I. EAB Preparation, Detection, and Control

Being a relatively new invasive species in North America, EAB has given the scientific community little time to study it. To date, there have been no scientific discoveries for eliminating EAB infestations. In addition, there has been no break through on how to cost effectively control its spread or keep its population in check. However, research is on going and has made great strides in developing tools and methodologies that will help mitigate the impact on local communities. Based on these new discoveries, general guidelines for emerald ash borer detection and control in both rural and urban situations have been developed.

This section provides a summary of the most up to date management efforts that municipalities can conduct to help with detection and control of EAB. This section is not intended to be an exhaustive review of all literature, but to serve as a guide and resource. Keep in mind as research continues, guidelines could be modified and the following information would be subject to change.

Tree Inventories[1]

The first and most important step in managing your community's urban forest resource and preparing for EAB is to conduct a tree inventory. A tree inventory is the process of counting, characterizing, and recording information about the public and sometimes private trees that make up the urban forest or the trees within a stand for woodlots. It is a useful tool that documents important information related to the total number of trees, their condition, location, and species composition.

The goal of any community tree inventory is to provide information essential for management in a timely fashion, at a reasonable cost. But, how do you determine what type of inventory is best for your community? The type of inventory that will fit your community best depends on community size, size of the tree population, the technology level of your community, budget, staff availability, and how the information will be used. Therefore, the first step in any inventory is to identify objectives. Objectives will help your community to determine how much information needs to be collected. It is a waste of time and money to collect information you don't need. On the other hand, if the objectives include specific management actions then more detailed information may need to be taken. The most common type of data collected in tree inventories are: location, land use, species, size, condition, site information, and maintenance needs. For help in determining what is the best type of tree inventory for your community, WDNR put together a series of articles to help communities. They can be found in the *Emerald Ash Borer Toolkit for Wisconsin Communities* by WDNR. In addition, the information below gives a short explanation of the major categories of tree inventories.

[1] Wisconsin Department of Natural Resources, Emerald Ash Borer Toolkit

Street Tree Inventory

Street tree inventories document and help with management of trees along roads and within the public right-of–way. They are conducted using a variety of on-the-ground sampling methods ranging from a relatively quick windshield survey to the more detailed walking survey using notepads to personal digital assistants (PDA's) to geographic information systems (GIS). Documentation of street trees is useful for identifying the species, location, and condition of trees the community government is responsible for maintaining. This information can then be used to identify areas of susceptibility (high ash component), low species diversity (species and/or age), and future planting opportunities. In addition, community forest management plans can be developed from the inventory to provide direction for urban forestry initiatives.

Park and Open Space Inventory

Park and open space inventories document the publicly owned trees away from streets and right-of-ways. These trees comprise a smaller part of the entire community tree population, but may be the most important part of the urban forest to many residents. They make up the more natural areas of communities and are usually a place of refuge or recreation for residents.

Some trees in parks and open spaces typically do not need to be inventoried as often or as thoroughly as street trees because they are in areas of lower pedestrian traffic. Because of this, these trees pose a lower liability risk and do not need to be documented as intensely. It is still a good idea to keep tabs on the resource in the interest of overall species diversity and forest management practices.

There are other trees within parks that should be more closely monitored, these would be trees within manicured areas (i.e. along trails, picnic tables, playground equipment, mowed areas, etc) which experience higher use. These areas are designed to be inviting and keeping tabs on the health and condition of trees in this area is in the community's best interest. A documented risk assessment program can help to identify trees prone to failure and preemptively deal with them. Additionally, in the case of an accident, being able to produce a risk assessment and work history log indicates the community's active role in maintaining safe trees.

Woodlot Inventory

For woodlots, it is often impractical to inventory every tree. Therefore, information on woodlots is obtained through a field inventory called a timber cruise. When conducting a timber cruise the woodlot is divided into stands containing different timber types, much like the different fields on a farm. Individual stands may contain various sizes of trees, including new plantations. They may also vary by species composition or management techniques. Most stands are easily distinguished from others. Some woodlots are uniform throughout and may be managed as one stand. Once the stands are delineated sample plots are located in each stand where the all the trees in the plots are then identified and measured. The plots are then used to estimate the total number of trees in the woodlot. For more information on how to

conduct a woodlot survey refer to the *Emerald Ash Borer Toolkit for Wisconsin Communities* by WDNR.

Monitoring and Detection

One of the first line of defenses against EAB is to enact a program to monitor and detect for the pest. It has been estimated in many instances where EAB was found, that EAB was usually present in the community for a number of years before it was detected. If a new EAB infestation can be detected while it is still limited in scale, it may be more controllable. In addition, identifying infestations early will give communities more time to implement a management strategy before their ash trees are in a late stage of decline and become hazardous, ultimately saving communities money.

Monitoring for EAB involves knowing the signs and symptoms of EAB (refer to *Section II - Host Tree Signs and Symptoms* of this plan), and the use of surveys and inspections. When conducting surveys and inspections, using the most current tree inventory results from your community can be helpful in designating high-risk areas and appropriate areas in your community for an EAB survey.

Inventory information will show areas of high ash tree density, and tree health or conditions. Both of which can help delineate high-risk areas. Ash trees that are stressed or unhealthy tend to attract EAB better than others. If a given area meets both criteria---a high density of ash and stressed ash trees---this is a good place to start surveying for EAB.

In addition to locating high-risk areas based on inventory information, consider locations in the community where EAB has a greater probability of being introduced, such as:

- Businesses that import firewood from non-local sources. Know where your firewood comes from.
- Local campgrounds or festival grounds, where overnight camping and potential firewood use occur.
- Developments or subdivisions built within the last 12 years. EAB was identified in 2002, but has probably been in the country since the 1990's. Ash nursery stock planted in these developments could have been infested with EAB long before any quarantine was in place.
- Industries that utilize raw ash products, such as mills and furniture manufacturers.
- Industries and businesses that import goods shipped on solid wood packaging materials from Asia.[2]

After identifying high-risk areas and locations for possible EAB introduction, develop a survey schedule and begin by conducting inspections in these areas. There are

[2] Wisconsin Department of Natural Resources, Emerald Ash Borer Toolkit, Section 06, c, 1. Where to Look for EAB, Using Municipal Tree Inv to Set Up EAB Surveys1.doc

several different methods of surveying for EAB, each having its own advantages and disadvantages. A brief description of each survey method is discussed below.[3]

Visual Survey

Visual surveys include looking for outwardly visible signs and symptoms of EAB on ash trees by a person on the ground. A visual survey can be conducted either by systematically covering an area or by selecting individual trees from an inventory. The advantage of visual surveys is that a large area, using few resources, can be covered in a short amount of time. The main disadvantage is that by the time visual symptoms of EAB are present, it usually means the infestation has been in the area for several years. An example of a visual survey data form can be found in Appendix X.

Canopy Survey

Canopy surveys are used when a closer look at the tree's canopy is warranted. Usually the tree has exhibited signs and symptoms through a visual survey that calls for a closer look. Once in the tree's canopy, small windows of the canopy's trunk and branches can be peeled back using a drawknife to look for EAB larvae. The advantage of a canopy survey is that a close up inspection can occur where EAB symptoms show up first. The disadvantages include the costs of using professional tree climbers and/or the use of a bucket truck along with the time it takes to perform individual tree inspections.

Detection Trees

Detection trees are created by artificially wounding an ash tree to purposely stress it, which has been shown to attract EAB. The most effective way to wound a tree for this purpose is girdling (remove a band of bark around the trunk) the tree. Detection trees are currently the most effective tool available for proactively surveying for EAB. The disadvantage of this method is the ash tree used is destroyed. WDNR and DATCP have been using this method since 2004 to look for EAB infestations across the state.

EAB Detection Tree
Source: WDNR

Destructive Sampling

Destructive Sampling includes the removal and/or peeling of an ash tree to look for EAB larvae and larval galleries. Ash trees that are sampled can be of any size, but trees between 4"-12" DBH are the most efficient to peel. The advantage of this method is the discovery of early EAB infestations. A disadvantage is the sampled

[3] **Survey methods**: Emerald Ash Borer Community Preparedness Plan, Michigan Department of Natural Resources and Michigan Department of Agriculture.

ash tree is destroyed. Currently, WDNR and DATCP are conducting this method along with Detection Trees to help delimitate the areas of current infestations.

Purple Traps

Purple Trap
Source: Wisconsin EAB Information Source Website

Purple panel traps were used as a survey tool in Wisconsin for the first time in 2007. The survey was initiated by the DATCP, USDA-APHIS and WDNR. To date, researchers still consider the use of detection trees to be the best method for detecting low-density emerald ash borer infestations. However, there are situations in which purple traps may be favored over detection trees in order to prevent the loss of a ash tree. Such situations include surveying in areas where the tree may be considered a prize urban or campground shade tree or when surveying where the ash resource is limited, but risk still exists (e.g. firewood piles, mills and nurseries).

The traps are made of a purple corrugated plastic board, that is coated with a non-toxic glue. Research shows that EAB is visually attracted to purple and to increase the attractiveness of the trap to the beetles, it is baited with a lure (Manuka oil). The traps are 24" in length, triangular in shape, and open in the center. It is recommended to hang the traps on an open grown or edge ash tree at a height of 33-40 feet above ground.

Detection

Due to there being numerous EAB look-a-likes, if EAB is found while conducting surveying efforts, the specimen will need to be verified by officials at USDA-APHIS and/or WI DATCP. Once there has been official confirmation of EAB in Sheboygan County, appropriate managers and core staff will be notified early in the response. In addition, providing timely, accurate and consistent communication to others will be important in enhancing credibility and community support of your plan and actions. For details of the proper notification and communication procedures along with regulations that will go into effect when EAB is confirmed refer to *Section VI - EAB Authority and Responsibility* of this plan.

Control

A major section of your community's EAB Plan will be how your community intends on managing its ash trees. Management options vary and there is no one all-inclusive method. Your community will need to weigh the options carefully and select the combination of methods that works best for them. Some of the factors

that could influence management decisions and questions that should be asked are listed below:[4]

- Environmental impact – What are the environmental impacts of the control method considered? And how would those impacts be different if no action or a different method was considered?
- Land Ownership – Who owns the affected land and how does that influence access to the site?
- Land use and classification – What is the predominant land use in the affected and surrounding area? Natural area? Residential neighborhood? Downtown district? And is the method being considered consistent with the land use goals for the affected area?
- Cost of implementation – How much does the selected control method cost?
- Availability of resources to carry out control method – Is there sufficient financial and human resources to carry out the control method selected? Is the necessary equipment available? Does additional funding need to be obtained or allocated?
- Sociological impact – What are the potential social, cultural, and/or psychological impacts of the control method?
- Size of infestation – How large is the infestation and how long has it been there?
- Traditional ecological knowledge – Do indigenous people live in the area and will their resources or traditions be affected?

The following subsections provide information on methods of preventing the introduction of EAB, controlling it when it gets here and minimizing the impact of the insect on your community's trees.

Prevention

To date, EAB has not been found in Sheboygan County and prevention entails striving to keep EAB from arriving. Two strategies for prevention are education and preemptive removals, both of which are described below.

Education

One of the most effective methods of control for EAB is educational outreach. EAB is believed to move slowly through the landscape on its own, staying within ½ mile of their emergence point with some mated females flying several miles. However, accidental movement of nursery stock, logs, and firewood by humans greatly accelerates its movement. Most individuals and industries who are made aware of the risks of moving this type of materials will usually voluntarily alter their practices to reduce the risk of moving EAB. Therefore, education of how EAB can be moved long distances through these materials is critical to slowing its movement.

[4] Wisconsin Emerald Ash Borer Response Plan, Updated: July, 2008 and Dane County Emerald Ash Borer and Wood Utilization Strategic Management Plan, May 15, 2009.

Preemptive Removals

Once EAB arrives in your community, the burden of dealing with hundreds or thousands of ash trees can be overwhelming. It can place strain on your community budget, personnel, and resources. By preemptively removing ash trees before the arrival of EAB in your community, it can minimize the strains placed on your community and provide flexibility in tree removal budgets. In addition, they can potentially diminish the movement of EAB across the landscape by making it difficult for dispersing beetles to find host trees.

The scale of preemptive removals can vary from removing all ash trees in a short amount of time (i.e. 10% removal each year for 10 years) to only removing ash trees in poor health. It could also include only removing and replacing young trees (i.e. all ash trees less than 5" caliper or less than 3 years old). All of the options will make removals more manageable when EAB arrives. Another consideration is to work with your local utility company to remove or phase ash trees out of the utility easements.

Communities will have to decide if this method is right them. Listed below are some of the pros and cons of preemptive removals.[5]

Pros:

- Opportunity to spread removal costs over longer time frame.
- Reduces problem of dealing with many dead and/or hazardous ash trees at one time.
- Opportunity to start the replanting/recovery process right away.
- Greater flexibility in organizing removal and routine work schedules.
- Ability to utilize ash wood for products or use it as a local source of firewood.

Cons:

- Immediate impacts to tree canopy and aesthetics.
- Removing healthy ash may create negative feeling in within the community.
- Does not take into account that research may find an effective control of EAB.

<u>Reactive Management</u>

This subsection contains current management strategies for when EAB arrives in your community. When controlling EAB through any of these methods, it will be important to continue surveys to know the extent of the infestation and education for the public to understand the method chosen.

[5] Emerald Ash Borer Community Preparedness Plan, Michigan Department of Natural Resources and Michigan Department of Agriculture.

Biological Control

Biological control is the use of natural enemies such as insect parasites, predators, and pathogens to kill various stages of pests. Research on EAB biological control began in 2002 leading to the discovery of three species of wasps from China: *Spathius agrili*, *Oobius agrili*, and *Tetrastichus planipennisi*. These natural enemies are tiny stingless wasps that seek and kill EAB eggs and larvae. In their native ranges these wasps have been found to parasitize between 50 to 90% of EAB larvae. In 2007, USDA-APHIS and the State of Michigan approved the small-scale inoculative release of these wasps to evaluate establishment, monitor spread rates, and determine the effects on EAB population dynamics and ash survival.[6] Thus far it does appear that these parasitoids can survive Michigan winters and research continues at these sites to monitor long-term parasitoid establishment and impacts on EAB populations. Another parasitoid is a native wasp that showed up during the trials, *Atanycolus capertus*. Currently it is showing promise, with parasitism approaching 20% on one site. The main challenge for using these wasps in biological control is the mass-rearing of the insects to use.[7]

Woodpeckers, in particular Downy and Hairy Woodpeckers, are commonly observed feeding on EAB larvae and pupae within infested trees. Although extremely valuable for detecting EAB, the effects on controlling the population are small.

Additionally, because biological control agents cannot reduce EAB population densities to zero, they are not considered alternatives that will completely control and manage EAB on their own. Therefore, future management of EAB will depend on an integrated pest management program that includes the use of parasitoids as biological control agents.

Insecticide Control[8]

Since EAB has arrived in Wisconsin there have been many questions to the effectiveness of insecticides in protecting ash trees and if it is an appropriate management option. If you elect to treat your ash trees, there are several insecticide options available and research has shown that treatments can be effective. However, keep in mind that controlling insects that feed under the bark with insecticides has always been difficult and success is not guaranteed. This is especially true with EAB because our native North American ash trees have little natural resistance to this pest.

In some university trials, insecticide treatments were effective, while other trials failed with the same treatments. Also, some studies conducted over multiple years revealed that EAB infestations continued to increase in the same tree despite

[6] Biological Control of Emerald Ash Borer (Agrilus planipennis), USDA-APHIS, http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/eab-biocontrol.pdf

[7] Emerald Ash Borer University, Pesticides and Biocontrol to Manage EAB Webinar

[8] Insecticide Options for Protecting Ash Trees From Emerald Ash Borer, North Central IPM Center and Emerald Ash Borer: Insecticide Options for Protecting Ash Trees and Their Effectiveness, R. Chris Williamson

ongoing treatment programs. Research in recent years has led to a better understanding how EAB can be managed successfully with insecticides. The current state of this understanding is detailed in a bulletin by North Central IPM Center, Appendix x.

When considering an insecticide option, some of the highlights are:

- Insecticides are not effective in eradicating EAB infestations, but can effectively protect ash trees from EAB. They are best used as a preventative.
- The best control can be achieved when insecticide treatments are started before the tree is infested or in the earliest stages of infestation before visible symptoms are present.
- Rule of thumb for starting treatment is if EAB is found within your county or within 10-15 miles.
- Some formulations can be purchased and applied by homeowners, others must only be applied by professional applicators.
- 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.
- Since insecticide treatments must be repeated each year, it may be more cost-effective to remove and replace the ash tree with an alternative tree to increase species diversity.
- 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.
- Homeowners wishing to protect trees larger than 15-inch DBH should consider having their trees professionally treated.
- Treatment programs must comply with any label restrictions on the amount of insecticide that can be applied per acre in a given year.

It is important to note that research on insecticide 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.

Eradication

Eradication is the attempt to completely eliminate EAB from a local area by removing all infested trees and all potential host trees. In the recent past, this was a widely recommended form of control and containment of EAB. However, many eradication efforts have failed. This is believed to have happened because it is very difficult to adequately determine the extent of the infestations. Therefore, eradication is now only a favored option for the occasional outlier infestation that is at a very small scale, has traceable origins, and is less than two years old.

Reactive Removals

Reactive removal is the process of waiting to remove ash trees that are already infested with EAB or dead. Some communities will decide to take the path of preemptively removing a portion or all of their ash trees. However, some will be reluctant to do this not realizing the magnitude of the situation till it is too late, or because they were not financially capable of doing so. Communities will have to decide if this method is right them. Listed below are some of the pros and cons of reactive removals. [9]

Pros:

- Delayed impacts to tree canopy and aesthetics.
- No negative public perception or removing healthy trees.
- Delayed budgetary impacts until EAB hits.
- Further EAB research may offer effective control, minimizing need for removals.

Cons:

- If no action is taken to control EAB infestations, studies have shown that the rate of spread will be much faster.
- Budget impacts can be severe once EAB is in community.
- Replanting funds may be available due to extreme removal costs.

Woodlot Management Options

Woodlots and parks, whether private or community owned, play an important role in a community's forest ecosystem and should be considered when preparing for EAB. If there are community owned forested areas, it is recommended that there should be a management plan in place that addresses the long-term management options. Within the plan there should be details looking at the impacts EAB will have on the goals and uses of that area. Whether private or community owned, management recommendations from WDNR forest health specialists can help when considering the options for these areas. Recommendations can be found in the WDNR document "Emerald Ash Borer and Forest Management", Appendix x.

<u>Diversification</u>

The impacts of EAB on a community are directly dependent on the number, size and location of ash. The more ash a community has, the higher the infestation and the faster the insect will spread. In addition, the larger the trees are, the greater the cost for removal and the greater the loss of environmental services.

Providing for species and age diversity in your urban forest are two significant ways to reduce the impact of a destructive pest such as EAB. Recent pilot studies show

[9] Emerald Ash Borer Community Preparedness Plan, Michigan Department of Natural Resources and Michigan Department of Agriculture.

that ash trees comprise around 12% of the all tree species within the boundaries of Wisconsin's communities. Ash is also the second most common street tree in Wisconsin communities (behind Norway maple), making up to as much as 30% of the street trees in a community. Through the most recent tree inventory conducted by Sheboygan County ash trees comprise anywhere from 5% in Glenbeulah to 40% in Cascade and Howards Grove, with the average being 23%.

When considering the diversity in your community an old rule of thumb is no more than 5% of one species, 10 % of one genus and 20% of one family. If you were to adhere to this, in the case of EAB, the loss of trees would still be pretty drastic at one fifth of your entire forest. Optimally, you'd like to have the greatest diversity of species you can manage.

In addition to species composition, the size of trees in your community needs to be considered. EAB has been shown to attack all ash trees regardless of size. However size will play a part in the sustainability of the whole forest and the cost of management. If all your trees are large, removal costs will be more. In the same instance if all the trees in community are the same size/age, they could potentially start to fall apart at the same time and eventually you will be faced with the same catastrophic tree loss even without EAB.

Communities need to start planning now for a more diverse urban forest. This includes having a replacement plan (for more information refer to *Section V – Preparation, Detection, and Control* of this document) for when ash trees in your community have to be removed to an overall goal of species and size diversity within your community's forest. Finding a wider variety of species will be potentially harder and more expensive, but it is worth it. For a list of alternative species see Appendix x.