



Emerald Ash Borer Management Plan

City of Lancaster, Pennsylvania



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a city authentic



pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES



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Pennsylvania Urban & Community Forestry Council

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1.0 Executive Summary

All North American ash (*Fraxinus* spp.) species are susceptible to attack by the emerald ash borer (*Agrilus planipennis* Fairmaire), an insect pest introduced from Asia. In 2013 and 2014 this pest was discovered in the adjacent counties of York, Dauphin, Lebanon, and Berks, and its arrival in the City of Lancaster is imminent (Figure 1). When established, we can expect to lose the vast majority of the ash trees in the City within several years.

The City of Lancaster recognizes the intrinsic value and benefits that a tree canopy provides to its citizens. Trees help to remove pollutants from the air and water, capture stormwater, shade streets and residences, increase property values, benefiting individuals and entire neighborhoods alike. The City's ash trees are especially important for meeting the Environmental Protection Agency's (EPA) mandate to reduce combined sewer overflows (CSO's) and for increasing the City's tree canopy.

Unfortunately, the emerald ash borer (EAB) threatens the City's ash trees and consequently its green infrastructure goals. Ash is an important species in our City tree population. Ninety-nine (99) ash trees are found on our streets and one hundred and ninety-one (191) in our parks, accounting for three percent (3%) of City trees. According to iTree Streets, a USDA analysis and benefits assessment tool, these ash trees have a compensatory value of about \$2.3 million and they mitigate about 1,000,000 gallons of stormwater annually through interception.

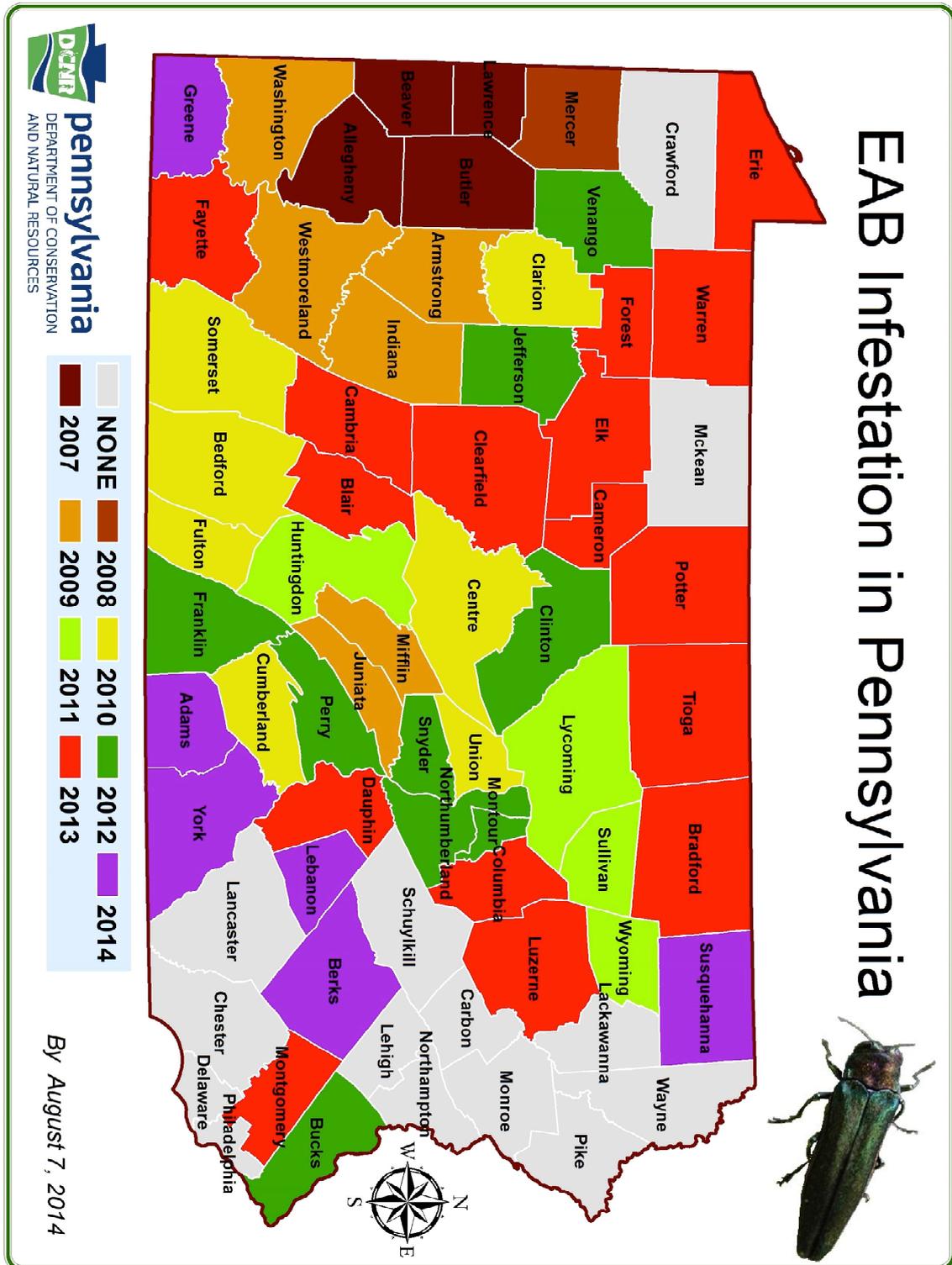
Furthermore, dead ash trees are a serious hazard to people and property. The wood becomes very brittle within two (2) years after death and large branches can fall unexpectedly. Dying and dead ash trees are particularly dangerous during storms and high winds.

Ash trees on private property and in the right-of-way are the responsibility of the property owners and adjacent property owners, respectively; however, in this document the City has planned to treat, remove, and replant ash trees in the right-of-way so it can be prepared to mitigate hazardous trees if necessary. The City will also conduct community outreach throughout the program period including technical assistance by the City's Shade Tree Commission and the Pennsylvania Department of Conservation and Natural Resources' (PADCNR) Bureau of Forestry. The City will collect citizen input and notify the public about the progress of the program in a timely fashion. Furthermore, City residents are encouraged to be part of this program through cooperation and volunteering.

To manage the ash tree population and to mitigate potential damages, the city is proposing this 10-year selective management program (2015-2025). Our intent is to chemically treat the highest-value ash trees and remove and replant the rest in a manner that is consistent with the City's tree ordinance and tree management plan. The program has a total cost estimated at more than \$250,000 over ten (10) years; this represents about ten percent (10%) of the compensatory value of all city ash trees in parks and public right-of-way, and includes the total cost for chemical treatment, tree removal, and replanting. The annual cost ranges from \$16,000 to \$50,000.

The Department of Public Works (DPW) and the City Arborist will administrate the program with assistance from the City Arborist and the Shade Tree Commission. Annual auditing of the program will be conducted by DPW. Necessary adjustments will be recommended each year based on progress reports on the status of forest conditions and EAB infestations within the City.

Figure 1. Map of documented EAB infestations in PA as of August 2014.



2.0 Goals & Actions

GOAL Protect high value ash trees for their social and environmental benefits.	
1	Actions <ul style="list-style-type: none">▪ Define and identify high value ash trees▪ Maintain an ash tree population within the City using selective management▪ Treat valuable ash trees with TREE-äge™, or the best insecticide available▪ Explore new treatment options and cost saving opportunities on an ongoing basis
GOAL Minimize public safety and liability risk from EAB infestation within the community.	
2	Actions <ul style="list-style-type: none">▪ Monitor EAB infestation on City trees yearly▪ Remove dead or dying ash trees from roadways and public areas▪ Dispose of ash-related material properly and utilize it when possible▪ Investigate the costs and benefits of in-house versus contracted operations for all EAB mitigation strategies
GOAL Replace canopy cover that will be lost to EAB infestation.	
3	Actions <ul style="list-style-type: none">▪ Replant using non-host tree species at locations where ash trees were removed▪ Pursue tree replanting grant opportunities such as TreeVitalize▪ Plant two (2) trees in accord with tree ordinance for each ash tree removed▪ Replant within one (1) year of removal
GOAL Conduct outreach and public education on EAB.	
4	Actions <ul style="list-style-type: none">▪ Communicate with the public through a variety of media outlets, including newspaper, social media, and City blogs and websites▪ Provide informational resources on EAB treatments, ash removal, and replanting▪ Engage private land owners on EAB to prevent dying ash trees from becoming hazards to people and property

3.0 Administration

The City of Lancaster's Emerald Ash Borer Management Plan is administrated by the Department of Public Works and the City Arborist with support by the City Shade Tree Commission. City residents are encouraged to contact the Department of Public Works with any questions or concerns related to this plan.

4.0 Authority

The health of ash trees in the City is threatened by the emerald ash borer (EAB). Damage to ash trees will have a negative impact on the public safety and quality of life for City residents. Federal and state regulations provide the local authority to manage this pest and mitigate its damage in Pennsylvania; ash trees infested with emerald ash borer are regulated pursuant Ordinance 273 Article IV, notice to trim or remove tree:

§ 273-4 Notice to trim or remove tree.

[Amended 7-26-2005 by Ord. No. 15-2005]

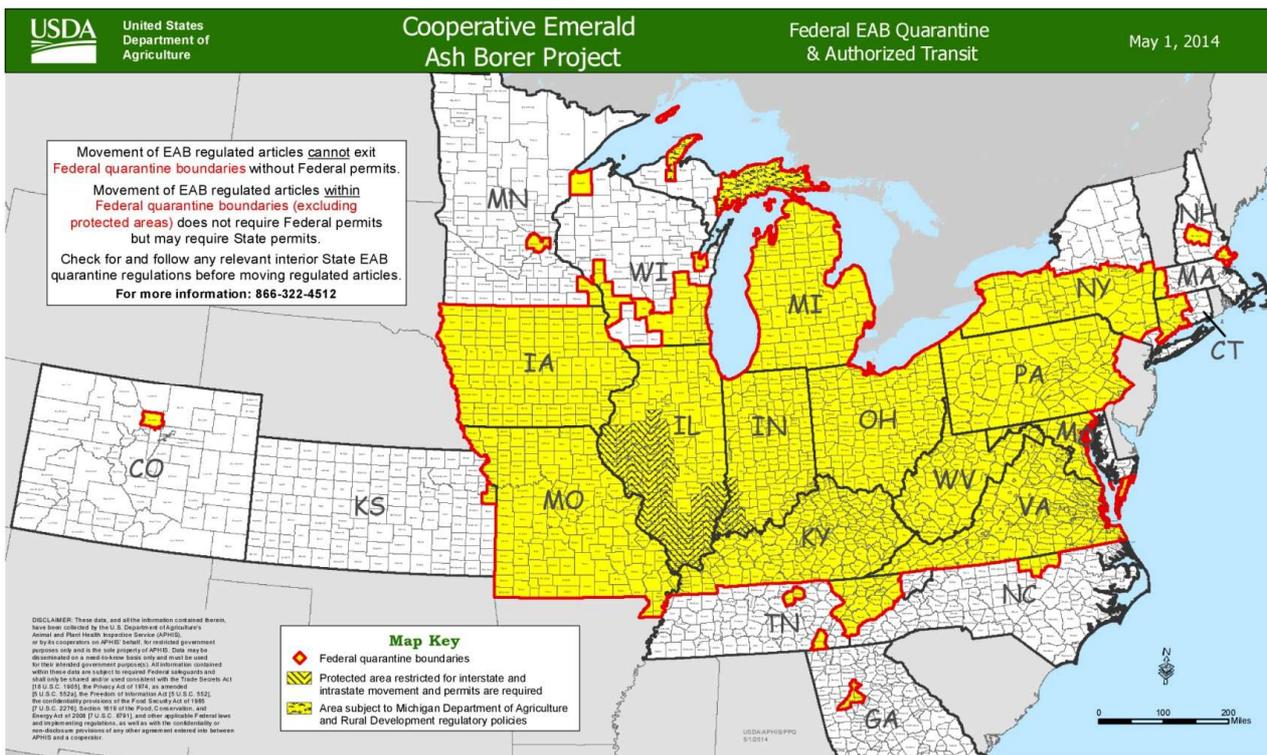
Any person owning a shade tree which is deemed by the Bureau of Parks and Public Property to be a danger to public welfare and property by reason of its damaged or diseased condition or its not being maintained in compliance with the care provisions of § 273-6 will be notified, in writing, to remove or trim the tree as appropriate, within such time as is therein specified. If the notice to remove or trim the tree is not complied with within the time period specified in the notice, the Bureau may cause the removal or trimming, as appropriate, to be done at the expense of the property owner. The entire cost thereof plus the administrative fee prescribed by Chapter 36 shall be charged to the property owner. Any bill for such trimming or removal undertaken pursuant to this chapter shall be paid by the owner in accordance with Chapter 36, Municipal Claims. Upon failure of the property owner to pay the amounts due the City in accordance with Chapter 36, the City shall be entitled to collect all amounts and pursue any or all of the remedies identified in Chapter 36, Municipal Claims.

5.0 State & Federal Quarantine

State and Federal quarantines on the movement of ash wood products in Pennsylvania became effective during 2007 following initial detection of the pest in Butler County, PA. The quarantine restricted the movement of all ash material beyond the quarantined area, including nursery stock, green lumber, logs, stumps, roots and branches, and wood chips. The movement of all hardwood firewood was also restricted.

However on April 15, 2011, acting Agriculture Secretary George Greig lifted the State quarantine. According to Greig, "As emerald ash borer has moved rapidly across the state, the in-state quarantine restrictions no longer serve a productive purpose." Lifting the quarantine now allows for the free movement of emerald ash borer-regulated materials within Pennsylvania. Although the State quarantine has been lifted, a Federal quarantine remains in effect (Figure 1). Specifically, the Federal quarantine restricts the movement of wood products across the quarantine boundary; interstate movement within the quarantine area is allowed without federal permits, but may require state permits. Wood products include: ash nursery stock, green lumber, waste, compost and chips of all ash species, and firewood of all hardwood species.

Figure 2. Map of Federal EAB Quarantine as of May 1, 2014, which includes the City of Lancaster.



6.0 Introduction

The City of Lancaster, Pennsylvania was incorporated in 1818. It served as the National Capital of the American Colonies for a brief time during the American Revolutionary War. As the county seat, surrounded by some of the most productive non-irrigated farmland soil in the country, the City became a market place for the sale and purchase of various crops and livestock. This market place tradition continues today with Central Market – the oldest, continuously operating farmer’s market in the country.

The City, like many other historic urban communities in the Northeast, is served by combined sewers. Both stormwater runoff and sanitary sewage are combined in one pipe for conveyance to the City’s Advanced Wastewater Treatment Facility (AWWTF). During heavy rainfall, the runoff exceeds the capacity of the AWWTF, and a portion of the combined runoff and sanitary sewage overflows to the Conestoga River. The Environmental Protection Agency (EPA) established a Total Maximum Daily Load (TMDL) for the Chesapeake Bay, and thus all tributaries, which discharge into it, including the Conestoga River. The TMDL for the Chesapeake includes phosphorous, nitrogen, and sediment. Therefore, maintaining the tree canopy is important not only for the visual character and health of City residents, but also for mitigating combined sewer overflows (CSO’s) into the Chesapeake Bay. Planting and maintaining city trees is an important means of accomplishing these goals, but EAB threatens the City’s progress.

EAB was first discovered in Michigan in 2002 and was likely transported to the United States from Asia on wooden shipping crates approximately five (5) years prior to its discovery. An estimated 20 to 55 million ash trees have been killed by this pest so far. The potential economic damage may exceed \$10 billion in twenty-five (25) states within the next ten (10) years.¹ In Pennsylvania it is now found in fifty-three (53) counties, including the adjacent counties of Berks, Dauphin, and Lebanon. The arrival of EAB in Lancaster is imminent.

Difficulties in early detection, limitations in control options, and scarcity in available resources have confounded the management of this pest in North America. Tree removal is the only option for sick and dying trees, whereas chemical control can be effective on high-value ash trees.

The City is committed to preserve its urban forest resources as a designated "Tree City USA" community. The *Emerald Ash Borer Management Plan* is to serve as the master plan for the City to manage its urban ash trees over the next 10 years. Property owners are encouraged to manage their ash trees according to the guidelines set by this document.



Emerald Ash Borer (EAB) is an invasive, non-native insect that feeds on, and ultimately causes the death of ash trees. The beetle is metallic green in color and approximately one half inch in length. Adult females lay their eggs under the bark where they hatch. Larvae feeding in the cambial region disrupt water and nutrient transport inside the tree, creating S-shaped galleries and D-shaped exit holes. EAB results in 99% tree mortality within 4-5 years after initial attack.



¹ Kovacs, K.F., Height, R.G., McCullough, D.G., Mercader, R.J., Siegert, N.W., and Liebhold, A.M. 2010. Cost of potential emerald ash borer damage in U. S. communities, 2009-2019. *Ecological Economics* 69: 569-578.

7.0 Ash Resources

In June 2011, the City of Lancaster commissioned Pennsylvania State University (PSU) Department of Forest Resources to conduct an urban tree inventory (Table 1). Researchers documented three hundred and five (305) ash trees along city streets and in parks, making up approximately 3% of the City's inventoried trees, of which two hundred and ninety (290) are currently surviving (Figure 2). There are Green and White Ash species. On average, the City's ash trees are in 'good' health and have a diameter at breast height (DBH) of nineteen (19) inches (Table 2). Furthermore, the City Arborist estimates that there are an additional one hundred (100) ash trees on private property within the city limits.

The city-managed parks have the majority of ash trees (Table 1). Of the one hundred and ninety-one (191) ash trees within the parks, Long's Park is home to one hundred and forty-seven (147) of them, which is by far the largest concentration of ash trees in the city. The parks with the next most include Buchanan (13), Reservoir (13), Conestoga Pines (8), and Brandon (5).

While the adjacent private property owners are legally responsible for the maintenance of the 99 trees within the right-of-way, the City has included these ash trees in this plan to help mitigate any potential public hazards.

Two important notes: the City does not manage the Lancaster County Central Park even though part of it is within the City limits; also, the tree inventory did not include semi-natural woodlands in parts of Conestoga Pines and Long's Park. There may be stocks of ash trees in these and other such locations, which are unaccounted for in this plan.

Table 1. Distribution of ash trees by property type in City of Lancaster.

Location	# of Trees
Right-of-Way	99
City Managed Parks	191
Private Property*	100
Total	390

** This is an approximation by the City Arborist. The City is not responsible for ash trees on private property, and the City does not monitor them.*



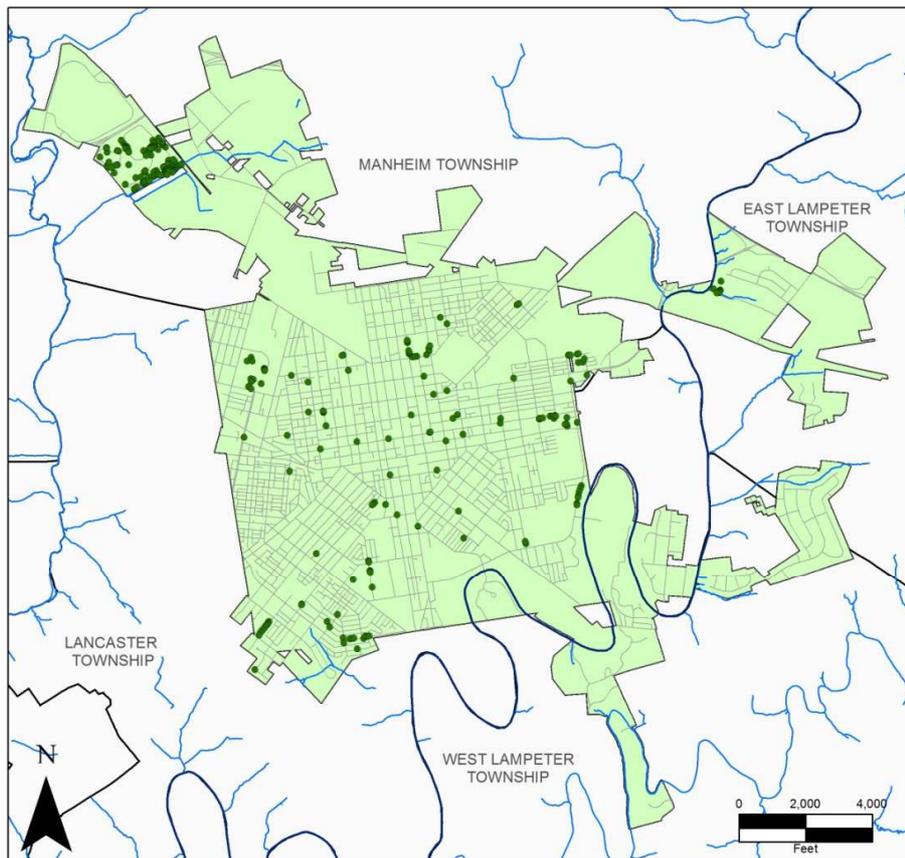
Ash trees (*Fraxinus*) are a common North American hardwood, deciduous tree. Green and white ash trees are the most commonly found varieties along streets in and around Lancaster City. However, the City stopped planting ash in 2005 in response to the spread of EAB.

Table 2. Diameter and condition of street and park ash trees in City of Lancaster*

Tree Conditions	Diameter Class (inches)						Total
	0<5	6-10	11-20	21-30	31-40	41+	
Excellent	4	3	2	0	0	0	9
Good	23	47	53	40	34	8	205
Fair	1	12	12	24	8	4	61
Poor	1	1	3	6	0	1	12
Dead	0	2	0	1	0	0	3
Total	29	65	70	71	42	13	290

* The most recent estimate by the City Arborist based on the 2011 Tree Inventory.

Figure 3. An inventory map of all City ash trees in parks and public right-of-way (2014).



Source: City of Lancaster, PA Spatial Data Access

Draft prepared June 2014

City of Lancaster
 Emerald Ash Borer Management Plan
 City Ash Trees - Streets and Parks

- Ash Trees
- City of Lancaster
- Municipal Boundary
- Waterways
- Streams
- Roadways

8.0 EAB Infestation

DCNR began trapping for EAB in 2014; however, EAB has not been found in the City of Lancaster. When the EAB arrives within the next couple years, all the ash trees in the parks and on the streets will be intensively surveyed using pest signs and symptoms, such as crown dieback, characteristic D-shaped holes, and woodpeckers. A pest status component will be added to routine maintenance for the Departments of Public Works and Parks & Recreation. Residents will be encouraged to report EAB infestations on private ash trees to the City Arborist (717)-291-4846 and (or) the PA Dept. of Agriculture (866)-253-7189.

9.0 Management Strategies

With the arrival of EAB, all communities will be forced to respond to the infestations to some degree, regardless of the strategies they choose to adopt. Dead trees on streets and in community parks present real threats to public safety. Also, sudden changes in urban canopy cover may result in negative impacts to local communities (e.g. air quality, aesthetics). Addressing some or all of these concerns requires a well-conceived management strategy. There are four (4) management options that a community can choose from, each with pros and cons; they are outlined in the table below (Table 3).

Table 3. Management strategies for emerald ash borer infestations.

OPTION	DESCRIPTION	PROS	CONS
No Special Actions	Allow trees to die in place with no allotted budget or management plan.	<ul style="list-style-type: none"> No upfront costs 	<ul style="list-style-type: none"> Unrealistic Trees are safety hazards Loss of tree canopy
Preemptive Management (remove & replant)	Preemptively remove and replace all ash trees with non-host species.	<ul style="list-style-type: none"> No costs beyond completion of project No future concern for EAB 	<ul style="list-style-type: none"> No EAB surveying High initial cost Potentially large canopy gaps Complete loss of ash
Aggressive Management (intense chemical use)	Active management with all available tools on all properties, public and private, including a complete inventory of ash resources. Aggressive pesticide application to infested trees.	<ul style="list-style-type: none"> Property specific tree management High value ash trees are saved Minimal tree loss 	<ul style="list-style-type: none"> High annual cost Ongoing investment Saving ash trees is not guaranteed
Selective Management (mix of remove, replant, & chemical use)	High-value ash trees actively managed in public areas and private property owners are engaged through outreach. Mix of tree removal, replanting, and chemical treatment. Planting two (2) trees for every one (1) removed.	<ul style="list-style-type: none"> Cost effective High-value ash trees are saved Flexible management structure Public education efforts 	<ul style="list-style-type: none"> Private property ash trees not directly managed Saving high-value ash trees is not guaranteed Ongoing investment for selected high-value ash trees

10.0 Management Tools

Each EAB management strategy employs a variety of tools to varying degrees, including tree removal, chemical treatment, biological control, and replanting.

10.1 Tree Removal

EAB kills ninety-nine percent (99%) of ash trees after several years of infestation. The City should assume that all untreated ash trees in the City will be dead or dying within the next decade. Most of these will need to be removed, especially those within the right-of-way, near infrastructure, or near passersby. However, if an ash tree exists within a natural, open space away from doing any harm, then it may be desirable and less expensive to allow it to decay. Dying and dead trees provide habitat for wildlife, restore soil, and are an important part of the natural landscape.

10.2 Chemical Treatment & Application

There are currently four (4) insecticides that can protect healthy ash trees from EAB infestation: Azadirachtin, Emamectin benzoate, Dinotefuran, and Imidacloprid. All of these are harmful to humans and wildlife to some degree and their use must be weighed against the benefits of preserving the ash trees (Table 4). Current research suggests that Emamectin benzoate, commonly known as TREE-äge™ is the most effective treatment for EAB, but it can only be used on trees with a DBH over ten (10) inches.²

Each pesticide has a specific method of application, but they can be generalized into the following four (4) categories:

- **Soil Applications** – Some pesticides may be poured directly on the ground surrounding the tree or may be injected into the soil several inches below the surface. This method is not effective for trees much larger than twenty inches (20") DBH and there are strict pound per acre application restrictions. Soil must be moist, but not saturated or dry; the chemical is applied within eighteen inches (18") of the tree base and leaves and grass should be raked away for maximum penetration. This method should not be used in sandy or otherwise highly permeable soils or near any water features. There is a high risk for water contamination.
- **Trunk Injection** – This method can be used on trees where soil application is not feasible. Generally, tree injections are more rapidly absorbed compared to other methods and there is less risk of water contamination. Drilling holes for injection can damage the tree minimally. Improper injection may cause separation between cambium and bark, permanently damaging vascular tissue. Injections should be administered mid-May to early-June, after leafing, but before EAB hatches.
- **Basal Trunk Sprays** – When applied correctly, these sprays are not physically invasive to the tree and may not contaminate soil. The pesticide is absorbed into the bark of the tree. This method is quick and easy and requires very simple equipment; however, wind may cause the chemicals to drift, which can be dangerous.
- **Cover Sprays** – Pesticides that use this method are not effective on larvae underneath the bark. Generally, the pesticide is sprayed on the bark, branches, and leaves, although this is specific to the chosen chemical. To be effective, application must be timed with the emergence of adult beetles.

² http://www.extension.umn.edu/garden/insects/find/emerald-ash-borer/docs/ncbipm_eab_insecticide_bulletin_2nd_ed_may_2014.pdf

Table 4. Common information on EAB pesticides and their pros and cons.

Active Ingredient	Common Product Names	Type of Application	Timing & Frequency of Treatment	Average Cost Per 20 inch DBH Ash Tree	Pros	Cons
Azadirachtin	TreeAzin®	Trunk injection	May until mid-June, annually	\$/per year unknown	Classified as bio-pesticide (made from Neem). Minimal or no exposure risk. Biodegrades quickly.	Does not effectively treat adult beetles, only larvae.
Dinotefuran	Safari™ Transect™ Xylam®	Systemic bark spray or soil injection	May through June, annually	\$35/year	Easily and quickly applied.	Not for trees > than 12" DBH. Strong leaching potential to shallow groundwater. Restrictions on lb/acre.
Emamectin benzoate	TREE-äge™	Trunk injection	Early May through June, every other year.	\$200 every 2 years*	Most effective compound. Trunk Injections have fewer water quality concerns. Treats trees with up to 50% canopy loss. Good for large trees.	Not for trees < 8" DBH. Leaves drill holes in tree. Application slow and expensive. Highly toxic to fish.
Imidacloprid	Merit® Xytext™ Imicide®	Trunk injection, soil injection, or drench	Mid-fall and/or mid- to late spring, annually	\$20/year	Trunk injections have fewer water quality issues.	Very toxic to aquatic invertebrates. Can leach to shallow groundwater. Not for trees > 20" DBH.

Source: Madison WI EAB Plan, Philadelphia EAB Plan, and Minnesota Department of Agriculture.

10.3 Biological Control

This is a highly experimental EAB management tool with unknown and potentially serious ecological risks. Biological control (or bio-control) is the practice of importing and releasing natural enemies from a pest's native range to control populations in the area of introduction. The United States Department of Agriculture (USDA) Animal Plant Health and Inspection Service (APHIS) is currently working on a bio-control program. A total of three (3) species of predatory insects have been collected from the EAB's native range (China) and the USDA has begun rearing and releasing these insects at appropriate sites. Based on data collected following predatory insect release, the bio-control program has not yet resulted in a reduction in ash mortality. It may take quite a while before predatory insects can effectively control the EAB.³ Should these bio-control agents ultimately become established, ash may return as a component of our future forest; however, researchers are not able to predict what the future holds for our native ash species.

10.4 Side Effects & Risks

Chemical and biological control treatments for EAB or any other insect pest can have potentially harmful side effects. It is essential that best practices for safety, as specified by the manufacturer and federal and state regulatory agencies, be carefully followed. Only trained and licensed applicators shall be permitted to apply the treatments. All city regulations must be followed. In selecting a treatment for EAB, effectiveness as well as potential side effects should be considered.

Appendix 1 presents the executive summary of an extensive review of the risks of TREE-äge™, as quoted here. TREE-äge™ has been approved for treatment of EAB only by injection, although further research is needed on the movement and fate of injected chemicals. The review concluded that "[i]f workers handle emamectin benzoate with care and effectively use chemical resistant gloves, no substantial or significant risks to workers are anticipated." Workers must have a response plan in place in case of accident. In terms of risk to the general public, further study is needed to quantify any risks, but the report stated

³ USDA-APHIS/ARS/FS. 2010. Emerald Ash Borer, *Agrilus planipennis* (Fairmaire), Biological Control Release Guidelines. USDA-APHIS-ARS-FS, Riverdale, Maryland.

that at this time “[s]ubstantial exposures to members of the general public do not appear to be plausible.”

Some hazard assessments have been performed on the risks of emamectin benzoate to non-target organisms. “Based on the accidental spill scenario, no risks are apparent for mammals, birds, fish, aquatic plants, or tolerant species of aquatic invertebrates.” However, there may be effects on some sensitive species of aquatic invertebrates, so particular caution is needed to avoid an accidental spill when emamectin benzoate is used near bodies of water. Emamectin benzoate may harm non-target insects that feed on ash trees. DPW staff should monitor ongoing research on emamectin benzoate or any other EAB insecticide.

With any biological control, there is a potential risk that the control organism may cause more problems than it solves. Before any biological control is approved by federal and state regulators, this issue will be carefully scrutinized.

10.5 Replanting

All replanting efforts should be consistent with the City’s tree manual and tree ordinance and the selected species should be disease resistant. According to the City’s tree inventory from 2011, the following trees, and trees with similar characteristics, would be suitable for Lancaster City and also help increase species diversity:

- London planetree
- Ginkgo (male)
- Tulip poplar
- Disease- resistant Elm cultivars
(e.g. Triumph, Native Charm, Accolade)
- Honey locust
- Basswood

Replacement Ratio

Additionally, the City should consider how many trees to plant for every one (1) removed; many cities are implementing a ratio strategy. West Chester Borough, PA plans to plant two (2) trees for every one (1) removed. However, Philadelphia is losing so many ash trees that it can only afford to plant one (1) tree for every two (2) trees removed.

Given that the City of Lancaster only has two hundred and ninety (290) ash trees, it could be feasible to use a higher replacement ratio. This could be beneficial to the City’s goals to mitigate stormwater. Inevitably, there will be net loss of canopy and loss of stormwater mitigation in the near term due to EAB. However, if the City wishes to lessen this, then it should aim for a much higher replanting ratio on the order of five (5) trees for every one (1) removed.

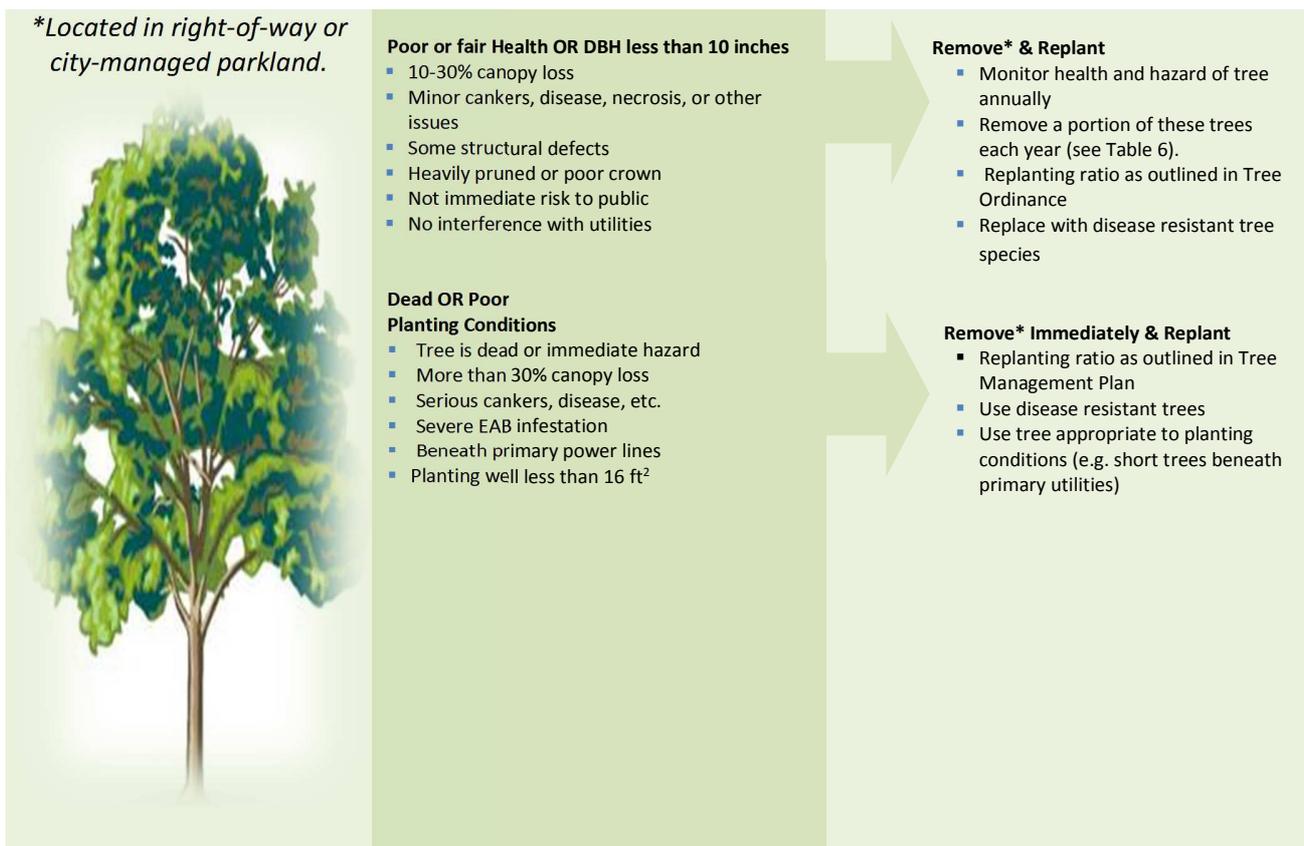
11.0 Selective Management Model

The following model is the City's decision-making matrix for a selective management strategy; it aims to remove unhealthy and hazardous ash trees while preserving those that are high quality (Table 5). This strategy employs three (3) of the management tools outlined above: removal, chemical treatment, and replanting.

The health and growing conditions should be inspected for every city ash tree. Those in Good or Excellent health with a DBH over ten (10) inches are candidates for chemical treatment, and those deemed to be Fair, Poor or Dead need to be removed and replanted. Small ash trees less than ten inches (10") DBH cannot be treated with bark injections. Poor growing conditions are also taken into consideration too. For example, even a tree in excellent health may need to be removed if it interferes with utilities. Finally, if a tree exists in a natural space and it is not dangerous to property or passersby, then it should be left in place; dead trees provide habitat and improve soil, and they are an important part of ecosystems.

Table 5. Selective management decision-making model for City of Lancaster.

STEP 1	STEP 2	STEP 3
<p>Locate a City Ash Tree*</p>	<p>Assess Tree Condition</p>	<p>Determine Treatment</p>
	<p>Good/Excellent Health AND DBH more than 10 inches</p> <ul style="list-style-type: none"> ▪ Less than 10% canopy loss ▪ No cankers, disease, or other issues ▪ No structural defects ▪ Provides shade, water infiltration, and ot public amenities ▪ May or may not be infested ▪ Adequate growing space ▪ No interference with utilities 	<p>Chemical Treatment</p> <ul style="list-style-type: none"> ▪ 10-year treatment plan begins immediately ▪ Use best available insecticide for EAB ▪ Assess tree health annually ▪ Despite treatment, some trees may decline in health and need to be removed and replanted.



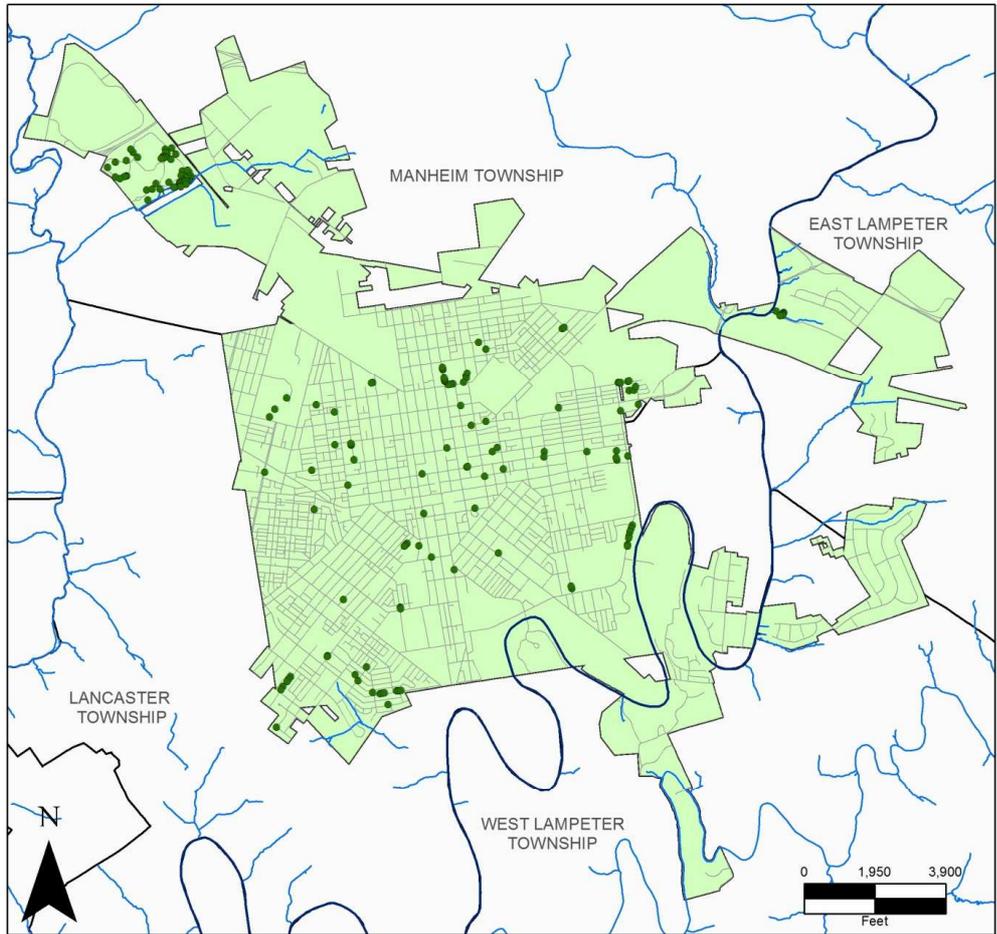
* Ash trees in natural spaces could be allowed to die in place, if it is safe to do so; dead trees provide habitat and improve soil, and they are an important part of the ecosystem.

11.1 Tree Removal

With the selective management model applied to our urban forest, a total of one hundred and seventy-eight (178) trees on streets and in parks will need to be removed to protect public safety and reduce liability (Figure 4). Sixty-eight (68) of these are in Longs Park, which could damage the aesthetic value of the park. Ash trees targeted for removal are either under primary utility lines, planted in tree wells sixteen square feet (16 ft²) or less, have health conditions of dead, poor, or fair, or have a DBH of ten (10) inches or less. To accomplish this goal, no less than eighteen (18) trees should be removed each year over the next five (5) years, even if these trees are not yet infested.

Note: ninety-two (92) of the one hundred and seventy-eight (178) ash trees identified for removal are in the right-of-way, making it the responsibility of the adjacent landowner to remove or treat them. However, these trees are included this plan in the case that the City must act quickly to mitigate risks to the public.

Figure 4. Locations of the ash trees that are selected for removal.



Source: City of Lancaster, PA Spatial Data Access

Draft prepared June 2014

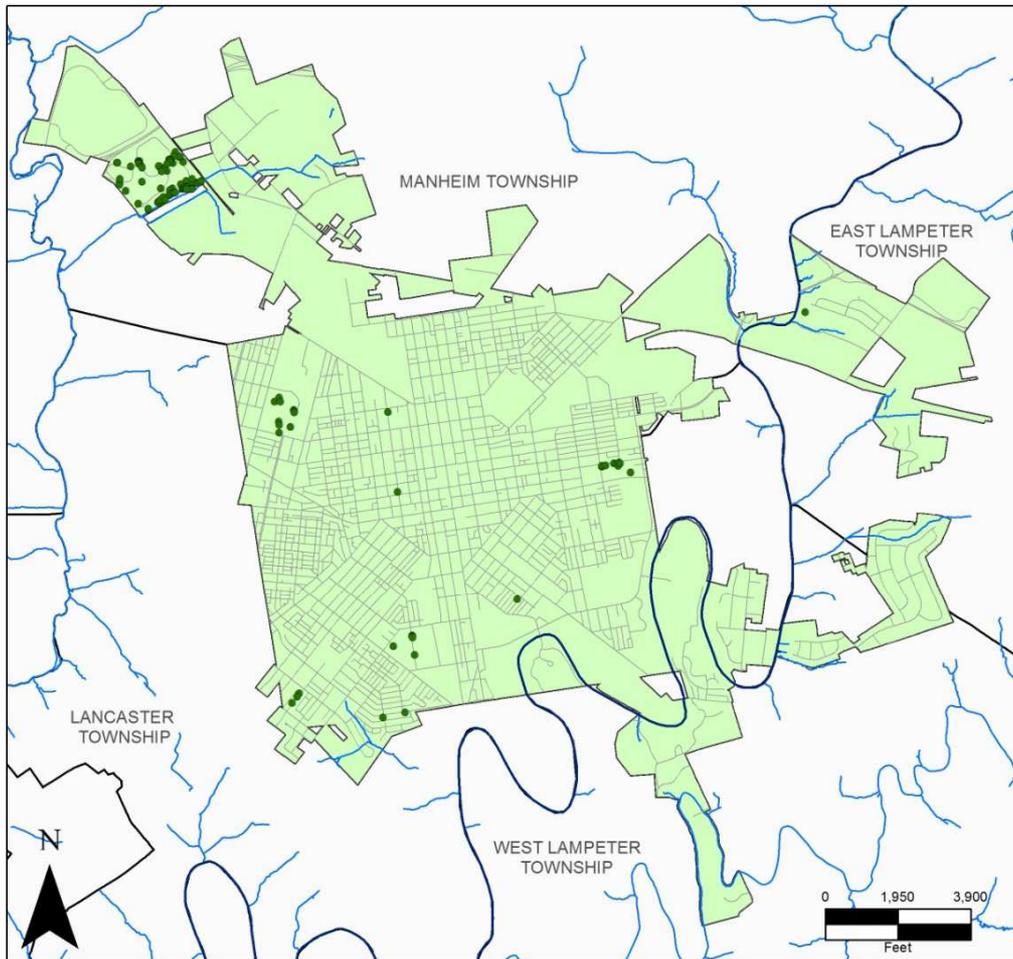
City of Lancaster
Emerald Ash Borer Management Plan
Ash Trees Proposed for Removal

- Ash Trees for Removal
- City of Lancaster
- Municipal Boundary
- Waterways
- Streams
- Roadways

11.2 Chemical Treatment

According to the model in Section 11.0, trees in excellent and good conditions that have a DBH of more than ten (10) inches and are not under primary power lines are considered for treatment. High-value ash trees in the City will be treated with TREE-äge™ (Figure 5) (see Appendix 1 for technical information on product), unless another insecticide is deemed more effective. Large diameter trees are favored over small diameter trees as they typically have higher value and provide more benefits to the community. Also, trees less than ten (10) inches DBH are not suitable for trunk injection. A total of one hundred and twelve (112) trees were selected to receive treatments.

Figure 5. Ash trees that will be treated with TREE-äge™ (emamectin benzoate), or best available pesticide.



Source: City of Lancaster, PA Spatial Data Access

Draft prepared June 2014

**City of Lancaster
Emerald Ash Borer Management Plan**

**Ash Trees Proposed for
Chemical Treatment**

- Ash Trees for Chemical Treatment
- City of Lancaster
- Municipal Boundary
- Waterways
- Streams
- Roadways

11.3 Tree Replanting

All removed ash trees will be replaced for canopy cover in the community in accord with city ordinances and tree management plans. At minimum two (2) trees will be planted for every one (1) ash tree removed, requiring at least three hundred and fifty-six (356) trees to be replanted. Trees should be replanted within one (1) year of their removal. Temporary reduction of canopy cover is expected in affected streets and parks as replacement trees are usually small and not guaranteed one hundred percent (100%) survival rate. Replacement trees that do not survive will be replanted as soon as possible. The City will work with Master Naturalists, the Lancaster County Conservancy's Urban Greening Program, Tree Vitalize, Master Gardeners, Lancaster City Alliance and other nonprofit organizations and private citizens for the replanting effort.

12.0 Wood Utilization & Material Disposal

The one hundred and seventy-eight (178) ash trees to be removed from city streets and parks have value as timber and landscape mulch. Residue value recovered from these trees by the City will be used for replanting efforts each year. Public Works will contact local lumber mills and attempt to sell the ash timber for local use. Other ash tree material from the city will be mulched, composted, or disposed of according to established guidelines, and will not be shipped to states outside the federal quarantine.

13.0 Community Outreach

The City intends to reach out to the community in the following ways:

- Establish an EAB Task force to create an awareness campaign using a variety of media and outreach efforts, which may include, press releases, websites, city blog posts, news conferences, trainings, and neighborhood meetings.
- Contact landowners that have ash trees in the public right-of-way (as identified in the tree inventory) with a letter that explains EAB, its dangers, and mitigation options (Appendix 3).
- Contact institutions and large businesses with a letter that explains EAB, its dangers, and mitigation options (Appendix 3).
- Encourage residents to check whether they have an ash tree on their private property, and, if they do, to contact Public Works for technical advice about removal, treatment, and replanting.

These outreach activities will be especially important to increasing awareness among private property owners who have ash trees outside the public right of way. The City will partner with the Lancaster County Conservancy's Urban Greening Program, Lancaster City Alliance, Penn State Agricultural Extension, gardeners, naturalists, and other non-profit organizations and private citizens to develop an educational program and outreach strategy to help raise awareness about emerald ash borer. All trees on private properties (including street trees) are the responsibility of the property owners; however, where trees are located in the public right-of-way (i.e., street trees), the City reserves the right to remove trees at the property owner's expense if they become an imminent hazard. However, the City will provide technical assistance to the property owner on deciding whether an ash tree should be treated or removed and replaced.

The PA Cooperative Extension Service will also make technical staff available to assist property owners on EAB and ash related problems. Contact the City Arborist for details (717) 291-4846 or PA Department of Conservation and Natural Resources (DCNR) (717) 948-3941.

14.0 Cost/Benefit Analysis

The selective management strategy described in Section 11.0 is not only the most effective in saving valuable ash trees, but it is also the most affordable option over the ten (10) year duration of this plan, depending on the ambition of the replanting effort. Removing all the ash trees would cost over \$300,000 and would need to be done within several years of infestation, making the annual cost very expensive. Treating all the trees would also cost nearly \$300,000 over ten (10) years, and there is no guarantee that the ash trees will survive beyond that. Therefore, a mix of removal, chemical treatment, and replanting is the most reasonable and affordable response to EAB in the short-term and long-term. It also allows the City to save the healthiest and most valuable ash trees.

The total cost for this selective management program is estimated at about \$250,000 over 10 years, which is about ten percent (10%) of the total compensatory value of all ash trees, according to USDA's iTree Streets. This includes about \$47,000 for tree removal, \$75,000 for replanting and \$162,322 for chemical treatment. Included in the costs for chemical treatment, removal, and replanting are the ninety-nine (99) trees within the right of way, which are typically the responsibility of private landowners; however, they have been budgeted in this plan so the City can actively mitigate any danger to the public.

14.1 Tree Removal

Although this plan considers a ten (10) year time period, EAB can kill trees within several years of infestation and removal should be planned on a shorter time horizon. Within 5 years a total of ninety-two (92) ash trees on City streets will need to be removed to mitigate hazards. The cost for the City to remove one (1) ash tree is estimated at \$50 per DBH inch;⁴ the trees that need to be removed have an average DBH of fifteen (15) inches and an average removal cost of \$750. The total cost of tree removal is estimated at about \$47,000 ranging from about \$8,500 to \$10,000 per year (Table 6). Additionally, eighty-six (86) ash trees in City parks will also need to be removed, but they are not included in this analysis because tree removal is budgeted for annually by Public Works.

On average the city staff will remove about eighteen (18) trees each year for five (5) years. The City Arborist estimates that he removed fifty-five (55) trees per year on average during 2008-2013. Removing an additional eighteen (18) trees in a year is about a thirty percent (30%) increase. This increase has the potential to stress the existing City tree management staff. The City should consider supplementing their tree removal work with private contractors as needed.

Table 6. Cost of removing ash trees only from right-of-way over 5 years.

Year	No. Trees	Average DBH	\$/DBH	Unit Price (\$)*	Cost (\$)
2015	18	14.8	32.24	477.15	8,589
2016	18	14.9	32.88	491.56	8,848
2017	18	15.1	33.54	506.41	9,115
2018	19	15.2	34.21	521.70	9,912
2019	19	15.4	34.90	537.46	10,211
2020	0	15.6	35.60	553.69	0
2021	0	15.7	36.31	570.41	0
2022	0	15.9	37.03	587.63	0
2023	0	16.0	37.77	605.38	0
2024	0	16.2	38.53	623.66	0
Total	92	NA	NA	NA	46,676

* 2% annual increase in removal cost and DBH growth is assumed

14.2 Chemical Treatment

A total of one hundred and twelve (112) ash trees on the City streets and in parks are recommended for chemical treatment. According to the Pennsylvania Department of Conservation and Natural Resources and Philadelphia, PA's EAB Management Plans, a private contractor charges an average of \$10 per DBH inch for treatment with TREE-äge™, (active ingredient: emamectin benzoate), which is currently the best available chemical treatment. EAB insecticides require special training and sometimes it takes several hours to treat one tree. The City should consider a public bidding process with private contractors to supplement the capacity of the Department of Public Works staff in treating such a large number of ash trees. The financial analysis below assumes a contractor will be hired. See Appendix 2 for more detailed financial tables of each scenario.

There are several treatment scenarios that are outlined, each with benefits and drawbacks. It is

⁴ This figure was determined from information provided by the City Arborist.

important to note that these estimates could change if a more effective chemical becomes available.

Chemical Treatment Scenario 1

In this scenario, all park and public-right-of-way trees are treated every other year. This is the recommended timeline by researchers and the producer of TREE-äge™ and valuable ash trees will be protected immediately, making it the most ideal scenario. Annual cost ranges between \$28,000 and \$36,000, totaling about \$162,000 over ten (10) years making this the second most expensive option (Table 7).

Chemical Treatment Scenario 2

In this scenario, all park and public-right-of-way trees are treated over the course of (2) years; half are treated in year one (1) and half in year two (2), and this continues to alternate (Table 7). The annual yearly cost is low, but in the first year there is a risk that half of the valuable ash trees could become infested, threatening the effectiveness of future treatments. Due to the costs of inflation each year this is also the most expensive scenario of the three (3), totaling about \$165,000.

Chemical Treatment Scenario 3

In this scenario, one third of all park and public-right-of-way trees are treated each year (Table 7). Some researchers say that TREE-äge™ can be effective up to three (3) years, but this may require larger doses.¹ The annual cost for treating 1/3rd of ash trees per year ranges between \$9,000 and \$12,000; however, waiting to treat some ash trees will put them at a higher risk of infestation and declining health; there is also some risk that treating every three (3) years will be less effective against EAB. Although the ten-year cost of \$110,000 is the most affordable of the scenarios, it is not a recommended approach.

Table 7. Cost comparison of three (3) chemical treatment scenarios using TREE-äge™ in the City of Lancaster over 10 years.

Year	Scenario 1	Scenario 2	Scenario 3
	Treating Every Other Year	Treating Half Each Year	Treating 1/3 rd Each Year
2015	28,720	14,360	9,573
2016	-	14,793	9,862
2017	30,480	15,240	10,160
2018	-	15,700	10,467
2019	32,349	16,174	10,783
2020	-	16,663	11,108
2021	34,333	17,166	11,444
2022	-	17,685	11,790
2023	36,438	18,219	12,146
2024	-	18,769	12,512
Total	162,321	164,773	109,849

* 2% annual increase in chemical treatment cost and DBH growth is assumed.

14.3 Replanting

If the city plants two (2) trees for every one (1) ash tree removed, then it will need to plant three hundred and fifty-six (356) ash trees on City streets and parks. At least ninety-two (92) trees should be planted in the right of way to replace those that are removed. Currently, one non-host tree species is estimated at \$200 per tree. This does not include labor, which is covered through annual budgeting.⁵

If all ash trees are removed in five (5) years, then seventy-two (72) trees will be need to be planted each year by city staff to keep pace with the loss of ash trees and plant two trees for every one removed (Table 8). The City Arborist estimates that over the last five (5) years he has planted two hundred and fifty (250) trees per year and sometimes as many as four hundred (400) per year;

⁵ This is the average price per tree through the City’s tree planting program, which is available to all residents.

therefore, current City staffing should be able to accommodate these additional planting needs. The total cost of tree replanting is estimated at about \$74,000, ranging from approximately \$14,000 to \$15,000 per year.

The annual cost could be lowered by planning to replant over ten (10) years instead of five (5) (Table 9); however, the overall cost would increase due to inflation and it may take longer to replenish the City canopy from the loss of ash trees. The total cost of this scenario would be about \$78,000 over ten (10) years, ranging from \$7,000-\$8,000 a year.

Table 8. Cost of planting two (2) trees for every one (1) ash tree removed to mitigate effects of Emerald Ash Borer in the City of Lancaster over 5 years.

Year	No. Trees	Average DBH (inch)	Unit Price (\$)*	Cost (\$)
2015	72	2.5	200	14,400
2016	71	2.5	204.00	14,484
2017	71	2.5	208.08	14,773
2018	71	2.5	212.24	15,069
2019	71	2.5	216.49	15,370
2020	0	2.5	220.82	-
2021	0	2.5	225.23	-
2022	0	2.5	229.74	-
2023	0	2.5	234.33	-
2024	0	2.5	239.02	-
Total	356	NA	NA	\$ 74,097

* 2% annual increase in cost and tree growth is assumed for inflation.

Table 9. Cost of planting two (2) trees for every one (1) ash tree removed to mitigate effects of Emerald Ash Borer in the City of Lancaster over 10 years.

Year	No. Trees	Average DBH (inch)	Unit Price (\$)*	Cost (\$)
2015	36	2.5	200	7,200
2016	36	2.5	204.00	7,344
2017	36	2.5	208.08	7,490
2018	36	2.5	212.24	7,640
2019	36	2.5	216.49	7,793
2020	36	2.5	220.82	7,949
2021	36	2.5	225.23	8,108
2022	36	2.5	229.74	8,270
2023	36	2.5	234.33	8,435
2024	32	2.5	239.02	7,648
Total	356	NA	NA	\$77,881

* 2% annual increase in cost and tree growth is assumed for inflation.

15.0 Fiscal Planning

This fiscal plan reflects the most likely circumstances when EAB arrives, and it considers the most practical response from the City. Within the next five (5) years it is likely that all City ash trees will be dead or in poor health as a result of EAB. The best possible response is to immediately begin chemical treatment of healthy and valuable ash trees, as recommended in chemical treatment scenario 1, and remove all other ash trees within five (5) years. For each ash tree removed a minimum of two (2) non-host tree species should be replanted, so the City can mitigate the loss of stormwater capture and tree canopy.

The City could choose to pull its resources together and train its staff to carry out all tasks to try to save money; however, this may result in added costs from new hiring and delay or cancellation of other tasks previously assigned to City workers. Additionally, lower prices may be achieved through a public bidding process.

To support the EAB management plan, the City of Lancaster will need to create a new line item in its budget for this program, with an estimated annual cost ranging from approximately \$16,000 to \$48,000 (Table 10). However, there are many cost saving opportunities for the City to explore.

Table 10. Annual cost of City of Lancaster EAB management plan for 10 years

Year	Chemical treatment (\$)	Tree removal (\$)	Replanting (\$)	Total (\$)
2015	28,720	8,589	7,200	44,509
2016	-	8,848	7,344	16,192
2017	30,481	9,115	7,491	47,087
2018	-	9,912	7,641	17,553
2019	32,350	10,212	7,794	50,355
2020	-	-	7,949	7,949
2021	34,333	-	8,108	42,442
2022	-	-	8,271	8,271
2023	36,438	-	8,436	44,874
2024	-	-	7,649	7,649
Total	162,322	46,676	77,882	286,880

* 2% annual increase in replanting cost is assumed.

15.1 Cost Saving Opportunities

Additional staff and training may be needed to manage EAB in the City, which could increase costs and labor. However, the costs for removal, replanting, and chemical treatment could be reduced through a public bidding process.

PPL Electric Utilities has also recently removed several ash trees in the City because they were beneath primary utilities that they manage. Currently, there are thirteen (13) ash trees under primary utilities within the public right-of-way. If PPL continues to be proactive about removing nuisance ash trees, then this may save the city approximately \$10,000.

Furthermore, grants such as TreeVitalize may also be available for tree replanting. The City will work diligently with federal, state, and local government agencies, non-governmental organizations, and institutions to secure awards and grants to fund the tree replanting.

15.2 Alternative Scenarios

This plan assumes that chemical treatment, removal, and replanting will begin at the same time; however, while it is inevitable that EAB will arrive in the City of Lancaster, it is difficult to estimate the year of its arrival and the severity of the infestation. These variables are unpredictable and the City may need to react differently than this plan recommends.

For instance, the City could choose to remove the ash trees that this plan identifies for such before EAB arrives. Chemical treatment would not need to start until the infestation became apparent. This scenario would spread out the costs of the EAB program beyond ten (10) years.

Alternatively, the infestation could come rapidly and severely. Trees may die suddenly and many of them may need to be removed within the first several years of infestation. This scenario would require more money upfront for removal, replanting, and treatment.

Lastly, the City may decide to not assist homeowners with the removal, treatment, and replanting of right-of-way ash, or they could share the cost. Both of these options could dramatically reduce the cost of this program; however, it could also create hazardous trees if landowners are not proactive.

16.0 Timetable

A 10-year timetable will be developed to specify program objectives and procedures for each year. Activities such as tree inventory, EAB monitoring, chemical treatment, tree removal, replanting, efficacy evaluation, etc. will be included. Necessary adjustments will be made at the beginning of each year to reflect the changes of the field situation. Furthermore, the timeline in this plan is hypothetical and it cannot predict the precise arrival of EAB in the City of Lancaster or the severity of the infestation; however, it can serve as a foundation for budgeting City resources.

17.0 Data Collection & Reporting

All data from the program will be collected according to established guidelines and entered electronically into a centralized database. Status reports are required for all aspects of the program. An annual report will be used to summarize the progress of the program for the current year. By the end of the program a final report will be issued.

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18.0 Contacts and Information

Pennsylvania Department of Conservation and Natural Resources (www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx)

Pennsylvania Department of Agriculture EAB hotline: or Badbug@state.pa.us

Pennsylvania State University Extension
(<http://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer>)

Emerald Ash Borer (www.emeraldashborer.info)

USDA APHIS
(http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml)

USDA Forest Service (<http://na.fs.fed.us/fhp/eab/>)

i-Tree - Tools for Assessing and Managing Community Forests (<http://www.itreetools.org/>)

TreeVitalize - A partnership to restore tree cover in Pa. communities
(<http://treevitalize.net/TreeCare/SelectingTrees.aspx>)

EAB Cost Calculator (<http://extension.entm.purdue.edu/treecomputer/index.php>)

National Tree Benefit Calculator (<http://extension.entm.purdue.edu/treecomputer/index.php>)

19.0 References

Dana, M.N. 2006. Landscape tree appraisal. Purdue Cooperative Extension Service, Department of Horticulture. Landscape Horticulture HO-201-W. 4pp.

Dwyer, J.F., McPherson, E.G., Schroeder, H.W., and Rowntree, R.A. 1992. Assessing the benefits and costs of the urban forest. *Journal of Arboriculture* 18: 227-234.

Kovacs, K.F., Height, R.G., McCullough, D.G., Mercader, R.J., Siegert, N.W., and Liebhold, A.M. 2010. Cost of potential emerald ash borer damage in U. S. communities, 2009-2019. *Ecological Economics* 69: 569-578.

Nowak, D.J., Crane, D.E., and Dwyer, J.F. 2002. Compensatory value of urban trees in the United States. *Journal of Arboriculture* 28: 194-199.

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Appendix 1: Emamectin Benzoate Information

A human health and ecological risk assessment was done on this chemical by the Syracuse Environmental Research Associates, Inc.

http://www.fs.fed.us/foresthealth/pesticide/pdfs/052-23-03b_Emamectin-benzoate.pdf

General Considerations

Emamectin benzoate is used for control of the emerald ash borer (*Agrilus planipennis* Fairmaire, commonly abbreviated as EAB), an insect pest of ash trees (*Fraxinus spp.*). This document provides human health and ecological risk assessments to support an assessment of the environmental consequences of using this pesticide in Forest Service programs. Emamectin benzoate is an insecticide that acts by adversely affecting the nervous system. This insecticide is registered for national use on a variety of agricultural commodities. The anticipated uses of emamectin benzoate in Forest Service programs is limited to one formulation of emamectin benzoate, Tree-äge, and one application method, tree injection. Relatively little information is available on the transport of emamectin benzoate in trees following tree injection and uncertainties with the movement of emamectin benzoate in ash trees following tree injection is a dominant factor in the current Forest Service risk assessment in terms of adequately assessing exposures to humans and other nontarget species.

Human Health

In terms of potential human health effects, the most plausible exposure scenarios are those for workers applying emamectin benzoate in a manner that is consistent with labeled directions including the proper use of chemical resistant gloves. If workers handle emamectin benzoate with care and effectively use chemical resistant gloves, no substantial or significant risks to workers are anticipated. If workers fail to effectively use chemical resistant gloves or if workers do not effectively and rapidly respond to accidental exposures, adverse effects in workers, possibly including degenerative changes in nerve tissue, could occur.

Substantial exposures to members of the general public do not appear to be plausible although quantitative estimates of expected exposures and hence quantitative estimates of risks cannot be developed at this time. Based on accidental exposure scenarios associated with the spill of emamectin benzoate into a pond, the central estimates of hazard quotients are below the level of concern (HQ=1). The upper bound estimates of the hazard quotients range from 0.6 to 3. The inability to estimate exposures to members of the general public associated with the normal and expected use of emamectin benzoate –i.e., injection into ash trees – is a serious limitation in this risk assessment. Nonetheless, the upper bound HQ for all of the accidental exposure scenarios is only 3. Thus, in the normal use of emamectin benzoate, about one-third of the emamectin benzoate that is injected into an ash tree would need to be transported to surface water in order for the HQs associated with non-accidental exposures to reach a level of concern. It does not seem reasonable to assert that this level of exposure would or could occur.

Ecological Effects

As with the human health risk assessment, the ecological risk assessment for emamectin benzoate is dominated by uncertainties in the exposure assessment. Because of limited information on the transport of emamectin benzoate in trees following tree injection and the lack of information on the transport of emamectin benzoate in ash trees, reliable estimates of exposures in nontarget species associated with the injection of emamectin benzoate into ash trees cannot be made. The inability to estimate expected exposures of nontarget species limits confidence in the risk characterization for nontarget species.

Uncertainties in the exposure assessments associated with the potential contamination of surface water in the normal use of emamectin benzoate for the injection of ash trees is addressed with an accidental spill scenario. Based on the accidental spill scenario, no risks are apparent for mammals, birds, fish, aquatic plants, or tolerant species of aquatic invertebrates. The lack of risk in the accidental spill scenarios for these groups of organisms suggests that the contamination of surface water associated with the normal use of emamectin benzoate to inject ash trees is not likely to adversely impact these organisms. Risks to sensitive species of aquatic invertebrates, however, are apparent in the accidental spill scenario with an upper bound HQ of 120. Thus, in the event of an accidental spill of a significant amount of emamectin benzoate into a pond, adverse effects including mortality could be anticipated. The high hazard quotients for sensitive species of aquatic invertebrates associated with the accidental spill scenario also prevent a clear risk characterization for this group of organisms in the normal use of emamectin benzoate. At least in situations in which high doses of emamectin benzoate are used or a relatively large number of trees are treated near surface water, risks to sensitive species of aquatic invertebrates can neither be discounted nor characterized clearly.

While uncertainties associated with contaminated surface water can be addressed reasonably well, other exposure pathways are problematic. The most likely exposures for mammals or birds involve the consumption of bark, stem tissue, or seeds of ash trees as well as the consumption of herbivorous insects that may feed on ash leaves. Only the pathway involving the consumption of herbivorous insects is developed quantitatively. Under worst-case exposure assumptions, risks to mammals are marginal (an upper bound HQ of 1.1) and risks to birds are negligible (an upper bound HQ of 0.03). For herbivorous insects, however, the risk characterization is well-defined. Both tolerant and sensitive species and populations of herbivorous insects are likely to be adversely affected if they feed on ash trees injected with effective doses of emamectin benzoate.

While the risk characterization for emamectin benzoate is dominated by uncertainties in 32 the exposure assessments, it is worth noting that the most relevant toxicity studies on 33 aquatic organisms and birds are limited to relatively standard bioassays on relatively few 34 species of organisms compared to other more fully studied pesticides. In addition, no 35 data are available on reptiles, amphibians, or soil invertebrates.

ⁱ http://www.extension.umn.edu/garden/insects/find/emerald-ash-borer/docs/ncbipm_eab_insecticide_bulletin_2nd_ed_may_2014.pdf

Appendix 2. Additional Tables

Table A. Cost of chemically treating half of all healthy ash trees against Emerald Ash Borer each year in the City of Lancaster over 10 years.

Year	No. Trees	Total DBH (inch)	Chemical Treatment*	Cost (\$)
2015	56	1436	10.00	14,360
2016	56	1450	10.20	14,794
2017	56	1465	10.40	15,240
2018	56	1480	10.61	15,701
2019	56	1494	10.82	16,175
2020	56	1509	11.04	16,663
2021	56	1524	11.26	17,167
2022	56	1540	11.49	17,685
2023	56	1555	11.72	18,219
2024	56	1571	11.95	18,769
Total				164,773

*2% annual increase in chemical treatment cost and DBH growth is assumed.

Table B. Cost of chemically treating all healthy ash trees every other year with TREE-äge™ in the City of Lancaster over 10 years

Year	No. Trees	Total DBH (inch)*	Chemical Treatment*	Cost (\$)
2015	112	2872	10.00	28,720
2016	0	2901	10.20	0
2017	112	2930	10.40	30,481
2018	0	2959	10.61	0
2019	112	2989	10.82	32,350
2020	0	3019	11.04	0
2021	112	3049	11.26	34,333
2022	0	3079	11.49	0
2023	112	3110	11.72	36,438
2024	0	3141	11.95	0
Total				162,322

*2% annual increase in chemical treatment cost and DBH growth is assumed.

Table C. Cost of treating 1/3rd of all healthy ash trees every year with TREE-äge™ in the City of Lancaster over 10 years

Year	No. Trees	Total DBH (inch)	Chemical Treatment*	Cost (\$)
2015	37	957	10.00	9,573
2016	37	967	10.20	9,862
2017	38	977	10.40	10,160
2018	37	986	10.61	10,467
2019	37	996	10.82	10,783
2020	38	1006	11.04	11,109
2021	37	1016	11.26	11,444
2022	37	1026	11.49	11,790
2023	38	1037	11.72	12,146
2024	37	1047	11.95	12,513
Total				109,848.68

*2% annual increase in chemical treatment cost and DBH growth is assumed.

Appendix 3. Community Outreach Materials



ALERT!
Protect our
Forests and Trees.

*Help Stop the Movement
of Exotic Pests.*



**DO NOT MOVE
FIREWOOD!**

Exotic pests like the emerald ash borer can be spread when infested firewood is transported to new areas.

- Use **LOCAL** firewood
- Do not bring firewood into PA. This is banned under order of quarantine.
- If you have already transported firewood, do not take it home, do not leave it - **BURN IT!**



REPORT!

If you think you have found emerald ash borer, report it by contacting:

PA Department of Agriculture:
1-866-253-7189

PA Department of Conservation and Natural Resources (DCNR)
Penn State Cooperative Extension
or
United States
Department of Agriculture

Report your sighting by e-mail at:
Badbug@state.pa.us
or
Consult
www.paemeraldashborer.psu.edu/
or
www.emeraldashborer.info/

DCNR
PA Department of Conservation and Natural Resources
PENNSTATE
Penn State Cooperative Extension

USDA
United States Department of Agriculture
The USDA is an equal opportunity provider and employer. FS-808c

**What is the
Emerald
Ash
Borer?**



**USDA Forest Service
Northeastern Area
State and Private Forestry
NA-PR-0-5-04
Revised January 2008
(PA)**

The emerald ash borer,

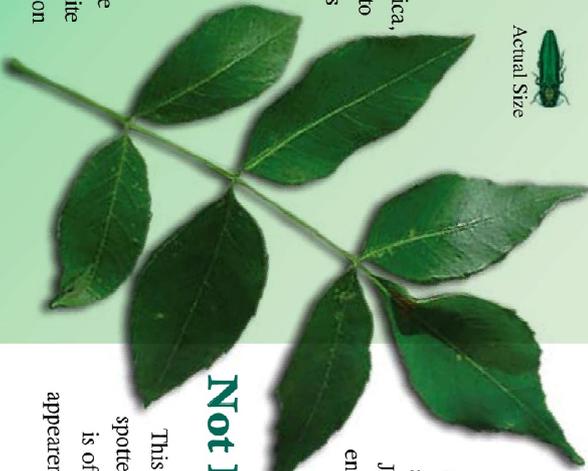
Agilus planipennis Fairmaire, a beetle native to Asia, was first detected in Michigan in 2002. Evidence suggests that the beetle was established in Michigan for years prior to its discovery. Emerald ash borer (EAB) has since been detected in several states including Pennsylvania, and Ontario, Canada.

In addition to spreading by natural means, EAB can be transported to new areas in infested firewood, timber, and nursery stock. This beetle has been responsible for the loss of millions of ash trees in North America.



Host:

In North America, EAB is known to infest all species of ash (*Fraxinus* spp.). Ash can be recognized by the presence of compound leaves which are arranged opposite of one another on the branches.



D-Shaped Emergence Hole

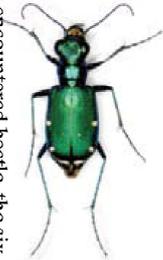


Biology:

Eggs are laid between layers of bark and in bark crevices. Larvae hatch in about one week and bore into the tree where they feed on the inner bark and phloem, creating "S"-shaped galleries. Larvae go through three feeding stages, and then excavate a pupal chamber in the fall, where they will overwinter as prepupae. Pupation occurs in late spring, and adults begin to emerge through "D"-shaped exit holes in May and early June. Adults will remain active until the end of summer.

Not EAB:

This commonly encountered beetle, the six-spotted green tiger beetle, *Cicindela sexguttata*, is often mistaken for EAB due to its similar appearance. It is a predator of small insects and is frequently found on hiking trails.



Photographs: James W. Smith, David Copinger, www.invasive.org and PA DCMR

Symptoms and Signs:

New infestations are difficult to detect, as damage to the tree may not be apparent for up to three years. Symptoms of an infestation can include branch dieback in the upper crown, excessive epicormic branching on the tree trunk, and vertical bark slits. Woodpecker damage is sometimes apparent.



Other Stressors:

Ash may also be stressed by drought, diseases such as ash yellows, and by native wood-boring insects like the redheaded ash borer, *Neoclytus acuminatus*, (Fabricius) which creates a round emergence hole.





City of Lancaster

DEPARTMENT OF PUBLIC WORKS

Dear Neighbor,

This letter contains important information about the street tree at your property. The City of Lancaster is preparing for the imminent arrival of the emerald ash borer, an Asian insect that is rapidly killing ash trees across North America. Nearly every county in Pennsylvania, including several surrounding us, has already been invaded. Once an ash tree dies, it soon becomes brittle and dangerous, and creates a potentially hazardous condition. The City has developed a comprehensive management plan for the ash trees along streets and in City parks; you are being notified because our street tree survey indicates that the tree in front of your property is an ash. We encourage you to consult an arborist or landscaper for advice and cost information as you consider one of the following options:

- **Chemical Treatment** – if you wish to preserve your ash tree, then it must be treated with an insecticide. There are several options available, but they may not guarantee the long-term survival of your ash tree; contact a local arborist or landscaper for more information.
- **Removal** – untreated ash trees in the City will most likely die within the next several years. If you choose to not treat your ash tree, then it should be removed immediately to prevent it from becoming a hazard. Contact a local arborist or landscaper for more information.

Street trees are an important feature of the City of Lancaster, and help remove pollutants from the air, provide shade, reduce stormwater, provide wildlife habitat, and beautify your property. As the property owner, you are required to replace any street tree that dies or is removed. The city's tree planting program enables you to purchase a replacement tree at low cost, and the city will plant the new tree at no cost to you. To participate in the City's tree replanting program please call the City Arborist, Jim Bower, at 717-291-4846.

More information on city trees can be found at www.saveitlancaster.com and www.cityoflancasterpa.com.

Should you have any questions or specific concerns, please contact Karl Graybill at the City of Lancaster Department of Public Works at (717) 291-4764.

*** Si necesitas mas informacion sobre este tema, por favor llame al (717) 291-4708.**

PO BOX 1599 120 N. DUKE STREET LANCASTER,
PENNSYLVANIA 17608-1599
WWW.CITYOFLANCASTERPA.COM



City of Lancaster

DEPARTMENT OF PUBLIC WORKS

Dear Neighbor,

This letter contains important information about the trees on your property. The City of Lancaster is preparing for the imminent arrival of the emerald ash borer, an invasive insect that is rapidly killing millions of ash trees across the United States. Nearly every county in Pennsylvania, including several surrounding us, has already been invaded. Once an ash tree dies, it soon becomes brittle and dangerous, and hazardous conditions must be avoided. The city has developed a comprehensive management plan for our ash trees along streets and in parks, and urges you to survey your property for ash trees as soon as possible. We encourage you to consult an arborist or landscaper for advice and cost information as you consider the following options:

- **Chemical Treatment** – if you wish to preserve your ash tree, then it must be treated with an insecticide. There are several options available, but they may not guarantee the long-term survival of your ash tree; contact a local arborist or landscaper for more information.
- **Removal** – untreated ash trees in the City will most likely die within the next several years. If you choose to not treat your ash tree, then it should be removed immediately to prevent it from becoming a hazard. Contact a local arborist or landscaper for more information.

Trees are an important feature of the City of Lancaster, and you are encouraged to replace trees that are removed and plant new trees where appropriate. Trees help to clean the air, provide shade, reduce stormwater runoff, provide wildlife habitat, and help beautify your property.

More information on city trees can be found at www.saveitlancaster.com and www.cityoflancasterpa.com.

Should you have any questions or specific concerns, please contact Karl Graybill at the City of Lancaster Department of Public Works at (717) 291-4764.

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