

City of Duluth Emerald Ash Borer Management Plan



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TABLE OF CONTENTS

Introduction

Overview of Emerald Ash Borer

Life Cycle

Tree Inventory Summary

Proposed Management Plan

Administration

Monitoring and Inspection

Insecticide Use

Certified Pesticide Applicators in Duluth

Community Outreach

Ash Tree Removal

Ash Wood Disposal

Reforestation and Canopy Replacement

Biological Control

Emerald Ash Borer Distribution Map as of July, 2015

Introduction

Emerald ash borer, or EAB, is a non-native beetle that feeds on and causes widespread mortality in all native species of ash (genus *Fraxinus*). The insect bores into the tree, eating the phloem tissue, the innermost layer of bark, and disrupts the uptake of nutrients and water. If left alone, EAB can kill an ash tree in as little as 2 to 7 years, depending on age, size, and initial tree vigor. EAB was first found in the United States in Michigan near Detroit in 2002. As of July 2015, it has migrated to 25 states and the Canadian provinces of Ontario and Quebec, decimating the ash tree populations wherever it is found. EAB was first discovered in Minnesota in Ramsey County on May 13, 2009.

EAB was confirmed in St. Louis County in Duluth MN in October of 2015. An earlier infestation was confirmed in Douglas County, in Superior, WI in 2013. Once EAB has been detected within 10-15 miles of a non-infested area, all ash trees within the 15 miles are at risk of infestation. Now that EAB has been Detected in Duluth (specifically Duluth's Park Point) The City of Duluth will develop and Implement a city wide EAB management plan.

EAB detection methods are improving and more is being learned about EAB weaknesses every day. An effective EAB management plan will spread out the costs of selective tree removal and pesticide application over time, while the science catches up.

According to the Minnesota Department of Agriculture, Minnesota has the highest volume of ash trees in the U.S. with almost a billion forestland and urban wood ash trees. Duluth has about 2,404 boulevard ash trees alone, not including park or privately owned ash. The impacts of losing such a large population of trees in an urban area are important to consider when managing the pest. Trees allow for reduced electricity use for air conditioning in summer as they shade homes and business. Consequently, due to reduced electricity use, there will be reduced air pollutants deposited on tree surfaces and reduced emissions from power plants. Trees contribute to annual reductions in CO₂, as well as carbon storage in the urban forest over the life of the trees, in atmospheric CO₂ due to sequestration by trees. Another benefit of trees in the urban landscape is reductions in annual storm water runoff due to rainfall interception. Direct benefits of urban trees to humans include reduced incidence of cardiovascular disease and asthma, faster recovery from surgery, increased physical activity, and increases in property values within communities.

EAB populations increase exponentially over time and, accordingly, a proactive plan is recommended which will ensure selective ash tree protection; preserving economic and environmental benefits and supporting public safety through a combination of monitoring, insecticide treatment, structured removals, sanitation, canopy replacement, community outreach and the possibility of biological control agents. By defining and beginning an integrated pest management strategy now, the City hopes to lessen disruption to our urban forest, stretch the management costs associated with EAB over a longer period of time, and create an atmosphere of EAB awareness to detect an infestation as early as possible.

Overview of Emerald Ash Borer

Emerald Ash Borer (EAB), *Agrilus planipennis* Fairmaire is an extremely destructive tree-killing flatheaded boring beetle. This insect is a non-native species from China that likely arrived in the United States as larvae living in wooden shipping pallets. The beetle was first discovered in the U.S. in Michigan, in 2002. In the forests near the initial site of the invasion in southeast Michigan, over 99% of the ash trees with stems larger than 2.5 cm in diameter are dead. The invasive pest has spread and is now devastating the ash tree genus throughout 25 states in 2015 in the eastern half of the United States, with mortality rates in the tens of millions. These insects can quickly decimate ash populations in an infested area, which poses a significant loss of tree benefits to communities as well as a high financial burden due to the expense of treating or removing trees for municipalities and property owners.

EAB are defoliators but the damage caused by the adults feeding on leaves is not what causes mortality. Tree decline caused by EAB happens in the larval stage. After initial infestation, EAB populations increase throughout the tree. As populations increase in the tree, more larvae are feeding on the phloem, girdling the tree. The loss of the phloem layer prevents the transportation of vital nutrients throughout the tree. Research estimates symptoms of decline occur after about 5 years of infestation, making early visual detection difficult. Once canopy dieback occurs, trees typically die within 2-4 years. Green ash (*Fraxinus pennsylvanica*) has proven to be the most susceptible species to EAB attack and is also the most heavily planted ash species throughout Duluth. The beetle will attack stressed trees as well as healthy, vigorous trees, while most native wood boring beetles are attracted only to trees under stress.

The borer has been shown to survive winter temperatures as low as -30°F. This is good news for parts of Northern Minnesota as it is not unheard of to experience temperatures below -30°F which could cause mortality in EAB populations. The City of Duluth is not so lucky. According to www.usclimatedata.com, average low temperatures in Duluth in the coldest months sit above zero; 7°F in December, 2°F in January, and 6°F in February. The warmer temperatures in Duluth are attributed to proximity to Lake Superior.

Life cycle

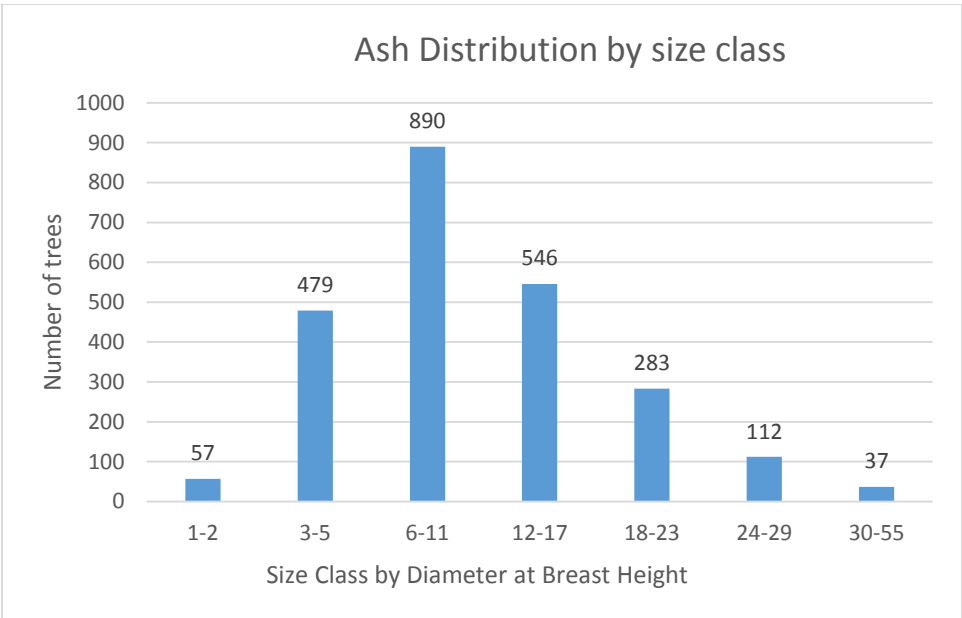
From mid-June through August, adult female EAB beetles will deposit eggs on the trunk and major branches of ash trees. After the larvae hatch, they tunnel through the bark to the cambial region just under the bark. Larvae begin feeding on the phloem tissue for several weeks. The phloem tissue is part of the tree's vascular system where sugars and nutrients are conducted throughout the tree, making a great meal for the larvae. As the larvae feed they leave S-shaped galleries under the bark. Most larvae are full grown by September and overwinter in a pupation cell in the bark of the ash. Larvae that have not reached maturity by the time winter comes may feed for another summer before reaching adulthood. This biennial life cycle typically only occurs in healthy ash trees with low larval densities. In April or May the following year, the larvae in the pupation cells will fully pupate. After about two weeks, the adult beetles will emerge from the bark, leaving the D-shaped exits holes which are associated with flatheaded borers. Emergence starts in May and will peak in July. The beetles are active during the day, feeding on leaves in the ash canopy. About a week after emergence, adult beetles will begin to mate. Females will begin laying individual eggs on the bark surface of ash shortly after mating. The average female will oviposit about 55 eggs but have potential to lay more than 150 eggs.

Tree Inventory Summary

Between 2010 and 2013, an inventory and assessment survey was conducted of the entire boulevard tree population to track and manage individual urban trees. The survey was conducted by Green Corps members and volunteers. The survey reported 2,404 ash trees out of a total 11,485 trees, or 21% of the population. Of all the ash, the most prominent species found throughout the city is green ash, which is also the most susceptible to EAB attack. The variables of interest in this boulevard survey were diameter of tree trunk at breast height (4.5ft from the ground), whether or not the tree needs maintenance, maintenance priority, sidewalk damage from roots, power wire conflict, trunk condition and crown condition.

There has yet to be a survey conducted for park trees. A complete park tree inventory, with information on the health of each tree, is required for the city to strategically target individual trees for treatment or removal, and to make planting decisions that ensure tree diversity within the parks.

Table 1: Duluth’s ash size class distribution based on diameter at breast height. Data from inventory conducted from 2010 to 2013.

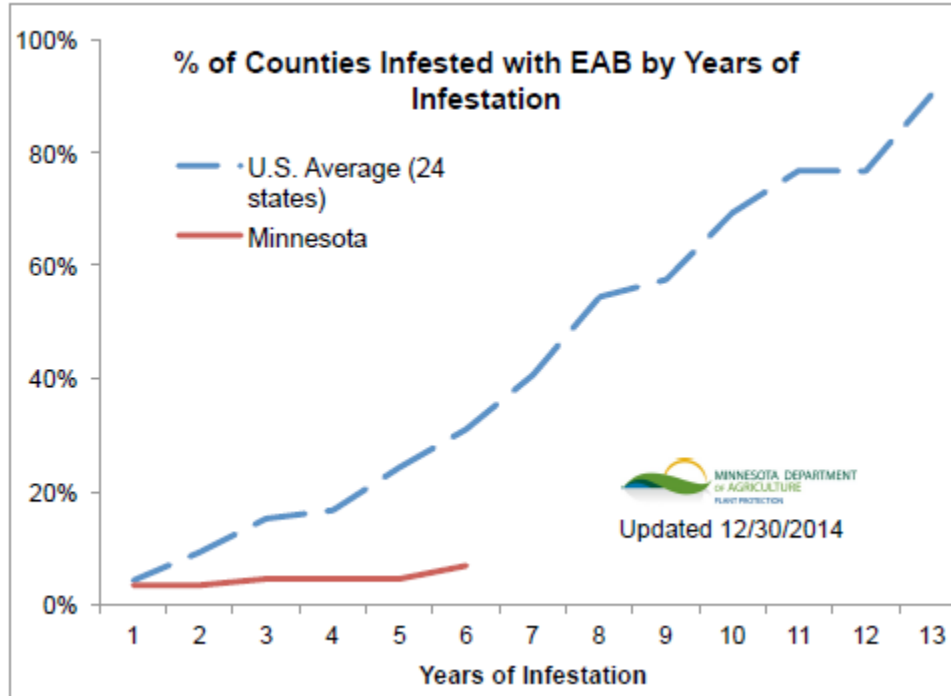


Proposed Management Plan

When EAB was first found in Minnesota, it was believed that the state would eventually lose all ash trees. Due to advances in treatment options and early detection, EAB may spread differently in Minnesota than it has in states that were on the forefront of the attack. It has been detected relatively early making it possible to slow ash tree mortality through integrated pest management strategies. So far, the percent of infested counties over time is much lower than the national average for infested states (see Graph 1). Duluth’s management approach will involve a combination of monitoring, structured removal of ash trees, systemic insecticide injection treatments, and the possibility of biological control. Slowing the spread of EAB and slowing ash

tree mortality enables the City to stretch management costs over a longer time period and allows for the retention of some of the more mature, high-quality ash trees and canopy cover.

Graph 1: Percent of Minnesota counties infested with EAB verses percent national average of counties infested over time, prepared by the Minnesota Department of Agriculture.



Administration

The Supervisor of the City of Duluth's Park Maintenance Department will be responsible for implementing this plan and will monitor grant opportunities and apply for grants when appropriate to help fund this management plan.

Monitoring and Inspection

City staff need to be key players in detection. It is recommended that parks and public works crew members undergo EAB training so they can help monitor the ash trees in the areas where they work. In addition, it is recommended that EAB training be provided for all employees interested in learning about the insect and its threat. The University of Minnesota holds annual Forest Pest First Detector workshops throughout the state, including one at the Cloquet Forestry Center. It is encouraged that anyone with a background in tree or forest health become a Forest Pest First Detector.

The Urban Forest Commission will encourage private property owners to monitor their ash trees and will reach out to the community through the 'Friends of Duluth Trees' Facebook page. City residents are often concerned about trees on their private lands and are encouraged to report any suspicion of EAB infestation. In addition to reporting to the city, the state maintains an Arrest-the-pest-hotline (1-888-545-6684 - Greater Minnesota). Citizens may call the hotline to report a suspected incidence of EAB. If EAB is suspected in a county that has not been confirmed to be infested, the MDA will ask for a photo and send someone out to inspect the ash tree in question.

If an infestation is suspected in an area that is under quarantine, it is still recommended to report it to the hotline, as the MDA is mapping all known infestation in Minnesota.

The implementation of an annual EAB inspection program for urban trees to detect infections as early as possible is essential for immediate management of the pest.

- Purple prism traps are in place throughout the city and is an ongoing project organized by the USDA and Minnesota Department of Agriculture (MDA) as a means of early detection. Purple traps are used during the summer to capture adult EAB beetles and are monitored by the MDA.
- Branch sampling is the process of pulling back the bark of ash trees to monitor for larval galleries. This inspection technique is best done during fall or winter months. Branch sampling conducted in 2015 by the MDA in Park Point Park revealed the presence of the Emerald Ash Borer in 4 ash trees on Duluth's Park Point .
- Visual inspection includes monitoring for crown dieback, decline and thinning, epicormic sprouts (suckers) on limbs or trunk, vertical splits in bark, D-shaped adult emergence holes, or excessive woodpecker activity. These signs are usually apparent only after heavy infestation.

Insecticide Use

One aspect of the integrated pest management strategy for EAB will be the preventative treatment of ash trees with insecticides. There are now two formulations of emamectin benzoate that are available for EAB injections: TREE-äge and Arbormectin. TREE-äge (pronounced "triage") will be used by the city. TREE-äge has been shown to be more effective than alternative insecticides, such as imidacloprid. Healthy, mature ash trees will be treated.

Of the 2,404 boulevard ash trees in the City of Duluth, 911 ash trees are candidates for injection in 2015. Candidacy is based on a given tree's diameter at breast height (4.5 feet above the ground), and location within the City. Because larger trees provide more community benefits and take longer to replace, only mature trees over 12" DBH will be treated by the city. Areas with high concentrations of large ash trees will be the focus of these treatments. Of those 911 ash trees, about 20% will be treated with injections every year. During the spring and summer of 2015, 176 boulevard ash trees were treated and injections will continue throughout Duluth yearly for 5 years. (If additional Confirmed EAB is detected in other neighborhoods these areas will become priorities for injection.) This figure was chosen considering cost and time constraints of administering injections. Treatment will need to be repeated every 2 years thereafter. If additional confirmed EAB sites are found, those neighborhoods would be given preference for injections.

The insecticide will be administered to the tree's vascular system via trunk injection. It is not applied to bark, leaves or soil. Animals and insects that crawl or land on the tree, but do not feed on the tissue, will not be effected by the insecticide, however, Emamectin Benzoate (TREE-age), has been shown to affect a broad range of plant-feeding insects. Ash trees that are not treated will likely be killed by EAB, and this will also negatively impact these insects associated with ash trees. Emamectin Benzoate does not contain neonicotinoids that have been proven to be harmful

to honey bees. As it is, ash trees are wind pollinated and not a source of nectar for bees. Additionally, because Emamectin Benzoate is administered exclusively through trunk injections, there is no concern about adjacent trees or plants absorbing the insecticide through the soil.

Evidence shows that woodpeckers that feed on larvae under the bark of ash trees are not likely at risk of being poisoned by the trunk injections. Woodpeckers do not tend to feed on larval cadavers and insecticides are less toxic to birds than to insects.

Once an infestation is detected, some trees will be beyond treatment. Various sources have suggested that if a given ash tree has at least 50 to 75 percent of its canopy intact it may be a candidate for insecticide use. Trees exhibiting more than 50 percent canopy thinning or dieback are unlikely to recover from EAB infestations even if treated with a highly effective systemic insecticide like emamectin benzoate.

Our injection results show treatment costs can be lower than removal costs when compared as an annual cost. As treatment options continue to evolve, costs of treatment will likely change. It will be important to stay up to date on these options and management recommendations. Insecticide use is a worthwhile EAB strategy for large trees that contribute a significant amount to the community.

The advantage of the insecticide treatment program is that in treating select ash trees, the city will continue to derive the many environmental and social benefits of large canopy shade trees while reforestation efforts take hold. Although concerns exist over use of pesticides, arguably, an equal environmental impact exists for the potential benefits lost that are provided by large canopy shade trees. Insecticide use began in July 2015 in Gary New Duluth.

The city will encourage property owners to carefully evaluate environmental impacts before using pesticides to treat EAB on private property. Owners that decide to use EAB pesticides are urged to use trunk injection rather than soil drenching, which will help reduce pesticide drift and reduce impacts to groundwater and surface water.

As of this date Certified Pesticide Applicators in Duluth that are currently offering EAB injection treatment options:

- Levy Tree Care – 218 393 4847
- Ricks Tree and Stump Removal – 218 728 2427

Pesticide tree injection/applications must be done by a MDA certified pesticide applicator.
Community Outreach

Adult beetles have been reported to travel about a ½ a mile from the tree they emerge from. Because EAB does not travel very far on its own, it is important for the public to be aware that the spread of this pest is primarily anthropocentric. Many infestations are started when people move infested ash nursery trees, logs, or firewood into uninfested areas.

Keeping residents informed on status of EAB, and encouraging involvement plays a key role in managing the pest. The City and the Tree Commission will contribute by providing community

members with the resources to learn how to identify EAB on their land and highlight the importance of restricted movement of hardwood ash materials. It is encouraged that interested citizens participate in the annual Minnesota Forest Pest First Detector course. This course is available at the Cloquet Forestry Center (located in Cloquet, MN) annually. The Urban Forest Commission will regularly update the 'Friends of Duluth Trees' Facebook page. The page will serve as an outlet for local and region tree news as well as a public forum.

Although there is no federal quarantine in St. Louis County, the MDA and the MNDNR have community outreach in place to discourage movement of firewood throughout the state. Residents are informed via signage and pamphlets of the importance of slowing the spread of EAB and other invasive species. A Law is in place to discourage the spread of forest insect pests: MN Statute 89.551 restricts movement of unapproved firewood on MN DNR state land. A violation of this restriction results in confiscation of the firewood and a \$100 fine.

Ash Tree Removal

Once EAB is detected in the (mainland) of Duluth, prompt removal and sanitation of infested boulevard trees is recommended. Based on the degree of infestation and health, ash trees need to be removed to limit hazardous conditions (large falling branches) and minimize the public safety risk associated with dead and declining trees. Ash wood is brittle by nature requiring removals to be carried out within a short period of time after tree death. Recent research has shown that ash trees that die as a result of EAB infestation are extremely dry and brittle and require removal within a 12 to 18 month period after death to avoid the risk of failure.

Upon detection of EAB, the City will start with an aggressive structured removal plan that will involve community input. Structured removal is the proactive, systematic removal and replacement of non-infested ash trees in a planned or "structured" approach. The removal of non-infested ash trees, trees primarily in declining health, helps to reduce the number of ash trees that would eventually have to be dealt with while spreading out the available time, cost and resources to do so. The vast majority of Structured Removal will take place on boulevard trees, as they will pose the highest safety risk once infested. The program will focus on declining ash trees (>30% dieback in the canopy), those with general health problems, structural defects such as old bolt/cable installations, poor form, those growing beneath utility power lines and all ash under 12" in DBH. The current ash population is 21% of the urban trees in Duluth. The goal is to treat 37% of the ash throughout the city. This will require the removal of about 1,500 ash trees from the boulevards. Once EAB is detected, regular pruning will temporarily be put on hold until such time that all untreated boulevard ash trees are removed from Duluth.

Removing ash under 12" and replacing with resistant species makes the most economic sense, according to Cliff Sadof with Department of Entomology at Purdue University. Trees under a DBH of 12" will take less time than trees over 12" DBH to become an equally valuable shade tree. The economic break-even point for removing and replacing trees under 12" happens after about 13 to 14 years. The break-even point to replace a tree with an 18" DBH or greater will happen after over 40 years. The long-term investment in large shade trees is much higher in trees 12" DBH or greater. Large trees are economically worth saving, smaller trees should be removed and replaced.

After a (mainland) infestation is detected, Park Maintenance workers will mark ash prior to removal. They will also be responsible for hanging EAB information cards on the doors of resident's homes nearby. Residents will have the option of treating boulevard trees at their own expense. After trees are marked, the resident will have 30 days to respond before trees are removed. A record of trees being treated by homeowners will be kept by the Park Maintenance Department to ensure the city does not accidentally remove citizen treated ash.

Typically, infestation centers are not detected for 3-5 years after insects arrive due to subtleties of initial signs in the tree. When an infested tree is identified, surrounding trees will need to be surveyed to determine the extent of infestation and the number of trees that will need to be removed. The city should consult with the MDA and the USDA to make an official determination of infestation.

The removal of dead ash trees in parks and open spaces is proposed to be done on a risk management basis. Those trees in parks and open spaces that are adjacent public areas will be the first to be removed once they have died. Ash trees that are far away from human activity are proposed to be left to fall on their own.

The City will not require the removal of ash trees on private property unless an ash should become a hazard to the public. In the event a private ash becomes a hazard to the public, the property owner will be notified by the Park Maintenance Department and be given notice that the tree must be removed.

Trees that are removed from boulevards and parks have economic value. Once EAB is detected, if wood is to be utilized it will have to be processed before it can be used as lumber. See the ash wood disposal section below for more information.

Ash Wood Disposal

When an EAB infestation is discovered anywhere else in Duluth (currently the City of Duluth Park Point Peninsula is the only area quarantined in St. Louis County) or another city within the county, St. Louis County will be placed under quarantine. Once the county is quarantined, movement of ash wood waste with bark and sapwood intact, green lumber, ash nursery stock, and all hardwood firewood will be regulated by the MDA. Movement from a quarantined area to a non-quarantined area is prohibited within the State of Minnesota.

Now that EAB has been detected on Duluth's Park Point Peninsula a secured collection and staging area has been established on our Park Property at the end of Park Point. This site will be available for City of Duluth Staff, Park Point residents and Tree Contractors working on Park Point to dispose of ash trees, limbs and chips.

After all bark including ½ inch of sapwood is removed from ash, the wood can be used for lumber. This lumber could be used for park projects including mulching, constructing benches, playground equipment, etc. If ash mulch is to be used, the chips must be chipped at no greater than 1" X 1" in two dimensions.

Reforestation and Canopy Replacement

Reforestation with a variety of tree species is the primary objective in managing and retaining Duluth's urban forest. Green ash was one of three or four species that were heavily emphasized by Midwest communities, including Duluth, as the replacement species for the American elms lost to Dutch elm disease. Ash was chosen because of its tolerance of a range of environmental conditions and resistance to other pests. The choice to replace elm with ash resulted in yet another large monoculture. At the time, species diversity was not a well understood concept as a means to manage unforeseen devastation to plant communities. Learning from the mistakes made in the past, the city will avoid monocultures through diversity and mixed planting schemes. Species diversity will help to reduce the impact of devastating tree loss events caused by biological factors.

Once (mainland) EAB is detected, the spring and fall will be dedicated to replanting where ash trees once stood throughout the city. The reforestation goal will be to plant 1 tree for every 1 ash tree that was removed. The Parks Maintenance Department will continue to remove hazard trees. All other pruning and tree removal work will be delayed.

As part of the replanting plan, the city will have a 2-year aftercare program for trees planted after removals. Stressed trees are more susceptible to diseases and insect pests. It is important to water regularly and prune properly to maintain tree vigor. The Park Maintenance Department will be responsible for new tree aftercare.

Biological Control

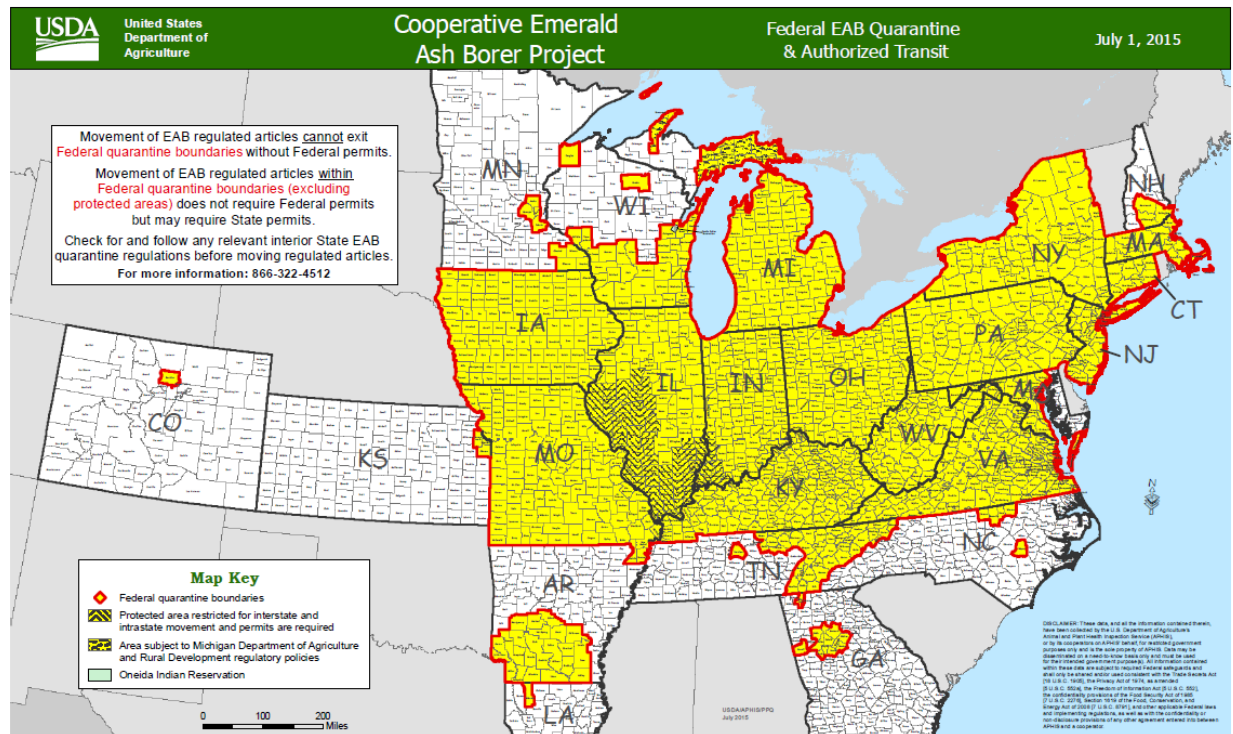
As part of the integrated pest management strategy the City of Duluth will explore the possibility of the use of biological control agents after infection has been detected. Biological control agents are natural enemies of pests used to reduce pest populations. Biocontrol requires an active human role, such as release into the environment, unlike natural controls which occur naturally and require no human involvement.

EAB in its native range is not considered a major issue, except on ash trees that are stressed or already in decline, or ornamental ash trees from North America planted in China. This natural resistance in Asian ash is due in part to EAB's natural control agents found in China. Several species of parasitic wasps have been identified to control EAB. Only three species have been approved, so far, for release in the United States, *Oobius agrili*, *Spathius agrili*, and *Tetrastichus planipennisi*. These wasps, in their native range parasitize anywhere from 50-90% of EAB larvae or eggs, which is an effective control method. If the parasitoids can become established in the U.S. they might be a significant contributor to the success of managing the pest.

In order for the USDA and affiliates to agree to release of parasitoid wasps, the city must have a forested area with 15 – 40 acres or more of infestation. The wasps must have enough EAB to parasitize and establish a population. The possibility of release will only arise if city forest, outside residential areas, becomes heavily infested.

Biological control has shown some success in the southern part of the state where infestation has been detected. The status of biological control agent establishment has yet to be tested in the northern part of the state.

U.S. EAB Distribution Map July 1, 2015



(Map above does not indicate Park Point)

For more information on EAB, please refer to www.emeraldashborer.info/ The information on this site is peer-reviewed and approved prior to being added to the site and is highly reliable.

Full product information about insecticide Duluth is using to treat the ash trees - https://www.arborjet.com/assets/pdf/marketing/IntroTREEage_Slideshow.pdf