# The City of Eden Prairie

# Emerald Ash Borer Management Plan

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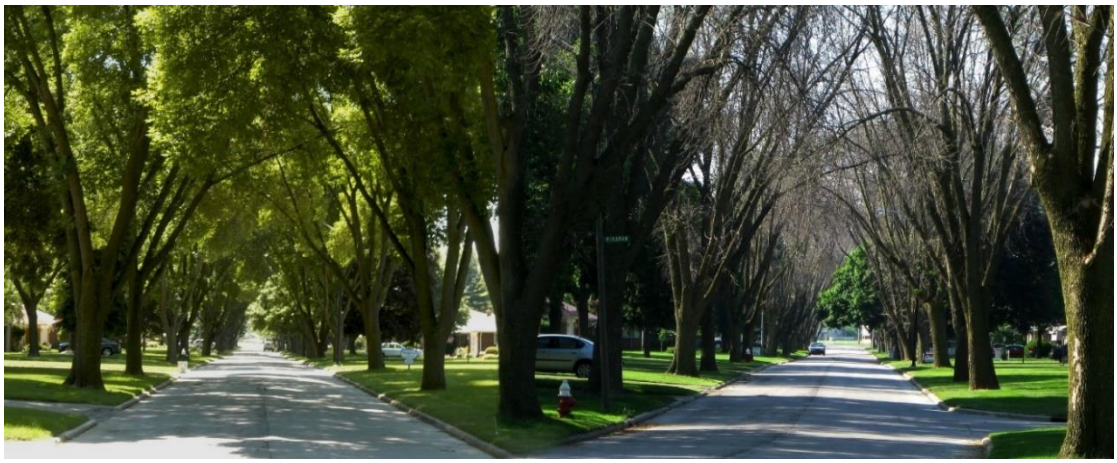
## What is Emerald Ash Borer?

Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The adult beetles nibble on ash foliage but cause little damage. The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. As of August 2017, it was found in 31 states and the Canadian provinces of Ontario and Quebec. Since its discovery, EAB has:

- Killed hundreds of millions of ash trees in North America.
- Caused regulatory agencies and the USDA to enforce quarantines and fines to prevent potentially infested ash trees, logs or hardwood firewood from moving out of areas where EAB occurs.
- Cost municipalities, property owners, nursery operators and forest products industries hundreds of millions of dollars.



*Ash trees before and after Emerald Ash Borer infestation, Toledo, OH 2006 - 2009 (Credit: Dan Herms, OSU)*

*Street in St. Paul, MN, before-after EAB (Credit: Unknown)*

# Executive Summary

Once EAB establishes in a community, its population roughly doubles each year, as does the number of ash trees killed. When all of the unprotected ash in an area are dead, which is EAB's food source, its population crashes and is sustained at lower levels into the future. Based on other states who have experienced this EAB wave, unmanaged this takes about 8-10 years. Through integrated management, EAB's impacts can be spread out over a much longer period of time - allowing for a smoother transition from a canopy of mature ash trees to different tree species, and preserving many ash into the future.

Below are some takeaways from this management plan.

- EAB will cost the City a significant amount of money regardless of what management strategy is taken-see 'Budget Impacts/Management Costs'.
- All unprotected ash trees will succumb to EAB in an estimated 8-10 years.
- A trunk injection of emamectin benzoate (chemical treatment) has proven to protect an ash tree from EAB for 2-3 years.
- An estimated *50,000 ash trees are in Eden Prairie* on maintained property. 3,164 of those are on maintained City property and will need to either be chemically treated or removed. Ash is the second most common tree species in maintained areas within the City, spruce being the most common (see Appendix B for map of maintained public ash trees).
    - 906 ash trees are in City parks.
    - 1,295 ash trees are in City right-of-way (street trees).
    - 963 ash trees are in natural areas and within falling distance of a trail.
- All management of EAB (tree removals, planting, and treatments) will be in addition to the City's typical workload of tree removals, planting, and pruning.

**Overview of City's Management Strategy**

- Preserve (treat) ash trees which are 12"+, healthy, and well placed.
    - Approximately 751 ash will be protected long term and 212 short term.
        - Refer to "Overview of Ash Management Options" section below for definitions of 'short' and 'long' term treatments.
- Remove and replace all unprotected ash trees over the next 7-12 years.
    - Approximately 2114 ash trees will be removed and 3171 trees will be replanted (replanting at 1.5X what is removed). Replanting with a diverse pallet of species (avoiding spruce, maple, apple, and other species currently significant in our urban forest).
    - Encourage residents to protect healthy ash trees on private property and replace any removed trees with forest diversity in mind.
    - Enforce Disease Tree Ordinance (Section 9.70) when and where applicable.
    - Review/update landscaping standards for construction in regards to tree diversity and installation specifications.

This strategic plan will help the City reduce and distribute the costs, environmental impacts, and liabilities associated with EAB over a longer period of time; and will lessen the social and economic

impacts on the quality of life in the City. It is intended to demonstrate leadership in our community, rather than inaction or total reaction.

## Current Extent of Infestation in the Metro

EAB was first identified in St. Paul, MN in May of 2009. The EAB population has been building in the metro, and throughout other areas of Minnesota since that point. As of December 27, 2017, 16 counties in Minnesota have been quarantined by the Minnesota Department of Agriculture for EAB.

## Current Extent of Infestation in Eden Prairie

EAB was confirmed in Eden Prairie in April of 2017 in the area of Shady Oak Road and Highway 212. The trees identified were estimated to be infested for 2-3 years prior to being found. Infested ash trees continue to be found in this area, and removed. It can be expected that the infestation will build from this point and likely show up in other satellite infestations around the City in the next few years. See Appendix C and D for maps of currently infested areas in Eden Prairie and around the state.

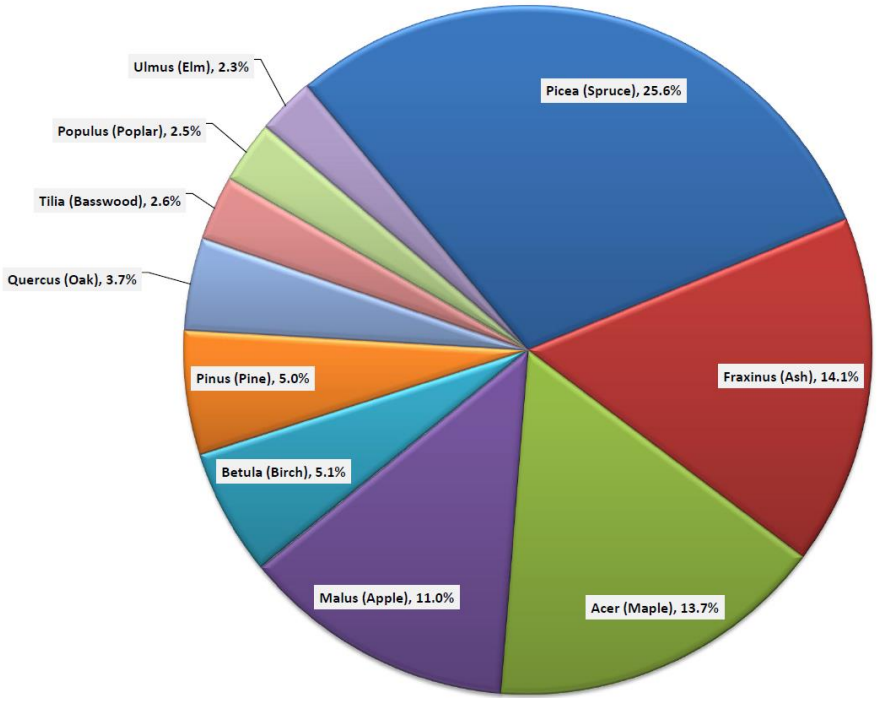
## Plan Administration

Primarily, the City's Parks and Natural Resources Department, in collaboration with other city departments, will be responsible for implementing this EAB Plan. The City's Parks and Natural Resources Manager along with lead forestry staff will monitor the plan implementation, report back to City Council and make recommendations for changes to the plan as new research emerges for managing EAB.

## Eden Prairie Ash Population

Of the estimated 358,000 total trees in maintained areas in the City, over 50,000 are ash trees. On City property, we have about 3164 ash trees* within maintained areas. This means the majority of ash trees are on private property, with some neighborhoods being essentially a monoculture of mature ash.

***Species composition for all trees in maintained areas within the City of Eden Prairie.***
*Source: 2010 MNDNR Community Tree Survey. See Appendix A for details.*



**The ash tree inventory of public property includes all ash within a mowed/maintained area and those adjacent to trails which need to be removed. It does not include ash in public conservation areas adjacent to private property (mostly in private back yards), or other ash in unmaintained areas.*

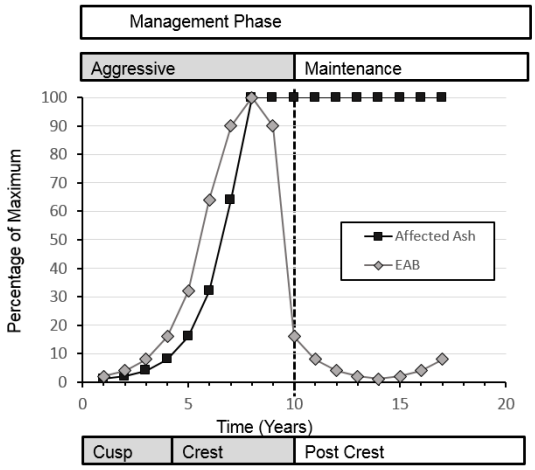
## Ash Mortality Curve

In North America, regions that have experienced EAB have shown essentially all ash trees not chemically treated were killed. In areas where there was minimal proactive management, EAB populations (and tree mortality) have roughly doubled each year until it exhausts their food supply-untreated ash. This means once EAB establishes in a community it can be expected in 8-10 years all ash will be dead or dying. During the first 3-4 years after infestation, the likelihood of detection is very low which has given most communities 4-6 years to remove all of their ash trees, with about 70% of the removals occurring in the last two years. The initial infestation identified in Eden Prairie likely began sometime in 2014-2016. Gone unmanaged, the table to the right shows projected ash tree removals per year-removing over 2,100 trees in year 7-8 of the infestation. This mortality curve leaves little options rather than to quickly remove all ash trees, often resulting in an overwhelming workload and hazardous situations. By taking a proactive management approach, EAB population growth can be slowed, allowing more time for our community to be proactive rather than reactive in re-planting, removing, and treating ash trees.[1]

| No Management | Ash on Maintained Public Property | |
|---|---|---|
| | Year | Est. # ash to remove/yr |
| | 1 | 14 |
| | 2 | 32 |
| | 3 | 63 |
| | 4 | 127 |
| | 5 | 253 |
| | 6 | 506 |
| | 7 | 1,012 |
| | 8 | 1,157 |
| | Total | 3,164 |

*Projected Ash Removals on City Property-if left unmanaged*

**Destruction Wave and Management**




Protection needs and populations waves of EAB and ash trees with at least 30% canopy thinning

*Source: Purdue University Emerald Ash Borer Cost Calculator*

## Benefits Provided by Trees

The economic costs for trees are quite easily seen by reviewing an annual budget. On the other hand, the economic benefits may not be as obvious. In the last several decades there has been a significant amount of research around the benefits 'green infrastructure' provides, and it has found that trees are

providing a significant economic and social contribution. To give an idea of what and how much trees contribute, below are some of the benefits provided.

**Trees reduce stormwater.**
Urban trees reduce the amount of stormwater a city has to deal with through interception, evapotranspiration, and infiltration. This reduces the amount of infrastructure needed by a city to transport and treat stormwater as well as aides in the recharging of aquifers and reduces runoff into our lakes and streams. The street trees alone in New York City were found to intercept 890 million gallons of stormwater annually, that's 1,525 gallons per tree on average, with a total value of over $35 million each year.[2]

**Trees reduce utility bills.**
Trees can save us a tremendous amount of energy through shading buildings and pavements, along with serving as windbreaks. The net cooling effect of a well-placed healthy tree is equivalent to 10 air conditioners operating 20 hours a day.[3] Evergreens serving as windbreaks in the winter can save 10-50% on heating costs.[4] These savings can really add up, in Minneapolis, street trees alone save $6.8 million in energy costs annually.[5]

**Trees can extend the life of our streets.**
Although trees can cause damage to infrastructure in situations of poor planning, they can also increase the life and decrease maintenance for infrastructure in cases of good planning. One example comes from Modesto, California where they found that paved streets shaded with large-stature trees reduced costs for repaving by 58% or ($0.66/ft$^2$) compared to unshaded streets over a 30 year period.[6]

**Trees increase home values.**
Properties with or in close proximity to trees are typically worth more money. A study done in east Portland found having one average sized tree for that area in front of a home increased its sale price by $7,130. The tree's benefits spilled over to homes within a 100-foot radius, increasing their combined value by $12,828.[7] A similar study done in the Philadelphia neighborhood of New Kensington showed new tree plantings increased surrounding housing values by approximately 10%, which translated to a $4 million gain in property value just through tree planting.[8]

**Trees fight crime!**
A study done of public housing residents in inner-city Chicago found that 25% fewer acts of domestic aggression and violence were reported in areas with nearby trees and natural landscapes than areas without.[9] A separate study conducted in the same area found that apartment buildings with high levels of vegetation had 52% fewer total crimes reported than those with low levels of vegetation. Proposed reasons for this reduction of crime is the increase in surveillance due to higher outdoor activity and lowered mental fatigue due to exposure to green space.[10] Considering in Minnesota the taxpayer pays on average $41,364 per inmate annually[11] this reduction in crime could save us a significant amount of money.

**Trees keep us healthy.**
Increased air quality is another benefit of trees. They clean the air by absorbing carbon dioxide, sulphur dioxide, nitrous oxides and other pollutants.[12] Increased air quality means less health risks. Researchers from Columbia University found childhood asthma rates were highest in parts of New York City where tree density was lowest. The rate of asthma fell by 24% for every extra 343 trees/km$^2$, a pattern that held true even after taking account of differing sources of pollution, levels of affluence and population

density.[13] On the same track, patients recovering from surgery in hospital rooms with window views of a natural scene had shorter postoperative hospital stays, received fewer negative evaluations in nurses' notes, and took fewer painkillers than matched patients in similar rooms with windows facing a brick wall.[14]

**Trees are good for business.**
Shoppers are willing to travel further to visit a business district with high quality trees and spend more time there once they arrive. They are also willing to spend 9%-12% more for products in well treed business districts than those with no trees. This was found to be true in cities of varying sizes and across the US.[15]

**Trees are job creators.**
In 2002 the environmental horticultural industry was estimated to employ 1,964,339 people, adding $95.1 billion in property value, and contributed $64.3 billion in labor income.[16]

**Costs vs. Benefits.**
Do the costs outweigh the benefits? In the early 90's a study was done in Chicago to determine if benefits from their newly planted trees outweighed planting and maintenance costs over a 30 year period. They determined there was a *net* benefit of $38 million over the 30 years or $402 per tree planted. For every $1 invested in planting and maintenance costs, they received $2.83 back in benefits.[17]

In 1997-1998 the City of Modesto, California set out to find if the annual $2.6 million municipal budget spent on urban trees was justified. The results of the study found the total annual benefit from Modesto's urban trees to be $4.95 million, *netting* $2.3 million or on average $54.33/tree annually.[18]

In Davis, California a study of 24,000 maintained public street trees showed a *net* annual benefit of $1.2 million, with every $1 invested returning $3.80 in benefits. The costs factored in included infrastructure damage, price of litter/storm clean up, litigation and settlement expenditures, as well as planting, maintenance, and removal costs.[19]

Minneapolis receives an annual net benefit of $15.7 million or $79/tree from its municipal trees. [20] Trees in New York City provide $5.60 in benefits for every $1 spent on tree planting and care. [21] Studies done by a variety of researchers across the nation and world continue to tell us that investing in urban trees has significant returns. These returns can be increased greatly through proper planning (site and species selection) as well as using proper planting techniques and continued maintenance.

Although we cannot stop EAB from causing the inevitable loss of benefits associated with ash trees, we can decrease that loss through preserving some, and replacing others with a variety of species.

## EAB Management Strategy

Since EAB has been shown to kill all ash trees not chemically treated, this leaves us only two options: chemical treatment (which has proven effective) [22] or tree removal.

Based on experiences from many other cities who have experienced EAB, taking a 'wait and see' reactive approach vs. proactive management should be avoided; as it has shown to result in higher costs, unsustainable workloads, and more environmental and aesthetic impacts. The ultimate goal of our

management plan is to spread out and minimize impacts, including costs and workloads associated with EAB on both public and private property.

The goal of our management strategy for public property is to; protect large, high quality, well placed, ash trees in maintained areas (through chemical treatment), strategically remove smaller and lesser quality ash trees, replant with tree species that promote urban forest diversity, and slow the spread of EAB through treatments and tree sanitation (through enforcement of Section 9.70 of City Code).

It is recognized the majority of ash trees within the City are on private property. In order to effectively manage EAB it is essential for the City to work with private property owners in promoting proper treatment of high quality, well placed ash trees, removal of infested trees, and replanting to promote tree diversity.

## Potential Effects of Herd Immunity

Herd immunity (also known as community immunity) is the public health phenomenon where protection from a disease for a critical percentage of the population allows protection for untreated individuals in the population. This principal occurs with a range of microscopic 'bugs,' but the same concept applies to a larger bug—the emerald ash borer. By treating a certain amount of the population of ash trees, there is the potential of offering some 'protection' to adjacent untreated ash trees.

Ash tree mortality and EAB populations are directly related. As EAB populations increase, so does ash tree mortality. In 2012, researchers out of Michigan State University published a study[23] which included over 200 computer simulations based on field-derived data and included a best-case scenario that was most effective at preserving ash trees at the lowest cost. This best-case scenario predicted that random treatment of 20% of the population of ash trees annually should protect 99% of the trees after 10 years. This strategy was based on the high likelihood an adult EAB would feed on a treated tree and be killed, keeping populations in check.

Although this strategy has only been proven in theory and not in the field, conversations with both urban foresters and researchers offer anecdotal evidence that it is working. Brian Aukema, an Associate Professor of Forest Entomology at the University of Minnesota, is taking part in the study of herd immunity in 8 Minnesota communities. Starting the summer of 2017, he is following 1200 ash trees (half are treated) over the next four years to see what levels of protection the untreated trees might receive from their treated neighbors. Results from this study may impact our management strategy and should be reviewed once completed.

## Ash Tree Conservation (chemical treatment)

Chemical treatment is an essential component of a successful EAB management strategy. It can be used as a tool to allow only an acceptable amount of EAB damage per year. Treatment can ease the transition from mature ash to newly planted trees, allow us to better manage costs and workloads, retain a portion of the benefits mature ash provide us, and maintain the character of our community. The potentials of herd immunity, could amplify these benefits.

Fortunately, we have a large body of research available to us from regions who have already dealt with EAB. Several chemicals on the market have proven effective to protect ash trees against EAB. That being said, there is a varying amount of chemical exposure, cost, and overall protection offered by each product. On public property a trunk injection of emamectin benzoate is recommended - due to its

limited chemical exposure and proven effectiveness. Optimal timing of trunk injection is after trees have leafed out in spring but before EAB eggs have hatched, or generally between mid-May and mid-June. *During each review of this plan, city staff will review any new research and products related to ash tree treatment and update treatment protocols as necessary.*

## Treatment Protocols

For treatment purposes, we assume 2017 is Year 1 of infestation.

**Aggressive Treatment Protocol – Year 2 (2018) to Year 13 (2029)*:** Treat ash trees beginning with those closest to the confirmed infestation. Treat approximately 1/3 of the trees each year to even out annual treatment costs and continue on a three year treatment interval. While emamectin benzoate products are labeled to effectively treat EAB for two years, research indicates treatment offers protection into the 3rd year.[24] Research confirms that treatments using emamectin benzoate will keep trees completely free of pests for the first two years after the injection, and that it takes three to four years after the start of an infestation for trees to decline to the degree which requires removal. If there are specimen ash trees where zero canopy thinning is tolerable, it may be recommended to treat those trees every two years during the peak of infestation.

**The budget impacts shown below are an increase in annual spending compared to 2017.**

| **BUDGET IMPACTS** Estimated annual cost to treat 1050 high quality ash trees. | |
|---|---|
| Aggressive Treatment Protocol | $ 23,228.00 |
| Maintenance Treatment Protocol | $ 11,532.00 |
| Average estimated cost per tree to treat for 25 years | $ 397.26 |

*See 'Budget Impacts and Ash Population Summary' below for more details on treatment costs.*

***Year 13 is an *estimate* of when the local EAB population will exhaust its food source (ash) and will crash. This timeframe will vary based on management taking place in surrounding cities and private property. If EAB populations are determined to still be high, the aggressive treatment protocol should be continued.

**Maintenance Treatment Protocol—Year 14 (2030) and beyond:** Inspect all trees scheduled to be treated long/short term in Year 14. Randomly select 20% of the trees scheduled for long term (and any continued short term) treatment in Year 14. Thereafter, annually treat 20% of randomly selected trees that have not been treated during the prior five years. As there are a number of studies currently in process regarding herd immunity and EAB management strategies, a review of the latest research should be completed once switching from an aggressive treatment protocol to a maintenance treatment protocol.

*Below is a statement from the Coalition for Urban Ash Tree Conservation – a group of university scientists with expertise in EAB management, commercial arborists, municipal foresters, public works officials, and non-governmental organizations (NGOs).*

"We the undersigned strongly endorse ash tree conservation as a fundamental component of integrated programs to manage emerald ash borer (EAB) in residential and municipal landscapes. Cost-effective, environmentally sound EAB treatment protocols are now available that can preserve ash trees through peak EAB outbreaks with healthy canopy intact. Used in association with tree inventories and strategic removal / replacement of unhealthy ash, tree conservation will help retain maximum integrity and value of urban forests. This integrated approach to urban EAB management is supported by university scientists with expertise in EAB management, commercial arborists, municipal foresters, public works officials, and non-governmental organizations (NGOs)."

*See document in full at* http://www.emeraldashborer.info/documents/conserve_ash.pdf

### Pesticide Safety

There are increasing and well-warranted concerns regarding the overreliance on pesticides. Neonicotinoids and their effects on pollinators, such as bees, and soil-applied products that have the potential to reach storm/ground water are a growing concern.

Aligning with the City's efforts to be a pollinator friendly community (see Resolution No. 2016-37 Endorsing "Pollinator-Safe" Policies and Procedures), the pesticide emamectin benzoate is not a neonicotinoid. It is a systemic insecticide injected directly into the trunk of a tree, which minimizes its non-target effects. Ash trees are wind pollinated; they are not a substantial nectar source for bees, they flower early in the growing season and only for a limited number of days. According to research conducted at Purdue University, "It is highly unlikely that bees would be exposed to systemic insecticides applied to ash." Emamectin benzoate has a low toxicity rating for mammals, a low bioaccumulation potential within ecosystems, and is immobile in soil. This means that the insecticide will not build up levels within an ecosystem and will be minimally harmful to people and animals that might encounter tree debris. [25]

While there are valid concerns regarding the overuse of pesticides in our environment, those concerns should be aimed at reducing pesticide use where fewer benefits result. The known environmental consequences of losing thousands of ash trees are vastly greater than the minimal risk associated with inoculating ash trees to protect them from certain death. Marla Spivak, the Distinguished McKnight Professor in Entomology at the University of Minnesota, and an internationally recognized expert on bees, has said that the benefits of trunk-injected emamectin benzoate for ash trees outweigh the minimal potential harm to bees. [26]

## Overview of Ash Management Options

During the tree inventory process, city staff assigned an 'Ash Management Option' from the list below to each ash tree on public property. See "Tree Ownership" in the Definitions for details on determining ownership/management of border trees.

**City treating (short term)** – City is planning to treat tree, protecting it from EAB until surrounding area has additional trees established, or to delay removal. *(Approximately 279 trees)*

**City treating (long term)** – City is planning to treat tree with the intent of maintaining its health long term. This would only be for high quality ash tree which are well placed and in good health, or of great significance. *(Approximately 771 trees)*

**Pre-emptive removal** – Tree will not be treated and should be removed pre-emptively, before it succumbs to EAB. *(Approximately 1813 trees)*

**Remove after infested** – Tree will not be treated, and will be removed after it is infested with EAB. *(Approximately 301 trees)*

**Resident treating** – Does not meet City's treatment criteria, and resident is paying for treatment of tree. This designation is only given to trees that are located on City property directly adjacent to a private property owner who is treating the tree.

## Ash Tree Treatment Criteria

In general, to be considered for treatment by the City the tree must meet the criteria below.

- A diameter (DBH) of 12" or greater
- Condition rated as fair or better (see Definitions for criteria)
- No utilities overhead or conflicting
- Not causing damage to sidewalks/trails or other infrastructure
- A well placed tree (not in extreme competition with other trees/infrastructure)
- Has sufficient soil volume to reach maturity

## Resident Treatment of Public Ash Trees

In cases where a public ash tree does not meet the City's treatment criteria, a resident may pay for the treatment of a public tree with the following stipulations:

1. Uses the City's current treatment contractor (or other approved contractor).
2. Has approved permit (free) from the City's Parks and Natural Resources Division.
3. Meets treatment specifications in City's current treatment contract.

It is not allowed for a resident to treat a public ash tree with home applied products. All contractors must meet minimum requirements set in City's current EAB treatment contract.

## Ash Tree Removals

All tree removals on public property within the capabilities of city staff will be completed by the City's Parks/Streets maintenance staff. Ash tree removals will be prioritized based on potential risk to public, trees with wood pecker damage, efficiency of removal (attempt to reduce trips to one location), and spreading out impacts of tree removal in high density ash areas.

A significant amount of wood debris will be produced through tree removal on public property. City staff should annually attempt to find buyers of saw logs, or utilize wood in other ways where practical. Remaining debris shall be disposed of meeting Minnesota Department of Agriculture's BMPs.

**Strategic Removals**

Once a tree is infested with EAB it can be more hazardous and costly to remove than an uninfested tree. On public property, in order to reduce costs and flatten the peaks of tree removals, a portion of ash trees which are not being treated will be pre-emptively removed at a rate of roughly 259/year for the next 7 years.

Approximately 301 ash trees on public property will be left untreated. These trees should not be located adjacent to structures/utilities, on slopes, in areas inaccessible with a bucket truck, or in other locations increasing the difficulty of removal.

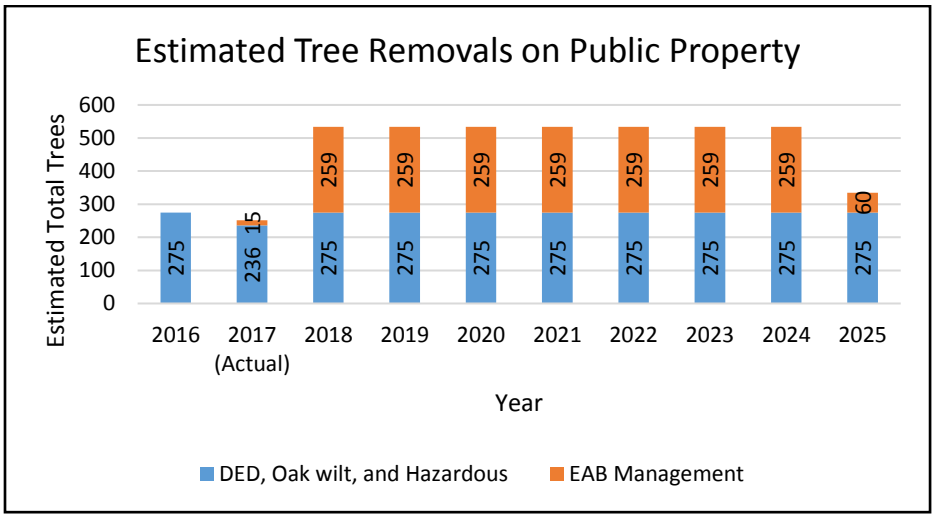
**The budget impacts shown below are not a projected increase in annual spending.**

| **BUDGET IMPACTS** Estimated annual cost of ash tree removal (removing approximately 2,114 trees total) | |
|---|---|
| Removing Approximately 259 Trees Annually | $85,460.95 |
| Average estimated cost per tree to remove | $ 337.77 |

*See 'Budget Impacts and Ash Population Summary' below for more details on removal costs.*

Ash trees in natural woodlands adjacent to trails or other highly used public spaces should be removed prior to signs of infestation in order to increase the number of trees able to 'cut and scattered' in the woodland rather than chipped and hauled away.

*The strategy of proactively removing ash before the tree is infested with EAB is not proven to reduce population growth or slow the ultimate mortality of ash.* Proactive removal on public property is strictly to manage costs and spread out workloads.




## Replanting

On maintained property in Eden Prairie, ash trees are the second most abundant tree-currently making up about 15% of our urban forest, or a total of approximately 50,000 ash trees. Considering all untreated ash trees will succumb to EAB, replanting is an essential component of this plan.

Tree diversity will be a top priority in re-planting. Species choice should meet the following requirements:

- Choose the largest growing tree for the available above and below ground space.
- Spacing should be a minimum of ¾ of the crown spread for the selected variety.
- Plant parks/streets with no more than 10% of one genus.
- All maple, apple, and spruce should be avoided due to high existing populations.
- Plan for Asian Longhorned Beetle (ALB) - do not use high numbers of ALB host trees in localized area.
    - ALB Host Trees: birch, buckeye/horsechestnut, maple, elm, plane tree/sycamore
    - Non-ALB Host Trees: alder, catalpa, coffeetree, corktree, ginkgo, hackberry, honeylocust, linden, oak, tamarack, crabapple, ironwood, hawthorn, Japanese tree lilac, amur maackia, serviceberry, cherry

**The budget impacts shown below are an increase in annual spending compared to 2017.**

| **BUDGET IMPACTS** Estimated annual cost for planting stock to replace 1.5X removed trees (planting approximately 3171 trees). | |
|---|---|
| Planting Approximately 317 Trees Annually | $28,539.00 |

*See 'Budget Impacts and Ash Population Summary' below for more details on replanting costs.*

Tree planting associated with this plan will be at a minimum replacement ratio of 1:1.5 removed vs. replaced. Therefore it can be expected to plant roughly 317 trees per year for the next 10 years. Initial years of planting will focus on areas with highest densities of ash trees and areas with trees designated as 'Short-term Treatment".

New tree plantings will mainly consist of 1.25-1.5 caliper inch trees, giving preference to planting stock in the following order; bare-root (highest preference), container, balled and burlap (lowest preference). Tree tube plantings may also supplement tree replacement, but mainly when exceeding minimum tree replacement quantities.

Tree planting locations will mainly be focused in parks/areas where ash tree removal takes place; with the exception of on local residential streets, where trees will be replanted on arterial and collector streets that meet the planting criteria below. Residents who wish to plant in the right-of-way must have an approved permit (free) from the City's Parks and Natural Resources Division.

City staff will be looking into programs to encourage replanting in front yards where the City is not replanting; such as a tree sale or giveaway, city-wide planting contract, or others.

*A recently planted 1.25 caliper inch bare-root bicolor oak tree.*

**Tree Planting Criteria**

*Tree planting locations should meet the following criteria unless otherwise approved by the City Engineer. Distances listed are minimums.*

1. Boulevard width of 6' or wider and streets with wider than normal medians
2. 40' from street corner
3. 30' from stop sign or signal
4. 10' from ped ramp, fire hydrant, driveway
5. 6' from utility box
6. 10' or not within growing distance of street light
7. Not within growing distance of overhead power lines or will interfere with public utilities

## Public Education and Outreach

Considering the vast majority of ash trees are on private property, successful public education and outreach are essential to minimizing the impacts of EAB in our City. Public outreach will take place in the following ways:

- Information on EAB management options, including up to date treatment recommendations on the City's website.
- As a service to Eden Prairie residents, maintain a City EAB treatment contract with a separate bid price for private property owners, through the Aggressive Treatment period.
- Targeted mailings/notifications in neighborhoods with high ash densities on private property.
- Provide educational materials on website and at City events such as Arbor Day.
    - One EAB meeting/workshop open to public by the City in 2018, 2019, and 2020 at minimum.

## Disease Tree Program

In accordance with City Code Section 9.70, ash trees infested with EAB on public and private property shall be required to be removed according to the procedures outlined in City Code and criteria below:

Management of EAB infested trees in natural areas will be limited to the following situations:

- In the first 5 years after the initial infestation (in 2017) or in areas where new infestations are found and city staff determines tree removal would result in beneficial EAB population reduction (even after initial 5 years of infestation).
- If there are infested trees which would result in a hazardous situation for a person or property.

In areas with known EAB infestation, woodpecker damage on ash trees is a very strong indicator of EAB presence. Through research[27] and personal experience, Brian Aukema, an Associate Professor at the University of Minnesota, Department of Entomology estimates based on the extent of infestation Eden Prairie has already confirmed, 75-100% of wood pecked trees can be expected to have EAB. *Therefore, on ash trees, wood pecker damage alone shall be enough evidence of EAB to declare it a "nuisance" and require removal.*

### Management in Natural Areas

Based on research completed in Ohio of ash tree mortality in EAB infested natural areas, ash populations in forested sites can progress from healthy to almost complete mortality of mature trees within 6 years.[28]

In general, removing infested ash trees in a natural wooded area to control EAB population has proven to be unattainable. Strategies such as using girdled 'trap trees' may be used in some situations in an attempt to decrease EAB population growth, or pull populations away from certain areas. See "Trap trees and population sinks" in the Definitions for more detail.

## Budget Impacts and Ash Population Summary

The tables below are results from an inventory of ash trees on public property, in maintained areas, along with annual management tasks, and associated costs and benefits.

*Summary tables found on next page.*

## Ash Population Summary

| Ash Population | Quantity | Ash Management | | | | Condition | | Size | | | Replanting |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Treating | Total Removing (Pre-emptive + Remove After Infested) | Pre-emptive Removal | Remove after Infested | Poor | Fair or better | Avg DBH | <12" | >=12" | Replanting at 1.5 remove: replace |
| Ash in Parks | 906 | 279 | 627 | 547 | 80 | 183 | 723 | 13.1 | 360 | 546 | 941 |
| Ash in ROW | 1295 | 771 | 524 | 303 | 221 | 111 | 1184 | 15.9 | 380 | 915 | 786 |
| Ash adjacent to trails (>4") | 963 | N/A | 963 | 963 | N/A | N/A | N/A | | | | 1445 |
| All Ash | 3164 | 1050 | 2114 | 1813 | 301 | 294 | 1907 | 14.8 | 740 | 1461 | 3171 |

## Ash Management Options Overview

| Ash Management Option | Number Trees | Average Diameter in inches | Average Cost to Perform Management Option (per time) | Average Annual Benefits Provided |
|---|---|---|---|---|
| Remove After Dead | 301 | 13.6 | $ 388.15 | $110.11 |
| Pre-Emptive Removal | 1813 | 11.8 | $ 335.40 | $ 86.63 |
| City Treating (Short Term) | 279 | 14.2 | $ 56.72 | $120.13 |
| City Treating (Long Term) | 771 | 18.5 | $ 74.11 | $157.03 |
| Total | 3164 | 14.9 | - | - |

**Annual Tasks, Costs, and Benefits**

| Est. years after infestation (initial year 2016) | Year | Annual Tasks | | | Costs** | | | Benefits*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | *With Management/ Preservation* | | *Without Management/* | |
| | | Treatment interval | Average annual ash removals | Min. Tree Replanting | Treatment | Removal | Planting (tree stock only) | Annual benefits provided by ash/yr | Annual benefits lost from ash/yr | Annual benefits provided by ash/yr | Annual benefits lost from ash/yr |
| 1 | 2017 | | | | | | | $333,655 | | | |
| 2 | 2018 | 1 | 259 | 317 | $23,228 | $85,461 | $28,539 | $321,112 | $22,045 | $336,294 | $6,863 |
| 3 | 2019 | 2 | 259 | 317 | $23,228 | $85,461 | $28,539 | $299,067 | $22,045 | $329,431 | $6,863 |
| 4 | 2020 | 3 | 259 | 317 | $23,228 | $85,461 | $28,539 | $277,022 | $22,045 | $315,705 | $13,726 |
| 5 | 2021 | 1 | 259 | 317 | $23,228 | $85,461 | $28,539 | $254,977 | $22,045 | $288,252 | $27,453 |
| 6 | 2022 | 2 | 259 | 317 | $23,228 | $85,461 | $28,539 | $232,932 | $22,045 | $233,347 | $54,905 |
| 7 | 2023 | 3 | 259 | 317 | $23,228 | $85,461 | $28,539 | $210,887 | $22,045 | $123,537 | $109,810 |
| 8 | 2024 | 1 | 259 | 317 | $23,228 | $85,461 | $28,539 | $188,842 | $22,045 | $96,084 | $27,453 |
| 9 | 2025 | 2 | Remove remaining 301 after infested | 317 | $23,228 | $115,818 | $28,539 | $181,112 | $7,730 | No public ash left to provide benefits | No public ash left to provide benefits |
| 10 | 2026 | 3 | | 317 | $23,228 | | $28,539 | $173,382 | $7,730 | | |
| 11 | 2027 | 1 | | 317 | $23,228 | | $28,539 | $165,651 | $7,730 | | |
| 12 | 2028 | 2 | | | $23,228 | | | $157,921 | $7,730 | | |
| 13 | 2029 | 3 | | | $23,228 | | | $150,191 | $7,730 | | |
| 14 | 2030 | Maitenance Treatment Protocol* | | | $11,532 | | | $147,187 | $3,004 | | |
| 15 | 2031 | | | | $11,532 | | | $144,243 | $2,944 | | |
| 16 | 2032 | | | | $11,532 | | | $141,359 | $2,885 | | |
| 17 | 2033 | | | | $11,532 | | | $138,531 | $2,827 | | |
| 18 | 2034 | | | | $11,532 | | | $135,761 | $2,771 | | |
| 19 | 2035 | | | | $11,532 | | | $133,046 | $2,715 | | |
| 20 | 2036 | | | | $11,532 | | | $130,385 | $2,661 | | |
| 21 | 2037 | | | | $11,532 | | | $127,777 | $2,608 | | |
| 22 | 2038 | | | | $11,532 | | | $125,221 | $2,556 | | |
| 23 | 2039 | | | | $11,532 | | | $122,717 | $2,504 | | |
| 24 | 2040 | | | | $11,532 | | | $120,263 | $2,454 | | |
| 25 | 2041 | | | | $11,532 | | | $117,857 | $2,405 | | |
| **Total** | | | 2114 | 3171 | $417,120 | $714,044 | $285,390 | $4,197,444 | $225,300 | $1,722,649 | $247,073 |

*Year 13 is an estimate of when the local EAB population will exhaust its food source (ash trees) and crash. This timeframe will vary based on management taking place in surrounding cities and private property. If EAB populations are determined to still be high, the aggressive treatment protocol should be continued.

**Tree removal price is based on average cost for municipal tree/stump removal. Tree treatment cost is based anticipated price per inch for a contractor to perform trunk injection. Tree stock cost for replanting is based on average cost per tree (stock only) of previous municipal tree orders (for 1.25 cal inch).

***Tree benefits were calculated with the National Tree Benefit Calculator (http://www.treebenefits.com) which is internationally used, peer reviewed software. The calculator estimates the monetary value trees provide in relation to stormwater interception, energy consumption, property value, air quality, and CO2 sequestration and reduction. Calculations account for differences in park/street trees, tree size, local climate, species, and 'Ash Management Option'. Other less researched benefits are not accounted for (e.g., human, social, and communal health).

## Definitions

**Tree Condition:**

**Poor –** The tree appears unhealthy and may have structural defects such as codominant stems, severe included bark, or severe trunk and/or limb decay. A tree in this category may also have severe mechanical damage, crown dieback, or poor vigor threatening its ability to thrive. Trees in poor condition may respond to appropriate maintenance procedures, although these procedures may be cost-prohibitive to undertake.

**Fair** -- The tree may exhibit the following characteristics: minor structural problems and/or mechanical damage, significant damage from non-fatal or disfiguring diseases, minor crown imbalance or thin crown, or stunted growth compared to adjacent trees or shrubs. This condition should show reasonable vitality and show no obvious signs of decay.

**Good** -- The tree has no major structural problems, no significant mechanical damage, may have only minor aesthetic insect, disease, or structure problems, yet is in good health.

**Excellent** -- Overall, the tree is healthy and satisfactory in condition, vigor, and form. The tree has no major structural problems, no mechanical damage, and may only have insignificant aesthetic, insect, disease, or structure problems.

**Tree Ownership:** It is the City's policy when dealing with ash trees, and all other trees, that the City shall be responsible for all management of trees on city property, including city right-of-way. The ownership of a tree shall be determined based on the center of the tree and the property boundary. Tree management will not be split based on X% on one property and X% on another.

**Trap trees and population sinks:** Rather than preemptively removing low-value ash trees, many can be girdled to serve several vital roles before they die. Girdling stresses a tree and usually kills it within a year. Recent studies have shown that EAB beetles are attracted to stressed ash trees, especially those in sunny locations such as along roads and trails, and tend to lay more eggs on stressed trees than on healthy trees. Girdled trees organized in a grid pattern are very effective for detection and assessment. This best practice also has a second important purpose, to function as beetle population "sinks" that concentrate and eliminate adult beetles before they can disperse and reproduce.

Girdled trees can serve a third important purpose as "trap-trees," a technique with a long history of use in forest pest management. The key to managing the infestation is reducing pest pressure; or put more bluntly—killing the beetles, not the trees. The following are important considerations listed in the SLAM[23] study to accomplish this:

- If trees are girdled and remain standing for more than one year, they will serve as beetle magnets. Since girdled trees must be removed before the next generation of adults can emerge, a large component of future adults can be eliminated.
- If tree cutting and removal is not a viable option (for example in woodland areas), then creating *lethal* trap trees should be considered. As the infestation builds, it may be economically preferable to invest in reducing pest pressure near high-priority trees. Lethal trap trees can be used by treating trap trees a few weeks before girdling. However, the effectiveness of girdled trees to function as traps or sinks appears to diminish as EAB densities build in an area.[29]

- Clustering three or four girdled trees creates a more powerful attraction for EAB adults than isolated single girdled trees in areas with low-density populations.
- There is evidence to suggest that at very low EAB population levels, the location of sink trees can influence how beetles disperse. Sink trees will pull some beetles towards them as EAB adults respond to the presence of artificially stressed trees. Placing clusters of sink trees inside the core of an outbreak versus outside the outer edges could pull dispersing beetles away from the edges and potentially reduce spread rates.
- Although all native ash trees will attract EAB adults, some species are more attractive than others. If different ash species are present, select by priority, from most to least preferred: (1) green ash, (2) black ash, (3) white ash, and (4) blue ash.
- Timing for girdling trees: Dates for girdling trap trees or setting traps and debarking trees or retrieving traps should be based on accumulated degree days for the local area since adults predictably fly at the same number of degree days each year. Girdled trees should be felled and debarked or destroyed in the fall, winter or early spring following their establishment to ensure that larvae die before completing development.

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## DNR 2010 Community Tree Survey for the City of Eden Prairie, Hennepin County

** Only maintained areas are surveyed. Maintained areas are periodically mowed or fall within an artificial surface, (e.g. parking lot).

Table 1. Diversity of tree genera, size class distribution, and healthy tree population and percents.

| | Dead trees are included in population numbers & all percents. | | | | | | Only live trees are included in numbers & percents. | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Size Classes ++ | | | | All Classes | | |
| Genera | Population | Genera % | Small | Medium | Large | Super | Population | Genera % | Healthy |
| Picea (Spruce) | 91,400 | 25.5% | 26.0% | 62.1% | 11.5% | 0.3% | 91,200 | 25.6% | 97.2% |
| Fraxinus (Ash) | 50,300 | 14.0% | 15.9% | 53.7% | 29.0% | 1.4% | 50,200 | 14.1% | 90.5% |
| Acer (Maple) | 49,100 | 13.7% | 23.6% | 56.4% | 14.7% | 5.3% | 48,900 | 13.7% | 84.6% |
| Malus (Apple) | 39,000 | 10.9% | 53.1% | 46.7% | 0.2% | 0.0% | 39,000 | 11.0% | 97.8% |
| Betula (Birch) | 18,300 | 5.1% | 27.9% | 60.9% | 11.2% | 0.0% | 18,300 | 5.1% | 80.3% |
| Pinus (Pine) | 17,900 | 5.0% | 26.3% | 61.4% | 12.3% | 0.0% | 17,900 | 5.0% | 97.4% |
| Quercus (Oak) | 13,300 | 3.7% | 12.9% | 31.8% | 34.7% | 20.6% | 13,300 | 3.7% | 59.8% |
| Populus (Poplar) | 10,100 | 2.8% | 31.8% | 36.4% | 23.3% | 8.5% | 8,900 | 2.5% | 84.2% |
| Tilia (Basswood) | 9,300 | 2.6% | 7.6% | 56.8% | 33.1% | 2.5% | 9,300 | 2.6% | 89.8% |
| Boxelder | 8,200 | 2.3% | 27.9% | 49.0% | 23.1% | 0.0% | 8,100 | 2.3% | 94.2% |
| Ulmus (Elm) | 8,400 | 2.3% | 29.9% | 40.2% | 23.4% | 6.5% | 8,100 | 2.3% | 87.4% |
| Gleditsia (Honeylocust) | 6,900 | 1.9% | 13.6% | 55.7% | 29.5% | 1.1% | 6,900 | 1.9% | 80.7% |
| Carya (Hickory) | 6,400 | 1.8% | 13.4% | 76.8% | 8.5% | 1.2% | 6,400 | 1.8% | 97.6% |
| Japanese Lilac | 5,300 | 1.5% | 67.2% | 32.8% | 0.0% | 0.0% | 5,300 | 1.5% | 92.5% |
| Prunus (Plum) | 5,300 | 1.5% | 48.5% | 44.1% | 7.4% | 0.0% | 5,300 | 1.5% | 82.4% |
| Salix (Willow) | 4,500 | 1.2% | 59.6% | 24.6% | 7.0% | 8.8% | 4,500 | 1.3% | 93.0% |
| Ostrya (Ironwood) | 3,200 | 0.9% | 53.7% | 46.3% | 0.0% | 0.0% | 3,200 | 0.9% | 100.0% |
| Robinia (Black Locust) | 3,200 | 0.9% | 22.0% | 63.4% | 14.6% | 0.0% | 3,200 | 0.9% | 90.2% |
| Celtis (Hackberry) | 3,000 | 0.8% | 84.2% | 7.9% | 7.9% | 0.0% | 3,000 | 0.8% | 50.0% |
| Juglans (Black Walnut) | 1,300 | 0.4% | 35.3% | 41.2% | 23.5% | 0.0% | 1,300 | 0.4% | 100.0% |
| Juniperus (Red Cedar) | 1,200 | 0.3% | 20.0% | 60.0% | 20.0% | 0.0% | 1,200 | 0.3% | 100.0% |
| Abies (Fir) | 500 | 0.2% | 28.6% | 71.4% | 0.0% | 0.0% | 500 | 0.2% | 100.0% |
| Sorbus (Mountain Ash) | 500 | 0.2% | 57.1% | 42.9% | 0.0% | 0.0% | 500 | 0.2% | 85.7% |
| Elaeagnus (Russian Olive) | 200 | 0.1% | 0.0% | 100.0% | 0.0% | 0.0% | 200 | 0.1% | 100.0% |
| Exotic/Other | 400 | 0.1% | 100.0% | 0.0% | 0.0% | 0.0% | 400 | 0.1% | 100.0% |
| Ginkgo | 200 | 0.1% | 100.0% | 0.0% | 0.0% | 0.0% | 200 | 0.1% | 100.0% |
| Morus (Mulberry) | 400 | 0.1% | 40.0% | 60.0% | 0.0% | 0.0% | 400 | 0.1% | 100.0% |
| Amelanchier (Juneberry) | <100 | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | <100 | 0.0% | 100.0% |
| Thuja (White Cedar) | 200 | 0.0% | 50.0% | 50.0% | 0.0% | 0.0% | 200 | 0.0% | 100.0% |

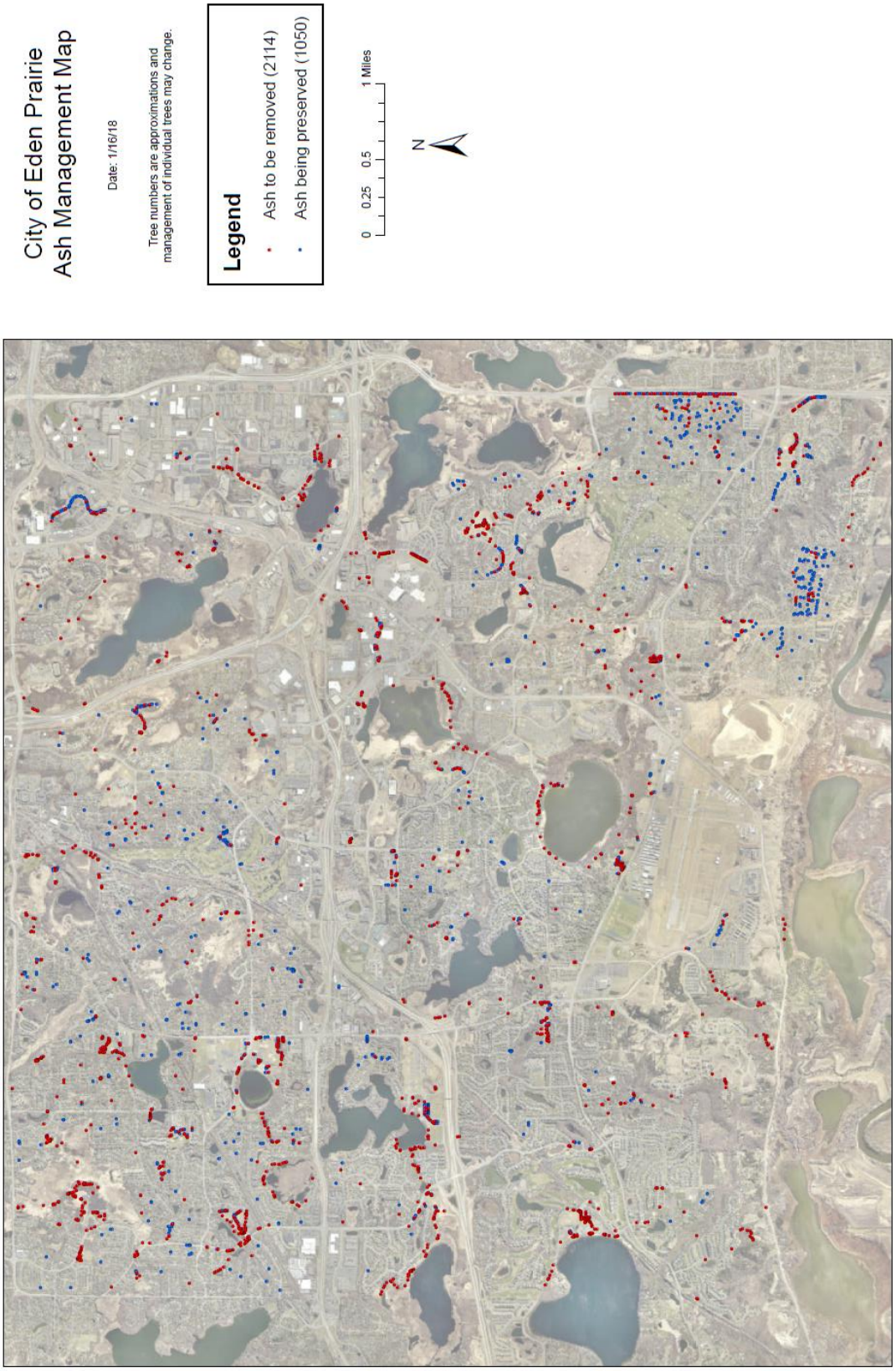
Table 2. Tree condition by size class.

| Size Classes ++ | Population | Size Class % | Healthy | Dieback | Discolor | Both | Dead |
|---|---|---|---|---|---|---|---|
| Small (1" - 4.9") | 101,900 | 28.5% | 87.5% | 6.5% | 2.8% | 1.8% | 1.4% |
| Medium (5" - 11.9") | 192,500 | 53.8% | 92.0% | 5.8% | 1.4% | 0.5% | 0.3% |
| Large (12" - 20.9") | 55,100 | 15.4% | 89.9% | 8.8% | 0.9% | 0.3% | 0.1% |
| Super (21" +) | 8,500 | 2.4% | 72.5% | 24.8% | 0.0% | 1.8% | 0.9% |

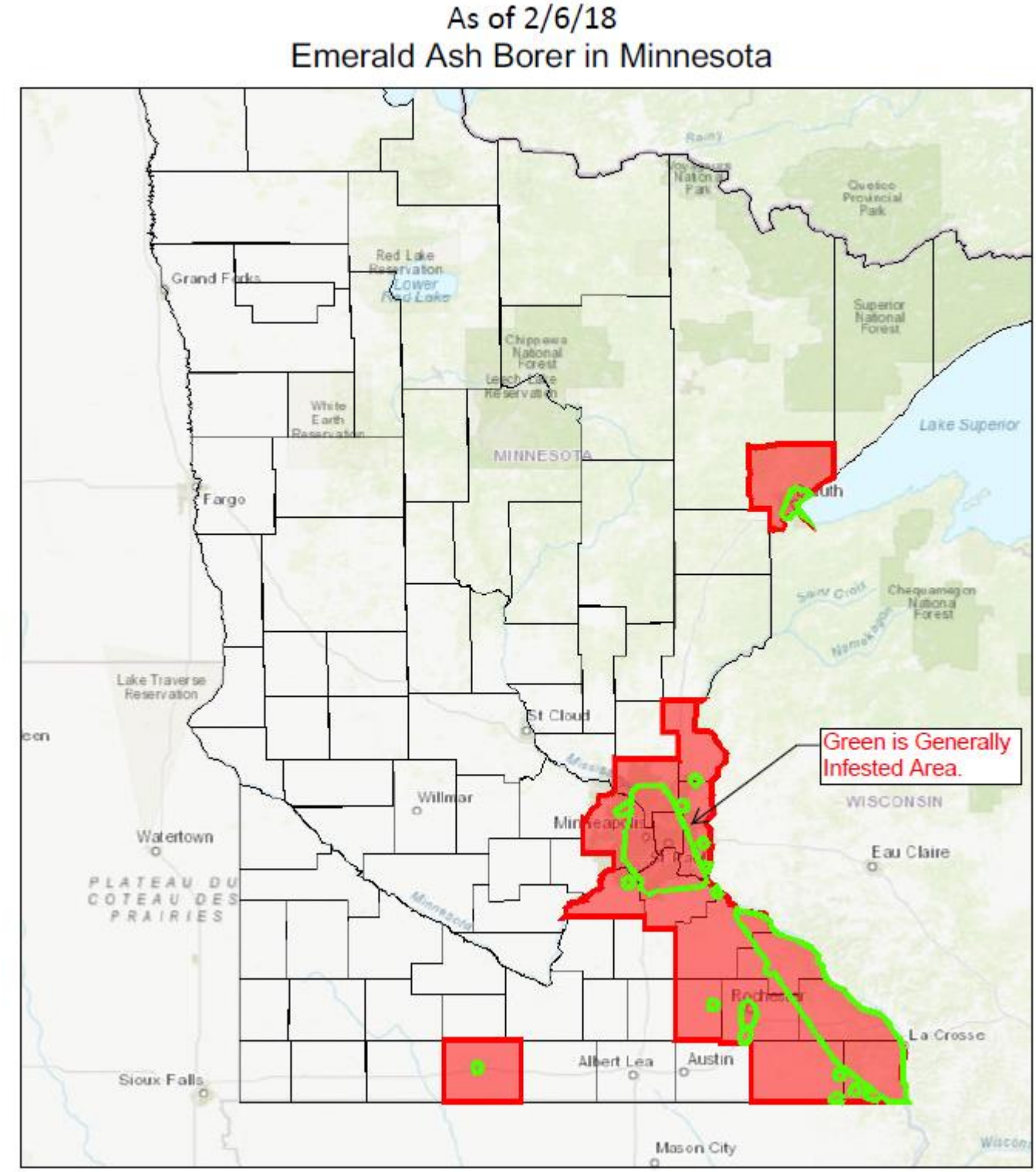
The numbers above (both tables) do not include shrub-like trees (e.g. Arbovitae) or non-maintained areas such as vacant areas.

**Area within city limits is 22.508 acres. The Business & Residential area is 13.967 acres. of which 93.3% (13.027 acres) is considered Maintained while 6.7% (940 acres) is considered Non-Maintained.

# Appendix B

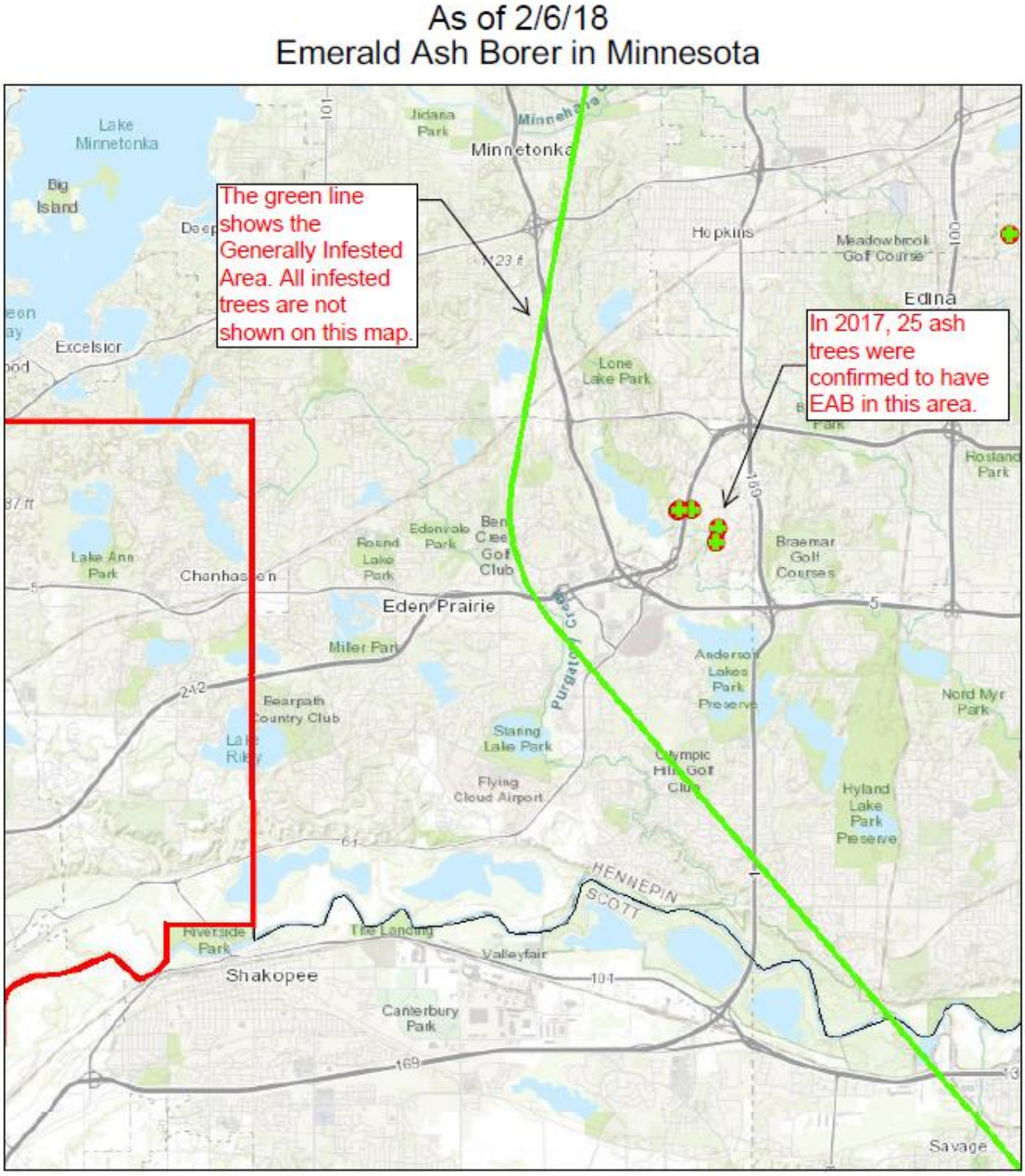

City of Eden Prairie
Ash Management Map
Date: 1/16/18
Tree numbers are approximations and management of individual trees may change.
Legend
Ash to be removed (2114)
Ash being preserved (1050)
0 0.25 0.5 1 Miles
N

## Appendix C




Source: MDA Interactive EAB Map

## Appendix D




Source: MDA Interactive EAB Map