Tree Management Plan

The City of Creve Coeur, Missouri

April 2015

Prepared for:
The City of Creve Coeur
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Acknowledgments

The City of Creve Coeur's vision to promote and preserve its urban forest and improve the management of public trees was a fundamental inspiration for this project. This vision will ensure canopy continuity, which will reduce stormwater runoff and improve air quality, public health, and aesthetic values.

The City of Creve Coeur is thankful for the grant funding it received from the Missouri Department of Conservation (MDC) in cooperation with the U.S. Forest Service through its Tree Resource Improvement and Maintenance (TRIM) cost-share program. The TRIM grant program is designed to encourage communities to create and support long-term and sustained urban and community forestry programs.

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Barry Glantz - Mayor
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Robert Kent - Ward 4

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Executive Summary

This plan was developed for the City of Creve Coeur by Davey Resource Group with a focus on addressing short- and long-term maintenance needs for inventoried public trees. Davey Resource Group completed a tree inventory to gain an understanding of the needs of the existing urban forest and to project a recommended maintenance schedule for tree care. To develop this *Tree Management Plan,* analysis of inventory data was utilized, along with information about the city's existing program and vision for the urban forest. The economic, environmental, and social benefits that trees provide to Creve Coeur are presented, and a strategy for addressing and managing the threat of emerald ash borer (EAB) in the City's urban forest is also included in the plan.

State of the Existing Urban Forest

The February–March 2014 and January–February 2015 inventories included trees along city street rights-of-way (ROW), trees on the city administration building property, and trees within designated areas of the I-270 ROW including medians along Olive Boulevard. A total of 6,376 tree sites were recorded during the inventory.

Analysis of the tree inventory data found:

- The overall condition of the inventoried tree population was assigned a rating of Good.
- One species, *Quercus palustris* (pin oak), made up such a large percentage of the street ROW (16%) that it threatens biodiversity.
- Overall, the diameter size class distribution of the inventoried tree population trended towards the ideal, with a greater number of young trees.
- Creve Coeur's trees have an estimated replacement value of $14,000,000.
- Trees provide approximately $368,462 in annual environmental benefits.
    - Energy Savings: 9,979.8 therms and 394.2 megawatt-hours ($36,518/year).
    - Stormwater Interception: 18,665,357 gallons ($115,725/year).
    - Net Carbon Sequestration: 15,986 tons ($6,858/year).
    - Air Pollutant Removal: 4.9 tons ($12,803/year).
    - Aesthetic Value: $196,558

Tree Maintenance and Planting Needs

Maintenance needs recommended based on the inventory include tree removal (5%) and pruning (95%). Trees should be planted to mitigate removals and create canopy.

Trees provide many environmental and economic benefits that justify the time and money spent for planting and maintenance. Maintenance should be prioritized by addressing trees with the highest risk first. Moderate and Low Risk trees should be addressed after all Severe and High Risk tree maintenance has been completed.

The inventory noted several Severe and High Risk trees (<1% and 5.5% of trees assessed, respectively); these trees should be removed or pruned immediately to promote public safety.

Photograph 1. This* Pinus taeda *(loblolly pine) on Lesparre Drive is a beautiful example of how well city trees can grow when they have plenty of open space.

Tree Removal	• Severe Risk = 1 tree • High Risk = 136 trees • Moderate Risk = 140 trees • Low Risk = 9 trees
Pruning	• High Risk = 209 trees
Routine Pruning Cycle	• Total Trees = 4,492 • Trees in cycle each year = approximately 900
Young Tree Training Cycle	• Total Trees = 1,389 • Trees in cycle each year = at least 463
Tree Planting	• Number of trees each year = at least 100

In addition to priority maintenance, Creve Coeur's urban forest will greatly benefit from a three-year young tree training cycle and a five-year routine pruning cycle. Based on inventory data, at least 463 young trees should be structurally pruned each year during the young tree training cycle; approximately 900 trees should be cleaned during the routine pruning cycle each year.

Photograph 2. These young trees on Bellerive Manor Drive will provide increasing environmental and aesthetic benefits as they grow.

In these proactive pruning cycles, all established trees are visited at least once in five years and young trees receive a training prune every three years. Proactive pruning cycles improve the overall health of the tree population and may eventually reduce program costs. In most cases, pruning cycles will correct defects in trees before they worsen, which will avoid costly problems.

Planting trees is necessary to maintain canopy cover and to replace trees that have been removed or lost to natural mortality (expected to be 1–3% per year) or other threats (for example, construction, invasive pests, or impacts from weather events such as storms, wind, ice, snow, flooding, and drought). The City currently plants an average of 25 trees per year. We recommend planting at least 100 trees of a variety of species each year to offset these losses and maintain canopy and maximum benefits.

Citywide tree planting should focus on creating canopy in areas that promote economic growth (such as business districts) in parking lots and near buildings with insufficient shade, and where there are gaps in the existing canopy. Trees of varied species should be planted; however, the planting of pin oak should be discontinued due to a serious pest problem. The City's existing planting list offers smart choices for species selection. Due to the species distribution and impending threats from emerald ash borer (EAB, *Agrilus planipennis*), all *Fraxinus* spp. (ash) trees should be temporarily removed from the planting list or planted only when a landscape plan is in place.

Urban Forest Program Needs

Adequate funding will be needed for the City to implement an effective management program that will provide short- and long-term public benefits to ensure that priority maintenance is expediently performed, and to establish proactive maintenance cycles. The estimated total cost for the first year of this five-year program is $179,000; by Year 3 of the program, this total will decrease to approximately $138,000 per year. High-priority removal and pruning is costly; most of this work is scheduled during the first year of the program, which is why the budget is higher for that year. After high-priority work has been completed, the urban forestry program will mostly involve proactive work, which is generally less costly, meaning budgets for later years are projected to be lower.

In the long term, the costs of proactive tree management will reduce municipal tree care management costs and possibly the costs to build, manage, and support some city infrastructure.

Creve Coeur has many opportunities to improve its urban forest. Planned tree planting and a systematic approach to tree maintenance will transform an on-demand, priority-based operation into a cost-effective, proactive program. Investing in this tree management program will promote public safety, improve tree care efficiency, and increase the economic and environmental benefits the community receives from its trees.

Emerald Ash Borer Strategy

EAB, is a death sentence for untreated ash trees, has been found in nearby St. Charles County. It is only a matter of time before EAB reaches Creve Coeur. In the meantime, Davey Resource Group recommends a combination of treatment and removal for the 830 *Fraxinus* (ash) trees identified in the inventory. See Section 4 of this plan for specific recommendations. Recommendations regarding previously inventoried park trees are included in Appendix F.

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Introduction

The City of Creve Coeur is home to more than 17,900 full-time residents who enjoy the beauty and benefits of their urban forest. The city's forestry program manages trees on public property—along the street ROW, in parks, and in public spaces. There are four full-time employees working to maintain Creve Coeur's urban forest.

Funding for the City's urban forestry program comes from both the parks and public works budgets. The City has a tree ordinance, maintains a budget of more than $2 per capita for tree-related expenses, celebrates Arbor Day, and has been a Tree City USA for 17 years.

Photograph 3. A street well stocked with trees in the street ROW provides economic, environmental, and social benefits, including temperature moderation, reduction of air pollutants, energy conservation, and increased property values.

Approach to Tree Management

The best approach to managing an urban forest is to develop an organized, proactive program using tools (such as a tree inventory and tree management plan) to set goals and measure progress. These tools can be utilized to establish tree care priorities, generate strategic planting plans, draft cost-effective budgets based on projected needs, and ultimately reduce to a minimum the need for costly, reactive solutions to crises or urgent hazards.

In February and March 2014 and January and February 2015, Creve Coeur worked with Davey Resource Group to inventory trees and develop a management plan. The plan considers the general condition, diversity, and distribution of the inventoried trees and provides a prioritized system for managing city street ROW trees, designated trees within I-270 ROW, and trees on the city administration building property. Davey Resource Group completed the following tasks:

- inventory of trees within the designate areas
- analysis of tree inventory data
- development of a plan that prioritizes the recommended tree maintenance

This plan is divided into four sections:

- Section 1 (*Tree Inventory Analysis*) summarizes the tree inventory data and presents trends, results, and observations.
- Section 2 (*Benefits of the Urban Forest*) summarizes the economic, environmental, and social benefits that trees provide to Creve Coeur.
- Section 3 (*Tree Management Program*) utilizes the inventory data to develop a prioritized maintenance schedule and projected budget for the implementation of the recommended tree maintenance over a five-year period.
- Section 4 (*Emerald Ash Borer Strategy*) presents proactive maintenance and policy strategies for the prevention and mitigation of an emerald ash borer infestation.

Photograph 4. This* Gymnocladus dioicus *(Kentucky coffee tree) on Conway Road is an example of a tree species which does very well in urban situations. It has very few pest or disease problems and can tolerate smaller spaces.

Section 1: Tree Inventory Analysis

In February and March of 2014 and January and February of 2015, Davey Resource Group arborists certified by the International Society of Arboriculture (ISA) assessed and inventoried trees along city street ROW, trees on the city administration building property, and trees within designated areas of the I-270 ROW including medians along Olive Boulevard. A total of 6,376 tree sites were collected during the inventory.

Data Collection Methods

Tree inventory data were collected using a system developed by Davey Resource Group that utilizes a customized ArcPad program loaded onto pen-based field computers equipped with geographic information system (GIS) and global positioning system (GPS) receivers. The knowledge and professional judgment of Davey Resource Group's arborists ensure the high quality of inventory data.

Data fields are defined in the glossary, and the site location method is provided in Appendix A. At each site, the following data fields were collected:

- aboveground utilities
- canopy spread
- condition
- failure
- further inspection
- location
- primary maintenance needs
- mapping coordinate
- notes
- risk assessment
- risk rating
- species
- stems
- street name
- tree size*

* measured in inches in diameter at 4.5 feet above ground (or diameter at breast height [DBH])

Primary maintenance recommendations are based on ANSI A300 (Part 1) (ANSI 2008). Risk assessment and risk rating are based on Urban Tree Risk Management (Pokorny et al. 1992).

The data collected were provided in shapefile and Microsoft Excel™, Access™, and i-Tree streets formats on a CD-ROM that accompanies this plan.

Project Area

The inventory included all trees along city street ROW, trees on the city administration building property, and trees within designated areas of the I-270 ROW including medians along Olive Boulevard.

Photograph 5. Davey Resource Group's ISA Certified Arborists inventoried trees along street ROWs and in selected public areas to collect information about trees that could be used to assess the state of the urban forest.

Assessment of Tree Inventory Data

Data analysis and professional judgment are used to make generalizations about the state of the inventoried tree population. Recognizing trends in the data can help guide short- and long-term management planning. In this plan, the following criteria and indicators of the inventoried tree population were assessed:

- *Species Diversity*: The variety of species in a specific population; affects the population's ability to sustain threats from invasive pests and diseases; impacts tree maintenance needs and costs, tree planting goals, and canopy continuity.

- *Diameter Size Class Distribution Data*: Statistical distribution of a given tree population's trunk-size class; affects the valuation of tree-related benefits as well as the estimation of maintenance needs and costs, planting goals, and canopy continuity; the diameter size class distribution be used to indicate relative age of a tree population.
- *Condition*: The general health of a tree population; indicates how well trees are performing given their site-specific conditions; general health affects both short- and long-term maintenance needs and costs as well as canopy continuity.
- *Street ROW Stocking Level*: The portion of existing street ROW trees compared to the total number of potential street ROW trees (number of inventoried trees plus the number of potential planting spaces); stocking level can help determine tree planting needs and budgets.

Species Diversity

Species diversity affects maintenance costs, planting goals, canopy continuity, and the forestry program's ability to respond to threats from invasive pests or diseases. Low species diversity (large number of trees of the same species) can lead to severe losses in the event of species-specific epidemics such as the devastating results of Dutch elm disease (*Ophiostoma novo-ulmi*) throughout New England and the Midwest. Because of the introduction and spread of Dutch elm disease in the 1930s and its presence today, massive numbers of *Ulmus americana* (American elm), a popular street tree in Midwestern cities and towns, have perished (Karnosky 1979). Many Midwestern communities were stripped of most of their mature shade trees, creating a drastic void in canopy cover. Many communities replanted to replace the lost elm trees. Ash and maple trees were popular replacements for American elm in the wake of Dutch elm disease. Unfortunately, some of the replacement species for American elm trees are now overabundant and are a concern for biodiversity. EAB and Asian longhorned beetle (ALB, *Anoplophora glabripennis*) are non-native insect pests that attack some of the most prevalent urban shade trees and certain agricultural trees throughout the country.

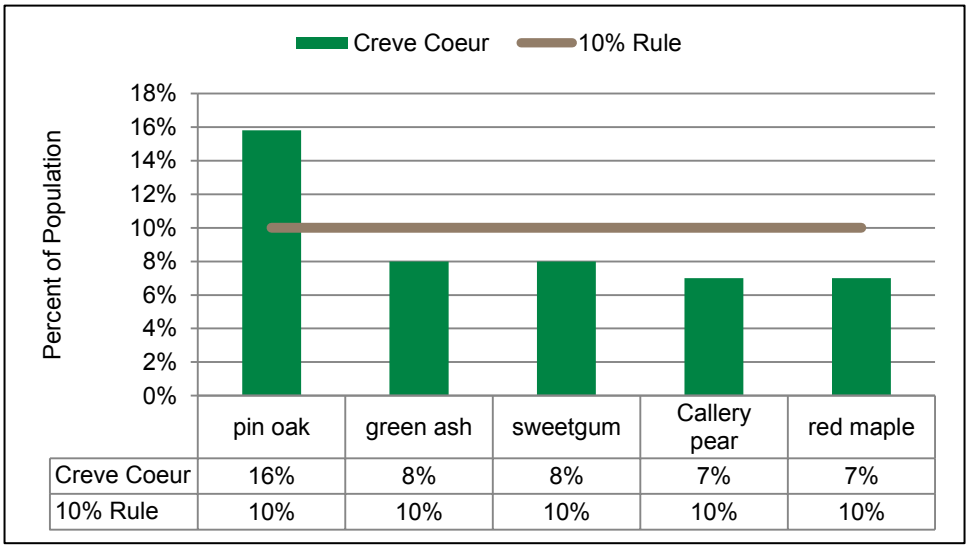
Photograph 6. Remnants of natural forest in Creve Coeur containing* Carya *(hickory) and* Quercus *(oak) work in conjunction with planted trees to provide a diverse urban forest. These old stands can also provide examples for future species selection.

The composition of a tree population should follow the 10-20-30 Rule for species diversity: a single species should represent no more than 10% of the urban forest, a single genera no more than 20%, and a single family no more than 30%.

Findings

Analysis of Creve Coeur's tree inventory data indicated that the population had relatively good diversity, with 56 genera and 121 species represented.

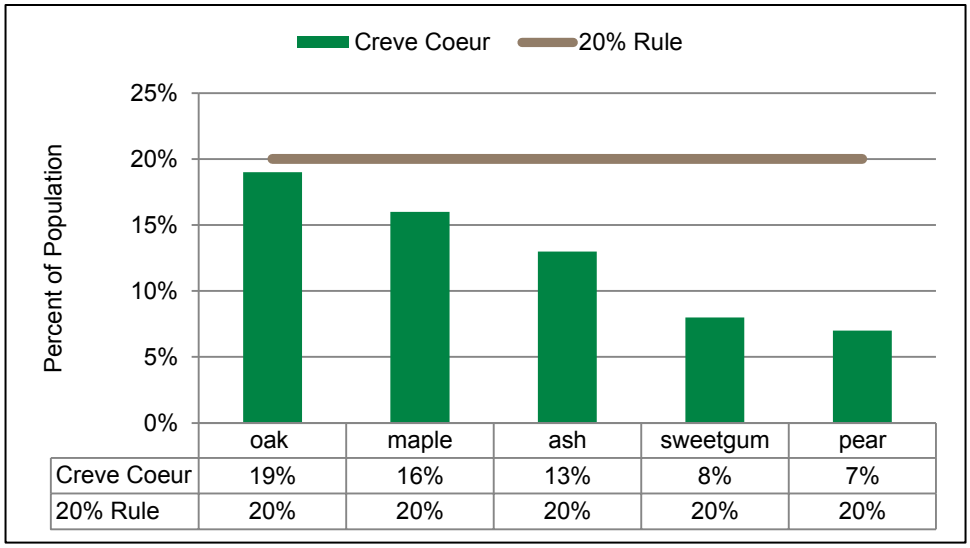
Figure 1 compares the percentages of the most common species identified during the inventory to the 10% Rule. Pin oak, which comprises 16% of the inventoried tree population, exceeds the recommended 10% maximum for a single species in a population. *Acer rubrum* (red maple), *Fraxinus americana* (green ash), *Liquidambar styraciflua* (sweetgum), and *Pyrus calleryana* (Callery pear) are approaching the 10% threshold as well.



	pin oak	green ash	sweetgum	Callery pear	red maple
Creve Coeur	16%	8%	8%	7%	7%
10% Rule	10%	10%	10%	10%	10%

Figure 1. The five most abundant species of ROW trees during the 2014 and 2015 inventories.

Figure 2 compares the percentages of the most common genera on the street ROW in relation to the 20% Rule. *Quercus* (oak) and *Acer* (maple) are both approaching the point where they will meet or exceed this guideline.



	oak	maple	ash	sweetgum	pear
Creve Coeur	19%	16%	13%	8%	7%
20% Rule	20%	20%	20%	20%	20%

Figure 2. The five most abundant genera of ROW trees during the 2014 and 2015 inventories.

Discussion/Recommendations

The abundance of pin oak, in relation to the landscape as a whole, is a biodiversity concern. . Also, pin oak is a target of gouty and horned galls, which are the result of the breeding activities of certain non-stinging wasps. This is having a serious effect on the health of the vast majority of pin oak in Creve Coeur. These galls will not kill individual trees immediately upon infection. However, over the course of several years, they can greatly compromise the health of a tree, leaving it susceptible to other pests, diseases, or weather events. Overplanting of pin oak from the past several decades has led to the current severe outbreak. Planting of pin oak should be discontinued for the moment.

Photograph 7. Once the gouty and horned galls afflicting* Quercus palustris *(pin oak) reach this size and density, they have a significant negative effect on tree health and failure risk. They also reduce the aesthetic benefits provided.

A lower density of pin oak and a general increase of diversity would have limited the spread and impact of the harmful galls. The impending arrival of EAB means that the entirety of Creve Coeur's ash population (13% currently) will have to be either treated or removed in the next few years. Considering the large quantity of maple already present in the population and its susceptibility to Asian longhorned beetle (ALB), the planting of maple should be limited to minimize the potential for loss should ALB arrive in the St. Louis area. The density of other genera should be limited as much as possible to avoid damage from any future outbreaks of pests and diseases. See Appendix B for a recommended planting list of tree species.

Diameter Size Class Distribution

Analyzing the diameter size class distribution provides an estimate of the relative age of a tree population and insight into maintenance practices and needs.

The inventoried trees were categorized into the following diameter size classes: Young trees (0–8 inches DBH), Established (9–17 inches DBH), Maturing (18–24 inches DBH), and Mature trees (>24 inches DBH). These categories were chosen so that the population could be analyzed according to Richards ideal distribution (1983). Richards proposed an ideal diameter size class distribution for street trees based on observations of well-adapted trees in Syracuse, New York. Richards' ideal distribution suggests that the largest fraction of trees (approximately 40% of the population) should be young (<8 inches DBH), while a smaller fraction of trees (approximately 10%) should be in the large-diameter size class (>24 inches DBH). A tree population with an ideal distribution would have an abundance of newly planted and Young trees, and a low number of Established, Maturing, and Mature trees.

Findings

Figure 3 compares Creve Coeur's diameter size class distribution of the inventoried tree population to the ideal proposed by Richards (1983). Creve Coeur's street tree distribution trends toward the ideal; however, trees of a larger diameter size classes fall short.

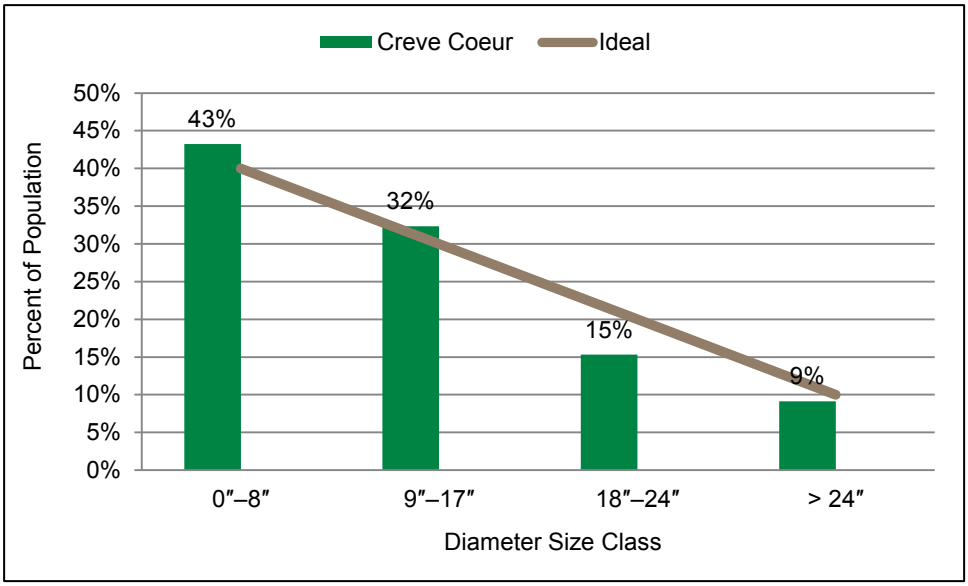
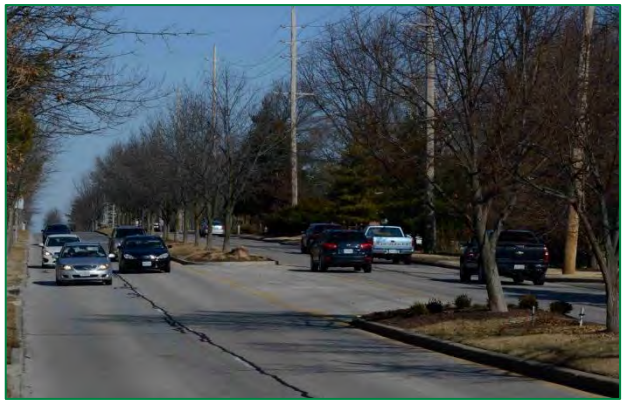


Figure 3. Diameter distribution of Creve Coeur street trees compared to the ideal.

Discussion/Recommendations

Creve Coeur's diameter distribution normally would bode well for the future. The slight skew toward younger trees is the result of heavy planting by the city, developers, and residents over the past decade. In time this would normalize as Young trees move into the larger diameter classes. To date, however, Creve Coeur's ash population is comprised mostly of Young (294 trees) and Established trees (407 trees). These trees will need to be removed in the near future unless they receive EAB treatments.



Photograph 8. The medians on New Ballas Road have been beautifully planted with* Fraxinus americana *(white ash). Unfortunately, the imminent arrival of emerald ash borer means that these trees will probably need to be replaced in the near future.

One of Creve Coeur's objectives is to have an uneven-aged distribution of trees at the street, neighborhood, and management zone levels, as well as citywide. Davey Resource Group recommends a strong planting and maintenance program to ensure that young, healthy trees are in place to fill in gaps in tree canopy and provide for gradual succession of older trees and the ash which will need to be removed. The city must promote tree preservation and proactive tree care to ensure older trees survive as long as possible. Tree planting and tree care will allow the distribution to normalize over time.

Planting trees is necessary to increase canopy cover and replace trees lost to natural mortality (expected to be 1%–3% per year) and other threats (for example, invasive pests or impacts from weather events such as storms, wind, ice, snow, flooding, and drought). Planning for the replacement of existing trees and finding the best places to create new canopy is critical.

Condition

Davey Resource Group assessed the condition of individual trees based on methods defined by the ISA. Several factors were considered in assessing the condition of each tree: root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests were all evaluated. The condition of each inventoried tree was rated Excellent, Very Good, Good, Fair, Poor, Critical, or Dead.

In this plan, the general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory.

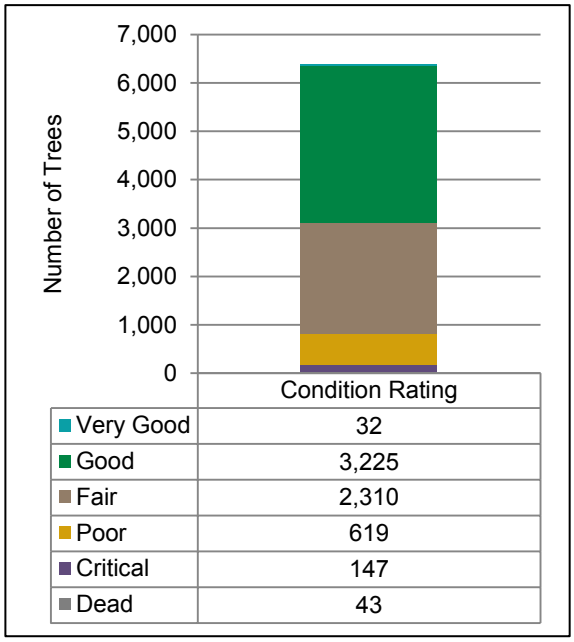


Figure 4. Condition of trees inventoried during the 2014–2015 inventory.

Comparing the condition of the inventoried tree population with relative tree age can provide some insight into the stability of the population. In this plan, relative age was based on DBH. Since tree species have different lifespans and mature at different diameters, heights, and crown spreads, actual tree age cannot be determined from diameter size class alone. However, general classifications of size can be extrapolated into relative age classes. The following categories are used to describe relative age: Young (0–8 inches DBH), Established (9–17 inches DBH), Maturing (18–24 inches DBH), and Mature (>24 inches DBH).

Figures 4 and 5 illustrate the general health and percent of Young, Established, Mature, and Maturing trees.

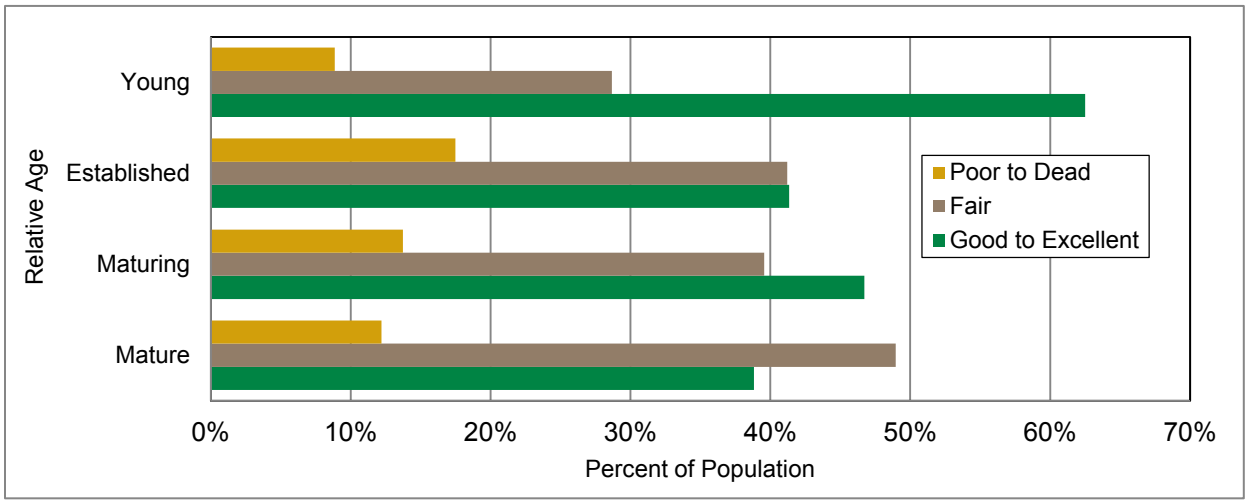


Figure 5. Condition of trees inventoried during the 2014-2015 inventory by relative age class.

Findings

Figures 4 and 5 reflect the general health and percent of Young, Established, Mature, and Maturing trees. As illustrated in Figure 4, most of the inventoried trees are in Good or Fair condition (51% and 36% respectively). Based on the data, the general health of the overall inventoried tree population is Good.

Most of the inventoried trees were recorded to be in Good or Fair condition, 51% and 36%, respectively (Figure 4). Based on these data, the general health of the overall inventoried tree population is rated Good. Figure 5 illustrates that most of the young and maturing trees were rated to be in Good condition, and most of the established and mature trees were rated to be in Fair condition.

Discussion/Recommendations

Even though the condition of Creve Coeur's inventoried tree population is typical, there are still a number of maintenance needs and historical maintenance practices worth considering:

- The large number of Established trees in Fair condition is due to the large number of Callery pear in this diameter class. This species tends to have serious structural problems, which compromise the condition of the trees as they mature.
- Dead trees and trees in Critical condition should be removed; they most likely will not recover, even if care is increased.
- Younger trees in Fair or Poor condition may benefit from improvements in structure that could improve their health over time. Pruning should follow *ANSI A300 (Part 1)* (ANSI 2008).
- Poor condition ratings assigned to Mature trees were generally due to visible signs of decline and stress, including decay, dead limbs, sparse branching, or poor structure. These trees will require corrective pruning, regular inspections, and possible intensive plant health care to improve their health.

- Proper tree care practices are essential to the long-term general health of the urban forest.. Many of the newly planted trees were improperly mulched or had staking hardware attached to them long after they should have been removed. Following guidelines developed by the ISA and those recommended by *ANSI A300 (Part 6)* (ANSI 2012) will ensure that tree maintenance practices will improve the general health of the urban forest.

Photographs 9 and 10. The close branching of* Pyrus calleryana *(Callery pear) leads to structural weaknesses that often result in failure during severe weather events. Young trees need regular training pruning to reduce the likelihood of failure.

Street ROW Stocking Level

Stocking is a traditional forestry term used to measure the density and distribution of trees. For an urban/community forest such as Creve Coeur's, stocking level is used to estimate the total number of sites along the street ROW that could contain trees. Because this is a measure of the capacity of the street ROW to contain trees, park and public property trees are excluded from this measurement.

Stocking level is the ratio of total street ROW spaces that are occupied by trees to the total street ROW spaces that are suitable for trees. For example, a street ROW tree inventory of 1,000 total sites with 750 existing trees and 250 vacant planting sites would have a stocking level of 75%.

For an urban area, Davey Resource Group recommends that the street ROW stocking level be at least 90% so that no more than 10% of the potential planting sites along the street ROW are vacant.

Photograph 11. This* Magnolia stellate *(star magnolia) planted on Timber Run Drive is an example of a city tree that has received a great deal of care from residents. Partnership between residents and the city is one of the keys to increasing street tree stocking levels.

Street ROW stocking levels may be estimated using information about the community, tree inventory data, and common street tree planting practices. Inventory data containing the number of existing trees and vacant plantings along the street ROW will increase the accuracy of the projection. However, street ROW stocking levels can be estimated using only the number of existing trees and the number of street miles in the community.

Since data on planting sites were not collected, stocking level must be determined by establishing another way. Some cities set a goal of having one tree per household. Others use the ratio of trees per person to determine a desired stocking level. One study found that the average number of trees per person in 22 American cities to be 0.37 reported for 22 U.S. cities (McPherson and Rowntree 1989). We can use these two benchmarks to determine a stocking goal for the City of Creve Coeur.

Findings

According to the 2010 Census, Creve Coeur's population is approximately 18,000, with a total of 7,700 households. The current stocking level is 0.35, just below the national average. There are approximately 0.83 trees per household.

Discussion/Recommendation

Fully stocking the street ROW with trees is a reasonable goal. The combination of inadequate tree planting, maintenance budgets, and tree mortality lead to decreased stocking levels. Nevertheless, working to attain a fully stocked street ROW is advisable because it would promote canopy continuity and environmental sustainability. The City of Creve Coeur should work to increase its street ROW population from 0.35 trees per resident to a stocking level of 0.37. This goal would entail a planned program that includes planting, care, and maintenance for the city's street ROW trees. If Creve Coeur's goal is to have 0.37 trees per resident, the city needs to increase its stocking level by approximately 300 trees.

If Creve Coeur wants to reach its goal of one tree per household in the space of ten years, Davey Resource Group recommends that the city plant approximately 100 trees per year. Half of these plantings will add to the current street tree population, while the other half account for tree mortality. If possible, more than 100 trees should be planted to better prepare for impending threats and to increase the urban forest's benefits. This is especially true if a large number of ash trees are going to be removed in response to emerald ash borer.

Photograph 12. Newer developments like Bellerive Farm Drive have one tree per house. This is a good goal for the city as a whole. If this goal is achieved, the City of Creve Coeur would far surpass the national average for street trees per person.

Overhead Utilities

The presence of overhead utilities can present a challenge for urban forest managers. Davey Resource Group recommends that small statured tree species such as *Malus sp*. (flowering apple) or *Syringa reticulata* (Japanese tree lilac) be planted under wires. Large and medium statured trees will require drastic pruning to help ensure uninterrupted delivery of energy and information infrastructure. This pruning can often be detrimental to tree health and aesthetics.

The presence of overhead utility lines above or 10 feet away from a tree were noted as "yes." Trees in contact with overhead utilities were noted as "conflicting."

Findings

Table 1. Inventoried Trees with Overhead Utility Conflicts

Presence of Overhead Utilities	Occurrences	Percentage
No	6,005	94.2%
Yes	355	5.6%
Conflicting	16	0.3%

There were 371 inventoried trees (6%) with utilities directly above or passing through the tree canopy. Of those trees, 299 (81%) were large- or medium-sized trees. Less than 1% of all trees were in contact with overhead utilities.

Photograph 13. This* Magnolia acuminate *(cucumber tree) is an excellent addition to the species diversity in Creve Coeur. Unfortunately, its close proximity to overhead utilities leaves it subject to drastic, unsightly utility pruning.

Discussion/Recommendations

The city has done a great job of planting trees in appropriate locations, such that most trees avoid contact with overhead utilities. Trees planted under wires were often too large for the space. Many of these are volunteer (naturally growing) trees or were likely planted by residents. The city should be sure to follow established guidelines for planting trees under wires and encourage residents to do the same.

Planting only small-growing trees within 20 feet of overhead utilities, medium-sized trees within 20–40 feet, and large-growing trees outside 40 feet will help minimize future conflicts, improve future tree conditions, and reduce the costs of maintaining trees under utility lines.

Further Inspection

This data field indicates whether a particular tree requires further inspection, such as a Level III risk inspection in accordance with ANSI A300, Part 9 (ANSI, 2011), or periodic inspection due to particular conditions that may cause the particular tree to be a safety risk, and therefore, hazardous. If a tree was noted for further inspection, city staff should investigate as soon as possible to determine corrective actions.

Findings

Davey Resource Group recommended 17 trees for further inspection.

Discussion/Recommendations

An ISA Certified Arborist should perform additional inspections of the 17 trees. If it is determined that these trees exceed the threshold for acceptable risk, the defective part(s) of the trees should be corrected or removed. In some cases, the entire tree may need to be removed.

Potential Threats from Pests

Insects and diseases pose serious threats to tree health. Awareness and early diagnosis are essential to ensuring the health and continuity of the street trees. Appendix C provides information about some of the current potential threats to Creve Coeur's trees and includes websites where more detailed information can be found.

Many pests target a single species or an entire genus. The inventory data were analyzed to provide a general estimate of the percentage of trees susceptible to some of the known pests in Missouri (see Table 2 below). It is important to note that the table presents data only from the inventory. Many more trees throughout the city, including those on public and private property, may be susceptible to these invasive pests.

Table 2. Percentage of Trees Susceptible to Some of the Known Pests in Missouri

Pest	Number of Susceptible Trees	Percentage of Inventoried Trees
Granulate ambrosia beetle	1,598	25%
Asian longhorned beetle	1,939	30%
Emerald ash borer	830	13%

Findings

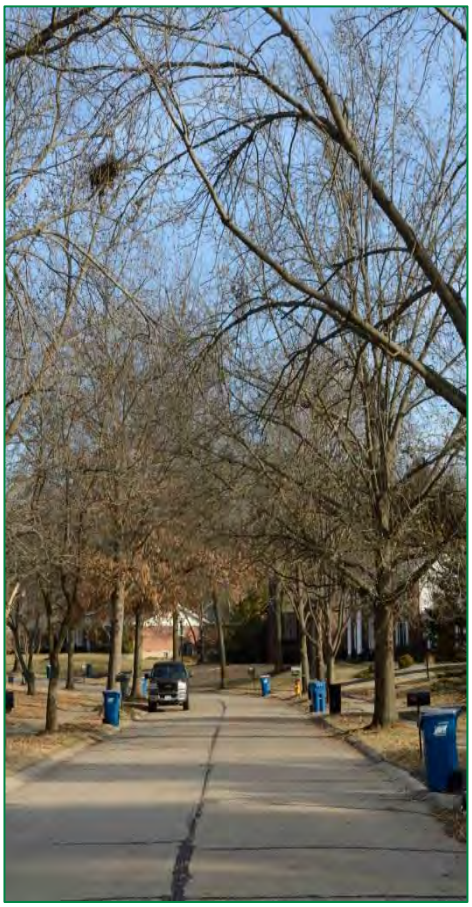
Granulate ambrosia beetle (*Xylosandrus crassiusculus*) and ALB are known threats to a large percentage of the inventoried street trees (25% and 30%, respectively). These pests were not detected in Creve Coeur, but if they were, the city could see severe losses in its tree population.

Photograph 14. These green ash will succumb to emerald ash borer in the near future. Increasing species diversity is the best way to limit the damage exotic pests and diseases can cause.

While EAB is not present in Creve Coeur, it has been found in nearby St. Charles County. There has been no success controlling the spread of this pest in regions of the nation where it has already struck. Infestation in Creve Coeur is highly likely in the next few years and virtually guaranteed in the long term. There were 830 ash trees inventoried within the street ROW. There are also a large number of ash trees in un-inventoried public and private areas. Please see *Section 4: Emerald Ash Borer Strategy* for more detailed information.

Discussion/Recommendations

The City of Creve Coeur should be aware of the signs and symptoms of infestations and should be prepared to act if a significant threat is observed in its tree population or a nearby community. An integrated pest management plan should be established. Tasks and goals should include: identifying and monitoring threats, understanding the economic threshold, selecting the correct treatment, properly timing management strategies, recordkeeping, and evaluating results. Once again, increasing species diversity is an important way to limit damage should any severe pests or disease arrive in Creve Coeur.

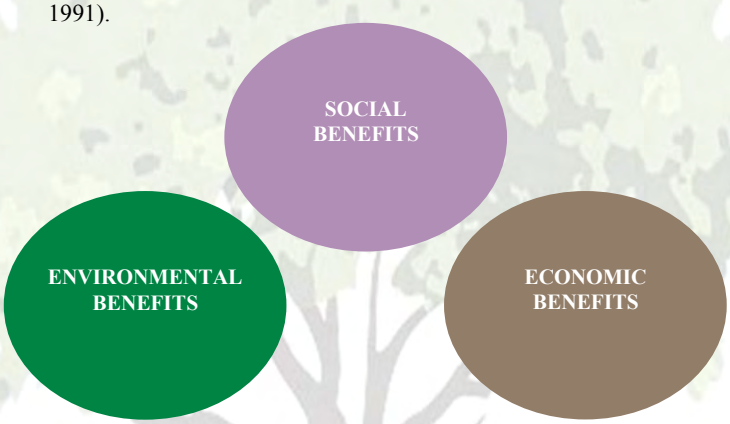


Photograph 15. High-density planting of pin oak from decades ago has facilitated the spread of gouty and horned galls throughout Creve Coeur and other St. Louis suburbs. This illustrates that block by block diversity is as important as city-wide diversity.

Section 2: Benefits of the Urban Forest

The urban forest plays an important role in supporting and improving the quality of life in urban areas. A tree's shade and beauty contributes to the community's quality of life and softens the often hard appearance of urban landscapes and streetscapes. When properly maintained, trees provide numerous environmental, economic, and social benefits to a community far in excess of the time and money invested in planting, pruning, protection, and removal.

- Tree-lined streets are safer; traffic speeds and the amount of stress drivers feel are reduced, which likely reduces road rage/aggressive driving (Wolf 1998a, Kuo and Sullivan 2001b).
- Chicago apartment buildings with medium amounts of greenery had 42% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Chicago apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Employees who see nature from their desks experience 23% less sick time and report greater job satisfaction than those who do not (Wolf 1998a). Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall (Ulrich 1984, 1986).
- When surrounded by trees, physical signs of personal stress, such as muscle tension and pulse rate, were measurably reduced within 3–4 minutes (Ulrich 1991).



- Trees decrease energy consumption and moderate local climates by providing shade and acting as windbreaks.
- Trees act as mini-reservoirs, helping to slow and reduce the amount of stormwater runoff that reaches storm drains, rivers, and lakes. 100 mature tree crowns intercept ~100,000 gallons of rainfall per year (U.S. Forest Service 2003a)
- Trees help reduce noise levels, cleanse atmospheric pollutants, produce oxygen, and absorb carbon dioxide.
- Trees can reduce street-level air pollution by up to 60% (Coder 1996). Lovasi (2008) suggested that children who live on tree-lined streets have lower rates of asthma.
- Trees stabilize soil and provide a habitat for wildlife.

- Trees increase residential property values by an average of 7% when present in a ~~the~~ yard or neighborhood. Commercial property rental rates were 7% higher when trees were on the property (Wolf 2007).
- Trees moderate temperatures in the summer and winter, saving on heating and cooling expenses (North Carolina State Univ. 2012, Heisler 1986)
- On average, consumers will pay about 11% more for goods in landscaped areas, with this figure being as high as 50% for convenience goods (Wolf 1998b, Wolf 1999, and Wolf 2003).
- Consumers also feel that the quality of the products is better in business districts having trees than those considered barren (Wolf 1998b).
- The quality of landscaping along the routes leading to the business district had a positive influence on consumers' perceptions of the area (Wolf 2000).

The i-Tree Streets application was used to assess the trees inventoried—this management and analysis tool uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits provided by trees, including energy conservation, air quality improvement, CO_2 reduction, stormwater control, and increases in property value. It estimates the costs and benefits of a street tree population and creates annual benefit reports that demonstrate the value street trees have and give to a community.

The inventoried urban forest of Creve Coeur has recorded benefit savings of $368,462 annually from energy savings, stormwater reduction, increased property values, and overall air quality improvements. Figure 6 provides a breakdown of the annual benefits provided to the city.

Photograph 16. This giant* Diospyros virginiana *(common persimmon) shows how open areas and natural trees contribute greatly to the street stocking level of Creve Coeur.

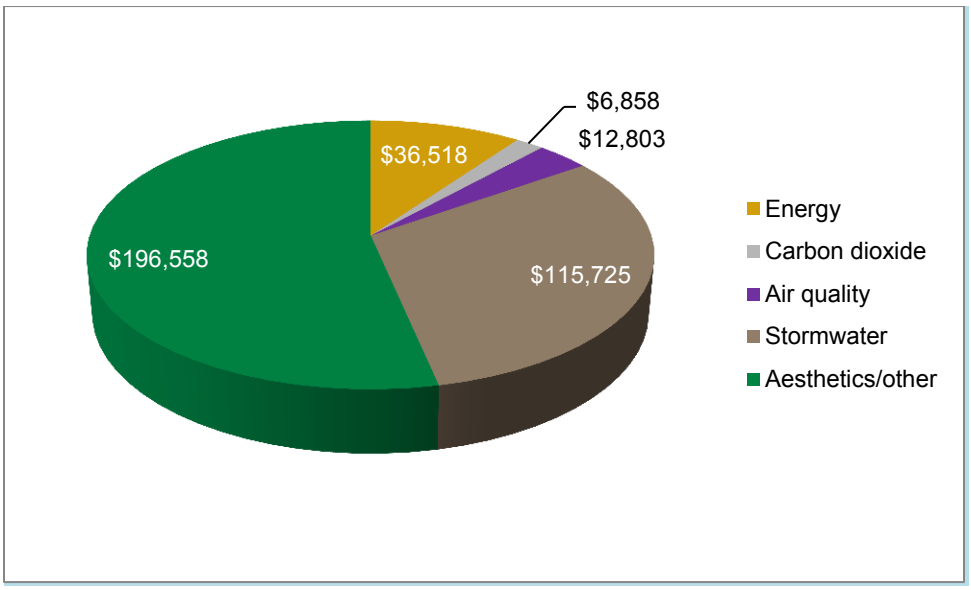


Figure 6. Annual Benefits Provided to the City of Creve Coeur.

Stormwater

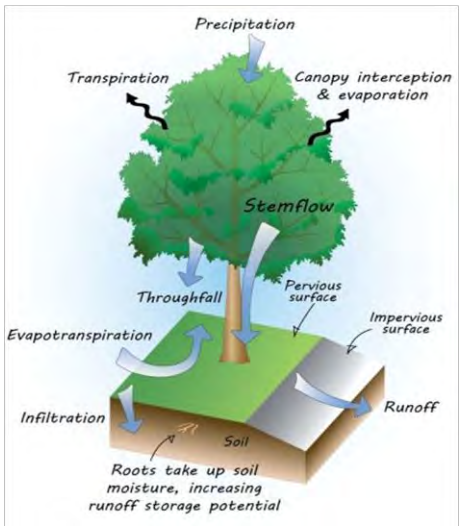
Trees intercept rainfall, reducing costs to manage stormwater runoff—Creve Coeur's inventoried ROW trees intercept 18,665,357 gallons of rainfall annually. The estimated average savings for the City in the management of stormwater runoff is $115,725 annually.

Air Quality Improvements

The inventoried tree population removes 4.9 tons of air pollutants and avoids 6,791 pounds annually. The i-Tree Streets calculation takes into account the biogenic volatile organic compounds (BVOCs) that are released from trees. The net total value of these benefits is estimated to be $12,803.

Carbon Storage and Carbon Sequestration

Trees absorb carbon dioxide (CO_2) as a process of photosynthesis. Some of this CO_2 is stored as the woody tree biomass and some is sequestered during growth (Nowak et al. 2013). Both services reduce the total amount of CO_2 that is in the atmosphere at any given time. Over the lifetime of the existing population CO_2 storage is valued at $105,515. CO_2 sequestration is annually valued at $5,102/year.



- *Trees reduce stormwater runoff by capturing and storing rainfall in their canopy and releasing water into the atmosphere.*
- *Tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil.*
- *Trees help slow down and temporarily store runoff and reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots.*
- *Trees transform pollutants into less harmful substances.*

The i-Tree Streets calculation takes into account the carbon emissions that are *not* released from power stations because of the subsequent heating and cooling effect of trees (buildings and homes use less energy). It also calculates the additional emissions released during tree care and maintenance (like driving to the site and operating equipment). The net carbon benefit is approximately $6,858 per year.

Energy Use

The contribution of the public trees towards conserving energy is reflected in their ability to shade structures and surfaces, reduce electricity use for air conditioning in summer, and divert wind in the winter reducing natural gas use. Based on the inventoried trees, the annual electric and natural gas savings are equivalent to 394.2 MWh of electricity and 9,979.8 therms of natural gas. When converted into monetary values using default economic data, this accounts for a savings of $36,518 in energy consumption each year. These large leafy canopies provide shade, which reduces energy usage and increases their value.

Aesthetic/Other

Trees provide social benefits in numerous quantifiable ways. These benefits stem, in part, from increases in property and real estate values. Creve Coeur's trees contribute $196,558 worth of Aesthetic/Other Benefits.

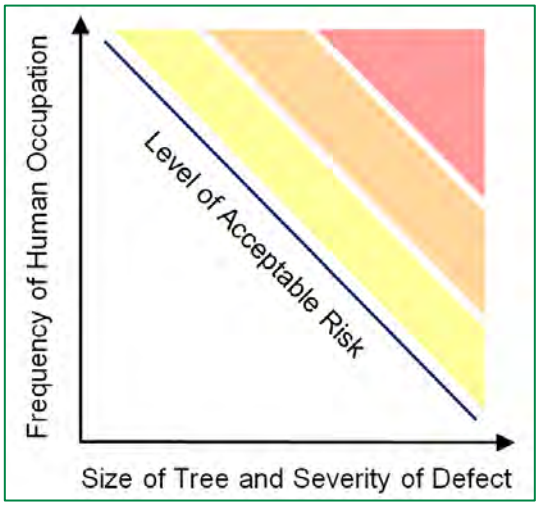
Section 3: Tree Management Program

This tree management program was developed to uphold Creve Coeur's comprehensive vision for preserving its urban forest. This five-year program is based on the tree inventory data and was designed to reduce risk through prioritized tree removal and pruning and to improve tree health and structure through proactive pruning cycles. Tree planting to mitigate removals and increase canopy cover and public outreach are important parts of the program as well.

Implementing a tree care program is an ongoing process; however, tree work must always be prioritized to reduce public safety risks. Davey Resource Group recommends completing the work identified during the inventory based on the risk rating assigned; however, it is also essential to routinely monitor the tree population to identify other Severe or High Risk trees so that they may be systematically alleviated. Pruning cycles and tree planting should be completed regularly; however, priority work (especially for trees rated as Severe or High Risk) must at times take precedence to ensure that risk is managed expediently.

How Risk Was Assessed During the Inventory

Every tree has an inherent risk of tree failure or defective tree part failure. During the inventory, Davey Resource Group performed a risk assessment for each tree and assigned a risk rating following protocol based on the *Urban Tree Risk Management* (Pokorny et al. 1992). The probability of failure, size of defective part, probability of target impact, and other risk factors were evaluated for each tree inventoried. Independent point values were assigned and summed to generate the risk rating.



- *Probability of Failure* (1–4 points). Identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions.
- *Size of Defective Part* (1–3 points). Rates the size of the part most likely to fail.
- *Probability of Target Impact* (1–3 points). Rates the use and occupancy of the area that would be struck by the defective part.
- *Other Risk Factors* (0–2 points). This category is used if professional judgment suggests the need to increase the risk rating. It is especially helpful when growth characteristics become a factor in risk rating. For example, some tree species have growth patterns that make them more vulnerable to certain defects such as weak branch unions and branching shedding.

Once the risk rating is calculated, a level of risk is assigned to each tree based on its risk rating. The assigned risk rating allows for effective prioritization of tree maintenance work.

- *Severe Risk* (rating of 9 or 10): Trees described as Severe Risk have defects that cannot be cost-effectively or practically treated. Most of the trees in this category have multiple or significant defects in the trunk, crown, or critical root zone. Defective trees and/or tree parts are generally larger than 20 inches in diameter and are found in areas of frequent occupation, such as a main thoroughfare, a congested street, and/or near a school.

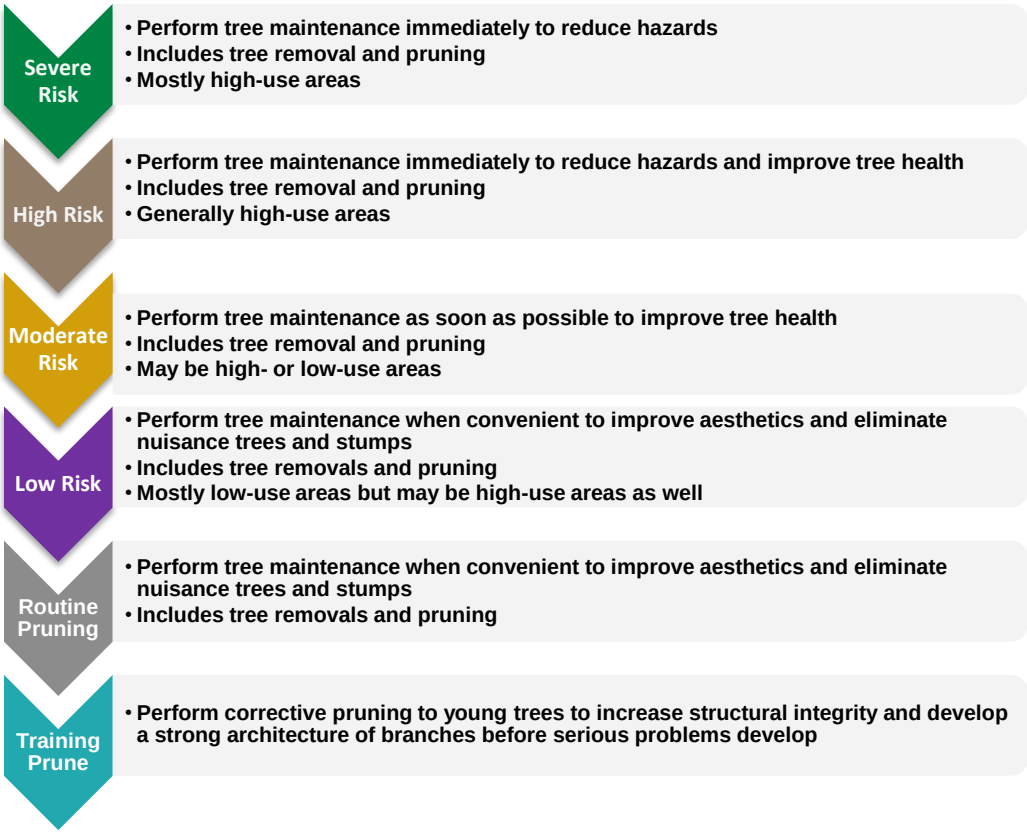
- *High Risk* (rating of 7 or 8): Trees designated as High Risk have defects that may or may not be cost-effectively or practically treated. Most of the trees in this category have multiple or significant defects affecting more than 40% of the trunk, crown, or critical root zone. Defective trees and/or tree parts are generally 4–20 inches in diameter and are found in areas of frequent occupation, such as a main thoroughfare, a congested street, and/or near a school.
- *Moderate Risk* (rating of 5 or 6): Trees described as Moderate Risk have defects that may be cost-effectively or practically treated. Most of the trees in this category exhibit several moderate defects affecting less than 40% of a tree's trunk, crown, or critical root zone. These trees may be in high-, moderate-, or low-use areas.
- *Low Risk* (rating of 3 or 4): Trees designated as Low Risk have minor visible structural defects or wounds and are typically found in areas with moderate- to low-use areas.
- *None* (rating of 0): Used for planting sites and stumps.

Trees with elevated (Severe or High) risk levels are usually recommended for removal or for pruning to eliminate the defects that warranted their risk rating. However, in some situations, risk may be reduced by adding support (cabling or bracing) or by moving the target away from the tree. Davey Resource Group recommends only removal or pruning to alleviate risk. But in special situations, such as a significant or memorial tree or a tree in an historic area, Creve Coeur may decide that cabling, bracing, or moving the target may be the best option for alleviating risk.

Determination of acceptable risk ultimately lies with Creve Coeur urban forest managers. Trees often have associated risks; the location of a tree is an important factor in the determination and the acceptability of risk for any given tree. The level of risk associated with a tree increases as the frequency of human occupation increases in the vicinity of the tree. For example, a tree located next to a heavily traveled street will have a higher level of risk than a similar tree in an open field.

Priority and Proactive Maintenance

In this plan, the recommended tree maintenance work was divided into either priority or proactive maintenance. Priority maintenance includes tree removals and pruning of trees with an assessed risk rating of seven or greater (High and Severe Risk). Proactive tree maintenance includes pruning of trees with an assessed risk of six or less (Moderate or Low Risk) and trees that are young. Tree planting, inspections, and community outreach are also considered proactive maintenance.



Priority Maintenance

Identifying and ranking the maintenance needs of a tree population enables tree work to be assigned a priority based on observed risk. Once tree work is prioritized, it can be accomplished systematically to eliminate the greatest risk and liability first (Stamen 2011).

Risk is a graduated scale that measures potential tree-related hazardous conditions. A tree is considered hazardous when the potential risks associated with it exceed an acceptable level. Managing trees for risk reduction provides many benefits, including:

- Lower frequency and severity of accidents, damage, and injury
- Less expenditure for claims and legal expenses
- Healthier, long-lived trees
- Fewer tree removals over time
- Lower tree maintenance costs over time

Regularly inspecting trees and establishing tree maintenance cycles generally reduce the risk of failure as problems can be found and addressed before they escalate.

In this plan, all tree removals and Severe and High Risk pruning are included in the priority maintenance program.

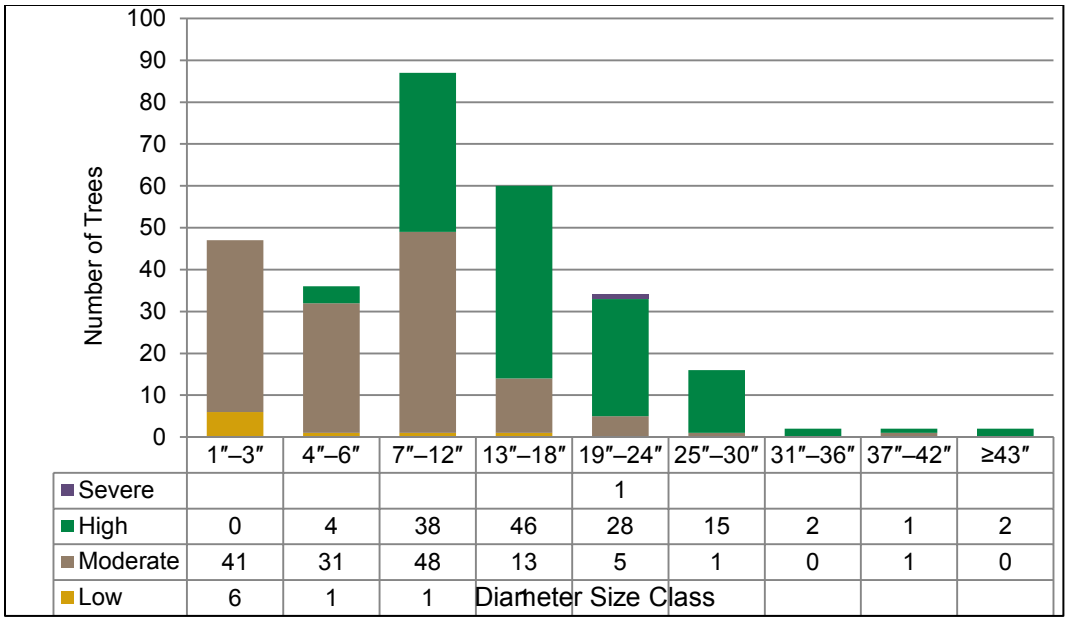
Priority Tree Removal

Although tree removal is usually considered a last resort and may sometimes create a reaction from the community, there are circumstances when it is necessary. Trees fail from natural causes, such as diseases, insects, and weather conditions, and from physical injury due to vehicles, vandalism, and root disturbances. Davey Resource Group recommends that trees be removed when corrective pruning will not adequately eliminate the hazard or when it is cost-prohibitive to correct problems. Trees causing obstructions or interfering with power lines or other infrastructure should be removed when their defects cannot be corrected through pruning or other maintenance practices. Nuisance trees and diseased trees also merit removal.

Photograph 17. This* Gleditsia tricanthos *(honeylocust) has many dead branches and limbs hanging over the sidewalk. High risk trees in critical condition, such as this one, are recommended for high priority removal.

Even though large short-term expenditures may be required, securing the funding required to expediently complete priority tree removals is important to reduce risk and to promote public safety.

Figure 7 presents tree removals identified during the inventory by risk rating and diameter size class. The following sections briefly summarize the recommended removals. This section includes all ash trees recommended for removal due to current health or safety concerns. It does not include ash trees which are recommended for removal as part of the emerald ash borer response strategy.



	1″–3″	4″–6″	7″–12″	13″–18″	19″–24″	25″–30″	31″–36″	37″–42″	≥43″
Severe					1				
High	0	4	38	46	28	15	2	1	2
Moderate	41	31	48	13	5	1	0	1	0
Low	6	1	1						

Figure 7. Tree removals by risk rating and diameter size class.

Severe Risk

The inventory identified 1 Severe Risk trees that were recommended for removal. The size of the defect, the probability of failure, or the location of the trees in relation to their surroundings were reasons for Severe Risk ratings. This tree is medium in size (20 inches) and should be removed immediately to promote public safety. Severe Risk removals can be performed concurrently with Severe Risk pruning.

High Risk

High Risk removals have observable and sizeable defects with elevated probabilities of failure. The location of these trees in relation to their surroundings also increases their risk. The inventory identified 136 High Risk trees recommended for removal. The diameter size classes for these trees ranged between 4 inches DBH and 45 inches DBH. These trees should be removed immediately because of their assigned risk. Severe and High Risk removals and pruning can be performed concurrently.

Moderate Risk

Tree removals in this category still pose some risk, but have a smaller size of defect and/or less potential for target impact. The inventory identified 140 Moderate Risk trees recommended for removal. Most Moderate Risk trees were smaller than 13 inches DBH. These trees should be removed as soon as possible after all Severe and High Risk removals and pruning have been completed.

Low Risk

Low Risk removals pose little threat; these trees are generally small, dead, invasive, or poorly formed trees that need to be removed. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. Healthy trees growing in poor locations or undesirable species are also included in this category.

The inventory identified 9 Low Risk trees recommended for removal. Almost all of these trees were smaller than 7 inches DBH. Most of these trees were dead, in poor locations, or invasive species that may be in Fair or Good condition but still should be eliminated due to negative impact on desirable vegetation. All Low Risk trees should be removed when convenient and after all Severe, High, and Moderate Risk removals and pruning have been completed.

Photograph 18. This pin oak was planted right next to a mailbox. Sincethis will inevitably become a problem, the tree was marked as a low risk removal because of its poor location.

Priority Pruning

Priority pruning generally requires cleaning the canopy of both small and large trees to remove hazardous defects such as dead and/or broken branches that may be present even when the rest of the tree is sound. In these cases, pruning the branch or branches can correct the problem and alleviate risk associated with the tree. Priority pruning includes trees with Severe and High Risk.

Figure 8 presents the number of trees recommended for pruning by size class and the sections that follow briefly summarize the recommendations. This includes ash trees which are recommended for treatment in the emerald ash borer response strategy, but does not include those which are recommended for removal.

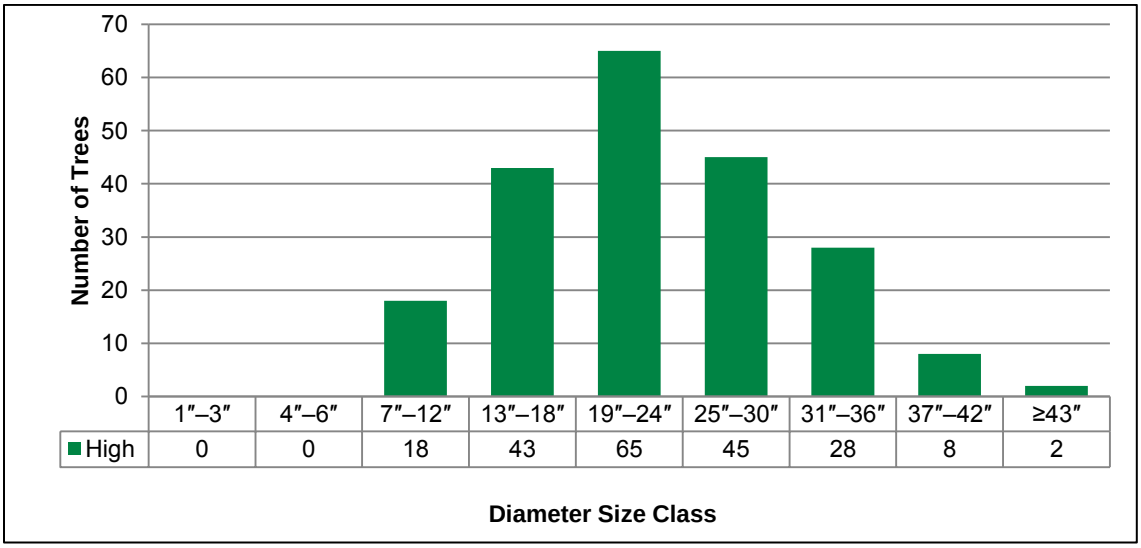


Figure 8. High risk trees identified for pruning by diameter class.

Severe Risk

There were no severe risk trees identified for pruning.

High Risk

High Risk trees recommended for pruning have observable and sizeable defects with elevated probabilities of failure. The location of these trees in relation to their surroundings also increases their risk. The inventory identified 209 High Risk trees recommended for pruning. The diameter size classes for these trees ranged between 7 inches DBH and 44 inches DBH. This pruning should be performed immediately because of assigned risk and may be done at the same time as other Severe and High Risk removals and pruning.

Proactive Maintenance

Proactive tree maintenance requires that trees are managed and maintained under the responsibility of an individual, department, or agency. Typically, tree work is performed during a cycle. Individual tree health and form are routinely addressed during the cycle. When trees are planted, they are planted selectively and with purpose. Ultimately, proactive tree maintenance should reduce crisis situations in the urban forest as every tree in the managed population is visited, assessed, and maintained regularly. Davey Resource Group recommends proactive tree maintenance that includes pruning cycles, inspections, and planned tree planting.

Pruning Cycles

The goals of pruning cycles are to visit, assess, and prune trees on a regular schedule to improve health and reduce risk. Typically, Davey Resource Group recommends that pruning cycles begin after all Severe and High Risk trees are corrected through priority removal or pruning. However, because of the long-term benefit that will come from implementing pruning cycles, Davey Resource Group may recommend it be implemented sooner. To ensure all trees receive the type of pruning they need to mature with better structure and fewer hazards, two pruning cycles are recommended: the young tree training cycle (YTT Cycle) and the routine pruning cycle (RP Cycle). The cycles differ in the type of pruning, the general age of the target tree, and the cycle length.

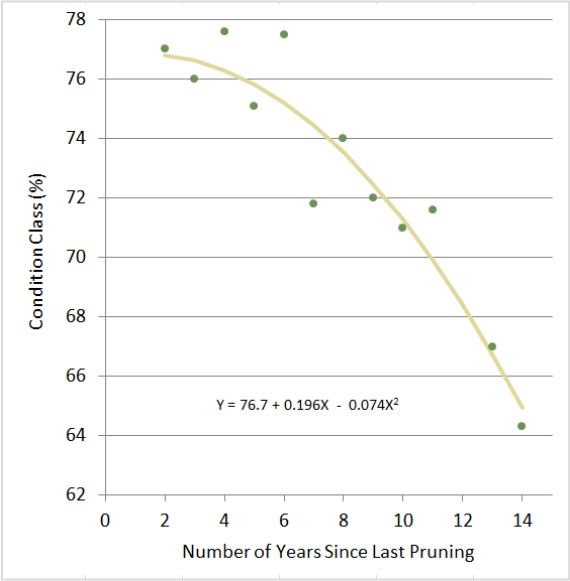


Figure 9. Relationship between average tree condition class and number of years since last pruning (adapted from Miller and Sylvester 1981).

The recommended number of trees in the pruning cycles will need to be modified to reflect changes in the tree population as trees are planted, age, and die. Newly planted trees will enter the YTT Cycle once they become established. As young trees reach maturity, they will be shifted from the YTT Cycle into the RP Cycle. When a tree reaches the end of its useful life, it should be removed and, thus, eliminated from the RP Cycle.

For many communities, a proactive tree management program is considered to be unfeasible, and an on-demand response to urgent situations is the norm. Research has shown that a proactive program that includes a routine pruning cycle will improve the overall health of a tree population (Miller and Sylvester 1981). Proactive tree maintenance has many advantages over priority maintenance; the most significant of which is reduced risk. When trees are assessed and pruned regularly in a proactive program, most defects will be found and eliminated before they escalate to a hazardous situation with an unacceptable level of risk. Other advantages of a proactive program include more predictable budgets and projectable workloads, reduced long-term tree maintenance costs, and increased environmental and economic benefits from trees.

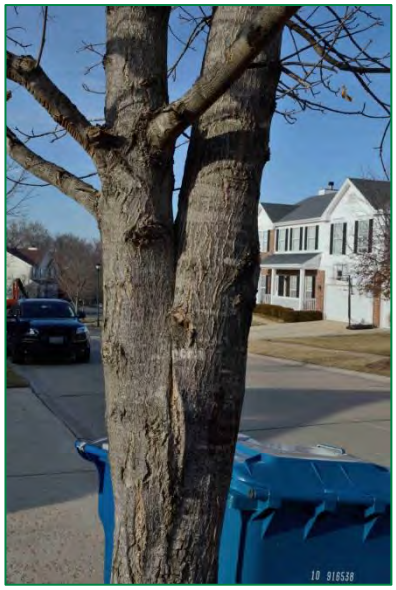
Why Prune Trees on a Cycle?
Miller and Sylvester (1981) examined the frequency of pruning for 40,000 street and boulevard trees in Milwaukee, Wisconsin. They documented a decline in tree health as the length of the pruning cycle increased. When pruning was not completed for more than 10 years, average tree condition was rated 10% lower than when trees had been pruned within the last several years. Miller and Sylvester suggested that a pruning cycle of five years is optimal for urban trees.

YTT Cycle

Trees included in the YTT Cycle are generally less than seven inches DBH. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, increasing risk and creating potential liability.

YTT pruning is performed to improve tree form or structure; the recommended length of a YTT Cycle is three years because young trees tend to grow at faster rates (on average) than more mature trees.

The YTT Cycle differs from the RP Cycle in that these trees generally can be pruned from the ground with a pole pruner or pruning shear. The objective is to increase structural integrity by pruning for one dominant leader. Of course, this is species-specific since many trees such as *Betula nigra* (river birch) may naturally have more than one leader. For these and similar trees, YTT pruning is used to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree.



Photograph 19. This young* Acer saccharum *(sugar maple) has structural problems which significantly limit its health and growth potential. Training pruning would have corrected this defect before it became a problem.

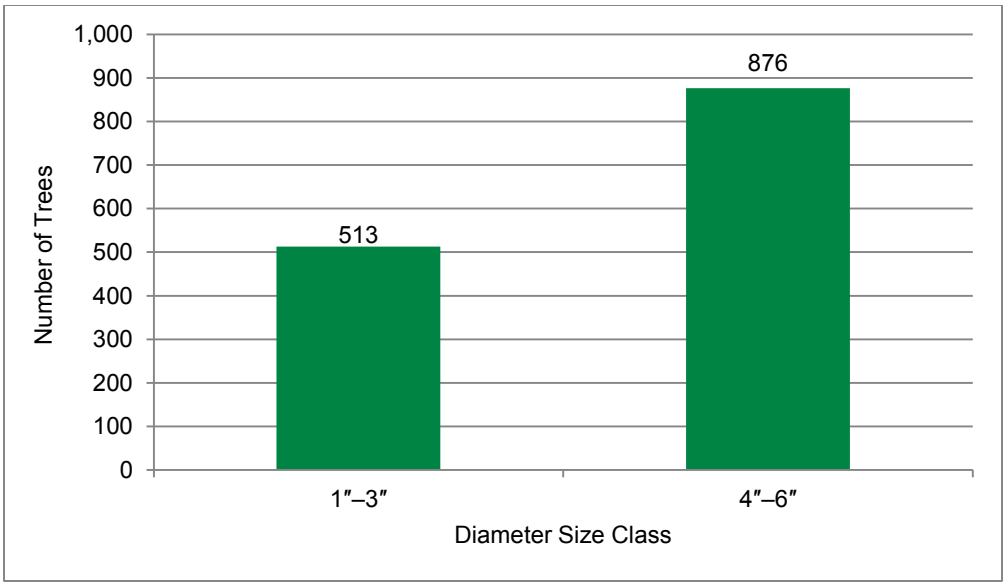


Figure 10. Trees recommended for inclusion (by diameter class) in the YTT cycle.

Discussion/Recommendations

Davey Resource Group recommends that The City of Creve Coeur implement a three-year YTT Cycle to begin after all Severe and High Risk trees are removed or pruned. The YTT Cycle will include existing young trees. During the inventory, 1,389 trees smaller than seven inches DBH were inventoried. Since the number of young trees is relatively small and the benefit of beginning the YTT Cycle is great, Davey Resource Group recommends that all 1,389 trees be structurally pruned each year beginning in Year One. If trees are planted, they will need to enter the YTT Cycle after establishment, typically a few years after planting.

In future years, the number of trees in the YTT Cycle will be based on tree planting efforts and growth rates of young trees. Creve Coeur should strive to prune approximately one-third of the city's young trees every year.

RP Cycle

The RP Cycle includes established, maturing, and mature trees (mostly greater than six inches DBH) that need cleaning and crown raising and reducing to remove deadwood and to improve structure. Over time, routine pruning generally improves health and reduces risk as most problems can be corrected before they escalate into more costly priority tree work. Included in this cycle are Moderate and Low Risk trees that require pruning and pose some risk but have a smaller size of defect and/or less potential for target impact. The hazards found within these trees can usually be remediated during the RP Cycle.

The length of the RP Cycle is based on the size of the tree population and what was assumed to be a reasonable number of trees for a program to prune per year. Generally, the RP Cycle recommended for a tree population is five years but may extend to seven years if the population is large.

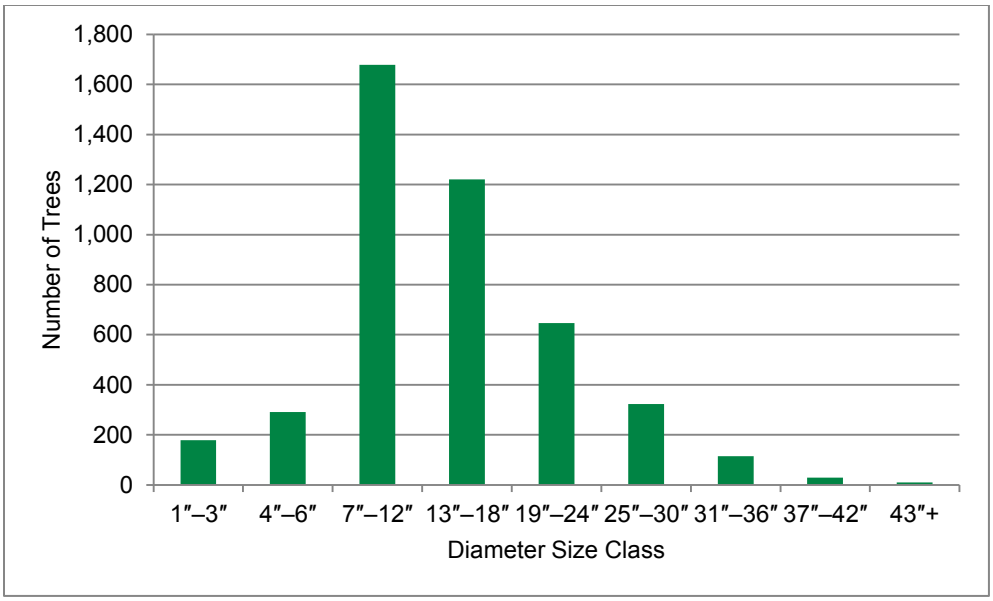
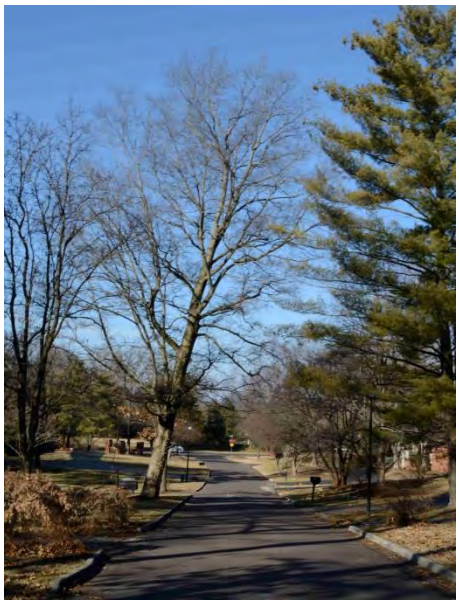


Figure 11. Trees recommended for the RP cycle by diameter size class.

Discussion/Recommendations

Davey Resource Group recommends that Creve Coeur establish a five-year RP Cycle and that approximately one-fifth of the tree population be pruned every year. The 2014 and 2015 tree inventories identified approximately 4,492 trees that should be pruned each year. Davey Resource Group recommends that the RP Cycle begin in Year One of this five-year plan, after all Severe and High Risk trees are removed or pruned.

The inventory found that most trees (70%) on the street ROW need routine pruning. Figure 11 shows that a variety of tree sizes require pruning, however most of the trees are smaller than 25 inches DBH.



Photograph 20. This* Celtis laevigata *(sugarberry) on Mason Forest Drive is an impressive specimen by any measure. The tree, however, is starting to develop a lean. The tree should be regularly inspected to make sure this lean doesn't become more extreme.

Inspections

Inspections are essential to unveiling potential problems with trees. They should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care.

Trees along the street ROW and in parks should be inspected regularly and attended to as needed based on the inspection findings. When trees need additional or new work, they should be added to the maintenance schedule and budgeted for as appropriate. In addition to locating new hazards, inspections are an opportunity to look for signs and symptoms of pests and diseases. Creve Coeur has a large population of trees susceptible to pests and diseases including maple, a target for the Asian longhorned beetle, ash which are susceptible to the emerald ash borer, and species that fall prey to granulate ambrosia beetle. A brief discussion of key pests is found in Appendix C.

Tree Planting

Planting trees is a worthwhile goal as long as trees species are carefully selected and correctly planted. When trees are planted, they are planted selectively and with purpose. Without upfront planning and follow-up tree care, a newly planted tree may become a future problem instead of a benefit to the community.

When planting trees

- Consider the specific purpose of the tree planting.
- Assess the site and know its limitations, for example, overhead wires, confined spaces, and/or soil type.
- Select the species or cultivar best suited for the site conditions.
- Examine trees before buying them, and buy for quality.

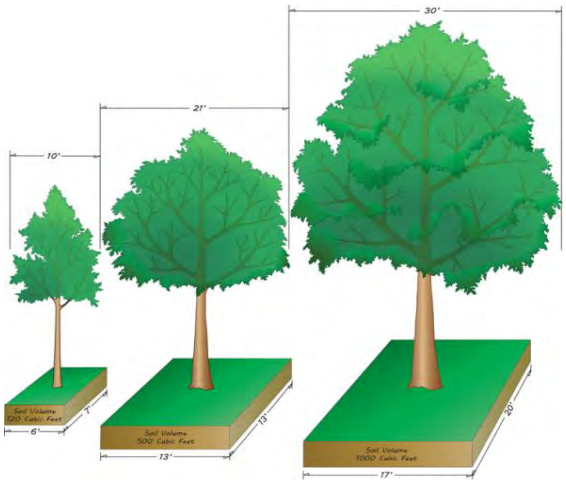


Illustration based on the work of Casey Trees (2008).

Tree Species Selection

Selecting a limited number of species could simplify decision-making processes; however, careful deliberation and selection of a wide variety of species will be more beneficial and can save money. Planting a variety of species can decrease the impact of species-specific pests and diseases by limiting the number of susceptible trees in a population, which will reduce the time and money spent to mitigate a problem if such an event were to occur. A wide variety of tree species may help to limit the impacts from physical events such as strong storms, wind, ice, flooding, and drought, as different tree species react differently to stress.

The City of Creve Coeur is located in USDA Hardiness Zone 6a, which is identified as a climatic region with average annual minimum temperatures between −10°F and −5°F. Tree species selected for planting in Creve Coeur should be appropriate for this zone.

Tree species should be selected for their durability and low-maintenance characteristics. These attributes are highly dependent on site characteristics below ground (soil texture, soil structure, drainage, soil pH, nutrients, road salt, and root spacing). Matching a species to its favored soil conditions is the most important task when planning for a low-maintenance landscape. Plants that are well-matched to their environmental site conditions are much more likely to resist pathogens and insect pests and will, therefore, require less maintenance overall.

The Right Tree in the Right Place is a mantra for tree planting used by the Arbor Day Foundation and many utility companies nationwide. Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Some grow tall, some grow wide, and some have extensive root systems. Before selecting a tree for planting, make sure it is the right tree—know how tall, wide, and deep it will be at maturity. Equally important to selecting the right tree is choosing the right spot to plant it. Blocking an unsightly view or creating some shade may be a priority, but it is important to consider how a tree may impact existing utility lines as it grows taller, wider, and deeper. If at maturity the tree's canopy will reach overhead lines, it is best to choose another tree or a different location. Taking the time to consider location before planting can prevent power disturbances and improper utility pruning practices.

A major consideration for street trees is the amount of litter dropped by mature trees. Trees such as *Acer saccharinum* (silver maple) have weak wood and typically drop many small branches during a growing season. Others, such as *Liquidambar styraciflua* (American sweetgum), drop high volumes of fruit. In certain species, such as *Ginko biloba* (ginko), female trees produce offensive smelling/large fruit; male ginko trees, however, produce no fruit. Furthermore, a few species of trees, including *Crataegus* spp. (hawthorn) and *Gleditsia triacanthos* (honeylocust), may have substantial thorns. These species should be avoided in high-traffic areas.

Photograph 21.* Liriodendron tulipifera *(tulip tree) is a species that Creve Coeur may want to consider planting in significant number. This young tree is an example of proper staking and mulching.

Seasonal color should also be considered when planning tree plantings. Flowering varieties are particularly welcome in the spring and deciduous trees that display bright colors in autumn can add a great deal of interest to surrounding landscapes.

Appendix B lists tree species recommended for planting based on inventory findings; this list provides expected height at maturity for each species and is designed to promote species diversity.

Davey Resource Group recommends limiting the planting of maple, which make up approximately 16% of the street tree population, until the species distribution normalizes. Pin oak already occupies 16% of the street ROW and has a serious pest problem. It should not be planted. Since the arrival of of EAB is imminent, white and green ash should not be planted. There is some evidence that *Fraxinus quadrangulata* (blue ash), native to Missouri, has some degree of resistance to emerald ash borer. Planting of this species could be conducted on an experimental basis until more is known.

Tips for Planting Trees

To ensure a successful tree planting effort:

- Handle trees with care. Trees are living organisms and are perishable. Protect trees from damage during transport and when loading and unloading. Use care not to break branches and do not lift trees by the trunk.
- If trees are stored prior to planting keep the roots moist.
- Dig the planting hole according to the climate. Generally, the planting hole is two to three times wider and not quite as deep as the root ball. The root flair is at or just above ground level.
- Fill the hole with native soil unless it is undesirable, in which case add soil amendments as appropriate for local conditions. Gently tamp and add water during filling to reduce large air pockets and to ensure a consistent medium of soil, oxygen, and water.
- Stake the tree as necessary to prevent it from shifting too much in the wind.
- Add a thin layer (1–2 inches) of mulch to help prevent weeds and keep the soil around the tree moist. Do not allow mulch to touch the trunk.

Newly Planted and Young Tree Maintenance

Equal in importance to planting trees is caring for them after they are planted. After planting a tree, it must receive maintenance for several years.

Watering

Initially, watering is the key to survival; new trees typically require at least 60 days of watering to establish. Determine how often to irrigate trees based on time of planting, drought status, species selection, and site condition.

Mulching

Mulch can be applied to the growspace around a newly planted tree (or even a more mature tree) to ensure that no weeds grow, the tree is protected from mechanical damage, and the growspace is moist. Mulch should be applied in a thin layer, generally one to two inches, and the growing area covered. Mulch should not touch the tree trunk or be piled up around the tree.

Life-Long Tree Care

After the tree is established it will require routine tree care, which includes inspections, routine pruning, watering, plant health care, and integrated pest management as needed.

The City should employ qualified arborists to provide most of the routine tree care. An arborist can determine the type of pruning necessary to maintain or improve the health, appearance, and safety of trees. These techniques may include eliminating branches that rub each other; removing limbs that interfere with wires and buildings or that obstruct streets, sidewalks or signage; removing dead, damaged, or weak limbs that pose a hazard or may lead to decay; removing diseased or insect-infested limbs; creating better structure to lessen wind resistance and reduce the potential for storm damage; and removing branches—or thinning—to increase light penetration.

An arborist can help decide whether a tree should be removed and, if so, how urgent the removal is. Additionally, an arborist can provide advice about and perform tree maintenance when disasters, such as storms or droughts, occur. Storm-damaged trees can often be dangerous to remove or trim. An arborist can assist in advising or performing the job in a safe manner while reducing further risk of damage to property.

Plant Health Care, a concept of preventive maintenance to keep trees in good health, will help a tree better defend itself against insects, disease, and site problems. Arborists can help determine proper plant health so the City's tree population will remain healthy, providing benefits to the community for as long as possible.

Integrated Pest Management is a process involving common sense and sound solutions for treating and controlling pests. These solutions incorporate basic steps: identifying the problem, understanding pest biology, monitoring trees, and determining action thresholds. The practice of Integrated Pest Management can differ dramatically site by site, individual tree by individual tree; a qualified arborist will be able to make sure that the City's trees are properly diagnosed and that a beneficial and realistic action plan is developed.

The arborist can also help with cabling or bracing for added support to branches with weak attachment, aeration to improve root growth, and installation of lightning protection systems.

Educating the community in basic tree care is a good way to promote the City's urban forestry program and encourage tree planting on private property. The City should encourage citizens to water trees on the ROW adjacent to their homes and to reach out to the City if they notice any changes in the trees such as: signs or symptoms of pests, early fall foliage, or new mechanical or vehicle damage.

Community Outreach

The data that have been collected and analyzed to develop this plan contribute significant information about the tree population and can be utilized to guide the proactive management of that resource. These data can also be utilized to promote the value of the urban forest and the tree management program in that:

Photograph 22. Community volunteering can complement Creve Coeur's tree urban forestry program by helping plant and prune young trees. Tree Pittsburgh volunteers such as this group have helped grow Pittsburgh's urban forest into one of the best in the nation.

- Tree inventory data can be utilized to justify needed priority and proactive tree maintenance activities as well as tree planting and preservation initiatives.
- Species data can be utilized to guide the development of tree species selection for planting projects with an objective of improving species diversity and limiting the introduction of invasive pests and diseases.
- Information in this plan can be utilized to advise citizens about the presence of threats, such as emerald ash borer and Asian longhorn beetle, to urban trees.

Various avenues for outreach exist. Maps can be created and posted on websites, in parks, or in business areas. Public service announcements can be developed. Articles can be written and programs developed about trees and the benefits they provide. Arbor Day or Earth Day celebrations can be magnified and signs can be hung from trees to show the contributions trees make to the community. Even contests can be created to make people aware that trees are important. Trees provide oxygen we need to breathe, shade to cool our neighborhoods, and canopies to stand under to get out of the rain.

Creve Coeur has the data to provide solid, meaningful outreach about the urban forest.

Inventory and Plan Updates

Davey Resource Group recommends that the inventory and management plan be updated so the city can sustain its program and accurately project future program and budget needs:

- After all severe weather events, conduct tree inspections and record changes in tree condition, maintenance needs, and risk/risk rating in the inventory database. Update the tree maintenance schedule and acquire the funds needed to restore trees to a safe state. Schedule work based on risk.
- Perform routine inspections of public trees as needed. Windshield surveys (inspections performed from a vehicle) in line with *ANSI A300 (Part 9)* (ANSI 2011) will help City staff stay current regarding changing conditions. Update the tree maintenance schedule and the budget as needed so that identified tree work may be performed efficiently. Schedule work based on risk.
- If the recommended work cannot be completed as suggested in this plan, modify maintenance schedules and budgets accordingly.
- Update the inventory database as work is performed. Add new tree work to the schedule when work is identified through inspections or a citizen call process.
- Re-inventory the street ROW and parks in five to seven years updating all data fields.
- Revise the *Tree Management Plan* after five or seven years when the re-inventory has been completed.

Maintenance Schedule

Utilizing data from the 2014–2015 City of Creve Coeur tree inventory, an annual maintenance schedule was developed detailing the number and type of tasks recommended for completion each year. Budget projections were made by Davey Resource Group utilizing industry knowledge and public bid tabulations; actual costs were not specified by the City of Creve Coeur. A summary of the maintenance schedule is presented here and the complete table of estimated costs for Creve Coeur's five-year tree management program is presented in Appendix D.

The schedule provides a framework for completing the inventory maintenance recommendations over the next five years. Following this schedule can shift tree care activities from an on-demand system to a more proactive tree care program.

To implement the maintenance schedule, the city tree maintenance budget should be no less than $179,000 for the first year of implementation, $164,000 for the second year, $138,000 for the following three years. Annual budget funds are needed to ensure that hazard trees are remediated and that critical YTT and RP Cycles can commence. With proper professional tree care, the safety, health, and beauty of the urban forest will improve.

If routing efficiencies and/or contract specifications allow for the accomplishment of more tree work, or if the schedule requires modification to meet budgetary or other needs, then it should be modified accordingly. Unforeseen situations, such as severe weather events, may arise and change the maintenance needs of trees. Should conditions or maintenance needs change, budgets and equipment will need to be adjusted to meet the new demands.

Year 1 **$178,765**

- 137 Priority Removals
- 209 Priority Pruning
- RP Cycle: 1/5 of Public Trees Cleaned or approximately 900 Trees
- YTT Cycle: 463 Trees
- 100 Trees Recommended for Planting and Follow-Up Care
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

Year 2 **$163,545**

- 149 moderate or low risk removals
- RP Cycle 1/5 of Public Trees Cleaned or approximately 900 Trees
- YTT Cycle: 463 Trees
- 100 Trees Recommended for Planting and Follow-Up Care
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

Year 3 **$138,320**

- RP Cycle 1/5 of Public Trees Cleaned or approximately 900 Trees
- YTT Cycle: 463 Trees
- 100 Trees Recommended for Planting and Follow-Up Care
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

Year 4 **$138,320**

- RP Cycle 1/5 of Public Trees Cleaned or approximately 900 Trees
- YTT Cycle: 463 Trees
- 100 Trees Recommended for Planting and Follow-Up Care
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

Year 5 **$138,320**

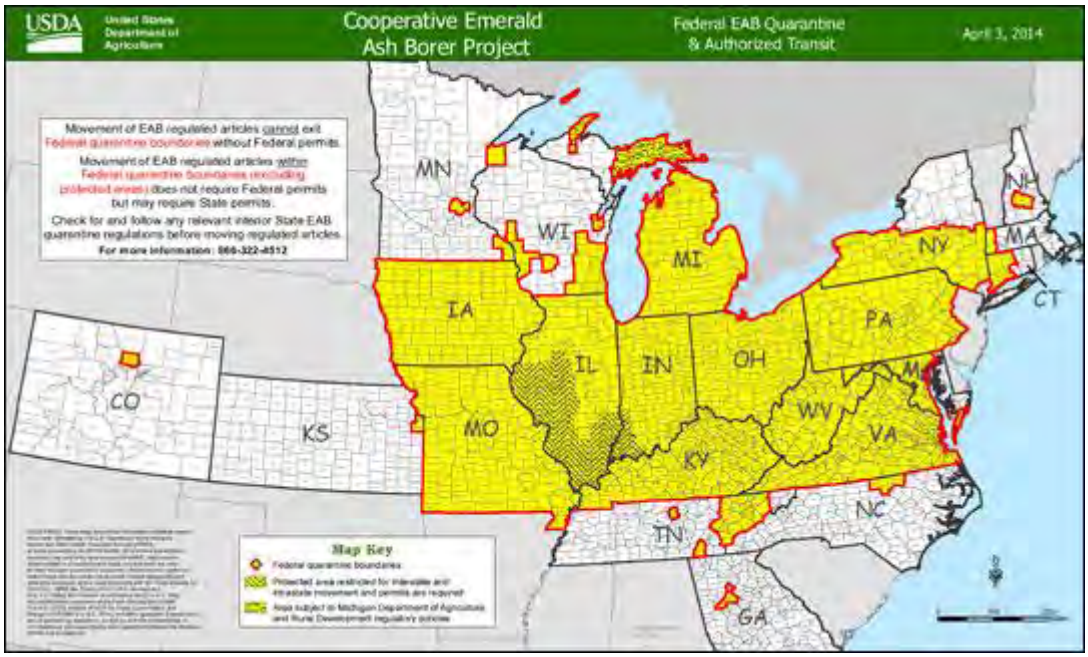
- RP Cycle 1/5 of Public Trees Cleaned or approximately 900 Trees
- YTT Cycle: 463 Trees
- 100 Trees Recommended for Planting and Follow-Up Care
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

Section 4. Emerald Ash Borer Strategy

Throughout the United States, urban and community forests are under increased pressure from exotic and invasive insects and diseases. Exotic pests that arrive from overseas typically have no natural predators and become invasive when our native trees and shrubs do not have appropriate defense mechanisms to fight them off. Mortality from these pests can range from two weeks with oak wilt (*Ceratocystis fagacearum*), to seven years with emerald ash borer (EAB) (*Agrilus planipennis*) or more.

An integral part of tree management is being aware of invasive insects and diseases in the area and how to best manage them. Depending on the tree diversity within Creve Coeur's urban forest, an invasive insect or disease has the potential to negatively impact the tree population.

This chapter provides the different management strategies for dealing with EAB. Included are sections on how to effectively monitor EAB, increase public education, handle ash debris, reforestation, work with stakeholders, and utilize ash wood. Appendix E contains additional EAB reference materials.



Source: http://www.extension.missouri.edu/treepests/EABquarantine.as

Map 1. EAB detections throughout North America as of August 2013. Map by United States Department of Agriculture, Animal and Plant Health Inspection Service.

Emerald Ash Borer

Emerald ash borer is a small insect native to Asia. In North America, the borer is an invasive species highly destructive to ash trees in its introduced range. The potential damage of EAB rivals that of chestnut blight and Dutch elm disease.

Chestnut blight is a fungus that was introduced in North America around 1900 and, by 1940, it virtually wiped out most of the mature American chestnut population. It is believed that chestnut blight was imported by chestnut lumber or through imported chestnut trees. Dutch elm disease is a fungus spread sexually by the elm bark beetle. It was first reported in the United States in 1928 and was believed to have been introduced by imported timber. Since its discovery in the United States, it has killed millions of elm trees.

EAB is thought to have been introduced into the United States and Canada in the 1990s but was not positively identified in North America until 2002 in Canton, Michigan. It has now been confirmed in 14 states and has killed at least 50–100 million ash trees so far and threatens another 7.5 billion ash trees throughout North America. Missouri's EAB infestation was discovered July 2008 in the U.S. Army Corps of Engineers' Wappapello Lake campground in Wayne County, Missouri. It was found in St. Charles County in the summer of 2014. See Map 2 for Missouri counties with known EAB infestations. The EAB is a serious pest that threatens the health of all ash tree species in the state. With an estimated 3% ash trees at risk in Missouri woods—and another 14% to 30% in cities and towns—the state is committed to early detection and thoughtful management of this pest. In the United States, EAB has been known to attack all native ash trees.

EAB has been identified in Missouri and poses a serious threat to the health and condition of Crece Coeur's urban forest.

Photograph 23. EAB adults grow to 5/8 inch in length (photograph credit www.wisconsin.gov).

Photograph 24. EAB larvae (photograph credit www.emeraldashborer.info).

Identification

The adult beetle is elongate, metallic green, and 3⁄8- to 5⁄8-inch long. The adult beetle emerges from late May until early August, feeding on a small amount of foliage. The adult females then lay eggs on the trunk and branches of ash trees and, in about a week, the eggs hatch into larvae which then bore into the tree. Larvae are creamy white in color and can grow up to an inch long and are found underneath the bark of the trees. The larvae tunnel and feed on the inner bark and phloem, creating winding galleries as they feed. This cuts off the flow of the water and nutrients to the tree, causing dieback and death.

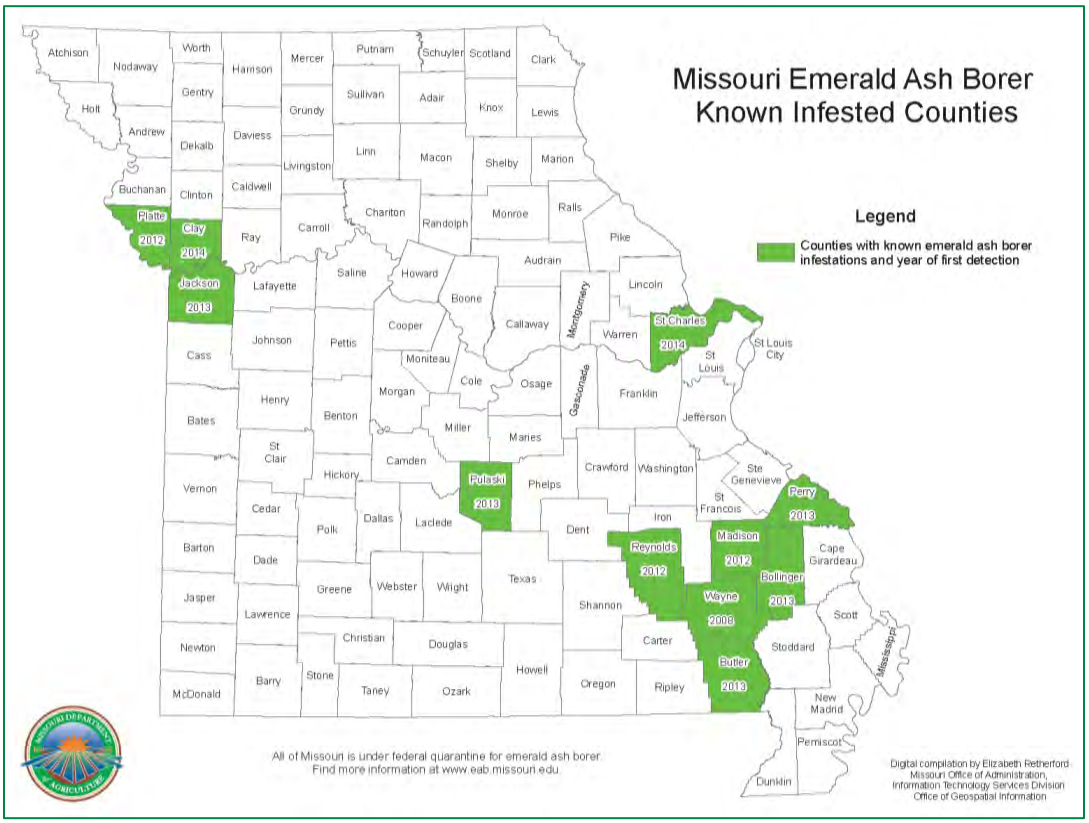
Photograph 25. Stock Photo. Larvae consume the cambium and phloem, effectively girdling the tree and eventually causing death within a few years.

Photograph 26. This ash tree is declining from EAB infestation. The loss of water and nutrients from the intense larvae tunneling can cause the trees to lose between 30% and 50% of their canopies during the first year of infestation. (Photograph courtesy http://labs.russell.wisc.edu/eab/signs-and-symptoms/).

EAB can be very difficult to detect. Initial symptoms include yellowing and/or thinning of the foliage and longitudinal bark splitting. The entire canopy may die back, or symptoms may be restricted to certain branches. Declining trees may sprout epicormic shoots at the tree base or on branches. Woodpecker injury is often apparent on branches of infested trees, especially in late winter. Removal of bark reveals tissue callusing and frass-filled serpentine tunneling. The S-shaped larval feeding tunnels are about 1⁄4 inch in diameter. Tunneling may occur from upper branches to the trunk and root flare. Adults exit from the trunk and branches in a characteristic D-shaped exit hole that is about 1/8 inch in diameter. The loss of water and nutrients from the intense larvae tunneling can cause trees to lose between 30% and 50% of their canopies during the first year of infestation. Trees often die within two years following infestation.

Missouri/Federal Response

In Missouri, the Missouri Department of Agriculture (MDA) is the lead agency responsible for control of invasive pests. The federal agency USDA-APHIS assists with regulatory and control action of invasive pests. The MDA has declared EAB a public nuisance in Missouri, and enacted a quarantine restricting the movement of ash trees and non-coniferous firewood.



Map 2. Missouri is under a federal quarantine for EAB to limit its spread.

Federal agencies have been actively researching control measures, including biological controls, developing resistant species, and testing various insecticides. Since 2003, American scientists in conjunction with the Chinese Academy of Forestry have searched for natural enemies of EAB in the wild. This led to the discovery of several parasitoid wasps, namely *Tetrastichus planipennisi*, a gregarious larval endoparasitoid; *Oobius agrili*, a solitary, parthenogenic egg parasitoid; and *Spathius agrili*, a gregarious larval ectoparasitoid. These parasitoid wasps have been released into the Midwest, United States as a possible biological control of EAB. States that released parasitoid wasps include Indiana, Michigan, and Minnesota.

Ash Population

With the threat of EAB nearing Creve Coeur, it is crucial that the City have an action plan. Some of the most important questions to answer will be, "How many ash trees do we have, where are they located, and what actions should we take?" In order to answer these questions, Creve Coeur needs to maintain an up-to-date inventory, know what resources are available, and understand the City's priorities.

Based on the current public tree inventory, there are 830 ash trees distributed throughout the City. The majority of ash trees were rated to be in Fair condition. Table 3 has the diameter class of each ash tree by condition class. Of the 830 ash trees inventoried, none are currently showing signs and symptoms of EAB. However, 56 of these trees are recommended for removal due to current health or safety issues without regards to the impending arrival of EAB.

Davey Resource Group recommends 56 of the 830 ash trees for removal due to current health or safety issues without regards to the impending arrival of EAB. These trees although listed included in Table 3 are included in the recommended Five-Year Management Plan.

Table 3. Condition of all Creve Coeur Ash Trees by Diameter Class

		Diameter Class (inches)									
		1–3	4–6	7–12	13–18	19–24	25–30	31–36	37–42	43+	Total
Condition Class	Good	4	44	62	24	8	2		0	0	144
	Fair	6	63	193	164	51	8	5	0	0	490
	Poor		9	70	62	12		1	0	0	154
	Critical		8	17	10		2		0	0	37
	Dead			4	1				0	0	5
	Total	10	124	346	261	71	12	6	0	0	830

Ash Tree Risk Reduction Pruning and Removals

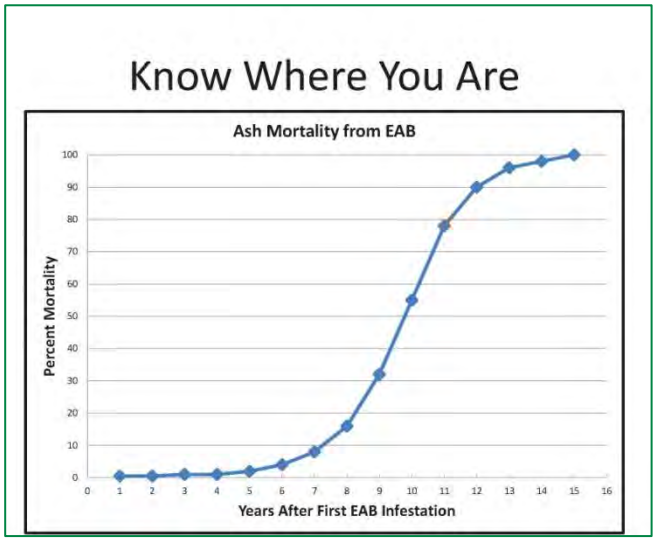
As the infestation of EAB nears Creve Coeur it becomes the City's highest priority and it is advisable to refocus budgeted funds and personnel to concentrate more closely on the ash tree population. Davey Resource Group recommends that the city perform both treatment and safety related activities on ash trees. This activity will end up saving the City money and increasing productivity. However, it is only recommended due to EAB and the eventual removal of infested ash trees.

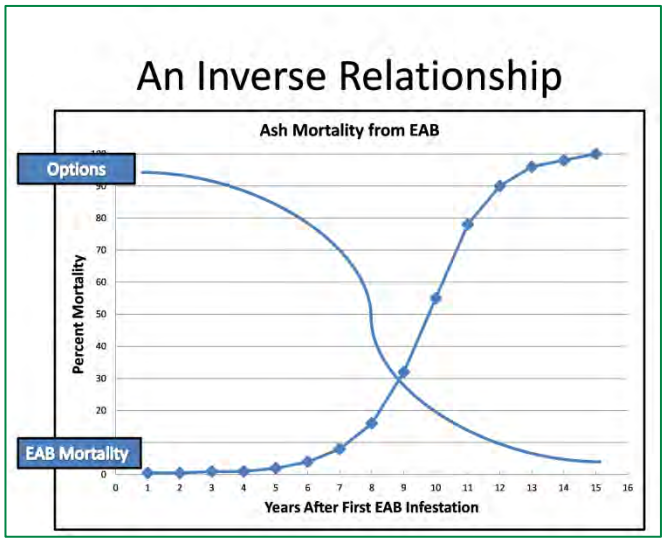
Davey Resource Group also recommends that Creve Coeur proactively remove ash trees during road reconstruction projects and other public works associated activities. By proactively removing ash trees during construction, the cost and impacts should be lower.

In the event that the Creve Coeur decides to proactively remove ash trees, Davey Resource Group recommends that the city remove all ash trees less than 7 inches DBH and trees that are rated as Poor, Critical, or Dead condition first. These trees are providing little benefit to the community and the cost for removals should not be significant.

EAB Management Options

Creve Coeur should explore different options for managing EAB. With the City striving to be proactive in EAB management before an infestation occurs, Creve Coeur has provided itself with multiple management strategies. The graphs below present a unique tool for a city when deciding on what management options are out there for varying levels of EAB infestations. Creve Coeur can currently be placed at Year One on both graphs for year after first EAB infestation. At this position, the City has ample time to prepare as well as select a management option. When infestation occurs, as depicted in the graph, the City's options for management decrease.





Source: Emerald Ash University (www.emeraldashborer.info)

At this time, Creve Coeur has the opportunity to select one of several management types; some of these include removing and replacing all ash, treating all ash, or a combination approach of the removals and treatment. The City should explore all options and develop their strategy based on the benefits to the community. The following are current strategy options for managing EAB and the costs associated with them.

EAB Management Options

With no current specific strategy or budget in place for the impending infestation of EAB, Creve Coeur should explore strategies for managing EAB that provide the most economic benefit and increase public safety. These EAB management strategies include do nothing, remove and replace all ash, treat all ash, or a combination of the strategies. The following are current strategies for managing EAB and costs associated with these strategies.

EAB Strategy 1: Do Nothing

This means letting EAB run its course and having no strategy for dealing with EAB. This strategy includes not removing and not treating any ash trees. This strategy is economical in the beginning of an infestation because it costs the City no money, but it would become a severe public safety issue within a few years. Since all ash trees will die and will need to be eventually removed, no money is saved in the long run. Likely liability claims mean that this will probably be the highest cost option. Davey Resource Group does not recommend this management strategy.

Photograph 27. This is an example of a Do Nothing strategy. These ash trees became infested with EAB and eventually died. They have now become a public safety issue.

EAB Strategy 2: Remove and Replace All Ash

Remove and replace all 774 remaining ash trees by 2016. This strategy would benefit public safety from the EAB infestation but would have an impact on the City's budget. In order to achieve this strategy and remove all of the ash trees by 2016, the City would most likely have to contract work out. Removing mature ash trees that are in Good and Fair condition would take away all of the valuable benefits that these trees provide to the City and leave some blocks with no street trees at all. This strategy ultimately benefits the City by increasing public safety but will require a lot of upfront cost. It will be very important to replace all of these ash trees once they have been removed.

The total approximate cost for this strategy would be $417,560; $220,075 would be the approximate cost to remove all ash trees, $26,525 would be the approximate cost to remove all stumps, and $170,280 would be the approximate cost to replace all ash trees (Table 4).

Table 4. Cost to Remove and Replace All Ash

Management Strategy	Management Action	# of Trees	Cost
Remove and Replace All Ash Trees	Removal All	774	$220,075
	Replace All	774	$170,280
	Stump Removal	774	$26,525
	Total	774	$417,560

In addition, and i-Tree analysis indicates that Creve Coeur ash trees provide approximately $51,000 worth of benefits annually. Mass removal would mean that those benefits would be forgone until replacement trees achieve the quantity and quality of the existing ash trees.

EAB Strategy 3: Treat all Ash

Treating all of Creve Coeur's ash trees could reduce the annual mortality rate, stabilize removals, and would be less expensive than removing and replacing all ash trees. Treating all ash would enable these trees to keep providing the City with the monetary benefits that they provide. On the other hand, treating all ash trees is not an ideal practice because some of these ash trees can eventually become infested with EAB, will die from other causes, or are in a condition where they provide few benefits.

If Creve Coeur wanted to annually treat all of its 774 ash trees that are not recommended for immediate removal, it would cost approximately $169,000 over a six-year period. Since treatments are necessary every two years this means that it would cost the City approximately $56,000 every two years to treat City's 774 ash trees not recommended for immediate removal.

Table 5. Cost to Treat All Ash

Management Strategy	Management Action	# of Trees	Cost
Treat All Ash Trees	Treat all Ash Trees for Six Years	774	$168,700

EAB Strategy 4: Combination of Removals and Treatment

This strategy is intended to give the City options for a combination of removing and treating ash trees to stabilize annual removals, annual budgets, and prolong the life of ash trees that are Good and Fair condition. Table 6 is an EAB matrix table that is intended to organize trees that should be considered for removal and trees that should be considered for treatment. The following sections will go into detail about why certain ash trees should be considered for removal and treatment.

Table 6. EAB Matrix Table

		Diameter Class (inches)							
		1–3	4–6	7–12	13–18	19–24	25–30	31–36	Total
Condition Class	Good	3	44	62	24	8	2	0	143
	Fair	6	63	193	164	51	8	5	490
	Poor	0	9	63	60	8	0	1	141
	Total	9	116	317	248	67	10	6	774

Based on these numbers, Davey Resource Group makes the following recommendations:

450 Trees to Be Removed

- Trees in the "Poor", "Critical", and "Dead" condition class are recommended for removal because they are more susceptible to EAB infestation and if not removed could pose a public safety issue in the future. A total of 141 trees in this category are recommended for removal and replacement.

- Trees in "Fair" condition which are between 7 and 12 inches should be removed, since the current level of benefits provided is low and they lack vigor for trees of their size. A total of 193 trees in this category are recommended for removal.
- The remaining 116 trees are <7 inches DBH and are recommended for removal and replacement. These trees don't provide as many benefits to the community compared to mature ash trees. It would be in the best interest of the City to remove these trees and replace them with a more diversified mix of trees.

228 Candidate Trees for Chemical Treatment (Low–Moderate Probability of Treatment)

- The intent here is to defer removal of a large block of Fair conditioned trees matrix between 19 inches and 43+ inches DBH. These 228 trees are considered to be low–moderate priority for chemical treatment. Eventually a lot of these trees will become infested with EAB and, therefore, have to be removed in a timely manner. However, treating these trees could stabilize annual budgets and removals each year. Treatment can be economically beneficial and reduce the chance for a public safety issue in the near future.

96 Candidate Trees for Chemical Treatment (High Probability of Treatment)

- Candidates for chemical treatment will exhibit Fair condition or better, no more than 30% dieback and located in an appropriate site (i.e., not under overhead utilities). Treating these 96 ash trees will help to keep these trees around for a long time and the City will profit from the monetary benefits these ash trees provide.

Davey Resource Group recommends that Creve Coeur follow option 4 in which they treat all trees identified in the EAB matrix table as candidates for chemical treatment and proactively remove the rest. Table 7 shows that the total cost for this option will cost about $238,000 for the first two years if all removals are done in the first two years. Treatment costs will continue to be about $31,000 every two years thereafter.

Photograph 28. These green and white ash on Executive Parkway Drive are in good condition and are of significant size. They are examples of trees which should be considered for treatment against EAB infestation rather than removal.

Table 7. Two-Year Cost of EAB Strategy #4 – Combination Treatment and Removal

Activity	Diameter	Cost/Tree	# of Trees	Total Cost
Removal	1–3"	$25	9	$225
	4–6"	$105	117	$12,285
	7–12"	$220	255	$56,100
	13–18"	$355	60	$21,300
	19–24"	$525	8	$4,200
	25–30"	$845	0	$0
	31–36"	$1,140	1	$1,140
	37–42"	$1,470	0	$0
	43"+	$1,850	0	$0
Activity Total(s)			**774**	**$95,250**
treatment (every two years)	1–3"	$9	0	$0
	4–6"	$30	0	$0
	7–12"	$57	62	$3,534
	13–18"	$93	188	$17,484
	19–24"	$129	59	$7,611
	25–30"	$165	10	$1,650
	31–36"	$201	5	$1,005
	37–42"	$237	0	$0
	43"+	$276	0	$0
Activity Total(s)			**324**	**$31,284**
Stump removal	1–3"	$25	9	$225
	4–6"	$25	117	$2,925
	7–12"	$25	255	$6,375
	13–18"	$40	60	$2,400
	19–24"	$60	8	$480
	25–30"	$85	0	$0
	31–36"	$110	1	$110
	37-42"	$130	0	$0
	43"+	$160	0	$0
Activity Total(s)			**450**	**$12,515**
Replanting		$220	450	$99,000
Activity Total(s)			**450**	**$99,000**
Option Totals			**1,998**	**$238,049**

Private Trees

In addition to ash trees located on public property, EAB will impact trees located on private property. The number of private ash trees is unknown but it could be equal to or greater than the ash trees located on public property. During the inventory, it was evident to the inventory arborists that there is an abundance of ash trees located on private properties. The cost to remove ash trees will be higher on private property because of the greater inaccessibility to these areas. It is crucial that the City promote public education about EAB so that it can reduce the potential of City involvement with regulating tree removals on private properties. The public education section explains more on how to minimize anxiety from private homeowners and give examples on how to go about informing the public about managing their ash trees.

Photograph 29 . Hangers will help make private homeowners aware of the management options available for EAB.

Dying and infested ash trees on private property will pose a threat to human and public safety. In the event that City officials have to get involved with private property owners about a potential infested ash tree, Creve Coeur should consider utilizing the current Creve Coeur tree and landscape ordinance. Creve Coeur should consider amending their tree ordinance so that EAB is acknowledged as a public nuisance and treated in similar fashion as Dutch elm disease and other insect pests or plant diseases.

Public Education

It is crucial for Creve Coeur property owners to be well informed about EAB. Their assistance and cooperation will be vital in helping detect EAB, managing ash trees on private property, and the reforestation process that will come from the removal of ash trees. Creve Coeur should inform the public if EAB has been discovered in the City. If the public is well informed, then they are more likely to accept what is happening without panicking and cooperate with the City's requests. The following are examples of how Creve Coeur should go about informing the public:

Photograph 30. Posting information about EAB on ash trees around the City could promote private homeowners to become more proactive in managing their ash trees.

- News releases
- City newsletter articles
- Radio programs
- Post information about EAB on the City's website

It is vital for Creve Coeur to educate the public on how to detect EAB, provide information about treatment options, and relay this is the importance for reforestation. If the public is advised on how to detect for EAB, then they can make proactive choices about managing infested ash trees. This could help put City officials at ease by not having as many private trees becoming a public safety issue. Property owners may want to keep their ash trees because of the benefits they receive from them.

The City should provide information about treatment options so that their trees can last for years to come. It will be important for the City to inform the public about reforestation, the important benefits that trees provide to neighborhoods, and how trees increase real estate value. This can help fund and promote neighborhood tree plantings. The following are examples of ways the City can inform the public about these issues.

- Display information packets at public buildings
- Postcard mailings to ash tree owners
- Door hangers explaining maintenance options
- Presentations to community groups
- Post information about EAB on the City's website
- Tie ribbons around ash trees and place tags on the trees with information about EAB

Reforestation

As the ash tree population is being reduced in Creve Coeur, the City will need to come up with a plan to replant where ash trees have been removed. The City could potentially lose over 6% of its tree population due to EAB. It will be vital for a prompt reforestation in the City because of the numerous benefits that the ash trees provide the community. Some of the benefits that these ash trees provide to the City include, but are not limited to, removing pollutants from the air, helping moderate temperatures, reducing storm water runoff, and providing social and psychological benefits.

If the City is to replace all the ash trees, it will cost approximately $170,280. This would be a huge financial burden on the City, but it will be important that these trees be replaced. The cost of replanting ash trees could be spread out over multiple years by establishing a goal that a certain amount of trees need to be planted each year. If the City was to plant 75 trees a year, then Creve Coeur could replace all of the ash trees within 10 years. This cost could be reduced if the City comes up with a plan to work with volunteers and private property owners. This could include giving private property owners the option of paying for the tree and getting to pick the tree they want from a list of recommended species. The City should also explore grants for reforestation. Organizing volunteer groups to participate in planting trees could help decrease the cost for planting trees.

It is important to consider diversification when replacing ash trees. Without diversification, a community is much more vulnerable to catastrophic losses that impact budgets and community appearance. Davey Resource Group recommends that no one species represent more than 10% and that no one genera comprises more than 20% of the total public tree population. Since EAB has hit local communities, there might be a possibility that local nurseries have a shortage of trees. Creve Coeur might want to consider nurseries in other regions for trees.

Conclusions

Every hour of every day public, trees in Creve Coeur are supporting and improving the quality of life. City trees are constantly providing benefits to residents. When properly maintained, trees provide abundant environmental, economic, and social benefits to a community far in excess of the time and money invested in their planting, pruning, protection, and removal.

Managing trees in urban areas is often complicated. Dealing with the recommendations of experts, the needs of residents, the pressures of local economics and politics, the concerns for public safety and liability issues, the physical aspects of trees, the forces of nature and severe weather events, and the expectation for all of these issues to be met at the same time is a considerable challenge. The City should prepare an EAB Management Plan.

The City must carefully consider each specific issue and balance these pressures with a knowledgeable understanding of trees and their needs. If balance is achieved, Creve Coeur's beauty will flourish and the health and safety of its trees and citizens will be maintained.

Glossary

aboveground utilities (data field): Shows the presence or absence of overhead utilities at the tree site.

address number (data field): The address number was recorded based on the visual observation by the Davey Resource Group arborist at the time of the inventory of the actual address number posted on a building at the inventoried site. In instances where there was no posted address number on a building or sites were located by vacant lots with no GIS parcel addressing data available, the address number assigned was matched as closely as possible to opposite or adjacent addresses by the arborist(s) and an "X" was added to the number in the database to indicate that the address number was assigned.

American National Standards Institute (ANSI): ANSI is a private, nonprofit organization that facilitates the standardization work of its members in the United States. ANSI's goals are to promote and facilitate voluntary consensus standards and conformity assessment systems, and to maintain their integrity.

***ANSI A300* standards:** Tree care performance parameters established by ANSI that can be used to develop specifications for tree maintenance.

arboriculture: The art, science, technology, and business of commercial, public, and utility tree care.

clean (primary maintenance need): Based on *ANSI A300 Standards*, selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk.

community forest: see **urban forest**.

condition (data field): The general condition of each tree rated during the inventory according to the following categories adapted from the International Society of Arboriculture's rating system: Excellent (100%), Very Good (90%), Good (80%), Fair (60%), Poor, (40%), Critical (20%), Dead (0%).

cycle: Planned length of time between vegetation maintenance activities.

diameter at breast height (DBH): See **tree size**.

diameter: See **tree size**.

failure: In terms of tree management, failure is the breakage of stem or branches, or loss of mechanical support of the tree's root system.

further inspection (data field): Notes that a specific tree may require an annual inspection for several years to make certain of its maintenance needs. A healthy tree obviously impacted by recent construction serves as a prime example. This tree will need annual evaluations to assess the impact of construction on its root system. Another example would be a tree with a defect requiring additional equipment for investigation.

genus: A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature, the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.

geographic information system (GIS): A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates.

global positioning system (GPS): GPS is a system of earth-orbiting satellites that make it possible for people with ground receivers to pinpoint their geographic location.

High Risk tree: Tree that cannot be cost-effectively or practically treated. Most High Risk trees have multiple or significant defects affecting less than 40% of the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely between 4–20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

invasive, exotic tree: A tree species that is out of its original biological community. Its introduction into an area causes or is likely to cause economic or environmental harm, or harm to human health. An invasive, exotic tree has the ability to thrive and spread aggressively outside its natural range. An invasive species that colonizes a new area may gain an ecological edge since the insects, diseases, and foraging animals that naturally keep its growth in check in its native range are not present in its new habitat.

inventory: See **tree inventory**.

i-Tree Streets: i-Tree Streets is a street tree management and analysis tool that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO_2 reduction, stormwater control, and property value increase.

i-Tree Tools: State-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the structure of community trees and the environmental services that trees provide.

location (data fields): A collection of data fields collected during the inventory to aid in finding trees, including address number, street name, site number, side, and block side.

Low Risk tree: Tree with minor visible structural defects or wounds in areas with moderate to low public access.

Management Costs: Used in i-Tree Streets, they are the expenditures associated with street tree management presented in total dollars, dollars per tree, and dollars per capita.

mapping coordinate (data field): Helps to locate a tree; X and Y coordinates were generated for each tree using GPS.

Moderate Risk tree: Tree with defects that may be cost-effectively or practically treated. Most of the trees in this category exhibit several moderate defects affecting more than 40% of a tree's trunk, crown, or critical root zone.

monoculture: A population dominated by one single species or very few species.

none (risk rating): Equal to zero. It is used only for planting sites and stumps.

notes (data field): Describes additional pertinent information.

ordinance: See **tree ordinance**.

plant tree (primary maintenance need): If collected during an inventory, this data field identifies vacant planting sites as small, medium, or large (indicating the ultimate size that the tree will attain), depending on the growspace available and the presence of overhead wires.

primary maintenance need (data field): The type of tree work needed to reduce immediate risk.

pruning: The selective removal of plant parts to meet specific goals and objectives.

removal (primary maintenance need): Data field collected during the inventory identifying the need to remove a tree. Trees designated for removal have defects that cannot be cost-effectively or practically treated. Most of the trees in this category have a large percentage of dead crown.

right-of-way (ROW): See **street right-of-way**.

risk: Combination of the probability of an event occurring and its consequence.

risk assessment (data fields): The risk assessment is a point-based assessment of each tree by an arborist using a protocol based on the U.S. Forest Service Community Tree Risk Rating System. In the field, the probability of tree or tree part failure is assigned 1–4 points (identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions), the size of defective tree part is assigned 1–3 points (rates the size of the part most likely to fail), the probability of target impact by the tree or tree part is assigned 1–3 points (rates the use and occupancy of the area that would be struck by the defective part), and other risk factors are assigned 0–2 points (used if professional judgment suggests the need to increase the risk rating). The data from the risk assessment is used to calculate the risk rating that is ultimately assigned to the tree.

risk rating (data fields): Calculated from the field risk assessment data (see **risk assessment**), this is the sum of total risk assessment values. Risk ratings range from 3–10, with 3 being the lowest risk and 10 being the highest risk. In this Plan, the risk rating was used to identify the severity of risk assigned to a tree and to prioritize tree maintenance needs. The following categories were used:

- risk rating of 9 or 10 = Severe Risk tree
- risk rating of 7 or 8 = High Risk tree
- risk rating of 5 or 6 = Moderate Risk tree
- risk rating of 3 or 4 = Low Risk tree
- risk rating of 0 = no risk (used only for planting sites and stumps)

Severe Risk tree: Tree rated to be Severe Risk cannot be cost-effectively or practically treated. Most Severe Risk trees have multiple and significant defects present in the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely larger than 20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

species (data fields): Fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

stem: A woody structure bearing buds and foliage, and giving rise to other stems.

stems (data field): Identifies the number of stems or trunks splitting less than one foot above ground level.

street name (data field): The name of a street right-of-way or road identified using posted signage or parcel information.

street right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

street tree: A street tree is defined as a tree within the right-of-way.

structural defect: A feature, condition, or deformity of a tree or tree part that indicates weak structure and contributes to the likelihood of failure.

topping: Topping, reducing tree size using internodal cuts without regard to tree health or structural integrity, is not an acceptable pruning practice.

tree benefit: An economic, environmental, or social improvement that benefits the community and results mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

tree inventory: Comprehensive database containing information or records about individual trees typically collected by an arborist.

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

tree size (data field): A tree's diameter measured to the nearest inch in one-inch size classes at 4.5 feet above ground, also known as diameter at breast height (DBH) or diameter.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, in parks and greenspaces, in forests, and on private property.

young tree train (primary maintenance need): Data field based on *ANSI A300* standards, pruning of young trees to correct or eliminate weak, interfering, or objectionable branches to improve structure. These trees, up to 20 feet in height, can be worked with a pole pruner by a person standing on the ground.

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Appendix A
Site Location Methods

Equipment and Base Maps

Inventory arborists use CF-19 Panasonic Toughbook® unit(s) and Trimble® GPS Pathfinder® ProXH™ receiver(s).

Base map layers were loaded onto these unit(s) to help locate sites during the inventory. Table 1 lists the base map layers utilized along with source and format information for each layer.

Table 1. Base Map Layers Utilized for Inventory

Imagery/Data Source	Date	Projection
St. Louis County Department of Planning	2012	NAD 83 State Plane Missouri East (FT)

Street ROW Site Location

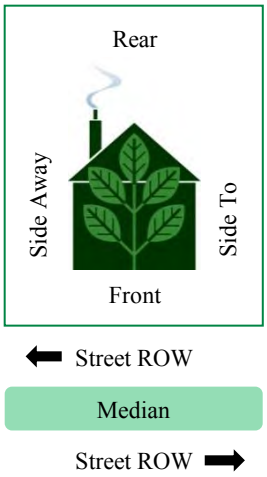
Individual street ROW sites (trees, stumps, or vacant planting sites) were located using a methodology developed by Davey Resource Group that identifies sites by *address number*, *street name, side, site number*, and *block side*. This methodology allows for consistent assignment of location.

Address Number and Street Name

The *address number* was recorded based on visual observation by the arborist at the time of the inventory (the address number posted on a building at the inventoried site). Where there was no posted address number on a building or where the site was located by a vacant lot with no GIS parcel addressing data available, the address number assigned was matched as closely as possible to opposite or adjacent addresses by the arborist and an "X" was added to the number in the database to indicate that it was assigned (for example, "37X Choice Avenue").

Sites in medians or islands were assigned an address number using the address on the right side of the street in the direction of collection closest to the site. Each segment was numbered with an assigned address that was interpolated from addresses facing that median/island. If there were multiple median/islands between cross streets, each segment was given its own assigned address.

The *street name* assigned to a site was determined by street ROW parcel information and posted street name signage.



Side values for street ROW sites.

Side Value

Each site was assigned a *side value* and *site number*. Side values include: *front*, *side to*, *side away*, *median* (includes islands), or *rear* based on the site's location in relation to the lot's street frontage (Figure 1). The *front side* is the side that faces the address street. *Side to* is the name of the street the arborist is walking towards as data are being collected. The *side from* is the name of the street the arborist is walking away from while collecting data. *Median* indicates a median or island. The *rear* is the side of the lot opposite of the front.

Block Side

Block side information for a site includes the *on street*, *from street*, and *to street*.

- The *on street* is the street that the site is physically located on. (The *on street* may not match the address street. A site may be physically located on a street that is different from its street address, for example, a site located on a side street.)
- The *from street* is the first cross street encountered when proceeding along the street in the direction of traffic flow.
- The *to street* is the second cross street encountered when moving in the direction of traffic flow.

Park and/or Public Space Site Location

Park and/or public space site locations were collected using the same methodology as street ROW sites; however, the *on street*, *from street*, and *to street* would be the park and/or public space's name (not street names).

Site Location Examples

The tree trimming crew in the truck traveling westbound on E Mac Arthur Street is trying to locate an inventoried tree with the following location information:

Address/Street Name:	226 E. Mac Arthur Street
Side:	Side To
Site Number:	1
On Street:	Davis Street
From Street:	Taft Street
To Street:	E. Mac Arthur Street.

The tree site circled in red is the site the crew is looking for. Because the tree is located on the side of the lot, the on street is Davis Street even though it is addressed as 226 East Mac Arthur Street. Moving with the flow of traffic, the from street is Taft Street, and the to street is East Mac Arthur Street.

Location information collected for inventoried trees at Corner Lots A and B.

Corner Lot A

Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 1
On Street:	Taft St.
From Street:	E Mac Arthur St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 2
On Street:	Taft St.
From Street:	E Mac Arthur St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 3
On Street:	Taft St.
From Street:	19th St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Front / 1
On Street:	Hoover St.
From Street:	Taft St.
To Street:	Davis St.

Corner Lot B

Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Side To / 1
On Street:	Davis St.
From Street:	Hoover St.
To Street:	E Mac Arthur St.
Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Front / 1
On Street:	E Mac Arthur St.
From Street:	Davis St.
To Street:	Taft St.
Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Front / 2
On Street:	E Mac Arthur St.
From Street:	Davis St.
To Street:	Taft St.

Appendix B
Recommended Species for Future Planting

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is offered to assist all relevant community personnel in selecting appropriate tree species. These trees have been selected because of their aesthetic and functional characteristics and their ability to thrive in the soil and climate (USDA Zones 5 and 6) conditions found throughout Missouri.

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer rubrum	red maple	Red Sunset®
Acer saccharum	sugar maple	'Legacy'
Acer nigrum	black maple	
*Betula alleghaniensis**	yellow birch	
*Betula lenta**	sweet birch	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Carya illinoensis**	pecan	
*Carya lacinata**	shellbark hickory	
*Carya ovata**	shagbark hickory	
*Castanea mollissima**	Chinese chestnut	
Celtis laevigata	sugarberry	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
*Diospyros virginiana**	common persimmon	
*Fagus grandifolia**	American beech	
*Fagus sylvatica**	European beech	(Numerous exist)
Ginkgo biloba	ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans nigra**	black walnut	
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	'Rotundiloba'
*Liriodendron tulipifera**	tuliptree	'Fastigiatum'
*Magnolia acuminata**	cucumbertree magnolia	(Numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	blackgum	
*Platanus occidentalis**	American sycamore	
Platanus × acerifolia	London planetree	'Yarwood'
Quercus alba	white oak	

Large Trees: Greater than 45 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	
Quercus montana	*chestnut oak*	
Quercus muehlenbergii	chinkapin oak	
Quercus imbricaria	shingle oak	
Quercus phellos	willow oak	
Quercus robur	English oak	Heritage®
Quercus rubra	northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
Tilia × euchlora	Crimean linden	
Tilia tomentosa	silver linden	'Sterling'
Ulmus parvifolia	Chinese elm	Allée®
Zelkova serrata	Japanese zelkova	'Green Vase'

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
Alnus cordata	Italian alder	
*Asimina triloba**	pawpaw	
Cladrastis kentukea	American yellowwood	'Rosea'
Corylus colurna	Turkish filbert	
Eucommia ulmoides	hardy rubber tree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	Amur corktree	'Macho'
Pistacia chinensis	Chinese pistache	
Prunus maackii	Amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
*Sassafras albidum**	sassafras	

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer buergerianum	trident maple	Streetwise®
Acer campestre	hedge maple	Queen Elizabeth™
Acer cappadocicum	coliseum maple	'Aureum'
Acer ginnala	Amur maple	Red Rhapsody™
Acer griseum	paperbark maple	
Acer oliverianum	Chinese maple	
*Acer pensylvanicum**	striped maple	
Acer triflorum	three-flower maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(Numerous exist)
Amelanchier laevis	Allegheny serviceberry	
*Carpinus caroliniana**	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Chionanthus virginicus	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus kousa	kousa dogwood	(Numerous exist)
Cornus mas	corneliancherry dogwood	'Spring Sun'
Corylus avellana	European filbert	'Contorta'
*Cotinus coggygria**	common smoketree	'Flame'
*Cotinus obovata**	American smoketree	
*Crataegus phaenopyrum**	Washington hawthorn	Princeton Sentry™
Crataegus viridis	green hawthorn	'Winter King'
*Franklinia alatamaha**	Franklinia	
*Halesia tetraptera**	Carolina silverbell	'Arnold Pink'
Laburnum × watereri	goldenchain tree	
Maackia amurensis	Amur maackia	
*Magnolia × soulangiana**	saucer magnolia	'Alexandrina'
*Magnolia stellata**	star magnolia	'Centennial'
*Magnolia tripetala**	umbrella magnolia	
*Magnolia virginiana**	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(Disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	'Pendula'
Prunus virginiana	common chokecherry	'Schubert'
*Staphylea trifolia**	American bladdernut	
Stewartia ovata	mountain stewartia	
*Styrax japonicus**	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Note: * denotes species that are **not** recommended for use as street trees.

Coniferous and Evergreen Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Abies balsamea	balsam fir	
Abies concolor	white fir	'Violacea'
Cedrus libani	cedar-of-Lebanon	
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
× *Cupressocyparis leylandii*	Leyland cypress	
Ilex opaca	American holly	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Pinus taeda	loblolly pine	
Pinus virginiana	Virginia pine	
Psedotsuga menziesii	Douglas-fir	
Thuja plicata	western arborvitae	(Numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Chamaecyparis thyoides	Atlantic whitecedar	(Numerous exist)
Juniperus virginiana	eastern redcedar	
Pinus bungeana	lacebark pine	
Pinus flexilis	limber pine	
Pinus parviflora	Japanese white pine	
Thuja occidentalis	eastern arborvitae	(Numerous exist)

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Ilex × attenuata	Foster's holly	
Pinus aristata	bristlecone pine	
Pinus mugo mugo	mugo pine	

This suggested species list was compiled through the use of the excellent references *Dirr's Hardy Trees and Shrubs* (Dirr 2003) and *Manual of Woody Landscape Plants (5th Edition)* (Dirr 1998). Cultivar selections are recommendations only and are based on Davey Resource Group's experience; tree availability will vary by nursery.

Appendix C
Invasive Pests and Diseases That Affect Trees

In today's worldwide marketplace, the volume of international trade brings increased potential for pests and diseases to invade our country. Many of these pests and diseases have seriously harmed rural and urban landscapes and have caused billions of dollars in lost revenue and millions of dollars in clean-up costs. Keeping these pests and diseases out of the country is the number one priority of the United States Department of Agriculture's (USDA) Animal and Plant Inspection Service (APHIS).

Although some invasive species enter the United States naturally via wind, ocean currents, and other means, most enter with some help from human activities. Their introduction to our country is a byproduct of cultivation, commerce, tourism, and travel. Many species enter the United States each year in cargo, mail, baggage, or contaminants of commodities.

Once here, hungry pests grow and spread rapidly because controls, such as native predators, are lacking. Invasive pests disrupt the landscape by pushing out native species, reducing biological diversity, killing trees, altering wildfire intensity and frequency, and damaging crops. Some pests may even push species to extinction. Following are key pests and diseases that adversely affect trees in America at the time of this plan's development. This list is not comprehensive and may not include all threats.

It is critical to the management of community trees to routinely check APHIS, USDA Forest Service, and other websites for updates about invasive species and diseases in your area and in our country so you can to be prepared to combat their attack.

APHIS, Plant Health, Plant Pest Program Information

•www.aphis.usda.gov/plant_health/plant_pest_info

The University of Georgia, Center for Invasive Species and Ecosystem Health

•www.bugwood.org

USDA National Agricultural Library

•www.invasivespeciesinfo.gov/microbes

USDA Northeastern Areas Forest Service, Forest Health Protection

•www.na.fs.fed.us/fhp

Asian Longhorned Beetle

The Asian longhorned beetle (ALB, *Anoplophora glabripennis*) is an exotic pest threatening a wide variety of hardwood trees in North America. The beetle was introduced in New York City, Chicago, and New Jersey and is believed to have been introduced in the United States from wood pallets and other wood packing material accompanying cargo shipments from Asia. ALB is a serious threat to America's hardwood tree species.

Adult Asian longhorned beetle.
Photograph courtesy of New Bedford Guide 2011.

Adults are large (3/4- to 1/2-inch long) with very long, black and white banded antennae. The body is glossy black with irregular white spots. Adults can be seen from late spring to fall depending on the climate. ALB has a long list of host species; however, the beetle prefers hardwoods including several maple species. Examples include *A. negundo* (box elder); *A. platanoides* (Norway maple); *A. saccharinum* (silver maple); *Aesculus glabra* (buckeye); *A. hippocastanum* (horsechestnut); *Betula* (birch); *Platanus* × *acerifolia* (London planetree); red maple; *Salix* (willow); sugar maple; and *Ulmus* (elm).

Dutch Elm Disease

Considered by many to be one of the most destructive, invasive diseases of shade trees in the United States, Dutch elm disease (DED) was first found in Ohio in 1930 and by 1933 it was in several East Coast cities. By 1959, it had killed thousands of elms. Today, DED covers about two-thirds of the eastern United States, including Illinois, and annually kills many of the remaining and newly planted elms. The disease is caused by a fungus that attacks the vascular system of elm trees blocking the flow of water and nutrients resulting in rapid leaf yellowing, tree decline, and death.

Branch death, or flagging, at multiple locations in the crown of a diseased elm.

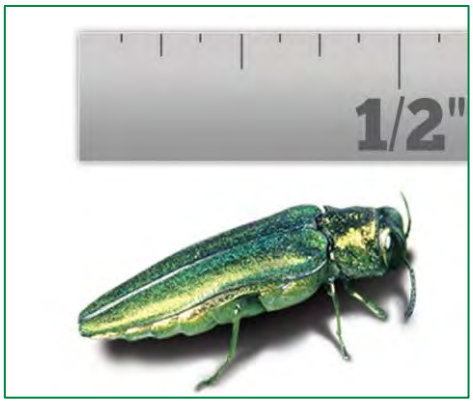
Photograph courtesy of Steven Katovich, USDA Forest Service, Bugwood.org (2011).

There are two closely related fungi that are collectively referred to as DED. The most common is *Ophiostoma novo-ulmi*, and is thought to be responsible for most of the elm deaths since the 1970s. The fungus is transmitted to healthy elms by elm bark beetles. Two species carry the fungus: the native elm bark beetle (*Hylurgopinus rufipes*) and the European elm bark beetle (*Scolytus multistriatus*).

Trees most affected by DED are the *Ulmus americana* (American elm).

Emerald Ash Borer

The emerald ash borer (EAB, *Agrilus planipennis*) is responsible for the death or decline of tens of millions of ash trees in 14 states in the American Midwest and Northeast. Native to Asia, it has been found in China, Korea, Japan, Mongolia, Taiwan, and eastern Russia. It likely arrived in the United States hidden in wood-packing materials commonly used to ship consumer goods, auto parts, and other products. The first official United States identification of EAB was in southeastern Michigan in 2002.



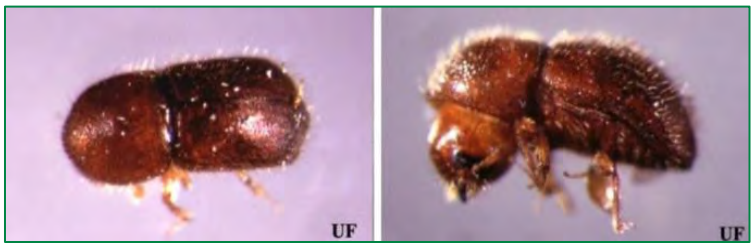
Close-up of the emerald ash borer. Photograph courtesy of APHIS (2011).

Adult beetles are slender and 1/2-inch long. Males are smaller than females. Color varies but adults are usually bronze or golden green overall with metallic, emerald-green wing covers. The top of the abdomen under the wings is metallic, purplish-red and can be seen when the wings are spread.

The tree species preferred as hosts by the EAB are in the genus *Fraxinus* (ash).

Granulate Ambrosia Beetle

The granulate ambrosia beetle (*Xylosandrus crassiusculus*), formerly the Asian ambrosia beetle, was first found in the United States in 1974 on peach trees near Charleston, South Carolina. The native range of the granulate ambrosia beetle is probably tropical and subtropical Asia and it is widely introduced elsewhere. It is currently found in equatorial Africa, Asia, China, Guinea, Hawaii, India, Japan, New South Pacific, Southeast Indonesia, Sri Lanka, and the United States. In the United States, this species has spread along the lower Piedmont region and coastal plain to North Carolina, Louisiana, Florida, and East Texas. Populations were found in Oregon and Virginia in 1992, and in Indiana in 2002.



Adult granulate ambrosia beetle.

Photograph courtesy of Paul M. Choate, University of Florida (Atkinson et al. 2011).

Adults are small and have a reddish-brown appearance with a downward facing head. Most individuals have a reddish head region and a dark-brown to black elytra (hard casings protecting the wings). Light-colored forms that appear almost yellow also have been trapped. A granulated (rough) region is located on the front portion of the head and long setae (hairs) can be observed on the back end of the wing covers. Females are 2–2.5mm and males are 1.5mm long. Larvae are C-shaped with a defined head capsule.

The granulate ambrosia beetle is considered an aggressive species and can attack trees that are not highly stressed. It is a potentially serious pest of ornamentals and fruit trees and is reported to be able to infest most trees and some shrubs (azalea, rhododendron) except for conifers. Known hosts in the United States include *Acer* (maple), *Albizia julibrissin* (mimosa), *Carya* (hickory), *Cercis canadensis* (redbud), *Cornus* (dogwood), *Diospyros* (persimmon), *Fagus* (beech), *Gleditsia* or *Robinia* (locust), *Juglans* (walnut), *Koelreuteria* (goldenrain tree), *Lagerstroemia* (crape myrtle), *Liquidambar styraciflua* (sweet gum), *Liriodendron tulipifera* (tulip poplar), *Magnolia* (magnolia), *Populus* (aspen), *Prunus* (cherry), *Quercus* (oak), and *Ulmus parvifolia* (Chinese elm). *Carya illinoinensis* (pecan) and *Pyrus calleryana* (Bradford pear) are commonly attacked in Florida and in the southeastern United States.

Oak Wilt

Oak wilt was first identified in 1944 and is caused by the fungus *Ceratocystis fagacearum*. While considered an invasive and aggressive disease, its status as an exotic pest is debated since the fungus has not been reported in any other part of the world. This disease affects the oak genus, and is most devastating to those in the red oak subgenus, such as *Q. coccinea* (scarlet oak), *Q. imbricaria* (shingle oak), *Q. palustris* (pin oak), *Q. phellos* (willow oak), and *Q. rubra* (red oak). It also attacks trees in the white oak subgenus, although it is not as prevalent and spreads at a much slower pace in these trees.

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of USDA Forest Service (2011a).

Just as with DED, oak wilt disease is caused by a fungus that clogs the vascular system of oaks and results in decline and death of the tree. The fungus is carried from tree to tree by several borers common to oaks, but more commonly the disease is spread through root grafts. Oak species within the same subgenus (white or red) will form root colonies with grafted roots that allow the disease to move readily from one tree to another.

Pine Shoot Beetle

The pine shoot beetle (*Tomicus piniperda L.*), a native of Europe, is an introduced pest of *Pinus* (pine) in the United States. It was first discovered in the United States at a Christmas tree farm near Cleveland, Ohio in 1992. Following the first detection in Ohio, the beetle has been detected in parts of 19 states (Connecticut, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, Vermont, West Virginia, and Wisconsin).

Mined shoots on Scotch pine. Photo courtesy of USDA Forest Service (1993).

The beetle attacks new shoots of pine trees, stunting the growth of the trees. The pine shoot beetle may also attack stressed pine trees by breeding under the bark at the base of the trees. The beetles can cause severe decline in the health of the trees and, in some cases, kill the trees when high populations exist.

Adult pine shoot beetles range from 3 to 5mm long, or about the size of a match head. They are brown or black and cylindrical. The legless larvae are about 5mm long with a white body and brown head. Egg galleries are 10–25cm long. From April to June, larvae feed and mature under the pine bark in separate feeding galleries that are 4–9cm long. When mature, the larvae stop feeding, pupate, and then emerge as adults. From July through October, adults tunnel out through the bark and fly to new or 1-year-old pine shoots to begin maturation feeding. The beetles enter the shoot 15cm or less from the shoot tip, and move upwards by hollowing out the center of the shoot for a distance of 2.5–10cm. Affected shoots droop, turn yellow, and eventually fall off during the summer and fall.

Pinus sylvestris (Scots pine) is preferred, but other pine species, including *P. banksiana* (jack pine), *P. nigra* (Austrian pine), *P. resinosa* (red pine), and *P. strobus* (eastern white pine) have been infested in the Great Lakes region.

Sirex woodwasp

Sirex woodwasp (*Sirex noctillio*) has been the most common species of exotic woodwasp detected at United States ports-of-entry associated with solid wood-packing materials. Recent detections of sirex woodwasp outside of port areas in the United States have raised concerns because this insect has the potential to cause significant mortality of pines.

Close-up of female Sirex Woodwasp. Photograph courtesy of USDA (2005).

Awareness of the symptoms and signs of a sirex woodwasp infestation increases the chance of early detection and, thus, the rapid response needed to contain and manage this exotic forest pest.

Woodwasps (or horntails) are large robust insects, usually 1.0 to 1.5 inches long. Adults have a spear-shaped plate (cornus) at the tail end; in addition females have a long ovipositor under this plate. Larvae are creamy white, legless, and have a distinctive dark spine at the rear of the abdomen. More than a dozen species of native horntails occur in North America.

Sirex woodwasp can attack living pines, while native woodwasps attack only dead and dying trees. At low populations, sirex woodwasp selects suppressed, stressed, and injured trees for egg laying. Foliage of infested trees initially wilts, and then changes color from dark green to light green, to yellow, and finally to red, during the 3-6 months following attack. Infested trees may have resin beads or dribbles at the egg laying sites which are more common at the mid-bole level. Larval galleries are tightly packed with very fine sawdust. As adults emerge, they chew round exit holes that vary from 1/8 to 3/8 inch in diameter.

Southern Pine Beetle

The southern pine beetle (SPB, *Dendroctonus frontalis*) is the most destructive insect pest of pine in the southern United States. It attacks and kills all species of southern yellow pines including *P. strobus* (eastern white pine). Trees are killed when beetles construct winding, S-shaped egg galleries underneath the bark. These galleries effectively girdle the tree and destroy the conductive tissues that transport food throughout the tree. Furthermore, the beetles carry blue staining fungi on their bodies that clog the water conductive tissues (wood) that transport water within the tree. Signs of attack on the outside of the tree are pitch tubes and boring dust, known as frass, caused by beetles entering the tree.

Adult southern pine beetles. Photograph courtesy of Forest Encyclopedia Network (2012).

Adult SPBs reach an ultimate length of only 1/8 inch, similar in size to a grain of rice. They are short-legged, cylindrical, and brown to black in color. Eggs are small, oval in shape, shiny, opaque, and pearly white.

Sudden Oak Death

The causal agent of sudden oak death (SOD, also known as *Phytophthora* canker disease), *Phytophthora ramorum*, was first identified in 1993 in Germany and the Netherlands on ornamental rhododendrons. In 2000, the disease was found in California. Since its discovery in North America, SOD has been confirmed in forests in California and Oregon and in nurseries in California, Oregon, Washington, and British Columbia. SOD has been potentially introduced into other states through exposed nursery stock. Through ongoing surveys, APHIS continues to define the extent of the pathogen's distribution in the United States and limit its artificial spread beyond infected areas through quarantine and a public education program.

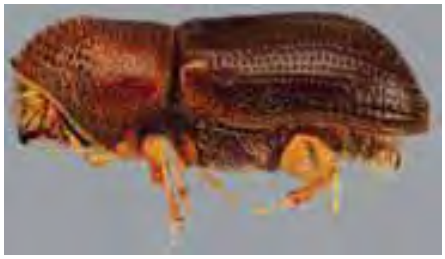
Drooping tanoak shoot. Photograph courtesy of Indiana Department of Natural Resources (2012.)

Identification and symptoms of SOD may include large cankers on the trunk or main stem accompanied by browning of leaves. Tree death may occur within several months to several years after initial infection. Infected trees also may be infested with ambrosia beetles (*Monarthrum dentiger* and *M. scutellare)*, bark beetles (*Pseudopityophthorus pubipennis*), and sapwood rotting fungus (*Hypoxylon thouarsianum*). These organisms may contribute to the death of the tree. Infection on foliar hosts is indicated by dark grey to brown lesions with indistinct edges. These lesions can occur anywhere on the leaf blade, in vascular tissue, or on the petiole. Petiole lesions are often accompanied by stem lesions. Some hosts with leaf lesions defoliate and eventually show twig dieback.

This pathogen is devastating to *Quercus* (oaks) but also affects several other plant species.

Thousand Cankers Disease

A disease complex referred to as Thousand Cankers disease (TCD) was first observed in Colorado in 2008 and is now thought to have been existence in Colorado as early as 2003. TCD is considered to be native to the United States and is attributed to numerous cankers developing in association with insect galleries.



Walnut twig beetle, side view. Photograph courtesy of USDA Forest Service (2011b).

TCD results from the combined activity of the *Geosmithia morbida* fungus and the walnut twig beetle (WTB, *Pityophthorus juglandis*). The WTB has expanded both its geographical and host range over the past two decades, and coupled with the *Geosmithia morbida* fungus, *Juglans* (walnut) mortality has resulted in Arizona, California, Colorado, Idaho, New Mexico, Oregon, Utah, and Washington. In July 2010, TCD was reported in Knoxville, Tennessee. The infestation is believed to be at least 10 years old and was previously attributed to drought stress. This is the first report east of the 100th meridian, raising concerns that large native populations of *J. nigra* (black walnut) in the eastern United States may suffer severe decline and mortality.

The tree species preferred as hosts for TCD are walnuts.

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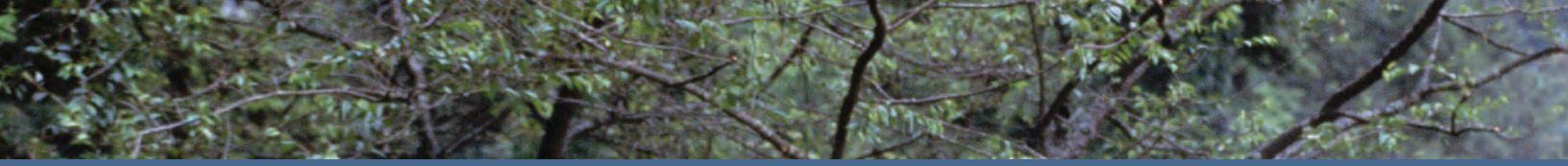
Appendix D
Estimated Costs for Creve Coeur's Five-Year Tree Management Program

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	Cost
Severe and High-Risk	1-3"	$25	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Removal	4-6"	$105	4	$420	0	$0	0	$0	0	$0	0	$0	$420
	7-12"	$220	38	$8,360	0	$0	0	$0	0	$0	0	$0	$8,360
	13-18"	$355	46	$16,330	0	$0	0	$0	0	$0	0	$0	$16,330
	19-24"	$525	29	$15,225	0	$0	0	$0	0	$0	0	$0	$15,225
	25-30"	$845	15	$12,675	0	$0	0	$0	0	$0	0	$0	$12,675
	31-36"	$1,140	2	$2,280	0	$0	0	$0	0	$0	0	$0	$2,280
	37-42"	$1,470	1	$1,470	0	$0	0	$0	0	$0	0	$0	$1,470
	43"+	$1,850	2	$3,700	0	$0	0	$0	0	$0	0	$0	$3,700
Activity Total(s)			**137**	**$60,460**	0	$0	0	$0	0	$0	0	$0	**$60,460**
Moderate-Risk Removal	1-3"	$25	0	$0	41	$1,025	0	$0	0	$0	0	$0	$1,025
	4-6"	$105	0	$0	31	$3,255	0	$0	0	$0	0	$0	$3,255
	7-12"	$220	0	$0	48	$10,560	0	$0	0	$0	0	$0	$10,560
	13-18"	$355	0	$0	13	$4,615	0	$0	0	$0	0	$0	$4,615
	19-24"	$525	0	$0	5	$2,625	0	$0	0	$0	0	$0	$2,625
	25-30"	$845	0	$0	1	$845	0	$0	0	$0	0	$0	$845
	31-36"	$1,140	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$1,470	0	$0	1	$1,470	0	$0	0	$0	0	$0	$1,470
	43"+	$1,850	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			0	0	**140**	**$24,395**	0	0	0	0	0	0	**$24,395**
Low-Risk Removal	1-3"	$25	0	$0	6	$150	0	$0	0	$0	0	$0	$150
	4-6"	$105	0	$0	1	$105	0	$0	0	$0	0	$0	$105
	7-12"	$220	0	$0	1	$220	0	$0	0	$0	0	$0	$220
	13-18"	$355	0	$0	1	$355	0	$0	0	$0	0	$0	$355
	19-24"	$525	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	25-30"	$845	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	31-36"	$1,140	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$1,470	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$1,850	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			0	$0	**9**	**$830**	0	$0	0	$0	0	$0	**$830**
Removal Total(s)			0	$0	149	$ 25,225	0	0	0	0	0	0	$25,225
High-Risk Prune	1-3"	$20	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$75	18	$1,350	0	$0	0	$0	0	$0	0	$0	$1,350
	13-18"	$120	43	$5,160	0	$0	0	$0	0	$0	0	$0	$5,160
	19-24"	$170	65	$11,050	0	$0	0	$0	0	$0	0	$0	$11,050
	25-30"	$225	45	$10,125	0	$0	0	$0	0	$0	0	$0	$10,125
	31-36"	$305	28	$8,540	0	$0	0	$0	0	$0	0	$0	$8,540
	37-42"	$380	8	$3,040	0	$0	0	$0	0	$0	0	$0	$3,040
	43"+	$590	2	$1,180	0	$0	0	$0	0	$0	0	$0	$1,180
Activity Total(s)			**209**	**$40,445**	0	$0	0	$0	0	$0	0	$0	**$40,445**
Routine Pruning	1-3"	$20	36	$720	36	$720	36	$720	36	$720	36	$720	$3,600
	4-6"	$30	58	$1,740	58	$1,740	58	$1,740	58	$1,740	58	$1,740	$8,700
	7-12"	$75	336	$25,200	336	$25,200	336	$25,200	336	$25,200	336	$25,200	$126,000
	13-18"	$120	244	$29,280	244	$29,280	244	$29,280	244	$29,280	244	$29,280	$146,400
	19-24"	$170	130	$22,100	130	$22,100	130	$22,100	130	$22,100	130	$22,100	$110,500
	25-30"	$225	65	$14,625	65	$14,625	65	$14,625	65	$14,625	65	$14,625	$73,125
	31-36"	$305	23	$7,015	23	$7,015	23	$7,015	23	$7,015	23	$7,015	$35,075
	37-42"	$380	6	$2,280	6	$2,280	6	$2,280	6	$2,280	6	$2,280	$11,400
	43"+	$590	2	$1,180	2	$1,180	2	$1,180	2	$1,180	2	$1,180	$5,900
Activity Total(s)			**900**	**$104,140**	**900**	**$104,140**	**900**	**$104,140**	**900**	**$104,140**	**900**	**$104,140**	**$520,700**
Pruning Total(s)			**1109**	**$144,585**	**900**	**$104,140**	**900**	**$104,140**	**900**	**$104,140**	**900**	**$104,140**	**$561,145**
Young Tree Training	1-3"	$20	171	$3,420	171	$3,420	171	$3,420	171	$3,420	171	$3,420	$17,100
	4-6"	$30	292	$8,760	292	$8,760	292	$8,760	292	$8,760	292	$8,760	$43,800
Activity Total(s)			**463**	**$12,180**	**463**	**$12,180**	**463**	**$12,180**	**463**	**$12,180**	**463**	**$12,180**	**$60,900**
Tree Planting	Purchasing	$110	100	$11,000	100	$11,000	100	$11,000	100	$11,000	100	$11,000	$55,000
	Planting	$110	100	$11,000	100	$11,000	100	$11,000	100	$11,000	100	$11,000	$55,000
Activity Total(s)			**200**	**$22,000**	**200**	**$22,000**	**200**	**$22,000**	**200**	**$22,000**	**200**	**$22,000**	**$110,000**
Activity Grand Total			**1,772**		**1,712**		**1,563**		**1,563**		**1,563**		**$8,173**
Cost Grand Total				**$178,765**		**$163,545**		**$138,320**		**$138,320**		**$138,320**	**$757,270**

Budget includes all *Fraxinus* recommended for immediate removal and those recommended for EAB treatment. Does not include ash trees slated for removal under the recommended EAB strategy.

Appendix E
Emerald Ash Borer Information



Extension Bulletin E-2942 New, May 2005

Ash Tree Identification

Ash species attacked by emerald ash borer include green (*Fraxinus pennsylvanica*), white (*F. americana*), black (*F. nigra*), and blue (*F. quadrangulata*), as well as horticultural cultivars of these species. Green and white ash are the most commonly found ash species in the Midwest with blue ash being rare.

While other woody plants, such as mountainash and pricklyash, have "ash" in their name, they are not true ash, or *Fraxinus* species. Only true ash are susceptible to attack by emerald ash borer.

To properly identify ash trees, use the following criteria:

Branch and Bud Arrangement

Branches and buds are directly across from each other and not staggered. When looking for opposite branching in trees, please consider that buds or limbs may die; hence not every single branch will have an opposite mate.

Diane Brown-Rytlewski

Leaves

Leaves are compound and composed of 5-11 leaflets. Leaflet margins may be smooth or toothed. The only other oppositely branched tree with compound leaves is boxelder (*Acer negundo*), which almost always has three to five leaflets. White ash (on left) and green ash (on right)

**Paul Wray, Iowa State University*

Bark

On mature trees (left), the bark is tight with a distinct pattern of diamond-shaped ridges. On young trees (right), bark is relatively smooth.

**Paul Wray, Iowa State University*

Seeds

When present on trees, seeds are dry, oar-shaped samaras. They usually occur in clusters and typically hang on the tree until late fall, early winter.

MICHIGAN STATE UNIVERSITY EXTENSION

Emerald Ash Borer

Tree Species Resembling Ash

Boxelder *(Acer negundo)*

Exhibits opposite branching and compound leaves. However, has 3 to 5 leaflets (instead of 5 to 11) and the samaras are always in pairs instead of single like the ash.

*Paul Wray, Iowa State University

*Bill Cook, Michigan State University

European Mountainash *(Sorbus aucuparia)*

Leaves are compound with alternate (staggered) branching. Tree bears clusters of creamy white flowers in May. Fruits are fleshy, red-orange berries.

Diane Brown-Rytlewski

*Boris Hrasovec, University of Zagreb

Shagbark Hickory *(Carya ovata)*

Leaves are compound with 5 to 7 leaflets, but the plant has an alternate branching habit. Fruit are hard-shelled nuts in a green husk.

*Paul Wray, Iowa State University

*Paul Wray, Iowa State University

Elm *(Ulmus species)*

Branching is alternate and the leaves are simple with an unequal leaf base.

*Paul Wray, Iowa State University

*Paul Wray, Iowa State University

*Paul Wray, Iowa State University

Black Walnut *(Juglans nigra)*

Leaves are compound with 9 to 15 leaflets, but the plant has an alternate branching habit. Fruit is a large dark brown nut inside a green husk.

*Paul Wray, Iowa State University

Authors: Kimberly Rebek and Mary Wilson

*www.forestryimages.org

MICHIGAN STATE UNIVERSITY EXTENSION

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New - 5:05 - 6,250 - KMF/LB

Illinois Department of Agriculture

NEWS

CHARLES A. HARTKE, DIRECTOR • ROD R. BLAGOJEVICH, GOVERNOR

FOR IMMEDIATE RELEASE
March 8, 2007

CONTACTS:
Jeff Squibb 217-558-1546

STATE TO PAY FOR REMOVAL OF EAB INFESTED ASH TREES

Voluntary program part of plan to reduce the population of the tree-killing pest

SPRINGFIELD, Ill. – The Illinois Department of Agriculture will pay to remove trees infested with the emerald ash borer (EAB) in 2007 as part of a plan to reduce the population of the tree-killing beetle.

The state's EAB Management and Science Advisory Panel today unveiled its strategy to control the pest. The plan gives landowners the option to have infested trees removed at no cost if they sign an indemnification waiver that holds the department and its contractors harmless should the work cause any damage.

"This strategy accomplishes two important objectives," Agriculture Director Chuck Hartke said. "It will reduce the population of the emerald ash borer and limit its potential spread while relieving landowners of an expense they may not have been able to afford."

-more-

To qualify for state-funded removal, the following conditions must be met:

1. The tree is located within ½ mile of a USDA-confirmed EAB infestation;
2. It exhibits multiple signs of EAB infestation (D-shaped exit holes, crown die-back, shoot growth near the base of the tree, larval tunneling or significant woodpecker damage); and
3. It is approved for removal by an authorized representative of the Illinois Department of Agriculture.

Trees approved for funding will be removed this spring prior to the start of the beetle's flight season.

In developing its plan, the advisory panel concluded the removal of every ash tree in close proximity to a known infestation, a management strategy known as a control cut, is neither feasible nor practical at this time.

"Our goal remains the eradication of this tree-killing pest," Warren Goetsch, bureau chief of Environmental Programs, said. "However, our tree surveys indicate not only that there isn't enough money available to remove both infested and non-infested trees, but also that some trees are inaccessible because they're located either in densely wooded areas or on steep slopes. Our hope is a population reduction strategy will contain the beetle until researchers discover a way to get rid of it once and for all."

The program covers all costs associated with the removal of an infested tree, including wood disposal and stump grinding. Landowners must pay for their own landscaping restoration.

-more-

EAB/3333

The emerald ash borer has killed more than 20 million trees in North America since its arrival here in 2002. It was first discovered in Illinois last June west of St. Charles in rural Kane County. Subsequent detections were made in the northern Cook County communities of Wilmette, Evanston and Winnetka.

A quarantine that prohibits the movement of potentially-infested wood products, including all types of firewood, is in effect to prevent the accidental spread of the beetle. Areas under quarantine include all of Kane County and 84 square miles of northern Cook County from the Lake County line to the northernmost city limit of Chicago and from Lake Michigan to Interstate 294.

Landowners who think they may qualify for free tree removal can view maps of the confirmed EAB infestations as well as download a copy of the indemnification waiver on the department's website at www.agr.state.il.us/eab. Only trees approved by IDOA and located within ½ mile of a USDA-confirmed infestation will be eligible for removal under this program.

###

EMERALD ASH BORER (EAB) COMMUNITY READINESS PLAN WORKBOOK

-A Framework for Local EAB Preparedness And Community Action

State of Illinois
Department of Natural Resources
Urban and Community Forestry Program

2006 Version 1: June; July 5; October 12; November 14; Dec. 6
2007 Version 2: March 10, 2007

Contributing agencies:

WHEN COMMUNITIES CREATE LOCAL

TREE CITY USA URBAN OR COMMUNITY

FORESTRY PROGRAMS,

THEY WILL HAVE A BETTER CAPACITY

FOR READINESS WHEN

THE EMERALD ASH BORER

REACHES THEIR COMMUNITY FOREST.

State of Illinois
Department of Natural Resources –
Urban and Community Forestry Program

EMERALD ASH BORER (EAB)
COMMUNITY READINESS PLAN
-A Framework For Local EAB Preparedness & Community Action

EMERALD ASH BORER (EAB) ANNOUNCEMENT WAS MADE BY THE ILLINOIS DEPARTMENT OF AGRICULTURE IN COOPERATION WITH APHIS on JUNE 13, 2006. ILLINOIS' FIRST OFFICIAL EMERALD ASH BORER SITE HAS BEEN FOUND IN KANE COUNTY. THE SECOND INFESTATION WAS NORTHERN COOK COUNTY AND INCLUDED TREE CITY USA DESINGATED COMMUNITIES OF WILMETTE, EVANSTON and WINNETKA. Both infestations were located in Northeastern Illinois.

The official announcement of the Emerald Ash Borer was made June 13th at the Kane County Governmental Center, Geneva, IL. The first official site has been verified by legal protocol in cooperation with APHIS.

A copy of the official news release can be seen on the Illinois Department Agriculture website: http://www.agr.state.il.us/ or in the Illinois Department of Natural Resource's Urban and Community Forestry Website (LISTING OF TREE CITY USA COMMUNITIES THAT ARE PROVIDING ASSISTANCE TO THE ILLINOIS DEPARTMENT OF AGRICULTURE FOR EMERALD ASH BORER IDENTIFICATION AND MONITORING). http://www.dnr.state.il.us/conservation/forestry/urban/index.htm

EMERALD ASH BORER (EAB)
COMMUNITY READINESS PLAN WORKBOOK

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Sarah Tien - Park Ridge
Sandy Clarke - Mount Prospect

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Rod R. Blagojevich, Governor
Sam Flood, Acting Director

EMERALD ASH BORER (EAB) COMMUNITY READINESS

March 10, 2007

Dear Workbook/Planning Participant:

This document creates a framework for local EAB preparedness and community action. For those communities who are compliant with the National Incident Management System (NIMS), examples of NIMS terminology in setting up incident based management have been included in the appendix. Additionally, Illinois authorizations and the national Urban and Community Forestry and/or Arboriculture standards have been integrated into this document.

This document is the second version of the original Emerald Ash Borer (EAB) Community Readiness Plan – A Framework for Local EAB Preparedness and Community Action (June, 2006; Nov., 2006) and the

EMERALD ASH BORER (EAB) COMMUNITY READINESS PLAN – A Checklist for Local EAB Preparedness (June, 2006). The document consists of a written description of actions to be taken, official forms to be filled out, a quick summary checklist, an appendix with easy fill-in-the blank forms for the various actions plus examples from Illinois communities. This document is designed to allow your community to tailor make an EAB Readiness Plan of Action.

The most important actions that can be accomplished from this document are 1) sending in the IDA Compliance Agreement Form; 2) creating a list of essential people to contact if Emerald Ash Borer is verified in your municipality; 3) and using the inventory form to create a list of suspect or potential EAB ash trees.

Good luck with your planning process.

Sincerely,
Reinee Hildebrandt
Urban Conservation Program Admin.

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http://dnr.state.il.us

Rod R. Blagojevich, Governor
Sam Flood, Acting Director

CHECK LIST OF MUNICIPAL ACTIONS FOR EMERALD ASH BORER READINESS

_____ **Develop** and **implement Local Community Readiness Plan of Action** addressing local readiness team assignments, protocol and actions to be taken, pro-active community forestry management strategies, and public relations for when EAB arrives.

_____ **Conduct a tree inventory and generate a list of the ash trees** on public lands. Conduct an initial inspection.

_____ **Develop** an **ash tree reduction program**.

_____ **Conduct debarking surveys** of removed ash to look for Emerald Ash Borer**.**

_____ **Find potential sites for EAB contaminated wood debris that are at least 2-8 acres in size and develop in-house procedures for EAB infested residual wood handling.**

_____ Review **local firewood policies**. If none exist consider implementing a no movement of firewood policy for new homeowners and /or a permitting policy for firewood vendors.

_____ **Keep** local authorities **updated on the status of EAB** as it moves or is found throughout Illinois. **A Public relations campaign is critical**. NOTE: It is extremely important that you do not discuss a potential find with the media until confirmation from APHIS has been made.

FOR COMMUNITIES IN OR NEAR A QUARANTIEN AREA:

_____ Submit Compliance Agreements

_____ Consider implementing an ash tree reduction program.

IF EMERALD ASH BORER IS FOUND, the EAB Community Readiness Plan should be implemented immediately with the Incident Commander providing oversight concerning action addressing local readiness team assignments, protocol and local actions to be taken, pro-active community forestry management strategies, and public relations for when EAB arrives.

For more information contact: Reinee Hildebrandt, Ph.D., Urban Conservation Program Admin.
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Emerald Ash Borer Community Readiness Plan – A Framework For Local EAB Preparedness & Community Action

Invasive Exotic Species Monitoring

With the increase in international trade and current mobility of the United States citizenry, the movement of exotic invasive species is inevitable. Therefore, every municipality within the nation should establish procedures to deal with the potential for invasion of an insect or disease that could potentially threaten the indigenous populations. In urban and community forestry, Dutch Elm Disease (DED) (nationally) and Asian Long-horned Beetle (ALB) (regionally) have been examples of past management concerns. Gypsy Moth is another non-native insect that has hitchhiked its way across the United States only to devastate our nation's oak trees. Currently, Emerald Ash Borer has been added to the ranks of exotic invasive pests that threaten to damage our urban, community, and rural forests.

When a potential exotic invasive is discovered in the United States Department of Agriculture's, the Animal and Plant Health Inspection Service (APHIS) serves as the lead federal agency. They will investigate and verify the existence of the insect or disease and determine the potential threat and will work closely with the State of Illinois' Department of Agriculture. *Appendix A* contains the federal APHIS and the Illinois Department of Agriculture contact information concerning exotic invasive species.

USDA APHIS authorities are defined in 7 CFR 301.53-1 through 301.53-9 as of (1-1-07) See *Appendix B* for a copy of the federal APHIS authorities.

The Illinois Department of Agriculture is the lead state agency. Their role is defined in 505 ILCS 90/1 through 90/30 – Insect, Pest and Plant Disease Act. The **Insect, Pest and Plant Disease Act** is an act to prevent the introduction into and the dissemination within this State of insect pests and plant diseases and to provide for their repression and control. *See Appendix C.* This law addresses the states authorities through the Illinois Department of Agriculture in dealing with invasive pests and diseases.

Other support agencies include: USDA Forest Service (Forest Health, Wood Utilization, and the Urban and Community Forestry Program); Illinois Department of Natural Resources (Forest Health Program and the Urban and Community Forestry Program); U o f I Extension Service; and the Illinois Natural History Survey.

Many Illinois communities have included local language in their local tree care ordinances that echoes the language in the Insect, Pest and Plant Disease Act. Municipal officials are also given regulatory authority to deal with exotic invasive species, in part, through the following statute:

> **65 ILCS 5/11-60-2 Definition and abatement of nuisances** (65 ILCS 5/11-60-2) (from Ch. 24, par. 11-60-2) Sec. 11-60-2. *See Appendix D.* The corporate authorities of each municipality may define, prevent, and abate nuisances. (Source: Laws 1961, p. 576.)

65 ILCS 5/11-80-2 Cities and Villages - use of streets (65 ILCS 5/11-80-2) (from Ch. 24, par. 11-80-2) Sec. 11-80-2. The corporate authorities of each municipality may regulate the use of the streets and other municipal property. (Source: Laws 1961, p. 576.)

These authorities and the use of the language in the Insect, Pest and Plant Disease Act has helped Illinois communities manage their urban and community forests in the past for Dutch Elm Disease (DED) infestations. Depending upon how broadly their mandatory tree removal language was written, the local tree care ordinance may also assist communities in the removal process of Emerald Ash Borer infested trees within their community

Initially, given a major threat such as Emerald Ash Borer, the Illinois Department of Agriculture and APHIS will dictate the terms and conditions of control for the infestation. Eventually, as the threat lessens or is removed it becomes the municipality's responsibility to monitor the situation. At that point it is greatly beneficial for a community to have this language in their local tree care ordinance. *See Appendix E* for examples of tree nuisance and tree removal language in local Illinois municipal ordinances showing varying levels of government control based on how the ordinance was written.

In mid-June 2006, upon verification by the USDA APHIS, Emerald Ash Borer was officially declared present in Illinois by the Illinois Department of Agriculture. In July, 2006, the Department of Agriculture secured language on the declaration of Emerald Ash Borer as an official nuisance in Illinois. Quarantine areas have been established in Northeastern Illinois. In December, APHIS declared a multiple state federal quarantine per their legal authorities. See Appendix F for a copy of the quarantine language.

With the past examples of DED and ALB and the current EAB as reminders of the potential cost and devastation that can occur, readiness planning is one tool that should be implemented by every Illinois community. For example, the Village of Wilmette estimates removal and replacement of all ash trees due to Emerald Ash Borer at $2.5 million

A Framework For Local Emerald Ash Borer Preparedness and Community Action

The framework for Local Emerald Ash Borer Readiness begins with the development of a local community forestry program. The Tree City USA program administered by the National Arbor Day Foundation and the Illinois Department of Natural Resources – Urban and Community Forestry Program provides a solid framework for developing a community forestry program. This program has four standards: 1) establishing local tree authority; 2) implementing a local tree ordinance that officially designates local tree authority and identifies tree care practices and municipal forestry practices and policies aimed at sustaining a healthy and safe community forest; 3) spending a minimum of $2 per capita; and 4) celebrating Arbor Day by planting a tree and having the Mayor sign an Arbor Day proclamation. See *Appendix G* for a Tree City USA Application and Instructions.

These Tree City USA communities and other communities with a functional municipal tree management program are better prepared to combat exotic invasive pests than other municipalities. These communities have local authorities in place that can be used or modified to address the invasive incidents. Through the Illinois Department of Natural Resources -Urban

and Community Forestry program, Illinois communities have been encouraged to conduct tree inventories and develop management plans. These tools are critical to efficient local municipal forestry tree management. For nearly a quarter of a century, IDNR has provided community assistance. In 1991, the USDA Forest Service began providing funds to states to assist in building the state's capacity to create state urban and community forestry programs. In part, this allowed the IDNR to fund the Urban and Community Forestry Assistance Grant Program. The statute that authorizes this grant program is: **30 ILCS 735/1 thru 7 Urban and Community Forestry Assistance Act (***An act to provide technical assistance, training and financial aid to municipalities for the development of plans and programs for the establishment and preservation of urban forestry programs. *See Appendix H.* This is the state's legal authority for municipal program development. Through this Illinois Department of Natural Resources program, the state can authorize funding to municipalities for the purposes of community tree planting, municipal insect/disease management plans, municipal/public tree inventories, municipal forestry management plans, municipal tree ordinances, public education and outreach concerning community forests, urban residual wood utilization, and other community forestry topics.

Pre-EAB Infestation
Recommended Municipal Actions

Municipalities can take several actions to prepare themselves for the Emerald Ash Borer. While this publication focuses on the development of a Local Municipal Emerald Ash Borer Readiness Plan, below are the top 10 readiness action items for local municipalities.

1) DEVELOP A LOCAL COMMUNITY READINESS PLAN

Develop a Local Community Readiness Plan of Action addressing local readiness team assignments, protocol and actions to be taken, pro-active community forestry management strategies, and public relations for when EAB arrives. **IF EMERALD ASH BORER IS FOUND, the EAB Community Readiness Plan should be implemented immediately with the Incident Commander providing** oversight concerning action addressing local readiness team assignments, protocol and local actions to be taken, pro-active community forestry management strategies, and public relations for when EAB arrives. One of the first critical actions within the Readiness plan is to establish protocol and ensure that those individuals are properly credentialed and educated

2) SUBMIT COMPLIANCE AGREEMENTS TO ILLINOIS DEPT. OF AGRICULTURE

Any municipality in or near the quarantine should submit a Compliance Agreement to the Illinois Department of Agriculture. The required compliance form is on the following page. If you have any questions, please go to the Illinois Department of Agriculture website at: **http://www.agr.state.il.us/eab/data/200701112388.pdf?PHPSESSID=c39d72b0979aefe98d1b6db2faa168c6**

If you currently have a contract with a tree service, that company or individual should also be required to sign a Compliance Agreement with the Illinois Department of Agriculture. For the protection of your citizens, tree care companies or individuals providing tree care service working within your municipality should also be required to be bonded (or insured) It is recommended that a certified arborist be hired.

Add IDA COMPLIANCE FORM

3) BE AWARE OF THE MOVEMENT OF ASH FIREWOOD IN YOUR AREA

Research has shown that an Emerald Ash Borer can fly six miles in a wind tunnel to get to a food source. Practical observation dictates that they will typically fly only about ½-2 miles annually. Human interaction, such as transporting infested firewood, results in spreading Emerald Ash Borer much farther then the biological norm.

State and federal quarantines restrict the movement of firewood within state quarantines and across state lines through federal quarantines. Additionally, municipalities could address this issue via their own ordinances pursuant to **5/11-60-2 Definition and abatement of nuisances** (65 ILCS 5/11-60-2) (from Ch. 24, par. 11-60-2) Sec. 11-60-2. The corporate authorities of each municipality may define, prevent, and abate nuisances. (Source: Laws 1961, p. 576.) See Appendix I for a listing of the Statutory Authorities focusing on insect and disease management and municipal forestry management. Within these authorities a local unit of government can search for local firewood policies and review them for adequacy or create local policies if needed. Another possible action is to establish a permitting policy for firewood vendors. A more user friendly approach is to inventory known firewood vendors and conduct an educational campaign. Let them know about the state and federal quarantine restrictions that do not allow movement of hardwood firewood. Teach them how to identify ash wood by the diamond shaped grooves or wood characteristics. Some communities already require that local tree care companies to go to their municipal center/city hall and secure a permit for tree trimming in their community. In light of EAB, municipalities may want to consider using this concept and the above authorities to develop a local permit process for firewood vendors.

4) ESTABLISH A LOCAL MUNICIPAL FORESTRY PROGRAM

Becoming involved in the Tree City USA program will provide an avenue for technical/financial assistance and information. Tree City USA participants are part of an electronic e-mail messaging system. Breaking news is provided to communities through the Tree City USA Newsbits. Tree City USA communities attend the annual conference and awards ceremony where they are given annual updates on issues important to the management of public municipal forests. Funds are available for tree inventories and reforestation. For more information contact: Reinee Hildebrandt, Ph.D., Urban Conservation Program Admin., Illinois Department of Natural Resources, One Natural Resources Way, Springfield, IL 62702-1271, Phone: 217-785-8771 reinee.hildebrandt@illinois.gov

In addition to previously mentioned statutes, Illinois municipalities can levy taxes for the purposes of reforestation. **65 ILCS 5/11-72-1 and 65 ILCS 5/11-73-1-2 and 65 ILCS 5/11-73.1-4Trees and Forestry** *Discusses the planting of trees by municipalities, and their rights to raise monies for that purpose. This law provides the local municipality the authority to create tax for the purpose of tree planting programs within the municipality. See *Appendix I* for a listing of the Statutory Authorities focusing on local municipal forest management.

5) CONDUCT A TREE INVENTORY AND
DEVELOP A MUNICIPAL FORESTRY MANAGEMENT PLAN

Municipalities are encouraged to conduct public tree inventories within their municipal boundaries. Most tree inventories are computer generated using a spreadsheet format. Analysis conducted include: percent of trees by species; percent of trees by size; percent of trees by condition; and total trees within the municipality. Trees can be listed by species such as *Fraxinus* or ash. With some systems trees can be listed by species by street or management area within the municipality.

Tree inventories can be conducted in-house, by volunteers, or by forestry consultants. They can be funded in-house, through grant funding or IDNR technical assistance programs. The USDA Forest Service has posted free software on the internet for municipalities around the nation to use. This program is called i-Tree. Personnel can use handheld computers to collect data in the field and then download it into a desk top computer for record keeping and report generating.

The Illinois Department of Natural Resources – Urban and Community Forestry program administers the Urban and Community Forestry Grant Program. This program provides funding on a 50/50 cost share reimbursement basis for municipal tree inventory/management plans. Tree City USA communities with a population of under 5,000 are also eligible for the TREES COUNT! Program. This program also provides a tree inventory/management plan service at no cost except a 50/50 in-kind match. See *Appendix J* for Urban and Community Forestry Grant information.

6) CONDUCT AN EAB – ASH TREE INSPECTIONS or
INITIAL DETAILED INSPECTION OF ALL MUNICIPAL ASH TREES

Once a municipality has **a tree inventory**/ urban and community forestry management plan, **a list of the ash trees** on public lands **should be** generated. With this list an EAB – Ash Tree Inspection can be conducted to note potential indicators of Emerald Ash Borer activity. The Emerald Ash Borer Inspection Form A and Form B are provided on the next two pages. This two page form is the official form to use for EAB inspections in Illinois. Once completed it should be filed locally unless an adult EAB was found or in lieu of an adult borer the inspector found both a D- shaped emergence hole and S-serpentine galleries. Then the form should be sent to Mark Cinnamon at the Illinois Department of Agriculture along with a request for local site inspection.

Form A is for Initial Site Review and Form B is for Potential Site Inspection. Form A provides a place to indicate all visual clues including that could help the Illinois Department of Agriculture know that other agents might be at work in the decline of the tree. Form B is used only if the three critical criterion indicators are found: green linear metallic insect, 1/8 inch D-shaped emergence hole and S-Shaped galleries.

In the forms below, when filing out Community Identifier:_____ use your community's full name. When filing out Sequential Record Number: _____ start with number one and assign numbers consecutively.

EMERALD ASH BORER INSPECTION

FORM A- Initial Site Review

Inspector Name: _____ Date of Inspection: _____
Community Identifier: _____ Sequential Record Number: _____

State: ___IL___ County Reference: _____
Legal Description, GPS coordinates or Street Address of Potential EAB Site:

Inspection Requested By Whom: Date of Request: _____
Name:
Address:
City/State/Zip:
Phone:
Cell Phone:

Overall condition of the Ash Tree *(Circle appropriate response to right)*	EXCELLENT or GOOD	FAIR	POOR

Check all the items below that are observed on site:

EAB/ASH TREE SYMPTOMS	ENVIRONMENTAL/MECHNICAL
_____ Dying branches in top of tree	_____ Evidence of Excessive Pruning
_____ Dying branches through out tree	_____ Evidence of Mechanical Damage _____ Evidence of Construction Damage
_____ Branch sprouts	_____ Excessive Drainage/Water saturation _____ Potential for salt damage (next to road)
_____ Basal Sprouting/epicormic shoots	_____ Drought current or previous year _____ Potential for chemical drift (near field)
_____ Bark fissures	_____ Limited growing space
_____ Wood pecker damage/holes	_____ Evidence of other insect of disease
_____ 1/8” D-shaped emergence holes (Remove 6”x4” bark section–Go to FORM B)	List sightings of other Insect or Disease problems below:
_____ Adult Emerald Ash Borer (Go to FORM B)	
_____ bark falling off and S-Shaped galleries are disclosed (Go to FORM B)	**POSSIBLE DIAGNOSIS**:

(Front of Form P. 1 of 2)

EMERALD ASH BORER INSPECTION
FORM B – POTENTIAL SITE

Inspector's Name: _____ Municipality/Location _____

(If not including Form A add:)
Community Identifier:_____ Date of Inspection: _____
Sequential Record Number: _____

Legal Description, GPS coordinates or Street Address, Community and County of Potential EAB Site:

It is advisable to take a Photograph of all details associated with the tree and the adult borer, if possible.

IF A POTENTIAL
ADULT EMERALD ASH BORER is found:

All actions must follow the regulatory protocol established jointly by the Illinois Department of Agriculture (IDOA) and the Animal and Plant Health Inspection Service (APHIS). Additionally, follow any additional precautions above and beyond the IDOA and APHIS requirements that are indicated in the Community Readiness Plan. Per the Emerald Ash Borer Readiness Plan, contact the Community Forestry Administrator – Deputy Commander for further instructions.

CONDUCT A 6"x4" BARK SECTION REMOVAL TO LOOK FOR S-SHAPED GALLERIES

Check observation:
_____ 6"x4" Bark Section Removed
Observation:
_____ S- Shaped galleries
_____ Linear Galleries
_____ No galleries
_____ Other (Please describe: _____)

Other comments:
___ Please contact _____ / at _____ concerning a potential EAB find

If an adult beetle is found or a combination of D-shaped holes and S-Shaped galleries are found, fax the Form A and B to IDA and request a site inspection. Fax Number: 815-787-5476. Contact: Mark Cinnamon, IDOA, 2280 Bethany Road, Suite B, DeKalb, IL 60115; Phone: 815-787-5476.
If the tree exhibits multiple symptoms, but no clear evidence of EAB, please maintain in an EAB file.

(Back of Form P. 2 of 2)

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7) CONDUCT DEBARKING SURVEYS OF ASH TREES

The Illinois Department of Agriculture is conducting Ash Tree De-barking training sessions. Watch the Department of Agriculture website http://www.agr.state.il.us/eab/ for further information. Municipal staff should be trained in the barking stripping process. One detection strategy is to implement a Bark stripping policy where municipal staff conduct a bark peeling exercise for any ash tree removed for any reason. Municipal staff should be training in identification of EAB larva, pupa or emerging adults. All potential findings should be first reported to the appropriate local official who will notify the Illinois Department of Agriculture.

When the Emerald Ash Borer infestation and/or quarantine gets close to your community, IDA may need to remove trees and conduct debarking surveys on selected ash trees. Please be prepared to provide a complete listing of the ash trees within your municipal forest by street address. Also provide the inspections forms drawing to IDA officials attention highly suspect ash trees and potential EAB infestation sites (such as near firewood dealers or known Michigan vacationers with campers. Beyond this any technical assistance you can provide IDA would be appreciated.

8) DEVELOP AN ASH TREE POPULATION REDUCTION PLAN

Use your tree inventory and EAB – Ash Tree Inspection information to develop an Ash tree Population reduction plan. Many communities have an over-abundance of ash. The first reduction strategy is to stop planting ash trees. Remove *Fraxinus* from your approved list of trees within your ordinances or program guidelines. Do not let developers of land to be annexed into your community, plant ash trees in new developments. An ash tree population reduction plan should consider citizen attitudes toward tree removal. If there would be no major citizen outcry consider reducing your ash tree population before the Emerald Ash Borer reaches your municipality and you are required to remove all known infested trees.

Consider the following priority criteria for removal:

high risk ash trees

ash trees in poor condition exhibiting 2 or more know EAB signs

high maintenance older ash trees

trees with poor placement

trees with poor structure that will grow into a higher maintenance tree

any topped or improperly pruned ash trees

(Basically, in municipal forests ash trees 35 to 40 years old begin to have major limb breakage during wind storms. Determine how many trees to remove per year by analyzing how much money is spent each year on tree removals and how many ash trees you have. See Appendix K for a copy of the IL Dept.of Agriculture's Emerald Ash Borer Population Reduction Strategy information

9) LOOK FOR WOOD HANDLING SITES AND ASH WOOD MARKETING OPPPORTUNITIES

Arrangements should be made for **tree removal and wood disposal.** The current policy is two-fold: **1) DURING THE NON FLIGHT SEASON, once the bark is removed EAB materials can be taken to any area for processing. 2) DURING THE FLIGHT SEASON (MAY TO SEPT.) ALL MATERIALS** must be taken to an **IDA Certified Processing Site/Marshalling Yard. Identify potential Certified Processing Sites.** Look for areas the are 2-8 acres in size and away from high risk or inappropriate areas such as areas with heavy ash tree populations, near school crossing, near rare or endangered plant species and habitats, or in an areas where water runoff into streams could cause excessive water pollution. Old industrial sites, designated brownsfield areas, old boot camp sites, or abandon commercial areas are all potentially viable sites. See Appendix L page 38 to determine if there are adequate areas in your vicinity to establish a **certified processing site/marshalling yard**.

To explore the ash wood markets in your vicinity, obtain a current list of known contact primary and secondary wood using industries to see what potential markets are available for EAB infested wood, contact Jay Hayek, University of Illinois Extension or the Illinois Wood Industry Association for an updated list. Consider energy alternatives using residual wood such as the heating/cooling system used by the Arbor Day Foundation's Lied Conference Center or local wood/coal energy generation plants. Illinois Forest Products Association. 217-782-2172 for more details.

10) BEGIN TO ESTABLISH COMMUNICATIONS STRATEGIES

Don't forget communications. Having a **public relations campaign** is critical. Assemble a list of reporters and media outlets to contact once an official confirmation has been made by the Illinois Department of Agriculture in cooperation with AHPIS. Prepare a press release with information such as: who found the site within your municipality (including the date, location), what was the process that you went through to verify the finding, and what should citizens do now that it is found in your municipality (check neighborhood trees for symptoms, don't move firewood, who to contact, don't remove trees, who will handle residual wood, and current recommendations about chemical treatment the trees). **Keep** local authorities **updated on the status of EAB** as it moves or is found throughout Illinois. See *Appendix L pages 21-25*

NOTE: It is extremely important that a potential find is not discussed with the media until confirmation form APHIS has been made.

Emerald Ash Borer Community Readiness Plan

Readiness planning process includes: 1) establishing protocol for action should there be an incident in your municipality. 2) Identifying appropriate procedures given the local ordinances, state and federal laws.

The official announcement of the Emerald Ash Borer was made June 13th at the Kane County Governmental Center, Geneva, IL. The first official site has been verified by legal protocol in cooperation with APHIS. A copy of the official news release can be seen on the Illinois Department Agriculture website: http://www.agr.state.il.us/ or in the Illinois Department of Agriculture's Urban and Community Forestry Website (Emerald Ash Borer Exclusive or Prairie Tree Companion News letter). http://www.dnr.state.il.us/conservation/forestry/urban/index.htm

Local Preparedness Plan

____ **1) Prepare a title page that clearly identifies the purpose of the document as a local municipal Emerald Ash Borer readiness plan**

____**2) Develop the Introductory Section of Your Plan** (Appendix L - Pages 1-4)

___ a) Community name, location and population (Appendix L - Pages 1-4)
___ b) Local community forestry management history

____ **3) Identify a team for creating a local Emerald Ash Borer Readiness Plan of Action**

____ **4) Develop a description of your local community forestry program**
____ Assessment of Communities Tree Population emphasizing the Ash population

____ **5) Update Municipal Policies relating to the local Community Forest and Insect Management** (Appendix L - Pages 5-8)

___a) Make sure your local community has a Tree care ordinance that addresses nuisance trees on private lands as well as public lands. This will provide community officials with the legal authorities to enforce the removal of trees killed by EAB within the community boundaries. The State of Illinois has provided this authority to enforce nuisance issues 65 ILCS 5/11-60-2 - Definitions and Abatement of Nuisances. Each municipality has the authority to include this language in their local tree care ordinances. Additionally, 50 ILCS 90/1 through 90/30 - Insect and Pest and Plant Disease Act addresses the states authorities through the Illinois Department of Agriculture in dealing with invasive pests and diseases. Some communities in Illinois have included local language that echoes concerns about movement of infected plant materials in their local ordinances. However, the authority for statewide enforcement is held by the State of Illinois Department of Agriculture. As of June 13, 2006, the Department of Agriculture has begun the process for securing language on the declaration of Emerald Ash Borer as an official nuisance in Illinois.

___b) Review your local ordinance to see what authorities your community has concerning the movement of firewood into your community and the inspection of said wood. It is advisable to create a firewood vendor permit to help regulate movement of firewood in and around your community.

____ **6) Identify Emerald Ash Borer Incident Objectives** (See Appendix L - Page 8)

____ **7) Establish a decision-making hierarchy pertaining to trees, nuisance provisions of the ordinance, and law enforcement pertaining to trees** (if one does not already exist). Consider using the Incident Command System and designate a point person based on that system. (See Appendix L - Pages 9-12 as an example)

___ a) Establish local protocol for reporting potential local EAB findings and determine a point person or department for contacting the Illinois Department of Agriculture at 815-787-5476 (DeKalb office) or USADA APHIS @ 1-866-EAB-4512.

___ b) Do not encourage citizens to directly contact Illinois Department of Agriculture or APHIS (due to workload issues).

___ **8) <u>Establish a Public Education and Awareness Campaign</u>** (Appendix L - Pages 21-31)

___a) Identify and educate the core internal team first. Provide staff training to Forestry Department, Street Department, Public Works Department and other local tree authorities. . <u>NOTE: It is extremely important that you do not discuss a potential find with the media until confirmation from APHIS has been made.</u>

(Appendix L - Pages 21-22)

___b) Make sure the Mayor's office and other appropriate elected officials are aware of the potential losses of trees in your community. Determine the potential cost to your community in tree losses and tree replacement costs. (Appendix L - Pages 21-22)

___c) Educate local advisory and tree advocacy groups of the Emerald Ash Borer biology and provide instructions for local monitoring programs. Provide a local protocol for reporting potential incidents in your community. Make sure that all inquiries go through one main local professional or tree authority. That one authority should be responsible for following standard protocol for reporting potential EAB sites. Emphasize that only the community's designee should be responsible for calling in the state officials in case a potential site is found. Please realize that the state system is not staffed heavily enough to accommodate the amount of calls that could potentially be generated from an unorganized approach to this potential epidemic. <u>The locally authorized person</u> should contact the Department of Agriculture at the Ag Hotline or Mark Cinnamon's office to verify a potential EAB finding. (Appendix L - Pages 23)

___d) Develop a local public outreach program to inform citizens of the Emerald Ash Borer that clearly identifies local protocol for calling in state and federal officials. Be careful not to create a public panic in this public education outreach. Only conduct local public outreach if you have an educated team in place to assist with initial response and identification. (Appendix L - Pages 24)

___e) Implement a public education campaign of educating real estate agents through out your community and providing them with a flyer to inform new residents not to bring their firewood into your community. Sharing a series of public relations articles with the local media during prime "out of state" vacation dates such as Memorial Weekend, Labor Day... is also advisably. For example" "IT'S GOOD TO LEAVE YOUR WOOD! Don't bring firewood back from your vacation." (Appendix L - Pages 24)

___f) Consider providing the local library and other public information locations in your community with EAB information and local procedures. Put up display boards that clearly identify local officials or urban forestry/Tree City USA officials who should be contacted initially. (Appendix L - Pages 24)

___g. Keep informed by visiting the following internet sites:
(plus the sources in Appendix L - Pages 26)
http://na.fs.fed.us/fhp/eab/ www.emeraldashborer.info
http://www.entm.purdue.edu/EAB/images/maps/fullSize/nationalMap.jpg

___ h. Stay networked by attending meetings such as the Northeastern Illinois Municipal Foresters Meetings and Illinois Arborist Association training sessions. (Appendix L - Pages 27)

___ i. In case EAB reaches your community, have a list of reporters and media outlets you will contact for an official announcement. Prepare a press release with information such as: who find the site within your community; when was it found; what was the process that you went through to verify the finding; and what should citizens to now that it is found in your community (check their trees, don't move firewood, who is the point of contact, don't remove trees, who will handle residual wood, should they treat the trees).
____ Establish Readiness Team and city official training on EAB prior to any public relations outreach so they will be able to respond to potential questions.

___ j) Include Public officials and decision makers in the public awareness/training events when appropriate. (Appendix L - Pages 28-89)

___ k) Develop a strategy for public awareness when or if EAB arrives in your community that will not evoke public panic.
(Appendix L - Pages 30-31)

i) Identify local media and public information outlets and determine the appropriate message via outlet.

ii) Include in any public information the local protocol for requesting an inspection of a site.

iii) It is advisable to provide a phone message on the point person's/agencies phone after the EAB reaches your community that allows citizens to hear critical information on EAB larva/adult stage or other commonly asked questions that might mitigate the need to talk directly to a person.

____ l) Develop a communications and public relations plan of actions for the time when/if EAB reaches your community (Appendix L - Pages 21-31)

___ **9) Determine Fiscal Impacts of EAB on your current budget structure**
(Appendix L - Pages 32-34)

___ a) Determine the costs to your community considering your percent of ash trees in your community's canopy. Provide this information to the Mayor and other appropriate elected officials so that they are aware of the potential losses of trees in your community. Suggestions include: a) the potential cost to your community in tree losses, b) costs to replacement trees, c) losses to individuals due to tree losses as they impact heating and cooling bills; d) losses of major visual impacts on the communities aesthetics. Ex. Entry ways into the community lined with ash trees or ash trees in prominent visual locations. e) compare your current budget to the budget needs for an EAB outbreak; and f) raise questions of using emergency funds or other sources of funding to mitigate the effects of the Emerald Ash Borer and the loss of forest canopy in your community. (Appendix L-Page 32)

___ b) Watch for state and federal funding that could assist with Emerald Ash Borer or Urban and Community Forestry Management. (Appendix L- Page 33)

___ c) Look for sources of Private funds for tree planting campaigns. (Appendix L - Page 34)

____ **10) Establish a Natural Resource Management Section/Statement**
(Appendix L - Pages 35-44)

___a) Conduct a street tree inventory to identify target areas of the community with high ash populations. (Appendix L - Page 35)

___b) From your tree inventory, list all *Fraxinus* (ash) species by street address and use this list for monitoring from April to July. Remember that EAB is considered the "HIDDEN THREAT". This means that you may have to rely not just on a visual inspection for die-back, yellows and sprouting but for suspect trees and areas you should consider checking for loose bark or even checking trees that are potential removal trees for galleries, egg masses and larvae depending on season. (Appendix L - Page 35)

___c) Consider evaluating the ash tree population and removing trees in poor condition and replacing them with a different species. This will help reduce the overall financial impact to your local community forestry budget should EAB come to your community. (Appendix L - Page 35)

___d) Consider diversifying the tree population in your community forest. Plant no more than 10% of one species (ex. red oak) and no more than 20% of one genus (Ex. oaks). In the mid 1900's Dutch Elm Disease caught some communities with 80% American Elm. Based on that experience, communities implemented local

community forestry programs and have diversified their community forests species composition. In Illinois, the average percent of ash tree in our community forests is about 20%. The impact of the Emerald Ash Borer will be a great loss and cost to our communities, but it will be a far less impact had local communities not adopted community forestry management programs to maintain a healthy urban forest and a safe environment for citizens. (Appendix L - Page 35)

___e) Create a list of Municipal Staff that will be designated or authorized for tree removal. Make sure your municipality has applied for the State of Illinois Department of Agriculture Compliance Agreement. Provide a copy of this agreement for each truck that is to have authority to move ash debris. Make sure these individuals are properly trained in EAB and ash tree identification. Make sure they are informed on the procedures that must be followed during an EAB incident. (Appendix L - Page 36)

___ f) A list of potential contractors for tree removal and debris handling should be created. These individuals must have an Illinois Department of Agriculture Compliance Agreement and must comply with your community's permit and bonding requirements per your local ordinances. (Appendix L - Page 37)

___ g) Determine if your community needs to designate, hire or subcontract with truck drivers who's sole or major responsibility will be driving debris to the designated debris handling centers. Make sure all drivers, have the appropriate driving license and skills needed. (Appendix L - Page 38)

____ h) Determine where potential debris handling sites would be. Try to identify areas that are 2-8 acres in size that would not disturb the current flora and fauna; not be disruptive to traffic or cause a safety hazard, or that are not so far away as to risk transporting EAB to another community. Try to find old brownsfield areas, abandon industrial areas or lots. (Appendix L - Page 39)

___j) Establish residual wood burning and recycling centers. NOTE: The outer slabs need to be cut off and burned. Since the infestation occurs only in the outer phloem, cambial and surface of the xylem of the wood, the inner wood can be used for structural lumber. Michigan officials were able to utilize the non-infested parts of the wood. Try to determine if there is a local sawmill or person with a portable sawmill in your area. (Appendix L - Page 40)

___ k) Include Tree Removal/Replacement program specifications including tree planting and care standards plus program monitoring procedures to be used during this process. (Appendix L - Page -41)

____ l) Select trees from approved Tree Replacement lists such as the Governor's Science and Management Task Force; IDNR/Morton Arboretum Tree Selection Guides or the Illinois Tree Selection Guide by the Council on Forestry Development or (Appendix L - Page 42-44)

See <u>Appendix</u> L for examples of a fill in the blank Municipal Emerald Ash Borer Readiness Plan forms.

Illinois Emerald Ash Borer Readiness Plan

Prepared by: Emerald Ash Borer Readiness Team (see attached)
Edited by: Edith Makra, Community Trees Advocate, The Morton Arboretum

The Emerald ash borer (EAB) is a significant threat to the urban and rural forests of Illinois. It was first identified in the spring of 2002 in Ontario and the Detroit area. It is estimated that it has already killed about 16 million ash trees in Michigan. In the two years since it was identified, infestations have broken out in several locations in Ohio, in Maryland, and most recently in Indiana. Thirteen counties in Michigan are quarantined and significant containment and clean-up operations are underway. The outbreaks in Indiana, Maryland and Ohio have required swift, aggressive and organized responses by regulatory and other government agencies and the cooperation of stakeholder groups.

The emerald ash borer, *Agrilus planipennis*, is a slender, elongated (3/4-inch), bright green beetle in the same genus as the bronze birch borer. It likely arrived in Michigan from China at least five years ago, probably traveling with ship cargo. Although chemical and biological controls are being researched and show promise, more aggressive containment and eradication efforts are necessary for new outbreaks outside the core zones and quarantined areas of Michigan.

The borer kills trees relatively quickly and affects white, green, black, pumpkin, and several horticultural varieties of ash whether healthy or stressed. The beetle deposits eggs on the surface or cracks of ash tree bark, which hatch to release larvae that feed on the tree's phloem and outer sapwood. Within several weeks, larval feeding creates S-shaped galleries in the tree's inner bark that wind back and forth, becoming progressively wider and girdling the trunk and branches as larvae grow. Adult beetles emerge headfirst, creating very small (3-4 mm) D-shaped exit holes that leave minimal evidence of infestation until the canopy begins to die back. Then the tree quickly declines in the second growing season and is usually dead by the third. The symptoms of emerald ash borer infestation resemble ash decline or damage from the native ash-lilac borer and the two-lined chestnut borer, making detection difficult.

The Morton Arboretum took the lead in organizing to minimize the risk of an EAB introduction into Illinois, to find it, and contain it quickly if it arrives. First, we conducted a survey of area municipalities to determine the scope of the ash population at risk. From a sample of municipal street tree inventories, we determined that about 19.2 % of public trees in the Chicago area are ash, usually white (*Fraxinus americana*) or green *(F. pennsylvanica.)* The US Forest Service did a sampling of public and private land in Cook and DuPage County in 1993 and determined that 19.4% of the overall urban and community forest is ash, essentially confirming the validity of the street tree sampling. Statewide, forests are 6% ash according to US Forest Service surveys.

The planning began in July of 2003 by assembling nearly 40 representatives from municipal, county, state, and federal governments, green industry professional associations, universities, and Chicago Wilderness (a coalition of public and private land management and educating organizations) to develop an Emerald ash borer 'readiness plan'. The group worked together to identify resources available from participating organizations and likewise, identify gaps. Existing EAB efforts and programs were compiled, including current regional efforts and work from other states that serve as useful models.

All members of the planning team brought useful and important knowledge and experience to the planning effort. The team itself creates a critical network for information sharing and dissemination. Educational outreach to the members and constituents represented on the planning team has already been effective in raising awareness and fostering cooperation and collaboration. The team's work has resulted in strengthening the ability of the state regulatory agency, putting more staff expertise in the field inspecting nursery stock and responding to possible sightings of EAB. The collaboration has also spawned and funded a survey of EAB in the Chicago area being done in the summer of 2004, and another statewide survey is in the works.

There is much work to be done to protect Illinois' ash trees from this aggressive pest. The following Plan lays out a comprehensive strategy to assess resources, minimize risk, identify an infestation promptly, and collaborate to contain an infestation. The network of the Readiness Planning Team already facilitates the administrative and technical readiness called for in the Plan. Public and professional education and awareness are critical to the overall success of the plan.

The Readiness Planning Team continues to collaborate and cooperate to implement the plan. Current priorities are public awareness to identify likely infestations and minimize the possible spread of EAB through firewood movement, and the regulation and inspection of the firewood industry in Illinois.

For information and inquiries, please contact Edith Makra, The Morton Arboretum, at 630-719-2425 or emakra@mortonarb.org.

Illinois Emerald Ash Borer Readiness Plan
June 12, 2006

1. GENERAL READINESS- to reduce risk, minimize impact, and respond more effectively to a possible infestation of the Emerald ash borer (EAB), *Agrilus planipennis*, and to work collaboratively towards overall health and sustainability of the forests, both urban and rural, throughout Illinois and northeast Indiana
(√ *indicates task completed, →indicates ongoing effort already begun)*

A. √ Establish a network of agencies and organizations that may be affected by the EAB into the **Emerald Ash Borer Readiness Team** (see attached list.) The team's goal is to collaborate in drafting a readiness plan; and to advise, advocate and lead in the implementation of the plan.

Subdivide into:

1. √Statutory Administrative Team – agencies that have, by law, been assigned the responsibility of managing an exotic infestation and have been granted the legal authority to act by the federal, state, or local government

- Illinois Department of Agriculture (IDA)
- USDA Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ)
- Affected local government(s) at site of infestation

2. √ Technical and Administrative Team – agencies and organizations that are vital to the design and rapid implementation of the readiness plan; and serve important roles in research related to Emerald ash borer; administration and coordination of policies, programs, and staff; and the education of stakeholders

- Illinois Department of Agriculture (IDA), Environmental Programs
- Illinois Department of Natural Resources (IDNR)
- USDA Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ)
- USDA Forest Service Urban and Community Forestry Program
- USDA Forest Service Forest Health Program
- USDA Forest Service, North Central Research Station
- University of Illinois
- Illinois Arborist Association
- Illinois Nurseryman's Association

3. √ <u>Education and Communication Team</u> – agencies that will collaborate to communicate accurate information, quickly and broadly in a manner that supports the prevention, identification and control of a possible infestation.

- APHIS PPQ
- USDA Forest Service, Public Affairs
- IDA, Environmental Programs
- Illinois Landscape Contractor's Association
- The Morton Arboretum
- Regional councils of governments (i.e., DuPage Mayor's and Manager's Association, Northwest Municipal Conference)
- Chicago Wilderness
- Illinois Department of Natural Resources (DNR)
- University of Illinois
- Municipalities
- Forest Preserve Districts
- Other Trade Groups and stakeholders

B. Administrative Readiness – to assure that current, relevant, and achievable policies are in place that allow the actions described in this plan to occur quickly and unencumbered:

1. √ Draft EAB Readiness Plan
   a) √ Distribute plan to readiness team
   b) Readiness Team members to distribute condensed plan to constituencies
   c) → Foster cooperation among agencies for implementation

2. Identify resources and needs
   a) √Evaluate staffing needs in regulatory agencies
   b) Monitor nursery field operations
   c) Determine firewood movement
   d) Identify sources of funding for readiness activities
   e) √ Assess human and technical resources

3. Take proactive steps to speed administrative processes
   a) √ analyze IDA procedures to identify streamlining opportunities
   b) √ analyze APHIS procedures to identify streamlining opportunities
   c) √ communicate EAB status to Illinois Emergency Management Agency (IEMA) liaison
   d) encourage communities to examine local administrative processes for streamlining opportunities

4. Educate the media and assure accuracy of information
    a) √Issue a press release on the final plan
    b) Coordinate Public Information Officers from statutory team
    c) √ Identify key sources of current information
    d) √ create a Core Communications Team for expedited communications clearance including representatives from:
        IDA
        Morton Arboretum
        Forest Service
5. Explore wood waste utilization opportunities to reclaim ash material to its highest possible use should a volume material suddenly become available

C. Technical Readiness – to assure that policy decisions, actions, and education initiatives are guided by the best and most current science

1. √ Review and distribute federal scientific guidelines to advise actions. (i.e., EAB biology and controls)
2. Reference national plan, when one is available
3. Operate under New Pest Response Guidelines or other relevant USDA technical guidelines
4. Advocate for continued research for greater understanding of EAB and management options
5. Participate in annual Forest Pest meeting in Annapolis, MD
6. Transfer technology as it becomes available

II. REDUCE RISK OF INFESTATION – to assure that all means of EAB introduction are known and blocked, whenever possible

A. Assess Risk_- to determine the size and scope of the ash resource and the severity of new and existing EAB infestations

1. →Analyze possible sources of EAB importation (i.e., ash logs, firewood and nursery stock from Michigan) and other affected areas
2. √ Assess the scope of the resource at risk (number of ash trees)
3. Analyze density of ash populations to determine high risk areas
4. →Track spread of EAB and distribute to Readiness Team

B. Reduce Risk

1. →Raise public awareness about risk from firewood importation
    b) install educational posters at State, and county campgrounds
    c) promote ”EAB-free” firewood from reputable firewood dealers

2. →Convene a Firewood Committee to analyze the firewood market and find ways to reduce the risk of importation with representatives from:
   IDNR
   APHIS
   IDA
   Lake County Forest Preserve District
3. Survey or inspect firewood dealers
4. Recruit campground and firewood dealers associations to participate
5. →Contact municipal officials to request trace-back of records for firewood transport
6. Educate industries about risk of ash importation
   a) reach out to wood products manufacturers through IDNR's licensed timber buyers and the Illinois Wood Products Association
   b) →educate contractors and municipalities about the importance of knowing the source of ash trees and assure they are IDA inspected
   c) educate garden centers, firewood dealers about risk
   d) reach out to trucking associations to help track movement of ash

7. √Assure full and thorough analysis of ash nursery stock movement and effective inspection of current ash stock
   a) → advocate for strong state support of nursery inspection program
   b) √ track nursery stock importation in recent past
   a. √review trace-back program for nursery shipping records from Michigan with the assistance of ANLA (American Nursery and Landscape Association)

8. Assure planting selections contribute to a diverse and sustainable urban forest
   a) → educate municipalities and large property managers about diversity in planting
   b) →encourage tree inventories to analyze diversity and guide planting decisions

9. Seek legislative support to reduce risk
   a. assure Michigan's control efforts are well supported
   b. advocate for readiness funding
   c. advise federal legislators of the hardship of state required match of federal funds

III. IDENTIFY INFESTATION PROMPTLY – to minimize the spread and improve odds of containing an infestation

A. Survey urban ash populations - to quickly find or rule out the presence of EAB using USDA Forest Service Forest Health survey protocols

1. Continue the University of Illinois, The Morton Arboretum, and APHIS collaborative detection surveys
2. Enable municipal and commercial green industry professionals to participate in monitoring and reporting in a systematic way
3. Communicate survey results to stakeholders and the media

4. √ Convene Monitoring and Surveying Committee to survey and monitor ash populations to determine the presence of the Emerald ash borer including representatives from:
   APHIS
   The Morton Arboretum
   US Forest Service
   University of Illinois

B. →Educate the public and professionals to provide stakeholders with current and accurate information in a targeted manner to aid in rapid identification of symptoms of an infestation

1. → Offer training and outreach based on current information to landscapers, arborists, nurserymen and other green industry workers to assess ash health and accurately identify EAB
2. Educate general public about ash health and EAB
   a) √ Convene a Public Education Committee
      IDNR
      The Morton Arboretum
      DuPage County Forest Preserve District
      University of Illinois
   b) √develop simple educational materials for the general public
   c) → pursue opportunities for speaking, educating, and exhibiting educational displays including EAB identification material broadly
   d) distribute and promote newly developed *Project Learning Tree* activities on EAB and Asian Longhorned Beetle (ALB)
   e) Broadly distribute U of I public education materials
3. Recruit and enable volunteer scouting
   a) Promote awareness through the media with regular press releases and public appeals for help in scouting
   b) Prepare kits to support volunteer scouting by both individuals and groups

C. Coordinate state and national information to address professional and public inquiries from Illinois and foster cooperation and communication

1. Have Readiness Team members link to USFS, APHIS and Michigan State websites
2. Coordinate with http://www.emeraldashborer.info/to add Illinois information
3. Support full staffing of regulatory agencies so that vital information about Illinois forest health is readily available

D. →Guide public inquiries and possible sightings through the following process for the most effective use of resources and quickest response:

1. Contact University of Illinois Extension, The Morton Arboretum Plant Clinic, municipal forestry programs and other professional resources, or the expertise of a certified arborist to pre-screen inquiries, i.e., assure suspect tree is an ash, rule out similar but common insects, etc.

2. If other pests are ruled out and EAB is still suspected, contact IDA's statewide Pesticide Hotline 800-641-3934 or in the Chicago area use 312-74BEETL (312-742-3385)
3. An IDA or APHIS official shall dismiss or confirm the identification of the Emerald ash borer

E. **Guide *professional* (arborist, entomologist, pathologist, plant health care specialist) inquiries and possible sightings** through the following process:

1. If a suspected Emerald Ash Borer is found, contact:
   Illinois Department of Agriculture (847) 294-4343
   or
   USDA-APHIS-PPQ (847) 299-6939
   Officers from these agencies will collaborate to inspect the suspected ash tree(s) and identify the specimen.

2. Collected specimen will be sent or delivered to:
   APHIS Identifier
   USDA-APHIS
   P.O. Box 61192
   Terminal 5
   O'Hare International Airport
   Chicago, Illinois 66192

3. If collected specimen is initially confirmed to be Emerald Ash Borer by an APHIS Identifier, the specimen will then be sent to the National Systematic Entomology Laboratory to make final identification:

   Systematic Entomology Laboratory
   ATTN: Communication and Taxonomic Services Unit
   Bldg. 005, Rm 137
   BARK - West
   10300 Baltimore Avenue
   Beltsville, MD 20705

4. All cooperators are notified that a suspect Emerald Ash Borer is in the system for identification. However, **at this point, all information is not for public dissemination.**
5. The result, either positive or negative for EAB, is received from the Systematic Entomology Laboratory and all cooperators are notified.

IV. IN THE EVENT OF AN INFESTATION CONTAIN AND MANAGE THE EAB POPULATION – the Statutory Administrative Team will be established with the affected local government(s) and will implement coordinated efforts to contain the infestation according to New Pest Response Guidelines established by USDA under the leadership of IDA and APHIS

A. APHIS and the Illinois Department of Agriculture will take the lead in planning and implementing actions.

1. Begin collaborative response with affected county and city government(s)
    a) schedule an emergency meeting with cooperators
    b) discuss and determine a preliminary plan of action
    c) release verified, accurate information to the press
2. Initiate and conduct a thorough delimiting survey to determine the outer boundary of the infestation.
3. **Illinois Department of Agriculture places into effect an Emerald Ash Borer State Interior Quarantine** regulating all potential host material (ash wood and ash wood products) within the quarantined area as determined by the delimiting survey. This would include the "declaration of all plants and part thereof infested with the Emerald Ash Borer as a nuisance in the State of Illinois" as well as the establishment of a formal quarantine of the infested area (s).
4. Reference APHIS State Plant Health Director's Emergency Plant Health Management Plan based on incident command.
5. Regulatory and control activities will be initiated as necessary.
    a) Administer provisional quarantine established by IDA consistent with the Insect Pest and Plant Disease Act (505 ILCS 90) and associated regulation 8 IAC 240
    b) Remove trees up to ½ mile from infestation or necessary distance as determined by current protocol based on research
    c) Municipalities may act under their own local authorities when local ordinances are applicable and consistent with IDA quarantine requirements

B. Communicate and coordinate actions, information and response

1. Provide accurate information and updates to the media through EAB Core Communications Team.
2. Provide accurate information to affected residents
    a) have an informational door-hanger ready for customizing and distributing to affected area immediately after infestation is found
    b) host local resident meetings or visit affected residents to share information as soon as possible after finding an infestation
3. Communicate with public and industry professionals to foster cooperation to maximize effective response
4. Communicate eradication success stories

C. Dispose of Wood debris

1. Establish processing facilities in the quarantine zones to efficiently handle ash debris and reclaim useable products as best as possible
    a) market reclaimed wood products

D. Develop and implement a reforestation program authorized under applicable federal, state and local authorities using available resources.

Illinois Emerald Ash Borer Readiness Team

City of Chicago
Chicago Wilderness
Chicago Park District
Cook County Forest Preserve
DuPage Mayors & Mgrs. Assoc.
DuPage County Forest Preserve Dist.
Hinsdale Nursery
IL Arborist Association
IL Department. of Agriculture
IL Department of Natural Resources
IL Forestry Development Council
IL Landscape Contractors Assoc.
IL Natural History Survey
IL Nurseryman's Assoc.
IL Parks and Recreation Association
IL Wood Products Association
Indiana Dept of Natural Resources
Lake County Forest Preserve Dist
Michigan State University
The Morton Arboretum
Northwest Municipal Conference
Purdue University
University of Illinois
USDA Forest Service, Northeastern Area
USDA Forest Service, North Central Research Station
USDA Animal and Plant Health Inspection Service, APHIS, Plant Protection and Quarantine, PPQ
Wilson Nurseries
Village of Bolingbrook, for Northeast Municipal Foresters
Village of Oak Lawn, for Northeast Municipal Foresters

Missouri Emerald Ash Borer Action Plan

May 2, 2008

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Missouri Emerald Ash Borer Action Plan

I. INTRODUCTION

The emerald ash borer (EAB), *Agrilus planipennis*, is a new, significant threat to the urban and rural forests of Missouri. This exotic beetle is an invasive species that has the potential to remove ash trees (*Fraxinus* spp.) from North American forests and urban landscapes. First identified in 2002 in southeastern Michigan, EAB has destroyed millions of ash trees across its known distribution in Illinois, Indiana, Michigan, Ohio, Pennsylvania, West Virginia, Maryland and Ontario. With state and federal quarantines in place, significant survey, containment, and clean-up operations are underway in the affected areas. However, EAB populations are well established in the core infestation area.

There are concerns that quarantine and containment efforts will not be adequate to stop the spread of this new pest, and that it will come to Missouri and neighboring states not only by natural spread, but by hitchhiking in infested firewood, logs or nursery stock. Although chemical and biological controls are under investigation, aggressive containment efforts are necessary for new outbreaks outside the core infestation area. Satellite outbreaks in several states have required swift, organized responses by government agencies and cooperation of stakeholder groups.

Details of EAB identification, biology, hosts, symptoms, and distribution are provided in a Pest Alert by the USDA Forest Service (http://www.na.fs.fed.us/spfo/pubs/pest_al/eab/eab.pdf) and on the Cooperative Emerald Ash Borer Project web site (http://www.emeraldashborer.info/).

Missouri Perspective

Information from community tree inventories indicates that ash trees comprise about 14% of street trees in Missouri communities and over 21% of trees in urban parks (data compiled by Missouri Department of Conservation, 2005). The percentages rise to well over 30% in some parks and residential subdivisions. Costs associated with hazard tree removal and replacement tree planting will be high for such a significant component of the urban forest. In Missouri's natural forest stands, ash trees comprise about 3% of total trees (USDA Forest Service, Forest Inventory and Analysis data). Thus the impact of this destructive pest is expected to be less in rural forests in terms of percentages, although ecological impacts could be significant in some areas.

Visual surveys to detect the presence of EAB are conducted annually in Missouri. The Missouri Department of Conservation (MDC) and Missouri Department of Agriculture (MDA) began surveying selected state parks, private campgrounds, and urban sites in 2005. The USDA Forest Service (USFS) began in 2004 to survey federal campgrounds and recreation areas managed by the Mark Twain National Forest, US Army Corps of Engineers, and Department of the Interior. Additionally, MDA Plant Protection Specialists have been examining ash nursery stock since 2003 (many thousand trees per year) during routine nursery inspections at all of the state's nursery growers.

MDC, MDA, and the Missouri Department of Natural Resources (MDNR) have been working cooperatively to raise public awareness about EAB through workshop presentations (green industry professionals, Master Gardeners, State Park staff and others), an informational web site (http://www.mdc.mo.gov/forest/features/firewood.htm), a *Missouri Conservationist* article (March 2007), a poster on the risk of firewood movement (developed and distributed to campgrounds and recreation sites throughout Missouri), and numerous media releases and media interviews.

II. PURPOSE

The Missouri Emerald Ash Borer Action Plan[1] has been developed to provide a statewide coordinated response, and to help local communities plan to respond to the potential negative effects of the emerald ash borer. The primary goal of the Plan is to delay introduction of EAB into Missouri, and to detect and contain EAB populations and mitigate impacts if and when EAB does arrive.

III. GENERAL READINESS

Objective: To reduce risk, minimize impact, and respond more effectively to a possible infestation of the EAB, and to partner towards overall health and sustainability of Missouri's forests.

A. **Establish a network of agencies and organizations that may be affected by the EAB as the Emerald Ash Borer Action Team.** The Team will draft an Action Plan and be responsible for advising, advocating, and leading in the implementation of the plan. The Action Team is comprised of a Technical Team and Communications Team. The Technical Team has the leadership role and is responsible for planning, coordination, and prompt evaluation and action. The Communications Team supports the Technical Team by providing uniform and accurate information and education.

   The following agencies have, by law, the responsibility and authority to manage an exotic plant pest introduction. See Appendix B for details.
   - Missouri Department of Agriculture
   - USDA, APHIS, Plant Protection and Quarantine
   - Affected local government(s) at sites of infestation.

   1. Technical Team – Serves as the lead group in planning and coordinating all EAB readiness and response activities. Committee members are listed in Appendix A. The following serve as Committee Co-chairs:
      - Missouri Department of Agriculture (State Entomologist)
      - Missouri Department of Conservation (Forest Entomologist)
      - Missouri Department of Natural Resources (State Parks representative)

[1] The Missouri Emerald Ash Borer Action Plan should be considered a dynamic and evolving document that may change as new research and management information becomes available.

2. Communications Team – Supports activities of the Technical Team by communicating accurate information quickly and broadly in a manner that increases the effectiveness of efforts to prevent and control EAB infestations. Committee members are listed in Appendix A. The following persons serve as Committee Co-chairs:
   - Missouri Department of Conservation (Community Forestry Coordinator and Public Relations Specialist)

B. Agency Roles and Responsibilities for major partners in the Emerald Ash Borer Action Team include but are not limited to the following.

1. **Missouri Department of Agriculture (MDA)** is the lead State agency responsible for preventing the introduction and spread of harmful plant pests, such as insects and diseases, into and within Missouri.

   a) Provide surveillance and detection, follow-up inspections on reported suspect invasive species, identification, assessment and monitoring.
   b) Notify and coordinate activities with the appropriate local, state, and federal agencies and other appropriate organizations related to program responsibilities and this Plan.
   c) Confirm identification of samples and suspect organisms.
   d) Cooperate with other members of the EAB Communications Team to develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.
   e) Implement and maintain appropriate state and federal quarantines.
   f) Review and coordinate pest control activities to ensure compliance with federal, state and local laws.
   g) Condemn and seize materials when appropriate.
   h) Oversee destruction of infested or potentially infested materials or vectors when appropriate.
   i) Provide or assist with the procurement of funding for survey, outreach, monitoring, and containment when appropriate.
   j) Provide pest management expertise and advice to all cooperators (including nursery operators) and the public.

2. **USDA, APHIS, Plant Protection and Quarantine (PPQ)** is the lead Federal agency responding to a harmful plant pest introduction.

   a) Assist in all response activities including quarantine, evaluation, identification, disposal, disinfection, epidemiology, trace-backs and trace-forwards, permitting, inspection, transportation control systems, and survey activities.
   b) Collect, collate, analyze, and disseminate technical and logistical information and distribute to field staff and cooperators.
   c) Cooperate with other members of the EAB Communications Team to develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.

d) Define training requirements for casual employees or support agencies involved in response operations. Training may consist of survey, sampling, diagnostic, and regulatory procedures.
e) Cooperate in the declaration of the emergency area and assist in defining the emergency area and control or quarantined zones.
f) Allocate funding for compensation to the owner of destroyed products, if an "Extraordinary Emergency" is declared by the Secretary of Agriculture.
g) Acquire necessary funding to support emergency program activities.
h) Provide investigations and support in cases of federal law violations.
i) Consult with State and local authorities regarding response operations.
j) Issue restrictions on interstate commerce.

3. **Missouri Department of Conservation (MDC)** is the lead State agency responsible for providing forest management information and technical forestry assistance to the people of Missouri and protecting and managing Missouri's forests for long-term resource sustainability.

   a) Provide forest management expertise and advice to private landowners, communities, forest products and tree care industries, consulting foresters, and the general public.
   b) Provide information and assistance to Missouri communities in planning community preparedness and response to EAB and other invasive forest species.
   c) Manage forests on MDC lands to mitigate the impacts of invasive forest pests.
   d) Lead the EAB Communications Team and, in partnership with other agencies, develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.
   e) Provide liaison with the USDA Forest Service, National Association of State Foresters, and Northeastern Area Association of State Foresters through the Missouri State Forester to request further assistance and funding.
   f) Assist in surveillance, detection, follow-up inspections on reported suspect invasive species, identification, assessment and monitoring.
   g) Assist with containment, restoration, and mitigation activities.
   h) Serve as the liaison (Missouri State Forester) to the Missouri Forest Resources Advisory Council.

4. **Missouri Department of Natural Resources (MDNR)** is the State agency responsible for environmental quality, waste disposal, energy, emergency response to environmental events, operation and management of State Parks and historic sites, and protecting natural resources in Missouri.

   a) Develop programs to reduce the likelihood of introduction of EAB and other invasive forest pests to State Parks and Historic Sites.
   b) Cooperate with other members of the EAB Communications Team to develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.

5. **USDA Forest Service, State and Private Forestry (USFS)** assists in the detection, evaluation, monitoring and management of invasive forest pests on all forest ownerships.

   a) Assist other agencies to identify and prioritize which invasive species to control and to effectively implement a management plan to minimize their impact and spread.
   b) Cooperate with other members of the EAB Communications Team to develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.
   c) Provide education and outreach materials to increase public awareness of EAB and other invasive forest pests.

C. Administrative Readiness – to ensure that current, relevant, and achievable policies are in place that allow the actions described in this plan to occur quickly and unencumbered.

1. Develop EAB Action Plan. [Technical Team]
   a) Distribute draft plan to stakeholders for review.
   b) MDA, MDC, and MDNR agree to implementation of the Plan.
   c) Educate internal stakeholders within cooperating agencies to promote common approach to Plan implementation.

2. Identify resources and needs. [Technical Team]
   a) Evaluate human and technical resources required to effectively monitor for EAB and respond to introductions.
   b) Assess human and technical resources available among partner agencies (e.g. survey personnel, delimiting personnel, tree climbers) and acquire commitments for their participation.
   c) Identify sources of funding for readiness activities.

3. Educate the media to ensure accuracy of information. [Communications Team]
   a) Identify key contacts (core members) on Communications Team as sources of current information.
   b) Develop a system among core members of the Communications Team for coordinating messages among agencies and providing expedited communications.
   c) Develop a media strategy to publicize the final Action Plan.

4. Explore wood waste utilization opportunities with the forest products industries and other partners to reclaim ash material to its highest possible use in the event a large volume of material suddenly becomes available. [MDC (Lead) and Technical Team]

D. Technical Readiness – Ensure that policy decisions, actions, and education initiatives are guided by the best and most current science.

1. Review and distribute to stakeholders recommendations for remedial control actions developed from recent government and university research. [Technical Team]

2. When issued, operate under New Pest Response Guidelines for EAB, or other relevant USDA technical guidelines. [Technical Team]

3. Transfer technology to field foresters, consulting foresters, arborists, and nursery professionals as it becomes available. [Communications Team]

IV. REDUCTION OF INFESTATION RISK

Objective: Identify all major pathways of EAB introduction and ensure actions are taken to reduce infestation risks, as soon as possible.

A. Assess Risk of Infestation

1. Assess the magnitude of the resource at risk (quantity of ash trees). [MDC]

2. Analyze density of ash populations to identify high-risk areas. [MDC]

3. Establish an EAB Pathways Committee [PPQ].
   a) Members include MDA, MDC, MDNR, PPQ, Missouri Forest Products Association, and representatives of the nursery industry, utility companies, and camping and recreational vehicle associations.
   b) Assess pathways and risks of EAB introduction into Missouri.
   c) Develop recommendations for reducing risk of EAB introduction.

4. Track the spread of EAB in infested states. [Technical Team]

B. Reduce Risk of Infestation

1. Raise public awareness about risks of firewood importation. [Communications Team]
   a) Install educational posters at public and private campgrounds and highway rest areas.
   b) Develop and employ a variety of educational tools (e.g., media releases, billboards, public service announcements).
   c) Educate firewood dealers and buyers on the benefits of buying and selling locally produced firewood in Missouri.
   d) Educate the public and implement "burn what you bring and bring only what you need" firewood policy in Missouri's private and public campgrounds
   e) Educate state and national camping and recreational vehicle associations and youth scouting organizations about the risks involved with transporting firewood.

2. Educate industries about risks and regulations associated with movement of ash logs and nursery stock. [Communications Team]
   a) Reach out to primary and secondary wood processors through landowner, industry, and professional associations.
   b) Educate municipalities, contractors, garden centers, and landscapers about importance of knowing the source of ash nursery stock.

c) Educate utility companies and others involved in tree management along rights-of-way.

3. Educate law enforcement agencies (Missouri State Highway Patrol, Missouri Sheriffs' Association, and local Police Departments and Associations) regarding existing regulations. [PPQ and MDA]

4. Maintain an effective nursery inspection program to ensure thorough inspection of ash nursery stock. [MDA]
   a) Advocate for strong state support of nursery inspection program.
   b) Ensure thorough inspection of ash nursery stock by providing EAB detection training to state inspectors.
   c) Encourage landscaping companies to obtain proper nursery license from MDA.

5. Promote planting selections that contribute to a diverse and sustainable urban forest.
   a) Educate municipalities and large property managers about diversity in tree planting and risk transfer (ash removal over time to spread out financial risks). [MDC (Lead) and Communications Team]
   b) Assist local governments in tree assessments and inventories to analyze diversity and guide planting decisions. [MDC]

6. Seek legislative support to reduce risk. [Technical Team]
   a. Invite active participation by Governor's representative.
   b. Advocate for readiness funding from stakeholders.

V. MONITORING PROGRAM

Objective: To detect EAB introductions promptly and improve the probability of containing an infestation.

A. Survey high-risk ash populations to detect the presence of EAB following USFS survey protocols.

1. Continue state and federal collaborative surveys of areas with high risk of EAB introduction. [Technical Team]

2. Annually review and plan EAB survey activities. [Technical Team]

3. Communicate survey results to stakeholders and the media by media releases and/or informational web site. [Communications Team]

B. Educate the public and professionals to aid in rapid identification of an infestation.

1. Provide EAB training and outreach to natural resource professionals including MDC Forestry, Private Lands Services and Nature Center staff, MDNR State Park naturalists,

landscapers, consulting foresters, arborists, nursery personnel, and other green industry workers. [Communications Team]

2. Educate the general public about EAB. [Communications Team]
   a) Obtain or develop simple educational materials for the general public.
   b) Pursue broad opportunities for speaking, publishing, and exhibiting educational material.

3. Recruit and enable volunteer scouting. [Communications Team]
   a) Promote awareness with media releases and public appeals for help in scouting.
   b) Prepare kits and training to support volunteer scouting by individuals and groups (e.g. Master Gardeners, Master Naturalists, Treekeepers, Missouri Community Forestry Council, Certified Arborists, Missouri Forestkeepers)

C. Coordinate state and national information to address professional and public inquiries from Missouri and foster cooperation and communication.

1. Link web sites of Action Team agencies to USFS, PPQ, and Cooperative Emerald Ash Borer Project web sites. [Communications Team]

2. Coordinate with the Cooperative Emerald Ash Borer Project to add Missouri information to their web site (http://www.emeraldashborer.info/). [Communications Team]

D. Facilitate Inquiries and Reporting of Suspect Infestations.

1. Educate the *general public* to submit inquiries and suspect infestation reports to a natural resource professional (See Appendix C), to allow pre-screening for appropriate tree species and insect group. [Communications Team]

2. Educate natural resource *professionals* (e.g., arborists, municipal foresters, nursery managers) to submit inquiries and suspect infestation reports to MDA, MDC, or PPQ as described below. [Communications Team]

3. Inquiries and reports of suspect EAB infestations are to be submitted to one of the following individuals. Personnel from these agencies will inspect the suspected ash tree(s) and identify the specimen(s).
   - State Entomologist, MDA
   - Forest Entomologist, MDC
   - State Plant Health Director, USDA-APHIS-PPQ

4. Collected specimens will be forwarded by the MDA State Entomologist or the PPQ State Plant Health Director to a PPQ identifier.

5. If a collected specimen is initially confirmed to be EAB by a PPQ Identifier, the specimen will then be sent to the National Systematic Entomology Laboratory for final confirmation.

6. All Technical Team members are to be notified that a suspect EAB is in the system for identification. However, at this point, all information is not for public dissemination. The public will be informed after a positive identification has been made.

7. The identification result from the Systematic Entomology Laboratory, either positive or negative for EAB, will be received by PPQ, who will notify the Technical Team and the Communications Team.

VI. RESPONSE TO DETECTION OF AN INFESTATION

Objective: To contain and manage EAB populations, when detected.

The Technical Team, with cooperation of affected local government(s), will implement coordinated efforts to contain the infestation according to current national policies and scientific information.

A. Plan and implement containment actions.

1. Coordinate response with affected local governments and other entities.
   a) Meet to discuss and determine the preliminary plan of action. [Technical Team]
   b) Schedule an emergency meeting with cooperators (e.g. regulated industries, city and county governments, utility companies, recreational areas, and others). [MDA (lead) and Technical Team]
   c) Release accurate information to the media. [Communications Team]

2. Organize and conduct a delimiting survey to determine the infestation boundaries. [MDA (lead) and Technical Team]
   a) All ash trees within 1/2 mile of a positive find will be identified and assessed for EAB activity within a reasonable time frame.
   b) If additional EAB-infested trees are detected in any area, an expanded survey will be initiated within ½ mile from the new find.

3. Initiate regulatory and control activities as necessary.
   a) Administer provisional quarantine established by MDA consistent with Missouri Revised Statutes, Chapter 263. Emergency rules will be issued describing the quarantined area and regulated articles. [MDA]
   b) Determine if removal of potential host trees is appropriate. [MDA (lead) and Technical Team]
   c) Develop compliance agreements with stakeholders to restrict movement from EAB-infested (regulated) areas. [MDA and PPQ]

4. Dispose of wood debris in cooperation with local governments. [Technical Team]
   a) Establish processing facilities in the quarantine zones to efficiently handle ash debris and reclaim useable products as practical.
   b) Market reclaimed wood products.

B. Communicate information about response.

1. Provide accurate information and updates to the media through the core members of the Communications Team. [Communications Team]

2. Provide accurate information to affected residents. [Communications Team]
   a) Prepare information for customizing and distributing to affected area immediately after infestation is found.
   b) Cooperate with local governments to host local resident/landowner meetings to share information as soon as possible after finding an infestation.

3. Communicate with public and industry professionals to foster cooperation and maximize effective response. [Communications Team]

VII. MITIGATION OF POTENTIAL IMPACTS

Objective: To develop processes and resources for mitigating potential impacts in the event of the establishment of EAB populations.

A. Response for urban forests

1. Assist communities in developing local response plans. [MDC (lead) and Technical Team]

2. Conduct training programs for local governmental staff. [Communications Team]

3. Develop and distribute relevant information (print media, web, public service announcements, etc.) for homeowners. [Communications Team]

4. Provide updated information on EAB management techniques to arborists, landscape professionals, utility companies, and other green industry personnel through publications and periodic workshops. [Communications Team]

5. Explore opportunities for potential reforestation programs. [MDC (lead) and Technical Team]

6. Participate in the National Ash Tree Seed Collection Initiative to secure native ash germplasm (seeds) to be preserved for possible future reforestation efforts. [USDA Natural Resources Conservation Service]

B. Response for rural forests

1. Develop [MDC] and distribute [Communications Team] silvicultural guidelines.

2. Evaluate and encourage local market utilization. [MDC (lead) and Technical Team]

C. **Seek legislative support** to cover costs associated with EAB management. [Technical Team]

1. Invite active participation by Governor's representative.

2. Advocate for matching funds at state and federal levels to assist local government(s) in clean-up efforts.

3. Advocate for readiness funding from stakeholders.

Appendix A. Missouri EAB Action Team and Partners

Technical Team

Missouri Department of Agriculture (Co-chair: State Entomologist)
Missouri Department of Conservation (Co-chair: Forest Entomologist)
Missouri Department of Natural Resources (Co-chair: State Parks representative)
USDA APHIS, Plant Protection & Quarantine
USDA Forest Service, State & Private Forestry, Forest Health Program
University of Missouri Extension

Communications Team

Missouri Department of Conservation (Co-Chairs: Community Forestry Coordinator and Public Relations Specialist)
Missouri Department of Agriculture
Missouri Department of Natural Resources
USDA APHIS, Plant Protection & Quarantine
USDA Forest Service, Northeastern Area, Office of Communications
University of Missouri Extension

Collaborators

Forest ReLeaf of Missouri
Missouri Community Forestry Council
Missouri Forest Products Association
Missouri Landscape and Nursery Association
USDA Forest Service, Mark Twain National Forest
USDA Natural Resources Conservation Service

Stakeholders

Conservation Federation of Missouri
Missouri Consulting Foresters Assn.
Missouri Municipal League
Missouri Parks & Recreation Assn.
Local Arborist Associations
Missouri Botanical Garden
Powell Gardens
Municipalities
Nurseries
Commercial campgrounds
Missouri Dept. of Economic Development
Missouri Office of Administration
Missouri State Emergency Management Agency
Missouri State University, Dept. of Agriculture
US Army Corps of Engineers
US Dept. of Interior, National Park Service
Univ. of Missouri, Division of Plant Science
Univ. of Missouri, School of Natural Resources
Univ. of Missouri, Plant Diagnostic Clinic

Appendix B. Legal Authorities

The following agencies have, by law, the responsibility and authority to manage an exotic plant pest introduction:

- Missouri Department of Agriculture
  - Missouri Revised Statutes, Chapter 263

- USDA, APHIS, Plant Protection and Quarantine.
  - Agricultural Bioterrorism Protection Act of 2002 (Public Law 107-188)
  - Plant Protection Act of 2000 (Public Law 106-224; June 20, 2000)
  - Federal Plant Protection Regulations (Title 7 Code of Federal Regulations 300-399)

- Affected local government(s) at sites of infestation.

Appendix C. Reporting Suspect Emerald Ash Borer Infestations

Reporting by the General Public:

1. If a suspect infestation is found, record date and description of location. If possible, collect suspect insects and a tree twig sample with leaves. Photos of suspect trees and insects can also be very helpful in identification.

2. Suspect insects can be placed in a plastic container such as a pill bottle and killed by placing in a freezer overnight. Soft, worm-like insect larvae can be preserved by placing them in rubbing alcohol.

3. Submit inquiries, samples, or suspect infestation reports to one of the following:

   - Missouri Dept. of Conservation
   - MU Extension offices
   - MU Plant Diagnostic Clinic
   - Missouri Dept. of Agriculture
   - City Foresters or Arborists

Reporting by Natural Resource Professionals:

Collect information and insect samples as described above and submit inquiries and reports to one of the following individuals. Personnel from these agencies will inspect the suspected ash tree(s) and identify the specimen(s).

State Entomologist
Missouri Department of Agriculture
P.O. Box 630, 1616 Missouri Blvd., Jefferson City, MO 65102
Ph. 573-751-5505

Forest Entomologist
Missouri Department of Conservation
1110 S. College Ave., Columbia, MO 65201
Ph. 573-882-9909

Letter of Approval by the
Missouri Department of Agriculture
Missouri Department of Conservation
And the
Missouri Department of Natural Resources

Subject: Missouri Emerald Ash Borer Action Plan

Executive Summary: The emerald ash borer (*Agrilus planipennis*) or EAB is an invasive species that has the potential to completely remove ash trees from North American forests and urban landscapes. First identified in 2002 in southeastern Michigan, EAB has destroyed many millions of ash trees and spread into Illinois, Indiana, Michigan, Ohio, Pennsylvania, West Virginia, and Maryland. There are concerns that quarantine and containment efforts by these states will not stop the spread of this pest. Should an outbreak occur in Missouri, it will require swift, organized responses by government agencies and stakeholder groups. The Missouri Emerald Ash Borer Action Plan has been developed to provide such a coordinated response. The primary goals of this plan are to delay introduction of EAB into Missouri, monitor Missouri's ash trees for the presence of EAB, and mitigate impacts of EAB if and when it arrives in the state. By following this plan, the cooperating agencies will protect Missouri's environmental, economic and social resources within the bounds of federal and state guidelines with programs that are biologically effective, environmentally responsible, economically justifiable and operationally efficient.

Approval of the Action Plan: This letter approves the Missouri Emerald Ash Borer Action Plan. Though this plan provides sound strategies for dealing with EAB, it should be considered a dynamic and evolving document that may change as new research and management information about EAB becomes available.

Successful Cooperation: EAB is a serious threat to Missouri's forests and urban landscapes. Overall, ash comprises about 3 percent of total trees in Missouri's forests. It forms an even greater percentage of the trees in Missouri's urban areas, making up 14 percent of street trees and over 21 percent of trees in urban parks. These percentages rise to well over 30 percent in some parks and subdivisions, Forest Park and the Jefferson National Expansion Memorial (Gateway Arch) in St. Louis being notable examples. The cooperating agencies have worked closely over the years to detect and eradicate gypsy moth populations in Missouri. It will take similar if not greater efforts to delay introduction of EAB into Missouri and mitigate its impacts when it arrives.

Appreciation: A special thanks is given to all the participants and contributors who have worked to make this plan a reality.

Katie Smith, Director
Missouri Department of Agriculture

John Hoskins, Director
Missouri Department of Conservation

Doyle Childers, Director
Missouri Department of Natural Resources

MARCH 2014

FROM THE MISSOURI DEPARTMENT OF CONSERVATION FOREST HEALTH LAB

MISSOURI Forest Health UPDATE

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Serving nature and you.

Emerald Ash Borer

Emerald Ash Borer (EAB), the invasive wood-boring beetle that is killing millions of ash trees across eastern North America, has so far been detected in 22 US states stretching from Colorado to the East Coast and in Ontario and Quebec, Canada. In Missouri, it has been detected in 9 counties (see map). Due to the locations of these counties in widely separate parts of the state, the Missouri Dept. of Agriculture and US Dept. of Agriculture expanded existing EAB quarantines statewide in 2013. See the December 2013 issue of this newsletter for more details (http://mdc.mo.gov/node/12746).

Expanded quarantines are needed, because it is difficult to completely detect EAB's spread, especially recently established infestations. But EAB has not yet spread everywhere in Missouri, and there are several things we all can do to respond to this pest threat. First, don't move firewood. Get your wood near where you are going to burn it. EAB and many other invasive insects and diseases hitchhike to new locations in firewood.

Second, watch for signs of an EAB infestation and report it. Familiarize yourself with how to identify an ash tree

Continued on page 2

Marianne Prue, Ohio DNR, Division of Forestry, Bugwood.org

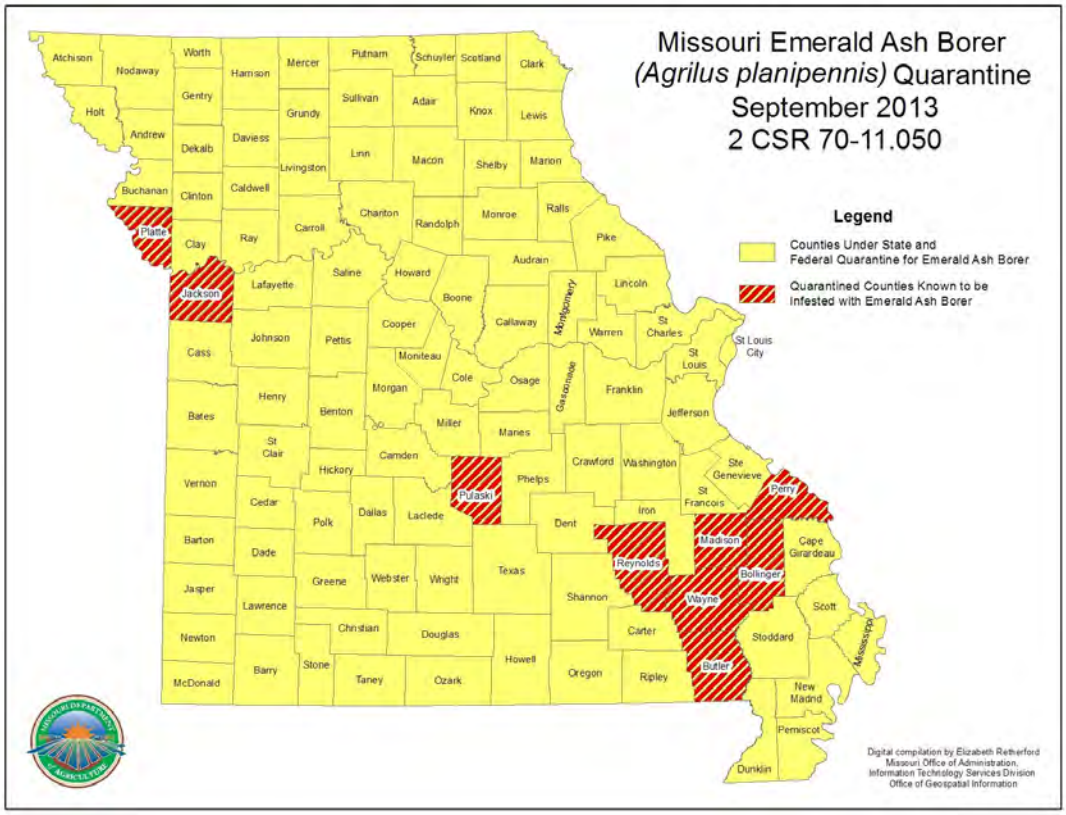
Emerald ash borer adult.

Emerald Ash Borer *continued*

and signs of an EAB infested ash at this site: http://eab.missouri.edu. Also at that site, consult the latest map of known EAB infestations. If you see evidence of EAB in one of the counties where EAB has not yet been detected, please report. There is no need to report for counties where EAB is already known to be present. Photos of suspect ash trees (images of the whole tree, leaves, and close-ups of damage) may be sent to your local Conservation Department forester (see Local Contact at http://mdc.mo.gov/) or to Forest.Health@mdc.mo.gov. Reports and questions may also be submitted by calling toll-free to 866-716-9974.

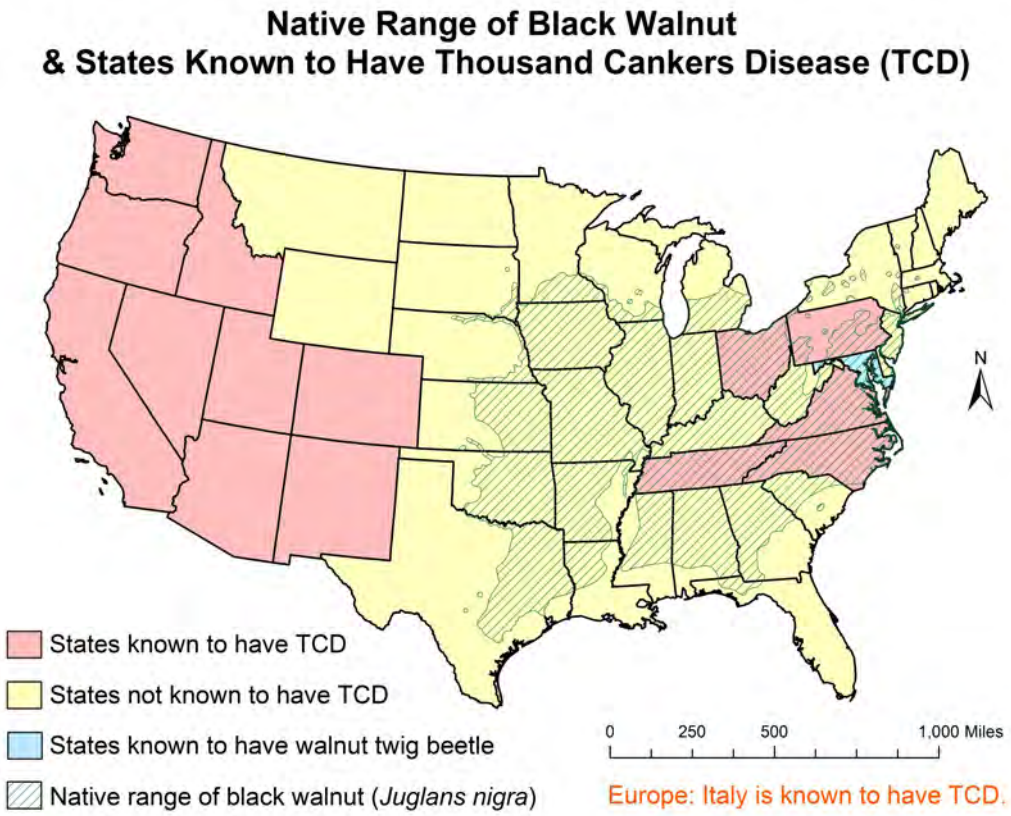
In 2014, EAB traps are being monitored by the Missouri Dept. of Agriculture in central Missouri and the St. Louis area to detect if infestations are present. Traps are a helpful tool, but many EAB infestations are found by people knowing what to look for. The EAB infestation in Kansas City was first detected by an alert arborist. A good opportunity to examine ash trees closely is whenever branches are pruned or a tree is cut down during routine tree care activities. This article describes a branch sampling technique: http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/32127.pdf.

Communities and homeowners should start now to plan for EAB's arrival. If no action is taken, large numbers of ash trees will eventually be killed in a few years' time after EAB arrives. How many ash trees are there in your community or on your property? Some high-value trees that provide shade, energy savings, or aesthetics can be kept alive with the appropriate use of systemic insecticides. But because of environmental and cost concerns, insecticides should not be applied until an EAB infestation has been found within your county. Ash trees that are already in poor health or bad locations, such as under power lines, are not worth treating and could be removed now. Treatment and eventual removal of other trees could be spaced out over a period of years. When planting replacement trees, a variety of species should be used. The important thing is to start evaluating your trees and have a plan of action.



Missouri counties where EAB infestations have been detected (red stripe).

Thousand Cankers Disease of Walnut



TCD has not been detected in Missouri, however there is concern that undetected TCD infestations could be present or that spread may occur from other states where detections have occurred. In the past year TCD detections have been confirmed in Ohio and Italy, as well as additional areas in states previously known to be infested. The walnut twig beetle, which spreads the fungal disease, has also been found in Maryland. Currently, the list of TCD-positive states includes 5 eastern and 9 western states. The risk of spread of TCD to Missouri on infested walnut wood from these areas of known infestation is high. It is important to follow the Missouri state quarantine rule restricting the movement of all species of walnut and all hardwood firewood from states where TCD has been detected. More information can be found at http://mda.missouri.gov/plants/pests/TCDEmergencyRule.pdf

Existing TCD detection technology is not very sensitive, and TCD is unlikely to be detected until several years after introduction. Consequently, it is important to watch for pockets of walnut trees displaying possible symptoms of TCD. More information on symptoms to look for and how to report suspect trees can be found at http://mdc.mo.gov/thousand-cankers.

TCD detection surveys are conducted annually by both the Department of Conservation and the Department of Agriculture. In 2014, survey efforts will include pheromone-baited walnut twig beetle traps placed at high-risk locations with declining walnut trees and visual surveys to look for trees displaying symptoms consistent with TCD. Surveys will focus on the Columbia, Rolla, Springfield/Branson, and St Louis metro areas and surrounding counties.

Hanging a walnut twig beetle trap.

Rapid White Oak Mortality (RWOM)

Reports of white oak dieback and mortality continue from east central and southeast Missouri. A complete description of the phenomenon can be found in the December 2013 Missouri Forest Health Update (see article titled "White Oak Decline"). http://mdc.mo.gov/sites/default/files/resources/2014/01/mo_fh_update_dec13.pdf

A USDA Forest Service Evaluation Monitoring grant with additional funding from the Missouri Department of Conservation will support a RWOM research project this year. The goal of the work is to better understand the mortality and begin to predict where and when it is likely to occur. Investigations will look in greater detail at associated insects and fungal pathogens and site characteristics. Reports of locations with significant numbers of dying white oaks will help with research efforts by indicating where the issue is common and what damage patterns are present. **Please consider filling out the reporting form on the opposite page.**

University of Missouri researchers evaluating roots near a dying white oak tree.

Rapid White Oak Mortality

Rapid White Oak Mortality Survey

Observer Name and phone / email	Date

Location of Declining and Dead trees

Location Name

Address of location or nearest intersection

MO city or town	Mo County

Describe declining and dead trees

Type of trees Declining and dying (all that apply): ☐ white oaks ☐ red oaks ☐ other species

(see http://forestkeepers.org/wp-content/uploads/2013/05/Missouris-Oaks-and-Hickories.pdf)

Number of white oak trees Declining and dead: ☐ few ☐ many ☐ all

Number of other trees declining and Dead: ☐ few ☐ many ☐ all

Describe the symptoms you are seeing (Check all that apply):

☐ Numerous dead branches in top of tree crown ☐ smooth slick grey or black patches on the trunk
☐ patches/spots where bark has fallen from the tree or bark at Tree base
☐ Most Dead leaves on tree ☐ Most dead leaves fallen ☐ Bleeding or wet areas on trunk

Describe Location

Site description (Check all that apply): ☐ steep hills ☐ gently rolling hills ☐ flat ☐ bottomland

☐ upland plateau ☐ near stream ☐ urban ☐ rural

Where are most declining and dead trees (all that apply): ☐ top half of hill ☐ bottom half of hill
☐ Everywhere ☐ near stream ☐ Other, describe: _____

Affected area size: ☐ smaller than football field ☐ larger than football field

Recent Site Disturbance (Check all that apply): ☐ construction ☐ wind damage ☐ tree harvest

☐ other management, describe:_____

Comments:	mail completed form to:
	Dr. Reed University of Missouri Plant Sciences Division 110 waters hall Columbia, MO 65211 Or email form to reedsh@missouri.edu

Weather Impacts on Insects

There have been many conflicting news stories around the country in recent weeks about whether the unusually cold weather this past winter will have a silver lining and kill many insect pests. Our general take on it is that for the emerald ash borer and many other insects, the cold will probably have little effect. But the story is complex and not very predictable. Like many temperate climate insects, EAB produce a type of "anti-freeze" that helps them withstand very cold temperatures. EAB larvae overwinter under ash tree bark, which provides insulation, raising temperatures a bit further for the insects.

Overwintering EAB larva within ash bark.

A few EAB larvae might be killed if temperatures fall below minus 10 degrees and remained there for a few days. But temperatures would need to remain below minus 20 or colder for an extended period for significant EAB mortality to occur. Air temperatures in most Missouri locations did not go below minus 15 during the polar vortex event this winter, and even then those lowest temperatures only existed for a few hours.

Many insects overwinter in the soil, under leaves and organic matter, or other sheltered places close to the ground. They are well-insulated from the cold. Snow cover provides additional insulation for insects overwintering beneath. Temperatures two inches deep in soil remained close to 30 degrees on the coldest nights and for most of the winter, according to University of Missouri weather data (Sanborn Field, Columbia, MO). We might expect insects that overwinter in more exposed locations, such as bagworms on tree branches, would be more at risk for winter mortality. But even then, the old bags provide insulation for bagworm eggs overwintering within.

There can be a greater impact on insect survival when we have a warm spell lasting for a few days in late winter followed by severe cold temperatures again. An extended warm spell may cause some insects to lose their cold hardiness. In much of Missouri, we did have daily high temperatures ranging from the 50s to low 70s during February 17-22, followed by sub-zero lows in early March. It's a guessing game when trying to predict how much that pattern might affect spring pest populations. We will just have to wait until later this spring to see what develops.

Weather Impacts on Trees

Preliminary data suggests this past winter may have been the coldest in 35 years and 9th coldest on record in Missouri (Pat Guinan, State Climatologist, www.climate.missouri.edu). However, most native plants on appropriate sites may not have been affected significantly. Because cold temperatures were fairly constant for several weeks prior to extreme low temperatures in January and February, most plants were near their maximum cold hardiness when the extremes occurred. Had temperatures fluctuated more widely, with several days of above normal temperatures prior to periods of extreme cold, we would expect more extensive damage. It is still possible that fluctuating temperatures this spring could cause damage.

Some non-native ornamental and fruit trees may have experienced low temperature damage to floral buds or even dieback of twigs and branches. Flowering may be poor this spring or growth may begin and then collapse due to tissue damage. Disease-causing fungi may infect winter-damaged tissues and lead to an increase in cankers (infections that can girdle and kill plant stems) resulting in more dieback later on.

Browning of evergreens may become apparent due to desiccation injury. Desiccation injury occurs on sunny, windy days when foliage continues to loose moisture but roots are unable to absorb moisture from dry or frozen soils. Evergreens in northern areas of the state where drought conditions were present during 2013 may be more susceptible to injury. However, desiccation injury is also more severe with rapidly fluctuating temperatures that occur in some years.

The bottom line is that the extreme winter cold is another stressor for species that are not well adapted to these temperatures. Across Missouri, trees are beginning 2014 severely stressed due to past weather extremes. As reported in the December 2013 Forest Health Update, some recent extremes include excessively wet weather in 2008-2009, the exceptionally severe drought in 2012, excessively wet weather in southern Missouri and drought in northern Missouri during 2013. Other events in recent years include multiple storm events, and spring frost damage. We anticipate the impacts of the past weather-related stresses to continue in 2014 and for the next several years. Damage from wood boring insects, canker diseases, root diseases, and general tree dieback and mortality may be apparent.

Most Missouri trees are well adapted to cold temperatures.

Diagnosing Tree Diseases

As the trees begin to grow, the diseases are not far behind. The warm weather also brings homeowners and landowners outside where tree problems begin to be noticed.

When diagnosing tree disease problems, the smallest clues and background information can make all the difference in obtaining a quality diagnosis. The following website has some useful pointers and great photos: http://www.extension.iastate.edu/Publications/SUL3.pdf

When a decision is made to submit a sample to a plant diagnostic lab, it is critical that the lab receive the proper sample fully representing the problem. An old dead branch tells no stories! Remember to:

⇒ Completely fill out lab submission forms with detailed background information.

⇒ When possible, take some digital photos showing the tree, surrounding landscape and close-up photos of the symptoms observed.

⇒ When you are unsure about what sample to send, you can call or email photos to the diagnostic lab and staff can provide more specific submission instructions.

⇒ Keep your sample cool and send early in the week to ensure your sample arrives at the lab in good condition.

The University of Missouri Plant Diagnostic Clinic is a resource providing a wide variety of services anyone can use. Services provided by the MU lab include tree health diagnosis, diagnosis of issues affecting other plant species, as well as identification of insects, arachnids, and plants. Additional information about the MU lab including fees, submission instructions and forms can be obtained at http://plantclinic.missouri.edu/, by contacting the lab at plantclinic@missouri.edu or by calling (573) 882-3019.

Forest Health News— sign up today!

The MDC Forest Health Lab periodically sends email updates on insects, diseases, phenology, weather, and much more. Emails are also sent when new forest health alerts and *Forest Health Update* newsletters are available. To receive these emails, please subscribe to the MO Forest Health electronic mailing list at:

http://mdc.mo.gov/user_mailman_register

Questions? Contact your local Resource Forester or Urban Forester with the Missouri Department of Conservation.

Find contact information for your county at:

www.mdc.mo.gov

An electronic copy of this document can be found at:

http://mdc.mo.gov/node/12746

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The USDA is an equal opportunity provider and employer.

www.emeraldashborer.info

Insecticide Options for Protecting Ash Trees From Emerald Ash Borer

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Emerald ash borer (*Agrilus planipennis* Fairmaire), an invasive insect native to Asia, has killed tens of millions of ash trees in urban, rural and forested settings. This beetle was first discovered in 2002 in southeast Michigan and Windsor, Ontario. As of May 2009, emerald ash borer (EAB) infestations were known to be present in 11 states and two Canadian provinces. Many homeowners, arborists and tree care professionals want to protect valuable ash trees from EAB. Scientists have learned much about this insect and methods to protect ash trees since 2002. This bulletin is designed to answer frequently asked questions and provide the most current information on insecticide options for controlling EAB.

EAB larvae damage the vascular system of the tree as they feed, which interferes with movement of systemic insecticides in the tree.

EAB adults must feed on foliage before they become reproductively mature.

Answers to Frequently Asked Questions

What options do I have for treating my ash trees?

If you elect to treat your ash trees, there are several insecticide options available and research has shown that treatments can be effective. Keep in mind, however, that controlling insects that feed under the bark with insecticides has always been difficult. This is especially true with EAB because our native North American ash trees have little natural resistance to this pest. In university trials, some insecticide treatments were effective in some sites, but the same treatments failed in other sites. Furthermore, in some studies conducted over multiple years, EAB densities continued to increase in individual trees despite annual treatment. Some arborists have combined treatments to increase the odds of success (e.g., combining a cover spray with a systemic treatment).

Healthy ash trees that have been protected with insecticides growing next to untreated ash trees killed by EAB.

Our understanding of how EAB can be managed successfully with insecticides has increased substantially in recent years. The current state of this understanding is detailed in the bulletin. It is important to note that research on management of EAB remains a work in progress. Scientists from universities, government agencies and companies continue to conduct intensive studies to understand how and when insecticide treatments will be most effective.

I know my tree is already infested with EAB. Will insecticides still be effective?

If a tree has lost more than 50 percent of its canopy, it is probably too late to save the tree. Studies have shown that it is best to begin using insecticides while ash trees are still relatively healthy. This is because most of the insecticides used for EAB control act systemically — the insecticide must be transported within the tree. In other words, a tree must be healthy enough to carry a systemic insecticide up the trunk and into the branches and canopy. When EAB larvae feed, their galleries injure the phloem and xylem that make up the plant's circulatory system. This interferes with the ability of the tree to transport nutrients and water, as well as insecticides. As a tree becomes more and more infested, the injury becomes more severe. Large branches or even the trunk can be girdled by the larval galleries.

Studies have also shown that if the canopy of a tree is already declining when insecticide treatments are initiated, the condition of the tree may continue to deteriorate during the first year of treatment. In many cases, the tree canopy will begin to improve in the second year of treatment. This lag in the reversal of canopy decline probably reflects the time needed for the tree to repair its vascular system after the EAB infestation has been reduced.

My ash tree looks fine but my county is quarantined for EAB. Should I start treating my tree?

Scientists have learned that ash trees with low densities of EAB often have few or no external symptoms of infestation. Therefore, if your property is within a county that has been quarantined for EAB, your ash trees are probably at risk. Similarly, if your trees are outside a quarantined county but are still within 10-15 miles of a known EAB infestation, they may be at risk. If your ash trees are more than 15 miles beyond this range, it is probably too early to begin insecticide treatments. Treatment programs that begin too early are a waste of money. Remember, however, that new EAB infestations have been discovered every year since 2002 and existing EAB populations will build and spread over time. Stay up to date with current EAB quarantine maps and related information at **www.emeraldashborer.info**. You can use the links in this Web site to access specific information for individual states. When an EAB infestation is detected in a state or county for the first time, it will be added to these maps. Note, however, that once an area has been quarantined, EAB surveys generally stop, and further spread of EAB in that area will not be reflected on future maps.

I realize that I will have to protect my ash trees from EAB for several years. Is it worth it?

The economics of treating ash trees with insecticides for EAB protection are complicated. Factors that can be considered include the cost of the insecticide and expense of application, the size of the trees, the likelihood of success, and potential costs of removing and replacing the trees. Until recently, insecticide products had to be applied every year. A new product that is effective for two years or even longer (emamectin benzoate) has altered the economics of treating ash trees. As research progresses, costs and methods of treating trees will continue to change and it will be important to stay up to date on treatment options.

Benefits of treating trees can be more difficult to quantify than costs. Landscape trees typically increase property values, provide shade and cooling, and contribute to the quality of life in a neighborhood. Many people are sentimental about their trees. These intangible qualities are important and should be part of any decision to invest in an EAB management program.

It is also worth noting that the size of EAB populations in a specific area will change over time. Populations initially build very slowly, but later increase rapidly as more trees become infested. As EAB populations reach their peak, many trees will decline and die within one or two years. As untreated ash trees in the area succumb, however, the local EAB population will decrease substantially. Scientists do not yet have enough experience with EAB to know what will happen over time to trees that survive the initial wave of EAB. Ash seedlings and saplings are common in forests, woodlots, and right-of-ways, however, and it is unlikely that

EAB will ever completely disappear from an area. That means that ash trees may always be at some risk of being attacked by EAB, but it seems reasonable to expect that treatment costs could eventually decrease as pest pressure declines after the EAB wave has passed.

Insecticide Options for Controlling EAB

Insecticides that can effectively control EAB fall into four categories: (1) systemic insecticides that are applied as soil injections or drenches; (2) systemic insecticides applied as trunk injections; (3) systemic insecticides applied as lower trunk sprays; and (4) protective cover sprays that are applied to the trunk, main branches, and (depending on the label) foliage.

Insecticide formulations and application methods that have been evaluated for control of EAB are listed in Table 1. Some are marketed for use by homeowners while others are intended for use only by professional applicators. The "active ingredient" refers to the compound in the product that is actually toxic to the insect.

Formulations included in Table 1 have been evaluated in multiple field trials conducted by the authors. Inclusion of a product in Table 1 does not imply that it is endorsed by the authors or has been consistently effective for EAB control. Please see the following sections for specific information about results from these trials. Results of some tests have also been posted on **www.emeraldashborer.info**.

Strategies for the most effective use of these insecticide products are described below. It is important to note that pesticide labels and registrations change constantly and vary from state to state. It is the legal responsibility of the pesticide applicator to read, understand and follow all current label directions for the specific pesticide product being used.

Table 1. Insecticide options for professionals and homeowners for controlling EAB that have been tested in multiple university trials. Some products may not be labeled for use in all states. Some of the listed products failed to protect ash trees when they were applied at labeled rates. Inclusion of a product in this table does not imply that it is endorsed by the authors or has been consistently effective for EAB control. See text for details regarding effectiveness.

Insecticide Formulation	Active Ingredient	Application Method	Recommended Timing
		Professional Use Products	
Merit® (75WP, 75WSP, 2F)	Imidacloprid	Soil injection or drench	Mid-fall and/or mid- to late spring
Xytect™ (2F, 75WSP)	Imidacloprid	Soil injection or drench	Mid-fall and/or mid- to late spring
IMA-jet®	Imidacloprid	Trunk injection	Early May to mid-June
Imicide®	Imidacloprid	Trunk injection	Early May to mid-June
Pointer™	Imidacloprid	Trunk injection	Early May to mid-June
TREE-äge™	Emamectin benzoate	Trunk injection	Early May to mid-June
Inject-A-Cide B®	Bidrin®	Trunk injection	Early May to mid-June
Safari™ (20 SG)	Dinotefuran	Systemic bark spray	Early May to mid-June
Astro®	Permethrin	Preventive bark and foliage cover sprays	2 applications at 4-week intervals; first spray should occur when black locust is blooming (early May in southern Ohio to early June in mid-Michigan)
Onyx™	Bifenthrin		
Tempo®	Cyfluthrin		
Sevin® SL	Carbaryl		
		Homeowner Formulation	
Bayer Advanced™ Tree & Shrub Insect Control	Imidacloprid	Soil drench	Mid-fall or mid- to late spring

Using Insecticides to Control EAB

Soil-Applied Systemic Insecticides

Systemic insecticides applied to the soil are taken up by the roots and translocated throughout the tree. The most widely tested soil-applied systemic insecticide for control of EAB is imidacloprid, which is available under several brand names for use by professional applicators and homeowners (see Table 1). All imidacloprid formulations can be applied as a drench by mixing the product with water, then pouring the solution directly on the soil around the base of the trunk. Dinotefuran is also labeled for use as a soil treatment, but to date it has been tested only as a basal trunk spray (discussed below). Studies to test its effectiveness as a soil treatment are currently underway.

Imidacloprid soil applications should be made when the soil is moist but not saturated. Application to water-logged soil can result in poor uptake if the insecticide becomes excessively diluted and can also result in puddles of insecticide that could wash away, potentially contaminating surface waters and storm sewers. Insecticide uptake will also be limited when soil is excessively dry. Irrigating the soil surrounding the base of the tree before the insecticide application can improve uptake.

The application rates for the homeowner product (Bayer Advanced™ Tree & Shrub Insect Control) and professional formulations of imidacloprid are very similar. Homeowners apply the same amount of active ingredient that professionals apply. However, there are certain restrictions on the use of homeowner formulations that do not apply to professional formulations. Homeowner formulations of imidacloprid can be applied only as a drench. It is not legal to inject these products into the soil, although some companies have marketed devices to homeowners specifically for this purpose. Homeowners are also restricted to making only one application per year. Several generic products containing imidacloprid are available to homeowners, but the formulations vary and the effectiveness of these products has not yet been evaluated in university tests.

Soil drenches offer the advantage of requiring no special equipment for application other than a bucket or watering can. However, imidacloprid can bind to surface layers of organic matter, such as mulch or leaf litter, which can reduce uptake by the tree. Before applying soil drenches, it is important to remove, rake or pull away any mulch or dead leaves so the insecticide solution is poured directly on the mineral soil.

Imidacloprid formulations labeled for use by professionals can be applied as a soil drench or as soil injections. Soil injections require specialized equipment, but offer the advantage of placing the insecticide under mulch or turf and directly into the root zone. This also can help to prevent runoff on sloped surfaces. Injections should be made just deep enough to place the insecticide beneath the soil surface (2-4 inches). Soil injections should be made within 18 inches of the trunk where the density of fine roots is highest. As you move away from the tree, large radial roots diverge like spokes on a wheel and studies have shown that uptake is higher when the product is applied at the base of the trunk. There are no studies that show that applying fertilizer with imidacloprid enhances uptake or effectiveness of the insecticide.

Optimal timing for imidacloprid soil injections and drenches is mid-April to mid-May, depending on your region. Allow four to six weeks for uptake and distribution of the insecticide within the tree. In southern Ohio, for example, you would apply the product by mid-April; in southern Michigan, you should apply the product by early to mid-May. When treating larger trees (e.g., with trunks larger than 12 inches in diameter), treat on the earlier side of the recommended timing. Large trees will require more time for uptake and transportation of the insecticide than will small trees. Recent tests show that imidacloprid soil treatments can also be successful when applied in the fall.

Trunk-Injected Systemic Insecticides

Several systemic insecticide products can be injected directly into the trunk of the tree including formulations of imidacloprid and emamectin benzoate (see Table 1). An advantage of trunk injections is that they can be used on sites where soil treatments may not be practical or effective, including trees growing on excessively wet, compacted or restricted soil environments. However, trunk injections do wound the trunk, which may cause long-term damage, especially if treatments are applied annually.

Products applied as trunk injections are typically absorbed and transported within the tree more quickly than soil applications. Allow three to four weeks for most trunk-injected products to move through the tree. Optimal timing of trunk injections occurs after trees have leafed out in spring but before EAB eggs have hatched, or generally between mid-May and mid-June. Uptake of trunk-injected insecticides will be most efficient when trees are actively transpiring. Best results are usually obtained by injecting trees in the morning when soil is moist but not saturated. Uptake will be slowed by hot afternoon temperatures and dry soil conditions.

Noninvasive, Systemic Basal Trunk Sprays

Dinotefuran is labeled for application as a noninvasive, systemic bark spray for EAB control. It belongs to the same chemical class as imidacloprid (neonicotinoids) but is much more soluble. The formulated insecticide is sprayed on the lower five to six feet of the trunk using a common garden sprayer and low pressure. Research has shown that the insecticide penetrates the bark and moves systemically throughout the rest of the tree. Dinotefuran can be mixed with surfactants that may facilitate its movement into the tree, particularly on large trees with thick bark. However, in field trials, adding a surfactant did not consistently increase the amount of insecticide recovered from the leaves of treated trees.

The basal trunk spray offers the advantage of being quick and easy to apply and requires no special equipment other than a garden sprayer. This application technique does not wound the tree, and when applied correctly, the insecticide does not enter the soil.

Protective Cover Sprays

Insecticides can be sprayed on the trunk, branches and (depending on the label) foliage to kill adult EAB beetles as they feed on ash leaves, and newly hatched larvae as they chew through the bark. Thorough coverage is essential for best results. Products that have been evaluated as cover sprays for control of EAB include some specific formulations of permethrin, bifenthrin, cyfluthrin and carbaryl (see Table 1).

Protective cover sprays are designed to prevent EAB from entering the tree and will have no effect on larvae feeding under the bark. Cover sprays should be timed to occur when most adult beetles are feeding and beginning to lay eggs. Adult activity can be difficult to monitor because there are no effective pheromone traps for EAB. However, first emergence of EAB adults generally occurs between 450-550 degree days (starting date of January 1, base temperature of 50°F), which corresponds closely with full bloom of black locust (*Robinia pseudoacacia*). For best results, consider two applications, one at 500 DD_{50} (as black locust approaches full bloom) and a second spray four weeks later.

How Effective Are Insecticides for Control of EAB?

Extensive testing of insecticides for control of EAB has been conducted by researchers at Michigan State University (MSU) and The Ohio State University (OSU). Results of some of the MSU trials are available at **www.emeraldashborer.info**.

Soil-Applied Systemic Insecticides

Efficacy of imidacloprid soil injections for controlling EAB has been inconsistent; in some trials EAB control was excellent, while others yielded poor results. Differences in application protocols and conditions of the trials have varied considerably, making it difficult to reach firm conclusions about sources of variation in efficacy. For example, an MSU study found that low-volume soil injections of imidacloprid applied to small trees averaging 4 inches in DBH (diameter of the trunk at breast height) using the Kioritz applicator (a hand-held device for making low-volume injections) provided good control at one site. However, control was poor at another site where the same application protocols were used to treat larger trees (13-inch DBH). Imidacloprid levels may have been too low in the larger trees to provide adequate control. Higher pest pressure at the second site also may have contributed to poor control in the large trees.

In the same trials, high-pressure soil injections of imidacloprid (applied in two concentric rings, with one at the base of the tree and the other halfway to the drip line of the canopy) provided excellent control at one

site. At another site, however, soil injections applied using the same rate, timing and application method were completely ineffective, even though tree size and infestation pressure were very similar. It should be noted that recent studies have shown that imidacloprid soil injections made at the base of the trunk result in more effective uptake than applications made on grid or circular patterns under the canopy.

Imidacloprid soil drenches have also generated mixed results. In some studies conducted by MSU and OSU researchers, imidacloprid soil drenches have provided excellent control of EAB. However, in other studies, control has been inconsistent. Experience and research indicate that imidacloprid soil drenches are most effective on smaller trees and control of EAB on trees with a DBH that exceeds 15 inches is less consistent.

This inconsistency may be due to the fact that application rates for systemic insecticides are based on amount of product per inch of trunk diameter or circumference. As the DBH of a tree increases, the amount of vascular tissue, leaf area and biomass that must be protected by the insecticide increases exponentially. Consequently, for a particular application rate, the amount of insecticide applied as a function of tree size is proportionally decreased as trunk diameter increases. Hence, the DBH-based application rates that effectively protect relatively small trees can be too low to effectively protect large trees. Some systemic insecticide products address this issue by increasing the application rate for large trees.

In an OSU study with larger trees (15- to 22-inch DBH), Xytect™ (imidacloprid) soil drenches provided most consistent control of EAB when applied experimentally at twice the rate that was allowed at that time. Recently, the Xytect™ label was modified to allow the use of this higher rate, which we now recommend when treating trees larger than 15-inch DBH. Merit® imidacloprid formulations, however, are not labeled for application at this high rate. Therefore, when treating trees greater than 15-inch DBH with Merit® soil treatments, two applications are recommended, either in the fall and again in the spring, or twice in the spring, about four weeks apart (for example in late April and again in late May). This is not an option for Bayer Advanced™ Tree and Shrub Insect Control and other homeowner formulations of imidacloprid, which are limited by the label to one application per year. Homeowners wishing to protect trees larger than 15-inch DBH should consider having their trees professionally treated.

All treatment programs must comply with the limits specified on the label regarding the maximum amount of insecticide that can be applied per acre during a given year.

Trunk-Injected Systemic Insecticides

Emamectin benzoate

In several intensive studies conducted by MSU and OSU researchers, a single injection of emamectin benzoate in mid-May or early June provided excellent control of EAB for at least two years, even under high pest pressure. For example, in a highly-replicated study conducted on trees ranging in size from 5- to 20-inch DBH at three sites in Michigan, untreated trees had an average of 68 to 132 EAB larvae per m^2 of bark surface, which represents high pest pressure. In contrast, trees treated with emamectin benzoate had, on average, only 0.2 larvae per m^2, a reduction of > 99 percent. When additional trees were felled and debarked two years after the emamectin benzoate injection, there were still virtually no larvae in the treated trees, while adjacent, untreated trees at the same sites had hundreds of larvae.

In two OSU studies conducted in Toledo with street trees ranging in size from 15- to 25-inch DBH, a single application of emamectin benzoate also provided excellent control for two years. There was no sign of canopy decline in treated trees and very few emergence holes, while the canopies of adjacent, untreated trees exhibited severe decline and extremely high numbers of emergence holes.

One study suggests that a single injection of emamectin benzoate may even control EAB for three years. Additional studies to further evaluate the long-term effectiveness of emamectin benzoate are underway. To date, this is the only product that controls EAB for more than one year with a single application. In addition, in side-by-side comparisons with other systemic products (neonicotinoids), emamectin benzoate was more effective.

Imidacloprid

Trunk injections with imidacloprid products have provided varying degrees of EAB control in trials conducted at different sites in Ohio and Michigan. In an MSU study, larval density in trees treated with Imicide® injections were reduced by 60 percent to 96 percent, compared to untreated controls. There was no apparent relationship between efficacy and trunk diameter or infestation pressure. In another MSU trial, imidacloprid trunk injections made in late May were more effective than those made in mid-July, and IMA-jet® injections provided higher levels of control than did Imicide®, perhaps because the IMA-jet® label calls for a greater amount of active ingredient to be applied on large trees. In an OSU study in Toledo, IMA-jet® provided excellent control of EAB on 15- to 25-inch trees under high pest pressure when trees were injected annually. However, trees that were injected every other year were not consistently protected.

In a discouraging study conducted in Michigan, ash trees continued to decline from one year to the next despite being treated in both years with either imidacloprid (Imicide®, Pointer™) or Bidrin (Inject-A-Cide B®) trunk injections. Imicide®, Pointer™ and Inject-A-Cide B® trunk injections all suppressed EAB infestation levels in both years, with Imicide® generally providing best control under high pest pressure in both small (six-inch DBH) and larger (16-inch DBH) caliper trees. However, larval density increased in treated and untreated trees from one year to the next. Furthermore, canopy dieback increased by at least 67 percent in all treated trees (although this was substantially less than the amount of dieback observed in untreated trees). Although untreated trees were more severely impacted, these results indicate that even consecutive years of treatment with these trunk-injection treatments may only slow or delay ash decline when pest pressure is severe.

In three other side-by-side comparisons, Imicide® consistently provided higher levels of control than did Pointer™. In another MSU study, ACECAP® trunk implants (active ingredient is acephate) were not effective under high pest pressure.

Noninvasive Basal Trunk Sprays with Dinotefuran

Studies to date indicate that systemic basal trunk sprays with dinotefuran are about as effective as imidacloprid treatments. MSU and OSU studies have evaluated residues in leaves from trees treated with the basal trunk spray. Results show that the dinotefuran effectively moved into the trees and was translocated to the canopy at rates similar to those of other trunk-injected insecticides, and faster than other soil-applied neonicotinoid products.

As with imidacloprid treatments, control of EAB with dinotefuran has been variable in research trials. In an MSU study conducted in 2007 and 2008, dinotefuran trunk sprays reduced EAB larval density by approximately 30 percent to 60 percent compared to the heavily infested untreated trees. The treatment was effective for only one year and would have to be applied annually. In general, control is better and more consistent in smaller trees than in large trees, but more research is needed with larger trees. Studies to address the long-term effectiveness of annual dinotefuran applications for control of EAB are underway.

Protective Cover Sprays

MSU studies have shown that applications of Onyx™, Tempo® and Sevin® SL provided good control of EAB, especially when the insecticides were applied in late May and again in early July. Acephate sprays were less effective. BotaniGard® (*Beauvaria bassiana*) was also ineffective under high pest pressure. Astro® (permethrin) was not evaluated against EAB in these tests, but has been effective for controlling other species of wood borers and bark beetles.

In another MSU study, spraying Tempo® just on the foliage and upper branches or spraying the entire tree were more effective than simply spraying just the trunk and large branches. This suggests that some cover sprays may be especially effective for controlling EAB adults as they feed on leaves in the canopy. A single, well-timed spray was also found to provide good control of EAB, although two sprays may provide extra assurance given the long period of adult EAB activity.

It should be noted that spraying large trees is likely to result in a considerable amount of insecticide drift, even when conditions are ideal. Drift and potential effects of insecticides on non-target organisms should be considered when selecting options for EAB control.

Key Points and Summary Recommendations

- Insecticides can effectively protect ash trees from EAB.
- Unnecessary insecticide applications waste money. If EAB has not been detected within 10-15 miles, your trees are at low risk. Be aware of the status of EAB in your location. Current maps of known EAB populations can be found at **www.emeraldashborer.info**. Remember, however, that once a county is quarantined, maps for that county are no longer updated.
- Trees that are already infested and showing signs of canopy decline when treatments are initiated may continue to decline in the first year after treatment, and then begin to show improvement in the second year due to time lag associated with vascular healing. Trees exhibiting more than 50 percent canopy decline are unlikely to recover even if treated.
- Emamectin benzoate is the only product tested to date that controls EAB for more than one year with a single application. It also provided a higher level of control than other products in side-by-side studies.
- Soil drenches and injections are most effective when made at the base of the trunk. Imidacloprid applications made in the spring or the fall have been shown to be equally effective.
- Soil injections should be no more than 2-4 inches deep, to avoid placing the insecticide beneath feeder roots.
- To facilitate uptake, systemic trunk and soil insecticides should be applied when the soil is moist but not saturated or excessively dry.
- Research and experience suggest that effectiveness of insecticides has been less consistent on larger trees. Research has not been conducted on trees larger than 25-inch DBH. When treating very large trees under high pest pressure, it may be necessary to consider combining two treatment strategies.
- Xytect™ soil treatments are labeled for application at a higher maximum rate than other imidacloprid formulations, and we recommend that trees larger than 15-inch DBH be treated using the highest labeled rate. Merit® imidacloprid formulations are not labeled for use at this higher rate. When treating larger trees with Merit® soil treatments, best results will be obtained with two applications per year. Imidacloprid formulations for homeowners (Bayer Advanced™ Tree & Shrub Insect Control and other generic formulations) can be applied only once per year.
- Homeowners wishing to protect trees larger than 15-inch DBH should consider having their trees professionally treated.
- All treatment programs must comply with label restrictions on the amount of insecticide that can be applied per acre in a given year.

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May 2009

BEFORE THE BUG COMES TO TOWN

Developing a State or Regional Readiness and Response Plan for Exotic Invasive Insects

PLAN DEVELOPMENT

An invasive pest can be a huge threat to the balance of the urban ecosystem. Managing an infestation – all the essential education, administration, information, communication, and regulation issues that need to be coordinated – is a staggering task for any agency. The main purpose for undertaking readiness planning *before* the bug comes to town is to learn as much as possible ahead of time, collaborate to share resources and information, and create a network to strengthen a coordinated response. **The primary goal is to protect the resource** to the extent possible.

1. BUILDING A TEAM - Bringing together stakeholders

A team approach is essential to tackle the imposing threat of an exotic species invasion. A strong and diverse team can be much more effective through collaboration, than any one organization can be alone. Members of the team should bring useful and important knowledge and experience to the planning effort. The team itself creates a critical network for information sharing and dissemination and supports and energizes individual member organizations in preparedness activities. A team working to plan for protection of the urban and community forest should include the following partners:

Regulatory agencies
- USDA APHIS-PPQ*
- State Department of Agriculture

Supporting agencies
- USDA* Forest Service – State and Private Forestry
- State Department of Natural Resources

Researchers
- Universities/Colleges
- USDA Forest Service – Research
- State Natural History Survey

Educators
- Arboreta and Botanic Gardens
- Non-profit organizations related to tree/forest issues

Resource managers
- Municipal Foresters Associations
- Local, County, Regional, and State Park Agencies
- Parks and Recreation Associations
- Forest Preserves
- Consulting Foresters Associations

Industry
- Arborist Associations
- Landscape Contractors Associations
- Nursery/Growers Associations
- Wood Products Associations
- Forestry Councils
- Golf Course Superintendent Associations

Municipalities
- Regional Councils of Governments
- Mayors & Managers Associations
- Individual Municipalities
- County and Township Agencies

Organizations/Agencies involved in outbreaks in other states

2. WHAT IS AT RISK? - Calculating consequences of infestation

In order to garner support, interest, and collaboration for readiness planning, it is important to determine the following:

- What is the extent of the resource at risk?
  (e.g. 6% of the forest cover is ash, 19% of all public trees are ash, and 35% of the public canopy cover is ash)
  - Research FIA* data for rural forests
  - State natural resources department
  - Survey of city foresters for urban forest data

- What consequences could arise from the infestation?
  (e.g. loss of canopy and resulting economic and environmental impacts such as increase in stormwater runoff; expenses associated with removal and replanting; visual/aesthetic impacts; property loss, hazardous conditions with dead standing trees; private homeowner assistance needs – be specific!)
  - Readiness planning team members can contribute from various perspectives
  - Research consequences of infestation in other states

3. WHAT IS ALREADY BEING DONE? – Coordinate with existing plans

APHIS* is directing all states to develop "Plant Resource Emergency Response Guidelines." These guidelines outline the legal authority, roles and responsibilities of various agencies and organizations, and a system for rapid response to an insect, disease, or weed that impacts plants. These general guidelines may be useful in developing a species-specific preparedness/response plan. For information about the status of your state's guidelines, contact your State Plant Health Director or State Plant Regulatory Official (visit the following websites for directories by state):

- State Plant Regulatory Officials
  http://nationalplantboard.org/member/index.html

- State Plant Health Directors
  http://ceris.purdue.edu/napis/names/sphdXstate.html

Look to management plans from other state. APHIS PPQ develops manuals and guidelines for all kinds of introduced pests. Review relevant manuals (e.g. New Pest Response Guidelines Asian Longhorned Beetle) to glean ideas for regional readiness.

- APHIS manuals for introduced pests
  http://www.aphis.usda.gov/ppq/manuals/online_manuals.html

Utilize the resources of the National Invasive Species Information Center, an interdepartmental coordinating council of federal agencies that compiles numerous model management and control plans into a Manager's Toolkit.

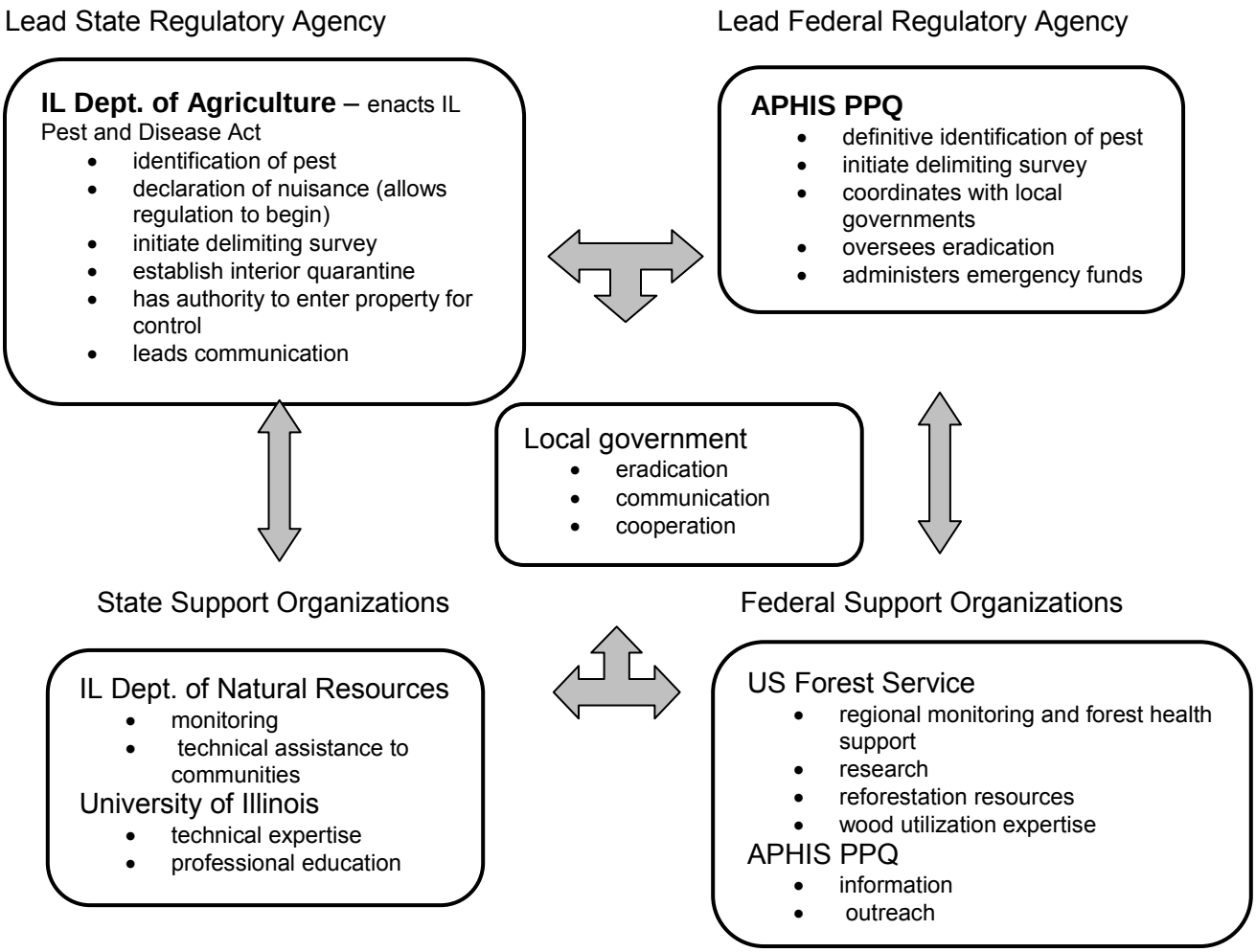
- Invasive Species Manager's Toolkit
  http://www.invasivespecies.gov/toolkit/main.shtml

4. WHAT HAVE YOU GOT? Identifying strengths, capacity, resources, and programs

- Determine who has authority and responsibility
- Inventory existing programs and efforts to educate, monitor and reduce risk

- Identify strengths
  (e.g. strong green industry professional networks to educate and disseminate information, previous ALB experience had success with public awareness and support)
- Find mechanisms to distribute information
- Locate expertise in team organizations
  (e.g. where are the entomologists, foresters, communications specialists, and lobbyists?)
- Look for sources of funds
  (e.g. US Forest Service Forest Health Program, APHIS, State Department of Agriculture, professional organizations, State Urban Forestry Grants, Councils of Governments, state and federal legislature)

Example: Illinois Authorities and Resources



5. WHERE ARE THE GAPS? - Identifying needs, shortages, and hindrances

- Are the public agencies adequately staffed and supported?
- Are all at-risk land managers engaged?
- What information do we need to know before we can plan?
- Are there any policies, attitudes or programs that would be obstacles to readiness?
  (e.g. Do state regulatory statutes allow for rapid response? Is there political support?)

6. WILL IT HAPPEN TO YOU? - Determining vulnerability

- What geographic area is at highest risk?

(e.g. most of the ash forests are in the Northeast part of the state--Windham, Olmsted, Orleans, and Lawrence Counties, most of the public ash trees are located in the highly populous areas of the Chicago metro)

- Where is the most probable source of an infestation?
  (e.g. human movement such as nursery stock, wood products and firewood transfer from out-of-state infested site)
- Where is the most probable port of entry into the state?
  (e.g. 1. urban areas with newly planted ash (from nursery stock),
  2. recreation areas like campgrounds from firewood transfer,
  3. Chicago due to its large population and proximity to Michigan and Indiana; because it is a major port for foreign shipments; there is a high concentration of industry and because there are multiple ports of entry via train, auto, and ship)

7. DRAFT A PLAN. - With consensus from major stakeholders draft a plan to guide planning and prioritize action.

8. MAINTAIN READINESS.

- Share evolving issues, actions, information and technology with team members.
- Collaborate with team member to act on key steps in the readiness plan.
  (e.g. Collaborate with land owners and universities to conduct a detection survey.)
- Inform stakeholders and constituents of plan and state of readiness.
- Communicate with the media about the plan and achievements to foster public cooperation and confidence.

PLAN COMPONENTS

This is an example of a plan developed in Illinois to prepare for the emerald ash borer (EAB):

1. **Readiness-** reduce risk, minimize impact, and respond more effectively to a possible infestation and work towards overall health and sustainability of the urban forest in Illinois and northeast Indiana
   A. <u>Administrative Readiness</u>
      1) Establish a network of agencies and organizations to be affected by EAB
         a. Statutory Administrative Team – lead regulatory agencies
         b. Technical and Administrative Team
         b. Education and Communication Team
      2) Finalize Develop an EAB Readiness Plan
      3) Identify resources and needs
      4) Take proactive steps to speed administrative processes i.e., shorten time required to establish quarantine
      5) Educate the media and assure accuracy of information
   B. <u>Technical Readiness</u>
      1) Review and distribute federal scientific guidelines to advise actions
      2) Advocate for continued research for greater understanding of EAB and management options
      3) Transfer technology

2. **Prevention infestation** – to assure that all means of introduction are known and blocked, whenever possible
    A. Assess Risk
        1) Identify possible sources of EAB importation (i.e., firewood and nursery stock from Michigan)
        2) Assess the scope of the resource at risk (number of ash trees)
        3) Track spread of EAB and distribute to Readiness Team
    B. Reduce Risk
        1) Advocate for appointment of vital vacant positions
        2) Raise public awareness about risk from firewood importation
        3) Track nursery stock, ash lumber and ash firewood importation in recent past
        4) Educate industries about risk of ash importation
        5) Assure plantings selections contribute to a diverse and sustainable urban forest
        6) Seek legislative support to reduce risk

3) **Identification** – minimize the spread and improve odds of containing an infestation
    A. Survey urban ash populations to quickly find, or rule out the presence of EAB
    B. Offer training and outreach to landscapers, arborists, nurserymen and other green industry workers to accurately identify EAB
    C. Educate general public about ash health and EAB
    D. Establish a hotline and a website
    E. Support full staffing of IDA Inspectors to respond quickly to possible sightings

4) **Response** - contain infestation and manage the EAB population
    A. Implement coordinated effort to contain the infestation
    B. Provide accurate information to the media through EAB Teams
    C. Communicate with public and industry professionals to foster cooperation to maximize effective response
    D. Reforest

*ACRONYMS

Federal Organizations:
APHIS – Animal and Plant Health Inspection Service
PPQ – Plant Protection and Quarantine (Under APHIS)
FEMA – Federal Emergency Management Agency
USDA – United States Department of Agriculture
FS – Forest Service

State Organizations:
DNR – State Department of Natural Resources
DA – State Department of Agriculture
EMA – State Emergency Management Agency
FHP – Forest Health Program

Other:
FIA – Forest Inventory and Analysis (program of the USDA Forest Service)
ALB – Asian longhorned beetle
EAB - emerald ash borer

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