DAVEY
Resource Group

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TREE INVENTORY SUMMARY REPORT

Sidney, Ohio

Prepared for:

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ACKNOWLEDGMENTS

This project supports Sidney's vision to promote and enhance community well-being through improved urban forestry management practices. This *Tree Inventory Action Plan* offers expertise in preserving and expanding urban canopy so the environmental, economic, and social benefits it provides continue for generations. This project was funded through an Inflation Reduction Act awarded by the United States Department of Agriculture Forest Service.

The City of Sidney would like to recognize the support of:

USDA Forest Service

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City of Sidney Mayor Mike Barhorst

Sidney City Council

The Sidney Tree Board

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TREE INVENTORY SUMMARY REPORT EXECUTIVE SUMMARY

The City of Sidney *Tree Inventory Summary Report*, written by Davey Resource Group, Inc. (DRG), focuses on summarizing the results of a tree inventory completed for Sidney in September 2024 by DRG and assessing the results of the Level 1 Risk Assessments conducted on 50 trees. DRG summarized the data and analyzed the inventory data to understand the structure of the City's inventoried tree resource and associated risk. DRG recommended a prioritized management program for future tree care for trees that had risk assessed as well as made management recommendations based on species and age composition of the urban forest.

The 2024 inventory included 3,549 trees in Sidney's rights-of-way and public parks. Species diversity was generally good, with 106 unique species inventoried. Supporting and funding proactive maintenance of the public tree resource is a sound long-term investment that will reduce tree management costs over time and help to promote the environmental, economic, and aesthetic benefits of a robust urban forest for the residents and visitors in Sidney.

INTRODUCTION

Sidney is a small municipality in Shelby County, Ohio, on the western edge of the state. Shelby County is part of the greater Ohio River watershed. Land use in the county is primarily agricultural. Sidney has 20,421 residents as of the 2020 census and covers an area of 12.10 square miles.

In early 2024, Sidney applied for and was awarded an Inflation Reduction Act grant through the USDA Forest Service awarded via the Ohio Department of Natural Resources to expand urban forest management activities within city limits. These activities included the 2024 tree inventory and risk assessment.

Improving urban forestry management with a strategy that encompasses planting, establishment maintenance, proactive pruning, and other plant health care management activities, as well as strong data management, is crucial to maintaining a healthy and resilient urban forest. With a multi-faceted approach, Sidney can continue to improve municipal urban forestry management, grow canopy cover, and maximize urban forestry benefits for city residents and visitors.

RECOMMENDED APPROACH TO TREE MANAGEMENT

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

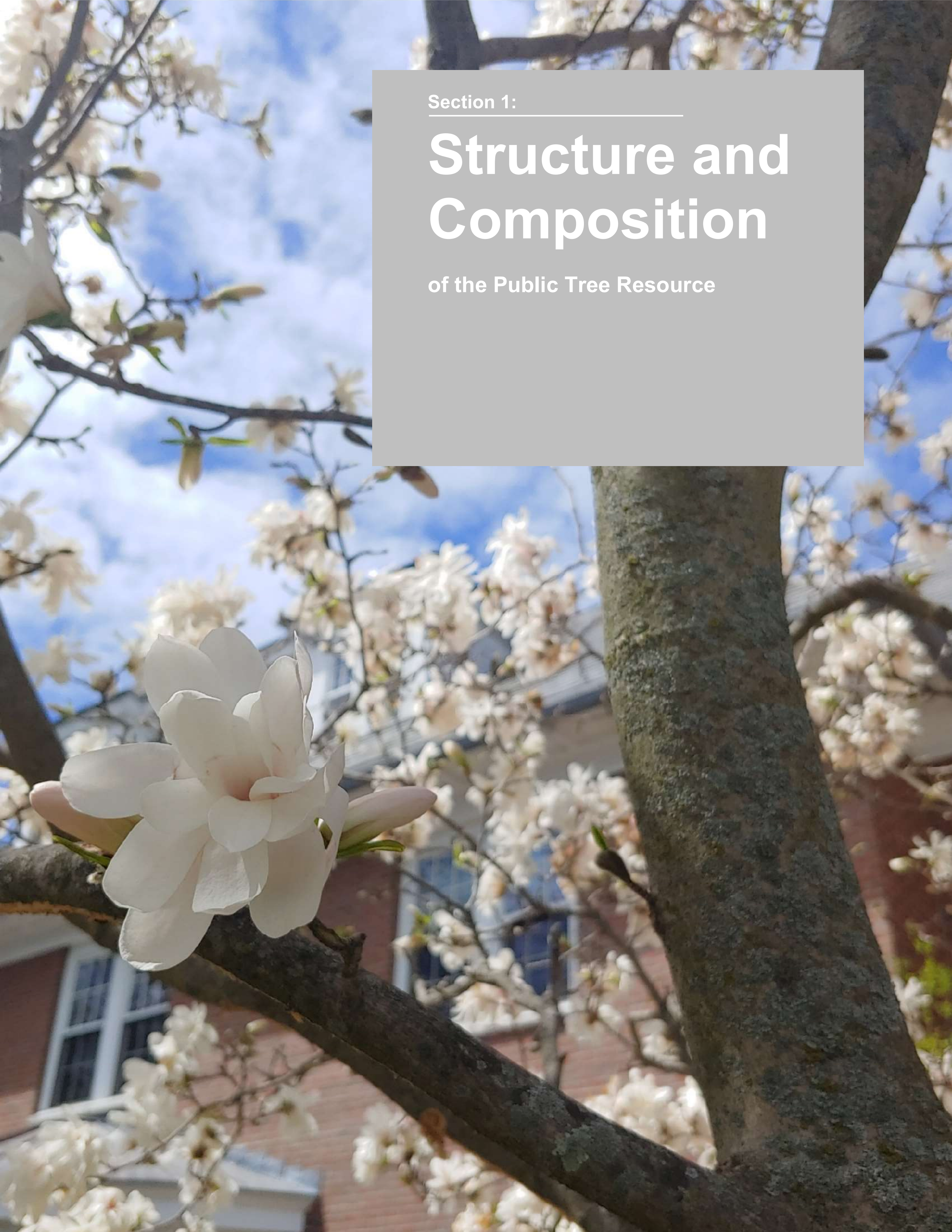
In September 2024, Sidney worked with DRG to inventory city trees, including both street and park trees, conduct Level 1 Risk Assessments on trees with significant hazards, and summarize findings in this *Tree Inventory Summary Report*. Consisting of three sections, this plan considers the diversity, distribution, and condition of the inventoried tree population and provides a prioritized system for managing the City'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: Recommended Management of the Public Tree Resource* details a prioritized management program and provides an estimated budget for recommended maintenance activities.
- *Section 3: Quality Control Summary of the Data Collection Process* details the methodology and steps taken to ensure data quality and perform quality assurance in the field and provides a summary of how trees were reviewed.

Section 1:

Structure and Composition

of the Public Tree Resource



SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In September 2024, DRG arborists collected site data on trees in city-maintained rights-of-way and parks for a tree inventory contracted by City of Sidney. In total 3,549 sites were inventoried. A Level 1 Risk Assessment was completed on trees with significant hazards; throughout the inventory, 50 trees were assessed for risk. Figure 1 breaks down the total sites inventoried by type and location, and Figure 2 shows the breakdown between trees surveyed and trees assessed for risk. See Appendix A for details about DRG's methodology for collecting site data.

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

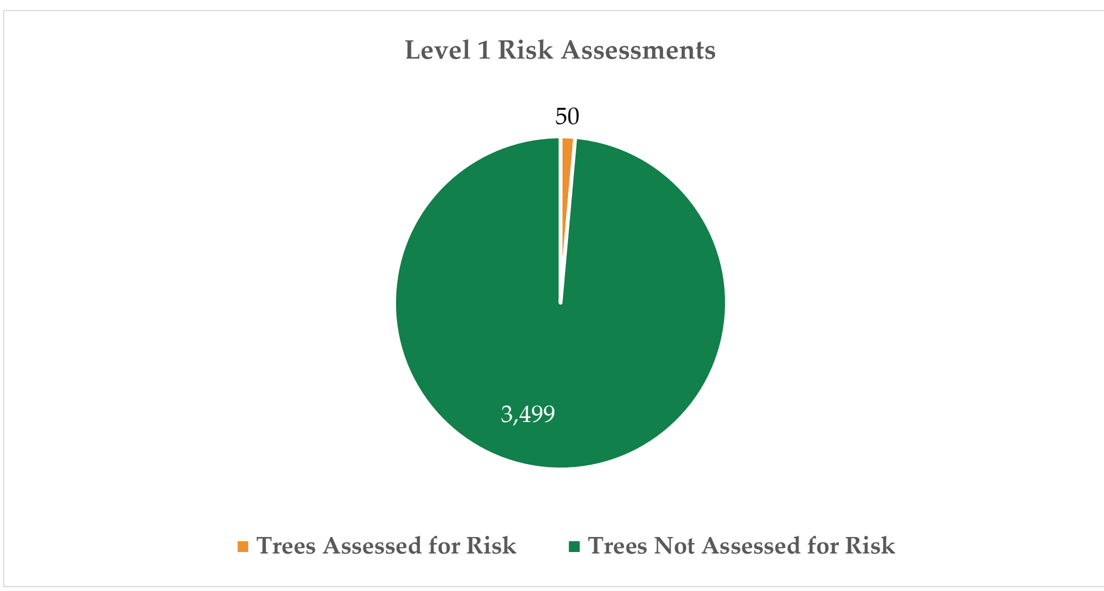


Figure 2. Number of trees assessed for risk out of the total number of trees inventoried.

SPECIES, GENUS, AND FAMILY DISTRIBUTION

The 10-20-30 rule is a common standard for tree population distribution, in which a single species should compose no more than 10% of the tree population, a single genus no more than 20%, and a single family no more than 30% (Santamour 1990). This rule was developed partially in response to tragedies such as the demise of vast swaths of American elm (*Ulmus americana*) after the introduction of Dutch elm disease to the United States (see side panel, "Resilience Through Diversity"). It provides a valuable guideline to help protect urban forests from both pests and diseases, as well as from the effects of extreme weather events and climate change.

Figure 3 shows the distribution of the most abundant tree species inventoried in Sidney compared to the 10% species threshold. Overall, one species makes up 11% of the inventoried tree population. Sugar maple (*Acer saccharum*) was the most abundant species overall at 11% of the total inventoried tree population. The next most populous species is crabapple (*Malus sylvestris*) which makes up 10% of the total inventoried tree resource.

One single species exceeds the threshold and the second-most populous is right at the ideal threshold of 10%. Future plantings should prioritize species that are underrepresented in Sidney's urban forest to promote resiliency in the urban canopy. See Appendix B for recommended tree species.

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 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 country. 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 species and genera to develop resilient urban forests.

Ash trees in an urban forest killed by emerald ash borer.
USDA Forest Service (2017)

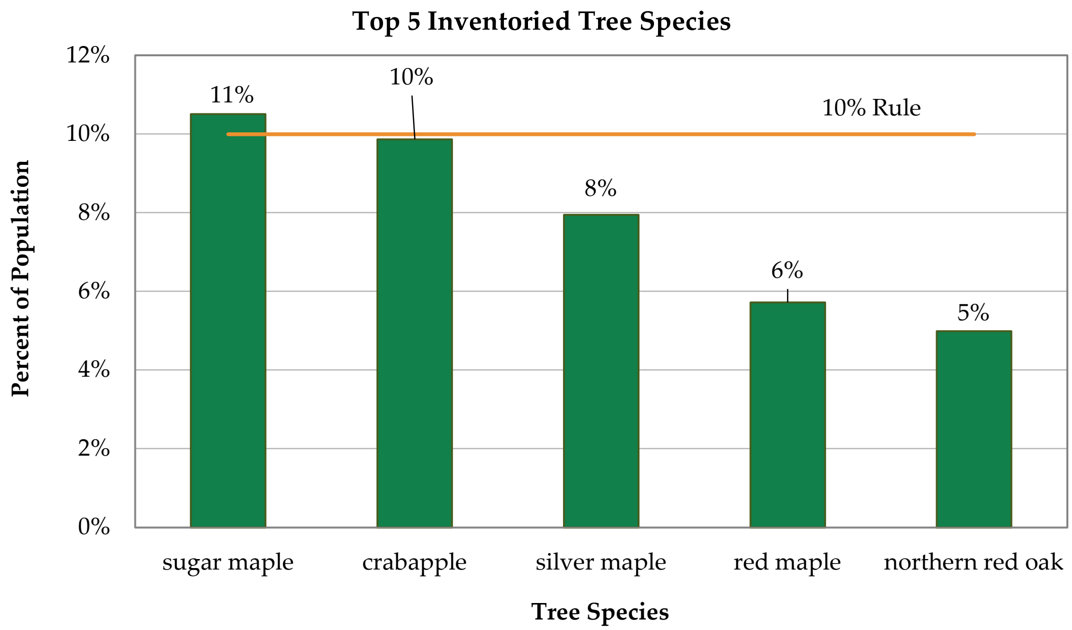


Figure 3. Species distribution of the inventoried tree population in Sidney.

Figure 4 shows Sidney's distribution of the most abundant tree genera inventoried. In total, 55 distinct genera were recorded during the inventory. Maple (*Acer*) is the most abundant genus out of the entire inventoried tree population at 32% of the population. The overrepresentation of maple in Sidney's urban forest can create a pest management challenge as insect pests such as spotted lanternfly and Asian longhorn beetle threaten urban maple trees. Future tree planting projects should select species from a wide array of genera to build resilience in the urban tree canopy.

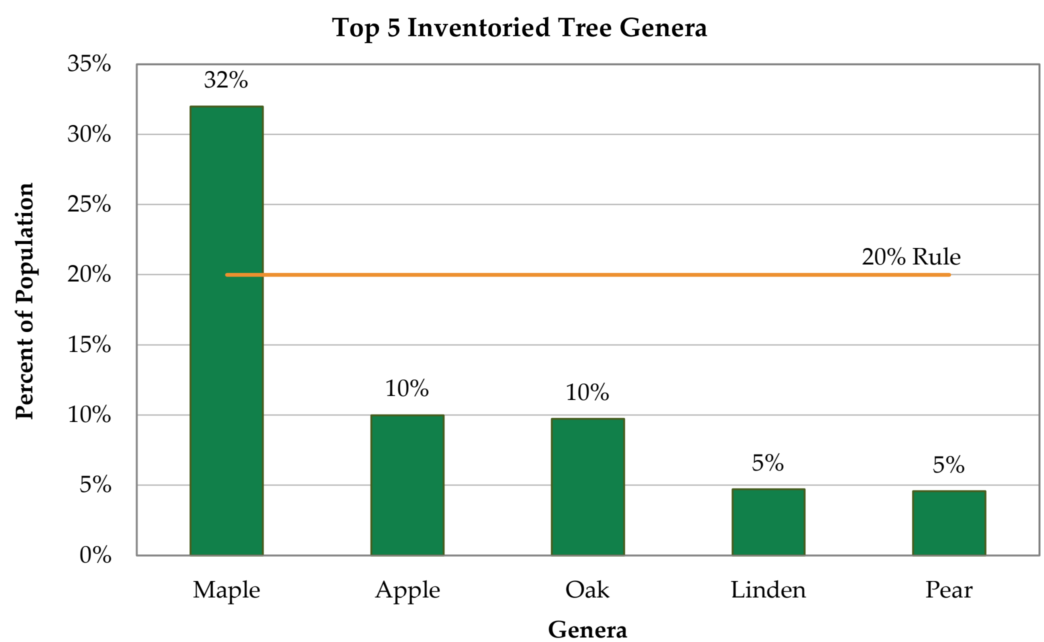


Figure 4. Genus distribution of the inventoried tree population in Sidney.

The species and genus distribution of an urban tree population can be an important metric for gauging the ability of the urban forest to both resist disruption by pests, diseases, extreme weather, and climate change, as well as the forest's resilience, or ability to recover from these disruptions (Ordóñez & Duinker 2014). For example, certain pests, like emerald ash borer (EAB, *Agrilus planipennis*), target a single genus (ash, *Fraxinus* spp.) as their host, and different species of tree have varying susceptibility to extreme weather events (Hauer et al. 2006, Duryea & Kampf 2007), which will become more common as the climate changes. Some pests also target a single family as their host, such as the bacterium *Erwinia amylovora*, commonly known as fireblight. Fireblight only affects plants in the rose family (*Rosaceae*), such as serviceberry (*Amelanchier* spp.), hawthorn (*Crataegus* spp.), apple/crabapple (*Malus* spp.), cherry/plum (*Prunus* spp.), and pear (*Pyrus* spp.). An urban forest with low species, genera, or family diversity is more likely to be damaged by pest, disease, weather, and climate disruptions due to large populations of susceptible trees. It is also likely to be less resilient, or less capable, of recovering from such disturbances, since large portions of the urban forest may be eliminated or damaged by said disturbances. Cultivating diversity on the species, genus, and family levels can help mitigate the effects of disturbances and ensure a thriving urban forest for generations to come.

PEST SUSCEPTIBLITY

Figure 5 shows the percent of inventoried trees susceptible to some of the known pests and diseases in and around Ohio. Spotted lanternfly (SLF, *Lycorma delicatula*), ambrosia beetle (XM *Xyleborus glabratus*), and Asian longhorned beetle (ALB, *Anaplophora glabripennis*) have the potential to affect the largest portion of the inventoried trees in Sidney due to the ability of these three insect pests to exist on a wide range of host species. Since these pests, as well as European spongy moth (ESM, *Lymantria dispar*) and oak wilt, threaten much of Sidney's urban canopy, encouraging species, genera, and family diversity can help to build a tree resource that is both resistant and resilient to disturbance by these pests and diseases. However, because most of these pests can exist on such a wide variety of tree species and genera, diversity among the City's tree population alone cannot guarantee the safety of the urban forest. Routine inspection of Sidney's trees for signs and symptoms of these and other pests and diseases should be conducted to catch and control infestations early, before pests and diseases can become well established within the urban forest. It is also important to remember that Figure 5 only represents data collected during the inventory. Many more trees throughout the city, such as private property trees, may be susceptible to hosting these and other invasive pests. See Appendix B for information about the pests mentioned in Figure 5 and websites where additional information on the pests and diseases of most concern in Ohio can be found.

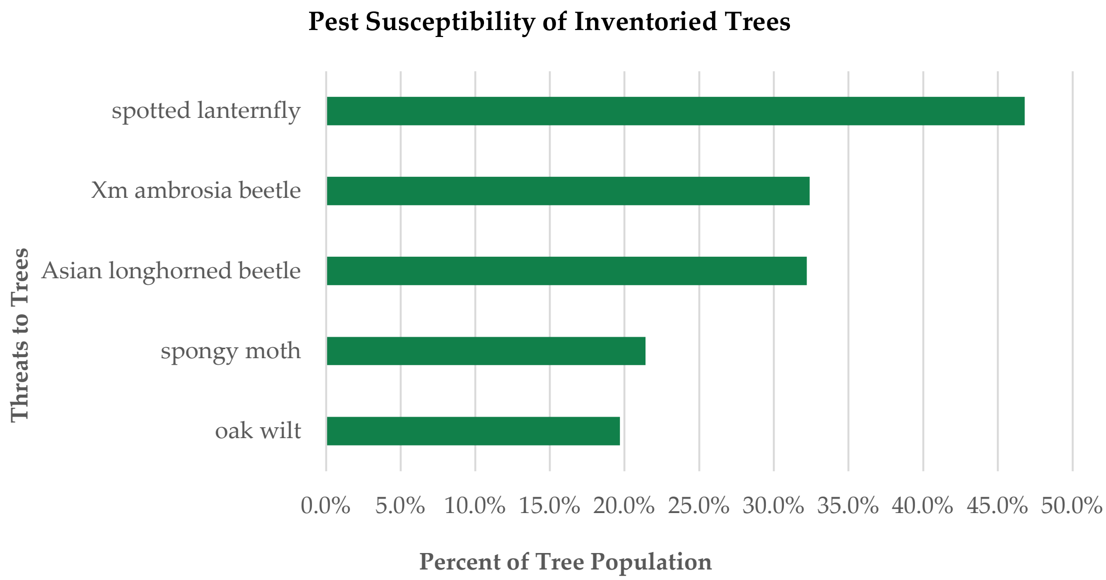


Figure 5. Inventoried tree susceptibility to invasive pests with a regional presence.

Diversity and Pest Susceptibility Recommendations

Overabundance of individual tree species and entire tree genera can reduce an urban forest's resistance and resilience to disruptions caused by insect pests, diseases, extreme weather events, and climate change (Safford et al. 2013). Sidney has good species diversity but an overrepresentation of the genus *Acer* (maple). Future planting projects should focus on building diversity resilience at the genus level. Selecting pest-resilient species from under-represented genera and families will help increase pest and disease resilience throughout the city.

Insect and disease monitoring along with integrated pest management strategies, such as insecticide and fungicide injections, should be prioritized. Some fungal and insect pathogens can be managed with prophylactic treatment which can help to ensure that Sidney public works staff is not overwhelmed with reactive management all at one time.

DEFECT OBSERVATIONS

Each time DRG arborists conducted a Level 1 Risk Assessment, the most significant defect associated with the tree was recorded. Out of 3,549 trees, 50 trees were assessed for risk. Defect observations were limited to the following categories:

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

Table 1. Defect observations recorded during the tree inventory

Defect	Number of Trees	Percent
Dead and dying parts	44	88.0%
Missing or decayed wood	5	10.0%
Broken and/or hanging branches	1	2.0%
Total	50	100%

When considering the defects, 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 2024 inventory recorded only the most significant defect observed on individual trees being assessed for risk. These qualifiers are essential to keep in mind when considering urban forest management planning and the prioritization of maintenance or monitoring activities.

Out of the 50 trees assessed for Risk, Dead and Dying Parts is the most common defect. Out of 50 trees, 44 were noted as having significant Dead and Dying Parts. Missing or decayed wood was recorded as the primary defect for 5 trees, and Broken and/or Hanging Branches was recorded for 1 tree.

Defect Observation Recommendations

Trees recorded with a defect and recommended for removal should be removed as soon as possible to eliminate the risk associated with a tree with defective parts. Trees recorded with a defect should be assessed by qualified personnel equipped with suitable tools and knowledge to determine the next steps needed to mitigate risk or salvage the tree. Routine assessments by qualified arborists or other qualified personnel can aid in identifying potentially hazardous tree defects before they become significant dangers to people or property.

CONDITION

Several factors affecting condition were considered for each tree assessed for risk, including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated by the DRG arborist as Good, Fair, Poor, or Dead.

Figure 6 shows that out of all of the assessed trees, 48% were recorded in Fair condition, 48% were recorded in Poor condition, and 4% were recorded as Dead. Utilizing Risk Rating, condition assessment, and severity of defect, maintenance for addressing and mitigating hazards in the urban forest can be prioritized.

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. These trees may present an elevated risk to people or property. 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. Trees in Fair condition may benefit from pruning to remove dead or defective limbs. Pruning should follow *ANSI A300 (Part 1)* guidelines. These trees may return to Good condition with time and care.

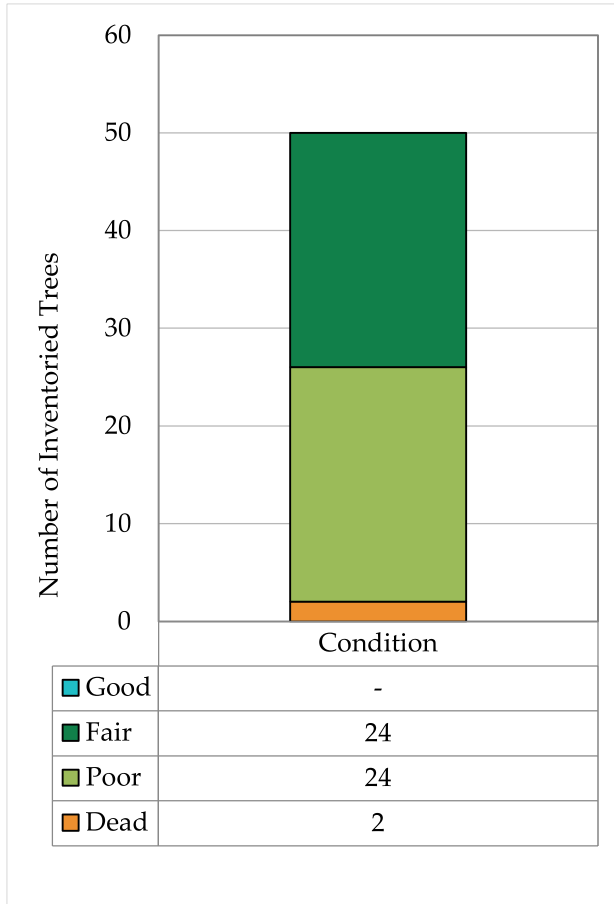


Figure 6. Condition of 50 trees assessed for risk in Sidney

RELATIVE AGE AND SIZE 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 Sidney's tree resource. The inventoried trees were 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)

The trees were also sorted into two Size Classes representing height at maturity, Large and Small, and then analyzed by age class. Table 2 shows the breakdown of DBH ranges for these age classes and the number of trees in each size class and age class.

These size classes were chosen so that the inventoried tree resource can be compared to the ideal relative age distribution, which holds that the largest proportion of the inventoried tree population (approximately 40%) should be young trees, while the smallest proportion (approximately 10%) should be mature trees (Richards 1983). This distribution helps ensure that there are sufficient young trees in a population to replace mature trees as they die or are removed.

Figure 7 compares the relative age distribution of the inventoried tree population to the ideal proposed by Richards (1983). Across Sidney, the age distribution of trees is skewed. Young trees are underrepresented at 28% of the inventoried population and Mature trees are overrepresented at 17% of the inventoried population. Establishing trees are 35% of the inventoried tree population, which is just over the ideal threshold of 30%. Maturing trees represent 20% of the inventoried population, which is ideal. When Mature trees exceed the ideal threshold and Young trees are underrepresented, Mature trees are not being replaced at an adequate rate as they age out of the urban forest. When Mature trees are removed without being replaced by younger trees, there is a potential for canopy loss. Sidney should prioritize planting trees and maintaining them through the establishment period so that when Mature trees are lost, there is succession within the urban forest.

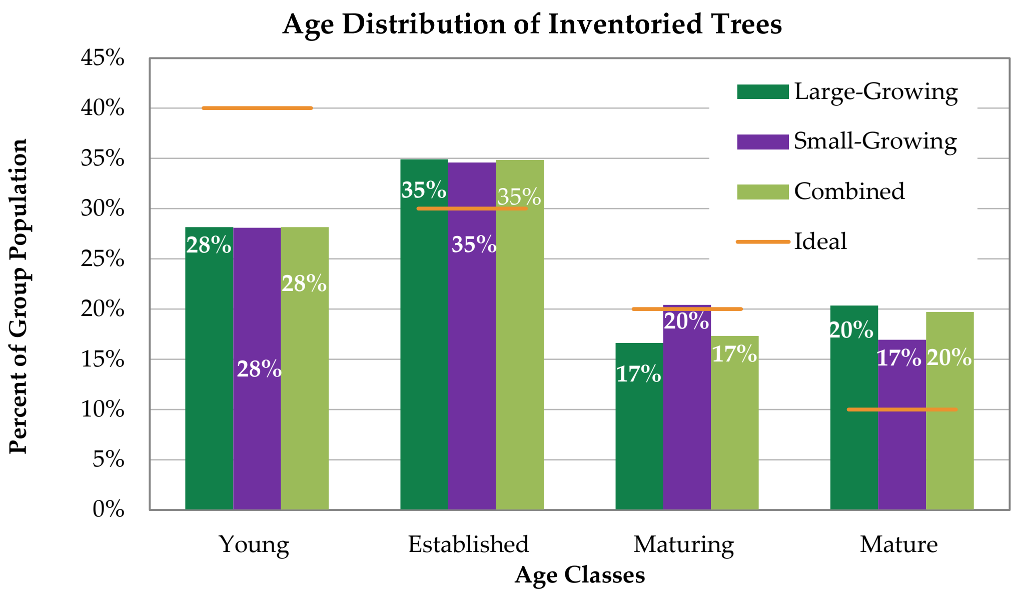


Figure 7. Relative age distribution of the inventoried trees in Sidney.

Relative Age Recommendations

DRG recommends that Sidney implement a planting initiative and robust young tree training program to conserve the condition of young trees as they age so they may replace removed trees and fill canopy gaps in maturity. The city should also continue to maintain and monitor Established and Maturing trees, so that they continue aging to maturity and can replace trees aging out of the urban forest. The cohort of Mature trees should be preserved and monitored, with limited pruning to remove hazards as necessary, until the end of their useful life. Focusing on preservation and proactive care, when possible, protects mature and maturing trees from unnecessary removal and to prevent them from succumbing to treatable defects. It is important to plan for the possible eventuality that the Mature cohort of trees requires similar maintenance at the same time; this can lead to removals across the city and a loss in canopy as this cohort of trees reaches senescence. A routine pruning schedule is helpful for gradually improving tree condition over time by removing defects while still minor and preventing trees from slipping from the Fair to the Poor condition category.

Section 2:

Recommended Management

of the Public Tree Resource

SECTION 2: 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 summary report takes a multi-faceted and proactive approach to recommending tree resource management prioritization.

Extreme & High Risk
- All Extreme and High Risk tree maintenance should be completed as soon as possible because these trees have serious defects that cause potential risk and liability for public safety.

Further Inspection
- Trees with a requirement in the Further Inspection data field have defects that could become worse and increase their risk, which should be assessed by an arborist as soon as possible.

Moderate Risk
- All Moderate Risk tree maintenance should be performed after all Extreme and High Risk tree maintenance has been completed, because these trees have defects that result in higher risk ratings.

Routine Inspection
- Routine Inspections detect significant defects before their risk level increases. Inventoried trees should be routinely inspected using windshield or foot surveys and attended to as needed.

Routine Pruning
- Routine Pruning cycles correct defects before their level of associated risk increases, and should begin after all higher risk tree maintenance has been completed.

Young Tree Training
- Young Tree Training cycles improve tree structure so they do not develop defects that become hazardous in the future, and should begin when Routine Pruning cycles begin.

Low Risk
- All Low Risk tree maintenance should be performed when convenient, after all Extreme, High, and Moderate Risk tree maintenance has been completed.

Stump Removal
- Stump removals should be performed when convenient, ideally before a planting season begins, so additional planting sites become available.

Tree Planting
- Tree planting is important for replacing removed trees, reaching ideal stocking level, and meeting canopy goals, but tree maintenance is often a greater priority.

RISK MANAGEMENT AND RECOMMENDED MAINTENANCE

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.

HIGH PRIORITY RECOMMENDED MAINTENANCE

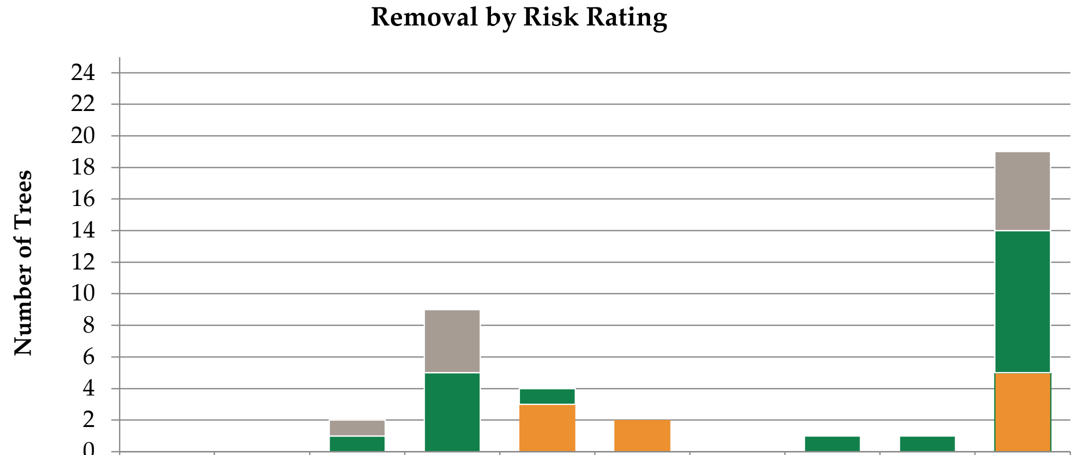
Even though large short-term expenditures may be required, it is important to secure the funding needed to complete priority tree pruning and removals. Expedient pruning or removal reduces risk and promotes public safety. Figure 8 presents recommended tree pruning and tree removals by risk rating and diameter size class for the 50 trees assessed for risk in Sidney.

Pruning or removing 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 that pose the greatest risk. Once these are addressed, recommended tree maintenance activities should be completed for smaller diameter trees that pose the greatest risk. Addressing High Risk trees in a timely and proactive manner often requires significant resources to be secured and allocated. However, peforming this work expediently will mitigate risk, improve public safety, and reduce long-term costs.

Although tree removal is usually considered a last resort and may 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. Proactively planning for removal allows Sidney to stage removals over time, plan for replacement plantings, and address hazardous trees before they fail and create a safety issue.

High Priority Removal Recommendations

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. DRG identified no Extreme Risk and 5 High Risk trees recommended for removal during the 2024 inventory. The diameter size classes for High Risk trees recommended for removal ranged between 20 and 30 inches DBH.



	1	2	3	4	5	6	7	8	9	10
Low Risk	0	0	1	4	0	0	0	0	0	5
Moderate Risk	0	0	1	5	1	0	0	1	1	9
High Risk	0	0	0	0	3	2	0	0	0	5

Diameter Size Class (inches)

Figure 8. Tree Removal by risk rating.

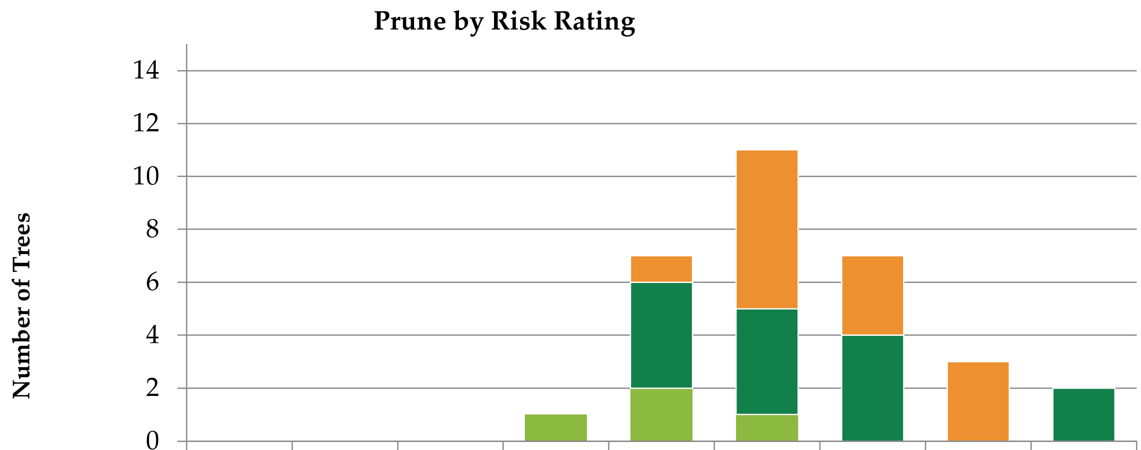
High Priority Pruning Recommendations

High Risk trees should be pruned immediately based on their 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 defective parts can correct the problem, risk associated with the tree is reduced while promoting healthy growth.

The inventory identified no Extreme Risk trees in the city but did identify 13 High Risk trees recommended for priority pruning. The diameter size classes for trees with recommended high-priority pruning ranged between 24 and 41 inches DBH. High priority pruning should be performed immediately based on the assigned risk rating and may be performed concurrently with Extreme and High Risk removals.

MODERATE AND LOW PRIORITY RECOMMENDED MAINTENANCE

Pruning or removing Moderate and Low Risk trees are generally the next priorities for maintenance activities after maintenance on higher risk trees has been completed. For efficiency, Moderate and Low Risk removals may also be addressed when removing adjacent higher risk trees. Figure 9 delineates pruning recommendations by risk rating.



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

Figure 9. Tree pruning recommendations by risk rating.

Moderate Risk Pruning Recommendations

Moderate Risk pruning should be performed after all Extreme and High Risk recommended maintenance is complete and may be performed concurrently with other Moderate Risk removals. The inventory identified 14 Moderate Risk trees recommended for pruning. The diameter size classes for Moderate Risk trees ranged between 16 and 49 inches DBH.

Moderate Risk Removal Recommendations

DRG identified 9 Moderate Risk trees recommended for removal. Moderate Risk trees recommended for removal were between 11 and 38 inches DBH. These trees should be removed as soon as possible after High Risk trees have been removed or pruned, with removal work generally starting with larger diameter trees and working down through the size classes to finish with smaller diameter trees. This ensures that the trees with the greatest potential to cause damage or injury are removed first, followed by those with less potential to cause severe consequences in the event of failure.

Low Priority Pruning Recommendations

There were 4 Low Risk trees recommended for routine pruning. Low Risk trees should be tended to after all higher risk trees have been pruned or removed. Routine pruning is recommended for ensuring compliance with street and sidewalk clearance, utility clearance, and addressing defects before they become significant hazards. Low Risk pruning may take place concurrently with routine pruning.

Low Priority Removal Recommendations

DRG identified 5 Low Risk trees recommended for removal. Low Risk removals pose little threat either due to their size or location and are recommended for removal because they are in poor condition or dead. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. All Low Risk trees should be removed when convenient after all higher risk pruning and removals have been completed and these removals may be performed concurrently with routine pruning.

FURTHER INSPECTION

The Further Inspection data field indicates whether a tree requires additional and/or future inspections to assess and/or monitor conditions that may cause it to become a risk to people, property, or other trees. The inventory identified 3 trees requiring one of four inspection types. Further inspections are beyond the scope of a standard tree inventory and can be one of the following:

a) Annual Inspection (e.g., a healthy tree that has a defect that may require further monitoring to determine whether it is a hazard, or a tree identified to be retained and monitored).
b) Advanced Risk Assessment (e.g., a tree with a defect requiring additional or specialized equipment for investigation).
c) Insect/Disease Monitoring (e.g., a tree that appears to have an emerging insect or disease problem).
d) No further inspection required.

Annual Inspection Recommendations

The inventory found 1 tree recommended for Annual Inspection. Annual Inspections allow for management decisions to be made as the condition of the tree either improves or worsens, such as following recent damage or monitoring the extent of decay.

Trees recommended for annual inspection should be assessed routinely to monitor their condition and look for signs of worsening defects that may merit intervention. Some of these trees will likely recover given time and will no longer need additional monitoring, while others may require removal if their defects worsen. Annual inspections should document any recent work, changes to the overall condition of the tree, note any defects and if they are new or continuing, and make a recommendation on maintenance and if the tree should continue to be inspected annually or not. For example, a young tree recommended for annual inspection due to establishment stress may make a full recovery and be removed from the list following the result of an annual inspection.

Advanced Risk Assessment Recommendations

In the ANSI A300 system, there are three levels of risk assessment. Each level is built on the one before it. The lowest level is designed to be a cost-effective approach to quickly identifying tree risk concerns, while the highest level is intended to provide in-depth information to make management decisions about an individual tree. These levels are:

a. **Level 1:** Level 1 inspection is defined as a limited visual assessment, which is often conducted as a walk-through or windshield survey designed to identify obvious defects or specified conditions.

b. **Level 2:** Level 2 inspection is defined as a basic assessment and is a detailed, 360-degree visual inspection of a tree and its surrounding site, and a synthesis of the information collected. All trees in the 2024 Sidney tree inventory were assessed to this level, provided that 360-degree access around the tree could be gained.

c. **Level 3:** Level 3 inspection is an advanced assessment and is performed to provide detailed information about specific tree parts, defects, targets, or site conditions. A Level 3 inspection may use specialized tools such as a resistance drill or require the input of an expert.

In total, the inventory found 2 trees recommended for Advanced Risk Assessments.

A Level 3 inspection was recommended for trees in which a defect was observed during the inventory which warranted closer inspection by a tree risk assessment qualified (TRAQ) arborist. These trees may need inspection utilizing techniques such as sonic tomography or a resistance drill to inspect conditions like basal trunk swelling or pockets of decay, or aerial lift equipment to ascertain the extent of defects in the canopy of the tree. Advanced risk assessments are recommended when an inspection from the ground without specialized equipment may not fully determine the extent of a tree's defect, and more information is needed to accurately describe the risk of the tree and recommend appropriate maintenance for risk mitigation.

Insect/Disease Monitoring Inspection

Trees known to host contagious and/or highly damaging pests and pathogens should be monitored routinely. Early detection is critical to managing pests and pathogens. Species noted for Insect/Disease monitoring should be cross-referenced against existing monitoring lists, inspected, and if necessary, plant health care (PHC) treatment should be implemented.

It is important to monitor ongoing insect, disease, and fungal infestations in the city tree population. Early detection of infestations is extremely important and depending on the infestation agent, quarantine or treatment can prevent an infestation from spreading.

ROUTINE INSPECTIONS

Routine 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 hold the ISA TRAQ credential.

Routine Inspection Recommendations

All trees in maintained areas of Sidney 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 computer management software such as TreeKeeper® to 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. Sidney has a significant population of trees that are susceptible to pests and diseases, including ash (*Fraxinus* spp.), maple (*Acer* spp.), and oak (*Quercus* spp.), and early detection of pests and disease can be more cost-effective long term than reactive remediation.

DRG recommends that Sidney perform routine inspections of inventoried trees by windshield survey (inspections performed from a vehicle), where possible, and by foot where vehicle traffic is excluded, 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. Use asset management software such as TreeKeeper® to update inventory data and schedule work records.

MAINTENANCE SCHEDULE AND BUDGET

Utilizing the 2024 Sidney tree inventory data, annual maintenance schedules for the city were developed detailing the recommended tasks to complete each year for the next 12 months (Table 2). DRG made these budget projections using industry knowledge and public bid tabulations. Because the pricing estimates used in the following budget tables were compiled using the average pricing of contractor services, they will be higher than the actual cost of doing the recommended maintenance work in-house and may vary depending on bid schedules and contract requirements.

Following the recommended maintenance outlined on the following pages can help address hazards and mitigate risk in the urban forest. Annual budget funds are needed to ensure that elevated 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.

Addressing all maintenance on trees assessed for risk may be daunting and budget-prohibitive. If annual budgets do not allow for all the work recommended in this plan to be completed, the budget suggestions put forth here can still help to guide decisions about how to prioritize maintenance tasks and allocate limited funds to best maintain, preserve, and grow the City's public tree resource. They can also serve as a useful tool when advocating for increased funding for urban tree management.

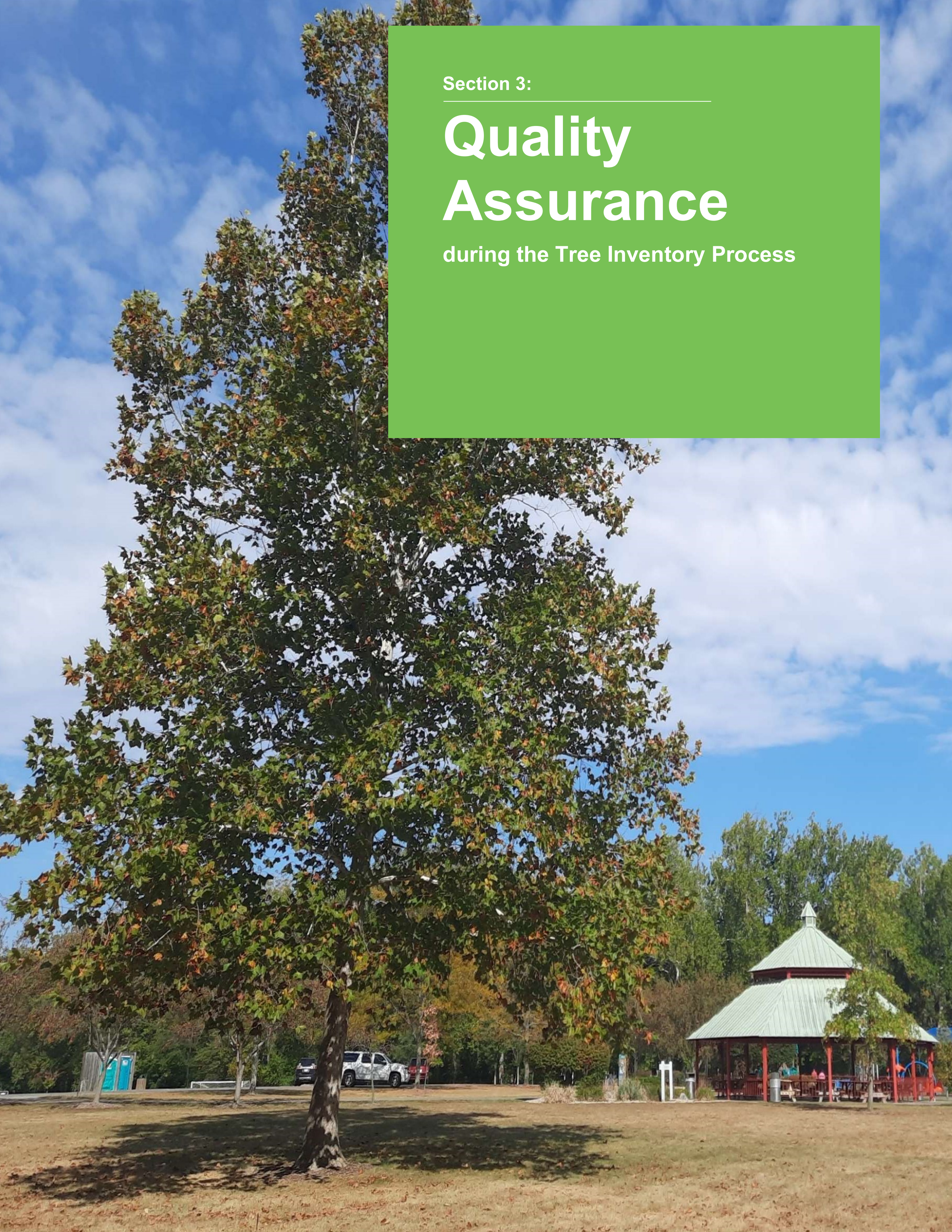
Table 2. Estimated costs for the tree management program

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
High Risk Removals	1-3"	$195	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$225	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$650	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	13-18"	$1,450	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	19-24"	$3,000	3	$9,000	0	$0	0	$0	0	$0	0	$0	$9,000
	25-30"	$3,600	2	$7,200	0	$0	0	$0	0	$0	0	$0	$7,200
	31-36"	$4,200	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$4,800	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$5,800	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**5**	**$16,200**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$16,200**
Moderate and Low Risk Removals	1-3"	$195	0	$0	**0**	$0	0	$0	0	$0	0	$0	$0
	4-6"	$225	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$650	2	$1,300	0	$0	0	$0	0	$0	0	$0	$1,300
	13-18"	$1,450	9	$13,050	0	$0	0	$0	0	$0	0	$0	$13,050
	19-24"	$3,000	1	$3,000	0	$0	0	$0	0	$0	0	$0	$3,000
	25-30"	$3,600	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	31-36"	$4,200	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$4,800	1	$4,800	0	$0	0	$0	0	$0	0	$0	$4,800
	43"+	$5,800	1	$5,800	0	$0	0	$0	0	$0	0	$0	$5,800
Activity Total(s)			**14**	**$27,950**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$27,950**
High Risk Pruning	1-3"	$110	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$220	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$440	1	$440	0	$0	0	$0	0	$0	0	$0	$440
	13-18"	$660	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	19-24"	$880	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	25-30"	$1,300	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	31-36"	$1,490	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$1,800	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$2,400	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**1**	**$440**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$440**
Moderate and Low Risk Pruning	1-3"	$110	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$220	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$440	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	13-18"	$660	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	19-24"	$880	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	25-30"	$1,300	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	31-36"	$1,490	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$1,800	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$2,400	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$0**
Activity Grand Total			**20**		**0**		**0**		**0**		**0**		
Cost Grand Total				**$44,590**		**$0**		**$0**		**$0**		**$0**	**$44,590**

Section 3:

Quality Assurance

during the Tree Inventory Process



SECTION 3: QUALITY ASSURANCE DURING THE INVENTORY PROCESS

DATA QUALITY CONTROL

Data verification is essential to building and maintaining a quality inventory that can be used efficiently to guide routine maintenance in the urban forest. Quality control starts before the project begins with a thorough review of the job scope and a review of the tree risk assessment process. Quality control also begins with ensuring that tree assessments and data collection are handled by qualified personnel. In this instance, the inventory arborist and site manager were both ISA Certified Arborists holding the Tree Risk Assessment Qualification (TRAQ), and the project manager was an ISA Certified Municipal Arborist holding TRAQ.

During the inventory data collection, DRG ensured that data underwent a review process during and after the inventory work through the following methods:

- **Hot Checks:** Hot checks are performed when site managers work directly alongside inventory arborists to ensure data collection is correct and consistent. Hot checks were performed by the site manager for the first 3 days of the inventory collection to ensure both site manager and arborist are consistent with their methodology.
- **Cold Checks:** Cold checks are performed by project managers reviewing data on the computer and site managers at the completion of the initial data collection. Project managers review data looking for anomalies and flag points to be reviewed later by arborists in the field during data collection. At the end of data collection, site managers visit 2% of trees in person to review data and ensure correct collection and assessment.
- **Daily Data Review:** At the end of each field day, inventory arborists perform a daily data review and ensure point placement, number of points, and other data metrics are complete. Points requiring more review are flagged for the site manager to review.

Figure 10. Trees reviewed by Site Manager.

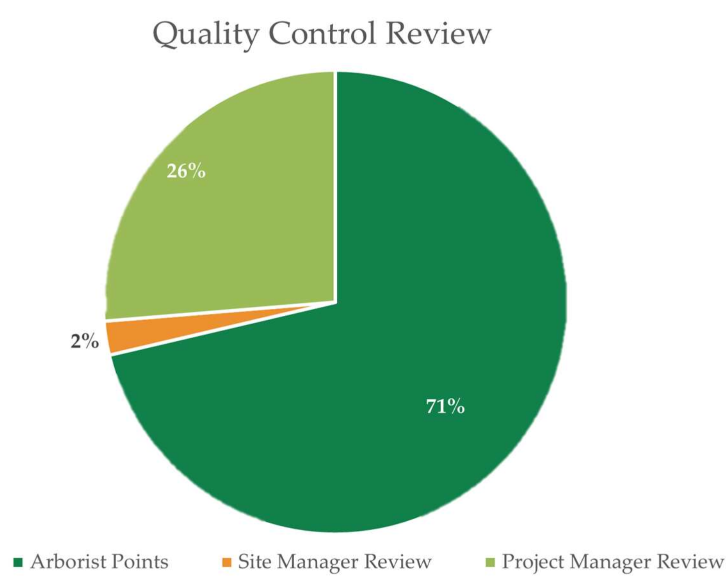


Figure 11. Trees reviewed by Site Manager and Project Manager.

In Figures 10 and 11, quality control is summarized by percentage of points reviewed at each level of supervision. Overall, the project manager reviewed 585 (33%) of the 1,770 points collected by the site manager. Figure 12 shows points collected by the inventory arborist, field-checked by the site manager, and reviewed by the project manager. The site manager reviewed 42 trees (2%) and the project manager reviewed 468 trees (26%) out of the 1,779 trees inventoried by the arborist.

With a review rate of over 30%, the City of Sidney can place trust in the accuracy of the data collection and utilize the dataset for ongoing routine maintenance of the urban forest with confidence.

CONCLUSION

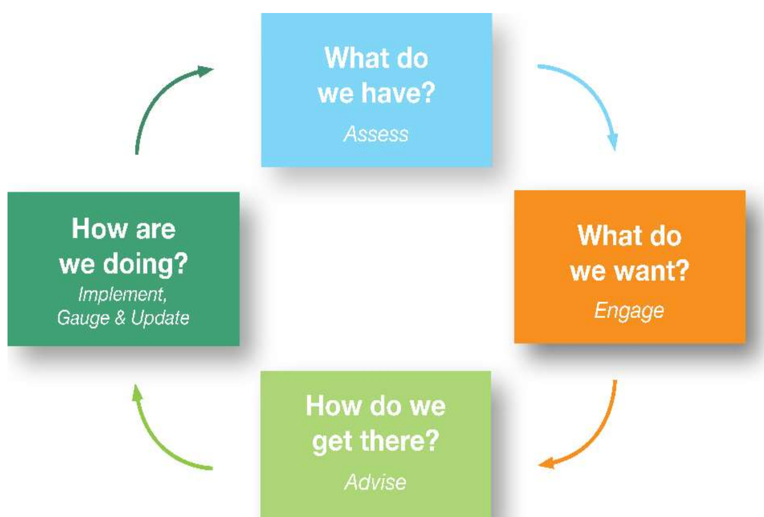
When properly maintained, the valuable benefits trees provide over their lifetimes far exceed the time and money invested in planting, pruning, and inevitably removing them.

The maintenance programs laid out in this document are ambitious and a challenge to complete in five years but become easier after all higher priority tree maintenance is completed. This *Tree Inventory Summary Report* has the potential to help Sidney advocate for an increased tree care budget to fund the recommended maintenance activities to mitigate risk in the urban forest. 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 Sidney residents, visitors, and tourists will increase as well. The city is well on their way to creating a sustainable and resilient urban 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 *Tree Inventory Summary Report* provides an overview of the inventory completed in Sidney and next steps to mitigating the risk as assessed in this inventory. It is important to update the tree inventory using TreeKeeper® as work is completed so that work forecasts remain on track. This will allow Sidney to assess progress over time and set goals to strive toward by following the adaptive management cycle depicted in the figure to the right. Below are some suggestions for 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.
- Compare the number of trees planted to the number of trees removed and the number of vacant planting sites remaining annually, then adjust future planting plans accordingly.
- Compare the species distribution of the inventoried tree resource with the previous year after completing planting plans to monitor recommended changes in species and genera 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 the standard procedure for tree work and routine inspections, so changes in tree size and health over time can be monitored.

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GLOSSARY

air pollution removal: In i-Tree Eco, air pollution removal refers to the removal of ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter less than 2.5 microns ($PM_{2.5}$).

American National Standards Institute (ANSI): ANSI is a private, nonprofit organization that facilitates the standardization work of its members in the United States. ANSI's goals are to promote and facilitate voluntary consensus standards and conformity assessment systems, and to maintain their integrity.

***ANSI A300*:** Tree care performance parameters established by ANSI that can be used to develop specifications for tree maintenance.

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

area (data field): The nearest building to a site was automatically assigned based on GIS data in the data collection program.

avoided runoff: In i-Tree Eco, avoided runoff measures the amount of surface runoff avoided when trees intercept rainfall during precipitation events.

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

canopy cover: As seen from above, it is the area of land surface that is covered by tree canopy.

Carbon Monoxide (CO): A colorless, odorless, highly toxic gas formed as a result of the incomplete combustion of a carbon or carbon compound.

carbon sequestration: The capture and storage of carbon from the Earth's atmosphere. In i-Tree Eco, carbon sequestration is calculated as an annual functional benefit of trees.

carbon storage: Storage of carbon in plant tissue. In i-Tree Eco, carbon storage is calculated as a structural benefit over the lifetime of the tree.

comments (data field): Additional comments on the state of the inventoried site. Comments may include the number of stems if the tree was multi-stemmed, additional defects that were significant but not the primary defect, explanations for why further inspection is needed, and other general information considered important by the inventory arborist.

community forest: see **urban forest**.

condition (data field): The general condition of each tree rated during the inventory according to the following categories adapted from the International Society of Arboriculture's rating system: Good, Fair, Poor, or Dead.

cycle: Planned length of time between vegetation maintenance activities.

dead (condition rating): A dead tree shows no signs of life.

defect: See **structural defect**.

defect (data field): The primary defect noted by the inventory arborist. Defects include missing or decayed wood, dead or dying parts, broken or hanging branches, weakly attached branches and codominant stems, cracks, root problem, tree architecture, other, and none.

diameter: See **tree size**.

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

Extreme Risk tree: Applies in situations where tree failure is imminent, there is a high likelihood of impacting the target, and the consequences of the failure are "severe." In some cases, this may mean immediate restriction of access to the target zone area in order to prevent injury.

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

fair (condition rating): A fair tree has minor problems that may be corrected with time or corrective action.

functional benefit: In i-Tree Eco, a benefit which is due to the physiological processes carried out by trees, calculated on an annual basis.

further inspection (data field): Notes that a specific tree may require an annual inspection for several years to make certain of its maintenance needs. A healthy tree obviously impacted by recent construction serves as a prime example. This tree will need annual evaluations to assess the impact of construction on its root system. Another example would be a tree with a defect requiring additional equipment for investigation.

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

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

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

good (condition rating): A tree in good condition shows no major problems.

High Risk tree: The High Risk category applies when consequences are "significant" and likelihood is "very likely" or "likely," or consequences are "severe" and likelihood is "likely." In a population of trees, the priority of High Risk trees is second only to Extreme Risk trees.

invasive tree: A tree species that is out of its original biological community. Its introduction into an area causes or is likely to cause economic or environmental harm, or harm to human health. An invasive, exotic tree has the ability to thrive and spread aggressively outside its natural range. An invasive species that colonizes a new area may gain an ecological edge since the insects, diseases, and foraging animals that naturally keep its growth in check in its native range are not present in its new habitat.

inventory: See **tree inventory**.

i-Tree Eco: i-Tree Eco is a street tree management and analysis tool that uses tree inventory data to quantify the dollar value of annual environmental benefits, including runoff reduction, air pollution reduction, and carbon sequestration, as well as life-long structural benefits trees provide, including carbons storage and structural value.

i-Tree Streets: i-Tree Streets is a street tree management and analysis tool that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO_2 reduction, stormwater control, and property value increase. While i-Tree Streets was not used for the tree benefits analysis in this management plan, it is still used as the basis for the tree benefits tab in TreeKeeper®.

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

Low Risk tree: The Low Risk category applies when consequences are "negligible" and likelihood is "unlikely"; or consequences are "minor" and likelihood is "somewhat likely." Some trees with this level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required.

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

memorial/donated/plaque (data field): indicates whether a tree is designated as a memorial or donated tree based on signifiers visible in the field at the time of the inventory.

Moderate Risk tree: The Moderate Risk category applies when consequences are "minor" and likelihood is "very likely" or "likely"; or likelihood is "somewhat likely" and consequences are "significant" or "severe." In populations of trees, Moderate Risk trees represent a lower priority than High or Extreme Risk trees.

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

multi-stem (data field): Indicates whether a tree has multiple trunks splitting less than 1.5 feet above ground level.

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

None (risk rating): Equal to zero. It is used only for planting sites and stumps, or as a residual risk rating when a tree is recommended for removal.

ordinance: See **tree ordinance**.

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

Particulate Matter ($PM_{2.5}$): A major class of air pollutants consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and mists.

poor (condition rating): A tree in poor condition has major problems that are irrecoverable.

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

prune (primary maintenance need): The tree needs priority pruning to remove dead limbs, provide clearance, remove an obstruction, or thin the canopy.

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

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

replacement value: See **structural value**.

residual risk (data field): The risk rating of a tree after the recommended primary maintenance has been carried out. Residual risk may be equal to but never greater than the original risk rating.

resilience: The ability of a community to absorb disturbance and reorganize while undergoing change to retain essentially the same function, structure, identity, and feedbacks as prior to the disturbance.

resistance: The ability of a community to remain unchanged when challenged by a disturbance such as pests, severe weather, or climate change.

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

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

risk assessment complete (data field): Indicates whether the arborist was able to complete a Level 2 qualitative risk assessment. Arborists may not be able to fully assess tree risk due to embankments, homeowner conflicts, fences, or other obstacles to getting a 360 degree view of the tree.

risk rating (data fields): Level 2 qualitative risk assessment will be performed on the ANSI A300 (Part 9) and the companion publication *Best Management Practices: Tree Risk Assessment*, published by International Society of Arboriculture (2011). Trees can have multiple failure modes with various risk ratings. One risk rating per tree will be assigned during the inventory. The failure mode having the greatest risk will serve as the overall tree risk rating. The specified time period for the risk assessment is one year.

routine prune (primary maintenance need): The tree requires no immediate pruning but should be included in a routine pruning cycle to maintain condition over time.

side (data field): Each site is assigned a side value to aid in locating the site. Side values include: *front*, *side, median* (includes islands), and *rear* based on the site's location in relation to the nearest building.

site: Any point for which data was recorded during the inventory, including trees, vacant sites, and stumps.

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

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

structural benefit: In i-Tree Eco, a benefit which is produced by the physical arrangement and composition of trees and tree parts and which is calculated as an aggregate over the lifetime of a tree.

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

structural value: In i-Tree Eco, the compensatory value calculated based on the local cost of having to replace a tree with a similar tree.

stump removal (Primary Maintenance Need): Indicates a stump that should be removed.

suffix (data field): Data field indicating whether the address was assigned by the arborist.

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

topping: Characterized by reducing tree size using internodal cuts without regard to tree health or structural integrity; this is not an acceptable pruning practice.

train (primary maintenance need): A young or small size tree that requires routine structural pruning to ensure good form as it grows.

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

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

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

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

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

tree tag removal (data field): Indicates whether or not a tree tag was present and removable (*yes*), present but not removable (*no*), or not present at the time of the inventory (*N/A***)**.

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

volunteer: A tree that was not intentionally planted, but rather grew naturally in a location and has been allowed to remain as part of the maintained landscaping.

APPENDIX A
DATA COLLECTION AND SITE LOCATION METHODS

DATA COLLECTION METHODS

DRG collects tree inventory data using a customized ArcPad program, called Rover, loaded onto pen-based field computers. At each site, the following data fields were collected:

- Address
- Street
- Side
- Species
- Tree Size (in inches at 4.5 ft off the ground

Maintenance needs are based on *Best Management Practices: Tree Risk Assessment* (International Society of Arboriculture 2011). The knowledge, experience, and professional judgment of DRG's arborists ensure the high quality of inventory data.

Unmaintained wooded areas of Sidney were not inventoried.

Only trees with a significant defect were assessed for condition, defect, Likelihood of Failure, Likelihood of Impact, Consequence of Failure, Risk Rating, Primary Maintenance, and Residual Risk.

SITE LOCATION METHODS

Equipment and Base Maps

Inventory arborists use CF-19 Panasonic Toughbook® units with internal GPS receivers. Geographic information system (GIS) map layers are loaded onto these units to help locate sites during the inventory. Aerial base maps were provided by Shelby County.

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).

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 U.S. is a byproduct of cultivation, commerce, tourism, and travel. Many species enter the United States 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 native species to extinction. The following appendix includes key pests and diseases that adversely affect trees in Massachusetts, or which are emergent threats for Massachusetts 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 so that you can be prepared to combat their attack. 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.

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

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*).

BEECH LEAF DISEASE

Beech leaf disease (BLD) was first identified in Ohio in 2012. Since then, it has been found in Pennsylvania, New York, Rhode Island, Connecticut, and most recently in Massachusetts. The first confirmed detection of this emergent disease in the state was made in Plymouth in 2020, but symptomatic trees have been observed in Worcester and Blandford as well. Although it does not yet appear to be widespread in Massachusetts, BLD is an emergent threat to forest health in the state.

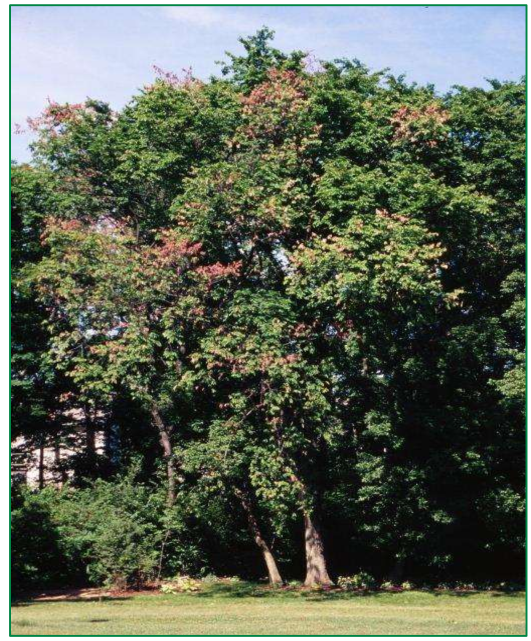
Dark stripes between leaf veins are an early symptom of BLD.

Photograph courtesy of Tom Macy, Ohio DNR Division of Forestry (2019)

The disease complex is associated with a nematode, *Litylenchas crenatae*, and impacts American beech (*Fagus grandifolia*), European beech (*F. sylvatica*), and Oriental beech (*F. orientalis*). Early signs of the disease include dark stripes between the veins of leaves, most noticeable when looking up through the canopy on sunny days. As the disease progresses, leaves become withered, curled, or develop a leathery texture and sections of canopy may die back. Infected trees often appear to have a thin canopy, and the disease can lead to tree mortality. Research into this disease is ongoing, and the method of spread and infection, as well as potential treatments, are not yet known. If you suspect a tree under your care to be infected, report it to the DCR Forest Health Program by e-mailing nicole.keleher@mass.gov or by calling (857) 337-5173.

DUTCH ELM DISEASE

Considered by many to be one of the most destructive invasive diseases of shade trees in the United States, Dutch elm disease (DED) was first found in Ohio in 1930. By 1933, the disease was present in several east coast cities, and by 1959, it had killed thousands of elm. Today, DED is present in about two-thirds of the eastern United States and kills many of the remaining and newly planted elm annually. The disease is caused by a fungus that attacks the vascular system of elm trees, blocking the flow of water and nutrients and resulting in rapid leaf yellowing, tree decline, and death. The species most affected by DED is the *Ulmus americana* (American elm).



Branch death, or flagging, at multiple locations in the crown of a diseased elm.

Photograph courtesy of Steven Katovich, USDA Forest Service, Bugwod.org (2011)

There are two closely related fungi that are collectively referred to as DED. The most common is *Ophiostoma novo-ulmi*, which is thought to be responsible for most of the elm deaths since the 1970s. The fungus is transmitted to healthy elm by elm bark beetles. Two species of beetle carry the fungus: native elm bark beetle (*Hylurgopinus rufipes*) and European elm bark beetle (*Scolytus multistriatus)*.

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 United States identification of EAB was in southeastern Michigan in 2002.

Close-up of an emerald ash borer.

Photograph courtesy of USDA APHIS (2020)

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).

EUROPEAN SPONGY MOTH

The spongy moth (SM, *Lymantria dispar*) is native to Europe and first arrived in the United States 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. SM caterpillars defoliate trees, which makes the host trees vulnerable to diseases and other pests that can eventually kill the tree.

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

Photograph courtesy of USDA APHIS (2019)

Male SMs 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 SM cannot fly.

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

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.

Hemlock woolly adelgids on a branch.

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

In their native range, populations of HWA cause little damage to the hemlock trees, as they are preyed on by 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.

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

OAK WILT

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of USDA Forest Service (2011a)

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.

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.

SPOTTED LANTERNFLY

Pinned spotted lanternfly nymph.

Photograph courtesy of PA Dept of Agriculture

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 (*Ailanthus altissima*) 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 United States, this pest could seriously impact the country's grape, orchard, and logging industries.

Symptoms of SLF include 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, apricot, cherry, nectarine, peach, plum (*Prunus* spp.), apple (*Malus* spp.), maple (*Acer* spp.), oak (*Quercus* spp.), pine (*Pinus* spp.), poplar (*Populus* spp.), sycamore (*Platanus* spp.), walnut (*Juglans* spp.), and willow (*Salix* spp.), as well as grape vines and hop plants.

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APPENDIX C
SUGGESTED TREE SPECIES FOR USDA HARDINESS ZONE 6

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 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 6 on the USDA Plant Hardiness Zone Map.

DECIDUOUS TREES

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
*Aesculus flava**	yellow buckeye	
*Betula alleghaniensis**	yellow birch	
*Betula lenta**	sweet birch	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Carya illinoensis**	pecan	
*Carya laciniosa**	shellbark hickory	
*Carya ovata**	shagbark hickory	
*Castanea mollissima**	Chinese chestnut	
Celtis laevigata	sugar hackberry	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsura	'Aureum'
*Diospyros virginiana**	common persimmon	
Ginkgo biloba	ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans nigra**	black walnut	
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	'Rotundiloba'
*Liriodendron tulipifera**	tuliptree	'Fastigiatum'
*Magnolia acuminata**	cucumbertree magnolia	(Numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	'Wildfire'; 'Tupelo Tower'
*Platanus occidentalis**	American sycamore	
Platanus × acerifolia	London planetree	'Yarwood'
Quercus alba	white oak	
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus lyrata	overcup oak	

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

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
Alnus cordata	Italian alder	
*Asimina triloba**	pawpaw	
Cladrastis kentukea	American yellowwood	'Rosea'
Corylus colurna	Turkish filbert	
Eucommia ulmoides	hardy rubber tree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	amur corktree	'Macho'
Pistacia chinensis	Chinese pistache	
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
*Sassafras albidum**	sassafras	

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(Numerous exist)
Amelanchier laevis	Allegheny serviceberry	
*Carpinus caroliniana**	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Chionanthus virginicus	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus kousa	Kousa dogwood	(Numerous exist)
Cornus mas	corneliancherry dogwood	'Spring Sun'
Corylus avellana	European filbert	'Contorta'
*Cotinus coggygria**	common smoketree	'Flame'
*Cotinus obovata**	American smoketree	
*Crataegus phaenopyrum**	Washington hawthorn	Princeton Sentry™
Crataegus viridis	green hawthorn	'Winter King'
*Franklinia alatamaha**	Franklinia	
*Halesia tetraptera**	Carolina silverbell	'Arnold Pink'
Laburnum × watereri	goldenchain tree	
Maackia amurensis	amur maackia	
*Magnolia × soulangiana**	saucer magnolia	'Alexandrina'
*Magnolia stellata**	star magnolia	'Centennial'
*Magnolia tripetala**	umbrella magnolia	
*Magnolia virginiana**	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(Disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	'Pendula'
Prunus virginiana	common chokecherry	'Schubert'
*Staphylea trifolia**	American bladdernut	
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
Cedrus libani	cedar-of-Lebanon	
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
× *Cupressocyparis leylandii*	Leyland cypress	
Ilex opaca	American holly	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Pinus taeda	loblolly pine	
Pinus virginiana	Virginia pine	
Psedotsuga menziesii	Douglas-fir	
Thuja plicata	western arborvitae	(Numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

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

Small Trees: 15 to 30 Feet in Height at Maturity

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

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