₂ Benefits of Public Trees by Species**

1/27/2014

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	12,770	96	-1,190	-4	-9	8,819	66	20,395	153 (N/A)	14.3	21.3	8.05
Northern white cedar	46	0	0	-3	0	79	1	122	1 (N/A)	9.8	0.1	0.07
Silver maple	14,408	108	-924	-2	-7	6,062	45	19,544	147 (N/A)	8.3	20.4	13.33
Siberian elm	5,749	43	-525	-2	-4	5,145	39	10,367	78 (N/A)	7.5	10.8	7.78
Red maple	665	5	-23	-2	0	657	5	1,298	10 (N/A)	6.0	1.4	1.22
Apple	397	3	-12	-2	0	408	3	791	6 (N/A)	6.0	0.8	0.74
Norway maple	2,620	20	-358	-1	-3	3,376	25	5,636	42 (N/A)	5.3	5.9	6.04
Sugar maple	2,847	21	-264	-1	-2	2,091	16	4,673	35 (N/A)	3.8	4.9	7.01
Birch	1,091	8	-61	-1	0	1,025	8	2,054	15 (N/A)	3.8	2.2	3.08
Honeylocust	4,496	34	-160	-1	-1	2,384	18	6,719	50 (N/A)	3.8	7.0	10.08
Black walnut	3,119	23	-294	-1	-2	2,147	16	4,972	37 (N/A)	3.0	5.2	9.32
Blue spruce	154	1	-5	-1	0	425	3	573	4 (N/A)	3.0	0.6	1.07
Eastern cottonwood	3,310	25	-706	-1	-5	2,847	21	5,450	41 (N/A)	3.0	5.7	10.22
Maple	171	1	-5	-1	0	199	1	364	3 (N/A)	2.3	0.4	0.91
Amur maple	55	0	-1	-1	0	48	0	102	1 (N/A)	2.3	0.1	0.26
Norway spruce	303	2	-58	-1	0	774	6	1,019	8 (N/A)	2.3	1.1	2.55
Eastern white pine	768	6	-108	-1	-1	933	7	1,593	12 (N/A)	2.3	1.7	3.98
Pin oak	4,474	34	-219	-1	-2	1,685	13	5,939	45 (N/A)	2.3	6.2	14.85
Broadleaf Deciduous	17	0	0	0	0	11	0	28	0 (N/A)	1.5	0.0	0.11
Conifer Evergreen	375	3	-32	0	0	493	4	835	6 (N/A)	1.5	0.9	3.13
American sycamore	859	6	-76	0	-1	557	4	1,340	10 (N/A)	1.5	1.4	5.02
Pear	17	0	0	0	0	11	0	28	0 (N/A)	1.5	0.0	0.11
Japanese tree lilac	17	0	0	0	0	11	0	28	0 (N/A)	1.5	0.0	0.11
Other street trees	778	6	-90	-1	-1	1,135	9	1,822	14 (N/A)	3.8	1.9	2.73
Citywide total	59,507	446	-5,113	-26	-39	41,324	310	95,693	718 (N/A)	100.0	100.0	5.40

Table 6: Annual Social and Aesthetic Benefits**Elk Horn****Annual Aesthetic/Other Benefits of Public Trees by Species**

1/27/2014

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	1,036	(N/A)	14.3	17.9	54.53
Northern white cedar	75	(N/A)	9.8	1.3	5.76
Silver maple	1,132	(N/A)	8.3	19.6	102.92
Siberian elm	427	(N/A)	7.5	7.4	42.68
Red maple	96	(N/A)	6.0	1.7	11.99
Apple	21	(N/A)	6.0	0.4	2.64
Norway maple	235	(N/A)	5.3	4.1	33.59
Sugar maple	290	(N/A)	3.8	5.0	57.98
Birch	114	(N/A)	3.8	2.0	22.78
Honeylocust	1,004	(N/A)	3.8	17.4	200.84
Black walnut	244	(N/A)	3.0	4.2	60.91
Blue spruce	84	(N/A)	3.0	1.5	21.08
Eastern cottonwood	220	(N/A)	3.0	3.8	55.03
Maple	30	(N/A)	2.3	0.5	9.97
Amur maple	2	(N/A)	2.3	0.0	0.71
Norway spruce	79	(N/A)	2.3	1.4	26.47
Eastern white pine	79	(N/A)	2.3	1.4	26.25
Pin oak	349	(N/A)	2.3	6.0	116.38
Broadleaf Deciduous	0	(N/A)	1.5	0.0	0.03
Conifer Evergreen Large	94	(N/A)	1.5	1.6	47.08
American sycamore	71	(N/A)	1.5	1.2	35.43
Pear	0	(N/A)	1.5	0.0	0.03
Japanese tree lilac	0	(N/A)	1.5	0.0	0.03
Other street trees	100	(N/A)	3.8	1.7	19.97
Citywide total	5,782	(N/A)	100.0	100.0	43.48

Table 7: Summary of Benefits in Dollars
Average Annual Benefits of Public Trees by
Species

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Green ash	1,108	153	197	1,640	1,036	\$4,134.44	(±0)	20.21
Northern white cedar	12	1	1	17	75	\$105.66	(±0)	0.52
Silver maple	731	147	134	1,328	1,132	\$3,472.25	(±0)	16.97
Siberian elm	644	78	116	815	427	\$2,079.15	(±0)	10.16
Red maple	80	10	13	62	96	\$260.85	(±0)	1.28
Apple	60	6	8	22	21	\$117.10	(±0)	0.57
Norway maple	447	42	81	575	235	\$1,380.83	(±0)	6.75
Sugar maple	257	35	42	388	290	\$1,011.50	(±0)	4.94
Birch	132	15	22	122	114	\$405.18	(±0)	1.98
Honeylocust	299	50	49	380	1,004	\$1,782.31	(±0)	8.71
Black walnut	268	37	48	402	244	\$999.30	(±0)	4.88
Blue spruce	59	4	6	82	84	\$235.86	(±0)	1.15
Eastern cottonwood	354	41	73	690	220	\$1,377.62	(±0)	6.73
Maple	27	3	4	18	30	\$80.75	(±0)	0.39
Amur maple	7	1	1	2	2	\$13.22	(±0)	0.06
Norway spruce	93	8	3	247	79	\$429.46	(±0)	2.10
Eastern white pine	115	12	-5	374	79	\$574.86	(±0)	2.81
Pin oak	212	45	27	292	349	\$924.27	(±0)	4.52
Broadleaf Deciduous Small	2	0	0	0	0	\$2.63	(±0)	0.01
Conifer Evergreen	61	6	3	161	94	\$325.19	(±0)	1.59
Large American sycamore	72	10	13	107	71	\$272.37	(±0)	1.33
Pear	2	0	0	0	0	\$2.63	(±0)	0.01
Japanese tree lilac	2	0	0	0	0	\$2.63	(±0)	0.01
Other street trees	151	14	26	177	100	\$467.37	(±0)	2.28
Citywide total	5,192	718	862	7,903	5,782	\$20,457.41	(±0)	100.00

Table 8: Recommended Maintenance by diameter class.

Elk Horn

Recommended Maintenance for Public Trees (None)

1/27/2014

Zone	DBH Class (in)									Total
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
1	0	0	0	0	0	0	0	0	0	0
Citywide total	0	0	0	0	0	0	0	0	0	0

Maintenance Type	DBH Class (in)									Total	% of Total Population
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42		
None	0	0	0	0	0	0	0	0	0	0	0.00
Young tree (routine)	36	6	0	0	0	0	0	0	0	42	31.58
Young tree (immediate)	0	0	0	0	0	0	0	0	0	0	0.00
Mature tree (routine)	0	1	13	11	12	20	10	3	1	71	53.38
Mature tree (immediate)	0	0	1	1	2	9	2	0	0	15	11.28
Critical concern (public safety)	0	0	1	0	1	1	1	0	1	5	3.76
Citywide total	36	7	15	12	15	30	13	3	2	133	100.00

Table 9: Priority Tasks by diameter class.

Elk Horn

Priority Task Summary for Public Trees (None)

1/27/2014

Zone	DBH Class (in)									Total
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
1	35	6	14	10	12	19	9	3	1	109
Citywide total	35	6	14	10	12	19	9	3	1	109

Maintenance Type	DBH Class (in)									Total	% of Total Population
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42		
None	35	6	14	10	12	19	9	3	1	109	81.95
Stake/Train	1	0	0	0	0	0	0	0	0	1	0.75
Clean	0	1	1	2	2	5	3	0	0	14	10.53
Raise	0	0	0	0	0	0	0	0	0	0	0.00
Reduce	0	0	0	0	0	0	0	0	0	0	0.00
Remove	0	0	0	0	1	3	1	0	0	5	3.76
Treat pest/disease	0	0	0	0	0	3	0	0	1	4	3.01
Citywide total	36	7	15	12	15	30	13	3	2	133	100.00

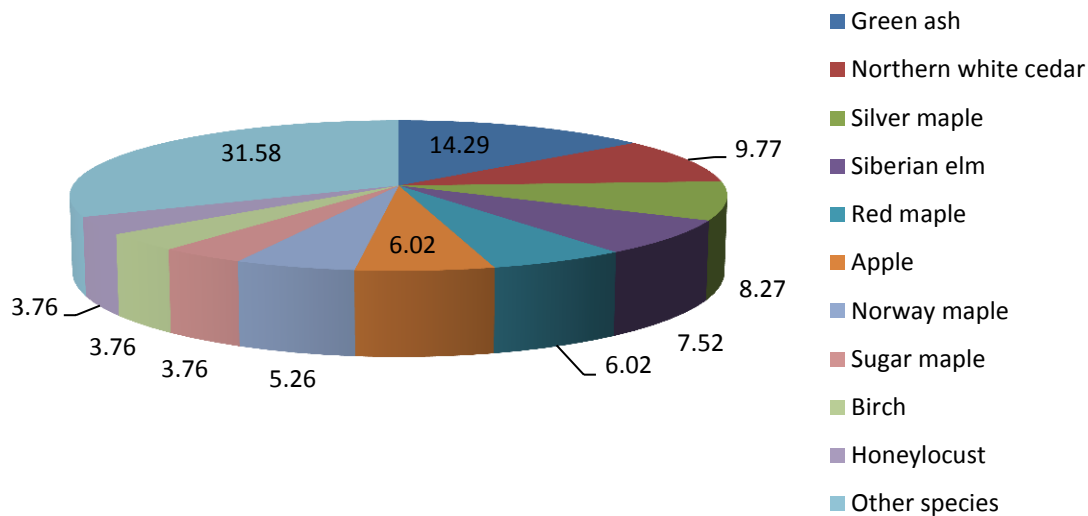


Figure 1: Species Distribution

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

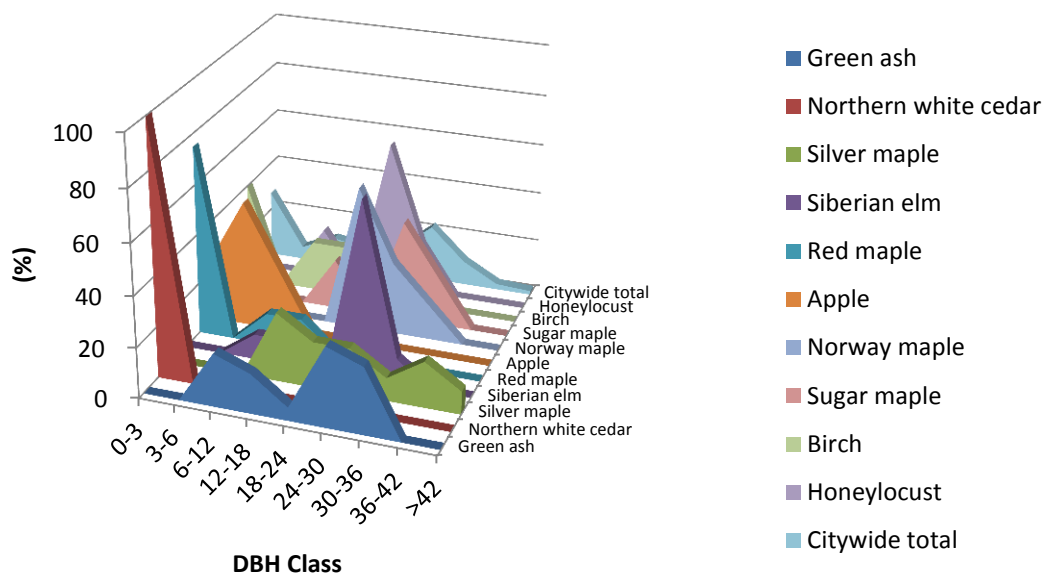


Figure 2: Relative Age Class

Leaf Condition

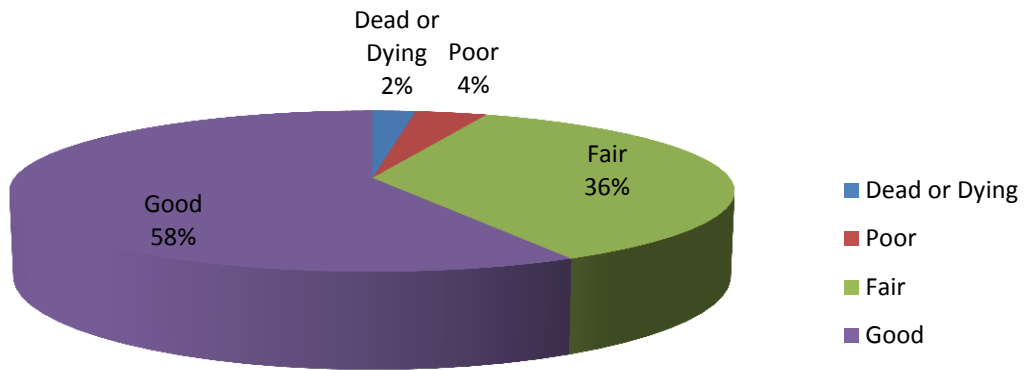


Figure 3: Foliage Condition

Wood Condition

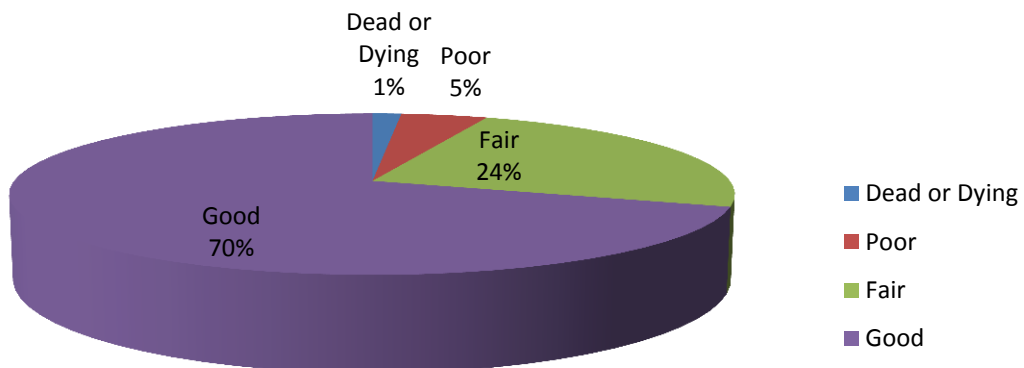


Figure 4: Wood Condition

Canopy Cover

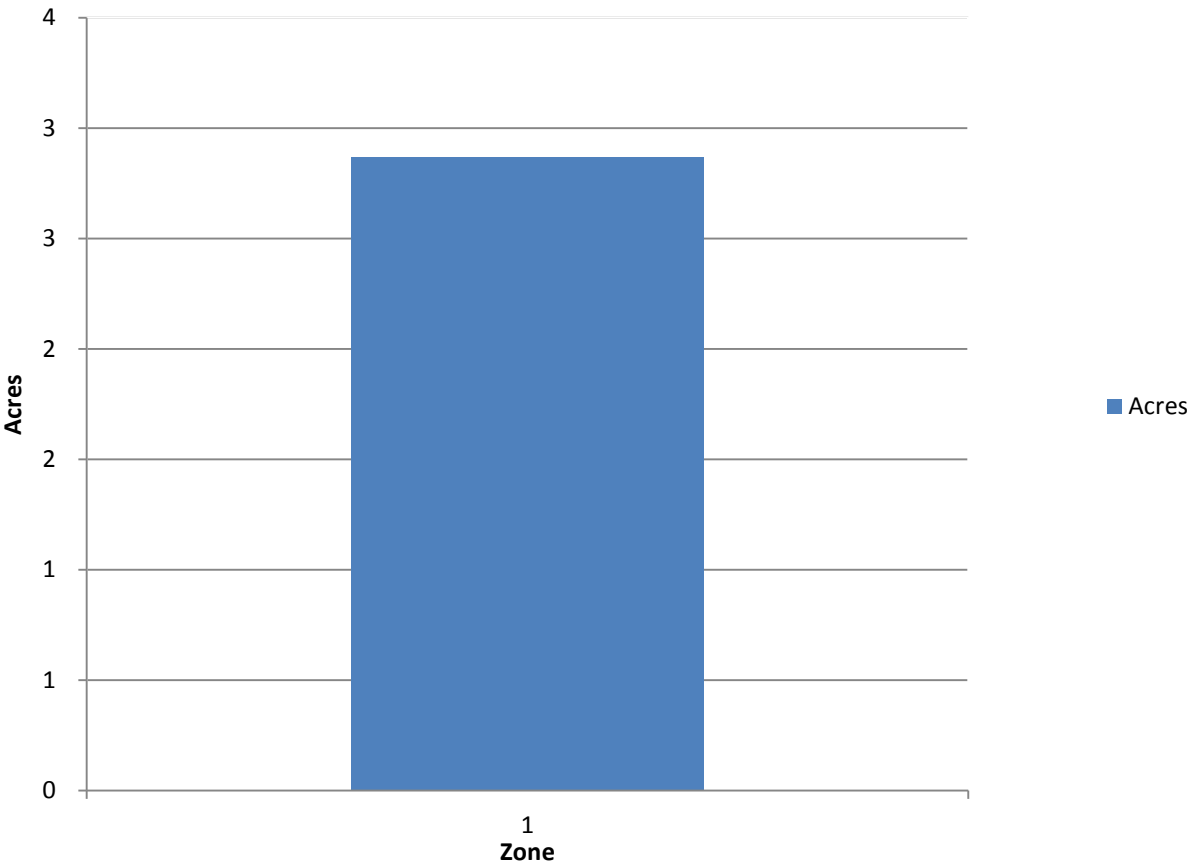


Figure 5: Canopy Cover in Acres

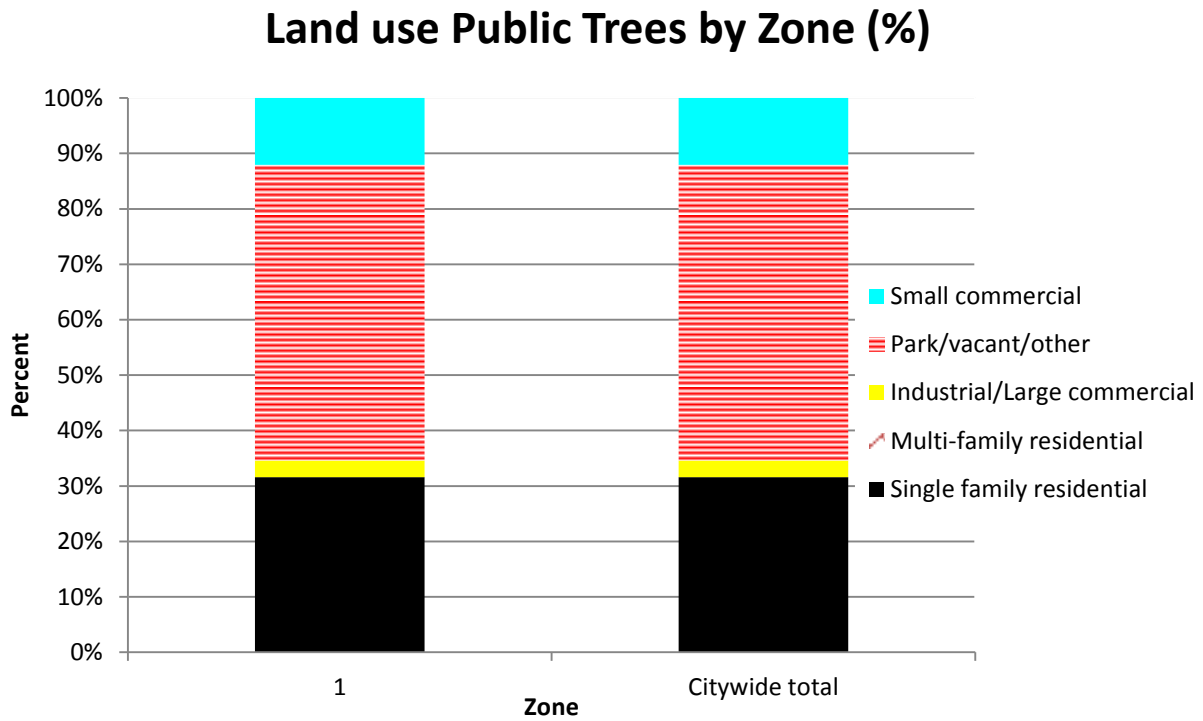


Figure 6: Land Use of city/park trees

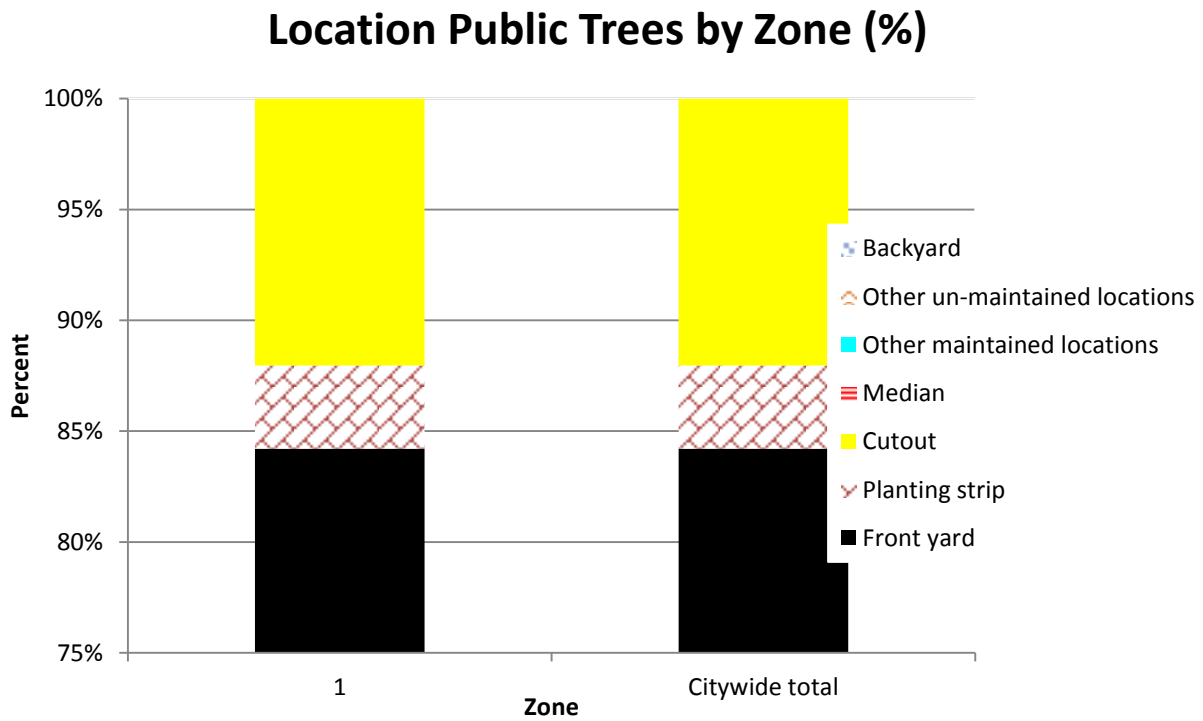


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

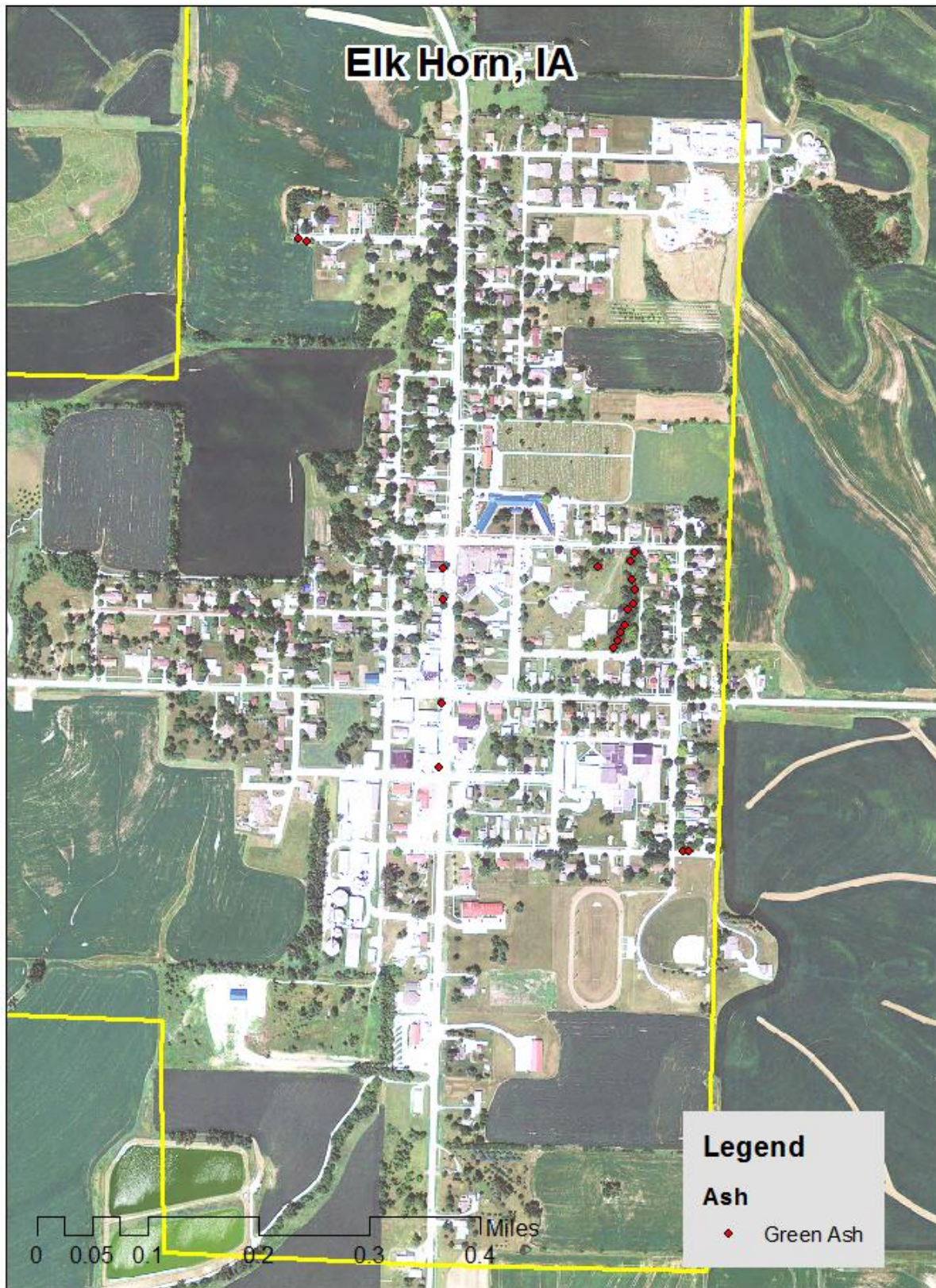


Figure 1: Location of Ash Trees

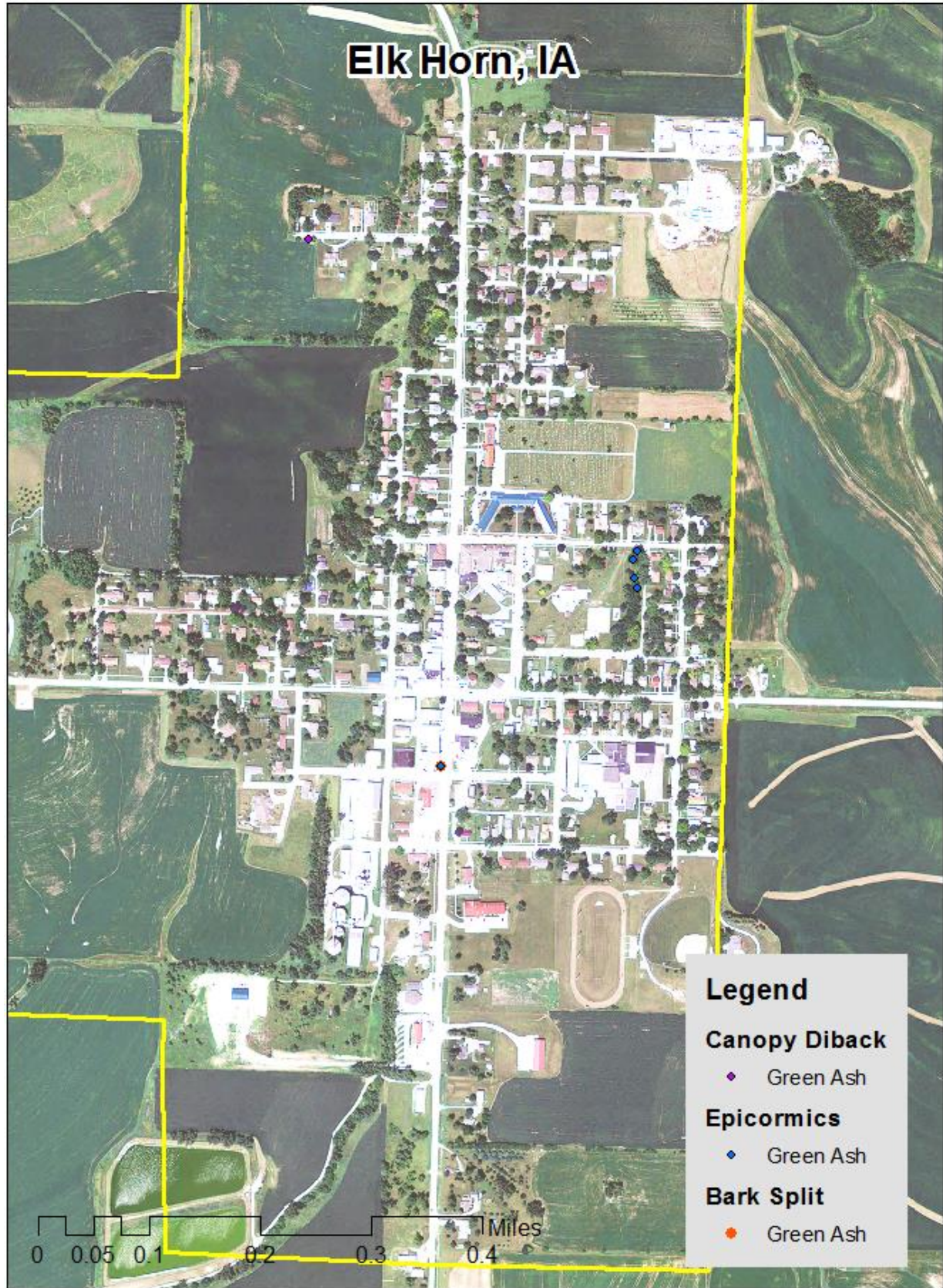


Figure 2: Location of EAB symptoms

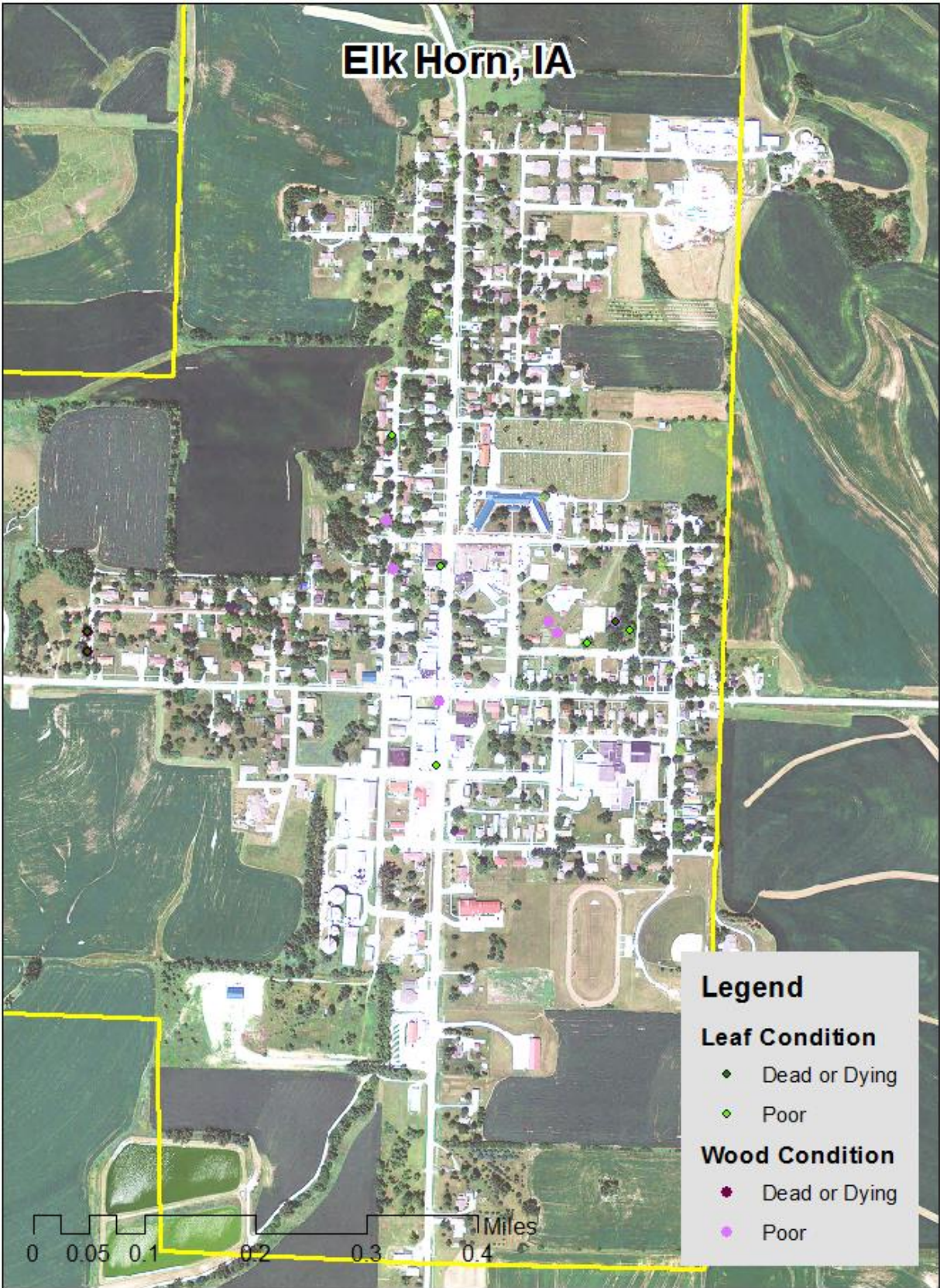


Figure 3: Location of Poor Condition Trees

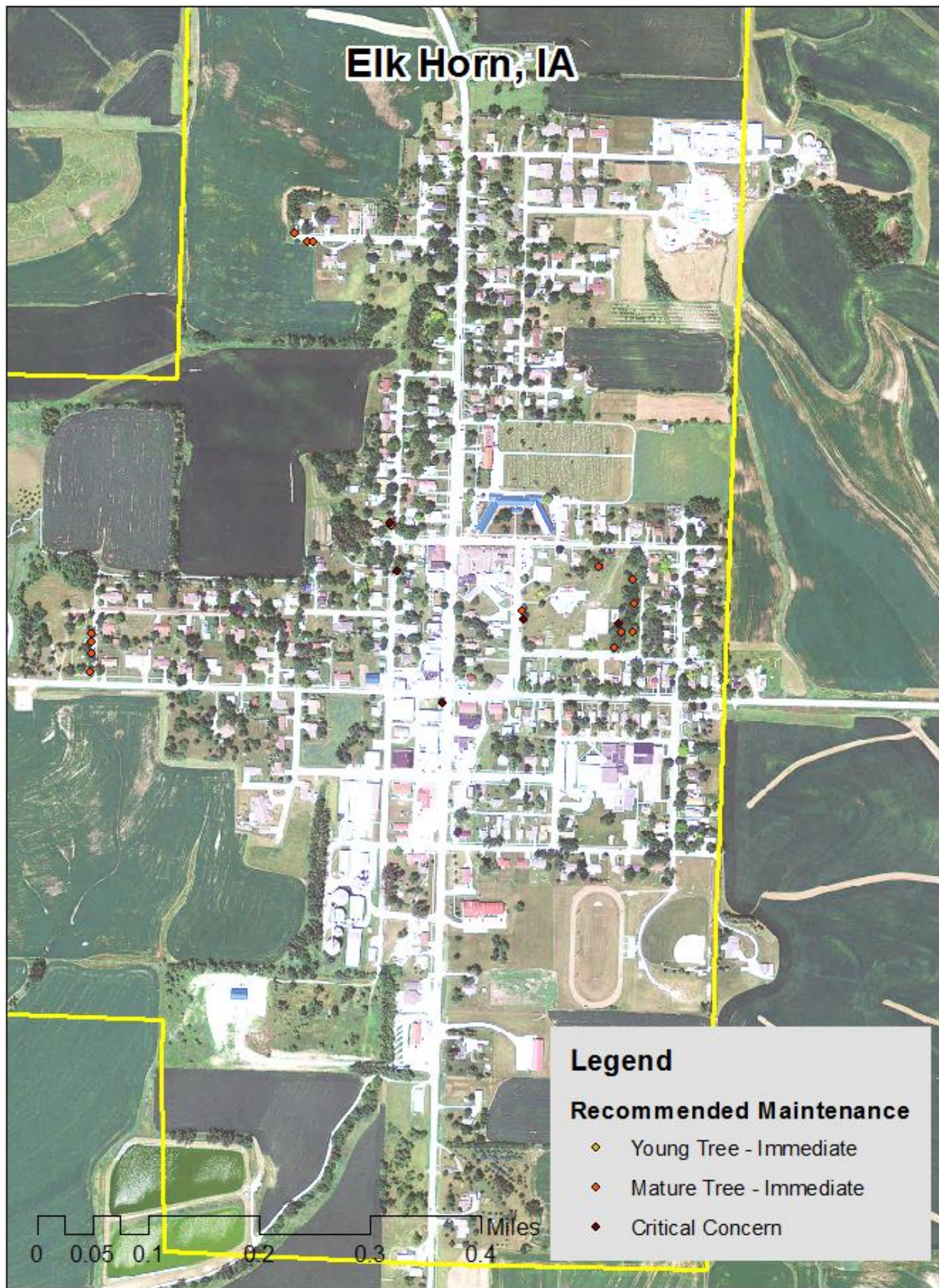


Figure 4: Location of Trees with Recommended Maintenance

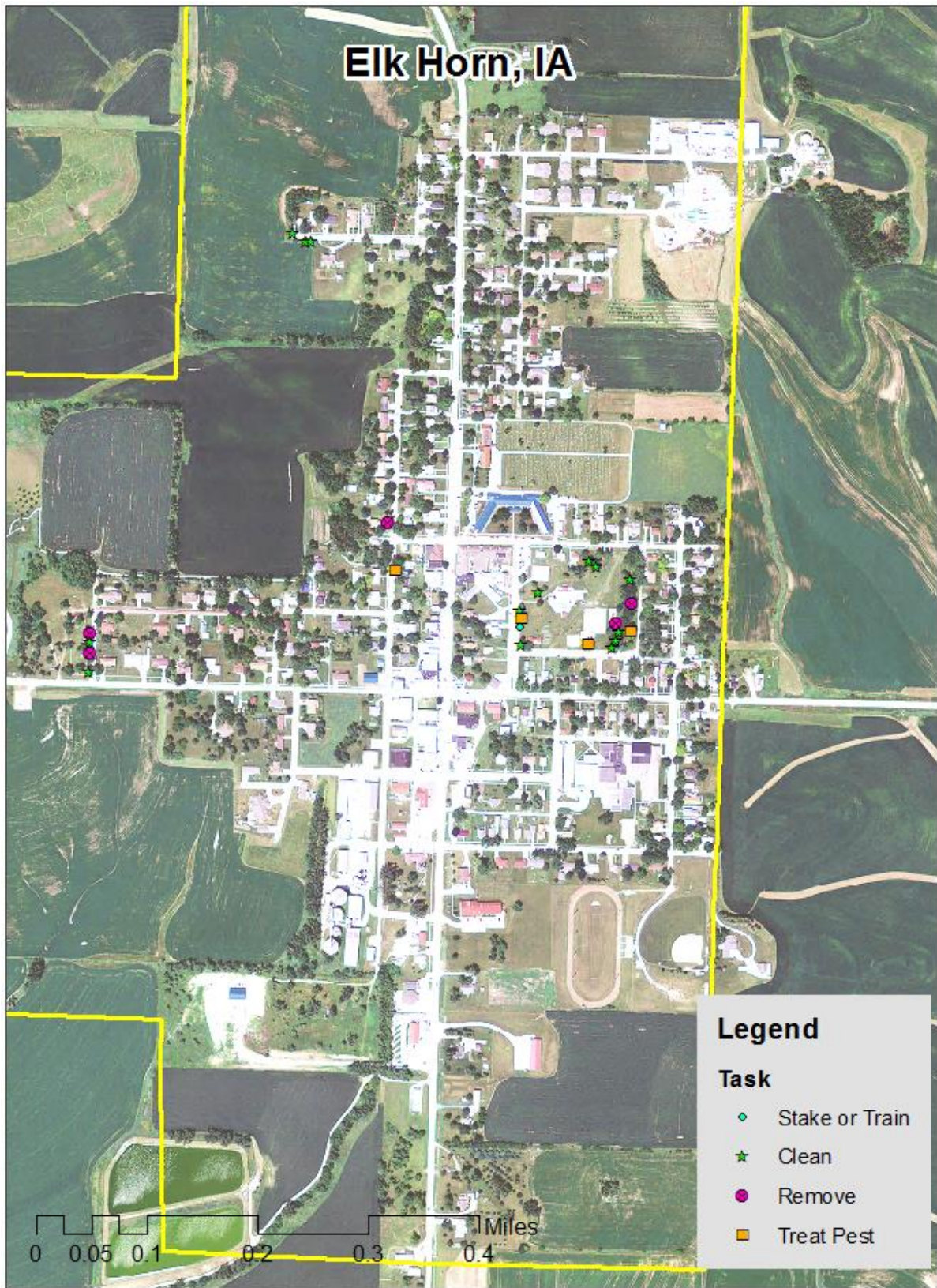


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal.*

Appendix C: Elk Horn Tree Ordinances

CHAPTER 151 TREES AND GRASS

151.01 Definition 151.05 Disease Control
151.02 Planting Restrictions 151.06 Inspection and Removal
151.03 Duty to Trim Trees 151.07 Cutting or Mowing of Grass
151.04 Trimming Trees to be Supervised

151.01 DEFINITION. For use in this chapter, “boulevard” 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 boulevard or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, 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 eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, 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])

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

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 infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:

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 the 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])

151.07 CUTTING OR MOWING OF GRASS.

1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.

2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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

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

If you need accommodations because of disability to access the services of this Agency, please contact Director Chuck Gipp at 515-281-5918.