Street Tree Assessment

&

Management Recommendations for Dyersville, IA

Provided by:

Iowa Department of Natural Resources

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Executive Summary

Overview:

This plan was developed to assist the City of Dyersville with 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 our native ash trees. There is a strong possibility that over 22% of Dyersville'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 1090 trees inventoried.

- Dyersville street trees provide roughly $308,614 of annual benefits, an average of $283 per tree.
- The top three species groups are: Maples (51%), Ash (22%) and Honeylocust (4%).
- Approximately 36% of trees are in need of some type of management.
- For various reasons, 76 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.

- Of the 76 trees needing removal, 2 trees should be removed very soon due to public safety concerns.
- 32 of the 241 ash trees inventoried are in need of follow up checking because they are displaying 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 Dyersville 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 Dyersville, 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 Dyersville'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 Dyersville 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 Dyersville'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 Dyersville's inventory data.

Annual Benefits

Annual Energy Benefits:

Trees conserve energy by shading buildings and blocking winds. Dyersville's trees reduce energy related costs by approximately $86,604 annually (Appendix A, Table 1). These savings are both in Electricity (420 MWh) and in Natural Gas (55,869 Therms).

Annual Storm water Benefits:

Dyersville's trees intercept about 3,687,266 gallons of rainfall and snow melt per year (Appendix A, Table 2). This interception provides $99,932 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 Dyersville, it is estimated that trees remove 5161 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 $14,520 (Appendix A, Table 3).

Annual Carbon Benefits:

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. Of the 1090 trees inventoried, the amount of carbon stored amounts to approximately 11,594,962 total lbs of CO_2 (Appendix A, Table 4) . Those trees are sequestering about 874,036 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 703,926 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. Dyersville receives approximately $95,724 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, Dyersville's trees provide $308,614 of benefits annually. Benefits of individual trees vary based on size, species, health and location. On average, each of the 1090 trees in Dyersville's inventory provides approximately $283 annually (Appendix A, Table 7).

Forest Structure

Species Distribution:

There were over 41 different tree species surveyed. The distribution of trees by genus is as follows:

Genus	# of trees	% of total
Maple (*acer*)	554	50.8%
Ash (*fraxius*)	241	22.1%
Honeylocust (*gleditsia*)	39	3.6%
Apple (*malus*)	37	3.4%
Spruce (*picea*)	34	3.1%
Linden (*tilia*)	32	2.9%
Oak (*quercus*)	30	2.8%
Lilac (*Syringa*)	23	2.1%
Hackberry *(Celtis)*	15	1.4%
Elm (*ulmus*)	14	1.3%
Arborvitae (*Thuja*)	11	1.0%
Other evergreens	8	0.7%
Other broadleaves	8	0.7%
Cherry (*prunus*)	7	0.6%
Walnut (*juglans*)	6	0.6%
Willow (*Salix*)	6	0.6%
Pine (*Pinus*)	5	0.5%
Birch (*betula*)	4	0.4%
Redbud (*cercis*)	3	0.3%
Pear (*Pyrus*)	2	0.2%
Cottonwood (*populus*)	2	0.2%
Plum (*Prunus*)	2	0.2%
Poplar (*populus*)	2	0.2%
Sycamore (*Platinus*)	2	0.2%
Ginkgo (*ginkgo*)	1	0.1%
Sweetgum (*liquidambar*)	1	0.1%
White Mulberry (*morus*)	1	0.1%
	1090	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.   Trees between 12" and 18" in diameter were most abundant (34.9%). The City's trees are found in a typical "bell shaped" distribution.   It would be nicer if the distribution was "flatter" with a greater proportion of trees in the small size classes. 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	71	6.5%
3 - 6	128	11.7%
6 - 12	185	17.0%
12 - 18	380	34.9%
18 - 24	206	18.9%
24 - 30	59	5.4%
30 - 36	28	2.6%
36 - 42	25	2.3%
42+	8	0.7%
	1090	100.0%

Condition: Wood and Foliage:

Leaf condition is a good indicator of the overall health of urban trees. The foliage condition results for Dyersville indicated that 88% of the trees were in good health, 10% in fair health, 2% in poor health or dead or dying. (Appendix A, Figure 3). Leaf health is largely a function of climatic factors during the growing season. This year was not too cool or two wet, therefore, leaf diseases were not a much of 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 Dyersville, 68% of the surveyed trees were in good health, 24% in fair health, 7% in poor health and 1% dead or dying for wood condition (Appendix A, Figure 4). The 8% in poor or dead or dying condition should be assessed more carefully. Many of these trees with poor wood condition are being recommended for removal due to public safety concerns. The 24% in fair health is to a large extent a reflection of having so many older Norway maple trees which tend to have problems with decay or cracking in their main stem.   The City already has too many maple trees, so please encourage far less planting of Norway maple; at least for awhile.

Management Needs:

Each surveyed tree was assessed for recommended maintenance needs. The following tables list the specific management needs and recommendations. Of the trees recommended for removal, only one was judged to be of critical concern for public safety and should be removed as soon as possible (See Appendix B, figure 4).

Priority Task	# of trees	% of trees
none	701	64.3%
clean	169	15.5%
stake/train	88	8.1%
remove	76	7.0%
reduce	37	3.4%
raise	19	1.7%
	1090	100.0%

Maintenance Recommendation	# of trees	% of trees
None	597	54.8%
mature tree (routine)	364	33.4%
young tree (routine)	79	7.2%
mature tree (immediate)	37	3.4%
young tree (immediate)	11	1.0%
critical concern (public safety)	2	0.2%
	1090	100.0%

Land Use and Location:

The majority of Dyersville'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
Single family residential	91%
Park/vacant/other	7%
Small commercial	2%

Location
Front yard	17%
Planting strip	69%
Back yard	6%
Other maintained locations	8%
Cutouts	<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:

Dyersville has 2 tree of "critical concern" that should be removed *immediate*. These trees can be seen on the *Location of Trees with Recommended Maintenance* map (Appendix B, Figure 4). A total of 76 trees are recommended for removal for one reason or another. Of those, 8 trees had leaves and branches that were dead or dying and 61 had poor wood condition or showed signs of severe decay. These trees with severe decay could easily break off or topple over in storms or under ice and snow loads.   Some of the trees were recommended for removal because they blocked the view for traffic or were growing in a bad location.

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 76 trees recommended for removal, 29 trees are ash with poor wood condition and 7 trees are ash with potential signs and symptoms that have been associated with EAB. 2 of the trees are boxelder which is considered a nuisance species.

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	701	64.3%
clean	169	15.5%
stake/train	88	8.1%
remove	76	7.0%
reduce	37	3.4%
raise	19	1.7%
	1090	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 Dyersville.

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 Maple (51%) and ash (22%) (Appendix A, Figure 1). Maples should not be planted until this percentage is dramatically 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: Autumn olive, black locust, black walnut, boxelder, Chinese elm, Siberian elm, cottonwood, poplar, tree of heaven, and willow. I noticed that white poplar was recommended in your City Tree Ordinance. This tree can become invasive so should probably be taken off of your list.

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

Ash Tree Removal:

Tree removal should 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 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.

Postponed Work:

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

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 Dyersville's urban forest. Private property owners should be given direction to the proper species to plant, spacing, and location. Dyersville has a city ordinance for trees.

Budget

Purposed Budget Increase:

EAB could potentially kill all of the ash trees in Dyersville 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.   There were a total of 241 ash trees surveyed. We recommend that at least 1/3 (80 trees) of them be removed and replaced over the next 6 years. You should replant 2 trees for everyone removed. First, remove the 2 tree of critical concern for public safely (Appendix B, Figure 4). Next, remove the 32 ash trees showing signs and symptoms of possible EAB infestation (Appendix B, Figure 2). Finally, remove any of the remaining 46 ash trees where they occur in groups throughout the City (Appendix B, Figure 1).   Finally, we 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 Dyersville's urban forest.

Recommended Budget: $83,000 total over 6 years.

FY 2011 Budget
   Removal: $7000
   Planting: $2800
   Routine trimming: $4000
   Watering & Maintenance: $500

FY 2012 Budget
   Removal: $7000
   Planting: $2800
   Routine trimming: $4000
   Watering & Maintenance: $500

FY 2013 Budget
   Removal: $7000
   Planting: $2800
   Routine trimming: $4000
   Watering & Maintenance: $500

FY 2014 Budget
   Removal: $7000
   Planting: $2800
   Routine trimming: $4000
   Watering & Maintenance: $500

FY 2015 Budget
           Removal: $6000
           Planting: $2400
           Routine trimming: $4000
           Watering & Maintenance: $500

FY 2016 Budget
           Removal: $6000
           Planting: $2400
           Routine trimming: $4000
           Watering & Maintenance: $500

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees by Species
10/17/2011

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	116.6	8,847	15,876.2	15,559	24,406	(N/A)	24.8	28.2	45.20
Green ash	105.7	8,026	13,930.9	13,652	21,678	(N/A)	21.2	25.0	46.92
Silver maple	81.7	6,204	10,542.2	10,331	16,535	(N/A)	14.9	19.1	51.03
Sugar maple	24.3	1,846	3,086.7	3,025	4,871	(N/A)	7.5	5.6	29.70
Honeylocust	21.7	1,650	2,784.5	2,729	4,379	(N/A)	3.6	5.1	56.14
Apple	3.6	274	566.1	555	828	(N/A)	3.4	1.0	11.19
Red maple	3.8	291	534.7	524	815	(N/A)	3.0	0.9	12.35
Littleleaf linden	4.5	343	643.7	631	974	(N/A)	2.7	1.1	16.78
Blue spruce	2.7	207	371.2	364	571	(N/A)	1.6	0.7	16.78
Northern hackberry	9.8	747	1,399.3	1,371	2,118	(N/A)	1.4	2.5	70.60
Pin oak	5.3	401	697.3	683	1,085	(N/A)	1.2	1.3	41.72
Japanese tree lilac	0.3	23	53.0	52	75	(N/A)	1.1	0.1	3.13
Lilac	0.3	23	51.8	51	74	(N/A)	1.0	0.1	3.34
Northern white cedar	0.9	66	138.8	136	202	(N/A)	1.0	0.2	9.19
Other street trees	38.3	2,905	5,192.2	5,088	7,994	(N/A)	11.7	9.2	31.47
Citywide total	419.7	31,852	55,868.7	54,751	86,604	(N/A)	100.0	100.0	39.76

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species
10/17/2011

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	840,775	22,787	(N/A)	24.8	22.8	42.20
Green ash	921,682	24,979	(N/A)	21.2	25.0	54.07
Silver maple	948,015	25,693	(N/A)	14.9	25.7	79.30
Sugar maple	176,298	4,778	(N/A)	7.5	4.8	29.13
Honeylocust	157,161	4,259	(N/A)	3.6	4.3	54.61
Apple	12,531	340	(N/A)	3.4	0.3	4.59
Red maple	19,525	529	(N/A)	3.0	0.5	8.02
Littleleaf linden	25,766	698	(N/A)	2.7	0.7	12.04
Blue spruce	33,959	920	(N/A)	1.6	0.9	27.07
Northern hackberry	99,729	2,703	(N/A)	1.4	2.7	90.09
Pin oak	47,727	1,293	(N/A)	1.2	1.3	49.75
Japanese tree lilac	913	25	(N/A)	1.1	0.0	1.03
Lilac	898	24	(N/A)	1.0	0.0	1.11
Northern white cedar	11,833	321	(N/A)	1.0	0.3	14.58
Other street trees	390,453	10,582	(N/A)	11.7	10.6	41.66
Citywide total	3,687,266	99,932	(N/A)	100.0	100.0	45.88

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species
10/17/2011

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O3	NO2	PM10	SO2		NO2	PM10	VOC	SO2							
Norway maple	146.0	25.2	75.1	6.5	798	557.0	81.1	77.3	529.0	3,470	-36.5	-137	1,460.7	4,132 (N/A)	24.8	7.65
Green ash	93.3	14.9	48.6	4.2	508	500.0	73.2	69.8	479.3	3,127	0.0	0	1,283.4	3,635 (N/A)	21.2	7.87
Silver maple	139.1	23.6	71.5	6.2	759	383.7	56.3	53.8	370.0	2,405	-80.0	-300	1,024.2	2,865 (N/A)	14.9	8.84
Sugar maple	18.4	3.1	10.5	0.8	104	113.8	16.7	16.0	110.2	715	-15.6	-59	274.0	760 (N/A)	7.5	4.63
Honeylocust	27.8	4.6	13.3	1.3	148	102.0	15.0	14.3	98.5	640	-18.4	-69	258.2	719 (N/A)	3.6	9.22
Apple	2.6	0.4	1.4	0.1	14	17.8	2.6	2.4	16.3	110	0.0	0	43.7	124 (N/A)	3.4	1.67
Red maple	2.6	0.4	1.5	0.1	14	18.3	2.7	2.5	17.4	114	-1.0	-4	44.5	125 (N/A)	3.0	1.89
Littleleaf linden	2.4	0.4	1.6	0.1	14	21.8	3.2	3.0	20.5	135	-1.5	-6	51.5	144 (N/A)	2.7	2.48
Blue spruce	4.0	0.8	3.5	0.5	27	13.0	1.9	1.8	12.3	81	-11.8	-44	25.9	63 (N/A)	1.6	1.87
Northern hackberry	17.0	2.9	8.5	0.8	92	47.5	6.9	6.6	44.6	295	0.0	0	134.8	387 (N/A)	1.4	12.90
Pin oak	7.5	1.3	4.0	0.3	42	25.0	3.7	3.5	24.0	156	-14.5	-54	54.8	144 (N/A)	1.2	5.52
Japanese tree lilac	0.0	0.0	0.1	0.0	0	1.6	0.2	0.2	1.4	9	0.0	0	3.5	10 (N/A)	1.1	0.41
Lilac	0.0	0.0	0.1	0.0	0	1.5	0.2	0.2	1.4	9	0.0	0	3.4	10 (N/A)	1.0	0.44
Northern white cedar	1.1	0.2	1.0	0.1	7	4.3	0.6	0.6	3.9	27	-4.4	-16	7.5	18 (N/A)	1.0	0.80
Other street trees	59.4	10.0	30.9	3.1	326	182.3	26.6	25.3	173.5	1,137	-20.3	-76	490.6	1,386 (N/A)	11.7	5.46
Citywide total	521.2	87.9	271.6	24.0	2,855	1,989.5	290.7	277.4	1,902.2	12,430	-204.0	-765	5,160.7	14,520 (N/A)	100.0	6.67

Table 4: Total Carbon Stored

Stored CO2 Benefits of Public Trees by Species
10/17/2011

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	2,409,202	18,069	(N/A)	24.8	20.8	33.46
Green ash	3,056,449	22,923	(N/A)	21.2	26.4	49.62
Silver maple	3,177,356	23,830	(N/A)	14.9	27.4	73.55
Sugar maple	544,825	4,086	(N/A)	7.5	4.7	24.92
Honeylocust	338,883	2,542	(N/A)	3.6	2.9	32.58
Apple	46,877	352	(N/A)	3.4	0.4	4.75
Red maple	36,612	275	(N/A)	3.0	0.3	4.16
Littleleaf linden	63,231	474	(N/A)	2.7	0.6	8.18
Blue spruce	22,733	171	(N/A)	1.6	0.2	5.01
Northern	268,292	2,012	(N/A)	1.4	2.3	67.07
Pin oak	195,152	1,464	(N/A)	1.2	1.7	56.29
Japanese tree lilac	2,299	17	(N/A)	1.1	0.0	0.72
Lilac	2,271	17	(N/A)	1.0	0.0	0.77
Northern white	8,617	65	(N/A)	1.0	0.1	2.94
Other street trees	644,958	10,664	(N/A)	11.7	12.3	41.98
Citywide total	11,594,684	86,960	(N/A)	100.0	100.0	39.93

Table 5: Annual Carbon Sequestered

Annual CO$_2$ Benefits of Public Trees by Species

10/17/2011

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
Norway maple	194,726	1,460	-11,564	-105	-88	195,516	1,466	378,573	2,839	(N/A)	24.8	24.0	5.26
Green ash	235,541	1,767	-14,671	-90	-111	177,370	1,330	398,150	2,986	(N/A)	21.2	25.2	6.46
Silver maple	279,101	2,093	-15,251	-63	-115	137,107	1,028	400,893	3,007	(N/A)	14.9	25.4	9.28
Sugar maple	40,346	303	-2,615	-32	-20	40,795	306	78,494	589	(N/A)	7.5	5.0	3.59
Honeylocust	49,394	370	-1,627	-15	-12	36,462	273	84,214	632	(N/A)	3.6	5.3	8.10
Apple	5,602	42	-225	-14	-2	6,046	45	11,409	86	(N/A)	3.4	0.7	1.16
Red maple	5,493	41	-176	-13	-1	6,433	48	11,738	88	(N/A)	3.0	0.7	1.33
Littleleaf linden	12,005	90	-304	-11	-2	7,572	57	19,262	144	(N/A)	2.7	1.2	2.49
Blue spruce	1,933	15	-109	-7	-1	4,568	34	6,386	48	(N/A)	1.6	0.4	1.41
Northern hackberry	12,438	93	-1,288	-6	-10	16,499	124	27,644	207	(N/A)	1.4	1.8	6.91
Pin oak	18,948	142	-937	-5	-7	8,871	67	26,878	202	(N/A)	1.2	1.7	7.75
Japanese tree lilac	559	4	-11	-5	0	514	4	1,057	8	(N/A)	1.1	0.1	0.33
Lilac	542	4	-11	-4	0	502	4	1,029	8	(N/A)	1.0	0.1	0.35
Northern white cedar	885	7	-41	-4	0	1,462	11	2,301	17	(N/A)	1.0	0.2	0.78
Other street trees	72,600	544	-6,825	-50	-52	64,208	482	129,933	975	(N/A)	11.7	8.2	3.84
Citywide total	930,115	6,976	-55,654	-425	-421	703,926	5,279	1,577,962	11,835	(N/A)	100.0	100.0	5.43

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

10/17/2011

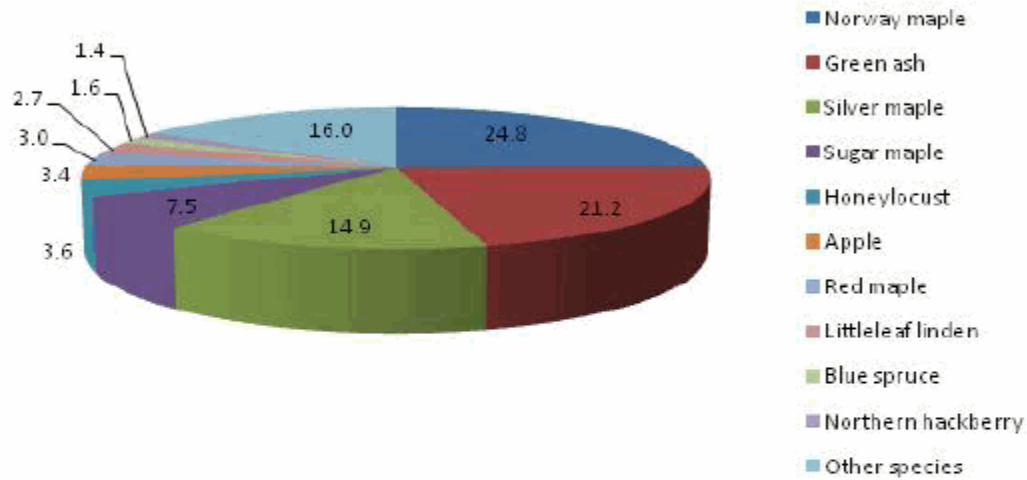| Species	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	19,452	(N/A)	24.8	20.3	36.02
Green ash	22,086	(N/A)	21.2	23.1	47.80
Silver maple	24,410	(N/A)	14.9	25.5	75.34
Sugar maple	4,787	(N/A)	7.5	5.0	29.19
Honeylocust	10,545	(N/A)	3.6	11.0	135.20
Apple	310	(N/A)	3.4	0.3	4.18
Red maple	913	(N/A)	3.0	1.0	13.84
Littleleaf linden	1,587	(N/A)	2.7	1.7	27.37
Blue spruce	668	(N/A)	1.6	0.7	19.65
Northern hackberry	1,659	(N/A)	1.4	1.7	55.31
Pin oak	1,606	(N/A)	1.2	1.7	61.77
Japanese tree lilac	25	(N/A)	1.1	0.0	1.05
Lilac	25	(N/A)	1.0	0.0	1.14
Northern white cedar	278	(N/A)	1.0	0.3	12.64
Other street trees	7,373	(N/A)	11.7	7.7	29.03
Citywide total	95,724	(N/A)	100.0	100.0	43.95

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species ($)
10/17/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway maple	24,406	2,839	4,132	22,787	19,452	73,615	(±0)	23.9
Green ash	21,678	2,986	3,635	24,979	22,086	75,365	(±0)	24.4
Silver maple	16,535	3,007	2,865	25,693	24,410	72,510	(±0)	23.5
Sugar maple	4,871	589	760	4,778	4,787	15,784	(±0)	5.1
Honeylocust	4,379	632	719	4,259	10,545	20,534	(±0)	6.7
Apple	828	86	124	340	310	1,687	(±0)	0.5
Red maple	815	88	125	529	913	2,470	(±0)	0.8
Littleleaf linden	974	144	144	698	1,587	3,547	(±0)	1.1
Blue spruce	570	48	63	920	668	2,270	(±0)	0.7
Northern hackberry	2,118	207	387	2,703	1,659	7,075	(±0)	2.3
Pin oak	1,085	202	144	1,293	1,606	4,330	(±0)	1.4
Japanese tree lilac	75	8	10	25	25	143	(±0)	0.0
Lilac	73	8	10	24	25	140	(±0)	0.0
Northern white cedar	202	17	18	321	278	836	(±0)	0.3
Other street trees	7,994	974	1,386	10,582	7,373	28,309	(±0)	9.2
Citywide Total	86,604	11,835	14,520	99,932	95,724	308,614	(±0)	100.0

Species Distribution of Public Trees (%)

10/17/2011

Legend:
- Norway maple
- Green ash
- Silver maple
- Sugar maple
- Honeylocust
- Apple
- Red maple
- Littleleaf linden
- Blue spruce
- Northern hackberry
- Other species

Species	Percent
Norway maple	24.8
Green ash	21.2
Silver maple	14.9
Sugar maple	7.5
Honeylocust	3.6
Apple	3.4
Red maple	3.0
Littleleaf linden	2.7
Blue spruce	1.6
Northern hackberry	1.4
Other species	16.0
Total	100.0

Figure 1: Species Distribution

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

10/17/2011
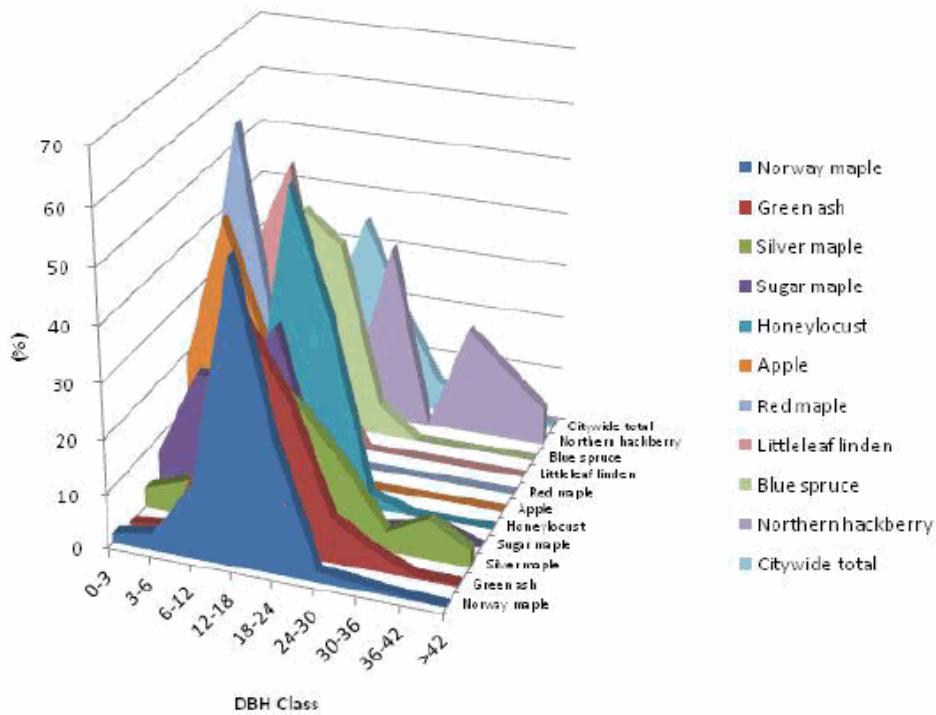
	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Norway maple	1.9	3.3	13.7	54.4	23.3	1.9	1.1	0.4	0.0
Green ash	0.4	1.3	17.7	40.3	27.7	8.2	3.5	0.4	0.4
Silver maple	3.7	6.2	9.9	29.0	22.8	14.2	3.7	7.4	3.1
Sugar maple	7.3	23.2	23.2	34.1	8.5	0.0	1.2	2.4	0.0
Honeylocust	0.0	0.0	7.7	56.4	33.3	2.6	0.0	0.0	0.0
Apple	18.9	45.9	24.3	10.8	0.0	0.0	0.0	0.0	0.0
Red maple	15.2	60.6	18.2	6.1	0.0	0.0	0.0	0.0	0.0
Littleleaf linden	0.0	34.5	51.7	13.8	0.0	0.0	0.0	0.0	0.0
Blue spruce	17.6	0.0	41.2	35.3	5.9	0.0	0.0	0.0	0.0
Northern hackberry	0.0	0.0	20.0	6.7	33.3	0.0	20.0	13.3	6.7
Citywide total	6.5	11.8	17.0	34.9	18.8	5.4	2.6	2.3	0.7

Figure 2: Relative Age Class

Functional (Foliage) Condition of Public Trees by Species (%)

10/17/2011
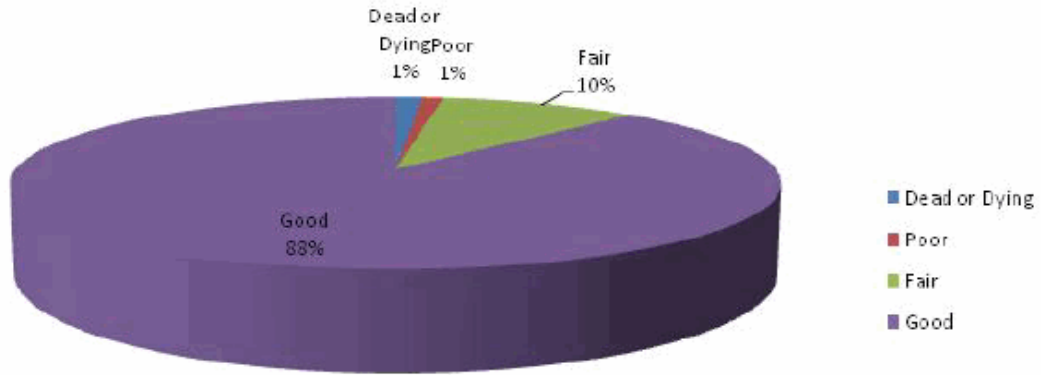
Citywide total

Figure 3: Foliage Condition

Structural (Woody) Condition of Public Trees by Species (%)

10/17/2011
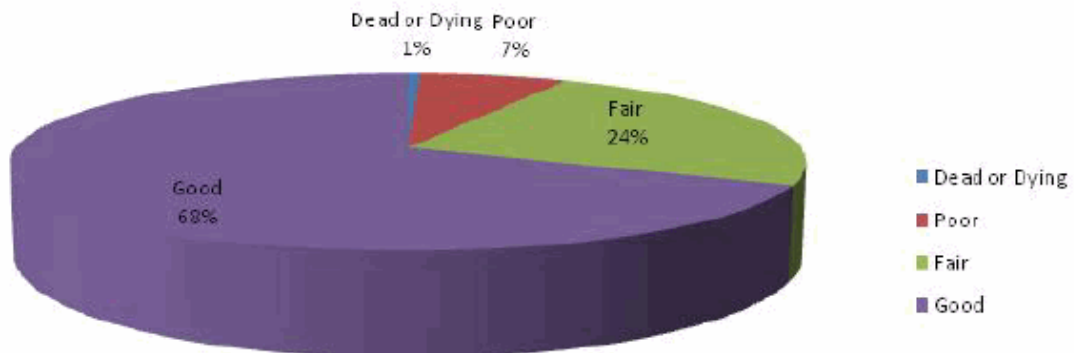
Citywide total

Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

10/17/2011
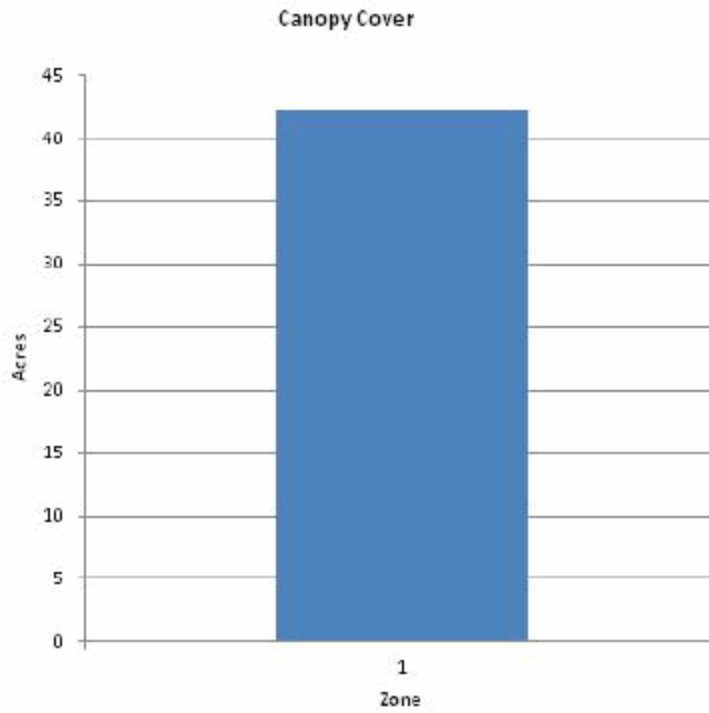
Canopy Cover

Zone	Acres	% of Total Canopy Cover
1	42	100.0
Citywide total	42	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	42		

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

10/17/2011
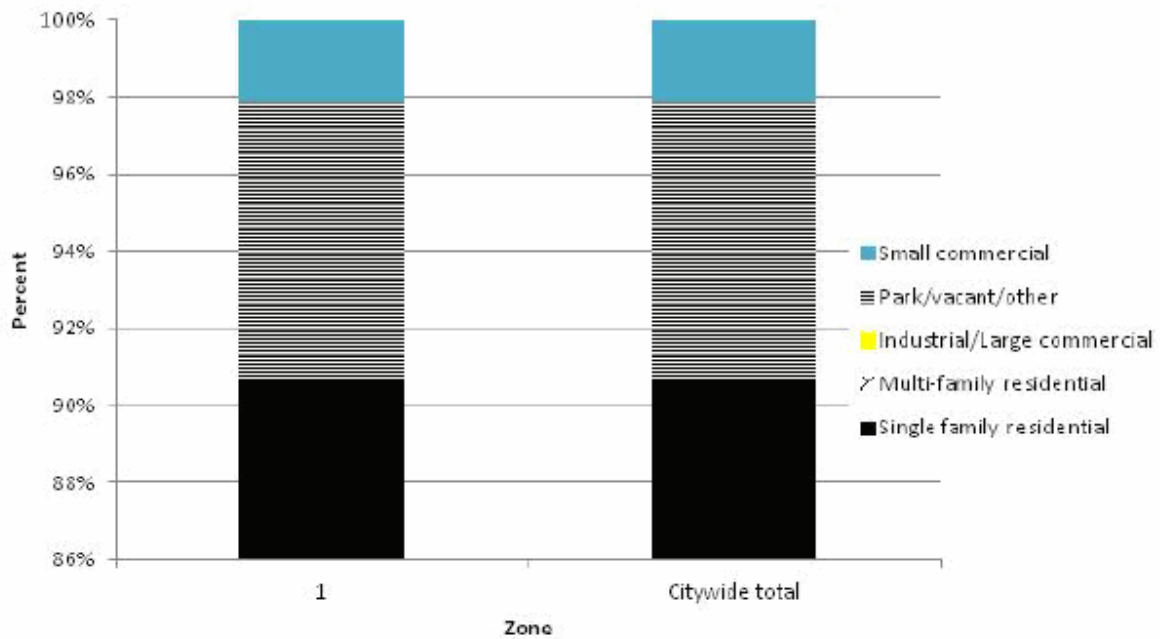
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	90.7	0.0	0.0	7.2	2.1
Citywide total	90.7	0.0	0.0	7.2	2.1

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

10/17/2011
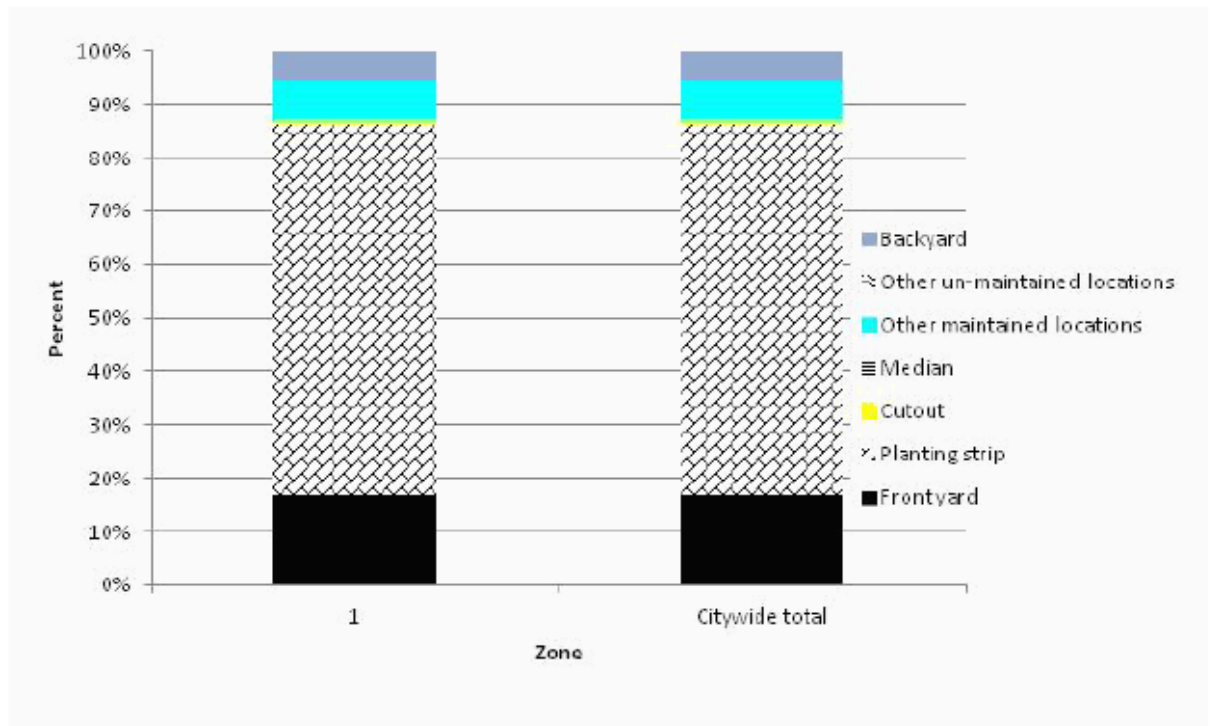
Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	17.0	69.4	0.5	0.0	7.6	0.0	5.5
Citywide total	17.0	69.4	0.5	0.0	7.6	0.0	5.5

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping
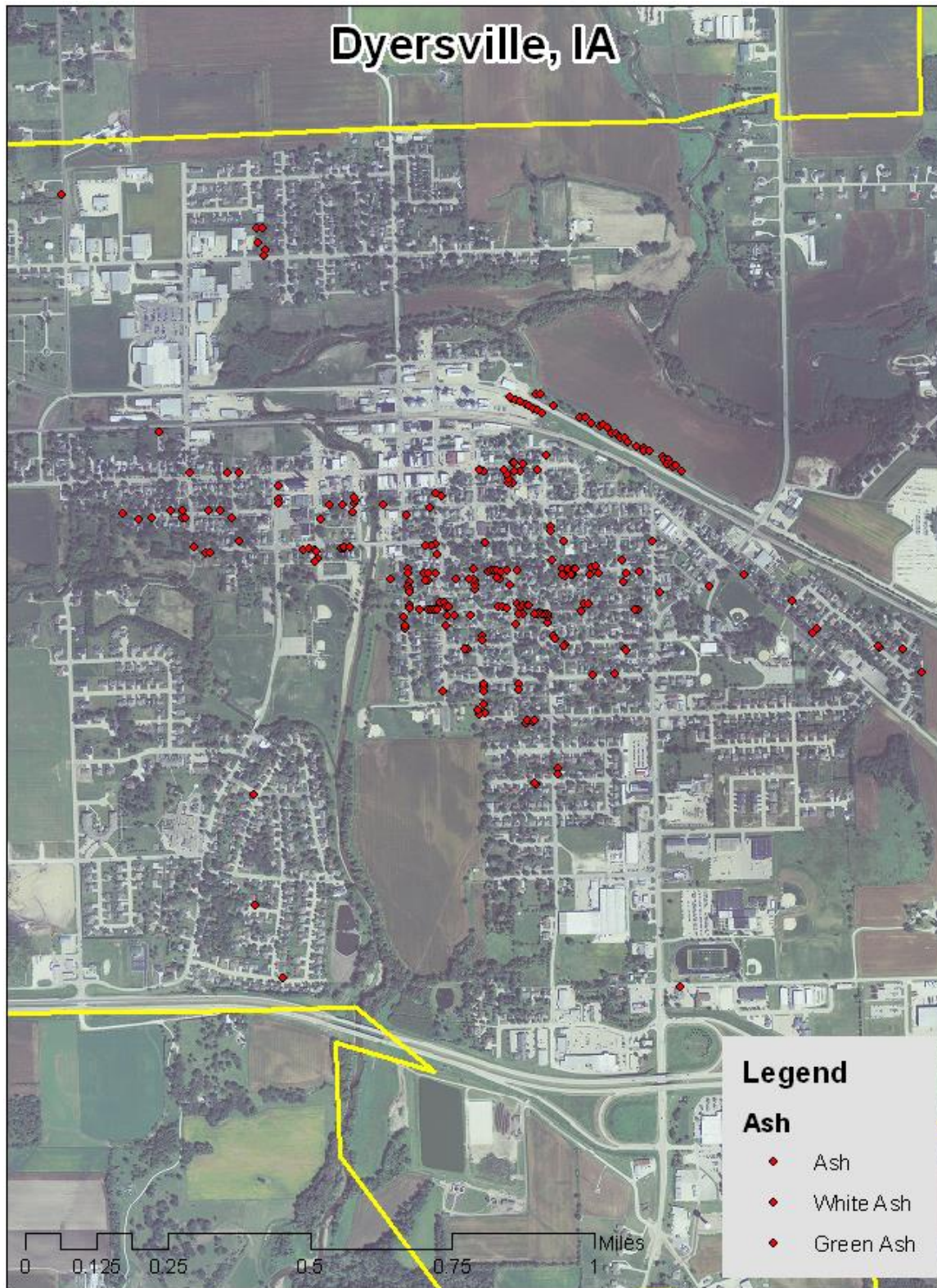
Figure 1: Location of Ash Trees

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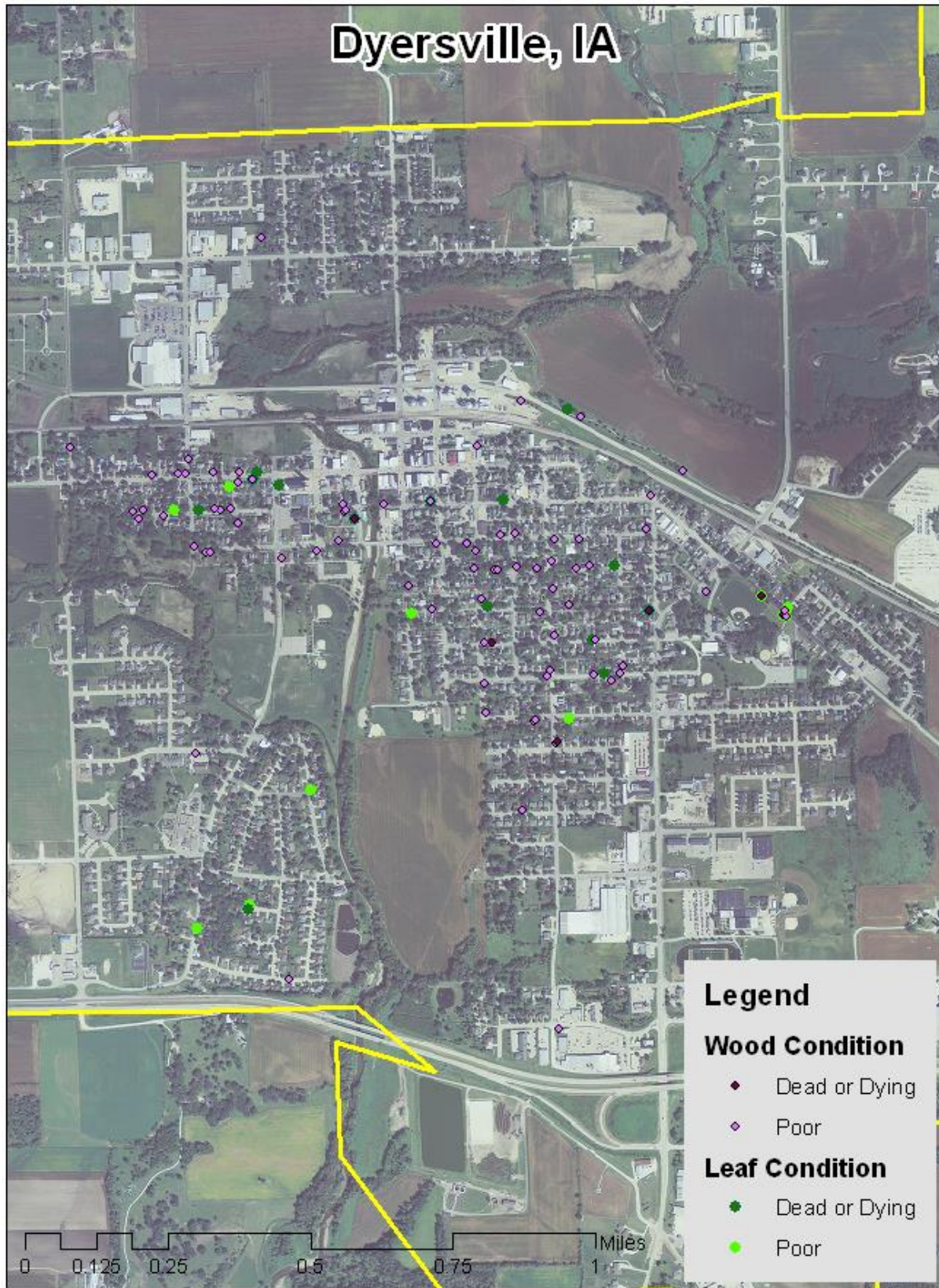
Figure 3: Location of Poor Condition Trees
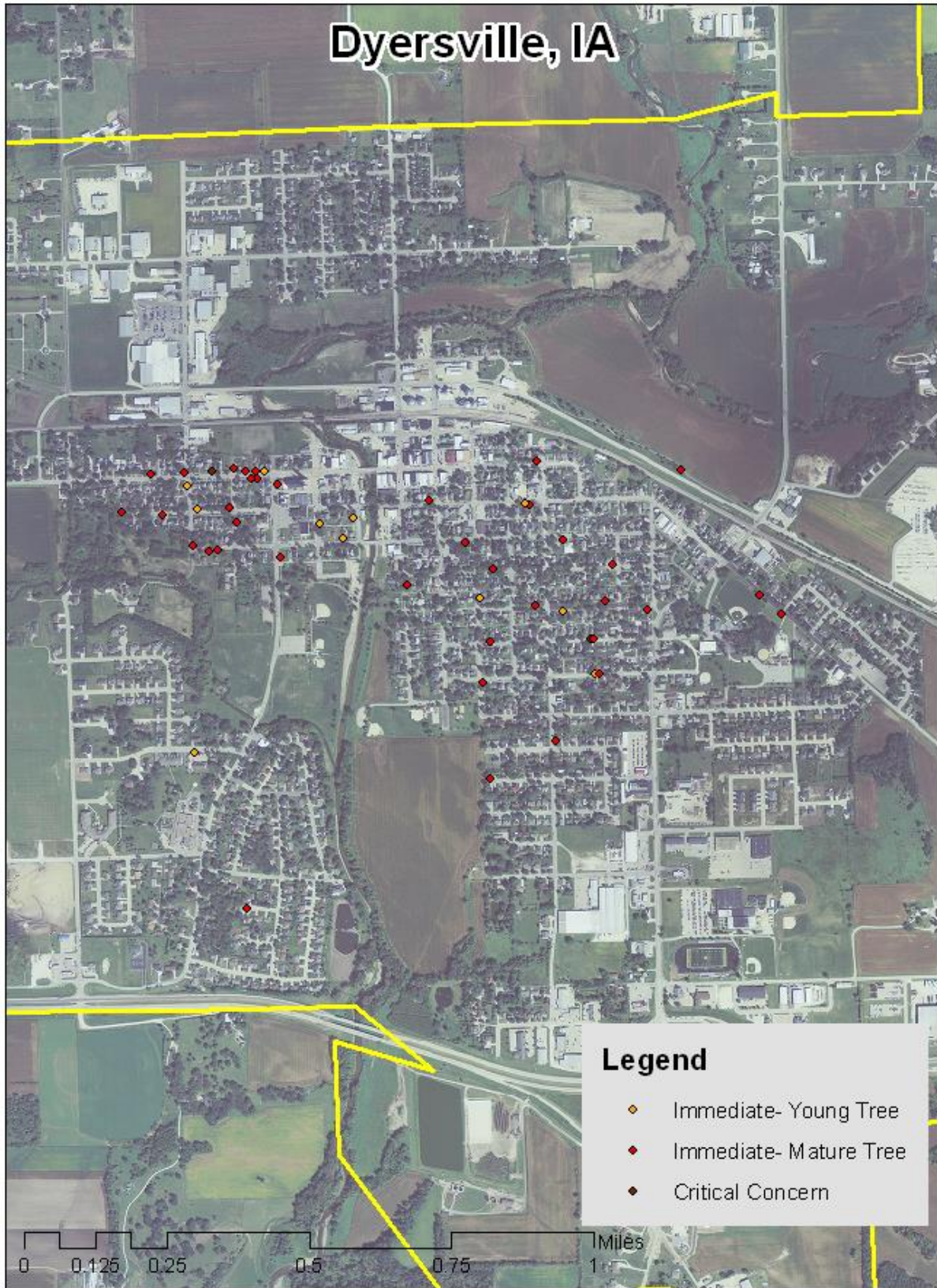
Figure 4: Location of Trees with Recommended Maintenance
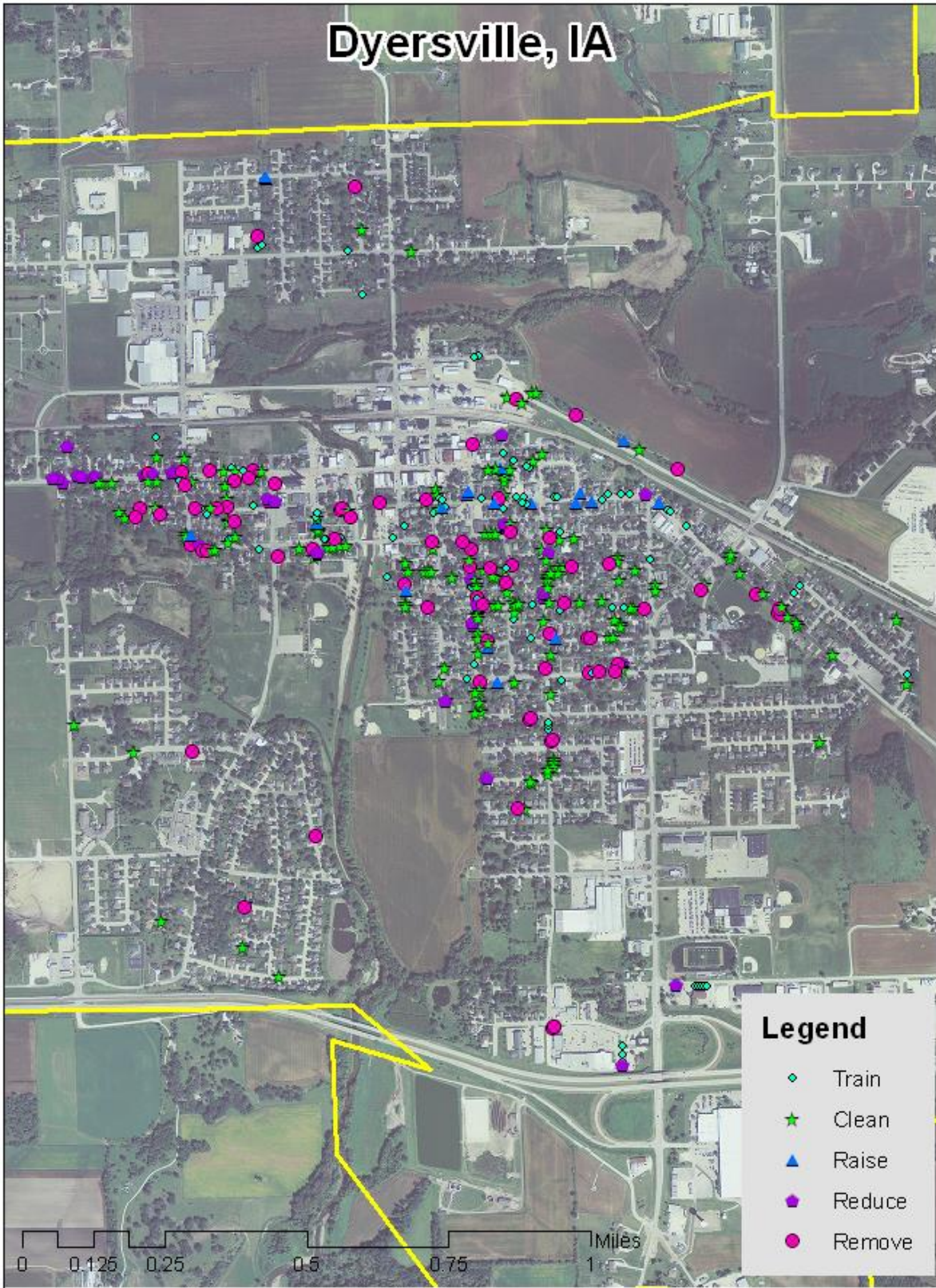
Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Dyersville Tree Ordinances

CHAPTER 151

TREES

151.01 Definition 151.05 Disease Control
151.02 Planting Restrictions 151.06 Inspection and Removal
151.03 Duty to Trim Trees 151.07 Trees Near Intersections Prohibited
151.04 Trimming Trees to be Supervised

151.01 DEFINITION. For use in this chapter, "parking" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No person shall plant any trees or shrubs within the parking unless said person agrees to plant and maintain the trees and shrubs according to an approved site plan and further agrees to be responsible for any and all liability arising from the planting of trees and shrubs within the parking. The work must be done by a responsible, insured contractor approved by the Council. Requests for such approval shall be made to the Council in writing and include a site plan showing the varieties and placement of the trees and shrubs to be planted within the parking and who is to do the work. Anyone violating any of the provisions of this section shall be ordered to remove the trees or shrubs, or removal shall be done by the City at the planter's cost.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on or overhanging the street trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

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

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 dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

      1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

      2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (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 TREES NEAR INTERSECTIONS PROHIBITED. All owners of corner lots within the City are prohibited from planting or maintaining trees, shrubs, vines or other plant life at the corner of such lots nearest the intersection of streets bounding such lots, which trees, shrubs or vines obstruct the view of motorists operating their automobiles at such intersections so that a clear view of the intersecting street cannot be had by the approaching motorists for a distance of at least fifty (50) feet along such intersecting street. In the event any person plants or maintains shrubs, trees, vines or other plant life at such corners which obstruct the view of motorists at such intersections, the same shall be trimmed or removed so that motorists approaching such intersection on both streets may have a clear view of the intersection.