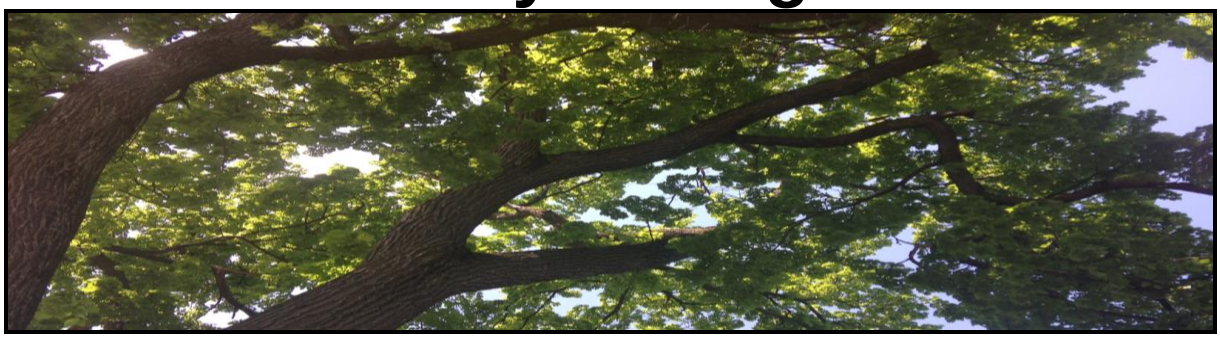
City of Berwyn

Urban Forestry Management Plan



Prepared by

Natural Path Urban Forestry Consultants

February, 2014

Table of Contents

1. Executive Summary

Natural Path Urban Forestry Consultants was contracted by City of Berwyn to conduct an assessment of the street tree population, develop an Urban Forestry Management Plan, and provide technical support. The impetus for the project was the Emerald Ash Borer (EAB) outbreak and the general desire to enhance community level urban forestry management practices and encourage the development of long-term policies based on the data collected. The project was funded, in part, by a grant from the United States Forest Service, administered by the Metropolitan Mayors Caucus.

Urban forestry is the term associated with the management of a City's tree population, a natural resource that provides important environmental, aesthetic, and economic benefits to the community over decades. Many communities throughout the United States have limited staff, equipment, and fiscal resources to manage their public trees. In addition, the treatment, removals, and replacement of the EAB infested ash trees have increased stress on municipal resources. City trees must be properly and routinely cared for to ensure the safety of the residents, foster a steady population of high-quality trees and to provide maximum benefits over time. The overall goal of urban forest management is to promote a healthy, diverse, safe, and sustainable urban forest that benefits the current and future residents of the community.

A total of 12,981 public trees were inventoried and mapped in Berwyn during this project. Their annual environmental contribution to the community is calculated to be about $**2,315,175**. The appraised value of Berwyn's municipal trees is 20.6 million dollars.

A management plan is implemented in the hopes of finding solutions to some of the complex issues that communities must contend with while also providing ongoing technical support. Many programs are reactive in nature because of the limited resources available. However, a proactive plan focuses on regular and preventative maintenance which in turn will promote a more stable forest and a balanced use of City resources. With the conclusion of the inventory and management plan phase, the implementation of support for the City of Berwyn will be provided by Natural Path Urban Forestry Consultants over the next year. Manageable goals include:

1) Initiating a pruning cycle to allow uniform and consistent care
2) Initiate a risk management program that identifies and mitigates high-risk trees in a timely fashion
3) Implement a planting program that focuses on diversity, appropriate placement and high-quality species
4) Increase staff and community knowledge, participation, and care
5) Mitigate the heavily EAB-infested ash population.

Two assessments within the project provide a broad understanding of the City's entire street tree system. First, a 100% inventory of all public trees of the City was conducted. Data included tree location, species, diameter, condition, defects, and maintenance needs. Each tree was also mapped and incorporated into a Geographic Information System (GIS). Second, the collected data was used to calculate forest canopy benefits using the United States Forest Service cost/benefit program *iTree Streets.*

This plan is presented with the intention of maintaining and enhancing the City's urban forestry program. NPUFC is confident that these recommendations are achievable given the City's existing and potential resources and that project will help lay the foundation for identifying the long-term partnership required by local, State, and private sector entities to realize a progression into managed urban forestry systems.

Mark Duntemann

Natural Path Urban Forestry Consultants

February, 2014

2. The Urban Forest Assessment

A total of 13,007 items were inventoried and mapped on the City's public streets. This included 12,981 trees and 26 stumps. The data was collected by a number of Natural Path staff over the course of the winter. This section separates the analysis of that data into three components: the whole population, the ash population, and the *iTree Streets* analysis.

2.1 The Urban Forest: Whole Population

Attachment 1 details each of the unique data fields collected during the data collection phase. (**See Attachment 1 – Tree Inventory Data Fields**) The following tables summarize the more relevant elements of the City of Berwyn's tree population.

Species Distribution: Table 1 presents data on species composition for the 10 most common species identified during the project. This distribution is helpful for understanding species dominance and City-wide issues such as species diversity and species specific maintenance burdens. There are 97 total species represented in Berwyn; any species that makes up more that 5% of the total population should be considered over-represented. Berwyn has four species that meet this criterion (Norway Maple, Silver Maple, Red Maple, and Green Ash).

Table 1 – Species Distribution

Species	Number	Percent
Maple, Norway	3,645	28.1%
Maple, Silver	2,352	18.1%
Maple, Red	1,296	10.0%
Ash, Green	1,190	9.2%
Honeylocust	605	4.7%
Linden, American	467	3.6%
Ash, White	401	3.1%
Spruce, Colorado	296	2.3%
Pear, Flowering	254	2.0%
Crabapple	220	1.7%
Balance of Species	2,255	17.4%
Total	**12,981**	**100.0%**

Genus Distribution: Table 2 presents the genus composition of the City for the ten most abundant genera. The significance of this table is identifying the number of trees that may have genus-specific pathology issues. For example, approximately 12.3% of the street tree population (1,598 trees) are in the ash genus and susceptible to the Emerald Ash Borer.

Table 2 – Genus Distribution

Genus	Number	Percent
Maple	7,630	58.8%
Ash	1,598	12.3%
Linden	637	4.9%
Honeylocust	605	4.7%
Spruce	349	2.7%
Pear	255	2.0%
Apple	225	1.7%
Elm	217	1.7%
Sycamore	164	1.3%
Cherry	145	1.1%
Balance of Genus	1,156	8.9%
Total	**12,981**	**100.0%**

Diameter Distribution: Diameter distribution offers tree data that is presented in terms of diameter size class. This detail is important for determining current management needs as well as anticipating how needs will change given total numbers and aging of individual species. The size distribution of within a tree population influences present and future costs as well as the flow of benefits. A staggered or uneven-aged population allows managers to allocate annual maintenance costs uniformly over many years and assure continuity in overall tree canopy coverage. **Table 3** provides diameter class data for the City of Berwyn's urban forest.

Table 3 - Diameter Distribution

Diameter Class	Quantity	Percent
1 – 6"	1,459	11.2%
7 - 12"	2,690	20.7%
13 – 18"	3,536	27.2%
19 – 24"	2,708	20.9%
25 – 30"	1,512	11.6%
31 – 36"	784	6.0%
37 – 42"	219	1.7%
43"+	73	0.6%
Total	**12,981**	**100.0%**

Condition: The condition distribution, as presented in **Table 4** affords a snapshot of the overall health of Berwyn's trees. Tree condition can be an indicator of how well trees are managed and their relative performance given site-specific conditions. It also provides a general idea of the number of trees that may be of significant consequence in the short term. In this instance, 1,832 trees are in poor or worse condition.

Table 4 – Condition Distribution

Condition	Number	Percent
Excellent	526	4.1%
Good	5,525	42.6%
Fair	5,098	39.3%
Poor	1,504	11.6%
Very Poor	291	2.2%
Dead	37	0.3%
Total	**12,981**	**100.00%**

Table 5 summarizes the condition distribution of the trees that had a maintenance action assigned to them. Actions were assigned to trees if relatively immediate issues were identified. All of the ash trees in very poor or worse condition have some mitigation assigned to them. Most of the removals are derived from the poor or worse condition classes. Taking actions on these trees is evidence of a developing program that identifies and mitigates the trees that pose the greatest risk potential to Berwyn's residents and visitors.

Most of the monitor trees are ash that show early signs of EAB and may need to be removed in the next year. The non-ash in this category are trees that did not immediately require removal, but should be inspected annually. A large number of trees require some form of crown cleaning to eliminate large dead wood or poor structure.

Table 5 – Condition Distribution by Action

Action	Condition Class						Total
	Excellent	Good	Fair	Poor	Very Poor	Dead	
Monitor	0	7	154	161	7	0	**329**
Prune	1	85	841	309	8	0	**1,244**
Cable	0	0	8	4	0	0	**12**
Remove	0	0	1	316	260	36	**613**
Grind Stump	0	0	0	0	0	26	**26**

2.2 The Urban Forest: Ash Population

The ash genus is highlighted here in greater detail because of the current issue of Emerald Ash Borer in Illinois. There are approximately six species of ash found in urban settings in Illinois. Four of these were identified in Berwyn. They were green ash (*Fraxinus pennsylvanica*), and white ash (*Fraxinus Americana,* black ash (*Fraxinus nigra*), and blue ash *(Fraxinus quadrangulata)*. Green ash dominates the ash population with 1,191 trees. **Table 6** shows the condition distribution for these two species. The ash were primarily found to be in the fair and poor condition classes.

The value of the ash condition distribution is that it allows communities to identify short-term mitigation goals, such as removals and chemical treatment. When considering removals, short-term implies within the next three year and include trees that are in poor or worse condition and have diminishing environmental benefits to the community. Additionally, the condition data identifies the trees that might be considered for enhanced treatment –trees in good or better condition.

Table 6 – Condition Distribution by Ash Species

Species	Condition Class						Total
	Excellent	Good	Fair	Poor	Very Poor	Dead	
Ash, Green	0	31	432	561	149	18	**1,191**
Ash, White	5	235	153	6	1	1	**401**
Ash, Black	0	1	2	0	0	0	**3**
Ash, Blue	0	0	3	0	0	0	**3**
Total	**5**	**267**	**590**	**567**	**150**	**19**	**1,598**

Table 7 summarizes the diameter distribution of the ash population in six-inch size classes. The largest number of trees in this population is in the 12-18 inch size class. Based on age studies in the Chicago area, ash trees of this size are approximately ten to thirty years old. The table also lists a summary of the number of inches that can be found within each size class, providing a basis for projecting present and future costs of arboricultural services. There is a total of 26,718 inches of ash in Berwyn.

Table 7 - Ash Diameter Distribution

		Diameter Class								
		6”	12”	18”	24”	30”	36”	42”	43”+	Total
Ash	**Quantity**	59	446	548	287	196	52	9	1	**1,598**
	Total Inches	**302**	**4,502**	**8,329**	**6,128**	**5,314**	**1,738**	**356**	**49**	**26,718**

Table 8 provides data summaries within a condition/diameter matrix. It is expected that most of the trees in good or better condition can be found in the smaller size classes, as there is an inverse relationship between diameter and condition ratings. Essentially, as diameters increase, conditions naturally decrease. Because chemical treatment and arboricultural costs are closely tied to diameter, the information in Table 8 can provide guidance regarding the prioritization of enhanced care for the City's trees. Specifically, trees that are in good or better condition and of a size that allows the maximum number of trees to be managed within the City's limited fiscal resources should be one short-term focus.

Table 8 - Ash Condition/Diameter Distribution

Condition	Diameter Class									
	6"	**12"**	**18"**	**24"**	**30"**	**36"**	**42"**	**43"+**	**Total Number**	**Total Inches**
Excellent	4	1	0	0	0	0	0	0	5	**32**
Good	18	143	94	9	2	1	0	0	267	**3,146**
Fair	27	208	201	87	54	10	3	0	590	**9,050**
Poor	8	80	200	142	99	34	4	0	567	**10,947**
Very Poor	2	14	45	45	35	6	2	1	150	**3,232**
Dead	0	0	8	4	6	1	0	0	19	**411**
Total	**59**	**446**	**548**	**287**	**196**	**52**	**9**	**1**	**1,598**	**26,718**

2.3 *iTree Streets* Analysis Summary

The assessment and application used for this component of the project was the United States Forest Service ***Streets*** software. ***Streets*** is a shareware application that is part of the larger *iTREE* suite of urban forestry analysis programs. ***Streets*** is a user-friendly software tool that is intended for municipal street trees. It enables a community to inventory and assess the benefits that its urban forest is providing. The analysis provides baseline data from which one can improve the management of the urban forest. The application assesses the following aspects of a street tree population:

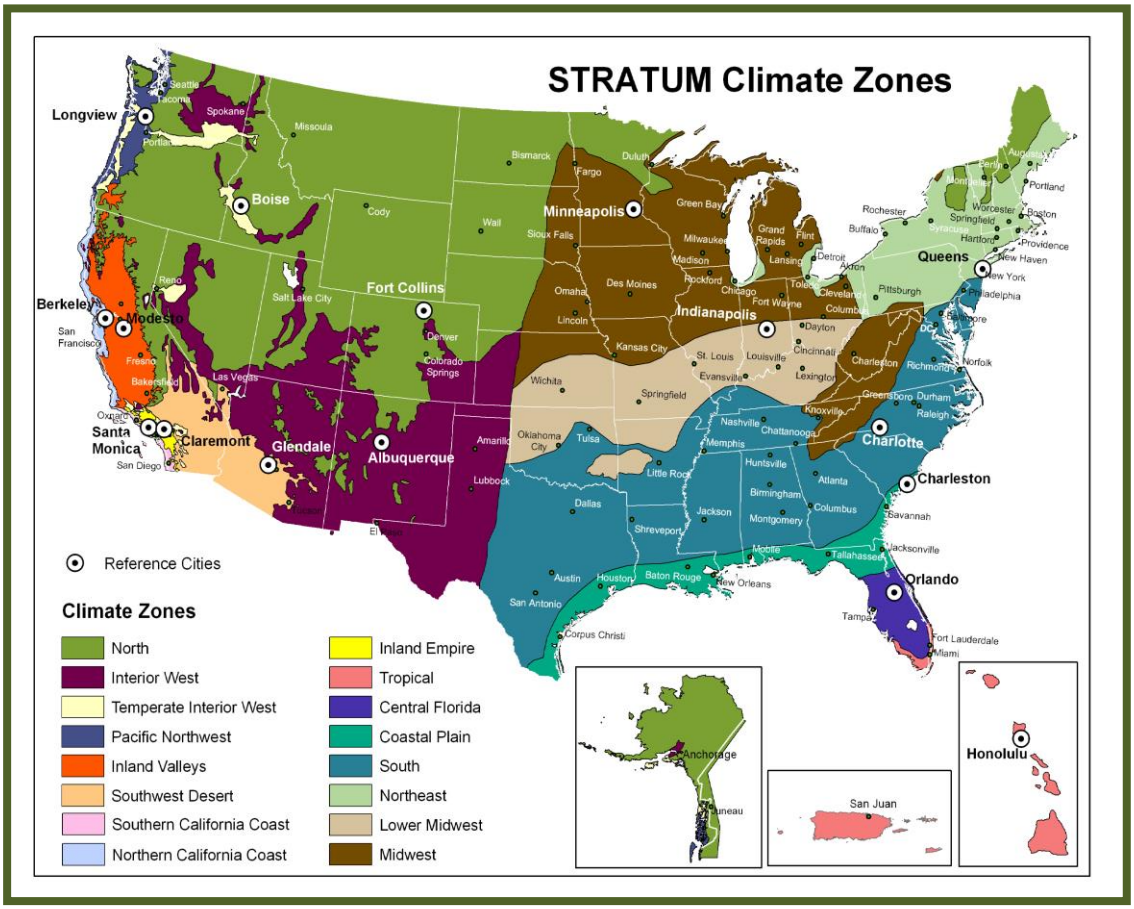
Structure: Defines the species composition, age distribution, species importance values, and canopy cover of the urban forest, helping managers anticipate future planting needs and the potential impact of pest threats.

Function: The core of ***Streets*** is its capacity to analyze the ecosystem services, i.e., the function that the urban forest is providing. These services include energy conservation, air quality improvement, storm water management, and carbon dioxide reduction. Increased property values due to aesthetic and other benefits are also calculated.

Value: ***Streets*** quantifies the environmental and other benefits that the urban forest is providing, this is both in unit terms (e.g., kilowatt hours of electricity conserved) and in dollars. Management costs can be included in the analysis to determine the return on investment the trees are providing.

The regional values used in the ***Streets*** application were based on research data from a range of communities within climate zones of the country. Northern and Central Illinois is within the Midwest climate zone (see **Graphic 2** below). The USFS Midwest Tree Guide accompanies this report and provides the details on the local parameters used in determining Berwyn's forest values.

As previously stated, ***Streets*** calculates the environmental and financial benefits provided by the urban forest. The data provided in ***iTreeStreets*** are divided into Benefit Analysis and Resource Structure Analysis; below are summaries of the Benefit Analysis and the Replacement Values.



Graphic 2: iTree Streets Climate Zones

Benefit Analysis

Calculations are provided as annual benefits and are presented in terms of resource units and dollars. The United States Forest Service's publication Midwest Community Tree Guide details how benefits were calculated in each of the categories listed. The benefits are:

Energy: The Energy report presents the energy conservation contributions of the urban forest in terms of reduced natural gas use in winter (measured in therms or gigajoules) and reduced electricity use for air conditioning in summer (measured in kilowatt-hours).

Stormwater: The Stormwater report presents the reductions in annual stormwater runoff due to rainfall interception by trees (measured in gallons or cubic meters).

Air quality: The Air Quality report quantifies the air pollutants (i.e., O3, NO2, SO2, PM10) deposited on tree surfaces and reduced emissions from power plants (i.e., NO2, PM10, VOCs, SO2) due to reduced electricity use (measured in pounds or kilograms). Also reported are the potential negative effects of trees on air quality due to Biogenic Volatile Organic Compounds (BVOC) emissions.

Carbon dioxide: The Carbon Dioxide report presents *annual* reductions in atmospheric CO_2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use (in pounds or kilograms). The model accounts for CO_2 released as trees die and decompose as well as CO_2 released during the care and maintenance of trees. The *Carbon Stored* report tallies all of the carbon dioxide stored in the urban forest *over the life of the trees* as a result of sequestration (in pounds or kilograms).

Aesthetic/other: The Aesthetic/Other report presents the tangible and intangible benefits of trees reflected in increases in property values (in dollars).

The total annual benefit that the residents of Berwyn derive from their street trees is $**2,315,175**. **Table 9** delineates the dollar amount from each of the areas outlined above.

Table 9 – Benefits Analysis ($)

Item	Value
Energy Conservation	$ 606,928
Carbon Dioxide Capture	$ 86,922
Air Quality Enhancement	$ 103,615
Stormwater Retention	$ 775,207
Aesthetic Value	$ 742,433
Total	**$ 2,315,175**

Replacement Values

The Replacement Values report estimates the appraised value of trees in their current condition, should they be removed. Replacement values are based on the Council of Tree and Landscape Appraisers (CTLA) Guide for Plant Appraisal, which uses a trunk formula methodology. The CTLA is a widely accepted methodology used by arborists for determining landscape tree replacement value based on regional species ratings, condition, location in the landscape, cross-sectional area of the trunk and regional replacement costs. The appraised value of this urban forest is $20,675,988.

3. Management Discussion

Forestry management is an ongoing process and the inventory of public trees is the first step. The assessment of the population allows City managers to determine the necessary immediate action and also to visualize how the forest will progress thereafter. While immediate care is mandatory, forethought in terms of maintenance and planting of the forest as a whole will increase stability and decrease susceptibility to widespread epidemics. Preventative care such as cyclic pruning, diverse and selective planting programs, and implementation of a City-wide risk management plan will address health and structural issues before they become problems. Actual time and money spent servicing trees will decline as problems are addressed before they become costly. Effective management requires that the City managers work to inform their employees as well as their residents to increase awareness and involvement. The overall value of the urban forest and consequently the entire community will be increased by the heightened quality of care. The following narrative outlines the various operational programs and concepts that form the core of a proactive urban forestry program.

3.1 Pruning

Pruning provides a number of benefits to a tree. First and foremost it serves to maintain a tree in a healthy and safe state, while promoting longevity. From early structural pruning to maintenance pruning over a trees mature life, a municipality can play a large role in increasing a tree's age and minimizing the reactive cost of future care such as storm damage. A regular pruning cycle is a critical component of an effective forestry program. The City of Berwyn will derive the following benefits from maintaining the cyclic maintenance program.

- Simply by pruning dead wood, the condition ratings will be upgraded for a large number of Berwyn's trees.
- Service requests and storm damage will be reduced.
- Cyclic maintenance guarantees that every tree in the City will be regularly inspected by staff and/or contractors.
- The City can demonstrate that they are exhibiting "reasonable care" in maintaining their urban forest. The notion of "reasonable care" is the strongest defense the City has in litigation due to a tree, or tree part failure.

Most community forestry programs try to implement a five to eight year pruning cycle. If the City cannot afford to contract services or does not have the time resource to have City staff prune, a combination of options are available to meet this goal. For example, the trimming of trees with diameters over a certain

size can be contracted out and trees with smaller diameters can be maintained by staff. The overall objective is to achieve a cyclic pruning program within fiscal and human resource constraints.

Any pruning activity should follow the American National Standard for Pruning (ANSI A300)—specifically for crown cleaning and raising.

3.2 Plantings

To guarantee the long-term health and a perpetuation of the urban forest, a good program must continue to plant trees on some form of regular basis. An important element of a planting program is species diversification. The Emerald Ash Borer is an example of how disaster can destroy poorly diversified urban forests. As within any ecosystem, species diversity within the City insures against a single disease or blight destroying large sections of the urban forest. The number of different high-quality species should be greatly increased and perpetuated in order to maximize benefits and minimize hazards. The following guidelines provide direction for developing a diverse, healthy, low-maintenance, and aesthetically improved urban forest:

- Long-term (i.e. 20 year) population targets for high-quality species should hover around 5%. The trees should be distributed over time: planted in small numbers on a regular basis. Lower quality species should have targets of less than 5%.
- Trees should be chosen based on their moisture, soil, and light requirements and their growth rate.
- Inspect nursery stock before planting and avoid any trees with damaged trunks, poor form or girdled roots.
- Planting sites should always be selected that maximize tree growth and health and minimize long-term infrastructure conflicts. Soil content, climate, and site size, and surrounding obstacles should be taken into consideration.
- A number of species should be avoided when selecting street trees because they may have a high maintenance cost, short life expectancy, high storm damage potential, and/or a high hazard potential.
- If a uniform visual appearance is desired, choose different species that have similar forms. When selecting trees for their visual effect, consider the tree's size, texture, form, and coloring.
- Species concentrations should be monitored both at the overall town and neighborhood levels.

After a certain age, all trees decline and require greater maintenance. When large numbers of trees are planted within a short time period, they become expensive and difficult to manage all at once. Multiple-aged stands are more desirable because they will disperse maintenance costs.

Slower-growing, longer-living trees minimize maintenance costs. Planting trees that live three times as long means spending approximately one third as much in removal costs over the same number of years. In general, the same slower-growing trees are higher quality and demand less pruning over their lifetime.

Finally, most urban trees have little utilization potential after their removal. Some underused species, such as swamp white oak provide an opportunity to divert wood from waste stream when the tree is removed. There are growing opportunities for converting resilient hardwood trees into high-quality firewood or low- and medium-grade lumber for the large secondary-wood industry in the Illinois area. This activity also introduces a possibility of generating revenue.

3.3 Tree Risk Management

While trees that have been properly cared for throughout their life generally pose little safety concern, there is always some risk associated with maintaining large-diameter, over-mature trees in public use areas. The goal of a risk management program is to develop a comprehensive hazard mitigation program that will increase the safety of the public right-of-way. A strong program provides many City-wide benefits:

- Accurate identification and timely removal of high-risk trees
- Heightened staff awareness of hazard abatement procedures.
- Maintenance of safe public roads and public spaces by reducing potentially hazardous trees and the liability and financial risk associated with them.
- Removal of dead and declining trees to make room for new diverse plantings, which in turn increases the overall health of the community forest.
- Allocation of limited fiscal resources toward maintaining healthy trees
- Demonstration that the City exercises a reasonable degree of care maintaining its urban forest.

Program Establishment

There can be no universal definition of reasonable care for a community's trees since the resources available to each community vary. Reasonable care in respect to high-risk trees should be defined by each community according to its resources. After a reasonable program is established it must be clearly documented. This allows a community to better defend their program if litigation occurs. The documented program must focus on not only how an individual tree is maintained in the community, but also the community policies directed at managing the total urban forest. Program elements:

1) Assess the Tree Population

The City should strive to reduce the most problematic features in the tree population. The tree inventory is the best tool for identifying them. Individually they may not pose a problem, but risk increases when combinations of the following parameters occur:

- High-risk or Problematic Species: high storm damage rate, enhanced structural decay, repetitive dieback, and a short life span.
- Large Diameter Trees: the most immediate attention should be given to trees in the larger-diameter classes
- Trees with Structural Defects: decay, trunk cavities, extensive root rot, etc. A "hazard tree" is any tree or tree part that demonstrates a high risk of failure or fractures, which would result in damage or injury to persons or property.
- Trees in Poor or Worse Condition: Trees in the poorest condition class are the most problematic in the short term to the City.
- High-traffic: Problematic trees located in high-use areas have a greater potential for causing harm.

A look at any combination of these features in the total tree population will result in a filtered list of problematic trees. By evaluating the unique interrelationship of these defects the City can begin to develop a template for an action plan of removal, monitoring and mitigating.

To determine some baseline cost estimates, Natural Path obtained bid quote information from a number of recent bid requests by communities. **Table 10** provides per inch tree removal cost estimates for six size classes. The lowest, highest, and average pricing details were compiled from eight bids.

Table 10 – Removal Cost Comparisons

Diameter Class	Per Inch Cost Comparison (Eight Bidders)		
	Low	High	Average
1 -12”	$7.00	$20.00	**$12.62**
13 – 18”	$7.50	$23.00	**$15.03**
19 – 24”	$11.50	$27.00	**$18.93**
25 – 30”	$13.50	$34.00	**$22.25**
31 – 36”	$15.72	$42.00	**$25.12**
37”+	$15.72	$60.00	**$29.12**

Table 11 provides the anticipated cost to remove the 613 trees identified for removal during the tree inventory project.

Table 11-Cost Estimates for Removing Current List of Removal Trees

Diameter Class	Calculations			
	Quantity	Total Inches	Average Per Inch Price	Total
1 -12	146	1,279	$12.62	$16,141
13 – 18	189	2,916	$15.03	$43,828
19 – 24	144	3,093	$18.93	$58,551
25 - 30	95	2,581	$22.25	$57,427
31 – 36	23	762	$25.12	$19,141
37"+	16	726	$29.12	$21,141
Total	**613**	**11,357**		**$216,229**

2) Evaluate Available Management Resources

Once a refined list of trees has been created, assess the budget and labor force to design a risk management program that is suited to the community:

- Assess Personnel Activities. Schedule tree assessments appropriately (i.e. right before a removal season) and so that they don't interfere with other activities.
- Review Work Schedule. Calculate the time available for staff to conduct assessments and removals of hazard trees. Every facet of a progressive forestry program incorporates risk management.
- Assess the financial resources. It may be possible to modify the budget and personnel time to allow for a slight increase in risk management tasks.

By evaluating management resources a community will be able to define the resource availability and task assignment. The City may find that they have no additional time or money available to conduct assessments, but at least they can document this conclusion.

3) Create a Tree Risk Policy Statement

An established risk reduction policy is the strongest defense a community has in court in respect to hazard trees. Develop a clear policy statement including the following:

- State the City's understanding of its responsibility to maintain a safe public area.
- Identify the manager of the risk reduction program.
- List any general constraints on managing hazard trees such as financial or personnel.
- Define the short and long term goals of the program and develop an action plan for each goal. While several communities may have the same overall goals, the defined objectives and actions will, and should, vary greatly between each community.
- Develop an implement a regular schedule of monitoring and mitigation that can be conducted within the limited resources available to the City.

4) Staff Training Record

The training record verifies that the staff is receiving ongoing and pertinent continuing education. If training records are stored in some other document within the City, a simple reference to its location can be made in the tree risk plan.

- List any and all specific training courses, conferences, and workshops attended. Include the title of the course, the date, the duration, and any applicable CEU credits.
- List any specific certifications achieved. Include the title, affiliation, and date.
- List all "tailgate" training attendance. Include the subject, date and duration.
- List all forensic discussions attended. Include the location, date, species, diameter, type of failure, and the final determination by staff of what caused the failure to occur.

5) Program Review

An annual risk program review allows staff the opportunity to critically evaluate the program over the last year. Staff can determine whether the defined goals are being met. If they are not being met, address why and what to change in the program to realize the planned outcomes. The creation of a tree risk working group for this purpose assures that there is a clear process for the different tree risk elements and activities carried out by the City to be critiqued, modified if necessary, and implemented.

3.4 Emerald Ash Borer Management

Emerald Ash Borer (EAB), *Agrilus planipennis* is an extremely destructive tree-killing beetle. This insect is an invasive species from China that most probably arrived in the United States as larvae living in shipping pallets. The beetle was first discovered in Michigan, but the pest is now devastating the ash tree (genus *Fraxinus*) population in Illinois. These insects can quickly decimate ash populations in an infested area, which poses a significant loss of tree benefits to communities as well as a high financial burden due to the expense of tree removals for municipalities and land owners.

Illinois communities were initially infested in 2006. The State of Illinois declared the insect a statewide nuisance, which allows municipalities some statutory control over eradication measures. (See Attachment 3 – State of Illinois EAB Nuisance Declaration). At the time of this writing, forty-three of the 102 Illinois counties were included in the State-quarantine. (See Attachment 4 – Quarantine Area – September, 2012) The Federal government predicts that, if the EAB's infestation continues unchecked, all ash will be lost in infested areas within a few years. The loss would be significant in both economic and environmental terms because the ash genus was heavily planted in the Chicago metro area in response to a previous devastation of American elm due to Dutch elm disease.

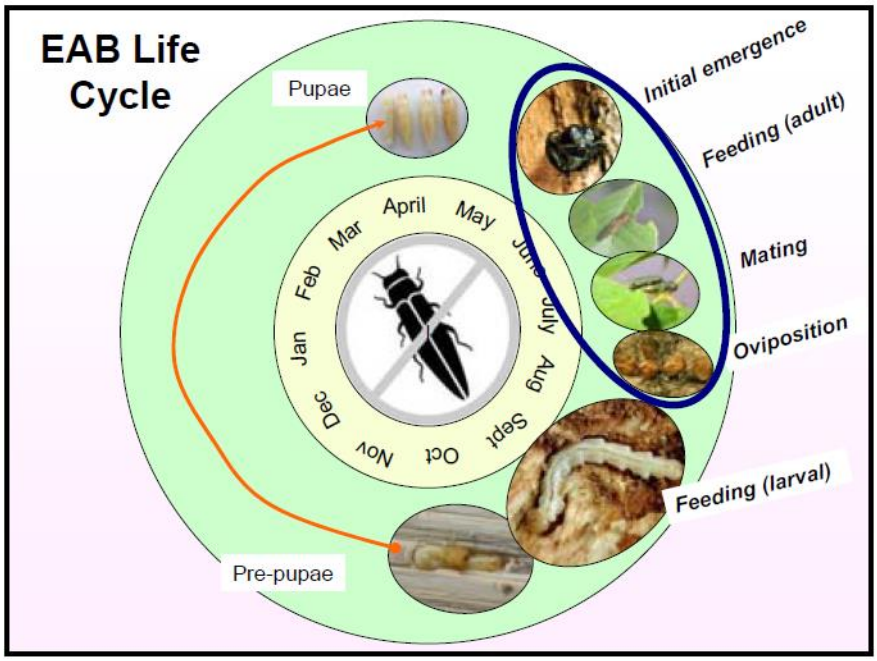
Emerald Ash Borer Life Cycle

The Emerald Ash Borer has three distinct phases: Pupae, Larvae and Adult. Each phase and the damage the insect does in that phase appears to follow a predictable timeline, as described in Graphic 1 below.

Pupae – The larvae from the previous season develop into pupae that spend winter in small chambers. Pupae develop into adult beetles in late spring.

Adult – The adult EAB emerges in May and takes flight. The adult eventually alights on a new tree and feeds on leaves for a few weeks. During this period, the tree damage is minimal. Although the adult stage seems to have minimal impact, in the later stage of this cycle the female deposits eggs on the bark, which are problematic.

Larvae – The deposited eggs mature, and the larvae produced bore into the phloem of the tree. The larvae feed for the next six to eight weeks, and they create tightly packed horizontal galleries that are in a zigzag pattern. The most destruction to the tree occurs during this phase. See Image 1 – Ash with typical EAB galleries.



Graphic 1: Emerald Ash Borer Life Cycle (Purdue University, 2009: http://extension.entm.purdue.edu/EAB/index.php?page=ident/eab_life_cycle

Damage to a tree's phloem and cambium disrupts the vascular system of the tree; this prevents the flow of water and nutrients to parts of the tree. Knowledge of the nature and timing of the various EAB phases is important, as this informs potential mitigation strategies and might optimize the effectiveness of treatments such as chemical injections or aerial spraying. For example, mid-spring treatment may prevent damage from the subsequent larval stage. Additionally, inspections in early fall, prior to leaf drop, will identify trees that have moved into the poor condition class since the early summer.

Image 1: Ash with typical EAB galleries

Visual Indicators of Emerald Ash Borer

There are no early and clear visual indicators of Emerald Ash Borer's presence in a tree. It can be assumed that most trees in the Chicago metropolitan area have some degree of infestation given the breadth of the quarantine areas. The most visually obvious indicators are only observable after extensive damage has already occurred; they include:

Crown Decline – As the phloem becomes damaged, water and nutrient distribution to the crown extremities are reduced. This results in a visually obvious disparity between the upper and lower crown where the upper crown will have fewer and smaller leaves. This gives the upper crown an anemic look.

Water Sprouts – As the tree is stressed, dormant buds at the base or lower portion of the trunk actively produce numerous aggressive sprouts that grow from the tree.

Woodpecker Damage – The presence of woodpecker damage provides a strong indicator of a heavily infested tree. The damage appears as patches of lightly colored bark from afar. A closer inspection shows that the patches are made from the chipping off of the older and grayer surface bark, which reveals the lighter exposed sub surface bark. An even closer inspection reveals numerous rough-edged quarter-inch holes (**Image 2**).

Image 2: Woodpecker damage

Galleries – The shape and style of the horizontal and zigzag patterned galleries are distinct to EAB. Unless the bark has sloughed off, however, the galleries are only visible once the bark has been physically removed with a draw knife (**Image 1**).

D-Shaped Exit Holes – The D-shaped 1/8th-inch exit holes are also a clear indicator of EAB. Again, unfortunately, this indicator is typically not observable unless the bark has been removed with a draw knife.

Emerald ash borer is the biggest problem in urban forestry since the outbreak of Dutch elm disease. Given that 12.3 percent of the Berwyn tree population consists of ash trees, which are susceptible to EAB, it is essential that the municipality act progressively and responsibly to minimize the spread of this beetle. At the community level, the infestation severity determines most of the options available to any one community. A heavily infested community will need to conduct a large number of removals in a short time period. Infestation patterns are not homogenous. Communities as geographically wide ranging as Elburn, Algonquin, Wilmette, Oak Park and Homewood have seen significant losses from EAB already. On the other hand, communities adjacent to the above communities have yet to experience the same level of losses. To complicate the issue, we have no strong visual indicators through which we can use to determine the extent of internal damage to ash. This point is an important factor if trying to establish a chemical treatment regimen. Although the direct economic burden that the City must assume for this tree

management is accompanied by the long-term environmental losses from canopy reduction, it is an issue that must be addressed to restore and maintain healthy, sustained and expanding canopy.

One option in the fight against EAB is the preventative treatment of ash trees with insecticides, such as Imidicloprid. Various sources have suggested that if a given ash tree has at least 50 to 75 percent of its canopy intact it may be a candidate for insecticide use. With an estimated cost of $3/diameter inch of tree/year however, treating a large portion of ash trees will be cost prohibitive, and more than likely, not sustainable. Insecticide use could be a worthwhile EAB strategy for large trees that contribute a significant amount to the community. Of the various ash species planted in Northeast Illinois, green ash, *Fraxinus pennsylvanica* is the most common and also presents the largest maintenance costs of the ashes due to frequent hanger shoots and poor structure. Because of this, we recommend focusing insecticide treatments only on a select few green ash. White ash make up a smaller percentage of the population and are generally higher quality which may warrant greater usage of insecticides.

Table 12 provides the anticipated cost to remove all of the remaining ash trees in poor or worse condition as a subset of the entire population.

Table 12- Removal Cost Estimates for Ash Trees in Poor or Worse Condition

Diameter Class	Calculations			
	Quantity	Total Inches	Average Per Inch Price	Total
1 -12	104	1,047	$12.62	**$13,213**
13 – 18	253	3,887	$15.03	**$58,422**
19 – 24	191	4,099	$18.93	**$77,594**
25 – 30	140	3,799	$22.25	**$84,528**
31 – 36	41	1,376	$25.12	**$34,565**
37”+	7	282	$29.12	**$8,212**
Total	**736**	**14,490**		**$276,534**

Table 13 provides the anticipated cost to remove the remaining ash in fair or worse condition.

Table 13- Removal Cost Estimates for Ash Trees in Fair or Worse Condition

Diameter Class	Calculations			
	Quantity	Total Inches	Average Per Inch Price	Total
1 -12	339	3,285	$12.62	**$41,457**
13 – 18	454	6,936	$15.03	**$104,248**
19 – 24	278	5,953	$18.93	**$112,690**
25 - 30	194	5,254	$22.25	**$116,902**
31 – 36	51	1,707	$25.12	**$42,880**
37"+	248	405	$29.12	**$11,794**
Total	**1,564**	**23,540**		**$429,971**

Table 14 provides chemical treatment cost estimates per inch, per year unless otherwise specified. The data was compiled from eight bids and on the three primary treatments that are currently available. In addition to the average of the eight bids, the lowest and highest quotes are also provided. The imidacloprid and Xytect are annual injections, while TreeAge requires a biennial treatment.

Table 14 - Chemical Treatment Cost Comparisons for Northeast Illinois

Treatment	Cost Comparisons (Eight Bidders)		
	Low	High	Average
Imidacloprid	$1.29	$8.00	**$2.96**
TreeAge	$3.90	$12.50	**$7.61**
Xytect	$1.65	$7.75	**$3.29**

Table 15 provides the anticipated cost to annually treat all of the trees in fair or better condition.

Table 15 - Cost Estimates of Treatment of all Ash in Fair or Better Condition

Treatment	Calculations			
	Quantity	Total Inches	Average Price per Inch	Total
Imidacloprid	862	12,228	$2.96	**$36,195**
TreeAge	862	12,228	$3.81*	**$46,589**
Xytect	862	12,228	$3.29	**$40,230**

*Adjusted for annual pricing.

Table 16 provides the anticipated cost to annually treat all of the trees in good or better condition.

Table 16 - Cost Estimates of Treatment of all Ash in Good or Better Condition

Treatment	Calculations			
	Quantity	Total Inches	Average Price per Inch	Total
Imidacloprid	272	3,178	$2.96	**$9,407**
TreeAge	272	3,178	$3.81*	**$12,108**
Xytect	272	3,178	$3.29	**$10,456**

*Adjusted for annual pricing.

4. Recommendations

The following are immediate steps that the City of Berwyn can take based on the tree population inventory and assessment. They include recommended responses to urgent problems as well as preventative care that will stabilize the forest and reduce the required action in the long run.

4.1 Pruning Recommendations

According to the inventory, there are 1,244 trees that currently require pruning. Immediate and ongoing care of tree limbs will improve the quality of Berwyn's forest, and a cyclic program will ensure that each street tree will be reviewed regularly.

1. Attend to trees that have been marked 'prune' in the inventory. Remove hazardous and or dead limbs and hanging dead branches.
2. Initiate a five-year cyclic pruning program.
3. Train young trees to prevent structural issues in the future.
4. Refer to the American National Standards Institute (ANSI) A300 pruning standards for information on pruning objectives, types (cleaning, thinning, etc.), correct pruning methods, and pruning hazards (topping, lion tailing, etc.).

4.2 Planting Recommendations

Berwyn's urban forest has the potential to be healthier and more diverse, with a focus on valuable, native, long-living trees. Although planting programs happen over time, the consideration and planning should begin immediately so that population targets can be met.

1. Broaden the City's planting palette. Define and emphasize under-used, high-quality, and low-maintenance species in the City's planting program with attention to population targets that align with a managed loss model. Some species that should receive increased presence in Berwyn are Swamp White Oak, Baldcypress, Kentucky Coffeetree, Black Gum, Silver Linden, and Hackberry.
2. Reduce the number of Norway Maple, Silver Maples, and Red Maples in future plantings.
3. Establish long-term percentage and quantity targets. Each high-quality species should make up 5% of the population.
4. Develop an annual planting scheme that emphasizes a balanced distribution over a 20 year period.

4.3 Risk Reduction Recommendations

Indicated in the inventory are issues that must be addressed immediately to avoid danger to residents and/or property as well as defects that may develop into problems if neglected. Removal of old, senescing, and/ or hazardous trees can make way for more beneficial and cost-effective new plantings.

1. Remove all of the 613 trees identified as “Removals” in the database. The trees were marked for a number of reasons including Emerald Ash Borer indicators, declining health, and compromised structure.
2. Tighten planting site specifications. Develop a policy regarding planting space specifications that aligns with current standards, attends to other constraints (e.g., hydrants, stop signs, residential trees), and targets tree canopy optimization by allowing trees to realize their full form.
3. Initiate an annual inspection of all trees marked as ‘monitor’ in the inventory. Natural Path Urban Forestry will work with the City on these inspections.
4. Be aware of the trees with noted structural defects. Although they are not marked for monitoring, they may become a risk in the future.

4.4 EAB Recommendations

Based on the data collected, a review of current operational policies and resources, and current thinking regarding EAB management, the following recommendations should be implemented to guide a long-term, sustained approach to managing Berwyn’ urban forest.

1. Remove trees that exhibited high visual indicators of EAB infestation or that had significant structural issues. Systematically reduce the ash population to 5% of the population as part of the long-term and proactive management policy. Develop an In-house/Contractor strategy to maximize the number of trees removed while minimizing budget pressures.
2. Generate a replacement list based on vacant spaces created by the removals. Replant during subsequent years.
3. Conduct an annual inspection. Anticipate that the ash population will decline quickly once the City becomes heavily infested, condition ratings will decline rapidly, and more rigorous tree monitoring will be required. Inspect all ash trees during the summer and generate a list of all poor conditioned ash trees
4. Modify City tree ordinances. Include ash trees in the nuisance ordinance. Codify the City’s response to EAB on private property.
5. Engage the community through a multi-leveled program of outreach to residents regarding the current status of EAB in Berwyn.

6. Consider chemical treatment of the ash in excellent condition. Acknowledge the cost-benefits of treating trees in excellent condition, which have the most potential to rebound from chemical treatment and may be resilient to the EAB infestation.

Green ash was one of three or four species that were heavily emphasized by Midwest communities as the replacement species for the American elms lost to Dutch Elm Disease. The concept of species diversity, as a means to manage the unanticipated, was minimally understood at that time. Hindsight has proven that the planting of a few species to replace the monoculture elm population was not good practice. Given the current treatment methods available, both the United States Department of Agriculture and the Illinois Department of Agriculture anticipate the eventual loss of all ash trees within infested areas.

5. Conclusion

Urban forestry as a management practice in the United States is very much in its infancy. Our understanding of the important role that trees play in enhancing the urban has only recently been quantified. Prior to this, our understanding focused on qualitative interpretations. As the urban forest becomes more relevant, the long-term consequences of our choices become magnified.

The defining characteristic of a sustainable system is persistence. In the context of urban forests, such a system has continuity over time in a way that provides maximum benefits in the present without compromising those of the future. An individual tree, and thus the collective forest, increases in value and community contributions as it ages. It is this contribution over generations and increasing value with time that differentiates trees from all other public assets. The need for an urban forestry program is closely tied to the economic, social, and environmental health of a town, and human intervention is required to maintain a sustainable urban forest. The inventory, management plan, and NPUFC support for staff over the next two years will provide an opportunity for the City of Berwyn to achieve a higher level of management throughout the community. This support, focused on routine tree care, sustainable forest perpetuation, and risk management, will enhance the urban forest and consequently the whole City.

Attachment 1- Inventory Components

Tree ID – A unique Identification number

Address – Street and building address with a locator code within GPS ID.

Land Use- Defined the ownership of the property

Parkway – Identified the width of the parkway in relation to the presence of a sidewalk.

Utility – Identified the presence of overhead utility lines.

Quad- The four directional locations of a tree when facing the front of a property: Front (F), Back (B), Left (L), Right (R), and Interior (I), see Diagram 1.

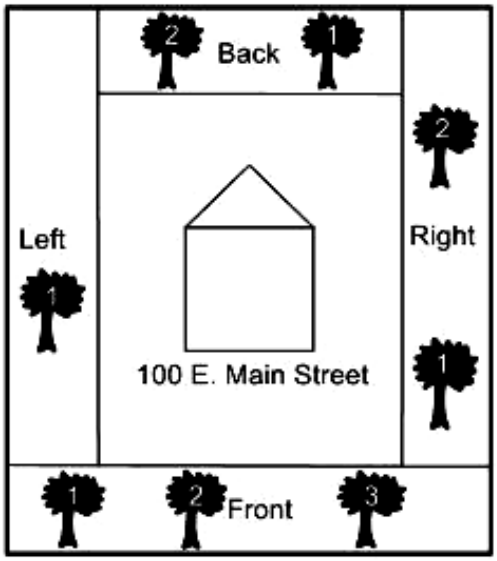


Diagram 1 shows the quadrant locations and tree sequencing trends.

Sequence- In the front and back quads the trees are numbered from left to right while looking at the property. Trees are sequenced from front to back on the two side quads (L and R).

Species – Each tree included in this assessment was identified to the species level.

Diameter – Each tree was measured to the nearest inch at the standard measuring height of four and a half feet (4.5') from the ground (DBH – Diameter Breast Height).

Condition – One of the following conditions was assigned to each tree based on a visual assessment of the individual tree's overall health and structure: Excellent, Good, Fair, Poor, Very Poor, or Dead.

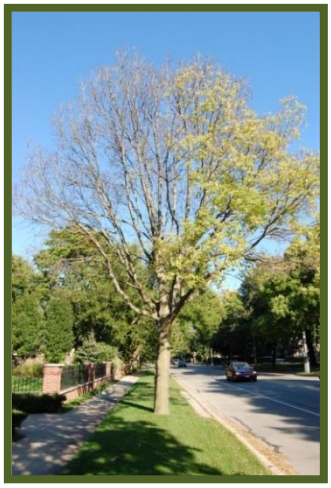
Attributes – A number of physical attributes could be assigned to an individual tree. The issues identified should assist in prioritizing future maintenance actions or filter for more immediate care:

Appressed Fork – A structural defect typified by branches that form a narrow attachment and has included bark present.

Canker – A dead area of cambium caused by a disease. Depending on the extent of the canker, the outer shell of the tree can be structurally compromised.

Cavity/Decay – Decay is the breakdown of wood structure from decay organisms. A natural process in trees, issues arise when the volume of decay exceeds the trees capacity to counter the decay.

Crack – A structural separation of wood. This presents a significant issue if the crack is a shear crack, but it is minor concern if the crack is of superficial depth.



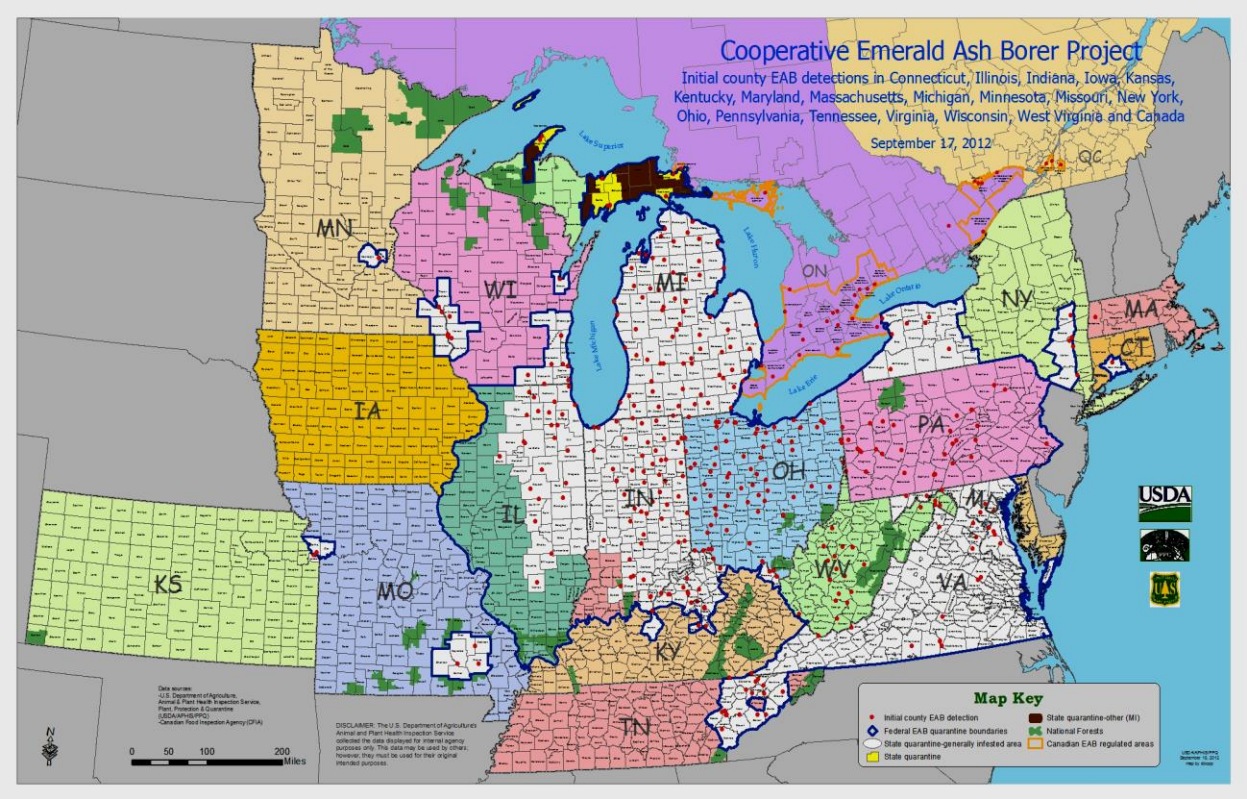
Decline – Denotes an overall and significant deterioration in tree health.

Action – A choice of four maintenance actions were available. Actions were only assigned if immediate action was necessary.

- **Cable** – Cabling was only assigned if it would correct a structural defect on a high-quality species in good condition that had a potential for a long life.
- **Monitor** – Trees that require an annual inspection because of a structural defect or condition were noted.
- **Prune** – When a tree exhibited a significant amount of dead wood or large dead wood, a prune maintenance action was assigned.
- **Remove** – Trees were identified for removal if they exhibited very poor or dead condition, or structural issues that posed a high-risk to residents and staff.
- **Grind Stump**- Existing stumps leftover from tree removal were noted to be ground.

Attachment 2

Extent of EAB in Canada and the Unites States as of December, 2012



http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/multistate.pdf

Attachment 3 – State of Illinois 2006 Declaration of Nuisance

State of Illinois

Department of Agriculture

Bureau of Environmental Programs

DECLARATION OF NUISANCE

NOTICE IS HEREBY GIVEN by the Illinois Department of Agriculture, Bureau of Environmental Programs, pursuant to the Insect Pest and Plant Disease Act (505 ILCS 90/14) that the Illinois Department of Agriculture is declaring all plants and plant products thereof infested with the Emerald Ash Borer (*Agrilus planipennis* Fairmaire), specifically but not limited to Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus Americana*), Black ash (*Fraxinus nigra*), as well as several horticultural varieties of ash, to be a nuisance in the State of Illinois and should be eradicated. The beetle is currently confined to portions of Kane and Cook Counties. There is currently no known treatment to control Emerald Ash Borer. Therefore, in accordance with 505 ILCS 90/15, eradication of infested trees according to Department guidelines will be required by the owner, or other persons in possession or control of the infested trees. The responsible party must remove all infested trees by the deadline and method specified by the Department. Failure of the property owner, or person in possession or control of the property to remove the infested trees will result in the tree removal by the State of Illinois and the expenses incurred by the State of Illinois shall be collected in a civil action against the person liable.

This declaration shall be effective this **19th** day of **July 2006**.

DEPT. OF AGRICULTURE STATE OF ILLINOIS

Charles Hartke, Director

http://www.agr.state.il.us/eab/PDFs_for_web/Home/Nuisance_Dec.pdf

Attachment 4 – Illinois EAB Quarantine Area as of December 2012

http://www.agr.state.il.us/eab/PDFs_for_web/State/8thAmend1101map.pdf