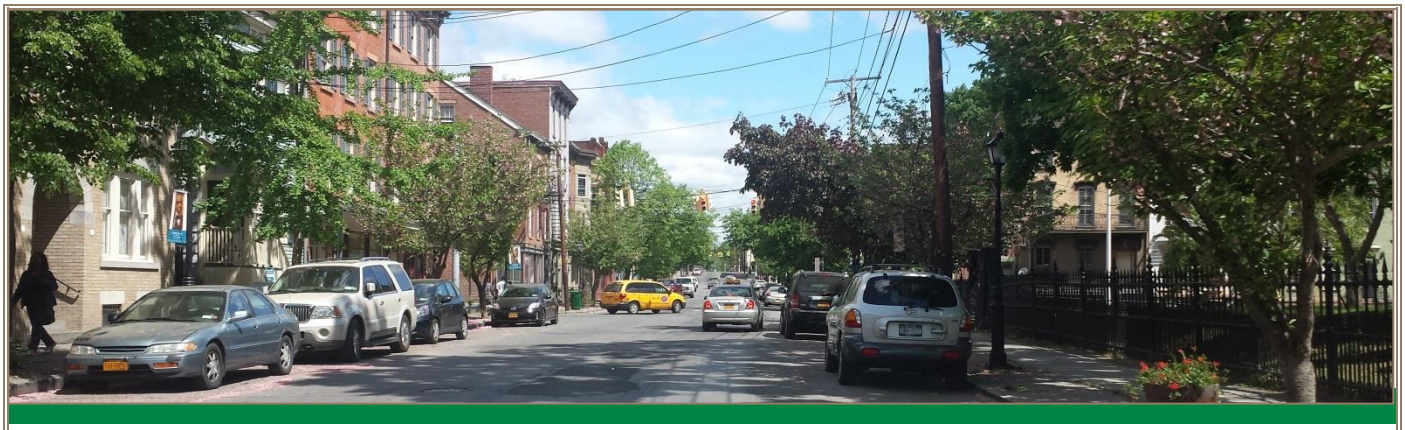

Community Forest Management Plan

City of Newburgh, New York

July 2015

Prepared for:
City of Newburgh
Conservation Advisory Council
City Hall
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Newburgh, New York 12550

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Acknowledgments

The City of Newburgh's vision to promote and preserve the urban forest and improve the management of public trees was a fundamental inspiration for this project. This vision will ensure canopy continuity, which will reduce stormwater runoff and improve air quality, public health, and aesthetic values.

The City of Newburgh also recognizes the support of its Mayor and City Council:

Judy Kennedy – Mayor

Genie Abrams – Council Member

Regina Angelo – Council Member

Cedric Brown – Council Member

Cindy Holmes – Council Member

Gay Lee – Council Member

Karen Mejia – Council Member

Executive Summary

This plan was developed for the City of Newburgh by Davey Resource Group with a focus on addressing short- and long-term maintenance needs for inventoried public trees. Davey Resource Group completed a tree inventory to gain an understanding of the needs of the existing urban forest and to project a recommended maintenance schedule for tree care. To develop this *Tree Management Plan*, analysis of inventory data was utilized, along with information about the city's existing program and vision for the urban forest.

Photograph 1. Beautiful vistas such as this one are located throughout the community of Newburgh. Proper tree care, selection, and maintenance will help accentuate these prominent features for generations.

State of the Existing Urban Forest

The 2015 inventory included trees, stumps, and planting sites in public rights-of-way, parks, and specified public areas. A total of 8,037 sites were recorded during the inventory: 4,273 individual trees, 3,381 planting sites, and 383 stumps. Analysis of the tree inventory data found:

- The overall condition of the inventoried tree population was assigned a rating of Fair.
- The five species that comprise the largest percentage of the city's urban forest include: *Acer platanoides* (Norway maple; 28%), *Pyrus calleryana* (pear; 9%), *Gleditsia triacanthos inermis* (thornless honey locust; 7%), *Prunus* spp. (cherry; 6%), and *Tilia cordata* (linden; 4%).
- *Acer* (maple) was found in abundance (37%), which is a concern for the community's biodiversity.
- Overall, the diameter size class distribution of the inventoried tree population was balanced. Tree planting and maintenance activities should be increased to balance the slight skew toward mature trees.
- There were 89 ash (*Fraxinus*) trees identified over the course of the inventory process. Specific management recommendations for this genus are discussed in the Emerald Ash Borer Strategy in Section 4, but are not included in the Tree Management Program section.
- Newburgh's trees have an estimated replacement value of $17,726,483.
- Trees provide approximately $431,226 in annual environmental benefits.
    - Energy Savings: $185,896/year
    - Stormwater Interception: $88,041/year
    - Net Carbon Sequestration: $13,183/year
    - Air Pollutant Removal: $52,467/year
    - Aesthetic Value and Other Benefits: $91,639/year

Tree Maintenance and Planting Needs

Recommended maintenance needs include tree removal (8%), routine tree pruning (35%), young tree training (10%), stump removal (5%), and tree planting (42%). Trees should be planted to mitigate removals and create canopy.

Trees provide many environmental and economic benefits that justify the time and money spent for planting and maintenance. Maintenance should be prioritized by addressing trees with the highest risk first. Moderate and Low Risk trees should be addressed after all Extreme and High Risk tree maintenance has been completed.

The inventory noted several Extreme or High Risk trees (3% of trees assessed); these trees should be removed or pruned immediately to promote public safety.

This chart excludes all ash trees which are addressed in the EAB strategy section.

Tree Removal	• Extreme Risk = 3 trees • High Risk = 113 trees • Moderate Risk = 232 trees • Low Risk = 260 trees
Pruning	• High Risk = 41 trees
RP Cycle	• Total trees = 2,775 • Average Number of Trees in cycle each year = approximately 555
YTT Cycle	• Total trees = 750 • Trees in cycle each year = at least 250
Tree Planting	• Replacement trees planted per year = at least 122
Stump Removal	• Total stumps = 383

In addition to priority maintenance, Newburgh's urban forest will benefit greatly from a three-year young tree training cycle and a five-year routine pruning cycle. Proactive pruning cycles improve the overall health of the tree population and may eventually reduce program costs. In most cases, pruning cycles will correct defects in trees before they worsen, which will avoid costly problems. Based on the inventory data, at least 250 young trees should be structurally pruned each year during the young tree training cycle; and approximately 555 trees should be cleaned each year during the routine pruning cycle.

In these proactive pruning cycles, all established trees are visited at least once in five years, and all young trees receive a training prune every three years.

Photograph 2. While this* Acer saccharinum *(silver maple) could be a beautiful addition to the streetscape, most of these trees unfortunately suffer from storm damage or are impeded by limited growing space. Silver maple is generally considered to be a very poor urban tree.

Planting trees is necessary to maintain canopy cover and to replace trees that have been removed or lost to natural mortality (expected to be 1–3% per year) or other threats (for example, construction; impacts from weather events such as storms, wind, ice, snow, flooding, and drought; or invasive pests). The inventory identified 3,381 acceptable, existing planting sites. We recommend planting at least 122 trees of a variety of species each year to offset these losses and maintain canopy and maximum benefits.

Citywide tree planting should focus on creating canopy in areas that promote economic growth (such as business districts), in parking lots and near buildings with insufficient shade, and where there are gaps in the existing canopy. Trees of varied species should be planted; however, the planting of maple should be avoided until the species distribution normalizes. The city's existing planting list should offer practical choices for species selection and diversity to build a resilient urban forest that will not be significantly affected by any single disease or invasive pest. Due to the species distribution and impending threats from emerald ash borer (EAB, *Agrilus planipennis*), all *Acer* spp. (maple) and *Fraxinus* spp. (ash) should be temporarily removed from the planting list or planted only when a landscape plan is in place.

Photograph 3. This* Fraxinus americana *(white ash) is an impressive tree, but ash planting should be avoided until the EAB threat has been mitigated in Newburgh.

Urban Forest Program Needs

Adequate funding will be needed for the City of Newburgh to implement an effective management program that will provide short- and long-term public benefit, ensures that priority maintenance is expediently performed, and establishes proactive maintenance cycles. The estimated total cost for the first year of this five-year program is $279,989; this total will decrease by Year 4 of the program to approximately $139,855 per year. High Priority removal and pruning is costly. Since most of this work is scheduled during the first year of the program, the budget is higher for that year. After High Priority work has been completed, the urban forestry program will mostly involve proactive work, which is generally less costly. Budgets for later years are thus projected to be lower.

Over the long term, funding that supports proactive tree management will reduce municipal tree care management costs and possibly reduce the costs to build, manage, and support city infrastructure.

Newburgh has many opportunities to improve its urban forest. Planned tree planting and a systematic approach to tree maintenance will transform an on-demand, priority-based operation into a cost-effective, proactive program. Investing in this tree management program will promote public safety, improve tree care efficiency, and increase the economic and environmental benefits the community receives from its trees.

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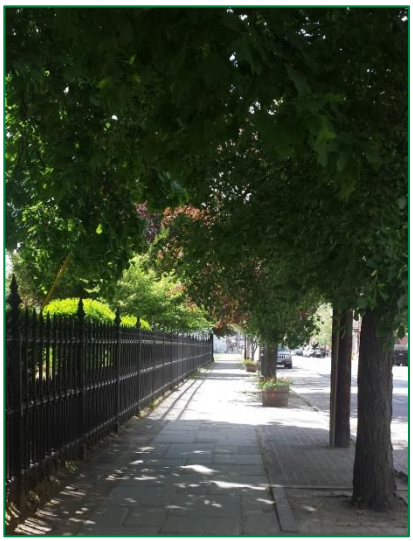
Introduction

The City of Newburgh is home to almost 28,000 residents who enjoy the beauty and benefits of their urban forest. The city's public works department manages trees on public property, in parks, and in other specified public spaces. In recent years, Newburgh also has a Conservation Advisory Council (CAC) dedicated to the urban forestry program.

Funding for the city's urban forestry program comes primarily from Newburgh's general fund with some additional fund provided by grants and the CAC. Newburgh conducted an inventory of public trees in 2015. The city has a tree ordinance, maintains a budget of more than $2 per capita for tree-related expenses, celebrates Arbor Day, and is a Tree City USA member. Past urban forestry projects have demonstrated a desire to improve the environment through higher levels of tree care.



Photograph 4. This street is well stocked with trees and provides economic, environmental, and social benefits, including temperature moderation, reduction of air pollutants, energy conservation, and increased property values.

Approach to Tree Management

The best approach to managing an urban forest is to develop an organized, proactive program using tools (such as a tree inventory and tree management plan) to set goals and measure progress. These tools can be utilized to establish tree care priorities, generate strategic planting plans, draft cost-effective budgets based on projected needs, and ultimately minimize the need for costly, reactive solutions to crises or urgent hazards.

In April–June 2015, Newburgh worked with Davey Resource Group to inventory trees and develop a management plan. This plan assesses the general condition, diversity, and distribution of the inventoried trees, but also provides a prioritized system for managing urban trees. Davey Resource Group completed the following tasks:

- Inventory of trees, planting sites, and stumps within city rights-of-way, parks, and public spaces
- Analysis of tree inventory data
- Development of a plan that prioritizes the recommended tree maintenance

This plan is divided into three sections:

- Section 1 (*Tree Inventory Analysis*) summarizes the tree inventory data and presents results and observations.
- Section 2 (*Benefits of the Urban Forest*) summarizes the economic, environmental, and social benefits that trees provide to Newburgh.
- Section 3 (*Tree Management Program*) develops a prioritized maintenance schedule and projected budget for the implementation of the recommended tree maintenance over a five-year period.
- Section 4 (*Emerald Ash Borer Strategy*) presents proactive maintenance and policy strategies for the prevention and mitigation of an emerald ash borer infestation.

Section 1: Tree Inventory Analysis

In 2015, Davey Resource Group arborists assessed and inventoried trees, stumps, and planting sites along the city rights-of-way, parks, and public spaces. A total of 8,037 sites were collected during the inventory: 4,273 trees, 3,381 planting sites, and 383 stumps. Sites were collected within city rights-of-way, parks, and public spaces. Figure 1 provides a detailed breakdown of the number and type of sites inventoried.

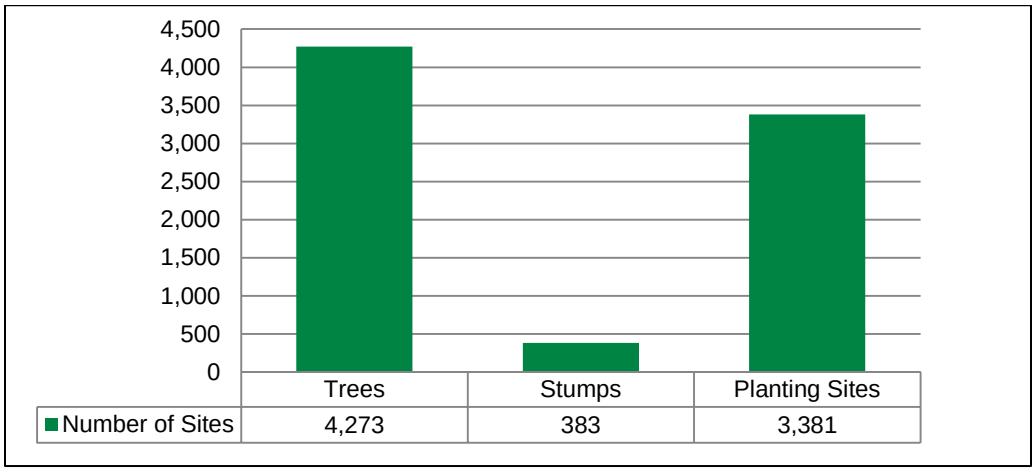


Figure 1. Total sites inventoried.

Data Collection Methods

Tree inventory data were collected using a system developed by Davey Resource Group that utilizes a customized ArcPad program loaded onto pen-based field computers equipped with geographic information system (GIS) and global positioning system (GPS) receivers. The knowledge and professional judgment of Davey Resource Group's arborists ensure the high quality of inventory data.

Data fields are defined in the glossary, and the site location method is provided in Appendix A. At each site, the following data fields were collected:

- aboveground utilities
- condition
- failure
- location
- maintenance needs
- mapping coordinate
- risk assessment
- risk rating
- species
- stems
- tree size*
- notes

* measured in inches in diameter at 4.5 feet above ground (or diameter at breast height [DBH])

Primary maintenance is based on *ANSI A300 (Part 1)* (ANSI 2008). Risk assessment and risk rating are based on *Urban Tree Risk Management* (Pokorny et al. 1992).

The data collected were provided in shapefile, Access™, i-Tree streets, and Microsoft Excel™ formats on a CD-ROM that accompanies this plan.

Project Area

The project area selected for the tree inventory included all trees, planting sites, and stumps within city rights-of-way, parks, and public spaces.

Assessment of Tree Inventory Data

Data analysis and professional judgment are used to make generalizations about the state of the inventoried tree population. Recognizing trends in the data can help guide short- and long-term management planning. In this plan, the following criteria and indicators of the inventoried tree population were assessed:

Photograph 5. Davey Resource Group's arborists inventoried trees along city streets and in community parks to collect information about trees that could be used to assess the state of urban forests.

- *Species Diversity*: The variety of species in a specific population; affects the population's ability to sustain threats from invasive pests and diseases; impacts tree maintenance needs and costs, tree planting goals, and canopy continuity.
- *Diameter Size Class Distribution Data*: Statistical distribution of a given tree population's trunk-size class; affects the valuation of tree-related benefits as well as the estimation of maintenance needs and costs, planting goals, and canopy continuity; the diameter size class distribution is used to indicate the relative age of a tree population.
- *Condition*: The general health of a tree population; indicates how well trees perform given their site-specific conditions; general health affects both short- and long-term maintenance needs and costs as well as canopy continuity.
- *City Stocking Level*: The portion of existing trees compared to the total number of potential trees (number of inventoried trees plus the number of potential planting spaces); stocking level can help determine tree planting needs and budgets.
- *Overhead Utilities*: Inventory data analysis that provides insight into how well the city has modified its tree planting plans to consider the impact of overhead wires on city trees.

Species Diversity

Species diversity affects maintenance costs, planting goals, canopy continuity, and the forestry program's ability to respond to threats from invasive pests or diseases. Low species diversity (large number of trees of the same species) can lead to extreme losses in the event of species-specific epidemics such as the devastating results of Dutch elm disease (*Ophiostoma novo-ulmi*) throughout New England and the Midwest. Because of the introduction and spread of Dutch elm disease in the 1930s, combined with its prevalence today, massive numbers of *Ulmus americana* (American elm), a popular street tree in Midwestern cities and towns, have perished (Karnosky 1979). Many Midwestern communities were stripped of most of their mature shade trees, creating a drastic void in canopy cover. Many communities replanted to replace lost elm trees. Ash and maple trees were popular replacements for American elm in the wake of Dutch elm disease. Unfortunately, some of the replacement species for American elm trees are now overabundant and are a concern for biodiversity. EAB and Asian longhorned beetle (ALB, *Anoplophora glabripennis*) are non-native insect pests that attack some of the most prevalent urban shade trees and some agricultural trees throughout the country.

The composition of a tree population should follow the 10-20-30 Rule for species diversity: a single species should represent no more than 10% of the urban forest, a single genus no more than 20%, and a single family no more than 30%. However, recent problems with exotic pests and diseases are currently destroying ash, hemlock, black walnut, and maple populations throughout the U.S. Many urban forestry organizations are recommending even lower species diversity thresholds. For example, The Wisconsin Department of Natural Resources recommends a 5-10-20 mix. In this management plan, we will use the standard 10-20-30 rule.

Appendix B lists tree species recommended for planting based on inventory findings; this list provides options designed to promote species diversity.

Findings

Analysis of Newburgh's tree inventory data indicated that the population had relatively good diversity, with one exception. There were 54 genera and 112 species represented. However, the top 5 genera comprised about 53% of the tree population, while the top 5 species made up 65% of the population. This could leave Newburgh's urban forest highly vulnerable to extreme damage and mortality if highly aggressive exotic pests or diseases do arrive.

Photograph 6.* Quercus palustris *(pin oak) comprises 2% of the tree population. Some of Newburgh's pin oaks are infested by galls, which slowly strangle trees. This will not be catastrophic since pin oaks comprise a modest percentage of the population. However, city managers should push species diversity so that these kinds of problems do not compromise the urban forest in the future.

Figure 2 compares the percentages of the most common species identified during the inventory to the 10% Rule. *Pyrus calleryana* (pear; 9%), *Gleditsia triacanthos inermis* (honey locust [thornless]); 7%), *Prunus* spp. (cherry; 6%), and *Tilia cordata* (linden; 4%) comprise a modest percentage of the city's urban forest. Based on this composition, the biodiversity and general health of Newburgh's urban forest should not be threatened. However, *Acer platanoides* (Norway maple; 28%) exceeds the 10% rule by a large margin and could compromise biodiversity or contribute to extreme loss in numbers from insects or disease. Planting of Norway maple should stop until these trees comprise a smaller percentage of the overall tree population.

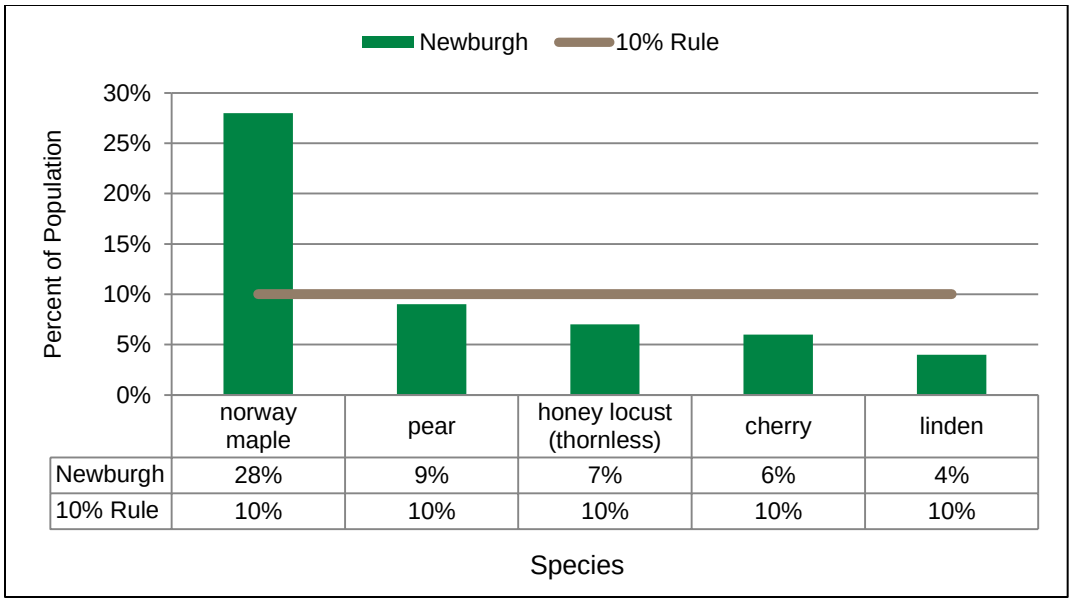


Figure 2. Five most abundant species of the city's trees compared to the 10% Rule.

Figure 3 compares the percentages of the most common genera of the city's trees in relation to the 20% Rule. *Acer* (maple, 37%) is exceeding overabundance, which creates a concern for biodiversity.

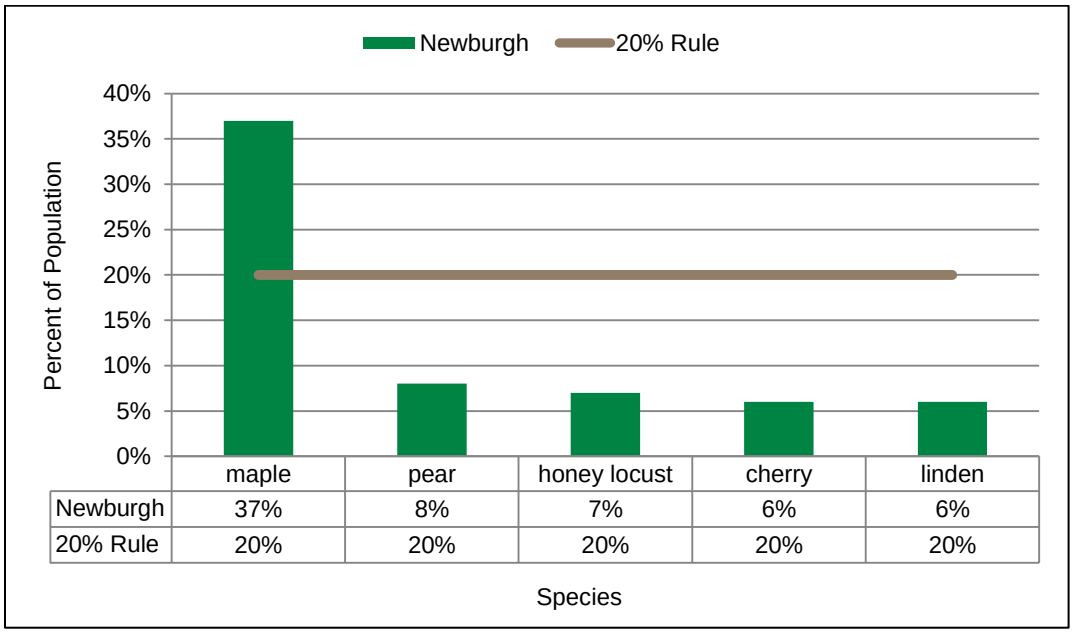


Figure 3. Five most abundant genera of the city's trees compared to the 20% Rule.

Discussion/Recommendations

Maple (*Acer*) dominates the urban forest of Newburgh. The abundance of maple, in relation to the landscape as a whole, is a biodiversity concern. Maple is one of the primary hosts for *Anoplophora glabripennis* (Asian longhorned beetle or ALB), which has had many extreme and continuing outbreaks throughout the eastern United States. ALB is present in New York, and a large proportion of Newburgh's urban forest (37%) is extremely threatened.

Photograph 7. This* Fraxinus pennsylvanica *(green ash) is one example of the ash genera, which makes up 2% of Newburgh's urban forest. The presence of emerald ash borer means that all of these trees will die soon if no action is taken.

While ash (*Fraxinus*) is not present at a level that compromises Newburgh's urban forest diversity, the issue of emerald ash borer still needs to be addressed. *Agrilus planiplennis* (ash borer) is a death sentence for untreated ash trees. If the city's urban forest trees had greater diversity, Newburgh would not be facing the possible loss of 2% of its trees in a very short period of time. Further discussion of emerald ash borer strategies is included in the EAB strategy section.

The prevalence of pear (*Pyrus calleryana*) is also a slight problem. The abundance of pear in the landscape makes it a limiting species and biodiversity concern. Also, pear is an extremely soft-fibered tree with poor structure, making it susceptible to structure failure. Storms and other natural events can greatly weaken the health of a tree, leaving it susceptible to other pests, diseases, or additional stressors. Planting of pear should be reduced for the time being.

Photograph 8. The tree population skews towards larger diameter trees. This means that there are many specimens such as these pin oaks. However, increased tree planting will ensure a better balanced size distribution of the urban forest.

Diameter Size Class Distribution

Analyzing the diameter size class distribution provides an estimate of the relative age of a tree population and insight into maintenance practices and needs.

The inventoried trees were categorized into the following diameter size classes: young trees (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature trees (>24 inches DBH). These categories were chosen so that the population could be analyzed according to Richards' ideal distribution (1983). Richards proposed an ideal diameter size class distribution for urban trees based on observations of well-adapted trees in Syracuse, New York. Richards' ideal distribution suggests that the largest fraction of trees (approximately 40% of the population) should be young (<8 inches DBH), while a smaller fraction of trees (approximately 10%) should be in the large-diameter size class (>24 inches DBH). A tree population with an ideal distribution would have an abundance of newly planted and young trees, and lower numbers of established, maturing, and mature trees.

Findings

Figure 4 compares Newburgh's diameter size class distribution of the inventoried tree population to the ideal proposed by Richards (1983). Newburgh's distribution trends towards the ideal; however, Young trees fall below the ideal by 7%, while mature trees exceed the ideal by 8%.

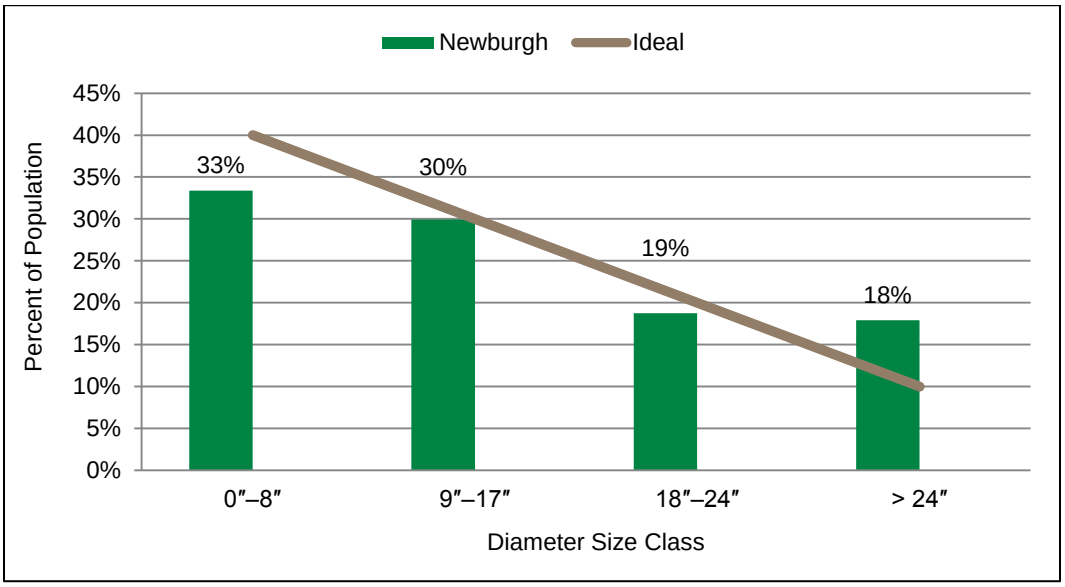


Figure 4. Comparison of diameter size class distribution for inventoried trees to the ideal distribution.

Discussion/Recommendations

The lack of young trees in Newburgh is the result of very low rates of tree planting and/or poor maintenance in recent years. One of Newburgh's objectives should be to aspire for an uneven-aged distribution of trees at the park, neighborhood, and management zone levels, as well as citywide. Davey Resource Group recommends that Newburgh support a planting and maintenance program to ensure that young, healthy trees are in place to fill in gaps in tree canopy and provide for gradual succession of older trees. The city must promote tree preservation and proactive tree care to ensure older trees survive as long as possible. Tree planting, but more importantly tree care, will allow the distribution to normalize over time.

Planting trees is necessary to increase canopy cover and replace trees lost to natural mortality (expected to be 1%–3% per year) and other threats (for example, invasive pests or impacts from weather events such as storms, wind, ice, snow, flooding, and drought). Planning for the replacement of existing trees and finding the best places to create new canopy is critical.

Condition

Davey Resource Group assessed the condition of individual trees based on methods defined by the International Society of Arboriculture (ISA). Several factors were considered for each tree, including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated Excellent, Very Good, Good, Fair, Poor, Critical, or Dead.

In this plan, the general health of the inventoried tree population was characterized by the most commonly assigned condition during the inventory.

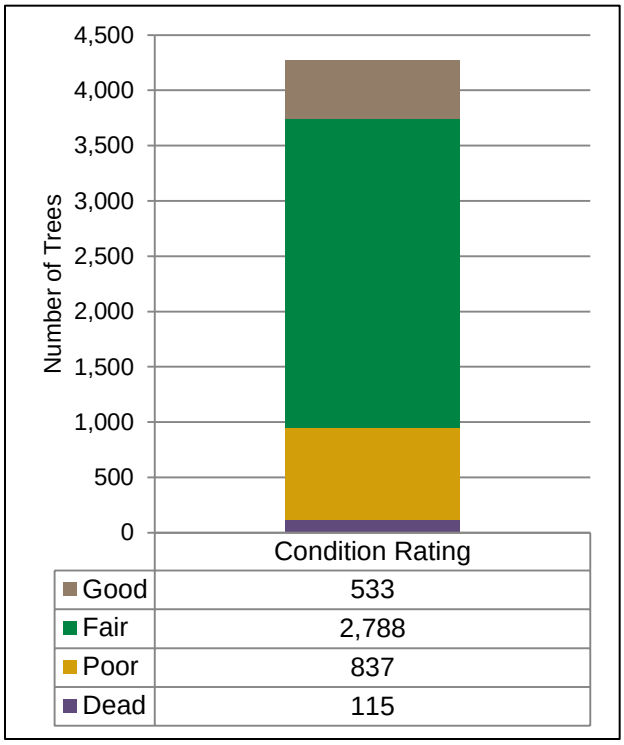


Figure 5. Condition of inventoried trees during the 2015 inventory.

Comparing the condition of the inventoried tree population with relative tree age can provide insight into the stability of the population. In this plan, relative age was based on DBH. Since tree species have different lifespans and mature at different diameters, heights, and crown spreads, actual tree age cannot be determined from diameter size class alone. However, general classifications of size can be extrapolated into relative age classes. The following categories are used to describe relative age: young (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature (>24 inches DBH).

Figures 5 and 6 illustrate the general health and percent of young, established, mature, and maturing trees to their condition.

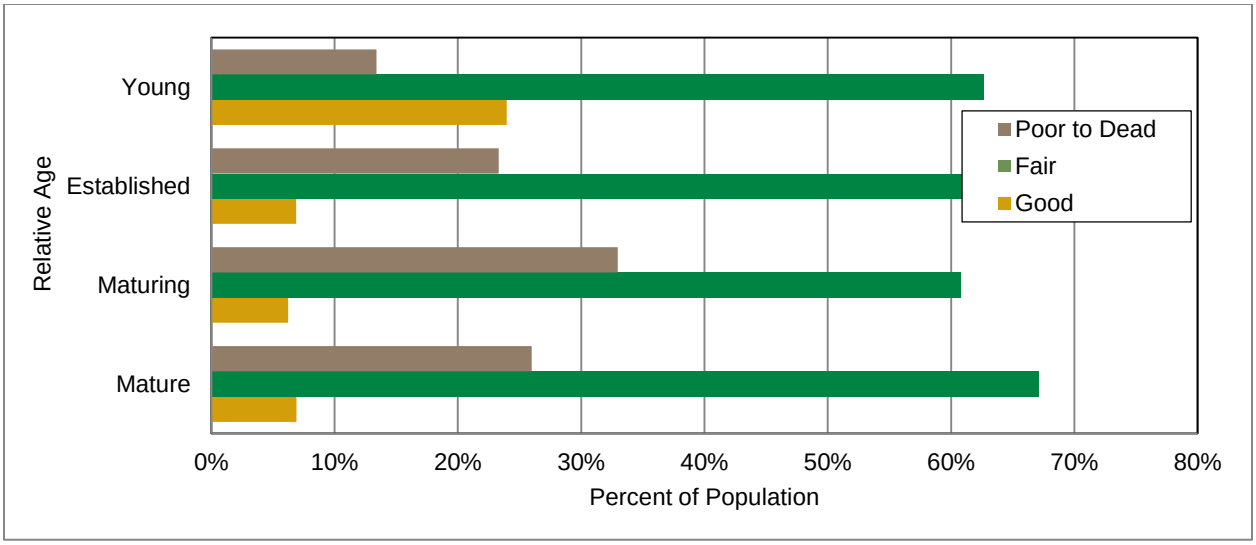


Figure 6. Tree condition by relative age during the 2015 inventory.

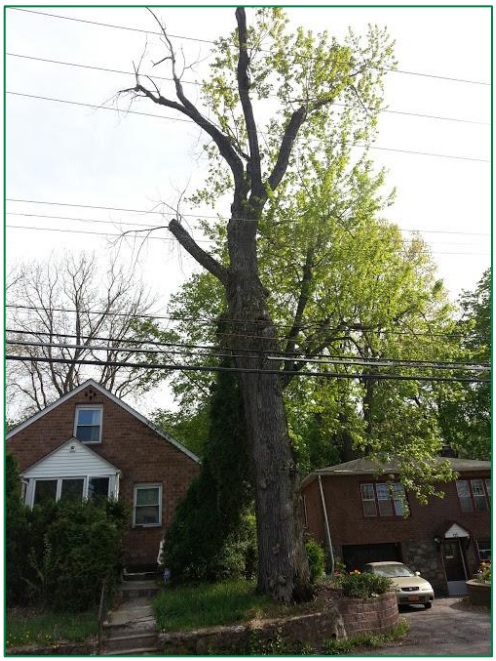
Findings

Most of the inventoried trees were assigned a rating of Good or Fair condition, 12% and 65%, respectively (Figure 5). Based on these data, the general health of the overall inventoried tree population is rated Fair. Figure 6 illustrates that most of trees in all development classes were in Fair condition. Young trees had the highest percentage of Good trees.

Discussion/Recommendations

Even though the condition of Newburgh's inventoried tree population is typical, data analysis has provided the following insight into historical maintenance practices and future maintenance needs:

- The similar trend in tree condition across city trees reveals that past conditions and/or past management of trees were consistent.
- Dead trees should be removed; because of their failed health, these trees will likely not recover, even with increased care.
- Younger trees rated in Fair or Poor condition may benefit from improvements in structure. Over time, such improvements may improve the health of these trees. Pruning should follow *ANSI A300 (Part 1)* (ANSI 2008).



Photograph 9. This maple, typical to most maple in Newburgh, has suffered greatly from storm damage and lack of space. This is a Poor tree that has been recommended for removal.

- Poor condition ratings assigned to mature trees were generally due to visible signs of decline and stress, including decay, dead limbs, sparse branching, or poor structure. These trees will require corrective pruning, regular inspections, and possible intensive plant health care to improve their health.
- Proper tree care practices are needs for the long-term general health of the urban forest. Following guidelines developed by the ISA and those recommended by *ANSI A300 (Part 6)* (ANSI 2012) will ensure that tree maintenance practices will improve the general health of the urban forest.

Stocking Level

Stocking is a traditional forestry term used to measure the density and distribution of trees. For an urban/community forest such as Newburgh's, stocking level is used to estimate the total number of sites inside the city that could have trees. This is a measure of the capacity of the city to contain trees.

Stocking level is the ratio of planting sites that are occupied by trees to the total city spaces that are suitable for trees. For example, a city tree inventory of 1,000 total sites with 750 existing trees and 250 vacant planting sites would have a stocking level of 75%.

For an urban area, Davey Resource Group recommends that the city's stocking level be at least 90% so that no more than 10% of the potential planting sites are vacant.

City stocking levels may be estimated using information about the community, tree inventory data, and common tree planting practices. Inventory data that contain the number of existing trees and vacant plantings in the city will increase the accuracy of the projection. However, city stocking levels can be estimated using only the number of existing trees and the number of park/public space acres and/or right-of-way miles in the community.

To estimate stocking level based on total city acres and the number of existing trees, it is assumed that any given public area should have room for 20 trees for every acre. For example, 10 acres of a city park with spaces for trees would have a potential for 200 trees. If the inventory found that 100 trees were present, the stocking level would be 50%.

A potential stocking level for a community with 10 acres would be measured as follows:

20 trees per park acre × 10 acres = 200 potential sites for trees

100 inventoried trees ÷ 200 potential sites for trees = 50% stocked

When the estimated stocking level is determined using theoretical assumptions, the actual number of vacant planting sites may be significantly less than estimated due to unknown space constraints, including inadequate space size, proximity of facilities or private trees, and utility conflicts.

Newburgh's inventory data set did include vacant planting sites; therefore, an accurate stocking level for Newburgh is presented. Since many areas may not be suitable for trees, a 70% theoretical stocking level for Newburgh is a reasonable goal.

Findings

Newburgh has 3,381 vacant planting sites and 4,273 trees. Based on these numbers, the city has the potential to support 7,654 trees at 100% stocking. With 44% of the potential tree sites currently vacant, Newburgh's urban forest sits at 56% stocking.

Photograph 10. Some areas of Newburgh are very well stocked, such as this group of maples. Unfortunately, this high level of stocking was achieved with one genus (Acer). If nothing is done to prepare for the impending arrival of Asian longhorned beetle, it is unlikely that any of these trees will be standing in five years.

Discussion/Recommendation

Fully stocking the city with trees is a reasonable goal. Inadequate tree planting and maintenance budgets and tree mortality will result in lowered stocking levels. Nevertheless, working to attain a fully stocked community forest is a worthwhile goal because it will promote canopy continuity and environmental sustainability. The city should consider increasing its urban forest population from its current stocking level of 56% towards the ideal of 70% or better. Generally, this entails a planned program of planting, care, and maintenance for the city trees.

At the moment budgets have allowed for new tree planting at an approximate rate of 25 trees per year. If budgets will also allow, Davey Resource Group recommends that the city increase the number of planted trees by 100. This amount would replace the annual average of 122 trees recommended for removal within a five-year period. If possible, exceed this recommendation to better prepare for impending threats and to increase the urban forest's benefits.

Stocking level can also be used to determine the number of trees per capita. Calculations of trees per capita are important in determining the quality of a city's urban forest. The more residents and greater housing density a city possesses, the greater the need for trees to provide benefits.

Newburgh's ratio of trees per capita is 0.15, which is well below the mean ratio of 0.37 reported for 22 U.S. cities (McPherson and City Rowntree 1989). Currently, there is 1 tree for every 6.5 residents.

Overhead Utilities

The presence of overhead utilities can present a challenge for urban forest managers. It is recommended that small-statured tree species such as *Malus* sp. (flowering apple) or *Syringa reticulata* (Japanese tree lilac) be planted under wires. Large- and medium-statured trees require drastic pruning to help ensure uninterrupted delivery of energy and information infrastructure. This type of pruning can often be detrimental to tree health and aesthetics.

The presence of overhead utility lines above or 10 feet away from a tree were noted as "yes". Trees which were not within 10 feet of overhead utilities were recorded as "no".

Findings

There were 1,279 inventoried trees (30%) with utilities directly above, or passing through, the tree canopy. Of this total, some will be large- or medium-sized trees at maturity.

Table 1. Inventoried Trees with Overhead Utility Conflicts

Utilities	Sites
No	2,994
Yes	1,279
Grand Total	4,273

Discussion/Recommendations

The city has done an adequate job of avoiding planting trees in inappropriate locations, such that most trees avoid contact with overhead utilities. Trees planted under wires were often too large for the space. Many of these are volunteer (naturally established) trees or were likely planted by residents. The city should be sure to follow guidelines for planting trees under wires and encourage residents to do the same.

Planting only small-sized trees within 20 feet of overhead utilities, medium-sized trees within 20–40 feet, and large-sized trees outside 40 feet will minimize future conflicts, improve future tree conditions, and reduce the costs of maintaining trees under utility lines.

Photograph 11. The heavy pruning performed on this Norway maple (*Acer plantanoides*) planted beneath overhead utilities would not have happened if a small-statured species had been planted in its space.

Potential Threats from Pests

Insects and diseases pose serious threats to tree health. Awareness and early diagnosis are crucial to ensuring the health and continuity of urban trees. Appendix C provides information about some of the current potential threats to Newburgh's trees and includes websites where more detailed information can be found.

Many pests target a single species or an entire genus. The inventory data were analyzed to provide a general estimate of the percentage of trees susceptible to some of the known pests either present or highly likely to spread to New York (see Figure 7). It is important to note that the figure presents data only from the inventory. Many more trees throughout Newburgh, including those on public and private property, may be susceptible to these invasive pests.

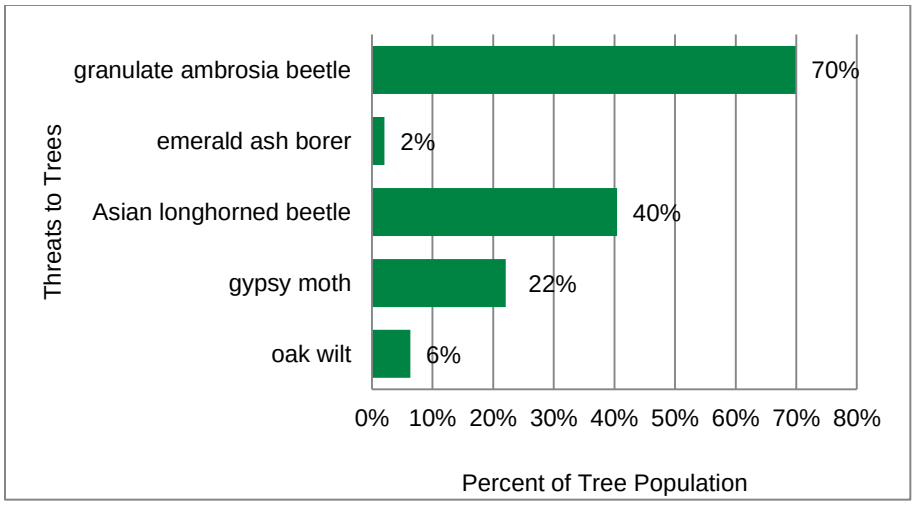


Figure 7. Potential impact of insect and disease threats noted during the 2015 inventory.

Findings

EAB has reached the outskirts of the City of Newburgh. There were 89 ash trees inventoried, of which 1 showed symptoms of potential infestation. There are also a number of ash trees in un-inventoried private areas. This is a concern which will need to be addressed. See *Section 4: Emerald Ash Borer Strategy* for more detailed information.

Photograph 12. These horned and gouty galls on a pin oak are numerous and large enough to start slowly strangling the tree. Leaf bearing twigs are squeezed off, weakening the tree and leaving it susceptible to other pests, diseases, heat, and drought. Pin oak planting should be reduced to avoid increasing the concentration in Newburgh.

Newburgh also has a small problem with its pin oaks being infested by horned and gouty gall, which is caused by egg-laying behavior of non-stinging wasps. When pin oaks are planted sparingly, this rarely develops into an extreme problem. Yet even the concentration of pin oaks in Newburgh could result in galls compromising the health and aesthetics of the small pin oak population.

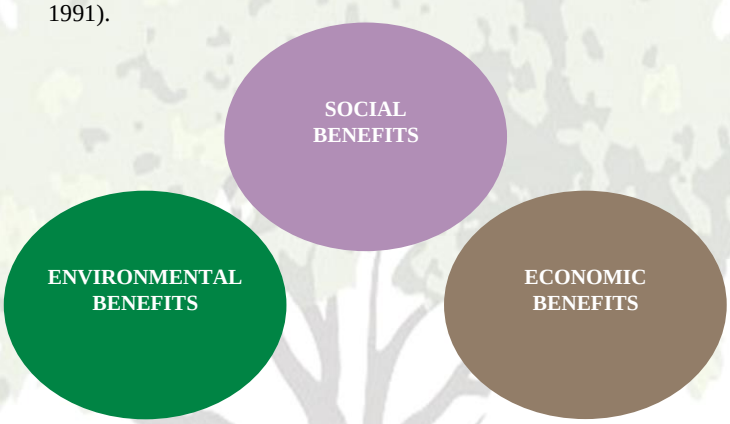
Granulate ambrosia beetle (*Xylosandrus crassiusculus*), ALB, and gyspy moth *(Lymantria dispar*) are known threats to a large percentage of inventoried trees in Newburgh. Although these pests were not immediately detected in Newburgh, they are most likely present, and the city could see extreme losses in its tree population.

Discussion/Recommendations

Newburgh should be aware of the signs and symptoms of infestations and should be prepared to act if a significant threat is observed in its tree population or a nearby community. An integrated pest management plan should be established. Tasks and goals should include: identifying and monitoring threats, understanding the economic threshold, selecting the correct treatment, properly timing management strategies, recordkeeping, and evaluating results.

Section 2: Benefits of the Urban Forest

The urban forest plays an important role in supporting and improving the quality of life in urban areas. A tree's shade and beauty contributes to the community's quality of life and softens the often hard appearance of urban landscapes and streetscapes. When properly maintained, trees provide abundant environmental, economic, and social benefits to a community far in excess of the time and money invested in their planting, pruning, protection, and removal.



- Tree-lined streets are safer; traffic speeds and the amount of stress drivers feel are reduced, which likely reduces road rage/aggressive driving (Wolf 1998a, Kuo and Sullivan 2001b).
- Chicago apartment buildings with medium amounts of greenery had 42% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Chicago apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Employees who see nature from their desks experience 23% less sick time and report greater job satisfaction than those who do not (Wolf 1998a). Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall (Ulrich 1984, 1986).
- When surrounded by trees, physical signs of personal stress, such as muscle tension and pulse rate, were measurably reduced within 3–4 minutes (Ulrich 1991).

- Trees decrease energy consumption and moderate local climates by providing shade and acting as windbreaks.
- Trees act as mini-reservoirs, helping to slow and reduce the amount of stormwater runoff that reaches storm drains, rivers, and lakes. Approximately 100 mature trees can intercept 100,000 gallons of rainfall per year (U.S. Forest Service 2003a)
- Trees help reduce noise levels, cleanse atmospheric pollutants, produce oxygen, and absorb carbon dioxide.
- Trees can reduce street-level air pollution by up to 60% (Coder 1996). Lovasi (2008) suggested that children who live on tree-lined streets have lower rates of asthma.
- Trees stabilize soil and provide a habitat for wildlife.

- Trees increase residential property values by an average of 7% when present in a yard or neighborhood. Commercial property rental rates were 7% higher when trees were on the property (Wolf 2007).
- Trees moderate temperatures in the summer and winter, saving on heating and cooling expenses (North Carolina State Univ. 2012, Heisler 1986)
- On average, consumers will pay about 11% more for goods in landscaped areas, with this figure being as high as 50% for convenience goods (Wolf 1998b, Wolf 1999, and Wolf 2003).
- Consumers also feel that the quality of products is better in business districts surrounded by trees than those considered barren (Wolf 1998b).
- The quality of landscaping along the routes leading to the business district had a positive influence on consumers' perceptions of the area (Wolf 2000).

The i-Tree streets application was used to assess the inventoried trees. This management and analysis tool uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits provided by trees, including energy conservation, air quality improvement, CO_2 reduction, stormwater control, and increases in property value. The tool estimates the costs and benefits of an urban tree population and creates annual benefit reports that demonstrate the value trees provide to a community.

The inventoried urban forest of Newburgh has recorded benefit savings of $431,226 annually from energy savings, stormwater reduction, increased property values, and overall air quality improvements. Figure 8 provides a breakdown of the annual benefits provided to the city.

Photograph 13. Tree benefits are maximized when the right tree is planted in the right place and the tree is allowed to mature without conflict. These trees provide many tangible benefits to the adjacent homes and to the community.

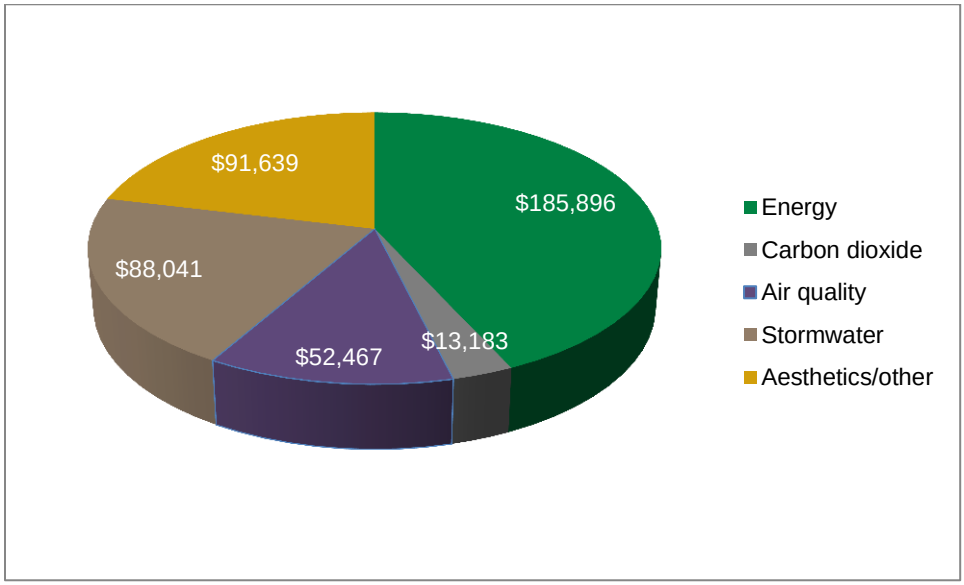


Figure 8. Annual benefits provided by Newburgh's trees.

Stormwater

Trees intercept rainfall, reducing costs to manage stormwater runoff—Newburgh's inventoried city trees intercept 8,892,994 gallons of rainfall annually. The estimated average savings for the city in the management of stormwater runoff is $88,041 annually.

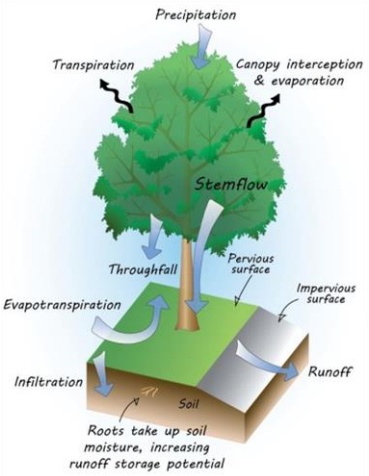
Air Quality Improvements

The inventoried tree population removes 26,552 pounds of air pollutants and avoids 28,112 pounds annually. The i-Tree Streets calculation takes into account the biogenic volatile organic compounds (BVOCs) that are released from trees. The total net value of these benefits is estimated to be $52,467.

Carbon Storage and Carbon Sequestration

Trees absorb carbon dioxide (CO_2) as a process of photosynthesis. Some of this CO_2 is stored as the woody tree biomass and some is sequestered during growth (Nowak et al. 2013). Both services reduce the total amount of CO_2 that is in the atmosphere at any given time. Over the lifetime of the existing population CO_2 storage is valued at $144,477. CO_2 sequestration is annually valued at $5,763.

The i-Tree Streets calculation takes into account the carbon emissions that are *not* released from power stations because of the subsequent heating and cooling effect of trees (buildings and homes use less energy). It also calculates the additional emissions released during tree care and maintenance (like driving to the site and operating equipment). The net carbon benefit is approximately $13,183 per year.



- *Trees reduce stormwater runoff by capturing and storing rainfall in their canopy and releasing water into the atmosphere.*
- *Tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil.*
- *Trees help slow down and temporarily store runoff and reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots.*
- *Trees transform pollutants into less harmful substances.*

Energy Use

The contribution of the public trees towards conserving energy is reflected in their ability to shade structures and surfaces, reduce electricity use for air conditioning in summer, and divert wind in the winter reducing natural gas use. Based on the inventoried trees, the annual electric and natural gas savings are equivalent to 419 MWh of electricity and 147,324 therms of natural gas. When converted into monetary values using default economic data, this accounts for a savings of $185,896 in energy consumption each year. These large leafy canopies provide shade, which reduces energy usage and increases their value.

Aesthetic/Other

Trees provide social benefits in numerous quantifiable ways. These benefits stem, in part, from increases in property and real estate values. Newburgh's trees contribute $91,639 in Aesthetic/Other Benefits.

Photograph 14. Business districts are improved by the addition of trees which can improve aesthetics and attract more patrons.

Section 3: Tree Management Program

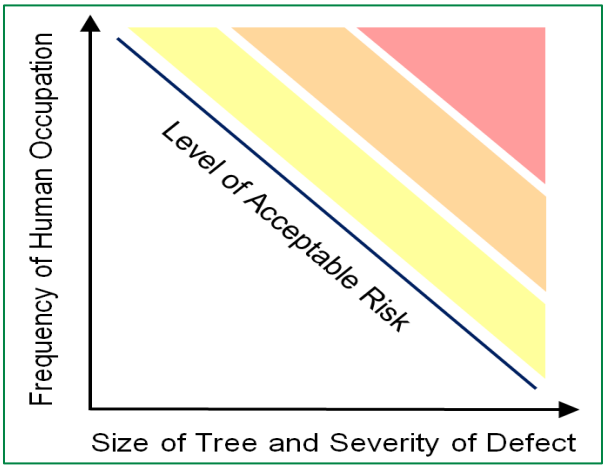
This tree management program was developed to uphold Newburgh's comprehensive vision for preserving its urban forest. This five-year program is based on the tree inventory data. The program was designed to reduce risk through prioritized tree removal and pruning, and to improve tree health and structure through proactive pruning cycles. Tree planting to mitigate removals and increase canopy cover and public outreach are important parts of the program as well.

Management recommendations for this section excludes all ash trees (89), which are addressed in the emerald ash borer action plan presented in *Section 4: Emerald Ash Borer Strategy*.

Implementing a tree care program is an ongoing process; however, tree work must always be prioritized to reduce public safety risks. Davey Resource Group recommends completing the work identified during the inventory based on the assigned risk rating; however, it is also essential to routinely monitor the tree population to identify other Extreme or High Risk trees so that they may be systematically addressed. Regular pruning cycles and tree planting should be routinely completed; however, priority work (especially for trees rated as Extreme or High Risk) must sometimes take precedence to ensure that risk is expediently managed.

How Risk Was Assessed During the Inventory

Every tree has an inherent risk of tree failure or defective tree part failure. During the inventory, Davey Resource Group performed a risk assessment for each tree and assigned a risk rating following protocol based on the ANSI A300 (Part 9) and the companion publication *Best Management Practices: Tree Risk Assessment*, published by the International Society of Arboriculture (2011). The likelihood of failure, likelihood of impacting a target, consequences of failure, and other risk factors were evaluated for each inventoried tree.



- *Likelihood of Failure*: Identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions.
    - Improbable—The tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time period.
    - Possible—Failure could occur, but it is unlikely during normal weather conditions within the specified time period.
    - Probable—Failure may be expected under normal weather conditions within the specified time period.
    - Imminent—Failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load. The tree may require immediate action.

- *Likelihood of Impacting a Target*: Rates the use and occupancy of the area that would be struck by the defective part.
  - Very low—The chance of the failed tree or branch impacting the target is remote.
    - Rarely used sites
    - Examples include rarely used trails or trailheads
    - Instances where target areas provide protection
  - Low—It is not likely that the failed tree or branch will impact the target.
    - Occasional use area fully exposed to tree
    - Frequently used area partially exposed to tree
    - Constant use area that is well protected
  - Medium—The failed tree or branch may or may not impact the target.
    - Frequently used areas that is partially exposed to tree on one side
    - Constantly occupied area partially protected from tree
  - High—The failed tree or branch will most likely impact the target.
    - Fixed target is fully exposed to tree or tree part
- *Categorizing Likelihood of Tree Failure Impacting a Target:* The likelihood for failure and the likelihood of impacting a target are combined in the matrix below to determine the likelihood of tree failure impacting a target.

Likelihood of Failure	Likelihood of Impacting Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

- *Consequences of Failure*: The consequences of tree failure are based on the categorization of target and potential harm that may occur. Consequences can vary depending upon size of defect, distance of fall for tree or limb, and any other factors that may protect a target from harm. Target values are subjective and should be assessed from the client's perspective.
  - Negligible—Consequences involve low value damage and do not involve personal injury:
    - small branch striking a fence
    - medium-sized branch striking a shrub bed
    - large tree part striking structure and causing monetary damage
    - disruption of power to landscape lights

- Minor—Consequences involve low to moderate property damage, small disruptions to traffic or communication utility, or very minor injury:
  - small branch striking a house roof from a high height
  - medium-sized branch striking a deck from a moderate height
  - a large tree part striking a structure, causing moderate monetary damage
  - short-term disruption of power at service drop to house
  - temporary disruption of traffic on neighborhood street
- Significant—Consequences involve property damage of moderate to high value, considerable disruption, or personal injury:
  - a medium-sized part striking a vehicle from a moderate or high height
  - a large tree part striking a structure resulting in high monetary damage
  - disruption of distribution primary or secondary voltage power lines, including individual services and street-lighting circuits
  - disruption of traffic on a secondary street
- Severe—Consequences involve serious potential injury or death, damage to high-value property, or disruption of important activities:
  - injury to a person that may result in hospitalization
  - a medium-sized part striking an occupied vehicle
  - a large tree part striking an occupied house
  - serious disruption of high-voltage distribution and transmission power line disruption of arterial traffic or motorways

- *Risk Rating*: The overall risk rating of the tree will be determined by combining the likelihood of tree failure impacting a target and the consequence of failure in the matrix below.

Likelihood of Failure	Consequences			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Once risk rating is calculated, a level of risk is assigned to each tree. The assigned risk rating allows for effective prioritization of tree maintenance work.

- *Extreme Risk*: The Extreme Risk category applies in situations where tree failure is imminent and there is a high likelihood of impacting the target, and the consequences of the failure are "severe." In some cases, this may mean immediate restriction of access to the target zone area to avoid injury to people.

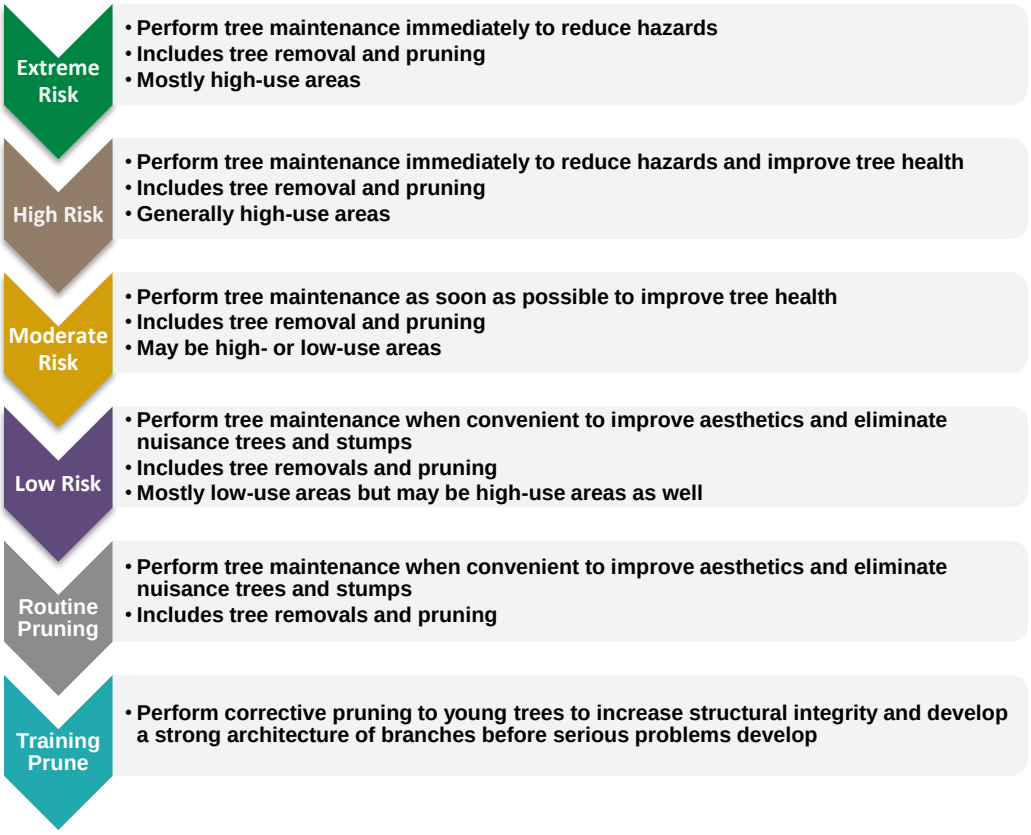
- *High Risk*: The High Risk category applies when consequences are "significant" and likelihood is "very likely" or "likely," or consequences are "severe" and likelihood is "likely." In a population of trees, the priority of High Risk trees is second only to Extreme Risk trees.
- *Moderate Risk*: The Moderate Risk category applies when consequences are "minor" and likelihood is "very likely" or "likely"; or likelihood is "somewhat likely" and consequences are "significant" or "severe." In a population of trees, Moderate Risk trees represent a lower priority than High or Extreme Risk trees.
- *Low Risk*: The Low Risk category applies when consequences are "negligible" and likelihood is "unlikely"; or consequences are "minor" and likelihood is "somewhat likely." Some trees with this level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required.
- *None*: Used for planting sites and stumps.

Trees with elevated (Extreme or High) risk levels are usually recommended for removal or pruning. However, in some situations, risk may be reduced by adding support (cabling or bracing) or by moving the target away from the tree. Davey Resource Group recommends only removal or pruning to minimize risk. However, in special situations, such as a significant or memorial tree or a tree in a historic area, Newburgh may decide that cabling, bracing, or moving the target may be the best option to reduce risk.

Determination of acceptable risk ultimately lies with Newburgh urban forest managers. Trees often have associated risks; the location of a tree is an important factor in the determination and acceptability of risk for any given tree. The level of risk associated with a tree increases as the frequency of human occupation increases in the vicinity of the tree. For example, a tree located next to a heavily traveled street will have a higher level of risk than a similar tree in an open field.

Priority and Proactive Maintenance

In this plan, the recommended tree maintenance work was divided into either priority or proactive maintenance. Priority maintenance includes tree removals and pruning of trees with an assessed risk rating of seven or greater (Extreme and High Risk). Proactive tree maintenance includes pruning of trees with an assessed risk of six or less (Moderate or Low Risk) and trees that are young. Tree planting, inspections, and community outreach are also considered proactive maintenance.



Priority Maintenance

Identifying and ranking the maintenance needs of a tree population enables tree work to be assigned priority based on observed risk. Once prioritized, tree work can be systematically addressed to eliminate the greatest risk and liability first (Stamen 2011).

Risk is a graduated scale that measures potential tree-related hazardous conditions. A tree is considered hazardous when its potential risks exceed an acceptable level. Managing trees for risk reduction provides many benefits, including:

- Lower frequency and severity of accidents, damage, and injury
- Less expenditure for claims and legal expenses
- Healthier, long-lived trees
- Fewer tree removals over time
- Lower tree maintenance costs over time

Regularly inspecting trees and establishing tree maintenance cycles generally reduce the risk of failure, as problems can be found and addressed before they escalate.

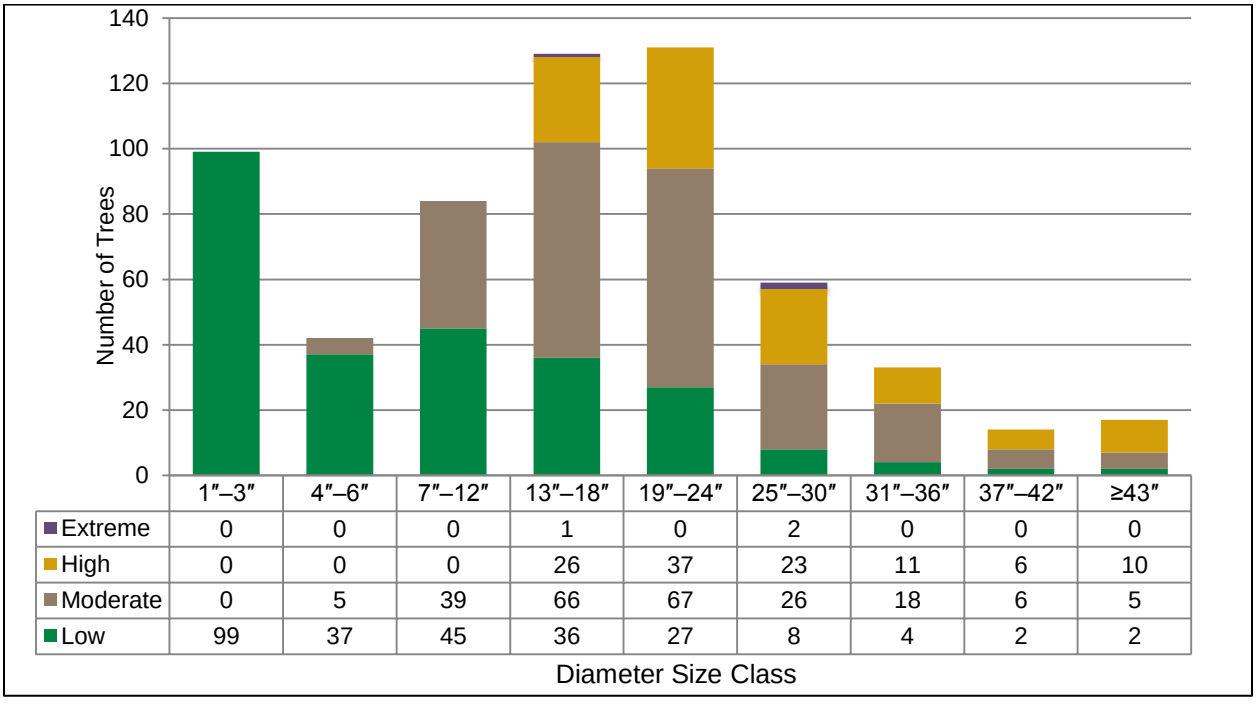
In this plan, all tree removals and Extreme and High Risk pruning are included in the priority maintenance program.

Extreme or High Risk Tree Removal

Although tree removal is usually considered a last resort and may sometimes create a reaction from the community, there are circumstances when removal is necessary. Trees fail from natural causes, such as diseases, insects, and weather conditions, and from physical injury due to vandalism, vehicles, and root disturbances. Davey Resource Group recommends that trees be removed when corrective pruning will not adequately eliminate the hazard or when correcting problems would be cost-prohibitive. Trees that cause obstructions or interfere with power lines or other infrastructure should be removed when their defects cannot be corrected through pruning or other maintenance practices. Nuisance trees and diseased trees also merit removal.

Even though large short-term expenditures may be required, securing the funding required to expediently complete priority tree removals is important to reduce risk and promote public safety.

Figure 9 presents tree removals by risk rating and diameter size class. There are 116 trees recommended for Extreme or High Risk removal. The following sections briefly summarize the recommended removals identified during the inventory.



	1″–3″	4″–6″	7″–12″	13″–18″	19″–24″	25″–30″	31″–36″	37″–42″	≥43″
Extreme	0	0	0	1	0	2	0	0	0
High	0	0	0	26	37	23	11	6	10
Moderate	0	5	39	66	67	26	18	6	5
Low	99	37	45	36	27	8	4	2	2

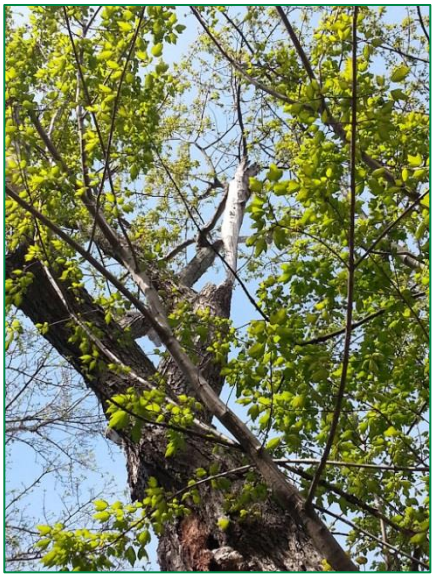
Figure 9. Tree removals by risk rating and diameter size class.

Extreme and High Risk

Extreme and High Risk removals have observable and sizeable defects with elevated probabilities of failure. The location of these trees in relation to their surroundings also increases their risk. The inventory identified 116 Extreme and High Risk trees recommended for removal. The diameter size classes for these trees ranged between 13 inches DBH and 43+ inches DBH. These trees should be immediately removed based on their assigned risk. Extreme removals can be performed concurrently with High Risk removals.

Moderate Risk

Tree removals in this category still pose some risk but have a smaller size of defect and/or less potential for target impact. The inventory identified 232 Moderate Risk trees recommended for removal. Most Moderate Risk trees were smaller than 36 inches DBH. These trees should be removed as soon as possible, after all Extreme and High Risk removals and pruning have been completed.



Photograph 15. This maple is an example of a Moderate Risk tree that needs to be removed. There is a high likelihood that this rotting branch will fail. Its proximity to a home increases the chance that it will hit someone or something when it fails.

Low Risk

Low Risk removals pose little threat; these trees are generally small, dead, invasive, or poorly formed trees that need to be removed. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. Healthy trees growing in poor locations or undesirable species are also included in this category.

The inventory identified 260 Low Risk trees recommended for removal. Almost all of these trees were smaller than 24 inches DBH. Most of these trees were dead, nearly dead, or in locations which made damage upon their failure unlikely. All Low Risk trees should be removed when convenient and after all Extreme, High, and Moderate Risk removals and pruning have been completed.

Stump Removal

The inventory identified 383 stumps recommended for removal. The majority (256) of these stumps (67%) were smaller than 25 inches DBH.

Extreme and High Risk Pruning

Extreme and High Risk pruning generally requires cleaning the canopy of both small and large trees to remove hazardous defects such as dead and/or broken branches that may be present even when the rest of the tree is sound. In these cases, pruning the branch or branches can correct the problem and reduce risk associated with the tree.

Figure 10 presents the number of trees recommended for Extreme and High Risk pruning by size class. The sections that follow briefly summarize the recommendations.

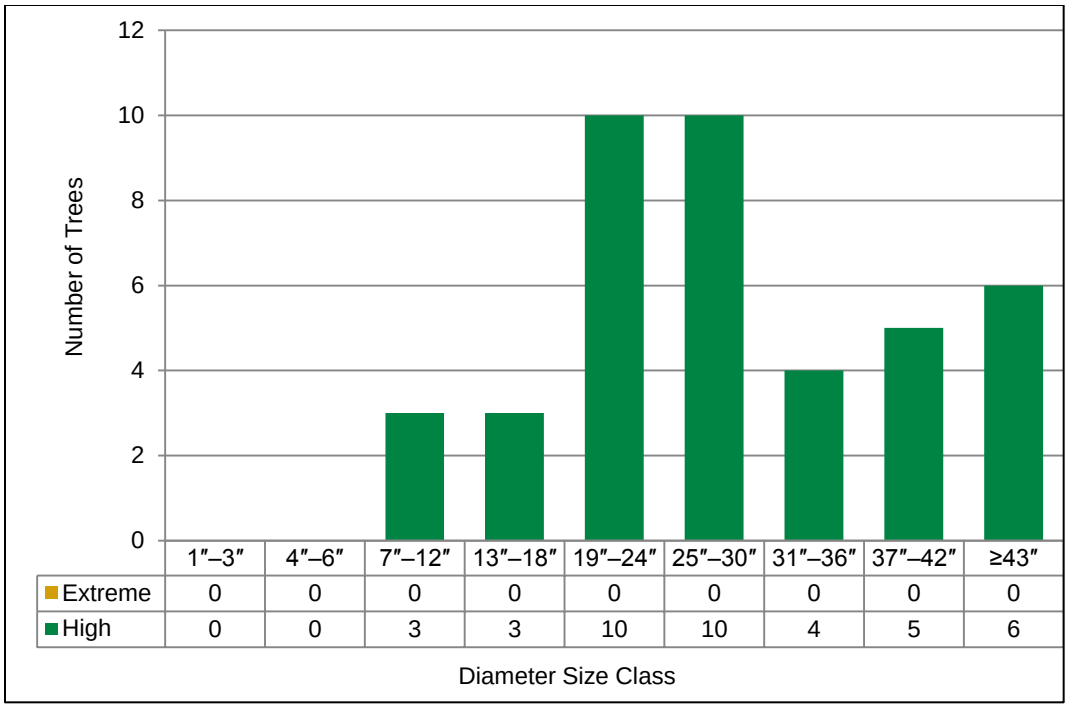


Figure 10. High Risk pruning by diameter size class.

The inventory identified 41 High Risk trees recommended for pruning. High Risk trees recommended for pruning have observable and sizeable defects with elevated probabilities of failure. The location of these trees in relation to their surroundings also increases their risk. The diameter size classes for these trees ranged between 7 inches DBH and 43+ inches DBH. This pruning should be performed immediately according to assigned risk and may be done at the same time as other Extreme and High Risk removals and pruning.

Proactive Maintenance

Proactive tree maintenance requires that trees are managed and maintained under the responsibility of an individual, department, or agency. Tree work is typically performed during a cycle. Individual tree health and form are routinely addressed during the cycle. When trees are planted, they are planted selectively and with purpose. Ultimately, proactive tree maintenance should reduce crisis situations in the urban forest as every tree in the managed population is regularly visited, assessed, and regularly maintained. Davey Resource Group recommends proactive tree maintenance that includes pruning cycles, inspections, and planned tree planting.

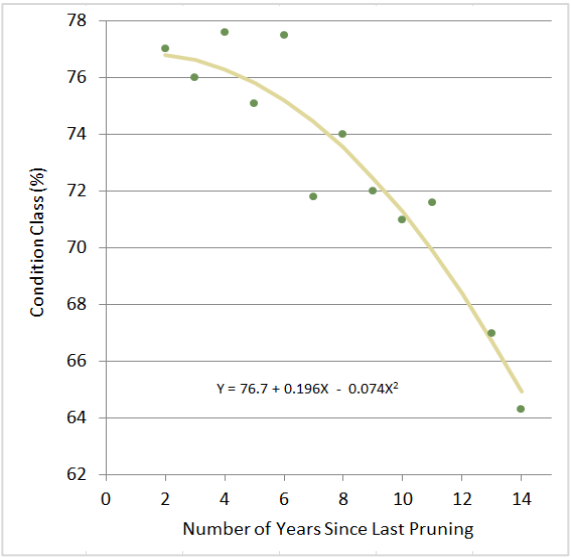
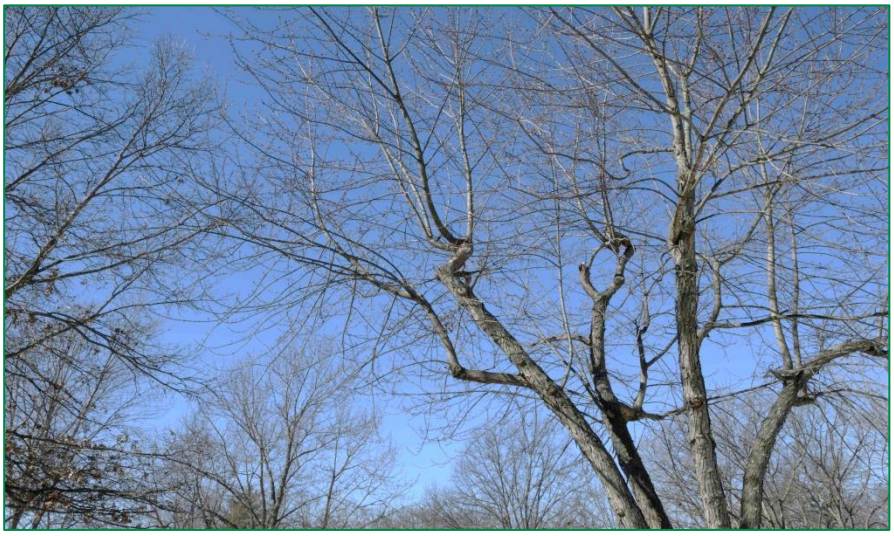


Figure 11. Relationship between average tree condition class and number of years since last pruning (adapted from Miller and Sylvester 1981).



Photograph 16. This silver maple has many weak branches due to past storm damage. Proactive maintenance will selectively remove weak branches and prevent future damage by encouraging the strongest limbs.

Pruning Cycles

The goals of pruning cycles are to visit, assess, and prune trees on a regular schedule to improve health and reduce risk. Typically, Davey Resource Group recommends that pruning cycles begin after all Extreme and High Risk trees are corrected through priority removal or pruning. However, due to the long-term benefits of pruning cycles, Davey Resource Group recommends that all cycles are implemented in Year 1, after all High Priority work is completed. To ensure that all trees receive the type of pruning they need to mature with better structure and fewer hazards, two pruning cycles are recommended: the young tree training cycle (YTT Cycle) and the routine pruning cycle (RP Cycle). The cycles differ in the type of pruning, general age of the target tree, and length.

The recommended number of trees in the pruning cycles will need to be modified to reflect changes in the tree population as trees are planted, age, and die. Newly planted trees will enter the YTT Cycle once they become established. As young trees reach maturity, they will be shifted from the YTT Cycle into the RP Cycle. When a tree reaches the end of its useful life, it should be removed and eliminated from the RP Cycle.

For many communities, a proactive tree management program is considered unfeasible. An on-demand response to urgent situations is the norm. Research has shown that a proactive program that includes a routine pruning cycle will improve the overall health of a tree population (Miller and Sylvester 1981). Proactive tree maintenance has many advantages over on-demand maintenance, the most significant of which is reduced risk. In a proactive program, trees are regularly assessed and pruned, which generally means that most defects will be found and eliminated before they escalate to a hazardous situation with an unacceptable level of risk. Other advantages of a proactive program include: more predictable budgets and projectable workloads, reduced long-term tree maintenance costs, and increased environmental and economic benefits from trees.

Why Prune Trees on a Cycle?
Miller and Sylvester (1981) examined the frequency of pruning for 40,000 street and boulevard trees in Milwaukee, Wisconsin. They documented a decline in tree health as the length of the pruning cycle increased. When pruning was not completed for more than 10 years, average tree condition was rated 10% lower than when trees had been pruned within the last several years. Miller and Sylvester suggested that a pruning cycle of five years is optimal for urban trees.

YTT Cycle

Trees included in the YTT Cycle are generally less than 8 inches DBH. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, which increases risk and creates potential liability.

YTT pruning is performed to improve tree form or structure; the recommended length of a YTT Cycle is three years because young trees tend to grow at faster rates (on average) than more mature trees.

The YTT Cycle differs from the RP Cycle in that these trees generally can be pruned from the ground with a pole pruner or pruning shear. The objective is to increase structural integrity by pruning for one dominant leader. Of course, this is species-specific since many trees such as *Betula nigra* (river birch) may naturally have more than one leader. For these and similar trees, YTT pruning is used to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree.

Photograph 17. This* Pyrus calleryana *(Callery pear) may not have suffered a high level of storm damage if young tree training would have been performed decades ago. Branches that grow together introduce decay into the tree and pry each other apart, leading to a high likelihood of failure.

Photograph 18. This* Zelkova serrata *(Japanese zelkova) is an excellent species to plant to increase species diversity. Training pruning at this young age will prevent storm damage and other health problem decades into the future.

Discussion/Recommendations

Davey Resource Group recommends that Newburgh implement a three-year YTT Cycle to begin after all Extreme and High Risk trees are removed or pruned. The YTT Cycle typically includes all existing young trees. A total of 750 trees smaller than 9 inches DBH were inventoried and recommended for a YTT (excluding any ash trees). Since the number of young trees is relatively good and the benefit of beginning the YTT Cycle is substantial, Davey Resource Group recommends that approximately 250 trees be structurally pruned every year beginning in Year 1.

If trees are planted, these trees will need to enter the YTT Cycle after establishment, typically a few years after planting. In future years, the number of trees in the YTT Cycle will be based on tree planting efforts and growth rates of young trees. The city should strive to prune approximately one-third of Newburgh's young trees each year.

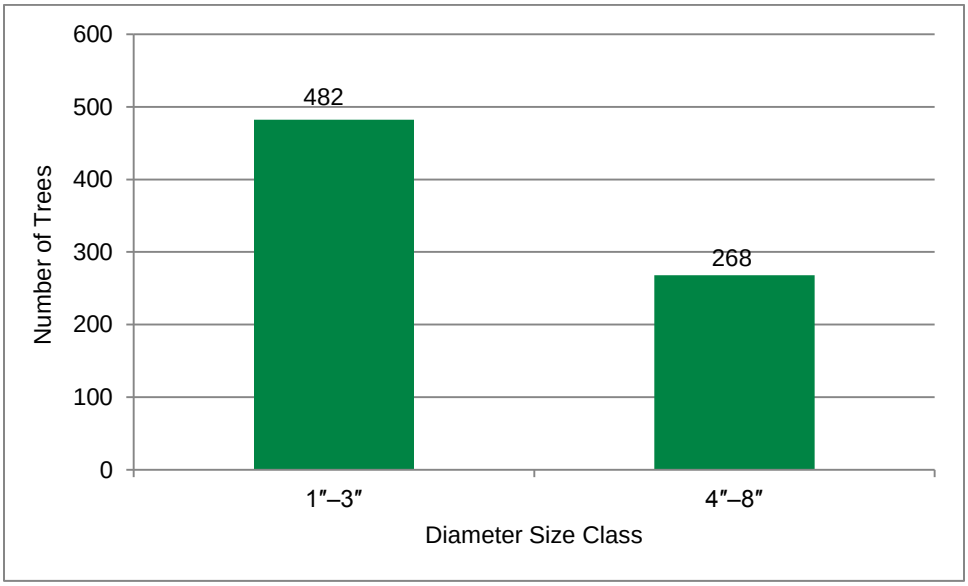


Figure 12. Trees recommended for the YTT Cycle by diameter size class.

RP Cycle

The RP Cycle includes Established, Maturing, and Mature trees (mostly greater than 8 inches DBH) that need cleaning, crown raising, and reducing to remove deadwood and improve structure. Over time, routine pruning generally improves health and reduces risk as most problems can be corrected before they escalate into more costly priority tree work. Included in this cycle are Moderate and Low Risk trees that require pruning and pose some risk but have a smaller size of defect and/or less potential for target impact. The hazards found within these trees can usually be remediated during the RP Cycle.

The length of the RP Cycle is based on the size of the tree population and what was assumed to be a reasonable number of trees for a program to prune per year. The recommended RP Cycle for a tree population is generally five years but may extend to seven years if the population is large.

Discussion/Recommendations

Davey Resource Group recommends that the city establish a five-year RP Cycle where approximately one-fifth of the tree population is to be pruned each year. The 2015 tree inventory identified 2,775 for the RP Cycle (excluding ash trees). Davey Resource Group recommends that the RP Cycle begin in Year One of this five-year plan, after all Extreme and High Risk trees are removed or pruned. Approximately 555 trees should be pruned every year as part of the Routine Pruning Cycle.

The inventory found most trees (65% of inventoried trees) in the city needed routine pruning (tree cleaning). Figure 13 shows that a variety of tree sizes will require pruning; however, most of the trees that require routine pruning were smaller than 30 inches DBH.

Photograph 19. This* Taxodium distichum *(bald cypress) makes an excellent urban tree. These trees will benefit from inclusion in the regular pruning cycle.

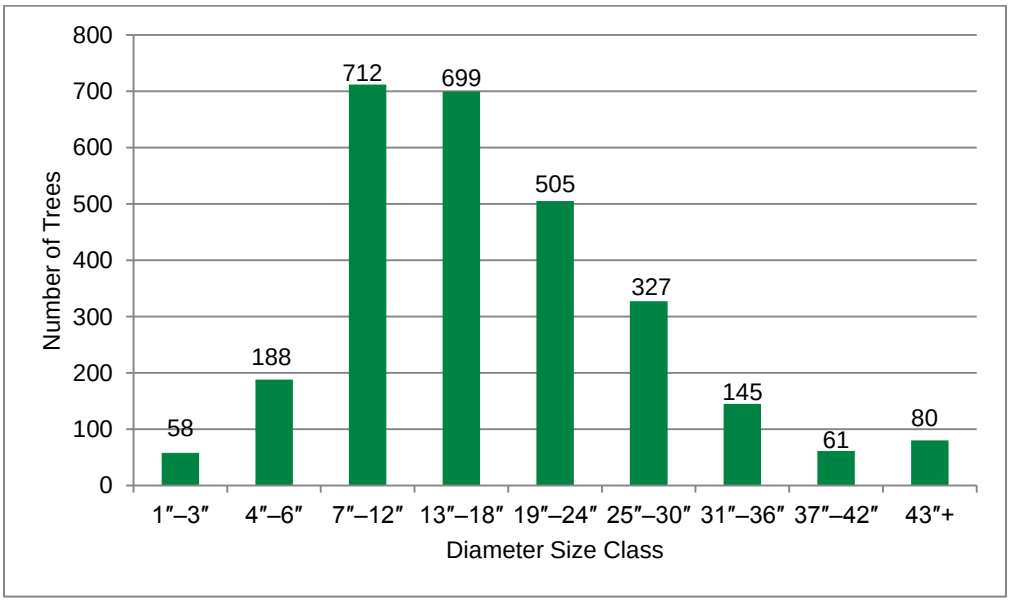


Figure 13. Trees recommended for the RP Cycle by diameter size class.

Tree Planting

Planting trees is a worthwhile goal as long as tree species are carefully selected and correctly planted. When trees are planted, they are planted selectively and with purpose. Without proactive planning and follow-up tree care, a newly planted tree may become a future problem instead of a benefit to the community.

When planting trees, it is important to be cognizant of the following:

- Consider the specific purpose of the tree planting.
- Assess the site and know its limitations (i.e., overhead wires, confined spaces, and/or soil type.
- Select the species or cultivar best suited for the site conditions.
- Examine trees before buying them, and buy for quality.

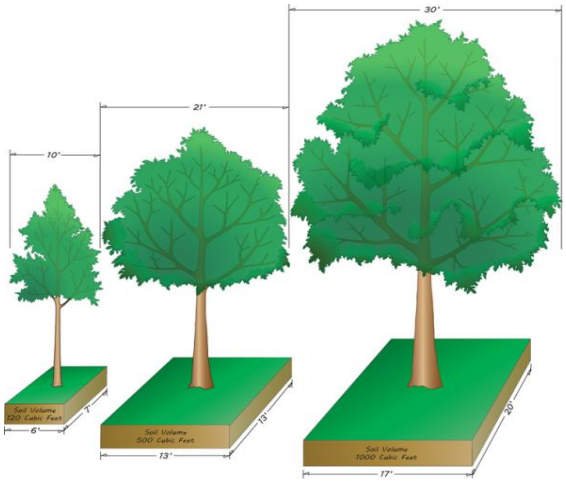


Illustration based on the work of Casey Trees (2008).

Tree Species Selection

Selecting a limited number of species could simplify decision-making processes; however, careful deliberation and selection of a wide variety of species will be more beneficial and can save money. Planting a variety of species can decrease the impact of species-specific pests and diseases by limiting the number of susceptible trees in a population. This reduces time and money spent to mitigate a problem if such an event were to occur. A wide variety of tree species can help limit the impacts from physical events, as different tree species react differently to stress. Species diversity helps withstand strong storms, wind, ice, flooding, and drought.

Newburgh is located in USDA Hardiness Zone 6a, which is identified as a climatic region with average annual minimum temperatures between −10°F and −5°F. Tree species selected for planting in Newburgh should be appropriate for this zone.

Tree species should be selected for their durability and low-maintenance characteristics. These attributes are highly dependent on site characteristics below ground (soil texture, soil structure, drainage, soil pH, nutrients, road salt, and root spacing). Matching a species to its favored soil conditions is the most important task when planning for a low-maintenance landscape. Plants that are well matched to their environmental site conditions are much more likely to resist pathogens and insect pests. Such plants require less maintenance overall.

The Right Tree in the Right Place is a mantra for tree planting used by the Arbor Day Foundation and many utility companies nationwide. Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Some grow tall, some grow wide, and some have extensive root systems. Before selecting a tree for planting, make sure it is the right tree—know how tall, wide, and deep it will be at maturity. Equally important to selecting the right tree is choosing the right spot to plant it. Blocking an unsightly view or creating some shade may be a priority, but it is important to consider how a tree may impact existing utility lines as it grows taller, wider, and deeper. If the tree's canopy, at maturity, will reach overhead lines, it is best to choose another tree or a different location. Taking the time to consider location before planting can prevent power disturbances and improper utility pruning practices.

Photograph 20. Trees can be selected for planting based on many characteristics. The flaky bark on this* Crataegus *sp. (hawthorn) provides aesthetic appeal even in the winter. They are also extremely hardy trees and can be planted in sites with harsh conditions. Thornless varieties are available.

A major consideration for urban trees is the amount of litter dropped by mature trees. Trees such as *Acer saccharinum* (silver maple) have weak wood and typically drop many small branches during a growing season. Others, such as *Liquidambar styraciflua* (American sweetgum), drop high volumes of fruit. In certain species, such as *Ginkgo biloba* (ginkgo), female trees produce offensive smelling/large fruit; male gingko trees, however, produce no fruit. Furthermore, a few species of trees, including *Crataegus* spp. (hawthorn) and *Gleditsia triacanthos* (honeylocust), may have substantial thorns. These species should be avoided in high-traffic areas.

Seasonal color should also be considered when planning tree plantings. Flowering varieties are particularly welcome in the spring and deciduous trees that display bright colors in autumn can add a great deal of interest to surrounding landscapes.

Appendix B lists tree species recommended for planting based on inventory findings; this list provides expected height at maturity for each species and is designed to promote species diversity.

Davey Resource Group recommends limiting the planting of maple, which comprises approximately 37% of the urban tree population, until the species distribution normalizes. Pear already occupies 8% of the city's community forest and planting should be reduced. Since the arrival of EAB is imminent, white and green ash should not be planted. There is some evidence that *Fraxinus quadrangulata* (blue ash), native to New York, has some degree of resistance to emerald ash borer. Planting of this species could be conducted on an experimental basis until more is known.

Tips for Planting Trees

To ensure a successful tree planting effort:

- Handle trees with care. Trees are living organisms and are perishable. Protect trees from damage during transport and when loading and unloading. Use care not to break branches and do not lift trees by the trunk.
- If trees are stored prior to planting, keep the roots moist.
- Dig the planting hole according to the climate. Generally, the planting hole is two to three times wider than and not quite as deep as the root ball. The root flair is at or just above ground level.
- Fill the hole with native soil unless it is undesirable, in which case soil amendments should be added as appropriate for local conditions. Gently tamp and add water during filling to reduce large air pockets and to ensure a consistent medium of soil, oxygen, and water.
- Stake the tree as necessary to prevent it from shifting too much in the wind.
- Add a thin layer (1–2 inches) of mulch to help prevent weeds and keep the soil moist around the tree. Do not allow mulch to touch the trunk.

Newly Planted and Young Tree Maintenance

Equal important to planting trees is caring for them after they are planted. After a tree is planted, maintenance is essential for several years.

Watering

Initially, watering is the key to survival; new trees typically require at least 60 days of watering to establish. Determine how frequently trees should be irrigated based on time of planting, drought status, species selection, and site condition.

Mulching

Mulch can be applied to the grow space around a newly planted tree (or even a more mature tree) to ensure that no weeds grow, that the tree is protected from mechanical damage, and that the growspace is moist. Mulch should be applied in a thin layer, generally 1 to 2 inches, and the growing area should be covered. Mulch should not touch the tree trunk, nor should it be piled up around the tree.

Life-Long Tree Care

Once the tree is established, it will require routine tree care, which includes inspections, routine pruning, watering, plant health care, and integrated pest management as needed.

The city should employ qualified arborists to provide most of the routine tree care. An arborist can determine the type of pruning necessary to maintain or improve the health, appearance, and safety of trees. These techniques may include eliminating branches that rub against each other; removing limbs that interfere with wires and buildings or that obstruct streets, sidewalks or signage; removing dead, damaged, or weak limbs that pose a hazard or may lead to decay; removing diseased or insect-infested limbs; creating better structure to lessen wind resistance and reduce the potential for storm damage; and removing branches—or thinning—to increase light penetration.

An arborist can help decide whether a tree should be removed and, if so, to what extent removal is needed. Additionally, an arborist can provide advice about and perform tree maintenance when disasters, such as storms or droughts, occur. Storm-damaged trees can often be dangerous to remove or trim. An arborist can assist in advising or performing the job in a safe manner while reducing further risk of damage to property.

Plant Health Care, a concept of preventive maintenance to keep trees in good health, will help a tree better defend itself against insects, disease, and site problems. Arborists can help determine proper plant health so the city's tree population will remain healthy, thus providing benefits to the community for as long as possible.

Integrated Pest Management is a process involving common sense and sound solutions for treating and controlling pests. These solutions incorporate basic steps: identifying the problem, understanding pest biology, monitoring trees, and determining action thresholds. The practice of Integrated Pest Management can differ dramatically site by site, and tree by tree; a qualified arborist will be able to make sure that Newburgh's trees are properly diagnosed and that a beneficial and realistic action plan is developed.

The arborist can also help with cabling or bracing for added support to branches with weak attachment, aeration to improve root growth, and installation of lightning protection systems.

Photograph 21. This white ash has been "topped" by a tree worker hired by a resident. This greatly hurts the health of the tree and makes failure much more likely in the long run. Newburgh should be sure residents have proper permission to perform work on city trees and that all work is performed by certified arborists.

Educating the community in basic tree care is a good way to promote Newburgh's urban forestry program and encourage tree planting on private property. The city should encourage citizens to water trees on the city streets adjacent to their homes and to reach out to the city if they notice any changes in the trees such as: signs or symptoms of pests, early fall foliage, or new mechanical or vehicle damage.

Community Outreach

The data that have been collected and analyzed to develop this plan contribute significant information about the tree population and can be utilized to guide the proactive management of that resource. These data can also be utilized to promote the value of the urban forest and the tree management program in the following ways:

- Tree inventory data can be utilized to justify high priority and proactive tree maintenance activities as well as tree planting and preservation initiatives.
- Species data can be utilized to guide the development of tree species selection for planting projects with an objective of improving species diversity and limiting the introduction of invasive pests and diseases.
- Information in this plan can be utilized to advise citizens about the presence of threats to urban trees (i.e., emerald ash borer).

There are various avenues for outreach. Maps can be created and posted on websites, in parks, or in business areas. Public service announcements can be developed. Articles can be written and programs developed about trees and the benefits they provide. Arbor Day or Earth Day celebrations can be magnified, and signs can be hung from trees to showcase the contributions trees provide to the community. Contests can be even created to make people aware that trees are important. Trees provide oxygen we need to breathe, shade to cool our neighborhoods, and canopies to stand under to get out of the rain.

Newburgh's data are good barometers for identifying ways to provide tangible and meaningful outreach about the urban forest.

Photograph 22. Community volunteering can complement Newburgh's tree urban forestry program by helping plant and prune young trees. Tree volunteers such as this group will help grow Newburgh's urban forest to its full potential.

Inventory and Plan Updates

Davey Resource Group recommends that the inventory and management plan be updated so that Newburgh can sustain its program and accurately project future program and budget needs:

- After all extreme weather events, conduct tree inspections and record changes in tree condition, maintenance needs, and risk/risk rating in the inventory database. Update the tree maintenance schedule and acquire the funds needed to restore trees to a safe condition. Schedule and prioritize work based on risk.
- Perform routine inspections of public trees as needed. Windshield surveys (inspections performed from a vehicle) in line with *ANSI A300 (Part 9)* (ANSI 2011) will help city staff stay current regarding changing conditions. Update the tree maintenance schedule and the budget as needed so that identified tree work may be performed efficiently. Schedule and prioritize work based on risk.
- If the recommended work cannot be completed as suggested in this plan, modify maintenance schedules and budgets accordingly.
- Update the inventory database as work is performed. Add new tree work to the schedule when work is identified through inspections or a citizen call process.
- Re-inventory the City Streets in five to seven years.
- Update all data fields.
- Revise the *Tree Management Plan* after five or seven years when the re-inventory has been completed.

Maintenance Schedule

Utilizing data from the 2015 City of Newburgh tree inventory, an annual maintenance schedule was developed that details the number and type of tasks recommended for completion each year. Davey Resource Group made budget projections using industry knowledge and public bid tabulations. A summary of the maintenance schedule is presented to the right; the complete table of estimated costs for Newburgh's five-year tree management program is presented in Appendix D.

FY 2016 **$279,989**

- **116 High or Extreme Risk Removals**
- **41 High Risk Prunes**
- **383 Stump Removals**
- **RP Cycle: 1/5 of Public Trees Cleaned**
- **YTT Cycle: 251 Trees**
- **122 Trees Recommended for Replacement Planting and Follow-Up Care**
- **Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined**

FY 2017 **$233,404**

- **248 Moderate or Low Risk Removals**
- **RP Cycle: 1/5 of Public Trees Cleaned**
- **YTT Cycle: 250 Trees**
- **122 Trees Recommended for Replacement Planting and Follow-Up Care**
- **Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined**

FY 2018 **$230,241**

- **244 Moderate or Low Risk Removals**
- **RP Cycle: 1/5 of Public Trees Cleaned**
- **YTT Cycle: 249 Trees**
- **122 Trees Recommended for Replacement Planting and Follow-Up Care**
- **Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined**

FY 2019 **$139,855**

- **RP Cycle: 1/5 of Public Trees Cleaned**
- **YTT Cycle: 251 Trees**
- **122 Trees Recommended for Replacement Planting and Follow-Up Care**
- **Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined**

FY2020 **$139,430**

- **RP Cycle: 1/5 of Public Trees Cleaned**
- **YTT Cycle: 250 Trees**
- **122 Trees Recommended for Replacment Planting and Follow-Up Care**
- **Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined**

The schedule provides a framework for completing the inventory maintenance recommendations over the next five years. Following this schedule can help tree care activities evolve from an on-demand system to a more proactive tree care program.

To implement the maintenance schedule, the city's tree maintenance budget should be no less than $279,989 for the first year of implementation, $233,404 and $230,241 for Years Two and Three, and about $140,000 for the following two years. Annual budget funds are needed to ensure that hazard trees are remediated and that critical YTT and RP Cycles can begin. With proper professional tree care, the safety, health, and beauty of the urban forest will improve.

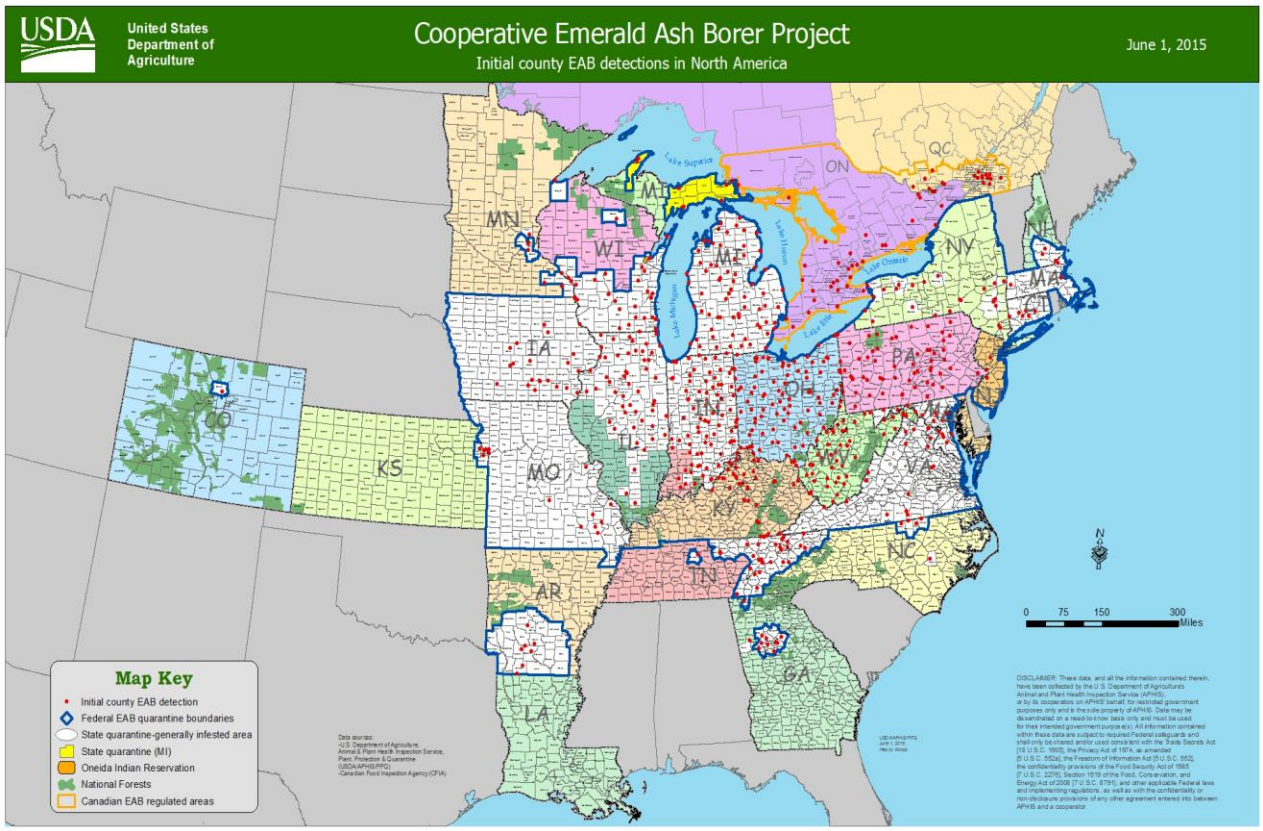
If routing efficiencies and/or contract specifications allow for the completion of more tree work, or if the schedule requires modification to meet budgetary or other needs, the schedule should be modified accordingly. Unforeseen situations, such as extreme weather events, may arise and change the maintenance needs of trees. Should conditions or maintenance needs change, budgets and equipment will need to be adjusted to meet the new demands.

Section 4. Emerald Ash Borer Strategy

Throughout the United States, urban and community forests are under increased pressure from exotic and invasive insects and diseases. Exotic pests that arrive from overseas typically have no natural predators and become invasive when our native trees and shrubs do not have appropriate defense mechanisms to fight them off. Mortality from these pests can range from two weeks with oak wilt (*Ceratocystis fagacearum*), to seven years with emerald ash borer (EAB) (*Agrilus planipennis*) or more.

An integral part of tree management is maintaining awareness of invasive insects and diseases in the area and how to best manage them. Depending on the tree diversity within Newburgh's urban forest, an invasive insect or disease has the potential to negatively impact the tree population.

This chapter provides the different management strategies for dealing with EAB. Included are sections on how to effectively monitor EAB, increase public education, handle ash debris, reforestation, work with stakeholders, and utilize ash wood. Appendix E contains additional EAB reference materials.



Map 1. EAB detections throughout North America as of June 1, 2015.
Map by United States Department of Agriculture,
Animal and Plant Health Inspection Service.

Emerald Ash Borer

Emerald ash borer is a small insect native to Asia. In North America, the borer is an invasive species that is highly destructive to ash trees in its introduced range. The potential damage of EAB rivals that of chestnut blight and Dutch elm disease.

Chestnut blight is a fungus that was introduced in North America around 1900. By 1940, chestnut blight virtually wiped out most of the mature American chestnut population. Chestnut blight is believed to have been imported by chestnut lumber or through imported chestnut trees. Dutch elm disease (DED) is a fungus spread sexually by the elm bark beetle. DED was first reported in the United States in 1928 and was believed to have been introduced by imported timber. Since its discovery in the United States, it has killed millions of elm trees.

EAB is thought to have been introduced into the United States and Canada in the 1990s but was not positively identified in North America until 2002 in Canton, Michigan. The presence of EAB has been confirmed in 14 states. It has killed at least 50–100 million ash trees and threatens another 7.5 billion ash trees throughout North America. New York's EAB infestation was discovered June 2009 just off Exit 16 of Route 17/I-86 in Cattaraugus County, New York. EAB was found in Orange County in 2011. See Map 2 for New York counties with known EAB infestations. EAB is a serious pest that threatens the health of all ash tree species in the state. With an estimated 11% ash trees at risk in New York's woods—and another 16% to 28% in cities and towns—the state is committed to early detection and thoughtful management of this pest. In the United States, EAB has been known to attack all native ash trees.

EAB has been identified in New York—specifically near Newburgh, at West Point—and poses a serious threat to the health and condition of Newburgh's urban forest.

Photograph 23. EAB adults grow to 5/8 inch in length (photograph credit www.wisconsin.gov).

Photograph 24. EAB larvae (photograph credit www.emeraldashborer.info).

Identification

The adult beetle is elongate, metallic green, and 3⁄8- to 5⁄8-inch long. The adult beetle emerges from late May until early August, feeding on a small amount of foliage. The adult females then lay eggs on the trunk and branches of ash trees and, in about a week, the eggs hatch into larvae, which then bore into the tree. Larvae are creamy white in color and can grow up to an inch long and are found underneath the bark of the trees. The larvae tunnel and feed on the inner bark and phloem, creating winding galleries as they feed. This cuts off the flow of the water and nutrients to the tree, causing dieback and death.

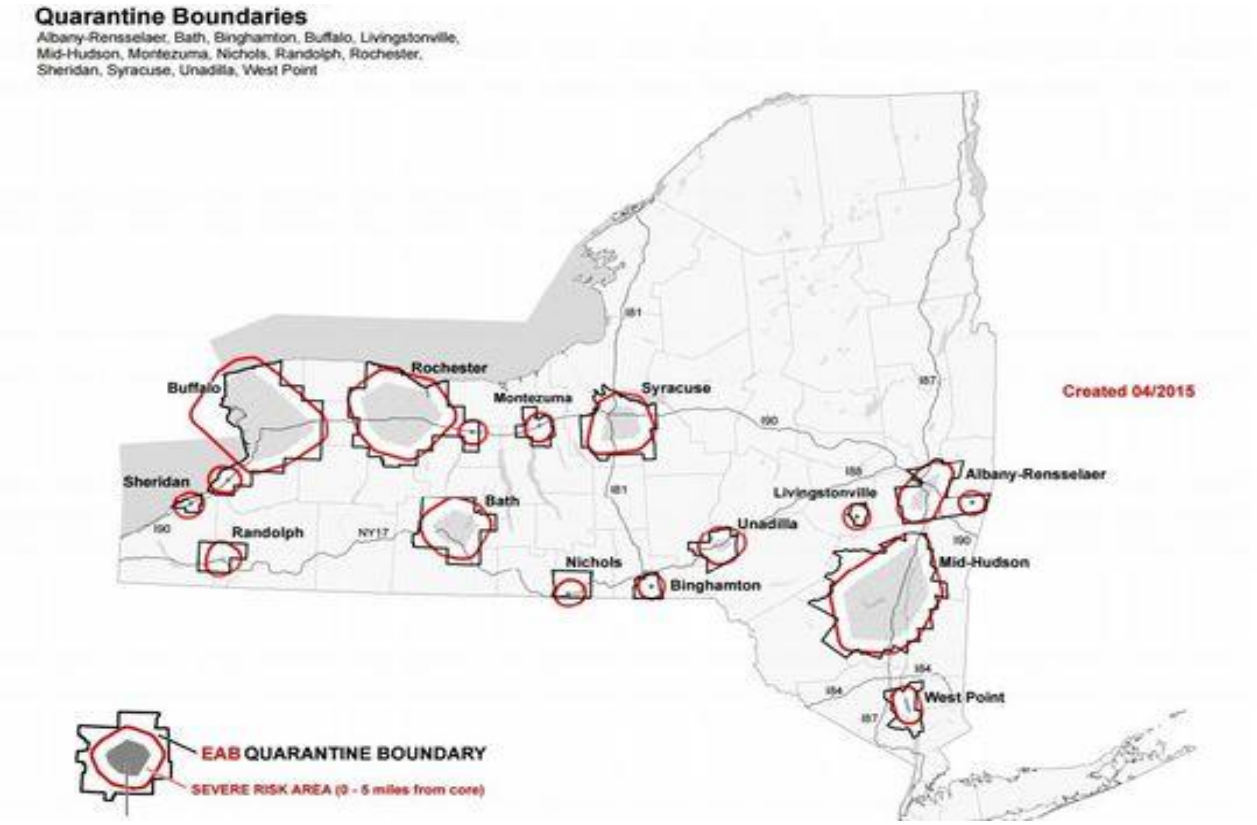
Photograph 25. Larvae consume the cambium and phloem, effectively girdling the tree and eventually causing death within a few years.

Photograph 26. This ash tree is declining from EAB infestation. The loss of water and nutrients from intense larvae tunneling can cause the trees to lose between 30% and 50% of their canopies during the first year of infestation. (Photograph courtesy http://labs.russell.wisc.edu/eab/signs-and-symptoms/).

EAB can be very difficult to detect. Initial symptoms include yellowing and/or thinning of the foliage and longitudinal bark splitting. The entire canopy may die back, or symptoms may be restricted to certain branches. Declining trees may sprout epicormic shoots at the tree base or on branches. Woodpecker injury is often apparent on branches of infested trees, especially in late winter. Removal of bark reveals tissue callusing and frass-filled serpentine tunneling. The S-shaped larval feeding tunnels are about 1⁄4 inch in diameter. Tunneling may occur from upper branches to the trunk and root flare. Adults exit from the trunk and branches in a characteristic D-shaped exit hole that is about 1/8 inch in diameter. The loss of water and nutrients from the intense larvae tunneling can cause trees to lose between 30% and 50% of their canopies during the first year of infestation. Trees often die within two years following infestation.

New York/Federal Response

The New York Department of Agriculture (MDA) is the leading agency responsible for control of invasive pests in New York. The federal agency USDA-APHIS assists with regulatory and control action of invasive pests. The MDA has declared EAB a public nuisance in New York and has enacted a quarantine restricting the movement of ash trees and non-coniferous firewood.



Map 2. New York is under a federal quarantine to limit the spread of EAB.

Federal agencies have been actively researching control measures, including biological controls, developing resistant species, and testing various insecticides. Since 2003 American scientists, in conjunction with the Chinese Academy of Forestry, have searched for natural enemies of EAB in the wild. This has led to the discovery of several parasitoid wasps, namely *Tetrastichus planipennisi*, a gregarious larval endoparasitoid; *Oobius agrili*, a solitary, parthenogenic egg parasitoid; and *Spathius agrili*, a gregarious larval ectoparasitoid. These parasitoid wasps have been released into the Midwestern United States as a possible biological control of EAB. States that have released parasitoid wasps include Indiana, Michigan, and Minnesota.

Ash Population

With the threat of EAB nearing Newburgh, it is crucial that the city has an action plan. Some of the most important questions to answer will be:

- How many ash trees do we have?
- Where are they located?
- What actions should we take?

In order to answer these questions, Newburgh needs to maintain an up-to-date inventory, know what resources are available, and understand the city's priorities.

Based on the current public tree inventory, there are 89 ash trees distributed throughout the city's urban forest. Of these, 41 were recommended for removal based on health or safety concerns identified during the 2015 inventory. The majority of the ash population was in Fair (87%) condition, with a significant smaller percentage in Poor (9%) or Good condition (4%). Table 2 reflects the diameter class of each ash tree by the condition class. Of the 89 ash trees inventoried, 1 was identified as showing potential signs and symptoms of EAB.

Table 2. Tree Condition Versus Diameter Class Matrix

	1–3	4–6	7–12	13–18	19–24	25–30	31–36	37–42	43+	Total
Excellent	0	0	0	0	0	0	0	0	0	0
Very Good	0	0	0	0	0	0	0	0	0	0
Good	0	1	2	1	0	0	0	0	0	4
Fair	1	4	33	28	8	0	1	0	2	77
Poor	1	0	2	2	1	0	1	0	1	8
Critical	0	0	0	0	0	0	0	0	0	0
Dead	0	0	0	0	0	0	0	0	0	0
Total	2	5	37	31	9	0	2	0	3	89

Ash Tree Risk Reduction Pruning and Removals

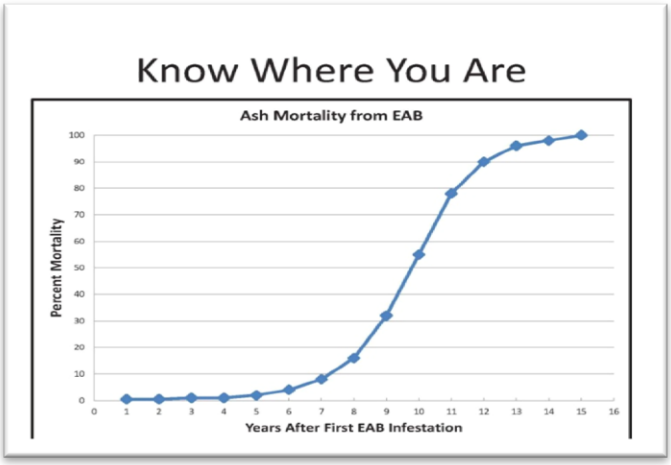
As the infestation of EAB approaches Newburgh, the city's highest priority is to focus budgeted funds and personnel to concentrate more closely on the ash tree population. Davey Resource Group recommends that Newburgh perform both treatment and safety related activities on ash trees. This activity will end up saving money and increasing productivity in Newburgh.

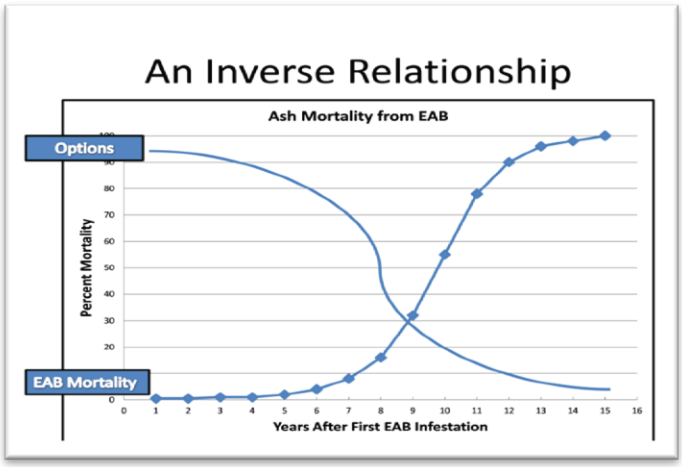
Davey Resource Group also recommends that Newburgh proactively remove ash trees during road reconstruction projects and other public works associated activities. By proactively removing ash trees during construction, the cost and impacts should be lower.

Davey Resource Group recommends that Newburgh remove all ash trees less than 7 inches DBH, as well as trees that are rated as Poor, Critical, or Dead condition first. We also recommend that Fair trees between 7 and 12 inches be removed. These trees provide little benefit or have current health problems.

EAB Management Options

Newburgh should explore different options for managing EAB. With the city striving to be proactive in EAB management before an infestation occurs, Newburgh has developed multiple management strategies. The graphs below present a unique tool for a city when deciding on viable management options for varying levels of EAB infestations. Considering its proximity to the West Point infestation, Newburgh can be placed at Year Four on both graphs after first EAB infestation. At this position, the city has time to prepare as well as select a management option. When infestation occurs, as depicted in the graph, the city's options for management decrease.





Source: Emerald Ash University (www.emeraldashborer.info)

EAB Management

EAB Management Options

With no specific strategy or budget in place for the impending infestation of EAB, Newburgh should explore strategies for managing EAB that provide the most economic benefit and increase public safety. These EAB management strategies include doing nothing, remove and replace all ash, treat all ash, or a combination of the strategies. The following are current strategies for managing EAB and costs associated with these strategies.

Photograph 27. This is an example of a Do Nothing strategy. These ash trees became infested with EAB and eventually died. They have now become a public safety issue.

EAB Strategy 1: Do Nothing

This means letting EAB run its course and having no strategy for dealing with EAB. This strategy includes not removing and not treating any ash trees. This strategy is economical in the beginning of an infestation because it doesn't cost the city any money, but it would become an extreme public safety issue within a few years. Davey Resource Group does not recommend this management strategy.

EAB Strategy 2: Remove and Replace All Ash

By the end of 2016, remove and replace all 89 ash trees. This strategy would benefit public safety from the EAB infestation but would have an impact on the city's budget. In order to achieve this strategy and remove all of the ash trees by 2016, the city would most likely have to contract work out. Removing mature ash trees in Good and Fair condition would take away all of the valuable benefits that these trees provide to the city and would leave some areas with a full canopy of ash with no moderate- or large-sized trees at all. This strategy ultimately benefits the city by increasing public safety but requires a lot of upfront cost. It will be very important to replace all of these ash trees once they have been removed.

The total approximate cost for this strategy would be $55,435: $33,275 would be the approximate cost to remove all ash trees; $3,580 would be the approximate cost to remove all stumps; and $19,580 would be the approximate cost to replace all ash trees. Refer to Table 3.

Table 3. Cost to Remove and Replace All Ash

Management Strategy	Management Action	# of Trees	Cost
Remove and Replace All Ash Trees	Removal All	89	$32,275
	Replace All	89	$19,580
	Stump Removal	89	$3,580
	Total		$55,435

EAB Strategy 3: Treat all Ash

Treating all of Newburgh's ash trees could reduce the annual mortality rate, stabilize removals, and would be less expensive than removing and replacing all ash trees. Treating all ash would enable these trees to keep providing the city with the monetary benefits that they provide. On the other hand, treating all ash trees is not an ideal practice because some of these ash trees eventually become infested with EAB and some are less desirable to retain.

If Newburgh wanted to treat all of its 89 ash trees every two years, it would cost approximately $22,653 over a six-year period. This means that it would cost the city approximately $7,551 every two years to treat the 89 ash trees.

Table 4. Cost to Treat All Ash

Management Strategy	Management Action	# of Trees	Cost
Treat All Ash Trees	Treat all Ash Trees for Six Years	89	$22,653

EAB Strategy 4: Combination of Removals and Treatment

This strategy is intended to give the city options for a combination of removing and treating ash trees to stabilize annual removals, annual budgets, and prolong the life of ash trees in Good and Fair condition. Table 5 is an EAB matrix table that is intended to organize trees that should be considered for removal and trees that should be considered for treatment. The following sections explain why certain ash trees should be considered for removal and treatment.

Table 5. EAB Matrix Table

		1–3	4–6	7–12	13–18	19–24	25–30	31–36	37–42	43+	Total
Condition Class	Excellent	0	0	0	0	0	0	0	0	0	0
	Very Good	0	0	0	0	0	0	0	0	0	0
	Good	0	1	2	1	0	0	0	0	0	4
	Fair	1	4	33	28	8	0	1	0	2	77
	Poor	1	0	2	2	1	0	1	0	1	8
	Critical	0	0	0	0	0	0	0	0	0	0
	Dead	0	0	0	0	0	0	0	0	0	0
	Total	2	5	37	31	9	0	2	0	3	89

Based on these numbers, Davey Resource Group makes the following recommendations:

47 Trees for Removal

- Trees in the "Poor," "Critical," and "Dead" condition class are recommended for removal because they are more susceptible to EAB infestation. If these trees are not removed, they could pose a public safety issue in the future. A total of 8 trees are recommended for removal and replacement.
- The remaining 39 trees are <7 inches DBH, or are in Fair condition and between 7" and 12" DBH, are recommended for removal and replacement. These trees don't provide as many benefits to the community compared to mature ash trees. It would be in the best interest of the city to remove these trees and replace them with a more diversified mix of trees.

39 Candidate Trees for Chemical Treatment (Low–Moderate Probability of Treatment)

- The intent here is to defer removal of a large block of Fair conditioned trees matrix between 13 inches and 43+ inches DBH. These 39 trees are considered to be low–moderate priority for chemical treatment. Eventually a lot of these trees will become infested with EAB and, therefore, have to be removed in a timely manner. However, treating these trees could stabilize annual budgets and removals each year. Treatment can be economically beneficial and reduce the chance for a public safety issue in the near future.

3 Candidate Trees for Chemical Treatment (High Probability of Treatment)

- Candidates for chemical treatment will exhibit Fair condition or better with no more than 30% dieback and are located in an appropriate site (i.e., not under overhead utilities). Treating these 3 ash trees will help keep these trees around for a long time; the city will profit from the monetary benefits these ash trees provide.

Table 6. Costs Associated with Combination Treatment and Removal EAB Strategy

Activity	Diameter	Cost/Tree	# of Trees	Total Cost
Removal	1–3"	$25	2	$50
	4–6"	$105	5	$525
	7–12"	$220	35	$7,700
	13–18"	$355	2	$710
	19–24"	$525	1	$525
	25–30"	$845	0	$0
	31–36"	$1,140	1	$1,140
	37–42"	$1,470	0	$0
	43"+	$1,850	1	$1,850
Activity Total(s)			**47**	**$12,500**
Treatment (over six years)	1–3"	$9	0	$0
	4–6"	$30	0	$0
	7–12"	$57	2	$342
	13–18"	$93	29	$8,091
	19–24"	$129	8	$3,096
	25–30"	$165	0	$0
	31–36"	$201	1	$603
	37–42"	$237	0	$0
	43"+	$276	2	$1,656
Activity Total(s)			**42**	**$13,788**
Stump Removal	1–3"	$25	2	$50
	4–6"	$25	5	$125
	7–12"	$25	35	$875
	13–18"	$40	2	$80
	19–24"	$60	1	$60
	25–30"	$85	0	$0
	31–36"	$110	1	$110
	37–42"	$130	0	$0
	43"+	$160	1	$160
Activity Total(s)			**47**	**$1,460**
Replanting		$220	47	$10,340
Activity Total(s)			**47**	**$10,340**
Option Totals			**183**	**$38,088**

For maximum retention of urban tree canopy, Davey Resource Group recommends that the City of Newburgh treat all ash trees that are low, moderate, and high candidates for treatment, and that the rest of the ash trees be removed. Davey Resource Group also recommends that all stumps be removed and that replacement trees be planted immediately. Table 6 shows that the cost will be approximately $38,088 during the first six years of the strategy. While this is only slightly lower than the cost to remove all ash trees, this option means that many beautiful, shady trees will be saved. After six years, treatment costs will be something less than $4,500 every two years, depending on ash tree mortality.

Private Trees

Photograph 28. Hangers will help make private homeowners aware of the management options available for EAB.

In addition to ash trees located on public property, EAB will impact trees located on private property. The number of private ash trees is unknown but it could be equal to or greater than the ash trees located on public property. During the inventory, it was evident to the inventory arborists that there is an abundance of ash trees located on private properties. The cost to remove ash trees will be higher on private property due to greater inaccessibility to these areas. It is crucial that the city promotes public education about EAB so that it can reduce the potential of city involvement with regulating tree removals on private properties. The public education section explains more on how to minimize anxiety from private homeowners. The section also provides examples on how to go about informing the public about managing their ash trees.

Dying and infested ash trees on private property will pose a threat to human and public safety. In the event that city officials have to get involved with private property owners about a potential infested ash tree, Newburgh should consider utilizing the current city tree and landscape ordinance. Newburgh should consider amending the ordinance so that EAB is specifically acknowledged as a public nuisance and treated in similar fashion as Dutch elm disease and other insect pests or plant diseases.

Public Education

It is crucial for Newburgh property owners to be well informed about EAB. Their assistance and cooperation will be vital in helping detect EAB, managing ash trees on private property, and expediting reforestation that will occur after removals of infected ash trees are complete. Newburgh should inform the public that EAB has been discovered in Orange County. If EAB should be identified in Newburgh itself, the public must be immediately informed. If the public is well informed, they are more likely to accept what is happening without panicking and cooperate with the city's requests. The following are examples of how the city should go about informing the public:

- News release
- City newsletter articles
- Radio programs
- Post information about EAB on the city's website

It is vital for Newburgh to educate the public on how to detect EAB, provide information about treatment options, and relay the importance for reforestation. If the public is advised on how to detect for EAB, they can make proactive choices about managing infested ash trees. This could help put city officials at ease by not having as many private trees become a public safety issue. Property owners may want to keep their ash trees because of the benefits they receive from them.

Photograph 29. Posting information about EAB on ash trees around the city could encourage private homeowners to become more proactive in managing their ash trees.

The city should provide information about treatment options so that their trees can last for years to come. It will be important for the city to inform the public about reforestation, the important benefits trees provide to neighborhoods, and how trees increase real estate value. This can help fund and promote neighborhood tree plantings. The following are examples of ways the city can inform the public about these issues.

- Display information packets at public buildings
- Postcard mailings to ash tree owners
- Door hangers explaining maintenance options
- Presentations to community groups
- Post information about EAB on the city's website
- Tie ribbons around ash trees and place tags on the trees with information about EAB

Reforestation

As the ash tree population is being reduced in Newburgh, the city will need to come up with a plan to replant where ash trees have been removed. The city could potentially lose over 2% of its tree population due to EAB. A prompt reforestation in Newburgh is essential due to the numerous benefits ash trees provide to the community. Benefits include removing pollutants from the air, helping moderate temperatures, reducing stormwater runoff, and providing social and psychological benefits.

If the city is able to replace all of the ash trees, it will cost approximately $55,435. This would be a financial burden on the city, but it will be important that these trees be replaced. The cost of replanting ash trees could be spread out over multiple years by establishing a goal that a certain amount of trees need to be planted each year. If the city was to plant 20 trees a year, Newburgh could replace all of the ash trees within 5 years. This cost could be reduced if the city comes up with a plan to work with volunteers and private property owners. This could include giving private property owners the option of paying for the tree and getting to pick the tree they want from a list of recommended species. Newburgh should also explore grants for reforestation. Organizing volunteer groups to participate in planting trees could help decrease the cost for planting trees.

It is important to consider diversification when replacing ash trees. Without diversification, a community is much more vulnerable to catastrophic losses that impact budgets and community appearance. Davey Resource Group recommends that at most, no one species represents more than 10% and that no one genera comprise more than 20% of the total public tree population. Even smaller percentages would reduce the likelihood of major loss due to future infestation from another pest or disease. Since EAB has hit local communities, there might be a possibility that local nurseries have a shortage of trees. Newburgh might want to consider nurseries in other regions for trees.

Conclusions

Every hour of every day, public trees in Newburgh are supporting and improving the quality of life. Specifically, Newburgh's urban forest is currently providing approximately $431,226 in benefits annually. When properly maintained, trees provide a community with abundant environmental, economic, and social benefits far in excess of the time and money invested in planting, pruning, protection, and removal.

Managing trees in urban areas is often complicated. Navigating the recommendations of experts, the needs of residents, pressures of local economics and politics, concerns for public safety and liability, the physical aspects of trees, forces of nature and severe weather events, and the expectation that these issues are resolved all at once is a considerable challenge. The City of Newburgh should implement its selected EAB Strategy as soon as possible.

The city must carefully consider these challenges to fully understand the needs of maintaining an urban forest. With the knowledgeable and wherewithal to address the needs of its trees, the City of Newburgh is well-positioned to thrive. If the management program is successfully implemented, the health and safety of Newburgh's trees and citizens will be maintained for years to come.

Photographs 30 and 31. This* Alnus glutinosa *(common alder) is another species which could be planted to increase the diversity of Newburgh's urban forest. Its gorgeous form and colorful fruits provide a striking visual accent year round.

Glossary

aboveground utilities (data field): Shows the presence or absence of overhead utilities at the tree site.

address number (data field): The address number was recorded based on the visual observation by the Davey Resource Group arborist at the time of the inventory of the actual address number posted on a building at the inventoried site. In instances where there was no posted address number on a building or sites were located by vacant lots with no GIS parcel addressing data available, the address number assigned was matched as closely as possible to opposite or adjacent addresses by the arborist(s) and an "X" was added to the number in the database to indicate that the address number was assigned.

American National Standards Institute (ANSI): ANSI is a private, nonprofit organization that facilitates the standardization work of its members in the United States. ANSI's goals are to promote and facilitate voluntary consensus standards and conformity assessment systems, and to maintain their integrity.

***ANSI A300* standards:** Tree care performance parameters established by ANSI that can be used to develop specifications for tree maintenance.

arboriculture: The art, science, technology, and business of commercial, public, and utility tree care.

clean (primary maintenance need): Based on *ANSI A300 Standards*, selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk.

community forest: see **urban forest**.

condition (data field): The general condition of each tree rated during the inventory according to the following categories adapted from the International Society of Arboriculture's rating system: Excellent (100%), Very Good (90%), Good (80%), Fair (60%), Poor, (40%), Critical (20%), Dead (0%).

cycle: Planned length of time between vegetation maintenance activities.

diameter at breast height (DBH): See **tree size**.

diameter: See **tree size**.

Extreme Risk tree: The Extreme Risk category applies in situations where tree failure is imminent and there is a high likelihood of impacting the target, and the consequences of the failure are "severe". In some cases, this may mean immediate restriction of access to the target zone area to avoid injury to people.

failure: In terms of tree management, failure is the breakage of stem or branches, or loss of mechanical support of the tree's root system.

further inspection (data field): Notes that a specific tree may require an annual inspection for several years to make certain of its maintenance needs. A healthy tree obviously impacted by recent construction serves as a prime example. This tree will need annual evaluations to assess the impact of construction on its root system. Another example would be a tree with a defect requiring additional equipment for investigation.

genus: A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature, the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.

geographic information system (GIS): A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates.

global positioning system (GPS): GPS is a system of earth-orbiting satellites that make it possible for people with ground receivers to pinpoint their geographic location.

High Risk tree: The High Risk category applies when consequences are "significant" and likelihood is "very likely" or "likely", or consequences are "severe" and likelihood is "likely". In population of trees, the priority of High Risk trees is second only to Extreme Risk trees.

invasive, exotic tree: A tree species that is out of its original biological community. Its introduction into an area causes or is likely to cause economic or environmental harm, or harm to human health. An invasive, exotic tree has the ability to thrive and spread aggressively outside its natural range. An invasive species that colonizes a new area may gain an ecological edge since the insects, diseases, and foraging animals that naturally keep its growth in check in its native range are not present in its new habitat.

inventory: See **tree inventory**.

i-Tree Streets: i-Tree Streets is a tree management and analysis tool that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO_2 reduction, stormwater control, and property value increase.

i-Tree Tools: State-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the structure of community trees and the environmental services that trees provide.

location (data fields): A collection of data fields collected during the inventory to aid in finding trees, including address number, street name, site number, side, and block side.

Low Risk tree: The Low Risk category applies when consequences are "negligible" and likelihood is "unlikely"; or consequences are "minor" and likelihood is "somewhat likely". Some trees with this level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required.

Management Costs: Used in i-Tree Streets, they are the expenditures associated with urban tree management presented in total dollars, dollars per tree, and dollars per capita.

mapping coordinate (data field): Helps to locate a tree; X and Y coordinates were generated for each tree using GPS.

Moderate Risk tree: The Moderate Risk category applies when consequences are "minor" and likelihood is "very likely" or "likely"; or likelihood is "somewhat likely" and consequences are "significant" or "severe." In populations of trees, Moderate Risk trees represent a lower priority than High or Extreme Risk trees.

monoculture: A population dominated by one single species or very few species.

none (risk rating): Equal to zero. It is used only for planting sites and stumps.

notes (data field): Describes additional pertinent information.

ordinance: See **tree ordinance**.

plant tree (primary maintenance need): If collected during an inventory, this data field identifies vacant planting sites as small, medium, or large (indicating the ultimate size that the tree will attain), depending on the growspace available and the presence of overhead wires.

primary maintenance need (data field): The type of tree work needed to reduce immediate risk.

pruning: The selective removal of plant parts to meet specific goals and objectives.

removal (primary maintenance need): Data field collected during the inventory identifying the need to remove a tree. Trees designated for removal have defects that cannot be cost-effectively or practically treated. Most of the trees in this category have a large percentage of dead crown.

right-of-way (ROW): See **street right-of-way**.

risk: Combination of the probability of an event occurring and its consequence.

risk assessment (data fields): The risk assessment is a Level 2 qualitative risk assessment based on the ANSI A300 (Part 9) and the companion publication *Best Management Practices: Tree Risk Assessment*, published by the International Society of Arboriculture (2011). Trees can have multiple failure modes with various risk ratings. One risk rating will be assigned per tree. The failure mode having the greatest risk will serve as the overall tree risk rating. The specified time period for the risk assessment is one year. The data from the risk assessment is used to calculate the risk rating that is ultimately assigned to the tree.

risk rating (data fields): Calculated from the field risk assessment data (see **risk assessment**), the overall risk rating of the tree will be determined based on combining the likelihood of tree failure impacting a target and the consequence of failure. In this Plan, the risk rating was used to identify the severity of risk assigned to a tree and to prioritize tree maintenance needs. The following categories were used:

- Extreme Risk tree
- High Risk tree
- Moderate Risk tree
- Low Risk tree
- None (used only for planting sites and stumps)

species (data fields): Fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

stem: A woody structure bearing buds and foliage, and giving rise to other stems.

stems (data field): Identifies the number of stems or trunks splitting less than one foot above ground level.

street name (data field): The name of a street right-of-way or road identified using posted signage or parcel information.

street right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

street tree: A street tree is defined as a tree within the right-of-way.

structural defect: A feature, condition, or deformity of a tree or tree part that indicates weak structure and contributes to the likelihood of failure.

topping: Topping, reducing tree size using internodal cuts without regard to tree health or structural integrity, is not an acceptable pruning practice.

tree benefit: An economic, environmental, or social improvement that benefits the community and results mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

tree inventory: Comprehensive database containing information or records about individual trees typically collected by an arborist.

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

tree size (data field): A tree's diameter measured to the nearest inch in one-inch size classes at 4.5 feet above ground, also known as diameter at breast height (DBH) or diameter.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, in parks and greenspaces, in forests, and on private property.

young tree train (primary maintenance need): Data field based on *ANSI A300* standards, pruning of young trees to correct or eliminate weak, interfering, or objectionable branches to improve structure. These trees, up to 20 feet in height, can be worked with a pole pruner by a person standing on the ground.

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Appendix A
Site Location Methods

Equipment and Base Maps

Inventory arborists use CF-19 Panasonic Toughbook® unit(s) and Trimble® GPS Pathfinder® ProXH™ receiver(s).

Base map layers were loaded onto these unit(s) to help locate sites during the inventory. The table below lists the base map layers utilized, along with source and format information for each layer.

Base Map Layers Utilized for Inventory

Imagery/Data Source	Date	Projection
Orange County, New York GIS	2014	NAD 1983 StatePlane New York East Feet
Imagery from New York GIS Clearinghouse	2013	NAD 1983 StatePlane New York East Feet

Street ROW Site Location

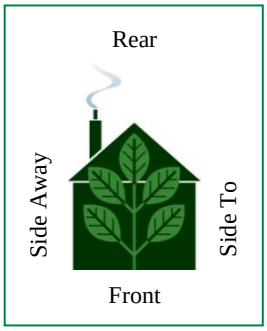
Individual street ROW sites (trees and stumps) were located using a methodology developed by Davey Resource Group that identifies sites by *address number*, *street name*, or *side*. This methodology allows for consistent assignment of location.

Address Number and Street Name

The *address number* was recorded based on visual observations by the arborist at the time of the inventory (the address number was posted on a building at the inventoried site). Where there was no posted address number on a building or where the site was located by a vacant lot with no GIS parcel addressing data available, the assigned address number was matched as closely as possible to opposite or adjacent addresses by the arborist. An "X" was then added to the number in the database to indicate that it was assigned (for example, "37X Choice Avenue").

Sites in medians or islands were assigned an address number using the address on the right side of the street in the direction of collection closest to the site. Each segment was numbered with an assigned address that was interpolated from addresses facing that median/island. If there were multiple median/islands between cross streets, each segment was assigned its own address.

The *street name* assigned to a site was determined by street ROW parcel information and posted street name signage.



Side values for street ROW sites.

Side Value and Site Number

Each site was assigned a *side value*. Side values include: *front*, *side to*, *side away*, *median* (includes islands), or *rear* based on the site's location in relation to the lot's street frontage. The *front side* is the side that faces the address street. *Side to* is the name of the street the arborist walks towards as data are being collected. *Side from* is the name of the street the arborist walks away from while collecting data. *Median* indicates a median or island. The *rear* is the side of the lot opposite of the front.

Block Side

Block side information for a site includes the *on street*.

- The *on street* is the street on which the site is located. The *on street* may not match the address street. A site may be physically located on a street that is different from its street address (i.e., a site located on a side street).

Site Location Examples

The tree trimming crew in the truck traveling westbound on E Mac Arthur Street is trying to locate an inventoried tree with the following location information:

Address/Street Name:	226 E. Mac Arthur Street
Side:	Side To
Site Number:	1
On Street:	Davis Street
From Street:	Taft Street
To Street:	E. Mac Arthur Street.

The tree site circled in red is the site the crew is looking for. Because the tree is located on the side of the lot, the *on street* is Davis Street, even though the site is addressed as 226 East Mac Arthur Street. Moving with the flow of traffic, *the from* street is Taft Street, and the *to street* is East Mac Arthur Street.

Location information collected for inventoried trees at Corner Lots A and B.

Corner Lot A

Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 1
On Street:	Taft St.
From Street:	E Mac Arthur St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 2
On Street:	Taft St.
From Street:	E Mac Arthur St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 3
On Street:	Taft St.
From Street:	19th St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Front / 1
On Street:	Hoover St.
From Street:	Taft St.
To Street:	Davis St.

Corner Lot B

Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Side To / 1
On Street:	Davis St.
From Street:	Hoover St.
To Street:	E Mac Arthur St.
Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Front / 1
On Street:	E Mac Arthur St.
From Street:	Davis St.
To Street:	Taft St.
Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Front / 2
On Street:	E Mac Arthur St.
From Street:	Davis St.
To Street:	Taft St.

Appendix B
Suggested Tree Species

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is designed to assist all relevant community personnel in selecting appropriate tree species. These trees have been selected because of their aesthetic and functional characteristics and their ability to thrive in soil and climate (USDA Zones 5 and 6) conditions found throughout New York.

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer saccharum	sugar maple	'Legacy'
Acer nigrum	black maple	
*Betula alleghaniensis**	yellow birch	
*Betula lenta**	sweet birch	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Carya illinoensis**	pecan	
*Carya lacinata**	shellbark hickory	
*Carya ovata**	shagbark hickory	
*Castanea mollissima**	Chinese chestnut	
Celtis laevigata	sugarberry	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
*Diospyros virginiana**	common persimmon	
*Fagus grandifolia**	American beech	
*Fagus sylvatica**	European beech	(Numerous exist)
Ginkgo biloba	ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans nigra**	black walnut	
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	'Rotundiloba'
*Liriodendron tulipifera**	tuliptree	'Fastigiatum'
*Magnolia acuminata**	cucumbertree magnolia	(Numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	blackgum	
*Platanus occidentalis**	American sycamore	
Platanus × acerifolia	London planetree	'Yarwood'
Quercus alba	white oak	

Large Trees: Greater than 45 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	
Quercus montana	chestnut oak	
Quercus muehlenbergii	chinkapin oak	
Quercus imbricaria	shingle oak	
Quercus phellos	willow oak	
Quercus robur	English oak	Heritage®
Quercus rubra	northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common bald cypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
Tilia × euchlora	Crimean linden	
Tilia tomentosa	silver linden	'Sterling'
Ulmus parvifolia	Chinese elm	Allée®
Zelkova serrata	Japanese zelkova	'Green Vase'

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
Alnus cordata	Italian alder	
*Asimina triloba**	pawpaw	
Cladrastis kentukea	American yellowwood	'Rosea'
Corylus colurna	Turkish filbert	
Eucommia ulmoides	hardy rubber tree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	Amur corktree	'Macho'
Pistacia chinensis	Chinese pistache	
Prunus maackii	Amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
*Sassafras albidum**	sassafras	

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer buergerianum	trident maple	Streetwise®
Acer campestre	hedge maple	Queen Elizabeth™
Acer cappadocicum	coliseum maple	'Aureum'
Acer ginnala	Amur maple	Red Rhapsody™
Acer griseum	paperbark maple	
Acer oliverianum	Chinese maple	
*Acer pensylvanicum**	striped maple	
Acer triflorum	three-flower maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(Numerous exist)
Amelanchier laevis	Allegheny serviceberry	
*Carpinus caroliniana**	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Chionanthus virginicus	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus kousa	kousa dogwood	(Numerous exist)
Cornus mas	corneliancherry dogwood	'Spring Sun'
Corylus avellana	European filbert	'Contorta'
*Cotinus coggygria**	common smoketree	'Flame'
*Cotinus obovata**	American smoketree	
*Crataegus phaenopyrum**	Washington hawthorn	Princeton Sentry™
Crataegus viridis	green hawthorn	'Winter King'
*Franklinia alatamaha**	Franklinia	
*Halesia tetraptera**	Carolina silverbell	'Arnold Pink'
Laburnum × watereri	goldenchain tree	
Maackia amurensis	Amur maackia	
*Magnolia × soulangiana**	saucer magnolia	'Alexandrina'
*Magnolia stellata**	star magnolia	'Centennial'
*Magnolia tripetala**	umbrella magnolia	
*Magnolia virginiana**	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(Disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	'Pendula'
Prunus virginiana	common chokecherry	'Schubert'
*Staphylea trifolia**	American bladdernut	
Stewartia ovata	mountain stewartia	
*Styrax japonicus**	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Note: * denotes species that are **not** recommended for use as street trees.

Coniferous and Evergreen Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Abies balsamea	balsam fir	
Abies concolor	white fir	'Violacea'
Cedrus libani	cedar of Lebanon	
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
× *Cupressocyparis leylandii*	Leyland cypress	
Ilex opaca	American holly	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Pinus taeda	loblolly pine	
Pinus virginiana	Virginia pine	
Psedotsuga menziesii	Douglas-fir	
Thuja plicata	western arborvitae	(Numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Chamaecyparis thyoides	Atlantic whitecedar	(Numerous exist)
Juniperus virginiana	eastern redcedar	
Pinus bungeana	lacebark pine	
Pinus flexilis	limber pine	
Pinus parviflora	Japanese white pine	
Thuja occidentalis	eastern arborvitae	(Numerous exist)

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Ilex × *attenuata*	Foster's holly	
Pinus aristata	bristlecone pine	
Pinus mugo mugo	mugo pine	

This suggested species list was compiled through the use of the excellent references *Dirr's Hardy Trees and Shrubs* (Dirr 2003) and *Manual of Woody Landscape Plants (5th Edition)* (Dirr 1998). Cultivar selections are recommendations only and are based on Davey Resource Group's experience; tree availability will vary by nursery.

Appendix C
Invasive Pests and Diseases That Affect Trees

In today's worldwide marketplace, the volume of international trade carries increased potential for pests and diseases to invade our country. Many of these pests and diseases have seriously damaged rural and urban landscapes and have resulted in billions of dollars in lost revenue and millions of dollars in clean-up costs. Keeping these pests and diseases out of the country is the number one priority of the United States Department of Agriculture's (USDA) Animal and Plant Inspection Service (APHIS).

Although some invasive species enter the United States naturally via wind, ocean currents, and other means, most species enter with help from human activities. Invasive species being introduced to our country is a byproduct of cultivation, commerce, tourism, and travel. Many species enter the United States each year via baggage, cargo, contaminants of commodities, or mail.

Once in the U.S., hungry pests grow and rapidly spread because controls, such as native predators, are lacking. Invasive pests disrupt the landscape by pushing out native species, reducing biological diversity, killing trees, altering wildfire intensity and frequency, and damaging crops. Some pests may even push species to extinction. The following key pests and diseases have adversely affected trees in America at the time of this plan's development. This list is not comprehensive and may not include all threats.

It is critical to the management of community trees to routinely check APHIS, USDA Forest Service, and other websites for updates about invasive species and diseases in your area and in our country. Staying apprised of all potential threats is important so that you can be prepared if invasive species and diseases arrive.

APHIS, Plant Health, Plant Pest Program Information
- www.aphis.usda.gov/plant_health/plant_pest_info

The University of Georgia, Center for Invasive Species and Ecosystem Health
- www.bugwood.org

USDA National Agricultural Library
- www.invasivespeciesinfo.gov/microbes

USDA Northeastern Areas Forest Service, Forest Health Protection
- www.na.fs.fed.us/fhp

Asian Longhorned Beetle

The Asian longhorned beetle (ALB, *Anoplophora glabripennis*) is an exotic pest threatening a variety of hardwood trees in North America. First introduced in Chicago, New Jersey, and New York City, the beetle is believed to have arrived in the United States via wood pallets and other wood-packing material accompanying cargo shipments from Asia. ALB is a serious threat to America's hardwood tree species.

Adult Asian longhorned beetle.

Photograph courtesy of New Bedford Guide 2011.

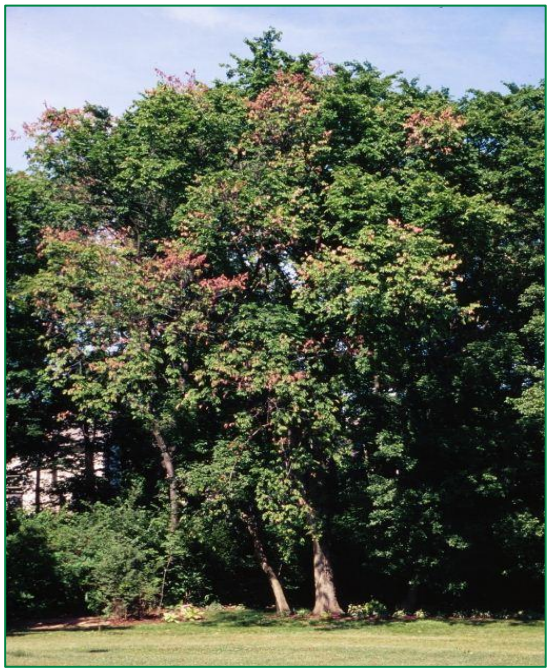
Adults are large (3/4- to 1/2-inch long) with very long, black and white banded antennae. The body is glossy black with irregular white spots. Adults can be seen from late spring to fall depending on the climate. ALB has a long list of host species; however, the beetle prefers hardwoods including several maple species. Examples include *Acer negundo* (box elder), *A. platanoides* (Norway maple), *A. saccharinum* (silver maple), *Aesculus glabra* (buckeye), *A. hippocastanum* (horsechestnut), *Betula* (birch), *Platanus* × *acerifolia* (London planetree), red maple, *Salix* (willow), sugar maple, and *Ulmus* (elm).

Dutch Elm Disease

Considered by many to be one of the most destructive, invasive diseases of shade trees in the United States, Dutch elm disease (DED) was first found in Ohio in 1930; by 1933, the disease had spread to several East Coast cities. By 1959, it had killed thousands of elms. Today, DED affects about two-thirds of the eastern United States, including Illinois, and kills many of the remaining and newly planted elms every year. The disease is caused by a fungus that attacks the vascular system of elm trees and blocks the flow of water and nutrients, which results in rapid leaf yellowing, tree decline, and death.

There are two closely related fungi that are collectively referred to as DED. The most common, *Ophiostoma novo-ulmi*, is thought to be responsible for most of the elm deaths since the 1970s. The fungus is transmitted to healthy elms by elm bark beetles. Two species carry the fungus: native elm bark beetle (*Hylurgopinus rufipes*) and European elm bark beetle (*Scolytus multistriatus)*.

The tree most affected by DED is *Ulmus americana* (American elm).



Branch death, or flagging, at multiple locations in the crown of a diseased elm.

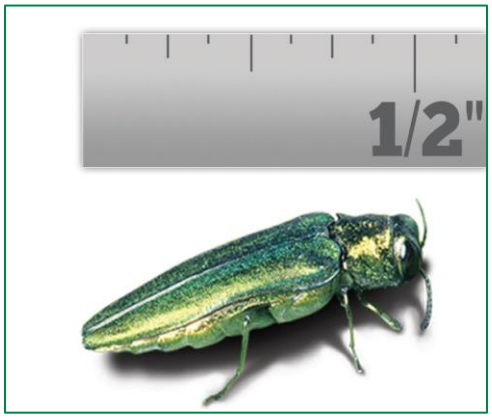
Photograph courtesy of Steven Katovich, USDA Forest Service, Bugwood.org (2011).

Emerald Ash Borer

The emerald ash borer (EAB) *(Agrilus planipennis*) is responsible for the death or decline of tens of millions of ash trees in 14 states in the American Midwest and Northeast. Native to Asia, EAB has been found in China, Japan, Korea, Mongolia, eastern Russia, and Taiwan. It likely arrived in the United States hidden in wood-packing materials commonly used to ship consumer goods and auto parts. The first official United States identification of EAB was in southeastern Michigan in 2002.

Adult beetles are slender and 1/2-inch long. Males are smaller than females. Color varies but adults are usually bronze or golden green with metallic, emerald-green wing covers. The top of the abdomen under the wings is metallic, purplish-red and can be seen when the wings are spread.

The tree species preferred as hosts by the EAB are in the genus *Fraxinus* (ash).



Close-up of the emerald ash borer.

Photograph courtesy of APHIS (2011).

Gypsy Moth

The gypsy moth (GM) *(Lymantria dispar*) is native to Europe and first arrived in the United States in Massachusetts in 1869. This moth is a significant pest because its caterpillars have voracious appetites for more than 300 species of trees and shrubs. GM caterpillars defoliate trees, leaving them vulnerable to diseases and other pests that can eventually kill the tree.

Male GMs are brown with a darker brown pattern on their wings and have a 1/2-inch wingspan. Females are slightly larger with a 2-inch wingspan and are nearly white with dark, saw-toothed patterns on their wings. Although they have wings, the female GM cannot fly.

The GM prefers approximately 150 primary hosts but feeds on more than 300 species of trees and shrubs. Some trees are found in these common genera: *Betula* (birch), *Juniperus* (cedar), *Larix* (larch), *Populus* (aspen, cottonwood, poplar), *Quercus* (oak), and *Salix* (willow).

Close-up of male (darker brown) and female (whitish color) European gypsy moths.

Photograph courtesy of APHIS (2011b).

Granulate Ambrosia Beetle

Adult granulate ambrosia beetle.

Photograph courtesy of Paul M. Choate, University of Florida (Atkinson et al. 2011).

The granulate ambrosia beetle (*Xylosandrus crassiusculus)*, formerly the Asian ambrosia beetle, was first found in the United States in 1974 on peach trees near Charleston, South Carolina. The native range of the granulate ambrosia beetle is probably tropical and subtropical Asia and it is widely introduced elsewhere. The beetle is currently found in equatorial Africa, Asia, China, Guinea, Hawaii, India, Japan, New South Pacific, Southeast Indonesia, Sri Lanka, and the United States. In the United States, this species has spread along the lower Piedmont region and coastal plain to East Texas, Florida, Louisiana, and North Carolina. Populations were found in Oregon and Virginia in 1992, and in Indiana in 2002.

Adults are small and have a reddish-brown appearance with a downward facing head. Most granulate ambrosia beetles have a reddish head region and a dark-brown to black elytra (hard casings protecting the wings). Light-colored forms that appear almost yellow have also been trapped. A granulated (rough) region is located on the front portion of the head; long setae (hairs) can be observed on the back end of the wing covers. Females are 2–2.5mm, while males are 1.5mm long. Larvae are C-shaped with a defined head capsule.

The granulate ambrosia beetle is considered an aggressive species and can attack trees that are not highly stressed. It is a potentially serious pest of ornamentals and fruit trees and is reported to be able to infest most trees and some shrubs (azalea, rhododendron), except for conifers. Known hosts in the United States include *Acer* (maple), *Albizia julibrissin* (mimosa), *Carya* (hickory), *Cercis canadensis* (redbud), *Cornus* (dogwood), *Diospyros* (persimmon), *Fagus* (beech), *Gleditsia* or *Robinia* (locust), *Juglans* (walnut), *Koelreuteria* (goldenraintree), *Lagerstroemia* (crape myrtle), *Liquidambar styraciflua* (sweet gum), *Liriodendron tulipifera* (tulip poplar), *Magnolia* (magnolia), *Populus* (aspen), *Prunus* (cherry), *Quercus* (oak), and *Ulmus parvifolia* (Chinese elm). *Carya illinoinensis* (pecan) and *Pyrus calleryana* (Bradford pear) are commonly attacked in Florida and in the southeastern United States.

Hemlock Woolly Adelgid

The hemlock woolly adelgid (HWA, *Adelges tsugae*) was first described in western North America in 1924 and first reported in the eastern United States in 1951 near Richmond, Virginia.

In their native range, populations of HWA cause little damage to the hemlock trees, as they feed on natural enemies and have become increasingly tree resistant. In eastern North America and in the absence of natural control elements, HWA attacks both *Tsuga canadensis* (eastern or Canadian hemlock) and *T. caroliniana* (Carolina hemlock), often damaging and killing them within a few years of infestation.

Currently, the HWA is established from northeastern Georgia to southeastern Maine and as far west as eastern Kentucky and Tennessee.

Hemlock woolly adelgids on branch.

Photograph courtesy of USDA Forest Service (2011a).

Oak Wilt

Oak wilt was first identified in 1944 and is caused by the fungus *Ceratocystis fagacearum*. While considered an invasive and aggressive disease, its status as an exotic pest is debatable, since the fungus has not been reported in any other part of the world. This disease affects the oak genus and is most devastating to those in the red oak subgenus, such as *Quercus coccinea* (scarlet oak), *Q. imbricaria* (shingle oak), *Q. palustris* (pin oak), *Q. phellos* (willow oak), and *Q. rubra* (red oak). The disease also attacks trees in the white oak subgenus, although it is not as prevalent and spreads at a much slower pace in these trees.

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of USDA Forest Service (2011a).

Just as with DED, oak wilt disease is caused by a fungus that clogs the vascular system of oaks and results in decline and death of the tree. The fungus is carried from tree to tree by several borers common to oaks but, more commonly, the disease is spread through root grafts. Oak species within the same subgenus (red or white) will form root colonies with grafted roots that allow the disease to move readily from one tree to another.

Pine Shoot Beetle

The pine shoot beetle (*Tomicus piniperda L.*), a native of Europe, is an introduced pest of *Pinus* (pine) in the United States. It was first discovered in the United States at a Christmas tree farm near Cleveland, Ohio in 1992. Following the first detection, the beetle has been detected in parts of 19 states (Connecticut, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, and Wisconsin).

Mined shoots on Scotch pine.

Photo courtesy of USDA Forest Service (1993).

The beetle attacks new shoots of pine trees, stunting the growth of the trees. The pine shoot beetle may also attack stressed pine trees by breeding under the bark at the base of the trees. The beetles can cause severe damage to the health of the trees and, in some cases, kill the trees when high populations exist.

Adult pine shoot beetles range from 3 to 5mm long, or about the size of a match head. They are brown or black and cylindrical. The legless larvae are about 5mm long with a white body and brown head. Egg galleries are 10–25cm long. From April to June, larvae feed and mature under the pine bark in separate feeding galleries that are 4–9cm long. When mature, the larvae stop feeding, pupate, and emerge as adults. From July through October, adults tunnel out through the bark and fly to new or 1-year-old pine shoots to begin maturation feeding. The beetles enter the shoot 15cm or less from the shoot tip and move upwards by hollowing out the center of the shoot for a distance of 2.5–10cm. Affected shoots droop, turn yellow, and eventually fall off during the summer and fall.

P. sylvestris (Scots pine) is preferred, but other pine species, including *P. banksiana* (jack pine), *P. nigra* (Austrian pine), *P. resinosa* (red pine), and *P. strobus* (eastern white pine), have been infested in the Great Lakes region.

Sirex Woodwasp

Sirex woodwasp (*Sirex noctillio*) has been the most common species of exotic woodwasp detected at United States ports-of-entry associated with solid wood-packing materials. Recent detections of sirex woodwasp outside of port areas in the United States have raised concerns because this insect has the potential to cause significant mortality of pines. Awareness of the symptoms and signs of a sirex woodwasp infestation increases the chance of early detection and, thus, the rapid response needed to contain and manage this exotic forest pest.

Close-up of female Sirex Woodwasp.

Photograph courtesy of USDA (2005).

Woodwasps (or horntails) are large robust insects, usually 1.0 to 1.5 inches long. Adults have a spear-shaped plate (cornus) at the tail end; in addition females have a long ovipositor under this plate. Larvae are creamy white, legless, and have a distinctive dark spine at the rear of the abdomen. More than a dozen species of native horntails occur in North America.

Sirex woodwasp can attack living pines, while native woodwasps attack only dead and dying trees. At low populations, sirex woodwasp selects suppressed, stressed, and injured trees for egg laying. Foliage of infested trees initially wilts, and then changes color from dark green to light green, to yellow, and finally to red, during the 3 to 6 months following attack. Infested trees may have resin beads or dribbles at the egg laying sites, which are more common at the mid-bole level. Larval galleries are tightly packed with very fine sawdust. As adults emerge, they chew round exit holes that vary from 1/8 to 3/8 inch in diameter.

Southern Pine Beetle

The southern pine beetle (SPB, *Dendroctonus frontalis*) is the most destructive insect pest of pine in the southern United States. It attacks and kills all species of southern yellow pines including *P. strobus* (eastern white pine). Trees are killed when beetles construct winding, S-shaped egg galleries underneath the bark. These galleries effectively girdle the tree and destroy the conductive tissues that transport food throughout the tree. Furthermore, the beetles carry blue staining fungi on their bodies that clog the water conductive tissues (wood) that transport water within the tree. Signs of attack on the outside of the tree are pitch tubes and boring dust, known as frass, caused by beetles entering the tree.

Adult southern pine beetles.

Photograph courtesy of Forest Encyclopedia Network

Adult SPBs reach an ultimate length of only 1/8 inch, similar in size to a grain of rice. They are short-legged, cylindrical, and brown to black in color. Eggs are small, oval in shape, shiny, opaque, and pearly white.

Sudden Oak Death

The causal agent of sudden oak death (SOD, also known as *Phytophthora* canker disease), *Phytophthora ramorum*, was first identified in 1993 in Germany and the Netherlands on ornamental rhododendrons. In 2000, the disease was found in California. Since its discovery in North America, SOD has been confirmed in forests in California and Oregon and in nurseries in British Columbia, California, Oregon, and Washington. SOD has been potentially introduced into other states through exposed nursery stock. Through ongoing surveys, APHIS continues to define the extent of the pathogen's distribution in the United States and limit its artificial spread beyond infected areas through quarantine and a public education program.

Drooping tanoak shoot.

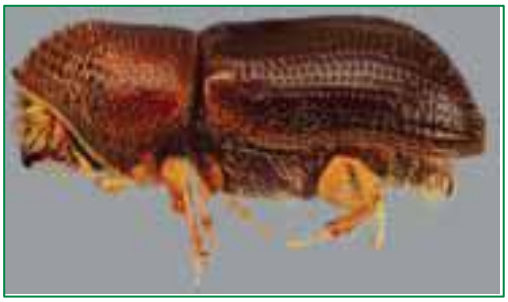
Photograph courtesy of Indiana Department of Natural Resources (2012.)

Identification and symptoms of SOD may include large cankers on the trunk or main stem accompanied by browning of leaves. Tree death may occur within several months to several years after initial infection. Infected trees may also be infested with ambrosia beetles (*Monarthrum dentiger* and *M. scutellarer*), bark beetles (*Pseudopityophthorus pubipennis*), and sapwood rotting fungus (*Hypoxylon thouarsianum*). These organisms may contribute to the death of the tree. Infection on foliar hosts is indicated by dark grey to brown lesions with indistinct edges. These lesions can occur anywhere on the leaf blade, in vascular tissue, or on the petiole. Petiole lesions are often accompanied by stem lesions. Some hosts with leaf lesions defoliate and eventually show twig dieback.

This pathogen is devastating to *Quercus* (oaks) but also affects several other plant species.

Thousand Cankers Disease

A complex disease referred to as Thousand Cankers disease (TCD) was first observed in Colorado in 2008 and is now thought to have existed in Colorado since as early as 2003. TCD is considered to be native to the United States and is attributed to numerous cankers developing in association with insect galleries.



Walnut twig beetle, side view.

Photograph courtesy of USDA Forest Service (2011b).

TCD results from the combined activity of the *Geosmithia morbida* fungus and the walnut twig beetle (WTB, *Pityophthorus juglandis*). The WTB has expanded both its geographical and host range over the past two decades. Coupled with the *Geosmithia morbida* fungus, *Juglans* (walnut) mortality has resulted in Arizona, California, Colorado, Idaho, New Mexico, Oregon, Utah, and Washington. In July 2010, TCD was reported in Knoxville, Tennessee. The infestation is believed to be at least 10 years old and was previously attributed to drought stress. This is the first report east of the 100th meridian, raising concerns that large native populations of *J. nigra* (black walnut) in the eastern United States may suffer severe decline and mortality.

The tree species preferred as hosts for TCD are walnuts.

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Appendix D
Estimated Costs for Newburgh's Five-Year Tree Management Program

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
Extreme or High-Risk Removal	1-3"	$28	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$28	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$138	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	13-18"	$314	27	$8,465	0	$0	0	$0	0	$0	0	$0	$8,465
	19-24"	$605	37	$22,385	0	$0	0	$0	0	$0	0	$0	$22,385
	25-30"	$825	25	$20,625	0	$0	0	$0	0	$0	0	$0	$20,625
	31-36"	$1,045	11	$11,495	0	$0	0	$0	0	$0	0	$0	$11,495
	37-42"	$1,485	6	$8,910	0	$0	0	$0	0	$0	0	$0	$8,910
	43"+	$2,035	10	$20,350	0	$0	0	$0	0	$0	0	$0	$20,350
Activity Total(s)			**116**	**$92,230**	0	$0	0	$0	0	$0	0	$0	**$92,230**
Moderate and Low-Risk Removal	1-3"	$28	0	$0	50	$1,375	49	$1,348	0	$0	0	$0	$2,723
	4-6"	$28	0	$0	22	$605	20	$550	0	$0	0	$0	$1,155
	7-12"	$138	0	$0	42	$5,775	42	$5,775	0	$0	0	$0	$11,550
	13-18"	$314	0	$0	51	$15,989	51	$15,989	0	$0	0	$0	$31,977
	19-24"	$605	0	$0	47	$28,435	47	$28,435	0	$0	0	$0	$56,870
	25-30"	$825	0	$0	17	$14,025	17	$14,025	0	$0	0	$0	$28,050
	31-36"	$1,045	0	$0	11	$11,495	11	$11,495	0	$0	0	$0	$22,990
	37-42"	$1,485	0	$0	4	$5,940	4	$5,940	0	$0	0	$0	$11,880
	43"+	$2,035	0	$0	4	$8,140	3	$6,105	0	$0	0	$0	$14,245
Activity Total(s)			0	$0	**248**	**$91,779**	**244**	**$89,661**	0	$0	0	$0	**$181,440**
Stump Removal	1-3"	$28	5	$138	0	$0	0	$0	0	$0	0	$0	$138
	4-6"	$28	29	$798	0	$0	0	$0	0	$0	0	$0	$798
	7-12"	$44	62	$2,728	0	$0	0	$0	0	$0	0	$0	$2,728
	13-18"	$72	72	$5,148	0	$0	0	$0	0	$0	0	$0	$5,148
	19-24"	$94	80	$7,480	0	$0	0	$0	0	$0	0	$0	$7,480
	25-30"	$110	61	$6,710	0	$0	0	$0	0	$0	0	$0	$6,710
	31-36"	$138	39	$5,363	0	$0	0	$0	0	$0	0	$0	$5,363
	37-42"	$160	21	$3,350	0	$0	0	$0	0	$0	0	$0	$3,350
	43"+	$182	14	$2,541	0	$0	0	$0	0	$0	0	$0	$2,541
Activity Total(s)			**383**	**$34,254**	0	$0	0	$0	0	$0	0	$0	**$34,254**
Extreme or High-Risk Prune	1-3"	$20	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$75	3	$225	0	$0	0	$0	0	$0	0	$0	$225
	13-18"	$120	3	$360	0	$0	0	$0	0	$0	0	$0	$360
	19-24"	$170	10	$1,700	0	$0	0	$0	0	$0	0	$0	$1,700
	25-30"	$225	10	$2,250	0	$0	0	$0	0	$0	0	$0	$2,250
	31-36"	$305	4	$1,220	0	$0	0	$0	0	$0	0	$0	$1,220
	37-42"	$380	5	$1,900	0	$0	0	$0	0	$0	0	$0	$1,900
	43"+	$590	6	$3,540	0	$0	0	$0	0	$0	0	$0	$3,540
Activity Total(s)			**41**	**$11,195**	0	$0	0	$0	0	$0	0	$0	**$11,195**
Routine Pruning (5-year cycle)	1-3"	$20	13	$260	12	$240	12	$240	11	$220	10	$200	$1,160
	4-6"	$30	39	$1,170	38	$1,140	38	$1,140	37	$1,110	36	$1,080	$5,640
	7-12"	$75	143	$10,725	143	$10,725	142	$10,650	142	$10,650	142	$10,650	$53,400
	13-18"	$120	141	$16,920	141	$16,920	140	$16,800	139	$16,680	138	$16,560	$83,880
	19-24"	$170	101	$17,170	101	$17,170	101	$17,170	101	$17,170	101	$17,170	$85,850
	25-30"	$225	68	$15,300	67	$15,075	65	$14,625	64	$14,400	63	$14,175	$73,575
	31-36"	$305	29	$8,845	29	$8,845	29	$8,845	29	$8,845	29	$8,845	$44,225
	37-42"	$380	14	$5,320	13	$4,940	12	$4,560	11	$4,180	11	$4,180	$23,180
	43"+	$590	16	$9,440	16	$9,440	16	$9,440	16	$9,440	16	$9,440	$47,200
Activity Total(s)			**564**	**$85,150**	**560**	**$84,495**	**555**	**$83,470**	**550**	**$82,695**	**546**	**$82,300**	**$418,110**
Young Tree Training Pruning (3-year cyle)	1-3"	$20	161	$3,220	161	$3,220	160	$3,200	161	$3,220	161	$3,220	$16,080
	4-8"	$30	90	$2,700	89	$2,670	89	$2,670	90	$2,700	89	$2,670	$13,410
Activity Total(s)			**251**	**$5,920**	**250**	**$5,890**	**249**	**$5,870**	**251**	**$5,920**	**250**	**$5,890**	**$29,490**
Replacement Tree Planting	Purchasing	$110	122	$13,420	122	$13,420	122	$13,420	122	$13,420	122	$13,420	$67,100
	Planting	$110	122	$13,420	122	$13,420	122	$13,420	122	$13,420	122	$13,420	$67,100
Activity Total(s)			**244**	**$26,840**	**244**	**$26,840**	**244**	**$26,840**	**244**	**$26,840**	**244**	**$26,840**	**$134,200**
Replacement Young Tree Maintenance	Mulching	$100	122	$12,200	122	$12,200	122	$12,200	122	$12,200	122	$12,200	$61,000
	Watering	$100	122	$12,200	122	$12,200	122	$12,200	122	$12,200	122	$12,200	$61,000
Activity Total(s)			**244**	**$24,400**	**244**	**$24,400**	**244**	**$24,400**	**244**	**$24,400**	**244**	$24,400	**$122,000**
Activity Grand Total			**1,599**		**1,302**		**1,292**		**1,045**		**1,040**		**$6,278**
Cost Grand Total				**$279,989**		**$233,404**		**$230,241**		**$139,855**		**$139,430**	**$1,022,918**

*Note: Excludes All Ash Trees