TREE MANAGEMENT PLAN

Downtown Traverse City, Michigan

August 2021

DAVEY Resource Group

DOWNTOWN TC TRAVERSE CITY

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FIGURES & TABLES

Notice of Disclaimer: Inventory data provided by Davey Resource Group, Inc. "DRG" 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. DRG 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. DRG 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 DRG'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.

INTRODUCTION

The ***2021 Downtown Traverse City Tree Management Plan*** is a supplement to the *2018 Traverse City Tree Management Plan and Urban Tree Canopy Assessment*, completed by Davey Resource Group, Inc. (DRG). The ***2021 Downtown Plan,*** funded and supported by the Traverse City Downtown Development Authority (DDA), focuses on the specific maintenance and management needs of the public trees, stumps, and planting sites within the **DDA District.**

The planning process included:

- **Tree inventory update** of the public street and park trees within the Traverse City DDA District.
- **Tree management plan** detailing recommended maintenance activities for the DDA District, including timing, and estimated costs based on the updated tree street and park tree inventory.
- **Outreach and engagement** to understand the Traverse City community's values and preferences related to trees and streetscapes in the DDA District.

The Plan is organized into three sections:

Section 1: Tree Inventory Summary presents data from the updated Downtown street and park tree inventory to understand the current state of downtown Traverse City's tree population.

Section 2: Tree Management Program details recommended tree maintenance activities based on the updated street and park tree inventory for Downtown Traverse City. It includes a four-year tree maintenance program with budget table estimating costs per year.

Section 3: Tree Planting in Downtown Traverse City provides considerations, tools, and strategies for planting downtown. This section includes a summary of community themes and priorities that emerged during the project's community engagement activities.

Section 1:

Tree Inventory Summary

SECTION 1: TREE INVENTORY SUMMARY

In February 2021 Davey Resource Group, inc. (DRG) conducted a tree inventory update of the trees within the Traverse City DDA District. Data was collected on trees, stumps, and planting sites in the street right-of-way (ROW) and in Clinch Park, Hannah Park, Lay Park, Mini Park, Union Street Dam Park, Wellington Plaza, and West End Beach.

A total of 1,146 sites were collected (Figure 1):

- 96% the sites collected are trees.
- 3% are vacant planting sites.
- 1% are stumps.

Note: 7 sites were determined to be unplantable and are not included in the tree inventory summary data.

See Appendix A for details about DRG's methodology for collecting site data.

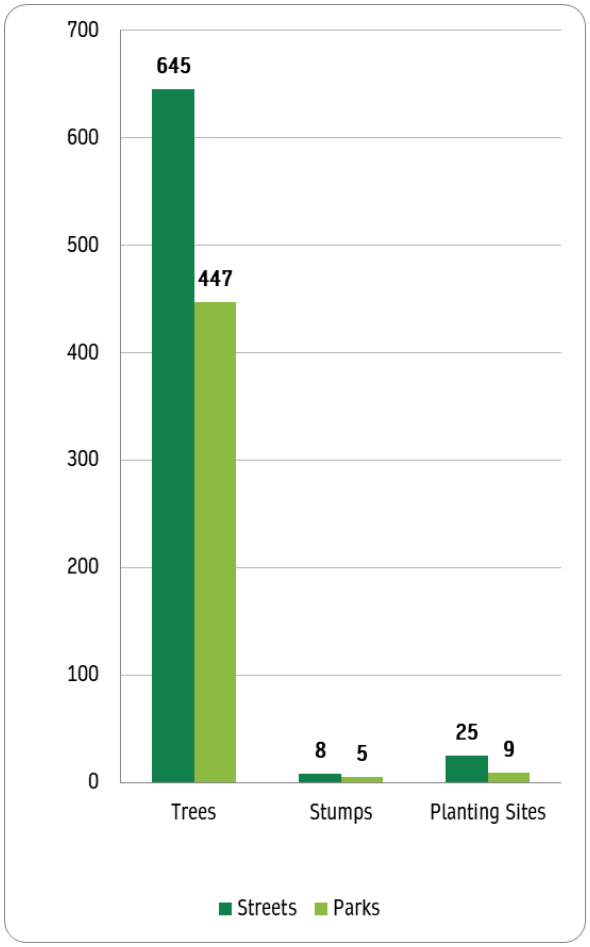


Figure 1. Number of inventoried sites by location and type.

SPECIES, GENUS, AND FAMILY DISTRIBUTION

Species and genus diversity, or the variety of trees growing in a community, is crucial for ensuring that Downtown Traverse City's trees are resilient to invasive pests and diseases. The 10-20-30 rule is a common urban forestry industry recommendation for tree species, genus, and family distribution (Santamour 1990). The rule states that a single species should not represent more than 10% of the public tree population, a single genus no more than 20%, and a single family no more than 30%. Even when the 10-20-30 standard is met, it is important for community planting plans to continue to prioritize diversity by including species, genera, and families that are less represented in the population to ensure future diversity.

Population Distribution

Figure 2 shows the most abundant species in Downtown Traverse City's inventoried tree population using the 10% species rule. Callery Pear (*Pyrus calleryana)* at 29% of the population is well above the 10% rule. Norway maple (*Acer platanoides*, 7%) and sugar maple (*Acer saccharum,* 5%) do not exceed the recommended species threshold but contribute to a greater abundance of maple (*Acer*) in the genus distribution discussed next. Littleleaf linden (*Tilia cordata*, 5%) and Honeylocust (*Gleditsia triacanthos*, 4%) are both below the 10% species threshold. Table 1 shows the top 10 species growing in Downtown Traverse City's streets and parks.

RESILIENCE THROUGH DIVERSITY

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

Ash tree with emergence hole from emerald ash borer.

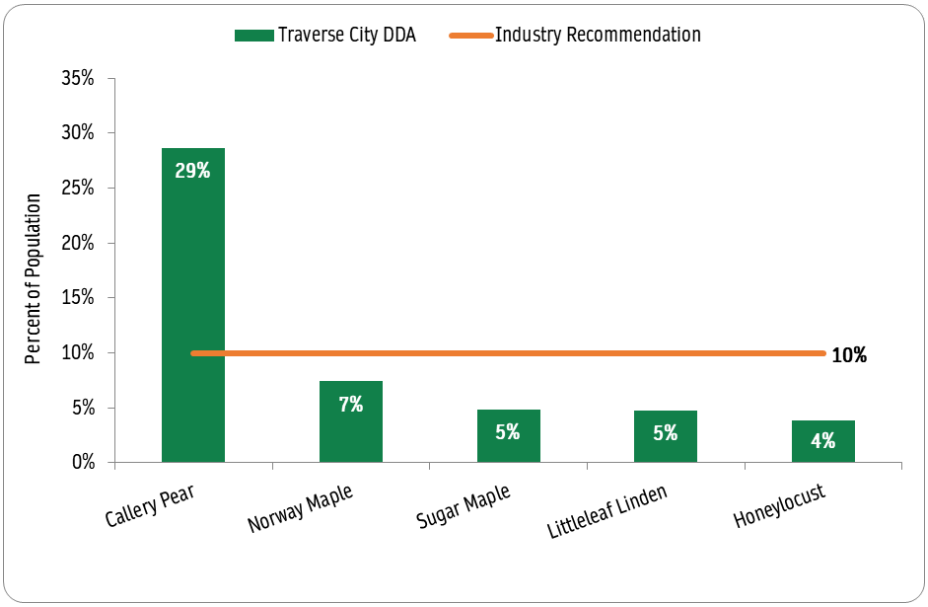


Figure 2. Species distribution of Downtown Traverse City's inventoried public trees

Common Name	Latin Name	# of Trees
Callery Pear	*Pyrus calleryana*	313
Norway Maple	*Acer platanoides*	81
Sugar Maple	*Acer saccharum*	53
Littleleaf Linden	*Tilia cordata*	52
Honeylocust	*Gleditsia triacanthos*	42
Red Pine	*Pinus resinosa*	38
Japanese Tree Lilac	*Syringa reticulata*	37
Apple sp.	*Malus spp.*	34
Quaking Aspen	*Populus tremuloides*	29
Common Chokecherry	*Prunus virginiana*	26

Table 1. Top 10 Street and Park Trees in the DDA District

Genus (genera) is a group of tree species that have the same primary traits in common – for example the species red maple (*Acer rubrum),* sugar maple (*Acer saccharum)*, and silver maple (*Acer saccharinum)* all belong the genus maple (*Acer).* **Figure 3** details the most abundant genera in Downtown Traverse City's inventoried tree population compared to the 20% recommended genus rule. The only genus that has a population above the 20% threshold is pear (*Pyrus)* at 30%.

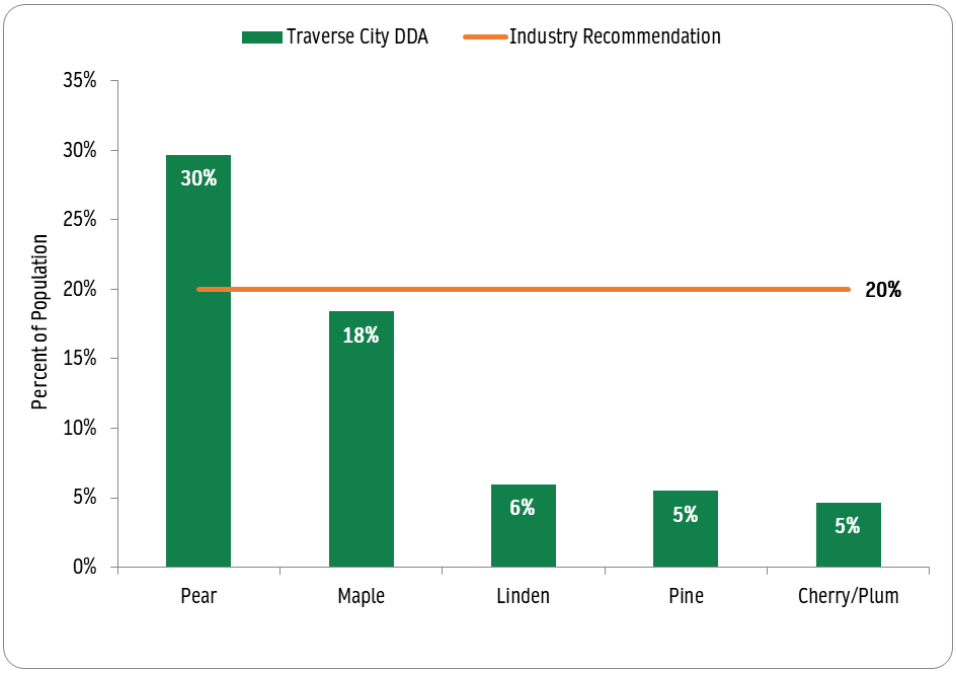


Figure 3. Genus distribution of Downtown Traverse City's inventoried public trees.

CONDITION

The condition of each inventoried tree was rated by an International Society of Arboriculture (ISA) Certified Arborist as Good, Fair, Poor, or Dead. Factors including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests, were considered when assigning a condition rating for each tree. The general health of the inventoried street and park tree population is characterized by the most prevalent condition rating assigned during the inventory.

As **Figure 4** shows most of the inventoried trees are in Fair condition (57%), while 29% are in Good condition, and 14% are in Poor or Dead condition. With 86% of the tree population having a condition rating of Fair or better **the overall condition of Downtown Traverse City's inventoried trees is Fair**.

Figure 4. Condition distribution of Downtown Traverse City's inventoried public trees

Common reasons that young trees were rated in Poor condition are structural defects that can be corrected by training, mechanical damage from weed whips and lawnmowers that could have been avoided, and improper planting with the root flare too high or below the soil surface. Poor condition ratings among mature trees are generally based on significant signs of decline including, dieback of primary leaders and decay. Trees in Poor condition with dieback and/or decay that is not too extensive can often be pruned to correct these defects. These trees should be monitored routinely and if their condition continues to decline removal may be the best option for mitigating risk.

Because mature trees provide exponentially more benefits than young trees it may be worthwhile to maintain overmature trees in that show signs of being able to endure for several more years. While maintaining these large trees might be costly, the annual value of the benefits they provide should be considered when removal has not yet been recommended by an ISA Certified Arborist. The health of some trees in Poor condition is unlikely to improve even with intensive maintenance and removal is recommended as the most cost-effective option for mitigating risk.

The condition of Downtown Traverse City's inventoried trees can be improved over time by following the proactive maintenance recommendations in Section 2. Among the **most important is structural pruning, or training, of young trees and routine pruning of established, maturing, and mature trees.** Both maintenance activities are important for correcting defects that could worsen over time and to mitigate risk concerns. All pruning should be specified and performed according to ANSI A300 (Part 1) standards (American National Standards Institute, 2017).

RELATIVE AGE DISTRIBUTION

Analysis of a tree population's relative age distribution is performed by assigning age classes to size classes. Specific tree age cannot be determined from diameter size class alone because many factors affect tree lifespan and growth rate such as species, soil conditions, and climate, but it is still useful to generalize size classes into relative age classes because of the insight it gives to managing the inventoried tree resource.

The inventoried tree population is grouped into the following relative age classes: young trees 0–8 inches diameter at breast height (DBH), established trees 9–17 inches DBH, maturing trees 18–24 inches DBH, and mature trees greater than 24 inches DBH. These size classes were chosen to allow the inventoried tree population to be compared to an ideal relative age distribution recommended by Richards, which holds that the largest proportion of a tree population (approximately 40%) should be young trees while the smallest proportion (approximately 10%) should be mature trees (Richards 1983).

A tree population within Richards' ideal relative age distribution provides enough social, economic, and environmental benefits that their annual value is generally greater than the cost of maintaining them. **Figure 5** compares the relative age distribution of Downtown Traverse City's inventoried tree population to Richards' ideal distribution.

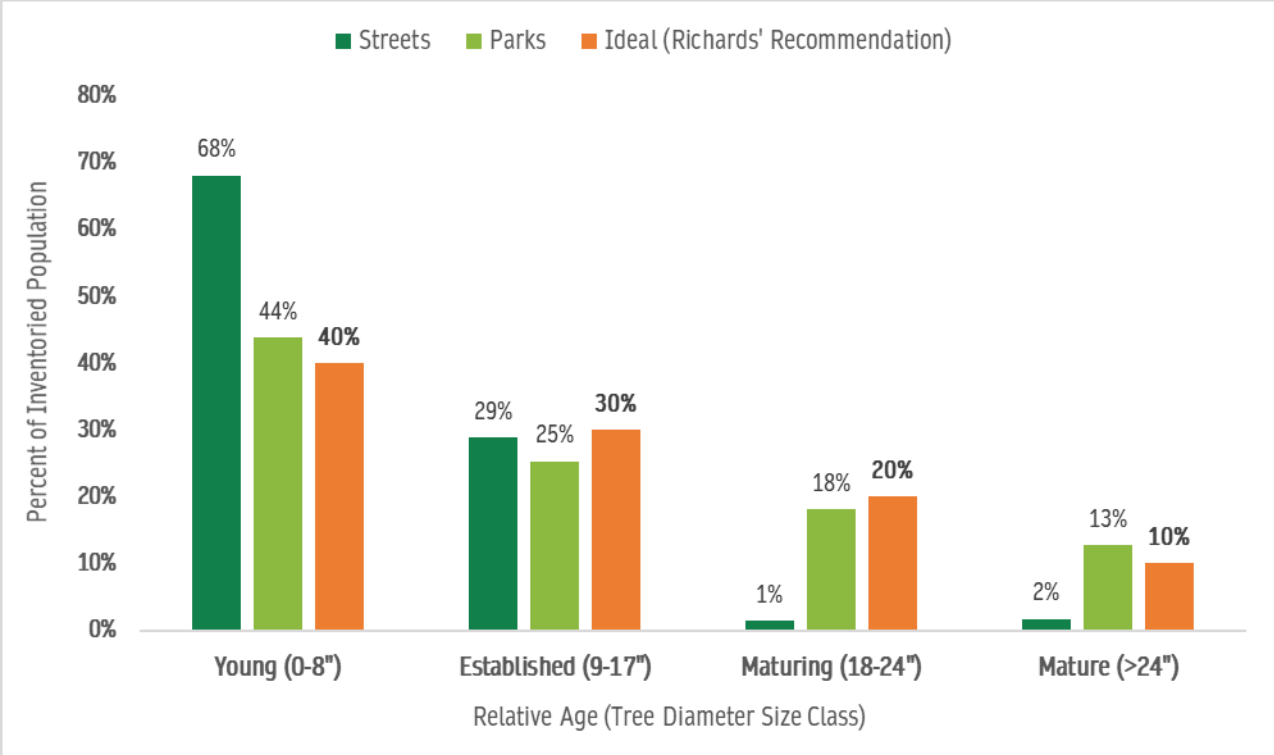


Figure 5. Relative age distribution of Downtown Traverse City's inventoried public trees compared to Richards' recommended ideal age distribution.

As seen in Figure 5, Downtown's park trees are trending toward Richards' ideal, however, the street tree population is trending young, **with 68% of the population in the young (small) tree** category. With the potential that many trees could reach maturity at the same time, there is a risk that canopy cover will be impacted as these trees die and are removed.

To maintain a sustainable urban forest, it is important to have a mix of size/age classes to prevent a significant loss in tree canopy cover. To ensure there is an adequate mix of size/age classes:

- the preservation and care of mature trees should be prioritized to prevent loss of current tree canopy.
- new trees, especially those with large canopies at maturity, should be planted to replace old, dying, dead trees.
- structural of young and established trees should be conducted to ensure there are trees to replace maturing and mature trees.

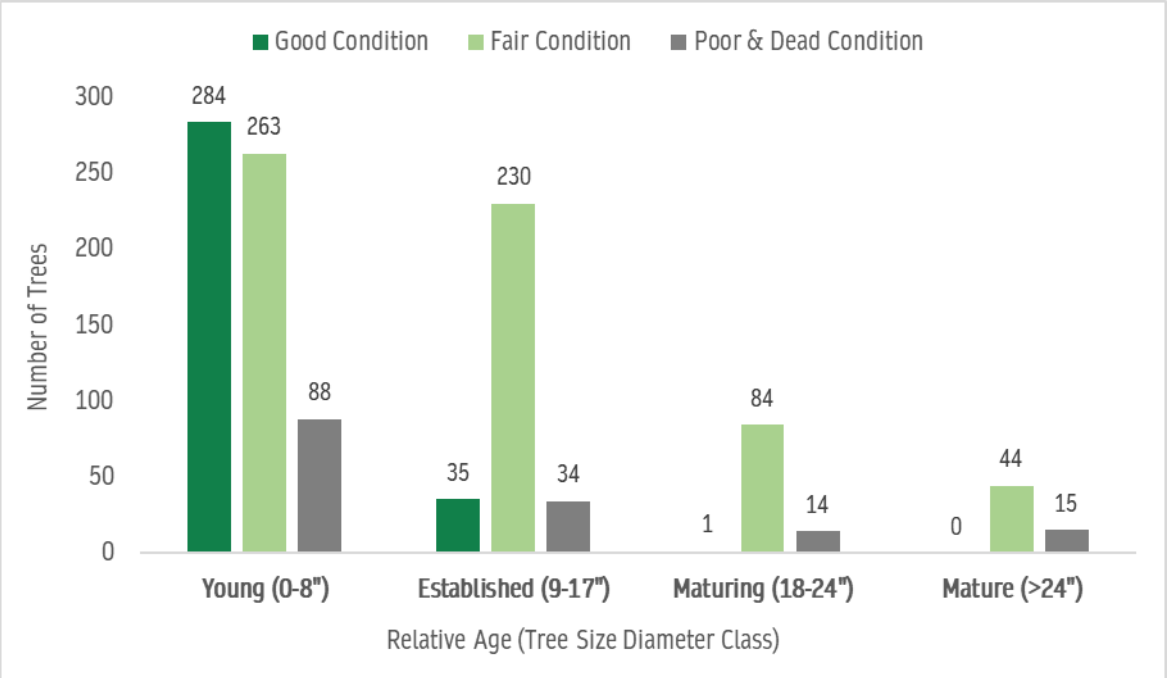


Figure 6. Condition by relative age class of Downtown Traverse City's inventoried public trees

Figure 6 cross-analyzes the condition of Downtown Traverse City's inventoried tree population with its relative age distribution. The **greatest proportion of trees in each age class are in Fair condition except for the young age class.** The proportion of the tree population in Good condition decreases sharply between the young and established age classes then continues decreasing in the mature and maturing age classes. **This trend emphasizes the importance of training and inspecting trees while they are young to improve their structure and address any issues that may lead to declining condition as they age.** Not only will this improve the

condition of trees as they mature, but it is far more cost effective to train young and established trees than it is to prune mature and maturing trees. The effort expended on training trees not only promotes a longer healthy life for Downtown Traverse City's public trees, but also reduces the number of large tree removals that could have been avoided by correcting structural defects or noting nonviable trees so they can be easily removed while they are still small.

BENEFITS OF TREES

Environmental Benefits

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

Economic Benefits

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

Social Benefits

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

TREEKEEPER BENEFITS ANALYSIS

TreeKeeper® is DRG's tree inventory management software utility that models the monetary value of benefits provided by individual trees, groups of trees, or an entire tree population. Using tree inventory data i-Tree Streets analyzes the inventoried tree population's size, structure, overall condition, and species composition to estimate the value of the environmental services performed by trees, including intercepting rainfall, reducing carbon dioxide (CO2) emissions, and removing atmospheric pollutants (see Appendix B for details about i-Tree Streets benefits methodology).

ENERGY AND PROPERTY BENEFITS

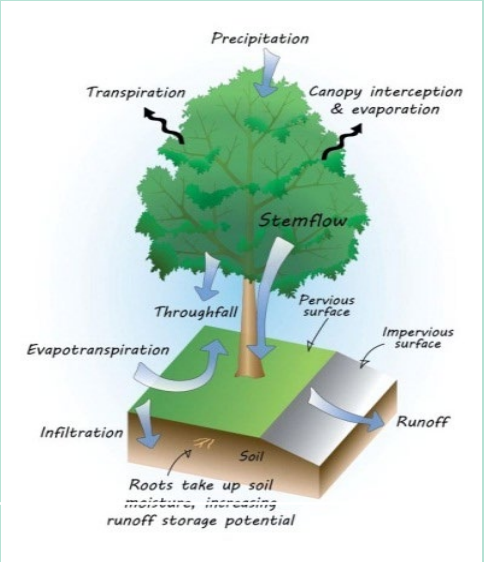
Downtown Traverse City's inventoried street and park trees helps conserve 107,636 kWh and 15,268 therms in energy usage each year by shielding buildings from temperature extremes caused by sun, wind, and precipitation. The total estimated value of these energy savings is $23,132.

Properties with trees have also been found to have higher property values, and the value of this benefit increases as trees and their canopies grow. Downtown Traverse City's inventoried tree population has an estimated property benefit of $26,738.

AVOIDING AND SEQUESTERING CARBON

Carbon dioxide (CO_2), the primary greenhouse gas driving climate change has negative impacts on people, infrastructure, and the environment. Trees act as carbon sinks by absorbing carbon emitted by automobiles, power plants, and other sources during photosynthesis and storing it in their tissue as they grow, which decreases the amount of carbon in the atmosphere. i-Tree Streets models the total carbon sequestered (absorbed) by inventoried tree populations each year using simulated growth rates for each species. The 141,051 lbs. of CO_2 avoided by having trees in the urban landscape and the 161,075 lbs. of CO_2 sequestered annually by Downtown Traverse City's inventoried tree

TREE BENEFITS



Trees perform many environmental services and provide many benefits simply by existing, including:

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

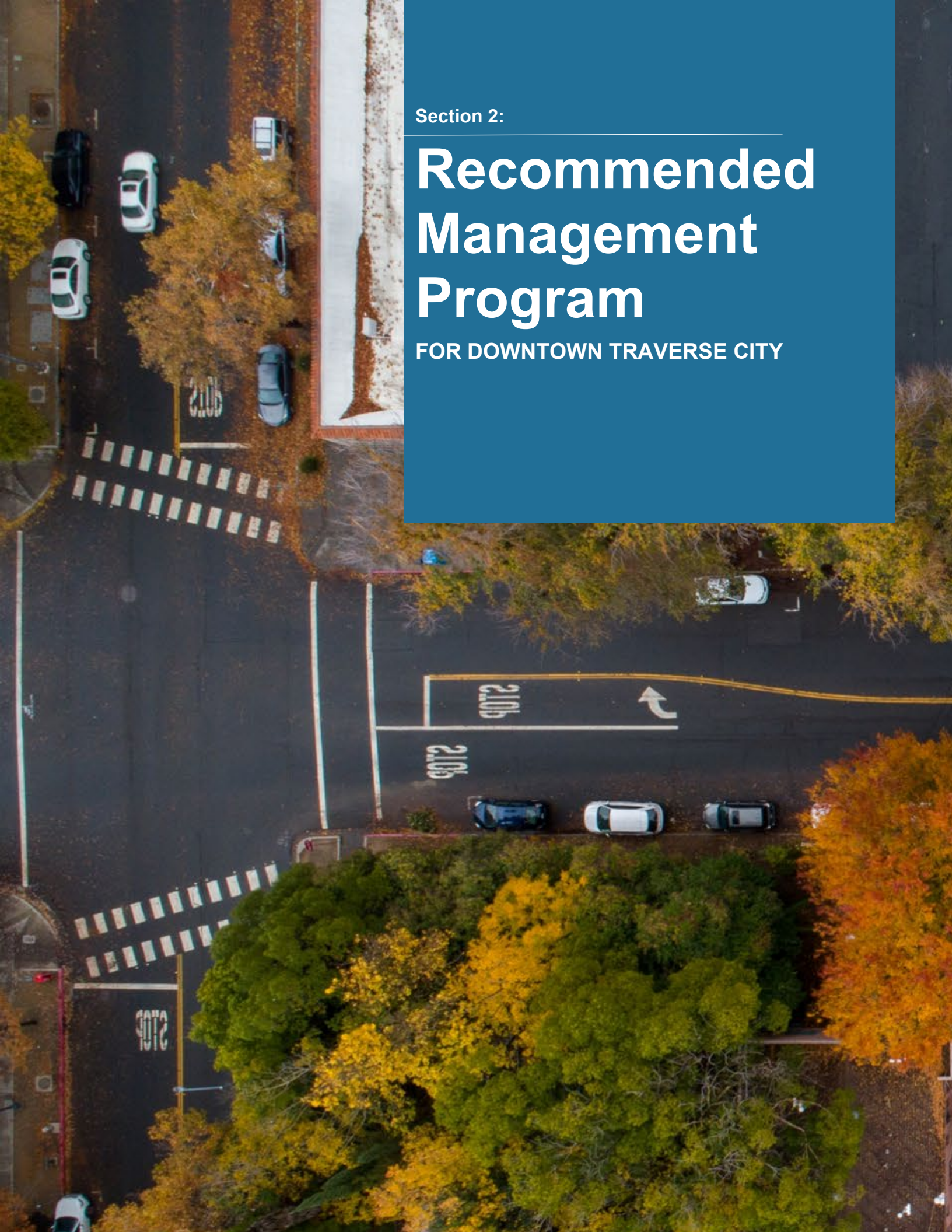
population have a total estimated annual value of $2,194.

CONTROLLING STORMWATER

Trees intercept rainfall with their leaves and branches reducing run-off and helping lower stormwater management. Avoided stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, infrastructure, and water quality. The 751,894 gallons of stormwater runoff intercepted by Downtown Traverse City's inventoried trees each year has an estimated total value of $20,376.

IMPROVING AIR QUALITY

Compared to rural landscapes, urban landscapes are characterized by higher emissions from automobiles, industry, and other sources in a relatively small area. The total weight of sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter (PM_{10}) removed from the air by the inventoried tree population is 988 lbs. The health consequences avoided by the City of Downtown Traverse City's residents has an estimated value of $3,080.



Section 2:

Recommended Management Program

FOR DOWNTOWN TRAVERSE CITY

Summary of Recommended Tree Maintenance

Tree & Stump Removal

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

Total = 81 trees
High Risk = 0 trees
Moderate Risk = 23 trees
Low Risk = 58 trees
Stumps = 13

Priority Pruning

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

Total = 9 trees
High Risk = 1 tree
Moderate Risk = 8 trees

3-Year Routine Pruning

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

Total = 524 trees
Number in cycle each year = 174 trees (minimum)

3-Year Tree Training Cycle

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

Total = 532 trees
Number in cycle each year = 177 trees (minimum)

Tree Planting

Planting new trees to replace trees removed and in areas with low tree canopy cover in areas helps ensure that tree benefits are distributed evenly across the city.

19 small vacant street sites
5 medium vacant street sites
1 large vacant street sites
60 replacements after street tree and stump removals

Routine Tree Inspection

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

Drive-by assessments each year = 878 trees (minimum)
Walk-by assessment each year = 219 trees (minimum)

SECTION 2: DOWNTOWN TREE MANAGEMENT PROGRAM

RECOMMENDED APPROACH TO TREE MANAGEMENT

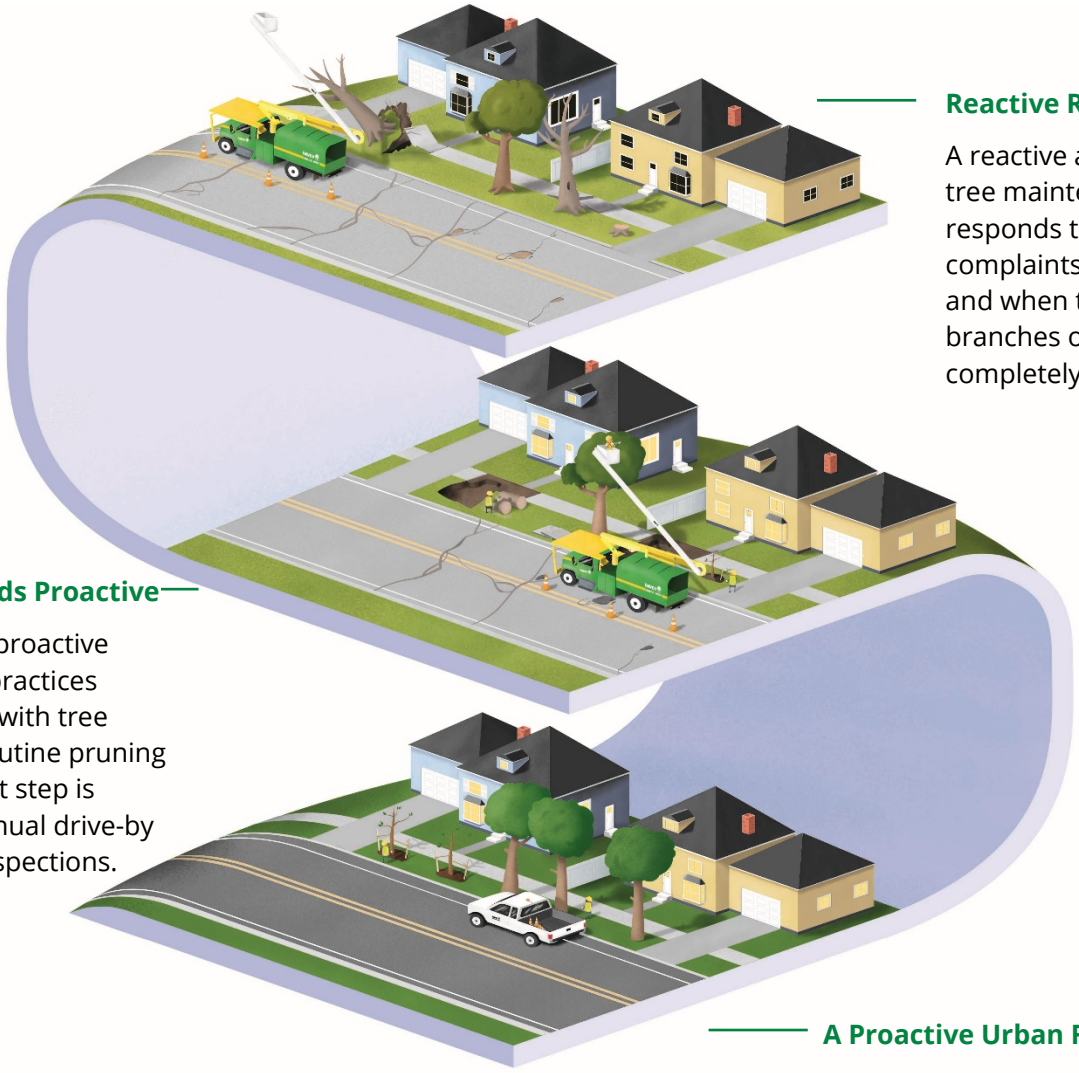
An effective approach to managing public trees is to follow a proactive and systematic program that sets clear and realistic goals, prescribes future action, and periodically measures progress. A robust urban forestry program establishes tree maintenance priorities and utilizes tools including a tree inventory and asset management software system with geographic data functionality (e.g., TreeKeeper®).

The management program for the Downtown District's trees includes a four-year maintenance schedule based on data from the updated street and park tree inventory. The schedule details the recommended tasks to complete each year along with estimated costs. To prioritize tree maintenance activities, the inventory includes a Risk Rating and a recommended maintenance activity for each tree. **The recommended maintenance activities for all trees with a High or Moderate Risk Rating are prioritized first before shifting to proactive, routine tree maintenance.** While large short-term expenditures may be required to address these trees, it is important to secure the funding needed to complete high priority tree maintenance as soon as possible, to promote public safety and reduce long-term costs.


High Priority
•All High Risk tree removals and pruning should be completed immediately, because these trees have significant defects that will become severe over time.
Moderate Priority
•Moderate Risk tree removals and pruning should only start after all High risk tree removals and pruning has been completed.
Low Priority
•Low Risk tree removals and pruning should be performed after all High and Moderate Risk tree removals and pruning have been completed.
Stump Removal
•Stump removals should be performed either when a tree is removed or before a planting season begins, so planting sites become vacant for replacement trees.
Young Tree Training
•Tree Training Cycles improve branching structure so defects do not worsen and become more costly to correct as trees grow, and should begin as soon as possible.
Routine Pruning
•Routine Pruning Cycles correct defects before they worsen, which is crucial for maintaining the overall condition of the inventoried tree population for the long-term.
Replace Trees
•Removed trees should be replaced so there is no net loss of the tree resource, which should enter the Tree Training Cycle after one or two years.
Routine Inspection
•Routine Inspection from a drive-by perspective is important for detecting major defects before they worsen, and a walk-by perspective is important for updating inventory data.
Tree Planting
•Planting new trees is important for increasing population size and urban canopy, but can wait until higher priority maintenance is complete or at least in progress.

FROM REACTIVE TO PROACTIVE TREE MAINTENANCE

Trees require routine attention and upkeep to maximize the benefits they provide to Downtown Traverse City's residents, businesses, and visitors. Many communities find themselves following a reactive approach to maintaining their public trees. A program based on regular tree assessments, updated inventory data, and routine maintenance of public trees prevents common issues before they arise—saving time and money and freeing it to be spent elsewhere within the urban forestry program.



Reactive Response

A reactive approach to tree maintenance responds to issues as complaints get called in and when trees drop branches or fail completely.

Moving towards Proactive

Implementing proactive management practices typically starts with tree training and routine pruning cycles. The next step is performing annual drive-by and walk-by inspections.

A Proactive Urban Forest

Proactive maintenance uses the tree inventory data to systematically plan all tree maintenance activities. Tree training and routine pruning are cost-effective by preventing the declining conditions that and lead to removal. These cost savings can leverage new tree plantings and community outreach efforts.

RECOMMENDED MAINTENANCE BY RISK RATING

Trees fail from natural causes such as diseases, insects, and weather conditions as well as from physical injury due to vehicles, vandalism, and root disturbances. While trees that decline into Poor condition may have defects that are cost-effective to prevent, they often have defects that cannot be cost-effectively corrected and can pose a risk to people and property. Trees should be removed when corrective pruning, or plant health care will not adequately mitigate risk or would be cost-prohibitive. DRG recommends completing maintenance for all High Risk trees as soon as possible. Maintenance activities for Moderate Risk trees can then be systematically addressed depending on a given tree's location, its particular defects, and risk tolerance.

Low is the lowest category of Risk Rating. Barring tree removal, there is no feasible way to reduce a tree's Risk Rating below Low. Low Risk recommended maintenance activities should be prioritized based on how that fit within Downtown Traverse City's priorities such as tree aesthetics, tree longevity, or when the possible consequences of a particular tree or tree part failing are unacceptably high.

Important Note: Proactively training and pruning trees on routine cycles can reduce management costs over time by correcting issues early, improving tree condition, and increasing longevity.

Removal Recommendations

Shown in **Figure 7**, Downtown Traverse City's tree inventory data identifies 0 High Risk Trees, 23 Moderate Risk trees, and 58 Low Risk trees recommended for removal. If High Risk tree removals were present those should be completed within 3 months because observed defects can worsen over time and increase the risk posed by the tree. **The focus for Downtown Traverse City should be on removing the 23 trees listed as Moderate Risk.** Following the removal of the Moderate Risk trees, the focus should shift to removing the Low Risk trees in the DDA District. **Figure 8** provides the street tree and park tree removals by risk rating and relative age distribution.

Figure 7. Street and park tree removals prioritized by risk rating

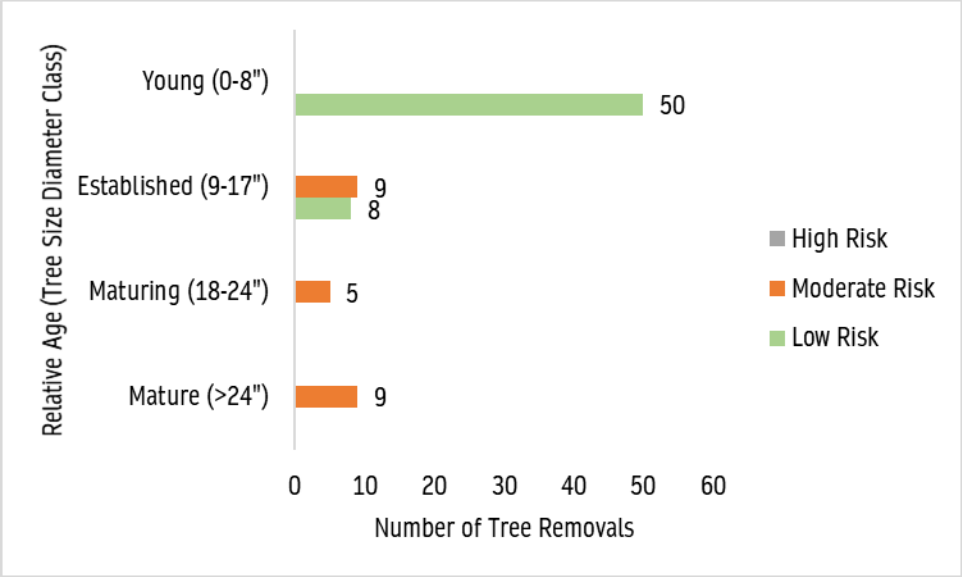


Figure 8. Recommended street and park tree removals prioritized by relative age class and risk rating.

Pruning Recommendations

The tree inventory data **identifies 8 Moderate Risk trees and 1 High Risk tree recommended for priority pruning** (Figure 9)**.** Trees with the maintenance recommendation of priority pruning have at least one dead branch that is 2-inches in diameter or larger, or multiple large dead branches. All High Risk tree pruning should be completed within 3 months because observed defects can worsen over time and increase the risk posed by the tree. After High Risk trees have been addressed, Moderate Risk trees should be pruned. Pruning of Moderate Risk trees should be prioritized based

on their location, defects, and the City/DDA's risk tolerance. Low Risk trees should be pruned as part of a routine pruning cycle.

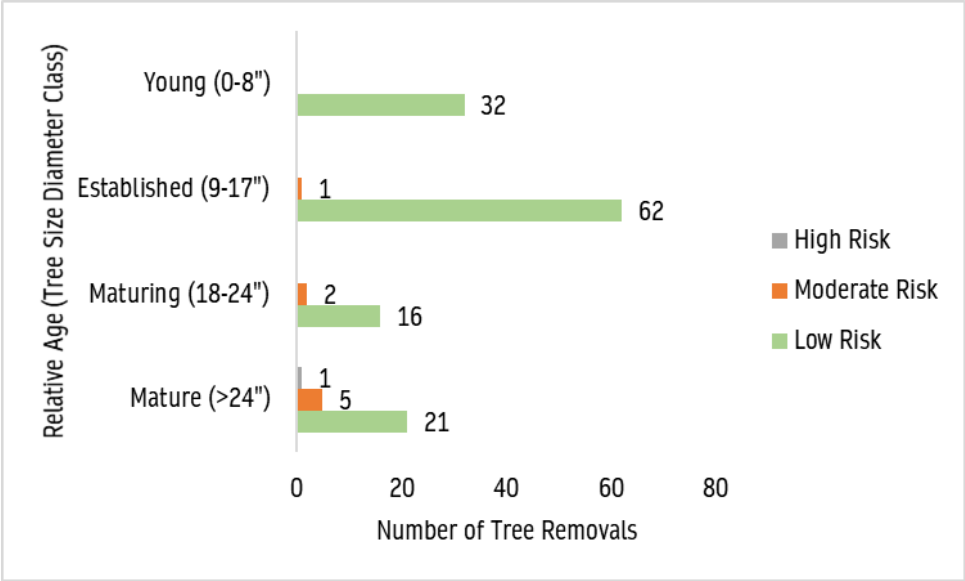


Figure 9 Recommended pruning prioritized by relative age class and risk rating.

ROUTINE INSPECTIONS

Routine inspections are necessary to detect defects that have either already become a risk or can be corrected so they do not become a risk in the future. Inspections should be performed by a qualified arborist, that is knowledgeable in arboriculture and tree risk and can provide proper assessment, care, and informed recommendations. Ideally, the arborist will be ISA Certified and hold the ISA Tree Risk Assessment Qualification credential.

Routine Inspection Recommendations

All inventoried trees should be regularly inspected to identify and mitigate for emerging risk factors. **Annual inspections of 878 DDA District trees, or 80% of the inventoried tree population, should be performed via drive-by assessment** consistent with *ANSI A300 (Part 9)* standards to identify major defects. Drive-by assessments can take place via a slow-moving vehicle. During this assessment, an arborist should attempt to identify any dead or dying trees or any significant tree defects such as large dead branches, major cavities, or trunk decay.

20% of the inventoried tree population or **219 trees should be inspected via walk-by assessment each year.** These walk-by assessments should include a total review and update of the City's tree inventory data and are important for keeping tree inventory updated on five-year cycle. Routine walk-by assessments are also an opportunity to detect early signs of insect and disease pests.

ROUTINE PRUNING CYCLE

Based on the amount of vehicular and pedestrian traffic in the Downtown District, **a three-year Routine Pruning Cycle to maintain the condition of the inventoried tree population should be implemented**. Pruning improves tree condition by correcting defects that would otherwise worsen over time and negatively impact tree health. Over time, routine pruning helps minimize reactive maintenance and instances of elevated risk, serving as the basis for a proactive management program.

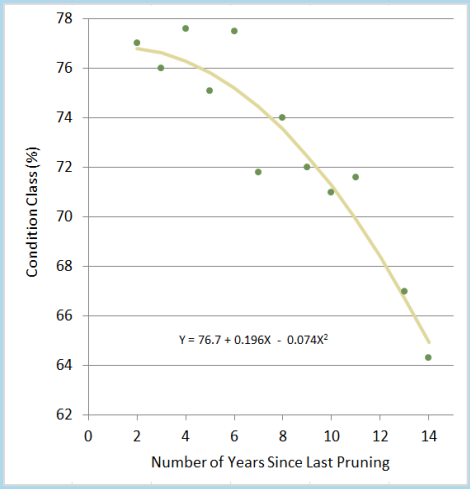
524 trees in the DDA District are recommended for routine pruning (Discretionary Maintenance) or Priority Pruning with a Low Risk Rating (Table 2).

Low Risk trees with the Priority Prune maintenance recommendation should be addressed whenever urban forestry program funding allows, because they have at least one dead branch that is 2 inches in diameter or larger or have multiple large dead branches. Priority pruning for Low Risk trees should be systematically addressed depending on a given tree's location, its particular defects, and Downtown Traverse City's risk tolerance.

	Tree Diameter Class	Number of Trees		
		FY2022	FY2023	FY2024
Routine Pruning (3-year Cycle)	7-12"	99	98	98
	13-18"	41	41	41
	19-24"	22	21	21
	25-30"	11	11	10
	31-36"	2	2	2
	37-42"	2	1	1
	≥43"	-	-	-

Table 2. Recommended three-year routine pruning cycle by diameter class

PROACTIVE MAINTENANCE



Relationship between tree condition and years since previous pruning. (adapted from Miller and Sylvester 1981)

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

Routine inspection and pruning cycles help detect and correct most defects before they reach higher risk levels. DRG recommends two pruning cycles: a Young Tree Training Cycle and a Routine Pruning Cycle.

Newly planted trees will enter the Young Tree Training Cycle once they become established and will move into the Routine Pruning Cycle when they reach maturity. A tree should be eliminated from the Routine Pruning Cycle and removed when its condition warrants it or ages beyond its healthy lifespan.

TREE TRAINING CYCLE

Young tree training (pruning) promotes the development of a strong structure that increases the longevity of Downtown Traverse City's public trees. Young trees can have defects in branching structure that can lead to problems as they age such as codominant leaders, branches with included bark, crossing limbs, and multiple limbs originating from the same point on the trunk. It is best to correct these defects when trees are young while they can be reached from the ground, and pruning wounds are smaller allowing for quicker wound closures. Clearance pruning should also be prioritized when trees are young, because branches causing clearance conflicts will become more difficult and costly to remove as a tree grows.

The Tree Training Cycle should include all deciduous trees that can be pruned from the ground using shears, loppers, and/or polesaw.

Young Tree Training Cycle Recommendations

A total of 532 trees have a maintenance recommendation of Train or Routine prune (trees 6" DBH or less), amounting to an **annual training prune cycle of 178 trees.** When the first three-year Young Tree Training Cycle is complete a new one should begin and include any replacement trees and new trees that were planted during the first cycle. Trees should enter the Young Tree Training Cycle within three years of planting after they have recovered from transplant shock and should continue in the cycle every three years until they can no longer be pruned from the ground, at which point they should move into the Routine Pruning Cycle.

Young Tree Training (3-year Cycle)	Tree Diameter Class	Number of Trees		
		FY2022	FY2023	FY2024
	1-6"	166	166	166
	7-12"	12	11	11

Table 3. Recommended three-year young tree training cycle by tree diameter class

The Young Tree Training Cycle also provides an opportunity to observe new plantings. Periodic inspections after tree planting can help identify which new plantings are having difficulty establishing and to correct the tree's condition, the site's condition, the species planting palette, or some combination.

TREE PLANTING AND STUMP REMOVAL

The inventory identified 25 vacant tree planting locations, 8 stumps, and 52 tree removals along the streets in the DDA District. The 52 street trees recommended for removal will leave behind an additional 52 stumps. Because these sites may be replanted once they become vacant, these 60 stumps should be removed to create planting sites. **It is recommended that all 52 trees are removed in Year 1, along with the 60 stumps (8 existing plus 52 generated from the tree removals) to allow for the planting of 85 trees in the DDA District during Year 1.**

It is anticipated that 11 trees per year will be removed due to natural mortality (1% annual mortality rate). It is recommended that stump removals are routinely completed following tree removals to systematically prepare sites for replanting. Following stump removals, sites should be inspected to assess their suitability for future planting. In some situations where the site is not currently suitable for replanting, soil amendments may be effective at restoring the site's viability. Section 3 provides tree planting considerations, tools, and strategies for planting in downtown Traverse City and Appendix C provides a recommended tree species list.

MAINTENANCE SCHEDULE AND BUDGET

Using Downtown Traverse City's tree inventory data, a four-year tree maintenance schedule was developed with the highest priority recommended maintenance tasks to complete each year. Budgetary projections are made using industry knowledge. **Table 4** provides a summary of all inventoried trees and estimated costs. **Tables 5 & 6** provide a summary of activities and estimated costs broken down by whether the trees are grown along street (street trees) or in parks (park trees). street and park trees, respectively. **Tables 7, 8 and 9** provide detailed information on tree counts by size and estimated costs for each maintenance activity over four years for all inventoried trees (Table 7), street trees (Table 8) and park trees (Table 9). These schedules provide a framework for completing the recommended tree maintenance as quickly as possible to transition the maintenance program for the DDA District to a more proactive program.

Adequate funding is needed to ensure that high priority trees are expediently managed and that the Young Tree Training and Routine Pruning cycles begin immediately. If routing efficiencies and/or contract specifications allow more tree work to be completed each year, or if this maintenance schedule requires adjustment to meet budgetary or operational needs, then it should be modified accordingly. Unforeseen situations such as severe weather events may arise and change the maintenance needs of Downtown Traverse City's inventoried tree population. If maintenance needs change, then budgets, staffing, and equipment should be adjusted to meet the new demand.

SUMMARY ALL INVENTORIED STREET & PARK TREES				
	Number of Street & Park Trees			
Activity	**2021**	**2022**	**2023**	**2024**
Tree Removal	52	40	11	11
Stump Removal	60	40	11	11
Tree Planting	85	11	11	11
Tree Pruning (includes, tree risk pruning, young tree training and routine pruning)	1	363	351	350
TOTAL	**198**	**454**	**384**	**383**

	Estimated Costs			
Activity	**2021**	**2022**	**2023**	**2024**
Tree Removal	$ 8,763.00	$ 15,977.00	$ 6,655.00	$ 6,655.00
Stump Removal	$ 6,485.00	$ 6,195.00	$ 2,200.00	$ 2,200.00
Tree Planting	$ 34,000.00	$ 5,500.00	$ 5,500.00	$ 5,500.00
Tree Pruning (includes tree risk pruning, young tree training and routine pruning)	$ 325.00	$ 26,065.00	$ 23,240.00	$ 23,015.00
Total	**$ 49,573.00**	**$ 53,737.00**	**$ 37,595.00**	**$ 37,370.00**

Table 4. Summary Tree Maintenance All Inventoried Trees

STREET TREE SUMMARY				
	Number of Street Trees			
Activity	**2021**	**2022**	**2023**	**2024**
Tree Removal	52	6	6	6
Stump Removal	60	6	6	6
Tree Planting	85	6	6	6
Tree Pruning (includes, tree risk pruning, young tree training and routine pruning)	1	217	216	216
TOTAL	**198**	**235**	**234**	**234**

	Estimated Costs			
Activity	**2021**	**2022**	**2023**	**2024**
Tree Removal	$ 8,763.00	$ 3,630.00	$ 3,630.00	$ 3,630.00
Stump Removal	$ 6,485.00	$ 1,200.00	$ 1,200.00	$ 1,200.00
Tree Planting	$ 34,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00
Tree Pruning (includes tree risk pruning, young tree training and routine pruning)	$ 325.00	$ 11,025.00	$ 10,955.00	$ 10,955.00
Total	**$ 49,573.00**	**$ 18,855.00**	**$ 18,785.00**	**$ 18,785.00**

Table 6. Summary Tree Maintenance Street Trees

SUMMARY OF PARK TREES				
	Number of Park Trees			
Activity	**2021**	**2022**	**2023**	**2024**
Tree Removal	0	34	5	5
Stump Removal	0	34	5	5
Tree Planting	0	5	5	5
Tree Pruning (includes, tree risk pruning, young tree training and routine pruning)	0	146	135	134
TOTAL	**0**	**219**	**150**	**149**

	Estimated Costs			
Activity	**2021**	**2022**	**2023**	**2024**
Tree Removal	$ -	$ 12,347.00	$ 3,025.00	$ 3,025.00
Stump Removal	$ -	$ 4,995.00	$ 1,000.00	$ 1,000.00
Tree Planting	$ -	$ 2,500.00	$ 2,500.00	$ 2,500.00
Tree Pruning (includes tree risk pruning, young tree training and routine pruning)	$ -	$ 15,040.00	$ 12,285.00	$ 12,060.00
Total	**$ -**	**$ 34,882.00**	**$ 18,810.00**	**$ 18,585.00**

Table 5. Summary Tree Maintenance Park Trees

Street & Park Trees Estimated Activity Costs			2021		2022		2023		2024		Total Cost
Activity	Diameter Class	Avg. Cost/Tree	Count	Cost*	Count	Cost	Count	Cost	Count	Cost	
High & Moderate Risk Tree Removals**	1-6"	$50		$ -		$ -		$ -		$ -	$ -
	7-12"	$138	2	$ 276.00	1	$ 138.00		$ -		$ -	$ 414.00
	13-18"	$314	3	$ 942.00	4	$ 1,256.00		$ -		$ -	$ 2,198.00
	19-24"	$605	1	$ 605.00	14	$ 8,470.00	11	$ 6,655.00	11	$ 6,655.00	$ 22,385.00
	25-30"	$825	1	$ 825.00	2	$ 1,650.00		$ -		$ -	$ 2,475.00
	31-36"	$1,045	3	$ 3,135.00	3	$ 3,135.00		$ -		$ -	$ 6,270.00
	37-42"	$1,485		$ -		$ -		$ -		$ -	$ -
	≥43"	$2,035		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**10**	**$ 5,783.00**	**24**	**$ 14,649.00**	**11**	**$ 6,655.00**	**11**	**$ 6,655.00**	**$ 33,742.00**
Low Risk Tree Removals	1-6"	$50	32	$ 1,600.00	10	$ 500.00		$ -		$ -	$ 2,100.00
	7-12"	$138	10	$ 1,380.00	6	$ 828.00		$ -		$ -	$ 2,208.00
	13-18"	$314		$ -		$ -		$ -		$ -	$ -
	19-24"	$605		$ -		$ -		$ -		$ -	$ -
	25-30"	$825		$ -		$ -		$ -		$ -	$ -
	31-36"	$1,045		$ -		$ -		$ -		$ -	$ -
	37-42"	$1,485		$ -		$ -		$ -		$ -	$ -
	≥43"	$2,035		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**42**	**$ 2,980.00**	**16**	**$ 1,328.00**	**0**	**$ -**	**0**	**$ -**	**$ 4,308.00**
Stump Removals**	1-6"	$85	37	$ 3,145.00	10	$ 850.00		$ -		$ -	$ 3,995.00
	7-12"	$100	14	$ 1,400.00	7	$ 700.00		$ -		$ -	$ 2,100.00
	13-18"	$130	3	$ 390.00	4	$ 520.00		$ -		$ -	$ 910.00
	19-24"	$200	1	$ 200.00	14	$ 2,800.00	11	$ 2,200.00	11	$ 2,200.00	$ 7,400.00
	25-30"	$250	1	$ 250.00	2	$ 500.00		$ -		$ -	$ 750.00
	31-36"	$275	4	$ 1,100.00	3	$ 825.00		$ -		$ -	$ 1,925.00
	37-42"	$300		$ -		$ -		$ -		$ -	$ -
	≥43"	$325		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**60**	**$ 6,485.00**	**40**	**$ 6,195.00**	**11**	**$ 2,200.00**	**11**	**$ 2,200.00**	**$ 17,080.00**
High & Moderate Risk Pruning	1-6"	$70		$ -		$ -		$ -		$ -	$ -
	7-12"	$120		$ -		$ -		$ -		$ -	$ -
	13-18"	$200		$ -	2	$ 400.00		$ -		$ -	$ 400.00
	19-24"	$260		$ -	1	$ 260.00		$ -		$ -	$ 260.00
	25-30"	$290		$ -	3	$ 870.00		$ -		$ -	$ 870.00
	31-36"	$325	1	$ 325.00	2	$ 650.00		$ -		$ -	$ 975.00
	37-42"	$380		$ -		$ -		$ -		$ -	$ -
	≥43"	$590		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**1**	**$ 325.00**	**8**	**$ 2,180.00**	**0**	**$ -**	**0**	**$ -**	**$ 2,505.00**

Table 7. All Inventoried Trees Four-Year Tree Maintenance Program

Street & Park Trees Estimated Activity Costs			2021		2022		2023		2024		Total Cost
Activity	Diameter Class	Avg. Cost/Tree	Count	Cost*	Count	Cost	Count	Cost	Count	Cost	
Tree Training (3-year Cycle)***	1-6"	$25		$ -	166	$ 4,150.00	166	$ 4,150.00	166	$ 4,150.00	$ 12,450.00
	7-12"	$70		$ -	12	$ 300.00	11	$ 275.00	11	$ 275.00	$ 850.00
Activity Total(s)			**0**	**$ -**	**178**	**$ 4,450.00**	**177**	**$ 4,425.00**	**177**	**$ 4,425.00**	**$ 13,300.00**
Routine Pruning (3-year Cycle)****	7-12"	$70		$ -	99	$ 6,930.00	98	$ 6,860.00	98	$ 6,860.00	$ 20,650.00
	13-18"	$120		$ -	41	$ 4,920.00	41	$ 4,920.00	41	$ 4,920.00	$ 14,760.00
	19-24"	$170		$ -	22	$ 3,740.00	21	$ 3,570.00	21	$ 3,570.00	$ 10,880.00
	25-30"	$225		$ -	11	$ 2,475.00	11	$ 2,475.00	10	$ 2,250.00	$ 7,200.00
	31-36"	$305		$ -	2	$ 610.00	2	$ 610.00	2	$ 610.00	$ 1,830.00
	37-42"	$380		$ -	2	$ 760.00	1	$ 380.00	1	$ 380.00	$ 1,520.00
	≥43"	$590		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**0**	**$ -**	**177**	**$ 19,435.00**	**174**	**$ 18,815.00**	**173**	**$ 18,590.00**	**$ 56,840.00**
Street Tree Planting and Post Planting Care (Vacant Sites, Stumps & Tree Removals)	Purchasing B&B Nursery Stock	$275	85	$ 23,375.00		$ -		$ -		$ -	$ 23,375.00
	Planting, Staking, & Mulching	$125	85	$ 10,625.00		$ -		$ -		$ -	$ 10,625.00
	Watering (1/wk - Growing Season - 2 years)	$100	85	$ 8,500.00		$ -		$ -		$ -	$ 8,500.00
Activity Total(s)			**170**	**$ 34,000.00**	**0**	**$ -**	**0**	**$ -**	**0**	**$ -**	**$ 34,000.00**
Planting and Post Planting Care based on Natural Mortality (1% of the street and park tree population per year)	Purchasing B&B Nursery Stock	$275		$ -	11	$ 3,025.00	11	$ 3,025.00	11	$ 3,025.00	$ 9,075.00
	Planting, Staking, & Mulching	$125		$ -	11	$ 1,375.00	11	$ 1,375.00	11	$ 1,375.00	$ 4,125.00
	Watering (1/wk - Growing Season - 2 years)	$100		$ -	11	$ 1,100.00	11	$ 1,100.00	11	$ 1,100.00	$ 3,300.00
Activity Total(s)			**0**	**$ -**	**11**	**$ 5,500.00**	**11**	**$ 5,500.00**	**11**	**$ 5,500.00**	**$ 13,200.00**
Activity Grand Total			**283**		**454**		**384**		**383**		**$ 1,221.00**
Cost Grand Total			**$**	**49,573.00**	**$**	**53,737.00**	**$**	**37,595.00**	**$**	**37,370.00**	**$ 128,702.00**

*Based on average U.S. tree care contractor costs

**An annual tree mortality rate of 1% of the downtown street and park tree population has been factored into Tree Removal and Stump Removals after 2021.

***Includes trees in the "Train" maintenance category and 1-6" tree size in the "Prune Category"

****Includes trees with in the Discretionary Maintenance Category & Trees that are Low Risk in the Prune Maintenance category

Table 7. All Inventoried Trees Four-Year Tree Maintenance Program (continued)

Street Trees Estimated Activity Costs			2021		2022		2023		2024		Total Cost
Activity	Diameter Class	Avg. Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High & Moderate Risk Tree Removals**	1-6"	$50		$ -		$ -		$ -		$ -	$ -
	7-12"	$138	2	$ 276.00		$ -		$ -		$ -	$ 276.00
	13-18"	$314	3	$ 942.00		$ -		$ -		$ -	$ 942.00
	19-24"	$605	1	$ 605.00	6	$ 3,630.00	6	$ 3,630.00	6	$ 3,630.00	$ 11,495.00
	25-30"	$825	1	$ 825.00		$ -		$ -		$ -	$ 825.00
	31-36"	$1,045	3	$ 3,135.00		$ -		$ -		$ -	$ 3,135.00
	37-42"	$1,485		$ -		$ -		$ -		$ -	$ -
	≥43"	$2,035		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**10**	**$ 5,783.00**	**6**	**$ 3,630.00**	**6**	**$ 3,630.00**	**6**	**$ 3,630.00**	**$ 16,673.00**
Low Risk Tree Removals	1-6"	$50	32	$ 1,600.00		$ -		$ -		$ -	$ 1,600.00
	7-12"	$138	10	$ 1,380.00		$ -		$ -		$ -	$ 1,380.00
	13-18"	$314		$ -		$ -		$ -		$ -	$ -
	19-24"	$605		$ -		$ -		$ -		$ -	$ -
	25-30"	$825		$ -		$ -		$ -		$ -	$ -
	31-36"	$1,045		$ -		$ -		$ -		$ -	$ -
	37-42"	$1,485		$ -		$ -		$ -		$ -	$ -
	≥43"	$2,035		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**42**	**$ 2,980.00**	**0**	**$ -**	**0**	**$ -**	**0**	**$ -**	**$ 2,980.00**
Stump Removals**	1-6"	$85	37	$ 3,145.00		$ -		$ -		$ -	$ 3,145.00
	7-12"	$100	14	$ 1,400.00		$ -		$ -		$ -	$ 1,400.00
	13-18"	$130	3	$ 390.00		$ -		$ -		$ -	$ 390.00
	19-24"	$200	1	$ 200.00	6	$ 1,200.00	6	$ 1,200.00	6	$ 1,200.00	$ 3,800.00
	25-30"	$250	1	$ 250.00		$ -		$ -		$ -	$ 250.00
	31-36"	$275	4	$ 1,100.00		$ -		$ -		$ -	$ 1,100.00
	37-42"	$300		$ -		$ -		$ -		$ -	$ -
	≥43"	$325		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**60**	**$ 6,485.00**	**6**	**$ 1,200.00**	**6**	**$ 1,200.00**	**6**	**$ 1,200.00**	**$ 10,085.00**
High & Moderate Risk Pruning	1-6"	$70		$ -		$ -		$ -		$ -	$ -
	7-12"	$120		$ -		$ -		$ -		$ -	$ -
	13-18"	$200		$ -		$ -		$ -		$ -	$ -
	19-24"	$260		$ -		$ -		$ -		$ -	$ -
	25-30"	$290		$ -		$ -		$ -		$ -	$ -
	31-36"	$325	1	$ 325.00		$ -		$ -		$ -	$ 325.00
	37-42"	$380		$ -		$ -		$ -		$ -	$ -
	≥43"	$590		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**1**	**$ 325.00**	**0**	**$ -**	**0**	**$ -**	**0**	**$ -**	**$ 325.00**

Table 8. Street Trees Four-Year Tree Maintenance Program

Street Trees Estimated Activity Costs			2021		2022		2023		2024		Total Cost
Activity	Diameter Class	Avg. Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Tree Training (3-year Cycle)***	1-6"	$25		$ -	112	$ 2,800.00	112	$ 2,800.00	112	$ 2,800.00	$ 8,400.00
	7-12"	$70		$ -	7	$ 175.00	7	$ 175.00	7	$ 175.00	$ 525.00
Activity Total(s)			**0**	**$ -**	**119**	**$ 2,975.00**	**119**	**$ 2,975.00**	**119**	**$ 2,975.00**	**$ 8,925.00**
Routine Pruning (3-year Cycle)****	7-12"	$70		$ -	82	$ 5,740.00	81	$ 5,670.00	81	$ 5,670.00	$ 17,080.00
	13-18"	$120		$ -	12	$ 1,440.00	12	$ 1,440.00	12	$ 1,440.00	$ 4,320.00
	19-24"	$170		$ -	2	$ 340.00	2	$ 340.00	2	$ 340.00	$ 1,020.00
	25-30"	$225		$ -	1	$ 225.00	1	$ 225.00	1	$ 225.00	$ 675.00
	31-36"	$305		$ -	1	$ 305.00	1	$ 305.00	1	$ 305.00	$ 915.00
	37-42"	$380		$ -		$ -		$ -		$ -	$ -
	≥43"	$590		$ -		$ -		$ -		$ -	$ -
Activity Total(s)			**0**	**$ -**	**98**	**$ 8,050.00**	**97**	**$ 7,980.00**	**97**	**$ 7,980.00**	**$ 24,010.00**
Street Tree Planting and Post Planting Care (Vacant Sites, Stumps & Tree Removals)	Purchasing B&B Nursery Stock	$275	85	$ 23,375.00		$ -		$ -		$ -	$ 23,375.00
	Planting, Staking, & Mulching	$125	85	$ 10,625.00		$ -		$ -		$ -	$ 10,625.00
	Watering (1/wk - Growing Season - 2 years)	$100	85	$ 8,500.00		$ -		$ -		$ -	$ 8,500.00
Activity Total(s)			**85**	**$ 34,000.00**	**0**	**$ -**	**0**	**$ -**	**0**	**$ -**	**$ 34,000.00**
Planting and Post Planting Care based on Natural Mortality (1% of the street and park tree population per year)	Purchasing B&B Nursery Stock	$275		$ -	6	$ 1,650.00	6	$ 1,650.00	6	$ 1,650.00	$ 4,950.00
	Planting, Staking, & Mulching	$125		$ -	6	$ 750.00	6	$ 750.00	6	$ 750.00	$ 2,250.00
	Watering (1/wk - Growing Season - 2 years)	$100		$ -	6	$ 600.00	6	$ 600.00	6	$ 600.00	$ 1,800.00
Activity Total(s)			**0**	**$ -**	**6**	**$ 3,000.00**	**6**	**$ 3,000.00**	**6**	**$ 3,000.00**	**$ 7,200.00**
Activity Grand Total			**198**		**235**		**234**		**234**		**$ 703.00**
Cost Grand Total			**$**	**49,573.00**	**$**	**18,855.00**	**$**	**18,785.00**	**$**	**18,785.00**	**$ 56,425.00**

*Based on average U.S. tree care contractor costs

**An annual tree mortality rate of 1% has been factored into Tree Removal and Stump Removals after 2021.

***Includes trees in the "Train" maintenance category and 1-6" tree size in the "Prune Category"

****Includes trees with in the Discretionary Maintenance Category & Trees that are Low Risk in the Prune Maintenance category

Table 8. Street Trees Four-Year Tree Maintenance Program (continued)

Park Trees Estimated Activity Costs			2021		2022		2023		2024		Total Cost
Activity	Diameter Class	Avg. Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High & Moderate Risk Tree Removals	1-6"	$50		$ -		$ -		$ -		$ -	$ -
	7-12"	$138		$ -	1	$ 138.00		$ -		$ -	$ 138.00
	13-18"	$314		$ -	4	$ 1,256.00		$ -		$ -	$ 1,256.00
	19-24"	$605		$ -	8	$ 4,840.00	5	$ 3,025.00	5	$ 3,025.00	$ 10,890.00
	25-30"	$825		$ -	2	$ 1,650.00		$ -		$ -	$ 1,650.00
	31-36"	$1,045		$ -	3	$ 3,135.00		$ -		$ -	$ 3,135.00
	37-42"	$1,485		$ -		$ -		$ -		$ -	$ -
	≥43"	$2,035		$ -		$ -		$ -		$ -	$ -
Activity Total(s)					**18**	**$ 11,019.00**	**5**	**$ 3,025.00**	**5**	**$ 3,025.00**	**$ 17,069.00**
Low Risk Tree Removals**	1-6"	$50		$ -	10	$ 500.00		$ -		$ -	$ 500.00
	7-12"	$138		$ -	6	$ 828.00		$ -		$ -	$ 828.00
	13-18"	$314		$ -		$ -		$ -		$ -	$ -
	19-24"	$605		$ -		$ -		$ -		$ -	$ -
	25-30"	$825		$ -		$ -		$ -		$ -	$ -
	31-36"	$1,045		$ -		$ -		$ -		$ -	$ -
	37-42"	$1,485		$ -		$ -		$ -		$ -	$ -
	≥43"	$2,035		$ -		$ -		$ -		$ -	$ -
Activity Total(s)					**16**	**$ 1,328.00**	**0**	**$ -**	**0**	**$ -**	**$ 1,328.00**
Stump Removals**	1-6"	$85		$ -	10	$ 850.00		$ -		$ -	$ 850.00
	7-12"	$100		$ -	7	$ 700.00		$ -		$ -	$ 700.00
	13-18"	$130		$ -	4	$ 520.00		$ -		$ -	$ 520.00
	19-24"	$200		$ -	8	$ 1,600.00	5	$ 1,000.00	5	$ 1,000.00	$ 3,600.00
	25-30"	$250		$ -	2	$ 500.00		$ -		$ -	$ 500.00
	31-36"	$275		$ -	3	$ 825.00		$ -		$ -	$ 825.00
	37-42"	$300		$ -		$ -		$ -		$ -	$ -
	≥43"	$325		$ -		$ -		$ -		$ -	$ -
Activity Total(s)					**34**	**$ 4,995.00**	**5**	**$ 1,000.00**	**5**	**$ 1,000.00**	**$ 6,995.00**
High & Moderate Risk Pruning	1-6"	$70		$ -		$ -		$ -		$ -	$ -
	7-12"	$120		$ -		$ -		$ -		$ -	$ -
	13-18"	$200		$ -	2	$ 400.00		$ -		$ -	$ 400.00
	19-24"	$260		$ -	1	$ 260.00		$ -		$ -	$ 260.00
	25-30"	$290		$ -	3	$ 870.00		$ -		$ -	$ 870.00
	31-36"	$325		$ -	2	$ 650.00		$ -		$ -	$ 650.00
	37-42"	$380		$ -		$ -		$ -		$ -	$ -
	≥43"	$590		$ -		$ -		$ -		$ -	$ -
Activity Total(s)					**8**	**$ 2,180.00**	**0**	**$ -**	**0**	**$ -**	**$ 2,180.00**

Table 9. Park Trees Four-Year Tree Maintenance Program

Park Trees Estimated Activity Costs			2021		2022		2023		2024		Total Cost
Activity	Diameter Class	Avg. Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Tree Training *** (3-year Cycle)	1-6"	$25		$ -	54	$ 1,350.00	54	$ 1,350.00	54	$ 1,350.00	$ 4,050.00
	7-12"	$70		$ -	5	$ 125.00	4	$ 100.00	4	$ 100.00	$ 325.00
Activity Total(s)					**59**	**$ 1,475.00**	**58**	**$ 1,450.00**	**58**	**$ 1,450.00**	**$ 4,375.00**
Routine Pruning **** (3-year Cycle)	7-12"	$70		$ -	17	$ 1,190.00	17	$ 1,190.00	17	$ 1,190.00	$ 3,570.00
	13-18"	$120		$ -	29	$ 3,480.00	29	$ 3,480.00	29	$ 3,480.00	$ 10,440.00
	19-24"	$170		$ -	20	$ 3,400.00	19	$ 3,230.00	19	$ 3,230.00	$ 9,860.00
	25-30"	$225		$ -	10	$ 2,250.00	10	$ 2,250.00	9	$ 2,025.00	$ 6,525.00
	31-36"	$305		$ -	1	$ 305.00	1	$ 305.00	1	$ 305.00	$ 915.00
	37-42"	$380		$ -	2	$ 760.00	1	$ 380.00	1	$ 380.00	$ 1,520.00
	≥43"	$590		$ -		$ -		$ -		$ -	$ -
Activity Total(s)					**79**	**$ 11,385.00**	**77**	**$ 10,835.00**	**76**	**$ 10,610.00**	**$ 32,830.00**
Street Tree Planting and Post Planting Care (Vacant Sites, Stumps & Tree Removals)	Purchasing B&B Nursery Stock	$275		$ -		$ -		$ -		$ -	$ -
	Planting, Staking, & Mulching	$125		$ -		$ -		$ -		$ -	$ -
	Watering (1/wk - Growing Season - 2 years)	$100		$ -		$ -		$ -		$ -	$ -
Activity Total(s)					**0**	**$ -**	**0**	**$ -**	**0**	**$ -**	**$ -**
Planting and Post Planting Care based on Natural Mortality (1% of the street and park tree population per year)	Purchasing B&B Nursery Stock	$275		$ -	5	$ 1,375.00	5	$ 1,375.00	5	$ 1,375.00	$ 4,125.00
	Planting, Staking, & Mulching	$125		$ -	5	$ 625.00	5	$ 625.00	5	$ 625.00	$ 1,875.00
	Watering (1/wk - Growing Season - 2 years)	$100		$ -	5	$ 500.00	5	$ 500.00	5	$ 500.00	$ 1,500.00
Activity Total(s)			**0**	**$ -**	**5**	**$ 2,500.00**	**5**	**$ 2,500.00**	**5**	**$ 2,500.00**	**$ 6,000.00**
Activity Grand Total			**0**		**219**		**150**		**149**		**$ 518.00**
Cost Grand Total			**$**	**-**	**$**	**34,882.00**	**$**	**18,810.00**	**$**	**18,585.00**	**$ 72,277.00**

*Based on average U.S. tree care contractor costs

**An annual tree mortality rate of 1% has been factored into Tree Removal and Stump Removals after 2021.

***Includes trees in the "Train" maintenance category and 1-6" tree size in the "Prune Category"

****Includes trees with in the Discretionary Maintenance Category & Trees that are Low Risk in the Prune Maintenance category

Table 9. Park Trees Four-Year Tree Maintenance Program (continued)

Section 3:

Tree Planting

DOWNTOWN TRAVERSE CITY

TREE PLANTING IN DOWNTOWN TRAVERSE CITY

Considerations, Tools & Strategies

CONSIDERATIONS

Understanding site characteristics including, size of planting area, soils, and location of utilities and infrastructure, along with community preferences ensures that tree planting is conducted based on specific local conditions and the values, needs, and priorities of the community.

Community Themes & Preferences

In 2021, the Traverse City Downtown Development Authority (DDA) and Davey Resource Group, Inc. engaged the Traverse City DDA Board and community, through public meetings and an on-line survey, to understand their preferences related to trees and streetscapes in the DDA District. Participants were asked general questions and then viewed a series of streetscape images and asked to comment on what they liked and did not like about each streetscape. The following **community themes and preferences** emerged from this engagement.

- **Top five words selected to describe downtown Traverse City's trees**:
    1. Beauty
    2. Small Flowering /Ornamental Trees
    3. Too Few Trees
    4. Shade
    5. Trees Need Maintenance

- **82% of respondents** feel the **level of tree care maintenance** required is an **important consideration when selecting species** to plant downtown.

- **60% feel that diversity of tree species is important** to have in downtown Traverse City.
    - Age diversity should also be considered.

- **Streetscapes with medium/large size shade trees are preferred** (see *Streetscape Preference* below).

- **Flowering trees** are appreciated as **accent trees.**

- Streetscapes should **represent the uniqueness of Traverse City**.

- The use of **native tree species should be prioritized** for planting when conditions allow.

- On average, **65% of respondents preferred trees mixed with landscaping in planting beds** (raised or at grade).

- **Equal split between respondents who prefer a more uniform look and those that prefer more diversity** in streetscape tree species.

- Tree species should be selected based on their matures size for the site and **avoid blocking building architecture, facades, and signs.**
    - Views should also be a consideration, including those of people who work or reside in buildings that are above street level.

- Amount and type of **debris tree species produce should be a factor in species selection.**

- **Consideration of site factors** including width of sidewalk, size of planting area, and potential hardscape and infrastructure conflicts.

- Equal interest in having **access to both shady and sunny locations along the street** – plan for access to both.

- **Use green infrastructure,** including trees and bioswales, **to manage stormwater**.

- **Plan for the full lifecycle of the tree** from planting and removal to utilizing the wood after it has been removed.

- **Consider the benefits different tree species provide** including carbon storage and temperature reductions (urban heat island impacts)

- **57% of respondents are interested in planting ornamental cherry trees** to celebrate Traverse City's designation as the "Cherry Capital" in parks or other open spaces downtown (not as street trees).

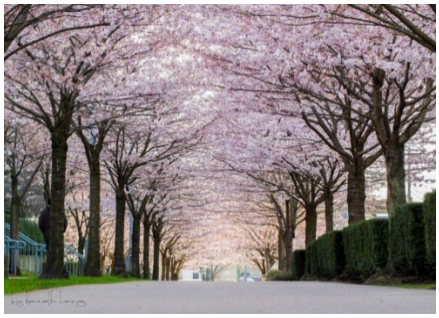
Community Streetscape Preferences (Ranked in Order)

#1 Medium/Large Shade Trees (Holland, MI)

Like the size of these trees for downtown area; trees are mixed with landscaping in a raised bed; and look to be well-maintained.

#2 Mix of Medium Shade Trees & Flowering Trees (Fullerton, CA)

Like the size of trees for a downtown area; the mix of different tree species (flowering and shade trees); and the boulevard planted with trees.



#3 Medium Flowering Trees (Ornamental Cherry) (Vancouver, BC)

Like the size of these trees for a downtown area.
There is interest in planting ornamental flowering cherry trees (where appropriate) to celebrate Traverse City's title of "Cherry Capital of the World" (57% of respondents).

#4 Large Shade Trees (Savannah, GA)

Like the size of these trees and the look of this park promenade but acknowledged that the size of these tree is too large for downtown. There are, however, opportunities to plant large shade trees with spreading canopies in parks or other open spaces.

#5 Large Shade trees
(Greenville, SC)

Like the shade and tree canopy that these trees provide but noted that the size of these trees is too large for downtown Traverse City

#6 Large Shade Trees
(Clinton, TN/Seattle, WA)

Like the shade size of these trees (at maturity) for a downtown area and that the trees are mixed with landscaping.

#7 Small/Ornamental Flowering Trees
(Knoxville, TN)

Did not like the tree species and felt the flowering/ornamental trees were too small but liked how trees were mixed with landscaping in planting strips.

#8 Medium/Large Specimen Shade Tree
(Madison, WI)

This was the least preferred streetscape presented because there were too few trees growing along the street.

Soil Types

The soils and land characteristics of the Traverse City region have been influenced by the glaciers and lake that once covered the land. As the glaciers receded and melted, they left behind glacial deposits of rocks, boulders, gravels, sand, silt, and clay which formed the parent materials of Traverse City's soils. Downtown's soils are primarily sandy loam (Lake beach and Eastport sand, and East Lake-Mancelona loamy sands) which tend to be very well draining and do not readily hold on to soil moisture (USDA Natural Resources Conservation Service, n.d.).

Soil Volume

The amount or volume of soil available directly effects a tree's ability to grow and thrive. Many communities have adopted minimum soil volumes to ensure the optimum growth and health of their street trees. The amount of soil available for trees also has a positive impact on the quantity and quality of stormwater entering lakes, rivers, and streams. Studies have found that by intercepting and slowing rainwater and allowing it to slowly soak into the soil - trees can reduce the amount of stormwater runoff and pollutants by 20-60% (Johnson, et al., 2017).

The following minimum soil volumes, by mature size, have been adopted by many communities throughout the United States (Deeproot, 2020). Traverse City should consider adopting these minimum soil volume standards as an urban forest best management practice.

- Small Trees: 300 cubic feet
- Medium Trees: 600 cubic feet
- Large Trees: 1,000 cubic feet

Note: These are *minimum* soil volumes and the amount of uncompacted soil for trees to grow should be as large as possible.

Streetscape redesign and infrastructure replacement projects provide an ideal opportunity to incorporate trees and adequate soil volume into the planning and design phases, which can make providing this optimal soil volume less daunting. There are also technologies to assist in maximizing rooting space available for trees (see Tools and Strategies below).

Utilities

Knowledge of the location of overhead and underground utilities ***before*** selecting both tree planting locations and species, is one of the keys to successfully growing and caring for trees in urban and suburban areas. Overhead utilities are easy to identify and include both electrical and telecommunications lines, as well as utility service lines to homes and businesses. For underground utilities, including, water, sanitary sewer, electrical, telecommunication, and gas lines - Miss Dig, Michigan's utility notification system (811) - should be contacted to mark their location. Identifying the location of service leads for water, sewer, and gas to homes and businesses is also important to ensure that trees are not planted on top of these lines. There may be other

underground utilities, like traffic lights and streetlights that are in the right-of-way that Miss Dig may not mark, working in close coordination with the City of Traverse City to identify their location is also important for proper site selection.

To avoid future conflicts, trees should be planted a minimum of five (5) feet from all utility **service leads** for homes and businesses, and ten (10) feet from fire hydrants.

Tree Lawn, Driveways, Street Corners, and Signs

The width of the tree lawn (the area between the sidewalk and the curb), and the location of driveways and signs are also important to consider when selecting tree species. In general, the following guidelines should be followed:

Tree Lawn Width

Less than 3-feet wide: No tree

4-6 feet wide: Small Mature Tree Species (less than 25' tall at maturity)

6-8 feet wide: Medium Tree Species (less than 50' tall at maturity)

Greater than 8' wide: Large Mature Tree Species (greater than 50' tall)

Driveways

Trees should be planted to at least 10-feet from driveways.

Street Corners

Trees should be planted at least 25-feet from street corners and intersections (measured from the point of the nearest intersecting curb or curb lines).

Signs

Trees should be planted to ensure they will not block traffic and wayfinding signs at the time of planting and as they grow.

TOOLS AND STRATEGIES

One of the key considerations for trees to grow and thrive in Downtown Traverse City is having adequate soil volume. Establishing minimum soil volumes, as described above, can help to ensure that trees have enough soil to develop healthy canopies and reach their optimal mature size. There are a number of strategies and technologies that can help achieve this soil volume, even in areas that currently have sidewalk and pavement.

Contiguous Open Tree & Landscape Beds

Contiguous tree and landscape beds are connected and have exposed soil and mulch that can help provide adequate soil volume and space for trees to grow (Figure 10). These planting beds can be curbed or at grade; curbed beds can provide some protection from snow and ice melting products and other elements that may damage trees.

Figure 10.
Contiguous Open Tree & Landscape Bed
Photo: sfbetterstreets.org

Bump Outs/Curb Extensions

A landscape bump-out/curb extension is a vegetated area that protrudes into the parking lane of a street, to provide a growing space for plants or trees (Figure 11). These spaces can be used to beautify a streetscape while providing greater stormwater retention and slowing traffic at the bump-out location.

Figure 11.
Landscaped Bump Out/Curb Extension
Photo: Philadelphia Water Department

Suspended Pavement and Soil Cell Systems

Suspended pavement and soil cells are engineered systems that help transfer the weight and force of a sidewalk while creating areas of uncompacted soils for tree root growth. The cell systems can be interlocked (depending on manufacturer) and expanded to meet the specific needs of the project. To install soil cells, existing soils are excavated to the desired depth, the area is then compacted, and the soil cell units are installed, filled with un-compacted soil, and topped with the desired hardscape or pavement material (Figure 12). Due to the amount of excavation needed in order to make room for this system, soil cells are best suited for new construction areas or for areas where existing trees will not be impacted. Soil cells provide the greatest amount of un-compacted soil volume. Examples of soil cell systems include Silva Cells and Stratavault Soil Cells.

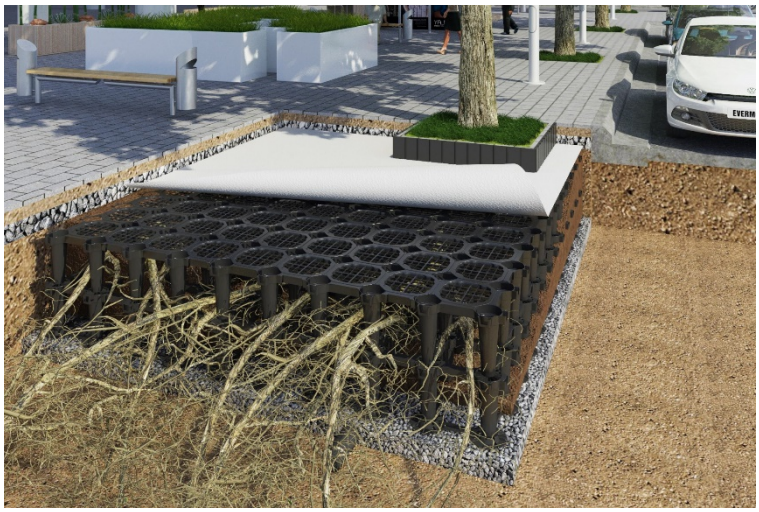


Figure 12.
Stratavault Soil Cells
Photo: citygreen.com

Pavement Suspension Systems

Pavement suspension systems were originally designed to suspend hardscape and pavement on soils that lacked the structural cohesion and qualities to support it. One adaptive and beneficial use for trees is in construction of new or expansion of roadways, walkways, and other pavement areas where trees currently exist. Instead of excavating areas to install beds of compaction-suitable material, pilings are driven in a systematic grid and topped with formwork where the desired pavement is installed (Figure 13). The pilings transfer the weight of the pavement down into the ground similar to piling foundations in building construction. The benefit of the system is that the pilings are driven into the ground with minimal disruption to existing tree root systems. An example of this system is the Cupolex system.

Figure 13.
Cupolex Pavement Suspension System
Photo: Pontarolo Engineering

Structural Soil

Structural soils are a specific, usually patented, soil mix that combines clay loam soil with various sized crushed stones (aggregates) and a hydrogel (binding agent), that can be compacted under pavement to give structural support. The aggregates allow for compaction of the structural soil, while creating gaps between the aggregate material for the clay loam soil and tree roots to grow (Figure 14). While it does not create the most optimum conditions for tree growth (when compared to soil cells), structural soils are best suited for compacted areas beneath hardscape improvements that are completely surrounded by large amounts of un-compacted soils and pervious areas. An example of a structural soil manufacturer/provider is the patented structural soil mix patented by Cornell University, termed CU-Structural Soil

Figure 14.
CU-Structural Soil
Photo: Urban Horticulture Institute, Cornell University

APPENDICES

APPENDIX A
DATA COLLECTION AND SITE LOCATION METHODS

DATA COLLECTION METHODS

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

- Address/Location
- Species
- Tree Size (measured in inches in diameter at 4.5 feet above ground or diameter at breast height (DBH])
- Multi-stem Tree
- Condition
- Primary Maintenance
- Defects
- Risk Rating
- Overhead Utilities
- Clearance Conflicts
- Date of Inventory

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

SITE LOCATION METHODS

Equipment and Base Maps

Inventory arborists use FZ-G1 Panasonic Toughpad® units with internal GPS receivers. Geographic information system (GIS) map layers from the City of Traverse City were loaded onto these units to help locate sites during the inventory.

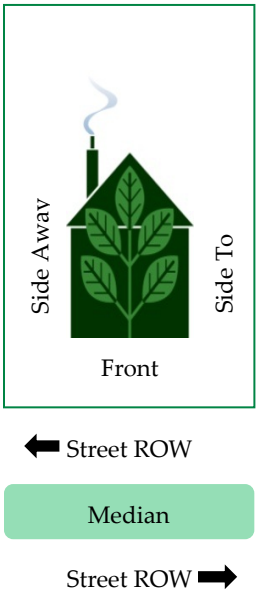
STREET ROW SITE LOCATION

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

Address Number and Street Name

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

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



Side Value

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

PARK AND PUBLIC SPACE SITE LOCATION

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

APPENDIX B

I-TREE STREETS METHOLOGY

i-Tree Streets regionalizes the calculations of its output by incorporating detailed reference city project information for 16 climate zones across the United States. Big Rapids falls within the Midwest Climate Zone. Sample inventory data from Minneapolis represent the basis for the Midwest Reference City Project for the Midwest Community Tree Guidelines. The basis for the benefit modeling in this study compares the inventory data from Big Rapids to the results of Midwest Reference City Project to obtain an estimation of the annual benefits provided by Big Rapids' tree resource.

Growth rate modeling information was used to perform computer-simulated growth of the existing tree population for one year and account for the associated annual benefits. This "snapshot" analysis assumed that no trees were added to or removed from the existing population. Calculations of carbon dioxide (CO_2) released due to decompositions of wood from removed trees did consider average annual mortality. This approach directly connects benefits with tree-size variables such as diameter at breast height (DBH) and leaf-surface area. Many benefits of trees are related to processes that involve interactions between leaves and the atmosphere (e.g., interception, transpiration, photosynthesis); therefore, benefits increase as tree canopy cover and leaf surface area increase.

For each of the modeled benefits, an annual resource unit was determined on a per-tree basis. Resource units are measured as megawatt-hours of electricity saved per tree; therms of natural gas conserved per tree, pounds of atmospheric CO_2 reduced per tree; pounds of nitrogen dioxide (NO_2), particulate matter (PM_{10}), and volatile organic compounds (VOCs) reduced per tree; cubic feet of stormwater runoff reduced per tree; and square feet of leaf area added per tree to increase property values.

Prices were assigned to each resource unit using economic indicators of society's willingness to pay for the environmental benefits trees provide. Estimates of benefits are initial approximations as some benefits are difficult to quantify (e.g., impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions make estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification provides first-order approximations. It is meant to be a general accounting of the benefits produced by urban trees—an accounting with an accepted degree of uncertainty that can, nonetheless, provide science-based platform for decision-making.

A detailed description of how the default benefit prices are derived, refer to the *City of Minneapolis, Minnesota Municipal Tree Resource Analysis* (McPherson *et al.* 2005) and the *Midwest Community Tree Guide: Benefits, Costs, and Strategic Planning* (McPherson *et al.* 2009). i-Tree Streets' default values from the Midwest Climate Zone were used for air quality and stormwater benefit prices and local values were used for energy usage, aesthetics, and other benefits.

Benefit Prices Used by i-Tree Streets in the Analysis of Big Rapids' Tree Inventory

Benefits	Price	Unit	Source
Electricity	$0.00759	$/Kwh	Xcelenergy 2004
Natural Gas	$0.0098	$/Therm	Centerpoint Energy
CO_2	$0.0075	$/lb	US EPA 2003
PM_{10}	$2.84	$/lb	US EPA 2003
NO_2	$3.34	$/lb	US EPA 2003
O_3	$3.34	$/lb	US EPA 2003
SO_2	$2.06	$/lb	US EPA 2003
VOCs	$3.75	$/lb	Ottinger and others
Stormwater	$0.0046	$/gallon	McPherson & Xiao
Aesthetic Value	$218,000	Average Midwest Housing Price	TreeKeeper®

Using these prices, the magnitude of the benefits provided by the public tree resource was calculated based on the science of i-Tree Streets using DRG's TreeKeeper® inventory management software. For a detailed description of how the magnitudes of benefit prices are calculated, refer to the *Midwest Community Tree Guide: Benefits, Costs, and Strategic Planning* (McPherson *et al.* 2009)

TREEKEEPER BENEFIT CATEGORIES

- *Greenhouse Gas Benefits:* Estimates annual reduction in CO_2 via sequestration by trees combined with the lower emissions from power plants (measured in pounds [lbs.]) resulting from lower energy use. The i-Tree model accounts for CO_2 released as trees die and decompose as well as CO_2 released during the care and maintenance of trees.
- *Stormwater Benefits:* Estimates the annual gallons of runoff avoided from rainfall intercepted by tree leaves, which increases with total leaf surface area.
- *Energy Benefits:* Estimates the contribution of inventoried trees towards conserving energy by reducing natural gas use for heating in the winter (measured in therms [thm]) and reducing electricity use for air conditioning in the summer (measured in Kilowatt-hours ([kWh]).
- *Air Quality Benefits:* Estimates the total weight in lbs. of air pollutants (ozone [O_3], nitrogen dioxide [NO2], sulfur dioxide [SO_2], particulate matter less than 10 micrometers in diameter [PM_{10}]) that are captured by trees or deposited on leaf surfaces as well as the reduced emissions from power plants (NO_2, PM_{10}, volatile organic compounds [VOCs], SO_2) due to reduced electricity use. The potential negative effects of trees on air quality due to biogenic volatile organic compounds (BVOC) emissions is also calculated, although these are relatively insignificant.
- *Property Value Benefits:* Uses leaf surface area to estimate the increased property value resulting from the tangible and intangible benefits that trees provide.

APPENDIX D: RECOMMENDED TREE SPECIES LIST

This species list is not inclusive of all trees recommended and/or suitable for Traverse City's climate; there are many native and non-native shade and ornamental trees that can be planted. When selecting tree species for planting - the diversity of tree species on individual streets, in neighborhoods, and in the entire community should be taken into consideration. The planting of a single species (monoculture) or genus should be avoided.

Downtown Traverse City Tree Species List*

Botanical Name	Common Name	Cultivar	Native to MI	Showy Flower	Type of Fruit/Seed	Drought Tolerance	Soil Drainage Tolerance	Soil Salt Tolerance	Salt Spray Tolerance	Soil pH	Shape	Mature Size	Mature Spread (feet)	Mature Height (feet)	Growth Rate	Open space/Parks	Tree Lawsn (ROW) Width < 4'	Tree Lawn (ROW) Width 4 - 6'	Tree Lawn (ROW) Width > 6'	Suitable Under Overhead Wires
Acer griseum	Paperbark Maple		No	No	Samara (Winged Seed Pod)	Low	Moist to Well Drained	Mod	Mod	Acidic to Alkaline	Oval/Rounded	Small	20 to 30	20 to 30	Slow	•		•		•
Acer miyabei	Miyabei Maple	State Street	No	No	Samara (Winged Seed Pod)	Mod	Moist to Well Drained	Mod	Mod	Acidic to Alkaline	Oval/Rounded	Medium	20 to 30	35 to 45	Mod			•		
Aesculus x carnea	Red Horsechestnut	Briotti; Ft. McNair	No	Yes	Nut	Mod	Moist to Well Drained	Poor	Mod	Acidic to Alkaline	Upright/Oval	Large	30 to 40	60 to 80	Mod			•	•	
Amelanchier x grandiflorio	Serviceberry or Juneberry	Autumn Brilliance; Princess Diana	Yes	Yes	Drupe/ Berry	Low to Mod	Well Drained	Low	Low	Acidic to Neutral	Rounded	Small	10 to 15	10 to 25	Mod	•	•	•	•	•
Betula nigra	River Birch	Single Stem varities for streets	Yes	No	Catkin (Seed Pod)	High	Extended Flooding to Moist	Low	Mod	Acidic	Upright/Oval	Large	30 to 40	40 to 60	Fast	•		•	•	
Carpinus betulus	European Hornbeam	Fastigiata; Various	No	No	Catkin (Seed Pod)	Mod	Well Drained	Low	Low	Acidic	Oval	Small	20 to 30	10 to 30	Mod		•	•	•	•
Carpinus caroliniana	American Hornbeam		Yes	No	Catkin (Seed Pod)	Mod	Moist to Well Drained	Low	Low	Acidic	Upright	Small	20 to 30	20 to 30	Mod	•	•	•	•	•
Celtis occidentalis	Eastern Hackberry		Yes	No	Drupe/ Berry	Mod	Occassionally Wet to Well Drained	Mod	Mod	Acidic	Rounded	Large	40 to 50	60 to 70	Fast	•			•	
Cercidiphyllum japonicum	Katsuratree		No	No	Small Seed Pod	Low	Moist	High	High	Acidic to Slightly Alkaline	Upright to Pyramidal	Large	30 to 40	40 to 60	Mod				•	
Cercis canadensis	Redbud	Various	Yes	Yes	Seed Pod	Mod	Moist to Well Drained	Low	Low	Neutral to Alkaline	Rounded	Small	15 to 25	15 to 30	Mod	•	•	•	•	•
Cladrastis kentukea	American Yellowwood		Yes	Yes	Seed Pod	Mod	Well Drained	Low	Low	Acidic to Alkaline	Rounded/Vase	Medium	20 to 50	30 to 50	Slow			•	•	
Crataegus crus-galli var. inermis	Thornless Hawthorn	Thornless variety	Yes	Yes	Drupe/ Berry	Yes	Moist to Well Drained	High	Mod	Acidic to Alkaline	Rounded/ Spreading	Small	20 to 25	15 to 20	Mod	•		•		•
Cornus kousa	Kousa dogwood		No	Yes	Drupe/ Berry	Low	Moist to Somewhat Well Drained	Low	Low	Acidic to Neutral	Rounded/Vase	Small	15 to 30	15 to 30	Mod		•	•	•	•
Gleditsia triacanthos var inermis	Thornless Honeylocust	Various Thornless varieties	Yes	No	None (cultivared varieties)	High	Moist to Well Drained	High	High	Acidic to Alkaline	Rounded	Large	30 to 70	40 to 70	Fast	•		•	•	
Ginkgo biloba	Ginkgo	male trees only	No	No	None (male only)	High	Moist to Well Drained	High	High	Acidic to Alkaline	Round/Pyramidal	Large	30 to 60	50 to 75	Slow			•	•	
Gymnocladus dioicus	Kentucky Coffeetree		Yes	No	Seed Pod	High	Moist to Well Drained	Mod	High	Acidic to Alkaline	Upright to Rounded	Large	40 to 70	50 to 70	Fast	•		•	•	

Downtown Traverse City Tree Species List*

Botanical Name	Common Name	Cultivar	Native to MI	Showy Flower	Type of Fruit/Seed	Drought Tolerance	Soil Drainage Tolerance	Soil Salt Tolerance	Salt Spray Tolerance	Soil pH	Shape	Mature Size	Mature Spread (feet)	Mature Height (feet)	Growth Rate	Open space/Parks	Tree Lawsn (ROW) Width < 4'	Tree Lawn (ROW) Width 4 - 6'	Tree Lawn (ROW) Width > 6'	Suitable Under Overhead Wires
Liquidambar styraciflua	Sweetgum	Rotundiloba (fruitless variety)	Yes (S. MI)	No	Spiked Ball/ None (cultivated variety)	Mod	Extended Floodig to Well-Drained	Low	Mod	Acidic to Slightly Alkaline	Pyramidal/Oval	Large	35 to 50	60 to 75	Mod	•			•	
Liriodendron tulipifera	Tuliptree		Yes	Yes	Cone-like	Low	Moist to Well Drained	Low	Low	Acidic to Neutral	Pyramidal/Oval	Large	35 to 50	70 to 90	Fast	•			•	
Malus spp.	Crabapple	Sugar Tyme; Prairie Fire; Various	No	Yes	Drupe/ Berry (Fruitless cultivars	High	Moist to Well Drained	Low	Low	Acidic to Alkaline	Rounded	Small	20 to 25	20 to 25	Mod		•	•	•	•
Metasequoia glyptostroboides	Dawn Redwood		No	No	Cone-like	Low	Occassionally wet to Moist.	Low	Low	Acidic to Neutral	Upright Pyramidal	Large	20 to 30	60 to 80	Fast				•	
Nyssa sylvatica	Blackgum		Yes	No	Drupe/ Berry	Low	Extended Floodingto Well-Drained	Low	High	Acidic	Pyrmadial / Oval	Medium	25 to 35	30 to 50	Slow	•			•	
Ostrya virginiana	American Hophornbeam		Yes	No	Cluster of winged-seeds; Looks like	High	Moist to Well Drained	Mod	Low	Acidic to Alkaline	Oval	Medium	25 to 30	25 to 40	Slow	•		•		•
Platanus x acerifolia	London Planetree	Bloodgood; Various	No	No	Spiked Ball	Mod	Extended flooding to Well-Drained	Mod	Mod	Acidic to Alkaline	Pyramidal / Rounded	Large	50 to 70	75 to 90	Mod	•			•	
Platanus occidentalis	Sycamore		Yes	No	Spiked Ball	Mod	Extended Flooding to Well-Drained	Mod	Mod	Acidic to Alkaline	Pyramidal / Rounded	Large	50 to 70	75 to 90	Fast	•			•	
Prunus sargentii	Sargent Cherry		No	Yes	Drupe/ Berry	Mod	Moist to Well Drained	High	Mod	Acidic to Neutral	Vase/Round	Small	30 to 50	20 to 30	Mod	•		•		
Prunus serrulata	Kwanzan Cherry	Kwanzan	No	Yes	None	Mod	Moist to Well Drained	Low	Mod	Acidic to Slightly Alkaline	Upright/Vase	Small	15 to 25	15 to 25	Mod	•		•		•
Prunus subhirtella	Higan Cherry		No	Yes	Drupe/ Berry	Mod	Moist to Well Drained	Low	Low	Acidic to Neutral	Vase	Small	25 to 35	25 to 35	Mod	•		•		•
Prunus x yedoensis	Yoshino Cherry		No	Yes	Drupe/ Berry	Mod	Moist to Well Drained	Low	Low	Acidic to Neutral	Vase	Medium	25 to 40	40 to 50	Mod	•		•		
Quercus bicolor	Swamp White Oak		Yes	No	Acorn	High	Extended flooding to Well Drained	Mod	Mod	Acidic to Slightly Alkaline	Upright Oval / Rounded	Large	50 to 60	50 to 70	Mod	•			•	
Quercus macrocarpa	Bur Oak		Yes	No	Acorn	High	Moist to Well Drained	High	High	Acidic to Alkaline	Upright Oval / Spreading	Large	40 to 60	60 to 70	Slow	•			•	
Quercus imbricaria	Shingle Oak		Yes	No	Acorn	Yes	Moist to Well Drained	Mod	Mod	Acidic to Alkaline	Pyrimdial/Rounded	Large	40 to 60	40 to 60	Mod	•			•	
Quercus rubra	Northern Red Oak		Yes	No	Acorn	High	Moist to Well Drained	High	Low	Acidic to Slightly Alkaline	Rounded	Large	60 to 80	50 to 60	Fast	•			•	

TRAVERSE CITY TREE SELECTION GUIDE

Revised 12/11/2012

SITUATION : Residential area
Low salt use
Treelawn 4-6 feet
Overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Acer glabrum	Rocky Mountain Maple	
Acer grandidentatum	Big Tooth Maple	'Rocky Mountain Glow'
Acer griseum	Paperbark Maple	'Ginzam' (Gingerbread)
Acer pensylvanicum	Striped Maple	
Acer pseudosieboldianum	Korean Maple	
Acer saccharum 'Barrett Cole'	Apollo Maple	
Acer saccharum 'Sugar Cone'	Sugar Cone Maple	
Acer tegmentosum	Manchustriped Maple	
Acer triflorum	Three-Flower Maple	
Alnus rugosa	Speckled Alder	
Amelanchier spp.	Serviceberry	'Robin Hill', 'Cole Form' 'Autumn Brillance', 'Tradition' 'Cumulus', 'Snow Cloud' 'Princess Diana', 'Spring Glory'
Carpinus caroliniana	American Hornbeam	
Carpinus japonicus	Japanese Hornbeam	
Cercidiphyllum japonicum 'Pendula'	Weeping Katsura	
Cercis canadensis	Eastern Redbud	
Chionanthus retusus	Chinese Fringetree	
Chionanthus virginicus	White Fringetree	
Cornus alternifolia	Pagoda Dogwood	
Cornus kousa	Kousa Dogwood	'Chinensis', 'Milky Way' 'Summer Stars', 'Select'
Cornus racemosa	Grey Dogwood	
Cotinus obovatus	American Smoketree	'Red Leaf'

Downtown Traverse City Tree Species List*

Botanical Name	Common Name	Cultivar	Native to MI	Showy Flower	Type of Fruit/Seed	Drought Tolerance	Soil Drainage Tolerance	Soil Salt Tolerance	Salt Spray Tolerance	Soil pH	Shape	Mature Size	Mature Spread (feet)	Mature Height (feet)	Growth Rate	s
Syringia reticulata	Japanese Tree Lilac	Ivory Silk	No	Yes	Small Seed Cluster	High	Moist to Well Drained	High	High	Acidic to Alkaline	Oval to Rounded	Small	15 to 20	20 to 30	Mod	
Taxodium distichum	Bald Cypress		No	No	Seed Ball	High	Extended Flooding to Well-Drained	High	High	Acidic to Slightly Alkaline	Pyramidal	Large	25 to 35	60 to 80	Fast	
Tilia americana	American Linden		Yes	Yes	Seed Pod	Mod	Moist to Moderately Well Drained	Low	Low	Slightly Acidic to Alkaline	Rounded	Large	30 to 50	50 to 80	Mod	
Tilia cordata	Little-leaf Linden	Greenspire	No	Yes	Seed Pod	Mod	Moist to Moderately Well Drained	Low	Low	Slightly Acidic to Alkaline	Pyramidal to Rounded	Large	30 to 40	40 to 60	Mod	
Tilia tomentosa	Silver Linden		No	Yes	Seed Pod	High	Moist to Moderately Well Drained	Low	Low	Acidic to Alkaline	Broad Columnar	Large	30 to 50	50 to 70	Mod	
Ulmus americana	American Elm	Valley Forge; Princeton	Yes	No	Winged Seed Pod	Mod	Extended Flooding to Well-Drained	High	Mod	Acidic to Alkaline	Vase	Large	50 to 70	70 to 90	Fast	
Ulmus X	Hybrid Elm	Patriot; Triumph; Accolade	No	No	Winged Seed Pod	High	Extended Flooding to Well-Drained	High	High	Acidic to Alkaline	Vase	Large	30 to 45	40 to 60	Fast	
Zelkova serrata	Zelkova	Green Vase; Village Green	No	No	Small Seeds	Mod	Moist to Moderately Well Drained	Low	Low	Acidic to Slightly Alkaline	Vase	Large	40 to 50	60 to 80	Mod	

**This species list is not inclusive of all trees recommended and/or suitable for Traverse City's climate; there are many native and non-native shade and ornamental trees that can be planted. When selecting tree species for plant diversity of tree species on individual streets, in neighborhoods, and in the entire community should be taken into consideration. The planting of a single species (monoculture) or genus should be avoided.*

Tree species highlighted in blue are native species that are also listed on the City of Traverse City's Tree Selection Guide (revised 12/11/2012)

Tree Selection Resources:

Cornell University Woody Plants Database http://woodyplants.cals.cornell.edu/home
Michigan State University Extension, https://www.canr.msu.edu/home_gardening/trees-shrubs/
Missouri Botanical Garden Plant Finder https://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx
Morton Arboretum Trees and Plant Finder https://mortonarb.org/plant-and-protect/search-trees-and-plants/
University of Illinois Extension Tree Selector Tool https://web.extension.illinois.edu/treeselector/search.cfm

Malus spp.	Crabapple	'Red Baron', 'Lancelot' 'Golden raindrops' 'Purple Prince', 'Spring Snow' 'Pinkspire', 'Sentinel'
Parrotia Persica	Persian Parrotia	'Ruby Vase'
Prunus virginiana	Choke Cherry (Canada Red Select)	'Shubert'
Pyrus fauriei 'Westwood'	Korean Sun Pea Pear	
Pterostyrax hispida	Epaulette Tree	
Syringa reticulata	Tree Lilac	'Ivory Silk'
Quercus gambelii	Gamble Oak	
Zelkova serrata 'Wireless'	Compact Zelkova	

SITUATION : Residential area
Low salt use
Treelawn 4-6 feet
No overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Acer davidii	Striped-bark Maple (David)	
Acer mandshuricum	Manchurian Maple	
Acer rubrum 'Brandywine'	Brandywine Red Maple	
Carpinus betulus	European Hornbeam 'Frans Fontaine"	'Fastigiata'
Halesia carolina	Carolina Silverbell	'Meehanii', 'Rosea'
Liquidambar stryaciflua 'Clydesform'	Emerald Sentinel Sweetgum	
Magnolia denudata (M. heptapeta)	Yulan Magnolia	
Ostrya virginiana	Hophornbeam	
Tilia cordata 'Chancole'	Chancellor Linden	

SITUATION : Residential area
Moderate to high salt use
Treelawn 4-6 feet
No overhead utility wires

Gleditsia triacanthos inermis	Thornless Honeylocust	'Skyline' 'Halka' 'Sunburst' 'Imperial'
Koelreuteria paniculata	Goldenrain Tree	
Nyssa sylvatica	Black Gum (Tupelo)	'Red Range' 'Wildfire'
Zelkova serrata	Zelkova	'Village Green' 'Green Vase'

SITUATION : Residential area
Low salt use
Treelawn greater than 8 feet
No overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Acer nigrum	Black Maple	
Acer rubrum	Red Maple	'Autumn Flame', 'Firefall' 'Northfire' 'Northwood' 'October Glory', 'Supersonic'
Acer saccharum	Sugar Maple	'Green Mountain', 'Legacy' 'Fall Fiesta', 'Seneca Chief' 'Commemoration'
Aesculus flava (A. octandra)	Yellow Buckeye	
Castanea mollissima	Chinese Chestnut	
Fagus grandifolia	American Beech	
Fagus sylvatica	European Beech	'Asplenifolia' 'Atropunicea'
Liquidambar styraciflua	Sweetgum	'Burgundy' 'Moraine' 'Cherokee' 'Festival' 'Worplesdon'
Liriodendron tulipifera	Tulip Tree	
Tilia americana	American Basswood	'Boulevard' 'Legend' 'Redmond' 'Sentry'
Tilia x euchlora	Crimean Linden	
Tilia heterophylla	Beetree Linden	'Continental'
Tilia platyphyllos	Bigleaf Linden	

SITUATION : Residential area
Moderate to high salt use
Treelawn greater than 8 feet
No overhead utility wires

Ulmus spp.	Hybrid Elm	'Princeton', 'Accolade' 'Valley Forge', 'Regal', 'Frontier' 'Pioneer', 'Homestead' 'Sapporo Autumn Gold'
Ulmus wilsoniana	Wilson Elm	'Prospector'
Zelkova serrata	Japanese Zelkova	'Green Vase', 'Village Green'

SITUATION : Limited space for tree crown
Low salt use
Treelawn greater than 6 feet
No Overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Acer nigrum	'Green Column'	Green Column Black Maple
Acer rubrum	Red Maple	'Autumn Spire' 'Brandywine', 'Bowhall'
Acer saccharum 'Endowment'	Endowment Sugar Maple	
Carpinus betulus	European Hornbeam	'Fastigiata', 'Frans Fontaine'
Fagus sylvatica 'Fastigiata'	Pyramidal European Hornbeam	
Liriodendron tulipifera	Tuliptree	'Arnold', 'Fastigiatum'
Tilia cordata 'Corinthian'	Corinthian Linden	

SITUATION : Limited space for tree crown
Moderate to high salt use
Treelawn greater than 6 feet
No overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Acer x freemanii	Freeman Maple	'Armstrong', 'Scarlet Sentinel'
Alnus glutinosa 'fastigiata'	Pyramidal Black Alder	
Corylus colurna	Turkish Filbert	
Ginko biloba	Maidenhair Tree	'Lakeview', 'Magyar' 'Princeton Sentry', 'Saratoga'
Koelreuteria paniculata 'Fastigiata'	Pyramidal Goldenrain tree	
Quercus alba x robur	Hybrid Oak	'Crimson Spire'
Quercus robur	English Oak	'Attention', 'Fastigiata', 'Skymaster' 'Skyrocket', 'Regal Prince'
Zelkova serrata 'Musashino'	Musashino Zelkova	

Celtis occidentalis	Hackberry	'Prairie Pride', 'Magnifica'
Ginkgo biloba	Maidenhair Tree	'Princeton Sentry' 'Magyar', 'Lakeview'
Gleditsia triacanthos inermis	Thornless Honeylocust	'Halka', 'Skyline', 'Imperial'
Gymnocladus dioicus	Kentucky Coffeetree	'Prairie Titan', 'Stately Manor' 'Expresso', 'J.C. McDaniels'
Koelreuteria paniculata	Goldenrain Tree	'September', 'Rose Lantern'
Quercus imbricaria	Shingle Oak	
Sophora japonica	Pagoda Tree	'Regent', 'Upright', 'Princeton'
Tilia cordata	Littleleaf Linden	'Glenleven', 'Shamrock'
Ulmus parvifolia	Lacebark Elm	'Ohio', 'Pathfinder', 'Burgandy' 'Dynasty', 'Emerald Isle' 'Emerald Vase'

SITUATION : Sidewalk pits
Overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Malus spp.	Crabapple	'Red Baron', 'Sentinel'
Syringa reticulata	Tree Lilac	'Ivory Silk'

SITUATION : Sidewalk pits
No overhead utility wires

Latin Name	Common Name	Suggested Cultivars
Ginkgo biloba	Maidenhair tree	'Magyar', 'Lakeview' 'Princeton Sentry'
Gleditsia triacanthos inermis	Thornless Honeylocust	'Skyline'

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