EAB report
CITY OF GRAND RAPIDS | 2019

TEN YEAR REVIEW
of Grand Rapids emerald ash borer history, pest management activities, monitoring, treatment evaluation, and future planning.
EAB IN SOUTHEAST MICHIGAN

The emerald ash borer (EAB), a non-native invasive insect, was first discovered in southeast Michigan in 2002. A native of China, the borer was brought to the U.S. through international shipping. Several million ash trees in southeast Michigan had succumbed to the borer before the seriousness of the infestation was recognized.

Known for its metallic green color and small size, EAB was hard to see with an untrained eye. Quicklv, its larvae burrowed into ash trees to feed on tissue, over time, signs of infestation were present: yellowing leaves, D-shaped exit holes and canopy and bark loss.

Since EAB was a new invasive species, there was little research to draw on in combating its spread. Initial expert recommendations for addressing EAB focused on removing ash trees in and near infested areas, because the conventional wisdom was that treatments would be extremely expensive and have low rates of success. However, early efforts to create a “firebreak” by removing ash trees in a six-mile swath around southeast Michigan and Ontario failed to confine the infestation.

Defying the conventional wisdom of the time, in 2002 the southeast Michigan city of Grosse Pointe Farms chose to treat its ash tree population. Unlike most cities, Grosse Pointe Farms had previously chosen to treat its remaining elm tree population, with successful results. Several years after many nearby cities had removed all of their street ash trees to deal with EAB, Grosse Pointe Farms was boasting a healthy ash population.

Within 5 years of EAB detection, early research began to confirm the effectiveness of several types of treatments. Michigan State University researchers were reporting “excellent control” of EAB with insecticide treatments, while private contractors treating large number of ash trees in southeast Michigan were reporting overwhelming success—even as nearby untreated trees died.

Communities and other entities considering EAB treatment hoped that treatments would minimize, in particular, the loss of mature ash trees and the significant benefits associated with mature trees. Factors behind the idea of prioritizing protection of mature trees included research showing that large trees return nearly 50 times the average annual net benefits of small trees—for example, in stormwater interception, mitigating heat island effects, improving air and water quality, supporting wildlife species, beautifying neighborhoods, and providing a variety of other quality of life benefits.

EAB IN GRAND RAPIDS

The first evidence of EAB in West Michigan occurred around 2007 in the Kentwood-Wyoming area, followed by confirmed presence of EAB in Cascade Township. By 2009, EAB was evident in all areas of Grand Rapids.

By the time EAB hit West Michigan, the region was in the fortunate position of being able to take advantage of several years of research on EAB treatment. As the research began showing increasing success in combating EAB with insecticide treatments, treatments were also becoming more affordable. The treatment protocols began with assessing trees individually to determine treatment feasibility; it was evident early on that treatment was not a one-time fix, rather, protection with use of insecticides ranged from one to three years.

In light of the impending infestation, in 2006 the City of Grand Rapids conducted an initial inventory of public ash trees that revealed an ash population comprised of approximately 7,000 street trees and 1,500 park trees. It’s important to note that the inventory included only developed areas of parks, no forested natural areas were considered. The inventory estimated that ash trees comprised about 15% of Grand Rapids’ total street tree population—a situation typical of many Midwestern cities.
management begins

INITIAL GRAND RAPIDS RESPONSE

The City of Grand Rapids’ initial EAB response plan, approved in April 2007, called for removing and replacing all ash trees—both healthy trees and infested trees—over a ten-year period. The idea was that every second or third ash in a given area would be removed, replacement trees would be planted, and the ash population would be removed over a ten-year period. The plan aimed to avoid the widespread and devastating urban deforestation that characterized the early response to EAB in southeast Michigan.

The initial plan estimated removal and replacements costs at $1,200–$2,000 per tree, with 700 trees being removed and replaced annually at an annual cost of $700,000–$1.2 million. Over the ten years, the total costs were estimated at $7–$12 million.

The City’s plan also allowed property owners to place ash street trees on a “no-cut” list, providing they agreed to treat the trees. In response to this opportunity, more than 200 trees were placed on the no-cut list by residents in 2007 and by 2010 the list had grown to 341 trees. Residents were beginning to save the city’s ash trees.

EARLY EAB TREATMENTS

In Grand Rapids, the early adopters of the concept of EAB treatments included a group of homeowners on Anneshee Drive SE, a one-block street lined on both sides with mature ash trees. Living near Shaver Drive, the site of the city’s first major ash tree removals, Anneshee Dr SE property owners were determined to avoid the deforestation they saw nearby. To do so, in 2007 they contracted Bartlett Tree Experts to administer annual treatment of soil-injected imidacloprid and fertilizers. In their 45+ ash trees, at a cost of $15,000 per tree, the property owners covering treatment costs.

In 2008, a larger group of community members, concerned about the loss of valuable ash canopy, rallied the City to implement a three-year pilot treatment program to test the effectiveness of EAB treatments. Under the program, 150 trees throughout seven sites were selected for annual treatment with soil-injected imidacloprid and fertilizers. The sites chosen for the program included three parks and five streets with healthy trees and high-value mature ash canopy. The annual cost of the treatments, provided by West Michigan Tree Services, was $61,000.

TREATMENT MOMENTUM

East Hills Council of Neighbors became involved in evaluating ash for potentially EAB-infected trees. East Hills raised funds to secure a grant and partner with Bartlett Tree Experts to complete a tree inventory of their neighborhood’s public and private trees which revealed:
- East Hills had 229 total ash trees in the neighborhood, 15% of the city’s total.
- East Hills public ash were valued at $344,000.
- Nearly 200 of the trees were deemed feasible for treatment.
In 2009, East Hills advocates convinced the City to fund treatment of 190 trees.

RE-EVALUATION: EAB TASK FORCE

The City’s implementation of its initial EAB plan resulted in the removal and replacement of 1,327 ash trees, at an average of $500 per each removal and replacement (lower than estimated), totaling $636,000 between mid-2007 to mid-2009.

By 2009, amid increasing commitment to treatments, the Grand Rapids Urban Forestry Committee created a task force charged with reviewing the City’s 2007 EAB response plan and making recommendations for updating the plan. The committee’s action was based on the recognition that significant changes had occurred in the two years since the City had adopted its remove-and-replace plan.

- Research findings during the two-year period indicated that treatments (particularly imidacloprid and emamectin benzoate) were both more effective and more affordable than previously believed.
- New tools had been developed to assess urban forest asset values and the annual benefits derived from trees, thus offering better data to support cost-benefit decision-making.
- The City had adopted a new Urban Forest Plan, as well as completing its Green Grand Rapids planning process.

The task force included eight members of the Urban Forestry Committee (including the City Forester) and six additional community members. The group reviewed information from a wide variety of sources, including EAB research conducted at Michigan State University, the City of Milwaukee’s EAB treatment program, and results of the City’s pilot EAB treatment program. The research showed that a growing number of cities were opting to implement treatment programs rather than wholesale ash removal and replacement approaches.

The task force articulated both a goal for the City’s response to EAB—to mitigate the negative environmental, economic, and quality of life impacts of the emerald ash borer—and these guiding principles:

- The City’s response to EAB should be consistent with its Urban Forest Plan and Green Grand Rapids recommendations:
  - Recognize the urban forest as a significant green infrastructure asset providing critical economic, environmental and quality of life benefits
  - Prioritize public policy changes to maximize tree preservation
  - Prioritize increasing public awareness and involvement in urban forest issues
  - Set a 40% canopy goal
  - Call for increasing tree canopy to create more “green corridors”

- The City’s response to EAB should be based on a cost-benefit analysis that included the value of public ash trees as a green infrastructure asset and the annual benefits of trees, as well as the comparative costs of treatment, removal and replacement.

- The City’s response should be based on the most current available scientific research.

The task force recommended that the City’s steps include:

- Hailing contracted ash tree removals for three months, during which it would develop a plan for identifying ash trees for which treatment would be feasible (based on size, condition, and location factors), determine treatment methodologies and costs, and identify funding sources for treatment.

- Using available resources (e.g., the City’s web site, Parks and Recreation Department programming) to increase public awareness and involvement in treating ash trees on private property

- Exploring additional resources to support treatment and enhance public education (e.g., colleges and universities).
charting a new course

RESPONSE PLAN IMPLEMENTATION

In response to the EAB Task Force recommendations, the City revised its approach to ash removals, moving from “pro-active” removal and replacement to handling ash removals in the same manner as removals of other tree species, i.e., removing only trees that are dead or deemed hazardous.

With help from community volunteers, including arborists from Bartlett Tree Experts, West Michigan Trees Services and Consumers Energy, the City developed criteria for evaluating remaining individual ash trees to determine their treatment potential (e.g., trees larger than 8” in diameter, in good condition, etc.). The volunteers also assisted the City in conducting evaluations of all street ash trees.

The evaluations identify a total of 1,400 trees larger than 8” in diameter as treatment candidates. Approximately half of these trees were located in target areas eligible for Community Development Block Grant (CDBG) funds, and the City’s Community Development Director subsequently gained federal approval to use CDBG funds for ash treatments in these target areas.

The City’s research on treatment options led it to select trunk-injected emamecin benzoxale (TREE-aje) as the most cost-effective and least environmentally impactful treatment, given the high rate of effectiveness of the chemical, its potential to provide protection for 2-3 years, and because it stays within the trees trunk.

Under its revised approach to EAB, the City’s development plans to treat the 1,400 identified candidates, with half of the funding coming from CDBG funds. In 2010, the first year of city-wide treatment, 438 ash trees were treated with trunk-injected TREE-aje, at an average cost of $63.74 for chemicals, equipment and labor per tree.

WHERE WE ARE NOW

1,268 ash trees continue to be treated by the City through trunk injections of the insecticide TREE-aje. Trees are treated on a 3-year rotation, around 425 trees a year. The average DBH (diameter at breast height) of treated ash is 19.3. During treatment, each tree is re-evaluated, their growth and any exhibiting symptoms are tracked. Tree decline is noted and work orders are created to remove any hazardous ash. Staff labor, equipment and material used treating ash trees is tracked on a tree by tree basis, providing accurate total treatment costs. In 2019, the total cost of treating 435 ash trees was $12,952.

COST-BENEFIT ANALYSIS

Although reported costs of treating EAB throughout the US are high ($29.5 million annually) so is the value of existing ash trees ($262 billion), and treating ash trees has proven to be more cost-effective than tree removal or replacement (Ginsel et al. 2017).

Ash trees in Grand Rapids’ urban environment provide a multitude of benefits, such as purifying air, abating noise, supplying shade, increasing privacy, cooling air temperatures, intercepting stormwater, and reducing runoff. They also provide unique aesthetic benefits that make the otherwise gray infrastructure and densely populated conditions of an urban environment a beautiful place to live.

Based on a 2019 i-Tree Eco analysis, Grand Rapids treated ash trees provide up to $198,838 overall monetary benefits annually through numerous services including stormwater prevention, carbon sequestration, and energy savings (Table 1). Computed to an annual treatment cost of $12,952 Grand Rapids derives more annual economic value from ash trees than the cost of treating them.

Table 1. Grand Rapids Treated Ash Tree i-Tree Eco Analysis

<table>
<thead>
<tr>
<th>Eco Benefit Type</th>
<th>Unit</th>
<th>Monetary Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stormwater runoff prevention</td>
<td>3,055,400 gallons</td>
<td>$82,620.93</td>
</tr>
<tr>
<td>Heat prevention</td>
<td>42,981 therms</td>
<td>$42,099.03</td>
</tr>
<tr>
<td>natural gas savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy savings</td>
<td>316,515 kWh</td>
<td>$24,025.23</td>
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<tr>
<td>Air quality pollutants removed</td>
<td>3,929 lbs</td>
<td>$11,324.83</td>
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<tr>
<td>Carbon benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$29,805 lbs avoided</td>
<td></td>
<td>$9,231.50</td>
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<tr>
<td>1226,705 lbs stored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>750,200 lbs sequestered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$198,838.58</td>
</tr>
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Monetary benefits increase with DBH, and the biggest savings lie in stormwater mitigation and natural gas savings. Property values and energy savings are notable, but air quality and carbon sequestration savings are marginal (Figure 1). The estimated average monetary benefits of Grand Rapids treated ash is $8.59/DBH, compared to a treatment cost of $4.50/DBH. The estimated average monetary savings of treating Grand Rapids ash trees is $4.09/DBH (Table 2).

| Total estimated benefit of treated ash in Grand Rapids, MI (2018) | $196,636.58 |
| Average cost of treatment (2019) | $49,952.61 |
| Estimated average monetary benefit (2018) | $8.59/DBH |
| Average cost of treatment (2019) | $4.50/DBH |
| Estimated average treatment savings | $4.09/DBH |

10 YEAR ASH CONDITION STUDY

EAB’s devastation of regional forests and urban plantings is estimated to have cost up to $18 billion due to reductions in land value, removal of dead ash trees, and tree replacement (Kovacs et al. 2010, Syfnor et al. 2007). Thanks to responsive action, Grand Rapids was among the few municipalities that implemented large-scale EAB treatment as an alternative, cost-effective approach to help retain the maximum value of the City’s ash tree population. Now that over 10 years has passed since the first prophylactic EAB treatments were conducted in Grand Rapids, monitoring ash trees post-treatment to assess success and determine ongoing decline is vital in understanding Grand Rapids’ complete EAB-story.

In 2018, the City of Grand Rapids Parks and Recreation Forestry Division began a Post-treatment Ash Monitering and Evaluation Study led by resident-led volunteers and Forestry crew, which conducted ash monitoring surveys on over 1,000 trees throughout Grand Rapids.

The Monitoring and Evaluation Study aimed to answer three questions:
- Does treatment significantly improve the canopy condition of ash trees in Grand Rapids?
- Does tree location type significantly influence likelihood of symptoms?
- Do the pilot program trees exhibit significantly less symptoms than the ones that began treatment later?

Tree inventory data, which included unique tree ID, DBH, and GPS location were used to make data collection efficient. A survey protocol was developed and volunteers were trained. The survey protocol was established to define the effectiveness of Grand Rapids’ Emerald Ash Borer (EAB) treatments by evaluating treated ash trees for EAB infestation using the visual assessment of canopy health called ash canopy condition (AC) developed by the USDA (Knight et al., 2014; adopted in part from Ball and Simmons, 1980). Ash canopy condition exhibits a significant relationship with tree-level EAB densities (larvae/adult) and EAB gallery cover (Flower et al., 2011, 2013b) representing a visual proxy for EAB infestation levels or other tree stress.

To track the condition of each tree, volunteers gave ash trees a canopy rating of 1 to 5, with 1 being a full canopy, 5 being a dead tree, and 2 through 4 being progressively thinner canopies. Presence of symptoms of emerald ash borer, including unusual trunk sprouting, bark splitting, or emerald ash borer exit holes were also recorded. Exit holes were identified by a “D” shaped hole measuring roughly 1.25 cm in diameter. Information about what type of location the trees were growing (a tree lawn, park, or parking lot) was also recorded.

1,051 total ash trees were assessed by eleven volunteers, though 22 of the trees ended up being stumps. Data was compiled on two groups: Treated Ash 939 trees (Variable group) and Untreated Ash (control group) 90 trees. Data was analyzed by Bradford Dykes of the Statistics Department at Grand Valley State University using a chi-squared test that compared likelihood of ash trees to have “good” canopy conditions using the symptom and treatment variables. Trees were considered to have “good” canopies if they received a 1 or 2 canopy condition rating, and “poor” if they received a 3, 4, or 5.
Figure 2. Ash Canopy Condition (AC) is graded on a 1 (healthy) to 5 (dead) scale:

1. Healthy/Full
   a healthy ash canopy is full and exhibits no defoliation

2. Thinning
   slight reduction in leaf area, all top branches exposed to sunlight have leaves

3. Dieback
   some top branches exposed to sunlight are defoliated; lower branches which exhibit natural thinning are not considered

4. 50% Dieback
   canopy has less than 50% of the leaves left; over half of the top branches are defoliated

5. Dead Canopy
   no leaves remain in the canopy portion of the tree, regardless of unusual trunk sprouting

ASH CONDITION STUDY RESULTS

Although the data gathered on untreated trees was about 1/10 that of the treated trees, treated trees fared better across the spectrum, with a better canopy condition mean, and less proportions of every symptom (Figure 3). The pilot program subset of treated trees did test to consistently had less symptoms and the healthiest average canopy condition rating (Table 3).

Results of statistical analysis were significant for both treatment and symptom variables (Figure 3 and 4). This means that at 95% confidence, odds for better canopy ratings are between 4 to 11 times higher for treated ash.

Table 3. Overview of Study Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treated</th>
<th>Untreated</th>
<th>Pilot Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total trees</td>
<td>939</td>
<td>90</td>
<td>134</td>
</tr>
<tr>
<td>Average Canopy Condition Rating</td>
<td>1.63</td>
<td>2.62</td>
<td>1.47</td>
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<tr>
<td>Exhibiting</td>
<td>56.3%</td>
<td>81.1%</td>
<td>44.8%</td>
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<tr>
<td>Exit Holes</td>
<td>13.2%</td>
<td>47.8%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Trunk Sprouting</td>
<td>25.0%</td>
<td>36.7%</td>
<td>17.9%</td>
</tr>
<tr>
<td>Bark Splitting</td>
<td>40.7%</td>
<td>76.7%</td>
<td>28.4%</td>
</tr>
</tbody>
</table>

Figure 3. Chi-squared results of treatment and symptom variables impact on canopy condition rating
CONCLUSIONS

Treatment is effective, resulting in higher probability of good canopy condition

STATUS

Remainign ash population, not just the treated trees...

NEXT STEPS

Treatment in City Works, planned out. Costs are tracked once work order is closed and mL used is plugged in.

<table>
<thead>
<tr>
<th>Category</th>
<th># ash trees</th>
<th>% ash trees</th>
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</thead>
<tbody>
<tr>
<td>S4B treatments</td>
<td>1285</td>
<td>49.7%</td>
</tr>
<tr>
<td>P3 Removal</td>
<td>387</td>
<td>14.9%</td>
</tr>
<tr>
<td>P2 Removal</td>
<td>244</td>
<td>9.4%</td>
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<tr>
<td>Need Assessment</td>
<td>173</td>
<td>6.7%</td>
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<tr>
<td>Vacancy</td>
<td>147</td>
<td>5.7%</td>
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<tr>
<td>Stump</td>
<td>78</td>
<td>3.0%</td>
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<tr>
<td>P4 Removal</td>
<td>72</td>
<td>2.8%</td>
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<tr>
<td>European ash</td>
<td>60</td>
<td>2.3%</td>
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<td>Retired</td>
<td>44</td>
<td>1.7%</td>
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<tr>
<td>P1 Removal</td>
<td>35</td>
<td>1.4%</td>
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<tr>
<td>Replanted</td>
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<td>1.2%</td>
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<tr>
<td>Verify Vacancy</td>
<td>24</td>
<td>0.9%</td>
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<tr>
<td>Verify Removal</td>
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<td>0.3%</td>
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</table>

2587 100%

Tracking data matters!