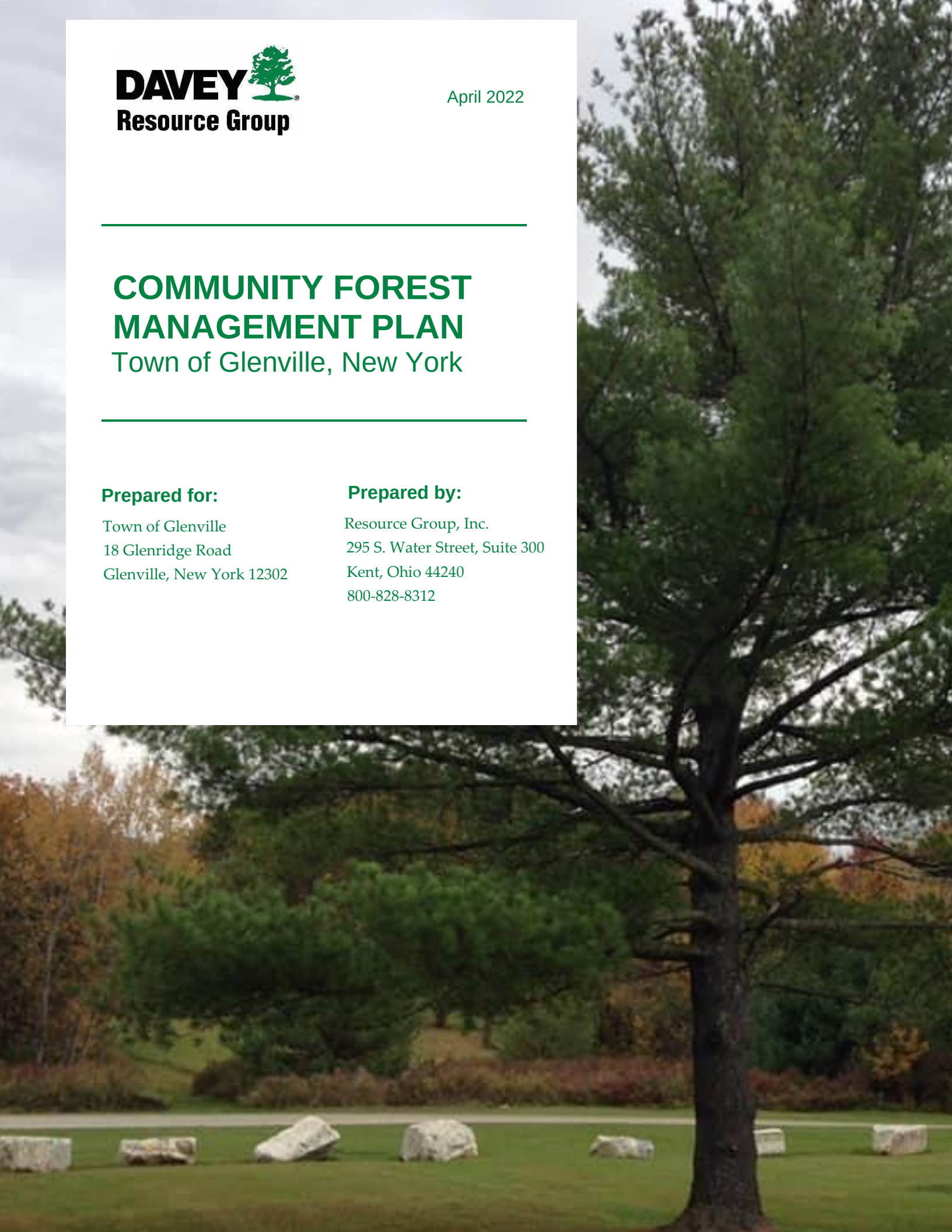

April 2022

COMMUNITY FOREST MANAGEMENT PLAN

Town of Glenville, New York

Prepared for:

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ACKNOWLEDGMENTS

This project supports the Town of Glenville's vision to promote and enhance community well-being through public tree conservation and improved forestry management practices. This *Standard Inventory Analysis and Management Plan* offers expertise in preserving and expanding urban canopy so the environmental, economic, and social benefits it provides continue for generations.

Glenville is thankful for the grant funding it received from the New York State Department of Environmental Conservation (NYSDEC) in cooperation with U.S. Forest Service through its Urban and Community Forestry (U&CF) Grant Program. The U&CF Grant Program is designed to encourage communities to create and support sustainable urban forestry programs throughout the United States.

Glenville would also like to recognize the support of the following people:

Town Supervisor Christopher Koetzle

Kris William at Cornell Cooperative Extension

And Tree Board Members:

Vicki Hillis

Dan Hill

Rob Titus

Don Rodbell

Charles Story

Edwin Droz

Five-Year Tree Resource Maintenance Schedule

EXECUTIVE SUMMARY

The Town of Glenville *Standard Inventory Analysis and Management Plan*, written by Davey Resource Group, Inc. "DRG", focuses on quantifying the benefits provided by the inventoried tree resource and addressing its maintenance needs. DRG completed a partial inventory in 2018 and returned to complete it in August 2021. DRG then analyzed the completed inventory data to understand the structure of the town's inventoried tree resource. DRG also estimated the economic values of the various environmental benefits provided by this public tree resource by analyzing inventory data with i-Tree Eco and recommended a prioritized management program for future tree care.

The functions of Glenville 's 6,615 inventoried trees provide benefits with an estimated total value of $19,806 annually. The functions of Glenville 's inventoried tree population throughout its trees' lifetimes are worth an estimated $12,694,734. Supporting and funding proactive maintenance of the public tree resource is a sound long-term investment that will reduce tree management costs over time.

High priority tree removal and pruning is costly, accounting for the larger budget in Year 1 of the ten-year schedule, as shown in Figure 1. After high priority work has been completed, budgets are expected to decrease and stabilize as tree management transitions from reactive to proactive maintenance. This also reduces the number of new elevated risk trees over time by preventing deteriorating conditions of trees with initial minor defects.

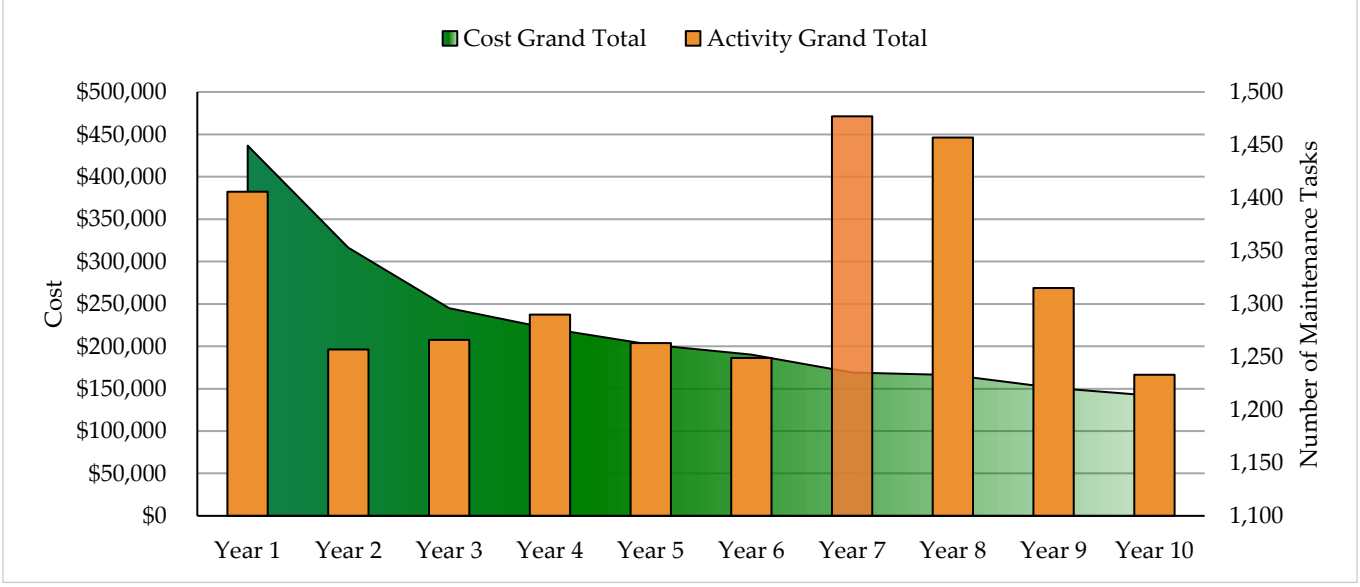


Figure 1. Budget grand totals.

Recommended Maintenance Types

Removal

Trees designated for removal have defects that cannot be cost-effectively or practically corrected. Most of the trees in this category have a large percentage of dead crown.

Total = 620 trees
High Priority = 113 trees
Moderate Priority = 130 trees
Low Priority = 377 trees
Stumps = 233

Priority Pruning

Priority pruning removes defects such as Dead and Dying Parts or Broken and/or Hanging Branches. Pruning the defected branch(es) can lower risk associated with the tree while promoting healthy growth.

Total = 606 trees
High Priority = 38 trees
Moderate Priority = 568 trees

Routine Pruning Cycle

Over time, routine pruning of Low and Moderate Risk trees can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

Total = 4,992 trees
Number in cycle each year = at least 998 trees

Young Tree Training Cycle

Younger trees can have branch structures that lead to potential problems as the tree ages, requiring training to ensure healthy growth. Training is completed from the ground with a pole pruner or pruning shear.

Total = 397 trees
Number in cycle each year = at least 132 trees

Tree Planting

Planting new trees in areas that have poor canopy continuity is important, as is planting trees where there is sparse canopy, to ensure that tree benefits are distributed evenly across the city.

Total replacement plantings = 657 trees
Total new plantings = 1,515 trees

Routine Tree Inspection

Routine inspections are essential to uncovering potential problems with trees and should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees.

Total Number of trees= 6,615

INTRODUCTION

The Town of Glenville is home to 29,500 residents benefitting from public trees in their community. The town's Public Works Department manages all trees, stumps, and planting sites along the street rights-of-way (ROW) and throughout public parks. For the past three years, Glenville's staff in the Public Works Department have shown continued commitment to developing a thriving public tree resource.

The Town of Glenville has a dedicated tree ordinance (Town Code, Chapter 250), which was developed to promote and preserve the urban forest, maintain municipal trees and replant to protect the environment. The ordinance established a Tree Board dedicated to tree-related activities throughout the town. The Town also has an Environmental Conservation Commission that attends to environmental issues that directly affect the town. The Town spends more than $2 per capita on tree maintenance, celebrates Arbor Day with a "Love Your Parks" clean-up and tree planting event, and has been a Tree City USA community for 3 years.

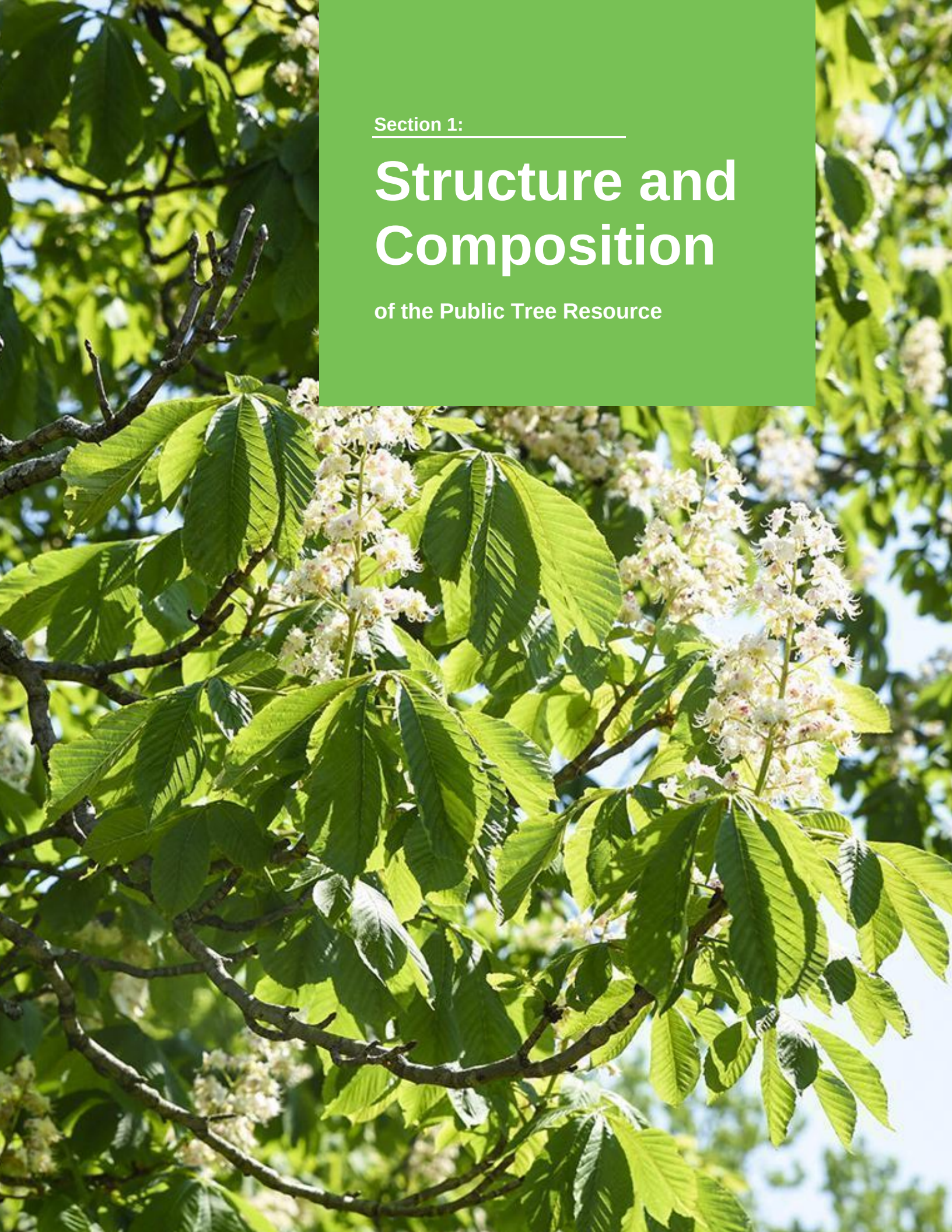
The Town of Glenville works in collaboration with the Tree Board, the Environmental Conservation Commission, the Parks Department, the Department of Public Works, and the Planning Department to effectively manage Glenville's urban forest. Using this *Standard Inventory Analysis and Management Plan,* the town will be able to set goals and perform proactive maintenance in a way that meets the immediate needs of the town's urban forest. The town's urban forestry program is well on its way to creating a sustainable and resilient public tree resource, and it is important to stay on track by consistently renewing program funding and routinely updating the tree inventory.

RECOMMENDED APPROACH TO TREE MANAGEMENT

An effective approach to tree resource management follows a proactive and systematic program that sets clear and realistic goals, prescribes future action, and periodically measures progress. A robust urban forestry program establishes tree maintenance priorities and utilizes modern tools, such as a tree inventory accompanied by TreeKeeper® or other asset management software.

In 2018 and August 2021, the Town of Glenville worked with DRG to inventory its public trees and develop this management plan. Consisting of six sections, this plan considers the diversity, distribution, and condition of the inventoried tree population and provides a prioritized system for managing the town's public tree resource.

- *Section 1: Structure and Composition of the Public Tree Resource* summarizes the inventory data with trends representing the current state of the tree resource.
- *Section 2: Functions and Benefits of the Public Tree Resource* summarizes the estimated value of benefits provided to the community by public trees' various functions.
- *Section 3: Recommended Management of the Public Tree Resource* details a prioritized management program and provides an estimated budget for recommended maintenance activities over a five-year period.
- *Section 4: Planting Plan*
- *Section 5: Storm Preparedness Plan*
- *Section 6: Invasive Insect and Disease Strategy*



Section 1:

Structure and Composition

of the Public Tree Resource

SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In August 2021, DRG performed a tree inventory, contracted by the Town of Glenville. DRG's arborists collected site data on trees, stumps, and planting sites along the street ROW and on trees in public parks. Of the total 8,139 sites inventoried, 97% were collected along the street ROW, and the remaining 3% were collected in Indian Meadows and Maalwyck parks. Figure 2 breaks down the total sites inventoried by type, although planting sites were not collected in parks. See Appendix A for details about DRG's methodology for collecting site data.

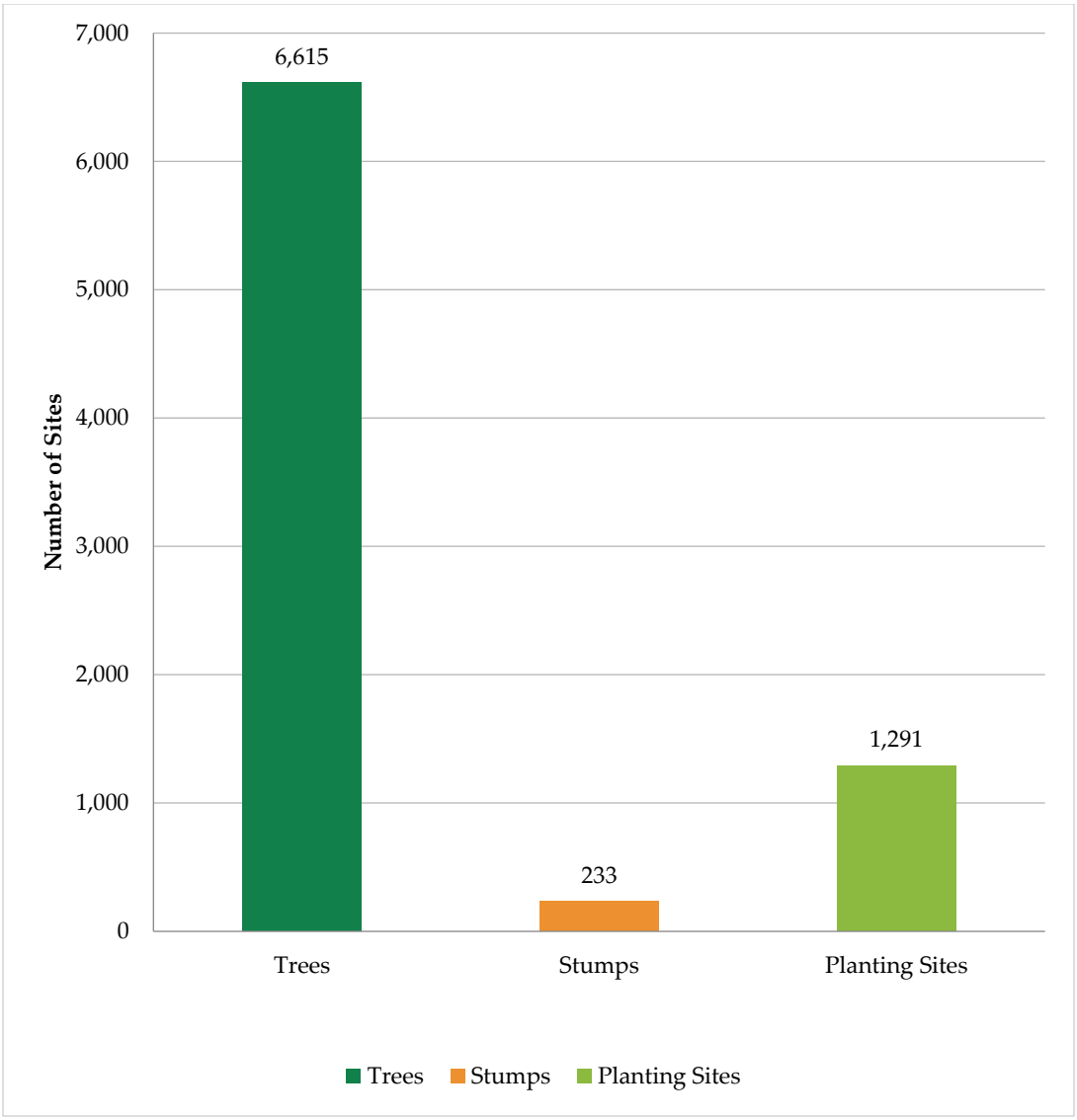


Figure 2. Number of inventoried sites by type.

SPECIES, GENUS, AND FAMILY DISTRIBUTION

The 10-20-30 rule is a common standard for tree population distribution, in which a single species should compose no more than 10% of the tree population, a single genus no more than 20%, and a single family no more than 30% (Santamour 1990).

Figure 3 shows Glenville 's distribution of the most abundant tree species inventoried compared to the 10% threshold. Norway maple (*Acer platanoides)* is the most abundant species, making up 20% of the inventoried population. This species is significantly higher than the recommended 10% threshold. Glenville should refrain from planting Norway maple in the future, in an effort to increase species diversity. The next most abundant species were red maple (*Acer rubrum*) and silver maple (*A. saccharinum*), making up 8% and 6% of the population, respectively, which is within, but approaching, the 10% recommended threshold.

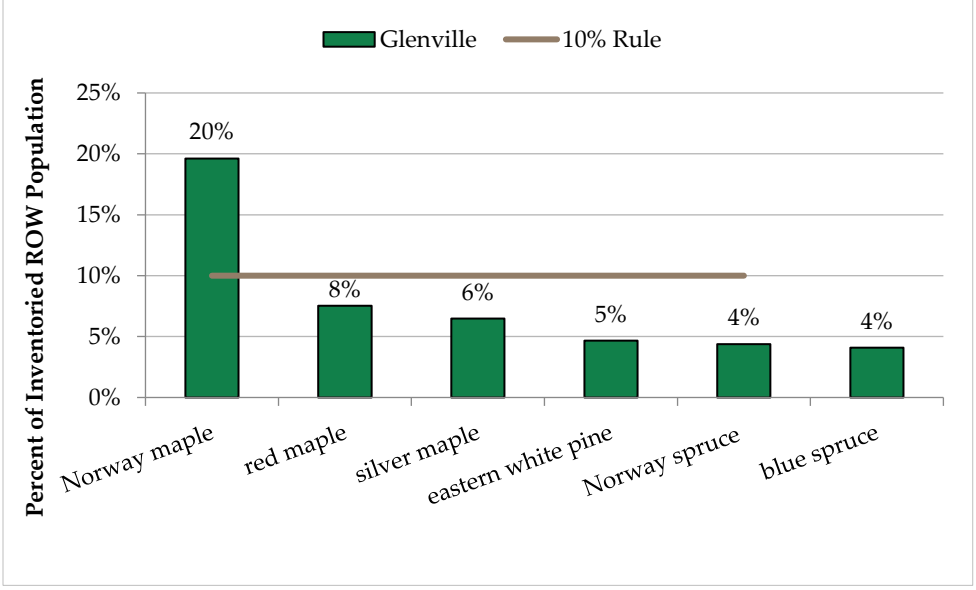


Figure 3. Species distribution of inventoried trees.

RESILIENCE THROUGH DIVERSITY

The Dutch elm disease epidemic of the 1930s provides a key historical lesson on the importance of diversity (Karnosky 1979). The disease killed millions of American elm trees, leaving behind enormous gaps in the urban canopy of many communities. In the aftermath, ash trees became popular replacements and were heavily planted along city streets. History repeated itself in 2002 with the introduction of the emerald ash borer into America. This invasive beetle devastated ash tree populations across the United States. Other invasive pests spreading across the country threaten urban forests, so it is vital that we learn from history and plant a wider variety of tree species and genera to develop a public tree resource that is both resistant to and resilient after disturbances.

Ash trees in an urban forest killed by emerald ash borer.

USDA Forest Service (2017)

Figure 4 shows the town's distribution of the most abundant tree genera inventoried, and maple (*Acer*) is significantly higher than the 20% threshold. This means that while red maple and silver maple are less than the 10% species threshold, the Town of Glenville should make an effort to refrain from planting maple in the future, until the composition of genera is more evenly distributed.

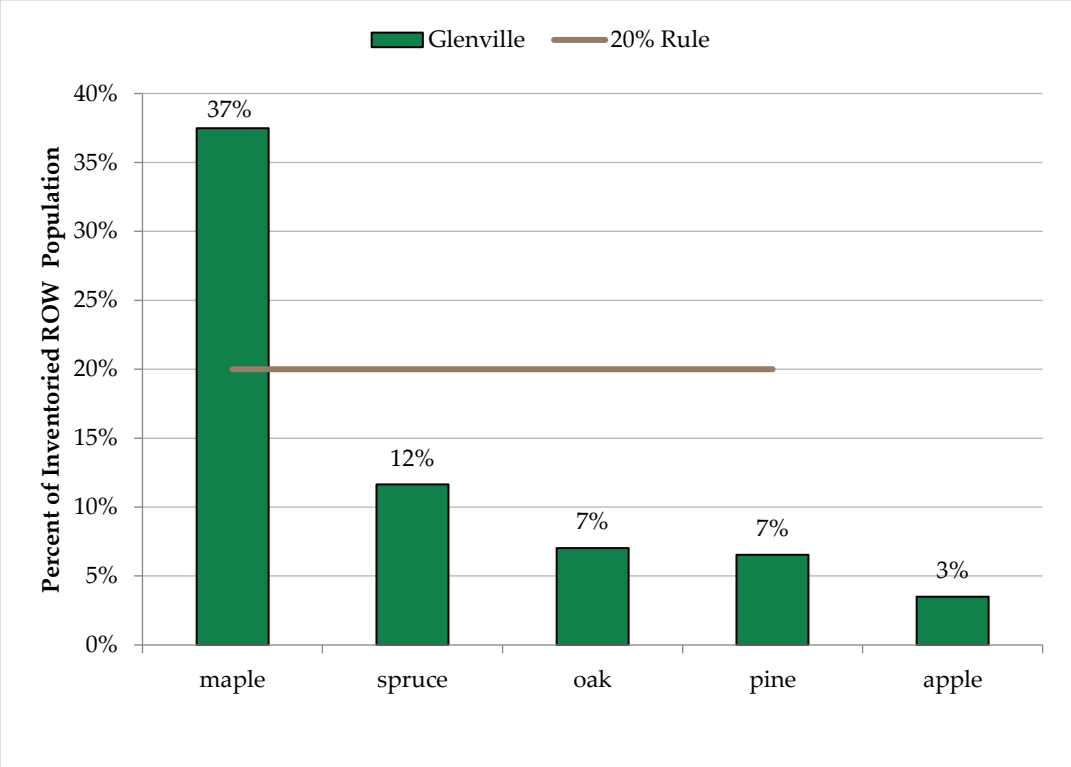


Figure 4. Genus distribution of inventoried trees.

This illustrates how species distribution alone does not completely represent tree population diversity. Genus distribution is an important consideration because some pests, such as emerald ash borer (EAB, *Agrilus planipennis*), target a single genus as its host. Some pests also target a single family as its host, such as the bacterium *Erwinia amylovora*, commonly known as fireblight. Fireblight only affects plants in the rose family (*Rosaceae*), such as serviceberry, hawthorn, apple/crabapple, hawthorn, cherry/plum, and pear.

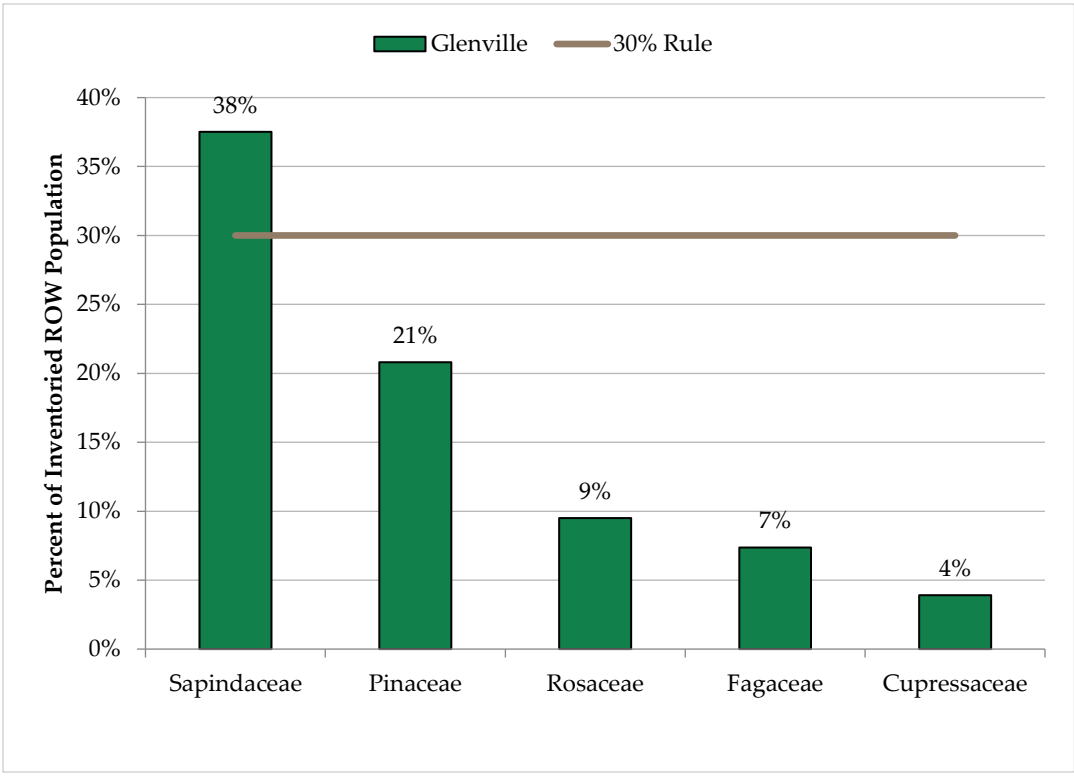


Figure 5. Family distribution of inventoried trees.

Figure 5 shows the town's distribution of the most abundant tree families inventoried compared to the 30% threshold. Sapindaceae (38%) exceeds the threshold by far, this is due to the large portion of maple in Glenville's urban tree resource.

It is worth noting that the trees accounted for in the 10-20-30 rule reflect the trees located in the public right-of-way and does not include trees located in parks or on private property.

PEST SUSCEPTIBILITY

Early diagnosis of disease and infestation is essential to ensuring the health and continuity of Glenville's public tree resource.

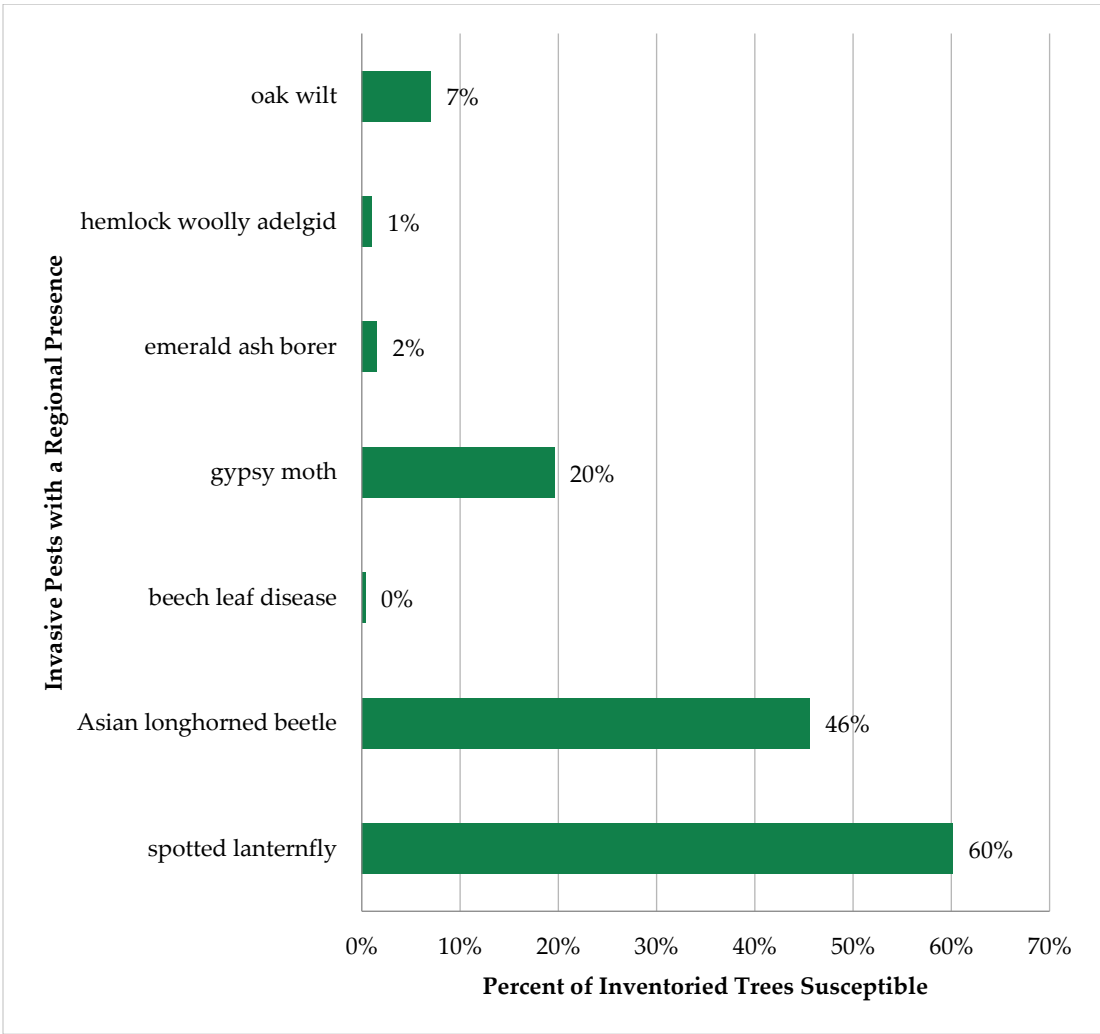


Figure 6. Tree resource susceptibility to invasive pests that have a regional presence.

Figure 6 shows the percent of inventoried trees susceptible to some of the known pests in and around New York State. It is important to remember that this figure only represents data collected during the inventory. Many more trees throughout Glenville, especially those on private property, may be susceptible to hosting these invasive pests. While certain invasive species may not currently be present in the Glenville area, there is potential for infestation due to the pests' regional presence and rapid dispersal ability. Spotted lantern fly (SLF, *Lycorma delicatula*)] and Asian longhorned beetle (ALB, *Anoplophora glabripennis*)] are known threats to a large percentage of the inventoried tree resource, 60% and 46%, respectively.

Pest Susceptibility Recommendations

The overabundance of maple in Glenville 's tree resource is a management concern, as it poses a risk in the event of an invasive pest outbreak. Maple are susceptible to pervasive invasive species, such as SLF or ALB. The over-abundance of maple makes the town vulnerable to large-scale urban canopy loss. Increasing species diversity is a critical goal that will help Glenville's tree resource be resilient in the event of future pest invasions.

While it might be prudent for the town to limit planting species in the Sapindaceae family, efforts to improve diversity at the genus and species level are a better use of short-term resources. For this reason, Glenville should use its resources to inspect trees in the *Acer* genus for signs of infestation on a routine basis, so affected trees can be quarantined to contain the pest before an outbreak begins.

It is important to remember that Figure 6 only represents data collected during the 2018/2021 inventory. Many more trees throughout Glenville, including those on private property, may be susceptible to hosting these and other invasive pests and diseases. Therefore, early diagnosis of disease and pest infestation is essential to ensuring the health and continuity of the town's public tree resource.

CONDITION

Several factors affecting condition were considered for each tree, including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated by an arborist as Good, Fair, Poor, or Dead. The general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory.

Figure 7 shows most of the inventoried trees were recorded in Good or Fair condition, 18% and 69%, respectively. Only 11% of trees were recorded to be in Poor condition and only 2% were recorded to be Dead. Based on these data, the general health of the inventoried tree population is rated as Fair.

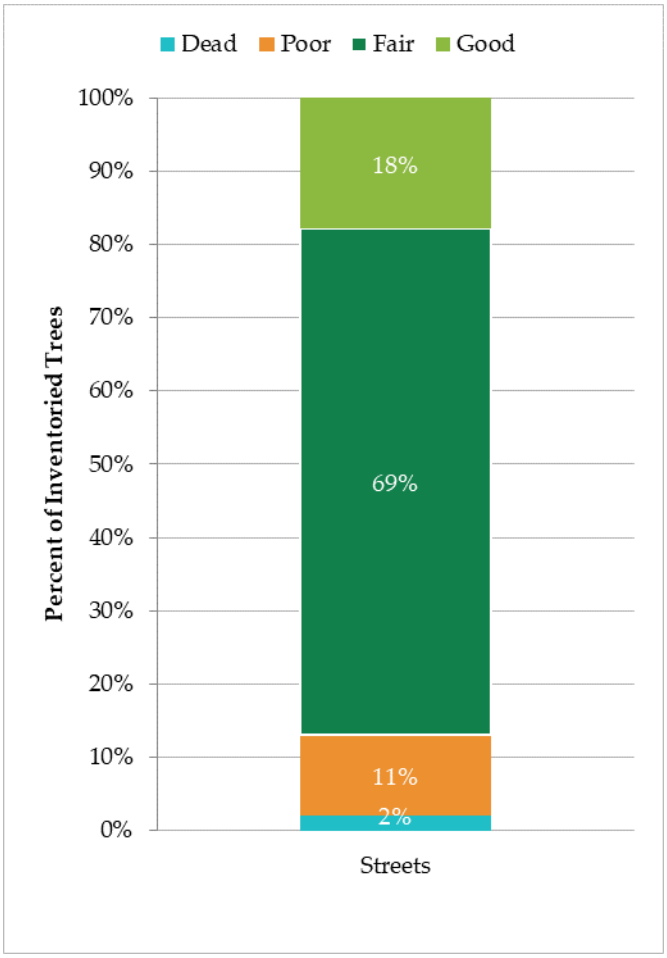


Figure 7. Condition of inventoried trees.

Condition Recommendations

Condition alone should not be used to prioritize maintenance activities. TreeKeeper® should be used to prioritize Poor condition or Dead tree removals with a high-risk rating. Younger trees rated in Fair or Poor condition may benefit from structural pruning to improve their health over time. Pruning should follow *ANSI A300 (Part 1)* guidelines. Poor condition ratings among mature trees were generally due to visible signs of decline and stress, including decay, dead limbs, sparse branching, or poor structure. These trees will likely require corrective pruning and intensive plant health care to improve their vigor and should be monitored for worsening conditions. Trees rated as Fair condition may benefit from pruning to remove dead or defective limbs; improved structure may elevate their condition with time and care.

RELATIVE AGE DISTRIBUTION

Analysis of a tree population's relative age distribution is performed by assigning age classes to the size classes of inventoried trees, offering insight into the maintenance needs of Glenville 's tree resource. The inventoried trees are grouped into the following relative age classes:

- Young trees (0–8 inches diameter at breast height (DBH))
- Established trees (9–17 inches DBH)
- Maturing trees (18–24 inches DBH)
- Mature trees (greater than 24 inches DBH)

These size classes were chosen so that the inventoried tree resource can be compared to the ideal relative age distribution, which holds that the largest proportion of the inventoried tree population (approximately 40%) should be young trees, while the smallest proportion (approximately 10%) should be mature trees (Richards 1983). Since tree species have different lifespans and mature at different diameters, actual tree age cannot be determined from diameter size class alone; however, size classifications can be used as a proxy for relative age classes.

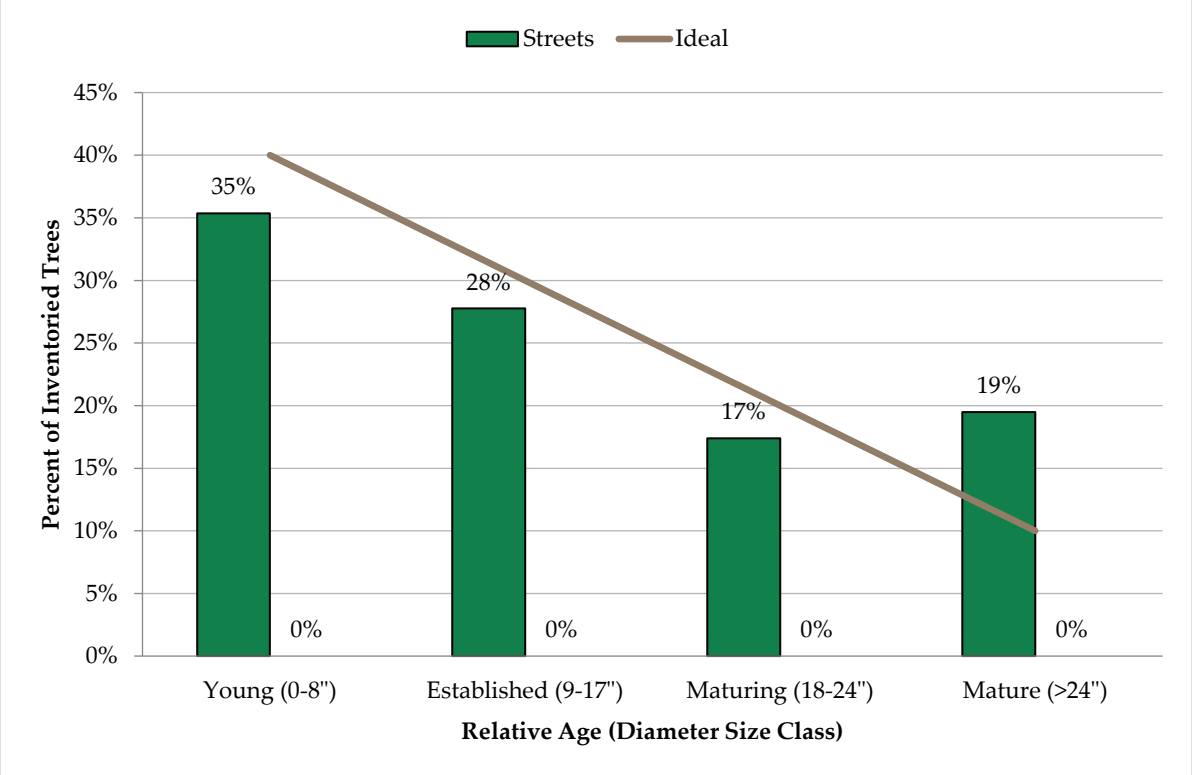


Figure 8. Relative age distribution of inventoried trees.

Figure 8 compares Glenville 's relative age distribution of the inventoried tree population to the ideal. The town's inventoried tree resource closely resembles the ideal age distribution, with a relatively small gap between each size class. The town should focus its effort on increasing the young tree population by planting new trees.

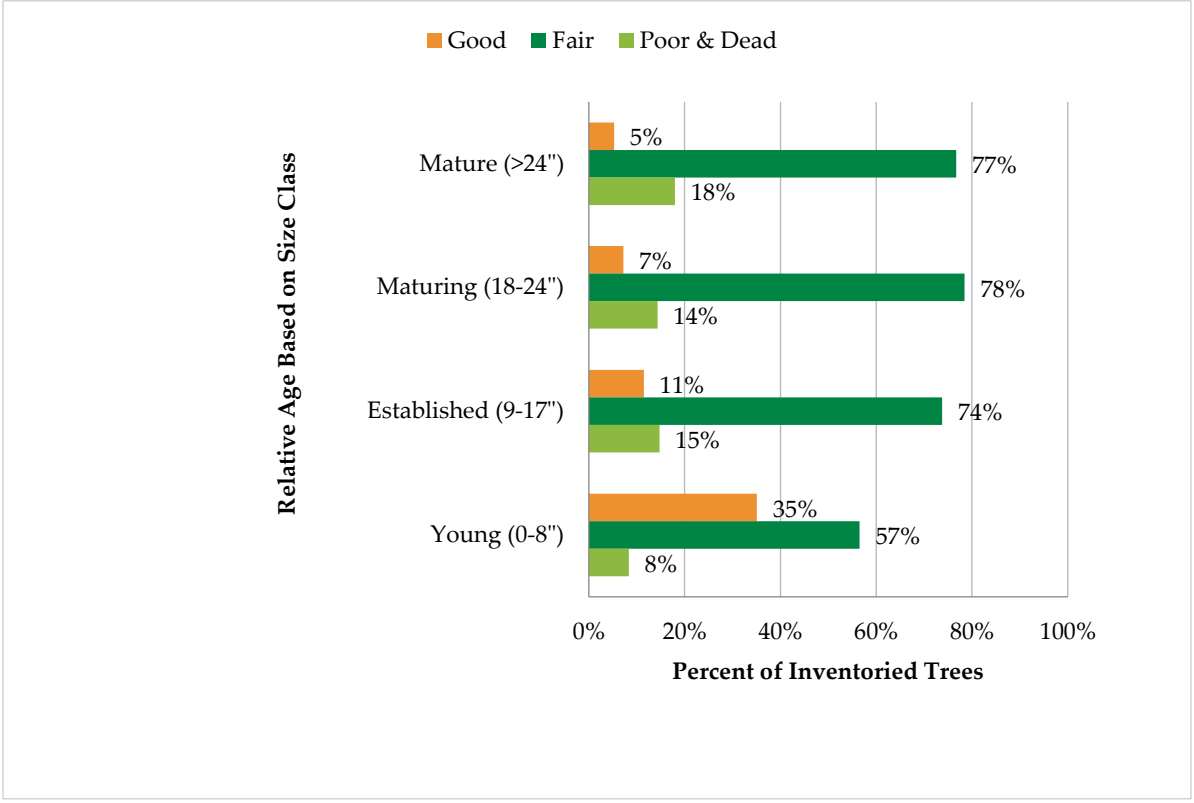


Figure 9. Condition of inventoried trees by relative age class.

Figure 9 cross analyzes the condition of the inventoried tree resource with its relative age distribution, providing insight into the inventoried population's stability. In Glenville's urban forest, 82% of mature trees and 85% of maturing trees are rated in Fair or Good condition, which matters because these larger trees would have a more damaging impact in the event of failure. Of the Young and Established trees, 92% and 85%, respectively, are rated in Fair or Good condition. It is important for Glenville to provide the maintenance they need to remain healthy as they age, to reduce the future proportion of mature and maturing trees in Poor condition.

Relative Age Recommendations

The town has a low percentage of trees in Poor condition, indicating that young trees have the potential of reaching maturity if they are well maintained. DRG recommends that Glenville implement a robust maintenance program, to conserve the condition of young trees as they age. Implementing an early maintenance program will reduce future tree care costs. The town should also focus on tree preservation and proactive care, to protect mature and maturing trees from unnecessary removal and to prevent them from succumbing to treatable defects. Prioritizing tree planting will shift the relative age distribution towards the ideal over time.

DEFECT OBSERVATIONS

For each tree inventoried, DRG assessed conditions indicating the presence of structural defects and recorded the most significant condition. Defects were limited to the following categories:

- Dead and dying parts
- Broken and/or hanging branches
- Cracks
- Weakly attached branches and codominant stems
- Missing or decayed wood
- Tree architecture
- Root problems
- Other

Photograph 1. Tree in Glenville with co-dominant stems and included bark. Co-dominant stems undermine the structural integrity of the tree, increasing tree failure.

Table 1. Tree defect categories recorded during the inventory

Defect	Trees	Percent of Street Trees
Broken and/or Hanging Branches	684	10%
Cracks	58	1%
Dead and Dying Parts	1,663	25%
Missing or Decayed Wood	423	6%
None	1,785	27%
Other	366	6%
Root Problems	195	3%
Tree Architecture	503	8%
Weakly Attached Branches and Codominant Stems	938	14%
Total	**6,615**	**100%**

The two most frequently recorded defect categories were Dead & Dying Parts and Weakly Attached Branches/Codominant Stems at 25% and 14% of inventoried trees, respectively (Table 1). Of the 1,663 trees with Dead & Dying Parts, 179 were recommended for removal.

Defect Observation Recommendations

When considering the defect recorded for each tree, there are two important qualifiers to keep in mind. First, the categories are broadly inclusive. For example, the "Dead and Dying Parts" category can include trees with just one or two smaller diameter dead limbs, as well as trees found with large-diameter dead limbs or entire sections of dead canopy. Therefore, inferences on overall tree condition or risk rating cannot be derived solely from the presence or absence of a defect recorded during the inventory. Second, an inventoried tree may have multiple defects; the 2018/2021 Town of Glenville inventory recorded only the most significant defect observed for each tree. These two qualifiers are important to keep in mind when considering urban forest management planning and the prioritization of maintenance or monitoring activities.

INFRASTRUCTURE CONFLICTS

In an urban setting, space is limited both above and below ground. Trees in this environment may conflict with infrastructure, such as buildings, sidewalks, utility wires, and pipelines, which could pose risks to public safety. Existing or possible conflicts between trees and infrastructure recorded during the inventory include:

- Overhead Utilities — The presence of overhead utility lines above a tree or planting site was noted; it is important to consider these data when planning pruning activities and selecting tree species for planting. For the inventory, overhead utilities were defined as primary and secondary electrical lines only, due to the safety considerations, and did not include service drops or telecommunication lines.

Photograph 2. Trees in Glenville that are in conflict with power lines. Tree pruning done to minimize contact with power lines can decrease tree health and structure.

Table 2. Tree conflicts with overhead infrastructure recorded during the inventory

Overhead Utilities	Street Trees	Percent of Street Trees
Present and Conflicting	123	2%
Present and Not Conflicting	2,119	26%
Not Present	5,897	72%
Total	**8,139**	**100%**

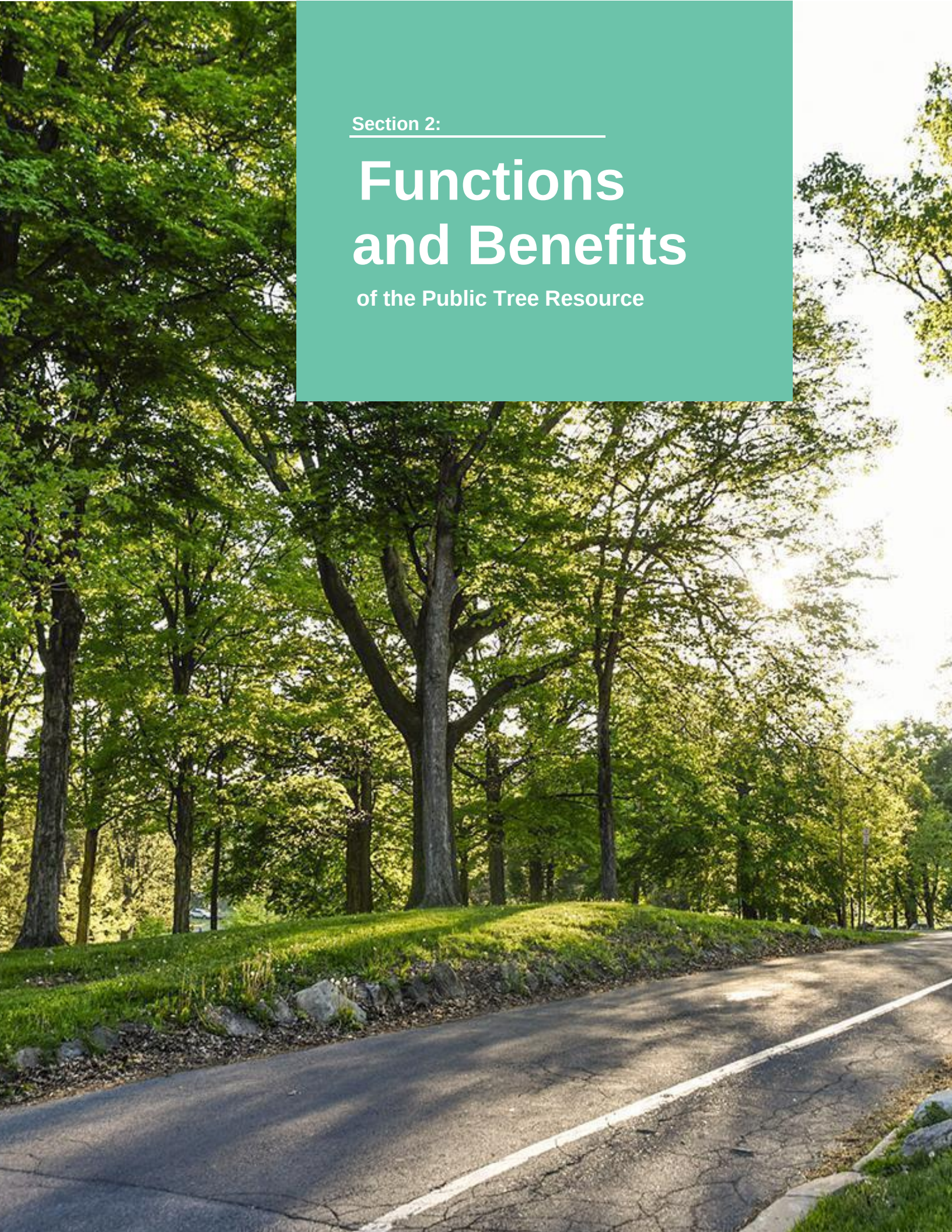
Only 2% of the inventoried population was recorded to be conflicting with overhead utilities. Another 26% of the inventoried population had primary or secondary electrical overhead utilities present but were not conflicting with them at the time of the inventory. Since overhead utilities were defined as only primary or secondary electrical lines for the purposes of this inventory, conflicts with telecommunication lines or service drops for buildings were not considered and may be more plentiful than recorded conflicts with overhead utilities.

Infrastructure Recommendations

Tree canopy should not interfere with vehicular or pedestrian traffic, nor should it rest on buildings or block signs, signals, or lights. Pruning to avoid clearance issues and raise tree crowns should be completed in accordance with *ANSI A300 (Part 9)* (2011). DRG's clearance distance guidelines are as follows: 14 feet over streets; 8 feet over sidewalks; and 5 feet from buildings, signs, signals, or lights.

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

When planting around hardscape, it is important to give the tree enough growing room above ground. Guidelines for planting trees among hardscape features are as follows: give small-growing trees 4–5 feet, medium-growing trees 6–7 feet, and large-growing trees 8 feet or more between hardscape features. In most cases, this will allow for the spread of a tree's trunk taper, root collar, and immediate larger-diameter structural roots.



Section 2:

Functions and Benefits

of the Public Tree Resource

SECTION 2: FUNCTIONS AND BENEFITS OF THE PUBLIC TREE RESOURCE

Trees provide a wide array of economic, environmental, and social benefits, which often exceed the cost associated with planting, maintaining, and removing them. Trees reduce air pollution, improve public health outcomes, reduce stormwater runoff, sequester, and store carbon, reduce energy use, and increase property value. The i-Tree Eco Software and other models in the i-Tree software suite, calculate the monetary value associated with the ecological services of the urban forest. Through this software, Glenville can calculate the return on investment of their urban forest.

Environmental Benefits

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

Economic Benefits

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

Social Benefits

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

i-TREE ECO ANALYSIS

i-Tree Eco utilizes tree inventory data along with local air pollution and meteorological data to quantify the functional benefits of a community's tree resource. By framing trees and their benefits in a way that everyone can understand, dollars saved per year, i-Tree Eco helps a community to understand trees as both a natural resource and an economic investment. Knowledge of the composition, functions, and monetary value of trees helps to inform planning and management decisions, assists in understanding the impact of those decisions on human health and environmental quality, and aids communities in advocating for the necessary funding to manage their vested interest in the public tree resource appropriately.

ANNUAL RETURN ON INVESTMENT FROM THE PUBLIC TREE RESOURCE

The i-Tree Eco analysis of the Town of Glenville's inventoried trees quantified the functional benefits of three critical ecosystem services that they provide: air pollution removal, carbon sequestration, and avoided surface runoff. The total annual benefit of the three ecosystem services is estimated at $19,806 (Figure 10).

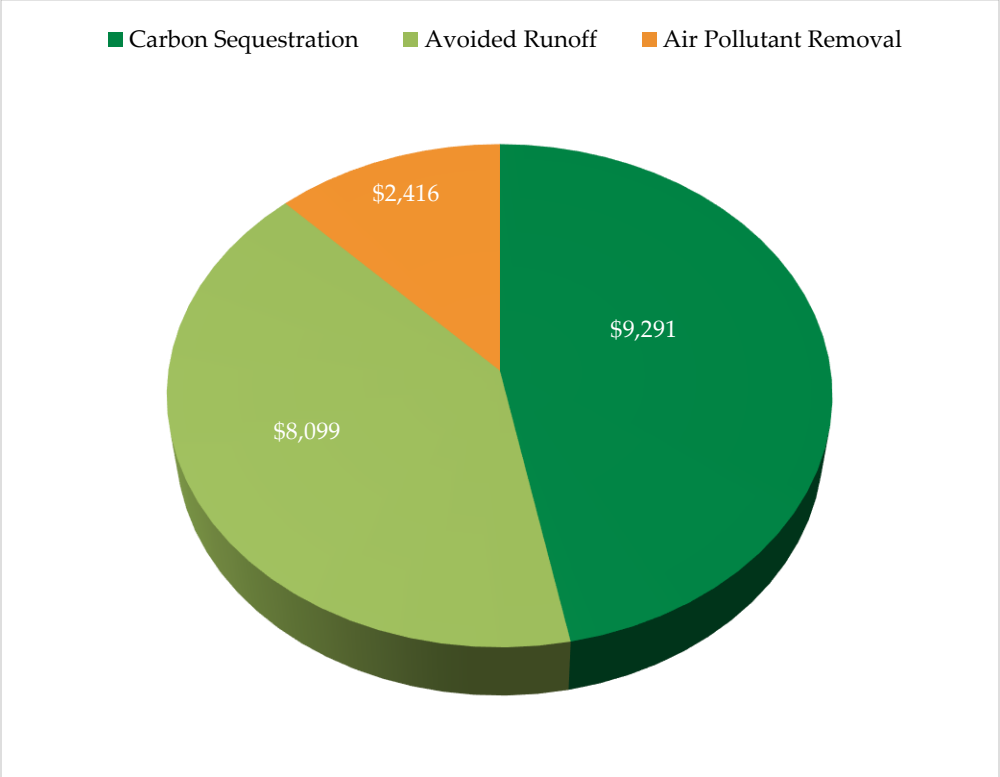


Figure 10. Estimated value of benefits provided by inventoried trees.

The urban forest provides a host of other ecosystem services that were not quantified in this assessment, but provide important benefits to the town, including oxygen production, building energy savings, UV protection, and aesthetic value.

Compared to rural landscapes, urban landscapes are characterized by high pollutant emissions in a relatively small area. The inventoried trees in Glenville remove approximately 2,740 lbs. of airborne pollutants each year, a service that is valued at $2,416. Reducing stormwater runoff decreases the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment. The town's inventoried trees help divert 906,306 gals. of runoff annually, a service valued at $8,099. Carbon dioxide ($CO_2$) also impacts people, property, and the environment as the primary greenhouse gas driving climate change. The inventoried trees sequester around 54.5 tons (109,000 lbs.) of carbon derived from airborne CO_2 every year; a service valued at $9,291.

The replacement value, or cost of replacing existing trees with trees of similar size, species, and condition, of the town's inventoried tree population is estimated to be $12,694,734. In Glenville, seven species account for about 51% of the inventoried tree resource and between 67% and 74% of the functional benefits it provides (see Table 3). If any of these species were lost to invasive pests, disease, or other threats, the loss would have significant costs. It is therefore critical to routinely inspect town trees for signs of emergent disease, insect, or other problems and take steps to prevent wide-spread loss of valuable tree species. Promoting species diversity with future plantings will also help to increase the inventoried tree resource's resistance to and resilience after disturbances. Planting large-statured broadleaf tree species wherever possible will help to maximize potential environmental and economic benefits. See Appendix C for a tree species planting list recommended by DRG.

SEQUESTERING AND STORING CARBON

Trees are carbon sinks - the opposite of carbon sources. While carbon is emitted from cars and smokestacks, it is absorbed into trees during photosynthesis and stored in their tissues as they grow. The i-Tree Eco model estimates both the carbon sequestered each year and total carbon stored by the inventoried tree resource. Glenville's inventoried trees have stored 5,737 tons (11,474,000 lbs.) of carbon, which is all the carbon each tree has amassed throughout their lifetimes and is valued at $983,015. The populations of Norway maple (*Acer platanoides*) and silver maple (*Acer saccharinum*) store the most carbon; 1,231 tons and 1,200 tons, respectively. On a per-tree basis, the two northern red oak (*Quercus rubra*) in the inventory store the most carbon; 8.3 tons per tree, valued at over $1,410 per tree. When looking at the annual carbon sequestration of Glenville's trees, the populations of Norway maple (*Acer platanoides*) and red maple (*Acer rubrum*) sequester the most carbon (13.5 tons per year and 7.7 tons per year, respectively). On a per-tree basis, river birch (*Betula nigra*) and red maple (*Acer rubrum*) sequester the most carbon annually (107 lbs. per tree per year and 100 lbs. per tree per year, respectively), a service valued at around $9 per tree per year.

Table 3. Summary of benefits provided by inventoried trees ranked by species importance value

Most Common Trees Inventoried		Count	Percent of Total	Benefits Provided by Street Trees				
				CO_2 Stored	CO_2 Sequestered	Avoided Runoff	Air Pollution Removed	Replacement Value
Common Name	Botanical Name		%	tons	tons/year	gal/year	lbs/year	Dollars
Norway maple	*Acer platanoides*	1,298	19.7%	1,231.1	13.5	211,093	640	$2,521,796
red maple	*Acer rubrum*	498	7.5%	548.6	7.7	97,121	300	$1,248,742
silver maple	*Acer saccharinum*	429	6.5%	1,199.8	6.7	188,545	560	$1,455,717
eastern white pine	*Pinus strobus*	309	4.7%	166.0	2.2	43,519	140	$874,583
Norway spruce	*Picea abies*	290	4.4%	213.9	1.7	64,966	200	$854,701
blue spruce	*Picea pungens*	270	4.1%	81.5	0.8	14,898	40	$316,039
northern red oak	*Quercus rubra*	267	4.0%	500.4	4.0	53,487	160	$1,281,346
apple spp	*Malus* spp.	219	3.3%	40.0	0.7	4,041	20	$125,635
white spruce	*Picea glauca*	162	2.5%	37.6	0.4	5,802	20	$163,926
European buckthorn	*Rhamnus cathartica*	151	2.3%	3.4	0.2	679	0	$28,927
sugar maple	*Acer saccharum*	150	2.3%	208.4	1.4	29,393	80	$506,610
northern white cedar	*Thuja occidentalis*	133	2.0%	9.1	0.2	866	0	$48,282
black locust	*Robinia pseudoacacia*	131	2.0%	118.9	1.2	12,089	40	$254,190
Callery pear	*Pyrus calleryana*	124	1.9%	22.2	0.5	3,386	20	$71,340
black cherry	*Prunus serotina*	123	1.9%	42.4	0.9	5,401	20	$99,137
All Other Trees Inventoried		2,050	31.0%	1,341	12.4	171,020	400	$2,843,762
Total		**6,604**	**100%**	**5,764**	**54.5**	**906,306**	**2,740**	**$12,694,734**

CONTROLLING STORMWATER

Trees intercept rainfall with their leaves and branches, helping lower stormwater management costs by avoiding runoff. The inventoried trees in the Town of Glenville avoid 906,306 gals. of runoff annually. Avoided runoff accounts for 41% of the annual functional benefits provided by Glenville's public tree resource.

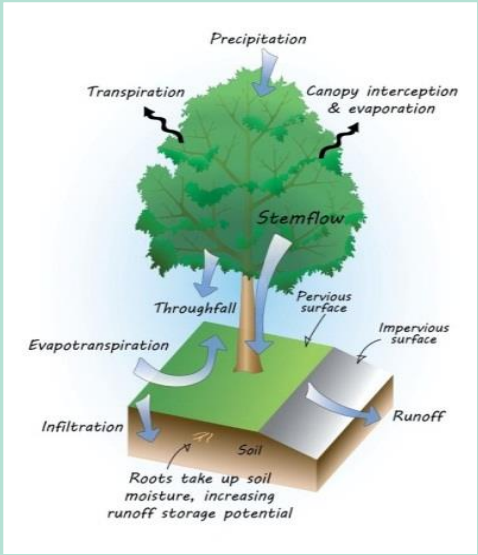
The population of Norway maple (*Acer platanoides*) diverted the most runoff annually, around 211,093 gals., valued at $1,886. On a per tree basis, two silver maple (*Acer saccharinum*) provided the greatest benefits, diverting over 1,400 gals. each.

IMPROVING AIR QUALITY

The inventoried tree population annually removes 2,730 lbs. of air pollutants, including sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter ($PM_{2.5}$). The i-Tree Eco model estimated the value of this benefit at $2,416, which is 12% of the value of all annual benefits. As shown in Figure 11, a small reduction of $PM_{2.5}$ is more valuable than any of the other pollutants removed. The tree populations that provided the highest annual air quality benefits were Norway maple and silver maple which removed a value of $1,886 and $1,685, respectively. On an individual tree level, Norway maple removed 0.5 lb. of pollutants per tree per year and silver maple removed 1.3 lbs. or pollutants per tree per year.

Even though the population of Norway maple removed more pollutants as a whole, silver maple removed more pollutants on a per tree basis.

CANOPY FUNCTIONS



Trees provide many functions and benefits all at once simply by existing, such as:

- Catching rainfall in their crown so it drips to the ground with less of an impact or flows down their trunk.
- Helping stormwater soak into the ground by slowing down runoff.
- Creating more pore space in the soil with their roots, helping stormwater to move through the ground.
- Cooling the surrounding landscape by casting shade with their canopy and releasing water from their leaves.
- Catching airborne pollutants on their leaves and absorbing them with their roots when they wash off in the rain.
- Transforming some pollutants into less harmful substances and preventing other pollutants from forming.

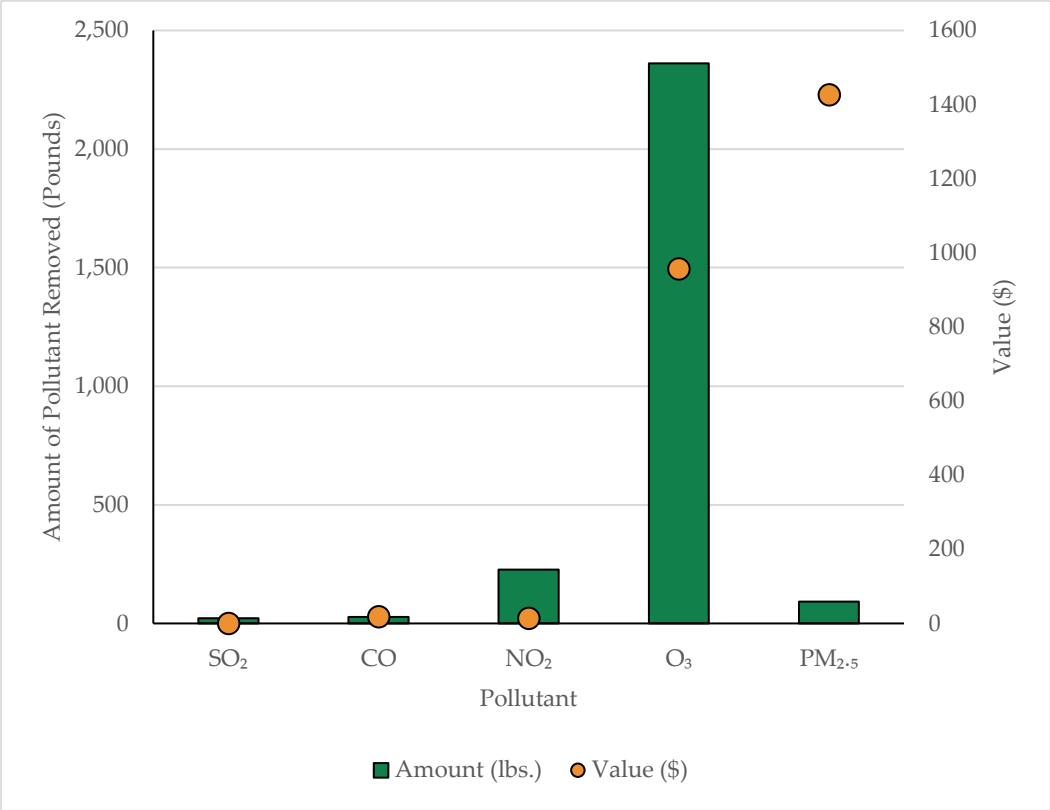


Figure 11. Estimated value of removing airborne pollution by weight and type.

REPLACEMENT VALUE

Replacement value is an estimate of the local cost of replacing an existing tree with a similar tree. It can help provide an estimate of the overall value of a tree population or individual tree. Collectively, Glenville's inventoried tree population has a replacement value of $12,694,734, which averages out to around $1,919 in replacement value per tree. The populations of Norway maple (*Acer platanoides*) and silver maple (*Acer saccharinum*) were the most valuable ($2,521,733 and $1,445,717, respectively), which is at least partially due to the size of these two tree populations. On a per tree basis, a northern red oak (*Quercus rubra*) was the most valuable inventoried tree in Glenville, with a replacement value of $20,061. It is also important to note that the top 20 most structurally valuable trees were oak. Northern red oak made up only 4% of the inventoried population but accounted for 10% of the structural value of the inventoried population. Norway maple made up 19.7% of the population and only accounted for 19.9% of the structural value of the inventoried population.

CONCLUSIONS

Overall, Glenville's population of Norway maple (*Acer platanoides*), silver maple (*Acer saccharinum*), and red maple (*Acer rubrum*), provide the largest share of the benefits enjoyed by the town. This is due, at least in part, to the number of individuals of these species included in the 2018/2021 inventory. Norway maple was the most common tree in the inventory (19.7% of the inventoried trees), followed by red maple (7.5%). Interestingly, northern red oak (*Quercus rubra*), which accounted for only 4.0% of the inventoried trees, provided almost double the benefits that the Norway maple provided, on a per tree basis. Glenville should make sure to check these high-value tree populations frequently for signs of pests or disease, and when it is necessary remove individuals of these species and replace them with other large-stature, broadleaf trees.

Section 3:

Recommended Management

of the Public Tree Resource

SECTION 3: RECOMMENDED MANAGEMENT OF THE PUBLIC TREE RESOURCE

During the inventory, both a risk rating and a recommended maintenance activity were assigned to each tree. DRG recommends prioritizing and completing each tree's recommended maintenance activity based on the assigned risk rating. This five-year tree management program takes a multi-faceted and proactive approach to tree resource management.

High Priority

- All High Priority tree removals and pruning should be completed as soon as possible, because these trees have significant defects that will become severe over time.

Moderate Priority

- Moderate Priority tree removals and pruning should only start after most High Priority tree maintenance has been completed and be performed concurrently.

Low Priority

- Low Priority tree maintenance should be performed after all High and Moderate Priority maintenance has been completed.

Stump Removal

- Stump removals should be performed either when a tree is removed or before a planting season begins, so planting sites become vacant for replacement trees.

Routine Inspection

- Routine Inspection from a drive-by perspective is important for detecting major defects before they worsen, and a walk-by perspective is important for updating inventory data.

Young Tree Training

- Young Tree Training Cycles improve tree structure so defects do not worsen and become more costly to correct as they grow, and should begin as soon as possible.

Routine Pruning

- Routine Pruning Cycles correct defects before they worsen, which is crucial for maintaining the overall condition of the inventoried tree resource over the long-term.

Tree Removal

- Removed trees should be replaced so there is no net loss of the tree resource, which should enter the Young Tree Training Cycle immediately.

Tree Planting

- Planting new trees is important for increasing population size and urban canopy, but can wait until higher priority maintenance is complete or at least in progress.

RISK MANAGEMENT AND RECOMMENDED MAINTENANCE

Every tree, regardless of condition, has an inherent risk of whole or partial tree failure. During the inventory, DRG performed a Level 2 qualitative risk assessment for each tree and assigned a risk rating based on ANSI A300 (*Part 9*) and the companion publication *Best Management Practices: Tree Risk Assessment* (ISA 2011). Trees can have multiple potential modes of failure, each with its own risk rating. The potential mode of failure with the highest risk rating was recorded for each tree during the 2018/2021 tree inventory. The specified time frame for the risk assessment was one year. See Appendix D for further information on the risk assessment and rating system.

DRG recommends that tree maintenance activities are prioritized and completed based on the risk rating that was assigned to each tree during the inventory. Trees with extreme or high risk ratings should be attended to first, followed by trees with a moderate risk rating, and trees with a low risk rating should be maintained once higher risk trees have been pruned or removed. The following sections describe the recommended maintenance activities for each risk rating category.

EXTREME AND HIGH PRIORITY RECOMMENDED MAINTENANCE

Pruning or removing trees with an elevated level of risk (i.e., extreme, high, or moderate risk ratings) is strongly recommended to be prioritized and completed as soon as possible. In general, maintenance activities should be completed first for the largest diameter trees that pose the greatest risk. Once these trees are addressed, recommended tree maintenance activities should be completed for smaller diameter trees that pose the greatest risk. Addressing elevated risk trees in a timely and proactive manner often requires significant resources to be secured and allocated. However, performing this work expediently will mitigate risk, improve public safety, and reduce long-term costs.

High Priority Pruning Recommendations

Extreme and High risk trees should be pruned immediately based on assigned risk rating, which generally requires removing defects such as dead and dying parts, broken and/or hanging branches, and missing or decayed wood that may be present in tree crowns, even when most of the tree is sound. In these cases, when pruning the defected branch(es) can correct the problem, risk associated with the tree is reduced while promoting healthy growth.

The inventory identified 38 High risk trees recommended for pruning. At the time of survey, no Extreme risk trees were identified. The diameter size classes for trees with recommended high-priority pruning ranged between 13–18 inches DBH and >43 inches DBH. This maintenance should be performed immediately based on assigned risk rating and may be performed concurrently with other High Risk removals.

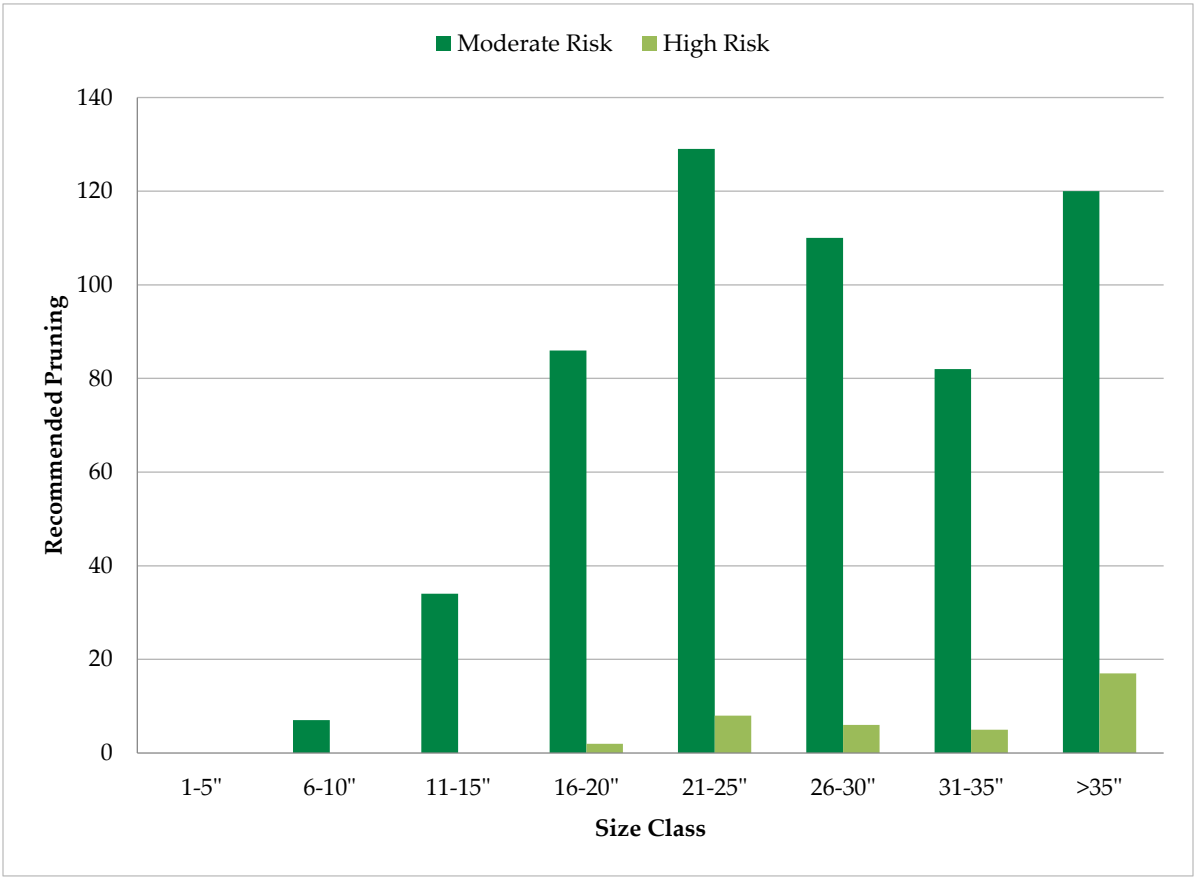


Figure 12. Recommended pruning by size class and risk rating.

High Priority Removal Recommendations

Trees with elevated risk ratings recommended for removal should be removed immediately. DRG recommends that trees be removed when pruning will not correct their defects, eliminate the risks that their defects cause, or when corrective pruning would be cost-prohibitive. These trees should be removed immediately and prioritized based on their risk rating and size class.

DRG identified 113 High Risk trees recommended for removal. No Extreme risk trees were identified at the time of survey. The diameter size classes for the majority of High-risk trees ranged between 21 inches DBH and >35 inches DBH.

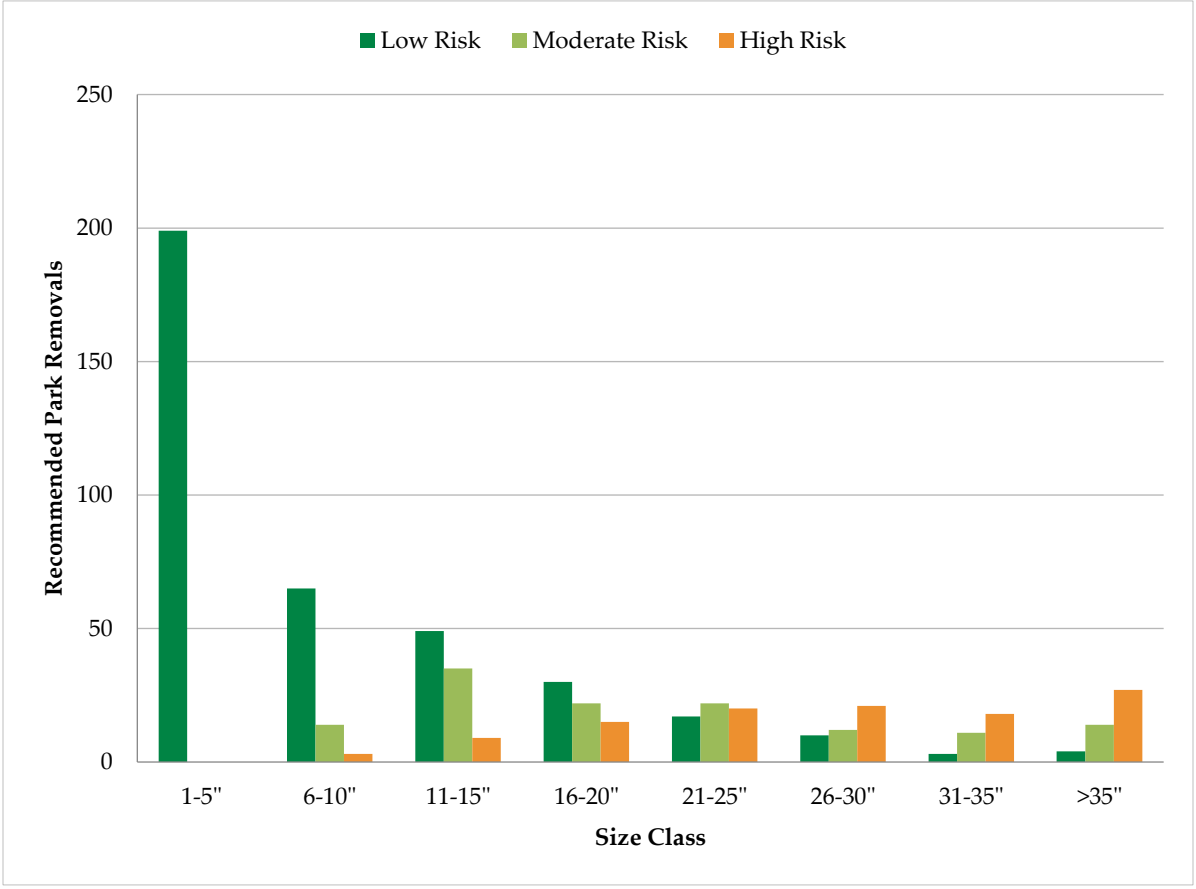


Figure 13. Recommended removals by size class and risk rating.

MODERATE AND LOW PRIORITY RECOMMENDED MAINTENANCE

Pruning or removing Moderate and Low Risk trees are generally the next priorities for maintenance activities. For efficiency, Moderate and Low Risk removals may also be addressed when removing adjacent higher risk trees, if the budget allows. Most trees recommended for pruning with these risk levels can be maintained during proactive, routine pruning cycles. DRG recommends implementing proactive maintenance programs incrementally over time as the backlog of risk is reduced.

Moderate Risk Pruning Recommendations

Moderate Risk pruning should be performed after all Extreme and High Risk recommended maintenance is complete and may be performed concurrently with other Moderate Risk removals. The inventory identified 568 Moderate Risk recommended for pruning. The diameter size classes for Moderate Risk trees ranged between 7–12 inches DBH and >43 inches DBH.

Moderate Risk Removal Recommendations

DRG identified 130 Moderate Risk trees recommended for removal. Most Moderate Risk trees recommended for removal were smaller than 31 inches DBH. If corrective pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed. A total of 25 Moderate Risk trees larger than 31 inches DBH were recommended for removal. These trees should be removed as soon as possible after all Extreme High Risk removals and pruning have been completed.

Low Priority Removal Recommendations

DRG identified 377 Low Risk trees recommended for removal. Low Risk removals pose little threat; these trees are generally small, dead, invasive, or poorly formed trees that need to be removed. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. Healthy trees growing in poor locations or undesirable species are also included in this category. If pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed. All Low Risk trees should be removed when convenient after all higher risk pruning and removals have been completed and may be performed concurrently with routine pruning.

FURTHER INSPECTION

In the ANSI A300 system, there are three levels of risk assessment. Each level is built on the one before it. The lowest level is designed to be a cost-effective approach to quickly identifying tree risk concerns; whereas, the highest level is intended to provide in-depth information to decide about a tree. These levels are:

- **Level 1** inspection is defined as a Limited Visual assessment, which is often conducted as a walk through or windshield survey designed to identify obvious defects or specified conditions.
- **Level 2** inspection is defined as a Basic assessment and is a detailed, 360-degree visual inspection of a tree and its surrounding site, and a synthesis of the information collected.
- **Level 3** inspection is an Advanced assessment and is performed to provide detailed information about specific tree parts, defects, targets, or site conditions. A level 3 inspection may use specialized tools or require the input of an expert.

The Further Inspection data field indicates whether a tree requires additional and/or future inspections to assess and/or monitor conditions that may cause it to become a risk to people, property, or other trees. The inventory identified 193 requiring one of three inspection types.

Further Inspections are beyond the scope of a standard tree inventory, and can be one of the following:

- Multi-year Annual Inspection (e.g., a healthy tree that has been impacted by recent construction, weather, or other damage).
- Level 3 Risk Assessment (e.g., a tree with a defect requiring additional or specialized equipment for investigation).
- Insect/Disease Monitoring (e.g., a tree that appears to have an emerging insect or disease problem).
- No further inspection required.

Further Inspection Recommendations

DRG arborists found 1 tree recommended for annual inspection, 22 trees recommended for a Level 3 assessment, and 170 recommended for insect and disease monitoring. The trees recommended for a Level 3 risk assessment should be assessed by a Tree Risk Assessment Qualified (TRAQ) arborist as soon as possible to determine whether these trees require removal, pruning, or other corrective action to reduce the risk associated with their observed defects. Level 3 assessments may require specialized or additional equipment, such as bucket trucks, to access and assess tree defects.

Trees recommended for annual inspection should be assessed routinely to monitor their condition and look for signs of worsening defects that may merit intervention. Some of these trees will likely recover given time and will no longer need additional monitoring, while others may require removal if their defects worsen.

Almost half of the trees recommended for insect and disease monitoring were ash (*Fraxinus* spp.) which showed symptoms or signs of emerald ash borer (EAB, *Agrilus planipennis*). All trees recommended for insect/disease monitoring should be assessed to confirm the presence of damaging insects or diseases and should either be removed or treated, if necessary, to reduce the pest species load and improve the health of the public trees in Glenville.

ROUTINE INSPECTIONS

Inspections are essential to uncovering potential problems with trees. They should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care. Ideally, the arborist will be ISA Certified and also hold the ISA Tree Risk Assessment Qualification credential.

Routine Inspection Recommendations

All trees along the street ROW should be regularly inspected and attended to as needed. When trees require additional or new work, they should be added to the maintenance schedule. The budget should also be updated to reflect the additional work. Utilize computer management software such as TreeKeeper® to make updates, edits, and keep a log of work records. In addition to locating trees with unidentified defects, inspections also present an opportunity to look for signs and symptoms of pests and diseases. Glenville has a large population of trees that are susceptible to pests and diseases, including ash, maple, and oak.

DRG recommends that Glenville perform routine inspections of inventoried trees by windshield survey (inspections performed from a vehicle) in line with *ANSI A300 (Part 9)* annually and after all severe weather events, to identify defects with heightened risk, signs of pest activity, and symptoms of disease. When trees need additional maintenance, they should be added to the work schedule immediately. Use asset management software such as TreeKeeper® to update inventory data and schedule work records. Level 2 assessments should be done routinely as well, ideally every 5 years or less, to identify defects and problems that are not readily noticeable during windshield (Level 1) surveys. Routine Level 2 inspections can be done as part of routine pruning, removal, and planting operations, or can be done as part of a contracted re-inventory of the town.

ROUTINE PRUNING CYCLE

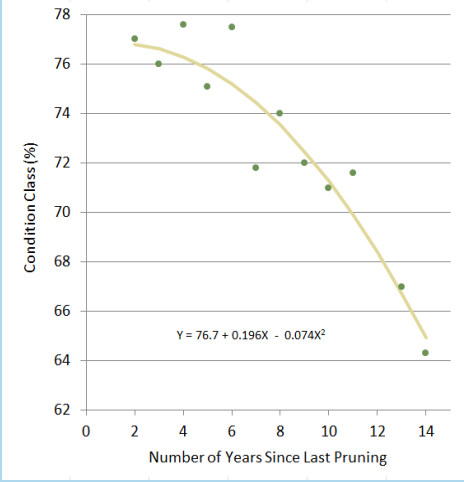
The Routine Pruning cycle includes all Low Risk trees that received "Prune" for their maintenance recommendation. These trees pose some risk but have a smaller defect size and/or a lower probability of impacting a target. Over time, routine pruning can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

Based on Miller and Sylvester's research, DRG recommends five-year Routine Pruning cycles to maintain the condition of the inventoried tree resource. However, not all municipalities are able to remain proactive with a five-year cycle based on budgetary constraints, the size of the public tree resource, or both. In these cases, extending the length of the Routine Pruning cycle is an option; however, it is in the municipality's best interest to not approach or exceed a 10-year pruning cycle. The reason is that this is around when tree condition deteriorates significantly without regular pruning, because their once-minor defects have worsened, reducing tree health and potentially increasing risk (Miller and Sylvester 1981).

Routine Pruning Cycle Recommendations

Glenville's inventory has 4,992 trees that should be routinely pruned, and DRG recommends that the town establish a ten-year Routine Pruning cycle with approximately 499 trees pruned each year. DRG recommends that the Routine Pruning cycle begins in Year One of the proposed ten-year program, after all Extreme and High Risk Recommended Maintenance is complete.

PROACTIVE PRUNING



Relationship between tree condition and years since previous pruning.

(adapted from Miller and Sylvester 1981)

Miller and Sylvester studied the pruning frequency of 40,000 street trees in Milwaukee, Wisconsin. Trees that had not been pruned for more than 10 years had an average condition rating 10% lower than trees that had been pruned in the previous several years. Their research suggests that a five-year pruning cycle is optimal for urban trees.

Routine pruning cycles help detect and correct most defects before they reach higher risk levels. DRG recommends that pruning cycles begin after all Extreme and High Risk tree maintenance has been completed.

DRG recommends two pruning cycles: a Young Tree Training cycle and a Routine Pruning cycle. Newly planted trees will enter the Young Tree Training cycle once they become established and will move into the Routine Pruning cycle when they reach maturity. A tree should be removed and eliminated from the Routine Pruning cycle when it outlives its usefulness.

YOUNG TREE TRAINING CYCLE

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

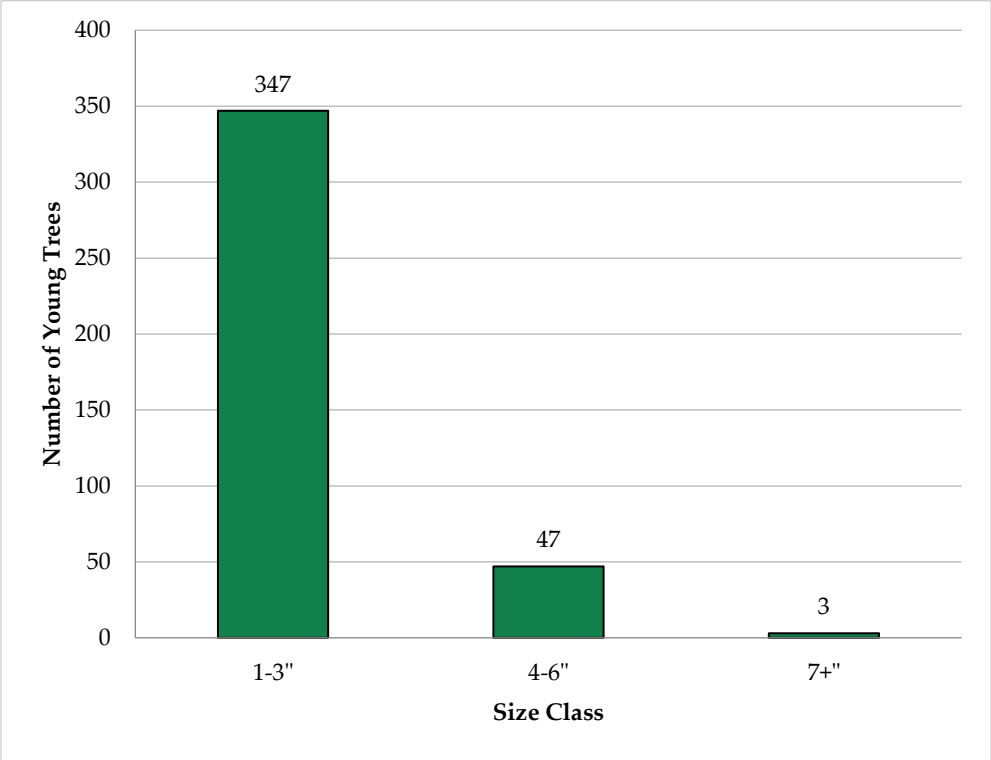


Figure 14. Three-year Young Tree Training cycle by size class.

The recommended length of a Young Tree Training cycle is three years because young trees tend to grow at faster rates than mature trees. The Young Tree Training cycle differs from the Routine Pruning cycle in that the Young Tree Training cycle generally only includes trees that can be pruned from the ground with a pole pruner or pruning shear.

Young Tree Training Cycle Recommendations

DRG recommends that Glenville implement a three-year Young Tree Training cycle beginning after the completion of all Extreme and High Risk Recommended Maintenance activities. During the inventory, 397 trees less than or equal to 8 inches DBH were inventoried and recommended for young tree training. Since Glenville has so many young trees, the Young Tree Training cycle is vital for the future condition of the inventoried tree population. DRG recommends that an average of 132 trees be trained with structural pruning each year over three years, beginning in Year One of the management program.

When new trees are planted, they should enter the Young Tree Training cycle after establishment, typically within 2–3 years after planting. In future years, the number of trees in the Young Tree Training cycle will be based on tree planting efforts and growth rates of young trees. The town should strive to train approximately one-third of its young trees each year (see Section 4: Comprehensive Planting Plan for more detail on YTT Program).

TREE PLANTING AND STUMP REMOVAL

Planting new trees in areas with sparse canopy and high to medium pedestrian traffic should be prioritized. It is also important to plant more trees in areas with poor canopy continuity or gaps in existing canopy. While Glenville as a whole receives value from the ecosystem services provided by the public tree resource, those benefits usually are not distributed evenly across the town.

"The Right Tree in the Right Place" is a mantra for tree planting used by the Arbor Day Foundation and many utility companies nationwide. Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Before selecting a tree for planting, make sure it is the right tree—know how tall, wide, and deep it will be at maturity. Equally important to selecting the right tree is choosing the right spot to plant it. Blocking an unsightly view or creating some shade may be a priority, but it is important to consider how a tree may impact existing utility lines and hardscape as it grows taller, wider, and deeper. If the tree at maturity will reach overhead lines, or conflict with sidewalks and curbs, it is best to choose another tree or a different location (see Section 4: Comprehensive Planting Plan for more detail on site characteristics).

Tree Planting and Stump Removal Recommendations

Creating larger growing sites for trees in the municipal ROW can be the single most beneficial management practice to improve the survival rate of planted and developing trees. Increasing planting space can also reduce the amount of tree-related infrastructure conflicts, as the trees will be planted further from curbs and sidewalks. Depending on the site, there are several methods available to create and/or increase the growing space for newly planted trees:

- Install or enlarge tree wells/pits in existing sidewalks of sufficient width. Ideally, the minimum growing space of a small-sized tree is 32 square feet. Where Glenville has sidewalks of a sufficient width and length, the city could install tree pits with enough space remaining for the sidewalk to still comply with Americans with Disability Act (ADA) standards.
- Planting trees 4 feet behind a curb without a sidewalk, or 4 feet behind an existing sidewalk, can be a low-cost alternative to more construction intensive methods. This can result in less damage to the sidewalk and give tree roots room to grow into the open soil.

- Re-routing the sidewalk around an area to create designated large tree sites is a relatively cost-effective method to increase growing spaces. This method can also be applied to existing large tree sites, where tree roots have already come in conflict with the sidewalk.
- A landscape bump-out/curb extension is a vegetative area that protrudes into the parking lane of a street, to provide a growing space for plants or trees. These spaces can be used quite effectively by municipalities to beautify a streetscape, provide greater storm water retention, along with the added benefit of slowing car speeds at the bump-out location.

The inventory identified 233 stumps recommended for removal, with a wide range of sizes from 3" to 67" in diameter. Stump removals should occur when convenient and be included in regular planting plans if the site would be feasible for planting after the stump is removed. For this reason, it is most convenient to remove all stumps in areas with scheduled tree planting work, so all feasible sites in an area are stocked at once.

A list of suggested tree species is provided in Appendix C. These tree species are specifically selected for the climate of Glenville. This list is not exhaustive but can be used as a guideline for species that meet community objectives and to enhance any existing list of approved species.

MAINTENANCE SCHEDULE AND BUDGET

Utilizing 2018/2021 Town of Glenville tree inventory data, an annual maintenance schedule was developed detailing the recommended tasks to complete each year. DRG made budget projections using industry knowledge and public bid tabulations. A complete table of estimated costs for Glenville 's five-year tree management program follows.

This schedule provides a framework for completing the recommended inventoried tree maintenance over the next five years. Following this schedule, Glenville can shift tree maintenance activities from being reactive to a more proactive tree care program.

To implement the maintenance schedule, Glenville 's tree maintenance budget should be:

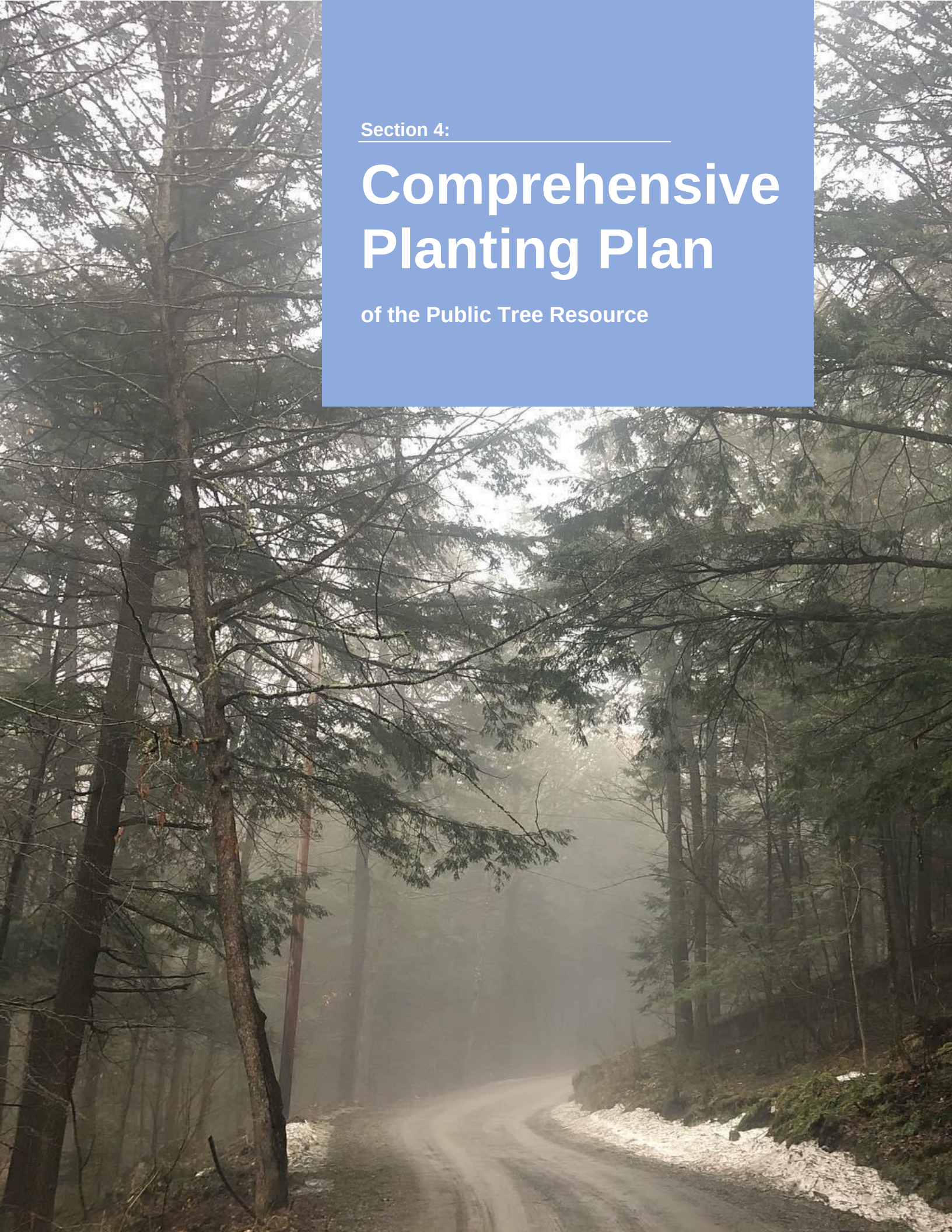
- No less than $436,703 for the first year of implementation.
- No less than $561,201 for the second and third years.
- No less than $613,063 for year four through six.
- No less than $486,011 for the remaining three years of the maintenance schedule.

Annual budget funds are needed to ensure that Extreme and High Risk trees are expediently managed and that the vital Young Tree Training and Routine Pruning cycles can begin as soon as possible. If routing efficiencies and/or contract specifications allow more tree work to be completed each year, or if this maintenance schedule requires adjustment to meet budgetary or other needs, then it should be modified accordingly. Unforeseen situations such as severe weather events may arise and change the maintenance needs of trees. If maintenance needs change, then budgets, staffing, and equipment should be adjusted to meet the new demand.

Table 4. Estimated budget for recommended ten-year tree resource management program

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8		Year 9		Year 10		Ten-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High Priority Removals	1-5"	$90	0	$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	$0
	6-10"	$225	3	$675		$0		$0		$0		$0		$0		$0		$0		$0		$0	$675
	11-15"	$575	9	$5,175		$0		$0		$0		$0		$0		$0		$0		$0		$0	$5,175
	16-20"	$1,080	15	$16,200		$0		$0		$0		$0		$0		$0		$0		$0		$0	$16,200
	21-25"	$1,820	20	$36,400		$0		$0		$0		$0		$0		$0		$0		$0		$0	$36,400
	26-30"	$2,430	21	$51,030		$0		$0		$0		$0		$0		$0		$0		$0		$0	$51,030
	31-35"	$2,900	18	$52,200		$0		$0		$0		$0		$0		$0		$0		$0		$0	$52,200
	>35"	$3,900	27	$105,300		$0		$0		$0		$0		$0		$0		$0		$0		$0	$105,300
Activity Total(s)			**113**	**$266,980**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$266,980**
Moderate Priority Removals	1-5"	$90		$0	0	$0		$0		$0		$0		$0		$0		$0		$0		$0	$0
	6-10"	$225		$0		$0		$0		$0	14	$3,150		$0		$0		$0		$0		$0	$3,150
	11-15"	$575		$0		$0		$0	35	$20,125		$0		$0		$0		$0		$0		$0	$20,125
	16-20"	$1,080		$0		$0		$0	22	$23,760		$0		$0		$0		$0		$0		$0	$23,760
	21-25"	$1,820		$0		$0	22	$40,040		$0		$0		$0		$0		$0		$0		$0	$40,040
	26-30"	$2,430		$0		$0	12	$29,160		$0		$0		$0		$0		$0		$0		$0	$29,160
	31-35"	$2,900		$0	11	$31,900		$0		$0		$0		$0		$0		$0		$0		$0	$31,900
	>35"	$3,900		$0	14	$54,600		$0		$0		$0		$0		$0		$0		$0		$0	$54,600
Activity Total(s)			**0**	**$0**	**25**	**$86,500**	**34**	**$69,200**	**57**	**$43,885**	**14**	**$3,150**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$202,735**
Low Priority Removals	1-5"	$90		$0		$0		$0		$0		$0		$0		$0	199	$17,910		$0		$0	$17,910
	6-10"	$225		$0		$0		$0		$0		$0		$0	65	$14,625		$0		$0		$0	$14,625
	11-15"	$575		$0		$0		$0		$0		$0		$0	49	$28,175		$0		$0		$0	$28,175
	16-20"	$1,080		$0		$0		$0		$0		$0		$0	30	$32,400		$0		$0		$0	$32,400
	21-25"	$1,820		$0		$0		$0		$0	17	$30,940		$0		$0		$0		$0		$0	$30,940
	26-30"	$2,430		$0	0	$0		$0		$0		$0	10	$24,300		$0		$0		$0		$0	$24,300
	31-35"	$2,900		$0	0	$0		$0		$0		$0	3	$8,700		$0		$0		$0		$0	$8,700
	>35"	$3,900		$0	0	$0		$0		$0		$0	4	$15,600		$0		$0		$0		$0	$15,600
Activity Total(s)			**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**17**	**$30,940**	**17**	**$48,600**	**144**	**$75,200**	**199**	**$17,910**	**0**	**$0**	**0**	**$0**	**$172,650**
Stump Removals	1-5"	$50		$0		$0	0	$0		$0		$0		$0		$0		$0	9	$450		$0	$450
	6-10"	$100		$0		$0	0	$0		$0		$0		$0		$0		$0	12	$1,200		$0	$1,200
	11-15"	$125		$0		$0	0	$0		$0		$0		$0		$0		$0	62	$7,750		$0	$7,750
	16-20"	$195		$0		$0	0	$0		$0		$0		$0	48	$9,360		$0		$0		$0	$9,360
	21-25"	$250		$0		$0	0	$0		$0		$0		$0		$0	26	$6,500		$0		$0	$6,500
	26-30"	$310		$0		$0	0	$0		$0		$0		$0	20	$6,200		$0		$0		$0	$6,200
	31-35"	$375		$0		$0	0	$0		$0		$0		$0	14	$5,250		$0		$0		$0	$5,250
	>35"	$425		$0		$0	0	$0		$0		$0		$0	18	$7,650		$0		$0		$0	$7,650
Activity Total(s)			**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**100**	**$0**	**26**	**$6,500**	**83**	**$9,400**	**0**	**$0**	**$44,360**
High Priority Pruning	1-5"	$62	0	$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	$0
	6-10"	$126	0	$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	$0
	11-15"	$183	0	$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	$0
	16-20"	$223	2	$446		$0		$0		$0		$0		$0		$0		$0		$0		$0	$446
	21-25"	$275	8	$2,200		$0		$0		$0		$0		$0		$0		$0		$0		$0	$2,200
	26-30"	$312	6	$1,872		$0		$0		$0		$0		$0		$0		$0		$0		$0	$1,872
	31-35"	$415	5	$2,075		$0		$0		$0		$0		$0		$0		$0		$0		$0	$2,075
	>35"	$450	17	$7,650		$0		$0		$0		$0		$0		$0		$0		$0		$0	$7,650
Activity Total(s)			**38**	**$14,243**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$14,243**
Moderate Priority Pruning	1-5"	$62	0	$0	0	$0		$0		$0		$0		$0		$0		$0		$0		$0	$0
	6-10"	$126	0	$0		$0		$0		$0	7	$882		$0		$0		$0		$0		$0	$882
	11-15"	$183	0	$0		$0		$0		$0	34	$6,222		$0		$0		$0		$0		$0	$6,222
	16-20"	$223	0	$0		$0		$0		$0	86	$19,178		$0		$0		$0		$0		$0	$19,178
	21-25"	$275	0	$0		$0		$0	129	$35,475		$0		$0		$0		$0		$0		$0	$35,475
	26-30"	$312	0	$0		$0	110	$34,320		$0		$0		$0		$0		$0		$0		$0	$34,320
	31-35"	$415	0	$0	82	$34,030		$0		$0		$0		$0		$0		$0		$0		$0	$34,030
	>35"	$450	0	$0	120	$54,000		$0		$0		$0		$0		$0		$0		$0		$0	$54,000
Activity Total(s)			**0**	**$0**	**202**	**$88,030**	**110**	**$34,320**	**129**	**$35,475**	**127**	**$26,282**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$184,107**

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8		Year 9		Year 10		Ten-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Further Inspection	Level 3 Risk Assessment	$400	22	$8,800	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$8,800
	Annual/ Multi-year Inspections	$65	1	$65	1	$65	1	$65	1	$65	1	$65	1	$65	1	$65	1	$65	1	$65	1	$65	$650
	Insect and Disease Monitoring	$30	170	$5,100	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$5,100
Activity Total(s)			**23**	**$13,965**	**1**	**$65**	**1**	**$65**	**1**	**$65**	**1**	**$65**	**1**	**$65**	**1**	**$0**	**1**	**$65**	**1**	**$65**	**1**	**$65**	**$650**
Young Tree Training (3-year Cycle)	1-8"	$5	133	$665	132	$660	132	$660	133	$665	132	$660	132	$660	133	$665	132	$660	132	$660	133	$665	$6,620
Activity Total(s)			**133**	**$665**	**132**	**$660**	**132**	**$660**	**133**	**$665**	**132**	**$660**	**132**	**$660**	**133**	**$0**	**132**	**$660**	**132**	**$660**	**133**	**$665**	**$6,620**
Routine Pruning (10-year Cycle)	1-5"	$62	107	$6,609	107	$6,609	107	$6,609	107	$6,609	107	$6,609	107	$6,609	107	$6,609	107	$6,609	107	$6,609	107	$6,609	$66,092
	6-10"	$126	100	$12,562	100	$12,562	100	$12,562	100	$12,562	100	$12,562	100	$12,562	100	$12,562	100	$12,562	100	$12,562	100	$12,562	$125,622
	11-15"	$183	94	$17,129	94	$17,129	94	$17,129	94	$17,129	94	$17,129	94	$17,129	94	$17,129	94	$17,129	94	$17,129	94	$17,129	$171,288
	16-20"	$223	78	$17,349	78	$17,349	78	$17,349	78	$17,349	78	$17,349	78	$17,349	78	$17,349	78	$17,349	78	$17,349	78	$17,349	$173,494
	21-25"	$275	51	$14,108	51	$14,108	51	$14,108	51	$14,108	51	$14,108	51	$14,108	51	$14,108	51	$14,108	51	$14,108	51	$14,108	$141,075
	26-30"	$312	36	$11,201	36	$11,201	36	$11,201	36	$11,201	36	$11,201	36	$11,201	36	$11,201	36	$11,201	36	$11,201	36	$11,201	$112,008
	31-35"	$415	16	$6,433	16	$6,433	16	$6,433	16	$6,433	16	$6,433	16	$6,433	16	$6,433	16	$6,433	16	$6,433	16	$6,433	$64,325
	>35"	$450	19	$8,460	19	$8,460	19	$8,460	19	$8,460	19	$8,460	19	$8,460	19	$8,460	19	$8,460	19	$8,460	19	$8,460	$84,600
Activity Total(s)			**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**499**	**$93,850**	**$938,504**
Tree Planting and Maintenance	Purchasing	$75	200	$15,000	200	$15,000	200	$15,000	200	$15,000	200	$15,000	200	$15,000	200	$15,000	200	$15,000	200	$15,000	200	$15,000	$150,000
	Planting & Watering	$130	200	$26,000	200	$26,000	200	$26,000	200	$26,000	200	$26,000	200	$26,000	200	$26,000	200	$26,000	200	$26,000	200	$26,000	$260,000
	Mulching	$30	200	$6,000	200	$6,000	200	$6,000	200	$6,000	200	$6,000	200	$6,000	200	$6,000	200	$6,000	200	$6,000	200	$6,000	$60,000
Activity Total(s)			**600**	**$47,000**	**600**	**$47,000**	**600**	**$47,000**	**600**	**$47,000**	**600**	**$47,000**	**600**	**$47,000**	**600**	**$0**	**600**	**$47,000**	**600**	**$47,000**	**600**	**$47,000**	**$470,000**
Activity Grand Total			**1,406**		**1,257**		**1,266**		**1,290**		**1,263**		**1249**		**1477**		**1457**		**1315**		**1233**		**$6,483**
Cost Grand Total				**$436,703**		**$316,105**		**$245,095**		**$220,940**		**$201,947**		**$190,175**		**$169,050**		**$165,985**		**$150,975**		**$141,580**	**$2,238,559**



Section 4:

Comprehensive Planting Plan

of the Public Tree Resource

SECTION 4
COMPREHENSIVE PLANTING PLAN

STATEMENT OF PURPOSE

The purpose of this *Public Tree Planting Plan* is to provide guidelines for the implementation of an organized public tree planting effort in the Town of Glenville, New York. The public tree inventory and subsequent Community Forestry Management Plan prepared by DRG in 2018–2021 provides information on suitable planting locations along with general recommendations on the size and species of trees for each site. This *Planting Plan*, in turn, provides specific and in-depth guidelines for the future plantings, allowing for more effective use of tree care funds and more accurate budget projections. Implementation of this planting plan will aid in increasing canopy cover and prioritizing planting areas with sparse canopy cover.

The 2018–2021 Town of Glenville tree inventory identified a total of 1,291 vacant potential planting sites. The identification and analysis of these sites will inform future development of Glenville's urban forest and community. Data analysis of site density and distribution will allow the city to target planting efforts in geographic locations that maximize community benefits.

SCOPE

This document discusses the findings of the viable public street planting sites by DRG and provides a comprehensive action plan for the Town of Glenville inventoried planting sites. The *Planting Plan* includes a brief analysis of the current tree population, the environment in which they grow, and needs of the urban forest. The scope of this discussion includes:

- A brief analysis of the public street tree inventory and species composition.
- Recommendations for the specific planting needs; related to species diversity, site restrictions, functionality of the urban forest, and canopy cover.
- A five-year budget for the planting program and training pruning program.

UNDERSTANDING POTENTIAL PLANTING SITES AND PARAMETERS

Potential planting sites, also called "vacant sites", are located by street and address. The sites are defined as areas suitable for tree planting within the existing ROW, as defined above. Typically, the size of each site is determined by the growing space available and the presence of overhead wires, and are spaced accordingly:

- *Small vacant sites:* The smallest dimension of the planting site is between 3 to 5 feet; 20 feet is kept between existing infrastructure or surrounding trees.
- *Medium vacant sites:* The smallest dimension of the planting site is between 6 to 8 feet; 30 feet is kept between existing infrastructure or surrounding trees.
- *Large vacant sites:* The smallest dimension of the planting site is 8 feet and greater; 40 feet is kept between existing infrastructure or surrounding trees.

Planting site parameters are determined based on an original agreement utilizing the experience from the Town of Glenville's personnel and DRG Inventory Urban Foresters. Some of these parameters are:

- No planting of a tree within 30 feet of any intersection or crosswalk.
- No planting of a tree within 50 feet of any stop signs.
- No planting of a tree within 10 feet of any fire hydrant, streetlight, utility pole, or underground utility (i.e., gas or sewer line).
- No planting of a tree within 10 feet of any driveway or walkway.
- Sites should not obstruct important traffic signs.
- Sites should not obstruct major road signage.

The overall landscape and existing planting scheme was also taken into account for the spacing and sizes of recommended planting sites. Where any types of overhead utility wires exist, planting sites are recorded as small, regardless of the available growing space. The shortest dimension in length and width (in feet) of each growing space type is noted in the inventory. The growing space size can be a limiting factor of the growth and natural habit of trees, and dictates which species are suitable for any given site. It is most beneficial ecologically and economically to plant the largest tree possible in each site.

Utilities

The presence of all overhead utility lines is noted in the inventory. These include, but are not limited to, power, telephone, and cable lines. As noted above, where any overhead wires exist, the planting site is recorded as small, regardless of the available growing space size or type, to avoid unnecessary future maintenance and interference with the lines.

SUGGESTED SPECIES CHARACTERIZATION

A list of suggested species is provided in the management plan and is meant to be a guideline for selecting which species to plant during future street tree plantings. The suggested species have been categorized by mature height classes (small, medium, and large) that match the potential planting site size designations. The size of the site refers to the mature size of a tree suitable to be planted in that site. Selecting trees from this list will help to ensure that appropriately sized trees are planted in a site suitable to sustain the tree's natural habit. Glenville's suggested tree species list can be found in Appendix B.

PRIORITY PLANTING BY INVENTORIED SITES

The Town of Glenville's tree inventory identified 1,291 vacant planting sites, of which 468 were for small vacant sites, 155 were medium, and the majority, 668, were large vacant sites (see Figure 15).

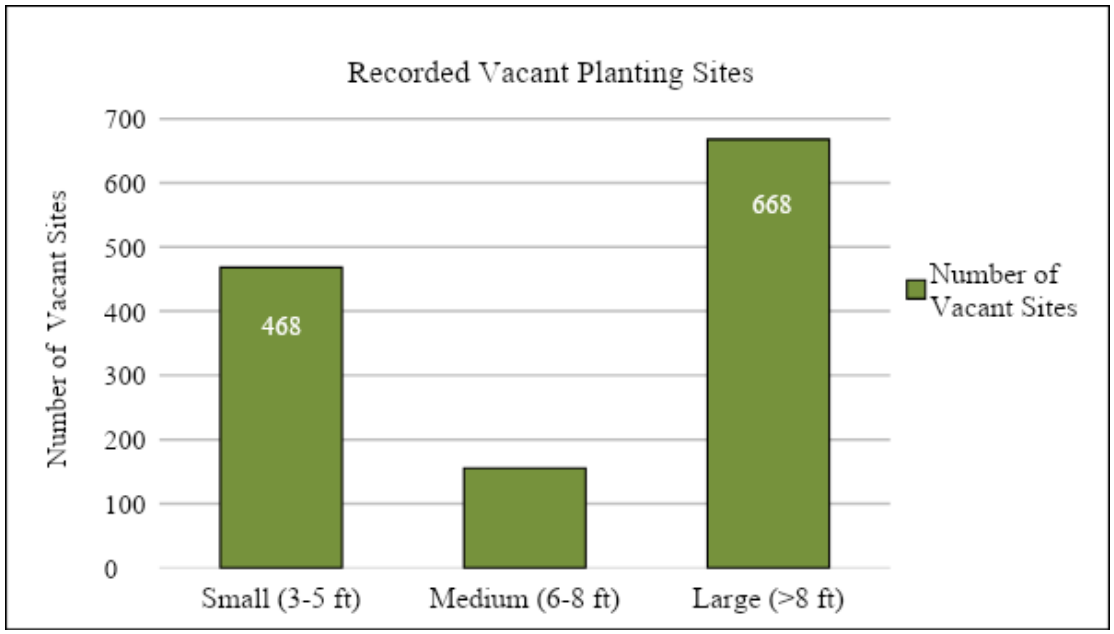


Figure 15. Vacant planting sites by site size.

Locations with a high-density of vacant planting sites are generally areas with less existing overall canopy cover and thus good candidates for new planting initiatives. Planting in areas with a high density of vacant sites will help save costs through increased operational efficiencies during installation and will also help maximize benefits to the community and the urban forest.

With the use of TreeKeeper®, high-density vacant site areas can be easily identified. The vacant sites are highlighted in gold in the pictures below. Neighborhoods with a greater proportion of vacant sites to trees should be prioritized for planting.

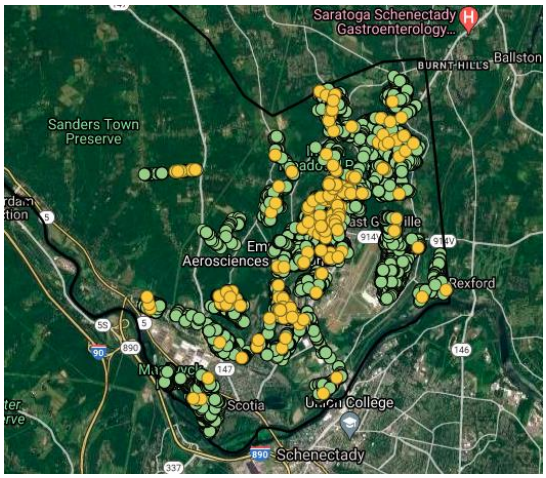
Spearhead Dr. off Route 50

Country Fair Ln.

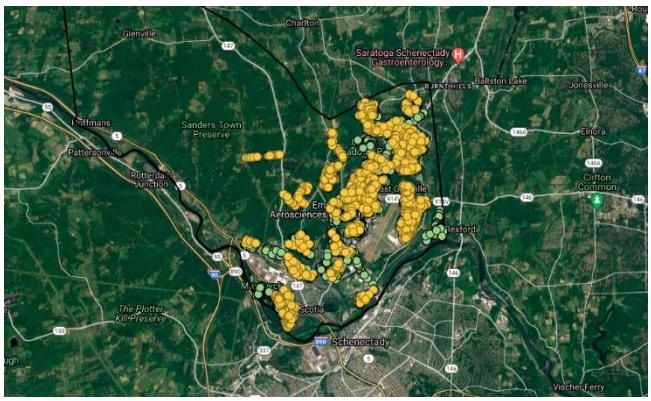
St. Anthony between St Jude Ln.

Stumps

Within the public tree inventory of Glenville's Right-of-way, 233 stumps were identified. Once removed, these areas can be used as tree planting sites. Based on the inventory findings, trees recommended for removal with high or moderate risk ratings should be removed as soon as possible and replaced as much as possible. Stump removals, however, because of the lower risk, should be spread out over time as costs allow.



Total Vacant sites available for planting (1,291). Shown in yellow. Inventoried trees are shown in green.



Stumps (233). Potential planting sites once removed. Shown in yellow. Inventoried trees are shown in green.

PLANTING CONSIDERATIONS

Site Characteristics and Species Selection

Proper site evaluation, planning and execution can result in a more resilient urban forest. The site characteristics need to be taken into consideration before a tree species is selected. "The Right Tree in the Right Place" is a mantra for tree planting used by the Arbor Day Foundation and many utility companies nationwide. Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Some grow tall, some grow wide, and some have extensive root systems. It is necessary to visit a site location before choosing a tree species. Your planting site has unchangeable characteristics that will limit the type of species that can grow and thrive in that location. Important site characteristics that should be considered include:

1. *Soils:* The soil will impact the type of tree that can be planted at the location. The soil pH, particle size (sand, silt, clay), soil moisture retention, and percent organic matter will all influence the survivability of the planted tree. Be sure that the soil used at planting is suitable for the chosen species.
2. *Hardiness Zone:* Plant tree species that thrive in the town's hardiness zone. The zones are determined by the average annual minimum *temperature* for each area. The Town of Glenville occurs in Zone 5b of the USDA Hardiness Zone Map, which identifies the climatic region where the average annual minimum temperature is between -15 to -10 (F). It is important to choose species that are adapted to the region's seasons. Lists of species based on this Hardiness Zone are provided in Appendix B.
3. *Site Conditions:* Take note of the direction the planting site faces; north or east aspects are generally cooler, moister, and shadier than south and west aspects. Certain species can grow in full sun, while others are more shade tolerant. Another important site characteristic is irrigation and position. Certain planting locations receive more water and may have constant moisture, while others are consistently dry. It is important to plant either flood-tolerant or drought-tolerant species in those locations.
4. *Site Traffic:* The level of vehicular or foot traffic should be noted. Hardier species will need to be planted in areas that experience high levels of vehicle and pedestrian use.
5. *Neighborhood:* Determine if the neighborhood is industrial, residential, or landscaped.
6. *Surrounding infrastructure:* It is best to account for all possible interferences the tree may encounter over the course of its life. Any buildings, traffic lights, stop signs, surrounding trees, overhead powerlines and underground utilities should be noted.

It is important to evaluate existing trees in the surrounding area to see which trees are doing well and which are stressed or in poor condition. While no two sites are exactly alike, it may provide some insight into the type of species that should be encouraged or avoided in that planting location. Another important consideration is to avoid over planting a single species. Low species diversity can lead to severe losses in the event of species-specific epidemics, such as the devastating results of emerald ash borer (EAB, *Agrilus planipennis*). The ideal distribution for a tree population should follow the 10-20-30 rule for species diversity: a single species should represent no more than 10% of the population, a single genus no more than 20%, and a single family no more than 30% of the population.

In the Town of Glenville, at the genus level, maple comprise 37% of the tree population, with 20% of the species being Norway maple (please see Figure 4). It is recommended that the Town of Glenville avoid large plantings of maple to avoid overabundance in the future.

A list of species suitable for Glenville's climate is included in Appendix B. Trees on this prospective planting list have been selected based on their maintenance requirements, adaptability to specific planting sites, and suitability to the restrictive conditions of the urban environment. When possible, Glenville should opt to plant native species, especially when planting in locations adjacent to naturalized areas. Planting non-native tree species is acceptable if the species is considered non-invasive and does not appear on the New York State Prohibited Invasive Species List.

The list can be sorted by mature tree size, suitability for park versus street locations, and tolerances. The Town of Glenville should use this list to help guide tree selection.

TEN-YEAR PLANTING PLAN

This chapter details the activities that will constitute the Five-Year Planting Program for the Town of Glenville. Headings in this chapter include:

- Developing an Effective Planting Program
- Young Tree Training Program
- Five-Year Planting Plan and Budget

STOCKING POTENTIAL

The potential tree population of the town's inventoried streets is 6,615 trees, with 1,291 vacant sites and 233 stumps. Glenville's urban forest (excluding park/public space trees) is 73% stocked. Stocking is a traditional forestry term used to measure the density and distribution of trees. This means that, of the total number of sites in the public ROW, 73% currently have a tree present. DRG generally recommends that the urban forest be at least 90% stocked so that no more than 10% of the existing planting sites remain vacant. The town should make every effort to budget for tree planting in the future so that it may reach the recommended stocking goal.

Full Stocking Potential

Full tree stocking can be an elusive goal, since mortality of young and old trees continues to make planting sites available. Nevertheless, it is worth the effort because working toward full stocking can help make other less glamorous aspects of urban forestry more palatable, especially removals.

Glenville has a stocking level of 73%. With a total of 1,291 vacant sites, Glenville would reach its full stocking potential in ten years following the desired planting schedule of 130 trees per year. This goal, however, assumes that no trees are removed, no new streets are added, and all the new plantings survive. A more accurate formula for determining the planting rate for such a goal comes from the textbook *Urban Forestry: Planning and Managing Urban Greenspaces* by Robert W. Miller (1997) and is written as:

$$N = \frac{R + (V/G)}{S}$$

Where:

N = number of trees to be planted annually
R = number of trees to be removed annually
V = existing vacant sites
G = years remaining to achieve full stocking potential goal
S = expected planting survival rate

For example, Glenville has 1,291 available planting sites scattered throughout its existing ROW. If it is known that an average of 80 trees per year will be removed (this number is based on the Ten-Year Urban Forestry Management Program budget, the average number of Removals in Years 1 through 10) and the planting survival rate over that period is 85%, the town will achieve full stocking in approximately 10 years if it follows its current planting plan of 246 trees per year:

$$N = \frac{80 + (1{,}291/10)}{0.85} = 246 \text{ trees/year}$$

It is important to note that reaching full stocking potential is an idealized goal and should be striven for if the funds are available. Glenville should aim to plant as many trees as possible within the town's budget. The planting number of 200 trees per year outlined in the ten-year budget is based on the Town's projected annual planting budget.

PROCURING PLANT MATERIAL

Good quality trees establish more quickly, are less likely to experience significant transplant shock, and live longer in the landscape. To ensure quality material, visit the local nursery and inspect trees prior to purchase. The buyer should perform a 360-degree inspection of the stem, branches, and roots. Shade trees should have one dominant trunk and major branches should not touch. All branches should be less than 2/3 trunk diameter.

The tree wrap should be removed from the stem so that the trunk can be inspected for hidden wounds. On balled and burlapped (B&B) trees, ensure the root ball is intact and the minimum root ball size for tree caliper is in accordance with the American National Standards and Standards for Nursery Stock. Adhering to these standards will help with tree survivability. The table below is the suggested height range and minimum root ball diameter by caliper size in the Standards for Nursery Stock.

Table 5. Root Ball Diameter and Depth by Caliper Size

Caliper Size	Average Height Range	Minimum Root Ball Diameter	Minimum Root Ball Depth
2 in.	12 to 14 ft.	24 in.	14 3/8 in.
2 1/2in.	12 to 14 ft.	28 in.	17 in.
3 in.	14 to 16 ft.	32 in.	19 in.
3 1/2in.	14 to 16 ft.	38 in.	23 in.
4 in.	16 to 18 ft.	42 in.	25 in.
4 1/2in.	16 to 18 ft.	48 in.	29 in.
5 in	18 ft. and up	54 in.	32 in.

The area where the topmost roots meet the trunk, referred to as the root collar or root flare, should be visible. If the root flare is buried, the topmost roots are not receiving enough oxygen. This can cause root decay, especially if the tree is planted in an area with heavy irrigation. Buried root flares can also cause stem girdling roots. If the trunk emerges from the soil like a telephone pole, remove the excess soil away from the base of the trunk to expose the root flare. If possible, it is best not to purchase trees that were planted too deeply.

The representative buyer for the Town of Glenville should reject any tree with a particular defect that cannot be easily corrected, and any tree that exhibits signs of pests or pathogens. If the trees are to be delivered directly from the nursery without prior inspection, the Town of Glenville should have a signed written agreement with the nursery that the trees will be inspected upon delivery with the right to reject trees with obvious defects.

THE TREE PLANTING PROCESS

Tree planting should follow the guidelines provided in the International Society of Arboriculture (ISA) *Best Management Practices - Tree Planting, Second Edition (2014)* and the associated *ANSI A300 Part 6* documents. The standards outline the most up-to-date knowledge on tree planting practices that help increase survivability in transplanted trees. For more detailed accounts on planting procedures, the documents can be purchased for $15 each on the ISA website.

Step 1. Digging the Hole

The depth of the planting hole is determined by the depth and firmness of the root ball. The depth should be measured at the base of the root flare to the bottom of the ball. The soil at the bottom of the planting site should be firm enough to prevent soil settling. Planting holes should be dug 1.5 to 2 times wider than the root ball. Ensure surrounding soil is not compacted, as this will prevent future root spread.

Step 2. Installing the Tree

For balled and burlapped material, place the tree in the hole by lifting and carrying it by the root ball so that the ball will not be loosened. A forklift with nursery jaws may be needed for larger caliper material. Set the tree straight and in the center of the planting site. Cut and remove rope or wire from at least the top 2/3 of the root ball and remove as much as the burlap and twine as possible. The more wire and burlap removed, the better. The tree shall be installed so that the trunk or root flare is flush with the finished grade after soil settling has taken place. Any obvious circling or girdling roots should be pruned at planting.

Step 3. Backfilling the Hole

In landscaped areas, with good quality soil, the hole should be backfilled with the soil originally removed from the hole. In industrial and heavily trafficked areas, soil may need to be replaced with more nutrient-rich, uncontaminated soil. If uncertain, soil testing is recommended. The hole should be backfilled in stages, watering in between filling, to help soil settle and prevent large air pockets which may cause the tree to tilt after planting. In particularly dry areas, building a berm of soil in a circle around the planting hole can help retain water when it rains. At no point should the topsoil be touching the trunk of the tree. The root flare should remain visible after backfilling.

Step 4. Mulching

Applying a layer of mulch to the surface of all planting sites helps protect tree roots from weather extremes, ameliorates water retention, and suppresses competition from weeds. The use of a natural forest product, such as shredded bark or wood chips, also helps with a steady nutrient supply as the material decomposes over time. Be sure that the mulch is natural in color and not dyed. Mulch should be applied at a depth of three to four inches at the time of planting. The mulch should be spread on the perimeters of the planting site, with little to no mulch on top of the root ball itself. This is to ensure roots are receiving adequate water. Mulch should not be touching the base of the tree. Contact with the stem creates moisture pockets, which can harbor fungi and bacteria.

Step 5: Staking

The need to stake trees is dependent on the ability of the tree to stand up on its own and the location of the planting. Once the tree can stand on its own and the root ball is anchored, stakes should be removed. Generally, stakes should be removed after one year. Stakes should be attached to the tree with loose, flexible material such as ArborTie. Staking materials should be removed within a year of tree installation. Leaving staking materials on a tree for prolonged periods of time can result in stem girdling and poorly developed stem taper and root systems due to decreased sway in the wind. If staking materials must be left for more than a year, they should be checked biannually to ensure they are not girdling the tree.

Step 6: Watering

Consistent watering in the first growing season is crucial for successful tree establishment. Newly planted trees should receive 3 gals. per inch of trunk diameter, 2 to 3 times per week, for the first growing season. As the tree becomes established, the volume should increase but the frequency can be diminished. The tree should be watered on a weekly basis in the second growing season and on a bi-monthly basis in the third growing season. By year four, the tree's root system should be adequately established. Watering bags may help provide a consistent source of water released slowly over time but must be installed correctly and checked to ensure they are releasing water.

YOUNG TREE TRAINING PROGRAM

The Town of Glenville has 397 young trees that can be put on an early pruning schedule to create a strong structure and improve the overall health and appearance of the tree. Any new trees planted in the Town of Glenville should be included in the YTTP. The Town of Glenville is encouraged to reach out to local volunteer groups to set up a tree care program that is carried out on an annual basis. The town should coordinate with church groups, local schools, or businesses to schedule tree training days. A certified arborist, either from the parks staff, or hired on a per day basis, should be present to train the volunteers and guide them as they prune the young trees.

Tree training does not apply to multi-stem trees and fruit trees.

Guidelines on Young Tree Training

Equipment needed:

- Hand pruners for branches up to 3/4 inch wide.
- Hand saw for branches up to several inches wide.
- Pole pruner or reach pruner for branches higher in the canopy.
- Gloves and safety glasses.

Be sure the tools are sharp and clean before pruning begins.

Training Schedule

Suggested Minimum Pruning Cycle
At planting
Year 2 or 3
Year 5 or 6
Year 8 to 10

The Young Tree Training Program should be put on a three-year cycle. One third of Glenville's young trees can be trained each year. In year 8 or 10, the tree will likely require minimal pruning.

Time of Pruning

Pruning in the winter months while the tree is dormant is recommended. Pruning in the winter and early spring, prior to bud break, encourages new growth, while summer pruning slows growth.

Location of Pruning Cut

At the base of each branch, where the branch meets the stem of the tree, you will find overlapping branch and trunk wood. This swollen section is referred to as the branch collar. If the tree is less than 2 inches in diameter, the branch collar may not yet be visible.

Right above the branch collar, where the branch and trunk connect (usually making a V shape), is the branch bark ridge. This area is a unique barrier, known as the branch protection zone. This section holds chemical properties that help seal off the wound to reduce the spread of decay into the trunk.

When removing a branch, it is important to make the cut just to the outside of the branch collar. Leaving the branch collar intact will ensure the tree is equipped to defend itself against potential pests invading the open wound.

Reduction cuts, which reduces the size of the branch, should always be made at the nodes of the branch.

How to Prune Young Trees

Step 1. Perform a 360-degree inspection around the tree and assess the overall form and structure of the tree.

Step 2. Remove all broken, dying, diseased and dead branches.

Step 3. Select a leader and cut back or subordinate any competing leaders. The leader is the central stem of the tree, follow the stem from bottom to top and carefully identify the leader. The most upright, vertical branch is a good candidate.

Step 4. Select the lowest permanent branch and loosely tie with flagging tape. Branches don't grow up the tree as the tree matures; therefore, any branch on a young tree will remain at the same height years later. The town should determine an acceptable clearance height and select the lowest branch at that height. The lowest branch should be healthy, well attached, and not more than half the size of the stem.

Step 5. Select scaffold branches and remove or reduce competing branches. Ensure the scaffold branches are well-attached, less than half the diameter of the main stem, and well-spaced, both vertically and radially. Walk around the tree and determine which are good candidates for scaffold branches. Tie loose flagging tape around selected branches to help gain a visual of the tree after pruning. Prune any branches with included bark, crossing branches or branches too close to the chosen scaffold branch. Small branches should remain between the larger scaffold branches if present.

Step 6. Select temporary branches below the lowest permanent branch. Temporary branches will eventually be removed as the tree grows but are important to retain when the tree is young. Vigorous temporary branches can be reduced, or pruned back, to slow the grow. The temporary branches can be removed in year 4, when the tree has fully established.

Young Tree Training Program Budget

Table 6. Young Tree Training Budget for First 5 Years of Program

Activity Cost		Year 1		Year 2		Year 3		Year 4		Year 5	
Activity Cost	**Cost/tree**	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost
Young Tree Training Program (3-year cycle)	$5	132	$660	133	$665	132	$660	132	$660	133	$665

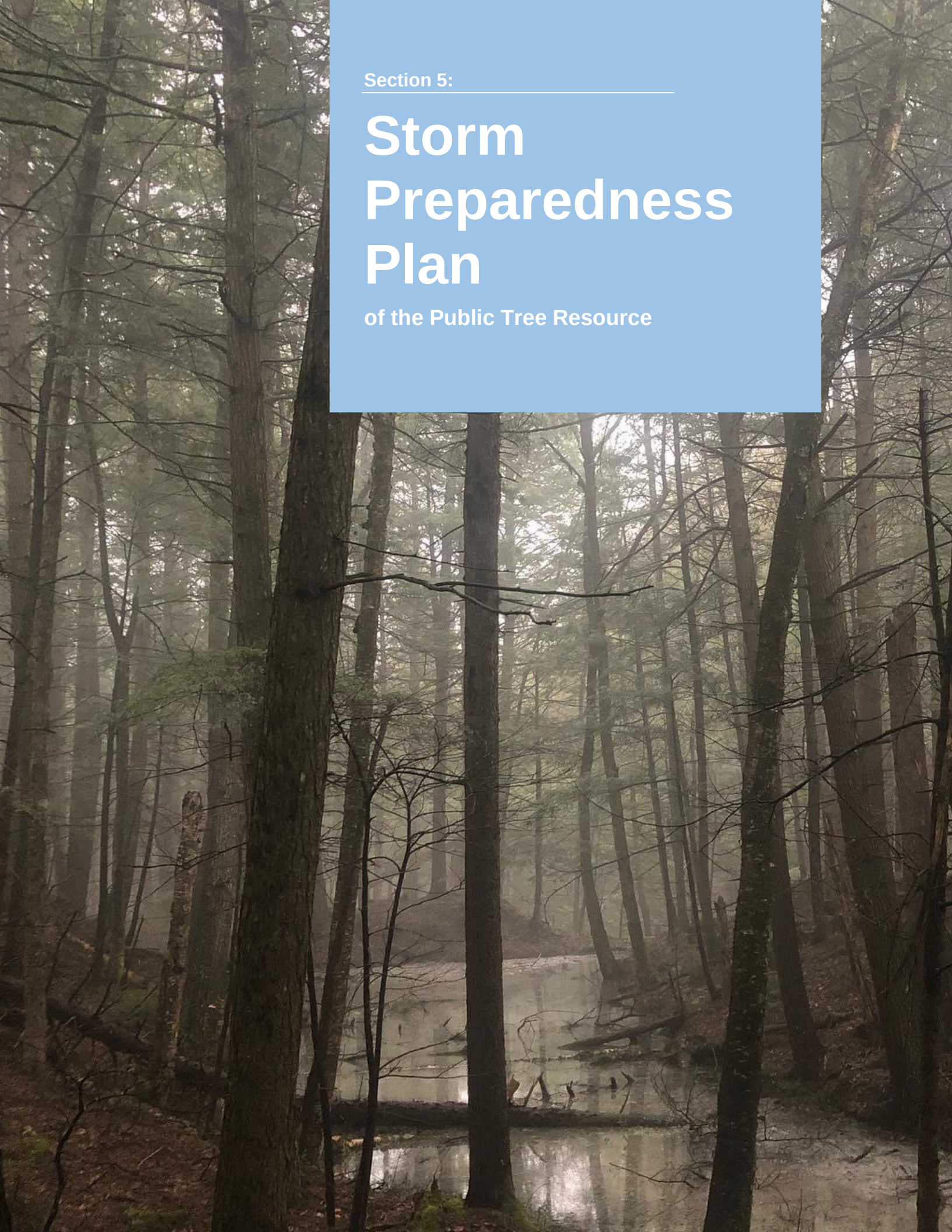
The cost per tree is estimated based on volunteer groups participating in the training program. The cost assumes the hiring of a certified arborist to train and guide volunteers, as well as the equipment cost associated with the program, divided by the number of trees trained per year.

TEN-YEAR PLANTING BUDGET

The inventory has indicated 1,291 vacant planting sites are suitable for new trees. Planting sites have been identified specifically by address number, street, side, and site number in the inventory. By setting a goal to plant trees in all of these sites, the town will be headed toward the full stocking of its street tree population. The table below represents the costs associated with a planting program over the course of ten years. The planting cost includes purchasing, planting, watering, and maintaining the tree. At the rate of estimation of plantings per year, it will take the town five years to plant all 1,291 identified vacant sites.

Table 7. Planting Cost over a Ten-Year Period

Year	Planting Cost	Number of Trees	Total Cost
1	$235	200	$47,000
2	$235	200	$47,000
3	$235	200	$47,000
4	$235	200	$47,000
5	$235	200	$47,000
6	$235	200	$47,000
7	$235	200	$47,000
8	$235	200	$47,000
9	$235	200	$47,000
10	$235	200	$47,000



Section 5:

Storm Preparedness Plan

of the Public Tree Resource

SECTION 5
STORM PREPAREDNESS PLAN

INTRODUCTION

The Town of Glenville, New York lies in a climate zone that exhibits four distinct seasons. This creates the potential for rapid changes in temperature, humidity, and barometric pressure, and sets the stage for severe weather events, such as thunderstorms, hurricanes, hail, high winds, ice, and snow.

Severe weather can lead to catastrophic damage, including downed utility lines, property damage due to fallen trees, injury to people, and can create significant volumes of vegetative debris. To prepare for these scenarios, proactive cities have developed emergency response and recovery plans.

The purpose of preparing an emergency storm preparedness plan is to mitigate, respond, and recover from an emergency or natural disaster in a timely manner. This section will focus on establishing protocols to outline the steps needed to have an effective strategy in place. Advanced planning will go a long way toward minimizing the impacts of natural disasters on the urban forest.

Keys of an Effective Emergency Storm Preparedness Plan

- Mitigation: activities to reduce the effects of disasters.
- Preparedness: plan a response prior to disaster.
- Response: activities performed during a disaster to minimize hazards in effective, efficient, and equitable ways.
- Recovery: returning to normal following a disaster.

SEVERE WEATHER EVENTS IN THE TOWN OF GLENVILLE

The Köppen climate classification rates the Town of Glenville as Dfb, which is characterized as a humid, continental region with a warm summer. The coldest month averages below 32 °F and no month's average temperature is above 71.6 °F. The town of Glenville receives above national averages in rainfall at 41 inches, snowfall at 60.2 inches, and precipitation days at 136.2 days.

The hurricane season in New York State begins June 1st and ends November 30th. According to the severe weather event archives, NY typically experiences hurricanes from May to October, when trees are fully leafed out. The higher wind intensity and speed, accompanied by heavy precipitation events, increases the dynamic load experienced by trees. The same is true in winter months when NY experiences blizzards and ice storms. The accumulation of ice and snow can increase the weight of branches by 30 times, significantly impacting the probability of tree failure.

As wind speed increases, trees are more susceptible to damage, resulting in greater urban forest loss. According to The National Oceanic and Atmospheric Administration's (NOAA) storm database publication, between the years 2010 and 2019, the town of Glenville experienced 149 high-force wind events, 110 snowstorms, and 32 flooding events. The events documented by the State's Hazard Mitigation Planning Team account for all events that are perceived to have a greater likelihood of producing damage and causing monetary losses. They occur with more frequency and/or intensity than those that are not considered hazards of concern.

Between 2016 and 2021, 46 high wind events were recorded in Glenville by NOAA, with a minimum wind speed of 46 miles per hour and a maximum wind speed of 56 miles per hour. A further 127 thunderstorm events were recorded during the same period, which produced wind gusts of 58 miles per hour.

The below table outlines the description of damage that can be expected at different wind speeds. The figures are compiled from the Beaufort Wind Scale and the Enhanced Fujita Scale degrees of damage. It is important to note that compounding factors, such as rain or snow, may influence the degree of damage.

Table 8. Expected Tree Damage at Varying Wind Speeds

Degree of Damage	Damage Description	Lower Bound Wind Speed	Upper Bound Wind Speed
1	Small limbs broken (up to 1" diameter)	39	72
2	Small branches broken (1" to 3" diameter)	58	88
3	Trees uprooted	73	118
4	Trunks snapped	88	134
5	Trees debarked with only stubs of largest branches remaining	120	167

IMPACT OF CLIMATE CHANGE

The climate is changing both globally and in New York State, causing an increase in storms and flooding. In the United States, 2019 was the second warmest year on record, and nine of the ten warmest recorded years have occurred since 2005. The average temperature across New York has risen 2.4°F since 1970. Annual precipitation and heavy precipitation events have gone up throughout the state, particularly during winter and spring; however, there has been less rain during summer and fall, leading to an increase in drought conditions during the hot season. Climate change has sparked a sense of urgency for urban forestry professionals, as weather and climate are integrally tied to urban forest health. As a result of climatic changes, increases in the frequency and severity of storms are occurring throughout the East Coast. This impacts the urban forest in several ways:

- Increased drought conditions lead to more stress on urban trees, weakening natural resistance to extreme weather events and tree pests and diseases.
- More storm damage and subsequent loss of trees.
- Poorly or infrequently managed trees are more susceptible to breakage in storms.
- Premature post-storm tree removals on private land tend to occur, often as a result of fear and lack of professional assessment.
- More frequent power outages from trees situated next to power lines.
- High volumes of stormwater runoff due to extensive impervious surfaces and shrinking amounts of green land cover, exacerbating existing issues of erosion and pollution.

A Comprehensive Community Forest Management Plan greatly reduces storm hazards through proper planting and preventative maintenance. However, when disasters occur, an Emergency Storm Plan as an addendum to this Plan can provide solid data, facts, and protocols to ensure service continuity and timely recovery and restoration.

TREE CARE MANAGER

The roles and responsibilities of individual staff members should be designated and clearly defined prior to a storm event. It is recommended that someone from the Town of Glenville be designated the Tree Care Manager and given the responsibility for coordinating management of staff and storm mitigation planning. Ideally, the Tree Care Manager should be an arborist, urban forester or horticulturist, and an ISA Certified Arborist.

The designated Tree Care Manager should be trained in tree risk assessment, tree maintenance standards, and best management practices. Computer software skills, such as Microsoft Word, Excel™, and basic geographic information systems will also help increase efficiency during storm response.

A Mitigation Team should also be clearly defined prior to a storm event. A spreadsheet should be created for the storm mitigation team that outlines the member's names, titles, radio number, phone numbers, and e-mail addresses and should be distributed to all participating members.

SAFETY PROCEDURES

Storms have the potential to produce a significant number of hazardous conditions. All staff involved in storm response procedures must be able to understand, apply, and comply with applicable safety regulations and practices.

An effective safety program should be implemented that addresses safety issues prior to, during, and after a storm event. The Town of Glenville's staff should receive safety and technical training, including First Aid/CPR certification, chainsaw safety course, tree risk assessments, and minimum approach distances for energized electric lines. The certifications should be kept current, and the courses should be administered on a yearly basis.

All possible contractors that are contracted to work with the Town of Glenville during storm events should be in compliance with OSHA Regulations and ANSI standards. A meeting should be held with contractors prior to storm events where the safety procedures and expectations are discussed in detail.

The Town of Glenville should identify personnel who have training in electrical hazard assessment (EHAP), aerial lift training, advanced climbing, crane operations, and aerial rescue. It is important to have the personnel identified and known by all staff, so response is as quick and efficient as possible.

The Town of Glenville should create a checklist to identify all tools and equipment required during a storm response. Conduct inspections of all the tools and equipment on a regular basis to ensure they're in good working condition.

MAPPING AND PLANNING

The Town of Glenville is encouraged to use TreeKeeper®, a geospatial database, to know where trees are in relation to critical areas or locations such as hospitals, major roads, emergency shelters, first responder (fire/police/emergency operations) buildings, town service centers, and debris storage yards. For example, Route 50 was identified as a major road in Glenville, which has primary and urgent care facilities along the route. TreeKeeper® should be used to identify high and moderate risk trees within proximity to critical areas so that maintenance or removals can be prioritized in such locations.

In the event of a storm, TreeKeeper® is an excellent tool to identify and locate trees of concern. The Tree Care Manager or other trained staff can use TreeKeeper® to create work orders as residents call in damaged or fallen trees from storm events.

The Contractor can have direct access to TreeKeeper® at a Contractor Level, meaning they cannot edit any points other than ones that were input as "emergency" work orders. The Contractor can then update the tree information in real time and include the hours devoted to work and the total cost of work completed for each tree. Using TreeKeeper®, the Town of Glenville will be able to input work orders as they are called in and track work completed by contractors in real time.

TREE CHARACTERISTICS RELATED TO STORM DAMAGE

DRG conducted a tree inventory in the Town of Glenville in the summer of 2018 and 2021. The tree inventory data provided Glenville with the knowledge to take proactive measures in managing and mitigating tree damage and damage related to trees.

In addition to wind speed and precipitation intensity and duration, there are other factors that influence urban forest damage during extreme weather events. While it is impossible to protect trees from storms or prevent damage from severe weather events, there are actions that can be taken to minimize injury to trees. Tree structure, health, species, and age are significant determining factors in the extent of damage an urban forest is likely to endure. Other considerations include site characteristics, such as soil depth, water table, soil compaction, and soil composition. The overall tree canopy density and configuration can also influence the likelihood of damage sustained by trees.

The following is a breakdown of important characteristics that impact the likelihood of damage sustained to trees, along with recommended measures the Town of Glenville can implement to lessen the extent of damage.

Tree Structure

A tree with good structure is characterized by a single dominant leader, strong branch unions without included bark, and a balanced crown. Branch and stem failure occur when loading exceeds wood resistance or when constant loading exacerbates a weakened area in a branch. Weakened areas take shape in the form of bark inclusions, clustered branching, co-dominant stems, cracks, over-extending branches, or trunk leans.

Poor structure physically weakens a tree's ability to withstand environmental loads, such as wind, rain, snow, and ice. For example, in 4-inch trees, co-dominant stems with included bark were found to be almost 20% weaker than stems without the presence of included bark. At 10 inches, included bark stems were 14% weaker than non-included bark unions (Smiley, E.T 2003). Research suggests that with the relatively low reduction in breaking strength as the tree increases in diameter, all co-dominant stem junctions should be considered weak.

Tree Structure Recommendations

Glenville's inventory identified 1,441 trees (22%) with weakly attached branches or co-dominant stems and trees with poor architecture. Of the 1,441 trees with poor tree structure, 247 are classified as having a moderate to high risk rating. There are 49 trees with a high or moderate risk rating slated for removal and 198 in need of pruning.

The 247 trees identified as having weak structural integrity are located near high value targets with medium to high occupancy rates.

To prepare for a storm event, the trees identified as being structurally defective with high to moderate risk ratings should be removed or pruned immediately to minimize damage during extreme weather events.

Trees with high or moderate risk ratings that cannot be removed immediately should be closely monitored on a bi-annual basis. If the tree is otherwise healthy, bracing and cabling is a lower cost option that decreases the risk of retaining the tree. Bracing and cabling can help stabilize weak crotches and can protect the trunk from twisting in violent weather.

Similarly, trees noted with cracks or cavities with high to moderate risk ratings should be monitored on an annual basis. Cracks and cavities are susceptible to pest and pathogen infestation. The defective area can create a weak point on the tree, causing it to split during severe weather. If the cracks are growing or decay is spreading rapidly within the cavity, to a point where the tree is structurally unsound, removal is recommended.

Developing a Preventative Pruning Program: Young Tree Training

Training a tree early in its life is the most cost-effective way to improve the overall structural integrity of the urban forest over time. Trees included in young tree training are generally less than 8 inches DBH (diameter at breast height). The Town of Glenville has 397 young trees that can be put on an early pruning schedule to create a strong structure and improve the overall health and appearance of the tree. Potential structural problems that should be corrected early on include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, increasing risk and creating potential liability.

Most of the tree training is done in the first 3 to 5 years of a tree's life, with less work in years 5 to 7. The tree should be pruned at planting, followed by a pruning on year two and year four, depending on the level of pruning completed.

The objective is to increase structural integrity by pruning for one dominant leader. This is done by making reduction cuts to any branches that are competing with the leader (see the following figure). All branches that are greater than one half the diameter of the trunk should be reduced (shortened) or removed. This will slow the growth of the lateral branch and improve branch attachment. All large, lower branches should be shortened while the tree is young to encourage growth in the tree trunk. Remove all broken, cracked or severely damaged branches. Do not remove more than 35% of the live foliage on the tree at any one time.

Training young trees helps reduce storm damage by creating stronger branch unions that are more resilient to wind and ice loading. Young tree training is species-specific, since many trees such as *Betula nigra* (river birch) may naturally have more than one leader. For such trees, young tree training is performed to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree. Stronger branch structure also helps minimize expensive pruning operations when the tree reaches maturity.

Illustration of Young Tree Pruning

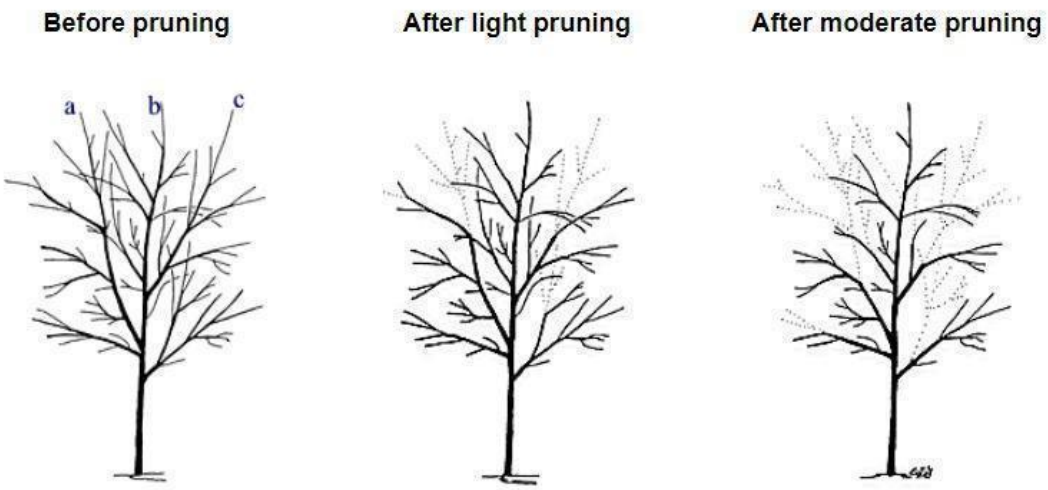


Figure. 1 Reference E. Gilman (2007)

The middle image above demonstrates the subordination of branches "a" and "c". This was done to minimize competition with the central leader, "b". The image to the far right demonstrates a tree after moderate pruning. Branch a and c were subordinated, extended branches were reduced, and larger canopy gaps were created to give each branch more space and access to more sunlight. More aggressive pruning can be done if the tree cannot be pruned for several years. However, this does increase potential for tree stress.

The Town of Glenville can coordinate with local volunteer groups to implement a young tree training program. Volunteers can be present at time of planting to ensure the newly planted tree is properly pruned and all dead, dying, and cracked branches are removed. The volunteer group can revisit the trees at a two-year interval to carry out maintenance pruning in the first 7 years of the tree's life.

Tree Species

Research suggests that different tree species have various susceptibility or resistance to ice and snowstorm damage (Warrillow, M. et al 2009). While the damage sustained to trees is highly dependent on storm and site characteristics, there are species that have proven more resilient across several studies.

The aspect ratio, which is the ratio of the branch diameter relative to the diameter of the trunk, is an important characteristic that determines branch strength. Gilman (2003) found that tree form that results in the least amount of breakage is one in which branches remain small compared to the trunk. This structure occurs naturally in some species, while others need to be carefully pruned to achieve a favorable form.

In addition to branching structure, wood strength has also been found to be a contributing factor to how well a given species holds up to storm damage. Faster growing species generally have weaker wood and lower load carrying capacity than their slow-growing counterparts.

Tree Species Recommendation

When choosing new species to plant in the town of Glenville, it is advised to focus on wind-resilient trees and species that are physically more resilient to storm breakage. If the tree is to be planted in a heavily frequented area with surrounding high value targets, it is advised to consult the below list of wind-resilient and ice-resilient species. The list was compiled from various studies that examined wind and ice susceptibility of most planted northeastern urban trees. It is important to note that species damage is highly variable with many compounding factors that influence the damage sustained to a given tree.

Table 9. Wind-Resilient Trees

Low	Medium-Low	Medium-High	High
Species			
Chinese elm (*Ulmus parvifolia*)	hybrid elm (*Ulmus* x)	hophornbeam (*Ostrya virginiana*)	American holly (*Ilex opaca*)
Leyland cypress (*Cupressocyparis leylandii*)	black cherry (*Prunus serotina*)	blackgum (*Nyssa sylvatica*)	Baldcypress (*Taxodium distichum*)
tuliptree (*Liriodendron tulipifera*)	boxelder (*Acer negundo*)	redbud (*Cercis canadensis*)	dogwood (*Cornus* spp.)
	Hackberry (*Celtis occidentalis*)	sweetgum (*Liquidambar styraciflua*)	magnolia (*Magnolia* spp.)
	red maple (*Acer rubrum*)	river birch (*Betula nigra*)	
	silver maple (*Acer saccharinum*)	hornbeam (*Carpinus* spp.)	
	sycamore/planetree (*Platanus* spp.)	pignut hickory (*Carya glabra*)	
	white oak (*Quercus alba*)	sugar maple (*Acer saccharum*)	

Table 10. Ice and Snow Damage-Resilient Trees

Low	Moderate	High
American linden (*Tilia americana*)	American beech (*Fagus grandifolia*)	baldcypress (*Taxodium distichum*)
bigtooth aspen (*Populus grandidentata*)	boxelder (*Acer negundo*)	bitternut hickory (*Carya cordiformis*)
black cherry (*Prunus serotina*)	chestnut oak (*Quercus prinus*)	black walnut (*Juglans nigra*)
black oak (*Quercus velutina*)	common chokecherry (*Prunus virginiana*)	blackgum (*Nyssa sylvatica*)
butternut (*Juglans cinerea*)	douglas-fir (*Pseudotsuga menziesii*)	bur oak (*Quercus macrocarpa*)
eastern cottonwood (*Populus deltoides*)	eastern white pine (*Pinus strobus*)	Colorado blue spruce (*Picea pungens*)
hackberry (*Celtis occidentalis*)	gray birch (*Betula populifolia*)	crabapple (*Malus* spp.)
honeylocust (*Gleditsia triacanthos*)	green ash (*Fraxinus pennsylvanica*)	eastern arborvitae (*Thuja occidentalis*)
hybrid elm (*Ulmus* x)	northern red oak (*Quercus rubra*)	eastern hemlock (*Tsuga canadensis*)
Jack pine (*Pinus banksiana*)	paper birch (*Betula papyrifera*)	eastern redcedar (*Juniperus virginiana*)
pin cherry (*Prunus pensylvanica*)	pin oak (*Quercus palustris*)	European mountainash (*Sorbus aucuparia*)
pitch pine (*Pinus rigida*)	red maple (*Acer rubrum*)	ginkgo (*Ginkgo biloba*)
quaking aspen (*Populus tremuloides*)	red pine (*Pinus resinosa*)	hedge maple (*Acer campestre*)
river birch (*Betula nigra*)	scarlet oak (*Quercus coccinea*)	hophornbeam (*Ostrya virginiana*)
Siberian elm (*Ulmus pumila*)	Scotch pine (*Pinus sylvestris*)	hornbeam (*Carpinus* spp.)
silver maple (*Acer saccharinum*)	sugar maple (*Acer saccharum*)	horse chestnut (*Aesculus hippocastanum*)
slippery elm (*Ulmus rubra*)	sycamore/planetree (*Platanus* spp.)	Kentucky coffeetree (*Gymnocladus dioicus*)
Virginia pine (*Pinus virginiana*)	tamarack (*Larix laricina*)	littleleaf linden (*Tilia cordata*)*
willow (*Salix* spp.)	white ash (*Fraxinus americana*)	northern catalpa (*Catalpa speciosa*)
tuliptree (*Liriodendron tulipifera*)	yellow birch (*Betula alleghaniensis*)	pignut hickory (*Carya glabra*)
white oak (*Quercus alba*)		red buckeye (*Aesculus pavia*)
tuliptree (*Liriodendron tulipifera*)		red horsechestnut (*Aesculus* x *carnea*)
white oak (*Quercus alba*)		shagbark hickory (*Carya ovata*)
		swamp white oak (*Quercus bicolor*)
		sweetgum (*Liquidambar styraciflua*)
		white spruce (*Picea glauca*)

Tree Placement

The surrounding site characteristics greatly influence a tree's ability to withstand extreme weather events. Trees with greater rooting space survive better during extreme wind events. In a study conducted in Puerto Rico in the aftermath of Hurricane Georges, it was found that trees that had enough space to allow for proper root anchorage and root spread, along with enough space for the development of the main root flare, fared substantially better in high wind events. Street trees with limited rooting space had a 64% survival rate, compared to a 91% survival rate among trees planted on campuses and in yards (Duryea 2007). The study suggests that adequate rooting space is the most critical factor to the ability of trees to withstand hurricane-force winds in urban areas (Duryea 2007).

Another important consideration is tree exposure. Stand-alone trees that are fully exposed to the elements are more susceptible to storm damage than trees planted in groups. Research conducted in the aftermath of Hurricane Ivan and Jeanne showed that trees growing in groups of five or more, with spacing of at least 10 feet, survived the winds better than individual trees (80% vs. 70% in Hurricane Ivan and 88% vs. 78% in Hurricane Jeanne) (Duryea, 2007).

Tree Placement Recommendation

When planting new species, the surrounding site characteristics should always be assessed before the species is chosen. Before choosing a species, take note of the tree bed dimension, the recommended minimum dimensions are referenced in the Planting Plan section. Make note if there are any overhead wires and consider if there will be a conflict when the tree reaches maturity. The planting guidelines in Glenville's Planting Plan should be referenced when choosing a planting location. When possible, plant trees in groups of five or more. Trees can act as windshields for one another, offering some protection during high-force wind events.

Tree Condition and Size

Healthier trees are more wind-resilient and are better equipped to handle storm-related damage. Trees with obvious health-related issues, in the form of decayed root systems, large, dead branches, butt swelling, and older wounds with internal decay are vulnerable to storm-related damage. Similarly, larger diameter trees have been found to sustain the most damage in severe ice and snowstorms (Hauer 1993).

Tree Condition Recommendation

The best defense against extreme weather events is a healthy tree population. Preparation should begin when the tree is young or newly planted (see Planting Plan guidelines). As trees mature, inspections should be conducted to assess the overall condition and defects associated with the tree. The inspector should record dead, broken or decayed branches, stem or root damage, pest problems, or signs of stress that could impact the tree's ability to withstand unfavorable weather.

Dead trees located in proximity to high value targets, such as people or valued infrastructure, should be prioritized for removal. Glenville currently has 620 trees that are recommended for removal, with 243 trees given a moderate to high-risk rating. It is strongly recommended that Glenville prioritize the 113 High Risk rating removals, followed by the 130 Moderate Risk rating removals.

Pruning should be prioritized on trees rated at High Risk with existing defects of dead and dying parts or missing and decayed wood. Glenville has 38 trees listed as high priority pruning, followed by 568 Moderate Risk trees with a recommended maintenance of pruning. Of the High and Moderate Risk rated trees, there are 12 in need of pruning that are located near primary electric lines. The necessary arrangements should be made to safely prune these trees in order to avoid power outages in the event of extreme weather conditions.

Actions should also be taken to help improve the overall health of the tree. Glenville currently has 730 trees in Poor condition. Appropriate watering and fertilization can help improve root growth and structure, vine removal should be routinely done to minimize the detrimental impacts of vine growth and soil aeration can be performed in highly compacted areas. A routine pruning schedule should be administered to help trees form a healthier, wind-resilient crown.

PARTNERS

Successful creation, implementation, and execution of a Storm Preparedness Plan will require the resources and expertise of a variety of external partners. Multiple partnerships are a reality in storm response given the variety of legal, jurisdictional, and operational missions within a municipal boundary. Partnerships can present challenges but can also result in an effective and efficient response when the expertise and resources of each partner are acknowledged, and roles are properly delineated.

The following is a brief description of Glenville's major partners in a storm emergency and during recovery efforts.

1. **Schenectady County**
   Schenectady County Department of Public works assists the Town of Glenville with tree removal on county roads.

2. **Utility Agencies**
   Electric distribution lines in the Town of Glenville are controlled by National Grid, who is a key partner during a storm emergency. Only Electrical Hazards Awareness Program (EHAP) trained staff are qualified to work around energized lines. They have the resources to mobilize quickly to appropriate responses to emergency situations involving trees and utilities. During a widespread storm event, Glenville will likely also need to communicate and coordinate with the New York Public Service Commission. Where whole trees or limbs are down or resting on energized lines, rescue and clean-up efforts cannot proceed until power lines have been addressed by the trained personnel of these agencies. Prioritization of where utility agencies respond first are: three-phase aerial electric lines; single-phase aerial electric lines; secondary electric lines; and then service (or residential) drops.

3. **New York State Department of Transportation (NYSDOT)**
   The NYSDOT is responsible for the safety and maintenance of interstate and state routes within and around the Town of Glenville. During a storm emergency, they can respond with staff and equipment to clear state-owned rights-of-way and assist with town streets, if authorized. The NYSDOT will likely have a priority of clearing routes which may affect debris staging or removal patterns for Glenville. Check with the local district DOT authority to determine their responsibilities and the municipal expectations for each storm category (Appendix A).

4. **Contractors**
   The Town of Glenville does not currently have contractual agreements in place with local tree service companies, debris processing companies, or equipment and tool rentals. However, the town frequently works with three local companies on an on-call basis. During an emergency, the town can enter new emergency contracts and modify existing contracts to supply the personnel and equipment necessary to efficiently deal with storm mitigation efforts.

5. **State of New York**
   When the response efforts appear to be beyond the capability of the Town of Glenville, the state can normally provide the next level of assistance by declaring a state of emergency. The New York State Division of Emergency Management and Homeland Security (DEMHS) aids local emergency response leaders for major or complex emergencies or disasters. The division also assists local jurisdictions with recovery from natural or man-made disasters, in addition to coordinating mitigation programs designed to reduce the impact of future disasters on a community. The division typically evaluates the disaster situation and provides advice to the Governor on the availability of state resources to assist local efforts. The Town of Glenville falls within DEMHS Region 5.

   The DEMHS website (dhses.ny.gov/) offers a toolbox of information to assist with the process of requesting aid and making claims for reimbursement. It offers several guide sheets and forms that provide excellent information about the application process and how to maintain adequate records of debris cleanup costs and contracting procedures.

6. **Federal Government**
   The U.S. Army Corps of Engineers may be able to respond for up to 10 days without a Presidential Declaration; the Federal Highway Administration may provide grant assistance to states for debris clearing, tree removal, and repair of roads; and the Federal Emergency Management Agency (FEMA) provides financial and administrative assistance after storms that are declared a federal emergency.

   FEMA is the major Federal agency that will be a partner of the Town of Glenville in the event of a severe storm emergency. FEMA recommends that communities have an *Emergency Operation Plan* and, since debris removal is reported as the most significant storm-related problem, communities should have a *Debris Management Plan.*

FEMA will reimburse the Town of Glenville for debris removal costs if a federal disaster is declared. FEMA will also reimburse the Town of Glenville for removing certain trees during a federal disaster. Trees which sustain greater than 50% crown loss and are on the public right-of-way are eligible for removal cost reimbursement. However, trees that are completely on the ground after a storm and can be moved away with other debris are usually included in the debris estimates. FEMA often does not cover stump removal unless a hazard situation is present.

FEMA will also reimburse the Town of Glenville for hazard reduction pruning immediately following a storm during a federal disaster. In general, broken or hanging branches that are 2 inches or greater in diameter and that are still in the crown of a tree can be pruned under the hazard reduction reimbursement policy. The pruning cost is not extended to the entire tree but is limited only to the removal of branches contributing directly to the hazard.

Final reimbursement of storm-related damages from FEMA is dependent on accurate record keeping and documentation of storm-related cleanup work.

FUNDING AND BUDGET FOR URBAN FOREST EMERGENCIES

While the scope of this plan does not permit detailed budgeting estimates, the Town of Glenville is strongly encouraged to analyze past catastrophic storm events (snow/ice storms, tornadoes, flooding) and provide for enough regular funding and contingency funding to support an adequate response for various levels of storm damage. Information on storm emergency categories can be found in Appendix C. Storm and emergency response will require funding for staff overtime, contractual services, and equipment rental.

Removal of debris from public property is eligible for reimbursement from the Federal Emergency Management Agency (FEMA) under most cases when a federal disaster has been declared and when it constitutes an immediate threat to life, public safety, or improved property. This includes the removal of tree debris (downed limbs, trees) and the pruning or removal of trees to remove imminent hazards (hanging limbs or trees so damaged that they are structurally unstable). Any tree debris located on public rights-of-way are eligible. This includes material that originated on private property that is dragged to the right-of-way by residents during a specified period.

In order to receive FEMA funding, it is critical to be prepared and fully document all losses and money spent. Most damage assessments through FEMA must be done immediately after the disaster event. The calculated dollar amount is then sent to the County Emergency Management Director. FEMA has a public assistance program that is open to municipal departments and nonprofit hospitals. These grants can be applied for to assist with a variety of damages, including debris removal and emergency protective measures.

SUMMARY OF RECOMMENDATIONS

- Be sure all staff are signed up for the New York Emergency Alert System through (alert.ny.gov/).
- Establish communication protocol for storm events. Both during and after a storm emergency, the Town of Glenville may be relying on and working with multiple departments and levels of government. Effective communication is key to effective and expedient action. An effective plan ensures that all potentially involved or relevant departments understand their roles in the storm response effort.
- Routinely update the tree inventory as maintenance activities occur or as otherwise warranted. The most effective storm preparedness and management plans rely on current data to prioritize work and ultimately reduce future storm damage.
- Annually review the Storm Preparedness and Response Plan and update as necessary.
- Utilize the Homeland Security office to provide quick notification to the NYS DEMHS and FEMA if reimbursement from disaster funds is anticipated. Understand in advance the FEMA system for reimbursement and develop a clear system of record keeping in order to streamline and expedite reimbursement.
- Promptly address elevated risk trees to remove them from the population or otherwise mitigate risk to reduce potential storm damage.
- Prioritize proactive tree maintenance activities by considering tree condition, the presence and type of defect, age of tree, and tree location.
- Remove Low Risk but storm damage-prone species from the population when their service lives are over and replace them with more resilient species.
- Provide staff training, particularly on tree risk and working in environments with potential electrical hazards.
- Commit to providing the citizens timely messaging about Glenville's response and recovery activities and about tree damage and correction topics. Prepare public relations materials ahead of time so that they are easily accessible when storms strike.
- Re-assess all the trees in impacted areas to determine if remedial work is needed.
- Review FEMA Debris Monitoring Guide (March 2021) for further guidance.

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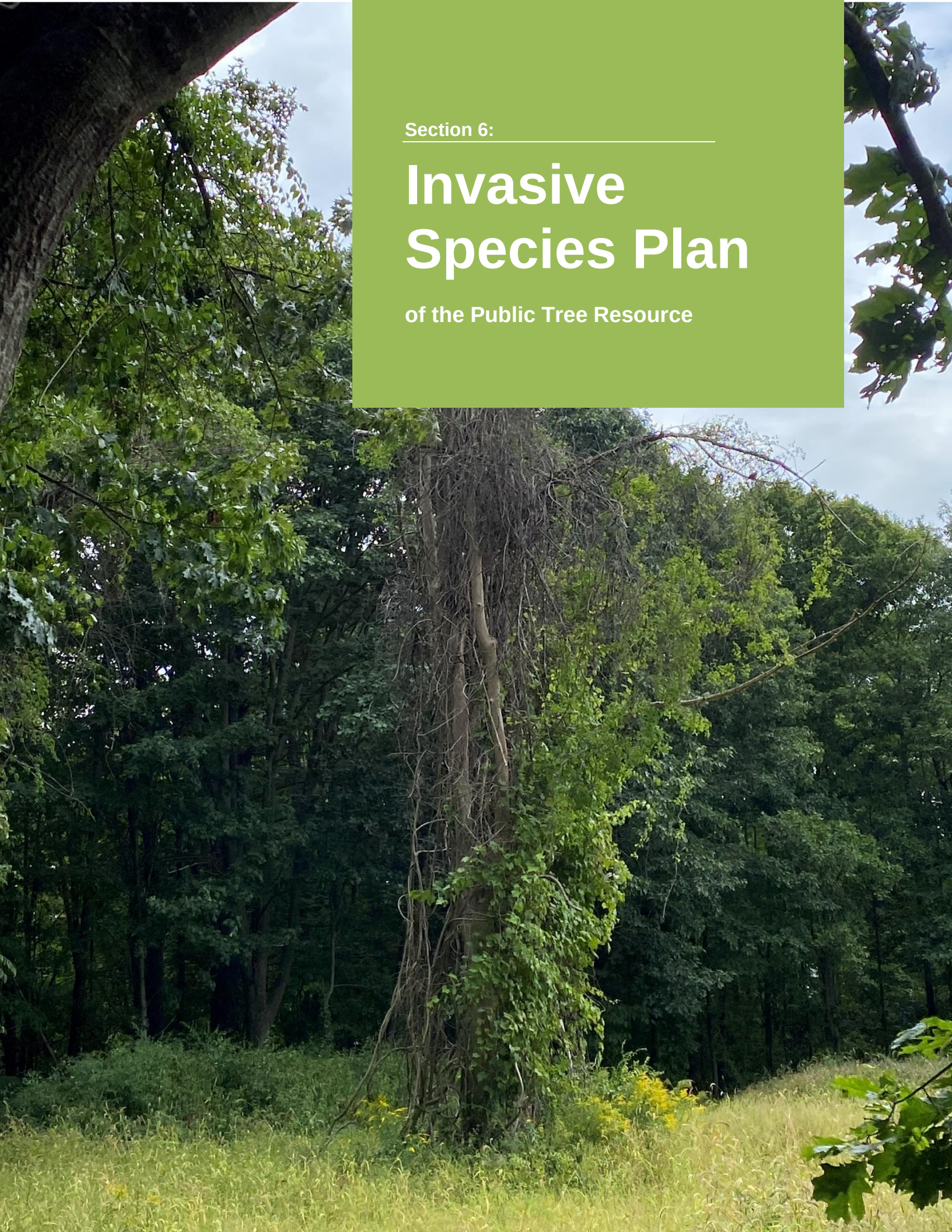

Section 6:

Invasive Species Plan

of the Public Tree Resource

SECTION 6
INVASIVE SPECIES PLAN

INTRODUCTION

Urban forests are under increased pressure from invasive pest species. Invasive species are defined as plants, insects, or pathogens which are not native to a particular ecosystem and which, because of their introduction, cause harm to the economy, environment, or human health. The high density of people and proximity to transport hubs, including airports and seaports, in urban areas increases the likelihood of new species being introduced to the environment through trade, tourism, and horticulture.

Urban trees are particularly vulnerable to invasive pest species, as they are already exposed to a host of other stressors, including construction activities, constricted root space, compaction, droughts, and flooding events. Compounding detrimental impacts make urban trees more susceptible to attacks.

The need for invasive species management was highlighted during the devastations of Dutch elm disease and the emerald ash borer. Invasive species have the potential to effectively eliminate entire tree species or genera from the urban forest within decades of their introduction. It is for this reason that Glenville is taking an active role in managing invasive species in their town.

BACKGROUND

The Town of Glenville, New York, is in Schenectady County. The 50-square-foot town is home to 30,000 residents that benefit from the town's trees, both urban and woodland. The town lost many ash trees due to emerald ash borer and is looking to become more proactive in managing invasive species such as oak wilt disease, gypsy moth, Asian longhorned beetle, spotted lanternfly, and hemlock woolly adelgid.

PURPOSE

The overarching goal of this management plan is to provide recommendations to better record, manage, and monitor invasive species in the Town of Glenville. The goal will be addressed through the following initiatives:

1. Commit to a centralized framework for sharing invasive species information.
2. Prioritize invasive species threats based on local impacts.
3. Identify species-specific management strategies and methods.
4. Set overarching invasive species management strategies.
5. Evaluate and report progress.

SCOPE

The non-native pest species discussed in this management plan focuses on the invasive species that were identified as being of primary importance to the Town of Glenville and is by no means an exhaustive list of all invasive species found within the town. The scope exclusively includes terrestrial invasive species that affect the urban forested landscape.

CENTRALIZED FRAMEWORK FOR INVASIVE SPECIES MANAGEMENT

The Town of Glenville, with the aid of volunteer groups, has previously collected data on the online invasive database and mapping tool, iMapInvasives. The software is the official invasive species database for New York, and it is recommended that all future invasive species surveys conducted within the Town of Glenville use iMapInvasives to record data.

Maintaining one source for collecting and recording data will avoid duplication of efforts and will allow invasive species managers to better visualize and understand the scale of invasive species infestations affecting Glenville.

Glenville should appoint a town staff or Tree Board member to be responsible for managing iMapInvasives. The appointed member would ensure all data are accurate and up to date. The appointed member would also be responsible for communicating collection and recording protocols with volunteer groups to ensure all data is being surveyed and recorded in a way that is consistent.

SET PRIORITIES FOR INVASIVE SPECIES MANAGEMENT

Limited funding means that invasive species managers need a structured process to evaluate invasive species risk. The Partnership for Regional Invasive Species Management (PRISM) developed a tiered ranking system for invasive species within New York State. The ranking system was developed with the intention of providing management and prioritization assistance. The following is a list of PRISMS' qualitative rankings based on 5 categories: Early detection, Eradication, Containment, Local Control and Monitor.

Tier 1. Early Detection: Conduct detection surveys to assign to appropriate Tier.

Early detection surveys should be focused on invasive species that have not yet been identified within the town limits but have the potential to become new invasive species. Early detection surveys are the most cost-effective invasive species management strategy, as it allows risk-mitigation measures to be taken before the invasive species becomes established.

Tier 2. Eradication: High impact species with low abundance. Eradication is feasible. Eradication should only be used when there are highly invasive species present in low enough numbers to be removed. Early detection makes eradication possible.

Tier 3. Containment: Strategic management to slow the spread, remove outlying and border populations to reduce the impact on surrounding areas. Containment is reserved for invasive species that are too widespread for eradication but are in low enough numbers for regional containment. If resources are limited, containment should be focused on high-priority areas, such as bordering naturalized areas. The goal is to slow the spread into surrounding neighboring areas.

Tier 4. Local control: Eradication is not feasible. Localized management over time to contain, exclude or suppress spread into high-priority areas. Local control will be tailored to the town's management goals for specific high impact invasive species. Measures will be taken to suppress infestations, as eradication is infeasible.

Tier 5. Monitor/Research: More research, mapping, and monitoring needed to determine invasive nature.

PRISM Ranking System

The following is a tier ranking system of the insect, trees, and terrestrial plant invasive species affecting the Town of Glenville. The five Tiers are taken from the Capital Region PRISM Tier List for Ranking Invasive Species 2021 found within NYS.

Tier 1	Early Detection
Tier 2	Eradication
Tier 3	Containment
Tier 4	Local Control
Tier 5	Monitor

Table 11. Invasive Insect and Pathogens Ranked by Tier

Insect/Pathogen	NYS Rank	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
oak wilt	Unknown	X				
gypsy moth	H				X	
Asian longhorned beetle	H	X				
spotted lanternfly	H	X				
hemlock woolly adelgid	H			X		
emerald ash borer	VH				X	

Table 12. Invasive Tree Species Ranked by Tier

Tree Species	NYS Rank	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
sycamore maple	H		X			
Tree-of-heaven	M-H				X	
Empress Tree	M		X			
black locust	VH				X	
Norway maple	VH				X	

(Rankings taken from Partnership for Regional Invasive Species Management and Cornell Cooperative Extension, Revision March 2020, https://www.capitalregionprism.org/uploads/8/1/4/0/81407728/crp_tier_list_combined_ais_and_tis_2021.pdf)

Terrestrial Plants

Each of the terrestrial invasives were assigned to Tier 4, Local Control. The Nature Conservancy and the Brooklyn Botanic Garden (reviewed by the Scientific Committee of the Long Island Invasive Species Management Aream 2013) designed a ranking system that incorporated components of previous invasive species ranking systems (Carlson et al. 2008; Morse et al. 2004; Randall et al. 2008; Williams and Newfield 2002) to effectively evaluate the negative impacts of individual invasive species on the natural systems in New York State. The invasive species are evaluated based on the four categories, which include: 1) the ecological impact, 2) dispersal ability 3) ecological amplitude and distribution rate, 4) the difficulty to control the infestation (Jordan et al. 2010).

The terrestrial plants are listed from the highest Relative Maximum Score to the lowest. Please note that the scores listed below are based on state-wide invasive rankings and will differ slightly by region within NYS. The terrestrial invasive species listed below are the most reported invasive species on iMapInvasives in Glenville. The Town should prioritize management based on the location and relative abundance of each species.

New York Invasiveness Rank	Relative Maximum Score
Very High	>80.00
High	70.00-80.00
Moderate	50.00-69.99
Low	40.00-49.99
Insignificant	<40.00
Not Assessable	Not persistent in NY

Species designated as High or Very High on the Relative Maximum Score are considered invasive and are recommended candidates for regulatory actions. Moderate ranked species may not be candidates for regulation but should still be managed. It is recommended that moderate species be removed from natural areas and be placed on the "do not plant" list. (Jordan et al. 2010).

Table 13. Invasive Terrestrial Plants Ranked by REL Max Score

Terrestrial Plants	NYS Rank	REL MAX SCORE	Tier 4
Japanese knotweed	VH	97.94	X
common reed grass	VH	92	X
purple loosestrife	VH	91	X
Japanese barberry	VH	91	X
multiflora rose	VH	89	X
Oriental bittersweet	VH	86.67	X
garlic mustard	VH	84	X
Japanese honeysuckle	VH	83.51	X
common buckthorn	VH	81	X

SPECIES-SPECIFIC MANAGEMENT STRATEGIES

This section goes into detail on the invasive species currently affecting or has the potential to affect the Town of Glenville. It includes a description of the invasive species, susceptible species, dissemination method, identification, and the appropriate management strategy and methods.

Management methods refer to the measures employed to carry out management strategies. They may include physical, chemical, biological, and cultural methods. Generally, a combination of these methods is necessary for effective management of invasive species, in what is known as integrated pest management (IPM). IPM methods aim to manage destructive agents such as invasive species at tolerable levels using a variety of preventative, management, and regulatory strategies which are ecologically and economically efficient as well as socially acceptable.

INVASIVE INSECTS AND PATHOGENS

Oak Wilt Disease

What Is Oak Wilt Disease?

Oak wilt is a vascular disease caused by the infiltration of a fungus, *Bretziella fagacearum*, in the outermost xylem of the tree. The xylem is responsible for carrying water from the root tips to the crown of the tree. When *B. fagacearum* infiltrates the xylem, the tree responds by developing tyloses and gums in the vessels to block passage of the invading pathogen. The sheer size and number of tyloses eventually clog the vessels completely, ultimately suffocating the tree.

Susceptible Oak Species

Oak wilt is a virulent disease, specifically for the red oak family. Red oak, including red, scarlet, pin, and black oak, typically succumb to the disease within a few weeks to 6 months of infection, with the disease spreading easily from tree to tree.

Oak wilt also affects the white oak family, but to a lesser extent. White oak is better equipped at fending off *B. fagacearum*, usually taking years to succumb to the disease. Fungal mats don't typically develop on white oak, making it difficult for the disease to spread from tree to tree.

How Is Oak Wilt Disseminated?

There are two main vectors of dissemination for oak wilt disease.

1. Insect transmission
2. Root graft transmission

Insect Transmission

The principal means of oak wilt transmission is through sap and bark-feeding beetles. Once an oak tree succumbs to the disease, the fungus produces sporulating mats in the bark, which are known to only develop on red oak. The fungal mats develop in late fall or early spring, giving off a sweet fruity odor that attracts insects. The sticky spores attach themselves to the beetles as they crawl over and feed on the fungal mats. The beetles subsequently carry the spores to healthy trees where they are deposited in fresh wounds.

Fagacearum is relatively short-lived in a dead tree, disappearing from the above-ground parts of the tree within a year of its death. The fungus, however, may survive longer below ground.

Root Graft Transmission

While insect transmission is the most common means of spreading oak wilt disease, it is not the most efficient. The disease is most virulent through underground transmission. Oak trees growing in close proximity to one another share their root system. Using root grafts, the disease effectively spreads from diseased trees to healthy ones, rapidly eradicating entire oak colonies.

Oak Wilt Symptoms

A characteristic symptom of an oak infected with *B. Fgacearum* is a wilting and bronzing of the foliage, starting at the tree top and tips of the branches, and spreading rapidly throughout the crown. A telltale sign is an abnormal amount of fallen leaves in summer months, either green or brown in color, surrounding the tree. An infected tree may display leaves that bronze from the leaf tip to the base, sometimes leaving a small green area at the base of the leaf.

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of USDA Forest Service (2011a)

Another sign of oak wilt disease is the presence of fungal spore mats, which develop under the bark of the tree. Once the tree dies, pressure builds in the spore mats, causing them to expand, splitting the oak bark.

It may not be obvious a tree is suffering from oak wilt as symptoms are variable and not always evident. Laboratory analysis is necessary to confirm the presence of oak wilt.

Management Strategy of Oak Wilt: Early Detection

Oak wilt has been detected in the Town of Glenville around the year 2020. While there haven't been recent cases of oak wilt in the community, it is important that the Town remain proactive in surveying for the disease, as the town has over 460 oak, with 342 belonging to the red oak family.

The goal is to have all town residents aware of the disease and know how to identify symptoms of oak wilt. Residents should also know who to notify if there is a potential sighting of oak wilt. This can be done through outreach programs and public awareness campaigns. Early detection and rapid response are the most cost-effective methods for controlling invasive species. It is worth getting ahead of diseases before they become established in the community.

Town staff should be provided with regular updates and continuing education on oak wilt. Many professional organizations, such as the International Society of Arboriculture (ISA), offer annual conferences where updates on invasive species can be obtained and experiences with managing invasive species can be shared.

The town should also coordinate yearly detection surveys with local volunteer groups. Volunteers can use TreeKeeper® to locate oak within the town limits and inspect trees for oak wilt symptoms. Any potential sightings should be noted in iMapInvasives and verified by a local forester. Confirmed sightings should be reported to the DEC immediately.

Oak Wilt Management Methods

Once an oak is infected with oak wilt disease, there is no cure. Therefore, it is important to be proactive in managing the disease before it spreads to healthy oak trees.

The following are the best management practices for keeping your oak tree healthy.

1. Don't prune oaks from early April to July to prevent spread from insects.
2. Oak trees that have been pruned during spring and summer months should be sealed immediately with wound covering.
3. Stop below-ground spread by cutting root connections of oak trees growing in close proximity to each other.
4. Rapidly remove diseased oak from the premises to avoid spread.
5. Treat high-value non-infected oak trees with a systemic fungicide, such as Propiconazole, to slow the spread of the disease.

Hemlock Woolly Adelgid

What Is Hemlock Woolly Adelgid?

The hemlock woolly adelgid, or HWA, is an invasive forest insect from Asia that attacks the eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*). Once hatched, the aphid-like insects insert their long mouthparts and feed on the tree's food storage cells. HWA continuously feed on the tree for the remainder of their lives, eventually disrupting the flow of water and nutrients to the twigs and needles of the host tree. Hemlock typically succumb to HWA within 4 to 10 years of infestation.

Susceptible Species

All species of hemlock are susceptible to HWA; however, only eastern hemlock and Carolina hemlock suffer from severe tree decline or death.

Hemlock Woolly Adelgid Identification

HWA is most easily identifiable by the white woolly masses they form on the underside of branches or at the base of the needles. They are relatively easy to spot as they stand out against the deep green of the hemlock needles. The individual ovisacs are quite small (1.5mm) and can contain up to 200 eggs. The white woolly masses are present on the tree year-round.

Hemlock woolly adelgids on a branch.

Photograph courtesy of Connecticut

Symptoms of Hemlock Woolly Adelgid

Once HWA begins feeding on their host, the tree tries to protect itself by walling off the insertions created by the long-sucking mouthparts (stylets). The continuous effort to compartmentalize the areas of attack eventually disrupts the flow of nutrients to the needles, leading to substantial dieback. The hemlock's needles will appear dried out and lose color, turning gray. Dieback of major limbs can occur in as little as two years and generally begins at the bottom of the tree, moving upwards.

Hemlock Woolly Adelgid Management: Eradication

Once infested and left untreated, trees infested with HWA rarely recover. It is important that the town be proactive in inspecting and treating hemlock woolly adelgid once sighted. The town has 65 living eastern hemlock trees, which should be inspected on a yearly basis for the presence of HWA.

Once sighted, the most effective means to manage HWA is to use an integrated chemical and biological control, as outlined by the U.S Forest Service (Mayfield, A et al. 2022).

The integrated management strategy requires some high value, or good condition, hemlock to be administered with chemical insecticides, while simultaneously releasing predators on nearby untreated trees. In theory, this will allow the HWA predators to become established on the untreated trees, and eventually disperse onto the temporarily treated trees after the insecticide protection wears off (Mayfield, A. et al. 2022). The intent of this strategy is to allow sufficient time for the HWA predator population to grow to effectively be able to reduce and maintain HWA infestations.

Chemical insecticides are ideal for individual trees and should not be used in a forest setting. Imidacloprid, an insecticide in the noenicitinoid class, was evaluated to be highly effective against HWA (HWA (Steward and Horner 1994, Cowles et al. 2006). It can be applied to the surrounding soil of an infested hemlock tree. The injection is administered into the soil below the organic layer or as a basal bark spray. As the tree takes up water from the soil, the insecticide is incorporated into the tree's sap flow, providing years of protection in a single treatment.

Chemical treatments have proved to be effective, however are costly and need to be well thought out before they are applied due to environmental safety concerns. For example, hemlock located near water resources may not be good candidates for chemical insecticide applications. If HWA is spotted, the town should perform a cost-benefit analysis for treatment, as the cost associated with application may be minimal compared to the loss of the ecological resource.

The use of biological controls has been popular for HWA management. The strategy with biological controls is to introduce the natural predators of HWA into the environment to reduce the insect's spread. Beetles, such as *Sasajiscymnus tsugae*, *Scymnus* spp., and *Laricobius nigrinus,* have been introduced to help control the spread

Emerald Ash Borer

What is Emerald Ash Borer?

Emerald ash borer (EAB, *Agrilus planipennis*) is an iridescent green beetle less than 1 inch long. It hosts on ash trees, laying eggs in bark crevices which hatch into larvae that feed on the phloem of the tree, creating characteristic s-shaped galleries. The adults eventually burrow out of the tree, leaving behind tiny D-shaped exit holes. The feeding and tunneling of the larvae eventually girdle the tree, causing dieback and death of infested ash trees. EAB infested trees may also become structurally unstable, leading to increased instances of branch or trunk failure.

EAB has killed tens of millions of ash trees since its introduction to the United States, resulting in decreased canopy cover, loss of wildlife habitat, and an overall reduction of ecosystem services.

Susceptible Species

Emerald ash borer attacks all species of ash tree (*Fraxinus* spp.).

Symptoms of EAB

An ash infested with EAB will typically exhibit canopy thinning and crown dieback, epicormic sprouting, woodpecker damage, and have D-shaped exit holes approximately 1/8" wide, along the trunk of the tree.

Emerald Ash Borer Management: Local Control

EAB is pervasive and abundant in New York State, making eradication or containment unlikely. Management needs to be done at a local level to help slow the spread of the insect.

Close-up of an emerald ash borer.

Photograph courtesy of USDA APHIS (2020)

Glenville has 100 ash trees, with 65 in Fair or Good condition. Individual trees along streets, in yards, or in parks that are in relatively good condition can be chemically treated with systemic insecticides to protect them from infestation. Treatments must be repeated, generally every one to three years, and are most effective when the trees being treated are young and have good vigor. Mature or damaged trees, as well as trees which are already heavily infested are not good candidates for chemical treatments.

Dead and dying ash trees should be removed when located in places that present a hazard to the public, as dead ash trees tend to drop limbs. Dead and dying ash trees located away from public use areas can be left to create snags and decompose, returning nutrients to the soil. Several different strategies for management of ash trees in urban settings exist, including complete removal of all ash trees as they die, complete removal of ash trees preemptively, and treatment of ash trees to prevent infestation. In any instance where ash trees are removed, they should be replaced with a non-susceptible tree to help return lost ecosystem service benefits in the future.

Biological controls are also being introduced as potential candidates to slow the spread of EAB. Four species of wasp have been deployed as biocontrol agents in 30 states and, although they can help reduce EAB populations, are not able to eradicate the invasive species.

Education of the public is key to help reduce the accidental movement of EAB in firewood, logs, nursery stock, and other ash products and to prevent the establishment of new infestations.

Asian Longhorned Beetle

What is Asian Longhorned Beetle?

Asian longhorned beetle (ALB, *Anoplophora glabripennis*) is a large black and white beetle native to Asia. These wood-boring beetles lay eggs below the bark and larvae feed on the cambium layer, disrupting the flow of water and nutrients throughout the tree. ALB infestation leads to crown dieback and, eventually, tree mortality. Trees infested with ALB are more prone to partial or whole tree failure due to weakened wood caused by larval tunneling.

Susceptible Species

The primary host in its native range is poplar (*Populus*); however, in the United States it has a wider host range which includes maple (*Acer*), ash (*Fraxinus*), poplar, birch (*Betulus*), willow (*Salix*), and elm (*Ulmus*).

Symptoms of ALB

A tree infested with ALB may have adult beetles present on the bark. There may also be chewed round depression or pencil-shaped, perfectly round holes on the bark. Another sign of ALB presence is excessive sawdust (frass) buildup near tree bases and unseasonable yellowed or drooping leaves.

Adult Asian longhorned beetle.

Photograph courtesy of New Bedford Guide

Asian Longhorned Beetle Management: Early Detection

Early detection is crucial for ALB, as the only way to currently combat infestations is to destroy infested trees. Detection surveys should be conducted on a yearly basis. Town residents should be aware of and know how to identify the insect. Residents should also know who to notify if there is a potential sighting of ALB. This can be done through outreach programs and public awareness campaigns.

The most effective method of preventing the continued spread of the insect is removal and destruction of infested trees. Infested trees should be physically removed, chipped, or burned to ensure no living beetles or larvae remain.

Chemical preventative measures have been implemented in the past, but research is ongoing into their efficacy.

Preventative measures include quarantines of infested areas, restrictions on the movement of firewood and other wood products, and public education about ALB and the use of local firewood.

Spotted Lanternfly

What is Spotted Lanternfly?

Spotted lanternfly (SLF, *Lycorma delicatula*) is a planthopper insect native to China and southern Asian countries. It goes through several distinctive life phases ending with an approximately one-inch-long adult with showy red lower wings.

Susceptible Species

The Tree of heaven (*Ailanthus altissima*) is SLF's preferred species; however, it has been found on apple (*Malus* spp.), plum, cherry, peach (*Prunus* spp.), pine (*Pinus* spp.), as well as 103 other tree species.

Pinned spotted lanternfly.

Photograph courtesy of PA Dept of Agriculture

Symptoms of SLF

SLF feed on sap from stems, leaves, and trunks of trees. Feeding does not kill host plants outright; however, it weakens trees, leaving them susceptible to secondary infections. In addition, SLF excrete a substance like honeydew, which encourages other pests, such as sooty mold and wasps, to congregate in infested areas.

Spotted Lanternfly Management: Early Detection

As with ALB, SLF is considered a Tier 1 species and monitoring should be done to detect any new infestations early. Management methods vary depending on whether it is found inside or outside a quarantine zone. Within quarantine zones, the primary management practice involves careful checking for and removal of any egg casing or SLF nymphs or adults from all surfaces that are going to be transported outside the quarantine zone. Although it feeds on many species, there is some evidence that SLF have a close association with an invasive tree species, Tree-of-heaven (*Ailanthus altissima*), and certain prevention and management programs have focused on removal of this prime host material. Any potential sightings of SLF should be reported to the DEC or PRISM. Stands of tree-of-heaven can also be reported to spottedlanternfly@agriculture.ny.gov and should be considered high-priority targets of monitoring for SLF.

Pinned spotted lanternfly nymph with wingspan open.

Photograph courtesy of USDA APHIS

European Spongy Moth

What is the European Spongy Moth?

The spongy moth (*Lymantria dispar*), formerly known as gypsy moth, is a defoliating forest tree species. This species is in the family Erebidae of Eurasian origin. Females can fly over long distances and can lay hundreds of eggs which in turn produce caterpillars that will cause widespread damage to local plants. Large spongy moth infestations can completely defoliate trees. This defoliation can severely damage and weaken trees leading to other diseases and pests.

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

Photograph courtesy of USDA APHIS (2019)

Tree Susceptibility

There are many species at risk for being a host to ESM; however, some common tree host species include: birch (*Betula*); cedar (*Juniperus*); larch (*Larix*); aspen, cottonwood, poplar (*Populus*); oak (*Quercus*); and willow (*Salix*).

Identification and Life Cycle

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

Infestation Symptoms

In regions where the moth is established, the species undergoes periodic outbreaks every 5–10 years, causing significant damage to forests for 2–3 years at a time. Larval feeding damage on host plant leaves is the most obvious symptom of spongy moth attack. Feeding damage appears as holes in the leaves or irregular leaf margins. As larvae grow, whole leaves may be consumed. Each larva consumes about 1 square meter of leaves in its lifetime. At low levels, the larvae do not impact the general health of trees, but at outbreak levels they can completely defoliate trees.

AGM Management: Local Control

There are several biological based controls with a focus on immediate suppression (*Bacillus thuringiensis*, Gypcheck®) and long-term management, (*Entomophaga maimaiga*). The efficacy of these controls is not known outside of North American populations. Spongy moth is managed at the national level with the SlowtheSpread.org program.

It is important to report any sightings to the proper local, state, or federal agency. Being that spongy moth cannot be fully eradicated or stopped from spreading to new areas, proper urban forest management is a critical management strategy. Species diversity is the best means of limiting damage from any insect defoliation. Encourage a mix of tree species, ages, and size classes. Second, managing for tree health and vitality limits the number of trees dying from defoliation.

MANAGING INVASIVE TREE SPECIES

In Glenville, the five invasive tree species are Tree of heaven, Empress tree, black locust, Norway maple, and sycamore maple. The Empress tree and sycamore maple are currently in Tier 2, meaning they are in the process of "eradication". Tree of heaven, black locust, and Norway maple are currently in Tier 4, meaning they are under "local control". To effectively manage these invasive tree species, it is important to understand the methods that are effective in eradicating each individual species. Each tree has different qualities and growth habits which cause them to react differently to physical and chemical eradication treatments.

In general, to prevent the spread of these invasives, a few methods are effective regardless of tree species. One of those methods is to rake, pick up, and dispose of seeds found on the ground to prevent more saplings of that species from sprouting. Another method is to pull and dig out young saplings out of the ground and remove the roots (most effectively done when the ground is wet). For smaller trees, foliar herbicide treatments are also effective. These methods are relatively effective in preventing more trees from growing in an area; however, it requires annual management and should be used in addition to other methods.

To further manage the spread of these invasives, a combination of physical and chemical methods must be done. For Empress trees, black locust, Norway maple, and sycamore maple, one method is to cut the tree down and apply herbicide to the exposed stump. This should prevent the roots from producing more suckers. For Norway and sycamore maple, another option is to prune seed-bearing branches to prevent saplings from forming. Also, girdling mature maple trees by removing the bark and cambium will effectively kill them. Once trees are removed, they need to be quickly replaced with native tree species to prevent them from growing back and taking over an area again.

An effective way to get rid of Empress trees called hack-and-squirt applications is where slits are cut around the tree stem into the bark and spraying herbicide into the cuts. If the Empress tree isn't dead the following year, reapplying herbicide may be necessary. Removing the roots of these trees is also very important because the roots can cause new growth even after the tree is removed.

One of the most difficult invasive trees to eradicate is the black locust. Due to the black locusts' resprouting abilities, it's hard to effectively control them from spreading. Surprisingly, cutting and burning these trees has shown to increase sprouting productivity. Chemical control of this species has proven rather hard because trees that seem dead are able to resprout many years later.

Similar to black locust, physical removal of Tree of heaven is ineffective due to its resprouting abilities. To effectively remove Tree of heaven, systemic herbicides should be applied to roots in mid- to late summer and monitored for signs of regrowth. The same method of hack-and-squirt that is used for Empress trees can also be used for Tree of heaven, but the herbicide application should only be in mid- to late summer.

TERRESTRIAL VEGETATION

Japanese Knotweed

What is Japanese Knotweed?

Reynoutria japonica or Japanese knotweed is a fast-growing, perennial, herbaceous plant native to East Asia. It was first introduced to the United States in the late 1800s and it has since spread rapidly to 42 states across the country. It can be found along streams and wetlands, along roadsides, along riverbanks, and on the edges of woodlands. It can tolerate high temperatures, lack of sunlight, high soil salinity, and dry soil conditions. Once Japanese knotweed becomes established in an area, it can quickly turn into a monoculture where no other plants can grow.

Japanese Knotweed Identification

Japanese knotweed can grow approximately 10 feet tall and has smooth, jointed, hollow stems which are typically pink and green in color. The leaves are triangular to heart shaped with smooth edges and are pointed at the tip. The leaves are alternately arranged in a zig-zag pattern from node to node. From August to September, small white flowers bloom in long clusters up to 10cm long.

Japanese Knotweed Management

To remove Japanese knotweed, it is suggested to use a combination of mechanical removal as well as herbicide application. Single young plants can be pulled out by hand, but it is important to remove the roots so that resprouting doesn't occur. To further remove and prevent roots from resprouting, a grubbing tool can be used as an effective control measure. In regions where herbicide can be used, glyphosate and triclopyr herbicides should be applied to freshly cut stems or to foliage.

Common Reed Grass

What is Common Reed Grass?

Phragmites australis or common reed grass is a dense, fast-growing, and invasive plant that is native to Europe and has since spread across the United States. It typically grows in wetland areas of low salinity and it prefers to grow where there is full sunlight. It will typically take over the growing space of an area and it outcompetes native plants creating a monoculture. Due to its very dense growth habitat, common reed grass increases the potential for fire and reduces and degrades wetland wildlife habitat.

Common Reed Grass Identification

Common reed grass can grow up to 15 feet tall and has skinny yellow to green stems. It has long, flat, green leaves that can grow up to 23 inches long and 2 inches wide and tapers to a thin point. It has golden-brown to purple-colored flowers which can reach up to 16 inches long that bloom in the late summer.

Common Reed Grass Management

In most cases due to the growth density of common reed grass, it is not effective to rely on physical removal to eradicate it in an area without the help of chemicals. A combination of cutting the reeds and applying pesticides afterwards is most effective. When spraying herbicides, it's important to take the surrounding environment into account. If spraying plants on land, a chemical like Roundup is effective but should never be used in an aquatic environment. If spraying plants in the water, it is important to use an aquatic safe chemical.

http://fingerlakesinvasives.org/invasive_species/common-reed-grass/

Purple Loosestrife

What is Purple Loosestrife?

The Eurasian forb purple loosestrife, *Lythrum salicaria*, is an erect, branching, perennial that has invaded temperate wetlands throughout North America. It grows in many habitats with wet soils, including marshes, ponds and lakesides, along streams and riverbanks, and in ditches. Once established, the prolific seed production and dense canopy of purple loosestrife suppresses growth and regeneration of native plant communities. Monotypic stands of purple loosestrife may inhibit nesting by native waterfowl and other birds. Other aquatic wildlife, such as amphibians and turtles, may be similarly affected. The dense roots and stems trap sediments, raising the water table and reducing open waterways, which in turn may diminish the value of managed wetlands and impede water flow.

Loosestrife Identification

Purple loosestrife is a perennial, with a dense, woody rootstock that can produce dozens of stems. Shoot emergence and seed germination occurs as early as late April, and flowering begins by mid-June. Seedlings grow rapidly, and first year plants can reach nearly a meter in height and may even produce flowers. A single plant can produce over 2 million seeds. Senescence occurs with the first frost, and dead stems persist throughout the winter.

Leaf pairs often grow at 90-degree angles from one another, and leaves near the flowers are sometimes alternate. Stems are upright, angular, and densely hairy. Mature plants can reach up to 4m in height, and older plants often appear bush-like, with sometimes dozens of woody stems growing from a single rootstock. The showy purple flowers have 5–7 petals and grow in pairs or clusters on 10–40cm tall spikes. Seeds are small (less than 1mm in length) and lack an endosperm.

Loosestrife Management

Mechanical**:** Small infestations can be pulled by hand, though care must be taken to completely remove the root crown. Glyphosate or triclopyr based herbicides can also effectively control small stands, but as they are expensive and non-selective, they are generally unsuitable for large purple loosestrife infestations. Mechanical or chemical management will require multiple years to completely remove adult plants and exhaust the seedbank.

Four species of beetles (2 leaf beetles and 2 weevils) have been released in the United States as biocontrol agents for purple loosestrife. They have had some measure of success controlling purple loosestrife populations. The leaf-feeding beetles *Galerucella calmariensis* and *G. pusilla* defoliate and attack apical buds as both adults and larvae and can slow growth and diminish seed production. The weevil *Nanophyes marmoratus* feeds on seeds and flower buds, and the weevil *Hylobius transversovittatus* attacks both roots (as larvae) and foliage (as adults).

Japanese Barberry

What is Japanese Barberry?

Berberis thunbergii or Japanese barberry is a small, spiny, deciduous shrub that is native to Japan and other regions of eastern Asia. They are commonly planted in yards and commercial landscapes but when birds and mammals eat their berries, they spread the seeds causing it to take over other areas. Japanese barberry provides a lot of shade for the lower understory of the forest which outcompetes native plants. It can grow well in either sun or shade and they are found in forests, wetlands, and fields. They are also linked to increasing the spread of lyme disease as hosts for the disease (ticks and deer mice) are found in higher populations where Japanese barberry is present.

Japanese Barberry Identification

Japanese barberry can grow 2 to 6 feet tall and equally as wide, and they are known for their prickly thorns. When they bloom, they have small, green, teardrop shaped leaves that are densely packed onto their branches. In the fall, the leaves often turn yellow, purple, red, and orange and they also have small, oval-shaped, berries that turn red in the fall. In late spring, they bloom ¼ inch light yellow flowers, each with 5 petals.

Japanese Barberry Management

The best mechanical method for removing Japanese barberry is by hand pulling or digging up the shrubs. This should be done early in the season before any seeds drop to prevent new growth. When choosing to apply herbicides, it's important what time of year they are applied. Herbicides should be applied in the fall so native plants are dormant while barberry is in active growth. Two effective methods of pesticide application are a foliar treatment done in the fall and cutting the stump in late summer/early fall to ground level and applying herbicides.

https://today.uconn.edu/2017/03/climate-change-puts-invasive-plants-move/

Multiflora Rose

What is Multiflora Rose?

Multiflora rose is a thorny, woody, flowering shrub which can grow up to 15 feet tall. It forms dense thickets which exclude native vegetation and degrades soils around it. It is also a host for the rose rosette disease which can infect any Rosa species, and which may spread to cultivated roses. Multiflora rose was discovered to become a problem in pasture lands and fallow fields. It is currently found in 41 states and banned in 13 states. This species is ranked among the top forest invasive plants in the Northeastern U.S. by the U.S. Forest Service. Multiflora rose is listed as Tier 4 species, meaning it is so widespread and difficult to manage that PRISM recommends targeted local management to protect high-value areas rather than broad-scale management practices designed to contain or eradicate the species.

Multiflora Rose Identification

Multiflora rose produces white flowers in clusters, as opposed to native roses which all produce single flowers. Clusters of showy, fragrant, white to white-pink, half-inch to one-inch diameter flowers, bloom in panicles, inflorescences with side stems, in late May or June. The red to green twigs may have numerous recurved thorns. The pinnately compound leaves grow alternately with 5, 7, 9, or 11 oval, saw-toothed leaflets. The leaflets are nearly smooth on the upper surface and paler with short hairs on the underside. The base of each leaf stalk bears a pair of fringed bracts or stipules. The fringed stipules are the best characteristic to use to distinguish multiflora rose from other species

Multiflora Rose Management

Mechanical**:** Seedlings can be pulled by hand. Small plants can be dug out or larger ones can be pulled using a chain or cable and a tractor, but care needs to be taken to remove all roots. Frequent, repeated cutting or mowing at the rate of three to six times per growing season, for two to four years, has been shown to be effective in achieving high mortality of multiflora Rose. Invaluable, natural communities, cutting of individual plants is preferred to site mowing to minimize habitat disturbance. Some success has resulted from the use of goats in controlling multiflora rose.

Chemical: Herbicides have been used successfully in controlling multiflora rose, but because of long-lived stores of seed in the soil, follow-up treatments are likely to be necessary. Applications of systemic herbicides, such as glyphosate or triclopyr, to freshly cut stomp or to re-grow, may be the most effective method, especially if conducted late in the growing season. The same chemicals can be employed as a foliar spray.

It is important to note that multiflora rose has the typical regenerative power of members of the rose family, and control programs must be monitored and followed up, if necessary, by repeated herbicide application or used in conjunction with other control methods such as mowing or burning. Plant growth regulators have been used to control the spread of multiflora rose by preventing fruit set.

Biological: Rose rosette disease is a sometimes-fatal viral disease that attacks multiflora rose and other roses. The virus is spread naturally by a tiny mite. Plants affected by rose rosette disease develop witches' brooms and small reddish leaves and shoots. The disease can kill plants in two years. This disease is not considered a useful biological control at this time because it may infect native roses and plums, as well as commercially important plants in the rose family such as apple, some types of berry, and ornamental rose.

Another biological control method involves the use of European rose chalcid (*Megastigmus aculeatus*), a wasp. During May and June, the female deposits her eggs in the seed and the larvae overwinter. Pupa formation occurs in April to June and the adult wasps appear from the rose hip in early summer, thus completing the cycle. More research needs to be completed before considering this method of control.

Honeysuckle

What is Honeysuckle?

Japanese honeysuckle prefers disturbed areas and margins, including floodplains, forest openings, and fields. Japanese honeysuckle choke any plant used as a scaffold, girdling, and killing them and potentially causing tree failure due to the increased weight placed on the tree.

Honeysuckle Identification

Japanese honeysuckle is a perennial woody vine (although its leaves can remain green throughout mild winters). The shrub forms range from 6 to 15 feet in height, while vines can reach 30 feet in length. The egg-shaped leaves range from 1 to 3 inches in length and are arranged oppositely along stems. Invasive honeysuckles begin flowering from May to June and bear small (less than 1 inch long), very fragrant tubular flowers ranging from creamy white through various shades of pink to crimson. *L. japonica* produce dark-purple or black berries in the fall and have a hollow stem.

Honeysuckle Management

Mechanical: In early stages of invasion, or in cases where populations are at low levels, hand removal of honeysuckle seedlings or young plants is a viable option when repeated annually, though care must be taken to avoid leaving behind root fragments which will resprout.

Chemical: Systemic herbicides can be utilized in cases of heavy infestation. Specific state rules should be followed and the appropriate (low environment impact, legally labeled for control of these plants) herbicides should be used. For invasive honeysuckles growing in open habitats, prescribed burning may be an effective control alternative.

Common Buckthorn

What is Buckthorn?

Common buckthorn (*Rhamnus cathartica*) has been the most reported invasive species in iMapInvasives for the Town of Glenville. These invasive species are fast growing and produce vast quantities of seed, allowing them to reproduce and spread readily. They crowd out native understory species and new tree seedlings and alter soil pH, making restoration of infested areas difficult due both to poor soils and a prolific seed bank. Invasive shrubs such as buckthorn have been demonstrated to reduce insect diversity and biomass and negatively impact bird populations through malnutrition caused by the poor nutritional quality of buckthorn berries and increased nest predation due to the dense thickets they form.

Buckthorn Identification

Common buckthorn can grow up to 25 to 30 feet tall and often can be a prominent feature of a forested area's understory. Buckthorn have ovate, or elliptic leaves with prominent veins curving toward the tip. Mostly opposite leaf arrangement 1 to 2.5 inches long with tiny teeth. Leaves remain on this plant and stay green well into the fall. Branches are tipped with a short thorn and a thorn may also be found in the fork between two branches.

The bark is gray to brown with prominent light-colored lenticels. Cutting into the bark exposes an inner orange cambium layer. Berries are small (5–6mm) in diameter and are dark purplish, or black in color. Common buckthorn is often found in lightly shaded areas and is tolerant of many different soil types from sandy to clay.

Buckthorn Management

The Prism system lists common buckthorn as a Tier 4 invasive species, which means it is a widely and well-established species that cannot be eradicated. Common buckthorn should be subject to targeted local management to protect high priority resources, rather than complete eradication.

There are several ways to manage common buckthorn as an invasive species.

Pulling or Digging: This method involves the physical removal of the shrub, including the root system. Small seedlings (1 inch in diameter), leaving approximately 2-inch-high stump, and covering the stump with black plastic (such as "Buckthorn Baggie") to prevent re-sprouting. Once the tree is cut, the bag should be tied to the stump and covering the root flare to catch any new buckthorn shoots. The plastic needs to be left in place for at least a year before removal. Bagging buckthorn is the recommended option. The technique is less labor intensive than tree removal and does not disturb soil.

Chemical: Herbicides, such as Roundup, Stalker, and Tordon, are widely used for buckhorn control. Typical procedure involves cutting or girdling buckthorn stems and applying herbicide to the girdled or cut stumps. The combination of physical and chemical application has proven to be an effective technique for minimizing buckthorn invasion (Pergams 2006). Buckthorn that was cut or girdled with no additional herbicide treatment demonstrated vigorous shoot growth from the base of the shrub (Pergams 2006), suggesting that cutting and girdling techniques used on their own is ineffective. While chemical use is often recommended for invasive management because of their effectiveness and relatively low cost, there is public concern that the application may be harmful to surrounding animal and plant species, making its use unsuitable in natural areas.

Larger infestations should be mowed before chemical treatment. Please note that seeds can persist in the ground for up to five years.

GENERAL MANAGEMENT RECOMMENDATIONS

Education, Outreach, and Training

Both vegetation managers, those hired by the town as well as independent contractors, and individual citizens need access to education on why invasive species are harmful, how to spot invasive species of concern for Glenville, and how to report and manage invasive species on public and private properties. Town staff should be provided with regular updates and continuing education on invasive species. Many professional organizations, such as the International Society of Arboriculture (ISA), offer annual conferences where updates on invasive species can be obtained and experiences with managing invasive species can be shared.

Preventing the Deliberate Planting of Invasive Species

Glenville should compile a list of non-native invasive plants to avoid planting, and this list should be considered when planning any public landscaping or tree planting projects. The list should also be made available to the public. Future tree ordinances or other legislation could codify compliance with do-not-plant lists. A comprehensive do-not-plant list should consider not only trees, but also shrubs, grasses, and aquatic plants which are considered invasive in the Glenville area.

Preventing the Introduction of Seeds/Eggs/Organisms into an Area

There are many methods by which propagules of invasive species can enter a new area. Glenville should consider by which routes invasive species are most likely to enter the island and how to prevent such introductions. Examples of this element include checking incoming boats for invasive aquatic plants and checking nursery stock for invasive insects before planting. Educating citizens and town staff on the ways in which invasive species travel and what to look for can aid in this task.

Developing Local Ordinances to Address Invasive Species

Local ordinances, such as a tree ordinance, can help prevent invasive species introduction. Such ordinances may include lists of species that are prohibited from planting, dictate the methods in which private landowners are required to report or manage invasive species, or determine standard practices for invasive species management within public areas of the town. Some examples of local ordinances which address tree preservation and invasive species prevention can be found on the Sustainable City Code website (https://sustainablecitycode.org/brief/require-native-trees-and-removal-of-invasive-trees-3/).

Early Detection and Eradication of Small Populations of Invasive Species

Infestations of invasive species which are detected early, while they affect a relatively small geographic area, may be possible to eradicate. Routine monitoring during other urban forestry activities as well as tips from the public can help identify infestations before they become widespread. This topic will be further discussed in Section 3.2.

Periodically Inspecting High Risk Areas

Glenville should identify areas at high risk of infestation. Such areas may include transportation corridors, recently disturbed areas such as new housing developments, and locations where previous infestations have undergone control measures. The town should also identify species at particular risk of infestation by invasive species, such as ash trees currently unaffected by EAB or species susceptible to other imminent invasive threats in the region (see Section 2.2). These areas and species should be routinely inspected, either by town staff, contractors (such as through an Inventory Pest Evaluation and Detection [IPED] survey), or by volunteer groups.

Maintaining Healthy and Vigorous Trees and Other Vegetation

Invasive species are uniquely suited to take advantage of already weakened individuals or communities of plants. Maintaining healthy and vigorous trees and communities of native vegetation can help limit the opportunities for invasive species to become established by ensuring that ecological niches are already filled by native vegetation. Additionally, maintaining healthy trees and vegetative communities provides other benefits, such as reduced stormwater runoff, improved carbon storage capacity, and increased pollutant removal. Establishing routine pruning cycles for urban trees, planning and creating landscapes of plants which are well suited to site and climate conditions, and managing utility corridors to promote the growth of native plant communities are all examples of this element of invasive species prevention.

Minimizing Disturbance of Desirable Vegetation

Areas where native or desirable vegetation have been disturbed provides opportunities for invasive species to establish. Many invasives are extremely good at colonizing disturbed sites and soils and thrive under conditions which often reduce the viability of native plant communities. Development plans which minimize the amount of disturbance to desirable vegetation, development of low-mow or no-mow plant communities in utility corridors and along public rights-of-way, and protection of delicate habitats such as wetland boundaries are all examples of this element of invasive species prevention.

Mulching, Revegetation, or Treating Areas of Bare Soil

As mentioned in above, many invasive plant species are well adapted to poor, disturbed, and bare soils and can easily establish in areas which native vegetation struggles in. Planning in advance of soil disturbances to mulch, revegetate, or otherwise treat bare soils can reduce the chances of invasive species establishing after disturbance.

Periodically Evaluating the Effectiveness of Prevention Efforts

No single technique will be completely effective at preventing the establishment of invasive species within Glenville. The methods which work best will be dependent on local factors including land use, citizen involvement, which invasive species are present, and many more environmental and social factors. To be effective in preventing invasive species infestations, Glenville should periodically assess and evaluate the effectiveness of prior invasive species prevention efforts and base future efforts on new information gleaned from these assessments as well as new developments within the scientific community.

MONITOR INVASIVE SPECIES PROGRESS

Proper monitoring requires a structured inventory program. Glenville should expand their volunteer programs to increase the number of observers in the field to identify and report species of concern. Larger and more frequent volunteer groups will enhance knowledge on the distribution of existing species across the town. Protocols should be clearly established and shared with volunteer groups to ensure the highest possible quality of data collection. Through continued surveys, invasive species managers will be able to detect pockets of invasive species and plan their management strategies accordingly. Any removal or containment efforts should be appropriately recorded. Managers should re-visit site on a yearly basis to monitor the progress of the containment or eradication efforts.

GOALS, TIMEFRAMES, AND ACTION ITEMS

Ultimately, the choice of management strategies and methods for any given invasive species infestation will have to be determined based on analysis of the invasive species in question, the location of the infestation, the harm the invasive species may do versus the harm management may do, and the resources available for management, among others. There is no one-size-fits-all solution to invasive species management. However, the goals and action items listed in the following table will help erect a framework for invasive species management in Grand Island.

Table 14. Goals, Timeframes, and Action Items for Invasive Species Management

Goal	Timeframe	Action Items
Remain up to date on invasive species threats	ongoing	Routinely check WNY PRISM, NYS DEC, and USDA for invasive species of concern
		Attend professional conferences (e.g.,. ISA) and talks on invasive species and management
		Provide information to town staff
Identify sources of funding	1-3 years	Set aside annual budget funds for invasive species management (ISM)
		Apply for grants through DEC, if needed
Connect with important partners	1-3 years	Educate town boards on ISM
		Reach out to local groups such as "Friends of…" for help with monitoring
		Establish contacts within organizations like the DEC or WNY PRISM
Develop an early detection and monitoring program	1-3 years	Educate town staff on invasive species of concern
		Look for invasive threats during routine park and ROW management
		Establish volunteer monitoring group
		Educate local groups and clubs on invasive species of concern
		Solicit citizen help through pest alerts
		Establish method for citizens to report potential invasive species sightings
Manage current infestations	ongoing	Use WNY PRISM information to locate infestations
		Assess the need for management
		Apply appropriate management methods for infestation type, size, and location
		Assess prior management effectiveness
		Revise future plans based on prior success or failure
Manage EAB infestation	ongoing	Remove dead and dying ash trees as needed
		Treat high-value ash trees on public property to prevent EAB
		Identify and treat specimen woodland ash trees to provide seed bank for ash regeneration
		Replant new nonhost trees to compensate for ash tree losses

Goal	Timeframe	Action Items
Prepare for future invasive threats	ongoing	Remain up to date on local invasive species threats
		Prepare rapid response plans for invasive species of concern
		Monitor for new infestations
		Deploy rapid response plans as needed to manage new infestations
Educate citizens about invasive species	ongoing	Use town websites to post pest alerts
		Provide education opportunities associated with Arbor Day
		Table or provide pamphlets at Welcome Center
Reduce opportunities for invasive establishment	ongoing	Develop and enforce a do-not-plant list
		Increase tree species and genus diversity
		Minimize soil disturbances during construction
		Plan to plant, mulch, or otherwise restore areas disturbed during construction
		Develop ordinances to minimize soil disturbance and restore disturbed areas due to construction
		Educate citizens on invasive species threats and how invasive species move
		Post signage at major boat put-in/take-out points to remind boaters to check for invasive species
		Alert citizens to invasive species reporting methods, such as the iMapInvasives tool

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CONCLUSION

When properly maintained, the valuable benefits trees provide over their lifetime far exceed the time and money invested in planting, pruning, and inevitably removing them. The 6,615 public trees inventoried provide $19,806 in estimated annual economic value, which is almost 33% of the town 's annual tree maintenance budget of roughly $60,000. Successfully implementing the five-year program may increase Glenville 's ROI over time, or at least maintain it over the years.

The program is ambitious and is a challenge to complete in five years but becomes easier after all high priority tree maintenance is completed. This *Standard Inventory Analysis and Management Plan* could potentially help the town advocate for an increased urban forestry budget to fund the recommended maintenance activities. Getting started is the most difficult part because of the expensive maintenance in the first year, which represents the transition from reactive maintenance to proactive maintenance. Significant investment early on can reduce tree maintenance costs over time.

As the urban forest grows, the benefits enjoyed by the Town of Glenville and its residents will increase as well. Inventoried trees are only a fraction of the total trees in Glenville when including private property, which is why it is important to also incentivize private landowners to care for their trees and to plant new ones. The town's urban forestry program is well on its way to creating a sustainable and resilient public tree resource, and can stay on track by setting goals, updating inventory data to check progress, and setting more ambitious goals once they are reached.

EVALUATING AND UPDATING THIS PLAN

This *Standard Inventory Analysis and Management Plan* provides management priorities for the next five years, and it is important to update the tree inventory using TreeKeeper® as work is completed, so the software can provide updated species distribution and benefit estimates. This empowers Glenville to self-assess the town's progress over time and set goals to strive toward by following the adaptive management cycle. Below are some ways of implementing the steps of this cycle:

- Prepare planting plans well enough in advance to schedule and complete stump removal in the designated area, and to select species best suited to the available sites.
- Annually comparing the number of trees planted to the number of trees removed and the number of vacant planting sites remaining, then adjusting future planting plans accordingly.
- Annually comparing the species distribution of the inventoried tree resource with the previous year after completing planting plans to monitor recommended changes in abundance.
- Schedule and assign high-priority tree work so it can be completed as soon as possible instead of reactively addressing new lower priority work requests as they are received.
- Include data collection such as measuring DBH and assessing condition into standard procedure for tree work and routine inspections, so changes over time can be monitored.

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APPENDIX A
DATA COLLECTION AND SITE LOCATION METHODS

DATA COLLECTION METHODS

DRG collects tree inventory data using their proprietary GIS software, called Rover, loaded onto pen-based field computers. At each site, the following data fields were collected:

- Address
- Comments
- Condition
- Date of Inventory
- Risk Assessment Complete
- Primary Maintenance Recommendation
- Multi-stem Tree
- Defect
- Park Name
- Relative Location
- Size*
- Overhead Utilities
- Risk Rating
- Further Inspection
- X and Y Coordinates

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

The knowledge, experience, and professional judgment of DRG's arborists ensure the high quality of inventory data.

SITE LOCATION METHODS

Data Source	Data Year	Projection
Shapefile Avineon, Inc.	2020	NAD 1983 2011 StatePlane Michigan Central, International Feet
Aerial Imagery Avineon, Inc.	2016	NAD 1983 2011 StatePlane Michigan Central, International Feet

Data Source	Data Year	Projection
Shapefile Avineon, Inc.	2020	NAD 1983 2011 StatePlane Michigan Central, International Feet
Aerial Imagery Avineon, Inc.	2016	NAD 1983 2011 StatePlane Michigan Central, International Feet

Equipment and Base Maps

Inventory arborists use FZ-G1 Panasonic Toughpad® units with internal GPS receivers. Geographic information system (GIS) map layers are loaded onto these units to help locate sites

during the inventory. This table lists these base map layers, along with each layer's source and format information.

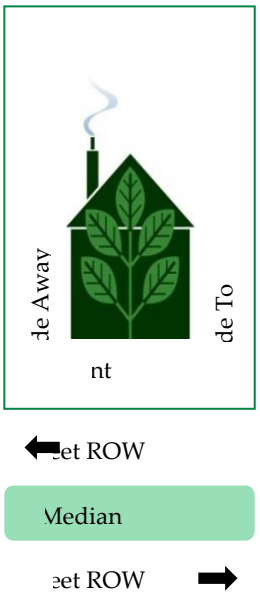
STREET ROW SITE LOCATION

Individual street ROW sites were located using a methodology that identifies sites by *address number*, *street name*, *side*, and *on street*. This methodology was used to help ensure consistent assignment of location.

Address Number and Street Name

Where there was no GIS parcel addressing data available for sites located adjacent to a vacant lot, or adjacent to an occupied lot without a posted address number, the arborist used their best judgment to assign an address number based on nearby addresses. An "X" was then added to the number in the database to indicate that it was assigned, for example, "37X Choice Avenue."

Sites in medians were assigned an address number by the arborist in Rover using parcel and streets geographical data. Each segment was numbered with an assigned address that was interpolated from addresses facing that median and addressed on that same street as the median. If there were multiple medians between cross streets, each segment was assigned its own address. The *street name* assigned to a site was determined by street centerline information.



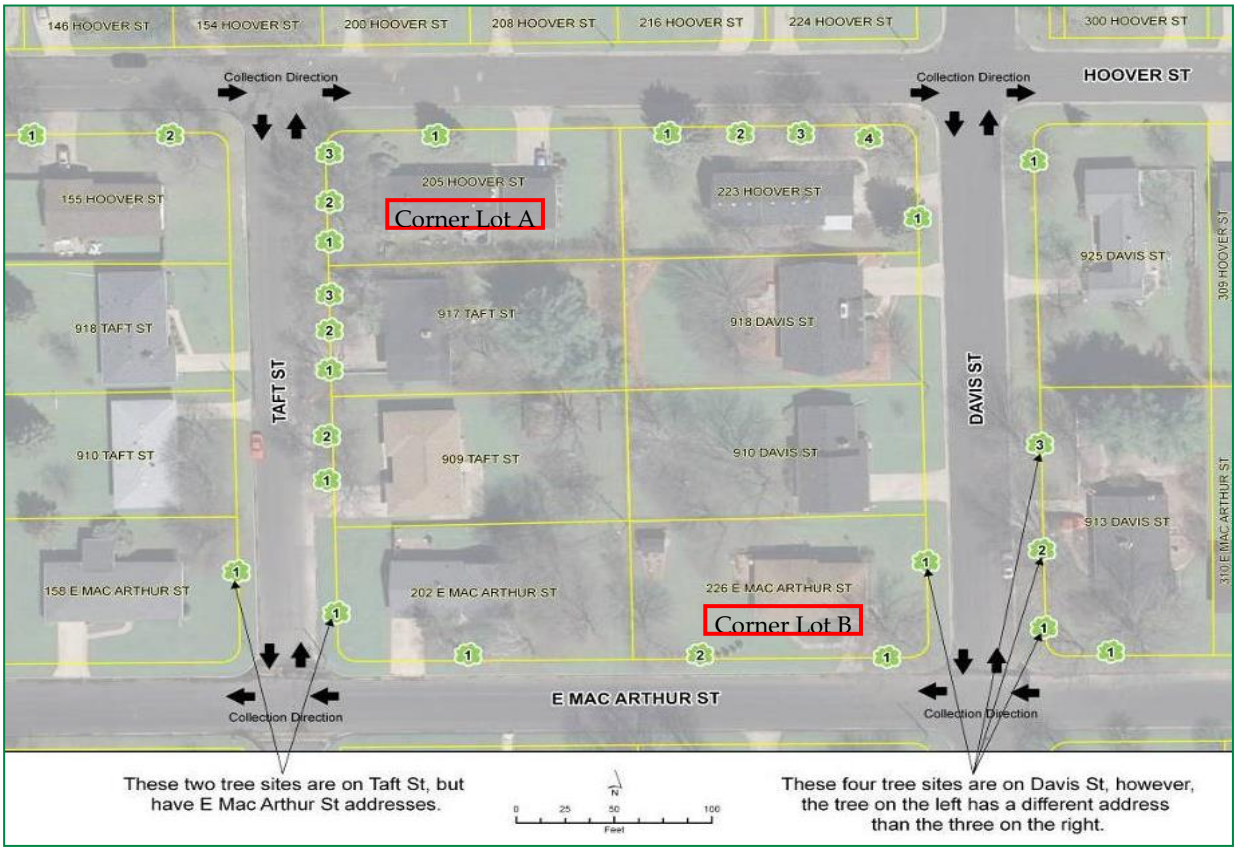
Side Value

Each site was assigned a *side value*, including *front*, *side*, *median*, or *rear* based on the site's location in relation to the lot's street frontage. The *front* is the side facing the address street. *Side* is either side of the lot that is between the front and rear. *Median* indicates a median or island surrounded by pavement. The *rear* is the side of the lot opposite of the address street.

PARK AND PUBLIC SPACE SITE LOCATION

Park and/or public space site locations were collected using the same methodology as street ROW sites; however, nearly all of them have the "Assigned Address" field set to 'X' and have the "Park Name" data field filled.

Site Location Example



Corner Lot A

Address/Street Name:	205 Hoover St.
Side:	Side
On Street:	Taft St.
Address/Street Name:	205 Hoover St.
Side:	Side
On Street:	Taft St.
Address/Street Name:	205 Hoover St.
Side:	Side
On Street:	Taft St.
Address/Street Name:	205 Hoover St.
Side:	Front
On Street:	Hoover St.

Corner Lot B

Address/Street Name:	226 E Mac Arthur St.
Side:	Side
On Street:	Davis St.
Address/Street Name:	226 E Mac Arthur St.
Side:	Front
On Street:	E Mac Arthur St.
Address/Street Name:	226 E Mac Arthur St.
Side:	Front
On Street:	E Mac Arthur St.

APPENDIX B
SUGGESTED TREE SPECIES FOR ZONE 5B

Small Trees 15 ft. – 30 ft.

Genus Species	Common Name	Crown Shape	Shade	Part Sun	Full Sun	Drought Tolerance
Amelanchier arborea	Common serviceberry	Upright, Vase		x	x	moderate
Amelanchier canadensis	Canadian serviceberry	Upright, Vase		x	x	moderate
Cercis canadensis	eastern redbud	Round, Vase		x	x	high
Cornus alternifolia	pagoda dogwood	round		x	x	moderate
Cornus kousa	Kousa dogwood	Round		x	x	moderate
Cornus mas	cornelian cherry dogwood	Round		x	x	moderate
Crataegus viridis	green hawthorn	Round, Vase			x	high
Maackia amurensis	amur maackia	Round, Vase			x	high
*Magnolia × soulangiana**	saucer magnolia	Round, Upright		x	x	moderate
*Magnolia stellata**	star magnolia	oval		x	x	moderate
*Magnolia tripetala**	umbrella magnolia	spreading	x	x	x	moderate
*Magnolia virginiana**	sweetbay magnolia	Columnar, Vase		x	x	moderate
Malus spp.	flowering crabapple	Oval, Spreading			x	moderate
Oxydendrum arboreum	sourwood	Oval, Pyramidal		x	x	moderate
Prunus subhirtella	Higan cherry	upright or weeping			x	moderate
Prunus virginiana	common chokecherry	Upright, Round		x	x	moderate
Stewartia ovata	mountain stewartia	spreading	x	x	x	low
*Styrax japonicus**	Japanese snowbell	round, vase		x	x	moderate
Ilex × attenuata	Foster's holly	upright, pyramidal		x	x	moderate

Medium Species 31 ft. - 45 ft.

Genus Species	Common Name	Crown Shape	Shade	Part Sun	Full Sun	Drought Tolerance
Aesculus × carnea	red horsechestnut	Round, Pyramidal			x	moderate
*Asimina triloba**	pawpaw	Pyramidal	x	x	x	high
Chamaecyparis thyoides	atlantic whitecedar	upright, columnnar		x	x	high
Cladrastis kentukea	American yellowwood	Round, Vase		x	x	moderate
Corylus colurna	Turkish filbert	Oval, Pyramidal		x	x	moderate
Eucommia ulmoides	hardy rubber tree	Upright, Narrow Oval			x	high
Ostrya virginiana	American hophornbeam	Oval, Round	x	x	x	low
Parrotia persica	Persian parrotia	Upright, Vase		x	x	high
Pistacia chinensis	Chinese pistache	Oval, Round, Spreading, Vase		x	x	high
Prunus maackii	amur chokecherry	Pyramidal	, round	x	x	moderate
Prunus sargentii	Sargent cherry	Columnar, Upright, Vase			x	high
Quercus acutissima	sawtooth oak	Round, Pyramidal			x	high
Quercus cerris	European turkey oak	Round, Pyramidal		x	x	high
*Sassafras albidum**	sassafras	oval		x	x	moderate
Juniperus virginiana	eastern redcedar	Pyramidal		x	x	high
Pinus flexilis	limber pine	Upright, Pyramidal		x	x	high
Thuja occidentalis	eastern arborvitae	Pyramidal	x	x	x	moderate

Large Species: 45 ft and above

Genus Species	Common Name	Crown Shape	Shade	Part Sun	Full Sun	Drought Tolerance
× *Cupressocyparis leylandii*	Leyland cypress	pyramidal		x	x	high
Abies balsamea	balsam fir	pyramidal		x	x	low
Abies concolor	white fir	pyramidal		x	x	high
Aesculus flava	yellow buckeye	upright		x	x	moderate
Betula alleghaniensis	yellow birch	upright, spreading		x	x	moderate
Betula lenta	sweet birch	pyramidal		x	x	moderate
Betula nigra	river birch	Oval, Pyramidal, Upright		x	x	moderate
Betula papyrifera	paper birch	upright, spreading			x	low
Carpinus betulus	European hornbeam	Columnar, Pyramidal, Upright		x	x	high
Carya cordiformis	bitternut hickory	upright			x	high
Carya ovata	shagbark hickory	upright		x	x	high
Castanea mollissima	Chinese chestnut	round		x	x	high
Celtis occidentalis	common hackberry	Oval, Upright		x	x	high
Cercidiphyllum japonicum	katsuratree	Oval, Spreading, Pyramidal, Upright		x	x	moderate
Chamaecyparis nootkatensis	Nootka falsecypress	Pyramidal		x	x	moderate
Cryptomeria japonica	Japanese cryptomeria	Pyramidal			x	high
Diospyros virginiana	common persimmon	spreading		x	x	high
Fagus grandifolia	American beech	Oval, Pyramidal	x	x	x	moderate
Fagus sylvatica	European beech	Upright, Oval		x	x	moderate
Ginkgo biloba	ginkgo	Round, Pyramidal		x	x	high
Gleditsia triacanthos inermis	thornless honeylocust	vase		x	x	high
Gymnocladus dioicus	Kentucky coffeetree	oval		x	x	high
Ilex opaca	American holly	Pyramidal	x	x	x	high

Genus Species	Common Name	Crown Shape	Shade	Part Sun	Full Sun	Drought Tolerance
Juglans nigra	black walnut	round			x	low
Larix decidua	European larch	round			x	high
Liquidambar styraciflua	American sweetgum	oval, pyramidal		x	x	moderate
Liriodendron tulipifera	tuliptree	Oval, Upright		x	x	moderate
Magnolia acuminata	cucumbertree magnolia	pyramidal		x	x	moderate
Magnolia macrophylla	bigleaf magnolia	oval		x	x	low
Metasequoia glyptostroboides	dawn redwood	pyramidal		x	x	moderate
Nyssa sylvatica	black tupelo	Oval, Pyramidal		x	x	high
Pinus strobus	eastern white pine	Oval, Pyramidal		x	x	moderate
Pinus sylvestris	Scotch pine	Oval			x	high
Pinus taeda	loblolly pine	oval		x	x	high
Pinus virginiana	Virginia pine	round			x	high
Platanus × acerifolia	London planetree	Round, Spreading, Pyramidal			x	high
Platanus occidentalis	American sycamore	oval			x	high
Psedotsuga menziesii	Douglas-fir	upright pyramidal		x	x	high
Quercus alba	white oak	Round, Pyramidal		x	x	moderate
Quercus bicolor	swamp white oak	Oval, Round		x	x	moderate
Quercus coccinea	scarlet oak	Round			x	moderate
Quercus imbricaria	shingle oak	Oval, Round, Pyramidal			x	high
Quercus lyrata	overcup oak	Oval, Round		x	x	moderate
Quercus macrocarpa	bur oak	Round, Spreading			x	high
Quercus montana	chestnut oak	oval			x	high
Quercus muehlenbergii	chinkapin oak	Round, Spreading			x	high
Quercus palustris	pin oak	Pyramidal			x	moderate
Quercus phellos	willow oak	Round, Pyramidal			x	high

Genus Species	Common Name	Crown Shape	Shade	Part Sun	Full Sun	Drought Tolerance
Quercus robur	English oak	Columnar, Upright			x	high
Quercus rubra	northern red oak	Round			x	high
Quercus shumardii	Shumard oak	Oval, Round			x	high
Styphnolobium japonicum	Japanese pagodatree	Round			x	high
Taxodium distichum	common baldcypress	Upright, Columnar			x	high
Tilia americana	American linden	Oval, Pyramidal		x	x	moderate
Tilia cordata	littleleaf linden	Pyramidal			x	moderate
Tilia tomentosa	silver linden	Oval, Pyramidal		x	x	moderate
Tsuga canadensis	eastern hemlock	upright pyramidal	x	x	x	low
Ulmus parvifolia	Chinese elm	Vase			x	moderate

APPENDIX C
STORM RESPONSE CATEGORIES FOR THE URBAN FOREST

STORM EMERGENCY CATEGORIES IN THE URBAN FOREST

Storm severity and resulting damage in the urban forest will vary; the degrees of response and resources needed to respond will vary as well. For planning purposes, severe weather can generally be classified into three classes: Class I, II, and III. The following descriptions of these classes and the responses are offered for town consideration and adoption as part of an official emergency response plan.

Class I – Minor Storm Event

Class I storms are those that are moderate in severity municipality-wide and/or those which are more severe, but damage is restricted to very few locations or a small geographic area.

Damage reports and service requests are made to the government department directly by citizens and from staff inspections. Damage is corrected, and debris is disposed of by municipal staff and contractors on site or following customary procedures.

Generally, Class I storms require no outside assistance for parks or streets personnel, and only limited (if any) assistance from contractors or others. Storm damage remediation and clean-up are achieved by municipal staff and/or contractors, require no additional funding or special equipment, and are completed quickly.

Class I – Storm Mitigation Procedures

- Municipal urban forestry staff receive calls/reports from citizens and partnering agencies.
- Municipal urban forestry staff inspect and determine appropriate mitigation; utility companies are called as required.
- Municipal urban forestry staff and/or contractors immediately resolve damage and dispose of debris.
- Municipal urban forestry staff perform a final inspection, complete a work order, and/or otherwise note the occurrence in the tree inventory database.

Class II – Large Storm Event

Class II storms are those that are long in duration or are severe enough to cause widespread damage. Damage mitigation may also include trees on private property that fall into or threaten the public ROW or other property. Mitigation priority areas will be major roads, public health and services facilities, and areas or sites where public safety is at risk.

Class II storms exceed the normal staff and resources of the municipality and/or contractors alone. Damage mitigation for these storms will usually require the assistance of outside contractors and from other government departments. The assistance will come in the forms of additional staff and equipment, communication assistance, public safety measures, electrical hazard reduction, and customer service.

Class II Storm Mitigation Procedures

- Municipal urban forestry staff assess damage and immediately communicate with police and fire to determine the extent of the damage.
- The informal Emergency Operations Center should be convened to receive calls/reports and to coordinate mitigation response.
- Municipal urban forestry staff inspect damage, determine mitigation levels and needs, and set work priorities.
- Municipal urban forestry staff designate personnel and equipment resources under the guidance of the EOC leader.
- Municipal urban forestry staff and contractual staff resolve damage, process debris on site where appropriate, or transport debris to storage sites.
- Municipal urban forestry staff will make the final inspection and update the tree inventory database.
- Debris is processed appropriately.
- Municipal urban forestry staff should communicate with the citizens about its response activities and status using the town's website and social media platforms.

Class III – Catastrophic Storm Event

Class III storms will be rare but can occur. Generally, these will result from hurricanes or snowstorms and widespread ice storms. Damage will be severe and widespread on both public and private property.

A "State of Emergency" will likely be called during and after a Class III storm event. A full EOC should be convened by municipality officials. Other local, state, and federal emergency management agencies will become involved, as well as the Department of Transportation and natural gas and electric utility providers. It will become necessary to identify municipal funding that can be used to finance additional contractual services, equipment, and staff overtime for the mitigation efforts.

Mitigation priorities will be first determined by public safety, health, and welfare needs. Primary streets and highways that provide for evacuation and/or access to hospitals, shelters, police, fire and rescue stations, and other facilities providing vital public services should be the first priorities when clearing roads.

The second priority of streets and highways to be cleared of debris are those that provide access to components of the public and private utility systems that are vital to the restoration of essential utility services, such as electrical power stations and substations, municipal water and sanitary sewer pumping stations, and communication stations and towers. The last priority of roadways to be cleared are residential streets and alleys/access ways.

No debris is intended to be removed during the initial emergency road-clearing operations. Rather, debris is to be moved to the side of the roadway that will allow for a minimum of one lane of traffic in each direction and not create conflict with future utility restoration efforts by others.

Class III - Storm Mitigation Procedures

- Municipal urban forestry staff assess damage and immediately communicate with the EOC and the designated municipal staff leader to determine the extent of the damage. County and State Emergency Management agencies may also be in the communication channels.
- Municipal urban forestry staff secure an additional regional tree debris disposal site(s) as needed.
- Municipal urban forestry staff inspect tree related damage, determine mitigation levels and needs, and set work priorities.
- Municipal, county, DOT, and other agencies combine sufficient and appropriate personnel and equipment resources under the guidance of the municipality to mitigate tree related situations.
- Municipality, allied agencies, and contractual staff resolve damage, process debris on site where appropriate, or transport debris to a storage site.
- Municipal urban forestry staff make a final inspection and update the tree inventory database.
- Debris is processed appropriately.
- Municipal urban forestry staff assist EOC team members and municipal leaders with completion of required state and Federal Emergency Management Agency (FEMA) forms.
- Municipal urban forestry staff should communicate with citizens about its response activities and status and provide advice for the treatment of private trees that have been damaged using the municipal website and social media platforms.