DAVEY Resource Group

February 2025

STANDARD INVENTORY ANALYSIS AND MANAGEMENT PLAN

Memorial Cemetery
Ste. Genevieve, Missouri

Prepared for:

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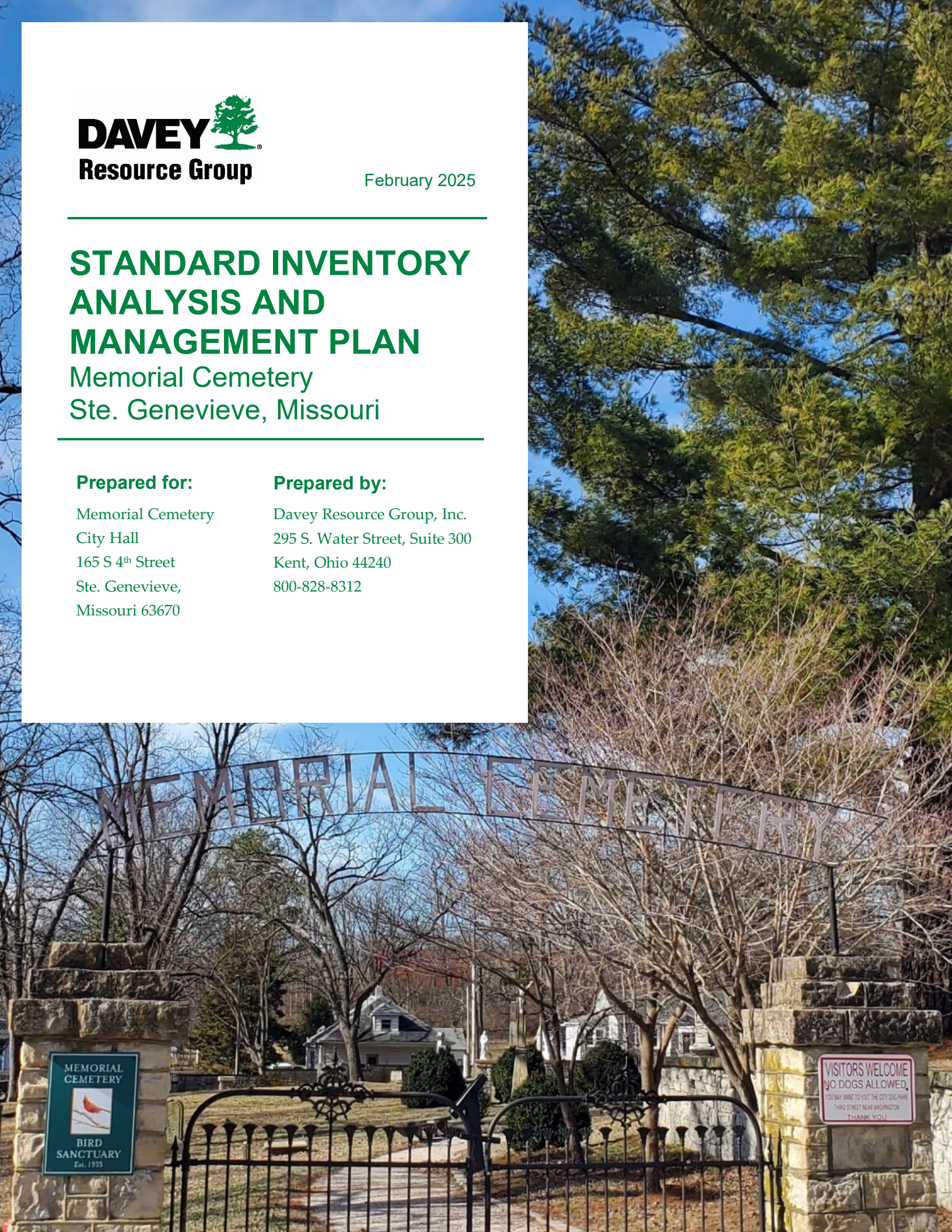

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ACKNOWLEDGMENTS

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

Memorial Cemetery is thankful for the grant funding it received from the Missouri Department of Conservation through its Community Forestry Cost Share program in cooperation with the Missouri Community Forestry Council and the U.S. Forest Service. This Grant Program is designed to encourage communities to create and support long-term and sustained urban and community forestry programs throughout Missouri.

Memorial Cemetery also recognizes the support of:

Mike Weiler - President of the Foundation for the Restoration of Ste. Genevieve.

Jennifer Behnken - the Department of Conservation

Five-Year Tree Resource Maintenance Schedule

EXECUTIVE SUMMARY

The City of Ste. Genevieve's Memorial Cemetery *Standard Inventory Analysis and Management Plan*, written by Davey Resource Group, Inc. (DRG), focuses on quantifying the benefits provided by the inventoried tree resource and addressing its maintenance needs. DRG completed a tree inventory for the Memorial Cemetery in January 2025, and analyzed the inventory data to understand the structure of the Cemetery's inventoried tree resource. DRG also estimated the economic values of the various environmental benefits provided by this public tree resource by analyzing inventory data with i-Tree Eco, and recommended a prioritized management program for future tree care.

The functions of Memorial Cemetery's inventoried tree population provide benefits with an estimated total value of $1,259 annually. The replacement value of Memorial Cemetery's inventoried tree population is worth an estimated $390,068. Supporting and funding proactive maintenance of the public tree resource is a sound long-term investment that will reduce tree management costs over time.

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

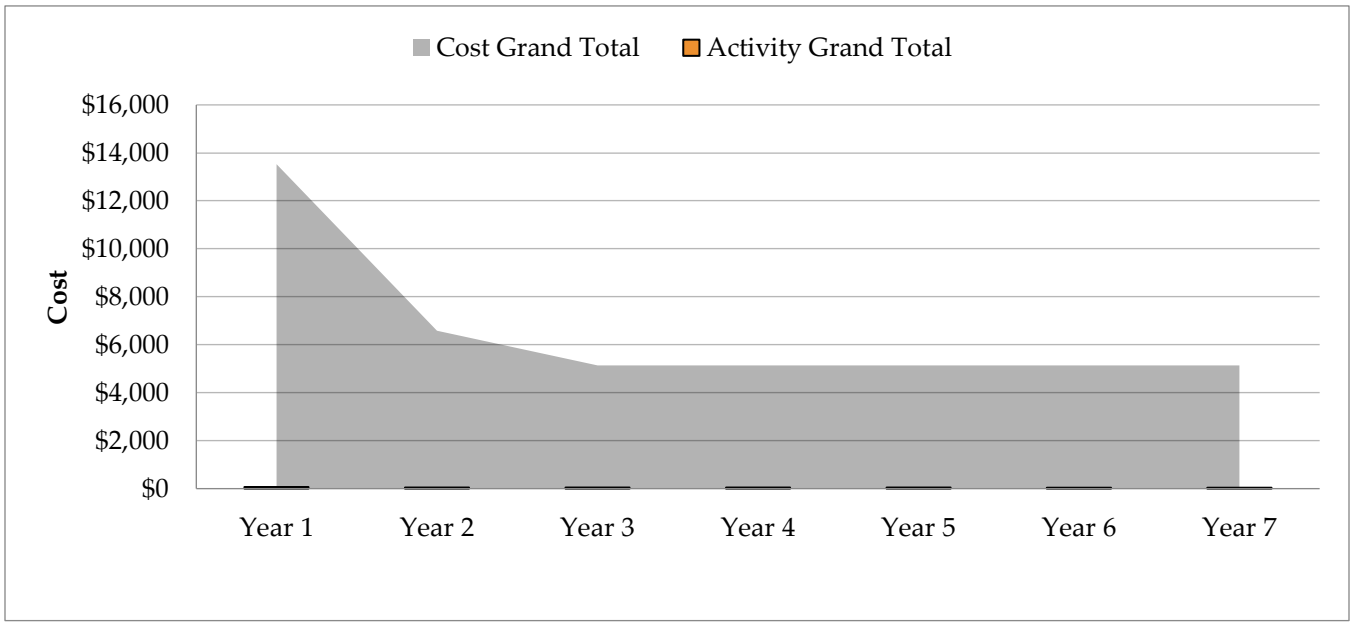


Figure 1. Budget Grand Totals by year.

Recommended Maintenance Types

Tree Removal

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

Total = 3 trees
High Priority = 1 tree
Low Priority = 2 trees
Stumps = 3

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 = 21 trees
High Priority = 1 tree
Moderate Priority = 20 trees

Routine Pruning Cycle

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

Total = 71 trees
Number in cycle each year = at least 14 trees

Young Tree Training Cycle

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

Total = 3 trees
Number in cycle each year = at least 1 tree

Tree Planting

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

Total replacement plantings = 4 trees
Total new plantings = 5 trees

Routine Tree Inspection

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

Number in drive-by assessment cycle each year = near 50 trees
Number in walk-by assessment cycle each year = near 5 trees

INTRODUCTION

The City of Ste. Genevieve is home to 5,000 residents benefiting from public trees in their community. The City's public works program manages all trees, stumps, and planting sites along the street rights-of-way (ROW) and throughout public parks.

The Cemetery's urban forestry program is on its way to creating a sustainable and resilient public tree resource, and it is important to stay on track by consistently renewing program funding and routinely updating the tree inventory.

RECOMMENDED APPROACH TO TREE MANAGEMENT

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

In January 2025, Saint Genevieve Memorial Cemetery worked with DRG to inventory its trees and develop this management plan. Consisting of three sections, this plan considers the diversity, distribution, and condition of the inventoried tree population and provides a prioritized system for managing the Cemetery's public tree resource.

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

Section 1:

Structure and Composition

of the Public Tree Resource

SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In January 2025, DRG arborists collected site data on trees, and stumps within the Memorial Cemetery for a tree inventory contracted by the City of Saint Genevieve. There were a total of 101 sites inventoried. Figure 2 breaks down the total sites inventoried by type. See Appendix A for details about DRG's methodology for collecting site data.

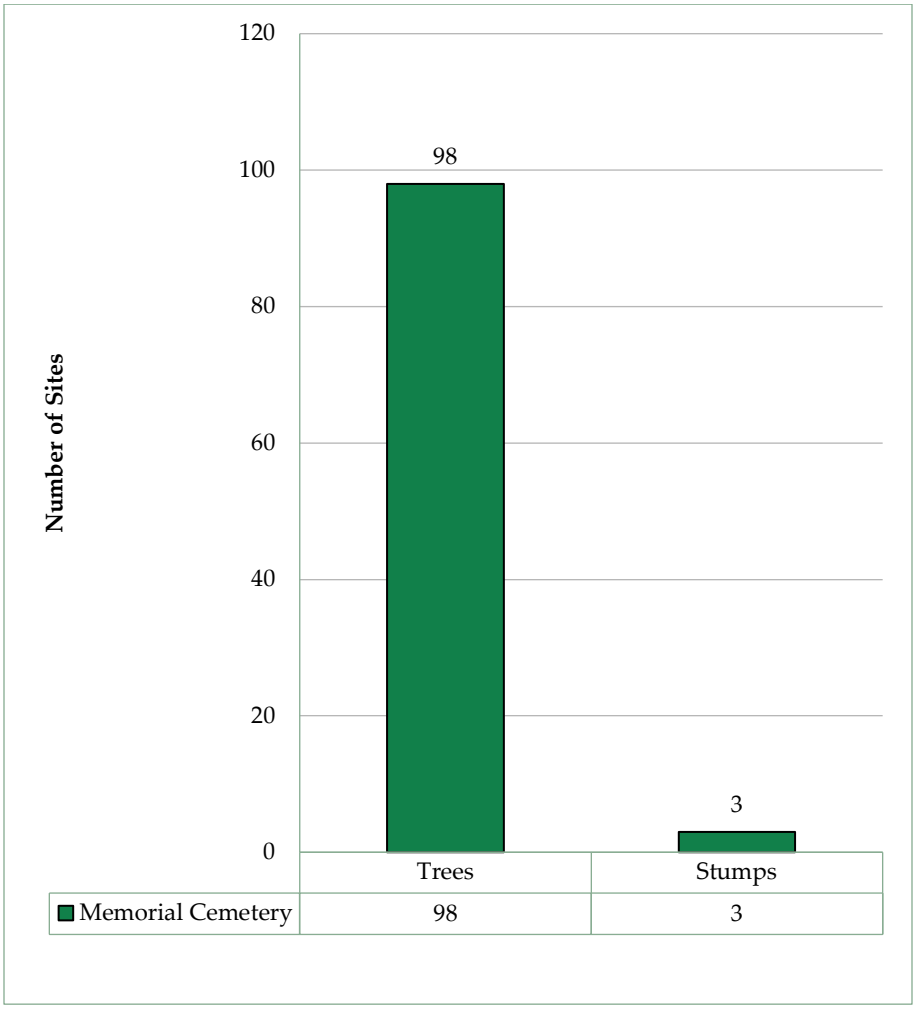


Figure 2. Number of inventoried sites by location and type.

The Foundation for the Restoration of Ste Genevieve designated the Memorial Cemetery to collect site data for the tree inventory. All trees and stumps within the cemetery were collected.

SPECIES, GENUS, AND FAMILY DISTRIBUTION

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

Figure 3 shows Memorial Cemetery's distribution of the most abundant tree species inventoried compared to the 10% threshold. Pecan (*Carya illinoinensis)* is the most abundant species with 24% of the population, which is significantly over the 10% threshold. However, it is not immediately concerning from this data alone. Memorial Cemetery is a small subset of the greater whole of Ste Genevieve. With only 98 standing trees, any species in decent number can skew the results to look as if there were a major issue.

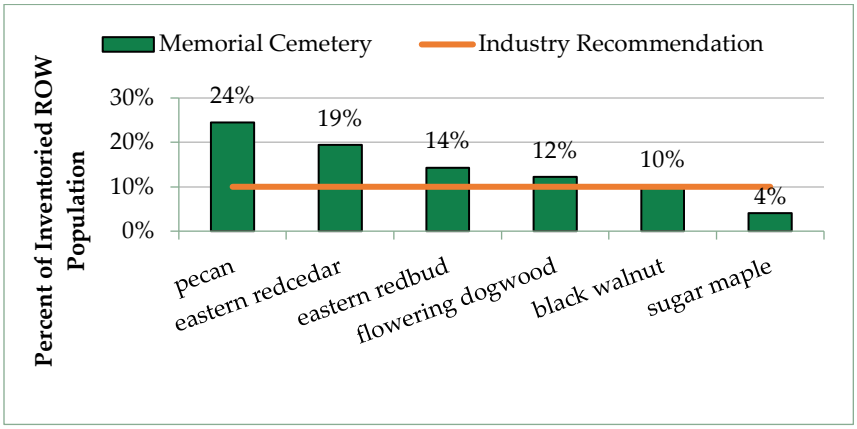


Figure 3. Species distribution of inventoried trees.

However, Figure 4 shows the Cemetery's distribution of the most abundant tree genera inventoried, and hickory (*Carya*) is also higher than the 20% threshold. This means that pecan is somewhat concerning after all within the bounds of the cemetery, because hickory compose 26% of the inventoried population. For this reason, Memorial Cemetery should not plant pecan or any other hickory species until this distribution becomes more ideal.

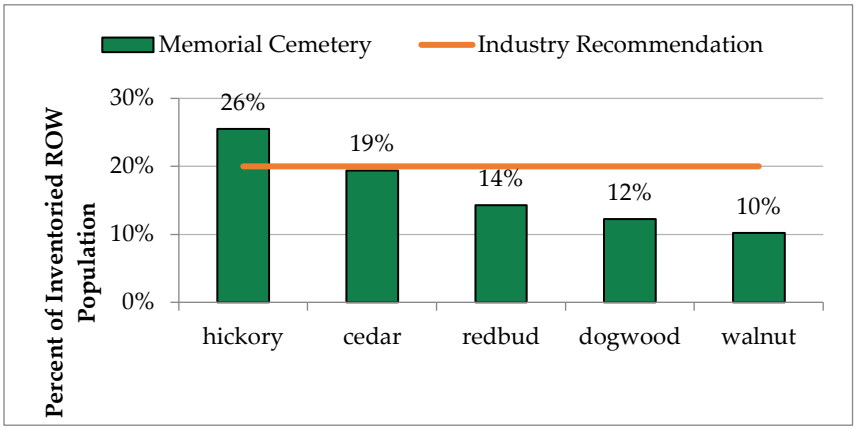


Figure 4. Genus distribution of inventoried trees.

RESILIENCE THROUGH DIVERSITY

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

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

USDA Forest Service (2017)

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

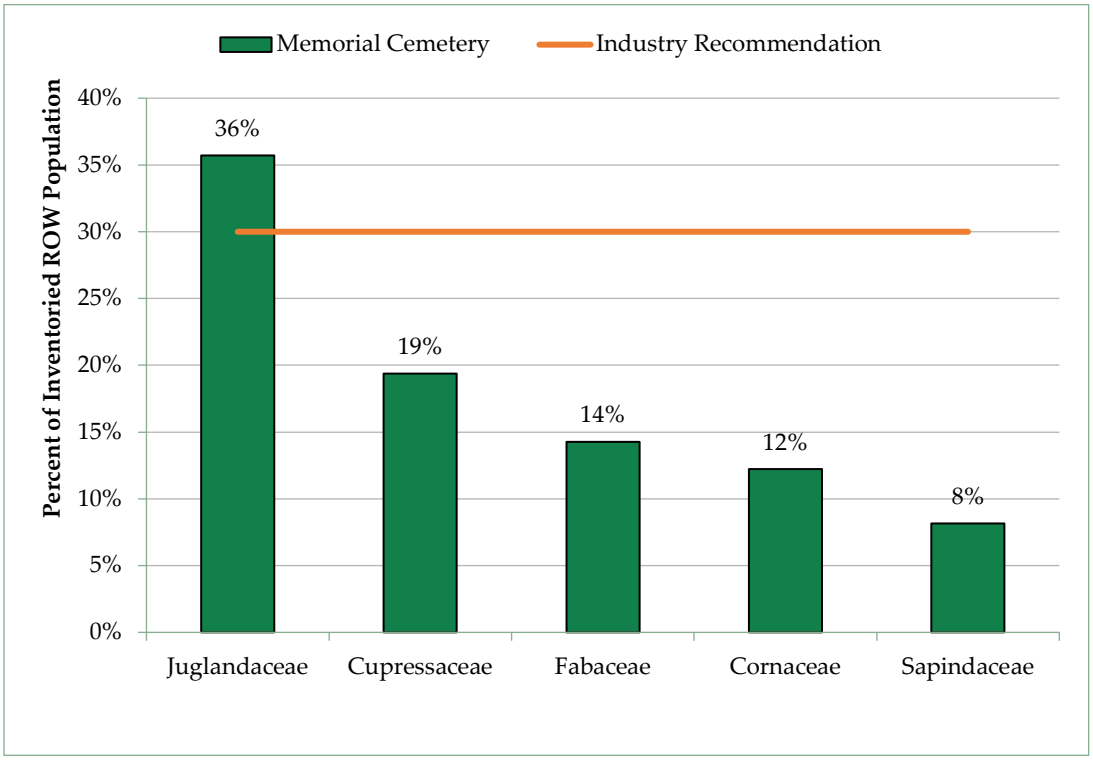


Figure 5. Family distribution of inventoried trees.

Figure 5 shows the Cemetery's distribution of the most abundant tree families inventoried compared to the 30% threshold. Once again, we see that due to the small sample size and large number of pecan trees, that Juglandaceae (36%) is over the threshold. All other families are well below the 30% threshold, with Cupressaceae composing the next highest proportion at 19% of the inventoried population.

PEST SUSCEPTIBILITY

Early diagnosis of disease and infestation is essential to ensuring the health and continuity of Memorial Cemetery's public tree resource. See Appendix B for some information about the pests listed below and websites where additional information can be found.

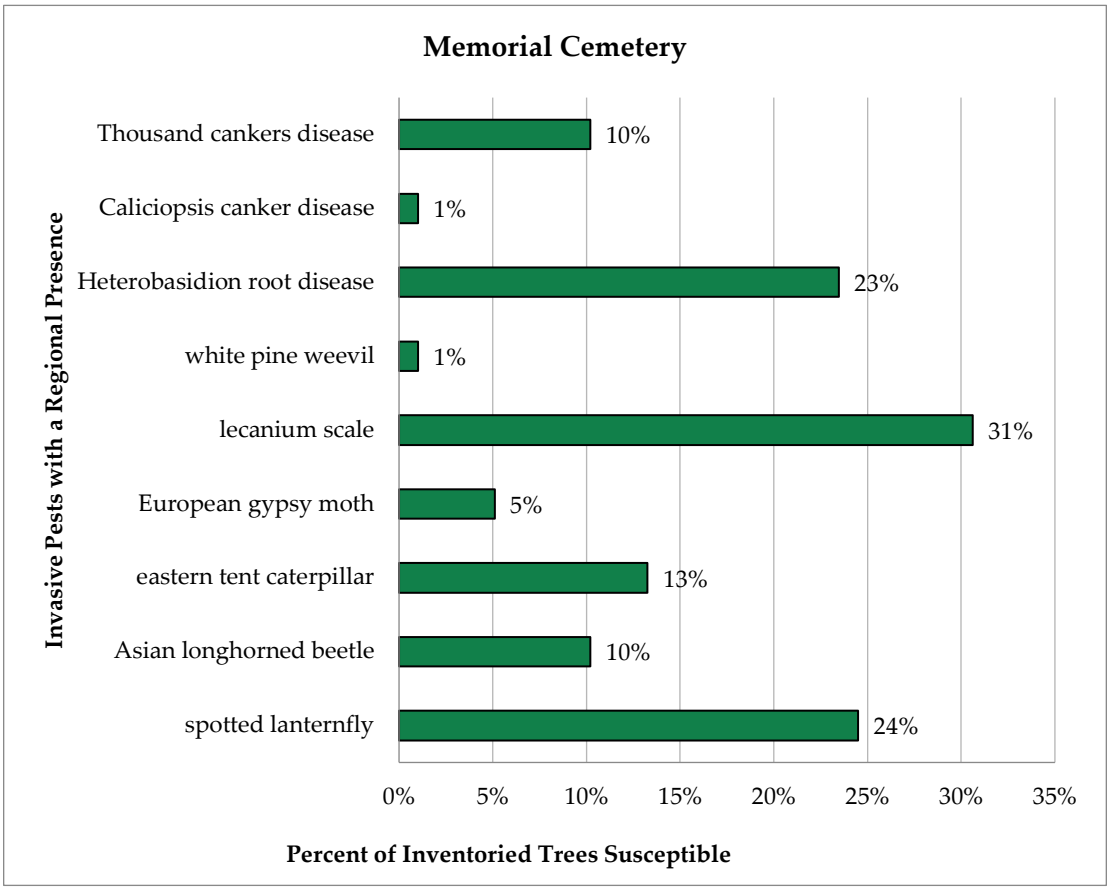


Figure 6. Tree resource susceptibility to invasive pests that have a regional presence.

Figure 6 shows the percent of inventoried trees susceptible to some of the known pests in and around Missouri. It is important to remember that this figure only represents data collected during the inventory. Many more trees throughout Ste Genevieve, especially those on private and public property outside of the cemetery, may be susceptible to hosting these invasive pests. Spotted lantern fly (SLF, *Lycorma delicatula*) and lecanium scale (LS, *Parthenolecanium* spp.) are known threats to a large percentage of the inventoried tree resource, 24% and 31%, respectively.

Pest Susceptibility Recommendations

The overabundance of pecan in Memorial Cemetery's tree resource is a management concern because it creates unnecessary risk in the event of an invasive pest outbreak. This abundance is not only more tree resource to lose but is also more habitat for the pests it is susceptible to, such as LS, making it easier for them to spread. Increasing species diversity is a critical goal that will help Memorial Cemetery's tree resource be resilient in the event of future pest invasions.

While it might be prudent for the cemetery to limit planting species in the Juglandaceae family to prevent it from exceeding the 30% threshold even further, efforts to improve diversity at the genus and species level are a better use of short-term resources until more research is done on family diversity as a mechanism for promoting system resilience. For this reason, Memorial Cemetery should use its resources to inspect trees in the Carya genus for signs of infestation on a routine basis, so affected trees can be quarantined to contain the pest before an outbreak starts.

CONDITION

Several factors affecting condition were considered for each tree, including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated by an arborist as Good, Fair, Poor, or Dead. The general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory. Figure 7 shows most of the inventoried trees were recorded in Good or Fair condition, 40% and 44%, respectively. Based on these data, the general health of the inventoried tree population is rated as Fair. Memorial Cemetery has a low percentage of Dead trees and trees in Poor condition, so the general health of the Cemetery's tree resource is approaching Good.

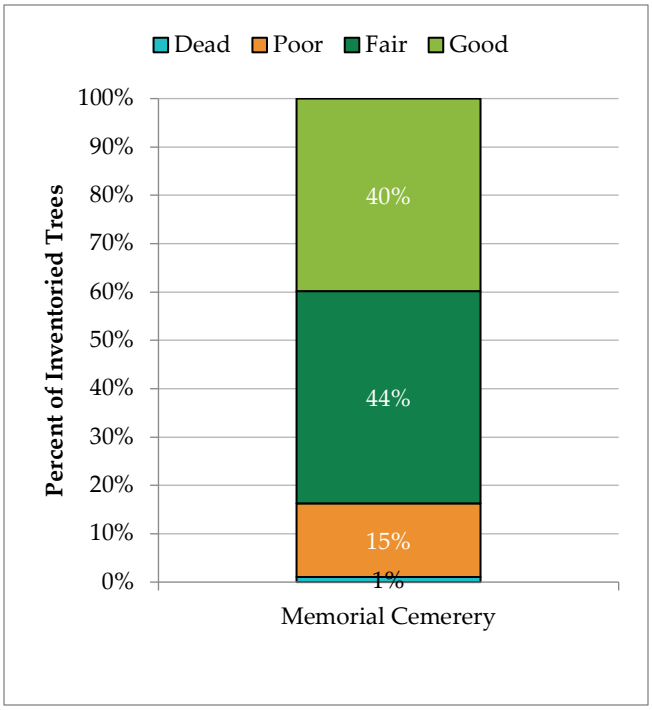


Figure 7. Condition of inventoried trees.

Condition Recommendations

- Dead trees and trees in Poor condition should be removed as soon as possible, because the health of these trees is unlikely to recover even with increased care and present a risk.
- Younger trees rated in Fair or Poor condition may benefit from structural pruning to improve their health over time. Pruning should follow *ANSI A300 (Part 1)* guidelines.
- Poor condition ratings among mature trees were generally due to visible signs of decline and stress, including decay, dead limbs, sparse branching, or poor structure. These trees will likely require corrective pruning and intensive plant health care to improve their vigor and should be monitored for worsening conditions.

RELATIVE AGE DISTRIBUTION

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

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

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

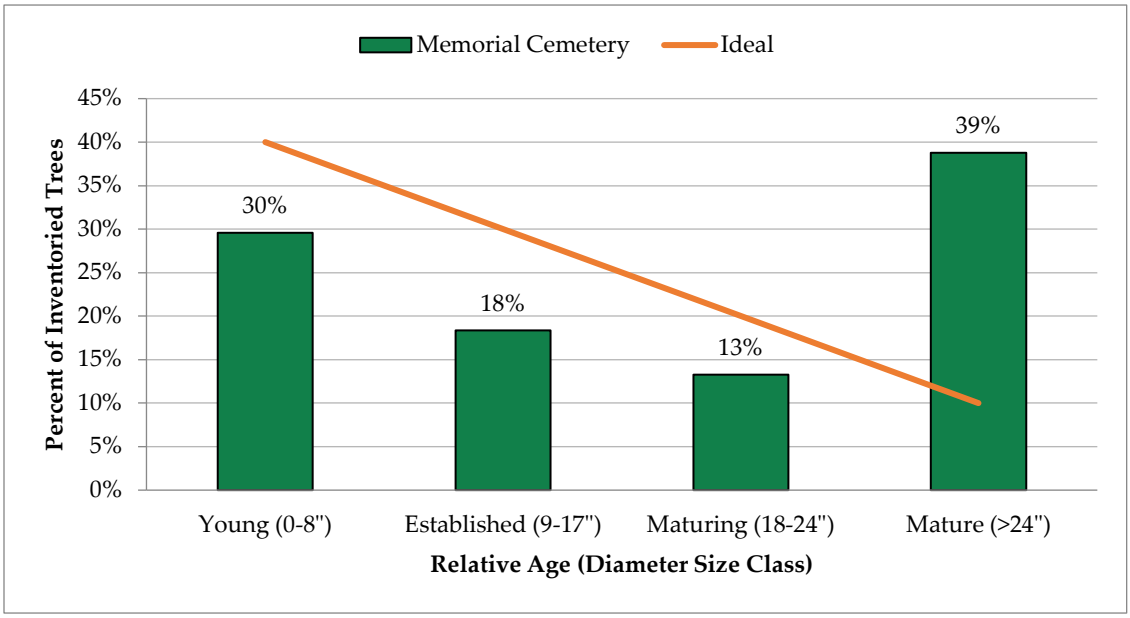


Figure 8. Relative age distribution of inventoried trees.

Figure 8 compares Memorial Cemetery's relative age distribution of the inventoried tree population to the ideal. The Cemetery's inventoried tree resource is trending towards the ideal; however, mature trees exceed the ideal by 29%, while all other age groups fall short by around 10%.

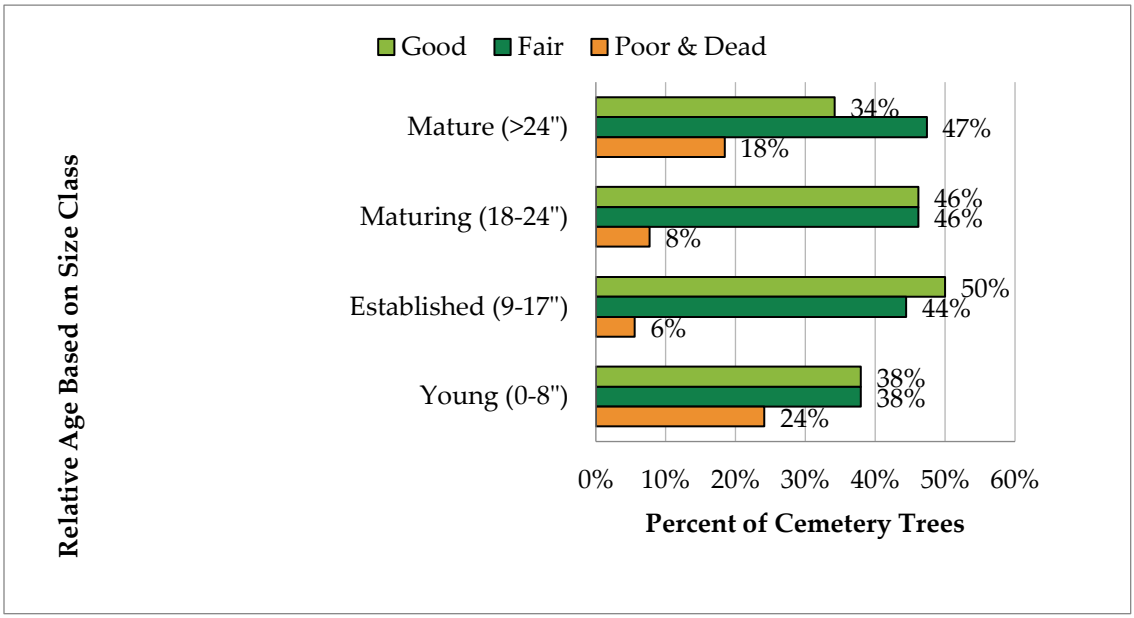


Figure 9. Condition of inventoried trees by relative age class.

Figure 9 cross analyzes the condition of the inventoried tree resource with its relative age distribution, providing insight into the inventoried population's stability. 81% of mature trees and 92% of maturing trees are rated in Fair condition or better, which matters because these larger trees would have a more damaging impact in the event of failure. 94% of established trees and 66% of young trees are rated in Fair condition or better, so it is important to provide the maintenance they need to remain healthy as they age and grow, to reduce the proportion of mature and maturing trees in Poor condition or worse.

Relative Age Recommendations

While Memorial Cemetery has an excess of mature trees and a shortage of young, established, and maturing trees, the cemetery has a low percentage of trees in Poor condition, indicating that young trees have the potential of reaching maturity if they are well maintained. Memorial Cemetery is an older cemetery and it makes sense why there is an older tree population. DRG recommends that Memorial Cemetery implement a robust maintenance program, to focus on tree preservation and proactive care, to protect mature and maturing trees from unnecessary removal and to prevent them from succumbing to treatable defects. The cemetery should also conserve the condition of young trees as they age so they replace removed trees and fill canopy gaps in maturity. Prioritizing proactive maintenance above tree planting will shift the relative age distribution towards the ideal over time.

DEFECT OBSERVATIONS

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

- Broken and/or hanging branches
- Cracks
- Dead and dying parts
- Missing or decayed wood
- Weakly attached branches and codominant stems
- Tree architecture
- None

Table 1. Tree defect categories recorded during the inventory.

Defect	Cemetery Trees	Percent of Cemetery Trees
Broken and/or hanging branches	14	14%
Cracks	1	1%
Dead and dying parts	31	32%
Missing or decayed wood	11	11%
None	26	27%
Tree architecture	5	5%
Weakly attached branches and codominant stems	10	10%
Total	**98**	**100%**

The two most frequently recorded defect categories were Dead & Dying Parts and Broken and/or hanging branches at 32% and 14% of inventoried trees, respectively (Table 1). Of the 31 trees with Dead & Dying Parts, only one was recommended for removal.

Defect Observation Recommendations

When considering the defect recorded for each tree, there are two important qualifiers to keep in mind. First, the categories are broadly inclusive. For example, the "Dead and Dying Parts" category can include trees with just one or two smaller diameter dead limbs as well as trees found with large-diameter dead limbs or entire sections of dead canopy. Therefore, inferences on overall tree condition or risk rating cannot be derived solely from the presence or absence of a defect recorded during the inventory. Second, an inventoried tree may have multiple defects; the 2025 Memorial Cemetery inventory recorded only the most significant defect observed for each tree. These two qualifiers are important to keep in mind when considering urban forest management planning and the prioritization of maintenance or monitoring activities.

INFRASTRUCTURE CONFLICTS

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

- *Overhead Utilities*—The presence of overhead utility lines above a tree or planting site was noted; it is important to consider this data when planning pruning activities and selecting tree species for planting.
- *Hardscape Damage*—Tree roots can adversely impact hardscape such as curbs and sidewalks, causing these features to lift and crack. This data should be used to schedule pruning and plan repairs to damaged infrastructure. To limit hardscape damage caused by trees, trees should only be planted in growing spaces where adequate above ground and below ground space is provided.
- *Pedestrian Conflict* – Low hanging branches of highly trafficked area were noted. This is also important to consider when planning pruning activities and selecting tree species for planting. These conflicts can present a public health problem.

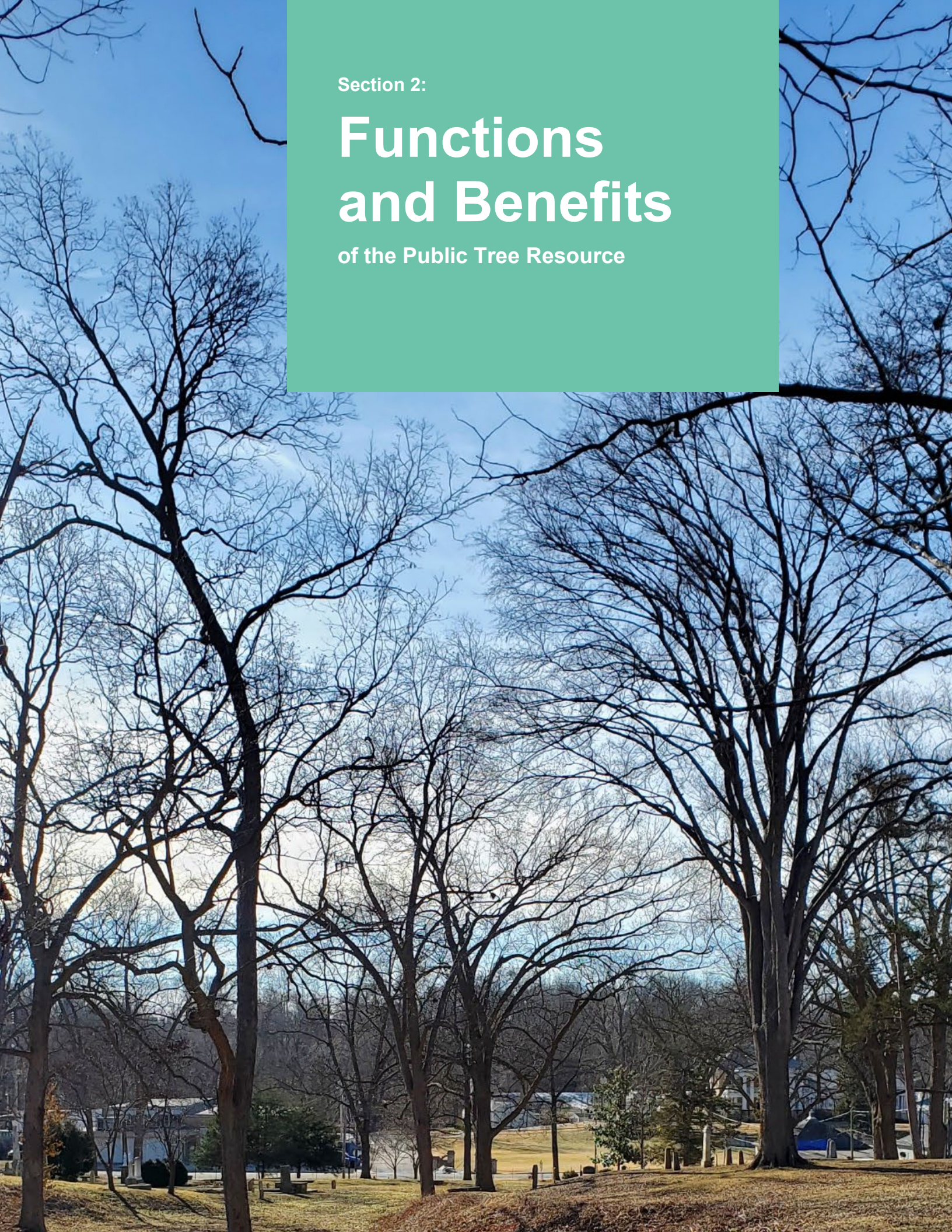
Table 2. Tree conflicts with overhead infrastructure recorded during the inventory.

Conflict	Cemetery Trees	Percent of Cemetery Trees
Pedestrian	9	9%
Sidewalks and other Hardscape	1	1%
Utility Lines	9	9%
None	82	81%
Total	**101**	**100%**

Table 2 shows 19 trees were recorded with an infrastructure conflict. The majority of those (18%) were related to conflicts with overhead utilities or pedestrian conflicts. There were 9 inventoried trees with utilities directly above, or passing through, the tree canopy. Hardscape damage was minimal: only 1% of the tree population raised sidewalk slabs or curbs.

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

When planting around hardscape, it is important to give the tree enough growing room above ground. Guidelines for planting trees among hardscape features are as follows: give small-growing trees 4–5 feet, medium-growing trees 6–7 feet, and large-growing trees 8 feet or more between hardscape features. In most cases, this will allow for the spread of a tree's trunk taper, root collar, and immediate larger-diameter structural roots. Tree roots can cause structural damage to pathways, gravestones, and underground utilities. Choose species with less invasive root systems when planting in areas where this could be a concern. It is also important to ensure that trees do not obscure important cemetery features like memorials, signage, or pathways. Keep a balance between providing shade and maintaining visibility for visitors.



Section 2:

Functions and Benefits

of the Public Tree Resource

SECTION 2: FUNCTIONS AND BENEFITS OF THE PUBLIC TREE RESOURCE

Trees occupy a vital role in the urban environment by providing of a wide array of economic, environmental, and social benefits far exceeding the investments in planting, maintaining, and removing them. Trees reduce air pollution, improve public health outcomes, reduce stormwater runoff, sequester and store carbon, reduce energy use, and increase property value. Using advanced analytics, such as i-Tree Eco and other models in the i-Tree software suite, understanding the importance of trees to a community continues to expand by providing tools to estimate monetary values of the various benefits provided by a public tree resource.

Environmental Benefits

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

Economic Benefits

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

Social Benefits

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

i-TREE ECO ANALYSIS

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

ANNUAL BENEFITS FROM THE PUBLIC TREE RESOURCE

The i-Tree Eco analysis of the Memorial Cemetery's inventoried trees quantified the functional benefits of three critical ecosystem services that they provide: air pollution removal, carbon sequestration, and avoided surface runoff.

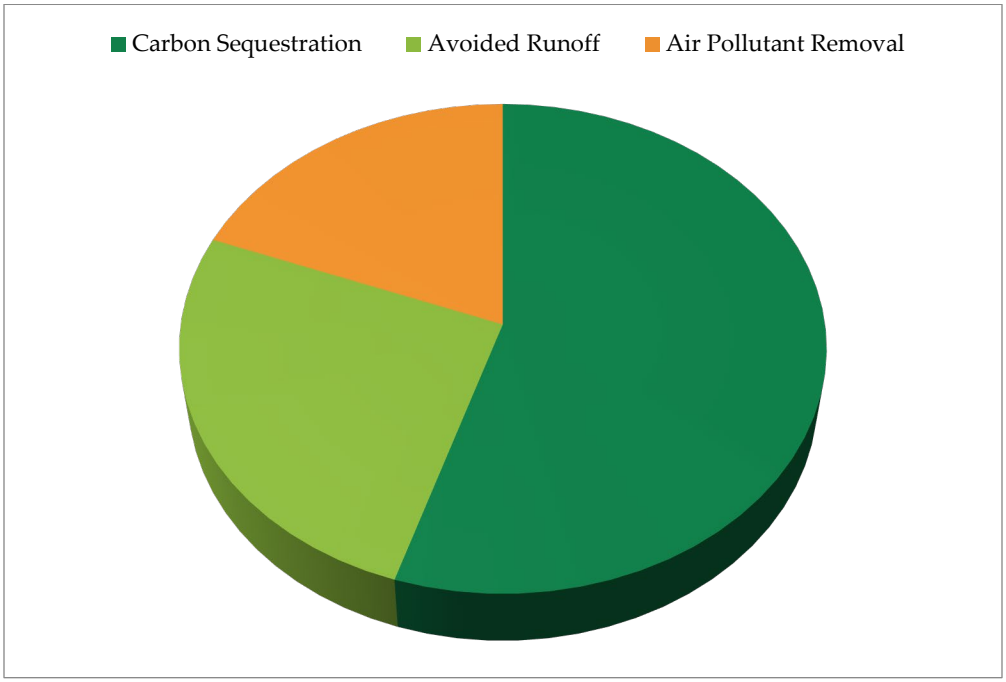


Figure 10. Estimated value of the benefits provided by inventoried trees.

Urban environments have unique challenges that make the estimated $1,259 of functional benefits provided by Memorial Cemetery's inventoried tree population an essential asset to the cemetery (Figure 10). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area. Memorial Cemetery's tree resource removes 140 lbs. of airborne pollutants annually. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment. Memorial Cemetery's tree resource avoids 4,896 cubic feet of runoff annually. Carbon dioxide (CO_2) also impacts people, property, and the environment as the primary greenhouse gas driving climate change. Memorial Cemetery's tree resource sequesters 3,200 lbs. annually.

The replacement value of the Cemetery's inventoried tree population is estimated to be $390,068. In Memorial Cemetery, only five species account for over 80% of the Cemetery's tree resource and most of the functional benefits it provides. If any of these species were lost to invasive pests, disease, or other threats, its loss would have significant costs. It is critical to promote species diversity with future plantings to minimize susceptibility to potential threats, and to plant large-statured broadleaf tree species wherever possible to maximize potential environmental and economic benefits. See Appendix C for a tree species list recommended by DRG.

SEQUESTERING AND STORING CARBON

Trees are carbon sinks, which are the opposite of carbon sources. While carbon is emitted from cars and smokestacks, carbon is absorbed into trees during photosynthesis and stored in their tissue as they grow. The i-Tree Eco model estimates both the carbon sequestered each year and total carbon stored. Memorial Cemetery's inventoried trees have stored 322,000 lbs. of carbon, which is all the carbon each tree has amassed throughout their lifetimes and is valued at $69,708.54. Pecan (*Carya illinoinensis*) and black walnut (*Juglans nigra*) store the most carbon: 7,483 lbs. per tree and 4,032 lbs. per tree, respectively. Both species also sequester the most carbon: 56 lbs. per tree per year and 70 lbs. per tree per year, respectively.

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

Most Common Trees Inventoried		Count	Percent of Total	Benefits Provided by Street Trees				
				CO_2 Stored	CO_2 Sequestered	Avoided Runoff	Air Pollution Removed	Replacement Value
Common Name	Botanical Name		%	tons	tons/year	ft^3/year	lbs/year	Dollars
freeman maple	*Acer × freemanii*	1	1.0%	0.1	0.0	13	0	$520
silver maple	*Acer saccharinum*	3	3.1%	5.4	0.1	320	0	$13,017
sugar maple	*Acer saccharum*	4	4.1%	4.0	0.1	205	0	$18,036
bitternut hickory	*Carya cordiformis*	1	1.0%	5.0	0.0	197	0	$7,907
pecan	*Carya illinoinensis*	24	24.5%	89.8	0.7	1,514	40	$149,470
eastern redbud	*Cercis canadensis*	14	14.3%	1.2	0.1	142	0	$9,264
northern hackberry	*Celtis occidentalis*	1	1.0%	0.2	0.0	119	0	$5,472
flowering dogwood	*Cornus florida*	12	12.2%	0.5	0.0	39	0	$3,233
black walnut	*Juglans nigra*	10	10.2%	20.2	0.4	849	20	$59,240
eastern redcedar	*Juniperus virginiana*	19	19.4%	8.5	0.1	728	20	$34,132
southern magnolia	*Magnolia grandiflora*	1	1.0%	0.1	0.0	18	0	$813
eastern white pine	*Pinus strobus*	1	1.0%	2.8	0.0	102	0	$20,847
black cherry	*Prunus serotina*	1	1.0%	0.9	0.0	48	0	$2,184
white oak	*Quercus alba*	2	2.0%	12.2	0.1	257	0	$39,516
bur oak	*Quercus macrocarpa*	1	1.0%	0.0	0.0	2	0	$121
northern pin oak	*Quercus palustris*	1	1.0%	1	0.0	116	0	$7,293
American elm	*Ulmus americana*	2	2.0%	9.0	0.1	227	0	$19,003
Total		**98**	**100%**	**161**	**1.6**	**4,896**	**140**	**$390,068**

CONTROLLING STORMWATER

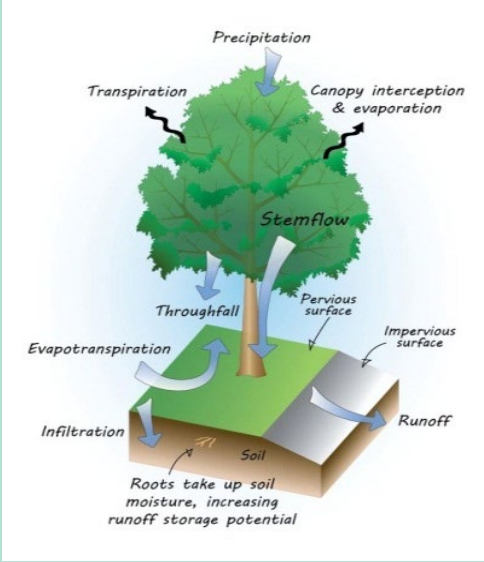
Trees intercept rainfall with their leaves and branches, helping lower stormwater management costs by avoiding runoff. The inventoried trees in Memorial Cemetery avoid 4,896 cubic feet of runoff annually. Avoided runoff accounts for 26% of the annual functional benefits provided by Memorial Cemetery's public tree resource.

Of all species inventoried, pecan contributed the most annual stormwater benefits. The pecan population (24.5% of inventoried trees) avoided 1,514 cubic feet of runoff. The second most abundant species in the inventoried tree population, eastern redcedar (*Juniperous virginiana*) (19.4%), avoided approximately 728 cubic feet of runoff. On a per-tree basis, large trees with leafy canopies provided the most functional benefits. Eastern redbud (*Cercis canadensis*) and black walnut (*Juglans nigra*) comprised 14.3% and 10.2% of the inventoried tree resource, respectively. Black walnut avoided 849 cubic feet of runoff, nearly six times as much as eastern redbud did, despite only having about two thirds of its population size. This illustrates how large-statured trees with wide canopies provide significantly greater benefits.

IMPROVING AIR QUALITY

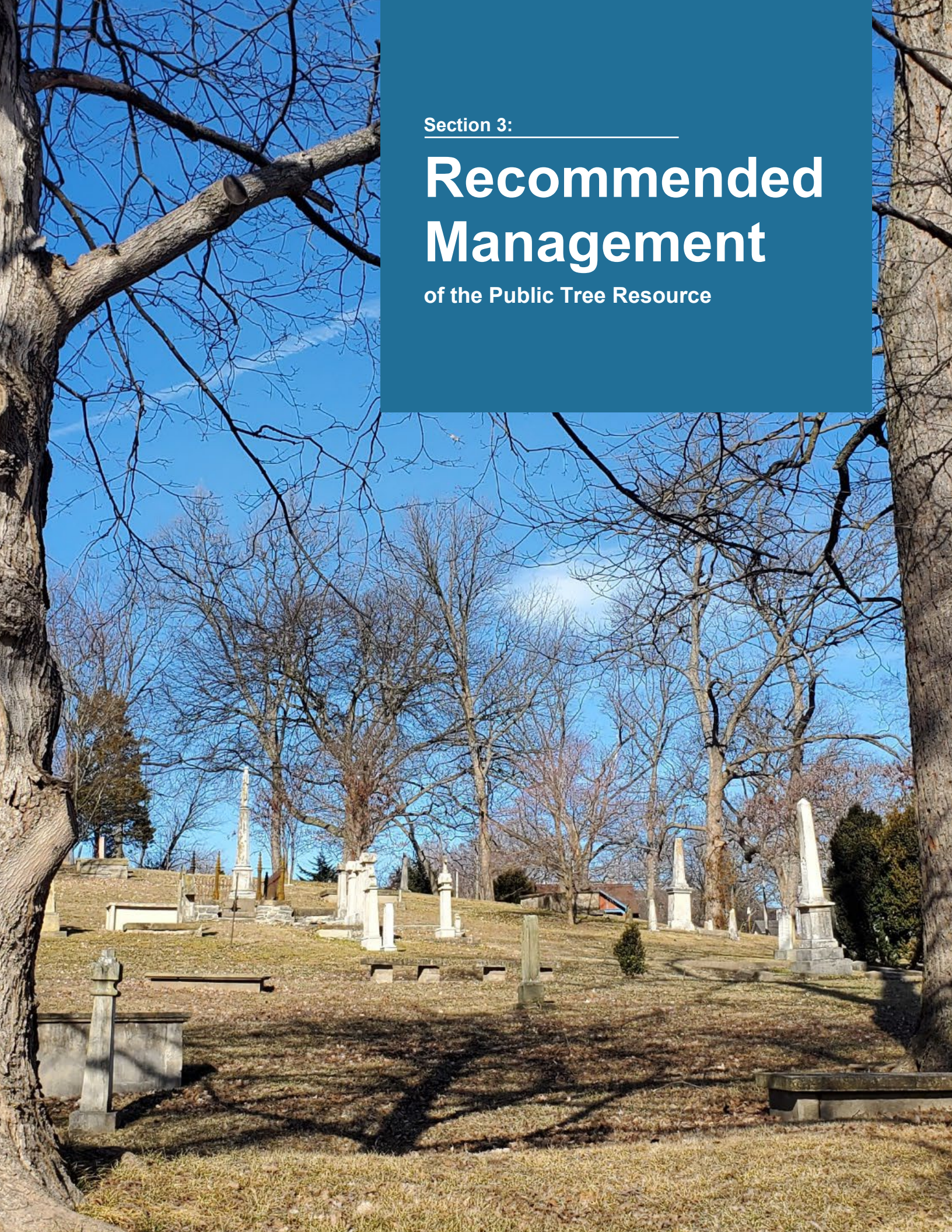
The inventoried tree population annually removes 140 lbs. of air pollutants, including sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter ($PM_{2.5}$). The i-Tree Eco model estimated the value of this benefit at $241, which is 19% of the value of all annual benefits.

CANOPY FUNCTIONS



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

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



Section 3:

Recommended Management

of the Public Tree Resource

SECTION 3: RECOMMENDED MANAGEMENT OF THE PUBLIC TREE RESOURCE

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

RISK MANAGEMENT AND RECOMMENDED MAINTENANCE

Although tree removal is usually considered a last resort, and may sometimes create a reaction from the community, there are circumstances in which removal is necessary. Trees fail from natural causes such as diseases, insects, and weather conditions, and from physical injury due to vehicles, vandalism, and root disturbances. DRG recommends that trees be removed when corrective pruning will not adequately mitigate risk or when correcting problems would be cost-prohibitive. DRG recommends that tree maintenance activities are prioritized and completed based on the risk rating that was assigned to each tree during the inventory. The following section describes recommended maintenance for each risk rating category.

Trees that cause obstructions or interfere with power lines or other infrastructure should be removed when their defects cannot be corrected through pruning or other maintenance practices. Diseased and nuisance trees also warrant removal. Even though large short-term expenditures may be required, it is important to secure the funding needed to complete priority tree removals. Expedient removal reduces risk and promotes public safety. Figures 11 and 12 present tree pruning and tree removals by risk rating and diameter size class. The following sections briefly summarize the recommended removals identified during the inventory.

EXTREME AND HIGH PRIORITY RECOMMENDED MAINTENANCE

Pruning or removing Extreme and High Risk trees is strongly recommended to be prioritized and completed as soon as possible. In general, maintenance activities should be completed first for the largest diameter trees (>25″) that pose the greatest risk. Once addressed, recommended tree maintenance activities should be completed for smaller diameter trees (<25″) that pose the greatest risk. Addressing Extreme and High Risk trees in a timely and proactive manner often requires significant resources to be secured and allocated. However, performing this work expediently will mitigate risk, improve public safety, and reduce long-term costs.

High Priority Pruning Recommendations

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

The inventory identified 1 High Risk trees and 20 Moderate Risk trees recommended for Pruning. The diameter for the tree with recommended high-priority pruning >43 inches DBH. The diameter size classes for Moderate Risk trees ranged between 19–24 inches DBH and >43 inches DBH. This maintenance should be performed immediately based on assigned risk rating and may be performed concurrently with the Moderate Risk removal.

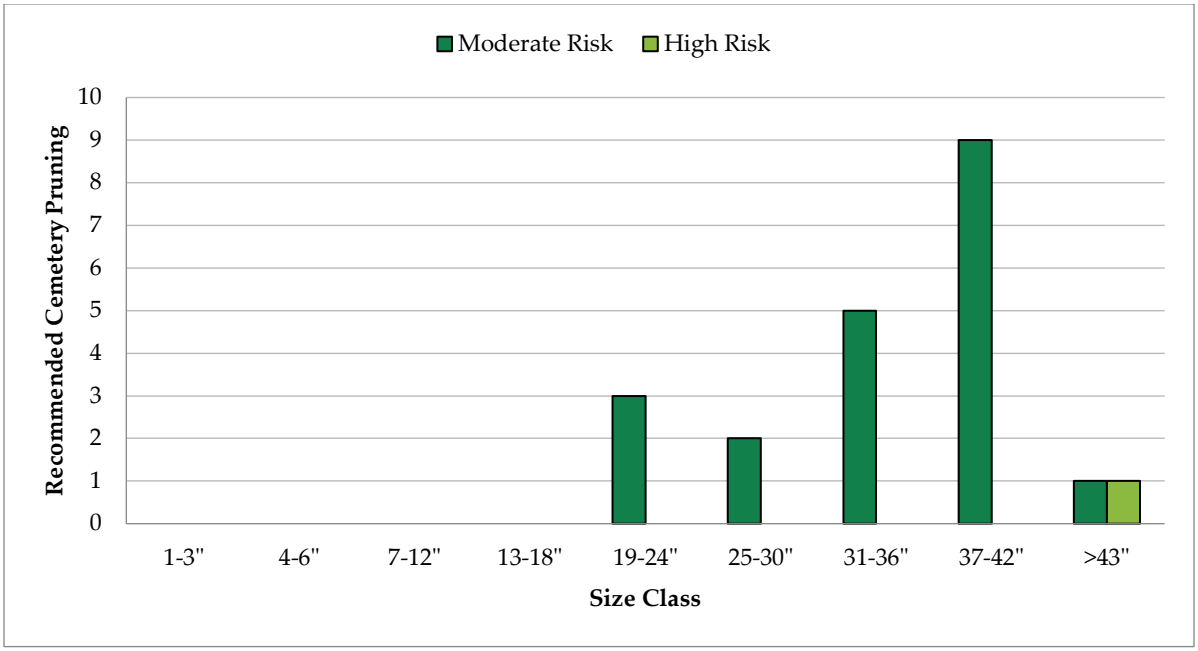


Figure 11. Recommended pruning by size class and risk rating.

High Priority Removal Recommendations

DRG identified only 1 Moderate Risk tree recommended for removal. The diameter size class for this Moderate Risk tree was between 25–30 inches DBH.

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

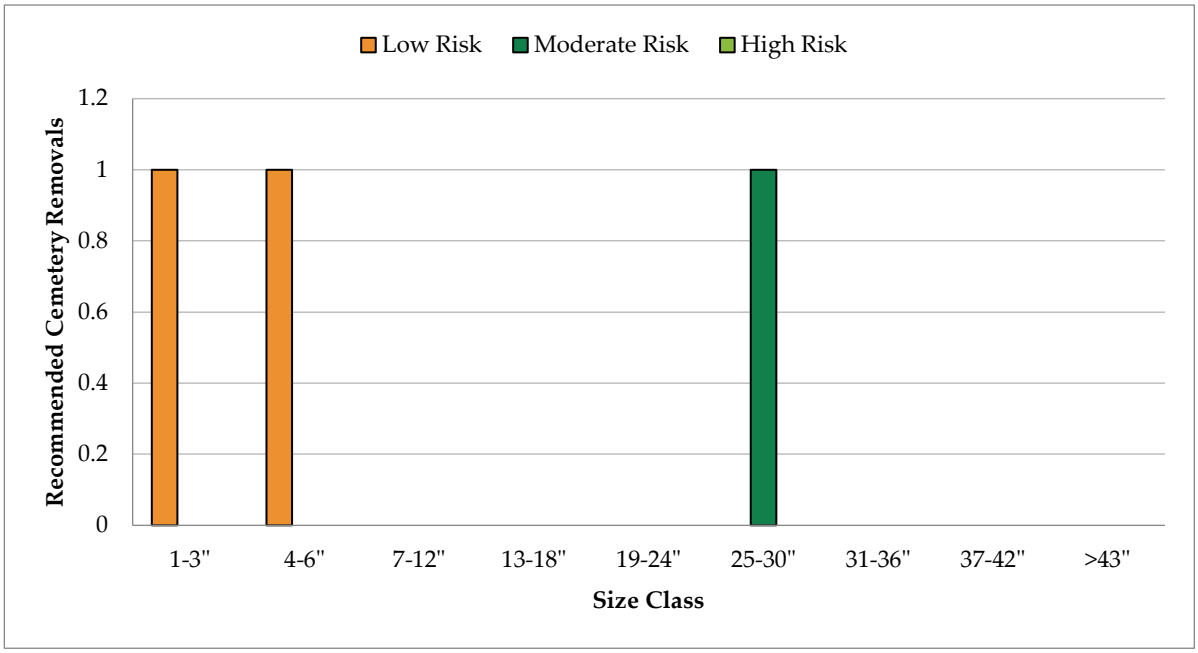


Figure 12. Recommended removals by size class and risk rating.

LOW PRIORITY RECOMMENDED MAINTENANCE

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

Low Priority Pruning Recommendations

There were 71 Low Risk trees recommended for pruning. Low Risk trees with the assigned maintenance of either "Prune", "Discretionary Prune", or "None". should be included in a proactive Routine Pruning cycle after all the higher risk trees are addressed.

Low Priority Removal Recommendations

DRG identified 2 Low Risk trees recommended for removal. Low Risk removals pose little threat; these trees are generally small, dead, invasive, or poorly formed trees that need to be removed. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. Healthy trees growing in poor locations or undesirable species are also included in this category. If pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed. All Low Risk trees should be removed when convenient after all higher risk pruning and removals have been completed and may be performed concurrently with routine pruning.

ROUTINE INSPECTIONS

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

Routine Inspection Recommendations

All trees should be regularly inspected and attended to as needed. When trees require additional or new work, they should be added to the maintenance schedule. The budget should also be updated to reflect the additional work. Utilize inventory data and make updates, edits, and keep a log of work records. In addition to locating trees with unidentified defects, inspections also present an opportunity to look for signs and symptoms of pests and diseases. Memorial Cemetery has a large population of trees that are susceptible to pests and diseases, including pecan and oak.

DRG recommends that Memorial Cemetery perform routine inspections of inventoried trees by windshield survey (this could be conducted with a quick level 1 inspection on foot) in line with *ANSI A300 (Part 9)* annually and after all severe weather events, to identify defects with heightened risk, signs of pest activity, and symptoms of disease. When trees need additional maintenance, they should be added to the work schedule immediately. Keep inventory data updated and schedule work records.

ROUTINE PRUNING CYCLE

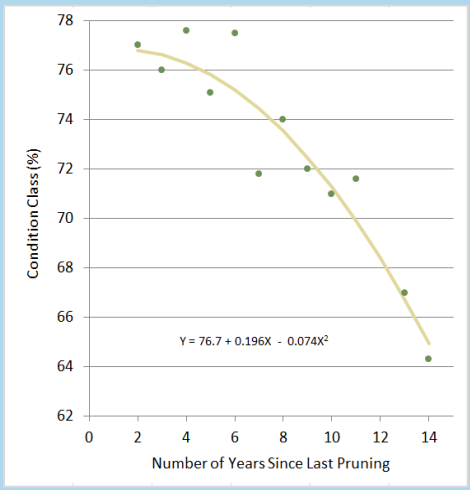
The Routine Pruning cycle includes all Low Risk trees that received a "Prune", "Discretionary Prune", or "None" maintenance recommendation. These trees pose some risk but have a smaller defect size and/or a lower probability of impacting a target. Over time, routine pruning can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

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

Routine Pruning Cycle Recommendations

Memorial Cemetery's inventory has 71 trees that should be routinely pruned, and DRG recommends that the cemetery establish a five-year Routine Pruning cycle with approximately 14 trees pruned each year. If this is not feasible for Memorial Cemetery, a six-year Routine Pruning cycle with approximately 12 trees pruned each year, or a seven-year Routine Pruning cycle with approximately 10 trees pruned each year, is acceptable considering the inventoried tree population's size. DRG recommends that the Routine Pruning cycle begins in Year One of the proposed five-year program, after all Extreme and High Risk Recommended Maintenance is complete.

PROACTIVE PRUNING



Relationship between tree condition and years since previous pruning.

(adapted from Miller and Sylvester 1981)

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

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

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

Approximately 73% of the inventoried tree population would benefit from routine pruning. Figure 13 shows that a variety of size classes recommended for pruning; however, most of the trees were smaller than 13″ DBH.

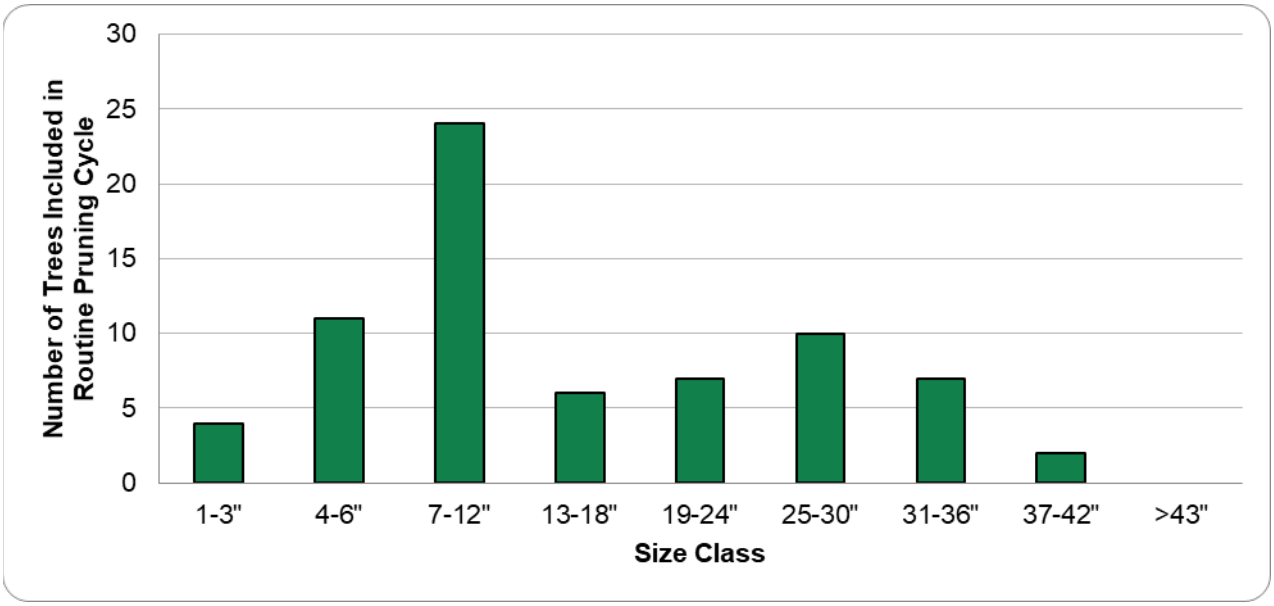


Figure 13. Number of Trees in Routine Pruning cycle by size class.

YOUNG TREE TRAINING CYCLE

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

The recommended length of a Young Tree Training cycle is three years because young trees tend to grow at faster rates than mature trees.

The Young Tree Training cycle differs from the Routine Pruning cycle in that the Young Tree Training cycle generally only includes trees that can be pruned from the ground with a pole pruner or pruning shear.

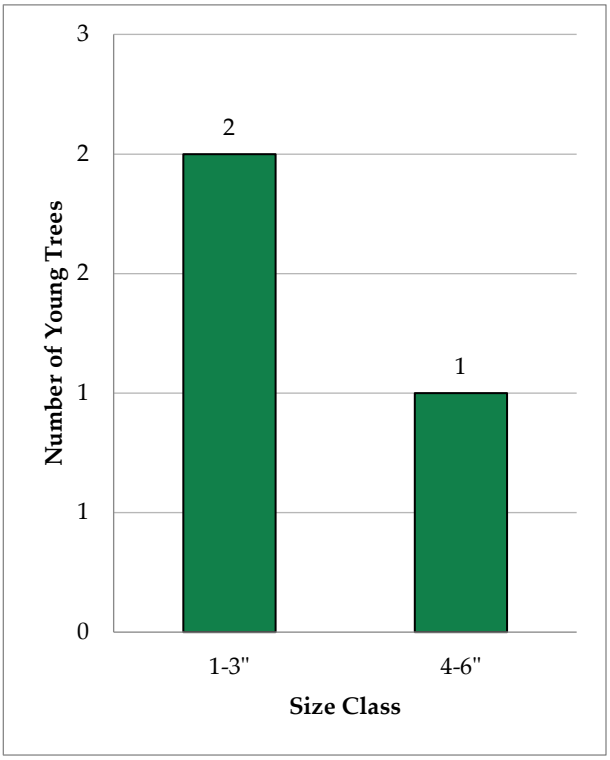


Figure 14. Three-year Young Tree Training cycle by size class.

Young Tree Training Cycle Recommendations

DRG recommends that Memorial Cemetery implement a three-year Young Tree Training cycle beginning after the completion of all Extreme and High Risk Recommended Maintenance activities. During the inventory, 3 trees less than or equal to 8 inches DBH were inventoried and recommended for young tree training. Since Memorial Cemetery has so few young trees, the Young Tree Training cycle is vital for the future condition of the inventoried tree population. DRG recommends that at least one tree be trained with structural pruning each year over three years, beginning in Year One of the management program.

When new trees are planted, they should enter the Young Tree Training cycle after establishment, typically within 2–3 years after planting. In future years, the number of trees in the Young Tree Training cycle will be based on tree planting efforts and growth rates of young trees. The Cemetery should strive to training prune approximately one-third of its young trees each year.

TREE PLANTING AND STUMP REMOVAL

Planting new trees in areas where there is sparse canopy already is the most important. It is also important to plant more trees in areas with poor canopy continuity or gaps in existing canopy. While the Memorial Cemetery as a whole receives value from the ecosystem services provided by the public tree resource, those benefits usually are not distributed evenly across the cemetery.

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

Tree Planting and Stump Removal Recommendations

Planting trees in cemeteries requires a thoughtful approach, considering both the aesthetic value and the practical needs of the space. You want to enhance the environment while respecting the solemn nature of the setting. Consider low maintenance varieties, or symbolic trees, to create a peaceful and respectful atmosphere. Plant trees near seating areas to create shaded spots where visitors can sit and reflect. Some ways to involve the community are to institute a Memorial tree program that offers the option for families to plant trees in memory of loved ones.

The inventory identified 3 stumps recommended for removal, with a wide range of sizes from 11" to 50" in diameter. Stump removals should occur when convenient and be included in regular planting plans if the site would be feasible for planting after the stump is removed. For this reason, it is most convenient to remove all stumps in areas with scheduled tree planting work, so all feasible sites in an area are stocked at once.

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

MAINTENANCE SCHEDULE AND BUDGET

Utilizing 2025 Memorial Cemetery tree inventory data, an annual maintenance schedule was developed detailing the recommended tasks to complete each year. DRG made budget projections using industry knowledge and public bid tabulations. A complete table of estimated costs for Memorial Cemetery's five-year tree management program follows.

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

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

- No less than $13,529 for the first year of implementation.
- No less than $6,578 for the second year.
- No less than $5,144 for each of the final three years of the maintenance schedule.

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

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

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Cost
High Priority Removals	1-3"	$28		$0		$0		$0		$0		$0	$0
	4-6"	$58		$0		$0		$0		$0		$0	$0
	7-12"	$138		$0		$0		$0		$0		$0	$0
	13-18"	$314		$0		$0		$0		$0		$0	$0
	19-24"	$605		$0		$0		$0		$0		$0	$0
	25-30"	$825	1	$825		$0		$0		$0		$0	$825
	31-36"	$1,045		$0		$0		$0		$0		$0	$0
	37-42"	$1,485		$0		$0		$0		$0		$0	$0
	>43"	$2,035		$0		$0		$0		$0		$0	$0
Activity Total(s)			**1**	**$825**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$825**
Low Priority Removals	1-3"	$28		$0	1	$28		$0		$0		$0	$28
	4-6"	$58		$0	1	$58		$0		$0		$0	$58
	7-12"	$138		$0		$0		$0		$0		$0	$0
	13-18"	$314		$0		$0		$0		$0		$0	$0
	19-24"	$605		$0		$0		$0		$0		$0	$0
	25-30"	$825		$0		$0		$0		$0		$0	$0
	31-36"	$1,045		$0		$0		$0		$0		$0	$0
	37-42"	$1,485		$0		$0		$0		$0		$0	$0
	>43"	$2,035		$0		$0		$0		$0		$0	$0
Activity Total(s)			**0**	**$0**	**2**	**$86**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$86**
Stump Removals	1-3"	$18		$0		$0		$0		$0		$0	$0
	4-6"	$28		$0		$0		$0		$0		$0	$0
	7-12"	$44		$0	1	$44		$0		$0		$0	$44
	13-18"	$72		$0		$0		$0		$0		$0	$0
	19-24"	$94		$0		$0		$0		$0		$0	$0
	25-30"	$110		$0		$0		$0		$0		$0	$0
	31-36"	$138		$0		$0		$0		$0		$0	$0
	37-42"	$160		$0		$0		$0		$0		$0	$0
	>43"	$182		$0	2	$364		$0		$0		$0	$364
Activity Total(s)			**0**	**$0**	**3**	**$408**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$408**
High Priority Pruning	1-3"	$20		$0		$0		$0		$0		$0	$0
	4-6"	$30		$0		$0		$0		$0		$0	$0
	7-12"	$75		$0		$0		$0		$0		$0	$0
	13-18"	$120		$0		$0		$0		$0		$0	$0
	19-24"	$170		$0		$0		$0		$0		$0	$0
	25-30"	$225		$0		$0		$0		$0		$0	$0
	31-36"	$305		$0		$0		$0		$0		$0	$0
	37-42"	$380		$0		$0		$0		$0		$0	$0
	>43"	$590	1	$590		$0		$0		$0		$0	$590
Activity Total(s)			**1**	**$590**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$590**
Moderate Priority Pruning	1-3"	$20		$0		$0		$0		$0		$0	$0
	4-6"	$30		$0		$0		$0		$0		$0	$0
	7-12"	$75		$0		$0		$0		$0		$0	$0
	13-18"	$120		$0		$0		$0		$0		$0	$0
	19-24"	$170	3	$510		$0		$0		$0		$0	$510
	25-30"	$225	2	$450		$0		$0		$0		$0	$450
	31-36"	$305	5	$1,525		$0		$0		$0		$0	$1,525
	37-42"	$380	9	$3,420		$0		$0		$0		$0	$3,420
	>43"	$590	1	$590		$0		$0		$0		$0	$590
Activity Total(s)			**20**	**$6,495**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$6,495**
Routine Inspection	Drive-by Assessment	$1	50	$50	50	$50	50	$50	50	$50	50	$50	$250
	Walk-by Assessment	$5	5	$25	5	$25	5	$25	5	$25	5	$25	$125
Activity Total(s)			**5**	**$25**	**5**	**$25**	**5**	**$25**	**5**	**$25**	**5**	**$25**	**$125**
Young Tree Training (3-year Cycle)	1-3"	$20		$0	1	$20	1	$20		$0	1	$20	$60
	4-6"	$30	1	$30		$0		$0	1	$30		$0	$60
	6"<	$40		$0		$0		$0		$0		$0	$0
Activity Total(s)			**1**	**$30**	**1**	**$20**	**1**	**$20**	**1**	**$30**	**1**	**$20**	**$120**
Routine Pruning (5-year Cycle)	1-3"	$20	1	$16	1	$16	1	$16	1	$16	1	$16	$80
	4-6"	$30	2	$66	2	$66	2	$66	2	$66	2	$66	$330
	7-12"	$75	5	$360	5	$360	5	$360	5	$360	5	$360	$1,800
	13-18"	$120	1	$144	1	$144	1	$144	1	$144	1	$144	$720
	19-24"	$170	1	$238	1	$238	1	$238	1	$238	1	$238	$1,190
	25-30"	$225	2	$450	2	$450	2	$450	2	$450	2	$450	$2,250
	31-36"	$305	1	$427	1	$427	1	$427	1	$427	1	$427	$2,135
	37-42"	$380	0	$152	0	$152	0	$152	0	$152	0	$152	$760
	>43"	$590	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**14**	**$1,853**	**14**	**$1,853**	**14**	**$1,853**	**14**	**$1,853**	**14**	**$1,853**	**$9,265**
Replacement Tree Planting and Maintenance	Purchasing	$250	1	$250	2	$500		$0		$0		$0	$750
	Planting & Watering	$200	1	$200	2	$400		$0		$0		$0	$600
	Mulching	$25	1	$25	2	$50		$0		$0		$0	$75
Activity Total(s)			**3**	**$475**	**6**	**$950**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$1,425**

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Cost
New Tree Planting and Maintenance	Purchasing	$250	5	$1,250	5	$1,250	5	$1,250	5	$1,250	5	$1,250	$6,250
	Planting & Watering	$200	5	$1,000	5	$1,000	5	$1,000	5	$1,000	5	$1,000	$5,000
	Mulching	$25	5	$125	5	$125	5	$125	5	$125	5	$125	$625
Activity Total(s)			**15**	**$2,375**	**15**	**$2,375**	**15**	**$2,375**	**15**	**$2,375**	**15**	**$2,375**	**$11,875**
Natural Mortality (1%)	Tree Removal	$314	1	$314	1	$314	1	$314	1	$314	1	$314	$1,570
	Stump Removal	$72	1	$72	1	$72	1	$72	1	$72	1	$72	$360
	Replacement Tree	$475	1	$475	1	$475	1	$475	1	$475	1	$475	$2,375
Activity Total(s)			**3**	**$861**	**3**	**$861**	**3**	**$861**	**3**	**$861**	**3**	**$861**	**$4,305**
Activity Grand Total			**63**		**49**		**38**		**38**		**38**		**227**
Cost Grand Total				**$13,529**		**$6,578**		**$5,134**		**$5,144**		**$5,134**	**$35,519**

CONCLUSION

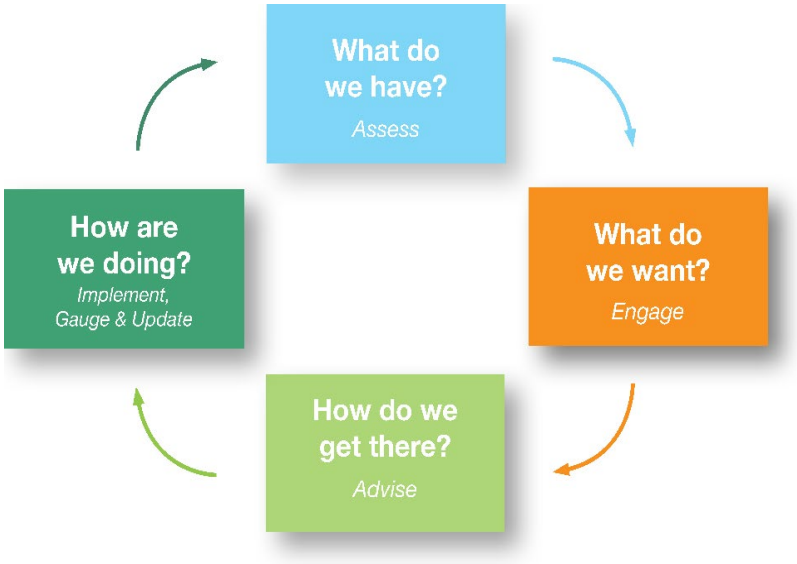
When properly maintained, the valuable benefits trees provide over their lifetime far exceed the time and money invested in planting, pruning, and inevitably removing them. The 98 cemetery trees inventoried have an estimated replacement value of $390,068. Successfully implementing the five-year program may increase Memorial Cemetery's annual economic value, or at least maintain it over the years.

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

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

EVALUATING AND UPDATING THIS PLAN

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



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

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APPENDIX A
DATA COLLECTION AND SITE LOCATION METHODS

DATA COLLECTION METHODS

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

- Address
- Comments
- Condition
- Date of Inventory
- Maintenance Recommendation
- Multi-stem Tree
- Notes
- Relative Location
- Size*
- Species and Identification Confidence Level
- Utility Interference
- X and Y Coordinates

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

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

SITE LOCATION METHODS

Equipment and Base Maps

Inventory arborists use FZ-G1 Panasonic Toughpad® units with internal GPS receivers. Geographic information system (GIS) map layers are loaded onto these units to help locate sites during the inventory. This table lists these base map layers, along with each layer's source and format information.

Data Source	Data Year	Projection
Shapefile Davey Resource Group, Inc. Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community	2023 - Current	AD 1983 StatePlane Missouri East FIPS 2401;Feet
Aerial Imagery Maxar imagery at 0.3m resolution	2024	NAD 1983 StatePlane Missouri East FIPS 2401;Feet

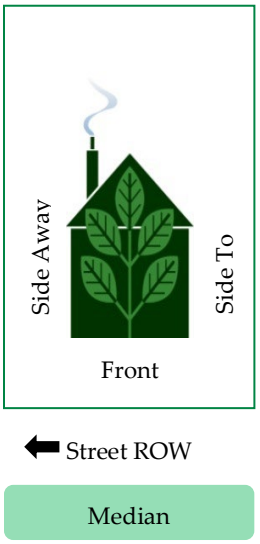
STREET ROW SITE LOCATION

Below shows our standard site location methodology. As this inventory was confined to Memorial Cemetery, no addressing information was collected. The only location information that was collected are GPS coordinates.

Address Number and Street Name

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

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



Side Value

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

PARK AND PUBLIC SPACE SITE LOCATION

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

Site Location Example

Corner Lot A

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

Corner Lot B

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

APPENDIX B
INVASIVE PESTS AND DISEASES

In today's worldwide marketplace, the volume of international trade brings increased potential for pests and diseases to invade our country. Many of these pests and diseases have seriously harmed rural and urban landscapes and have caused billions of dollars in lost revenue and millions of dollars in cleanup costs. Keeping these pests and diseases out of the country is the number one priority of the USDA's Animal and Plant Inspection Service (APHIS).

Updated pest range maps can be found at: https://www.nrs.fs.fed.us/tools/afpe/maps/ and updated pest information can be found at: https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/Pest-Tracker

Although some invasive species naturally enter the United States via wind, ocean currents, and other means, most invasive species enter the country with some help from human activities. Their introduction to the US is a byproduct of cultivation, commerce, tourism, and travel. Many species enter the US each year in baggage, cargo, contaminants of commodities, or mail.

Once they arrive, invasive pests grow and spread rapidly because controls, such as native predators, are lacking. Invasive pests disrupt the landscape by pushing out native species, reducing biological diversity, killing trees, altering wildfire intensity and frequency, and damaging crops. Some pests may even push species to extinction. The following sections include key pests and diseases that adversely affect trees in America at the time of this plan's development. This list is not comprehensive and may not include all threats.

It is critical to the management of community trees to routinely check APHIS, USDA Forest Service, and other websites for updates about invasive species and diseases in your area and in our country so that you can be prepared to combat their attack.

APHIS, Plant Health, Plant Pest Program Information
• www.aphis.usda.gov/plant_health/plant_pest_info

The University of Georgia, Center for Invasive Species and Ecosystem Health
• www.bugwood.org

USDA National Agricultural Library
• www.invasivespeciesinfo.gov/microbes

USDA Northeastern Areas Forest Service, Forest Health Protection
• www.na.fs.fed.us/fhp

SPOTTED LANTERNFLY

The spotted lanternfly (SLF, *Lycorma delicatula*) is native to China and was first detected in Pennsylvania in September 2014. SLF feeds on a wide range of fruit, ornamental, and woody trees, with tree-of-heaven being one of its preferred hosts. SLF is a hitchhiker and can be spread long distances by people who move infested material or items containing egg masses.

If allowed to spread in the US, this pest could seriously impact the country's grape, orchard, and logging industries. Be sure to inspect for the pest. Egg masses, juveniles, and adults can be on trees and plants, as well as on bricks, stone, metal, and other smooth surfaces. Also thoroughly check vehicles, trailers, and even the clothes you are wearing to prevent accidentally moving SLF.

Symptoms of SLF are plants oozing or weeping with a fermented odor, buildup of a sticky fluid called honeydew on the plant or on the ground underneath them, and sooty mold growing on plants. The following trees are susceptible to SLF: almond, apple, apricot, cherry, maple, nectarine, oak, peach, pine, plum, poplar, sycamore, walnut, and willow, as well as grape vines and hop plants.

Pinned spotted lanternfly.

Photograph courtesy of PA Dept of Agriculture

Pinned spotted lanternfly nymph with wingspan open.

Photograph courtesy of USDA APHIS

EASTERN TENT CATERPILLAR

Eastern tent caterpillar (*Malacosoma americanum*) was first observed in the US in 1646. In spring, caterpillars make nests in the forks and crotches of tree branches. Caterpillars do not feed within the nest; they leave the nest to feed up to 3 feet from nest and return to rest and take shelter in wet weather. Large infestations may occur at 8- to 10-year intervals. Egg masses overwinter on twigs. Trees are rarely killed by eastern tent caterpillar, but health is compromised that year and aesthetic value is decreased.

Easter tent caterpillar have a wide range of hosts, including apple (*Malus*) and cherry (*Prunus*).

Eastern tent caterpillar nest.

Photograph courtesy of Prairie Haven (2008)

ASIAN LONGHORNED BEETLE

The Asian longhorned beetle (ALB, *Anoplophora glabripennis*) is an exotic pest that threatens a wide variety of hardwood trees in North America. The beetle was introduced in Chicago, New Jersey, and New York City, and is believed to have been introduced in the United States from wood pallets and other wood-packing material accompanying cargo shipments from Asia. ALB is a serious threat to America's hardwood tree species.

Adult Asian longhorned beetle.

Photograph courtesy of New Bedford Guide (2011)

Adults are large (3/4- to 1/2-inch long) with very long, black and white banded antennae. The body is glossy black with irregular white spots. Adults can be seen from late spring to fall depending on the climate. ALB has a long list of host species; however, the beetle prefers hardwoods, including several maple species. Examples include: box elder (*Acer negundo*); Norway maple (*A. platanoides*); red maple (*A. rubrum*); silver maple (*A. saccharinum*); sugar maple (*A. saccharum*); buckeye (*Aesculus glabra*); horsechestnut (*A. hippocastanum*); birch (*Betula*); London planetree (*Platanus* × *acerifolia*); willow (*Salix*); and elm (*Ulmus*).

EUROPEAN GYPSY MOTH

The gypsy moth (GM, *Lymantria dispar*) is native to Europe and first arrived in the US in Massachusetts in 1869. This moth is a significant pest because its caterpillars have an appetite for more than 300 species of trees and shrubs. GM caterpillars defoliate trees, which makes the species vulnerable to diseases and other pests that can eventually kill the tree.

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

The GMs prefer approximately 150 primary hosts but feed on more than 300 species of trees and shrubs. Some trees are found in these common genera: birch (*Betula*); cedar (*Juniperus*); larch (*Larix*); aspen, cottonwood, poplar (*Populus*); oak (*Quercus)*; and willow (*Salix*).

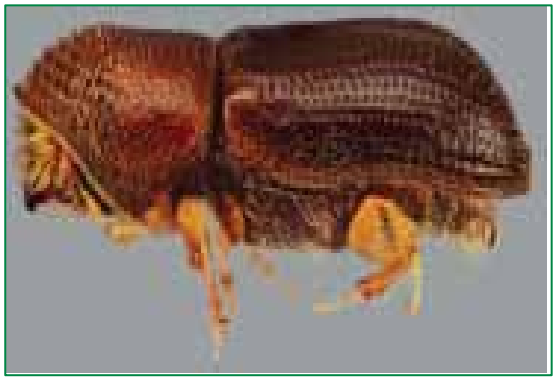
Close-up of male (darker brown) and female (whitish color) European gypsy moths.

Photograph courtesy of USDA APHIS (2019)

THOUSAND CANKERS DISEASE

A complex disease referred to as Thousand cankers disease (TCD) was first observed in Colorado in 2008 and is now thought to have existed in Colorado as early as 2003. TCD is considered to be native to the United States and is attributed to numerous cankers developing in association with insect galleries.

TCD results from the combined activity of the *Geosmithia morbida* fungus and the walnut twig beetle (WTB, *Pityophthorus juglandis*). The WTB has expanded both its geographical and host range over the past two decades, and coupled with the *Geosmithia morbida* fungus, walnut (*Juglans*) mortality has manifested in Arizona, California, Colorado, Idaho, New Mexico, Oregon, Utah, and Washington. In July 2010, TCD was reported in Knoxville, Tennessee. The infestation is believed to be at least 10 years old and was previously attributed to drought stress. This is the first report east of the 100th meridian, raising concerns that large native populations of black walnut (*J. nigra*) in the eastern United States may suffer severe decline and mortality.



Walnut twig beetle, side view.

Photograph courtesy of USDA Forest Service (2011)

The tree species preferred as hosts for TCD are walnut.

OAK WILT

Oak wilt was first identified in 1944 and is caused by the fungus *Ceratocystis fagacearum*. While considered an invasive and aggressive disease, its status as an exotic pest is debated since the fungus has not been reported in any other part of the world. This disease affects the oak genus and is most devastating to those in the red oak subgenus, such as scarlet oak (*Quercus coccinea*), shingle oak (*Q. imbricaria*), pin oak (*Q. palustris),* willow oak (*Q. phellos*), and red oak (*Q. rubra*). It also attacks trees in the white oak subgenus, although it is not as prevalent and spreads at a much slower pace in these trees.

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of USDA Forest Service (2011a)

Just as with DED, oak wilt disease is caused by a fungus that clogs the vascular system of oak and results in decline and death of the tree. The fungus is carried from tree to tree by several borers common to oak, but the disease is more commonly spread through root grafts. Oak species within the same subgenus (red or white) will form root colonies with grafted roots that allow the disease to move readily from one tree to another.

HEMLOCK WOOLY ADELGID

The hemlock woolly adelgid (HWA, *Adelges tsugae*) was first described in western North America in 1924 and first reported in the eastern United States in 1951 near Richmond, Virginia.

In their native range, populations of HWA cause little damage to the hemlock trees, as they feed on natural enemies and possible tree resistance has evolved with this insect. In eastern North America and in the absence of natural control elements, HWA attacks both eastern or Canadian hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*), often damaging and killing them within a few years of becoming infested.

The HWA is now established from northeastern Georgia to southeastern Maine and as far west as eastern Kentucky and Tennessee.

Hemlock woolly adelgids on a branch.

Photograph courtesy of Connecticut Agricultural Experiment Station, Bugwood.org (2011)

EMERALD ASH BORER

Emerald ash borer *(EAB) (Agrilus planipennis*) is responsible for the death or decline of tens of millions of ash trees in 14 states in the American Midwest and Northeast. Native to Asia, EAB has been found in China, Japan, Korea, Mongolia, eastern Russia, and Taiwan. It likely arrived in the United States hidden in wood-packing materials commonly used to ship consumer goods, auto parts, and other products. The first official US identification of EAB was in southeastern Michigan in 2002.

Adult beetles are slender and 1/2-inch long. Males are smaller than females. Color varies but adults are usually bronze or golden green overall with metallic, emerald-green wing covers. The top of the abdomen under the wings is metallic, purplish-red and can be seen when the wings are spread.

The EAB-preferred host tree species are in the genus *Fraxinus* (ash).

Close-up of an emerald ash borer.

Photograph courtesy of USDA APHIS (2020)

LECANIUM SCALE

Lecanium scale *(*LS, *Parthenolecanium spp.)* feeds on plant sap by piercing the plant tissue with its specialized mouthparts. This feeding weakens the plant, causing yellowing, premature leaf drop, and stunted growth. If left untreated, heavy infestations can weaken the plant severely, making it more susceptible to other stresses like disease.

Lecanium scale insects are generally round or oval, often brown or reddish-brown. They are covered by a hard, waxy shell that helps protect them from environmental stressors and natural predators. The adult female Lecanium scale attaches to the surface of the plant, where it feeds and lays eggs beneath its protective shell. The eggs hatch into mobile nymphs, known as "crawlers," which spread to other parts of the plant.

This redbud has been infested by European fruit lecanium. Lecanium scales are a soft scale species with globular, brown bodies

Photo by Jim Kalisch, University of Nebraska-Lincoln

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APPENDIX C
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 Interception	$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).

APPENDIX D
SUGGESTED TREE SPECIES FOR USDA HARDINESS ZONE 7

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

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer x freemanii	Freeman maple	
Acer rubrum	red maple	(Numerous exist)
*Aesculus flava**	yellow buckeye	
*Betula lenta**	sweet birch	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Carya illinoensis**	pecan	
*Carya lacinata**	shellbark hickory	
*Carya ovata**	shagbark hickory	
*Castanea mollissima**	Chinese chestnut	
Catalpa speciosa	northern catalpa	
Celtis laevigata	sugar hackberry	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
*Diospyros virginiana**	common persimmon	
*Fagus grandifolia**	American beech	
*Fagus sylvatica**	European beech	(Numerous exist)
Ginkgo biloba	ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans nigra**	black walnut	
*Juglans cinerea**	butternut	
Liquidambar styraciflua	American sweetgum	'Rotundiloba'
*Liriodendron tulipifera**	tuliptree	'Fastigiatum'
*Magnolia acuminata**	cucumbertree magnolia	(Numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
*Platanus occidentalis**	American sycamore	
Platanus × acerifolia	London planetree	'Yarwood'
Quercus alba	white oak	
Quercus coccinea	scarlet oak	

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

Scientific Name	Common Name	Cultivar
Quercus lobata	valley oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	
Quercus muehlenbergii	chinkapin oak	
Quercus palustris	pin oak	
Quercus robur	English oak	Heritage®, Fastigiata
Quercus rubra	northern red oak	
Quercus shumardii	Shumard oak	
Quercus virginiana	live oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
Tilia × euchlora	Crimean linden	
Tilia tomentosa	silver linden	'Sterling'
Ulmus X	Hybrid elm	'Pioneer', 'Princeton'
Ulmus parvifolia	Chinese elm	Allée®
Zelkova serrata	Japanese zelkova	'Green Vase'

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
Alnus cordata	Italian alder	
*Asimina triloba**	pawpaw	
Cladrastis kentukea	American yellowwood	'Rosea'
Corylus colurna	Turkish filbert	
Eucommia ulmoides	hardy rubber tree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Pistacia chinensis	Chinese pistachio	
Populus tremuloides	quaking aspen	
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	
Quercus cerris	European turkey oak	
*Salix babylonica**	weeping willow	
*Sassafras albidum**	sassafras	

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer palmatum	Japanese maple	(Numerous exist)
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(Numerous exist)
Amelanchier laevis	Allegheny serviceberry	
Asimina triloba	pawpaw	
*Carpinus caroliniana**	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Cornus alternifolia	pagoda dogwood	
Cornus florida	flowering dogwood	(Numerous exist)
Cornus kousa	Kousa dogwood	(Numerous exist)
*Cornus mas**	corneliancherry dogwood	'Spring Sun'
*Corylus avellane**	European filbert	'Contorta'
*Cotinus coggygria**	common smoketree	'Flame'
*Cotinus obovata**	American smoketree	
*Crataegus phaenopyrum**	Washington hawthorn	Princeton Sentry™
Crataegus viridis	green hawthorn	'Winter King'
*Franklinia alatamaha**	Franklinia	
*Halesia tetraptera**	Carolina silverbell	'Arnold Pink'
Laburnum × watereri	goldenchain tree	
Lagerstroemia spp.	crapemyrtle	(Numerous exist)
Maackia amurensis	amur maackia	
*Magnolia × soulangiana**	saucer magnolia	'Alexandrina'
*Magnolia stellata**	star magnolia	'Centennial'
*Magnolia tripetala**	umbrella magnolia	
*Magnolia virginiana**	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(Disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	'Pendula'
Prunus virginiana	common chokecherry	'Schubert'
*Salix caprea**	pussywillow	
*Staphylea trifolia**	American bladdernut	
Stewartia ovata	mountain stewartia	
*Styrax japonicus**	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

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

Coniferous and Evergreen Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Abies balsamea	balsam fir	
Abies concolor	white fir	'Violacea'
Cedrus deodara	deodar cedar	
Cedrus libani	cedar-of-Lebanon	
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
× *Cupressocyparis leylandii*	Leyland cypress	
Cupressus arizonica	Arizona cypress	
Ilex opaca	American holly	
Picea abies	Norway spruce	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Picea punges	Colorado blue spruce	
Pinus contorta	lodgepole pine	
Pinus densiflora	Japanese red pine	
Pinus nigra	Austrian pine	
*Pinus ponderosa**	ponderosa pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Pinus taeda	loblolly pine	
Pinus virginiana	Virginia pine	
Pseudotsuga menziesii	Douglas-fir	
Thuja occidentalis	American arborvitae	(Numerous exist)
Thuja plicata	western arborvitae	(Numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

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

Small Trees: 15 to 30 Feet in Height at Maturity

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

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

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