

# Maryland Emerald Ash Borer Long-term Management Plan FINAL



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Developed jointly by:



UNIVERSITY OF  
MARYLAND  
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## Executive Summary

The emerald ash borer (EAB) has been in Maryland since 2003, but aggressive eradication efforts limited its spread until 2009, when outlier infestations and regional spread made eradication unlikely. There is little resistance to EAB in North American ash trees, and more than 97% of ash trees infected with EAB have died within three years. EAB is now established in most neighboring states and has spread across all of the Western Shore counties, as well as three counties on the Eastern Shore. This plan outlines Maryland's response to this pest as a long-term issue for Maryland and guides cost-effective efforts to treat, remove, or replace ash trees as this deadly pest spreads. The basic components of Maryland's plan are as follows: 1) Detection of EAB; 2) Tree inventory and raising public awareness of problems and responses; and 3) Response to limit impacts of loss and hasten recovery of benefits.

**Detection:** Prior to the arrival of EAB on the Eastern Shore, survey efforts have been coordinated statewide through the Maryland Department of Agriculture (MDA), with support from federal partners in the U.S. Department of Agriculture (USDA), particularly Animal and Plant Health Inspection Services (APHIS) and U.S. Forest Service (USFS). University of Maryland Extension (UME) maintains a reporting and public information site at the Home Garden Information Center at <http://extension.umd.edu/hgic/invasives/emerald-ash-borer>. Now that all of Maryland is in the quarantined area, survey efforts will only be conducted as funding allows. However, Maryland will maintain lines of communication among agencies, tree professionals, local jurisdictions, and other stakeholders to provide current information on the status of EAB and the level of threat.

**Inventory/Awareness:** The most visible effects of EAB are likely to be in Maryland's communities, where ash trees have been widely used as an attractive, adaptable urban tree. Many communities do not have the basic inventory information needed to plan an effective response to the projected loss of a major urban tree. A Community EAB Management Plan can guide communities in developing appropriately scaled and targeted responses that minimize loss of urban forest trees and their benefits and contain costs for tree removal and replacement. Maryland Department of Natural Resources Forest Service (MFS) will provide an online Community EAB Management Plan outline, work with communities and counties to develop local plans, and provide inventory standards for a rapid urban tree inventory. On Maryland's protected lands, inventories will be conducted in cooperation with the Maryland Park Service, and other land protection agencies, to guide response options. On the Delmarva Peninsula, cooperative planning will be undertaken with Delaware and Virginia to develop inventory, outreach, and response options. MDA, UME, and MFS have apportioned responsibility for reaching designated stakeholders with timely information. Maryland will coordinate with federal efforts like <http://www.emeraldashborer.info/> and <http://eddmaps.org>.

**Response/Recovery:** Timely response can help retain some important ash trees through treatment, removal to minimize risk from hazard trees, and designed replacement plantings for future resilience in Maryland's forests. This plan combines state-level response and local options. Statewide, MDA will work with APHIS to maintain appropriate quarantines to restrict further spread, survey EAB status as funding permits, and continue biocontrol efforts. Public awareness efforts to discourage firewood movement will continue, and efforts to improve utilization of urban wood will be increased in coordination with local jurisdictions. Maryland will develop more cost-share options for EAB responses, assist with development of local management plans and a Protected Lands Plan, identify options for protecting rare ash species, and provide guidance on cost-effective strategies for treatment, removal, and tree replacement. In rural areas on the Delmarva Peninsula, options for a cooperative pest management area will be explored in cooperation with Delaware and Virginia.

## Introduction

Emerald Ash Borer, (*Agrilus planipennis*, Fairmaire), or EAB, is a non-native wood boring beetle of ash trees. This invasive species was first discovered in North America in 2002 near southeastern Michigan and surrounding areas in Ontario, Canada. It is believed that the beetle was introduced to North America in the 1990's by solid wood packing materials originating from Asia. Officials quickly established quarantines around the Detroit area. With funds and involvement from USDA, state and local agencies intensified surveys, and began aggressive eradication efforts in an attempt to contain the problem. The destructive invasive insect is a threat to all of North America's rural and urban ash resources. For North American ash species, mortality has been 97% or greater within three years, and all ashes native to Maryland appear to be susceptible.

Adult beetles are bright metallic green about 1/2 inch long and 1/8 inch wide. They emerge in the spring and lay eggs on the bark of ash trees. The larvae hatch and move into the cambium layer. Larvae live under the bark of ash trees, feeding on the tissue that carries food and water up and down the tree, girdling the tree and removing the supply of vital nutrients. Infested trees usually show symptoms within a year. The upper third of a tree dies back first, with more the next year. This is followed by many shoots or sprouts emerging below dead portions of the trunk. EAB kills stressed and healthy ash trees, most of which die within one to four years after infestation (Poland and McCullough 2006). Research by University of Maryland has found only one generation per year and determined that EAB infests North American ash species at higher rates than *Fraxinus mandshurica*, an Asian ash species. There are currently no effective natural enemies in Northern America, although some native pests have been identified on EAB. Pesticide treatments can be effective on individual trees, although they will have to be repeated at least every two years.

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Since its initial discovery in Michigan, EAB has spread through most of the central and eastern United States, and Canadian provinces including Quebec and Ontario. So far EAB has been confirmed in 30 states including Maryland, and two Canadian provinces.

Maryland was not believed to have any evidence of EAB until the spring of 2003, when a Michigan nursery evaded the quarantine and shipped ash trees into Prince George's County, Maryland. Unseen underneath the bark of the Michigan trees were EAB larvae, which developed into beetles and emerged that summer, before the infested trees were discovered in August 2003 by Maryland Department of Agriculture (MDA). After the discovery, MDA coordinated an extensive, well-organized, multi-agency emergency response to the EAB, including a quarantine in early 2004. Given the single point of infestation and limited geographic area, the goal was to eradicate EAB in Maryland. In 2004, MDA, with support from USDA, including the Animal and Plant Health Inspection Service (APHIS), the Maryland Department of Natural Resources (DNR), and many others, removed more than 1100 ash trees on 500 acres in a ½ mile buffer around the nursery where the infested trees arrived. MDA also identified and removed all ash trees planted for landscaping in nearby communities. A tree replacement program was offered.

MDA continued to monitor for EAB for three years as required. The intensive eradication effort was thought to be successful until 2006, when EAB was again discovered on sentinel and girdled trees established for ongoing surveillance. On August 15, 2006, routine stripping of the monitoring trees located EAB larvae near the original site in Prince George's County. The eradication area was then expanded to 1½ miles in 2007, and every ash tree greater than 1 inch in diameter at breast height within the newly expanded eradication area was removed. Surveys located a heavily infested tree just outside the original 1/2-mile eradication zone, causing the eradication area to be further expanded. All ash material removed was chipped to a size of less than one inch in any two dimensions. The quarantine was revised in 2006 to prohibit people from moving any ash wood and any hardwood firewood out of Prince George's County. Despite ongoing efforts and ash removals, in 2008, EAB was detected in Charles County, just south of Prince George's. Rate of spread averaged 1 km (0.6 mi.)/year, with a maximum rate of 1.4 km (0.9 miles) per year between 2003 and 2008. However, between 2009 and 2011, the rate of spread began increasing much faster than predicted by the earlier model (Figure 1, Martinson 2011). This suggests that either EAB could fly further than originally believed, or that humans moving infested ash products promoted a more rapid expansion. Prevailing wind direction was not found to significantly affect rate of spread.

Figure 1: Rate of spread of emerald ash borer in Maryland by year since introduction

After multiple years and thousands of hours of staff time devoted to eradication around the original infestation, it became clear that EAB had moved outside of a feasible eradication zone and many more infestations were identified in neighboring states. The rate of spread became exponential as more people accidentally transported EAB into new

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areas (Figure 1). Over 42,000 trees on about 17,000 acres had been removed, drawing on federal and state resources and professional staff from multiple states. In August 2009, the strategy was shifted from eradication to an approach using survey, insecticide treatments, and releases of natural enemies in the project area to reduce populations and prevent the spread of EAB. Maryland began releasing three of the approved biocontrol agents, species of wasps that are parasitoids specific to EAB. Intensive trapping was established to better track spread and the quarantine remained in place. In 2011, EAB was detected in several more counties: Anne Arundel, Howard, Allegany, and Washington (Appendix A). The spotty distribution suggested that the rapid spread was due to human-aided transport.

In 2015, EAB was found for the first time on the Eastern Shore, in Queen Anne's, Talbot, and Dorchester Counties. Following the arrival of EAB to the Eastern Shore, the entire state of Maryland entered into the federal quarantine under APHIS. Quarantine information is posted on the APHIS website at [https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/emerald-ash-borer/ct\\_emerald\\_ash\\_borer](https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/emerald-ash-borer/ct_emerald_ash_borer). The quarantine applies to:

- The emerald ash borer;
- Firewood of all hardwood (non-coniferous) species, including any piece thereof;
- Nursery stock;
- Green lumber;
- Other material living, dead, cut, or fallen, (e.g. logs, stumps, roots, branches) of the genus *Fraxinus*, including any piece thereof; and
- Uncomposted ash chips and uncomposted ash bark chips larger than 1 inch in diameter in two dimensions.

The APHIS quarantine regulates transfer of ash material across state lines, and effective July 1, 2012, allows movement of material within a large multi-state quarantine zone (Appendix B). This quarantine will support greater opportunities for utilizing ash wood within the regulated area, and keep federal regulatory activities at the edges of the infestation where they can have the greatest effect. To avoid spreading EAB more rapidly, basic precautions, such as not moving firewood or planting new ash trees, should be practiced even within the quarantine zone. States can put exterior quarantines on firewood. For example, the state of Pennsylvania prohibits the importation of firewood into the state unless it has been kiln-dried, heat treated, or fumigated.

## Plan Purpose

The purpose of this document is to assist the State of Maryland in preparing for and managing the adverse effects of emerald ash borer on urban and rural forests in the state. This document identifies major issues, potential responses, and cost-effective strategies. All counties west of the Chesapeake Bay, as well as Queen Anne's, Talbot, and Dorchester, are considered to be infested with EAB for planning purposes. Infestation is considered imminent in all other counties on the Eastern Shore where EAB has not yet been detected.

## Agencies and Authorizations

Response to invasive pests involves all levels of government, each with specific authorities, funding types, and expertise. Federal and State roles and responsibilities vary by the type of assistance they can provide for managing EAB, such as survey and detection, outreach and education, guidance on treatment and response, silvicultural recommendations for rural forests, and cost-share for needed actions. Local jurisdictions have responsibility for responses on locally owned lands, such as removal of dead trees. This document has been developed as an effort between DNR, MDA, US Forest Service (USFS), University of Maryland Extension (UME), and APHIS Plant Protection and Quarantine (APHIS-PPQ). Major roles and responsibilities are as follows:

**Maryland Department of Agriculture** is the lead state agency in responding to new forest pest introductions into Maryland.

1. Coordinate and collaborate with the lead federal plant pest regulatory agency, APHIS, to respond to new pest infestations.
2. Provide surveillance and detection, follow-up inspections on reported suspect invasive species, identification, assessment and monitoring.
3. Notify and coordinate activities with the appropriate local, state, and federal agencies and other appropriate organizations related to program responsibilities and this response plan.
4. Confirm identification of samples and suspect organisms.
5. Develop a communication and outreach plan for cooperators and the public on invasive species threats and develop specific messages once a damaging invasive species has been confirmed in Maryland.
6. Coordinate the communication of invasive species information with APHIS, USFS, DNR, UME, other appropriate universities, USDA Natural Resources Conservation Service (NRCS), local Soil Conservation Districts, tree care professionals, nurserymen, and other plant experts.
7. Implement and maintain appropriate state and federal quarantines.
8. Review and coordinate control activities to ensure compliance with federal, state, and local laws.
9. Condemn and seize materials when appropriate.
10. Oversee eradication or destruction of infested or potentially infested materials or vectors.
11. Provide or assist with the procurement of funding for survey, outreach, and monitoring when appropriate.
12. Provide pest management expertise and advice to all cooperators (including nurserymen) and the public.
13. Manage biocontrol activities across the state, in cooperation with USDA Agricultural Research Service (USDA-ARS) and University of Maryland.

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**USDA APHIS - Plant Protection and Quarantine** is the lead federal agency for responding to new forest pest introductions and to prevent the interstate movement of federally regulated pests.

1. Monitor ports of entry and conduct inspections for exotic plant pests, diseases, and noxious weeds.
2. Treat foreign agricultural commodities to prevent entry of plant pests.
3. Implement emergency measures at the federal level to prevent dissemination of exotic plant pests when discovered.
4. Provide identification of invasive species.
5. Provide federal funding for survey, outreach, monitoring and response (treatment, biocontrols, etc.) when appropriate and conduct surveys on federal/military properties in Maryland and Washington, D.C.
6. Conduct trace-forward activities, prevent smuggling, and conduct investigations when necessary.

**The Maryland Department of Natural Resources** is the lead state agency to prevent the introduction of undesirable forest and plant pests onto State managed lands.

### Forest Service

1. Assist with multi-agency coordination of activities through the Incident Command System (ICS) with the appropriate local, state, and federal agencies and other appropriate organizations related to program responsibilities and the Emergency Response plan.
2. Provide forest management technical assistance and advice, working with cooperators such as the forest products and tree care industries, private forest landowners, and the public.
3. Provide community forestry expertise and assistance to Maryland communities in preparing for and responding to the presence of EAB.
4. Provide liaison with the USFS and National Association of State Foresters through the Maryland State Forester to request further assistance and funding.
5. Assist with eradication and containment.
6. Assist with restoration and mitigation.
7. Provide environmental assessment and review.
8. Assist with permitting activities when appropriate.
9. Develop marketing and utilization opportunities for insect- and disease-killed trees, working with communities, landowners, and industries.

### Wildlife and Heritage Service (WHS)

1. Identify areas with rare, threatened, and endangered species and describe native community types.



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2. Recommend approaches for management in areas with sensitive species, including invasive species control.

### Park Service (MPS)

1. Coordinate with MFS and other agencies on the development and implementation of a Protected Lands Plan.

**USDA Forest Service** manages 193 million acres of national forests and grasslands, conducts world-renowned research on forestry issues including forest pests, and provides technical and financial assistance to state agencies to implement sound forestry practices on nonfederal public and private lands. Through its Forest Health Protection (FHP) Program, USFS is responsible for monitoring the health of the nation's forests.

1. Assist National Forests and Grasslands, other federal agencies, states, and tribal governments in the detection, evaluation, eradication, and monitoring of new pests.
2. Create new awareness of invasive pests through information, education and technology transfer.
3. Improve ability to detect and respond to new and established pests by developing new technologies, improving current methods, and assessing new strategies.
4. Provide technical assistance for control activities for non-federally-regulated exotic pests, including development of NEPA documentation, project planning documents, aircraft calibration, radio communication, and coordination of threatened and endangered species consultations.

**University of Maryland Extension** is the state agency responsible for research and assisting technical transfer of information to cooperators and the public.

1. Conduct research into the biology and management of exotic pests.
2. Create increased awareness of invasive pests through public education and technology transfer.
3. Assist with identification, detection and diagnostics of invasive pest species.
4. Serve as a triage center for reports of invasive pest infestations, and forward screened reports and specimens to MDA for site inspection.
5. Seek funding for research, diagnostics, detection, and extension.
6. Provide liaison to the plant nursery industry.
7. Provide liaison to volunteer groups like Master Gardener, Master Naturalist and Maryland Woodland Stewards.

## **Strategies for Management**

### ***Prevention: Detection and Outreach***

The goal of prevention efforts is to limit further spread of EAB to un-infested areas. The APHIS federal quarantine has been the primary tool for limiting spread to other states. Within infested areas, outreach efforts to limit the movement of wood products may also help to slow the spread of EAB both locally and regionally.

### **Detection**

Survey efforts provide the most basic information for detecting where and when EAB is present and responses are needed. Prior to the discovery of EAB on the Eastern Shore in 2015, MDA Plant Pest Program conducted surveys, usually with funding from APHIS or USFS FHP. Now that all of Maryland is within the infested quarantine area, MDA Forest Pest Management will continue to survey as funding allows. Mapping and annual progress are reported on the MDA website.

The surveying for emerald ash borer has undergone an evolution of tactics and application since the U.S. discovery of EAB in 2002. Surveys were originally based on visually detectable symptoms (D-shaped exit holes, bark cracks, epicormic branching, etc.) to determine presence or absence of EAB. Visual surveys were applied at various levels of intensity and with various techniques (ground surveys, ladders, climbing devices, bucket trucks). Overall results were poor and newly infested areas were often left undiscovered. Continued developments in trap and lure design allowed Maryland to implement a survey based on attractant-baited traps in 2008. Traps offer several advantages over trap trees including lower expense, uniformity of sampling unit, greater safety, fewer logistical problems, and more precision in sampling. The traps have generally proven to be reliable and effective, although very early infestations may not be caught if they aren't near one of the traps.

MDA has conducted surveys using purple prism traps and green funnel traps. The traps are placed in ash trees prior to the period adult beetles will be flying, and left in place for the duration of beetle flight. The beetles are collected from the traps and sent for positive identification by an entomologist. The traps provide a good outlet for communicating about EAB since many people have been curious about “the purple kites stuck in the trees.” Green traps or other trap designs and colors may be less visible, but could still be a useful approach for gaining attention on EAB.

### **Outreach for Prevention**

Most prevention efforts, including quarantines, depend on an effective communication strategy. Communication efforts have included mailings to Maryland's Licensed Tree

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Experts and Forest Product Operators to make them aware of the issue and educate them on how to identify EAB. Press releases and web sites have been used routinely to help spread information more widely, and targeted community outreach has been used in communities where ash removal was planned or underway. UME provides a statewide point of contact for identifying EAB through the Home and Garden Information Center (HGIC) website at [www.extension.umd.edu/hgic](http://www.extension.umd.edu/hgic). Users may submit their information using an online form and photo submission tool. APHIS maintains the Hungry Pests portal at <http://hungrypests.com/> for citizens to report suspected EAB or Asian long-horned beetle (ALB), and to spread the message not to move firewood. Organizations can be listed on the website and the number of phone calls is tracked by organization.

Substantial outreach has been done statewide and targeted in areas near infestations, supported in part by APHIS funding. In 2010 alone, there were at least four newspaper, one radio, and two TV interviews of MDA staff, in addition to 400 airings of the EAB Promise Campaign on four radio stations and 135 airings on two TV stations. For the younger crowd, 10,000 copies of ‘The Emerald Ash Borer Fun Activity Book’ from Purdue University were adapted for Maryland and printed, half of which were distributed through Maryland Park Service to its park visitors. MDA participated in EAB Week with press releases, Public Service Announcements (PSAs) and a feature in the MDA Newsletter. Program ads, t-shirt tosses, exhibits, outfield banners, and screen ads with loudspeaker announcements were ongoing through the summer months at the Bowie Baysox and Southern Maryland Blue Crabs minor league baseball games. Presentations were provided for natural resources professionals at three different workshops. Bus wraps were purchased to run in 2011 in Charles County. Staff responded to more than 40 homeowner calls to inspect potentially EAB-infested trees.

UME developed and printed a set of invasive pest and plant disease field ID cards that includes EAB. These have been distributed to foresters, loggers, landscapers, and arborists. UME has also conducted logger training and outreach to many other groups.

The University of Georgia Center for Invasive Species and Ecosystem Health (<http://bugwood.org>) has developed an invasive species reporting and mapping system available through their full website, the mobile version for smartphones, or the free iPhone applications. The iPhone app is capable of accepting reports of EAB sightings and forwarding them to the appropriate state contacts in the Mid-Atlantic region, a project of the Mid-Atlantic Early Detection Network (MAEDN).

Outreach efforts will continue to emphasize basic prevention, early detection, and effective response. The MDA, UME, and DNR websites will continue to be maintained. Three major messages for outreach will be targeted to different audiences.

- “Don’t Move Firewood” or “Buy Local Firewood”
  - Mailings to forest product operators (especially firewood)
  - Signs and on-line advisories for campers at state, local, and private campgrounds

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- Handouts for firewood permits on DNR lands
- Information in hunting license packets or online registration
- “Treat Early to Save Your Ash Trees”
  - Outreach will emphasize early action for treatment, while trees are still healthy enough to save. Efforts should be focused on appropriate trees, such as large or high quality trees, that will be cost effective to treat.
  - Homeowner guides and information for landowners
  - Presentations and planning with local governments
- “Look for and Report EAB on the Eastern Shore”
  - Mailings to licensed tree experts and forest product operators with renewals and on-line services
  - Handouts and training for Master Loggers, Master Gardeners, Master Naturalists, and forest landowners with management plans
  - EAB field ID cards distributed to foresters, loggers, landscapers, arborists, volunteer groups, and others who spend time in the field
  - Promotion of MAEDN iPhone app to audiences listed above

Other options were identified, and will be undertaken as funding and staff time permit, including articles for local newspapers and outreach to companies that sell wood stoves.

### ***Preparedness: Inventory and Plans***

Planning to be better prepared for EAB can make a tremendous difference in the costs to communities to manage effects of EAB infestations, the severity of tree loss, and the time it takes to recover the benefits and quality of life provided by the trees. Proactive removal and replacement of ash can work within existing budgets by replacing a small proportion every year, establishing more diverse species a few years ahead of expected widespread losses. Treatments are only effective on mostly healthy trees, so trees important for community identity or environmental function must be identified prior to an infestation. Budgeting ahead for some increased tree removal and replacement costs can make the difference between being able to respond effectively to tree deaths and having to live with increased risks from dead trees that become more hazardous over time. State and federal agencies can provide some of the information and support for local planning, but the response on the ground will depend primarily on local jurisdictions and landowners.

Key areas for inventory and planning include urban communities, protected lands, and the Delmarva Peninsula. In urban communities, inventory and planning objectives may include minimizing safety hazards and maximizing community benefits. Efforts on protected lands will be outlined and coordinated through the Maryland Protected Lands Plan, with emphasis on minimizing safety hazards and protecting ecological benefits. On the Delmarva Peninsula, cooperative inventory and planning with Delaware and Virginia

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will emphasize risks along key emergency and evacuation routes, areas with rare species and riparian ash stands, and developing shared benefits for rural communities.

Proactive responses can greatly affect how quickly some of the important functions are replaced. The following major topics should be considered for planning.

- Ash tree inventory
  - Where are there ash trees (public land, private land, stream buffers, street trees, or parks)?
  - Where are ash trees particularly meaningful for community or ecological function (major shade trees in a park or along a street)?
- Treatment
  - Where should different treatment approaches be used?
  - Which trees should be treated and how often?
- Removal and Replacement
  - Where should trees be removed prior to death and replaced with other species to buffer the sudden loss of ash trees?
  - Where should trees be removed and other trees allowed to fill in?
- Utilization
  - Where is there a need for improved efficiency in tree removal efforts?
  - Can ash trees be used to meet local needs for wood products (lumber, firewood, mulch, or other value added products)?
  - What equipment or facilities could improve utilization at a local or regional level?
- Biocontrol
  - Where is there potential for biocontrol releases to improve ash survival over time?
  - Where can biocontrol be combined with other methods to maintain forest health?

### **Planning and Inventory in Urban Areas**

In urban areas, planning will enable communities to better understand how EAB will affect their trees and what actions can be taken to minimize risk and diversify the urban canopy. Many communities in Maryland do not have an existing urban forest inventory, so some level of inventory is a basic action needed to guide planning. The inventory should determine whether the community has a lot of ash trees or a few, whether there are concentrations where loss would devastate a neighborhood, and where there are ash trees of special value, including large specimen trees, trees with historic significance, trees important for recreation, or trees with significant ecological value, such as those providing significant shade to a stream. Urban street tree areas will be the crucial areas of EAB infestation where most evaluation and treatment will occur. If not already available, street tree inventories should be done in order to determine the potential damage to a community's urban forest resource and opportunities to proactively reduce risk.

Surveys can be a very quick walk-through of the community or a very detailed inventory. For an inexpensive and quick approach, windshield surveys using visual inspection by a trained professional from a vehicle can generate some idea of where there are concentrations of ash trees or high-value specimens. A complete survey is an in-depth, systematic approach that examines detailed information about all of the trees found within the community limits. A complete inventory is recommended to support planning for other urban forest health threats such as Asian long-horned beetle or thousand cankers disease on black walnut. An ash-only survey can also be done, although this is not recommended because it does not support planning for future pests. Sampling is commonly used to gather repeatable quantitative measures without the time investment to sample every tree for a complete inventory.

### ***Response and Recovery***

#### **Outreach for Response Efforts**

Outreach efforts will focus on cost-effective response options for agencies, local jurisdictions, industry members, and private landowners. Efforts have included presentations, press releases and articles, and the distribution of homeowner guides.

When an EAB infestation is identified in a new county, partner agencies will coordinate communications and outreach.

- MDA will coordinate press releases to the media and contact DNR and UME, who will distribute the message widely among staff. DNR distribution will include the MFS, MPS, WHS, the Communications Office, and DNR wide message opportunities. UME distribution will include all Extension staff, the University of Maryland College of Agriculture, and University Media Relations Contact.
- DNR will contact the county government and incorporated municipalities in the county to encourage development of local plans if not already in place. Links to online community patches, blogs, or other venues will be considered.
- DNR will contact potentially affected stakeholders:
  - Forest products mills- remind of quarantine restrictions and encourage utilization within the quarantine area;
  - Forest Product Operators;
  - Licensed Tree Experts;
  - District Forestry Boards;
  - Tree Farm inspectors and owners; and
  - Landowners with Forest Stewardship Plans, as possible.
- MDA will contact the Maryland Nursery and Landscape Association.
- UME will maintain the identification and reporting functions on the HGIC website.

## Treatment Options

There are several products and application methods now available that can effectively treat ash trees to prevent loss to EAB. Trees should be reasonably healthy, having more than two thirds of their canopy. Most of the insecticides used for EAB control are systemic and need to be absorbed into the tree to control insects boring in the wood. Consequently, the tree needs to have enough capacity to transport the insecticide throughout the tree. The borers interrupt the phloem function that would transport the insecticides, so there is little capacity to deliver the chemical or ability to recover once the tree has lost more than a third of its canopy. While treatment is best done ahead of infestation, current information suggests that if EAB is more than 15 miles away, it is probably too early to begin treatment (Herms et al., 2014). Currently, nearly all of Maryland is within the 15 mile range of infestation, and would be considered appropriate for treatment.

Insecticides that can effectively control EAB come in a variety of products. Trunk injections and sprays are applied directly to the bark and wood and are systemic insecticides. Soil injections and drenches also are systemic, being taken up by roots from the soil. Some protective cover sprays may be applied to the trunk, main branches, and possibly foliage, depending on the pesticide label. The central website, [emeraldashborer.info](http://www.emeraldashborer.info), has publications with current information on treatment options and considerations for application (see [http://www.emeraldashborer.info/files/Multistate\\_EAB\\_Insecticide\\_Fact\\_Sheet.pdf](http://www.emeraldashborer.info/files/Multistate_EAB_Insecticide_Fact_Sheet.pdf)). Maryland has used Safari® (dinetofuran) and TREE-äge® (emamectin benzoate) to treat high value trees. Imidacloprid products like Merit® also can be used to good effect. Most require a licensed pesticide applicator and must be applied at the correct season, rates, and insect stage. Emamectin benzoate can provide protection for two years rather than one and has shown some of the highest rates of effectiveness (Herms et al. 2014).

Treatments can be expensive and will require repeated treatment as long as EAB is at high levels. Treatments can save a tree, but do not offer effective controls on the population of EAB. Treatments are often used on larger trees, whose losses have the greatest impact and which cannot be quickly replaced. Emamectin benzoate has been shown to effectively protect trees over 25 inches DBH (Herms et al. 2014).

MDA, DNR, and University of Maryland will work together with USDA ARS to develop an integrated pest management (IPM) strategy, incorporating paired chemical treatments and biocontrol releases in natural areas. While biocontrol has long-term potential for EAB management, it is not yet ready to be used as a stand-alone method for protecting ash trees. Treatments may be used to protect specimen trees, and preserve a future seed source in natural ash stands. Biocontrol releases in the surrounding area may help to limit EAB populations and improve ash survival over time. The IPM strategy may be useful for managing extensive or riparian ash stands, where treatments alone would be insufficient or impractical. Ash trees in natural stands may also be treated in clusters of about 5 females: 1 male to preserve a future seed source.

## **Rural EAB Management**

Rural EAB management is a crucial part of an overall response in Maryland, where ash species are distributed throughout the state. Maryland's forests have an estimated 14.2 million ash trees with more than 130 million cubic feet of wood; while ash is widely distributed, it is present only on about 4% of forest land, and usually makes up less than 25% of the basal area of the stand (Lister et al. 2011). However, some forest stands have more than 75% of the basal area in ash and could be hard hit when EAB arrives. Many of these areas will be on private land, which makes up 76% of Maryland's forest. In addition to the information available to the general public, forest landowners will have access to an EAB fact sheet relevant to rural forests, and efforts will be made to contact Tree Farmers and landowners with Forest Stewardship Plans when EAB is detected in that county.

Forest Stewardship Plans are written to provide technical assistance to a landowner, and can be an informative tool that provides inventory information by forest stand and recommendations to improve forest health. Annual monitoring for forest health issues like insects and disease is a common recommendation in a Stewardship Plan. Forest stewardship plans can be used to develop a silvicultural cutting strategy to reduce the ash component, salvage economic value, and reduce EAB larvae populations in infested trees. Many ash trees may be in stream buffer or wetland areas beyond typical harvest areas, but selective cutting could be considered in the buffer in places where the minimum basal area can be retained (60 square feet/acre). Stands can be evaluated for healthy natural regeneration of a diversity of species, or could be replanted with select species to replace the value of any harvested trees. In places where harvesting is a cost-effective option, it can be an important part of a strategy to slow the spread of EAB. Another possible forest treatment is using insecticides on specimen or high value trees. Although this method can be effective, it is expensive and is not practical for large numbers of trees. Appendix D has sources of information for identifying EAB and implementing management practices to reduce its impact.

Ash trees have been an important species in riparian forest buffer restoration over the last 15 years, given their frequent presence in natural riparian areas, fast growth, and adaptable nature. While restored buffers were not exclusively ash, ash frequently makes up more than 15% of stocking in buffers, particularly since they generally had good survival (Pannill et al. 2001). Black walnut was another commonly used species that may become at risk from thousand cankers disease, carried by the walnut twig borer. Underplanting could be used to introduce a variety of other species to reduce the impacts of impending loss of canopy cover and root systems. Cost-share assistance will be pursued for landowners who wish to undertake these planting projects or other options including the control of invasive species if needed after ash death or removal. Options for cost-share assistance may include state programs like Woodland Incentive Program (WIP), and federal programs like NRCS Environmental Quality Incentive Program (EQIP).



Ash prices on the general timber markets have been declining throughout the recent years, possibly due to EAB. The relatively low values and lack of markets prevent larger buyers of timber from being interested in a salvage cut. Focusing on smaller companies that are willing to remove trees and haul away all of the residue could provide the most effective method of utilization. However, this approach may leave out other options for high-value utilization that could further lower the costs of removal.

### **Urban EAB Management**

Cities and communities of Maryland are likely to endure the greatest impact from EAB. Ash trees are widely used in our communities and the nature of the EAB epidemic means that many ash trees in an area will likely die within a few years if not treated. There are direct costs associated with tree removal, replacement, and treatment that will fall on local jurisdictions and private landowners. There are additional ecosystem services provided by the urban trees that will be foregone with their untimely death, including the lower heating and cooling costs in shaded buildings, air and water quality improvements, recreational values, and carbon sequestration. Ash is the most common tree in the city of Baltimore with approximately 293,000 trees within the city limits and over six million trees in the Baltimore metropolitan area (Nowak 2002). The USDA has estimated that losses could exceed \$227.5 million in the Baltimore area alone.

The first step in responding to the threat of EAB is to develop a Community EAB Management Plan. A modest amount of time invested in the EAB Plan can help communities use resources more wisely and to greater effect, so they end up with a better outcome and more manageable costs and risks. Local response plans are recommended even outside of infested areas. Plans should clarify responsibility for a variety of actions, identify community priorities and resources, and identify actions to carry out the priorities. The plan lays out the elements for the community to consider and set priorities for treatment, removal, and replacement. Chemical treatments can be effective, but are only an option if applied early enough. Prior to infestation, replacement of ash trees could be done gradually, prioritizing those with other health issues or utility conflicts. Tree replacements could increase diversity in the future urban forest. Removing ash trees can limit the rate of spread of EAB and be more useful for products, but only if done prior to the major outbreak. Many communities in the Lake States have found out too late what their options could have been, and will need more than a decade to regain the benefits of the lost urban canopy. Having strategies and mechanisms in place prior to an EAB outbreak means that more options can be used effectively and important natural resources can be saved with persistent follow-up. A Community EAB Management Plan Outline can be found in Appendix C.

The EAB Cost calculator has been developed to assist communities in planning treatment strategies (<http://extension.entm.purdue.edu/treecomputer>). The website is free, but requires registration with a user name. Up to 15 “forests” can be entered under each user

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name. The calculator can compare several scenarios involving the following management options:

- Treat ash trees with insecticides;
- Remove ash trees; and
- Remove ash trees and replace them with resistant trees.

The calculator requires the following information:

- An inventory of the number and size of ash trees;
- An estimate of costs for removing and treating trees based on the size of each tree; and
- An estimate of costs for replacing each ash tree that is removed.

The calculator factors in the number and size of your ash trees as well as the size of your management budget to identify a combination of these options that is best for any forest. It can compare the annual and cumulative costs, and remaining forest size, over a 25 year period for management strategies that include a mixture of tree removal, replacement, and insecticide treatment. The calculator can generate printed reports of up to 3 management strategies at a time.

### **Protected Lands Management**

Maryland's protected lands contain ash trees in high traffic visitor areas, and are also home to rare ash species, riparian ash stands, and important ecological communities. To address responses to public safety and ecological threats, MFS will create a Protected Lands Plan, in cooperation with MDA, MPS, and WHS. The plan outlines the strategy for managing EAB on state-owned protected lands, including: management objectives, inventory protocols, response options for managing ash on protected lands, and replanting and recovery options. Managers of other protected lands, such as federal land or private conservation areas, can use this plan for guidance in developing EAB response plans. The plan will be available on the MFS website.

### **Delmarva Peninsula Management**

Areas on the Delmarva Peninsula may require special consideration for management. Extensive riparian stands could have downstream impacts on the Chesapeake Bay, rare species require additional conservation measures, and the potential for strong storms and coastal flooding require planning along emergency response and evacuation routes.

Many riparian stands and rare species stands on the Eastern Shore occur on protected lands, so the Protected Lands Plan will be a useful tool for prioritizing management of these areas. Partnerships with private conservation groups will be critical to protecting a greater number of these stands. Treatment as a response activity may be limited in these stands due to frequent or prolonged inundation. The IPM approach incorporating paired treatments and biocontrol, or treating clusters of male and female trees, may maximize long term survival in these areas.

Planning and response activities should be conducted at both a local and regional level. While EAB is not widespread across the Eastern Shore, its arrival in multiple counties indicates that it will quickly spread to new areas. At the community level, urban tree inventories and response plans will help to identify management needs and response options. At the regional level, planning will be coordinated with Delaware and Virginia to inventory along key emergency response and evacuation routes. A cooperative EAB management plan for the Delmarva Peninsula will address outreach and treatment needs in rural areas, and explore cross-boundary management options.

## **Ash Utilization**

Ash trees killed by EAB or cut to delay the spread are likely to generate a large volume of ash wood within a fairly short period of time (one to three years for most jurisdictions). As a result, one of the largest challenges in EAB management projects is the disposal or utilization of ash material in a cost-effective fashion. Because quarantine regulations restrict the movement of ash material out of quarantined areas, wood utilization becomes even more difficult. These restrictions may limit the ability to use this material as commercial landscape mulch, wood pulp chips and solid wood products. Ash is a modest component of Maryland's forests, and has not enjoyed a robust market for solid wood products in this area despite many good qualities of the wood. Many of the mills that had processed it have backed off due to quarantine restrictions. An expanded quarantine could ease this concern, but limited demand may still restrain some uses of the ash material.

Often, the timeline set for tree removals is quite short once an infestation is discovered in an area. This leaves little time for arranging utilization options once removing trees and clearing debris becomes top priority. Utilization programs have the best chance of success if much of the early groundwork (finding industry partners, organizing collection and transportation, etc.) is completed as much in advance as possible.

EAB infested ash trees are frequently found within rural forest ecosystems, but the abundance of ash in urban and suburban areas and the possible hazards from dead trees will require local governments to remove high volumes of ash in communities. The tree removals, wood disposal, and replanting associated with the EAB infestation can create an economic challenge for these communities. Urban areas, in particular, can be challenging for collecting wood residues. Few companies in urban areas have the equipment necessary to lift and transport whole logs. Partnering with multiple businesses, or even multiple communities, may allow access to suitable resources. Systems which rely on single logs being picked up from a variety of areas are inefficient and rarely successful in the long term. Infrastructure has to be developed to allow for residues to be collected, sorted, and merchandised as efficiently as possible, which may necessitate a cooperative effort among many public and private entities. These may be co-located with

sites that support reuse of reclaimed building materials, materials for restoration projects, or other projects. The Urban Hardwood Recovery website, <http://www.urbanwoodexchange.org/>, offers an online exchange that could improve utilization, and convey information about quarantine requirements and EAB issues.

Since larger forest product companies do not usually operate in urban areas, smaller forest products companies such as portable sawmills and urban based businesses are a more likely route. Some jurisdictions have been able to develop local uses for schools, prisons, parks, and public works (e.g., truck floorboards, trash bins, benches, shoring lumber).

Maryland will coordinate with existing industry infrastructure, the local mills and product outlets for mulch, chips, firewood, and sawmills, to convey opportunities associated with anticipated tree removal. DNR will collect inventory data from communities to the extent possible and summarize the likely volume and sizes of forest products to be available. With additional resources, DNR would like to coordinate community log or marshalling yards to create convenient drop-off sites for contractors and allow merchandizing for best use of products. This could also be associated with roadside pickup opportunities. DNR has purchased kilns and a portable sawmill to be used for education and coordination with technical schools and public works departments. DNR will continue to pursue use of wood products for energy and heat generation, and will work towards the development of a wood utilization pilot program, to be used as an example across the state.

## Rare Species

Maryland has small populations of pumpkin ash (*Fraxinus profunda*), black ash (*F. nigra*), and Carolina ash (*F. caroliniana*) in addition to the widespread green ash (*F. pennsylvanica*) and white ash (*F. americana*). Each rare species tends to be in wetland environments. Black ash has been found in small pockets in Western Maryland, described as part of the Central Appalachian Basic Seepage Swamp plant community type, along with white ash, red maple, and yellow birch. Pumpkin ash is currently known to be distributed on the Eastern Shore from Caroline to Wicomico and Worcester Counties and on the Western Shore from Anne Arundel to Prince George's and Charles Counties. Pumpkin ash has been found in some fairly large stands and is often associated with green ash, with pumpkin occupying the wetter areas with organic muck soils. Carolina ash has been found in a small pocket on the lower Eastern Shore, and is typically found in swamps or floodplains with prolonged inundation.

Potential protection strategies include:

- Collecting and preserving seeds and genetic material in national seed banks;
- Treating a proportion of male and female trees in the community with insecticides to protect seeds source and allow survival until (or if) EAB becomes less deadly;

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- Releasing biocontrol agents; and
- An IPM approach including combined treatments biocontrol releases and targeted treatments.

Maryland DNR will work with the National Arboretum to make sure that genetic material from rare species are incorporated into national seed/genetic banks. White and green ash are currently well-represented in the seed banks, and some pumpkin ash samples from Western Shore stands have been collected. Priority will be placed on collecting seeds from black ash, Eastern Shore pumpkin ash, and Carolina ash, where possible.

The physical location of most of the rare species is likely to greatly limit ability to treat these areas without other undesirable impacts. Most are in very wet locations with no road access and where fewer insecticide options would be available to use. Black ash wetlands also are likely to be surrounded by steep slopes, further limiting access for treatment. Stands containing rare species will be considered for biocontrol release sites as an alternative to chemical treatment. Treatment locations are likely to depend greatly on ability to access the sites in a timely manner, as well as health and integrity of the population.

## Research

Investment in research is a vital component of controlling EAB in Maryland, especially in the areas of management and recovery techniques. Partners will continue to pursue opportunities for research funding and work in cooperation with all agencies that deal with detection, monitoring and management.

Field trials currently being carried out by MDA include parasitoid releases in low to moderately infested EAB areas, cooperating with national biocontrol programs. An IPM approach is being developed to use combined biocontrol releases and targeted treatments. University of MD has taken the lead in research to determine the rate of spread of EAB, the survival and spread of biocontrol species, and the life history of EAB in Maryland.

Parasitoid releases have incorporated three species of wasps, all of whom attack EAB in its early stages. *Oobius agrilli* is an egg parasitoid and prevents the eggs from hatching. *Spathius agrili* and *Tetrastichus planipennisi* lay eggs on or in the EAB larvae, which will then hatch, feed on, and kill the EAB larvae before it can emerge as an adult. An additional larval parasitoid, *Spathius galinae*, was approved for release in the US in 2015 and will be incorporated into Maryland's biocontrol release program. In their native ranges in China and Russia, the parasitoids are found on the majority of eggs and larvae, but they have not been found at those densities here so far. The development of a biocontrol is difficult and carefully controlled, but it is the only approach that offers a long-term solution that could be cost-effective for ash across a landscape. The three previously approved wasp species have all been successfully released and have been

found again in the spring, showing that they can overwinter in Maryland's climate and conditions at some level, a necessary prerequisite for being a viable biocontrol in Maryland. *Spathius galinae* is native to a colder climate in Russia, and is expected to be capable of surviving Maryland's winters, as well. Wasp biocontrol agent populations are still too low to be able to identify potential for effectively curbing EAB population growth. Some native insects also are preying on EAB and their larvae, sometimes seen on 10-20% of the larvae, but effects on limiting spread of EAB have not yet been seen. Maryland will continue to cooperate with national biocontrol programs to develop long-term options for curbing EAB population growth.

Additional areas for research include the long term ecological impacts of EAB. Researchers at University of Maryland are studying changes to plant community structure and regeneration, productivity and nutrient cycling, soils, hydrology, and physical site characteristics in wetland ash stands. Long term research plots at the Smithsonian Environmental Research Center are monitoring changes in stand structure and composition in more upland ash forests.

## Outreach Summary

Outreach is critical throughout the elements of Maryland's long-term response to emerald ash borer infestations. Details of outreach are included in each section, and some efforts address more than one section. Efforts are summarized here by intended audience.

**Public:** Outreach for prevention and response includes a broad public education component through continuing presence on multiple websites, including MDA, UME HGIC, APHIS, USDA, and Maryland Invasive Species Council.

- UME: <http://extension.umd.edu/hgic/invasives/emerald-ash-borer>
- MDA: <http://mda.maryland.gov/plants-pests/Pages/eab.aspx>
- APHIS: <http://www.hungrypests.com/>

The goals are to spread awareness of EAB as a problem, share methods for minimizing risk and managing ash trees, and increase the public's ability to detect and report EAB. Press releases will be used to spread the word when infestations are found in a new county. This usually leads to requests for follow-up information, which will be provided to news outlets whenever requested. Additional mailings, web links, and strategic signs will be used to reach citizens most likely to use or move firewood, including hunters and campers. Information on response options will be distributed through mailings, presentations, press releases, and community outreach events.

**Industry:** Tree-related businesses will be affected by EAB and are an important part of detecting and managing the spread of EAB. Licensed tree experts and forest product operators have been mailed information on EAB in previous years on identification, reporting, and quarantines. They will receive updated information when the counties

they work in are newly infested. The Urban Hardwood Utilization Project already has notification of EAB issues on its website, and will contribute to coordinating utilization efforts as well as increased awareness of the problem and quarantine. The nursery industry will be kept informed of new infestations and quarantine restrictions through MDA. Forest products mills will be contacted regarding possibilities for using ash and managing with quarantine restrictions.

**Local Governments:** County and municipal governments will be the primary audience for efforts to encourage community planning for EAB response. In addition to caring for trees on public land and developing programs for their residents, they are another conduit for offering credible information to citizens to increase awareness of the issues and needed actions. Other outlets for planning information can include homeowners associations, watershed organizations, and community service groups. UME will continue to offer training for local governments in guiding inventory, planning, and response efforts. Technical assistance will be provided on urban forest inventory, treatment options, calculating costs and benefits of treatment, removal, replacement, and rural forest management.

**Landowners:** Beyond the identification and reporting information available to the general public, landowners with ash trees can receive assistance on options for managing their trees. For landowners with more than ten acres, Forest Stewardship Plans can be prepared that include stand-specific recommendations and relevant cost-share programs. A fact sheet has been developed to address issues specific to rural forests. Homeowners can benefit from publications that summarize current treatment options and address common concerns about insecticides.

## **Priority Actions**

### ***Prevention and Preparedness***

#### **Detection**

- Promote EAB reporting by citizens and professionals through the UME HGIC and the MAEDN websites and iPhone app.
- Continue survey efforts as funding allows.

#### **Outreach**

- When EAB is identified in a new county, the following should occur:
  - MDA prepares press release and notifies partners and MD Nursery and Landscape Association;
  - UMD Extension Service notifies UME faculty, UM College of Agriculture faculty, HGIC, and the public through social networking and standard outlets;
  - DNR contacts forest products mills in or close to the county, forest product operators, and licensed tree experts, notifying that EAB is in the county,

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- providing a reminder of quarantine, treatment, removal and replacement options, and explaining where to get more information; and
- DNR contacts affected jurisdictions, Forestry Board, Tree Farm volunteers, and stewardship plan landowners.
- Maintain and update MDA, UME HGIC, and DNR webpages.
- Target hunting and fishing license inserts or web page advisories, and state land firewood permits with the message to use local firewood/don't move firewood.
- Create fact sheets for forest landowners for use with Forest Stewardship Plans.
- Include EAB notice when seeking or posting firewood or logs on Urban Hardwood Recovery project website.
- Coordinate with surrounding jurisdictions to leverage other work and improve regional outcomes.

### ***Planning/Inventory***

- Encourage adoption of Community EAB Response Plans
  - UME and DNR will offer training to local governments.
  - DNR will provide technical assistance with developing plans and establishing rapid urban forest inventories.
- Work with state and private land protection groups to develop the Protected Lands Plan.
- Pursue cooperative planning and inventory opportunities with Delaware and Virginia.

### ***Response and Recovery***

- Encourage implementation of Community EAB Response Plans.
  - Identify funding or cost-share sources for inventory, treatment, removal, and replacement.
- Coordinate urban forest inventory results for statewide compilation.
- Provide recommendations for ash components of rural forests in Forest Stewardship Plans.
- Pursue EQIP and WIP practices for selective ash removal, underplanting to increase species diversity, multi-species timber stand improvements that reduce ash component, or snag creation for wildlife habitat.
- Develop an EAB Stewardship Plan Fact Sheet on control and management options, including removal strategies, treatment options for specimen trees, and standards for making a harvest practical.
- Develop a strategy to protect some stands and genetic material of rare species.
- Maintain a biocontrol program for a potential long-term response.
- Encourage ash utilization through integration with existing industry infrastructure (mulch, firewood, sawmill).
- Pursue response options on protected lands, as outlined in the Protected Lands Plan.



## Maryland Emerald Ash Borer Long-term Management Plan

- Coordinate treatment, removal, replacement, and biocontrol efforts on the Eastern Shore, in cooperation with efforts in Delaware and Virginia.

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## Contacts

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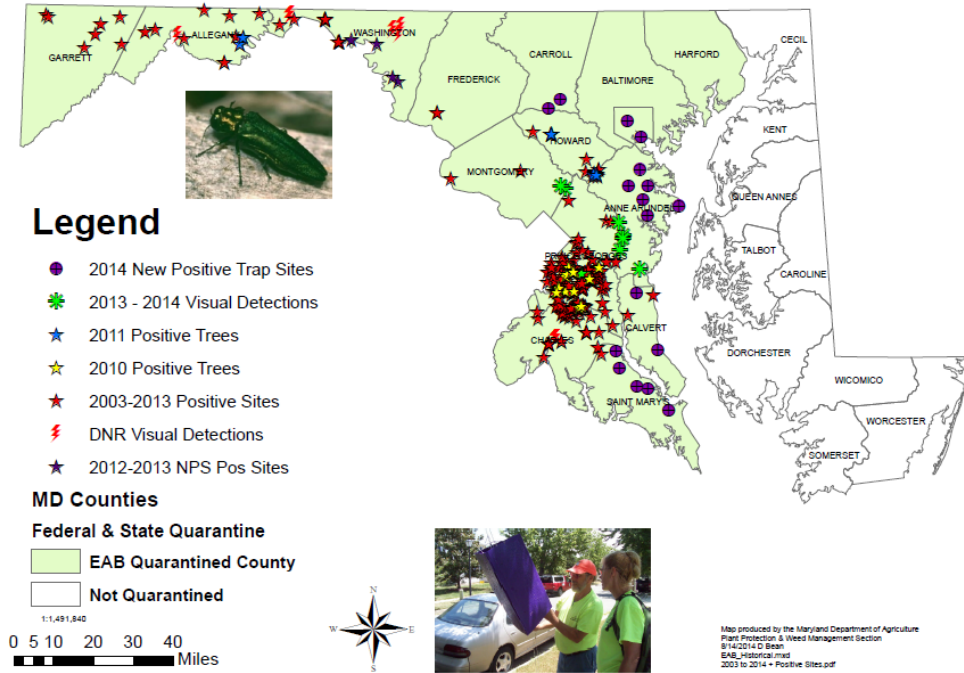
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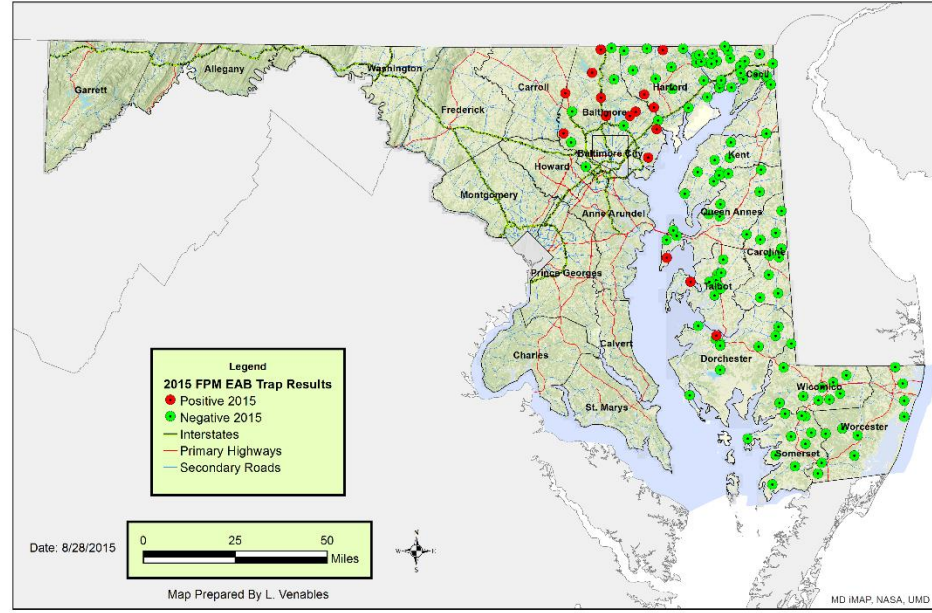
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# Appendix A: 2003-2014 and 2015 Emerald Ash Borer Survey Results

Maryland Emerald Ash Borer Project  
2003 to 2014 Positive Sites



Maryland Department of Agriculture  
2015 Maryland Emerald Ash Borer (*Agrilus planipennis*) Trap Results  
Plant Protection and Weed Management Section and Forest Pest Management Section









## **Appendix C: Community EAB Management Plan Outline**

### **Title**

An Emerald Ash Borer Management plan for the Community  
of \_\_\_\_\_ . Approved by \_\_\_\_\_ on Month Day, Year.

### **Purpose**

Declare the purpose and intent of the plan and how it affects public health, safety, and welfare. Some items that can be included are:

- Suppressing the spread of the EAB
- Reducing risk from dying trees and optimizing trees to be protected or replanted
- Distributing costs over a manageable time period
- Identifying and minimizing social and economic impact
- Maintaining long-term benefits of the urban forest and its ecosystem functions

### **Applicability**

What properties in the community will the plan apply to and who is responsible for each of those properties? Some items that could be included are:

1. Public properties
  - Rights of way
  - Parks and open spaces
  - Others
2. Private properties
  - Residential
  - Commercial
  - Industrial
3. Others

### **Administration**

Who will have principle responsibility for implementing the plan.

### **Executive Summary**

Provide a brief summary of EAB and the effect that it will have on the community.

- Summarize how much ash is in the community and where there are concentrations where losses would have greater effects
- Summarize desired actions for responses and recovery of urban forest benefits

### **Ash Management**

## Maryland Emerald Ash Borer Long-term Management Plan

Describe the actions that the community will take in preparation and response to the loss of its ash resources. Some items could include:

1. Urban Forest Inventory: How much ash is present?
  - Can use varied sources of information
    - i. Full inventory if available
    - ii. Sample of trees in areas of interest (e.g., street trees and parks)
      1. Tree species or at least genus (e.g., maple, ash, oak...)
      2. Diameter at breast height
      3. Location (street segment or coordinates)
      4. Special value (historic, community interest, ecological...)
      5. Public or private land
      6. Tree condition
    - iii. Planting lists from previous community plantings
    - iv. Windshield survey for quick evaluation of concentrations of ash
2. Responses: What do you do about it?
  - Identify areas of greatest risk
    - i. Street trees
    - ii. Special value trees
    - iii. Public lands
    - iv. Private lands
  - Evaluate cost effective strategies (see EAB cost calculator to estimate cost tradeoffs for chemical treatment, removal, or replacement (<http://extension.entm.purdue.edu/treecomputer> )
  - Plan and prioritize ash tree treatments
    - i. Selected street trees in areas of high ash concentrations
    - ii. Special value trees
    - iii. Treatment information or coordinated application for private landowner voluntary treatments
  - Prioritize ash tree removal
    - i. Targeted Removals- consider
      1. Size
      2. Condition, including interaction with other ash pests
        - a. Clearwing borers (attack even healthy trees)
        - b. Red-headed ash borers (usually in declining trees)
      3. Density of ash trees in the neighborhood
    - ii. Quotes or estimates on cost of removal by tree size
    - iii. Staff or contractors/retainers needed for timely action
    - iv. Utilization options to reduce costs, increase efficiency and sustainability, limit further transport of ash
      1. Community wood marshalling yards
      2. Agreements with local mills for retrieval of ash logs/chips
      3. Online hardwood exchange

## Maryland Emerald Ash Borer Long-term Management Plan

- Tree replacement
  - i. Species to use
  - ii. Locations
  - iii. Planting instructions
  - iv. Future care information
  - v. Time frame of planting
  - vi. Quotes or estimates on cost of replanting
- 3. Permits and Licenses needed (include quarantine requirements)

### **Monitoring and Reporting**

Determining if a community has EAB or the extent of the EAB infestation will be important to the management plan. Describe the methods that will be used to monitor and report EAB.

1. Methods (check with MDA, Forest Pest Management, for updates on status)
2. Personnel
  - Staff
  - Volunteers (HGIC website is a good resource for identification and reporting <https://extension.umd.edu/hgic/invasives/emerald-ash-borer>)

### **Education and outreach**

Describe the approach that will be used to educate the community. For example, presentations, and outreach materials (including handouts, brochures, flyers and mailings) for:

1. Officials
2. Staff
3. Public
4. Contractors
5. Training requests on treatment, monitoring, etc.

### **Definitions**

This section can be used by a community to provide a list of definitions for less commonly used words.

### **Contact List**

This section can be used to provide the contact information for the plan writer or responsible local official in the community.

## Appendix D: Resources for More Information

### Excellent Links to Emerald Ash Borer Information from HGIC site

- [Main Emerald Ash Borer Information Page](#) – excellent multi-state site from US Forest Service, Michigan State University, and Purdue University
- [Hungry Pests](#) – USDA APHIS
- [Maryland Department of Agriculture](#) - EAB information
- [Ash Tree Identification](#) – Michigan State University Extension
- [Emerald Ash Borer Pest Alert](#) - USDA Forest Service, Northeastern Area
- [Michigan Emerald Ash Borer site](#) - Michigan Department of Agriculture
- [Spanish language Emerald Ash Borer site](#)- Purdue University
- [Emerald Ash Borer Lookalike Chart](#) - University of Nebraska
- [2nd Edition Insecticide Options for Protecting Ash Trees from Emerald Ash Borer](#)
- [Managing Emerald Ash Borer Decision Guide](#)
- [Frequently Asked Questions Regarding Potential Side Effects of Systemic Insecticides Used to Control EAB](#)

See emerald ash borer on Facebook <http://www.facebook.com/stopthebeetle>  
University of Maryland Extension Twitter <https://twitter.com/umdhgic>