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TOWN AND VILLAGE OF PAWLING
COMMUNITY FOREST MANAGEMENT PLAN

Prepared by

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550 BEDFORD ROAD, BEDFORD HILLS, NY 10507

July 25, 2022

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Acknowledgments

The tree inventory and risk assessment performed at Murrow Park, Lakeside Park, and a connecting trail in the Town of Pawling and street trees throughout the Village of Pawling and this Community Forestry Management Plan was performed thanks to funding received from the New York State Department of Environmental Conservation's (DEC) Division of Lands and Forests' Urban and Community Forestry Program, which works to increase public awareness of the importance of trees and help communities develop and implement comprehensive tree management plans to create healthy forests while enhancing quality of life.

The Town and Village of Pawling would like to recognize the support from the following organizations and individuals:

Town of Pawling Supervisor James Schmitt

Town of Pawling Board

- Deputy Supervisor & Councilman James McCarthy
- Councilman Phillip DeRosa
- Councilwoman Coleen Snow
- Councilwoman Corinne Musella-Pitt

Town of Pawling Director of Recreation Jessica Dickinson

Town of Pawling Supervisor of Buildings and Grounds Wendel Weber

Village of Pawling Mayor Lauri Taylor

Village of Pawling Clerk Jennifer Osborn

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TOWN OF PAWLING 1788

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Executive Summary

In June and July 2021, the SavATree Consulting Group performed an inventory and risk assessment for trees growing at Edward R. Murrow Memorial Park and Lakeside Park in the Town of Pawling and street trees throughout the Village of Pawling, NY. The inventory also included the following properties: Village Hall and Sheriff's substation on Memorial Avenue; the Town Hall and Legion Annex on Charles Colman Blvd.; the Firehouse on South Street (on the town side of the road); Railroad Station on Memorial Avenue; and Village Green on Charles Colman Blvd. Trees growing within the maintained areas of the parks and within 30 feet of a trail connecting the parks were included. Data on available planting spaces along streets was also collected.

One thousand, five hundred and ninety-seven trees were assessed in the inventory: 631 within Town parkland and 966 on Village property. Of the park trees, 103 are at Murrow Park, 226 at Lakeside Park, and 302 are along the Yellow Trail that connects the parks. Seventy-four different species of trees were included in the inventory. The most common species is Norway spruce with 250 trees (15.7% of the inventoried population).

There are 120 dead trees in the inventory (8% of the population) and 210 that are in poor condition (13%). 78% of the population is in Fair or better condition.

The data was run through i-Tree Eco to provide an environmental analysis report on the benefits provided by the trees. Outputs include carbon sequestration, oxygen production, and stormwater runoff avoided, and pollution removal. The full i-Tree report has been provided as a separate document.

Management recommendations were made for 752 of the trees in the inventory. Three hundred and thirty-nine trees are recommended for removal; 105 are High priority, 88 are Medium, and 146 Low. Pruning and/or installation of supplemental support cables is recommended for 387 trees. Fourteen are High priority recommendations and 52 are Medium priority. In addition, there are 307 ow priority, routine pruning recommendations and 14 low priority, training pruning recommendations. The estimated cost to perform the recommended work over a five-year period is $600,460.

Introduction

The Village of Pawling is two square miles in size with a population of about 2,500. The Village is encircled by the Town of Pawling – a 45 square mile area with a population of 8,500. It maintains over 150 acres in parkland, of which residents are justifiably proud. Some of this land has been previously inventoried and is at the maintenance stage. But other productive work lies ahead for this environmentally conscious community. The scope of work for this project included two parks and a connecting trail in the Town of Pawling: Murrow and Lakeside Parks The goal is for commonly used areas in the parks to be proactively managed so that the Village will enjoy a greater use of the woods, including knowledge of trees, understanding of proper arboricultural techniques, and restoration of the health of the woodlands.

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Vision Statement

The Town and Village of Pawling intend to support tree management throughout Pawling's parks and along its rights-of-way to determine the types, quantities, location and health of its community forest, and to develop a management plan that will assist the Town and Village in expanding its forested areas, addressing forest health issues and threats, and securing community involvement in protecting and enhancing the town's forest resources.

How did Pawling perform the inventory?

The Town and Village of Pawling developed an RFP for the tree and planting space inventory and selected the SavATree Consulting Group to perform the work. Their assignment was to perform an inventory that included the following locations:

***Edward R. Murrow Memorial Park*:** All trees within the maintained areas of the park and ball field area. The wooded perimeter received a level 1 limited visual assessment; this means that the perimeter was walked from the maintained lawn to identify trees with structural/health issues in need to management. These trees were added to the inventory.

Figure 1: Satellite image of Murrow Park. Trees within the yellow outline were included in the inventory.

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***Lakeside Park*:** All trees within specific areas of the park were inventoried. This included a re-assessment of 215 that were originally inventoried by DC WSD.

Figure 2: Satellite image of Lakeside Park. Trees within the yellow outline were included in the inventory.

Yellow Trail Connecting Murrow and Lakeside Parks: The inventory included trees within 30 feet of each side of the trail.

***Village of Pawling*:** All street trees growing within 10 feet of municipal roads throughout the Village. County and State roads were not included.

The following Municipal properties were also included:

- **Village Hall and Sheriff's Substation on Memorial Avenue**
- **Town Hall and Legion Annex on Charles Colman Blvd**
- **The Firehouse on South Street**
- **Railroad Station on Memorial Avenue**
- **Village Green on Charles Colman Blvd**

Available planting spaces growing within ten feet of municipal roads were inventoried as well.

SavATree Consulting Group provided a Registered Consulting, ISA Certified, and ISA Tree Risk Assessment Qualified Arborist to perform the tree and planting space inventory. Each tree in the inventory received an ANSI A300 level 2 visual assessment (ground-based, 360-degree visual assessment of exposed roots, trunk, limbs, and foliage; includes sounding for internal decay with a mallet) and the following data points were collected:

• GPS Location (X and Y GPS coordinates) of trees
• Address Location of trees (for park trees, name of park and general location description is included)

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- Species (botanical and common names)
- Diameter at breast height (DBH; diameter measured 4.5 feet above grade)
- Crown condition (excellent to dead rating)
- Specific observations of concern
- ISA Qualitative Risk Rating (Extreme, High, Moderate, Low)
- Recommended tree maintenance actions (i.e., remove tree due to defects which cannot be treated), pruned to reduce risk (formative, deadwood, subordinate), prune young trees to improve shape and train, install structural support, pest treatment, stump removal, etc.)
- Priority level of recommended tree maintenance (Immediate, High, Medium, Low, None at this time)
- Residual Risk Rating (Estimated ISA Qualitative Risk Rating after recommended tree maintenance is performed; Extreme, High, Moderate, Low, NA (for trees recommended for removal))
- Root conflicts: Yes/No
- i-Tree-Eco summary report of environmental benefits

In addition to the tree inventory, a planting space inventory was performed along all municipal roads within the Village of Pawling. The following information was collected for this inventory:

- Planting Space Type: Pit (square/rectangular cutout within a sidewalk); Strip (lawn strip within road and sidewalk); Lawn (open area next to road or sidewalk).
- Planting Area Size: dimensions, in feet, for Pits; width of Strip, in feet; NA for lawn as the planting area size is not restricted
- Overheard Wires: Yes/No
- Recommended Tree Size: Small (<30 feet at maturity); Medium (30-70 feet); Large (>70 feet)
- Address Location
- Additional Notes

SavATree used ArcGIS Online on an iPad to perform the tree inventory. We used a diameter tape to measure the diameter at a height 4.5' from the base of the trunk.

SavATree input the data into Excel and analyzed it using Pivot Charts and Tables. After QA/QC was performed, we exported the results to a web app for your use.

The data was run through i-Tree Eco to obtain an estimate of the environmental benefits provide by the trees in the inventory.

What were the findings of the inventory?

SavATree included 1,597 trees and 115 potential plantings in the inventory. Six hundred and thirty-one trees are within the parks on Town property: 103 trees are at Murrow Park; 302 along the Yellow Trail connecting Murrow and Lakeside Parks; and 226 within Lakeside Park. Nine hundred and sixty-six trees are on Village roads and municipal properties.

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Inventory Map

The complete inventory database has been provided as a separate excel file. The web app for the overall inventory can be found here: https://arcg.is/1DziiC. The user can click on the three squares icon at the upper-right corner of the map to remove any layer from the visible map. Unclicking a layer will make it invisible, but will not delete it from the map, so it can be added back any point as needed.

Tree icons are color-coded circles based upon Priority Level of management recommendation where purple = Immediate; red = High; orange = Medium; yellow = Low; and green = None at this time.

Planting locations are color-coded stars based upon recommended size of planting were blue = small; purple = medium; and black = large.

The map can be zoomed by clicking on the +/- icons at the upper-left corner. Clicking on the Home icon below will restore to the map to its original extent. Clicking on any tree icon will bring up a pop-up window with all its collected data.

The map can be searched by address by using the text box at the top of the page. It can be searched by tree number by clicking on the magnifying glass at the upper-left corner. The map will zoom to the searched tree.

Trees can be filtered by Condition, ISA risk rating, tree care maintenance type, and/or tree maintenance priority by clicking on the funnel-shaped icon to the right of the tree number search box. In order to make the filters appear on the map, the toggle switch at the upper-right of the pop-up window must be activated. Note: when a filter is activated, a search will only be operated on the trees that are visible on the map within that filter.

The current extent of the map can printed/saved as a PDF by clicking on the printer icon to the right of filter.

The basemap (shows streets instead of satellite imagery, etc.) can be changed by clicking on the four-square icon to the right of print.

The map be shared via email or social media by clicking on the three arrows icon to the right of the basemap gallery.

Clicking on the arrow at the bottom-middle of the page will bring up the data table for the tree inventory. If a filter is activated, only those trees will appear in the table.

If the browser on your mobile device allows location/GPS access, clicking on the target icon under the home icon will show your location within the map.

The provided Excel file can be used to manually create tree lists for work orders and bid specifications.

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Tree Species

Dr. Frank Santamour has previously described a method for managing diversity in urban plantings; this is referred to as "the 10-20-30 formula". The formula states that for maximum protection against pest outbreaks, the urban forest should contain no more than 10% of any single tree species, no more than 20% of any tree genus, and no more than 30% of any tree family.

Notable failures of this general guide include the Dutch elm disease outbreak on American elms starting in the 1930's and the impact of emerald ash borer on ash trees that is currently taking place. These pests left some towns completely devoid of street trees and devastated certain parklands.

We would expect species composition to vary between park/trail land and street trees, so these populations will be summarized combined and separately.

Overall, species diversity within the study area is good (see Figure 3 below). A total of 74 species were included in the inventory; two of which exceed the 10% or more threshold. There are 250 Norway spruce (*Picea abies;* 15.7% of the population) and 206 Norway maple (*Acer platanoides*) trees (12.9% of the population). The number of Norway spruce trees is somewhat skewed by the grove of 143 trees growing to the left of the entrance to Lakeside Park.

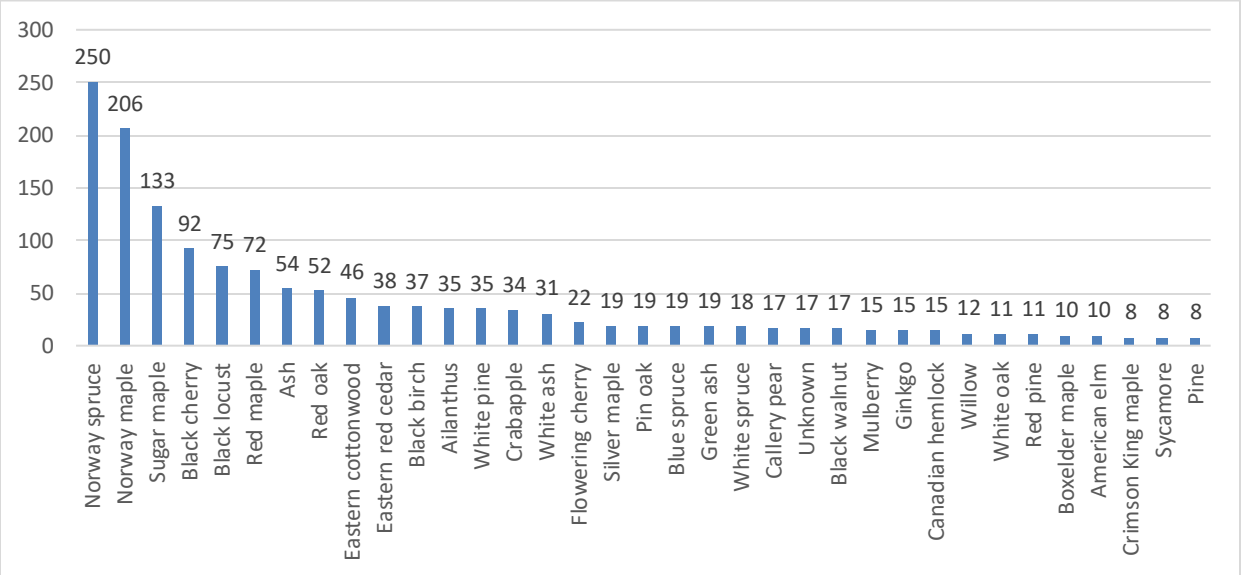

Figure 3: Species composition from the entire Pawling tree inventory. Species with 7 and fewer individuals were removed from this table to improve readability.

Only one genus exceeds the 20% recommended threshold. There are 453 maple (Acer) trees; this is 28.4% of the total population. No family exceeds the 30% threshold. The closest is the Sapindaceae family that includes.

Eight hundred and fifty-nine trees in the inventory are native to New York State. This is 53.8% of the population.

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Invasive species are non-native species that can cause harm to the environment, the economy or to human health. There are many different lists or ratings for the invasiveness of a given species. Three hundred and thirty-six trees (21%) within the inventory are considered invasive by some measure. These species include Norway maple, ailanthus (aka tree-of-heaven, *Ailanthus altissima*), black locust, sycamore maple (*Acer pseudoplatanus*), callery pear (*Pyrus calleryana*), sweet cherry (*Prunus avium*), and Siberian elm (*Ulmus pumila*).

Town Property – Murrow and Lakeside Parks

The inventory includes 631 trees growing in Murrow Park, Lakeside Park, and along the Yellow Trail that connects the park. Due to the large number of natural, unplanted trees in these areas (particularly along the trail), we anticipate differences in the tree populations in this area compared to Village properties.

Forty-seven different species were observed on park property (see Figure 4 below). Norway spruce account for 145 of these trees; 23% of the population. However, 143 of these are in a planted grove located near the entrance to Lakeside Park. If this grove is excluded and we look only at the other 488 trees, no species exceeds the 10% threshold. In addition to spruce, maples exceed 20% of the park tree population with 139 trees (22% of the total population; 28.4% of the population without the Norway spruce grove).

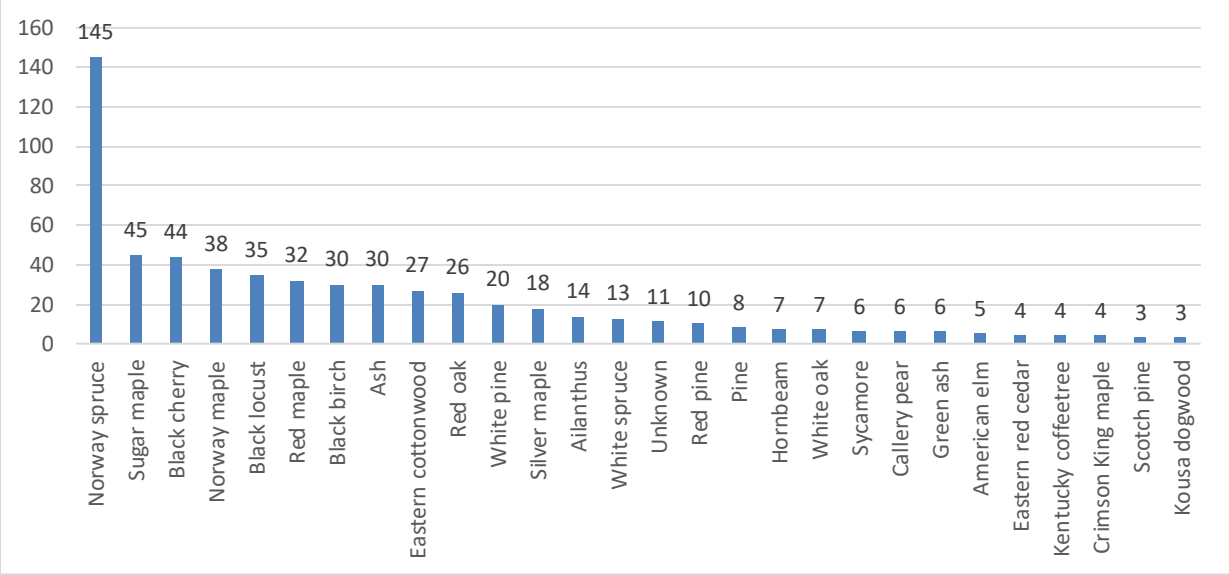

Figure 4: Species composition from the parks portion of the tree inventory. Species with 2 and fewer individuals were removed from this table to improve readability.

Two hundred and fifty-six (40.6%) of the park trees are native to NY State. If the Norway spruce grove is excluded, 52.5% of the trees are NY native.

There are 93 invasive trees within the parks. This is 14.7% of the population; 19% if the spruce grove is excluded.

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Photo 1: Row of ornamental pear trees (#617-622) growing at Lakeside Park.

Photo 2: Tree 24 at Edward Murrow Park is a mature sugar maple with some large deadwood in its canopy. Pruning to remove the deadwood will improve aesthetics and safety for visitors. Regular maintenance should allow the tree to remain a resource for the community for many years.

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Village Property – Street Trees and Municipal Properties

There are 966 trees growing on Village property in the inventory that are composed of 71 different species (see Figure 5 below). As expected, the variety of tree species is greater among street trees and areas that are planted as opposed to the natural areas within the parks.

Two species exceed the 10% threshold in these areas: Norway maple (168 trees; 17.4%) and Norway spruce (105 trees; 10.9%). Acer (maple) is the only genus to exceed 20% of the Village tree population with 314 trees (31.4%). Therefore, the maple family (Sapindaceae) also exceeds the 30% recommended level.

Based on these numbers, the Village should avoid planting Norway spruce and any maple trees in the near-term. Species that are under-utilized include black gum (*Nyssa sylvatica*), hickories (all species), oaks (other than red), magnolias, hawthorns, basswoods, among others.

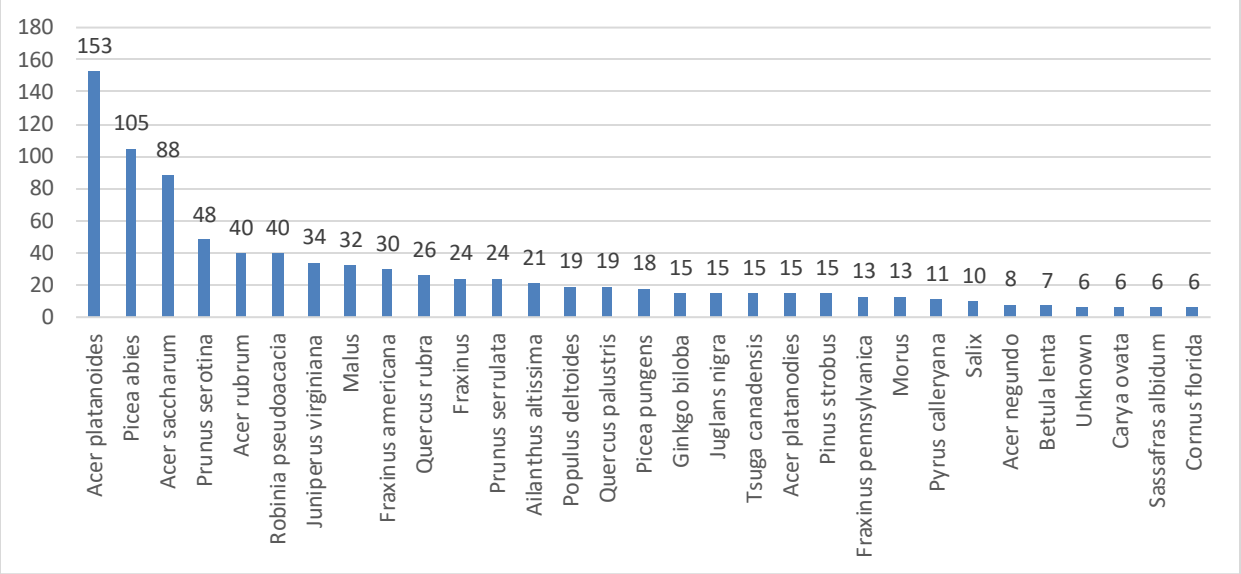

Figure 5: Species composition from the Village portion of the tree inventory. Species with 5 and fewer individuals were removed from this table to improve readability.

Four hundred and eighty-four of the trees on Village property are native to NY. This is 50.1% of the population.

Two hundred and forty-three (25.2%) of the trees are considered invasive.

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Photo 3 showing a large copper beech and dogwood along a Village road.

Tree Diameter Distribution

Tree diameter distribution provides a proxy for tree age and an indicator of population sustainability. A "reverse-J" curve represents a desirable diameter distribution in tree populations as most individuals should be in the smaller diameter classes. This provides for a sustainable canopy; as older and larger individuals die or fail, there is sufficient stock of younger individuals in the population to take their place.

We use size and a proxy for age when looking at the diameter distribution, realizing that this is inexact as some trees are small in stature and so may be mature and still quite small (ex: dogwood). However, this approach gives us a good "big picture" idea of how resilient or vulnerable the population is. The full tree inventory distribution generally shows a "reverse-J" shape (Figure 6 on the following page), meaning most trees are younger. This is desirable as you want to have enough younger individuals growing up to assume the roles of the older ones as they decline and are removed.

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The greatest number of trees peak from 6 through 16 inches in diameter at breast height.

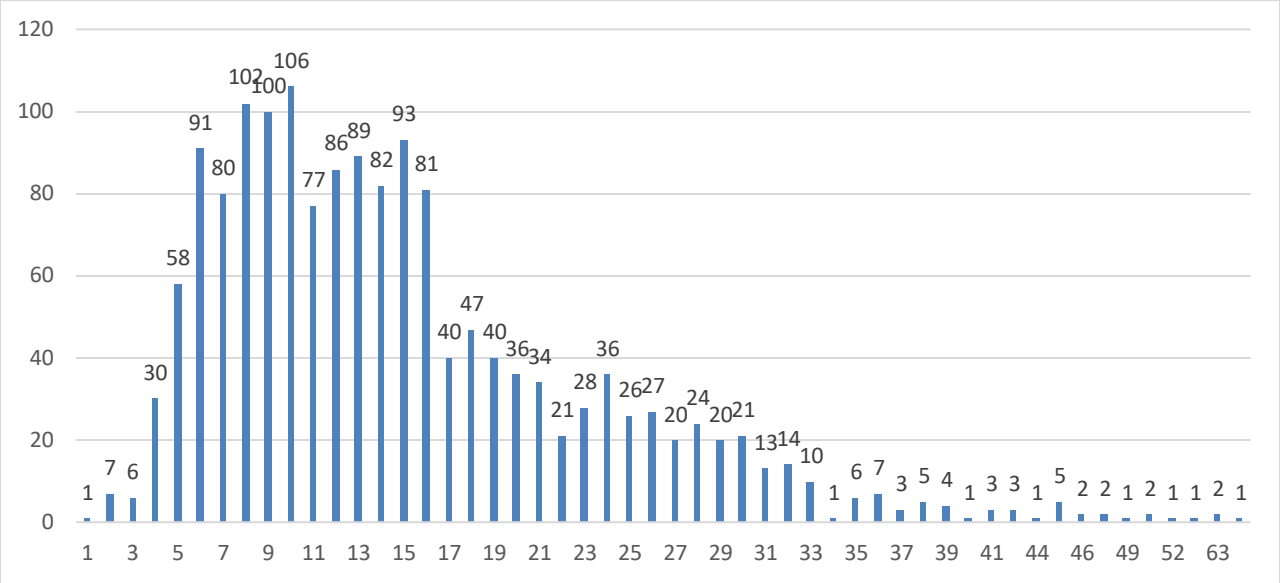

Figure 6: Diameter distribution of the 1597 trees in the Pawling tree inventory

Tree Condition

We assigned health condition ratings for each of the trees in the inventory. Five ratings were possible: Excellent, Good, Fair, Poor, and Dead. Figure 7 below shows the current breakdown of condition ratings in the study areas. 78% of the trees are in Fair or Good health. There are 210 trees in Poor condition (13%) and 120 dead trees (8%).

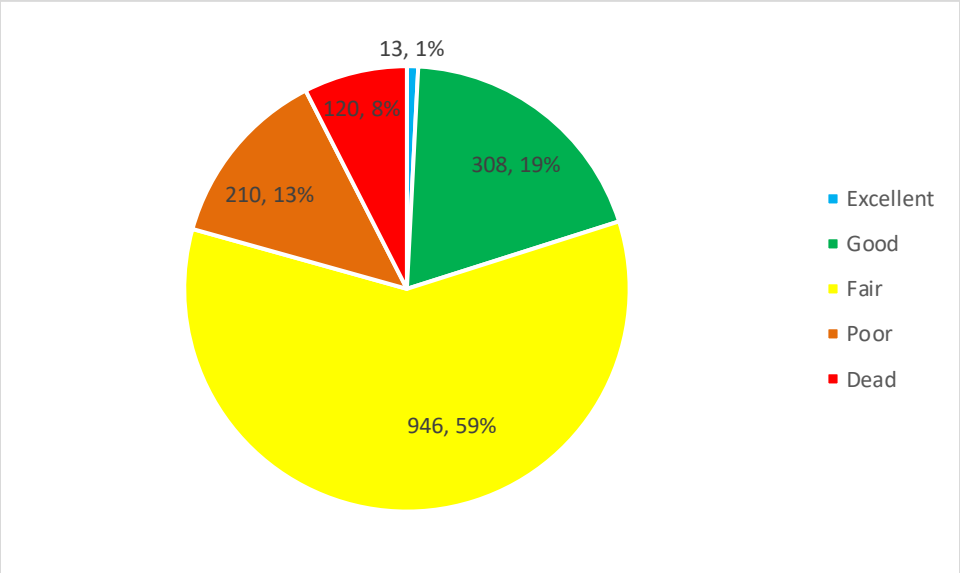

Figure 7: Condition of 1597 trees included in the Pawling tree inventory

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Invasive Species

An invasive species is an organism that causes ecological or economic harm in a new environment where it is not native. Related to tree population management, invasive species may be either non-native trees that displace native trees or insect/disease issues that damage native trees and do not have native predators.

As noted above, 21% of the total trees and 19% of the park trees in this inventory can be considered invasive. Only a small fraction of parkland was inventoried in this project, meaning there are potentially thousands of invasive tree species on a Town-wide scale. Eradication can only be obtained by removing all invasive trees and grinding/removing their stumps so that they cannot regenerate. Town-wide, this would not be economically feasible.

Several invasive insect issues were observed during the inventory. These include hemlock woolly adelgid, elongate hemlock scale, and emerald ash borer. These issues can be effectively treated if the infestations are not too severe. Emerald ash borer can kill trees within 2 or 3 years of initial infestation. Treatment is not recommended for trees that have greater than 33% crown die back.

Others to be on the lookout for that were not observed at this time are Asian longhorned beetle, spotted lanternfly, and beech leaf disease.

Fact sheets for these pests are included in Appendices A-F at the end of this report.

Photo 4 shows an ash tree infested with emerald ash borer. The dieback in its canopy and sprouting along the lower trunk are indicative of this pest. Preventative treatments are very effective to protect ash trees.

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i-Tree Eco Assessment and Tree Cover Benefits

The data from the tree inventory was run through i-Tree Eco. The full report based on the inventory data has been provided as a separate PDF document. The trees in the study area provide approximately 15 acres of tree canopy cover to the Town and Village. The three most common species are Norway spruce, Norway maple, and sugar maple.

The 1,552 trees studied provide the following ecosystem services:

• Tree cover: 14.92 acres; 103 acres of leaf area

• Pollution (carbon monoxide, ozone, nitrogen dioxide, particulate matter, and sulfur dioxide) removal: 862.7 pounds/year ($1.38 thousand/year)

• Carbon storage: 1160 tons ($198 thousand)

• Carbon sequestration: 10.58 tons/year ($1.8 thousand/year)

• Oxygen production: 28.21 tons/year

• Avoided runoff: 39,800 cubic feet/year ($2.7 thousand/year)

• Structural values (Urban forests have a structural value based on the trees themselves (e.g., the cost of having to replace a tree with a similar tree); the structural value of an urban forest tends to increase with a rise in the number and size of healthy trees. Through proper management, urban forest values can be increased; however, the values and benefits also can decrease as the amount of healthy tree cover declines): $3.39 million

ISA Qualitative Risk Assessment

All trees within striking distance of a potential target pose some level of risk – there is no way for a certified arborist to state that any tree has zero chance of failure. In any tree risk situation, there are three management options: remove the risk by removing all targets; remove the risk by removing the tree; mitigate the risk by treating the tree and/or the site.

If the tree is treated, reducing its risk can be accomplished by improving tree health and/or decreasing likelihood of limb failure by reducing the size of the tree and/or removing dead, diseased, or weakened branches. Tree health can be improved by restricting activities in the root zone that could lead to compaction and maximizing root health by turf removal, installation of composted mulch as a ground cover, prescription fertilization, and root health treatment.

The site can be treated by reducing the occupancy of the potential strike zone for a tree. This can be accomplished by moving benches or seating areas or the installation of fencing/barriers to prevent pedestrian access under a tree's canopy.

If the tree is removed, risk of tree failure would be removed. However, the benefits the tree provides would also be lost.

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The Qualitative Tree Risk Assessment protocol is the best management practice outlined by the International Society of Arboriculture (ISA) for assessing the level of risk associated with standing trees within a given time frame. To perform this type of risk assessment, the assessor first determines the Likelihood of Failure and Likelihood of Impacting a target. A potential target may be a person, structure, vehicles, etc. This likelihood of Failure is rated as: Imminent, Probable, Possible, or Improbable, where:

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.

A time period of five years was used for this assessment.

The likelihood of impacting a target is rated as: Very Low, Low, Medium, or High, where:

Very low: the chance of the failed tree or branch impacting the specified target is remote. This is the case in a rarely used site that is fully exposed to the assessed tree, or an occasionally used site that is partially protected by trees or structures. Examples include a rarely used trail or trail head in a rural area, or an occasionally used area that has some protection against being struck by the tree failure due to the presence of other trees between the tree being assessed and the targets.

Low: it is not likely that the failed tree or branch will impact the target. This is the case in an occasionally used area that is fully exposed to the assessed tree, a frequently used area that is partially exposed to the assessed tree, or a constant target that is well protected from the assessed tree. Examples are a little-used service road next to the assessed tree, or a frequently used public street that has a street tree between the street and the assessed tree.

Medium: the failed tree or branch may or may not impact the target, with nearly equal likelihood. This is the case in a frequently used area that is fully exposed on one side to the assessed tree, or a constantly occupied area that is partially protected from the assessed tree. Examples include a suburban street next to the assessed street tree or a house that is partially protected from the assessed tree by an intermediate tree.

High: the failed tree or branch will most likely impact the target. This is the case when a fixed target is fully exposed to the assessed tree or near a high-use road or walkway with an adjacent street tree.

The matrix on the next page is then used to determine the Likelihood of Failure and Impact.

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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

Figure 8 – Likelihood of failure and impact matrix adopted from the ISA Tree Risk Assessment BMP

Next, the assessor determines the most likely Consequences of tree failure. This is ranked as: Negligible, Minor, Significant, or Severe. The matrix below is used to determine the overall risk rating for the subject tree. The possible ratings are: Low, Moderate, High, and Extreme.

Likelihood of Failure and Impact	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

Figure 9 – Qualitative Risk Rating matrix adopted from the ISA Tree Risk Assessment BMP

Of the 1597 trees in the inventory, 1514 (95%) were assessed to be Low risk. There were 78 Moderate risk (5%) and five High risk trees (<1%). No trees were assessed to be Extreme risk.

Planting Space Inventory

As part of the project, we performed an inventory of available plantings spaces along municipal roads within the Village of Pawling. Data on type and size of plantings space, presence of overheard wires, recommended mature tree size, and address were collected. One hundred and fifteen plantings space were identified.

Potential planting space types were tree pits, lawn strips, and open lawn. No open tree pits were found within the Village. Strips are sections of lawn between the road/curb and an existing sidewalk. If the strips were less than five feet wide, I did not include them. Only six of the 115 planting spaces were strips. A planting space was considered lawn if there was no sidewalk present or if the sidewalk run directly along the road/curb.

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Overhead wires were present at 64 of the potential planting spaces. In most instances, the wires run directly over the planting space, but in some cases the line(s) run near the spot, but not directly overheard. For example, the wires are crossing the road, or a secondary wire runs to the house.

The recommended planting size options were small, medium, and large. Small trees are less than 30 feet tall at maturity; medium are 30-70 feet; and larger are greater than 70 feet. The above factors were used to determine the appropriate tree size for the location.

Small trees are recommended at 54 locations. These are all the strip locations that are less than seven feet wide and any sites directly under wires. Medium trees are recommended at 29 locations. These locations are nine-foot-wide strips; areas where wires are nearby, but not directly overheard; and lawn sites where large trees are not feasible due to other site restrictions such as nearby trees. The final 32 locations are for large trees. These sites are all open lawn locations without any canopy size restrictions.

Next Steps

The SavATree Consulting Group made management recommendations for 752 of the 1597 trees growing in the study areas. We made management recommendations and associated priority level for each tree in need of action. The tree management recommendations were developed to aid Pawling's goal for preserving its urban forest.

This five-year program was designed to mitigate risk through prioritized tree removal and pruning and to improve tree structure through proactive pruning. SavATree prioritized the work based first based upon risk rating, but also considered the likelihood of tree failure. This was particularly important along the Yellow Trail and open park areas where even standing dead trees had Low ISA Qualitative Risk Ratings. Tree conditions and associated risk change over time, so regular monitoring/re-assessment should be performed beyond these recommendations.

Goals of the Five-Year Plan

By implementing the five-year plan detailed below, the Town and Village of Pawling should accomplish the following goals:

1. Make roads and sidewalks within the Village safer for pedestrians, cars, and residents.
2. Improve canopy coverage through pro-active tree management and targeted tree plantings.
3. Make the parks and trails safer for visitors by retaining a qualified tree care company to implement recommendations.
    a. High priority recommendations should be performed first, following by medium, and low. Additional information on priority of recommendations is given below and in Table 1.
4. Maintain the municipal properties by performing industry-approved structural and clearance pruning.

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   a. Structural pruning is a cost-effective way to correct structural issues in young trees and help to reduce their associated risk as they mature.
   b. Clearance pruning, such as elevation over parking spaces, playgrounds, and fields will improve the visitor experience and make parklands more usable.
   c. Future plantings should be assessed for the need for young tree structural pruning.
5. Reassess all trees at least every-other-year as tree health and risk changes over time.
   a. Walk through high-use areas of the Village and parks following storm events to identify storm damage in need of immediate action.
   b. Consider sending members of DPW/Parks staff for training on tree risk assessment to assist with assessments.
6. Maintain and update the tree inventory as trees are removed, pruned, planted, etc. so that it remains current and useful.
   a. SavATree will update the online map based upon edits made by Pawling to the provided Excel file.

Management Priorities

While in the field performing the inventory, SavATree assigned a maintenance priority level to each tree of Immediate, High, Medium, Low, or None at this time. For budgeting the five-year management plan, these priority ratings were combined with the management type (remove, treat tree, treat site, etc.) to divide the recommendations into seven groups: High Priority Removals; Medium Priority Removals; Low Priority Removals; High Priority Pruning; Medium Priority Pruning, Low Priority Routine Pruning, Low Priority Training Pruning, and Pest Treatment.

The four Immediate priority recommendations are treating ash trees for emerald ash borer. If Pawling decides not to treat these trees, they should be removed in Year 2 or 3 (medium priority). Pawling should then perform all High priority recommendations before addressing the Medium priority and Low priority last.

The High and Medium Priority recommendations are designed to reduce risk associated with trees either through removal, pruning of deadwood, and/or installation of supplemental support systems. These actions should be performed in the first three years of the plan.

Low Priority Routine pruning addresses conflicts such as branches against buildings, power lines, road/building signs, and structural pruning of larger trees. Training pruning is performed on young trees to address structural issues, such as codominant stems. Performing this type of pruning is a cost-effective way to address issues that will be a problem at maturity. These actions should be performed in years 3-5 after the priority issues are addressed.

Tree Removals

Tree removal is a necessary management option to remove the risk and liability associated with Pawling trees. There are tree issues that cannot be resolved from pruning or installation of support cables and sites where targets cannot be eliminated. Some examples include standing dead trees; trees with

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significant decay, trees with significant decline that would not be cost-effective to prune because they are likely to die in the near-term, and invasive tree species that may not be cost-effective to prune.

It is important to secure the funding needed to complete priority tree removals. Removal eliminates risk/liability and promotes public safety. Tree removals can be performed at any time of the year. The tables on the following page show the number of High, Medium, and Low Priority removals sorted by diameter class. A total of 339 trees are recommended for removal: 105 High Priority, 88 Medium Priority, and 146 Low. The web app for the inventory can be filtered by Mitigation Type (Remove) and Priority to locate these trees : https://arcg.is/1DziiC.

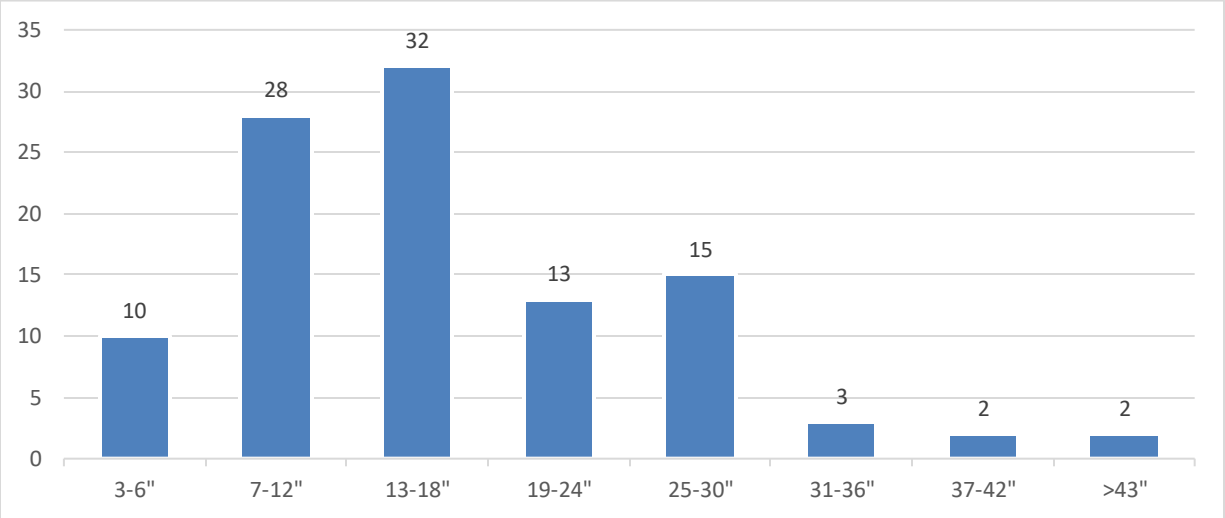

Figure 10 – High priority removals sorted by diameter class

Fifty-four of these trees are located within the parks on Town property; 51 on Village property.

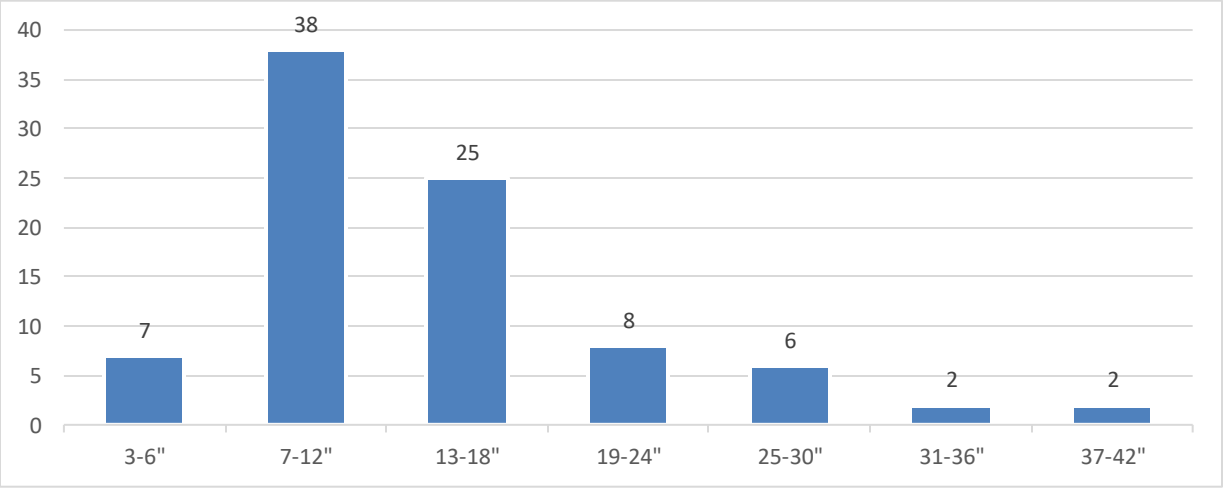

Figure 11 –Medium priority removals sorted by diameter class

Thirty-two are located on parks property; 56 on Village property.

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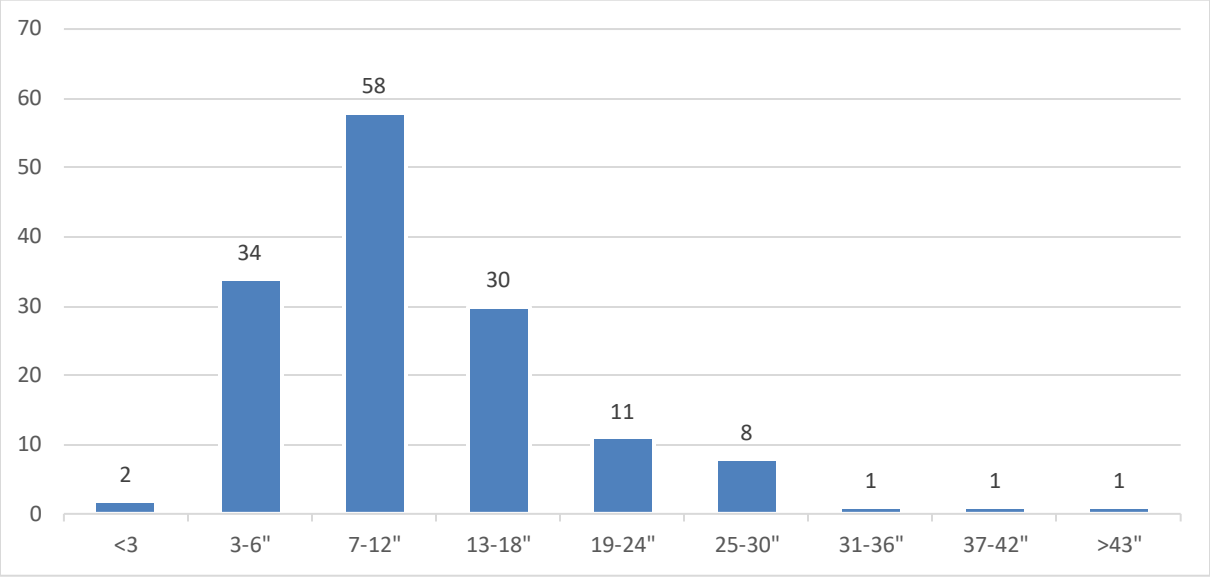

Figure 12 –Low priority removals sorted by diameter class

Fifty-six of the low priority removals are located on parks property and the other 90 are within the Village.

Photo 5: Group of three Norway maple trees (#609-611) growing at Lakeside Park. Although all three trees are in good health, Tree 610 has vertical crack that extends 15 inches into its trunk with associated decay. It is a Medium priority removal.

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Tree Pruning

Tree pruning for risk reduction commonly involves the removal of deadwood from the canopy, but also may include the installation of supplemental support systems and/or canopy reduction. Dead branches and limbs are prone to failure during storms and normal weather conditions. Codominant stems, particularly those with included bark at the branch union, are more likely to fail in storm events than trees with a single lead.

Removal of deadwood can reduce the risk associated with trees and improve their aesthetics. High Priority pruning is recommended for trees with large deadwood and deadwood over high-use areas such as sidewalks, parking lots, and playgrounds. Medium Priority pruning is for smaller deadwood and large deadwood over lower-use areas.

Pruning and installation of supplemental support cables should be performed by a qualified tree care company. Deadwood pruning is easiest to perform during the growing season because the dead branches are easier to see (and it's easier for the Village to confirm that trees were pruned properly). However, research shows that growth and wound closure are maximized if pruning takes place before the spring growth flush. Some trees, such as maples, tend to "bleed" (excessive sap flow from a wound) if pruned early in the spring. It may be unsightly, but it is of little consequence to the tree.

Pruning of live foliage should be avoided in the late spring/early summer right after the new flush of growth. Significant energy is used to push out new growth every year, so the tree needs foliage at that time to photosynthesize and create more.

As shown in the following figures, there are 14 High Priority pruning recommendations and 52 Medium Priority.

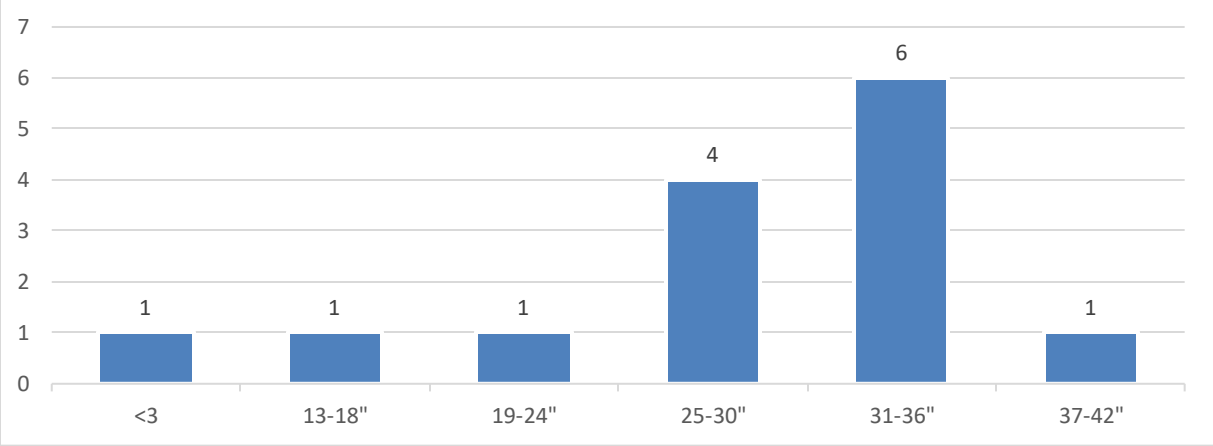

Figure 13 – High Priority Pruning recommendations sorted by diameter class

Four of the High Priority pruning recommendations are for trees within parks; 10 are on Village property.

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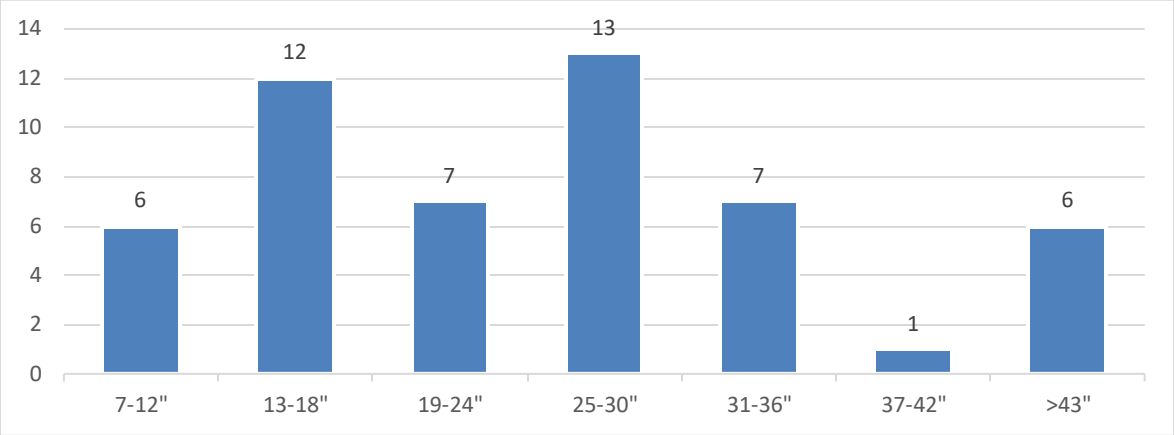

Figure 14 – Medium Priority pruning recommendations sorted by diameter class

Eighteen of these trees are in Town parks and the remaining 34 are in the Village.

Photo 6: This copper beech has deadwood in its upper canopy that could impact power lines, roads, and pedestrians in sidewalks below if it were to fail. Pruning of this deadwood will reduce the risk to people, improve aesthetics, and extend the life of the tree.

Routine Pruning

Low Priority Routine pruning is mainly used to address concerns other than risk reduction. This may include clearance pruning for utility lines, buildings, sidewalks, roads, etc. or pruning to improve tree structure and help reduce the likelihood of elevated risk in the future. Structural pruning includes canopy reduction and subordination pruning of codominant stems. Pruning to remove smaller

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deadwood over low-use areas is also included in this group. This routine pruning will help to lengthen and extend the life of trees for more generations to benefit and enjoy.

Removal and/or cutting of vines are also included in this group. This work can be performed by DPW/Parks staff. If left in place, vines can add significant weight to a tree's canopy and cover foliage leading to a decline in tree health. There are 76 such recommendations.

Young tree training is a specific type of routine pruning that is performed on young and recently planted trees. Three hundred and twenty-one trees have Low Priority Pruning recommendations.

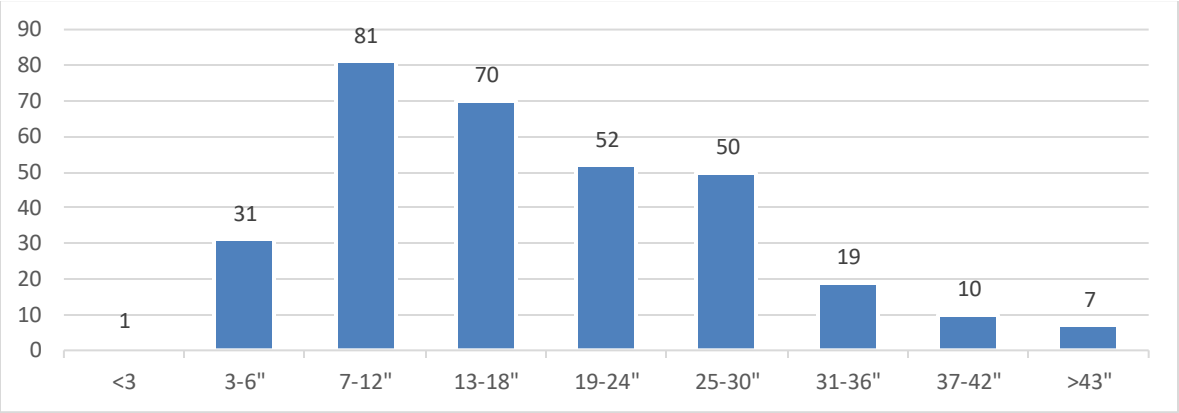

Figure 15 – Routine Pruning recommendations sorted by diameter class

Routine (low priority) pruning recommendations are more commonly made for smaller, still developing trees when compared to High and Medium Priority pruning. This type of pruning is very important as it will help to extend the length of a tree's life. It is also a very cost-effective way to manage tree issues as pruning younger/smaller trees is less expensive that pruning mature trees that require climbing or bucket truck access. Pruning codominant stems or trees with poor form when young is less expensive than pruning mature trees and installing supplemental support systems.

Routine pruning may need to be repeated at regular intervals. Examples include maintaining tree size below wires, over parking/sidewalk, or to maintain clearance from buildings. In addition, phased reductions may be needed to correct structural issues.

Pawling should consider hiring an ISA Certified Arborist to their staff in order to perform this type of pruning in-house. The only tools needed would be a hand saw, pole clip, and pole saw. Another option is to send a current DPW/Parks employee to a class to learn proper pruning methods and to obtain their ISA Certification. Having an effective young tree pruning program will reduce long-term maintenance costs.

One hundred and forty-seven of the low priority pruning recommendations are for trees growing in the parks. Most of these are large trees growing along the Yellow Trail or wooded edges that have deadwood over low/very low use areas.

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Training Pruning

Trees recommended for Training Pruning are under twelve inches in diameter. Training is recommended for young trees with structural issues such as codominant stems and limbs with relatively large diameters compared to the parent stem. Addressing these issues now will reduce long-term maintenance costs and improve the lifespan of the tree. All of these trees are on Village property; nine on the Village Green, two at the Fire Department, two near the Welcome to Pawling sign at E. Main & South Streets, and one at 172 Charles Colman Blvd.

Pawling is hoping to plant many trees over the next decade. Post-planting care is important to maintain the aesthetics and develop the structure of these trees. Trees that are trained properly will live longer, require less maintenance in the future, and, therefore, cost less money to maintain over their life.

If there is not a qualified arborist on staff, this work should be performed a tree care company.

Tree Planting

One hundred and fifteen potential planting locations were identified as part of this project – all location along municipal roads. SavATree worked under the assumption that the Village wants to maintain the existing greenspace within each park, so these areas were not considered. In addition to the identified locations, new plantings may be required to replace trees that are recommended for removal.

Planting should occur in the spring or fall seasons when soil temperatures are moderate, and rainfall is more likely. It is best to avoid planting during the summer when temperatures are high as soils tend to dry out and new trees are easily stressed.

Proper tree selection for each site is important to improve survivability. Some species are shade tolerant and will not grow well in full sun; other species thrive in full sun and will not grow shade. Consideration should also be given to the mature size and aesthetics of the tree. Does the Village want a large tree that will be provide shade at maturity or a flowering/fruiting tree that will benefit bees, insects, or birds? If there are wires or other canopy conflicts in the area, a smaller tree should be planted.

There are three commons ways for new trees to be purchased: balled and burlapped (B&B), bare root, and containerized. B&B and containerized are very similar. For B&B trees, the roots have been cut and the tree removed from the ground and placed into a burlap bag which is then covered with a wire basket to the keep the root together. Containerized trees are dug from the ground and placed into a plastic container that holds the root ball together (or may be grown directly in the container from seed). Containerized trees are often smaller than B&B. The advantage of these type of planting is that it is possible to obtain larger trees (especially for B&B) and they are easier to find at nurseries with a greater species selection. Some cons are that they are heavier to move and often require heavy machinery; they require larger holes to be dug, are more expensive, and the majority of roots are removed when the transferred into the burlap/container. In addition, these trees are often misplanted. Proper planting requires the hole be 1.5 to 2 times as wide as the root ball, excess soil be removed from the top of the root ball so that the first root is at ground level, and both the burlap and wire basket is removed.

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Bare root plantings are harvested from their growing nursery in the fall and all of the soil is removed from their roots. None of their roots are cut or pruned in any way. The trees are stored during the dormant season. The nursery must make sure the roots don't dry out before they are planted. The advantages of this type of planting is that the trees are very light as there is no soil, smaller holes are needed to plant the trees, they establish quicker because they have a full system, and they are less expensive than B&B. Some issues are that they can dry out if they aren't planted quickly, there tends to be less species diversity, and they are smaller at time of planting (generally less than 2-inches). Due to storage issues, bare root trees are only available in the early spring and tend to sell out. Bare root plantings tend to have higher survival rates.

Appendix F at the end of this report is a document created by the DEC with information on many native tree and shrub species. Our recommendations, listed by mature size, for species to improve diversity are given below. Due to the current levels of maple and spruce trees within Pawling, these trees are not recommended at this time.

Small trees:

- Alternate-leaf dogwood (*Cornus alternifolia*)
- Flowering dogwood (*Cornus florida*; disease-resistant cultivars should be prioritized)
- Shadbush serviceberry (*Amelanchier arborea*)
- Eastern redbud (*Cercis canadensis*)
- Sweetbay magnolia (*Magnolia virginiana*)
- American hornbeam (*Carpinus caroliniana*)

Medium trees:

- Black gum (*Nyssa sylvatica*)
- Tamarack (*Larix laricina*)
- River birch (*Betula nigra*)
- American yellowwood (*Cladrastis kentukea*)
- Sourwood (*Oxydendrum arboreum*)
- American hophornbeam (*Ostrya virginiana*)
- White fir (*Abies concolor*) – note: this is an evergreen tree and should not be planted in location that impede sightlines, such as intersections, bends in roads, next to driveways.

Large trees:

- Bur oak (*Quercus macrocarpa*)
- Swamp white oak (*Quercus bicolor*)
- White oak (*Quercus alba*)
- Additional oaks include scarlet, black, pin, and red. Note: some residents may not like acorns falling on their cars/property.
- Hackberry (*Celtis occidentalis*)

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- Kentucky coffee tree (*Gymnocladus dioicus*)
- All hickories (shagbark, bitternut, mockernut, pignut) – note: these are nut-bearing trees, so they shouldn't be planted over driveways/parking areas
- American sweetgum (*Liquidambar styraciflua*) – note: these trees have spiky seedpods that residents may not like falling on their property.
- American linden (*Tilia americana*)

Appendix G is a guide for proper b&b tree planting developed by ISA/Trees Are Good.

Appendix H is guide for proper bare root planting developed by the Arbor Day Foundation.

Storm Preparedness

Trees are more likely to fail to during storm events than "normal" weather. Trees that fail into roads or wires are easily identified and get removed in a timely fashion. However, there are often tree/tree parts that fail into low use areas or that partially fail and remain hanging in tree canopies that are not identified. Hanging or actively failing tree parts can now fail during normal weather when parks, roads, and parking lots are in use. For these reasons, it is important to have a storm response plan in place.

Following every storm event, high-use areas of the Village and parks should be given a level 1 limited visual assessment. For roads, this can be as simple as two people in car driving at a reduced rate of speed. One person drives and the other to look at the canopy of trees that may impact the road. The passenger should maintain a list of trees of broken/failing tree parts that occurred during the storm. It is not safe to perform this type of windshield assessment with only one person in the vehicle. Ideally, the passenger doing the assessment has received some level of tree risk assessment education and knows how to identify defects of concern.

For parks, someone should walk all the high-use areas (parking lots, playgrounds, ball fields, etc.) following every storm. These assessments should be performed by an individual who has tree risk assessment training.

Less used areas of the park do not to be assessed following every storm but should be walked at least at the end of the storm season (at the end of the winter/early spring) before park usage peaks in the summer.

Storm-damage issues that are observed following storms should be acted on with high priority. In some instances, in may be necessary to temporarily close a road, playground, parking lot, etc. until the risk is mitigated.

Maintenance Schedule

Based on the observations and recommendations from the inventory, an annual tree maintenance schedule was developed for the study areas within the Town and Village of Pawling. The local SavATree office provided general pricing for each recommendation type and diameter class. The High Priority removals and pruning should be performed first; ideally within the first year. The Medium Priority

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recommendations should be performed next, ideally in Year 2. Finally, the Routine and Training pruning should be performed in years 3 through 5.

The ability to perform this work in a timely fashion is dependent upon funding. Pawling may need to attempt to obtain grant money to implement the work on schedule.

The cost of planting trees at the 115 identified locations is included in the five-year plan. The number of trees per year was determined in order to equalize the cost of each year of the plan.

Each tree should be re-assessed on a regular basis with updated recommendations made. Storm damage, pest infestations, and age-related decline will occur and impact their management recommendations and associated priority.

Table 1 below provides estimated tree maintenance and planting costs over the next five years. (Note: the pricing does not include stump grinding/removal because many of the trees to be removed are growing in wooded areas. These are pre-bid, general prices; all costs are subject to change). It shows the cost for each of the maintenance-priority groups sorted by diameter class. The estimated total cost of tree maintenance over the next five years is $600,460. This includes the following costs:

- $119,970 in Year 1
- $120,320 in Year 2
- $119,680 in Year 3
- $119,950 in Year 4
- $120,540 in Year 5

Within the Year 1 work, the greatest priority should be given to the 83 trees with elevated risk ratings (5 High; 78 Moderate). In general, removals should be prioritized over pruning. In addition, larger trees should be treated before smaller trees when budget is an issue. This is because larger trees tend to have larger tree parts that may fall from a greater height if they were to fail. Therefore, the consequences of branch/tree failure from these trees tend to be greater (even if their overall risk is Low). In addition, larger trees tend to have larger strike zones that can impact larger areas of a road, park, trail, or private property.

In addition to the full dataset, there is a tab for each year's recommendations in the provided tree inventory data Excel. All of the trees with Year 1 recommendations are in a tab; Year 2 recommendations in another tab, etc.

Conclusions

Trees provide a wealth of benefits to the environment and for people. In addition to creating oxygen, they reduce stormwater runoff, absorb pollutants, and provide cooling shade. However, trees need to be properly maintained to reduce risk to people and extend their lifespan.

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The Town and Village of Pawling should use the findings of this tree inventory to pro actively manage their trees; starting with the High priority recommendations before moving onto Medium and Low priority work. It's important to point out that although some recommendations are Low priority, they are still important. Most of this work is structural pruning – addressing issues like codominant stems when trees are young is cost-effective and increases the life of the tree.

Going forward, it would be advantageous if Pawling had an ISA Certified Arborist on staff. This individual could perform the young tree and clearance pruning for the Town and Village and help with proper tree planting and post-storm tree assessments. Over time, training and existing team member or hiring a Certified Arborist would cost less than hiring a tree care company for all of this work.

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Table 1: Estimated Cost of Five-Year Maintenance Program

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five Year Cost
Activity	Diameter	Cost/Tree	Tree	Total Cost	Tree	Total Cost	Tree	Total Cost	Tree	Total Cost	Tree	Total Cost	
Pest Treatment			5	$425.00	18	$2,800.00	4	$365.00	0	$0.00	4	$400.00	$3,990.00
Activity Totals			**5**	**$425.00**	**18**	**$2,800.00**	**4**	**$365.00**	**0**	**$0.00**	**4**	**$400.00**	**$3,990.00**
High Priority Removals	3-6"	$180.00	10	$1,800.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$1,800.00
	7-12"	$460.00	28	$12,880.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$12,880.00
	13-18"	$760.00	32	$24,320.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$24,320.00
	19-24"	$1,250.00	13	$16,250.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$16,250.00
	25-30"	$1,550.00	15	$23,250.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$23,250.00
	31-36"	$2,000.00	3	$6,000.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$6,000.00
	37-42"	$3,000.00	2	$6,000.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$6,000.00
	43+"	$3,900.00	2	$7,800.00	0	$0.00	0	0.00	0	$0.00	0	$0.00	$7,800.00
Activity Totals			**105**	**$98,300.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**$98,300.00**
Medium Priority Removals	3-6"	$180.00	0	$0.00	7	$1,260.00	0	$0.00	0	$0.00	0	$0.00	$1,260.00
	7-12"	$460.00	0	$0.00	38	$17,480.00	0	$0.00	0	$0.00	0	$0.00	$17,480.00
	13-18"	$760.00	0	$0.00	25	$19,000.00	0	$0.00	0	$0.00	0	$0.00	$19,000.00
	19-24"	$1,250.00	0	$0.00	8	$10,000.00	0	$0.00	0	$0.00	0	$0.00	$10,000.00
	25-30"	$1,550.00	0	$0.00	6	$9,300.00	0	$0.00	0	$0.00	0	$0.00	$9,300.00
	31-36"	$2,000.00	0	$0.00	2	$4,000.00	0	$0.00	0	$0.00	0	$0.00	$4,000.00
	37-42"	$3,000.00	0	$0.00	2	$6,000.00	0	$0.00	0	$0.00	0	$0.00	$6,000.00
	43+"	$3,900.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$0.00
Activity Totals			**0**	**$0.00**	**88**	**$67,040.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**$67,040.00**
Low Priority Removals	3-6"	$180.00	0	$0.00	0	$0.00	1	$180.00	9	$1,620.00	26	$4,680.00	$6,480.00
	7-12"	$460.00	0	$0.00	0	$0.00	8	$3,680.00	32	$14,720.00	18	$8,280.00	$26,680.00
	13-18"	$760.00	0	$0.00	0	$0.00	10	$7,600.00	17	$12,920.00	3	$2,280.00	$22,800.00
	19-24"	$1,250.00	0	$0.00	0	$0.00	3	$3,750.00	8	$10,000.00	0	$0.00	$13,750.00
	25-30"	$1,550.00	0	$0.00	0	$0.00	8	$12,400.00	0	$0.00	0	$0.00	$12,400.00
	31-36"	$2,000.00	0	$0.00	0	$0.00	1	$2,000.00	0	$0.00	0	$0.00	$2,000.00
	37-42"	$3,000.00	0	$0.00	0	$0.00	1	$3,000.00	0	$0.00	0	$0.00	$3,000.00
	43+"	$3,900.00	0	$0.00	0	$0.00	1	$3,900.00	0	$0.00	0	$0.00	$3,900.00
Activity Totals			**0**	**$0.00**	**0**	**$0.00**	**33**	**$36,510.00**	**66**	**$39,260.00**	**47**	**$15,240.00**	**$91,010.00**
High Priority Prune	3-6"	$110.00	1	$110.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$110.00
	7-12"	$185.00		$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$0.00
	13-18"	$240.00	1	$240.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$240.00
	19-24"	$475.00	1	$475.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$475.00
	25-30"	$680.00	4	$2,720.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$2,720.00
	31-36"	$785.00	6	$4,710.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$4,710.00
	37-42"	$990.00	1	$990.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$990.00
	43+"	$1,225.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$0.00
Activity Totals			**14**	**$9,245.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**$9,245.00**
Medium Priority Prune	3-6"	$110.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	$0.00
	7-12"	$185.00	0	$0.00	6	$1,110.00	0	$0.00	0	$0.00	0	$0.00	$1,110.00
	13-18"	$240.00	0	$0.00	12	$2,880.00	0	$0.00	0	$0.00	0	$0.00	$2,880.00
	19-24"	$475.00	0	$0.00	7	$3,325.00	0	$0.00	0	$0.00	0	$0.00	$3,325.00
	25-30"	$680.00	0	$0.00	13	$8,840.00	0	$0.00	0	$0.00	0	$0.00	$8,840.00
	31-36"	$785.00	0	$0.00	7	$5,495.00	0	$0.00	0	$0.00	0	$0.00	$5,495.00
	37-42"	$990.00	0	$0.00	2	$1,980.00	0	$0.00	0	$0.00	0	$0.00	$1,980.00
	43+"	$1,225.00	0	$0.00	6	$7,350.00	0	$0.00	0	$0.00	0	$0.00	$7,350.00
Activity Totals			**0**	**$0.00**	**53**	**$30,980.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**$30,980.00**
Low Priority Prune	3-6"	$110.00	0	$0.00	0	$0.00	12	$1,320.00	5	$550.00	11	$1,210.00	$3,080.00
	7-12"	$185.00	0	$0.00	0	$0.00	4	$740.00	26	$4,810.00	42	$7,770.00	$13,320.00
	13-18"	$240.00	0	$0.00	0	$0.00	8	$1,920.00	30	$7,200.00	32	$7,680.00	$16,800.00
	19-24"	$475.00	0	$0.00	0	$0.00	12	$5,700.00	25	$11,875.00	15	$7,125.00	$24,700.00
	25-30"	$680.00	0	$0.00	0	$0.00	21	$14,280.00	21	$14,280.00	8	$5,440.00	$34,000.00
	31-36"	$785.00	0	$0.00	0	$0.00	10	$7,850.00	7	$5,495.00	2	$1,570.00	$14,915.00
	37-42"	$990.00	0	$0.00	0	$0.00	8	$7,920.00	2	$1,980.00	0	$0.00	$9,900.00
	43+"	$1,225.00	0	$0.00	0	$0.00	7	$8,575.00	0	$0.00	0	$0.00	$8,575.00
Activity Totals			**0**	**$0.00**	**0**	**$0.00**	**82**	**$48,305.00**	**116**	**$46,190.00**	**110**	**$30,795.00**	**$125,290.00**
Training Prune	3-6"	$110.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	4	$440.00	$440.00
	7-12"	$185.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	9	$1,665.00	$1,665.00
Activity Totals			**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**0**	**$0.00**	**13**	**$2,105.00**	**$2,105.00**
New Planting		$1,500.00	8	$12,000.00	13	$19,500.00	23	$34,500.00	23	$34,500.00	48	$72,000.00	$172,500.00
Activity Totals			**8**	**$12,000.00**	**13**	**$19,500.00**	**23**	**$34,500.00**	**23**	**$34,500.00**	**48**	**$72,000.00**	**$172,500.00**
Grand Total			**132**	**$119,970.00**	**172**	**$120,320.00**	**142**	**$119,680.00**	**205**	**$119,950.00**	**222**	**$120,540.00**	**$600,460.00**

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Further Reading

The International Society of Arboricultural (ISA) has a great website with useful information for tree owners. Here are a few of the applicable topics for additional reading:

- Choosing the Right Tree: https://www.treesaregood.org/treeowner/choosingtherighttree
- Managing Tree Hazards and Risks: https://www.treesaregood.org/treeowner/treehazards
- Storm-related Tree Damage: https://www.treesaregood.org/Portals/0/TreesAreGood_Storm%20Related%20Tree%20Damage_0721.pdf
- Plant Health Care, Mulching, and Mature Tree Care: https://www.treesaregood.org/treeowner/planthealthcare
- Tree Planting: https://www.treesaregood.org/treeowner/plantingatree
- Tree Pruning: https://www.treesaregood.org/treeowner/pruningyourtrees

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Appendix A: Hemlock Woolly Adelgid Fact Sheet

HEMLOCK WOOLLY ADELGID

Adelges tsugae

NEW YORK STATE | Department of Environmental Conservation

What is the hemlock woolly adelgid?

The hemlock woolly adelgid, or HWA, is an invasive, aphid-like insect that attacks North American hemlocks. HWA are very small (1.5 mm) and often hard to see, but they can be easily identified by the white woolly masses they form on the underside of branches at the base of the needles. These masses or ovisacs can contain up to 200 eggs and remain present throughout the year.

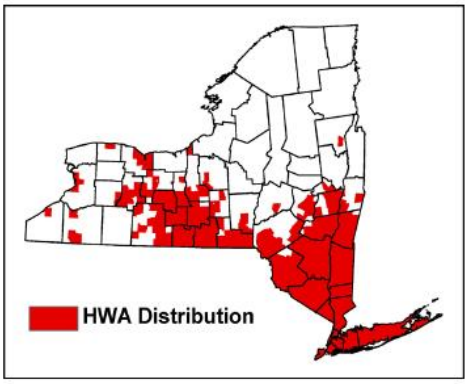
White woolly ovisacs on an eastern hemlock branch
Connecticut Agricultural Experiment Station, Bugwood.org

Where is HWA located?

HWA was first discovered in New York State in 1985 in the lower Hudson Valley and on Long Island. Since then, it has spread north to the Capitol Region and west through the Catskill Mountains to the Finger Lakes Region, Buffalo and Rochester. In 2017, the first known occurrence in the Adirondack Park was discovered in Lake George.

Where does HWA come from?

Native to Asia, HWA was introduced to the western United States in the 1920s. It was first observed in the eastern US in 1951 near Richmond, Virginia after an accidental introduction from Japan. HWA has since spread along the East Coast from Georgia to Maine and now occupies nearly half the eastern range of native hemlocks.



What does HWA do to trees?

Once hatched, juvenile HWA, known as crawlers, search for suitable sites on the host tree, usually at the base of the needles. They insert their long mouthparts and begin feeding on the tree's stored starches. HWA remain in the same spot for the rest of their lives, continually feeding and developing into adults. Their feeding severely damages the canopy of the host tree by disrupting the flow of nutrients to its twigs and needles. Tree health declines, and mortality usually occurs within 4 to 10 years.

What trees are affected?

All species of hemlock are vulnerable to attack, but severe damage and death typically occurs in eastern (Tsuga canadensis) and Carolina (Tsuga caroliniana) hemlocks only. Eastern hemlock is the most common species of hemlock in New York State.

HWA damage to needles and branches
Chris Evans, University of Illinois, Bugwood.org

What are the signs of an infestation?

- White woolly masses (ovisacs) about one-quarter the size of a cotton swab on the underside of branches at the base of needles
- Needle loss and branch dieback
- Gray-tinted foliage

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What is the impact on NYS ecosystems?

Hemlocks are ecologically important due to the unique environmental conditions they create under their dense canopies. These cooler, darker and sheltered environments are critical to the survival of a variety of species that rely on them for food, protection, and ideal growing conditions. Moose, black bears, salamanders, and migrating birds, as well as unique lichen and plant communities, are all closely associated with the hemlock ecosystem. Well suited for growing on steep slopes where not many other species can grow, hemlocks stabilize shallow soils and provide erosion control. In addition, they are often found along streams, where their shade helps moderate water temperatures, maintaining a suitable environment for cold-water species such as trout. Removal of hemlocks from NYS ecosystems can dramatically change ecosystem processes and may result in the loss of unique plants and wildlife.

What is being done?

Biological Control

Several predators from Asia have been successfully introduced in HWA- infested areas. In addition, Laricobius nigrinus, a beetle native to the Pacific Northwest, has been released at various locations in the Finger Lakes region with promising results, though more controls are needed to stop HWA.

Laricobius nigrinus feeding on HWA
US Forest Service, Bugwood.org

Chemical Control

Chemical insecticides can be used to treat an already infested tree or as a preventive measure in a high-risk infestation area. They are useful for treating individual, ornamental, or high-value trees, but are not practical or economical in a forest setting. Two insecticides that have shown promising results are Imidacloprid and Dinotefuran. Both must be applied by a licensed pesticide applicator, and either can kill HWA on its own. Applying both insecticides to an infested tree, however, combines the immediate effectiveness of the fast-acting Dinotefuran with the long-term protection of Imidacloprid, leaving the tree adelgid free for up to seven years.

Integrated Pest Management

The most effective management strategy for controlling HWA combines the short-term protection of insecticides with the long-term solution of biological control agents. As research continues on the effectiveness of natural enemies to control HWA populations, chemical insecticides can keep trees alive and free of infestation until natural enemies take over.

What can I do?

If you believe you have found HWA…

- Take pictures of the infestation signs as described above (include something for scale such as a coin or ruler).
- Note the location (intersecting roads, landmarks or GPS coordinates).
- Contact DEC (see below) or your local Partnership for Regional Invasive Species Management (PRISM) by visiting www.dec.ny.gov/animals/47433.html.
- Report the infestation to *i*MapInvasives at www.NYiMapInvasives.org.
- Slow the spread of HWA in our forests by cleaning equipment or gear after it has been near an infestation, and by leaving infested material where it was found.

CONTACT INFORMATION

Bureau of Invasive Species and Ecosystem Health
Division of Lands and Forests

New York State Department of Environmental Conservation
625 Broadway 5th Floor, Albany, NY 12233-4253
P: (518) 402-9425 | foresthealth@dec.ny.gov
www.dec.ny.gov

Updated January 8, 2018

NEW YORK STATE | Department of Environmental Conservation

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Appendix B: Hemlock Elongate Scale Fact Sheet

Pest Alert

United States
Department of Agriculture

Forest Service

Northeastern Area
NA-PR-01-02

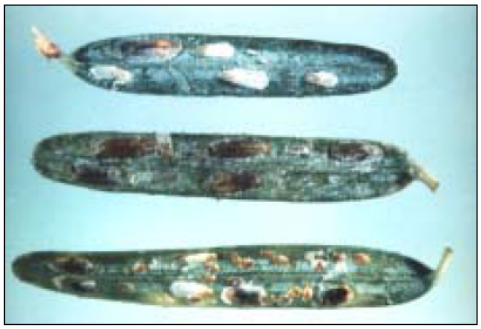
Elongate Hemlock Scale

The elongate hemlock scale, *Fiorinia externa* Ferris, native to Japan, is a pest of eastern hemlock, *Tsuga canadensis*, and Carolina hemlock, *T. caroliniana*, in the Eastern United States. It has been found in the District of Columbia and in nine states from Virginia to southern New England and west to Ohio. *F. externa* attacks the lower surface of the hemlock needle, where it removes fluids from the mesophyll cells through piercing and sucking mouthparts. Elongate hemlock scale sometimes occurs with two other exotic pests — a circular hemlock scale, *Nuculaspis tsugae* (Marlatt), and the hemlock woolly adelgid, *Adelges tsugae* Annand. Mixed infestations of scales and adelgids can greatly hasten hemlock decline.

Hosts: Elongate hemlock scale is known to develop and reproduce on 43 species, representing 7 genera of native and exotic conifers, including 14 species that are native to the United States. Spruce and fir tend to be even more susceptible than hemlock, although it has not yet spread into the natural ranges of these other native conifers.

Description: Adult females are soft-bodied, legless, wingless, and are enclosed in an elongate, parallel-sided cover that is light yellow to brown, translucent, and about 2mm long. The male cover is elongate, white, and about 1.5mm long. Adult males are light brown, about 1.5mm long, have legs and wings, but are feeble-flying insects. Crawlers are legged first-stage nymphs that hatch from translucent eggs within the female cover. Crawlers are soft bodied, lemon-colored, and about 0.1mm long. Second-stage nymphs are enclosed in an oval, amber-colored cover, and are soft bodied, sedentary, and vary in size from 0.1mm to 1.0mm.

Life History: The elongate hemlock scale completes two generations each year in the Southern and Mid-Atlantic States, but usually only one in the Northeast. Its life stages are broadly overlapping everywhere, so crawlers can be found throughout the spring and summer. Crawlers are the only stage capable of dispersing and establishing new infestations. Dispersal between trees is primarily by wind and birds. Females have three stages of development after the egg, while males have five. Within a day or two after hatching, crawlers of both sexes settle beneath the thin waxy cuticle on the lower surface of the youngest hemlock needles and begin to feed. The first-stage nymph for both sexes secretes a cover around itself as it grows. It then molts into a second feeding stage, continues to grow and add to its cover. The second-stage female then molts into the adult feeding stage. The second-stage male molts into a non-feeding prepupa and spins a cocoon, where it pupates before it emerges as an adult. The adult male mates with the female and dies soon thereafter without feeding. The adult female lays about 20 eggs within her cover. When crawlers hatch, they exit through a small opening at the posterior end of the cover. Elongate hemlock scale usually overwinters, either as an egg or as an inseminated adult female.



Nymphs and adults of elongate hemlock scale, *Fiorinia externa*, on the lower surface of hemlock needles.

Nymphs and adults of circular hemlock scale, *Nuculaspis tsugae*, on the lower surface of hemlock needles.

Damage to Hemlock: Scale populations build slowly on healthy trees, but much more quickly on stressed ones. Feeding by elongate hemlock scale causes foliage to turn yellow and drop prematurely. Dieback of major limbs, which progresses from the bottom of the tree upwards, usually occurs after scale density reaches about 10 individuals per needle. Trees often die within the next 10 years, but some survive longer in a severely weakened condition with only a sparse amount of foliage at the very top of the crown. These weakened trees are unsightly and have little chance for recovery. They often fall victim to secondary pests, such as hemlock borer and *Armillaria* root diease, and are readily broken and thrown by wind.

Damage to hemlock caused by elongate hemlock scale.

Control: Outbreaks of elongate hemlock scale often intensify following infestations of hemlock woolly adelgid, drought, or other stresses that have weakened the trees. Therefore, maintaining trees in healthy condition will discourage the buildup of scale populations. For example, hemlock have shallow roots and are consequently susceptible to drought, so ornamental trees should be watered during dry periods. However, applications of nitrogen fertilizer and broad-spectrum insecticides can exacerbate the pest problem. Nitrogen enhances the survival, development rate, and fecundity of *F. externa*, which results in higher scale densities on fertilized trees than on untreated ones. Also, inadequate pesticide application can cause resurgence in scale populations by eliminating natural enemies. The aphelinid parasitoid, *Aspidiotiphagus citrinus* Craw, consistently kills more than 90 percent of each generation of elongate hemlock scale in Japan. In the northeastern United States rates of parasitization are inconsistent (5-96 percent) because the life cycles of *A. citrinus* and *F. externa* are not synchronized. Two coccinellid beetles, the twice-stabbed ladybird beetle, *Chilocorus stigma* (Say), and *Microweisea misella* (LeConte), also attack *F. externa* in North America, but not frequently enough to control scale populations. Nevertheless, when broad spectrum or poorly applied pesticides eliminate these enemies, scale populations often rebound dramatically.

Adult of the aphelinid parasitoid, *Aspidiotiphagus citrinus*.

Adult of the twice-stabbed ladybird beetle, *Chilocorus stigma*.

Control of elongate hemlock scale is not possible in forests, but in ornamental plantings it can be controlled by thoroughly drenching trees with horticultural oil during early spring, when trees are dormant, and again, if needed, during the growing season. In forests, declining hemlocks should be salvaged to prevent buildup and spread of scale populations.

Photos and text by Mark S. McClure, The Connecticut Agricultural Experiment Station, P.O. Box 248, 153 Cook Hill Road, Windsor, CT 06095

For additional information, contact:

USDA Forest Service
Northeastern Area
Forest Health Protection
180 Canfield Street
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(304) 285-1542

USDA Forest Service
Northeastern Area
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271 Mast Road
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Appendix C: Emerald Ash Borer Fact Sheet

USDA

United States Department of Agriculture
Agricultural Research Service

ARS

BIOLOGICAL INTEGRATED PEST MANAGEMENT RESEARCH UNIT *FACT SHEET*
Robert W. Holley Center for Agriculture and Health, Ithaca, New York

EMERALD ASH BORER

A Lethal Invasive Threat to North American Ash

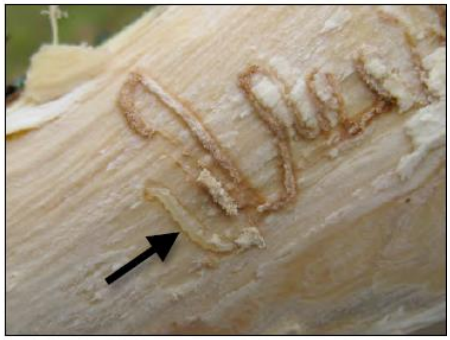
Emerald ash borer (EAB) was discovered for the first time in North America in 2002 near Detroit, Michigan. The beetles probably arrived in solid wood packing materials on cargo ships or airplanes arriving from Asia. Research indicates EAB has been in North America since the early 1990s. The known infested area now encompasses significant portions of several states and provinces. Within these areas, more than 25 million ash trees have already been killed by EAB. **Costs to municipalities, property owners, nursery operators and forest products industries will easily range into the billions of dollars.**

Although adult EAB can fly up to a few miles, the greatest risk of long-distance spread is from human movement of infested ash trees or firewood. Regulatory efforts are now being undertaken that include prohibitions on the movement of these items. Eradication efforts are now directed at small, localized infestations. Nevertheless, the beetle has been found in an increasingly wide area each year since its discovery. **Two Ithaca-based ARS entomologists made the first discovery of EAB in New York in June 2009.**

Adult beetles are metallic green and about a half-inch long. Adults feed only on ash foliage but the key damage is inflicted by larvae feeding on the inner bark of ash trees. They have a one- or two-year life cycle completed entirely in association with ash trees. Adult emergence in late spring is followed by mating, feeding and egg laying. Newly hatched larvae penetrate the tree and feed in the area between the bark and the wood, which is where tree nutrients are transported. Beetle larvae overwinter in the outer portions of wood or bark and pupate in the spring.

Emerald Ash Borer (EAB) adults

EAB larva (arrow) within its feeding gallery



Ash trees killed by EAB in Randolph the site of the first New York discovery

EAB larval galleries under bark

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Can Emerald Ash Borer Be Controlled?

Research is being done to help understand the EAB life cycle, detect and contain infestations, and control adults and larvae. Removal and destruction of infested trees is not always cost-effective and success depends on early detection. Chemical insecticide treatments may be effective at protecting selected trees but cannot be used safely over large areas. **Research focused on developing safe, sutainable, environmentally compatible biological management options is needed.** A successful management program will likely require several approaches, including the integration of arthropod biological control agents, microbial pathogens of EAB and other biological control organisms. The delivery and timing of the release of these agents must be studied to optimize effectiveness against emerald ash borer within infested areas.

➤ *By understanding beetle and natural enemy life cycles* ➤

Emerging EAB killed by a pathogenic fungus
(USDA FS photo)

Parasitic wasps attacking EAB egg (above) and larva within wood (below)
(USDA FS photos)

➤ *By developing effective ways to deploy biocontrol agents* ➤

Fungal spores being applied to ash trees

A cluster of girdled ash trees attracts EAB and will serve as release point for parasites
(SUNY ESF photo)

Research Partnerships Are Keys to Success

The current emerald ash borer program comprises many municipal, state and federal entities. A key component of the multiagency effort is a research team representing USDA Agricultural Research Service, SUNY-ESF, Cornell University, NYSDEC, USDA Forest Service, and USDA APHIS. Research is jointly conducted on assessing the status of EAB infestations and deploying safe, effective biological control agents for managing this pest. In addition, municipal officials and private landowners are cooperating in the research by providing access to trees on their properties.

The USDA ARS Biological Integrated Pest Management Research Unit (BioIPM) is located in the Robert W. Holley Center for Agriculture and Health on the Cornell University Campus. The Unit has, for more than 20 years, played a critical role in world-wide efforts to develop insect pathogenic fungi for biological control of insect pests of agriculture. The BioIPM Unit maintains the world's largest collection of entomopathogenic fungi and conducts biologically-based pest management research on key pests of greenhouses, nurseries and forests, including the emerald ash borer. For more information on this project, contact: Dr. John D. Vandenberg at **www.ars.usda.gov/ithaca/BioIPM**

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Appendix D: Asian Longhorned Beetle

ASIAN LONGHORNED BEETLE

NEW YORK STATE | Department of Environmental Conservation

Anoplophora glabripennis

What is the Asian longhorned beetle?

The Asian longhorned beetle, or ALB, is an invasive wood-boring insect that feeds on a variety of hardwoods including maple, birch, elm, ash, poplar, horse chestnut and willow, among others. Native to China and Korea, the beetles are approximately 1.5 inches long and shiny black, with white spots on their wing cases. They have black and white antennae that can be up to twice as long as their body.

An adult ALB
Joe Boggs, Ohio State, Bugwood.org

What are the signs of an infestation?

Trees being attacked by ALB often have wilted foliage and canopy dieback, but the main signs to look for include:

1. Round, ½ inch exit holes from adults emerging from trees beginning in late July.
2. Round, ½ inch depressions (egg-laying sites) in the outer bark.
3. Sap oozing from egg-laying sites and exit holes.
4. Deep exit holes, insert a pencil to determine if the hole is at least an inch deep.
5. Sawdust, or frass, collecting at the base of the tree or on branches.

Dennis Haugen, USDA Forest Service, Bugwood.org

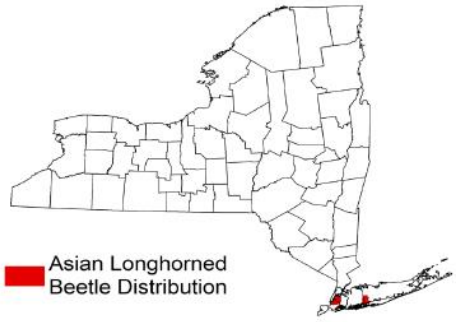
Dennis Haugen, USDA Forest Service, Bugwood.org

Joe Boggs, Ohio State, Bugwood.org

Robert A. Haack, USDA Forest Service, Bugwood.org

Where are ALB located?

In 1996, ALB were found infesting Norway maple trees in Brooklyn. Larvae and pupae likely hitchhiked from China in wooden packing material, and the adult beetles emerged after the materials reached the New York Harbor. Additional infestations were later discovered in Manhattan, Queens, Staten Island, Islip and central Long Island. To date, the Manhattan, eastern Queens, Staten Island and Islip infestation sites have been eradicated.



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What do they do to trees?

Females often chew depressions in the bark where they deposit one to two eggs at a time, laying up to sixty eggs on average. After they hatch, the larvae bore into the tree and begin feeding on the living tissue just underneath the bark which disrupts the nutrient and water flow within the tree. The larvae then continue deep into the heartwood where they continue to feed until they are ready to pupate. Repeated attacks from scores of larvae, generation after generation, eventually girdles the tree and kills it. Tree death usually occurs 7-9 years after the initial infestation, depending on site conditions and the tree's overall health.

What is the risk to NYS?

Since maples are a preferred host for ALB, the spread of the beetle into the rest of the state would mean devastating impacts to the maple syrup industry through the loss of healthy sugar bush. Maples are also a valuable hardwood for furniture, flooring, and other uses. Larval galleries through the heartwood may degrade the wood enough to make it useless for milling, costing the forest products industry billions of dollars. The larval galleries also compromise the structural integrity of the tree, resulting in falling limbs and trunks under heavy rain, snow or wind pressure. Removing these hazard trees in parks and towns would be expensive and have serious impacts on property values and tourism.

Before and after the removal of
ALB infested trees in Worchester, MA.
Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

What is being done?

- International standards require wooden packing materials to be chemically treated or kiln dried to help stop new introductions from occurring.
- Quarantines have been established around infested areas to prevent the movement of infested materials.
- The NYS Department of Agriculture and Markets has taken the lead on surveying for infested trees, tree removal and tree treatment to eradicate the ALB populations in New York City and on Long Island.

What can I do?

- Adhere to the NYS firewood regulation which limits untreated firewood movement to no more than 50 miles and obey the rules of the ALB quarantines (https://www.agriculture.ny.gov/PI/alb.html), which prevent regulated materials from leaving those areas.
- If you have a pool, you can participate in the ALB Swimming Pool Survey. Whenever you clean your pool, check your filter and skimmers for anything that resembles an ALB. Send a photo of what you find to foresthealth@dec.ny.gov.

If you believe you have found an ALB…

- Take pictures of the infestation signs as described above (include something for scale such as a coin or ruler).
- Note the location (intersecting roads, landmarks or GPS coordinates).
- Contact DEC (see below) or your local Partnership for Regional Invasive Species Management (PRISM) by visiting www.dec.ny.gov/animals/47433.html.
- Call the ALB tip line at 1-866-702-9938.
- Report the infestation to *i*MapInvasives at www.NYiMapInvasives.org.

CONTACT INFORMATION

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Division of Lands and Forests

New York State Department of Environmental Conservation
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www.dec.ny.gov

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Appendix E: Spotted Lanternfly Fact Sheet

New York State Integrated Pest Management Program | Cornell Cooperative Extension

Invasive Species & Exotic Pests

Spotted Lanternfly *Lycorma delicatula*

Juliet Carroll and Nicole Mattoon, New York State Integrated Pest Management Program, Cornell University

The spotted lanternfly, also known as Chinese blistering cicada, is a planthopper native to China and Southeastern Asia. Discovered in Pennsylvania in 2014, the spotted lanternfly presents a threat to both woody and non-woody hosts that are present throughout the United States. While their list of hosts is large, the greatest agricultural concern falls on grapes, hops, apples, blueberries, and stone fruits. Effort is underway to try to eradicate this insect in Pennsylvania. However, in 2018, it was found in Connecticut, Delaware, Maryland, New Jersey, New York, and Virginia.

Spotted lanternfly egg mass. Photo: Holly Raguza, Bugwood.org.

Concern

Due to the fact that this insect has already been found in the United States, there is great concern about its effect on vineyard, orchard, and forest industries. Its presence could lead to crop loss and increased management costs. Spotted lanternfly eggs are laid on any hard, smooth surface, including plants, trunks, stones, and bricks. Because of this, egg masses may be spread unknowingly. Spotted lanternfly nymphs are able to feed on many hosts, while adults prefer Tree of Heaven *(Ailanthus altissima)* and grapevine *(Vitis vinifera)*. Furthermore, abundant excretion of sticky honeydew by swarms feeding on shade trees and the associated growth of sooty mold can severely restrict people's enjoyment of parks and their own backyards.

The final nymph stage of the spotted lanternfly, shown on a branch, is distinctively colored. Photo: Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org.

Description

Spotted lanternfly adults are very colorful when their wings are displayed during hopping. They have red hind wings with black spots, have a black head, and a yellow abdomen with black bands. Their grayish forewings have black spots with a distinctive black brick-like pattern on the tips. There is one generation per year, with adults developing in July, laying eggs in September, and overwintering as eggs. Each egg mass contains 30-50 eggs that are covered in a waxy brown substance. The first nymphs to develop are wingless, black, and have white spots, while the final nymph stage turns red before becoming adults. Adult males are slightly smaller than the inch-long

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females, but are almost identical in appearance. Adults and nymphs commonly gather in large numbers on host plants to feed, and are easiest to see at dusk or at night.

Damage

This plant hopper is able to feed using specialized mouth parts that can pierce the plant and suck up sap. Both nymphs and adults feed this way, on leaves, stems, and trunks. Piercing the plant's tissues and feeding on the sap weakens the plant, causing it to ooze and weep, which may result in a fermenting odor and a gray/black trail on the bark. Spotted lanternflies also excrete honeydew while feeding, which overtime may encourage the growth of sooty mold if infestation levels are high. The presence of the fermenting odor and honeydew may also attract other insects.

Found a Spotted Lanternfly in New York?

1. Take pictures of the insect, egg masses, or infestation you see and, if possible, include something for size, such as a coin or ruler.
2. If possible, collect the insect. Place in a bag and freeze, or in a jar with rubbing alcohol or hand sanitizer.
3. Note the location (street address and zip code, intersecting roads, landmarks, or GPS coordinates).
4. **Email pictures and location** spottedlanternfly@dec.ny.gov

For More Information

New York State Integrated Pest Management Program: Spotted Lanternfly nysipm.cornell.edu/environment/invasive-species-exotic-pests/spotted-lanternfly

New York State Department of Environmental Conservation: Spotted Lanternfly dec.ny.gov/animals/113303.html

United State Department of Agriculture, Animal and Plant Health Inspection Service Pest Alert: Spotted Lanternfly aphis.usda.gov/publications/plant_health/2014/alert_spotted_lanternfly.pdf

PennState Extension: Spotted Lanternfly extension.psu.edu/spotted-lanternfly

Spotted lanternfly adult at rest on a branch. Photo: Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org.

Collected spotted lanternfly adult with wings spread. The yellow sides of the abdomen are visible because this is a mated female, full of eggs. Photo: Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org.

IPM

nysipm.cornell.edu

Produced by the New York State Integrated Pest Management Program, which is funded through Cornell University, Cornell Cooperative Extension, the NYS Department of Agriculture and Markets, the NYS Department of Environmental Conservation, and USDA-NIFA. Special funding for this project was provided by USDA Farm Bill 10201. Funding administered by the NYS Department of Agriculture & Markets and USDA-APHIS. Design by Karen English, New York State IPM Program. Cornell Cooperative Extension provides equal program and employment opportunities. Updated December 2018; search for this title at the NYSIPM Publications collection: hdl.handle.net/1813/43943

NEW YORK STATE | Agriculture and Markets | Department of Environmental Conservation

Appendix F: Beech Leaf Disease Fact Sheet

CAES
The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

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Founded in 1875
Putting science to work for society

BEECH LEAF DISEASE

Beach leaf disease was first discovered in Ohio in 2012. It has since been found in Pennsylvania, New York, and Ontario, Canada in North America. In Connecticut, this disease was first detected in August 2019 (Figure 1). The disease has been observed mainly in forests, but also in landscaped areas. Beech leaf disease causes premature leaf drop and thin canopies, and also makes the trees more susceptible to other pests.

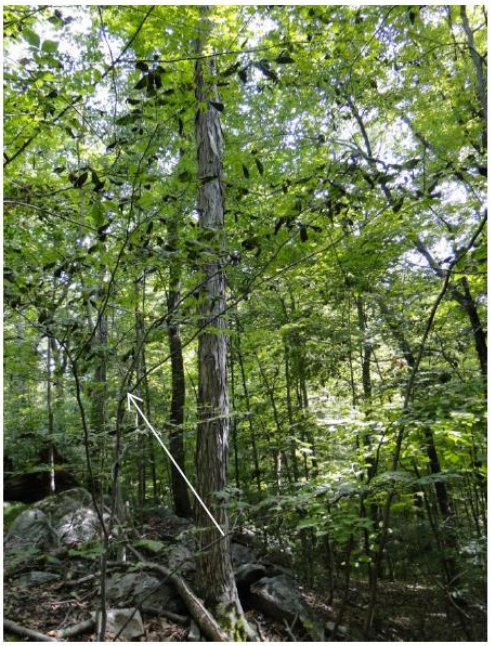

Figure 1. A beech sapling affected by beech leaf disease (arrow).

SYMPTOMS AND DIAGNOSTICS

Dark green striping between leaf veins is a chacteristic symptom of this disease, which is expecially noticeble when viewing upward into the canopy (Figure 2) or viewing against light (Figure 3). The symptom appears when leaves form in the spring. The initial symptoms are darkening and wrinkling of small portion of leaf tissues between veins (Figures 3 and 4). As disease progresses, the infected leaf tissues turn yellow, slightly raised, crinkly, and leathery (Figure 5). Heavily infected leaves are curled downward, shrunken, and are prematurely defoliated (Figure 6). Sapling and young trees are more susceptible to the disease and can die within three years after symptoms are observed, which can reduce the proportion of American beech in the affected forest areas. Symptoms of other

Figure 2. Dark green striping between veins on beech leaves.

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pests, such as beech blight aphid, European beech scale, eriophyid mites, and anthracnose, can resemble beech leaf disease, which stresses the need for a laboratory examination.

DISEASE DEVELOPMENT

A foliar nematode species, *Litylenchus crenatae,* that was first described in Japan is associated with beech leaf disease and pathogenic to American beech (*Fagus grandifolia*), European beech (*F. sylvatica*), and oriental beech (*F. orientalis*). However, the origin of the pathogen and its distribution is unclear. Emerging leaves can be infected by the pathogen in the spring. But, survival and dissemination of the pathogens are unknown.

DISEASE MANAGEMENT

Because little is known about the biology of the pathogen and epidemiology of the disease, no effective control or eradication measures have been developed. In general, the spread of invasive species can be prevented by restricting the movement of plant materials and monitoring trees closely for signs and symptoms. Beech leaf disease has spread very quickly eastward in the United States. Management efforts for the disease should focus on preventing the introduction of this invasive pathogen. Quarantines and regulations can be used to prevent further spread of beech leaf disease.

August 2019

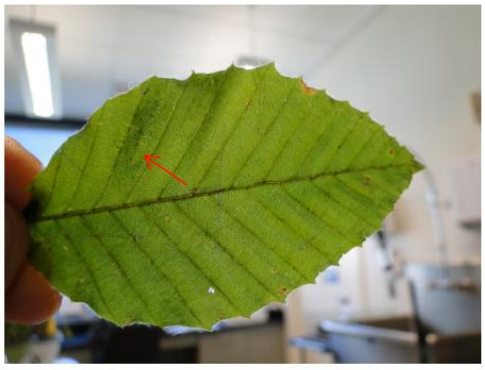

Figure 3. Darkening of leaf tissues between veins.

Figure 3. Wrinkling of leaf tissues between veins.

Figure 5. Yellow striping between veins on the upper surface of beech leaves.

Figure 6. Curling and browning of leaves.

Beech Leaf Disease Y. H. Li
The Connecticut Agricultural Experiment Station (www.portal.ct.gov/caes)

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Appendix G: DEC Recommended Trees and Shrubs

NATIVE TREES

For Gardening and Landscaping

NEW YORK STATE | Department of Environmental Conservation

White Spruce (*Picea glauca*)

Classic conical Christmas tree shape. Short stiff needles are bluish green. Most adaptable native spruce for landscape planting. Many cultivars.

Light	Soil	Height/Spread (ft)	Zone
Full sun - partial shade	Moist, well drained	50′/20′	2-6


Alternate-leaved Dogwood (*Cornus alternifolia*)

Also known as "Pagoda Dogwood" because of unusual horizontal branch structure. Excellent small tree for partial shade. Clusters of small white flowers, good fall color. Shade tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - full shade	Moist, well drained	20′/10′	3-7


Bur Oak (*Quercus macrocarpa*)

Rangy oak with shaggy-capped acorns and big dark glossy leaves, often with distinctive deep lobe in middle. Very adaptable and tough, will grow on both acidic and alkaline soils. Flood tolerant and somewhat drought tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - partial shade	Dry - wet	80′/60′	3-8


Red Maple (*Acer rubrum*)

Red flowers followed by red seeds in spring. Red-stemmed leaves with whitish undersides in summer. Red and yellow leaves in fall. Well-known as a swamp tree, but also grows well on upland sites. Most versatile native maple for landscapes. Many cultivars. Flood tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - light shade	Dry - wet	50′/30′	3-9


Eastern Red Cedar (*Juniperus virginiana*)

Young trees narrow, columnar. Older trees more conical form. Small, blue, berry-like cones on female trees are eaten by many birds. Tough tree which thrives on dry, harsh, rocky sites. Grows well on limestone, and also on more acidic sites. Very drought tolerant. Must have full sun.

Light	Soil	Height/Spread (ft)	Zone
Full sun	Dry - moist, well drained	40′/15′	3-9


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Serviceberry, Shadbush (*Amelanchier arborea*)


Graceful small tree. Has delicate white flowers in early spring. Flowers followed by oval leaves and edible berries in summer. Vivid fall colors.

Light	Soil	Height/Spread (ft)	Zone
Full sun - partial shade	Moist, well drained	20′/15′	4-9

Black Gum (*Nyssa sylvatica*)


Great fall color. Fruit attracts many birds and mammals, good nectar source for honey bees. Salt and shade tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - full shade	Dry - wet	50′/30′	4-9

Swamp White Oak (*Quercus bicolor*)


Dark green leaves with white undersides. Tolerates compacted soils and drought. Also good for wet areas, flood tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - full shade	Dry - wet	80′/50′	4-8

Tamarack (*Larix laricina*)


Deciduous conifer with soft bluish-green needles, small round cones. A northern species which does well on cool, wet sites. Bright yellow fall color.

Light	Soil	Height/Spread (ft)	Zone
Full sun	Moist - wet	50′/15′	2-4

River Birch (*Betula nigra*)


Young trees have spectacular, multi-colored, peeling bark in warm shades of tan, brown, pink and cream. Popular birch for landscape use because of heat tolerance and disease resistance. Flood tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - partial shade	Moist - wet	60′/30′	3-9

CONTACT INFORMATION

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Updated January 29, 2018

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NATIVE SHRUBS

For Gardening and Landscaping

NEW YORK STATE | Department of Environmental Conservation

Highbush Blueberry (*Vaccinium corymbosum*)

Bell-like white flowers. Clusters of delicious blue berries. Fall color is a range of reds. Striking in winter with colorful young branches and peeling multicolored bark on older stems. Tolerates flooding, needs acidic soil.

Light	Soil	Height/Spread (ft)	Zone
Full sun - light shade	Dry - wet	10'/8'	3-7


American Elderberry (*Sambucus nigra ssp. canadensis*)

Large compound leaves and plate-sized clusters of small white flowers. Small purple berries used in making preserves, pies, and elderberry wine.

Light	Soil	Height/Spread (ft)	Zone
Full sun - light shade	Moist, well drained	8'/8'	4-9


Virginia Rose (*Rosa virginiana*)

Versatile with glossy leaves and large, pink flowers. Spectacular fall colors. Salt tolerant, somewhat drought tolerant. Does well in sandy soil.

Light	Soil	Height/Spread (ft)	Zone
Full sun	Dry - moist	5'/10'	4-8


Buttonbush (*Cephalanthus occidentalis*)

Fragrant spheres of white flowers attract butterflies, hummingbirds and native bees. Top wildlife species. Good for rain gardens.

Light	Soil	Height/Spread (ft)	Zone
Full sun	Moist - wet	8'/8'	5-11


Maple-leaved Viburnum (*Viburnum acerifolium*)

Understory shrub with soft maple-shaped leaves. Clusters of small white flowers. Dark-blue berries. Unusual pale, bluish-pink fall colors.

Light	Soil	Height/Spread (ft)	Zone
Partial - full shade	Dry-moist, well drained	5'/5'	4-8


American Hazelnut (*Corylus americana*)

Dense, vase-shaped clumps of supple stems with large rough leaves and edible nuts. Important grouse food. Shades of orange, gold and red in fall.

Light	Soil	Height/Spread (ft)	Zone
Full sun - full shade	Dry - wet	10'/10'	4-9


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Nannyberry (*Viburnum lentago*)


Large multi-stemmed shrub. Can be trained into small single-stemmed tree. Glossy foliage, clusters of small white flowers. Resistant to viburnum leaf beetle. Dark-blue berries persist into winter. Good fall color.

Light	Soil	Height/Spread (ft)	Zone
Full sun - light shade	Moist - wet	25′/15′	3-7

Northern Bush-honeysuckle (*Diervilla lonicera*)


Not a true honeysuckle. Slender stems with large finely toothed, glossy leaves, yellow flowers. New leaves typically reddish bronze. Orange, gold and red fall colors. Spreads easily, good ground cover. Drought-resistant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - partial shade	Dry - moist	3′/3′	3-7

Bayberry (*Morella caroliniensis* (*formerly Myrica pensylvanica*))


Coastal species well adapted to sandy soil and occasional flooding. Fine urban shrub because of high salt tolerance and resistance to insects and diseases. Glossy, aromatic foliage, semi-evergreen. Tolerates pruning.

Light	Soil	Height/Spread (ft)	Zone
Full sun - partial shade	Dry - wet	10′/10′	3-6

Flowering Raspberry (*Rubus odoratus*)


Large fuzzy leaves with pointed lobes on thorn-less, arching canes. Single pink flowers are an inch across and resemble wild rose flowers. Small raspberry fruits. Wonderful shrub for edge areas. Shade tolerant.

Light	Soil	Height/Spread (ft)	Zone
Full sun - full shade	Moist	5′/3′	4-6

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Appendix H: B& B Tree Planting Methods

New Tree Planting

Information on proper practices for planting a tree with a nine-step approach to successful planting and establishment.

Purchasing a tree is an investment, and how well that investment grows depends on the type of tree selected, the location, and the care provided.

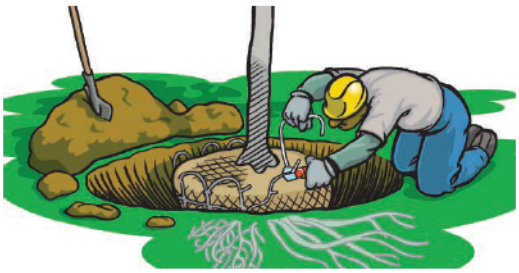
When to Plant

- Ideally during the dormant season—in the fall after leaf drop or in early spring before bud break.
- Weather conditions are cool and allow plants to establish roots in the new location before spring rains and summer heat stimulate new top growth.
- Healthy balled and burlapped or container trees can be planted throughout the growing season.
- In tropical and subtropical climates where trees grow year round, any time is a good time to plant a tree, provided that sufficient water is available.

Planting Stress

Balled-and-burlapped trees lose a significant portion of their root system when dug at the nursery. As a result, trees commonly exhibit what is known as "transplant shock." Transplant shock is a state of slowed growth and reduced vitality following transplanting.

Container trees may also experience transplant shock, particularly if they have circling (girdling) or kinked roots that must be cut. Proper site preparation, careful handling to prevent further root damage, and good follow-up care reduces transplant shock and promotes faster recovery.



Steps to Plant a Tree

Note: *Before you begin planting your tree, be sure you have located all underground utilities prior to digging.* ***811 is the national call-before-you-dig phone number.*** *Anyone who plans to dig should call 811 or go to their state 811 center's website.*

Carefully follow these nine steps to help your tree establish quickly in its new location:

1. The trunk flare is where the trunk expands at the base of the tree. **Ensure trunk flare is partially visible after the tree is planted.** Remove excess soil prior to planting if flare is not visible.
2. Dig a shallow, broad planting hole. **Holes should be 2–3 times wider than the root ball**, but only as deep as the root ball.
3. If wrapped, remove any cover from around the root ball and trunk to facilitate root growth. Remove wire basket or cut one or two rings off so it is low-profile and will not interfere with future root growth. Inspect tree root ball for circling roots and straighten, cut, or remove them. Expose the trunk flare if necessary.
4. Place the tree at the proper height. When placing the tree in the hole, lift by the root ball, not the trunk. The majority of tree's roots develop in the top 12 inches (30 cm) of soil. Planting too deep can be harmful to the tree.
5. Straighten the tree in the hole. Before filling the hole, have someone examine the tree from several angles to confirm it is straight.
6. Fill the hole gently but firmly. Pack soil around the base of the root ball to stabilize it. Fill the hole firmly to eliminate air pockets. Further reduce air pockets by watering periodically while backfilling. Avoid fertilizing at the time of planting.
7. If staking is necessary, three stakes or underground systems provide optimum support. **Studies have shown that trees develop stronger trunks and roots if they are not staked**; however, it may be required when planting bare root stock or on windy sites. Remove stakes after first year of growth.

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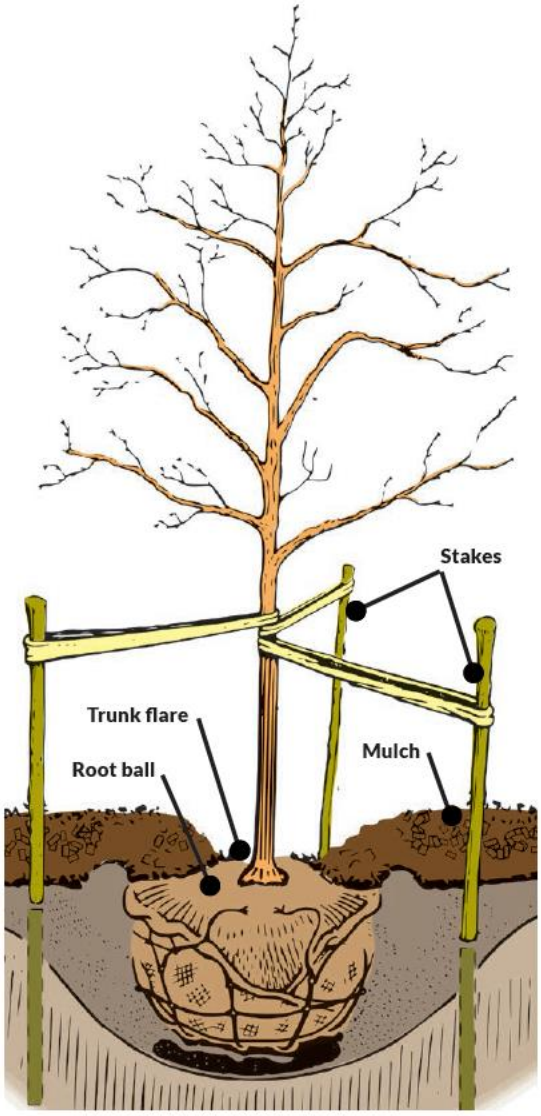
8. Mulch the base of the tree. Place a 2–3 inch (5–7.5 cm) layer of mulch, but be sure not to pile much right against the trunk. **A mulch-free area of 1–2 inches (2.5–5 cm) wide at the base of the tree will reduce moist bark and prevent decay.**

9. Provide follow-up care. Keep the soil moist by watering at least once a week, barring rain, and more frequently during hot, windy weather. Continue until mid-fall, tapering off as lower temperatures require less-frequent watering.

Other follow-up care to consider:

- Minor pruning of branches damaged during the planting process may be required.
- Prune sparingly after planting. Delay corrective pruning until a full season of growth.
- If trunk wrapping is necessary, use biodegradable materials and wrap from the bottom.



What Is a Certified Arborist?

ISA Certified Arborists® are individuals who have proven a level of knowledge in the art and science of tree care through experience and by passing a comprehensive examination developed by some of the nation's leading experts on tree care.
ISA Certified Arborists must also continue their education to maintain their certification. Therefore, they are more likely to be up to date on the latest techniques in arboriculture.

Finding an Arborist

Visit TreesAreGood.org for free tools:

- The "Find an Arborist" tool can help you locate an arborist in your area.
- The "Verify a Credential" tool enables you to confirm whether an arborist has an ISA credential.

Be an Informed Consumer

One of the best methods to use in choosing an arborist is to educate yourself about some of the basic principles of tree care. Visit TreesAreGood.org to read and download all brochures in this series.

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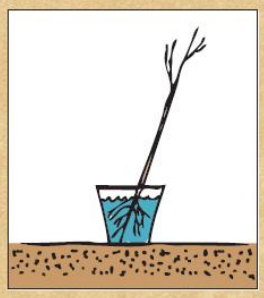
Appendix I: Bare Root Tree Planting Methods

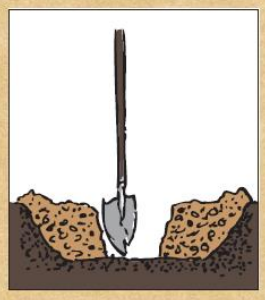
How to Plant Bare-root Trees

Members: Please also see "Important Notes for Planting Your 10 Free Trees" on the reverse side.

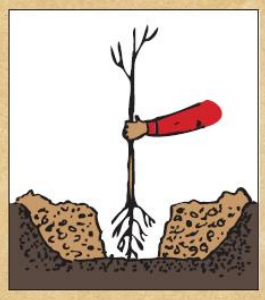
1. Unpack your trees, remove all packing materials, carefully untangle the roots and soak the roots in water 3 to 6 hours. Do not allow the roots to dry out.



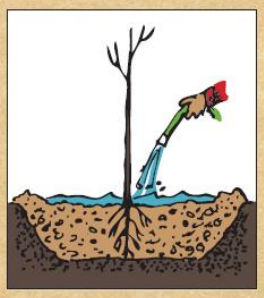
2. Dig a hole, wider than seems necessary, so the roots can grow outward without crowding. Remove any grass within a 3-foot circular area. To aid root growth, turn soil in an area up to 3 feet in diameter.



3. Plant the tree at the same depth it stood in the nursery, with plenty of room for the roots. Partially fill the hole, firming the soil around the lower roots. Do not add soil amendments such as peat or bark. Do not use fertilizer, potting soil, or chemicals on your new trees.



4. Shovel in the remaining soil. It should be firmly but not tightly packed. Construct a water-holding basin around the tree. Give the tree plenty of water.



5. After the water has soaked in, spread protective mulch two inches deep in a 3-foot diameter area around the base of the tree, but not touching the trunk.

6. The soil and mulch around your trees should be kept moist but not soggy. During dry weather, generously water the tree every 7 to 10 days during the first year. Water slowly at the dripline.

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