December 2023

COMMUNITY FOREST MANAGEMENT PLAN
Long Branch, NJ

Prepared for:

City of Long Branch, NJ
344 Broadway
Long Branch, New Jersey 07740

Prepared by:

Davey Resource Group, Inc.
295 S. Water Street, Suite 300
Kent, Ohio 44240
800-828-8312

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ACKNOWLEDGMENTS

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

The Long Branch Environmental Commission/Green Team (LBEC/GT) are thankful for the grant funding it received from the New Jersey State Department of Environmental Protection (DEP) in cooperation with the 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.

The City of Long Branch would also like to recognize the support of the following people:

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Executive Summary

The City of Long Branch, NJ's *Community Forest 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 tree inventory for the City of Long Branch in May 2023 and analyzed the inventory data to understand the structure of the City of Long Branch's inventoried tree resource. The inventory encompassed most ROW trees located north of Cedar Avenue, Appendix D contains an illustrated map showcasing the inventoried sites. Park trees were not included in the assessment. 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. Moreover, DRG conducted a citywide Urban Tree Canopy (UTC) assessment to offer insights into the distribution of canopy cover in Long Branch, aiding in the prioritization of planting locations.

The 2023 tree inventory for the City of Long Branch encompassed 2,505 trees and vacant planting sites situated along the public right-of-way (ROW). The city houses 102 tree species, with the London planetree (*Platanus hybrida*) emerging as the most abundant, closely trailed by the northern white cedar (*Thuja occidentalis*). Notably, 52% of the tree population comprises young trees. Despite potential threats from invasive pests like spotted lanternfly, Asian longhorned beetle, and eastern tent caterpillar, a reassuring 87% of street trees were rated in Fair or better condition, signifying the current stability of the urban forest. An observable trend in the data is the gradual decrease in the number of trees in Good condition as they progress through maturity. This trend signals a potential opportunity for the city to implement a robust maintenance program to sustain and enhance the longevity of the ROW tree population.

The UTC assessment unveiled that Long Branch presently maintains a canopy cover of 17%, encompassing both private and public trees, with an estimated 29% of sites classified as vacant. The assessment highlights a potential threefold increase in Long Branch's tree canopy cover, identifying 1,011 acres for plantable expansion. To strategically initiate municipal tree planting efforts, the Priority Planting Analysis should be employed to pinpoint areas with a "High" or "Very High" priority planting rating. Beyond public tree planting, the city and its collaborators are encouraged to promote tree planting on private properties within business and residential districts.

The functions of the City of Long Branch's inventoried tree population provide benefits with an estimated total value of $15,270 annually. The functions of the City of Long Branch's inventoried tree population throughout its trees' lifetimes are worth an estimated $3,056,279. Supporting and funding proactive maintenance of the public tree resource is a sound long-term investment that will reduce tree management costs over time.

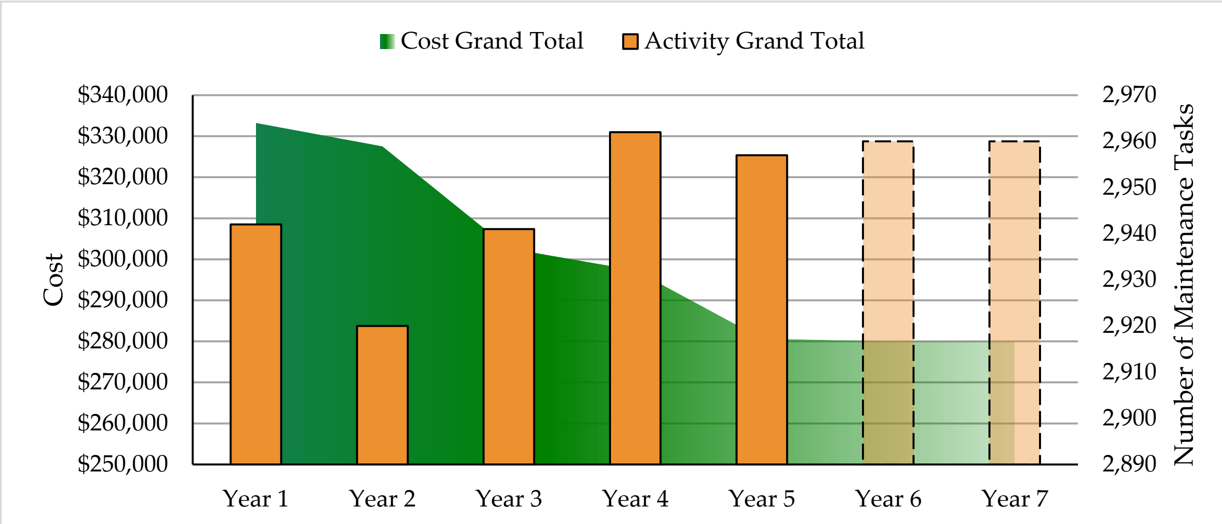


Figure 1. Recommended budget for street tree planting and maintenance, including pruning, removals, young tree training, and inspections.

Recommended Maintenance Types

Tree 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 = 221 trees

Extreme Priority = 1 tree
High Priority= 0 tree
Moderate Priority = 14 trees

Low Priority = 207 trees

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 = 28 trees

High Priority = 1 tree

Moderate Priority = 27 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 = 1,528 trees

Number in cycle each year = at least 305 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 = 78 trees

Number in cycle each year = at least 26 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 = 44 trees will change based on number of removals that year

Total new plantings per year = 223 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.

Number in Level 1 assessment cycle each year = near 1,864 trees

INTRODUCTION

Trees are an essential part of Long Branch's legacy and future. Recognizing their substantial impact, the city values trees for their roles in improving air quality, conserving energy, reducing noise, enhancing economic stability, and beautifying the community.

The City of Long Branch demonstrates its commitment to fostering a green urban environment through the implementation of a dedicated tree ordinance (Town Code, Chapter 319 and 345-47.3). This ordinance serves as a cornerstone for promoting and preserving the urban forest, ensuring the maintenance of municipal trees, and guiding strategic replanting initiatives to safeguard the environment. In 1998, recognizing the paramount importance of environmental stewardship, the city established the Long Branch Environmental Commission and Long Branch Green Team (LBGT). Entrusted with the responsibility of protecting, developing, and thoughtfully using the city's natural resources, the Environmental Commission and LBGT actively pursue a mission centered on creating a sustainable, healthy, safe, and productive natural environment for the residents of Long Branch.

The Environmental Commission and the LBGT are actively leveraging the insights provided by the Community Forest Management Plan (CFMP) to gain a comprehensive understanding of the spatial extent, structure, and composition of Long Branch’s urban forest. Recognizing the social and ecological significance of this urban greenery to the residents, the Commission's dedicated care for the city's trees stands as a linchpin for the community's well-being. The CFMP's findings and recommendations play a pivotal role in fostering a deeper comprehension of Long Branch’s forest resources. This, in turn, guides strategic planning, fuels advocacy efforts for securing funding, and supports the Commission and its collaborators in the ongoing task of expanding and sustaining a resilient public forest.

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.

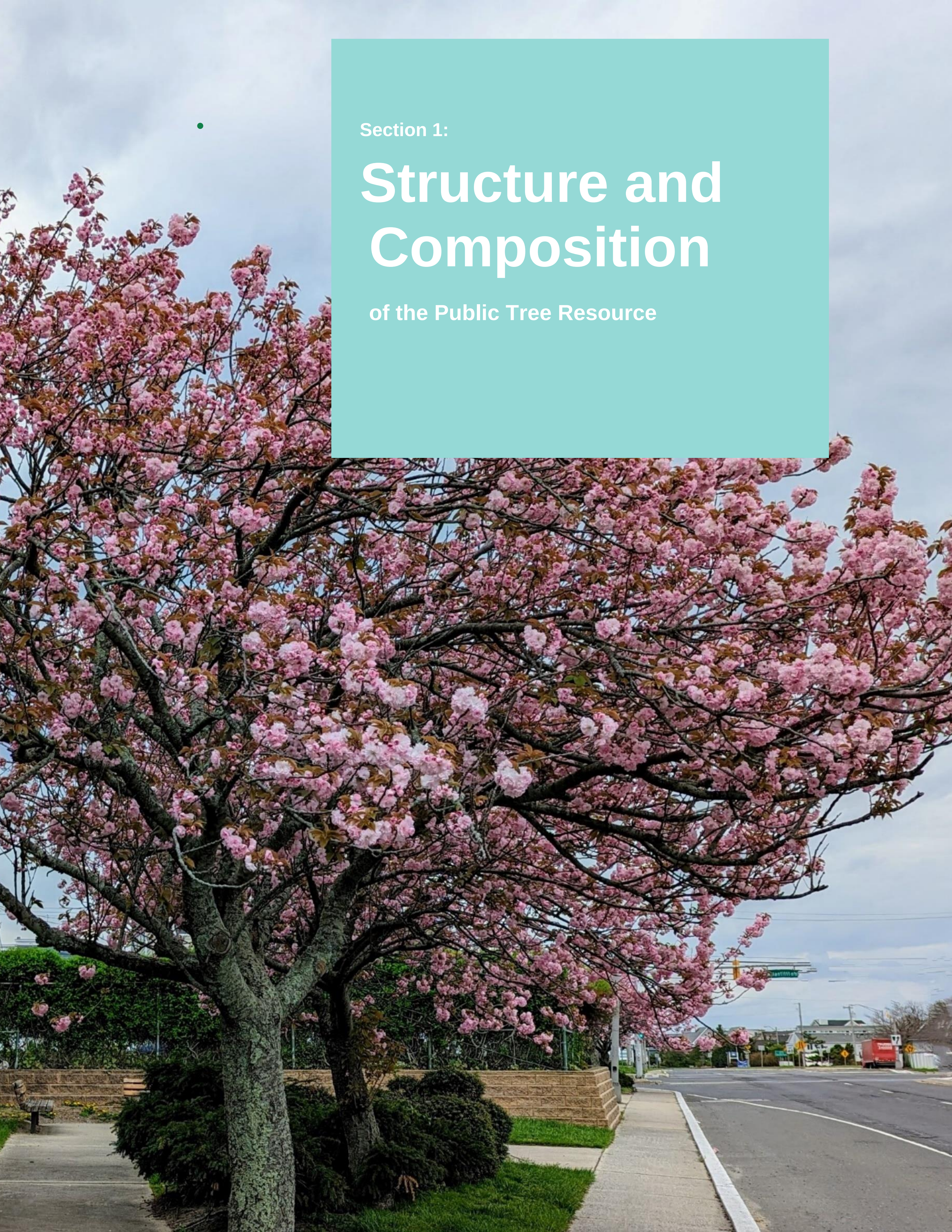
In August 2023, the LBGT worked with DRG to inventory its public trees and develop this management plan. Consisting of four sections, this plan considers the diversity, distribution, and condition of the inventoried tree population and provides a prioritized system for managing the city's tree resource.

- *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* will inform and advise tree managers and other stakeholders on the overall capacity for new trees where tree canopy should be expanded, species diversity measures improved, and the best planting techniques utilized.

Section 1:

Structure and Composition

of the Public Tree Resource



SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In August 2023, DRG arborists collected site data on trees and planting sites in the City of Long Branch for a tree inventory contracted by the LBGT. A total of 2,505 sites were inventoried along the street ROW in Long Branch, NJ. It is important to note, not all ROW trees within Long Branch were included in the collection process due to budget constraints. DRG successfully gathered the majority of trees situated north of Cedar Avenue, Appendix D contains an illustrated map showcasing the inventoried sites. Figure 2 breaks down the total sites inventoried by location and type. See Appendix A for details about DRG's methodology for collecting site data.

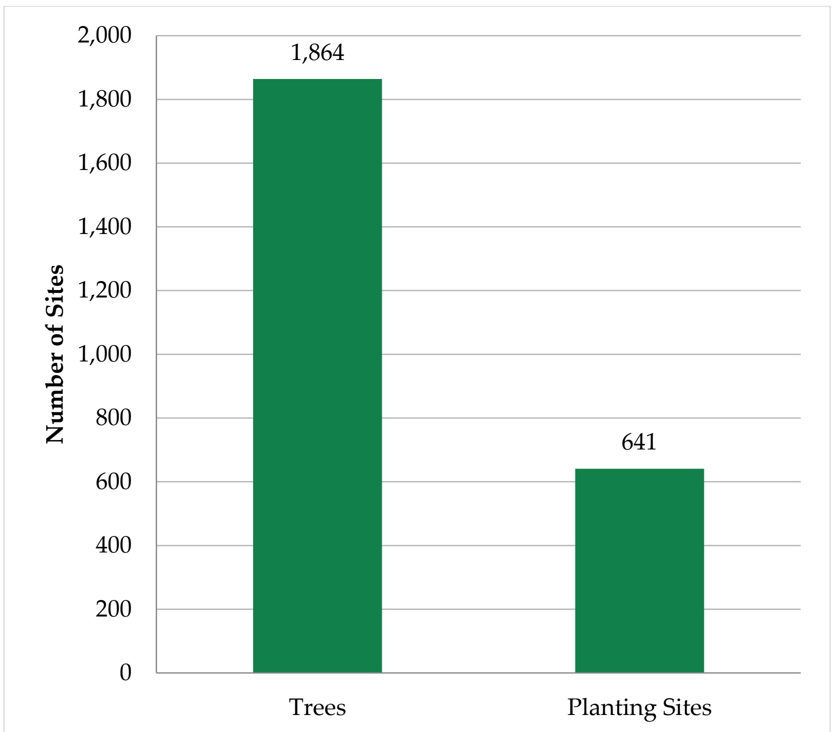


Figure 2. Number of inventoried sites by type.

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). This standard was developed partially in response to tragedies such as the demise of vast swaths of American elm (*Ulmus americana*) after the introduction of Dutch elm disease to the United States (see side panel, "Resilience Through Diversity"). It provides a valuable guideline to help protect urban forests from both pests and diseases as well as from the effects of extreme weather events and climate change.

Figures 3 shows the City of Long Branch's distribution of the most abundant tree species inventoried along the street ROW compared to the 10% threshold. London planetree (*Platanus hybrida)* is the most abundant tree species inventoried in the ROW, comprising 13% of the inventoried ROW trees, followed by northern white cedar (*Thuja occidentalis*) at 8%, and Tree of Heaven (*Ailanthus altissima)* at 7%.

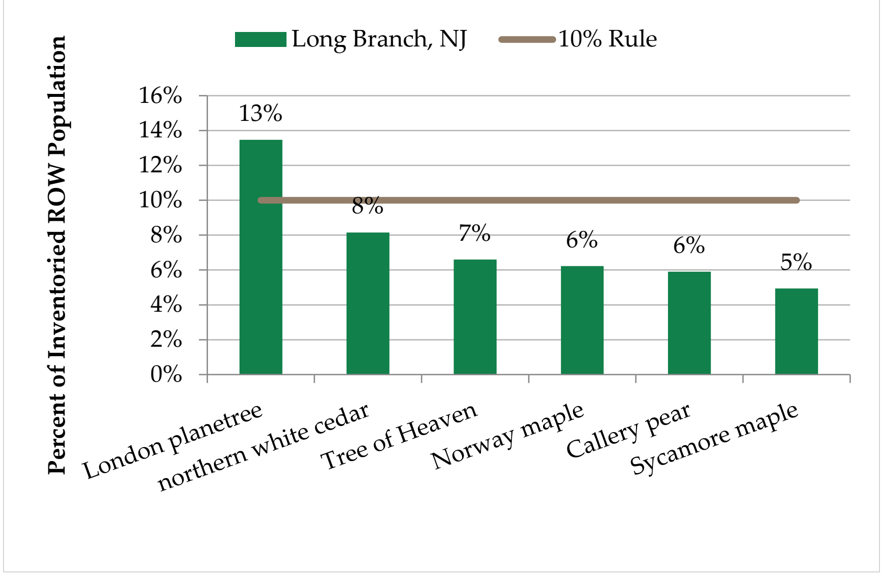


Figure 3. Species distribution of inventoried ROW trees.

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 Midwestern and Northeastern 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 Midwest. Other invasive pests spreading across the country threaten urban forests, so it's vital that we learn from history and plant a wider variety of tree genera to develop a resilient public tree resource.

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

Figures 4 show the City of Long Branch's distribution of the most abundant tree genera inventoried along the street ROW. The most abundant genera ROW trees is maple (*Acer)*, comprising 21% of the ROW tree population. All other genera fall below the 20% threshold.

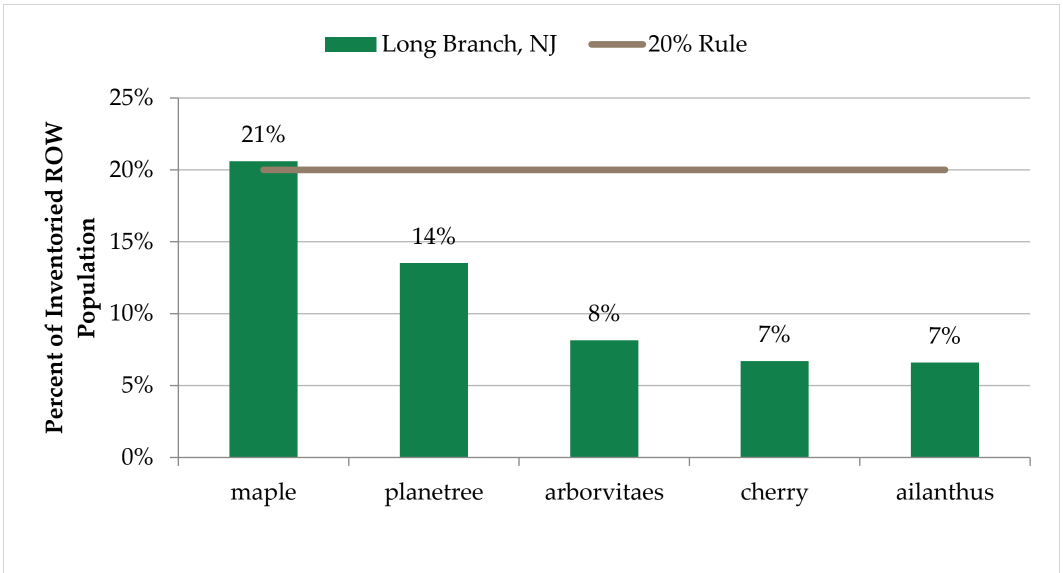


Figure 4. Genus distribution of inventoried park trees.

Figure 5 shows the City of Long Branch's distribution of the most abundant tree families inventoried in the street ROW compared to the 30% threshold. The most abundant family is *Sapindaceae*. All tree families fall below the 30% threshold.

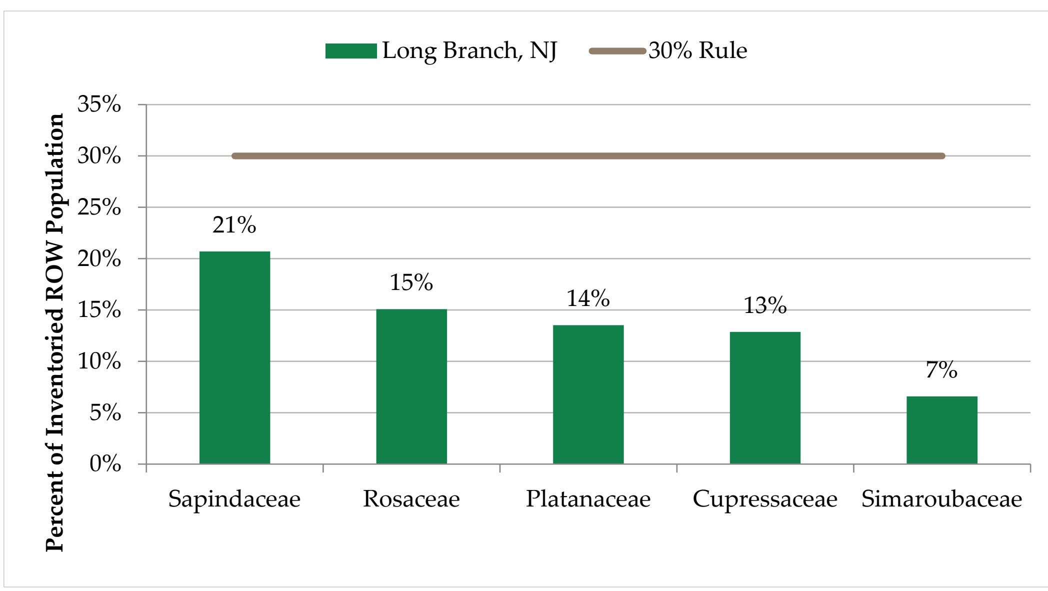


Figure 5. Family distribution of inventoried ROW trees.

Species, Genus, and Family Distribution Recommendations

The species, genus, and family distribution of an urban tree population can be a useful metric for gauging the ability of the urban forest to resist disruption by pests, diseases, extreme weather, and climate change, as well as the forest's resilience or ability to recover from these disruptions (Ordóñez & Duinker 2014). For example, certain pests, like emerald ash borer (EAB, *Agrilus planipennis*), target a single genus (ash, *Fraxinus* spp.) as their host. Some pests also target a single family as their host, such as the bacterium *Erwinia amylovora*, commonly known as fireblight. Fireblight affects plants in the rose family (*Rosaceae*).

An urban forest with low species, genera, or family diversity is more likely to be damaged by pest, disease, weather, and climate disruptions due to the presence of large populations of highly susceptible trees. It is also likely to be less resilient, or less capable, of recovering from such disturbances. Cultivating diversity on the species, genus, and family levels can help mitigate the effects of disturbances and ensure a thriving urban forest for generations to come.

The City of Long Branch's tree population has an overabundance of London planetree at the species level, and an overabundance of maple at the genus level. The City of Long Branch should aim to reduce or temporarily halt new plantings of London planetree and in the genus *Acer* along streets to help reduce the overabundance of these trees and reduce the risk of significant damage to the urban forest in the event of disturbances. It's noteworthy that four of the six common species are invasive in New Jersey. The city should prioritize native species in its planting efforts and provide a "do not plant" list for private tree planting.

PEST SUSCEPTIBILITY

Early diagnosis of disease and infestation is essential to ensure the health and continuity of the City of Long Branch's public tree resource.

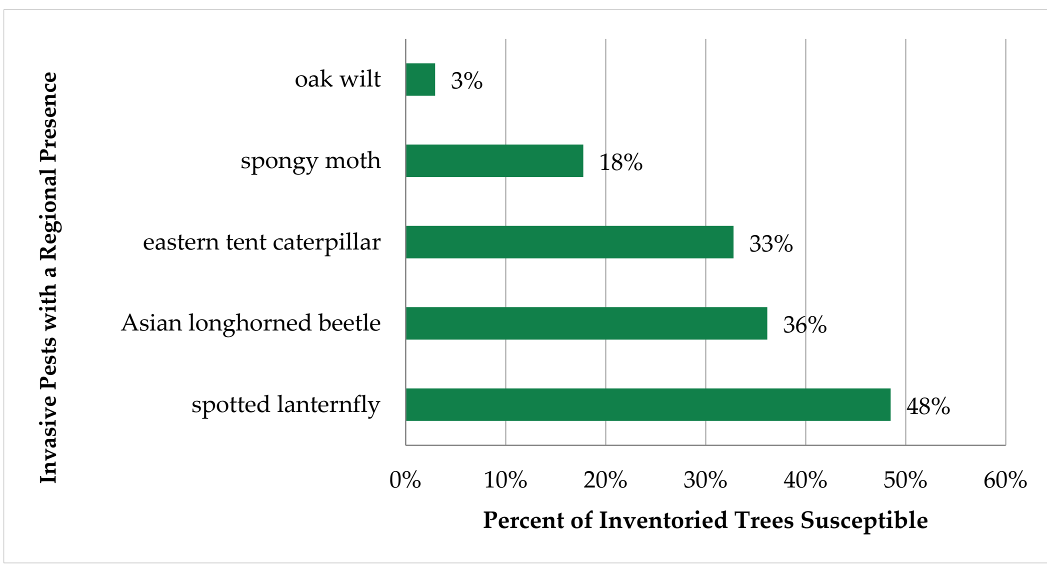


Figure 6. Tree resource susceptibility to invasive pests that have a regional presence.

Figure 6 shows the percentage of inventoried trees susceptible to some of the known pests in and around the state of New Jersey. While certain invasive species may not currently be present in the City of Long Branch, there is potential for infestation due to the pests' regional presence and rapid dispersal ability. Spotted lantern fly (SLF, *Lycorma delicatula*), eastern tent caterpillar (*Malacosoma americanum),* and Asian longhorned beetle (*Anoplophora glabripennis)* are known threats to a large percentage of the inventoried tree resource.

Pest Susceptibility Recommendations

Overabundance of individual tree species, genera, and families can reduce an urban forest's resistance and resilience to disruptions caused by insect pests, diseases, extreme weather events, and climate change (Safford et al. 2013). Due to the large population of trees susceptible to invasive species, such as those listed above, the City of Long Branch should continuously monitor for signs and symptoms of pests or diseases. Diverse urban forests with a mix of tree species and age classes are less susceptible to pest and disease outbreaks. Introducing a variety of native and non-native, non-invasive tree species that are well adapted to the local environment can create a more resilient urban forest.

Community engagement and education are instrumental in the effort to minimize the impacts of pests and diseases in urban woodlots. Raising awareness among local residents and stakeholders about the importance of urban forest health and the role they can play in preventing the spread of pests and diseases is essential. (Pincetl et al. 2012). Community involvement can include volunteer tree monitoring programs, workshops on pest identification and prevention, and educational outreach campaigns. When the community is actively engaged in protecting urban forests, there is a higher likelihood of early detection and more sustainable management practices, contributing to the long-term preservation of these valuable urban forest resources

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.

As illustrated in Figure 7, a substantial majority of the inventoried trees exhibited eith er Good or Fair condition, with 87% of street right-of-way (ROW) trees falling into these categories. The City of Long Branch boasts a low percentage of Dead trees and those in Poor condition. Based on these data points, it is evident that the general health of the inventoried tree population is rated as Fair or better.

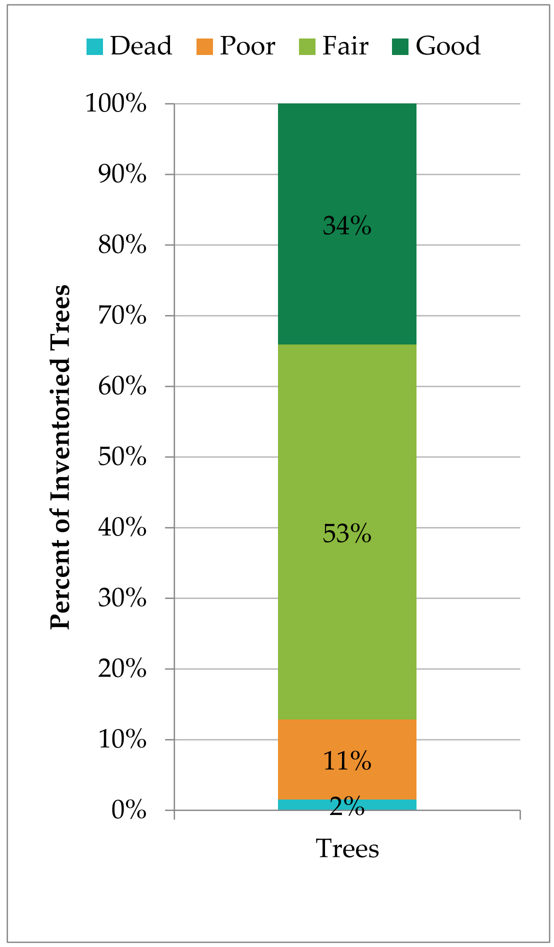


Figure 7. Condition of inventoried trees.

Condition Recommendations

The condition of individual trees plays a pivotal role in determining the overall health of an urban forest. Healthy trees are better equipped to resist pests, diseases, and environmental stresses, thus reducing the potential for widespread outbreaks or die-offs. They contribute to the structural integrity of the forest canopy, providing crucial habitat and forage opportunities for local wildlife. Additionally, healthy trees actively participate in critical ecosystem functions such as photosynthesis and carbon sequestration, which are essential for maintaining overall forest vitality. Conversely, the presence of diseased or stressed trees can weaken the forest's resilience, making it more susceptible to disturbances, diminishing its biodiversity, and compromising its capacity to provide ecological services, such as air and water purification. The condition of individual trees directly influences the health, diversity, and ecological functioning of the entire forest ecosystem.

While the assessment of tree condition is a valuable component in managing urban forests, it should not serve as the sole determinant for prioritizing maintenance efforts. Rather, a more comprehensive approach is recommended. In particular, the utilization of tools like TreeKeeper® can effectively guide the prioritization of actions, focusing on trees rated as having Poor condition or being in a Dead state, especially when these trees are associated with an Extreme, High, or Moderate Risk classification. Younger trees exhibiting a Fair or Poor condition rating could substantially benefit from structural pruning, aligning with the guidelines established by *ANSI A300* (Part 1). This approach aims to bolster their long-term health and vitality.

For mature trees that have garnered Poor condition ratings, their compromised state is often linked to visible indicators of decline and stress, which may manifest as decay, dead limbs, sparse branching, or structural deficiencies. In these cases, addressing their condition necessitates corrective pruning and intensive plant health care to rejuvenate their vigor. Continuous monitoring should be employed to track potential deterioration in their condition. As for trees falling into the Fair condition category, targeted pruning to eliminate dead or faulty limbs can foster improvement over time, ultimately elevating their overall condition with the proper care and attention.

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. Size is used as a proxy for age because of the difficulty of accurately and rapidly measuring tree age in the field. Since tree species have different lifespans and mature at different diameters, actual tree age cannot be determined from diameter size class alone, but size classifications can be extrapolated into relative age classes which can offer insight into the maintenance needs of the City of Long Branch'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).

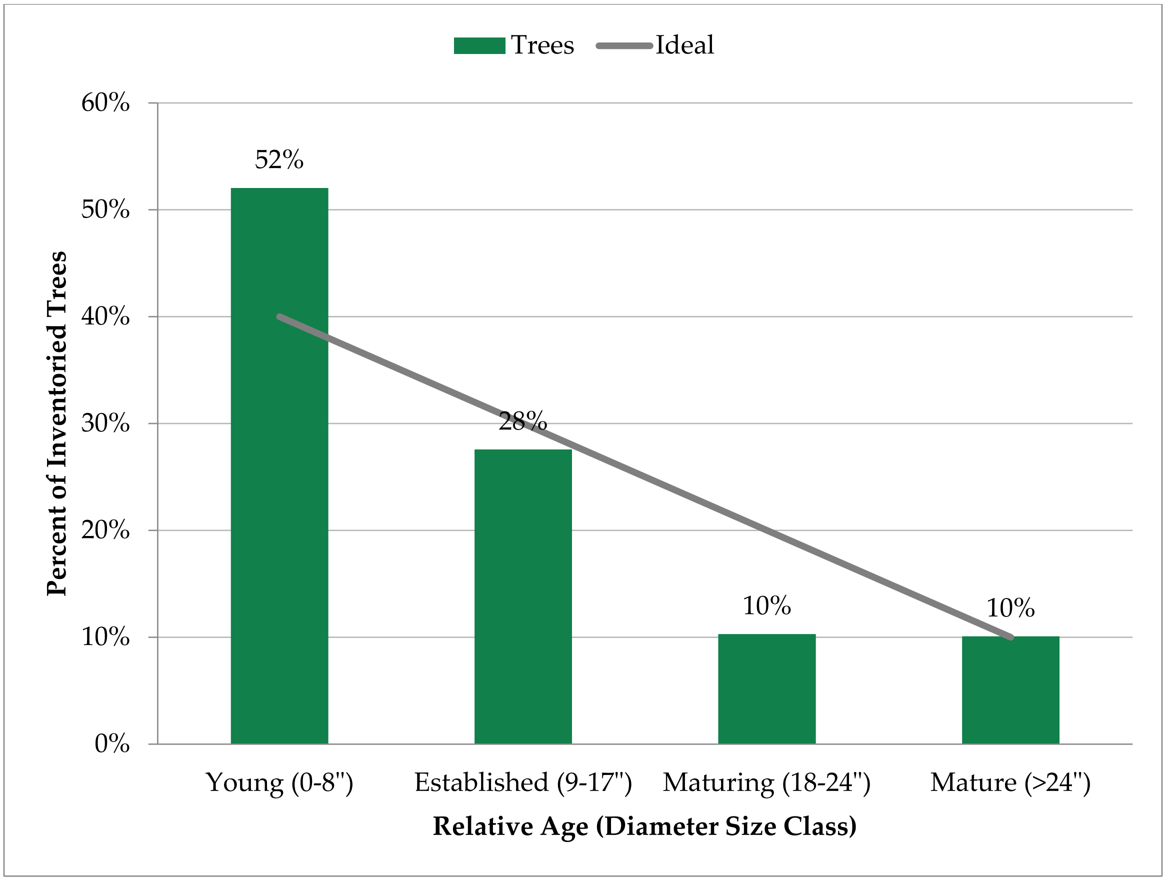


Figure 8. Relative age distribution of inventoried trees.

Figure 8 compares the City of Long Branch's relative age distribution of the inventoried tree population to the ideal. The "ideal" is used as a general guideline, as the relative proportions of each age class can be adjusted to align with the specific goals and constraints of the city. However, a balanced and diverse age structure is generally desirable in urban forests to promote both ecological health and community benefits.

The City of Long Branch's tree resource has a young relative age distribution with more than half, 52%, of the population in the young age class. The tree population is trending toward the ideal, with a large young tree population establishing to replace older trees as they approach senescence. The city's established (9-17") tree population constitutes 28% of the inventoried trees, approaching the ideal percentage of established trees. The established age group is a positive indicator of the future ecosystem services provided to the city, as large shade trees provide more shade, carbon sequestration, pollutant uptake, and rainfall interception than smaller trees. Maintaining an uneven age distribution will allow the city to allocate annual maintenance costs uniformly over many years and assures continuity in overall tree canopy coverage.

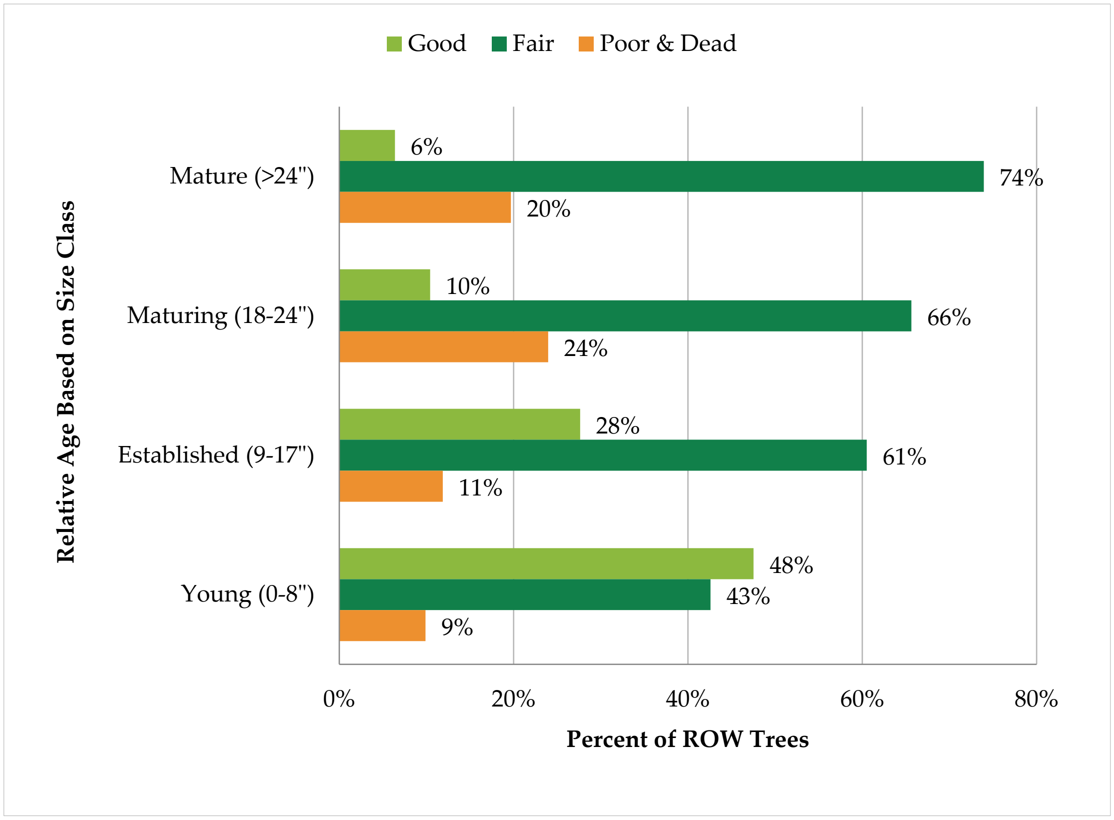


Figure 9. Condition of inventoried trees by relative age class.

Figure 9 offers a comprehensive analysis of the condition of Long Branch's inventoried tree resource in relation to its age distribution, shedding light on the overall stability of the tree resource. Notably, the data reveals that within the city, 80% of mature trees and 76% of maturing trees have received a rating of Fair condition or better. This observation holds significant relevance because these larger trees, due to their size and age, could potentially cause more significant damage in the event of structural failure. Equally noteworthy is that among the Young and Established trees, 91% and 89%, respectively, have received a Fair condition rating or better. The analysis suggests a positive trend in the establishment and survival of newly planted trees. With over 90% of Young trees in Fair condition or better, it indicates that a high proportion of recently planted trees are thriving in the urban environment. This positive survival rate and overall good condition of newly planted trees bode well for the future, as a significant portion of them is expected to grow into maturity.

This data underscores the city's responsibility to ensure the continued health and vitality of these trees as they mature and grow. The overall high percentage of trees in Fair condition or better across different age categories is a positive indicator of the urban forest's health. By providing the necessary maintenance and care, the city can effectively reduce the proportion of mature and maturing trees falling into the category of Poor condition or worse, safeguarding the urban forest's long-term resilience and minimizing potential risks associated with older, larger trees.

Relative Age Recommendations

A substantial portion of the Young and Established trees within the City of Long Branch currently boasts a Fair condition rating or better, signifying their potential for reaching full maturity if they receive adequate care and maintenance. However, it's worth noting that as these trees transition from the Young to the Established category, there is a decline in the number of trees rated as Good condition, implying the potential benefits of implementing focused maintenance efforts. In light of these findings, DRG strongly recommends the adoption of a robust maintenance program by the city, specifically designed to preserve the condition of young trees as they progress towards maturity. Such proactive measures can significantly reduce future tree care expenses and contribute to a healthier and more resilient urban forest.

Moreover, the city should prioritize tree preservation and proactive care strategies to safeguard mature and maturing trees against unnecessary removal and to prevent them from succumbing to treatable defects. By emphasizing tree planting initiatives, the city can gradually shift its relative age distribution closer to the ideal, promoting a more balanced and sustainable urban forest ecosystem over time. This holistic approach to tree management will not only enhance the longevity and health of individual trees but also fortify the overall resilience of Long Branch's urban forest.

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.
- None.

Table 1. Tree defect categories recorded during the inventory

Defect	Street Trees	Percent of Street Trees
Broken and/or Hanging Branches	30	2%
Cracks	4	0%
Dead and Dying Parts	482	26%
Missing or Decayed Wood	179	10%
None	635	34%
Other	7	0%
Root Problems	12	1%

Tree Architecture	308	17%
Weakly Attached Branches and Codominant Stems	207	11%
Total	**1,864**	**100%**

Among the recorded defect categories for the inventoried trees, two stood out as the most prevalent issues: "Dead & Dying Parts" accounted for 26% of the cases, while "Tree Architecture" constituted 17% of the total (Table 1). Within the 482 trees afflicted by "Dead & Dying Parts," a recommendation for removal was issued for 81 trees. These removal recommendations were made based on assessments that indicated the tree's inability to recover from the associated defect, necessitating their removal from the urban forest.

It's worth noting that a substantial portion of the inventoried trees, approximately 34%, did not exhibit any associated defects, signifying their relatively good health and structural integrity. This underscores the importance of proactive tree management and maintenance practices to ensure the continued well-being of these trees and to address defects in a timely manner where necessary.

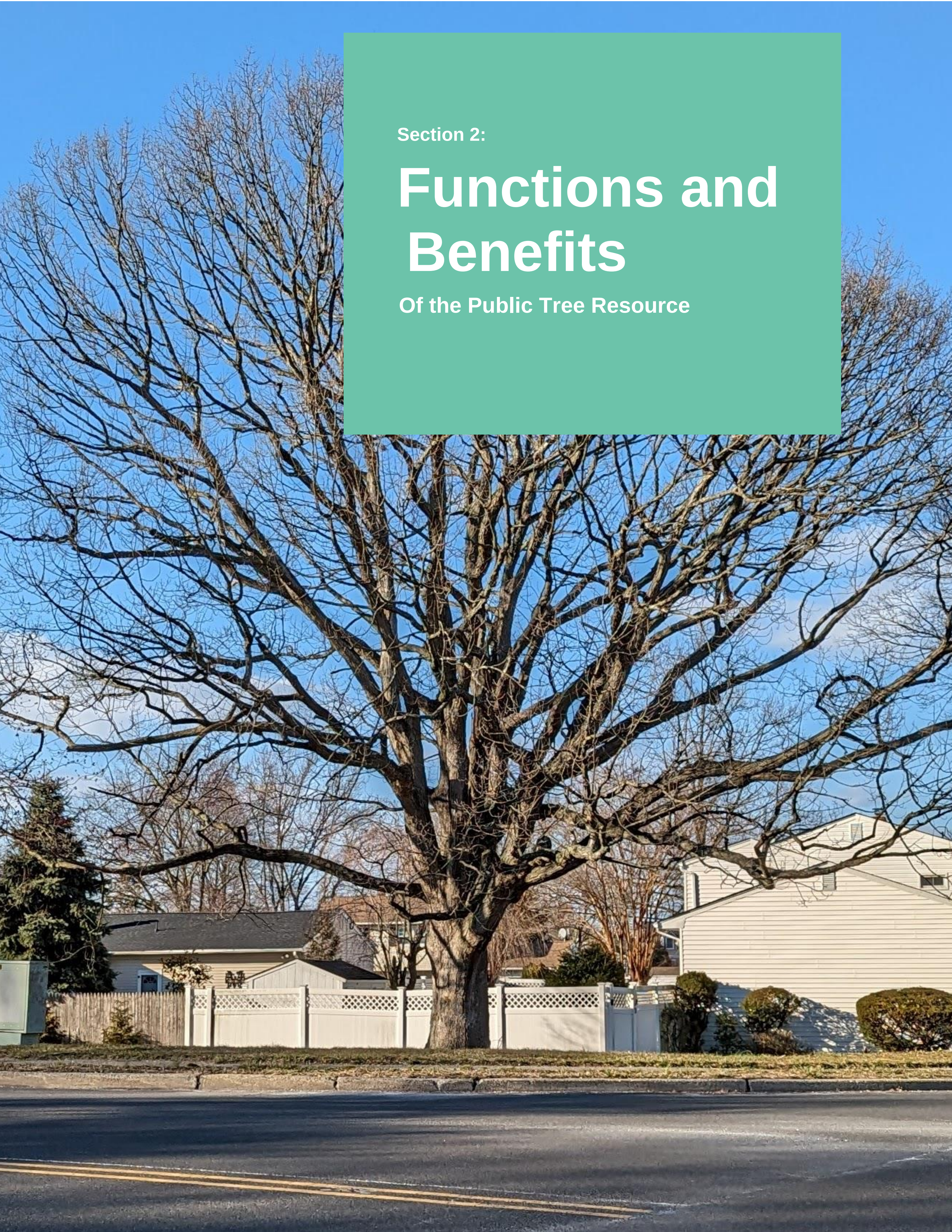
Defect Observation Recommendations

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 2023 City of Long Branch 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. With proper pruning, the overall health of trees in Fair condition with a defect of “Dead and Dying Parts” can be improved over time.

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, the city 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 conducted on the inventoried trees in the City of Long Branch has provided quantifiable insights into the essential ecosystem services these trees offer annually. These services encompass air pollution removal, carbon sequestration, and the prevention of surface water runoff. Collectively, the estimated annual value of these three benefits alone amounts to a substantial $15,270.

It's crucial to emphasize that the value of urban trees extends beyond these quantified benefits. While this analysis focuses on specific ecosystem services, it's important to recognize that urban trees also contribute to a range of additional advantages, including energy conservation and various aesthetic enhancements. Although these broader benefits were not encompassed in this particular iteration of the i-Tree Eco analysis, it's evident that the true value of the inventoried trees in Long Branch exceeds the figures presented here.

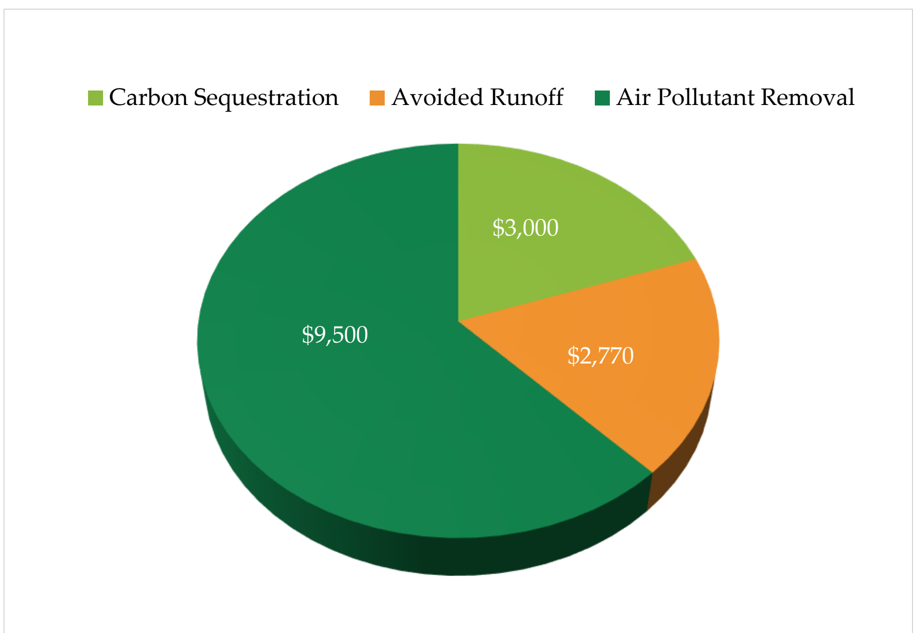


Figure 10. Estimated value of the benefits provided by inventoried trees.

In contrast to rural landscapes, urban environments are concentrated areas with relatively high pollutant emissions. The significance of the 1,177 lbs. of airborne pollutants removed by Long Branch's urban tree resource is estimated at approximately $9,500. Equally valuable is the prevention of stormwater runoff, which mitigates the risk of flooding and sewer overflow, safeguarding both people and the environment. This benefit, amounting to 310,330 gals. of runoff avoided, is estimated at around $2,770. Moreover, carbon dioxide (CO_2), the primary greenhouse gas contributing to climate change, impacts various facets of society and the environment. The sequestration of 18 tons of CO_2 by Long Branch's tree resource holds an estimated value of $3,000.

The calculated replacement worth of Long Branch's inventoried tree population is an impressive $3,060,000. It's essential to note that 15 tree species constitute a significant portion, approximately 71%, of the public tree resource and contribute more than half of the functional benefits. Preserving these species from invasive pests, diseases, or other threats is of paramount importance, given the substantial costs associated with their potential loss. Promoting species diversity in future plantings will help reduce susceptibility to potential threats, while prioritizing the planting of large-statured broadleaf tree species wherever feasible will maximize the environmental and economic benefits they offer. Please refer to Appendix B for a list of tree species recommendations provided by DRG.

SEQUESTERING AND STORING CARBON

Trees act as carbon sinks, essentially acting in opposition to carbon sources. While carbon is released into the atmosphere from sources like vehicles and industrial emissions, trees perform a vital role by absorbing carbon during the process of photosynthesis, subsequently storing it in their tissues as they grow. The i-Tree Eco model provides estimates for both annual carbon sequestration and total carbon storage. In the case of Long Branch, the inventoried trees have cumulatively stored a substantial 841.1 tons of carbon. This figure represents the total carbon each tree has accumulated over their lifetimes, and its estimated value stands at an impressive $143,000.

Among the tree species, London planetrees (*Platanus hybrida*) stand out as the top carbon storage and sequestration champions. This particular species stores approximately 210.6 tons, constituting 25% of the total carbon stored, and annually sequesters around 3.3 tons, which represents 18.6% of all carbon sequestered. This species accounts for only 14% of the total tree population in Long Branch, underlining its significance in the city's carbon management efforts.

Table 2. 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
London planetree	*Platanus hybrida*	251	13.7%	210.6	3.3	676,878	340	$939,400
northern white cedar	*Thuja occidentalis*	152	8.3%	6.6	0.4	19,159	0	$60,533
Tree of Heaven	*Ailanthus altissima*	123	6.7%	21.9	0.6	42,329	20	$20,423
Norway maple	*Acer platanoides*	120	6.5%	64.3	1.8	118,372	60	$258,986
Callery pear	*Pyrus calleryana*	110	6.0%	43.6	1.3	101,190	60	$159,709
sycamore maple	*Acer pseudoplatanus*	92	5.0%	45.0	1.0	132,473	60	$118,957
thornless honeylocust	*Gleditsia triacanthos*	81	4.4%	6.4	0.4	31,224	20	$59,396
Japanese maple	*Acer plamatum*	77	4.2%	12.2	0.2	40,387	20	$70,890
plum spp	*Prunus* spp.	69	3.8%	37.0	0.6	88,560	40	$113,899
red maple	*Acer rubrum*	45	2.5%	21.9	0.8	68,358	40	$99,221
eastern red cedar	*Juniperus virginiana*	41	2.2%	8.1	0.2	43,015	20	$40,153
Queen's crapemyrtle	*Lagerstroemia speciosa*	40	2.2%	0.8	0.1	2,744	0	$10,487
black cherry	*Prunus serotina*	37	2.0%	10.0	0.4	28,299	20	$40,988
white mulberry	*Morus alba*	36	2.0%	14.2	0.4	28,478	20	$44,453
blue spruce	*Picea pungens*	35	1.9%	5.7	0.2	30,065	20	$41,550
All Other Trees Inventoried		1,003	54.6%	656	8.5	906,150	320	$1,473,883
Total		**1,836**	**126%**	**841**	**17.6**	**2,321,108**	**1,180**	**$3,056,279**

CONTROLLING STORMWATER

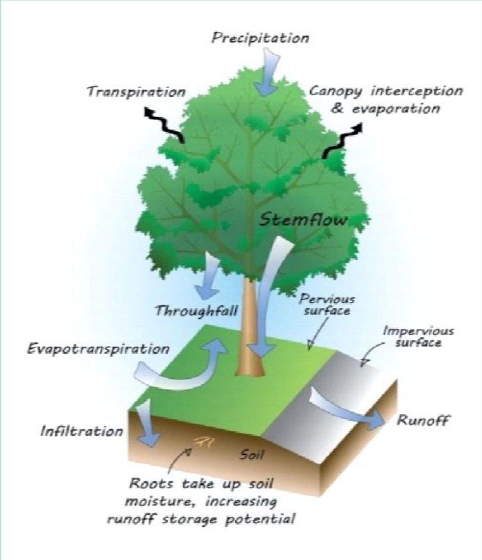
Trees intercept rainfall with their leaves and branches, helping lower stormwater management costs by avoiding runoff. The inventoried trees in the City of Long Branch avoid 310,300 gals. of runoff annually. Avoided runoff accounts for approximately 18% of the annual functional benefits provided by the City of Long Branch's tree resource.

The population of London planetree (*Platanus hybrida*), the most abundant species in the inventory, contributed the most annual stormwater benefits, avoiding 676,878 gals. of runoff each year, amounting to approximately 2,696 gals. of avoided runoff per tree. Japanese maple, a small stature tree, contributed 40,387 gals. of avoided runoff, amounting to approximately 525 gals. of avoided runoff per tree. On a per-tree basis, large trees with leafy canopies provided the most functional benefits. The difference in stormwater benefits between the population of London planetree and Japanese maple illustrates how large-statured trees with wide canopies provide significantly greater benefits.

IMPROVING AIR QUALITY

The inventoried tree population annually removes 940 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 $2,370, which is 36% 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 (*Acer platanoides)* and red maple (*Acer rubrum*), which removed approximately 200 lbs. per tree per year and 140 lbs. per tree per year, respectively.

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.

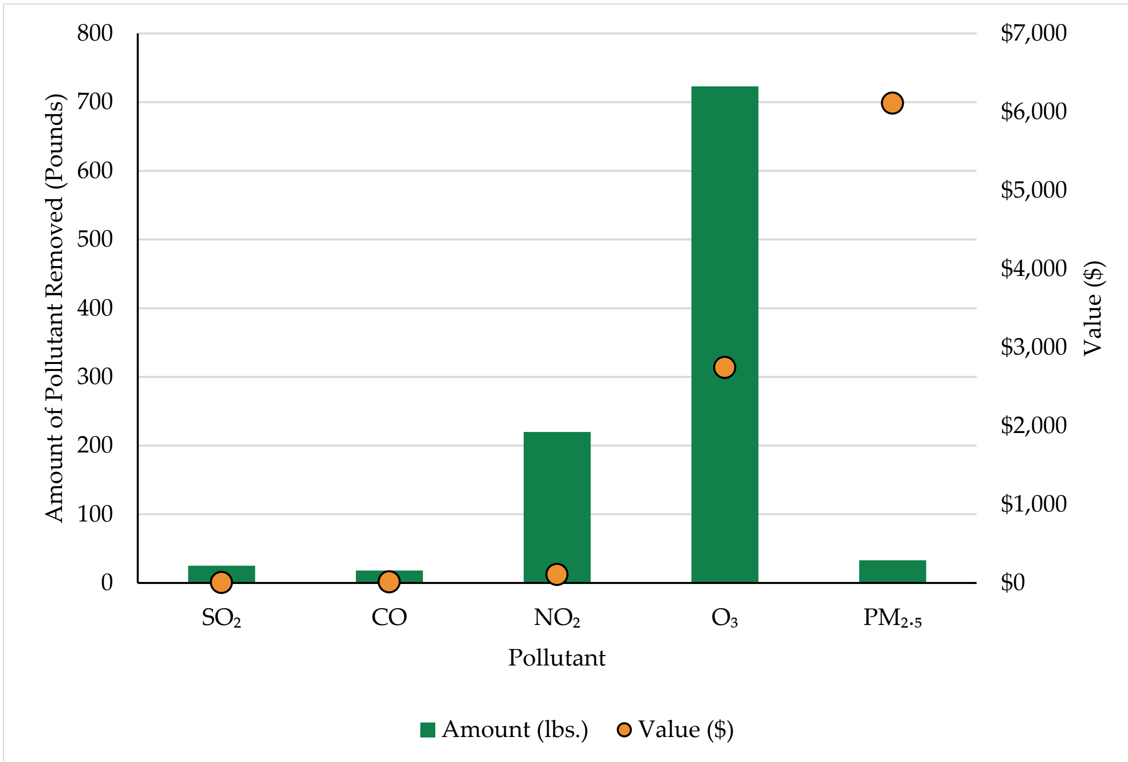


Figure 11. Estimated value of removing airborne pollution by weight and type.

REPLACEMENT VALUE

The concept of replacement value serves as a useful tool for estimating the local cost associated with replacing an existing tree with a similar one. This metric not only sheds light on the overall worth of a tree population, but also provides insights into the value of individual trees. In the context of Long Branch, the total replacement value for the inventoried tree population is a substantial $3,056,279, resulting in an average replacement value of approximately $1,664 per tree.

Among the various species, the population of London planetrees emerges as the most valuable, with a total replacement value of $939,400, equating to an estimated value of $3,742 per tree. Following closely are the red maple and Norway maple, which offer the greatest value on a per-tree basis, estimated at $2,204 and $2,158, respectively. In contrast, smaller stature trees, such as crepemyrtle and northern white cedar, are valued at $262 and $398 per tree, respectively.

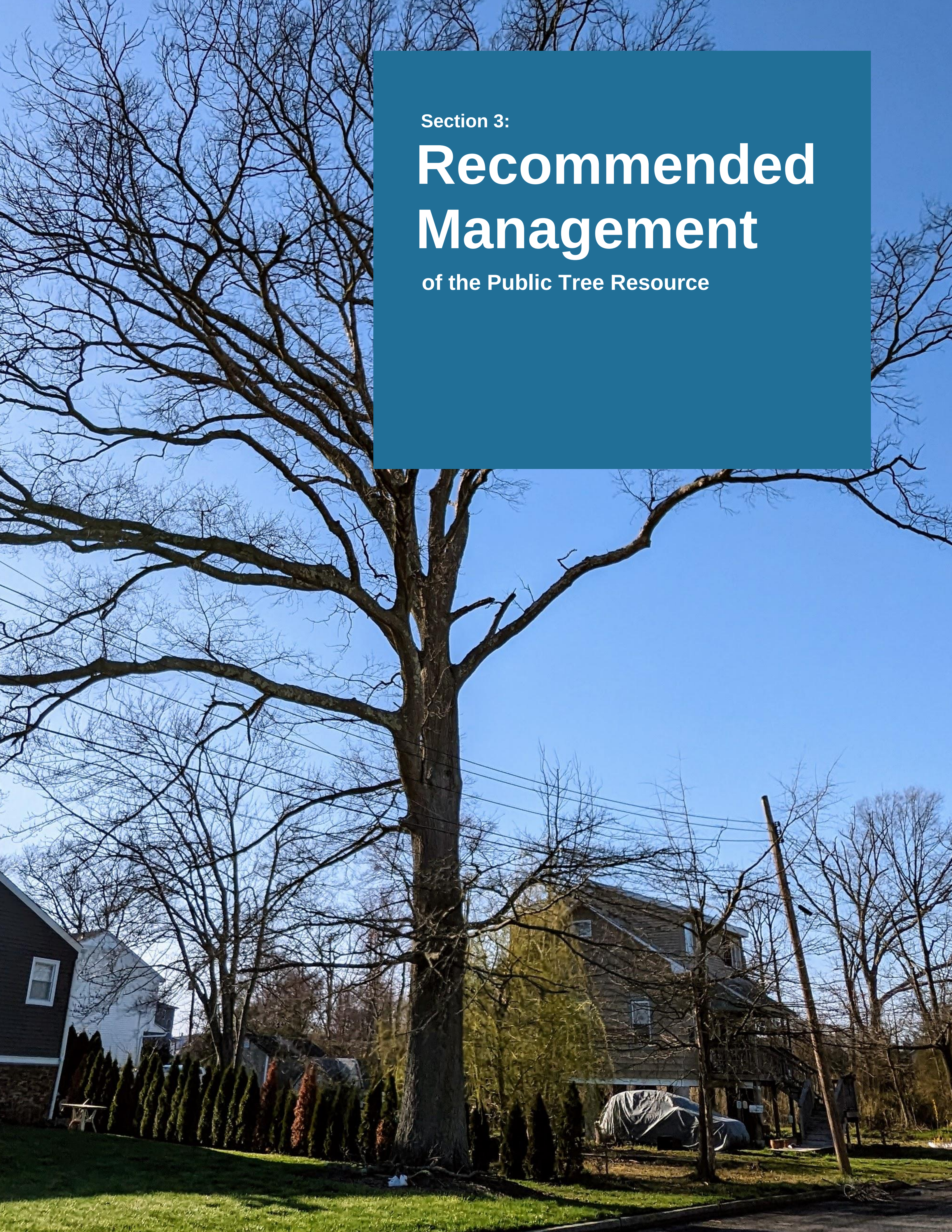
CONCLUSIONS

Maintaining a healthy and diverse population of trees is paramount for the well-being of the City of Long Branch. The numerous ecological services provided by trees, including air purification, carbon sequestration, and stormwater management, underscore their critical role in enhancing the overall quality of life for residents. By diligently caring for the existing tree population and prioritizing the planting of large-stature, broadleaf species, the city can bolster its resilience against environmental challenges, promote biodiversity, and continue reaping the multifaceted benefits that a thriving urban forest offers.

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 all High Priority tree maintenance has been completed.

Low Priority

- Low Priority tree maintenance should only be performed after all High and Moderate Priority maintenance (removals and prunes) 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 new high priority removals and prunes, and a walk-by perspective is important for updating inventory data and detecting major defects before they worsen.

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 the betterment of 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 2023 tree inventory. The specified time frame for the risk assessment was one year.

DRG strongly urges prioritizing and swiftly executing tree maintenance tasks in alignment with the risk assessments assigned to each tree during the inventory. Trees bearing Extreme or High Risk ratings demand immediate attention and should be addressed as the foremost priority. Subsequently, trees labeled with Moderate Risk ratings should be promptly attended to, with the maintenance of Low Risk trees scheduled only after the higher risk ones have undergone necessary pruning or removal. The ensuing sections delineate the crucial maintenance protocols designated for each risk rating category. Prompt attention to this matter is of utmost importance to safeguard the safety and vitality of our urban forest.

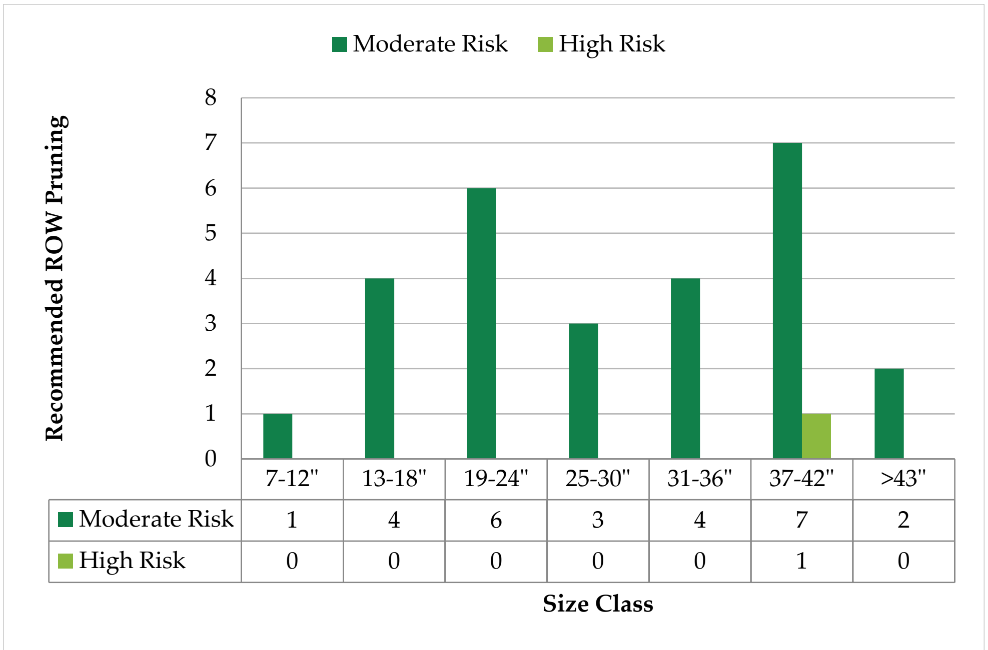
EXTREME AND HIGH PRIORITY RECOMMENDED MAINTENANCE

Prioritizing the pruning or removal of trees exhibiting an elevated risk level, namely those with Extreme, High, or Moderate Risk ratings, is strongly advised and should be carried out promptly. In the overall sequence of maintenance activities, it is generally recommended to address the largest diameter trees first, as they often pose the highest risk. Once these sizable trees have been addressed, attention should be directed toward implementing recommended maintenance procedures for smaller diameter trees that also present significant risks. Timely and proactive management of High Risk trees may necessitate a substantial allocation of resources. However, executing these tasks promptly is instrumental in risk mitigation, enhancing public safety, and reducing long-term expenses.

High Priority Pruning and Removal Recommendations

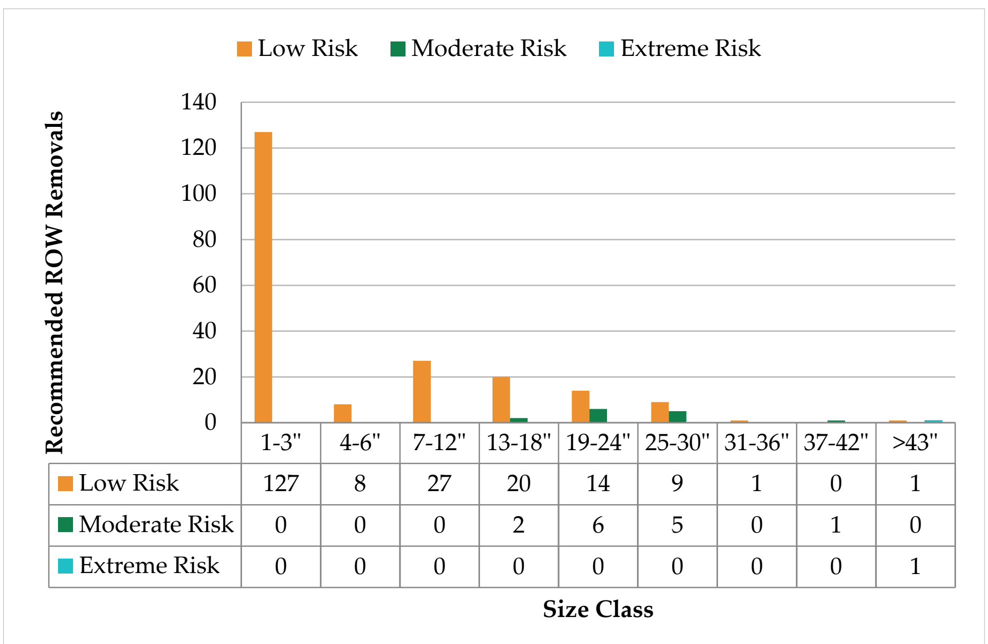
Trees categorized with Extreme or High Risk ratings, which necessitate pruning or removal, should receive immediate attention. High Risk pruning typically involves the removal of defective elements such as dead or dying limbs, broken branches, and portions with missing or decayed wood within the tree canopy. These measures are instrumental in reducing risks associated with the tree while promoting its overall health and growth. When pruning can rectify these defects and mitigate risks effectively, it is the recommended course of action.

The inventory identified 1 Extreme Risk removal and 1 High Risk pruning. The city should continue to monitor their tree resource to identify Extreme or High Risk trees as they appear.



Size Class	7-12"	13-18"	19-24"	25-30"	31-36"	37-42"	>43"
Moderate Risk	1	4	6	3	4	7	2
High Risk	0	0	0	0	0	1	0

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



Size Class	1-3"	4-6"	7-12"	13-18"	19-24"	25-30"	31-36"	37-42"	>43"
Low Risk	127	8	27	20	14	9	1	0	1
Moderate Risk	0	0	0	2	6	5	0	1	0
Extreme Risk	0	0	0	0	0	0	0	0	1

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

MODERATE AND LOW PRIORITY RECOMMENDED MAINTENANCE

Following the priority of addressing Extreme and High Risk trees, the subsequent focus should be on the maintenance of Moderate and Low Risk trees. As only 1 High Risk and 1 Extreme Risk trees were identified during the inventory assessment, it is recommended that Moderate Risk trees receive attention within the first year of the five-year maintenance plan. Once the maintenance tasks for Moderate Risk trees have been completed, the city can shift its focus to Low Risk trees and transition into a proactive and routine pruning maintenance schedule. This systematic approach ensures the comprehensive care and management of the urban forest while optimizing resource allocation and long-term maintenance planning.

Moderate Risk Pruning Recommendations

The inventory identified 27 Moderate Risk trees recommended for pruning, which can be completed within the first year of the maintenance cycle.

Moderate Risk Removal Recommendations

DRG identified 14 Moderate Risk trees recommended for removal. If corrective pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed.

Low Priority Pruning Recommendations

There were 1,528 Low Risk trees recommended for pruning. During the 2023 inventory, trees could be assigned a primary maintenance need of 'prune' or 'routine prune', the difference being that trees with a maintenance need of 'prune' needed more urgent attention than those with the maintenance need of 'routine prune', generally due to defects of larger size, such as dead branches greater than 2 inches in diameter. Low Risk trees recommended for pruning were included in the routine pruning cycle, starting in year one of the five-year management plan.

Low Priority Removal Recommendations

DRG identified 207 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

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. 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, or which has a defect that may require further monitoring to determine whether it is a hazard).
- 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.

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, while the highest level is intended to provide in-depth information to make management decisions about an individual tree. These levels are:

- **Level 1:** 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:** 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. All trees in the 2023 Long Branch tree inventory were assessed to this level, provided that 360-degree access around the tree could be gained.
- **Level 3:** 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.

Further Inspection Recommendation

DRG arborists found 4 trees recommended for an advanced Level 3 risk assessment, 59 trees recommended for annual/multi-year inspections, and 196 trees noted 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.

Most of the trees recommended for insect and disease monitoring were infested with spotted lanternfly. All trees recommended for insect/disease monitoring should be assessed to confirm the presence of damaging insects or diseases and should be treated, if necessary, to reduce the pest species load and improve the health of the public trees in the City of Long Branch.

Trees recommended for multi-year/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.

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

To ensure the continued health and safety of Long Branch's urban forest, it's imperative that all trees receive regular inspections and necessary attention as required. DRG recommends a proactive approach to tree management, proposing that all trees undergo annual inspections, with the possibility of extending the interval to biennial assessments based on budget considerations. Additionally, it is advised that trees be routinely inspected following storm events to promptly identify and address any potential damage or hazards.

To streamline the inspection process, DRG suggests implementing a Level 1 limited visual assessment, which can serve as an initial screening to identify trees requiring further attention. This preliminary evaluation can help prioritize trees for more in-depth Level 2 inspections, ensuring a focused and efficient use of resources in maintaining the health and safety of the urban forest.

Whenever a tree demands additional or new work, it should promptly be integrated into the maintenance schedule, accompanied by an adjustment of the budget to accommodate the additional workload. The implementation of advanced computer management software, such as TreeKeeper®, facilitates seamless updates, edits, and the maintenance of detailed work records. These inspections extend beyond defect identification; they also provide a valuable opportunity to detect early signs of potential pest infestations and disease outbreaks. Given the city's sizable tree population, particularly the susceptible maple (*Acer* spp.) and oak (*Quercus* spp.) varieties, this proactive approach to monitoring is paramount.

ROUTINE PRUNING CYCLE

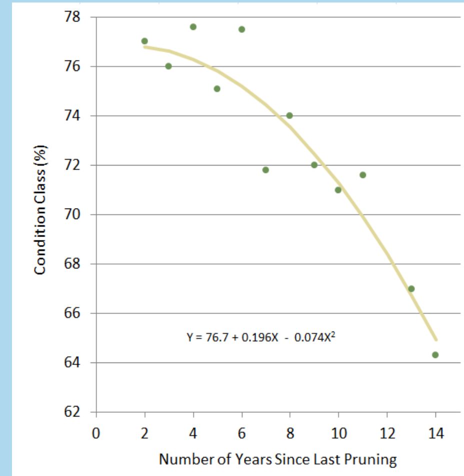
The Routine Pruning cycle includes all Low Risk trees that received a "Prune "or "Discretionary Prune" maintenance recommendation. These trees pose some risk but have a smaller defect size and/or a lower probability of impacting a target. Over time, routine pruning can minimize reactive maintenance, 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 communities 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 community'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

The City of Long Branch inventory has 1,528 trees that should be routinely pruned. DRG recommends that the City of Long Branch establish a five-year Routine Pruning cycle with approximately 305 trees pruned each year. If this is not feasible for the City of Long Branch, a six-year Routine Pruning cycle with approximately 254 trees pruned each year, or a seven-year Routine Pruning cycle with approximately 218 trees pruned each year, is acceptable considering the inventoried tree population's size.

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.

Keep in mind that as priority pruning work is completed, those trees should enter the routine pruning cycle, which will result in higher numbers of trees recommended for routine pruning in future years beyond the five-year management plan presented here. However, not every tree will require pruning every cycle, and actual costs of administering a routine pruning cycle for the City of Long Branch's trees may be lower than projected in Table 4. DRG recommends that the routine pruning cycle begins in year one of the proposed five-year program after all extreme and high risk recommended maintenance is complete.

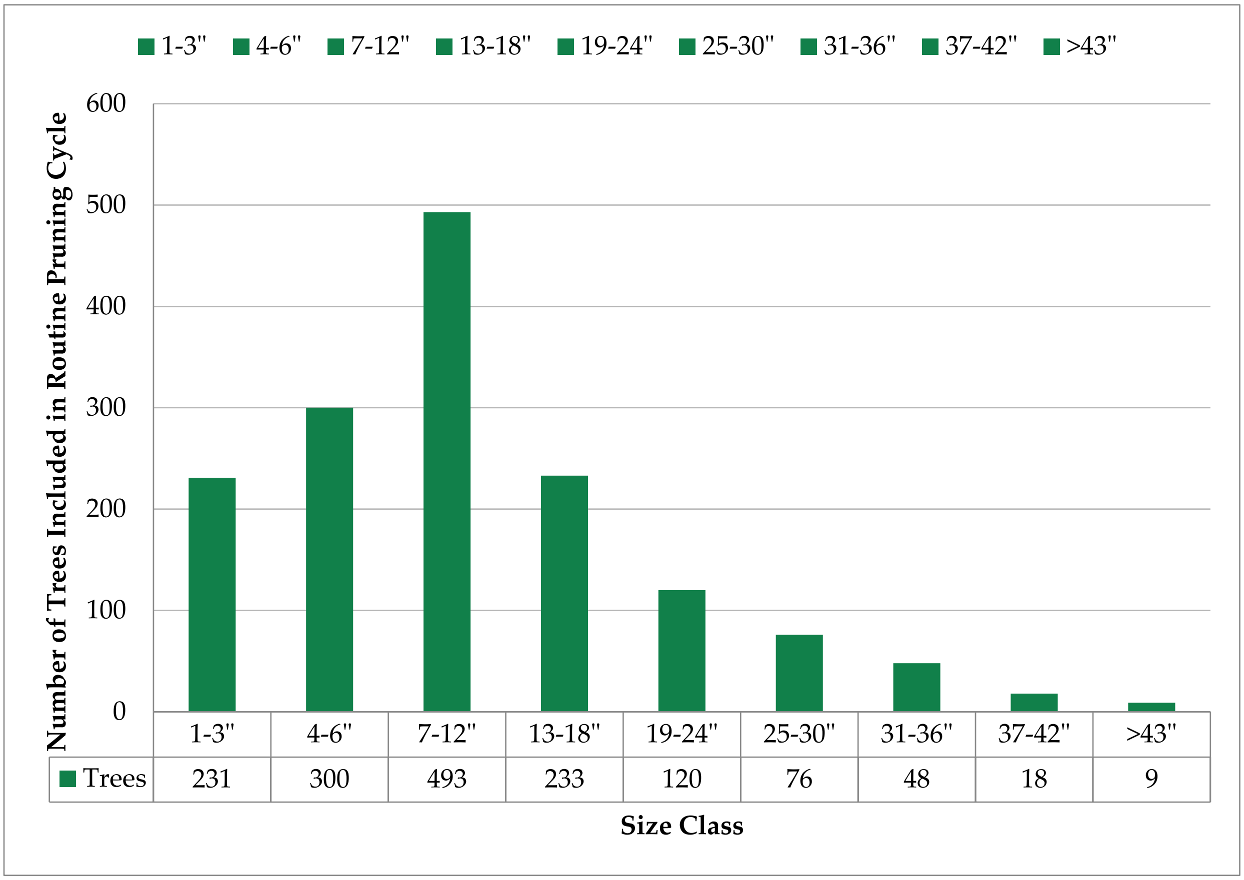


Figure 14. Routine pruning cycle by size class.

MAINTENANCE SCHEDULE AND BUDGET

Utilizing the 2023 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 the City of Long Branch'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 can shift tree maintenance activities from being reactive to a more proactive tree care program.

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

- No less than $333,249 for the first year of implementation.

- No less than $630,228 for the second and third years.
- No less than $578,028 in the final two years of the maintenance schedule.

Annual budget funds are needed to ensure that High Risk and Moderate 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, 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.

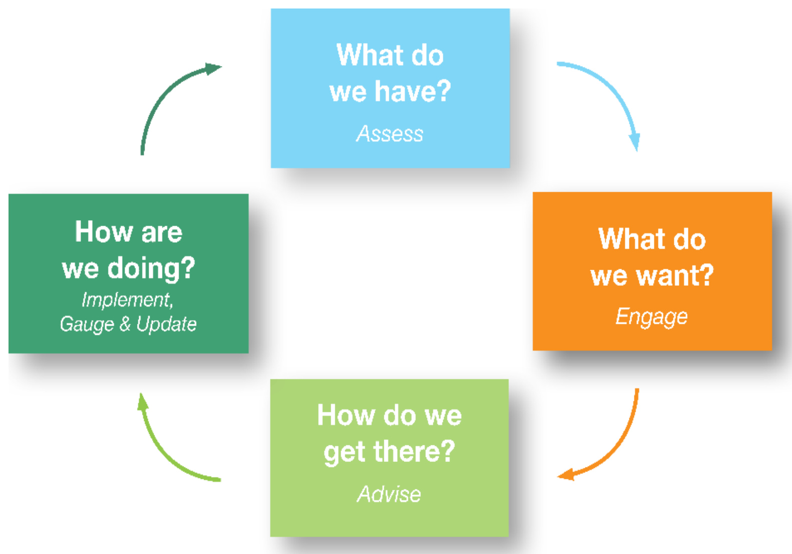
Table 3. Estimated budget for recommended five-year tree resource management program

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Extreme Priority Removals	1-3"	$250		$0		$0		$0		$0		$0	$0
	4-6"	$400		$0		$0		$0		$0		$0	$0
	7-12"	$750		$0		$0		$0		$0		$0	$0
	13-18"	$1,500		$0		$0		$0		$0		$0	$0
	19-24"	$1,900		$0		$0		$0		$0		$0	$0
	25-30"	$2,500		$0		$0		$0		$0		$0	$0
	31-36"	$3,800		$0		$0		$0		$0		$0	$0
	37-42"	$4,400		$0		$0		$0		$0		$0	$0
	>43"	$5,500	1	$5,500		$0		$0		$0		$0	$5,500
Activity Total(s)			**1**	**$5,500**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$5,500**
Moderate Priority Removals	1-3"	$250	0	$0		$0		$0		$0		$0	$0
	4-6"	$400	0	$0		$0		$0		$0		$0	$0
	7-12"	$750	0	$0		$0		$0		$0		$0	$0
	13-18"	$1,500	2	$3,000		$0		$0		$0		$0	$3,000
	19-24"	$1,900	6	$11,400		$0		$0		$0		$0	$11,400
	25-30"	$2,500	5	$12,500		$0		$0		$0		$0	$12,500
	31-36"	$3,800	0	$0		$0		$0		$0		$0	$0
	37-42"	$4,400	1	$4,400		$0		$0		$0		$0	$4,400
	>43"	$5,500	0	$0		$0		$0		$0		$0	$0
Activity Total(s)			**14**	**$31,300**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$31,300**
Low Priority Removals	1-3"	$250		$0	7	$1,750	20	$5,000	50	$12,500	50	$12,500	$31,750
	4-6"	$400		$0		$0		$0		$0	8	$3,200	$3,200
	7-12"	$750		$0		$0		$0	27	$20,250		$0	$20,250
	13-18"	$1,500		$0		$0	20	$30,000		$0		$0	$30,000
	19-24"	$1,900		$0	14	$26,600		$0		$0		$0	$26,600
	25-30"	$2,500		$0	9	$22,500		$0		$0		$0	$22,500
	31-36"	$3,800		$0	1	$3,800		$0		$0		$0	$3,800
	37-42"	$4,400		$0		$0		$0		$0		$0	$0
	>43"	$5,500		$0	1	$5,500		$0		$0		$0	$5,500
Activity Total(s)			**0**	**$0**	**32**	**$60,150**	**40**	**$35,000**	**77**	**$32,750**	**58**	**$15,700**	**$143,600**
High Priority Pruning	1-3"	$75		$0		$0		$0		$0		$0	$0
	4-6"	$150		$0		$0		$0		$0		$0	$0
	7-12"	$350		$0		$0		$0		$0		$0	$0
	13-18"	$650		$0		$0		$0		$0		$0	$0
	19-24"	$850		$0		$0		$0		$0		$0	$0
	25-30"	$1,000		$0		$0		$0		$0		$0	$0
	31-36"	$1,200		$0		$0		$0		$0		$0	$0
	37-42"	$1,500	1	$1,500		$0		$0		$0		$0	$1,500
	>43"	$1,800		$0		$0		$0		$0		$0	$0
Activity Total(s)			**1**	**$1,500**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$1,500**

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Moderate Priority Pruning	1-3"	$75		$0		$0		$0		$0		$0	$0
	4-6"	$150		$0		$0		$0		$0		$0	$0
	7-12"	$350	1	$350		$0		$0		$0		$0	$350
	13-18"	$650	4	$2,600		$0		$0		$0		$0	$2,600
	19-24"	$850	6	$5,100		$0		$0		$0		$0	$5,100
	25-30"	$1,000	3	$3,000		$0		$0		$0		$0	$3,000
	31-36"	$1,200	4	$4,800		$0		$0		$0		$0	$4,800
	37-42"	$1,500	7	$10,500		$0		$0		$0		$0	$10,500
	>43"	$1,800	2	$3,600		$0		$0		$0		$0	$3,600
Activity Total(s)			**27**	**$29,950**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$29,950**
Routine Inspection	Drive-by Assessment	$1	1,864	$1,864	1,864	$1,864	1,864	$1,864	1,864	$1,864	1,864	$1,864	$9,320
Activity Total(s)			**1,864**	**$1,864**	**1,864**	**$1,864**	**1,864**	**$1,864**	**1,864**	**$1,864**	**1,864**	**$1,864**	**$9,320**
Young Tree Training (3-year Cycle)	1-3"	$20	32	$640	32	$640	32	$640	32	$640	32	$640	$3,200
	4-6"	$30	14	$420	0	$0	14	$420	0	$0	14	$420	$1,260
Activity Total(s)			**46**	**$1,060**	**32**	**$640**	**46**	**$1,060**	**32**	**$640**	**46**	**$1,060**	**$4,460**
Routine Pruning (5-year Cycle)	1-3"	$75	46	$3,450	46	$3,450	46	$3,450	46	$3,450	46	$3,450	$17,250
	4-6"	$150	60	$9,000	60	$9,000	60	$9,000	60	$9,000	60	$9,000	$45,000
	7-12"	$350	98	$34,300	99	$34,650	98	$34,300	98	$34,300	98	$34,300	$171,850
	13-18"	$650	46	$29,900	47	$30,550	46	$29,900	46	$29,900	46	$29,900	$150,150
	19-24"	$850	24	$20,400	24	$20,400	24	$20,400	24	$20,400	24	$20,400	$102,000
	25-30"	$1,000	15	$15,000	15	$15,000	15	$15,000	15	$15,000	15	$15,000	$75,000
	31-36"	$1,200	9	$10,800	9	$10,800	10	$12,000	9	$10,800	9	$10,800	$55,200
	37-42"	$1,500	3	$4,500	3	$4,500	4	$6,000	3	$4,500	3	$4,500	$24,000
	>43"	$1,800	1	$1,800	2	$3,600	1	$1,800	1	$1,800	1	$1,800	$10,800
Activity Total(s)			**302**	**$129,150**	**305**	**$131,950**	**304**	**$131,850**	**302**	**$129,150**	**302**	**$129,150**	**$651,250**
New Tree Planting and Maintenance	Purchasing	$250	223	$55,750	223	$55,750	223	$55,750	223	$55,750	223	$55,750	$278,750
	Planting & Watering	$200	223	$44,600	223	$44,600	223	$44,600	223	$44,600	223	$44,600	$223,000
	Mulching	$25	223	$5,575	223	$5,575	223	$5,575	223	$5,575	223	$5,575	$27,875
Activity Total(s)			**669**	**$105,925**	**669**	**$105,925**	**669**	**$105,925**	**669**	**$105,925**	**669**	**$105,925**	**$529,625**
Natural Mortality (1%)	Tree Removal	$1,500	18	$27,000	18	$27,000	18	$27,000	18	$27,000	18	$27,000	$135,000
Activity Total(s)			**18**	**$27,000**	**18**	**$27,000**	**18**	**$27,000**	**18**	**$27,000**	**18**	**$27,000**	**$135,000**
Activity Grand Total			**2,942**		**2,920**		**2,941**		**2,962**		**2,957**		**14,722**
Cost Grand Total				**$333,249**		**$327,529**		**$302,699**		**$297,329**		**$280,699**	**$1,541,505**

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 Long Branch to self-assess 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.

Section 4:

Public Tree Planting Plan

of the Public Tree Resource

SECTION 4: PUBLIC TREE PLANTING PLAN

INTRODUCTION

The street and public space trees within the City of Long Branch constitute a vital component of its infrastructure, comparable to its streets, utilities, and sidewalks. While planting and maintaining trees require significant investment, unlike other urban infrastructure elements, the public tree population appreciates in value as trees mature—provided new trees replace those removed, and proactive maintenance enhances overall condition over time.

Urban trees offer a multitude of benefits to the community, transcending the resources invested in their planting, pruning, protection, and removal. They contribute to improved air and water quality, offer shade and windbreaks that reduce energy costs, and mitigate stormwater runoff and erosion. Beyond environmental advantages, trees yield psychological and social benefits, alleviating stress and mental fatigue, providing increased recreational opportunities, and fostering a sense of community pride. Recognizing these benefits, the City of Long Branch has instituted an Environmental Commission and Green Team dedicated to safeguarding, sustaining, and expanding the community's urban forest.

Despite the evident importance of trees to a community, maintaining the urban forest presents challenges. Threats such as invasive species, development, and adverse growing conditions can diminish canopy coverage and escalate management costs. This planting plan aims to address these challenges by proactively bolstering the city's stocking level and enhancing species diversity, thereby offsetting potential losses and fostering a resilient and thriving urban forest.

VISION FOR THE URBAN FOREST

The City of Long Branch is committed to increasing tree canopy cover throughout the city by preserving street and park trees where possible and by actively encouraging tree plantings on public lands. The City of Long Branch will use a systematic and organized approach to planting which will allow the city to replace trees which must be removed due to poor condition or development pressures, increase the tree canopy over time, and improve the survivability of new plantings through appropriate follow-up care during establishment and early growth. The City will focus on:

- Diversifying new plantings to reduce the damage caused by insects and diseases.
- Planting large-stature trees, where possible, to maximize the benefits provided by the urban forest.
- Planting appropriate species in each vacant planting site to minimize damage to existing infrastructure.
- Planting in key locations where the impact of greater canopy cover will be most beneficial to the citizens of the city.

LONG BRANCH'S TREE CANOPY

The City of Long Branch, home to a vibrant community of 30,000 residents, boasts an extensive natural landscape spanning approximately 603 acres of tree canopy. Currently, 17% of the city enjoys the shade provided by these trees, while an additional 29% holds the potential for further planting. To enhance the urban greenery and environmental benefits, the city can set a forward-looking goal of achieving a robust tree canopy cover of 46%. This initiative not only aims for a healthier and more sustainable urban environment but also seeks to create a greener, more inviting space for its residents.

17%

Existing Tree Canopy

+29%

Possible Planting Area

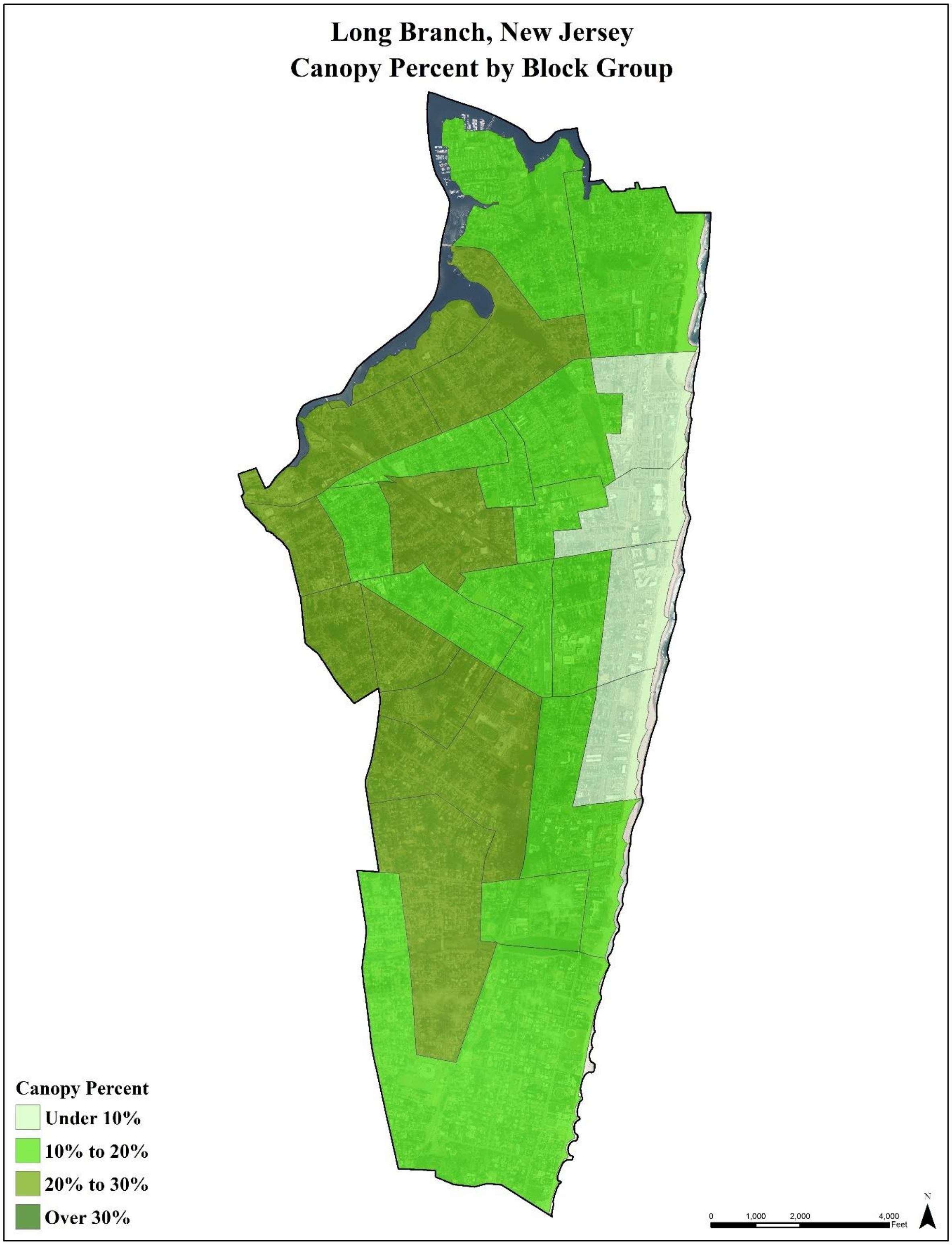
46%

Potential Tree Cover

TREE CANOPY ACROSS COMMUNITIES

In Long Branch, tree canopy is unevenly distributed across the city, ranging from 6% to 29% cover among U.S. Census block groups (Map 1). Tree canopy cover by U.S. Census block group.). Block groups are U.S. Census-defined geographic areas that are made up of 600–3,000 residents. During the study period from 2010–2022, nearly all block groups experienced a reduction in tree canopy, ranging from a 2% loss to 32% (Map 2). There are four Census block groups that gained canopy ranging from a 2% gain to 20%.

This finding suggests that emphasis should be placed on planting trees in communities with low canopy cover and on preserving trees in areas with high canopy cover. Fortunately, there are many plantable spaces in Long Branch, even in densely developed neighborhoods.



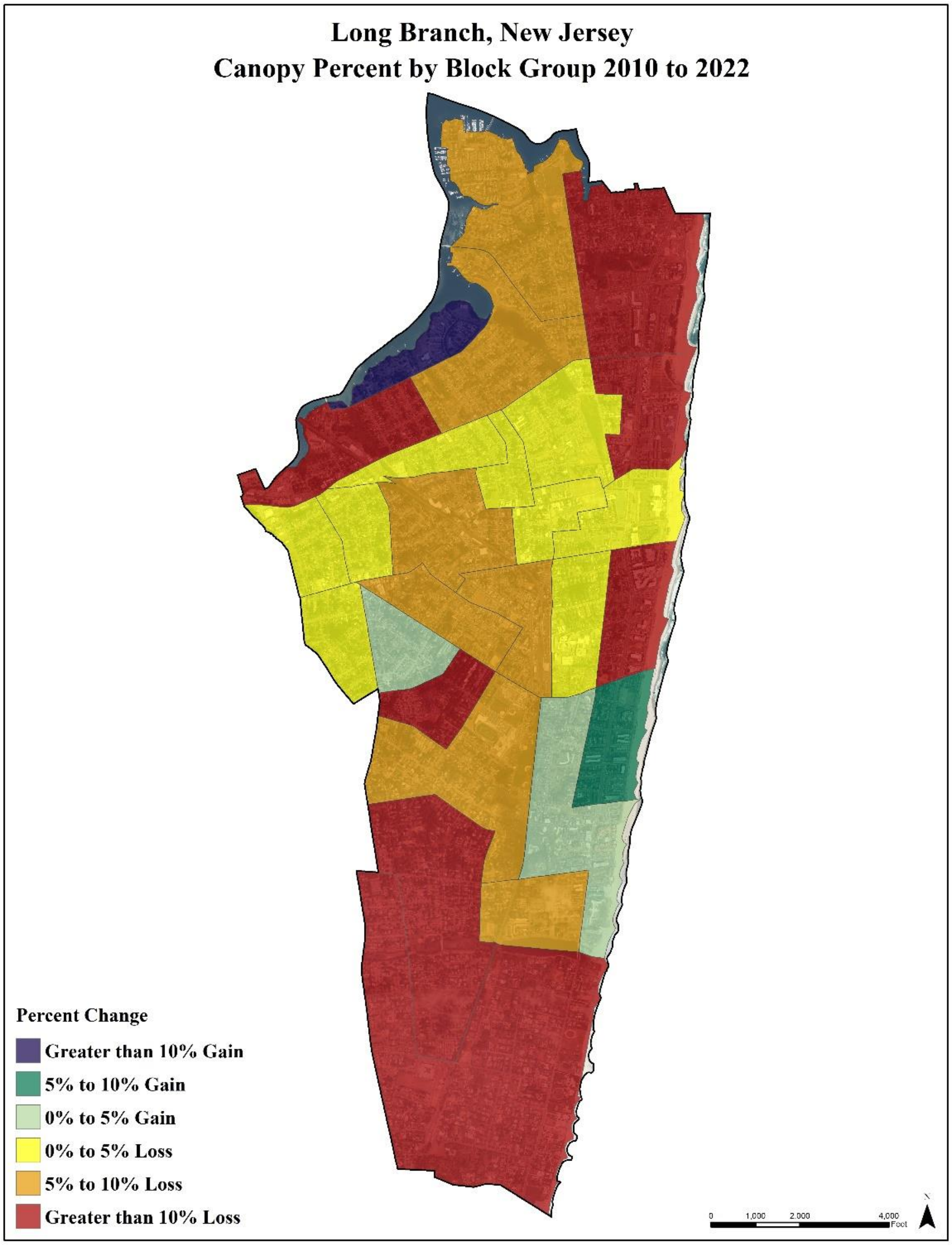
Map 1. Canopy percentage by census block

TREE CANOPY CHANGE, 2010–2022

Historic imagery of the City of Long Branch from 2010 was analyzed to compare past tree canopy cover to existing cover as of 2022 (Map 2). The comparison revealed a loss of 65 acres (9.7%) of tree canopy over 12 years (Table 4).

Table 4. Tree canopy change assessment, 2010–2022

Change Assessment	Total Acres	Tree Canopy Acres			Canopy Change	
		2010	2022		Acres	Percent
Long Branch, 2010–2022	3,505	668	603		-65	-9.7%
Canopy Cover		19.1%	17.2%			



Map 2. Change in tree canopy cover by U.S. Census block group, 2010–2022

FUTURE PLANTING SITES IDENTIFIED AND PRIORITIZED

Land cover analysis is helpful to understand current tree canopy distribution and its value, and to identify opportunities to expand tree canopy to increase and more evenly distribute the benefits of trees. While vacant planting sites present opportunities to plant trees, not all open spaces are candidates for tree plantings—examples include roads and sports or agricultural fields. Conversely, not all impervious areas (hard surfaces like roads and sidewalks) must remain impervious forever. Trees can be added to impervious surfaces, for example, by adding tree wells in sidewalks or landscape islands in parking lots.

Some locations are clearly better suited to meet community tree planting goals than others. A Priority Planting Analysis was conducted to eliminate areas that are unsuitable for planting and to prioritize planting locations based on optimizing benefits.

The Priority Planting Analysis categorized 1,011 acres of available tree planting areas in Long Branch from Very Low to Very High (Table 5). If the city, residents, and businesses of Long Branch were to plant trees in all locations (Very Low to Very High), **the city's tree cover would rise from 17%** (603 acres of the 3,505 acres total) **to 46%** (1,011 of the total acreage) **across both public and private property.**

Table 5. Available planting areas in Long Branch by level of priority for stormwater runoff reduction, urban heat island, social equity, and combined (composite) environmental and social factors, in acres and percent of city land area.

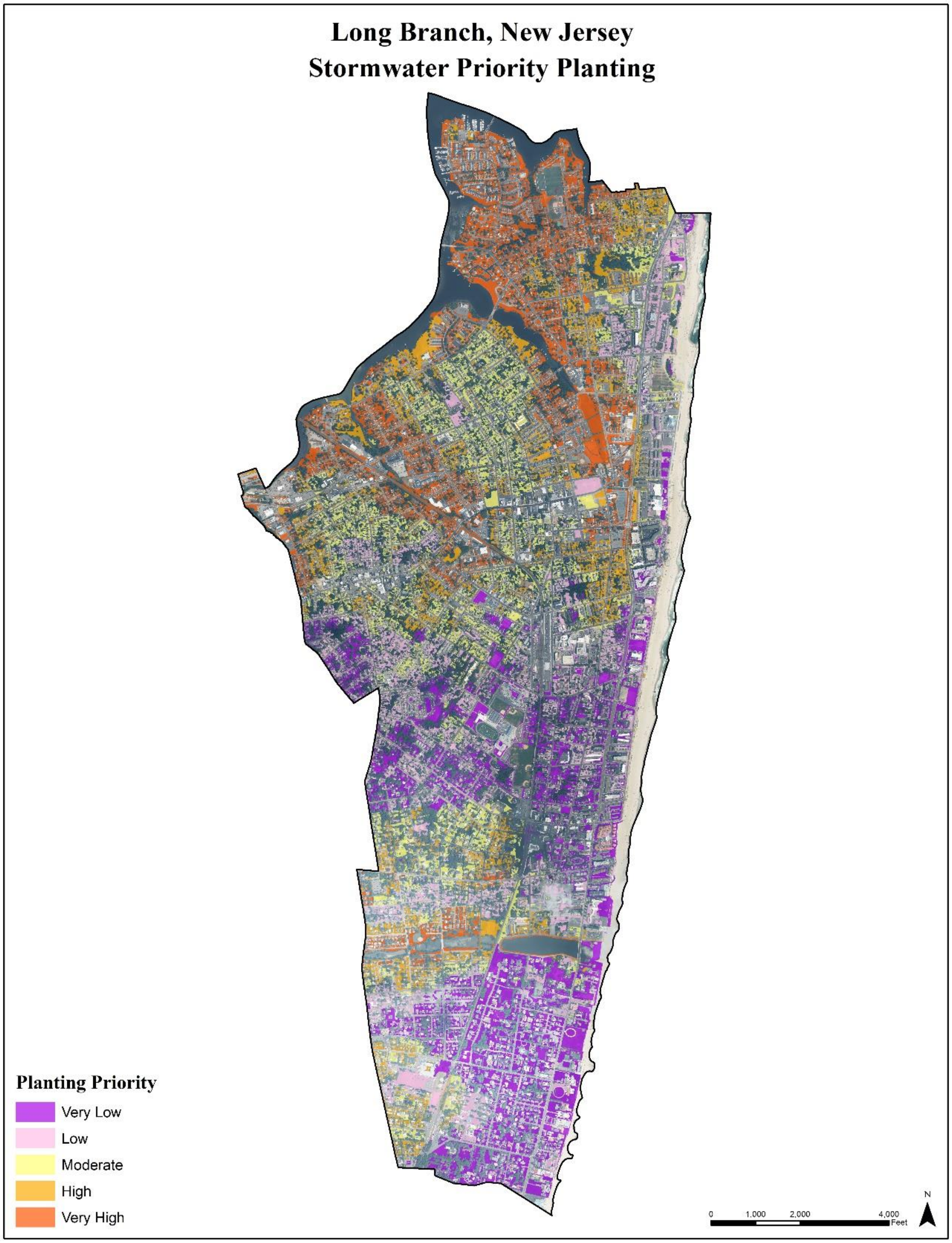
	Stormwater		Heat Island		Social Equity		Composite	
Priority Rank	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Very Low	277	8%	199	6%	255	7%	291	8%
Low	159	5%	219	6%	192	6%	261	8%
Moderate	179	5%	319	9%	183	5%	178	5%
High	175	5%	224	7%	253	7%	157	5%
Very High	221	6%	50	1%	127	4%	123	4%

Final planting decisions should be made by public works, but the prioritized planting areas provided in this study can serve as a starting point and guideline for determining where future plantings may have the most impact on water quality, social equity and other tree benefits.

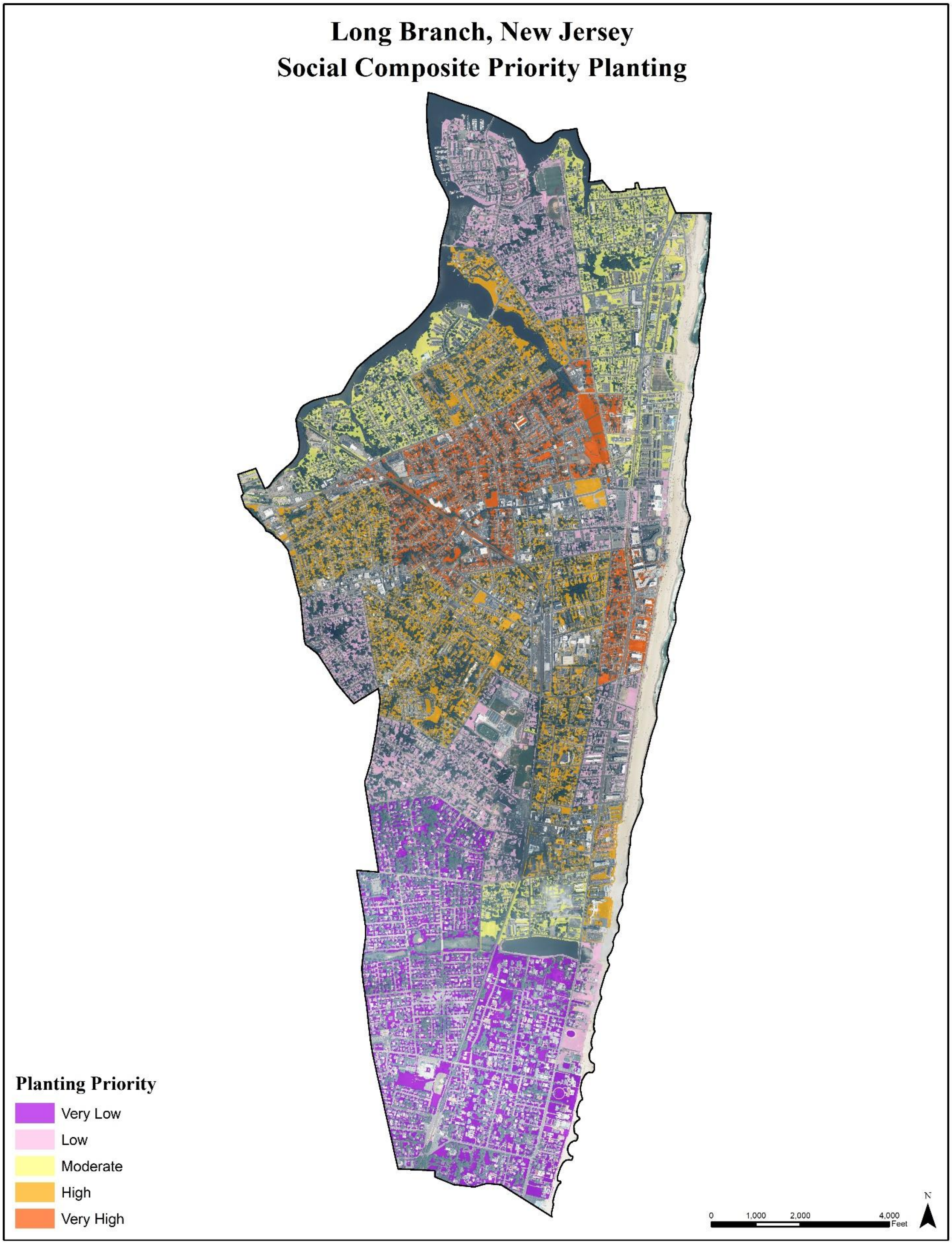
Priority Planting for Water Quality

A Priority Planting Analysis for stormwater runoff potential shows areas where tree canopy can be expanded for stormwater management, ranging from Very Low to Very High (Map 3). This analysis characterized 1,011 acres of land suitable for future tree planting based on its contribution to water quality (Table 5). Of this area, approximately **396 acres (39%) of land is**

prioritized as "High" or "Very High" planting areas based on projected impacts to stormwater management.



Map 3. Priority areas for canopy expansion based on stormwater runoff potential.



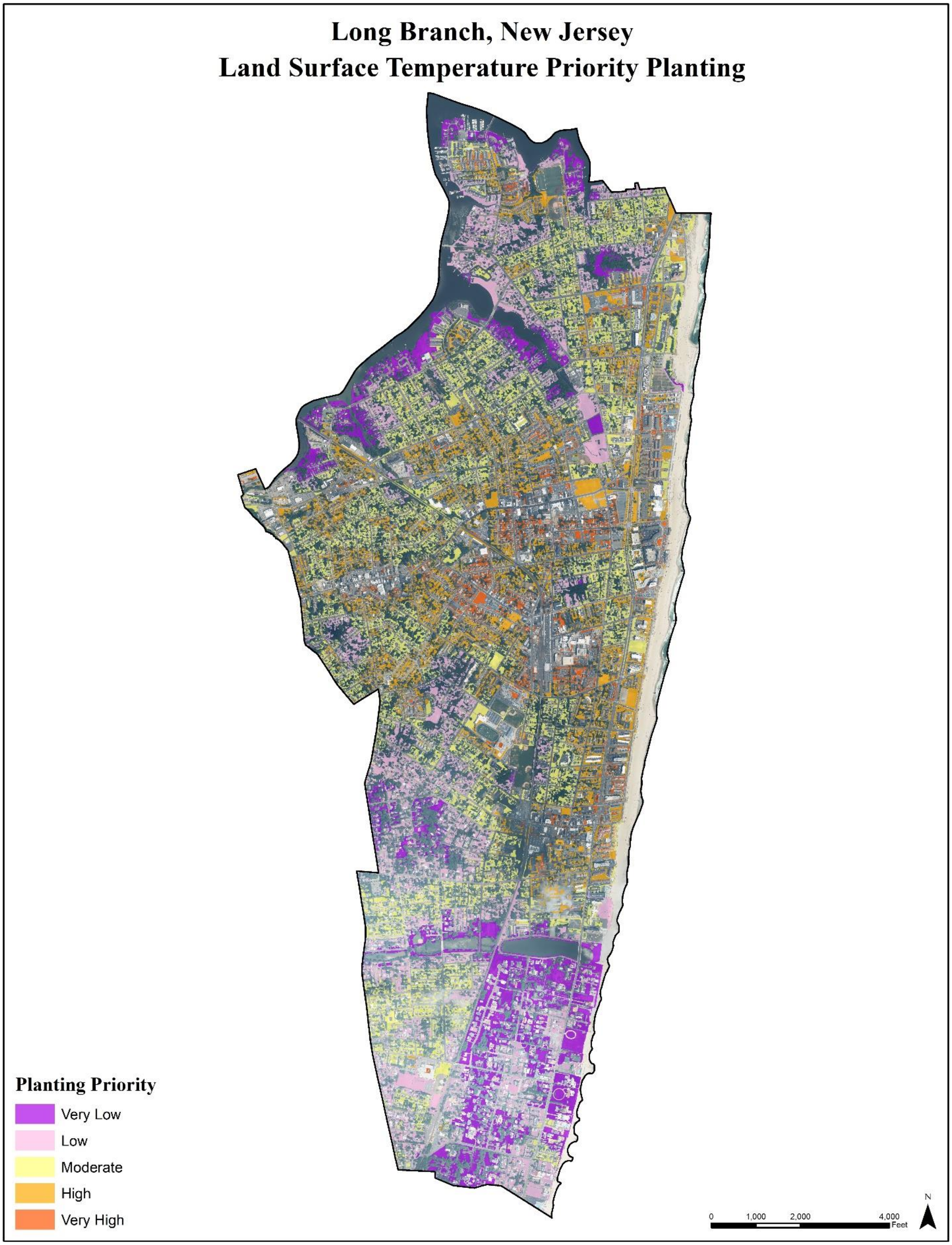
Map 4. Priority areas for canopy expansion based on social factors that relate to equity.

Priority Planting for Social Equity

A Priority Planting Analysis for social equity shows areas where tree canopy can be expanded to maximize benefits that will have the most impact on human health, economics, and well-being, ranging from Very Low to Very High (See "Methodology" in appendix for complete list of included factors). Of 1,011 acres of tree planting area, approximately 381 acres (38%) of land is prioritized as "High" or "Very High" planting areas based on projected impacts to social equity factors (Map 4).

Priority Planting for Heat Island

A Priority Planting Analysis for heat island shows areas where tree canopy can be expanded for urban heat island management, ranging from Very Low to Very High. This analysis characterized 1,011 acres of land suitable for future tree planting based on its contribution to heat island mitigation (Map 5). Of this area, approximately **275 acres (27%) of land is prioritized as "High" or "Very High" planting areas based on projected impacts to urban heat islands.**

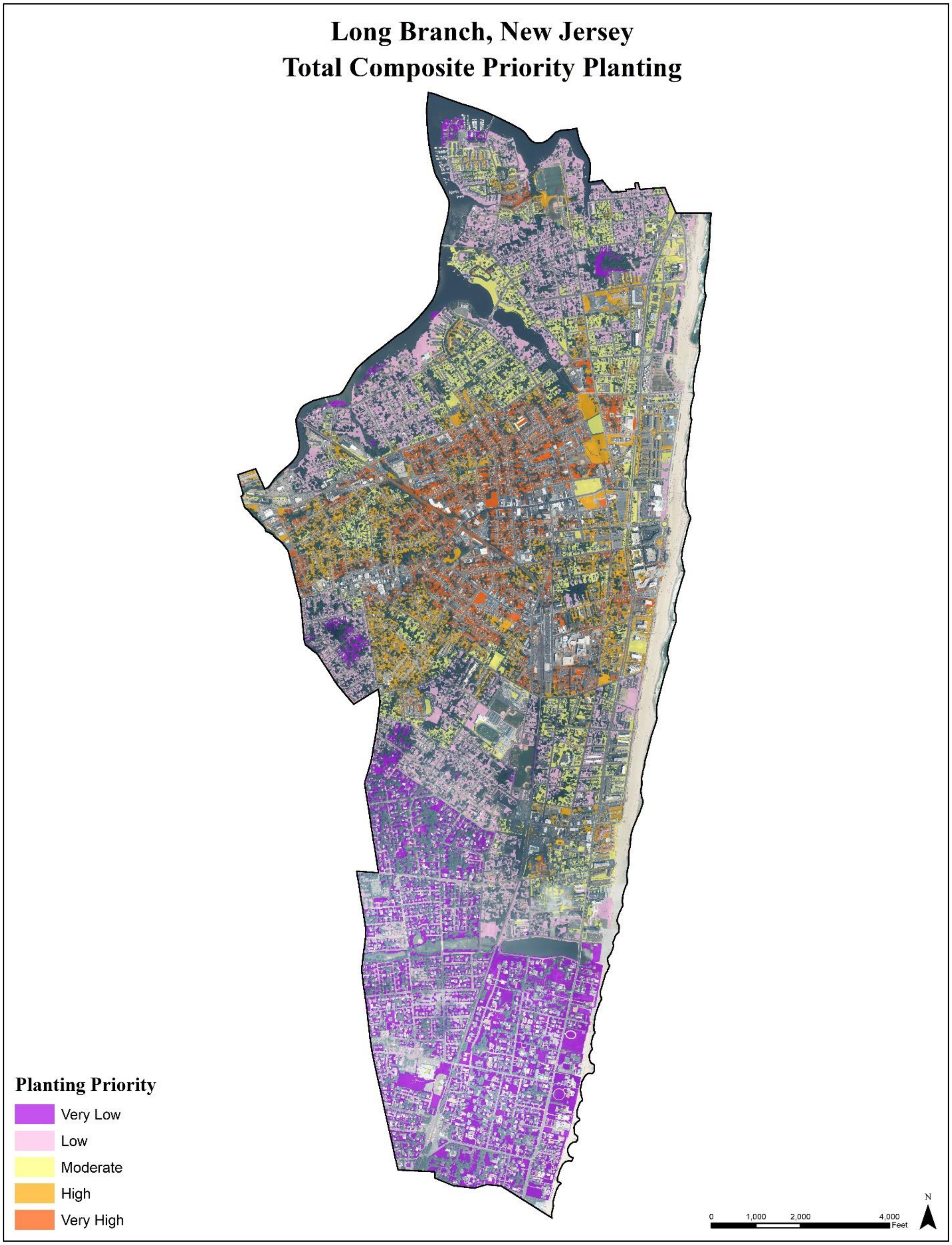


Map 5. Priority areas for canopy expansion based on land surface temperature

Priority Planting for Social Equity and Environmental Benefit

Overlapping all environmental and social indicators produced a composite priority planting rating based on a calculated average. The resulting map identifies areas that, if planted, have the highest potential to improve both water quality and quality of life for Long Branch's residents (Map 6).

In total, **280 acres (28%) of the 1,011 acres available land area for tree canopy expansion is categorized as High or Very High based on composite social and environmental equity** (Table 5). These areas indicate places where tree planting and preservation can have the greatest impact on quality of life for Long Branch's residents.



Map 6. Priority areas for canopy expansion based on a combination of socioeconomic and environmental factors

RECOMMENDATIONS

Long Branch's urban forest is an important asset that provides innumerable social, environmental, and economic benefits. Trees may be the only community asset that appreciates in value over time. Like any asset, though, trees require proper care and attention to maximize the value and benefits that they provide. Planning and assessment efforts, such as this project, can help raise awareness about the importance of trees in Long Branch and develop strategies to optimize tree canopy throughout the city.

This analysis is designed to help document the urban forest in Long Branch, quantify the value and benefits that it provides, and develop recommendations for future planting and preservation efforts. This study should be considered as a starting point—a springboard for conversations and opportunities that can enhance the tree canopy across Long Branch. Based on the findings of this study, the following actions are recommended.

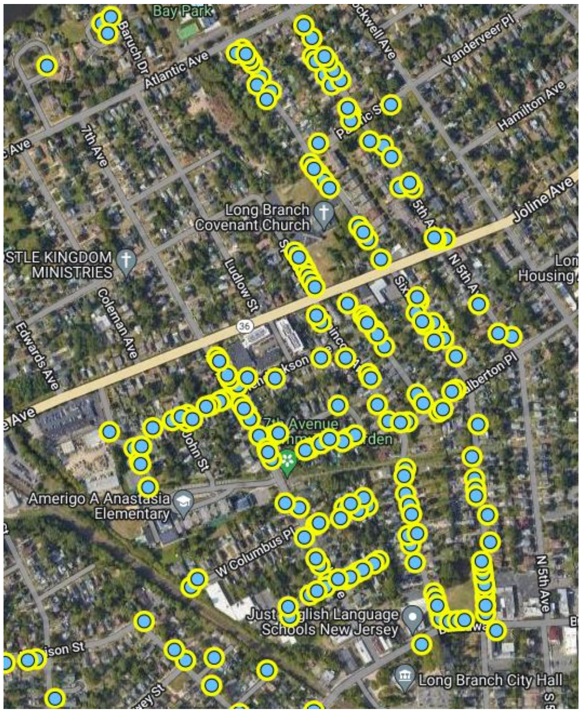
1. Plant New Trees

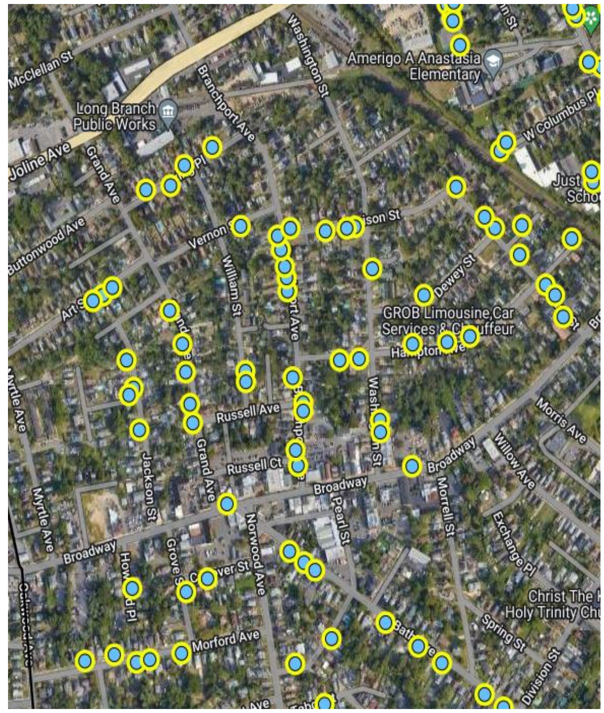
The study identified an additional 1,011 acres of plantable area in Long Branch that could increase tree canopy cover from 17% to 46%.

To identify areas where municipal tree planting efforts could begin, Long Branch should use the Priority Planting Analysis to identify locations with a "High" or "Very High" priority planting rating. In addition to public tree planting, the city and its partners should also encourage private property tree planting in business and residential districts. Planting in these areas will help reduce stormwater runoff and build social equity.

The Priority Planting Analysis and maps provide a great guideline for finding planting locations based on community goals; however, they do not consider specific site factors, neighborhood preferences, or on-the-ground realities. Ground survey is necessary to assess the planting locations for factors that may limit suitability.

Through the city-wide tree inventory, DRG has pinpointed 642 potential planting locations within the ROW, with the majority situated in areas of moderate to very high priority on the comprehensive planting map. In light of budget constraints and a restricted site count, DRG arborists concentrated on gathering data from the most advantageous planting spots within the right-of-way (ROW). It is worth noting that there are probably additional suitable planting locations in the high to very high priority zones. For an effective and strategic approach, Long Branch is encouraged to initiate planting activities in the very high to high priority areas, giving precedence to spacious vacant sites capable of accommodating large-stature trees





Map 7. Priority planting locations in Long Branch, NJ

The maps provided above serve as illustrations extracted from Long Branch's TreeKeeper® system. They pinpoint clusters of optimal planting locations within areas categorized as very high and high priority for planting initiatives.

Working with local partners or volunteer organizations can assist with increasing community canopy through tree planting. Additional strategies such as incentive and cost-share programs, grants, education and outreach, or policy changes can encourage residents and business owners to plant trees throughout the community.

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, each vacant site is classified into small, medium, and large categories, aligning with the respective size of trees the planting site can accommodate at maturity. This categorization equips the city of Long Branch with valuable information, facilitating a more streamlined strategy for determining the optimal number of trees to plant at various locations.

The following specifications are DRG's planting protocols and were used as a guide when collecting the vacant sites during the 2023 inventory:

- *Small Vacant Sites:* The smallest dimension of the planting site is between 3 to 5 feet; a minimum of 20 feet is kept between existing infrastructure.
- *Medium Vacant Sites:* The smallest dimension of the planting site is between 6 to 8 feet; a minimum of 30 feet is kept between existing infrastructure.
- *Large Vacant Sites:* The smallest dimension of the planting site is 8 feet and greater; a minimum of 40 feet is kept between existing infrastructure.

Planting site parameters are determined based on an original agreement utilizing the experience from City of Long Branch personnel and DRG Inventory Urban Foresters. Some of these parameters are:

- No planting of a tree within 35 feet of any intersection or crosswalk.
- No planting of a tree within 100 feet of any stop signs.
- No planting of a tree within 10 feet of any fire hydrant.
- No planting 25 feet from streetlight.
- No planting within 2 feet from gas, electric, water pipe, or valve.
- Sites should not obstruct important traffic signs.
- Sites should not obstruct major road signage.
- Clear vision shall be maintained on corner lots.

The overall landscape and existing planting scheme were also considered 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 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.

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. (See Appendix C for a list of suggested species). Planting sites have 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. *Hardiness Zone: Plant tree species that thrive in the city's hardiness zone.* The zones are determined by the average annual minimum temperature for each area. The City of Long Branch occurs in Zones 7a of the USDA Hardiness Zone Map, which identifies the climatic region where the average annual minimum temperature is between -0° to 5° (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 C.
2. *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, soil salinity, soil compaction, and percent organic matter will all influence the survivability of the planted tree. Soil should be tested before selecting a species. Be sure that the soil used at planting is suitable for the chosen species.
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. Trees near the water may also need to be tolerant to be salt tolerant.
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. 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.

2. Preserve Existing Tree Canopy

It is important to note that, while tree planting is a component of increasing and improving tree canopy, it is not the only component. Older, larger trees contribute significantly more to a community's current tree canopy than young, small trees. Caring for and preserving large trees should be an integral part of Long Branch's strategy to maximize the benefits provided by trees and ensure a sustainable canopy over time.

Unfortunately, trees do not live forever. They will need to be removed for a variety of reasons, including natural mortality, invasive pest and disease outbreaks, extreme weather events, and development pressure, all of which can have a significant impact on community tree canopy. While trees that pose a risk can and should be removed, finding ways to encourage the retention and care of existing trees can have a substantial impact on expanding tree canopy.

3. Set A Community-wide Tree Canopy Goal

A community tree canopy goal can provide inspiration for change. It can also be useful for establishing metrics with which to measure progress. Even with the latest data about urban tree canopy and its benefits, **setting a canopy goal can be more of an art than a science**. Ultimately, a canopy goal is a reflection of a community's unique vision about what is both inspiring and achievable in their community.

4. Review Ordinances and Policies

Long Branch's ordinances should be examined and revised to reduce barriers and provide incentives to protect and expand tree canopy. Review of internal policies and procedures and how the city projects impact trees can also be helpful when identifying ways to preserve and protect existing canopy. Small changes in the design of public projects, including sidewalk installation and street and infrastructure improvements, can often significantly improve impacts to tree canopy. Similarly, protection of existing trees during development and requirements for tree replacement or compensation can reduce tree losses as Long Branch grows.

5. Make Connections to Other City Initiatives

Trees are an essential and critical part of Long Branch's infrastructure. A review of City of Long Branch plans should be conducted to identify ways that trees can be used to meet goals, recommendations, and targets of other city plans and initiatives. For example, **information within this plan can be used to inform and update the Long Branch Master Plan.**

6. Community Outreach and Involvement

Outreach and education campaigns—including volunteer programs—can encourage citizens to care for and retain existing trees. Involving citizens in community tree initiatives is a great way to spread the word on the benefits of trees and develop a culture of tree appreciation that can have significant long-term impacts on tree canopy across Long Branch. Partnering with local organizations to help spread the word is a way to help get the message out.

7. Measure Canopy Changes On A Regular Basis

This project provided a tree canopy analysis with detailed information on the current canopy cover in Long Branch, as well as recommendations for supporting its growth and expansion. As initiatives are undertaken to preserve and care for existing trees and plant new ones, Long Branch will want to track progress and re-evaluate efforts towards meeting community goals. While a rigorous tree canopy analysis provides useful, detailed information, Long Branch can perform less rigorous self-assessments to track canopy changes using i-Tree Canopy. **Industry standards recommend assessing the tree canopy every 5–10 years.** For information on using i-Tree Canopy, visit www.itreetools.org. Long Branch is encouraged to continue to use the urban tree canopy data and additional datasets to analyze relationships and connections that can help develop community objectives, understand challenges, and frame urban forest management decisions.

FIVE-YEAR PLANTING PLAN

Stocking Potential

The tree population of the inventoried areas is 1,864 trees and 641 vacant planting sites. This means that the City of Long Branch's urban forest (excluding park/public space trees) is 74% stocked in the ROW. 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, 74% 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.

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.

The City of Long Branch has a stocking level of 74%. With a total of 641 vacant planting sites over a 5-year period, the City of Long Branch would reach its full stocking potential of 100% stocked in five years following the desired planting schedule of 128 trees per year. This goal, however, assumes that no trees are removed, no new streets are added, and all of 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 (annual average removals + natural mortality)

V = existing vacant sites

G = years remaining to achieve full stocking potential goal

S = expected planting survival rate

For example, the City of Long Branch has 641 available planting sites scattered throughout its existing ROW. If it is known that an average of 62 trees per year will be removed (this number is based on the Five-Year Urban Forestry Management Program budget, the average number of Removals in Years 1 through 5) and the planting survival rate over that period is 85%, the city will achieve full stocking in approximately 5 years if it follows its current planting plan of 223 trees per year:

$$N = \frac{62 + (641/5)}{0.85} = 223 \text{ trees/year}$$

In an effort to achieve the 29% increase in canopy coverage, the City of Long Branch is encouraged to strive for 100% stocking level.

Presented here is an estimated budget table that adheres to the optimal planting numbers recommended by Miller (1997) methodology. It's essential to acknowledge that the table doesn't factor in annual price fluctuations resulting from inflation. The provided figures serve as a baseline, and the actual costs may vary depending on local tree prices and labor rates. Keep in mind that the estimates offer a foundation, and additional considerations, such as potential yearly increases due to inflation, should be incorporated for comprehensive budget planning.

Table 6. Five-year ROW planting budget.

Year	Planting Cost/Tree (Purchasing, Planting, Watering and Mulch)	Number of Trees	Total Cost
1	$475.00	223	$105,925.00
2	$475.00	223	$105,925.00
3	$475.00	223	$105,925.00
4	$475.00	223	$105,925.00
5	$475.00	223	$105,925.00
Total		**233**	**$529,625.00**

YOUNG TREE TRAINING PROGRAM

The City of Long Branch has 78 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 trees. These include young trees under 6" DBH. Any new trees planted in the city should be included in the YTTP. The City of Long Branch's EC/GT is encouraged to reach out to local volunteer groups to set up a tree care program that is carried out on an annual basis. They should coordinate with the local garden clubs or local schools with environmental clubs, to schedule young tree training days. A certified arborist, from the City or hired on a per day basis, should be present to train the volunteers and guide them as they prune the young trees. The participants of the YTTP should be dedicated to the care and maintenance of the trees; they can participate in mulching, removing stakes, watering, and pruning the young trees.

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

It is important that 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 two or three-year cycle. One-half or one-third of the city's young trees can be trained each year. In Years 8 or 10, the tree will likely require minimal pruning. A two-year training cycle has been proposed within the framework of the 5-year budget plan (Table 3).

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 branches 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 reduce the size of the branch, should always be made at the nodes of the branch.

How to Prune Young Trees

Note: Prior to pruning, participants should tie loose flagging tape around selected branches to help gain a visual of the tree after pruning. While in training, the certified arborist should approve any cuts before they occur.

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 city 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. Lower branches should remain in trees that are 2 inches DBH and smaller.

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. 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

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. A total of 78 trees would benefit from training, 64 of which fall within 1-3" and 14 within 4-6". The table below assumes a two-year training cycle. As trees become established, they will move out of the young tree training program and into the five-year pruning cycle.

Table 7. Young Tree Training budget for first five years of program (excludes any new plantings).

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Young Tree Training (3-year Cycle)	1-3"	$20	32	$640	32	$640	32	$640	32	$640	32	$640	$3,200
	4-6"	$30	14	$420	0	$0	14	$420	0	$0	14	$420	$1,260
Activity Total(s)			**46**	**$1,060**	**32**	**$640**	**46**	**$1,060**	**32**	**$640**	**46**	**$1,060**	**$4,460**

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

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

Data Source	Data Year	Projection
Parcels NY GIS Clearinghouse	2022	GCS_North_American_1983 Authority: NJOGIS
Centerlines GIS Clearinghouse	2023	NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet WKID: 2263 Authority: NJOGIS

Data Source	Data Year	Projection
Boundary NY GIS Clearinghouse	2022	NAD_1983_StatePlane_New_Jersey_FIPS_2900_FeetWKID: 2263 Authority: NJGIN
Imagery	2020	NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet Authority: EPSG
ROW	2023	NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet Authority: EPSG

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

Methodology and Accuracy Assessment

Davey Resource Group Classification Methodology

Davey Resource Group utilized an object-based image analysis (OBIA) semi-automated feature extraction method to process and analyze current high-resolution color infrared (CIR) aerial imagery and remotely-sensed data to identify tree canopy cover and land cover classifications. The use of imagery analysis is cost-effective and provides a highly accurate approach to assessing your community's existing tree canopy coverage. This supports responsible tree management, facilitates community forestry goal-setting, and improves urban resource planning for healthier and more sustainable urban environments.

Advanced image analysis methods were used to classify, or separate, the land cover layers from the overall imagery. The semi-automated extraction process was completed using Feature Analyst, an extension of ArcGIS®. Feature Analyst uses an object-oriented approach to cluster together objects with similar spectral (i.e., color) and spatial/contextual (e.g., texture, size, shape, pattern, and spatial association) characteristics. The land cover results of the extraction process was post-processed and clipped to each project boundary prior to the manual editing process in order to create smaller, manageable, and more efficient file sizes. Secondary source data, high-resolution aerial imagery provided by each UTC city, and custom ArcGIS® tools were used to aid in the final manual editing, quality checking, and quality assurance processes (QA/QC). The manual QA/QC process was implemented to identify, define, and correct any misclassifications or omission errors in the final land cover layer.

Classification Workflow

1. Prepare imagery for feature extraction (resampling, rectification, etc.), if needed.
2. Gather training set data for all desired land cover classes (canopy, impervious, grass, bare soil, shadows). Water samples are not always needed since hydrologic data are available for most areas. Training data for impervious features were not collected because the City maintained a completed impervious layer.
3. Extract canopy layer only; this decreases the amount of shadow removal from large tree canopy shadows. Fill small holes and smooth to remove rigid edges.
4. Edit and finalize canopy layer at 1:2000 scale. A point file is created to digitize-in small individual trees that will be missed during the extraction. These points are buffered to represent the tree canopy. This process is done to speed up editing time and improve accuracy by including smaller individual trees.
5. Extract remaining land cover classes using the canopy layer as a mask; this keeps canopy shadows that occur within groups of canopy while decreasing the amount of shadow along edges.

6. Edit the impervious layer to reflect actual impervious features, such as roads, buildings, parking lots, etc. to update features.
7. Using canopy and actual impervious surfaces as a mask; input the bare soils training data and extract them from the imagery. Quickly edit the layer to remove or add any features. Davey Resource Group tries to delete dry vegetation areas that are associated with lawns, grass/meadows, and agricultural fields.
8. Assemble any hydrological datasets, if provided. Add or remove any water features to create the hydrology class. Perform a feature extraction if no water feature datasets exist.
9. Use geoprocessing tools to clean, repair, and clip all edited land cover layers to remove any self-intersections or topology errors that sometimes occur during editing.
10. Input canopy, impervious, bare soil, and hydrology layers into Davey Resource Group's Five-Class Land Cover Model to complete the classification. This model generates the pervious (grass/low-lying vegetation) class by taking all other areas not previously classified and combining them.
11. Thoroughly inspect final land cover dataset for any classification errors and correct as needed.
12. Perform accuracy assessment. Repeat Step 11, if needed.

Automated Feature Extraction Files

The automated feature extraction (AFE) files allow other users to run the extraction process by replicating the methodology. Since Feature Analyst does not contain all geoprocessing operations that Davey Resource Group utilizes, the AFE only accounts for part of the extraction process. Using Feature Analyst, Davey Resource Group created the training set data, ran the extraction, and then smoothed the features to alleviate the blocky appearance. To complete the actual extraction process, Davey Resource Group uses additional geoprocessing tools within ArcGIS®. From the AFE file results, the following steps are taken to prepare the extracted data for manual editing.

1. Davey Resource Group fills all holes in the canopy that are less than 30 square meters. This eliminates small gaps that were created during the extraction process while still allowing for natural canopy gaps.
2. Davey Resource Group deletes all features that are less than 9 square meters for canopy (50 square meters for impervious surfaces). This process reduces the amount of small features that could result in incorrect classifications and also helps computer performance.
3. The Repair Geometry, Dissolve, and Multipart to Singlepart (in that order) geoprocessing tools are run to complete the extraction process.
4. The Multipart to Singlepart shapefile is given to GIS personnel for manual editing to add, remove, or reshape features.

Accuracy Assessment Protocol

Land Cover Classification	Code Value
Tree Canopy	1
Impervious	2
Pervious (Grass/Vegetation)	3
Bare Soil	4
Open Water	5

Determining the accuracy of spatial data is of high importance to Davey Resource Group and our clients. To achieve to best possible result, Davey Resource Group manually edits and conducts thorough QA/QC checks on all urban tree canopy and land cover layers. A QA/QC process will be completed using ArcGIS® to identify, clean, and correct any misclassification or topology errors in the final land cover dataset. The initial land cover layer extractions will be edited at a 1:2000 quality control scale in the urban areas and at a 1:2500 scale for rural areas utilizing the most current high-resolution aerial imagery to aid in the quality control process.

To test for accuracy, random plot locations are generated throughout the city area of interest and verified to ensure that the data meet the client standards. Each point will be compared with the most current NAIP high-resolution imagery (reference image) to determine the accuracy of the final land cover layer. Points will be classified as either correct or incorrect and recorded in a classification matrix. Accuracy will be assessed using four metrics: overall accuracy, kappa, quantity disagreement, and allocation disagreement. These metrics are calculated using a custom Excel® spreadsheet.

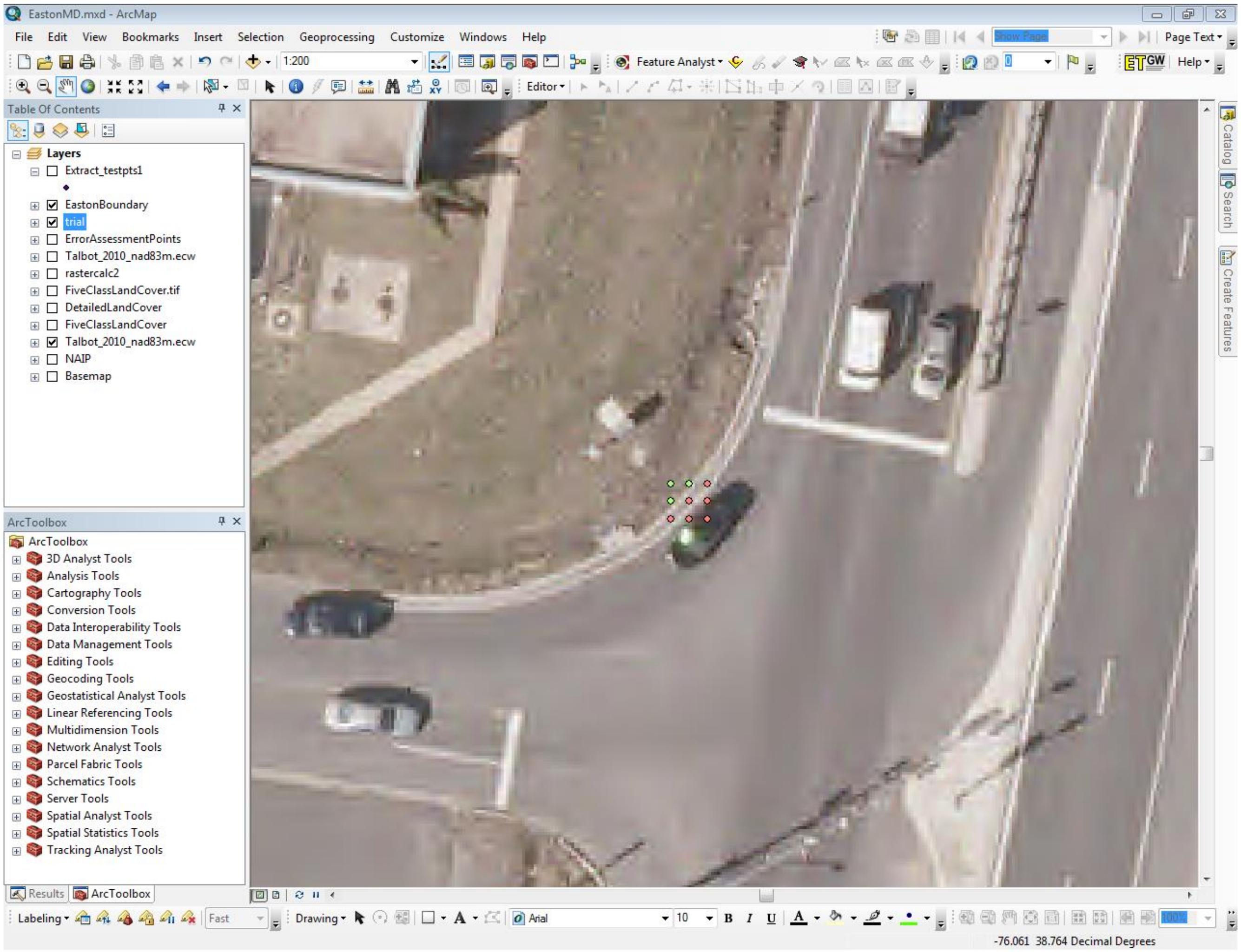
Land Cover Accuracy

The following describes Davey Resource Group's accuracy assessment techniques and outlines procedural steps used to conduct the assessment.

1. *Random Point Generation*—Using ArcGIS, 1,000 random assessment points are generated.

2. *Point Determination*—Each point is carefully assessed by the GIS analyst for likeness with the aerial photography. To record findings, two new fields, CODE and TRUTH, are added to the accuracy assessment point shapefile. CODE is a numeric value (1–5) assigned to each land cover class (Table 1) and TRUTH is the actual land cover class as identified according to the reference image. If CODE and TRUTH are the same, then the point is counted as a correct classification. Likewise, if the CODE and TRUTH are not the same, then the point is classified as incorrect. In most cases, distinguishing if a point is correct or incorrect is straightforward. Points will rarely be misclassified by an egregious classification or editing error. Often incorrect points occur where one

feature stops and the other
begins.



3. *Classification Matrix*—During the accuracy assessment, if a point is considered incorrect, it is given the correct classification in the TRUTH column. Points are first assessed on the NAIP imagery for their correctness using a "blind" assessment—meaning that the analyst does not know the actual classification (the GIS analyst is strictly going off the NAIP imagery to determine cover class). Any incorrect classifications found during the "blind" assessment are scrutinized further using sub-meter imagery provided by the client to determine if the point was incorrectly classified due to the fuzziness of the NAIP imagery or an actual misclassification. After all random points are assessed and recorded; a classification (or confusion) matrix is created. The classification matrix for this project is presented in Table 2. The table allows for assessment of user's/producer's

accuracy, overall accuracy, omission/commission errors, kappa statistics, allocation/quantity disagreement, and confidence intervals (Figure 1 and Table 3).

	Classes	Tree Canopy	Impervious Surfaces	Grass & Low-Lying Vegetation	Bare Soils	Open Water	Row Total	Producer's Accuracy	Errors of Omission
Reference Data	Tree Canopy	173	7	11	0	1	192	90.10%	9.90%
	Impervious	2	417	19	2	0	440	94.77%	5.23%
	Grass/Vegetation	5	4	261	0	0	270	96.67%	3.33%
	Bare Soils	0	0	1	44	0	45	97.78%	2.22%
	Water	0	0	0	0	53	53	100.00%	0.00%
	Column Total	180	428	292	46	54	1000		
	User's Accuracy	96.11%	97.43%	89.38%	95.65%	98.15%		Overall Accuracy	94.80%
	Errors of Commission	3.89%	2.57%	10.62%	4.35%	1.85%		Kappa Coefficient	0.9250

4. Following are descriptions of each statistic as well as the results from some of the accuracy assessment tests.

Overall Accuracy – Percentage of correctly classified pixels; for example, the sum of the diagonals divided by the total points ((173+417+261+44+53)/1,000 = 94.8%).

User's Accuracy – Probability that a pixel classified on the map actually represents that category on the ground (correct land cover classifications divided by the column total [173/180 = 96.11%]).

Producer's Accuracy – Probability of a reference pixel being correctly classified (correct land cover classifications divided by the row total [173/192 = 96.10%]).

Kappa Coefficient – A statistical metric used to assess the accuracy of classification data. It has been generally accepted as a better determinant of accuracy partly because it accounts for random chance agreement. A value of 0.80 or greater is regarded as "very good" agreement between the land cover classification and reference image.

Errors of Commission – A pixel reports the presence of a feature (such as trees) that, in reality, is absent (no trees are actually present). This is termed as a false positive. In the matrix below, we can determine that 3.89% of the area classified as canopy is most likely not canopy.

Errors of Omission – A pixel reports the absence of a feature (such as trees) when, in reality, they are actually there. In the matrix below, we can conclude that 9.9% of all canopy classified is actually classified as another land cover class.

Allocation Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than optimal match in the spatial allocation (or position) of the classes.

Quantity Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than perfect match in the proportions (or area) of the classes.

Confidence Intervals – A confidence interval is a type of interval estimate of a population parameter and is used to indicate the reliability of an estimate. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter based on the observed probability of successes and failures. Since all assessments have innate error, defining a lower and upper bound estimate is essential.

Confidence Intervals

Class	Acreage	Percentage	Lower Bound	Upper Bound
Tree Canopy	603.4	17.2%	16.6%	17.9%
Impervious Surfaces	1,538.9	43.9%	43.1%	44.7%
Grass & Low-Lying Vegetation	1,020.9	29.1%	28.4%	29.9%
Bare Soils	154.4	4.4%	4.1%	4.7%
Open Water	187.9	5.4%	5.0%	5.7%
Total	3,505.4	100.00%		

Statistical Metrics Summary	
Overall Accuracy =	94.80%
Kappa Coefficient =	0.9250
Allocation Disagreement =	3%
Quantity Disagreement =	2%

Accuracy Assessment

Class	User's Accuracy	Lower Bound	Upper Bound	Producer's Accuracy	Lower Bound	Upper Bound
Tree Canopy	96.1%	94.7%	97.6%	90.1%	87.9%	92.3%
Impervious Surfaces	97.4%	96.7%	98.2%	94.8%	93.7%	95.8%
Grass & Low-Lying Vegetation	89.4%	87.6%	91.2%	96.7%	95.6%	97.8%
Bare Soils	95.7%	92.6%	98.7%	97.8%	95.6%	100.0%
Open Water	98.1%	96.3%	100.0%	100.0%	100.0%	100.0%

APPENDIX C
SUGGESTED TREE SPECIES

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is offered to assist all relevant community personnel in selecting appropriate tree species. These trees have been selected because of their aesthetic and functional characteristics and their ability to thrive in the soil and climate conditions throughout Zone 7a on the USDA Plant Hardiness Zone Map.

DECIDUOUS TREES

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar	Native (Yes/No)	Aerosol Salt Tolerance	Soil Salt Tolerance
*Aesculus flava**	yellow buckeye		Y	Moderate	
*Betula lenta**	sweet birch		Y		
*Carya illinoensis**	pecan		N		
*Carya laciniata**	shellbark hickory		Y		
Celtis laevigata	sugar hackberry	'All Seasons'	Y	High	Moderate
Celtis occidentalis	common hackberry	'Prairie Pride'	Y	Moderate	Moderate
Cercidiphyllum japonicum	katsuratree	'Aureum'	N	Moderate	
*Diospyros virginiana**	common persimmon		Y	High	Moderate
*Juglans nigra**	black walnut		Y	High	Moderate
Liquidambar styraciflua	American sweetgum	'Rotundiloba'	Y	Moderate	
Magnolia grandiflora	Southern magnolia		Y	Moderate	Moderate
*Magnolia macrophylla**	*bigleaf magnolia*		N		
Nyssa sylvatica	black tupelo		Y	Moderate	Moderate
*Platanus occidentalis**	American sycamore		Y		
Quercus alba	white oak		Y	High	Moderate
Quercus coccinea	scarlet oak		Y	Moderate	
Quercus macrocarpa	bur oak		Y	High	Moderate
Quercus imbricaria	shingle oak		Y	High	
Quercus phellos	willow oak		Y	High	
Quercus robur	English oak	Heritage®	N	High	Moderate
Quercus rubra	northern red oak	'Splendens'	Y	High	Moderate
Quercus shumardii	Shumard oak		N	Moderate	

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

Scientific Name	Common Name	Cultivar	Native (Yes/No)	Aerosol Salt Tolerance	Soil Salt Tolerance
Styphnolobium japonicum	Japanese pagodatree	'Regent'	N	Moderate	
Taxodium distichum	common baldcypress	'Shawnee Brave'	Y	Moderate	Moderate
Tilia × euchlora	Crimean linden		N	Moderate	Moderate
Tilia tomentosa	silver linden	'Sterling'	N	Moderate	
Ulmus parvifolia	Chinese elm	Allée®	N	Moderate	
Zelkova serrata	Japanese zelkova	'Green Vase'	N	Moderate	

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar	Native (Yes/No)	Aerosol Salt Tolerance	Soil Salt Tolerance
Aesculus × carnea	red horsechestnut		N	Moderate	Moderate
Alnus cordata	Italian alder		N	High	
Cladrastis kentukea	American yellowwood	'Rosea'	Y	Moderate	Moderate
Eucommia ulmoides	hardy rubber tree		N	Moderate	Moderate
Koelreuteria paniculata	goldenraintree		N	Moderate	Moderate
Phellodendron amurense	amur corktree	'Macho'	N	Moderate	
Prunus maackii	amur chokecherry	'Amber Beauty'	N	Moderate	Moderate
Prunus sargentii	Sargent cherry		N	Moderate	Moderate
*Pterocarya fraxinifolia**	Caucasian wingnut		N		
Quercus acutissima	sawtooth oak		N	Moderate	
Quercus cerris	European turkey oak		N	Moderate	Moderate

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar	Native (Yes/No)	Aerosol Salt Tolerance	Soil Salt Tolerance
Acer griseum	paperbark maple		N	Moderate	Moderate
Amelanchier canadensis	shadblow serviceberry		Y	Moderate	Moderate
Amelanchier arborea	downy serviceberry	(Numerous exist)	Y	Moderate	Moderate
Amelanchier laevis	Allegheny serviceberry		Y	Moderate	Moderate
Cornus kousa	Kousa dogwood	(Numerous exist)	N	Moderate	Moderate
*Cotinus coggygria**	common smoketree	'Flame'	N	Moderate	Moderate
Maackia amurensis	amur maackia		N	Moderate	Moderate
Malus spp.	flowering crabapple	(Disease resistant only)	Y	Moderate	Moderate
Oxydendrum arboreum	sourwood	'Mt. Charm'	Y	Moderate	
Prunus virginiana	common chokecherry	'Schubert'	Y		Moderate
*Styrax japonicus**	Japanese snowbell	'Emerald Pagoda'	N	Moderate	
Syringa reticulata	Japanese tree lilac	'Ivory Silk'	N	High	Moderate

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

CONIFEROUS TREES

Large Trees: Greater than 45 Feet in Heigh at Maturity

Scientific Name	Common Name	Cultivar	Native (Yes/No)	Salt Tolerance	Soil Salt Tolerance
Picea abies	Norway spruce		N	Moderate	Moderate
Pinus strobus	eastern white pine		Y	Moderate	Moderate
Taxodium distichum	bald cypress	'Shawnee Brave'	Y	Moderate	Moderate

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar	Native (Yes/No)	Aerosol Salt Tolerance	Soil Salt Tolerance
Chamaecyparis thyoides	atlantic whitecedar	(Numerous exist)	Y		
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'	N	Moderate	Moderate
Juniperus virginiana	eastern redcedar		Y	High	Moderate
Pinus bungeana	lacebark pine		N		
Pinus flexilis	limber pine		N		
Pinus nigra	Austrian pine		N	High	Moderate
Pinus parviflora	Japanese white pine		N		
Pinus thunbergii	Japanese black pine		N	High	Moderate
Thuja occidentalis	eastern arborvitae	(Numerous exist)	Y	Moderate	

Dirr's Hardy Trees and Shrubs (Dirr 2013) and *Manual of Woody Landscape Plants (5th Edition)* (Dirr 1988) were consulted to compile this suggested species list. Cultivar selections are recommendations only and are based on DRG's experience. Tree availability will vary based on availability in the nursery trade.

NYC Parks and Street Tree + Park Tree Species Tolerance Guide 2017 was consulted for aerosol and soil salt tolerance.

APPENDIX D
MAP OF INVENTORIED SITES

Map 8. Map of inventoried sites in Long Branch, NJ pulled from TreeKeeper.