# Head of the Harbor
# Community Forest Management Plan
# December 2022

ARBORPRO INC
Yorba Linda, CA

# Acknowledgements

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## CFMP OPENING STATEMENT

The Village of Head of the Harbor applied for and was awarded a grant to conduct a tree inventory and management plan for the trees located on Village property. One hundred percent of the cost for developing the inventory and management plan was paid for by grant funds awarded to the Village by the Department of Environmental Conservation Division of Lands and Forests. Village trees are located on Village property which is predominantly along the edge (the first ten feet) of the Village roadways (called the Village right of way (ROW)) along with the Village Hall/Highway Department Campus.

From the data collected this management plan has been compiled to help the Village prioritize which trees to care for first. With a proactive approach the goal is to promote optimum health, safety and beauty while minimizing tree loss during storms and extreme weather events. Care options will range from various levels of pruning to the extreme approach of removal; this is necessary when trees are hazardous, dead or dying.

This Management Plan will be used by the Village Highway Department to develop an annual tree care program. Outside contractors will be engaged where the scope of work exceeds the skill level of inhouse staff. The creation of this tree inventory, and implementation of the Management Plan, qualifies the Village to apply for additional funds necessary to hire contractors to complete plan goals and purchase new trees to maintain a diverse healthy community forest.

In recognition of the integral importance of trees to our suburban and local wildlife community, the Village is committed to continuing forestry stewardship by remaining a Tree City USA city in good standing. Requirements include maintaining a Tree Board, having a community tree ordinance, spending at least $2 per capita on urban forestry, and Celebrating Arbor Day.

Our Village flourishes because of the efforts of our residents. All government and boards members are residents who through their volunteer efforts work to uphold the character of the Village. Please join us!

TREE CITY USA

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## Executive Summary

ArborPro, Inc. developed this plan for the Village of Head of the Harbor, New York. ArborPro inventoried trees on streets within the village. This document summarizes the information collected and provides a suggested order of work for inventoried trees based on maintenance recommendations made in the field. This Tree Management Plan was developed by analyzing tree inventory data collected in the spring of 2022. Like the trees, this document should be considered dynamic and adapt to change as various objectives are completed. Maintenance schedules and the associated costs should be updated annually to reflect the investment in the tree population and dedication to maintaining a high-quality tree population.

## Significant Findings from the Inventory

The 2022 tree inventory included trees and stumps at the assigned locations. A total of 3,755 sites were recorded during the inventory which included 3,716 trees (99%), with 39 stumps (1%).

The three most common species inventoried are Norway maple (491 trees, 13.21%), black birch (452 trees, 12.61%) and black locust (315 trees, 8.48%)

85 distinct tree species were recorded.

74% of the trees inventoried are in “Fair” or “Good” condition

The trees inventoried have a structural value of $9.9 million dollars.[1]

## Tree Maintenance

Maintenance recommendations recorded during the tree inventory were removal (13%) and pruning (77 %).

Tree maintenance can be considered an investment with the benefits that trees provide justifying the expense. Proper pruning and regular maintenance help ensure that trees are providing maximum benefits throughout their life span. In addition to maximizing benefits, regular maintenance mitigates tree-related risk by removing hazardous limbs; reducing future storm damage clean-up; removing limb conflicts on sidewalks and roadways; improving the overall appearance of urban trees; and promoting proper growth patterns in young trees. Trees in the Priority 1 removal and Priority 1 prune category should be addressed first to properly mitigate risk and prioritize maintenance. After all Priority 1 maintenance has been completed, the Priority 2 prunes and removals should be addressed.

[1] Itree Eco 2022.

# Introduction

The Village of Head of the Harbor consists of approximately 3 square miles and sits on the North Shore of Long Island within the famous town of Smithtown, New York, settled around 1665. The climate of Head of the Harbor is ideal for growing many types of trees as can be seen in the diverse species palette.

ArborPro worked with the Village to provide a tree inventory of the seventy-two streets in the Village boundaries. An arborist was assigned, and he visited each tree gathering attributes such as the tree diameter and height. Based on his opinion and knowledge of tree species he determined the trees' condition at the time of the inventory in the Spring of 2022 and recommended maintenance for each individual tree. This report and strategic plan is the result of that inventory and is presented in the hopes that it will be found to be of use for current and long-term tree management.

# Section I Highlights and Results of Inventory Data

In the spring of 2022, ArborPro, Inc. assigned an Inventory Arborist to inventory tree sites on seventy-two distinct streets. A total of 3,755 tree sites were reviewed. Table 1 and figure 1 show the top 10 populated streets.

*1 Table 1: Top 10 Populated Streets*

| Streets | Count |
|---|---|
| Harbor Rd | 586 |
| Shep Jones Lane | 258 |
| Farm Rd | 213 |
| Moriches Rd | 208 |
| Bacon Rd | 204 |
| Hitherbrook Rd | 137 |
| Fifty Acre Rd | 124 |
| Buckingham Court | 117 |
| Gate Rd | 109 |
| Pinoak Ln | 100 |

*Photo No. 2: Black Walnut at Hitherbrook and Harbor Road*

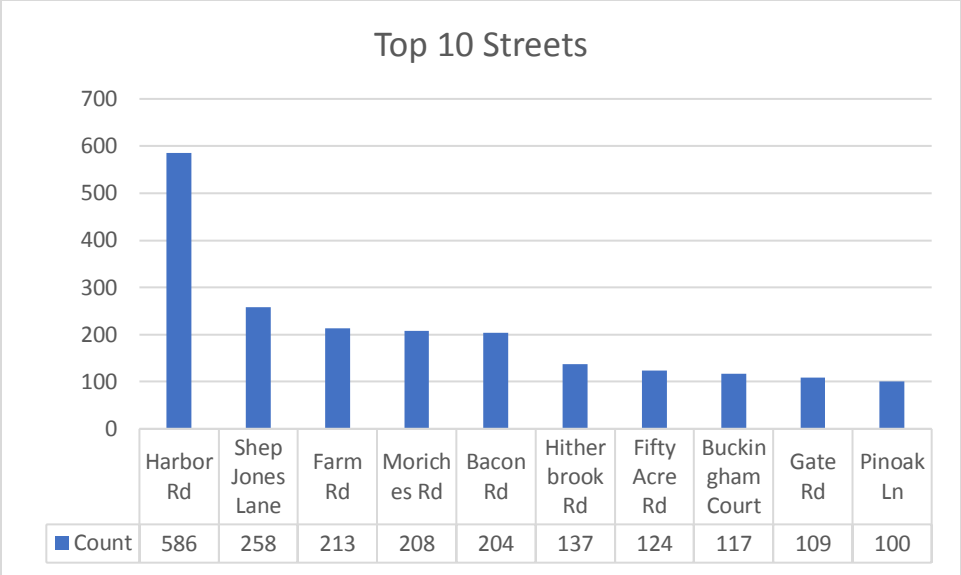



*Figure 1:Top 10 Streets*

## Methods of Data Collection

Information about the trees was collected using ArborPro's flagship software program Enterprise. ArborPro Enterprise 2.0 is accessed through the internet using iPads as collection devices, the iPads are equipped with geographic information systems (GIS) and use both aerial imagery and global positioning system technology (GPS). The following data fields were collected at each tree location:

| | |
|---|---|
| Address | Condition |
| Species | Recommended Maintenance |
| Diameter | Observations |
| Height | Latitude |
| Notes | Longitude |

## Assessment of Tree Inventory Data

Professional judgment based on experience and industry standards is used to determine maintenance recommendations. Data analysis is then used to summarize the inventoried trees. The summary helps identify trends in the tree population. Understanding and recognizing these trends will help guide short and long-term management planning. This section of the management plan summarizes the following criteria of the inventoried tree population:

- Size characteristics
- Tree condition
- Species and genus distribution

## Size Characteristics

A tree's general size provides insight into its age and value as well as the overall age of the trees at the surveyed locations. One industry-wide recognized size characteristic is diameter at breast height. Diameter at breast height (DBH) is determined by the diameter of the tree at 4.5 feet above grade. DBH range distribution can be used to analyze the relative age distribution of an urban forest. This information can be utilized by the village to create planting plans to ensure that there are enough young trees to replace aging and over-mature trees. It is important that all age classes are adequately represented throughout the urban forest to ensure a healthy, vibrant tree canopy for future generations. Figure 2 illustrates the distribution of the inventoried trees by diameter class.

As the graph shows, The Village has a distribution of size classes skewed towards the mature. An ideal size class distribution by diameter is typically considered to be 40% of trees at less than 8" (juvenile size class), 30% in the 8-16" range (semi-mature size class), 16 to 24" should be 20% (mature size class) and no more than 10% of trees should exceed 24" (senescent size class).[2] An analysis of the actual DBH, rather than the DBH ranges, of the trees reveals the juvenile population

DBH range distribution can be used as a proxy to analyze the relative age distribution of an urban forest. Due to the lack of data regarding the DBH growth rate of various species in any given location, utilizing DBH as proxy for age is one approach. It is understood that while the age/diameter relationship is generally consistent within a species the relationship is not the same for all species. There are many factors affecting DBH growth rate and while not ideal, it is a metric from which age can be inferred.

[2] Leff, "The Sustainable Urban Forest" 2016

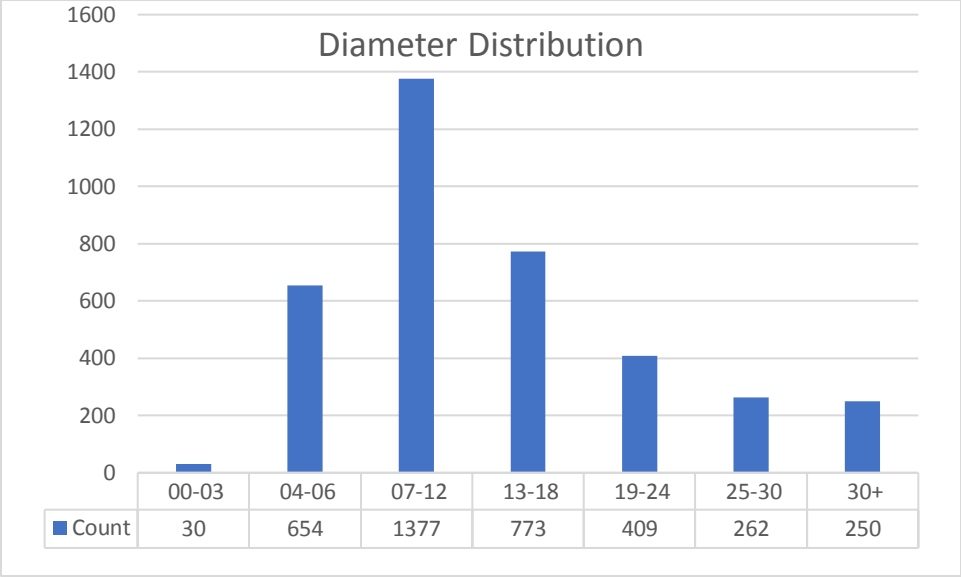



*Figure 2: Diameter at Breast Height Distribution*

(918) trees are 24%, well below the ideal of 40%. The semi-mature trees (1,704) account for 46%. Mature and senescent size class trees (1,202) are 31%. This analysis leads to the conclusion that new tree plantings should be scheduled where space allows as soon as possible. As the tree population ages new trees will take the place of older trees as they are removed creating a sustainable tree population based on age. This strategy will assure future generations will be able to enjoy the benefits of an uneven tree age distribution.

## Tree Condition

Not necessarily about desirability, tree condition is a subjective, qualitative representation of overall health, vitality, and structure. Likewise, appearance is not a complete indication of overall condition. Table 2 and Figure 3 show the number of trees recorded in each condition as well as the percentage of the total population that they represent.

| Condition | Count | Percentage |
|---|---|---|
| Good | 1233 | 32.84% |
| Fair | 1517 | 40.40% |
| Poor | 765 | 20.37% |
| Dead | 201 | 5.35% |
| Stump | 39 | 1.04% |
| Total | 3755 | 100.00% |

*Table 1:Tree Condition*

**Good** – The tree has no major structural problems; no significant damage from diseases or pests; no significant mechanical damage; a full, balanced crown; and normal twig condition and vigor for its species. Trees in this category are considered to be 80-90% healthy.

**Fair** – The tree may exhibit the following characteristics: minor structural problems and/or mechanical damage; significant damage from non-fatal or disfiguring diseases; minor crown imbalance or thin crown; minor structural imbalance; or stunted growth compared to adjacent trees. Trees in this category are considered to be 60-80% healthy.

**Poor** – A tree can appear healthy but may have structural defects. This classification also includes healthy trees that have unbalanced structures or have been topped. Trees in this category may also have severe mechanical damage, decay, severe crown dieback or poor vigor/failure to thrive. Trees in this category are considered to be 40-60% healthy.

**Dead** – This category refers only to trees or stumps that are completely dead. Trees in advanced states of decline that are still alive are generally recorded as poor or critical, not dead.

**Stump** – This category refers only to stumps. Typical maintenance is removal.

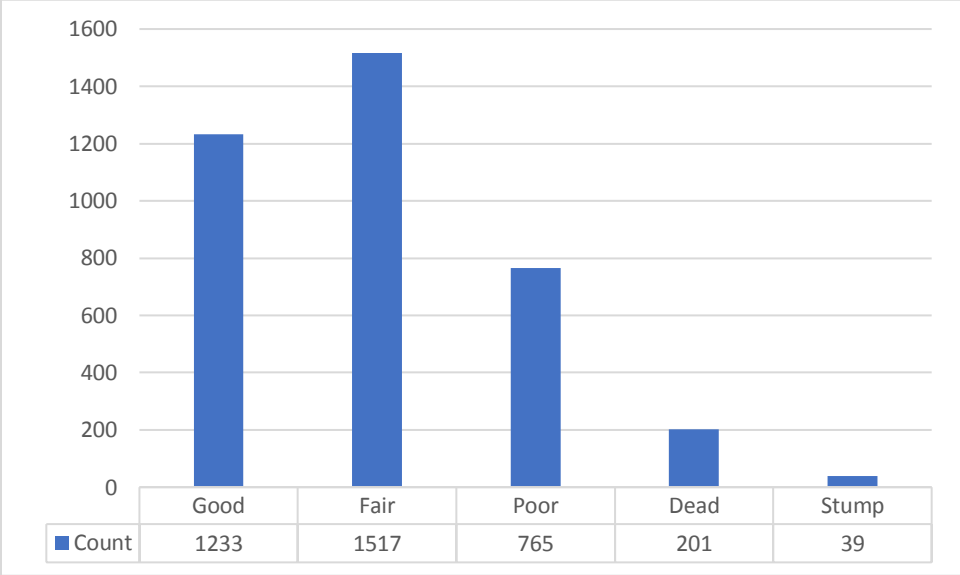



*Figure 3: Tree Condition*

## Discussion

Most trees inventoried in in the Village (75.0%) were observed to be in Fair or better condition at the time of the inventory. This number includes stumps and dead trees and is used to compare the condition of trees recorded in the inventory. Therefore, the overall health and condition of the Village's trees would be rated as Good. However, approximately 20.0% of the Village's trees are in poor condition; another 5% are dead. Figure 4 shows the maintenance recommendations by condition.

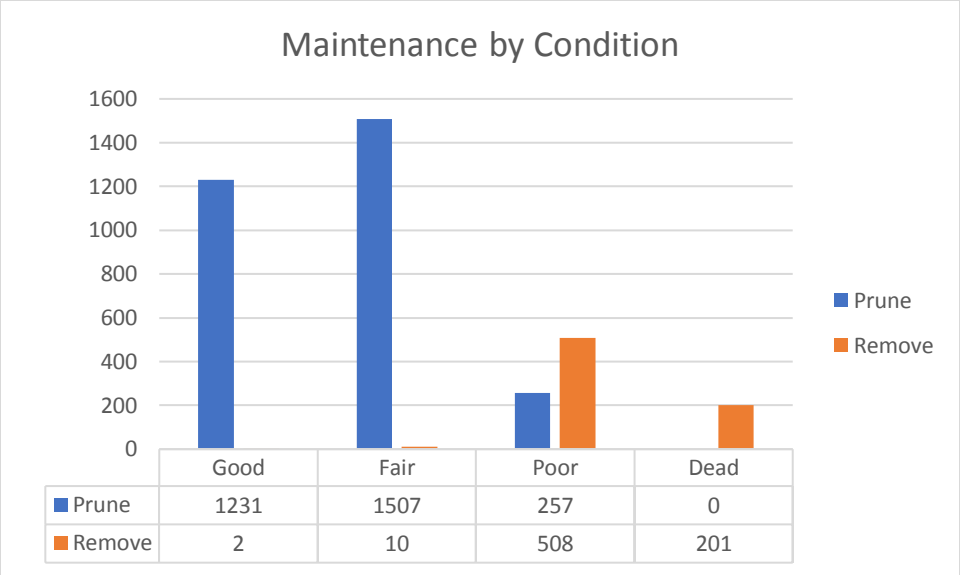



*Figure 4: Maintenance by Condition*

## Species Distribution

Understanding species distribution is important when determining which species should be planted and which ones are currently over-represented in the urban forest. Biodiversity is extremely important to the overall health and longevity of a tree population. The accepted guideline for urban biodiversity is the 10-20-30 rule. This means that no species should represent more than 10%, no genus should represent more than 20%, and no family should represent more than 30% of the total tree population. Figure 5 shows the distribution of species representing 2% or more of the total tree population.

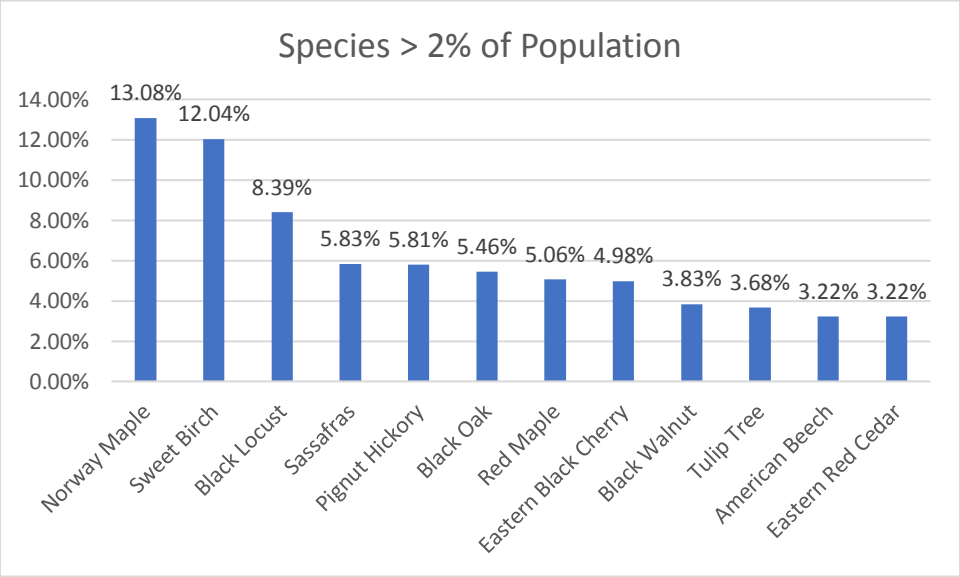



*Figure 5:Species >2%*

Figure 6 contains the top 10 species of trees recorded in The Head of The Harbor by count and as a percentage of the total tree population. A full species frequency report can be found in Appendix A.

| Rank | Top 10 Species | Count | % |
|---|---|---|---|
| 1 | Norway Maple | 491 | 13.21% |
| 2 | Black Birch | 452 | 12.16% |
| 3 | Black Locust | 315 | 8.48% |
| 4 | Sassafras | 219 | 5.89% |
| 5 | Pignut Hickory | 218 | 5.87% |
| 6 | Black Oak | 205 | 5.52% |
| 7 | Red Maple | 190 | 5.11% |
| 8 | Eastern Black Cherry | 187 | 5.03% |
| 9 | Black Walnut | 144 | 3.88% |
| 10 | Tulip Tree | 138 | 3.71% |

*Figure 6: Top 10 Species*

## Discussion

The Village of Head of the Harbor Manor maintains 85 distinct species of trees in the parks and trails that were inventoried. The distribution of these trees across species is heavily concentrated with Maple and Birch accounting for 25% of the population. ArborPro recommends the Village discontinue the planting of any species exceeding 10% of the population as they exceed the recommended threshold. The potential threat from the invasive pest the Asian long-horned borer is further cause for concern as the maples are susceptible and a serious infestation could result in high tree mortality This risk can be mitigated by analyzing the current list of species and focusing on species that do well in the area while actively promoting biodiversity in the landscape. A list of recommended tree species for future plantings can be found in Appendix B.

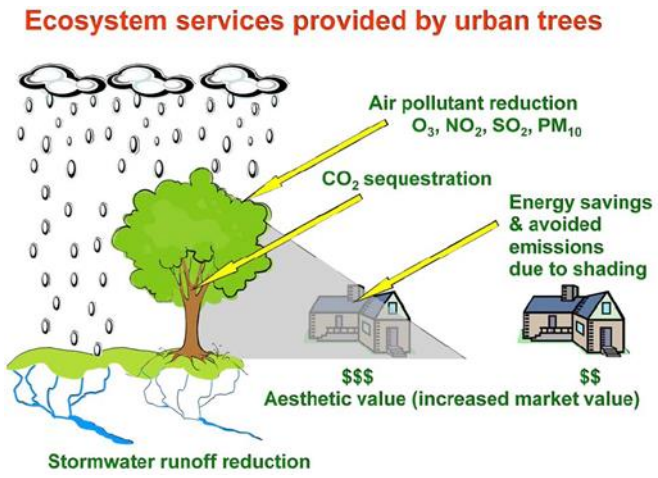
It is a goal of the management plan that no species constitute more than 10% of the tree population. Species selection for future plantings should focus on trees less represented in the population.

## Section II – Benefits of the Surveyed Trees

Trees provide a host of environmental, social, and economic benefits in urban areas. When properly maintained, trees can reduce pollution, divert stormwater runoff, and lower energy costs. The benefits trees provide can offset the cost associated with tree maintenance. A properly implemented tree maintenance program will maximize tree benefits in the urban setting, allowing trees to provide benefits that meet or exceed the time and money invested in maintenance activities.

The i-Tree Eco application was used to quantify the benefits provided by Head of the Harbor's trees. This application uses growth and benefit models designed around predominant urban trees to calculate the specific benefits that trees provide in dollar amounts. The benefits calculated by i-Tree Eco include, air quality improvements, carbon dioxide ($CO_2$) sequestration and storage, stormwater control. The i-Tree annual benefit reports demonstrate the value urban trees provide to the surrounding community.

In Appendix C notice that the Norway maples provide the significant benefits. This is due to their size. The canopy spread and tree height along with their larger diameters (think carbon sequestration) are the reason the maples are providing those benefits. As these trees age-out they should be replaced with trees that have the potential to be at least as large if not larger at maturity so the eco-benefits from the urban forest can be maintained for future generations.




### Benefit Summary by Trees

*Table 2: Benefits by Trees*

| Process | Total $ (USD) | $ Tree (USD) | $/Capita (USD) |
|---|---|---|---|
| Gross Carbon Sequestration | $11,400.00 | $3.05 | $7.78 |
| Pollution Removed | $4,800.00 | $1.30 | $3.31 |
| Avoided Runoff | $9,840.00 | $2.62 | $6.68 |
| Total Benefits | $26,040.00 | $6.97 | $17.77 |

Appendix C has a more complete analysis of the benefits provided by trees to Head of the Harbor.

## Carbon Dioxide Storage

It is well known that trees absorb carbon dioxide and release oxygen into the atmosphere as a product of photosynthesis. Carbon absorbed during this process is ultimately stored in the wood of trees. The amount of carbon sequestered by the inventoried tree population is 103 tons annually. Below is table 4 with the top carbon storing trees.

*Table 3 : Top 5 Carbon Sequestering Trees*

| Species | Carbon Storage (ton) | $CO_2$ Equivalent (ton) | $CO_2$ Equivalent (ton) |
|---|---|---|---|
| Black oak | 488.50 | 1791.30 | 1791.30 |
| Black locust | 292.00 | 1070.90 | 1070.90 |
| Scarlet oak | 210.90 | 773.40 | 773.40 |
| Norway maple | 186.20 | 682.70 | 682.70 |
| White oak | 176.80 | 648.40 | 648.40 |

## Stormwater Control

Trees reduce the costs associated with diverting stormwater by intercepting rainfall before it hits the ground and enters the storm runoff system. This greatly reduces the strain placed on public stormwater runoff systems. This can represent a significant monetary savings the amount of infrastructure needed to divert stormwater throughout the Village is reduced. Appendix D details the services provided by trees when it comes to rainfall. The estimated savings for the Village in the management of stormwater runoff is $9,840 annually.

## Replacement Value

In addition to environmental benefits, the Village can consider the total replacement value for its inventoried trees. Total replacement value is the amount of money it would take to completely replace the existing trees with trees of the same size. While this is a scenario that will likely never happen, it gives the Village a specific dollar value of its trees in their current state. Replacement value differs from environmental benefits in that it shows how much the trees are worth instead of the dollar values that they provide in benefits. According to i-Tree Eco, the total replacement cost for Head of the Harbor trees is $9,900,000. Table 7 shows the breakdown of replacement value by diameter class.

*Table 4: Replacement value by Diameter Class*

| Diameter | Value |
|---|---|
| 00-03 | $3,271.00 |
| 04-06 | $399,723.00 |
| 07-12 | $1,454,877.00 |
| 13-18 | $1,703,502.00 |
| 19-24 | $1,678,422.00 |
| 25-30 | $1,748,566.00 |
| 30+ | $3,433,651.00 |

*Photo No. 3: Oak tree on Harbor Road*

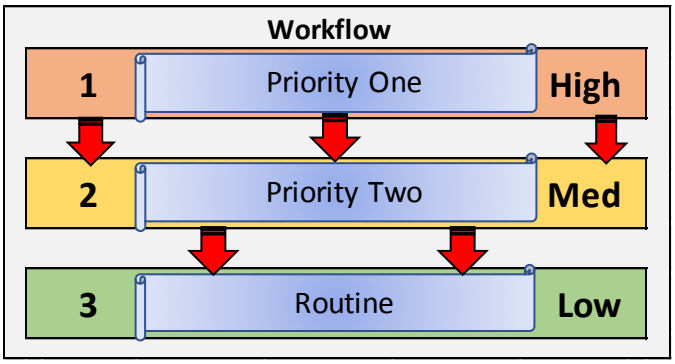
# Section III Tree Management

The purpose of this tree management plan is to provide a framework for the short and long-term maintenance of The Village of Head of the Harbor's trees. To manage the Village trees, it is important to understand the cost and scope of the work that needs to be done. This section of the management plan will detail the maintenance recommendations from the inventory. The information contained within this section can be used to create a budget, secure funding, and to understand the general needs of the trees in the inventory.

It is also important to recognize that the tree inventory data provides a snapshot of trees' current condition (Spring 2022). Prioritized tree maintenance will help reduce the overall risk of tree related catastrophes. However, because conditions can change drastically, routine maintenance should be coupled with the identification and monitoring of trees that may become hazardous in the future. The focus of this report is to identify and mitigate the trees that were deemed maintenance prioritizations at the time of the inventory while planning through proactive maintenance.

## Recommended Tree Maintenance

A description and summary of the maintenance recommendations for the entire inventory follows below. As the names imply, Priority 1 pruning and removals pose the highest risk and should be dealt with first. Priority 2 pruning and removals should be considered after all Priority 1 pruning and removals have been completed. The remaining trees will be assigned to either routine pruning (large or small) or young tree training activities, i.e. proactively pruned on a five-year and three-year basis respectively. The following more thoroughly describes each maintenance recommendation.




**Priority 1 Prune** – Trees that require Priority 1 pruning are recommended for trimming to remove hazardous deadwood, hangers, or broken branches. These trees have broken or hanging limbs; hazardous deadwood; and dead, dying, or diseased limbs or leaders greater than four inches in diameter.

**Priority 1 Removal** – Trees designated for removal have defects, which cannot be cost-effectively or practically treated. A majority of trees in this category have a large percentage of dead crown and pose an elevated level of risk for failure. Any hazards that cannot be mitigated with pruning could be seen as potential dangers to persons or property. Large dead and dying trees that are high liability risks are included in this category.

**Priority 2 Prune** – Trees that require Priority 2 pruning are recommended for trimming to remove deadwood, correct structural problems, or resolve clearance issues. These trees do not pose as much risk as "Priority 1" trees.

**Priority 2 Removal** – Trees that should be removed but do not pose a liability as great as the first priority will be identified here. This category would need attention as soon as "Priority 1" trees are removed.

*Table 8: Maintenance by Category*

| Maintenance | Count | % |
|---|---|---|
| Priority 1 Removal | 152 | 4.05% |
| Priority 1 Prune | 142 | 3.78% |
| Priority 2 Prune | 283 | 7.54% |
| Priority 2 Removal | 318 | 8.47% |
| Routine Prune | 2,792 | 74.35% |
| Training Prune | 29 | 0.77% |
| Stump Removal | 39 | 1.04% |

**Routine Prune** – These trees require routine horticultural pruning to correct structural problems or growth patterns, which would eventually obstruct traffic or interfere with utility wires or buildings. Trees in this category are large enough to require bucket truck access or manual climbing.

**Training Prune**– Small, young trees, up to 12 feet in height, that will grow to be large trees must be pruned to correct or eliminate weak, interfering, or objectionable branches in order to minimize future maintenance requirements. A person standing on the ground can prune these trees with a pole-pruner.

**Stump Removal** – Typically located in high use areas, stumps that interfere with pedestrian traffic and pose a tripping hazard should be removed.

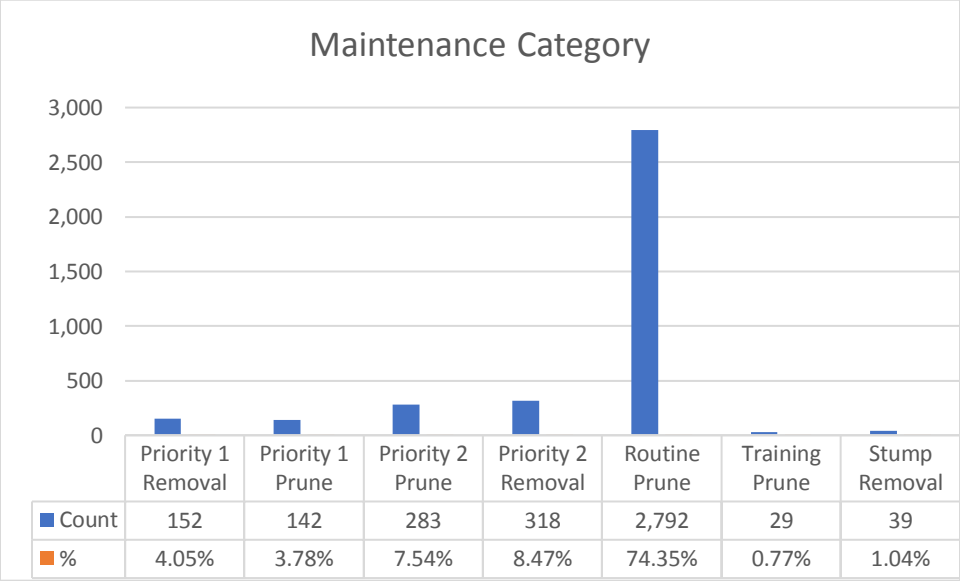



*Figure 7: Maintenance by Category*

## Priority and Proactive Maintenance

Communities are encouraged to implement a proactive maintenance schedule. Many communities often rely on an on-demand response to hazardous trees or urgent situations such as storm or wind damage. **However, a proactive program systematically reduces risk while improving the overall health of urban trees**. A proactive program will also help stabilize maintenance budgets and improve long-term planning.

In this plan, we chose to use a five-year cycle for routine tree trimming and a three-year cycle for young tree training. As previously explained, this involves pruning each tree every five years while conducting structural pruning on young trees every three years. These activities are considered proactive maintenance while trees in the Priority 1 and 2 categories are priority maintenance.

## Priority Maintenance

Prioritizing maintenance is one of the tree inventory's main objectives. It allows tree work to be assigned based on observed risk over multiple years. Once prioritized, the work can be approached systematically to mitigate risk by addressing the highest priority trees first. In this plan, all trees designated as Priority 1 prunes and removals will be considered first. Priority 2 prunes and removals will be considered after all Priority 1 trees have been addressed. Trees in the Routine Prune and Training Prune category will be entered into the proactive maintenance schedule. Figure 8 shows the trees and their respective diameter classes for these two priority maintenance categories.

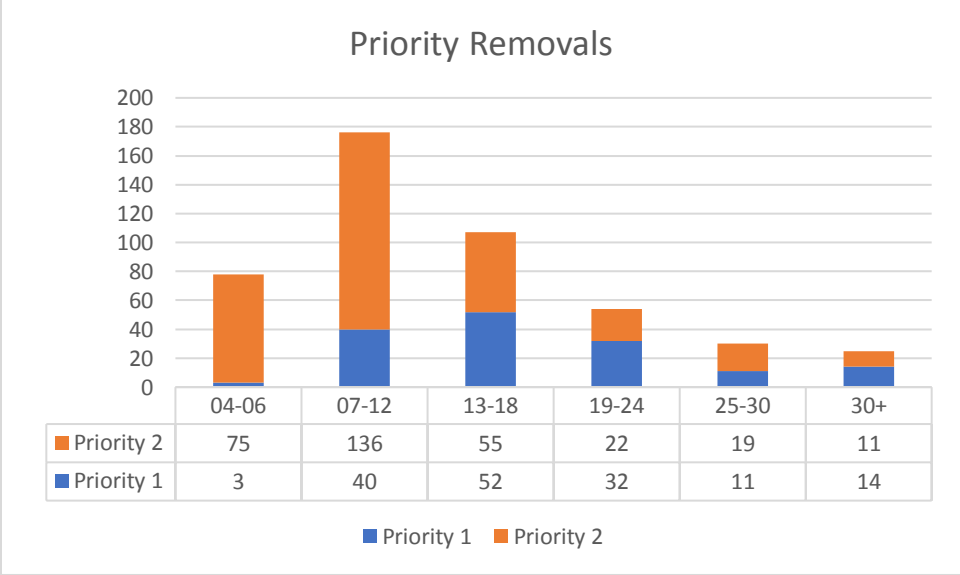



*Figure 8: Priority Removals by Diameter Class*

*Figure 9: An example of a Priority 1 removal, dead tree near a bench.*

## Priority Pruning

Priority pruning includes trees in the Priority 1 and Priority 2 category that need to be pruned to mitigate risk and remove obstructions to sidewalks, roads, etc. There are a total of 425 trees in the priority prune category. It should be noted that 115 of these trees have diameters that exceed 30". Figure 10 shows all the trees and their respective diameter classes for these two categories.

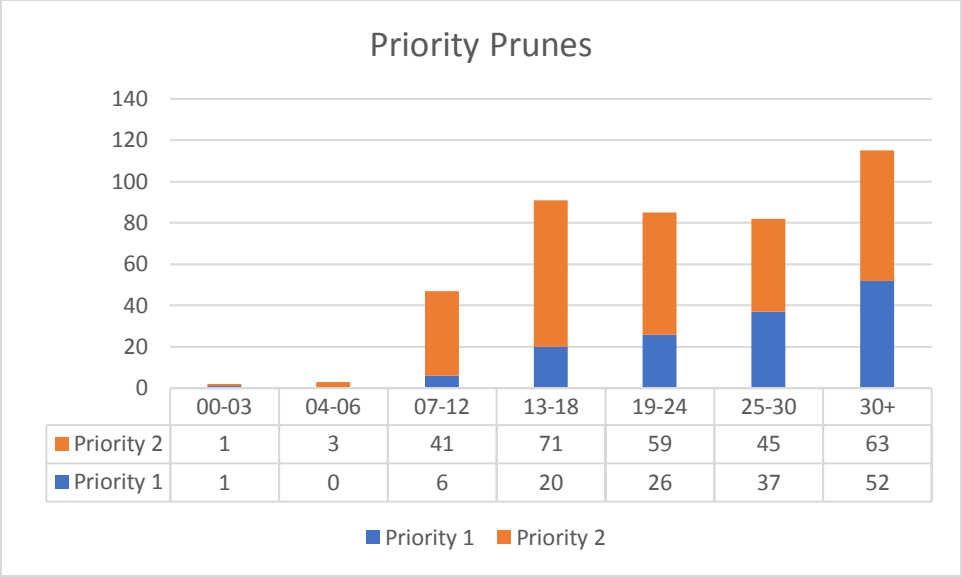



*Figure 10: Priority Prunes by Diameter Class*

Trees in the Priority 1 Prune category pose a risk to public safety that can be mitigated through pruning. ArborPro recommends pruning these trees in the first year of the five-year maintenance plan. The inventory found a total of 142 Priority 1 Prunes.

Trees in the Priority 2 Prune category pose a lower risk to public safety than Priority 1 Prunes and also can be mitigated through pruning. ArborPro recommends pruning these trees in the second and third year of the five-year maintenance plan. The inventory found a total of 283 Priority 2 Prunes

*Figure 11: A priority 1 prune, deadwood overhanging a street (red arrow).*

## Proactive Maintenance

Proactive tree maintenance requires that trees are systematically managed over time. To accomplish this, trees are placed in a pruning cycle that routinely addresses tree health and form. While it may be costly to implement a routine pruning cycle, it will reduce both risk and maintenance costs over time. Maintaining a routine pruning cycle will allow the City to address minor maintenance needs on a regular basis. Over time, this will reduce the number of emergency situations and will allow the City to regularly monitor potential problem trees.

There are two categories of proactive maintenance for Head of the Harbor. Routine pruning is usually recommended for most trees over 20' tall. From time to time depending on the opinion of the inventory arborist may assign a tree outside the typical category.

Training pruning is most often recommended for trees that have a diameter of less than 6" and are usually less than 20' tall. Again, from time to time a tree outside these parameters may be recommended for a training prune.

## Routine Pruning Cycle

The routine pruning cycle includes all trees entered as Routine Prune during the inventory. These trees pose little to no risk but could benefit from regular pruning to mitigate tree-related risk. By removing defective limbs, the Village can reduce future storm damage clean-up; remove limb conflicts on sidewalks and roadways, trails and paths; improve the overall appearance of urban trees; and promote proper growth patterns in young trees.

The length of a routine pruning cycle depends on the size of the tree population. ArborPro recommends a five-year cycle for the trees included in this inventory, i.e. prune approximately one-fifth of the tree population each year. This number will fluctuate as the Village removes trees and completes priority maintenance, and as young trees grow into maturity. This report and five-year maintenance plan will only consider trees in the Routine Prune category at the time of the inventory for the routine pruning cycle.

The 2022 tree inventory found a total of 2,792 trees that would benefit from routine pruning. Therefore, approximately 558 trees (one-fifth of the total population) will need to be pruned each year, starting in year four of the five-year maintenance plan. Figure 12 shows a breakdown of Routine Prunes by diameter class and count

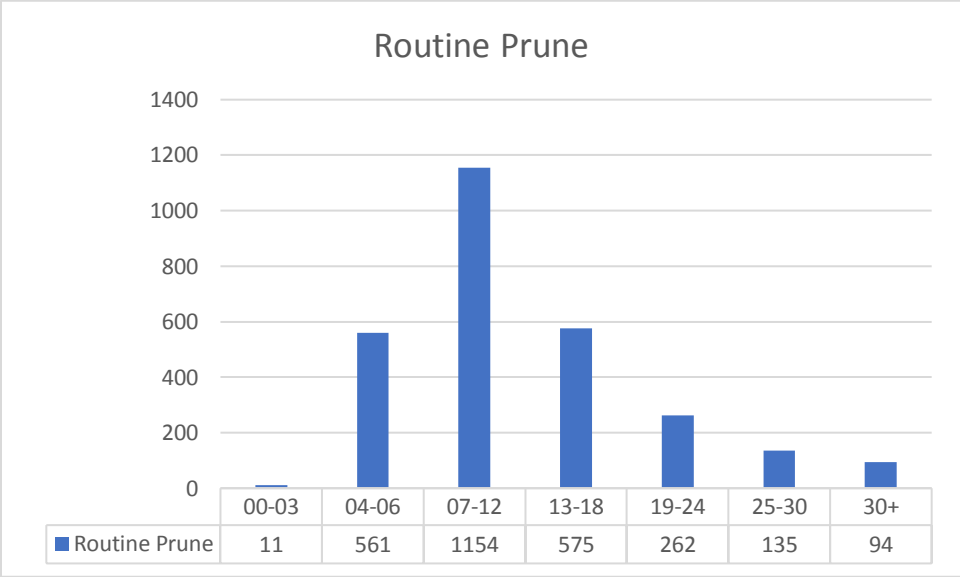



*Figure 12:Routine Prunes by Diameter Class*

## Young Tree Training Cycle

Trees included in the Young Tree Training Cycle are typically less than 6 inches DBH and will benefit from structural pruning. Young trees tend to have higher growth rate and therefore require a shorter pruning cycle than mature trees. For this reason, ArborPro recommends a three-year cycle for young tree training. Currently only 33 trees fall into the training prune cycle. Figure 13 illustrates the number of trees that would benefit from young tree training.

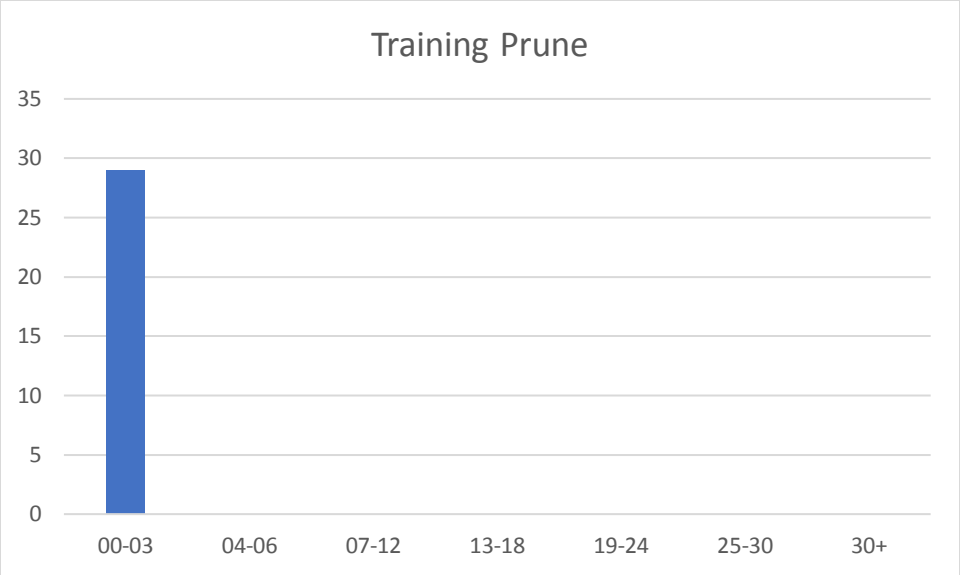



*Figure 13: Young tree training*

The three-year Young Tree Training Cycle should begin in year of the maintenance plan. For the sake of this management plan, it will only include existing young trees. All of the young trees should be structurally pruned the first year. The number of trees in the training cycle will fluctuate as new trees are planted and as older plantings become established and no longer require training. Therefore, the amount of money spent and the number of trees in the training cycle will not remain constant.

The inventory found a total of 33 trees under 6 inches DBH that would benefit from structural pruning.

Relatively inexpensive, young tree training can easily be done by Village staff or even volunteers. Training young trees helps to reduce future maintenance costs by

*Figure 14:Training Prune Example*

improving the structure and health of young trees. Since it can be done from the ground with little equipment,

While a three-year training cycle has been suggested a five-year cycle can be implemented. This will change the annual budget by reducing annual pruning expenses associated with young trees. If a five-year cycle is adopted, structural corrections should be made as early as possible in the cycle. For the purposes of this report a three-year schedule has been used for budgeting. To modify the budget for a five-year cycle for all trees a total of 33 trees should be added to the routine cycle and the training cycle eliminated. In either case the first three years should be used to address the high priority trees as outlined in the budget.

*Figure 15: Routine Prune example.*

## Importance of Tree Maintenance

Trees are naturally occurring, organic organisms. Often, they are treated as though they do not need human intervention to thrive. While this may be true in natural undisturbed forests, it is certainly not true for urban trees. Urban trees require regular maintenance to maximize the benefits they provide. When maintenance is neglected, trees can pose a serious risk to people and property. In addition, trees in urban environments are subject to many more

stressors than trees in forests or rural areas. Urban trees grow in restricted spaces; are exposed to pollutants and road salt; are subject to soil compaction; and can be easily damaged by mowers or other maintenance activities.

Proactive pruning can greatly reduce the risk of tree failure and subsequent damage. In addition, proactive maintenance will prolong the life of a tree and reduce future maintenance costs. A well-maintained urban forest will be less susceptible to disease and disaster. When trees are pruned on a regular basis — or removed when they become diseased or hazardous — it eliminates some of the pathways for potential pests and diseases. Many of these pests and diseases attack stressed trees or enter through open wounds or dead branches. Therefore, a well-maintained urban forest will be less likely to succumb to pest infestations. In addition, species selection is an important part of maintaining a healthy urban forest. Careful species selection will increase biodiversity and reduce the risk of a catastrophic pest infestation. Most pests have preferred hosts (Emerald Ash Borer for example). Increasing biodiversity will limit the number of species that are susceptible to individual pests.

While it is impossible to predict when a natural disaster will strike, a level of disaster preparedness can be achieved through regular maintenance. Trees that have been pruned to remove dead or hanging limbs will be less likely to experience branch failure in high winds, thus reducing storm damage clean-up. Also, removing diseased or declining trees from the landscape will reduce the risk of whole tree failure in major storm events.

The importance of urban tree maintenance cannot be understated. A well-maintained urban forest will provide maximum benefits to the community while reducing the inherent risk of tree failure.

An important goal is to create and maintain a tree maintenance schedule. Trees can be placed on a pruning cycle. For instance, a 4 year cycle means that 25% of the trees would be pruned each year (if necessary) this allows for more consistent budgets. Depending on pruning objectives the schedule can be incorporated into the municipal calendar, so trees are actively maintained similar to other infrastructure. Late spring pruning will result in the least amount of growth response and is an ideal time of year to assist in tree size control.

## Importance of Updating Inventory Data

Trees are living organisms that change with time. Inventory data, however, is static and will not reflect the current state of an urban forest unless it is continually updated. Whenever a tree is removed, inspected, pruned, or planted it should be updated in the inventory. If inventory data is not properly maintained, it will quickly become obsolete and will ultimately be of little use. Significant time and money have been invested in surveying Head of the Harbor's trees. The only way to protect this investment is to continually update the inventory. The inventory can be updated using a spreadsheet program. There are many features in spreadsheets that allow filtering by species, condition or recommended maintenance. It is possible to add a column to track work dates etc. The inventory can also be updated using ArborPro's flagship software Enterprise 2.0. All of Head of the Harbor's data is in the program and ready to be updated, assign work and print reports for distribution.

# Maintenance Cycle

Utilizing data from the 2022 tree inventory, ArborPro has developed a suggested annual maintenance schedule detailing the number and types of tasks to be completed each year. Budget projections were made using average cost of tree work based on diameter class. These costs are not specific to the Head of the Harbor; they only represent average costs based on industry knowledge and experience.

## Maintenance Plan

This summary will include tree data collected during the inventory. It represents the total cost of priority maintenance and the recurring cost of proactive maintenance. A summary of the maintenance schedule is presented here. The complete table of estimated costs for this five-year plan can be found in Appendix C.

In addition to the five-year maintenance plan, it is important to understand the total cost of priority maintenance and the recurring cost of proactive maintenance. It may not be possible to implement a five-year maintenance plan, but it is very important to understand what it would cost to maintain all of Head of the Harbor's trees. Priority maintenance is the one-time cost of pruning or removing all the Priority 1 and Priority 2 trees. Proactive maintenance is the recurring cost of routine pruning and young tree training.

The breakdown of cost for all priority maintenance is:

| Maintenance | Cost |
|---|---|
| Priority 1 Removal | $70,950 |
| Priority 1 Prune | $35,375 |
| Priority 2 Removal | $97,795 |
| Priority 2 Prune | $63,795 |
| **Total** | **$267,915** |

*Table 5: Cost of priority maintenance*

The recurring cost of proactive maintenance is:

| Maintenance | Cost per Year |
|---|---|
| Routine Prune | $63,125 |
| Young Tree Training | $580 |
| **Total** | **$63,705** |

*Table 6: Recurring cost of proactive maintenance*

To implement the recommended maintenance schedule, the maintenance plan budget should be no less than $111,000 for Year One; $161,000 for Year Two; $63,705 for Year Three; $63,705 for Year Four; and $63,705 for Year Five.

Head of the Harbor should implement a proactive maintenance cycle as soon as possible, it is an important goal to work towards. At very least, the priority maintenance should be

budgeted for and completed within the first three years. ArborPro recommends implementing the five-year maintenance plan as soon as possible.

Below is a suggested budget that can be used to fund the tree pruning activities recommended for the next sevearl years. This can be used in conjunction with a spreadsheet to track pruuing history costs and make budget projections based on local pricing.

| Year | | | 2022 | | 2023 | | 2024 | | 2024 | | 2026 | | Five-Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity | DBH | Cost/Tree | # of Trees | Total Cost | # of Trees | Total Cost | # of Trees | Total Cost | # of Trees | Total Cost | # of Trees | Total Cost | Cost |
| Priority 1 Removal | 00"-03" | $25 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 04"-06" | $105 | 3 | $315 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $315 |
| | 07"-12" | $220 | 40 | $8,800 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $8,800 |
| | 13"-18" | $355 | 52 | $18,460 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $18,460 |
| | 19"-24" | $525 | 32 | $16,800 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $16,800 |
| | 25"-30" | $845 | 11 | $9,295 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $9,295 |
| | 31"-36" | $1,140 | 10 | $11,400 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $11,400 |
| | 37"-42" | $1,470 | 4 | $5,880 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $5,880 |
| | 43+ | $1,850 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| **Total** | | | **152** | **$70,950** | **0** | **$0** | **0** | **$0** | **$0** | **$0** | **0** | **$0** | **$70,950** |
| Priority 2 Removal | 00"-03" | $25 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 04"-06" | $105 | 0 | $0 | 75 | $7,875 | 0 | $0 | 0 | $0 | 0 | $0 | $7,875 |
| | 07"-12" | $220 | 0 | $0 | 136 | $29,920 | 0 | $0 | 0 | $0 | 0 | $0 | $29,920 |
| | 13"-18" | $355 | 0 | $0 | 55 | $19,525 | 0 | $0 | 0 | $0 | 0 | $0 | $19,525 |
| | 19"-24" | $525 | 0 | $0 | 22 | $11,550 | 0 | $0 | 0 | $0 | 0 | $0 | $11,550 |
| | 25"-30" | $845 | 0 | $0 | 19 | $16,055 | 0 | $0 | 0 | $0 | 0 | $0 | $16,055 |
| | 31"-36" | $1,140 | 0 | $0 | 10 | $11,400 | 0 | $0 | 0 | $0 | 0 | $0 | $11,400 |
| | 37"-42" | $1,470 | 0 | $0 | 1 | $1,470 | 0 | $0 | 0 | $0 | 0 | $0 | $1,470 |
| | 43+ | $1,850 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| **Total** | | | **0** | **$0** | **318** | **$97,795** | **0** | **$0** | **0** | **$0** | **0** | **$0** | **$97,795** |
| Stump Removal | 00"-03" | $25 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 04"-06" | $25 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 07"-12" | $25 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 13"-18" | $40 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 19"-24" | $60 | 8 | $480 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $480 |
| | 25"-30" | $85 | 15 | $1,275 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $1,275 |
| | 31"-36" | $110 | 8 | $880 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $880 |
| | 37"-42" | $130 | 4 | $520 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $520 |
| | 43+ | $160 | 4 | $640 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $640 |
| **Total** | | | **39** | **$3,795** | **0** | **$0** | **0** | **$0** | **0** | **$0** | **0** | **$0** | **$3,795** |
| Priority 1 Prune | 00"-03" | $20 | 1 | $20 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $20 |
| | 04"-06" | $30 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 07"-12" | $75 | 6 | $450 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $450 |
| | 13"-18" | $120 | 20 | $2,400 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $2,400 |
| | 19"-24" | $170 | 26 | $4,420 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $4,420 |
| | 25"-30" | $225 | 37 | $8,325 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $8,325 |
| | 31"-36" | $305 | 28 | $8,540 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $8,540 |
| | 37"-42" | $380 | 14 | $5,320 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $5,320 |
| | 43+ | $590 | 10 | $5,900 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $5,900 |
| **Total** | | | **142** | **$35,375** | **0** | **$0** | **0** | **$0** | **0** | **$0** | **0** | **$0** | **$35,375** |
| Priority 2 Prune | 00"-03" | $20 | 0 | $0 | 1 | $20 | 0 | $0 | 0 | $0 | 0 | $0 | $20 |
| | 04"-06" | $30 | 0 | $0 | 3 | $90 | 0 | $0 | 0 | $0 | 0 | $0 | $90 |
| | 07"-12" | $75 | 0 | $0 | 41 | $3,075 | 0 | $0 | 0 | $0 | 0 | $0 | $3,075 |
| | 13"-18" | $120 | 0 | $0 | 71 | $8,520 | 0 | $0 | 0 | $0 | 0 | $0 | $8,520 |
| | 19"-24" | $170 | 0 | $0 | 59 | $10,030 | 0 | $0 | 0 | $0 | 0 | $0 | $10,030 |
| | 25"-30" | $225 | 0 | $0 | 75 | $16,875 | 0 | $0 | 0 | $0 | 0 | $0 | $16,875 |
| | 31"-36" | $305 | 0 | $0 | 31 | $9,455 | 0 | $0 | 0 | $0 | 0 | $0 | $9,455 |
| | 37"-42" | $380 | 0 | $0 | 15 | $5,700 | 0 | $0 | 0 | $0 | 0 | $0 | $5,700 |
| | 43+ | $590 | 0 | $0 | 17 | $10,030 | 0 | $0 | 0 | $0 | 0 | $0 | $10,030 |
| **Total** | | | **0** | **$0** | **313** | **$63,795** | **0** | **$0** | **0** | **$0** | **0** | **$0** | **$63,795** |
| Routine Prune | 00"-03" | $20 | 11 | $220 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $220 |
| | 04"-06" | $30 | 0 | $0 | 0 | $0 | 112 | $3,360 | 112 | $3,360 | 112 | $3,360 | $10,080 |
| | 07"-12" | $75 | 0 | $0 | 0 | $0 | 231 | $17,325 | 231 | $17,325 | 231 | $17,325 | $51,975 |
| | 13"-18" | $120 | 0 | $0 | 0 | $0 | 115 | $13,800 | 115 | $13,800 | 115 | $13,800 | $41,400 |
| | 19"-24" | $170 | 0 | $0 | 0 | $0 | 52 | $8,840 | 52 | $8,840 | 52 | $8,840 | $26,520 |
| | 25"-30" | $225 | 0 | $0 | 0 | $0 | 27 | $6,075 | 27 | $6,075 | 27 | $6,075 | $18,225 |
| | 31"-36" | $305 | 0 | $0 | 0 | $0 | 23 | $7,015 | 23 | $7,015 | 23 | $7,015 | $21,045 |
| | 37"-42" | $380 | 0 | $0 | 0 | $0 | 13 | $4,940 | 13 | $4,940 | 13 | $4,940 | $14,820 |
| | 43+ | $590 | 0 | $0 | 0 | $0 | 3 | $1,770 | 3 | $1,770 | 3 | $1,770 | $5,310 |
| **Total** | | | **11** | **$220** | **0** | **$0** | **576** | **$63,125** | **576** | **$63,125** | **576** | **$63,125** | **$189,595** |
| Young Tree Training | 00"-03" | $20 | 29 | $580 | 0 | $0 | 0 | $0 | 29 | $580 | 0 | $0 | $1,160 |
| | 04"-06" | $30 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| | 07"-12" | $75 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| **Total** | | | **40** | **$800** | **0** | **$0** | | **$0** | **29** | **$580** | **0** | **$0** | **$1,380** |
| **Cost Grand Total** | | | | **$111,140** | | **$161,590** | | **$63,125** | | **$63,705** | | **$63,125** | **$462,685** |

*16: Suggested Budget*

## Goals

Settings goals is one way to keep a focus on improving the community forest. This document has discussed three concepts that can be considered goals. The first goal to consider is committing to implementing the recommended work and creating a proactive tree maintenance program. This would involve scheduling annual inspections by a qualified arborist who can also through the inspection generate a scope of work.

The second goal is to maintain an uneven age stand by planting new trees on a regular schedule each year. This is to increase the tree count and to replace trees removed due to senescence or pest and disease issues.

The third goal is to create a diverse species palette. As new trees are planted, they should be chosen based on their ability to survive for the long term and where they fit on the diversity scale. For instance, in Head of the Harbor and the surrounding area the Maple genus is abundant. This species should be planted sparingly or not at all. (It has been purposely omitted from the suggested species list). The new plantings also represent an opportunity to "test" new species that may perform well in the future as the environment around Head of the Manor changes due to warming temperatures.

## Goal Statement

1) Create and implement a proactive tree maintenance program.
2) Commit to an uneven aged tree population by planting trees each year as budget and space permits
3) Adjust species palette so no species constitutes more than 10% of the tree population.

## Conclusion

Properly managing urban trees requires planning, communication, public support, and adequate funding. For these reasons, it is complicated and can only be accomplished through a well-defined vision for the future. The combination of priority and proactive maintenance detailed in this Tree Management Plan will create a framework for short- and long-term management that will help ensure a healthy, vibrant tree canopy for future generations. Head of the Harbor must balance the needs of its residents with a knowledge and understanding of tree management to create a safe, enjoyable environment for everyone.

Figure 17: Harbor Road

## Appendix A – Species Distribution

| Common Name | Botanical Name | Count | % |
|---|---|---|---|
| American Arborvitae | Thuja occidentalis | 27 | 0.72% |
| American Beech | Fagus grandifolia | 121 | 3.22% |
| American Elm | Ulmus americana | 4 | 0.11% |
| American Holly | Ilex opaca | 12 | 0.32% |
| American Hophornbeam | Ostrya virginiana | 8 | 0.21% |
| American Linden | Tilia americana | 1 | 0.03% |
| American Sweet Gum | Liquidambar styraciflua | 11 | 0.29% |
| Balsam Fir | Abies balsamea | 2 | 0.05% |
| Chestnut Oak | Quercus prinus | 14 | 0.37% |
| Bigtooth Aspen | Populus grandidentata | 1 | 0.03% |
| Black Locust | Robinia pseudoacacia | 315 | 8.39% |
| Black Oak | Quercus velutina | 205 | 5.46% |
| Black Walnut | Juglans nigra | 144 | 3.83% |
| Black Willow | Salix nigra | 1 | 0.03% |
| Blue Cedar-of-Lebanon | Cedrus libani 'Glauca' | 1 | 0.03% |
| Box Elder | Acer negundo | 2 | 0.05% |
| Bradford Pear | Pyrus calleryana 'Bradford' | 21 | 0.56% |
| Chokecherry | Prunus virginiana | 1 | 0.03% |
| Colorado Blue Spruce | Picea pungens f. glauca | 4 | 0.11% |
| Colorado Spruce | Picea pungens | 2 | 0.05% |
| Crabapple Species | Malus floribunda | 11 | 0.29% |
| Crape Myrtle (including hybrids) | Lagerstroemia indica (and hybrids) | 1 | 0.03% |
| Deodar Cedar | Cedrus deodara | 6 | 0.16% |
| Douglas Fir | Pseudotsuga menziesii | 1 | 0.03% |
| Eastern Black Cherry | Prunus serotina | 258 | 6.87% |
| Eastern Dogwood | Cornus florida | 49 | 1.30% |
| Eastern Hemlock | Tsuga canadensis | 3 | 0.08% |
| Eastern Red Cedar | Juniperus virginiana | 121 | 3.22% |
| Eastern Redbud | Cercis canadensis | 2 | 0.05% |
| Empress Tree | Paulownia tomentosa | 19 | 0.51% |
| European White Birch | Betula pendula | 1 | 0.03% |
| False Cypress Species | Chamaecyparis species | 2 | 0.05% |
| Fir Species | Abies species | 2 | 0.05% |
| Freeman Maple | Acer x freemanii | 2 | 0.05% |
| Green Ash | Fraxinus pennsylvanica | 3 | 0.08% |

| Common Name | Botanical Name | Count | % |
|---|---|---|---|
| Japanese Black Pine | Pinus thunbergiana | 1 | 0.03% |
| Japanese Cedar | Cryptomeria japonica | 1 | 0.03% |
| Japanese Flowering Cherry | Prunus serrulata | 1 | 0.03% |
| Japanese Maple | Acer palmatum | 67 | 1.78% |
| Japanese Tree Lilac | Syringa reticulata | 1 | 0.03% |
| Japanese Umbrella Pine | Sciadopitys verticillata | 2 | 0.05% |
| Kousa Dogwood | Cornus kousa | 5 | 0.13% |
| Kwanzan Flowering Cherry | Prunus serrulata 'Kwanzan' | 30 | 0.80% |
| Littleleaf Linden | Tilia cordata | 1 | 0.03% |
| Lombardy Poplar | Populus nigra var. italica | 1 | 0.03% |
| Mockernut Hickory | Carya tomentosa | 21 | 0.56% |
| Norway Maple | Acer platanoides | 491 | 13.08% |
| Norway Spruce | Picea abies | 48 | 1.28% |
| Oak Species | Quercus species | 7 | 0.19% |
| Ornamental Pear | Pyrus calleryana | 3 | 0.08% |
| Paper Birch | Betula papyrifera | 3 | 0.08% |
| Pignut Hickory | Carya glabra | 218 | 5.81% |
| Pin Oak | Quercus palustris | 23 | 0.61% |
| Purple-Leafed Plum | Prunus cerasifera | 3 | 0.08% |
| Red Maple | Acer rubrum | 190 | 5.06% |
| Red Oak | Quercus rubra | 72 | 1.92% |
| Red Spruce | Picea rubens | 3 | 0.08% |
| River Birch | Betula nigra | 1 | 0.03% |
| Sassafras | Sassafras albidum | 219 | 5.83% |
| Saucer Magnolia | Magnolia x soulangeana | 1 | 0.03% |
| Scarlet Oak | Quercus coccinea | 64 | 1.70% |
| Shagbark Hickory | Carya ovata | 3 | 0.08% |
| Siberian Elm | Ulmus pumila | 4 | 0.11% |
| Silver Maple | Acer saccharinum | 14 | 0.37% |
| Sour Gum | Nyssa sylvatica | 11 | 0.29% |
| Southern Magnolia | Magnolia grandiflora | 2 | 0.05% |
| Stone Fruit Species | Prunus species | 2 | 0.05% |
| Stump | Stump | 39 | 1.04% |
| Sugar Maple | Acer saccharum | 24 | 0.64% |
| Black Birch | Betula lenta | 452 | 12.04% |
| Thornless Honey Locust | Gleditsia triacanthos f. inermis | 1 | 0.03% |
| | | | |
| | | | |

| Common Name | Botanical Name | Count | % |
|---|---|---|---|
| Tree of Heaven | Ailanthus altissima | 26 | 0.69% |
| Tulip Tree | Liriodendron tulipifera | 138 | 3.68% |
| Unidentifiable Tree | Unidentifiable Tree | 1 | 0.03% |
| Weeping Higan Cherry | Prunus subhirtella 'Pendula' | 1 | 0.03% |
| Nothern Catalpa | Catalpa speciosa | 4 | 0.11% |
| White Fir | Abies concolor | 1 | 0.03% |
| White Mulberry | Morus alba | 10 | 0.27% |
| White Oak | Quercus alba | 74 | 1.97% |
| White Pine | Pinus strobus | 58 | 1.54% |
| White Spruce | Picea glauca | 12 | 0.32% |
| Yew Species | Taxus species | 22 | 0.59% |

# Appendix B – Recommended Species

| **Small to Medium Trees** | |
|---|---|
| **Botanical Name** | **Common Name** |
| Amelanchier species | Serviceberry Varieties |
| Carpinus caroliniana | American Hornbeam |
| Maackia amurensis | Amur Maackia |
| Malus species (Upright varieties) | Upright Flowering Crabapples |
| Prunus virginiana ‘Canada Red Select’ | Canada Red Select Cherry |
| Sorbus alnifolia | Korean Mountain Ash |
| Syringa reticulata (varieties) | Japanese Tree Lilac |
| Cornus mas | cornelian cherry dogwood |
| Carpinus caroliniana | American hornbeam |
| Cercis canadensis | Eastern redbud |
| Osage orange “white shield” | Maclura pomifera 'White Shield' |
| **Large Trees** | |
| **Botanical Name** | **Common Name** |
| Aesculus hippocastanum (varieties) | Horsechestnut |
| Aesculus x carnea (varieties) | Horsechestnut |
| Carpinus betulus ‘fastigiata’ | European Hornbeam |
| Catalpa speciosa | Northern Catalpa |
| Celtis occidentalis | Hackberry |
| Corylus colurna | Turkish Filbert |
| Gingko biloba | Gingko |
| Gleditsia triacanthos inermis | Thornless Honeylocust |
| Gymnocladus dioicus | Kentucky Coffeetree |
| Liriodendron tulipifera | Tulip Tree |

| | |
|---|---|
| Ostrya virginiana | American Hophornbeam (Ironwood) |
| Platanus x acerfolia | London Planetree |
| Prunus sargentii | Sargent Cherry |
| Quercus bicolor | Swamp White Oak |
| Quercus macrocarpa | Bur Oak |
| Quercus rubra | Northern Red Oak |
| Tilia cordata | Littleleaf Linden |
| Ulmus species | Elm (American elm hybrids only) |
| Metasequia glyptostoboides | Dawn redwood |
| Nyssa sylvatica | Black tupelo |
| Quercus alba | White oak |
| Quercus coccinea | Scarlet oak |
| Quercus imbricaria | Shingle oak |
| Quercus muehlengergii | Chinkapin oak |
| Quercus shumardii | Shumard oak |
| Quercus robur | English oak |
| Taxodium distichum | Bald cypress |
| Tilia Americana | American linden |
| Tilia tomentosa | Silver linden |

# Appendix C – Benefits by Species

| Species | Trees | Carbon Storage | | Gross Carbon Sequestration | | Avoided Runoff | | Replacement Value |
|---|---|---|---|---|---|---|---|---|
| | Number | (ton) | ($) | (ton/yr) | ($/yr) | ($ft^3$/yr) | ($/yr) | ($) |
| fir spp | 2 | 0.41 | 69.93 | 0.02 | 4.02 | 12.11 | 0.81 | 1795.46 |
| Balsam fir | 2 | 0.13 | 22.81 | 0.01 | 0.92 | 11.58 | 0.77 | 1478.37 |
| White fir | 1 | 0.11 | 19.20 | 0.00 | 0.62 | 12.81 | 0.86 | 1217.70 |
| Freeman maple | 2 | 0.39 | 66.65 | 0.03 | 5.96 | 33.02 | 2.21 | 1485.09 |
| Boxelder | 2 | 0.32 | 54.26 | 0.02 | 3.43 | 42.85 | 2.86 | 1352.68 |
| Japanese maple | 67 | 7.06 | 1204.87 | 0.25 | 42.20 | 538.53 | 36.00 | 56275.85 |
| Norway maple | 491 | 186.17 | 31751.01 | 7.69 | 1311.44 | 10579.79 | 707.22 | 763165.99 |
| Red maple | 190 | 72.80 | 12416.05 | 3.13 | 533.82 | 4937.49 | 330.05 | 335242.27 |
| Silver maple | 14 | 15.02 | 2561.45 | 0.35 | 60.45 | 905.08 | 60.50 | 36383.11 |
| Sugar maple | 24 | 27.80 | 4742.15 | 0.32 | 55.13 | 1093.44 | 73.09 | 96870.89 |
| Tree of heaven | 26 | 5.85 | 997.89 | 0.36 | 61.24 | 509.08 | 34.03 | 18373.56 |
| Black birch | 452 | 150.27 | 25629.23 | 5.75 | 981.04 | 12930.25 | 864.33 | 530418.00 |
| River birch | 1 | 0.05 | 8.92 | 0.01 | 1.10 | 10.88 | 0.73 | 655.59 |
| Paper birch | 3 | 0.47 | 79.62 | 0.04 | 6.72 | 66.57 | 4.45 | 3090.99 |
| European white birch | 1 | 0.11 | 19.24 | 0.01 | 1.76 | 23.51 | 1.57 | 844.69 |
| hickory spp | 21 | 18.22 | 3108.17 | 0.51 | 87.53 | 941.59 | 62.94 | 59606.15 |
| Pignut hickory | 218 | 140.27 | 23922.62 | 2.48 | 422.77 | 14410.87 | 963.31 | 641222.68 |
| Shagbark hickory | 3 | 1.65 | 281.88 | 0.03 | 5.60 | 152.91 | 10.22 | 8337.43 |
| Northern catalpa | 4 | 2.53 | 430.66 | 0.07 | 11.19 | 230.22 | 15.39 | 15304.32 |
| cedar spp | 1 | 7.30 | 1244.87 | 0.07 | 11.63 | 49.05 | 3.28 | 13018.89 |
| Eastern redbud | 2 | 0.03 | 5.94 | 0.00 | 0.70 | 5.85 | 0.39 | 741.26 |
| Deodar cedar | 6 | 5.32 | 907.42 | 0.14 | 23.70 | 234.54 | 15.68 | 20904.29 |
| Hinoki false cypress | 2 | 0.46 | 79.05 | 0.03 | 4.62 | 12.74 | 0.85 | 1718.09 |
| Flowering dogwood | 49 | 5.89 | 1003.81 | 0.33 | 56.19 | 343.40 | 22.96 | 39759.18 |
| Kousa dogwood | 5 | 0.30 | 50.68 | 0.02 | 3.24 | 12.54 | 0.84 | 1870.46 |
| Japanese red cedar | 1 | 0.03 | 4.47 | 0.00 | 0.55 | 4.57 | 0.31 | 584.21 |
| American beech | 121 | 88.29 | 15058.51 | 1.39 | 236.38 | 7735.42 | 517.08 | 321919.65 |

| Species | Trees | Carbon Storage | | Gross Carbon Sequestration | | Avoided Runoff | | Replacement Value |
|---|---|---|---|---|---|---|---|---|
| | Number | (ton) | ($) | (ton/yr) | ($/yr) | ($ft^3$/yr) | ($/yr) | ($) |
| Green ash | 3 | 2.00 | 340.92 | 0.05 | 7.95 | 193.19 | 12.91 | 11749.65 |
| Thornless honeylocust | 1 | 1.74 | 296.88 | 0.04 | 7.16 | 50.72 | 3.39 | 4942.10 |
| American holly | 12 | 2.49 | 425.36 | 0.06 | 10.03 | 324.76 | 21.71 | 16227.52 |
| marshelder spp | 73 | 151.39 | 25819.98 | 1.37 | 233.29 | 2691.93 | 179.94 | 327506.23 |
| Black walnut | 144 | 84.03 | 14331.74 | 2.66 | 454.14 | 7651.00 | 511.44 | 509015.34 |
| Eastern red cedar | 121 | 66.83 | 11398.27 | 1.07 | 182.91 | 5405.32 | 361.32 | 296751.31 |
| lagerstroemia spp | 1 | 0.16 | 27.15 | 0.01 | 1.63 | 4.59 | 0.31 | 960.48 |
| Sweetgum | 11 | 4.55 | 776.10 | 0.18 | 30.92 | 679.48 | 45.42 | 40130.23 |
| Tulip tree | 138 | 114.65 | 19553.70 | 3.19 | 543.52 | 10934.64 | 730.94 | 507596.23 |
| apple spp | 11 | 0.89 | 152.01 | 0.07 | 11.81 | 53.24 | 3.56 | 7829.51 |
| Southern magnolia | 2 | 0.13 | 22.99 | 0.01 | 1.69 | 23.35 | 1.56 | 1500.27 |
| Saucer magnolia | 1 | 0.04 | 6.68 | 0.00 | 0.73 | 6.06 | 0.41 | 588.71 |
| White mulberry | 10 | 4.80 | 818.86 | 0.11 | 18.70 | 353.72 | 23.64 | 24715.98 |
| Black tupelo | 11 | 4.09 | 697.18 | 0.12 | 20.78 | 311.31 | 20.81 | 23055.96 |
| Eastern hophornbeam | 8 | 0.46 | 77.60 | 0.03 | 4.30 | 102.68 | 6.86 | 5612.77 |
| Royal paulownia | 19 | 4.40 | 750.27 | 0.16 | 26.61 | 559.82 | 37.42 | 32853.81 |
| spruce spp | 4 | 0.51 | 86.41 | 0.04 | 7.02 | 17.35 | 1.16 | 2677.69 |
| Norway spruce | 48 | 40.54 | 6914.65 | 0.56 | 95.32 | 3438.24 | 229.83 | 208470.60 |
| White spruce | 12 | 0.99 | 168.86 | 0.04 | 6.67 | 132.64 | 8.87 | 10786.35 |
| Blue spruce | 2 | 0.15 | 25.22 | 0.01 | 1.11 | 13.88 | 0.93 | 1560.23 |
| Red spruce | 3 | 0.35 | 59.51 | 0.02 | 2.83 | 36.34 | 2.43 | 3325.06 |
| Eastern white pine | 58 | 10.52 | 1793.92 | 0.47 | 80.57 | 1662.05 | 111.10 | 110506.82 |
| Bigtooth aspen | 1 | 0.02 | 3.64 | 0.00 | 0.56 | 3.01 | 0.20 | 526.44 |
| Lombardy poplar | 1 | 0.30 | 50.78 | 0.02 | 3.15 | 15.56 | 1.04 | 655.59 |
| Black cherry | 69 | 21.49 | 3665.16 | 0.61 | 103.97 | 1028.99 | 68.78 | 84455.68 |
| Cherry plum | 3 | 0.74 | 126.18 | 0.04 | 6.66 | 64.68 | 4.32 | 3405.78 |
| Black cherry | 187 | 70.54 | 12030.34 | 3.43 | 585.78 | 4570.58 | 305.52 | 266386.12 |

| Species | Trees | Carbon Storage | | Gross Carbon Sequestration | | Avoided Runoff | | Replacement Value |
|---|---|---|---|---|---|---|---|---|
| | Number | (ton) | ($) | (ton/yr) | ($/yr) | ($ft^3$/yr) | ($/yr) | ($) |
| Japanese flowering cherry | 1 | 0.21 | 35.67 | 0.01 | 2.17 | 10.66 | 0.71 | 955.38 |
| Common chokecherry | 1 | 0.34 | 58.14 | 0.02 | 3.78 | 17.48 | 1.17 | 1232.12 |
| Douglas fir | 1 | 0.21 | 36.50 | 0.01 | 1.09 | 32.67 | 2.18 | 2313.11 |
| Callery pear | 24 | 3.54 | 604.51 | 0.21 | 36.04 | 291.24 | 19.47 | 22043.88 |
| oak spp | 21 | 21.34 | 3639.96 | 0.43 | 72.71 | 1198.78 | 80.13 | 83766.72 |
| White oak | 74 | 176.83 | 30157.77 | 2.16 | 368.52 | 6363.81 | 425.39 | 604067.74 |
| Scarlet oak | 64 | 210.92 | 35971.86 | 3.46 | 590.38 | 5396.74 | 360.75 | 620626.33 |
| Pin oak | 23 | 50.76 | 8657.22 | 0.86 | 146.69 | 3917.79 | 261.89 | 233958.35 |
| Northern red oak | 72 | 142.11 | 24236.56 | 2.29 | 391.03 | 4536.30 | 303.23 | 519393.63 |
| Black oak | 205 | 488.50 | 83314.42 | 7.82 | 1333.63 | 11191.32 | 748.09 | 1069213.95 |
| Black locust | 314 | 292.03 | 49805.34 | 9.03 | 1539.29 | 12704.37 | 849.23 | 941995.83 |
| Sassafras | 219 | 80.57 | 13741.46 | 2.85 | 486.88 | 4372.58 | 292.29 | 279352.30 |
| Black willow | 1 | 0.52 | 88.62 | 0.02 | 3.78 | 47.88 | 3.20 | 1135.26 |
| Umbrella pine | 2 | 0.14 | 23.99 | 0.01 | 1.45 | 8.80 | 0.59 | 1264.40 |
| Japanese tree lilac | 1 | 0.33 | 56.57 | 0.02 | 2.65 | 12.19 | 0.81 | 1240.35 |
| yew spp | 5 | 1.12 | 190.22 | 0.06 | 10.31 | 61.27 | 4.10 | 5102.27 |
| English yew | 17 | 2.44 | 415.61 | 0.08 | 13.15 | 207.67 | 13.88 | 18237.64 |
| Northern white cedar | 27 | 2.83 | 482.97 | 0.11 | 18.34 | 135.30 | 9.04 | 21555.50 |
| American basswood | 1 | 0.25 | 42.81 | 0.01 | 1.61 | 45.58 | 3.05 | 2269.87 |
| Littleleaf linden | 1 | 0.28 | 47.18 | 0.01 | 1.92 | 32.00 | 2.14 | 2093.45 |
| Eastern hemlock | 3 | 0.60 | 102.23 | 0.02 | 2.73 | 77.36 | 5.17 | 4519.64 |
| American elm | 4 | 1.63 | 278.62 | 0.06 | 9.90 | 103.31 | 6.91 | 6508.16 |
| Siberian elm | 4 | 2.50 | 427.19 | 0.09 | 15.95 | 164.81 | 11.02 | 5782.89 |
| **Total** | **3750** | **2806.07** | **478577.18** | **67.07** | **11437.76** | **147099.74** | **9833.00** | **$9,926.058.06** |

# Appendix D – Avoided Runoff

| Species Name | Number of Trees | Avoided Runoff ($ft^3$/yr) | Avoided Runoff Value ($/yr) |
|---|---|---|---|
| Pignut hickory | 218 | 14410.87 | 963.31 |
| Black birch | 452 | 12930.25 | 864.33 |
| Black locust | 314 | 12704.37 | 849.23 |
| Black oak | 205 | 11191.32 | 748.09 |
| Tulip tree | 138 | 10934.64 | 730.94 |
| Norway maple | 491 | 10579.79 | 707.22 |
| American beech | 121 | 7735.42 | 517.08 |
| Black walnut | 144 | 7651.00 | 511.44 |
| White oak | 74 | 6363.81 | 425.39 |
| Eastern red cedar | 121 | 5405.32 | 361.32 |
| Scarlet oak | 64 | 5396.74 | 360.75 |
| Red maple | 190 | 4937.49 | 330.05 |
| Black cherry | 187 | 4570.58 | 305.52 |
| Northern red oak | 72 | 4536.30 | 303.23 |
| Sassafras | 219 | 4372.58 | 292.29 |
| Pin oak | 23 | 3917.79 | 261.89 |
| Norway spruce | 48 | 3438.24 | 229.83 |
| marshelder spp | 73 | 2691.93 | 179.94 |
| Eastern white pine | 58 | 1662.05 | 111.10 |
| oak spp | 21 | 1198.78 | 80.13 |
| Sugar maple | 24 | 1093.44 | 73.09 |
| black cherry | 69 | 1028.99 | 68.78 |
| hickory spp | 21 | 941.59 | 62.94 |
| Silver maple | 14 | 905.08 | 60.50 |
| Sweetgum | 11 | 679.48 | 45.42 |
| Royal paulownia | 19 | 559.82 | 37.42 |
| Japanese maple | 67 | 538.53 | 36.00 |
| Tree of heaven | 26 | 509.08 | 34.03 |
| White mulberry | 10 | 353.72 | 23.64 |
| Flowering dogwood | 49 | 343.40 | 22.96 |
| American holly | 12 | 324.76 | 21.71 |
| Black tupelo | 11 | 311.31 | 20.81 |
| Callery pear | 24 | 291.24 | 19.47 |
| Deodar cedar | 6 | 234.54 | 15.68 |
| Northern catalpa | 4 | 230.22 | 15.39 |
| English yew | 17 | 207.67 | 13.88 |
| Green ash | 3 | 193.19 | 12.91 |
| Siberian elm | 4 | 164.81 | 11.02 |
| Shagbark hickory | 3 | 152.91 | 10.22 |
| Northern white cedar | 27 | 135.30 | 9.04 |
| White spruce | 12 | 132.64 | 8.87 |
| American elm | 4 | 103.31 | 6.91 |
| Eastern hophornbeam | 8 | 102.68 | 6.86 |
| Eastern hemlock | 3 | 77.36 | 5.17 |
| Paper birch | 3 | 66.57 | 4.45 |
| Cherry plum | 3 | 64.68 | 4.32 |
| yew spp | 5 | 61.27 | 4.10 |
| apple spp | 11 | 53.24 | 3.56 |
| Thornless honeylocust | 1 | 50.72 | 3.39 |

| Species Name | Number of Trees | Avoided Runoff ($ft^3$/yr) | Avoided Runoff Value ($/yr) |
|---|---|---|---|
| cedar spp | 1 | 49.05 | 3.28 |
| Black willow | 1 | 47.88 | 3.20 |
| American basswood | 1 | 45.58 | 3.05 |
| Boxelder | 2 | 42.85 | 2.86 |
| Red spruce | 3 | 36.34 | 2.43 |
| Freeman maple | 2 | 33.02 | 2.21 |
| Douglas fir | 1 | 32.67 | 2.18 |
| Littleleaf linden | 1 | 32.00 | 2.14 |
| European white birch | 1 | 23.51 | 1.57 |
| Southern magnolia | 2 | 23.35 | 1.56 |
| Common chokecherry | 1 | 17.48 | 1.17 |
| spruce spp | 4 | 17.35 | 1.16 |
| Lombardy poplar | 1 | 15.56 | 1.04 |
| Blue spruce | 2 | 13.88 | 0.93 |
| White fir | 1 | 12.81 | 0.86 |
| Hinoki false cypress | 2 | 12.74 | 0.85 |
| Kousa dogwood | 5 | 12.54 | 0.84 |
| Japanese tree lilac | 1 | 12.19 | 0.81 |
| fir spp | 2 | 12.11 | 0.81 |
| Balsam fir | 2 | 11.58 | 0.77 |
| River birch | 1 | 10.88 | 0.73 |
| Japanese flowering cherry | 1 | 10.66 | 0.71 |
| Umbrella pine | 2 | 8.80 | 0.59 |
| Saucer magnolia | 1 | 6.06 | 0.41 |
| Eastern redbud | 2 | 5.85 | 0.39 |
| lagerstroemia spp | 1 | 4.59 | 0.31 |
| Japanese red cedar | 1 | 4.57 | 0.31 |
| Bigtooth aspen | 1 | 3.01 | 0.20 |
| **Total** | **3750** | **147099.74** | **$9,833.00** |

Avoided runoff value is calculated by the price $0.067/$ft^3$. The user-designated weather station reported 50.3 inches of total annual precipitation. Eco will always use the hourly measurements that have the greatest total rainfall or user-submitted rainfall if provided.

# Appendix E – Species Review Comments

| Common Name | Native | Expand Use | Comments |
|---|---|---|---|
| Balsam Fir | Yes | No | Use in parks OK, but not really a street tree species. |
| White Fir | No | No | Use in parks OK, but not really a street tree species. |
| Fir Species | Varies | No | Use in parks OK, but not really a street tree species. |
| Box Elder | Yes | No | Soft-wooded, weedy. |
| Japanese Maple | No | No | Acceptable, but inconsistent as street tree. |
| Norway Maple | No | No | Invasive. |
| Red Maple | Yes | Yes | |
| Silver Maple | Yes | No | |
| Sugar Maple | Yes | Yes | |
| Freeman Maple | Yes* | Yes* | *Tho natural hybrids do occur, those used as street trees |
| Tree of Heaven | No | No | Invasive. |
| Sweet Birch | Yes | Yes | In rural sites. Not an urban tree. |
| River Birch | Yes | Yes | |
| Paper Birch | Yes | Yes | On rural sites. Not an urban tree. |
| European White Birch | No | No | |
| Pignut Hickory | Yes | Yes | On rural sites. Not an urban tree. |
| Shagbark Hickory | Yes | Yes | On rural sites. Not an urban tree. |
| Mockernut Hickory | Yes | Yes | On rural sites. Not an urban tree. |
| Western Catalpa | Yes | Yes | |
| Deodar Cedar | No | No | |
| Blue Cedar-of-Lebanon | No | No | |
| Eastern Redbud | Yes | Yes | |
| False Cypress Species | No | No | |
| Eastern Dogwood | Yes | Yes* | *Difficult to establish as street tree in urban settings; |
| Kousa Dogwood | No | No | |
| Japanese Cedar | No | No | |
| American Beech | Yes | Yes | On rural sites. Not an urban tree. |
| Green Ash | Yes | No | Emeral ash borer. |
| Thornless Honey Locust | Yes* | Yes | *Thorny forms are native. Thornless ones are |
| American Holly | Yes | Yes | |
| Black Walnut | Yes | Yes* | *Difficult to establish as street tree in urban settings; |
| Eastern Red Cedar | Yes | No | |
| Crape Myrtle (including hybrids | No | No | |
| American Sweet Gum | Yes | Yes | Seed balls are issue on pavement. |
| Tulip Tree | Yes | Yes | With sufficient space. |
| Southern Magnolia | No | No | SE US native. |
| Saucer Magnolia | No | No | |
| Crabapple Species | No | No | |
| White Mulberry | No | No | Invasive. |
| Sour Gum | Yes | Yes | |

| | | | |
|---|---|---|---|
| American Hophornbeam | Yes | Yes | |
| Empress Tree | No | No | Invasive |
| Norway Spruce | No | No | |
| White Spruce | Yes | No | |
| Colorado Spruce | No | No | |
| Colorado Blue Spruce | No | No | |
| Red Spruce | Yes | No | Coniferous evergreens generally not recommended for |
| White Pine | Yes | No | Coniferous evergreens generally not recommended for |
| Japanese Black Pine | No | No | |
| Bigtooth Aspen | Yes | No | |
| Lombardy Poplar | No | No | |
| Sweet Cherry | No | No | |
| Purple-Leafed Plum | No | No | |
| Eastern Black Cherry | Yes | No | |
| Japanese Flowering Cherry | No | No | |
| Kwanzan Flowering Cherry | No | No | |
| Stone Fruit Species | No | No | |
| Weeping Higan Cherry | No | No | |
| Chokecherry | Yes | No | |
| Douglas Fir | No | No | |
| Ornamental Pear | No | No | Invasive. |
| Bradford Pear | No | No | Invasive. |
| White Oak | Yes | Yes | |
| Scarlet Oak | Yes | Yes | |
| Pin Oak | Yes | No | Bacterial leaf scorch (BLS) |
| Basket Oak | Yes | Yes | Correct name is Quercus montana. |
| Red Oak | Yes | No | Bacterial leaf scorch (BLS) |
| Oak Species | Varies | Varies | |
| Black Oak | Yes | Yes* | *Difficult to establish as street tree in urban settings; |
| Black Locust | No | No | US native, but considered invasive in much of NE US. |
| Black Willow | Yes | No | |
| Sassafras | Yes | Yes* | *Difficult to establish as street tree in urban settings; |
| Japanese Umbrella Pine | No | No | |
| Stump | N/A | N/A | |
| Japanese Tree Lilac | No | No | |
| Yew Species | No | No | |
| American Arborvitae | Yes* | No | *Most used are horticultural selections, not technically |
| American Linden | Yes | Yes | |
| Littleleaf Linden | No | No | |
| Eastern Hemlock | Yes | No | Coniferous evergreens generally not recommended for |
| American Elm | Yes | Yes* | Use DED-resistant selections only. |
| Siberian Elm | No | No | Invasive. |