Strategic Preparation for the Emerald Ash Borer

Summary of Research Findings

Research Conducted for Onondaga County Office of Environment and Onondaga County Department of Parks and Recreation by an MPA Capstone Project Team from the Maxwell School of Citizenship and Public Affairs at Syracuse University

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Executive Memo

With an emerald ash borer (EAB) infestation on the horizon, the time to act is now. The pest is poised to deplete Onondaga County's ash tree population, approximately 11% of all trees in the County, within a span of just a few years. Onondaga County's most strategic response is to start EAB preparations now, utilize a mix of treatment, removal, and replacement of trees, and to leverage as many public and private partnerships as possible to create the capacity needed to effectively respond to this threat.

While the task of responding to EAB appears overwhelming, the County has a unique opportunity to learn best practices from local governments hit first in the Midwest, as well as those now in similar threat zones as the County. Skyrocketing tree care and removal costs, a high risk that unmanaged trees will cause catastrophic damage to property (or worse, a tragic accident involving a citizen or employee), and angry residents are just a few of the problems that result from waiting too long to respond to EAB.

The most common advice given by foresters, arborists and public administrators across the country is to have a strategic EAB plan, and to start preparations now. With clearly defined leadership, a full ash tree inventory, a prioritization plan in place for treatment, removal and replacement, funding sources identified, and an informed public, the County will be ready for the infestation to hit. These preparation measures will allow for the implementation of a strategic plan instead of a frenzied reaction, with significant cost savings as a result.

Various accounting methods have been used to claim that total removal of ash trees is the least expensive option (cut down trees when they are smallest), while other reasoning points to total treatment as most cost-effective (as treatment in any given year will always be less expensive than full removal of a tree). However, the true cost-savings are found in a mixed approach. Utilizing treatment to help lengthen the time for tree removals is the best way to handle a lack of capacity.

The other critical method for building capacity for EAB response is to form partnerships and leverage every resource available: citizen groups, academic institutions, state and federal agencies, private firms, residents and other stakeholders all have a valuable role to play. Inclusion of all parties will spread the burden, and facilitate a smoother process, both as the County looks to manage its own property as well as slow the spread at the community level. As one forester said regarding public engagement, "If they aren't part of the solution, they certainly will be part of the problem."

Heeding the simple advice of *don't wait*, *mix it up*, and *don't go it alone*, Onondaga County could be a shining example of how to effectively prepare for and respond to an EAB infestation – saving money and headaches along the way.

Summary of Research Findings

The Numbers	
States Researched	18
Cities/Counties	43
Contacts	83
Case Studies	32

In conducting research on communities across the United States that have been dealing with or preparing for an Emerald Ash Borer invasion, the Capstone Team interviewed and engaged in informal conversations with Forestry staff and other City and County officials in 18 states. The team also gathered information from local government websites dedicated to EAB and published EAB preparedness and response plans that were accessible online. The following summarizes conclusions and lessons learned from these case study investigations, organized roughly by preparedness plan component categories:

1) Ash Tree Inventory and EAB Detection
2) Ash Tree Ranking and Prioritization
3) EAB Response and Management Strategies
4) Wood Utilization and Disposal
5) Tree Planting and Replacement
6) Budget and Financing
7) Relevant Ordinances and Policy Options for Trees on Private Property
8) Education and Outreach

Where feasible within each category, case studies are grouped to highlight viable options that may be applicable in Onondaga County, considerations that emerged, approaches to avoid, and/or partnership opportunities. Additionally a short summary section provides an overview of the key takeaways from the research findings within each topic area.

1) Ash Tree Inventory and EAB Detection

A. Approaches to Conducting Inventories

Summary

Since Onondaga County has already begun its efforts to inventory ash trees on County-owned property, the research summary does not place a strong emphasis on this category. That said, the use of volunteers and community members to assist with tree identification and documentation seems to be a promising approach to conducting inventories. In addition there may be opportunities to partner with state agencies or academic institutions to leverage resources and gain efficiencies in conducting ash inventories and monitoring for EAB. Lastly, evidence suggests sampling trees or conducting partial inventories and extrapolating overall numbers based on percentages may be an effective method for estimating ash tree numbers and can be much less costly than a thorough survey.

Viable Options

Forest Sampling Techniques (Carmel, IN)
A comprehensive survey of ash trees within a particular county or municipality may have certain advantages, such as the identification of specific locations of concern (i.e., heavily traversed areas or those near electrical transmission lines), or the provision of a detailed inventory. However, this may not always be necessary. In contrast, forest sampling techniques have been successfully implemented in areas such as Carmel, IN, as a means of determining the number of ash trees present within a given vicinity. In this particular case, the city's Urban Forestry Office, which is housed within the Department of Planning and Zoning, utilized a 6% random sample of the forested area within their jurisdiction to determine the number of ash trees that were present. Then extrapolated from this statistically significant sample to ascertain that approximately 20% of trees within the city were ash trees. During inquiries in regards to the particular benefits of this technique, Carmel forestry personnel suggested that forest sampling techniques both provided cost savings and sufficiently accomplished the goal of ash tree identification.

iTree (Chattanooga, TN)
iTree is a software system developed by the USDA Forest Service and is utilized for urban forestry analysis. To assess its ash population, Chattanooga officials used iTree data from 3% of street trees to estimate that the city has 1% ash, or 2,000 street trees. In its EAB plan, this estimate is then extrapolated to 200,000 total ash in city. This is a low-cost and relatively fast way to conduct an inventory for initial cost estimates and planning, but does not give detailed information needed for treatment and removal prioritization once the infestation hits.

County-Wide Inventory Focused on "Active Use" Areas (Anoka County, MN)
Anoka County is in the process of drafting an EAB Management Plan, including conducting a county-wide inventory to identify hazardous trees in "active use areas" to be targeted for removal or treatment. The Excel spreadsheet they use to inventory trees is an effective means of documenting tree characteristics including: diameter at breast height (DBH); tree height; description of nearby

targets and distance to target; tree defects; hazard tree rating; treatment and equipment requirements; and maintenance date and activity. “Active use” areas are defined as outdoor spaces where two or more people may congregate for extended periods of time such as picnic pavilions, playgrounds, etc.

Using Volunteer Community Members to Help with Ash Identification in Public Spaces (Ulster County & Woodstock, NY)
Ulster County and the community of Woodstock are in the early stages preparing for, and mitigating the threat of the EAB by utilizing private citizens, environmental and community groups, and local-area networked partnerships. Partnerships allow a diverse set of stakeholders, governmental and non-governmental actors, private citizens, and business owners to actively participate in ash-tree health assessment and EAB identification. By expanding the scope of the EAB survey beyond publicly owned land, and empowering and utilizing local organizations and citizens, a more comprehensive and representative survey of ash-tree health is produced. USDA APHIS traps, “Purple Prism Traps,” and sentinel trees are used to track and monitor the presence and spread of EAB in Ulster County, and have proved to be a successful public outreach and educational tool. Volunteers from Catskill Regional Invasive Species Network (CRISP) in Ulster and Greene County are conducting large surveys of pedestrian right of way and high traffic areas for ash tree inventory purposes. The data collected from this survey is used to determine the size of the ash tree population, and the health of the stock and level of infestation. 12 CRISP volunteers survey 8 square miles of public right-of-ways to determine the presence of EAB and to map all of the exit holes on an infested tree. At present the survey is underway and data has not yet been made publicly available.

Use of Volunteers to Conduct Inventory (Saint Paul, MN)
In 2012 Saint Paul started a new program of using volunteers to collect inventory data. Trained forestry staff then enters tree data using specialized tree inventory software. Presently there are 6 volunteers dedicated to this effort, but they hope to expand the program in 2013, including training a data-entry volunteer. Despite the fact that Forestry staff time is required, the City views the use of volunteers as a successful effort, both in terms of data collection, and as a community outreach strategy, since volunteers regularly engage in conversations with local residents as they are out in the community collecting data.

Partnership Opportunities

Statewide Partnerships in Indiana (State of Indiana DNR/Purdue University Cooperative Extension)
Partnerships can be a useful tactic for accomplishing an ash tree inventory within a particular area. Purdue University Cooperative Extension has been a key stakeholder in regards to ash tree inventories within the state of Indiana. They offer training programs that both private property owners and government officials alike can participate in for the purposes of identifying ash trees within a particular area, as well as the presence of the EAB infestation. The State of Indiana Department of Natural Resources (DNR) also recommends the adoption of partnerships for County or municipal agencies managing EAB. EAB specialists within Indiana DNR suggests that government officials coordinate and consult with local arborists, foresters, and master gardeners if they are not already on staff to assist in both identification of ash trees, as well as detecting the presence of the EAB infestation.

Statewide Partnerships in New York (New York State Department of Environmental Conservation)
The State of New York Forester's office has initiated an interagency discussion and call to develop a partnership plan with the state Office of Parks, Recreation and Historic Preservation (OPRHP) and the Department of Transportation (DOT). The purpose of the interagency partnership and discussion is to combine technical, scientific and operational expertise in order to develop a preparedness response for EAB. This partnership recognizes that a one-size-fits-all approach is neither appropriate nor sufficient, but insists that a more comprehensive "monitor and tracking tool-kit" is a critical aspect for mitigating damage caused by EAB. In the NYS interagency plan the use of interagency resources in tracking and monitoring is encouraged. For Onondaga County, a partnership with the Office of Parks, OPRHP, NYS Forester's Office and the DOT could be useful in monitoring and tracking the spread of the EAB before and after arrival. The state-level coordinative ability of this interagency effort is a useful resource for Onondaga County as much of the information gathered at the state level can help Onondaga County prepare for EAB arrival.

Approaches to Avoid

Extensive Pilot Program (State of Pennsylvania Department of Agriculture)
In response to Maryland's EAB problems and confirmed evidence of EAB presence in southern Pennsylvania, the state started an aggressive EAB management pilot program. The program consisted of an extremely detailed survey and mapping of all found infested ash trees and subsequent exit holes. In a concentric 5-mile ring around and within the delimiting area, all ash trees were either removed or inoculated. The purpose of this technique was to determine if this aggressive approach was effective. Unfortunately, EAB infestations were found outside the ring and other areas within the state soon thereafter. The lesson is not that aggressive treatment does not work, but that relying on a survey of infested trees and exit holes is not 100% accurate, and a broader, more comprehensive approach should be used instead. Focusing on too narrow of an area can leave unattended areas more vulnerable. Time is of the essence and early sightings save trees and costly reactive management actions.

B. Detection Methods

Summary

In general, simple detection methods seem to be sufficient and most communities prefer to preserve staff time and resources for removal and treatment activities, rather than expending the effort to conduct extensive detection efforts. Again, random sampling may be a cost-effective method of monitoring for new infestations and there may be opportunities to partner with a cooperative extension service, state agency, or the US Forest Service to perform detection activities.

Viable Options

Simple Detection Methods (Carmel, IN)
Accurately identifying the presence of the EAB within a particular area can be accomplished through the utilization of "simple detection" methodologies. In this case simple detection methodologies are defined as those not requiring the usage of traps or girdling (complete bark removal) of trees. Rather professional forestry or arboricultural staff simply observationally examine ash trees within an area to ascertain their relative health. In Carmel, Indiana, professional staff in the Urban Forestry Office were able to accurately identify the presence of EAB within city limits utilizing simple detection techniques. In many cases staff members could spot EAB habitation prior to the formation of the telltale D-shaped holes that indicate infested ash trees. This demonstrates the potential utility of high-quality in-house forestry personnel.

Traps, Community Surveys and EAB Hotline (State of New York: Ulster County, Greene County, and Erie County)
Community organized surveys are used to provide local professionals with a more complete picture of ash tree inventory and distribution. Professionals such as entomologists and arborists, as well as other trained EAB experts, like local Master Gardeners, trained volunteers, Cornell Cooperative Extension staff, and other community members are used during the survey, mapping and community outreach stages. These counties also utilize the Purple Prism and Aphis traps as part of the survey. Erie, Ulster, and Greene Counties' plans also recommend providing the public with an invasive species or emerald ash borer hotline so the public can provide the necessary authorities information about possible infestations and sightings.

Partnership Opportunities

Random Branch Sampling Study (Saint Paul, MN)
Saint Paul is conducting a three-year EAB detection study between 2012 and 2014 in partnership with the University of Minnesota, US Forest Service, and Minnesota Department of Agriculture. The research team randomly samples public ash tree branches for EAB symptoms by removing two 3-foot long branches from each of the randomly selected trees. The branch samples are debarked and inspected for the presence of EAB. In the first year of the study, approximately 140 trees were sampled throughout Saint Paul and partner cities Minneapolis, Falcon Heights, Lauderdale, and Roseville.

2) Ash Tree Ranking and Prioritization

A. Criteria to Include in Inventory & Classification Categories

Summary

Various ranking and prioritization systems are used throughout the country. Most classify not only physical tree characteristics, but also note any structural damage the tree may have suffered and describe adjacent potential targets or conflicts (utility lines, etc.) when assigning a ranking to an individual tree. Forestry managers should aim to develop a classification system that is sufficiently detailed to provide the information needed to make a decision about how to manage the tree, while also remaining simple enough to be easy to understand and to implement.

Viable Options

Classifying Ash Trees by Distance to EAB Detection (State of New York)
The State of New York recommends using a tiered approach to classify the degree to which the EAB population has grown and spread and its proximity to a confirmed sighting. The following criteria are used. The first criterion confirms a new infestation, the second describes the level to which tree mortality in the area can be blamed on EAB infestations, and the third describes both infestation level and spatial distribution of separate infested areas.

1. Trigger Criterion: There is evidence of an infestation found in a new area.
2. Criterion two: There are different levels of EAB related ash tree death within new area.
    - Tier 1: No confirmed EAB infested trees have died in the new area.
    - Tier 2: Less than 25 EAB infested trees have died in the new area.
    - Tier 3: Greater than 25 EAB infested trees have died in the new area.
3. Criterion three: Distance of infestations from one another with included infestation description levels.
    - Tier 1: (EAB detection) = Areas are 0-500 miles from one another.
    - Tier 2: (EAB detection and small infestation) = Areas are 501- 6 miles from one another.
    - Tier 3: (Large-scale EAB detection or established infestation) = Areas spread more than 6 miles from one another.

New York State also prioritizes actionable responses by ranking management response areas into four ascending geographic areas, which start at ground zero and end in the rest of the state

1. Satellite Core Area: This area is used in the identification of an EAB delimiting area and can be used to assess overall forest health.
2. First Management Response Area (LEVEL 1~Threat level RED): Highest threat trees in the 0-5 mile zone around delimited area should be dealt with. Promote early utilization of ash products and replacement. Chemical treatments, such as soil drench, injection and other forms of inoculation can be used for highly valuable trees. Use private and public foresters to determine value of current ash stocks as a low cost method. Encourage landowners to do their own inventories to more accurately assess the County's ash tree needs.
3. Second Management Response Area (LEVEL 2~Threat Level ORANGE): Consists of the 5-10 mile ring around delimiting zone. Trees in this ring are at an elevated risk, but not yet

noticeably infected. They are likely to not be infected in the first 2-5 years after a confirmed infestation is established in the First Management Response Area. The State recommends encouragement of stakeholders in self-assessment and self-identification of EAB on private land areas.

4. Third Management Response Area (LEVEL 3~ Threat level YELLOW): This border is essentially the rest of the state. New York State recommends using state and federal partnerships as a way to manage regional spread of EAB.

Detailed Ranking Criteria by Certified Arborists (Leawood, KS)

In classifying ash trees for plan implementation, Leawood, KS, recorded each tree's diameter at breast height (DBH) and then assigned a condition rating based on attributes including leaf density, structural integrity, environmental stresses, apparent cavities, root flair/collar condition, crown dieback, fungal infections, insect damage, nutrient deficiencies, and heaving soil. Assessments were completed by certified arborists to ensure accurate evaluations. Using these criteria, trees were then categorized as excellent, good, fair or poor. Because the city is small, all trees except those rated as poor will be inspected annually to determine treatment or removal plans.

Percentage Rankings with Treatment Recommendations (Howard County, MD)

Ash trees in Howard County are ranked on a 0 – 100 scale and are given a percentage rating. These condition ratings are based on tree health, structure, decay, vigor, insect and disease problems, growth rate, crown development and life expectancy. Once given a percentage rating, trees that fall within certain ranges are assigned treatment recommendations. A rating of 0 – 30% is a dead tree or tree in poor condition with major defects or at the end of its life cycle, and is to be removed as soon as possible. Those trees rated as 31 – 50% have major structural problems or are in poor health, and are to be removed within 10 years. Trees between 51 – 70% have minor defects and should be expected to live ten or more years, while 71 – 90% trees have good form and health and can be expected to live 20 years of more; injection is recommended for trees both of these top categories. Finally, the top 10 percent of trees rated 90%+ are in excellent health with no structural defects, and are recommended for injection.

Risk Assessment Criteria for Ash Trees (Fort Wayne, IN)

In order to effectively prioritize ash tree treatment and removal within the city, Fort Wayne, IN contracted with a private risk management firm to develop risk assessment criteria. The ranking system ranges from 1 to 9, with 9 presenting the highest risk. Although detailed specifics of the risk assessment criteria are unknown, we can glean from information provided by the Superintendent of Urban Forestry that the higher the number, the more likely it is that an infested ash tree will cause some sort of harm (i.e. fall on utility lines). The risk assessment is useful in the sense that it allows forestry personnel to allocate scarce resources specifically to a particular tree or series of trees that are cause for concern.

Considerations

Considerations for Various Management Options (Saint Paul, MN)

Based on best management practices from several nationwide or statewide resources, Saint Paul has developed and published a set of considerations regarding treatment, removal and/or

replacement of ash trees. Considerations for ash treatment include: soil drench or soil injection; toxicity concerns; and preference for trunk injection. Associated concerns include water quality, and potential insecticide options. The Purdue Cost Calculator was used to compare treatment and removal costs. Additionally, web links to the required permit for homeowners to treat boulevard trees at their own expense are provided, along with a list of licensed tree care companies homeowners may contract to apply insecticide treatment. Considerations for removal include: EAB active season (May 1 - August 31); guidelines for selecting a tree care company (including a list of licensed, bonded, and insured companies); and ash tree waste disposal sites. Considerations for replacement include: a link to the US Forest Service tree owner's manual regarding species selection, site selection, planting and maintenance guidance; a link to recommended trees for Southwest Minnesota from an ecosystem perspective (published by University of Minnesota Extension Service); and a reference to the benefits of urban forestry and tree canopy as valuable green infrastructure.

B. Active Use Areas versus Highway Right-of-Way versus Forested Areas

Summary

The research did not yield much information specifically about how trees in highway right-of-ways are handled versus trees in actively used areas such as parks or campuses versus trees in forested areas. Conversations with officials in Minnesota suggest that the Parks Department does not take responsibility for managing trees in highway right-of-ways and that the primary focus of EAB management efforts is on active use areas where residents frequently congregate outdoors.

Viable Options

Right-of-Way Trees Responsibility of Public Works (Ramsey County, MN)
Ramsey County has long had a policy in place that it does not plant trees in County right-of-way (ROW). Tree planting in the ROW is done by municipalities or private landowners, and the maintenance of those trees is the responsibility of the entity that did the planting. Ramsey County Public Works removes dead, diseased, or otherwise hazardous trees from the ROW and Public Works staff estimates that EAB will increase removals along the ROW by 10% per year with an associated cost increase of $5,000 - $10,000 per year.

Considerations

Classification of "Active Use" Areas (Anoka County, MN)
Anoka County's Draft EAB Response and Management Plan defines "active use areas" as "areas in which the public is invited to participate in active recreational activities in which it is likely groups of two or more individuals may congregate for extended periods of time." Trails, forested areas, and highway right-of-way not classified as active use areas, as residents are unlikely to congregate in such areas. Anoka County plans to prioritize removal of hazardous trees on County property according to the "active use" designation, and to address these trees first before managing trees in non-active use areas.

3) EAB Response and Management Strategies

A. Slowing the Spread of Infestation

Summary

Once an EAB infestation is confirmed within the jurisdiction, efforts to slow the spread of the beetle should begin immediately. The national Slow Ash Mortality (SLAM) method provides a framework to help contain EAB and extend the "S-curve" of ash mortality, ideally delaying the steepest part of the curve where more than 80% of ash trees in a community can die within a four-year period. The research team's investigation did not reveal many communities that are using parasitoids as a way of combatting EAB, but Saint Paul is testing the use of parasitic wasps in designated natural areas surrounding infested trees.

Viable Options

Utilizing National SLAM Method (State of New York)
New York State's Department of Environmental Conservation (DEC) recommends that counties and municipalities adopt their recommended management plans because they are considered to be representative of best practices. These plans were developed in accordance with United States Department of Agriculture (USDA) APHIS program, and the United States Forest Service recommendations.

The Slow Ash Mortality (SLAM) method can be used to slow the spread of EAB as New York is a gateway to New England. The 8 Steps of the SLAM approach are: 1) slow spread by removing largest infected trees; 2) create annual clusters or groups of girdled trees to concentrate EAB; 3) establish sentinel trees, which are removed annually and studied as a way to determine pace of EAB expansion and movement in a specific geographic area; 4) ash reduction and utilization: remove and use ash ahead of time, before infestation; 5) release parasitoids and test effectiveness; 6) conduct and test insecticide; 7) participate in national ash conservation efforts (save ash seeds via volunteers); 8) annual evaluation and reporting of progress. The basic methodology of the SLAM approach is trees that are deemed hazardous, vulnerable, or not desirable should be removed; otherwise trees should be selectively inoculated.

Use of Parasitic Wasps in Hard to Maintain Areas (Saint Paul, MN)
One promising tool for ash trees in hard to access natural areas such as the river corridor is biological controls in the form of three species of parasitic wasps. These tiny wasps are fatal to EAB larvae. The USDA and Minnesota Department of Agriculture (MDA) introduced these wasps in 2011 in Langford Park (and Minneapolis), and later in the Summit-Dale area. MDA staff did a second release of the wasps in those same areas in 2012. Experts do not predict that the wasps will provide a permanent or even a short-term solution to EAB, but hope it may extend the time frame to manage EAB by balancing the population and prolonging the onset of an EAB "explosion" that other communities have experienced. Biological controls may be one of the most useful tools in the river corridor where other management options are either impossible or cost prohibitive.

B. Tree Removal and/or Treatment Application

Summary

Many of the communities identified in interviews and through online research are aggressively removing ash trees in advance of confirmed EAB infestation. In general, trees with a DBH less than or equal to 10" are targeted for removal. Some communities employ a diverse mix of management strategies while others have "put all their eggs in one basket." Criteria for tree treatment generally includes trees in good overall health with no nearby obstacles of concern (utility lines, structures, etc.) that have a greater than 10" DBH. The City of Chicago was the only community identified in the research that opted to fully inoculate all trees, and this work was done with a sizable budget of $2.4 million and a citywide commitment to preserving existing trees. Another key consideration in the decision of which trees to treat and which to remove is proximity to a known EAB infested tree. Inoculation of trees in a 1-2 mile radius surrounding a documented infestation is a generally agreed upon best practice.

Cut-off Points for Ash Tree Treatment

Community	Minimum DBH
Saint Paul, MN	10"
Anne Arundel County, MD (unofficial plan)	15"

Cut-off Points for Ash Tree Removal

Community	Maximum DBH
Leawood, KS	6"
Howard County, MD	6"
Minneapolis, MN	10"
Joliet, IL	12"

Viable Options

Preemptive Structured Removal (Fairway, KS)
Even though infestation has not hit the city yet, and an inventory has determined a relatively low ash population with 8% total ash, Fairway, KS, has already preemptively decided to remove all low-ranked trees. The city's inventory ranked trees from 0-5, and all trees rated 0, 1 or 2 have been removed. While perhaps the city did not need to do this because of the manageable number of ash, the argument can also be made that since the ash tree situation is quite manageable, it makes most sense to manage it early.

Selective Removal (Springfield, OH)
Selective removal of ash trees containing EAB may be an effective means of both slowing the spread of the infestation, and reducing the likelihood that infested trees can fall and hit targets (i.e., power lines, vehicles, property, and individuals). The term "selective removal" refers to the cutting down of specific ash trees located in areas where targets are present, such as highway right-of-ways. According to the Springfield, OH EAB management plan, the city's Services Department will remove ash trees from public right-of-ways. The cutting of such trees will happen in a progressive fashion, where some 70 to 100 trees will be removed each year. This tactic in theory will both spread out management costs, while simultaneously lowering the potential of infested trees hitting the aforementioned targets.

Selective and Systematic Removal (Toledo, OH)
According to the Toledo EAB management plan, the city plans to removal all ash trees that are within the boundaries of public right-of-ways. To accomplish this task, forestry personnel chose to cover portions of the 65 management units, where tasks such as ash tree prioritization will be conducted. Finally, the residual stumps from trees that were cut down will be removed as long as funding remains available for the project.

No Inoculation; All Removal (Minneapolis, MN)
Minneapolis Park and Recreation Board (MPRB) is responsible for managing EAB response in the City of Minneapolis. MPRB is very concerned about resident aversion to chemical treatment, and is opting instead for removal of boulevard and park ash trees. To date, MPRB has removed approximately 4,000 ash trees and has not used any treatment on boulevard or park trees. MPRB officials shared that the decision to pursue full removal and no inoculation was primarily based on the social and political climate in Minnesota, which was not conducive to pursuing chemical treatment. For example, in community meetings residents repeatedly raised questions about pesticide leakage into groundwater or other ill effects on other plant species or wildlife.

Full Removal, Mix of In-House and Contracted Work (Joliet, IL)
The City Arborist, with the help from city staff, plans to aggressively remove ash trees less than 12" in diameter during the winter months if they are sick, dying, diseased, or otherwise unhealthy. The City also plans to remove healthy ash trees planted under power lines, in front of stop signs, under light poles, and next to mailboxes. All trees larger than 12" in diameter will be removed by a contractor. An EAB Tree Removal Contract will be bid for the removal of right-of-way trees that are infested or become a public safety issue. The trees that become a safety issue will be given priority and be among the first removed. Those that are infested will come out before and after flight season. Joliet's plan is to contract out the removal of approximately 200 ash trees in 2011 and the same for the following years. The numbers will increase as the infestation intensifies.

Full Inoculation (Chicago, IL)
Given an extensive 2.4 million dollar budget, Chicago only needed to cut 6,500 ash trees of the roughly 97,000 ash trees within city limits. The legislature approved funding based on a comparison to cutting all standing ash trees, a truly "black or white" comparison. Inoculation doses have been effective enough to allow the city to spread inoculations out from 2-year to 3-year treatments. The Forestry department is beginning to experiment with 4-year doses as well. The extremely competitive bidding process allowed for a comparatively low inoculation cost of 5 - 9 dollars per diameter inch. Huge success was also found selling the few trees that did need to be removed and using the wood chips for landscaping as well as bidding out the materials.

Different Treatment Methods Used for Different Tree Rankings (Leawood, KS)
Leawood has a unique strategy of using different treatment methods depending on the category the tree has been assigned in an effort to keep costs down, as well as to manage the speed at which treatment needs to occur. The plan specifies that ash trees classified as excellent or good will be treated every two years with a trunk injection of emamectin benzoate, while trees rated as fair (with only structural issues) will be treated yearly with an imidacloprid soil drench, or a dinotefuran trunk spray. Other fair ash trees will be monitored annually. Prior to additional treatments, the City will

inspect the condition of the treated trees to determine the success level before continuing to invest in those trees.

Utilizing a Pilot Area for Implementing Plan (Howard County, MD)
A big question for EAB plan implementation is, "where to start?" Howard County has taken an approach that focuses on a specific pilot community that will allow the County to verify cost estimates and ensure treatments and removals are successful before launching large-scale efforts across the entire County. The Village of Oakland Mills was selected because it is one of the locations where infestation has been detected. The County plans to replace all removed trees where needed, and inoculate all planned trees in the 2-mile circle around the infestation site using the Arborjet (Tree-age) trunk injection system. Trunk injection was selected with the reasoning that it uses the least amount of chemicals and limits the environmental exposure to the insecticide. After the pilot is completed, the County will move forward with a plan to preemptively remove all ash trees with a DBH under 6" as well as those with a condition rating of 30% or less, by removing every fifth tree and replanting yearly over a 10-year period.

Mix of Removal, Inoculation, and Replacement (Saint Paul, MN)
The City of Saint Paul employs a set of City-Wide Management Strategies in its response to EAB. Management activities include monitoring, sanitation (removal of hazardous or infected trees) treatment, and structured removal. Ash tree surveys are conducted by forestry staff between December and April, and infested ash trees are removed prior to the EAB active period of May - August. The Forestry department is responsible for ash tree removals on public property, which take place during EAB inactive months of September - April. Insecticide is used to slow the spread of EAB, but is not considered a long-term strategy to save trees. 700+ boulevard ash trees were treated with Tree-Age by trunk injection between 2011 and 2013. Treatment areas primarily fall within a 1-mile radius surrounding the original site of EAB infestation, but have also expanded into additional neighborhoods. Criteria used to determine treatment eligibility include: 10-20 inch DBH (diameter at breast height); good overall health with no structural defects; and good growing location with wide boulevards and no utility conflicts. Treated trees are tagged with an aluminum tag stamped "EAB [Year treated]." Ash trees identified for structured removal are generally those suffering from non-EAB related symptoms such as drought, salt injury, mechanical injury, or structural defects.

Treatment Determination by Tree Size & Concentration (Anne Arundel County, MD)
While many EAB plans specifically mention tree DBH for determining removal, Anne Arundel's unofficial draft plan proposes to determine treatment by DBH, where trees greater than 15" will be top candidates for treatment. The condition will also be taken into consideration (trees with more than 50% dead canopy will not be treated), and those neighborhoods with very high ash density will require treatment to not lose all the benefits of canopy.

Considerations

Keeping Bee Health in Mind with Pesticide Use (Chattanooga, TN)
In speaking with city forestry personnel Chattanooga, it was noted that they are taking into account the potential negative effect of neonicotinoid insecticides on honey bees. While the ash is not a flowering tree that attracts honey bees, there is speculation that neonicotinoid applied to soils near

flowering plants may be absorbed by those plants and harm honey bees. Though not a proven fact, the city will not use these treatments in treating trees that may potentially negatively affect the honey bee population.

Treatment in Infestations Zones; Removal Avoided Near Infestation Sites to Contain EAB (Saint Paul, MN)
In the City of Saint Paul, removals in areas of known infestations are actually avoided in order to ensure energy requirements of current EAB population are met. This strategy is intended to help slow the spread of EAB by keeping beetles from traveling further to find ash trees to feed on. However, the Minnesota Department of Agriculture also recommends treating ash trees within a 1-mile radius buffer around a documented infestation site to help control the spread, which seems to conflict with the intention of providing adequate food.

Approaches to Avoid

Awaiting the Worst of the Infestation (Elmhurst, IL)
Currently relegated to emergency cuts (100-150 over the past 2 years), the village failed to establish a need among the community to make a plan for ash trees. The village is overwhelmed with the amount of chips and trees being taken down, and they are still one to two years away from the peak of the infestation. Elmhurst has failed to secure any labor or materials to attack this problem, but hopes to up contracting over subsequent years. Funding is currently dependent upon the situation worsening and community outrage growing enough to allow for hazardous tree removals.

Lack of Budgetary Foresight (Fort Wayne, IN)
In 2008, Fort Wayne piloted a robust EAB treatment strategy in which $250,000 was used to inoculate approximately 11,000 ash trees with imidacloprid. The treatment strategy was effective at both preserving canopy (due to the fact that the trees would have required removal without treatment), and allotting the city an additional 3 years to continue to develop management solutions. However, due to the effects of the global financial crisis, funding availability became limited to continue the same level of treatment. As such a significant ash tree die-off has occurred over the last three years where some 10,000 trees had to be removed. The costs associated with removal are only some of the cost that the city will face as a result of these lost trees, and costs also include the loss of ecosystem services (stormwater mitigation, etc.). Given this information it would have potentially been more prudent to continue to provide sufficient treatment funding, and avoid more significant costs in the future.

Partnership Opportunities

Incident Command System to Coordinate Efforts (Saint Paul, MN)
The arrival of EAB in Saint Paul, MN was considered a “significant event” that required coordination and communication between many agencies. An Incident Command System was employed to respond to EAB and is co-led by USDA and Minnesota Department of Agriculture. In 2009 weekly meetings were held with all agencies involved to provide updates to members and help with sharing of resources in the development of an Incident Action Plan. Saint Paul also coordinates, cooperates,

and communicates with Minnesota Department of Natural Resources (MN DNR), Ramsey County, City of Minneapolis, and other City of Saint Paul departments, neighborhood groups, and residents.

4) Wood Utilization and Disposal

A. Wood Storage, Marshaling Areas, and Drop-off Sites

Summary

Storing wood that is staged for processing can be a challenging aspect of EAB management. Smaller communities may have difficulty identifying sites large enough to collect, store, and process wood waste, and keeping wood contained within the quarantine zone adds another layer to this challenge. Since tree removal is anticipated to be at least partially contracted out, educating and coordinating with local tree service providers is crucial to ensure compliance with preferred wood disposal practices and quarantine requirements.

Viable Options

Contracting for Wood Disposal and Contingency Plans (Springfield, OH)
Wood disposal does not necessarily have to be exclusively an in-house operation by a county or municipality. In fact, contracting with private firms may be a viable option for local governments as means of properly disposing of ash wood waste as a result of EAB. Springfield, OH contracts with a private recycling firm as a means of disposing of dead ash wood. However, their EAB management plan also provides for a contingency strategy to be implemented in case contracts with private firms expire, or are no longer viable due to budgetary considerations. The contingency strategy involves the city reopening a composting area, and utilizing it as a location where infested ash wood can be disposed. This may be an important consideration for Onondaga County as they move forward with EAB management plan implementation because it is likely that circumstances will arise that make contingency wood disposal sites necessary.

Considerations

Need to Shuttle Between Marshaling Areas (Fort Wayne, IN)
Finding an open space for all the wood debris can be difficult, especially for cities. In Fort Wayne, the locations used are parking lots that are only used seasonally. In the summer, debris is stored in a parking lot next to a hill used for sledding. When winter comes, all of the wood is transferred to the parking lot near the outdoor concert venue. While this could be an option if little space is available, moving wood waste adds additional labor costs.

Quarantine Enforcement Left to State or Federal Government (Carmel, IN & State of Indiana DNR)
It is important to consider that state and federal EAB quarantines are seldom enforced at that local government level. As such, it may not be the most effective use of resources to implement any sort of quarantine enforcement plan at the county level. The County's role in this case will simply be to report to state and federal officials if an incident involving the movement of EAB infested ash wood were to occur. Both the State of Indiana DNR and the City of Carmel, IN have defined the local government role in this particular fashion. Carmel urban forestry personnel have suggested that the only means by which the city would become involved in a quarantine issue would be the result of citizen reporting or "a traffic incident" involving ash wood within their jurisdiction. They clearly

conveyed the unlikely nature of such an incident occurring and that provisions of funds for quarantine issues was unnecessary in his opinion.

Approaches to Avoid

State of Pennsylvania
The State of Pennsylvania recommends the use of monitored and regulated marshaling yards that encourage proper disposal of EAB infested wood and wood products. There were a few cases in Pennsylvania in which no marshaling areas were available to the public, and those that were available had inadequate oversight. As such, EAB infestation continued to spread despite other management efforts such as removal and inoculation. Pennsylvania blamed the spread on poor use of marshaling areas. The State recommends that each municipality or county establish a highly regulated marshaling yard with easy to use and quality equipment. Each marshaling yard should be monitored by personnel charged with ensuring safety and proper disposal of infested wood, and transportation guidelines. A small user fee, which can be used to offset the cost of having regulated oversight, is recommended. The State also recommends mandatory registration for individuals or businesses that wish to use the marshaling areas so as to better collect data about who is using these areas.

B. Wood Utilization Options – Bioenergy, Mulch, Firewood, etc.

Summary

Multiple uses have been successfully identified for wood waste from downed ash trees. Processing wood waste for bioenergy feedstock seems to be a promising option in many communities, especially where an opportune partnership can be formed between the municipality and a bioenergy facility. Additional niche markets may also exist or emerge including selling firewood, wood mulch, or manufacturing wood products.

Viable Options

Wood Waste Used for Bioenergy & Niche Markets (Minneapolis, MN)
The Minneapolis Park and Recreation Board has an arrangement and lease agreement with Koda Energy, which leases property on Park Board owned land and processes wood waste into chips for bioenergy. Wood chips are processed at no charge to the city and are transported to Shakopee, MN for use in a bioenergy facility. Another unique approach to wood utilization being employed in Minneapolis is a small company called *Wood From the Hood*, which buys usable logs to make into marketable consumer products (cutting boards, picture frames, etc.). MPRB staff mark trees that are slated for removal and *Wood From the Hood* staff survey the trees and flag those from which they are interested in purchasing logs. Logs are purchased from the city at $0.15 per board foot and are manufactured into household wood products that are marketed as being sourced from local wood (with the zip code, tree type, and other information about the origin of the wood used).

Wood Waste Used for Playground & Landscaping Mulch (Toledo, OH)
Managing wood waste would appear to be an important for counties and municipalities alike. In Toledo, OH, the city attempts to use the waste as efficiently as possible. As such, the city has developed as series of alternative uses and secondary markets for the disposed material. The city will take all ash wood material (i.e., logs, brush, and chips) to the wood recycling yard at the Forestry Division Field office. The ash wood is converted into playground mulch, while brush and chips will be turned into landscaping much, which will be made available for sale to both the general public and private contractors.

Creation of Marketplace for Wood (Chicago, IL)
Chicago successfully created a marketplace for wood, infected or not. Chicago established two large marshaling areas where the public is allowed to take woodchips for personal use. When the marshaling areas near capacity, a competitive bidding process is initiated in order to relieve capacity strains. Where possible, Chicago contracted to get paid for wood and have companies take logs and chips. This allowed the city to maximize cost savings per tree for the few trees that needed to be removed. The Forestry Department has been able to offset significant costs using their highly competitive bids and build partnerships with landscapers and tree cutting services.

Bioenergy Feedstock (Saint Paul, MN)
Saint Paul has a lease arrangement with Environmental Wood Supply (EWS) that processes all public trees for energy incineration at no charge to the city. EWS is located on city property and the processed chips are trucked to the District Energy plant in downtown Saint Paul. EWS also handles all wood at Ramsey County Yard Waste Disposal sites, which is where residents bring tree debris they handled themselves. EWS also handles the bulk of any trees cut down by commercial tree services working in the region.

Partnership Opportunities

Partnering for Effective Processing (State of Indiana Department of Natural Resources)
In regards to wood utilization and disposal, the value of partnerships cannot be overstated. Improper disposal and movement of wood products has resulted in the increased spread of EAB to 17 additional U.S. states (EAB originated in the state of Michigan) and 2 Canadian provinces. As such, it is important to develop partnerships that will ensure proper wood disposal, and thus facilitate compliance with state and federal quarantines. State of Indiana DNR suggests working closely with professional tree removal services and master gardeners to ensure they are both aware of, and comply with, quarantine regulations. Additionally, education of those entities that are frequently handling wood products (i.e., nurseries, professional landscapers, composting facilities, and tree removal services) to adequately “chip” ash wood to prevent the spread of EAB infestation is highly recommended.

5) Tree Planting and Replacement

A. Species Characteristics

Summary

It is important to keep diversity in mind when selecting tree species for replacement plantings. Many community arborists lay out guidelines for species diversity based on climate, landscape, etc. A helpful rule of thumb is the 10-20-30 rule, which states that forests should be made up of no more than 10% of one species, 20% of one genus, and 30% of one family. Since the quantity of replacement trees needed to address ash tree removals might be quite high, it would be wise to start thinking about where replacement trees will be sourced and the time required to grow trees big enough to be planted as viable replacements. Onondaga County could benefit from considering starting a nursery sooner rather than later to reduce costs by purchasing seedlings and nurturing them into larger trees ahead of when they will be replanted.

Viable Options

Species Criteria for Diversifying Urban Forest (Leawood, KS)
To help decide which trees to replace, Leawood will take into consideration its development ordinance, which requires one tree be planted for every 35' of property frontage for residential zoning. The tree must be 4" caliper (measured 4" above the ground) and at least 8' in height. While this tree does not have to be in the right-of-way, it is required to be in the front or side yard, which is adjacent to the street. This is interesting as it may result in the city planting trees on private property if the right-of-way is seen as unfit for a replacement tree. The city has a management goal of diversifying species so that no one is more than 10%, which means that the restricted plant list consists of Oak (Quercus - 16%), Maple (Acer - 27%), and Ash (Fraxinus - 25%).

Group Buys to Establish New Trees (Arlington Heights, IL)
The village of Arlington Heights, using their pre-existing nursery, bolstered the capacity of their nursery and biodiversity to counteract the impending infestation. Preparing their existing stock has diminished the community's risk for further tree diseases and infestations from invasive species. By expanding the nursery the community can save money on replacement trees. This occurs through the planting of older and healthier trees resulting in a reduction in maintenance and labor costs in their new planting site. Securing a nursery and staffing it now with volunteers could be a viable cost-saving measure for Onondaga County.

Considerations

NY CRISP Replacement Guidelines (State of New York)
The Catskill Regional Invasive Species Partnership (CRISP) guidelines about tree replacement recommend a basic and simple approach. First, no new ash trees should be planted, nor should anyone be allowed to plant additional ash trees. Second, newly planted trees should follow the 10-20-30 rule. This means that forested areas should not be comprised of more than 10% of one species, 20% of one genus and 30% of one family. CRISP encourages municipalities, cities and

counties to determine the level to which trees should be replaced internally, and does not recommend 1-to-1 replacement, or other method specifically. It does, however, urge for the maximum level of replacement that is deemed economically feasible. Preservation of forest and urban forest canopy has numerous benefits, such as oxygenating, carbon sequestration, air quality control, shade, cooling, as well as a host of other benefits; therefore, it is important to try and regain lost arboreal resources.

Locating Diverse Tree Species for Replacement (Fort Wayne, IN)
It is important to note that while an EAB management plan may desire or require a diversity of replacement trees, actually being able to locate and purchase them in large quantities may be challenging. Fort Wayne needed thousands of replacement trees and it proved difficult to find as many diverse species as they would have liked, as specified in the tree replacement code they created. It is important early in the planning stages to identify where all these replacement trees will come from, and if the species desired are readily available in large quantities.

B. Criteria for Replacement

Summary

In many cases it may not feasible to replant every ash tree that is removed due to EAB, but several communities are attempting to replace a majority of street trees or trees in other public areas. Priority is often given to replacing the most "prominent" trees and the surrounding landscape is an important consideration in determining which trees to replace. Another key consideration for replacement planting is overall availability of replacement species. It is important to set replacement goals in advance based on desired canopy and the ecosystem functions trees provide, since resource constraints may ultimately limit replanting activities. Failing to replace lost trees may lead to negative consequences such as an increase in water usage due to lost shade as seen in Westland, MI.

Viable Options

Replacement of Majority of Street Trees & Consulting with Residents (Springfield, OH)
The city of Springfield plans to replace the majority of "street trees" that are removed due to EAB infestation. Replacement trees will be 1¼" to 2" caliper in size and "of diverse species to prevent monoculture plantings." Citizens are encouraged to replace all ash trees that they have removed, and the Forestry Division is willing to play a consultative role in regards to replacement selections.

Replacement of Majority of All Ash Trees (Toledo, OH)
All removed ash trees will be considered for replacement, with the Forestry department staff making the final determination. Some examples of sites that would be considered "un-replantable" would be: close proximity to street signs or street lights; close proximity to existing trees; inadequate "tree lawn area," and utility uses. Replacement trees will be 1¾" to 2½" caliper in diameter, and the Forestry Department will determine which species are planted (diversity being a priority). Budgetary considerations will play a prominent role in determining how many trees will ultimately be replaced.

One-to-One Replacement of Ash Trees (Saint Paul, MN)
To date, Saint Paul has been able to maintain a commitment to a one-for-one replacement of every ash tree lost to EAB. The city is now on the verge of not being able to keep up with one-to-one replacement, however, and if EAB continues to spread rapidly and adequate funding is not secured, replanting could easily fall behind the number of trees removed. The Minnesota DNR granted the City of Saint Paul $150,000 of bonding funds in 2012 to support replanting activities.

Replacement for Prominent Trees Only (Chattanooga, TN)
According to its draft EAB plan, replacement of any ash killed by EAB will be determined by the Chattanooga city forester, and the city does not have plans to attempt a one-to-one replacement ratio. Only trees that are located in an important location, such as the Expanded Central Business District, or that have died in a prominent location in a city park will likely be replaced. Trees growing in a remote corner of a city park or trees within a city right-of-way that are not significant and valued will likely not be replaced due to budget constraints.

Considerations

Cost Comparison for Replacement Trees (Anoka County, MN)
Anoka County selects replacement trees according to specific needs of each site with the overall goal of creating a species diverse landscape with at least five tree species where feasible. Size of replacement trees depends on availability, site selection, and available resources with limited resources being the primary constraint on replacement size. Small bare root trees are relatively inexpensive, whereas mature spaded trees tend to be more costly. A cost breakdown appears in Anoka County's draft EAB Management Plan and compares different caliper prices for bare root, potted, spaded, or balled and burlap trees of different replacement species (Burr Oak, Majesty Maple, Hackberry, River Birch Clump, or Greenspire Linden).

Possible Increase in Water Consumption from Loss of Canopy (Westland, MI)
The City of Westland, MI removed all 3,000 of its ash trees once EAB was detected within city limits. As a result, water usage went up 33%, and the water authority in Detroit added a 10% surcharge to residents' water bills as a result. Energy savings and the value of shade is an important consideration in tree replacement.

6) Budget and Financing

A. Budgeted Cost Categories

Summary

Most communities seem to be using a mix of contracting out and repurposing in-house staff to take on additional EAB-related activities. City and County governments may own some of the equipment required to take down trees and perform maintenance on existing trees, but this equipment is expensive to procure and insure. Costs are generally broken down between labor and equipment according to the type of management activity pursued, but there is some variation in how communities report budget numbers for EAB programming. Detailed budget information is available for several of the counties and municipalities the research team contacted (Appendix G). Unanticipated consequences of an increased workload due to EAB infestation may also impact local government budgets including unexpected costs and the need to cut back on other routine forestry work to make room for EAB management. For this reason, developing a detailed budget well ahead of EAB arrival is prudent.

Viable Options

Cost Categories, Broken Down By Type of Treatment (Leawood, KS)
Leawood's EAB plan budget spans six years, and uses the categories of equipment (approximately 25% of the budget); emamectin, imidacloprid and dinotefuran each broken out individually (with all three equaling about 20% of the budget), disposal fees (2.5%) and reforestation (52.5%). Over the six years none of the budget lines change except for a large one-time cost for equipment in year one, as well as a slight decrease in disposal fees for years four through six. There are no additional funds for administration, and the cost of labor is incorporated into the reforestation price, but not the treatment price, since treatment will be done in-house by current staff.

Cost Categories, Broken Down by Labor (Howard County, MD)
Howard County has secured $750,000 a year for EAB as a capital project run through the Department of Public Works. This money is allocated as $300,000 for replacement trees, $200,000 for removing deadwood, $100,000 for inoculation, $150,000 for removal. The budget also includes a small amount of funding for EAB training for communities. Removal estimates are based on bids by a local tree service where an average tree will cost $505 to remove, both tree and stump, and plantings of a 2-2.5" caliber tree will cost approximately $425 per tree.

Costs Divided Between Labor w/ Fringe and Equipment (Saint Paul, MN)
Cost categories in Saint Paul's budget are split between labor and equipment. Budgeted labor/salaries include: EAB Coordinator, Forestry Supervisor I, Forestry Crew Leader, Tree Worker, EAB Inspectors, Parks Worker I, Office Assistant, Vehicle Mechanic, Technical and Admin Support, and Central Service Cost. Equipment expenses include: pick-up truck rental; clam loader truck rental; tandem dump truck rental; role off dump truck rental; aerial tower truck rental; 20-inch chipper; stump grinder; miscellaneous equipment; and tub grinder annual lease. Brief budget history for EAB

activities in the City of Saint Paul: 2009, $0 allocated to EAB; 2010, $722,000 (largely provided by a one-time grant); 2011, $915,000 (City Council passed a ROW Assessment increase to fund EAB Management Program which amounted to a 2% increase for property owners); 2012, $1.1 million (including a $150,000 DNR Bonding Grant); 2013, $1.9 million.

Full Contracting With No Specific EAB Budget (Carmel, IN)
Controlling the EAB spread rate is paramount in regards to controlling costs. Once a tree in a particular area has been confirmed as infested, the surrounding trees must also be removed. Over the past 4 years, Carmel has spent approximately $80,000 - $100,000 per year in ash tree removal, and has taken down an estimated one-third of their ash tree population (20% ash trees). However, both the city and Hamilton County in which it resides tend not to differentiate between ash trees that need to be removed, and other non-ash trees that also need to be taken down. In this way they sign one to two year contracts with professional tree removal services that simply remove all trees that the urban forestry office and highway department designate. This has been considered a cost-saving technique. This has also been the strategy implemented by homeowners associations and surrounding developments in the city of Carmel for the removal of trees on private property.

All In-House, Large Scale (Chicago, IL)
Coupled with inoculation, mortality rate for ash slowed in the City of Chicago, which allowed for a more manageable workload using the existing workforce. Using “laborers” that can be used flexibly during busy times and seasons and giving some of them the inoculation certification allowed Chicago to minimize their personnel costs. Once EAB hit, more money was given above the original $2.4 million. Successful budgeting before infestation allowed for tweaking of monetary strategy rather than overhaul. Using in-house personnel allowed for a more effective and focused reaction to EAB, something that a number of private contractors could not provide to the city. Having the leverage of its own personnel allowed minimal contracting that also helped keep budget requirements low.

Considerations

Sacrificing Routine Maintenance or Falling Behind on Tree Trimming (Saint Paul, MN; Minneapolis, MN)
At the time of EAB arrival, Saint Paul was already backlogged on keeping up with routine tree trimming and was following a 12-year cycle as opposed to the recommended 7-year cycle. Returning to a preferred 7-year trimming cycle would necessitate doubling the budget from $1.1 million to $2.2 million. The additional burden of managing trees affected by EAB is above and beyond the current pressures on the City Forestry Department. Overall, Saint Paul Forestry is concerned about staff levels remaining flat since 2010 despite the increase in workload associated with EAB management. Additional activities existing staff have had to take on include: branch sampling; pesticide treatment; maintenance of newly planted trees; working with private property owners on tree removal orders and abatements; and surveying to find infested ash trees. The City of Minneapolis faces a similar situation and is concerned that it will be hard for in-house staff to continue routine maintenance and pruning of existing trees as EAB infestation spreads because staff efforts will be focused on keeping up with tree removals.

Unreliable Contractors and Weather Conditions (Fort Wayne, IN)
In creating a timeline for tree removal, Fort Wayne cautions that a number of factors will delay planned schedules. Most notably are weather conditions, for obvious reasons, as well as the priorities of the large tree service companies that are hired. If it's big enough, other jobs may take precedence over your contract. For example, when the hurricanes hit the Northeast, Fort Wayne's timeline fell 6-8 weeks behind schedule because the tree service company went to deal with the emergency on the coast. This is less likely to happen with smaller firms.

Sidewalk Damage Costs (Fort Wayne, IN)
In budgeting for tree removal, it may be wise to put aside extra funds for sidewalk damage, or to try to hold contractors responsible for a certain level of damage. Fort Wayne had numerous examples of contractors damaging sidewalks during removals, which greatly upset the residents who are responsible for maintaining them. This was especially problematic if they were damaged in the middle of winter and getting them repaired would not be possible until spring.

B. Financing Options

Summary

The research shows that opportunities may exist to leverage federal or state funds to increase funding for EAB management. In particular, USDA and the USFS have provided targeted funds to communities dealing with EAB infestations. State agencies or neighboring municipalities may also be viable partners to leverage and expand program funds.

Viable Options

Partnering with State and Federal Agencies for Shared Funding (Ulster, Greene and Erie County, NY)
While no EAB specific federal grant opportunities are currently available, the New York DEC Urban and Community Forest Grant can provide financial assistance for tree planting and tree maintenance in urban environments such as Syracuse, DeWitt, and other areas in Onondaga County. Ulster County New York has extensive EAB problems and the Department of Transportation in Ulster County has reached an agreement with County Government to devote 75% of its highway right-of-way tree removal budget to ash specific removals. They also secured a $20,000 grant for this same effort. Erie and Greene County have utilized DEC education and outreach funding to co-develop and implement inclusive public campaigns in cooperation with local Cornell Cooperative Extension Offices. Creative approaches and partnerships with state, federal and local entities have reduced EAB management costs for Ulster, Greene, and Erie Counties.

Leveraging Partnerships and Tree Value (Chicago, IL)
Chicago leveraged the economic value of ash trees to minimize their workload. Contractors that wanted to be competitive during the bid process had to provide a more comprehensive service: cutting, chipping, and sometimes even replacing the ash trees. Large contracts allowed many contractors, large and small, to find niche partnerships with the City of Chicago. Chicago communicated with State and County officials to gauge interest in large joint bidding processes,

knowing that the size and scope of their project would bring down prices. Though Cook County neglected to accept the offer, they garnered quite a bit of goodwill, aiding the city during emergencies.

Grant Funding to Jumpstart EAB Response (Saint Paul, MN)
Initial grant funding provided through a unique Outdoor Heritage Fund supported by taxpayers helped to get Saint Paul's EAB management program off the ground in the first year (2010). Leveraging a partnership with the Minnesota Department of Agriculture (MDA) and the University of Minnesota allowed the City to be granted approximately $750,000 in funding in the first year. Saint Paul Forestry staff reported that making the case for maintaining and increasing program funding has been made easier because of the initial grant money.

7) Relevant Ordinances and Policy Options for Trees on Private Property

A. Types of Ordinances Used

Summary

Local ordinances should be reviewed in advance of EAB arrival to determine what authorities exist in the community related to hazardous tree removal, removals on private property, wood disposal and utilization, etc. The research revealed several communities that expanded or modified certain ordinances to include EAB concerns specifically or to expand local authority to intervene with regard to dead or dying trees. While local authorities must take some responsibility for tree removals, at least one community expressed concern about becoming overwhelmed by tree service requests from private citizens and the role of private sector tree service providers should not be overlooked. For sample ordinance language used in different communities, see Appendix F.

Viable Options

City Secures Low-Cost for Residents (Fairway, KS)
Fairway residents are required to take care of hazardous trees at their own expense according to a city ordinance. The city has actually enforced the code before, though officials admit that the affluence of its residents makes it easier to enforce than it might be in other communities. Additionally, in hiring contractors to do tree removal work for city-owned property, the city required that the contractor hired would offer residents the same price given to the city for any tree removal work done on private property to prevent price gouging once the infestation hit.

Property Maintenance Ordinance (Carmel, IN)
The development or reconfiguration of ordinances is often unnecessary for mitigating potential effects from trees infested with EAB. In most cases dead or dying ash trees on private property will be the responsibility of the homeowner. However, when instances arise where a dying tree on private property has the potential to fall into a public right of way, a municipality can invoke ordinances already developed within local code to force property owners to have the tree removed without financial burden on the municipality. In the city of Carmel, Indiana, dying trees on private property that have the potential to be a risk to a public right-of-way or other private property must be removed. In many case the private property owners may take responsibility upon themselves to remove the tree. However, in a situation where this is not the case, the city can utilize its property maintenance ordinance to force the private property owner to remove the tree. This is a principal example of the utilization of existing code to respond to the threats posed by EAB. In many cases the city is reluctant to use such regulation due to fear from political backlash. However, they have been able to ease these concerns by working with citizens group to negotiate lower cost tree removal contracts with professional tree removal services.

Dangerous Tree Ordinance with Referrals to Tree Removal Services (Springfield, OH)
Trees in boundary areas adjacent to public right of ways are of a paramount concern to counties and municipalities alike. This is fundamentally because the trees are technically on private property, but

the resulting impacts of a fall could significantly affect public property. In the city of Springfield, OH there are a large number of ash trees situated alongside public right-of-ways that will inevitably be affected by EAB. As such, the city of Springfield will utilize codified ordinance 1323.02 to "deal with dangerous trees on private property with enforcement through the City's Code Enforcement Division." Private property owners will ultimately bear the costs of both tree removal and disposes if scenarios arise where the usage of this regulatory provision is required. The city's Service Department webpage will provide a list of professional tree removal services that citizens can choose from in order to have "dangerous" trees removed on their property without government provocation.

Public Nuisance Ordinance (Saint Paul, MN)
Saint Paul's City Tree Ordinance was modified to include a subsection on the EAB pest that defines any infested ash as a "public nuisance," describes abatement and inspection protocols (Chapter 175A. Emerald Ash Borer Pest Insect). Ordinance Chapter 175 was also updated to include EAB in order to enable the City to enter private property for inspection, the ability to order removal of diseased trees, and the ability to abate the nuisance upon non-compliance of a property owner.

Commissioner of Forestry Authority to Remove Trees (Toledo, OH)
As mentioned in the cases of Leawood, KS, Springfield, OH, and Carmel, IN, trees on private property are generally the responsibility of the homeowner. Again, in many case the private property owners will take responsibility for trees on their property with little to no provocation from a government entity. However, when situations arise where this is not the case, the county or municipality generally has regulatory capacity to have the tree removed. In Toledo, OH, when public safety becomes a concern due to a dead or dying ash tree, the Commissioner of Forestry can have the tree removed through the use of city employees. When this action occurs an invoice will be sent to the private property owner to allow the city to be reimbursed for services rendered.

Ordinances Include Duty to Remove and Stump Removal (Leawood, KS)
Leawood has three ordinances to ensure residents take responsibility for hazardous trees on private property: duty to remove diseased and/or dead trees, ramifications of failing to comply, and a special ordinance on stump removal.

Tree Ordinance Covers All Invasive Species (Minneapolis, MN)
Minneapolis' tree ordinance covers invasive species of any kind, establishes infested trees as a "public nuisance," and authorizes the Park Board to condemn any infested trees on private property and mark them for removal (Chapter 10, Article II). For the purposes of the statute, "'invasive species' means any invertebrate animal, plant pathogen, parasitic plant, or similar or allied organism which can cause a tree to be diseased and is determined by either the commissioner of Agriculture of the State of Minnesota, or the commissioner of the Minnesota DNR, to be a pest causing economic or environmental harm and disease to trees in [the state]."

Outline of Planned Legislation (Joliet, IL)
The City Forester in Joliet created much of the preparedness plan. The recommended policy and ordinance changes are mostly to comply with state and federal regulations. There is an interesting suggested ordinance that would declare any tree infested with EAB as a "nuisance," thus allowing the Forester access to all private ash trees in the City. Additionally, Joliet has designed a permit

policy to allow the cutting of EAB infested trees. This type of "wish list" can help show gaps in current ordinances and policy and allow flexibility to change them.

Considerations

City Wary of Becoming Tree Service for Residents (Chattanooga, TN)
While an ordinance requiring residents to pay for tree removal takes the financial burden off the city, Chattanooga is concerned about the city's capacity to act as a tree service for non-compliant residents. Officials recommend considering a pricing structure that would dis-incentivize residents to rely on the city to take care of hazardous trees. Officials also note that they have not yet enforced this ordinance, and are unsure if politically it is a viable tool.

Jurisdictional Considerations (Chicago, IL)
The City of Chicago is divided into 50 "wards." City officials needed to be guaranteed that all cutting programs would be equal across all wards. The Supervisor of Forestry is directly accountable for the evenness of the cutting and inoculations in all wards. This could be a similar problem and a matter of public equity when EAB arrives.

8) Education and Outreach

A. Strategies and Partners

Summary

Partnership is a strong theme with regard to public outreach and education around EAB issues. The research also suggests a diversified public relations campaign will be most successful at reaching many different audiences. Many innovative outreach approaches have been tested in communities across the Midwest and Mid-Atlantic regions, but data regarding success rates for different campaign strategies was not readily available. Engaging local residents through partnerships with the private sector, academic institutions, government partners, and NGOs is a cost-effective way to expand education efforts and broaden the audience for EAB related information.

Viable Options

Traps as Public Relations Tool (Chattanooga, TN)
Many cities and counties with EAB plans cited that using the "Purple Traps" was just as much a public outreach tool as a mechanism for tracking the pest. Chattanooga has gone a step further by piloting new, green traps developed in Canada. The manufacturer is giving the traps to the city for two years as a pilot test to use side-by-side with the traditional purple traps. The city forester noted that he signed up for this pilot study because he knew it would help bring more public awareness to the issue.

Targeting Firewood Movers (State of West Virginia)
Officials from the State of West Virginia stated as advice to other states that it is wise to spend EAB funds on public awareness before the bug even arrives. With a low ash density, EAB planning is not a top priority in WV, however they do have a strong culture of cutting and selling firewood. Understanding that individuals who prefer to heat their homes with their own resources have very independent personalities, it will not work to just tell them they are banned from transporting or selling firewood outside the quarantine. To target this population, the State utilized hunting and fishing shows on local radio to reach the audiences who typically cut, sell and transport firewood, and speak to the issue in a way that matters to them.

Innovative and Bold Outreach Strategies (Minneapolis, MN)
Minneapolis Park and Recreation Board is trying a new "ribbon" program on boulevard trees to raise public awareness by tying yellow caution tape to street trees that reads "EAB Kills Ash" with a website and QR code for more information. Other more traditional outreach methods are also described in MPRB's EAB Preparedness Plan, including disseminating information at community meetings, through neighborhood newsletters, via the MPRB website, etc.

Utilizing Mobile Apps & Social Media (Maryland Extension)
Staff members with Maryland's Extension program are helping the University of Georgia pilot a mobile app from Bugwood.org where people can take pictures with their smart phones to help

identify, map and network EAB detections. More information can be found at: http://apps.bugwood.org.

Public Events (Woodstock, NY)
Public events have multiple purposes in Woodstock, New York and Ulster County. They function as a public outreach and education tool. These events are used to give the public information about the EAB, about how it spreads, about community or county management strategies and as ways to encourage the public to have a stake in fight against the EAB. Ash-tree tagging and mapping events are also recommended as a way to enhance public understanding of this problem and complete necessary inventories of ash trees. In Woodstock, 12 volunteers were trained by CRISP personnel and other volunteers to conduct ash tree location and health inventories. Cornell Cooperative Extension and CRISP outreach events were quite successful in educating the public about EAB and in garnering support for management action when the plan was implemented.

Multifaceted Outreach Strategy (Saint Paul, MN)
Saint Paul is prioritizing ongoing communication, resident education, and outreach including utilizing the City and MDA websites, hosting public meetings, and producing a video public service announcement that was broadcast on cable TV and via the City's website. Saint Paul has also identified commercial tree service providers as a crucial audience for EAB outreach and education. In addition, door-to-door fliers have been used in select neighborhoods to advise residents about street tree infestations.

Using Valuation Tools and Visuals (Fort Wayne, IN)
Using both visuals as well as tree valuation tools proved helpful in Fort Wayne for gaining public support for EAB efforts. Interns in the forestry department created Photoshop images of popular green streets lined with ash to show dramatic before and after images of what these streets would look like with full removal. This helped gain support for treatment options. In addition, the city calculated that trees in the city create $5.8M of value each year. With 25% ash, that equals $1.45M of ecosystem services, energy savings, and other benefits from ash trees alone. With that mindset, it makes it easier to make the business case that treating these trees is worth all the other values they provide.

Considerations

Complaint Call Volume (Fort Wayne, IN)
Fort Wayne saw upwards of 250 complaint calls a month to the city specifically related to EAB, both from residents who were upset that trees were being cut, along with those who were pleading to have their's removed sooner. An EAB plan should prepare for someone to handle this high volume of calls.

Partnership Opportunities

Utilizing Homeowners Associations & Libraries (Carmel, IN)
Partnerships are a fundamental component of educational and outreach efforts regard EAB, as such counties and municipalities should work diligently to discover potential partnership opportunities

within their communities in order to effectively manage the infestation. In many instances partnership opportunities manifest themselves in previously organized institutions such homeowners associations. Homeowners associations may be a useful outlet for information dissemination due to the fact that private homeowners tend to care about the wellbeing and upkeep of their property, which may be disrupted by dead or dying ash trees as a result of EAB. Working closely with homeowners associations may serve as a means of garnering support for potential management solutions and budget provisions, as well as stem the tide of potential political backlash if tree removal ordinances have to be invoked to curb the infestation. Partnerships with homeowners associations proved to be a successful tactic in the city of Carmel, IN. They have resulted in increased awareness of EAB, a willingness from private citizens to implement management solutions such as tree removal on their private property, and almost no political backlash regarding budgetary provisions for EAB management.

Libraries have also proven to be an effective mechanism for information dissemination regarding EAB. Libraries are useful in the sense that they are public spaces with access to a variety of media (i.e., computers with internet access, television, and newspapers) that can be utilized to provide the public with current EAB information. Additionally, libraries are traditionally involved with local community organizations and therefore may be a confluence for expanding information networks and bolstering community support for actionable management. In Carmel, IN libraries have been successfully recruited as facilitators of public information that has led to significant support for EAB management within the community.

Outreach Partnerships (State of Indiana DNR)
In addition to homeowners associations and libraries, state cooperative extension programs are likely to be optimal partners for counties and municipalities as they combat the effects of EAB. According the state of Indiana DNR Purdue University's cooperative extension program provides useful resources for local and state government entities within Indiana in regards to planning and management for EAB. Additionally, Purdue provides an effective means of information dissemination through both their website and an extensive list of "webinars" that discuss various facets of EAB.

The state of Indiana DNR also has recommended the counties and municipalities seek out private sector partnership in order to effectively communicate the issues associated with an EAB and combat the infestation. Examples of ideal private sector partnerships include but are not limited to: veneer industries; professional landscapers; tree nurseries; master gardeners; logging companies; and lumber retailers. These entities ultimately deal with the purchasing, handling, and distribution of wood product, and can act as both mechanisms to slow the spread of EAB, as well as facilitate public awareness.

Strategies for Outreach (Purdue University Cooperative Extension)
There are several additional partnership opportunities that counties and municipalities should consider as they attempt to mitigate the effects of EAB, these include: "tree-tagging;" development of grassroots organizations; and utilization of training workshops. "Tree-tagging" is a concept that is championed by Purdue University Cooperative Extension. It simply involves the utilization of local volunteer groups for the placement of a clearly visible marker or "tag" on ash trees within a particular community. These tags provide information regarding EAB, such as why it is a potential

threat to trees in a particular area, how it spreads, and why it is important for citizens to learn about it. Additionally the tags contain relevant contact information both at the local and state level that citizens or business can reach out to for more information or to report an EAB sighting to the proper management agency.

Purdue University has also recommended the creation or utilization of grass roots organizations or task forces to raise public awareness regarding EAB. An example organization that they work closely with is Neighbors Against Bad Bugs (NABB). This program utilizes Purdue University master gardeners to work closely with existing local organizations (i.e. homeowners associations) to raise awareness regarding EAB and potential consequences of inaction.

Training workshops may be another useful means of both spreading information regarding EAB as well as fostering local partners for counties and municipalities. Government entities can work closely with cooperative extensions to develop either in-house or outsourced training programs. These training workshops can be utilized by government officials, local business, or citizen groups as a means of gaining an understanding of what exactly EAB is, how it spreads, and why it is important for communities to take management actions.

Encouraging Citizen Foresters and Community Engagement (Saint Paul, MN)
Saint Paul is engaging in ongoing efforts to include local residents in planting and maintaining trees. The city's goal is for citizens to actively assist with tree planting and maintenance in public spaces and/or to help their neighbors plant trees on private property. A pilot demonstration project in the Frogtown Neighborhood in 2012 resulted in 18 boulevard trees and 24 shade and edible fruit trees planted over the course of the year. Forestry staff and community volunteers actively collaborated to complete the plantings and Saint Paul hopes to expand similar volunteer programs in future years.

Higher Education as a Potential Partner (Fort Wayne, IN)
Institutions of higher education have the potential to be quality partners for local governments in regards to their outreach efforts. In Fort Wayne, IN officials managing the EAB infestation reached out to a local colleges for assistance in the development of marketing strategies. The students in a marketing class developed potential campaigns for the city and presented them to local officials. The most impressive campaign strategy was implemented by the city and has been generally successful. Onondaga County could tap resources from all six of its institutions of higher education to assist in public relations efforts in regards to EAB as means of fostering both innovative ideas, and reducing internal capacity strain.