Tree Inventory Summary Report

Village of Nyack, New York

October 2015

Prepared for:
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Acknowledgments

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

Nyack is thankful for the grant funding it received from the New York State Department of Environmental Conservation (NYSDEC) Urban and Community Forestry grant.

Notice of Disclaimer:

Inventory data provided by Davey Resource Group, a division of The Davey Tree Expert Company, are based on visual recording at the time of inspection. Visual records do not include individual testing or analysis, nor do they include aerial or subterranean inspection. Davey Resource Group is not responsible for the discovery or identification of hidden or otherwise non-observable hazards. Records may not remain accurate after inspection due to the variable deterioration of inventoried material. Davey Resource Group provides no warranty with respect to the fitness of the urban forest for any use or purpose whatsoever. Clients may choose to accept or disregard Davey Resource Group's recommendations, or to seek additional advice. Important: know and understand that visual inspection is confined to the designated subject tree(s) and that the inspections for this project are performed in the interest of facts of the tree(s) without prejudice to or for any other service or any interested party.

Executive Summary

The Village of Nyack commissioned an inventory and assessment of the trees, stumps, and planting sites located within public street rights-of-way (ROW), and in public parks and facilities. Since the inventory was conducted without parcel data, the trees collected were assumed to fall within the ROW due to the presence of ROW indicators such as sidewalks, utility poles, fences, driveway cuts, and hydrants. Understanding an urban forest's structure, function, and value can promote management decisions that will improve public health and environmental quality. Davey Resource Group collected and analyzed the inventory data to understand species composition and tree condition, and to generate maintenance recommendations. Values and benefits of village-owned trees have been quantified using the i-Tree Streets benefits model (developed by the United States Department of Agriculture Forest Service in partnership with The Davey Tree Expert Company). The private trees included in the inventory are not reflected in the statistics of this summary report. This report will discuss the health and benefits of the inventoried public tree population throughout the village.

Key Findings

- The appraised value of Nyack's inventoried tree population is approximately $3 million.
- The overall condition of the tree population is rated Fair.
- The most common species are: *Acer platanoides* (Norway maple), 13%; *Pyrus calleryana* (Callery pear), 7%; *Acer rubrum* (red maple), 6%; *Morus alba* (white mulberry), 6%; and *Platanus* × *acerifolia* (London planetree), 6%.
- The plurality (47%) of the urban forest is in the young, 0–8 inches DBH class.
- Approximately 63% of the population is recommended for a Tree Clean, 26% is recommended for a Young Tree Train, and 11% is recommended for Removal.
- Trees provide approximately $104,712 in the following annual benefits:
    - *Aesthetic and Other Tangible Benefits*: valued at $43,311 per year.
    - *Air Quality*: valued at $7,567 per year.
    - *Net Total Carbon Sequestered and Avoided*: 149.12 tons valued at $984 per year.
    - *Energy*: 65.6 megawatt-hours (MWh) and 24,009 British thermal units (therms) valued at $42,991 per year.
    - *Stormwater:* 1,232,359 gallons valued at $9,859 per year.

See Appendix A for an overview of the methodology used in the inventory and assessment.

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Section 1: Tree Inventory Assessment

Project Area

In April 2015, Davey Resource Group arborists assessed and inventoried trees, stumps, and planting sites along Nyack's street ROW and in specified public parks and facilities within the village. Additional information about the inventory can be found in Appendix B.

Species Diversity

Throughout Nyack's ROW, 1,475 sites were inventoried, including 950 trees, 44 stumps, and 481 vacant planting sites. Figure 1 shows the composition of the most populous species compared to all inventoried species. The composition of a tree population should follow the 10-20-30 Rule for species diversity: a single species should represent no more than 10% of the urban forest, a single genus no more than 20%, and a single family no more than 30%.

Norway maple (13%) is the only species in Nyack that exceeds the 10% threshold. All other species comprise less than 10% of the total inventoried population.

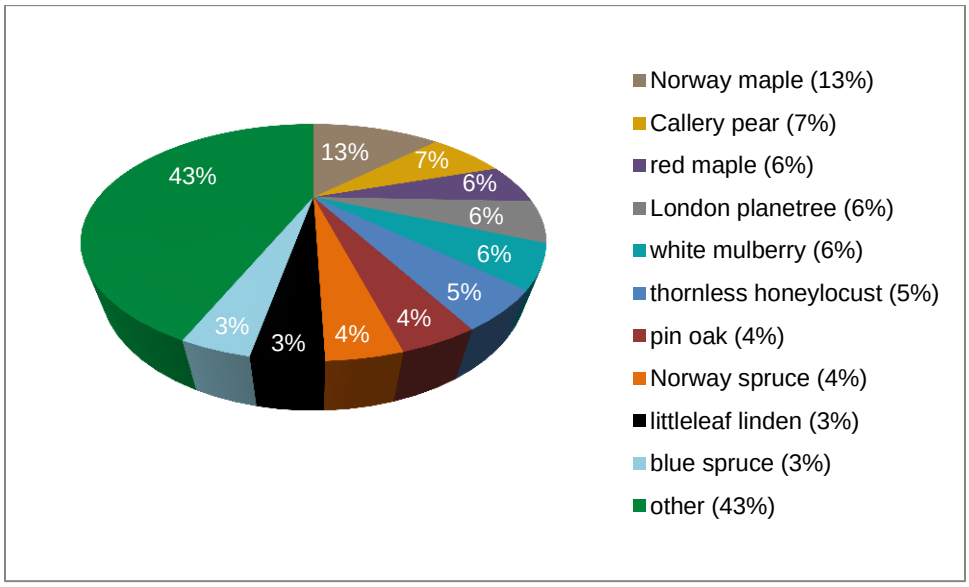
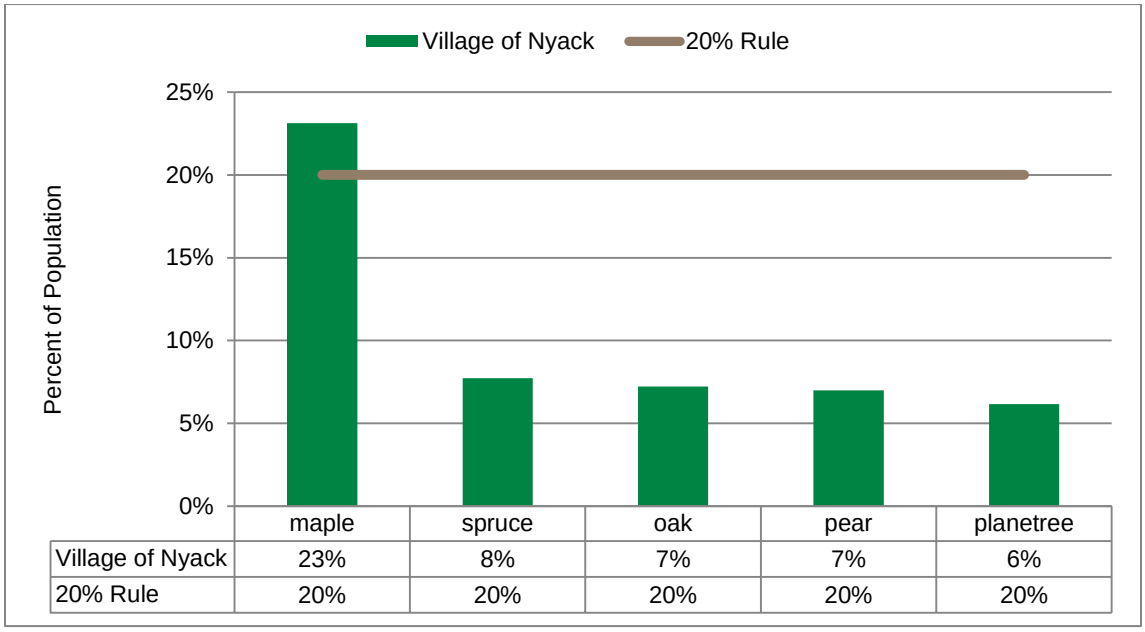


Figure 1. Tree species composition in the Village of Nyack.

Figure 2 compares the percentages of the most common genera identified during the inventory to the 20% Rule. *Acer* (maple) exceeds the recommended 20% threshold for a single genus in a population. Maple comprises 23% of the street ROW tree population, while all other genera comprise less than 10% of the population.



	maple	spruce	oak	pear	planetree
Village of Nyack	23%	8%	7%	7%	6%
20% Rule	20%	20%	20%	20%	20%

Figure 2. Top five genera in the Village of Nyack in relation to the 20% Rule.

Diameter Size Class Distribution

Analyzing the diameter size class distribution (measured as diameter at breast height [DBH]) provides an estimate of the relative age of a tree population and insight into maintenance practices and needs.

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

Figure 3 compares Nyack's inventoried street ROW tree diameter size class distribution to the ideal proposed by Richards (1983). Nyack's distribution trends toward the ideal; however, maturing and mature trees fall short of the ideal by nearly 7% and 2%, respectively. Continued tree planting, care, and maintenance of the young and established tree population will result in an ideal urban forest.

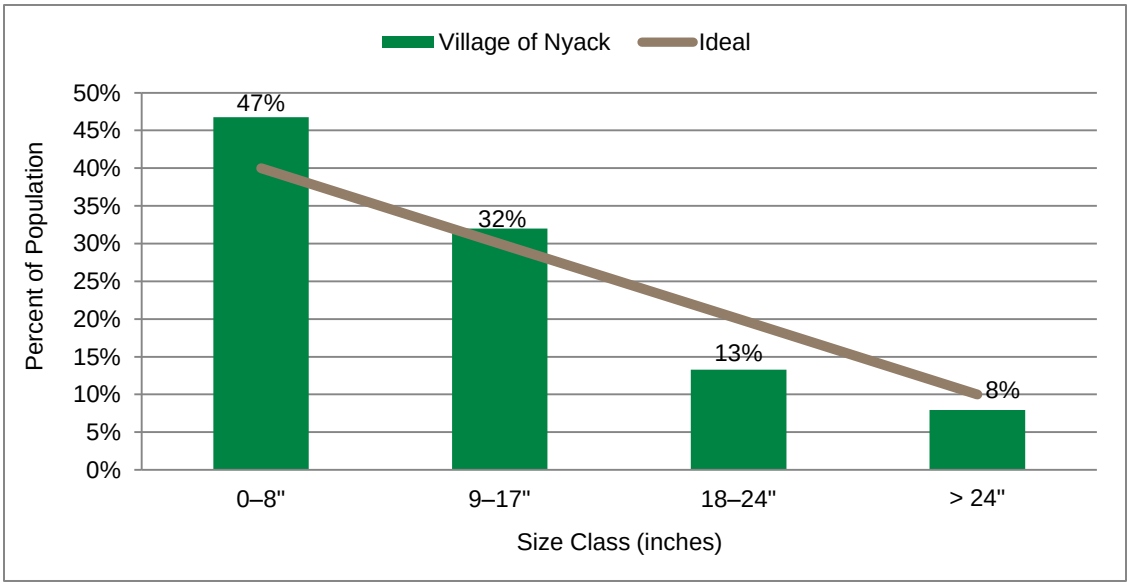
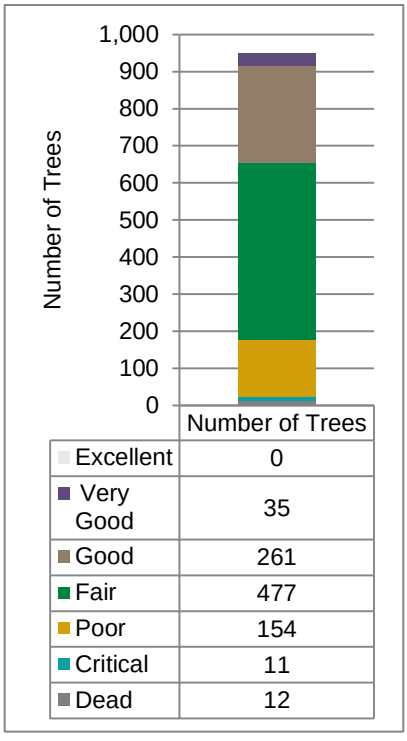


Figure 3. Age class distribution compared to Richards' (1983) ideal.

Condition

Several factors were considered for the condition of each tree, including: root characteristics; branch structure; trunk, canopy, and foliage condition; and the presence of pests. The condition of each inventoried tree was rated Excellent, Very Good, Good, Fair, Poor, Critical, or Dead.

Most of the inventoried ROW trees were recorded to be in Fair or Good condition, 50% and 27%, respectively (Figure 4). Based on these data, the general health of the overall inventoried tree population is rated Fair.



	Number of Trees
Excellent	0
Very Good	35
Good	261
Fair	477
Poor	154
Critical	11
Dead	12

Figure 4. Overall condition of the population.

Figure 5 illustrates the general condition of the urban forest in relation to the relative age classes. The majority of young, established, maturing, and mature trees were rated to be in Fair condition; however, there was also a significant number of young trees in Good condition. As the population became established, the number of Poor to Dead trees increased and remained relatively steady, while the number of Good trees decreased compared to young trees. With proactive care and an established maintenance schedule, Nyack can improve the long-term health of its urban forest.

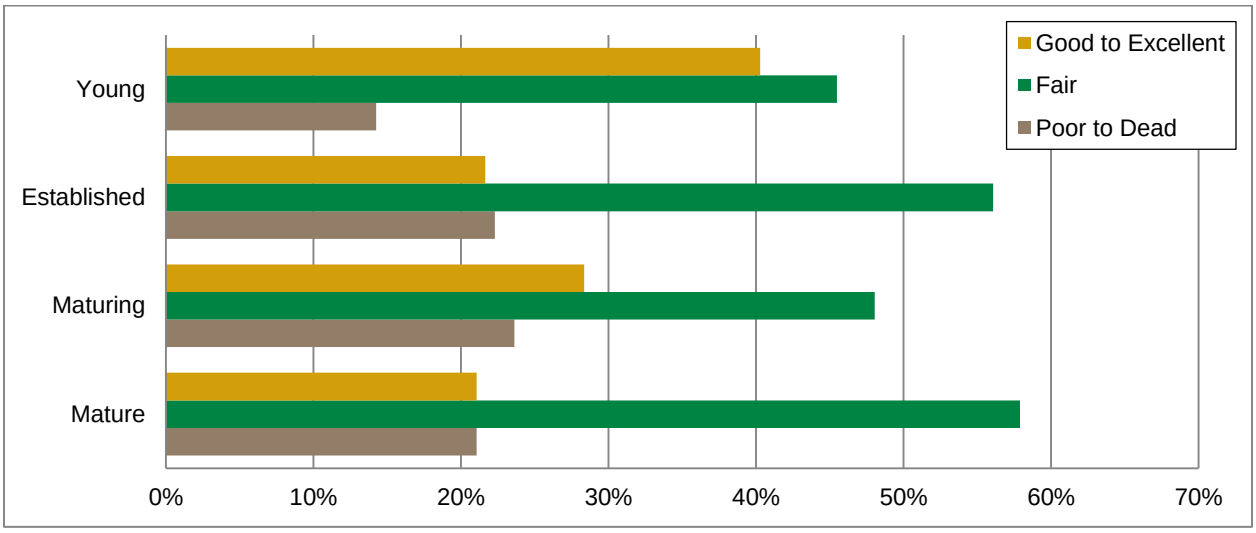


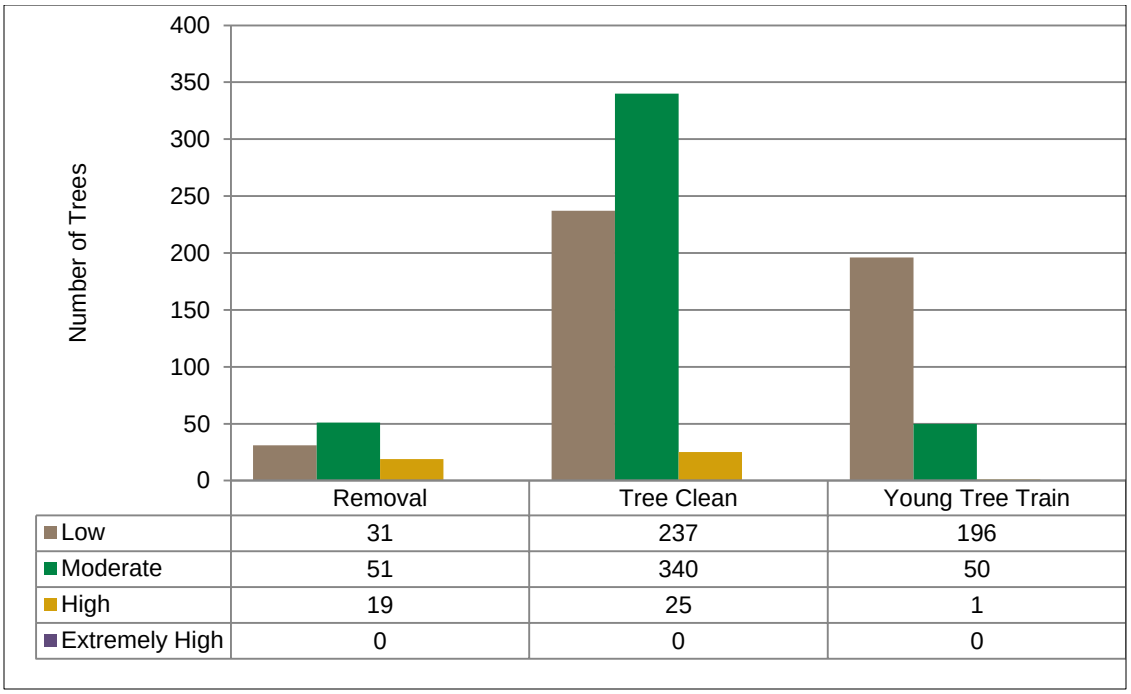
Figure 5. Tree condition by age class.

Primary Maintenance and Risk

Primary maintenance refers to the task identified for a tree or site: Removal, Tree Clean, or Young Tree Train. Risk is a graduated scale that measures potential tree-related hazardous conditions. A tree is considered hazardous when its potential risks exceed an acceptable level.

Davey Resource Group based the maintenance recommendations and probability of failure values (Figure 6) on the evaluation of species, diameter class, condition, impact of hazard, and defects found in the individual tree. Identifying and ranking the maintenance needs of a tree population enable tree work to be assigned priority based on observed risk. Once prioritized, tree work can be systematically addressed to eliminate the greatest risk and liability first (Stamen 2011).

The inventoried population in Nyack has a total of 101 recommended removals, 602 Tree Cleans, and 247 Young Tree Trains. Figure 6 illustrates the risk values associated with each maintenance need.



	Removal	Tree Clean	Young Tree Train
Low	31	237	196
Moderate	51	340	50
High	19	25	1
Extremely High	0	0	0

Figure 6. Maintenance needs by probability of failure.

Tree Plantings

Planting trees is necessary to maintain canopy cover and replace trees that have been removed or lost to natural mortality (expected to be 1–3% per year) or other threats (for example, construction, invasive pests, or impacts from weather events such as storms, wind, ice, snow, flooding, and drought).

Village tree planting should focus on creating canopy in areas that promote economic growth (such as business districts), in parking lots and near buildings with insufficient shade, and where there are gaps in the existing canopy. Trees of varied species should be planted; however, the planting of all *Acer* spp. (maple) should be limited until the species distribution normalizes. Due to the species distribution and impending threats from emerald ash borer (*Agrilus planipennis*) (EAB) in the Hudson Valley, all *Fraxinus* spp. (ash) trees should be temporarily removed from the planting list or planted only when a landscape plan is in place.

Trees provide many environmental and economic benefits that justify the time and money invested in their maintenance.

Due to the high density of infrastructure and extensive impervious surface area, the number of large and medium planting sites are relatively low within commercial zones because ample growing room was not sufficient to adequately support those tree sizes. If tree plantings are to occur in these locations, impervious surfaces will need to be removed. It is recommended that trees be planted in these areas so that the village receives the greatest return on benefits. Target areas for trees include parking lots and wide sidewalk areas where green infrastructure devices such as structural soil installations, manufactured tree box filters, or pervious pavement could be utilized to expand plantable areas.

Nyack has many opportunities to improve its urban forest, especially considering the relatively high volume of vacant planting sites and stumps. Planned tree planting can increase the economic and environmental benefits the village receives from its trees.

Recommendations

- Replace impervious pavement with permeable infrastructure whenever practical and/or when updates to current infrastructure are needed.
- Place trees in parking lots and along parking lot edges to reduce heavy sheet runoff from storm events and to mitigate the urban heat island effect.
- Plant medium and large trees to receive the greatest reduction of runoff and urban heat island effect.
- Plant small- to medium-sized trees based on available growth space.
- Grind stumps thoroughly to create additional planting sites wherever practical.
- Focus on planting sites that will be suitable for medium or large trees; consider the ultimate size and type of the engineered site when making this determination.

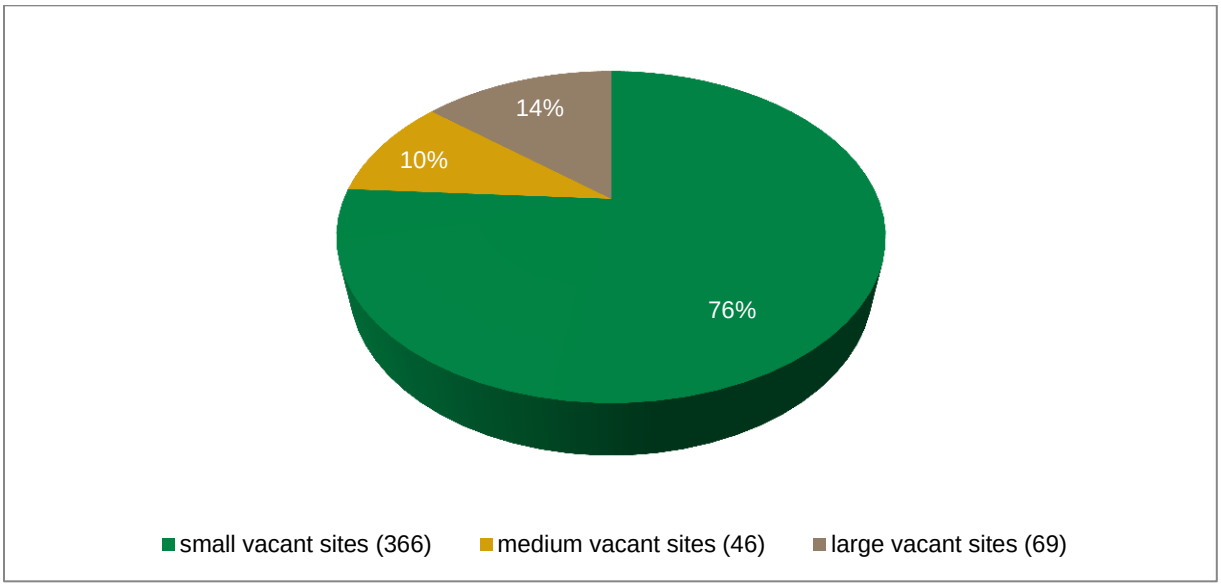


Figure 7. Planting site distribution.

Engineered Planting Sites

Of the 366 small tree planting sites, 58 potential planting sites (noted as small vacant sites) and 1 stump were inventoried that would require significant site modifications in order to be viable. These sites are referred to as "engineered" planting sites.

In order for trees to thrive in these engineered planting sites, hardscape modification is necessary. This could entail sidewalk narrowing or removal to expose existing native soil. Impervious hardscape including asphalt or concrete could be replaced by a porous surface treatment. A permeable articulating concrete block or mat can be installed quickly and economically. An example of this type of permeable hardscape is PaveDrain™.

An approximation of rooting volume that could allow medium- to large-sized trees to thrive is 1,000 cubic feet per planting site. This volume is not always achievable due to site restrictions; however, it is a target to strive towards when making planting decisions. There is also a crown projection method used to more accurately calculate required soil volume for specific trees. This method can be found at the Cornell University Urban Horticulture Institute website.

The Urban Horticulture Institute also has detailed information concerning the engineered rooting material known as CU Structural Soil™. This material satisfies the need for both a load-bearing subsurface treatment as well as enhanced root growth. Appendix D contains detailed diagrams for the use of CU Structural Soil™.

In addition, engineered planting sites that use PaveDrain™ and CU Structural Soil™ or comparable materials have been shown to support healthy trees while reducing stormwater runoff. There are other means to reach this goal, but this combination has a proven track record.

Section 2: i-Tree Streets Benefits

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

The inventoried urban forest of the Village of Nyack provides an annual benefit of approximately $104,712 in energy savings, stormwater reduction, increased property values, and overall air quality improvements. Figure 8 provides a breakdown of the annual benefits provided to Nyack.

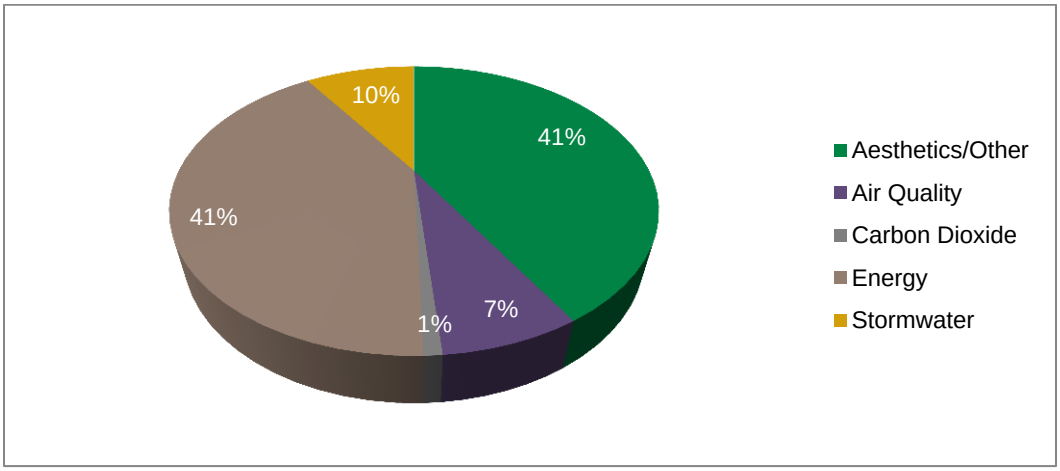


Figure 8. Annual i-Tree benefits.

Trees and Energy Use

Public trees conserve energy by shading structures and surfaces, reducing electricity use for air conditioning in the summer, and diverting wind in the winter to reduce natural gas use. Based on the inventoried trees, the annual electric and natural gas savings are equivalent to 65.6 MWh of electricity and 24,009 therms of natural gas. When converted into monetary values using default economic data, this accounts for an annual savings of $42,991 in energy consumption. Large leafy canopies provide greater reductions in energy use by providing shade and natural wind barriers. In contrast, smaller trees tend to have minor reductions in energy usage.

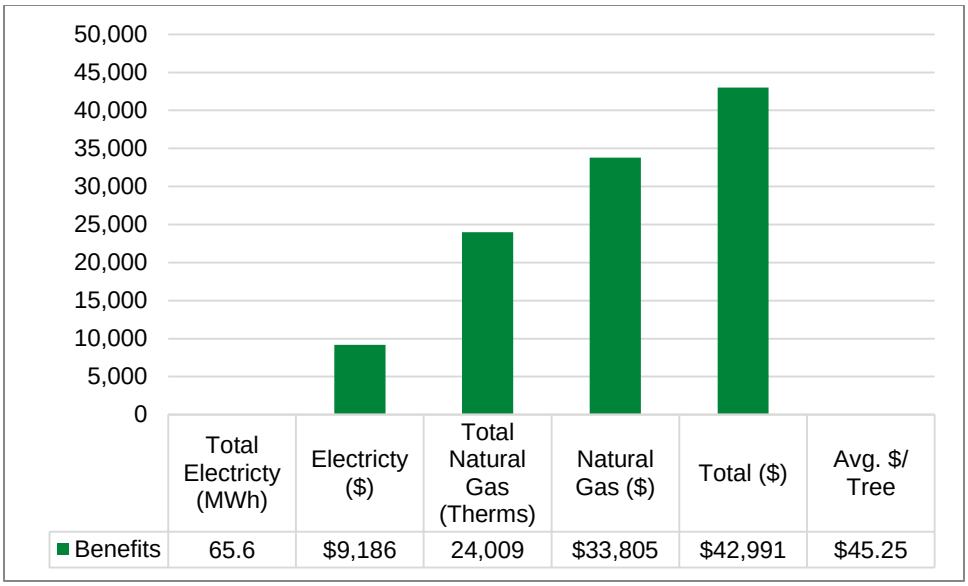


Figure 9. i-Tree energy report.

Stormwater Interception and Mitigation

Trees intercept rainfall, which reduces costs to manage stormwater runoff. Nyack's trees intercept 1,232,359 gallons of rainfall annually. The estimated average savings for Nyack in stormwater management is approximately $9,859 per year.

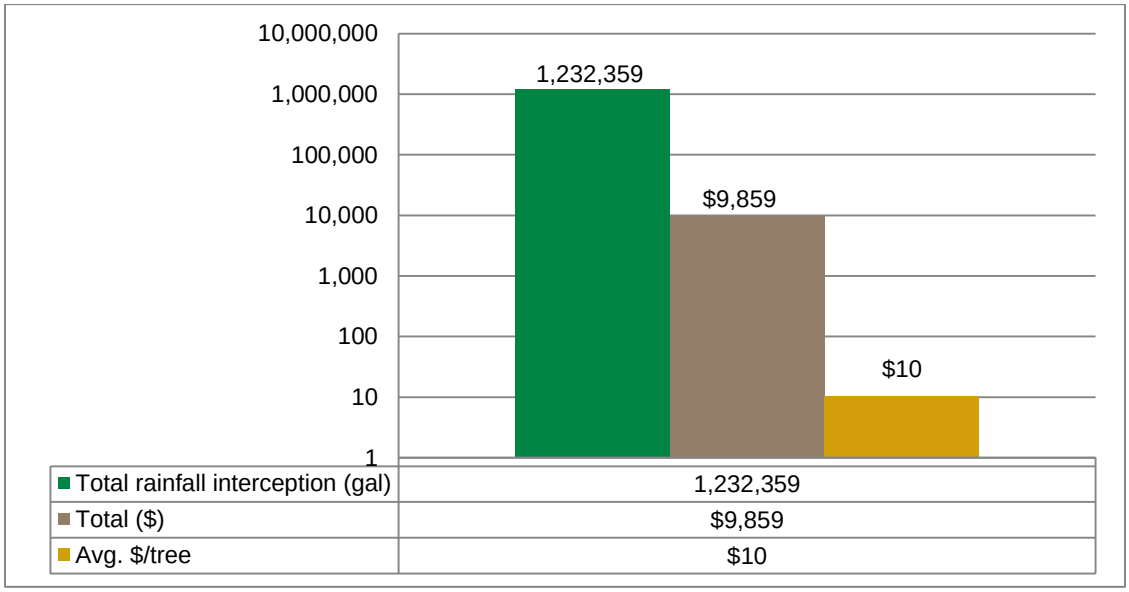


Figure 10. i-Tree stormwater report.

Conclusion and Recommendations

Managing trees in urban areas is often complicated. Navigating the recommendations of experts, the needs of residents, the pressures of local economics and politics, concerns for public safety and liability, physical components of trees, forces of nature and severe weather events, and the expectation that these issues are resolved all at once is a considerable challenge.

The Village of Nyack must carefully consider these challenges to fully understand the needs of maintaining an urban forest. By completing a tree inventory, the village has shown interest in preserving the urban forest, but also maintaining it for future generations. If the village successfully implements established planting and maintenance programs that include Young Tree Training, Routine Pruning, and public outreach, the health and safety of Nyack's trees and citizens will be maintained for years to come.

Nyack's urban forest is in Fair condition and provides $104,712 in annual benefits. With continued dedication to its street tree resource, the village can improve the condition and diversity of its trees and increase the annual benefits they provide.

Glossary

Aesthetic/Other Report: The i-Tree Streets Aesthetic/Other Report presents the tangible and intangible benefits of trees reflected in increases in property values in dollars ($).

Air Quality Report: The i-Tree Streets Air Quality Report quantifies the air pollutants (ozone [O_3], nitrogen dioxide [NO_2], sulfur dioxide [SO_2], coarse particulate matter less than 10 micrometers in diameter [PM_{10}]) deposited on tree surfaces, and reduced emissions from power plants (NO_2, PM_{10}, Volatile Oxygen Compounds [VOCs], SO_2) due to reduced electricity use measured in pounds (lbs.). Also reported are the potential negative effects of trees on air quality due to Biogenic Volatile Organic Compounds (BVOC) emissions.

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

canopy: Branches and foliage that make up a tree's crown.

Carbon Dioxide Report: The i-Tree Streets Carbon Dioxide Report presents annual reductions in atmospheric CO_2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use in pounds. The model accounts for CO_{2+} released as trees die and decompose and CO_2 released during the care and maintenance of trees.

clean (primary maintenance need): Based on *ANSI A300 (Part 1)* standards, selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk.

community forest: see **urban forest**.

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

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

diameter: See **tree size**.

Energy Report: The i-Tree Streets Energy Report presents the contribution of the urban forest toward conserving energy in terms of reduced natural gas use in winter measured in therms [th] and reduced electricity use for air conditioning in summer measured in megawatt-hours (MWh).

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

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

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

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

High Risk tree: Tree that cannot be cost-effectively or practically treated. Most High Risk trees have multiple or significant defects affecting less than 40% of the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely between 4–20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

Importance Values: A calculation in i-Tree Streets. Importance Values (IV) are displayed in table form for all species that make up more than 1% of the population. The Streets IV is the mean of three relative values (percentage of total trees, percentage of total leaf area, and percentage of canopy cover) and can range from 0 to 100 with an IV of 100 suggesting total reliance on one species. IVs offer valuable information about a community's reliance on certain species to provide functional benefits. For example, a species might represent 10% of a population, but have an IV of 25% because of its great size, indicating that the loss of those trees due to pests or disease would be more significant than their numbers suggest.

inventory: See **tree inventory**.

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

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

Low Risk tree: Tree with minor visible structural defects or wounds in areas with moderate to low public access.

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

Moderate Risk tree: Tree with defects that may be cost-effectively or practically treated. Most of the trees in this category exhibit several moderate defects affecting more than 40% of a tree's trunk, crown, or critical root zone.

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

Net Annual Benefits: Specific data field for i-Tree Streets. Citywide benefits and costs are calculated according to category and summed. Net benefits are calculated as benefits minus costs.

Nitrogen Dioxide (NO_2): Nitrogen dioxide is a compound typically created during the combustion processes and is a major contributor to smog formation and acid deposition.

Ozone (O_3): A strong-smelling, pale blue, reactive toxic chemical gas with molecules of three oxygen atoms. It is a product of the photochemical process involving the Sun's energy. Ozone exists in the upper layer of the atmosphere as well as at the Earth's surface. Ozone at the Earth's surface can cause numerous adverse human health effects. It is a major component of smog.

Particulate Matter (PM_{10}): A major class of air pollutants consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and mists.

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

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

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

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

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

risk assessment (data fields): The risk assessment is a point-based assessment of each tree by an arborist using a protocol based on the US Forest Service Community Tree Risk Rating System. In the field, the probability of tree or tree part failure is assigned 1–4 points (identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions), the size of defective tree part is assigned 1–3 points (rates the size of the part most likely to fail), the probability of target impact by the tree or tree part is assigned 1–3 points (rates the use and occupancy of the area that would be struck by the defective part), and other risk factors are assigned 0–2 points (used if professional judgment suggests the need to increase the risk rating). The data from the risk assessment is used to calculate the risk rating that is ultimately assigned to the tree.

risk rating: Calculated from the field risk assessment data (see **risk assessment**), this is the sum of total risk assessment values. Risk ratings range from 3–10, with 3 being the lowest risk and 10 being the highest risk. In this Plan, the risk rating was used to identify the severity of risk assigned to a tree and to prioritize tree maintenance needs. The following categories were used:

- risk rating of 9 or 10 = Severe Risk tree
- risk rating of 7 or 8 = High Risk tree
- risk rating of 5 or 6 = Moderate Risk tree
- risk rating of 3 or 4 = Low Risk tree
- risk rating of 0 = no risk (used only for planting sites and stumps)

secondary maintenance need (data field): Recommended maintenance for a tree, which may be risk oriented, such as raising the crown for clearance, but generally was geared toward improving the structure of the tree and enhancing aesthetics.

Severe Risk tree: Tree rated to be Severe Risk cannot be cost-effectively or practically treated. Most Severe Risk trees have multiple and significant defects present in the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely larger than 20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

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

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

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

Stored Carbon Report: Whereas, the i-Tree Streets Carbon Dioxide Report quantifies annual CO_2 reductions, and the i-Tree Streets Stored Carbon Report tallies all of the Carbon (C) stored in the urban forest over the life of the trees as a result of sequestration measured in pounds as the CO_2 equivalent.

Stormwater Report: A report generated by i-Tree Streets that presents the reductions in annual stormwater runoff due to rainfall interception by trees measured in gallons (gals.).

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

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

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

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

stump removal (primary maintenance need): Indicates a stump that should be removed.

Sulfur Dioxide (SO_2): A strong-smelling, colorless gas that is formed by the combustion of fossil fuels. Sulfur oxides contribute to the problem of acid rain.

Summary Report: The i-Tree Streets Summary report presents the annual total of energy, stormwater, air quality, carbon dioxide, and aesthetic/other benefits. Values are dollars per tree or total dollars.

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

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

tree size (data field): A tree's diameter measured to the nearest inch in 1-inch size classes at 4.5 feet above ground, also known as diameter at breast height (DBH) or diameter.

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

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

Volatile Organic Compounds (VOCs): Hydrocarbon compounds that exist in the ambient air and are by-products of energy used to heat and cool buildings. Volatile organic compounds contribute to the formation of smog and/or are toxic. Examples of VOCs are gasoline, alcohol, and solvents used in paints.

Young Tree Train (primary maintenance need): Data field based on *ANSI A300 (Part 1)* standards, pruning of young trees to correct or eliminate weak, interfering, or objectionable branches to improve structure. These trees, up to 20 feet in height, can be worked with a pole pruner by a person standing on the ground.

References

Richards, N.A. 1983. "Diversity and Stability in a Street Tree Population." *Urban Ecology* 7(2):159–171.

Stamen, R.S. "Understanding and Preventing Arboriculture Lawsuits." Presented at the Georgia Urban Forest Council Annual Meeting, Madison, Georgia, November 2–3, 2011.

Appendix A
Site Location Methods

Equipment and Base Maps

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

Base map layers were loaded onto these unit(s) to help locate sites during the inventory.

Street ROW Site Location

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

Address Number and Street Name

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

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

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

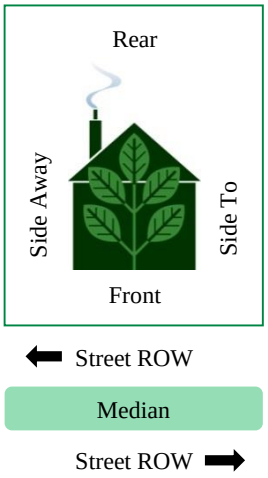


Figure 1. Side values for street ROW sites.

Side Value and Site Number

Each site was assigned a *side value* and *site number*. Side values include: *front*, *side to*, *side away*, *median* (includes islands), or *rear* based on the site's location in relation to the lot's street frontage (Figure 1). The *front side* is the side that faces the address street. *Side to* is the name of the street the arborist is walking towards as data are being collected. The *side from* is the name of the street the arborist is walking away from while collecting data. *Median* indicates a median or island. The *rear* is the side of the lot opposite of the front.

All sites at an address are assigned a *site number*. Site numbers are not unique; they are sequential to the side of the address only (the only unique number is the tree identification number assigned to each site). Site numbers are collected in the direction of vehicular traffic flow. The only exception is a one-way street. Site numbers along a one-way street are collected as if the street was a two-way street; thus, some site numbers will oppose traffic.

A separate site number sequence is used for each side value of the address (front, side to, side away, median, or rear). For example, trees at the front of an address may have site numbers from 1 through 999 and, if trees are located on the side to, side away, median, or rear of that same address, each side will also be numbered consecutively beginning with the number 1.

Block Side

Block side information for a site includes the *on street*, *from street*, and *to street*.

- The *on street* is the street on which the site is physically located. The *on street* may not match the address street. A site may be physically located on a street that is different from its street address (i.e., a site located on a side street).
- The *from street* is the first cross street encountered when proceeding along the street in the direction of traffic flow.
- The *to street* is the second cross street encountered when moving in the direction of traffic flow.

Site Location Examples

Figure 2. The tree trimming crew in the truck traveling westbound on E. Mac Arthur Street is trying to locate an inventoried tree with the following location information:

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

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

Figure 3. Location information collected for inventoried trees at Corner Lots A and B.

Corner Lot A

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

Corner Lot B

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

Appendix B
Tree Inventory Analysis Reports

Botanical	Total	Percentage of Entire Population
vacant site small	349	23.66%
Acer platanoides	112	7.59%
vacant site large	70	4.75%
Pyrus calleryana	64	4.34%
Acer rubrum	60	4.07%
Platanus x acerifolia	54	3.66%
stump	50	3.39%
Gleditsia triacanthos inermis	49	3.32%
Morus alba	48	3.25%
vacant site medium	45	3.05%
Thuja occidentalis	45	3.05%
Quercus palustris	36	2.44%
Picea abies	34	2.31%
Tilia cordata	33	2.24%
Picea pungens	33	2.24%
Robinia pseudoacacia	22	1.49%
Ginkgo biloba	22	1.49%
Ulmus pumila	19	1.29%
Juniperus virginiana	18	1.22%
Tilia americana	17	1.15%
Crataegus spp.	17	1.15%
Malus spp.	16	1.08%
Zelkova serrata	15	1.02%
Prunus spp.	15	1.02%
Quercus bicolor	14	0.95%
Pinus strobus	14	0.95%
Ailanthus altissima	14	0.95%
Quercus rubra	11	0.75%
Fraxinus pennsylvanica	10	0.68%
Acer palmatum	10	0.68%
Pinus nigra	9	0.61%
Cornus florida	9	0.61%
Cercis canadensis	9	0.61%
Acer saccharum	9	0.61%
Styphnolobium japonicum	7	0.47%

Botanical	Total	Percentage of Entire Population
Prunus serotina	7	0.47%
Juglans nigra	7	0.47%
Picea glauca	6	0.41%
Fraxinus americana	6	0.41%
Acer saccharinum	6	0.41%
unknown tree	5	0.34%
Ulmus americana	5	0.34%
Platanus occidentalis	5	0.34%
Acer x freemanii	5	0.34%
Zelkova sinica	4	0.27%
Betula nigra	4	0.27%
Acer tataricum ginnala	4	0.27%
Tsuga candensis	3	0.20%
Sassafras albidum	3	0.20%
Quercus spp.	3	0.20%
Quercus alba	3	0.20%
Magnolia x soulangiana	3	0.20%
Cornus kousa	3	0.20%
Celtis occidentalis	3	0.20%
Acer pseudoplatanus	3	0.20%
Quercus acutissima	2	0.14%
Liquidambar styraciflua	2	0.14%
Cryptomeria japonica	2	0.14%
Cedrus atlantica	2	0.14%
Amelanchier spp.	2	0.14%
Aesculus hippocastanum	2	0.14%
Salix matsudana	1	0.07%
Salix babylonica	1	0.07%
Nyssa sylvatica	1	0.07%
Magnolia stellata	1	0.07%
Maclura pomifera	1	0.07%
Liriodendron tulipifera	1	0.07%
Juglans regia	1	0.07%
Fagus grandifolia	1	0.07%
Cladrastis kentukea	1	0.07%
Chionanthus virginicus	1	0.07%
Chamaecyparis pisifera	1	0.07%
Catalpa speciosa	1	0.07%

Botanical	*Total*	*Percentage of Entire Population*
Carya ovata	1	0.07%
Amelanchier laevis	1	0.07%
Acer negundo	1	0.07%
Abies concolor	1	0.07%
Grand Total	*1475*	*100%*

Botanical Count: *77*

Common	Total	Percentage of Entire Population
vacant site, small	349	23.66%
maple, Norway	112	7.59%
vacant site, large	70	4.75%
pear, Callery	64	4.34%
maple, red	60	4.07%
planetree, London	54	3.66%
stump	50	3.39%
honeylocust, thornless	49	3.32%
mulberry, white	48	3.25%
vacant site, medium	45	3.05%
arborvitae, eastern	45	3.05%
oak, pin	36	2.44%
spruce, Norway	34	2.31%
spruce, Colorado	33	2.24%
linden, littleleaf	33	2.24%
locust, black	22	1.49%
ginkgo	22	1.49%
elm, Siberian	19	1.29%
redcedar, eastern	18	1.22%
linden, American	17	1.15%
hawthorn, spp.	17	1.15%
crabapple, flowering	16	1.08%
zelkova, Japanese	15	1.02%
cherry/plum, spp.	15	1.02%
tree of heaven	14	0.95%
pine, eastern white	14	0.95%
oak, swamp white	14	0.95%
oak, northern red	11	0.75%
maple, Japanese	10	0.68%
ash, green	10	0.68%
redbud, eastern	9	0.61%
pine, Austrian	9	0.61%
maple, sugar	9	0.61%
dogwood, flowering	9	0.61%
walnut, black	7	0.47%

Common	Total	Percentage of Entire Population
Japanese pagodatree	7	0.47%
cherry, black	7	0.47%
spruce, white	6	0.41%
maple, silver	6	0.41%
ash, white	6	0.41%
unknown tree	5	0.34%
sycamore, American	5	0.34%
maple, Freeman	5	0.34%
elm, American	5	0.34%
zelkova, Chinese	4	0.27%
maple, Amur	4	0.27%
birch, river	4	0.27%
sassafras	3	0.20%
oak, white	3	0.20%
oak, spp.	3	0.20%
maple, sycamore	3	0.20%
magnolia, saucer	3	0.20%
hemlock, eastern	3	0.20%
hackberry, common	3	0.20%
dogwood, Kousa	3	0.20%
sweetgum, American	2	0.14%
serviceberry, spp.	2	0.14%
oak, sawtooth	2	0.14%
Japanese cryptomeria	2	0.14%
horsechestnut	2	0.14%
cedar, Atlas	2	0.14%
yellowwood	1	0.07%
willow, weeping	1	0.07%
willow, corkscrew	1	0.07%
walnut, English	1	0.07%
tuliptree	1	0.07%
serviceberry, Allegheny	1	0.07%
osage-orange	1	0.07%
magnolia, star	1	0.07%
hickory, shagbark	1	0.07%
fringetree, white	1	0.07%
fir, white	1	0.07%
falsecypress, Japanese	1	0.07%

Common	Total	Percentage of Entire Population
catalpa, northern	1	0.07%
boxelder	1	0.07%
blackgum	1	0.07%
beech, American	1	0.07%
Grand Total	*1475*	*100%*

Common Count: *77*

DAVEY

Nyack, NY

Quantity Report: Condition

Condition	*Total*	*Percentage of Entire Population*
Critical	16	1.08%
Dead	11	0.75%
Fair	442	29.97%
Good	280	18.98%
N/A	514	34.85%
Poor	162	10.98%
Very Good	50	3.39%
Grand Total	*1475*	*100%*

DAVEY

Nyack, NY

Primary Maintenance/DBH Class Matrix Report

Primary Maintenance	*N/A*	*1 - 3*	*4 - 6*	*7 - 12*	*13 - 18*	*19 - 24*	*25 - 30*	*31 - 36*	*37 - 42*	*43 +*	*TOTAL*
Plant Tree	464										464
Removal		24	14	33	26	13	5			1	116
Stump Removal		2	1	12	11	9	7	4	2	2	50
Tree Clean		112	76	189	148	92	41	21	3	5	687
Young Tree Train		114	43	1							158
Grand Total	*464*	*252*	*134*	*235*	*185*	*114*	*53*	*25*	*5*	*8*	*1475*

Nyack, NY

Quantity Report: Primary Maintenance

Primary Maintenance	*Total*	*Percentage of Entire Population*
Tree Clean	687	46.58%
Plant Tree	464	31.46%
Young Tree Train	158	10.71%
Removal	116	7.86%
Stump Removal	50	3.39%
Grand Total	*1475*	*100%*

Maintenance Count: *5*

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 (USDA Hardiness Map Zone 5) conditions found in Nyack and throughout all of central New York.

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer rubrum	red maple	Red Sunset®
Acer saccharum	sugar maple	'Legacy'
Acer nigrum	black maple	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Castanea mollissima**	Chinese chestnut	
Celtis laevigata	sugarberry	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
*Diospyros virginiana**	common persimmon	
*Fagus grandifolia**	American beech	
*Fagus sylvatica**	European beech	(Numerous exist)
Ginkgo biloba	ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioicus	Kentucky coffeetree	Prairie Titan®
*Juglans regia**	English walnut	'Hansen'
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	'Rotundiloba'
*Liriodendron tulipifera**	tuliptree	'Fastigiatum'
*Magnolia acuminata**	cucumbertree magnolia	(numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
Platanus × acerifolia	London planetree	'Yarwood'
*Platanus occidentalis**	American sycamore	
Quercus alba	white oak	
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus ellipsoidalis	northern pin oak	

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

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

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
*Broussonetia papyrifera**	paper mulberry	
Cladrastis kentukea	American yellowwood	'Rosea'
Eucommia ulmoides	hardy rubber tree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	Amur corktree	'Macho'
Pistacia chinensis	Chinese pistache	
Prunus maackii	Amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
Sorbus alnifolia	Korean mountainash	'Redbird'
Toona sinensis	Chinese toon	

Small Trees: 15 to 30 Feet in Height at Maturity

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

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

Coniferous and Evergreen Trees

Large Trees: Greater than 45 Feet in Height at Maturity

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

Medium Trees: 31 to 45 Feet in Height at Maturity

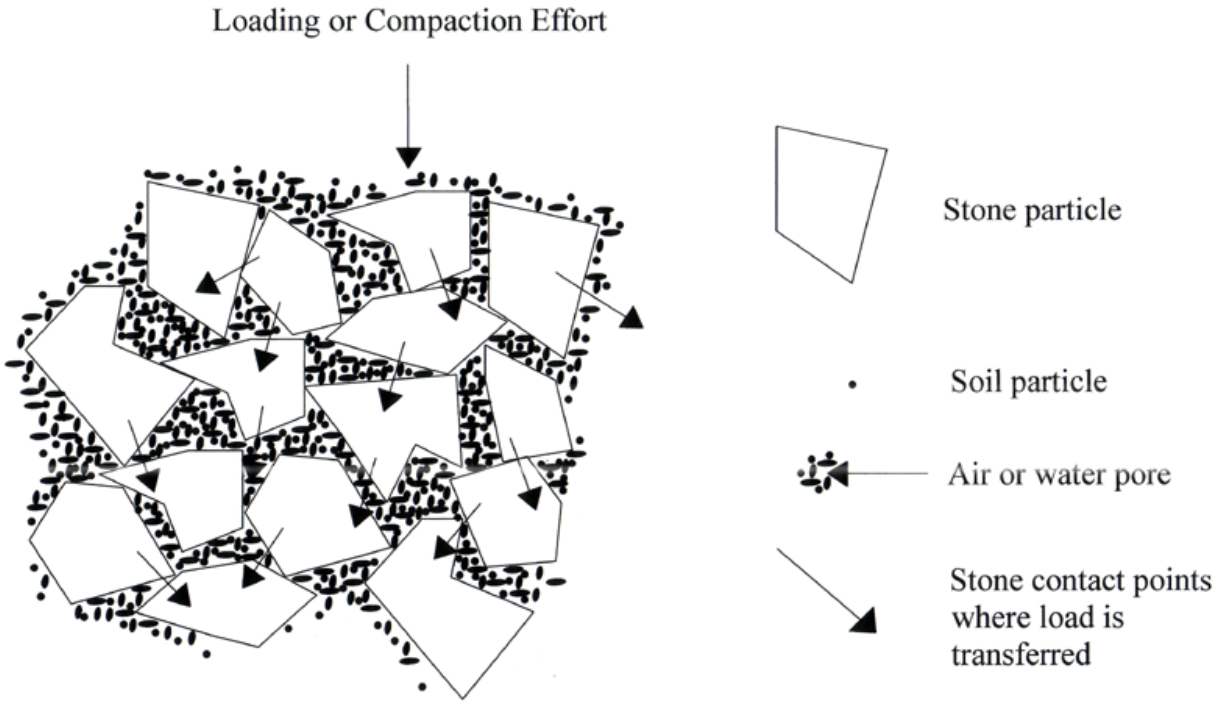
Scientific Name	Common Name	Cultivar
Chamaecyparis thyoides	atlantic whitecedar	(numerous exist)
Juniperus virginiana	eastern redcedar	
Pinus bungeana	lacebark pine	
Pinus flexilis	limber pine	
Pinus parviflora	Japanese white pine	
Thuja occidentalis	eastern arborvitae	(Numerous exist)

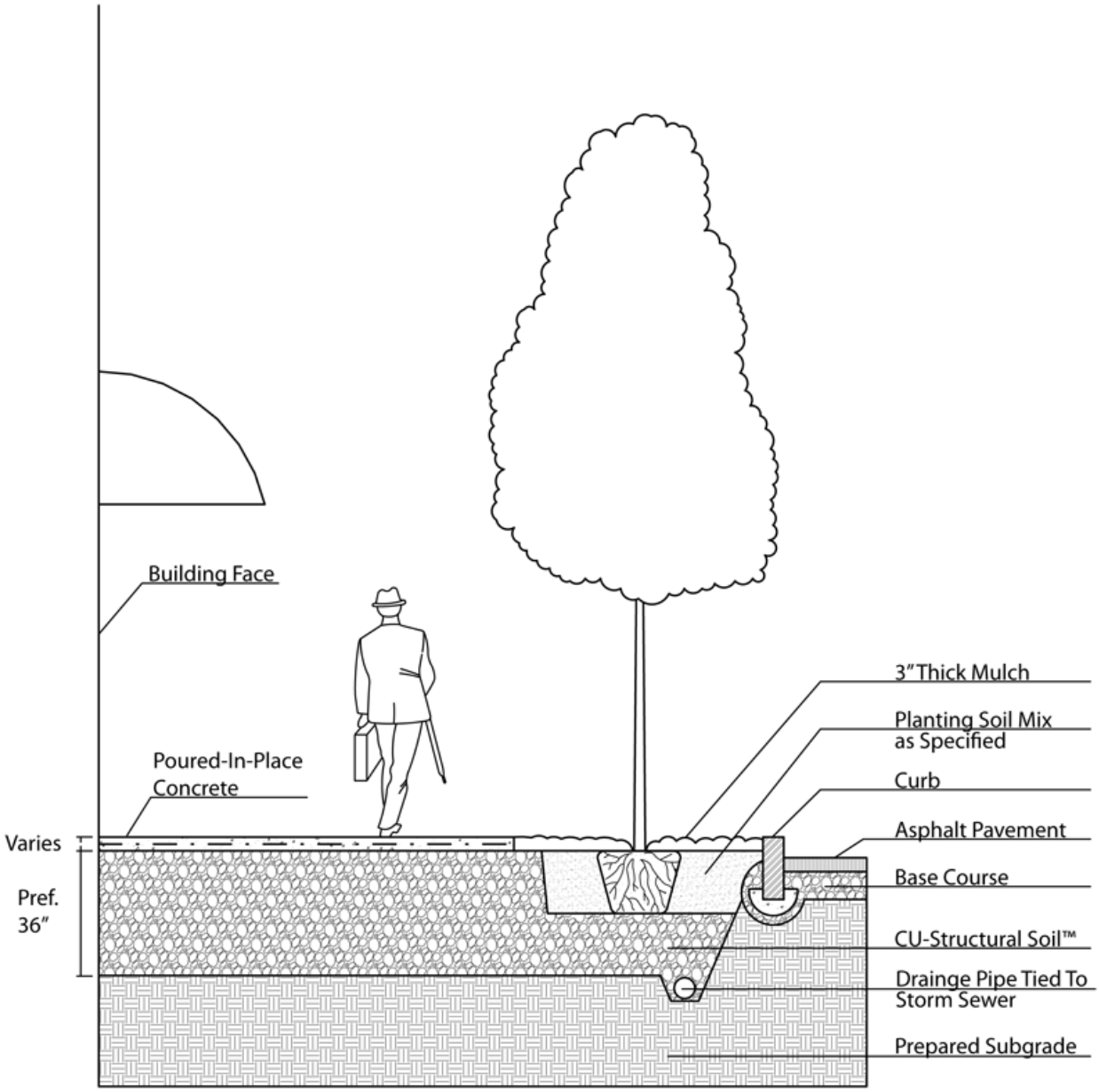
Small Trees: 15 to 30 Feet in Height at Maturity

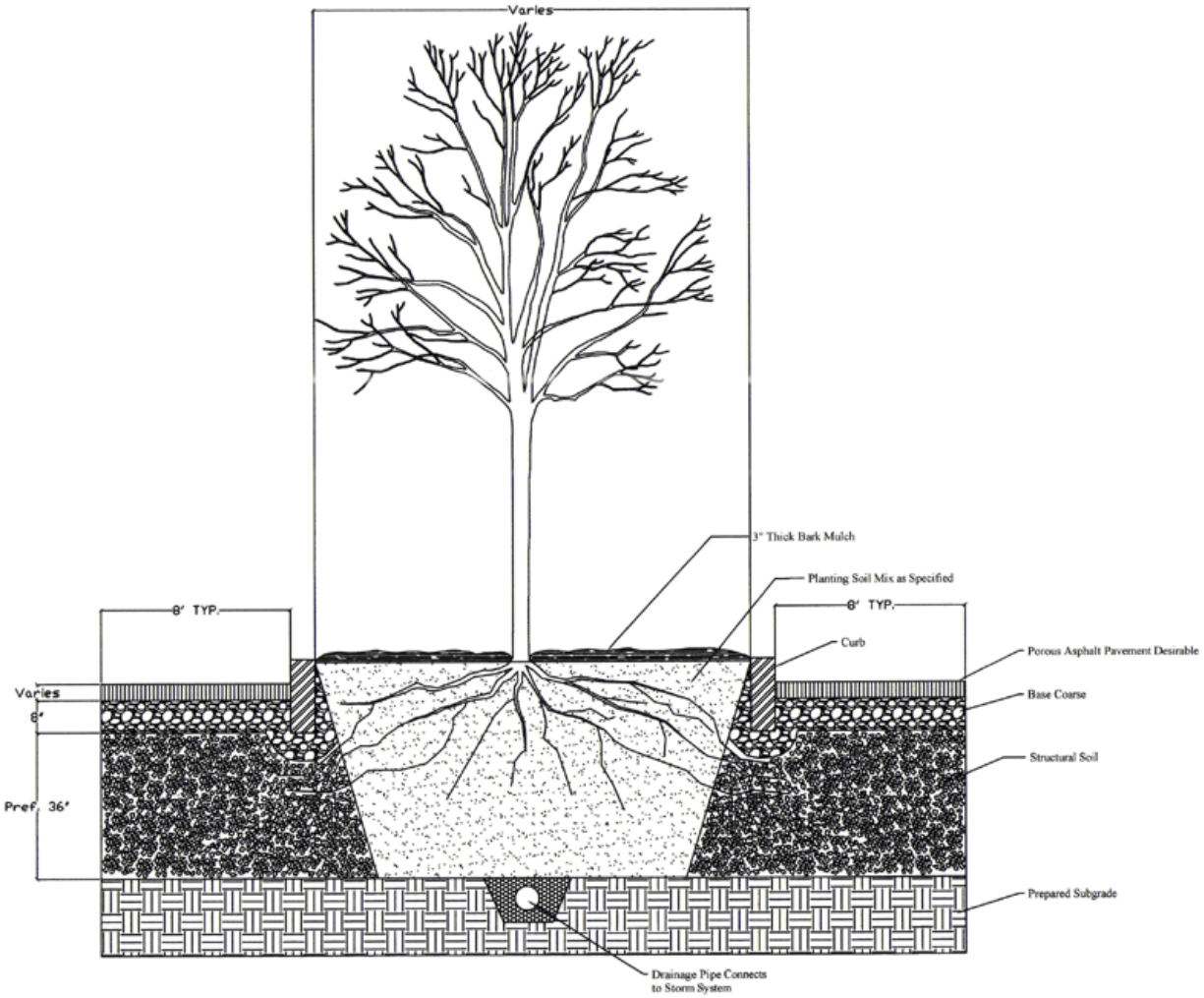
Scientific Name	Common Name	Cultivar
Ilex × *attenuata*	Foster's holly	
Pinus aristata	bristlecone pine	
Pinus mugo mugo	mugo pine	

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 Davey Resource Group's experience. Tree availability will vary based on availability in the nursery trade.

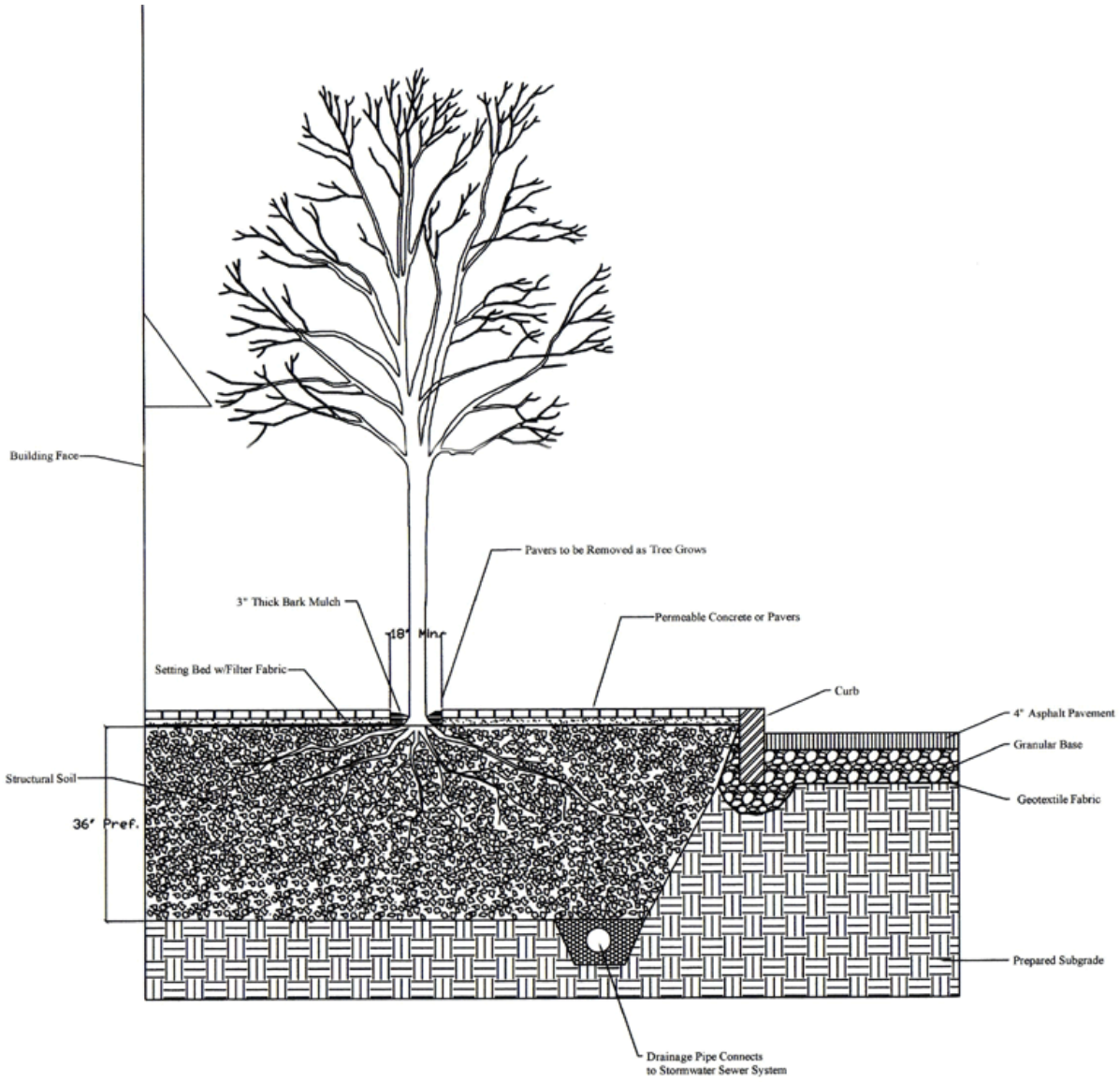
Appendix D
Green Infrastructure and Structural Soil



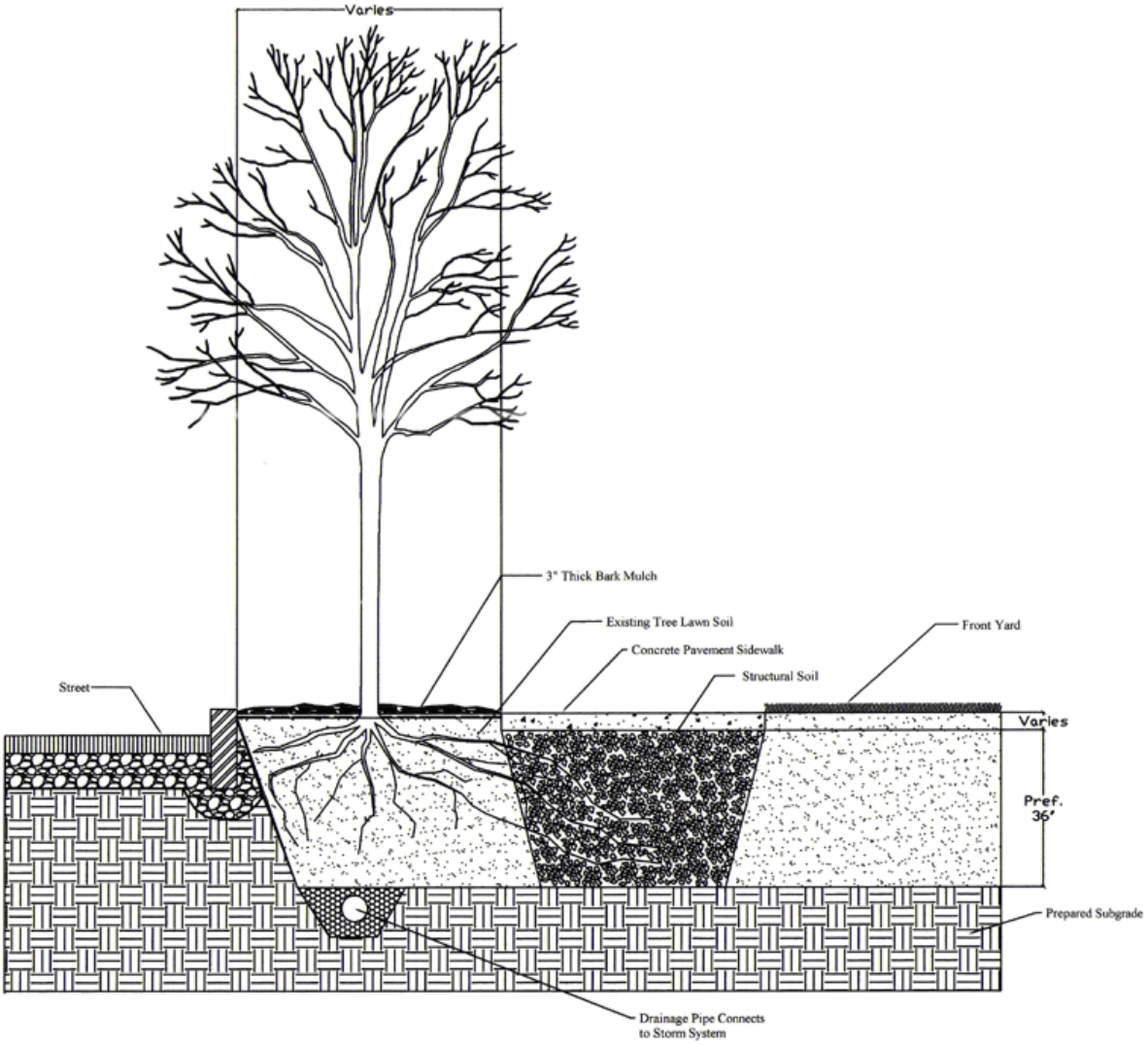

Building Face
Poured-In-Place
Concrete
Varies
Pref.
36"
3"Thick Mulch
Planting Soil Mix
as Specified
Curb
Asphalt Pavement
Base Course
CU-Structural Soil™
Drainge Pipe Tied To
Storm Sewer
Prepared Subgrade



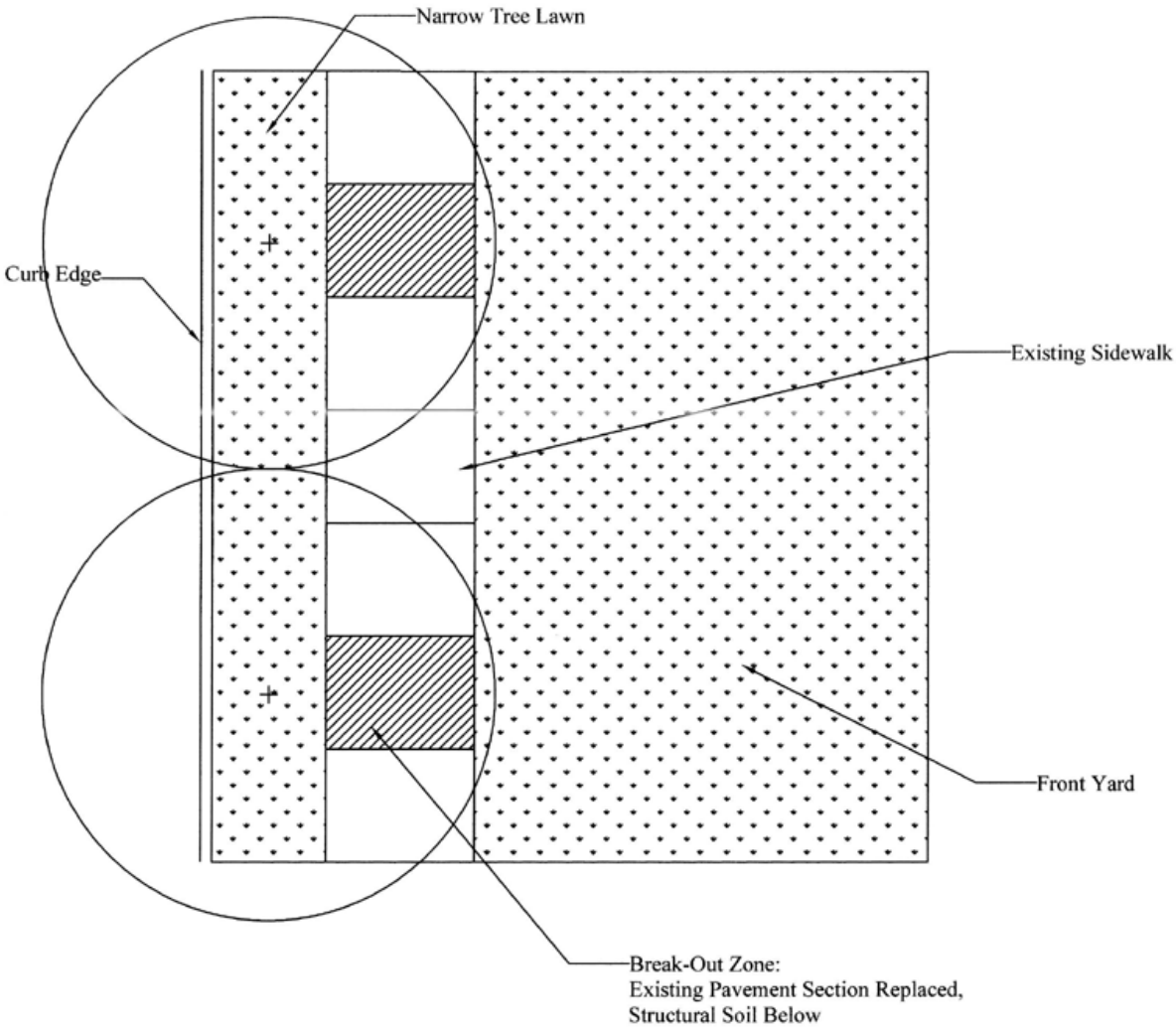
BARE ROOT TREE IN TYPICAL PARKING LOT ISLAND



STREET TREE DETAIL W/ PERMEABLE PAVERS



STRUCTURAL SOIL BREAK-OUT ZONE FROM NARROW TREE LAWN TO FRONT YARD



PLAN VIEW OF RETROFITTED STRUCTURAL SOIL BREAKOUT AREA

*Courtesy of Dr. Nina Bassuk, Urban Horticulture Institute at Cornell University