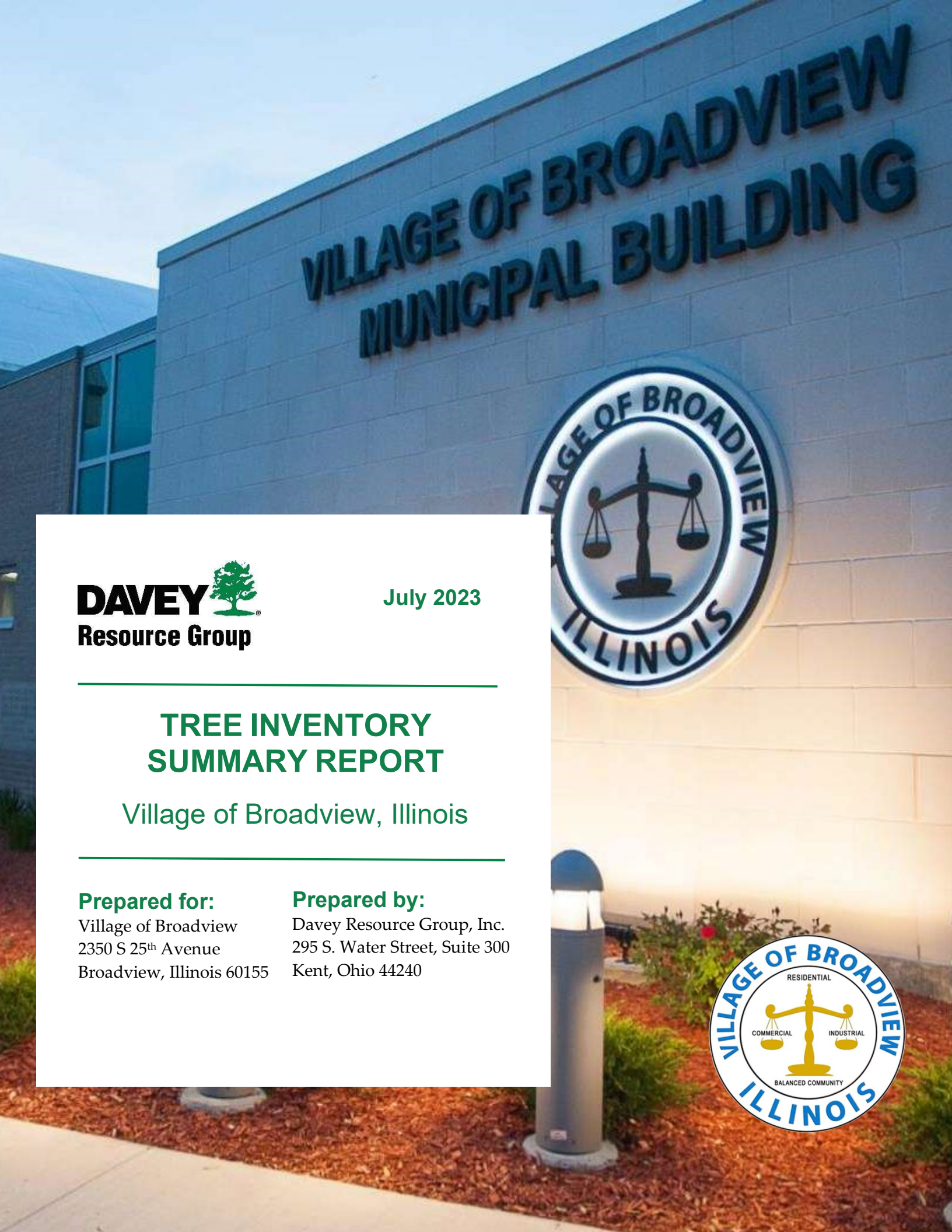

DAVEY Resource Group

July 2023

TREE INVENTORY SUMMARY REPORT

Village of Broadview, Illinois

Prepared for:
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INTRODUCTION

An effective tree resource management approach follows a proactive and systematic urban forestry program set by clear and realistic goals, prescribed tree work activities, and periodic progress measurement. A robust urban forestry program utilizes modern tools, such as a tree inventory accompanied by TreeKeeper® or other asset management software, to track the tree resource and request, schedule, and complete necessary tree work.

This *Tree Inventory Summary Report has* three parts. It reflects the state of inventoried resources, the maintenance need and risk of the inventoried resource, and the tree-related benefits of the inventoried tree resource. Additionally, this report provides industry standard general recommendations for managing most public tree resources.

- *Part 1: Structure and Composition of the Public Tree Resource* shows trends representing the current state of the inventoried population.
- *Part 2: Recommended Management of the Public Tree Resource* uses risk assessment findings to prioritize tree maintenance activities.
- *Part 3: Treekeeper® Benefit Analysis* estimates the monetary value of the benefits provided by the public tree resource.

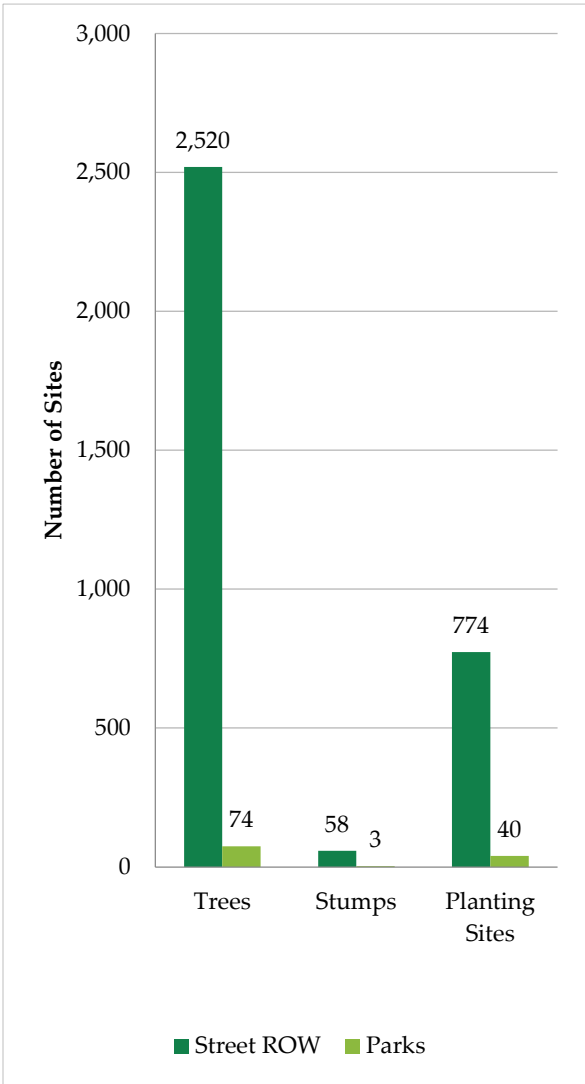


Figure 1. Tree data collected in street ROW and parks.

In April 2023, Davey Resource Group, Inc. "DRG" arborists collected site data on trees, stumps, and planting sites along the street right-of-way (ROW) and within parks (parks) for a tree inventory contracted by the Village of Broadview, Illinois (village). In addition to streets, the village assigned DRG village hall and several parks for conducting the inventory: Pioneer Park, Playhaven Park, Playdale Park, Schroeder Park, Beverly Center, and Beverly Park. Figure 1 breaks down all sites inventoried into street ROW and parks. Of the total 3,469 sites inventoried, 97% were collected in the street ROW and the remaining 3% were collected in parks. This will be only figure separating street and park trees. The rest of this document will reflect the total tree population combing the street and park trees. See Appendix A for details about DRG's methodology for collecting site data.

PART 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

SPECIES, GENUS, AND FAMILY DISTRIBUTION

Increasing species and genus diversity is a crucial priority that improves the public tree population's resilience to pests and disease. The 10-20-30 rule is a common standard for the species, genus, and family distribution of a tree population, in which a single species should not represent more than 10% of the population, a single genus no more than 20%, and a single family no more than 30% (Santamour 1990).

Figure 2 shows the distribution of the most abundant species in Broadview's tree population compared to Santamour's 10% species threshold. Silver maple (*Acer saccharinum*, 18%) is the most abundant species followed closely by Norway maple (*Acer platanoides*, 13%) and thornless honeylocust (*Gleditsia triacanthos inermis*, 12%), all significantly exceeding the recommended threshold. Littleleaf linden (*Tilia cordata*, 8%), Callery pear (*Pyrus calleryana*, 6%), and sugar maple (*Acer saccharum*, 6%) are well below the threshold.

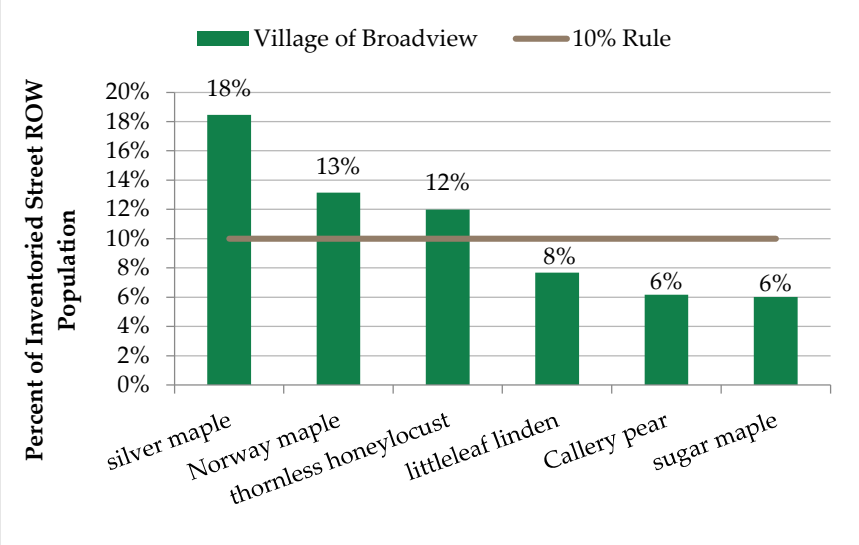


Figure 2. Species distribution of Broadview's tree resource.

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 village streets. History repeated itself in 2002 with the introduction of the emerald ash borer into America. This invasive beetle devastated ash tree populations across the Midwest. Other invasive pests spreading across the country threaten urban forests, so it is vital that we learn from history and plant a wider variety of tree genera to develop a resilient public tree resource.

Urban ash tree with emergence hole from emerald ash borer.

Figure 3 shows the distribution of the most abundant genera in Broadview's tree population compared to Santamour's 20% genus threshold. The only genus with a proportion greater than 20% is maple (*Acer*, 41%), and it is drastically above the recommended threshold. The significant presence of maple is a management concern because it risks an extreme loss of the tree resource in the event of a spotted lanternfly (SLF, *Lycorma delicatula*) or Asian longhorned beetle (ALB, *Anoplophora glabripennis*) invasion and provides higher concentrations of habitat thus easier to spread. While other genera besides maple are susceptible to both pests, they represent a much smaller proportion of the public tree resource.

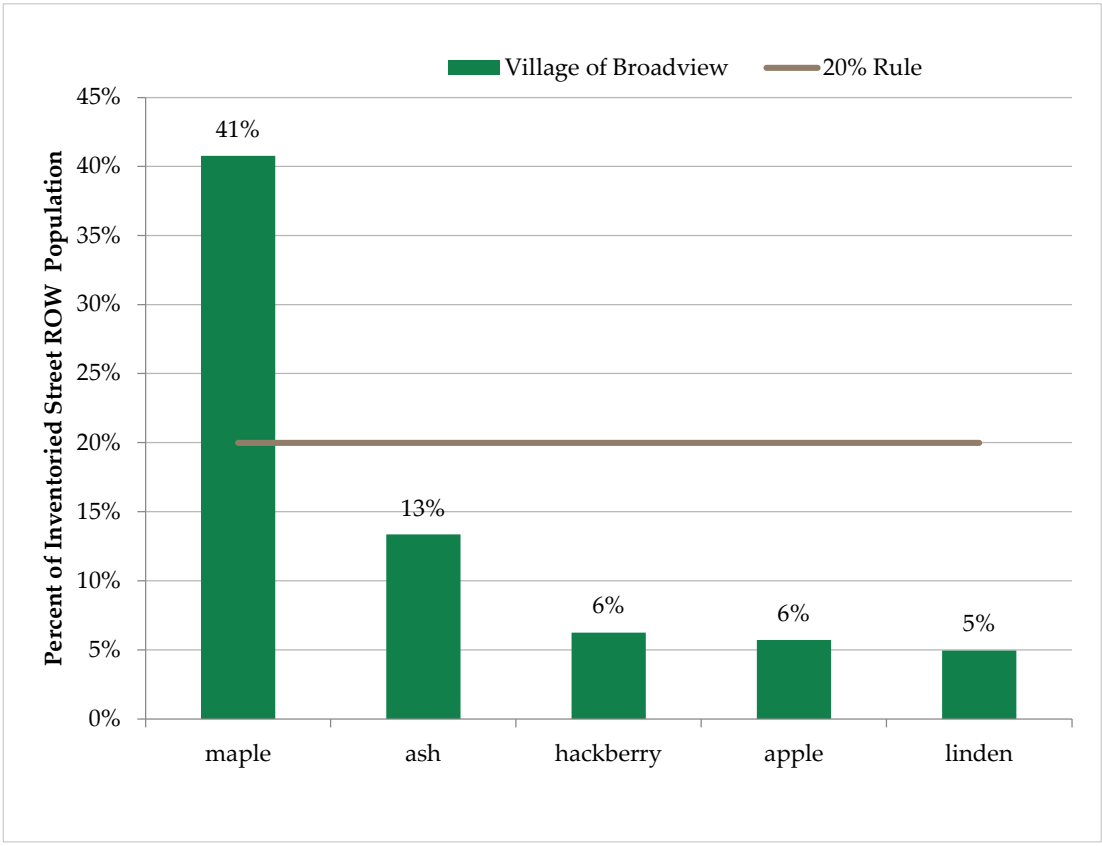


Figure 3. Genus distribution of Broadview's tree resource.

Figure 4 shows the distribution of the most abundant families inventoried in Broadview's tree population compared to Santamour's 30% family threshold. The overabundance of maple significantly influences the family distribution, causing the soapberry family (*Sapindaceae*, 43%) to represent almost half of the population. The olive family (*Oleaceae*, 14%) is relatively abundant, but not enough to be concerning.

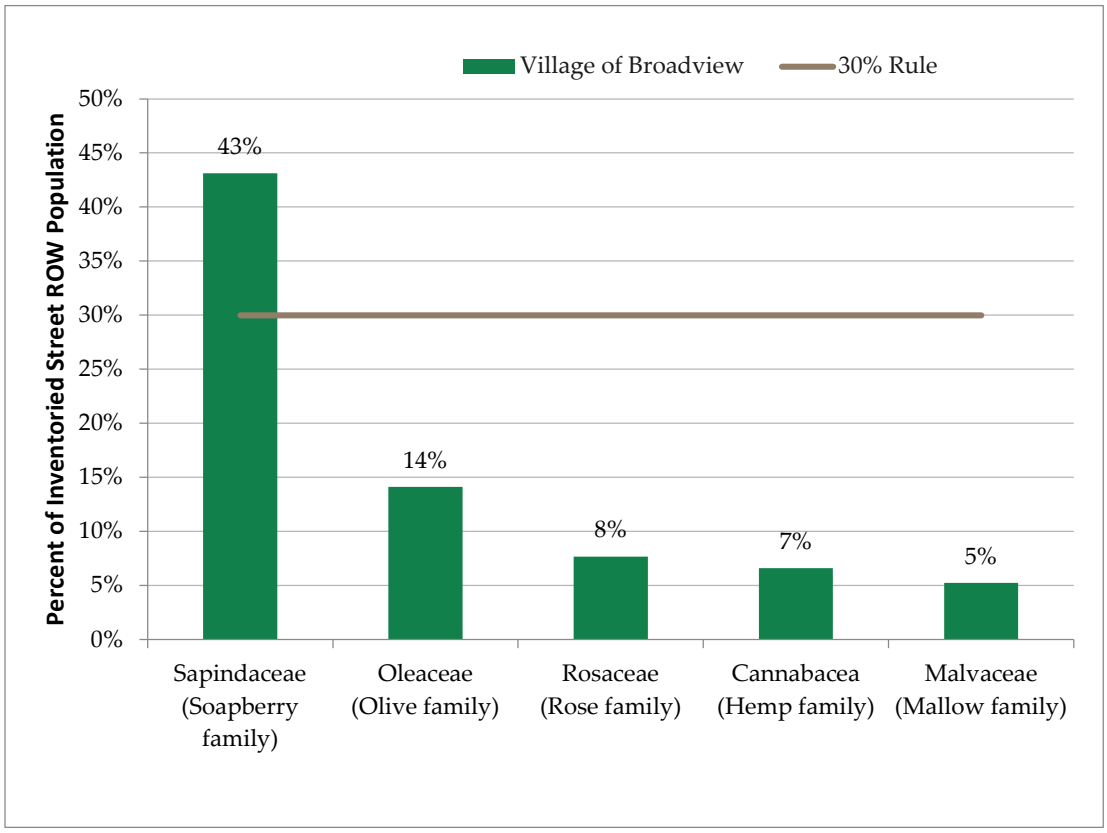


Figure 4. Family distribution of Broadview's tree resource.

Pest Susceptibility

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

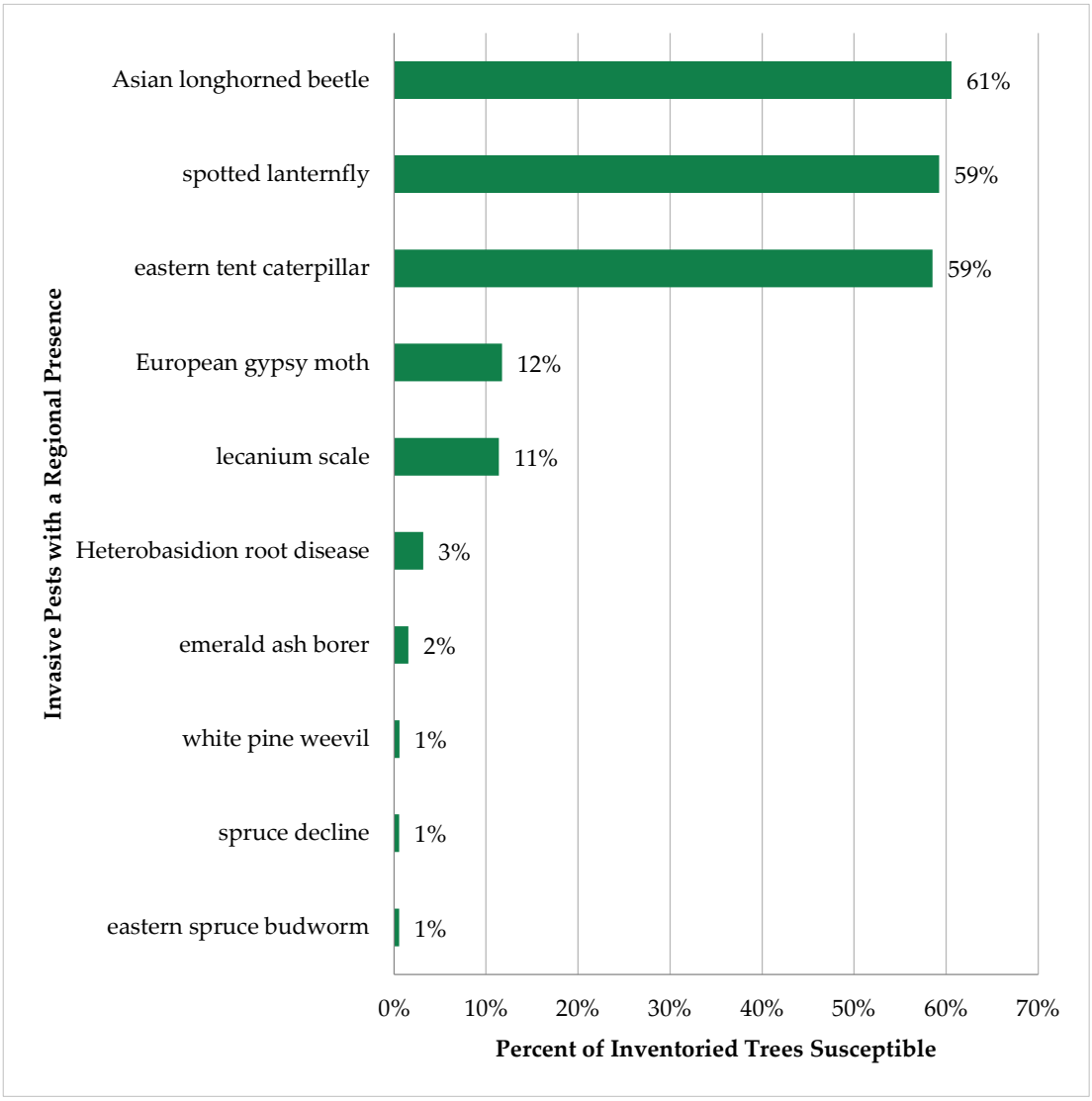


Figure 5. Tree susceptibility to pests and diseases with a regional presence.

Figure 5 shows the proportion of inventoried trees susceptible to some of the known pests in and around Illinois. It is important to remember that this figure only represents data collected during the inventory; there are many trees in Broadview's private properties and natural areas that can spread pests and disease. The inventoried tree population is most susceptible to Asian longhorned beetle (ALB), spotted lanternfly (SLF), and eastern tent caterpillar (ETC, *Malacosoma americanum*) because maple are hosts to all three and are about one third of the population. ETC is a native species with fluctuating population levels that only cause outbreaks once every several years; however, SLF, ALB, and EAB are aggressive invasive pests that could cause massive losses to Broadview's public tree resource if established in Iowa.

EAB has only one host, ash (*Fraxinus*). The wood boring beetle ultimately causes tree mortality within 3–5 years of infestation and an entire municipal population within 16 years. Having 517 ash trees along street ROWs and in the parks is of concern due to the elevated risk to public safety and large loss to Broadview's tree canopy. As of 2021, EAB has been found in 5 Canadian provinces and 35 states including Illinois (USDA APHIS 2020).

While SLF also has several hosts, it does not cause tree mortality as directly as ALB. SLF feeds on tree sap rather than boring into wood. Sap has more sugar than can be readily digested by SLF, so its excrement is referred to as "honeydew". The "honeydew" attracts other insects to the infested tree as well as providing growth substrate to sooty molds. The sap-sucking and pest attraction cause stress making it difficult for a tree to withstand other environmental stress over time, leading to condition decline or death. Currently, SLF has been found in Connecticut, Virginia, West Virginia, Pennsylvania, New York, New Jersey, Maryland, Delaware, Ohio, and most recently as of last year Indiana (USDA APHIS 2020).

ALB has been found in Ohio, South Carolina, New York, and Massachusetts (USDA APHIS 2020). While ALB has not yet been detected in Iowa, there are active populations in southern Ohio, and like emerald ash borer (EAB, *Agrilus planipennis*), it can be transported in firewood (Michigan.gov 2020). While ash (*Fraxinus*) trees are the only host of EAB, several tree genera are preferred hosts of ALB, such as horsechestnut/buckeye (*Aesculus*), birch (*Betula*), willow (*Salix*), and elm (*Ulmus*) (USDA APHIS 2020). Planting species representing smaller proportions of the public tree resource is a proactive approach to avoid losses on the scale of EAB.

Condition Distribution

Several factors affecting condition were considered for each tree, including surface root characteristics, bud and twig condition, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated by an ISA certified arborist as Good, Fair, Poor, or Dead. The general health of the inventoried tree resource is characterized by the most prevalent condition rating. Figure 6 shows that Broadview's public tree resource is in Fair condition (73%). The remainder of the public tree resource was either Good (13%), Poor (11%), or Dead (3%).

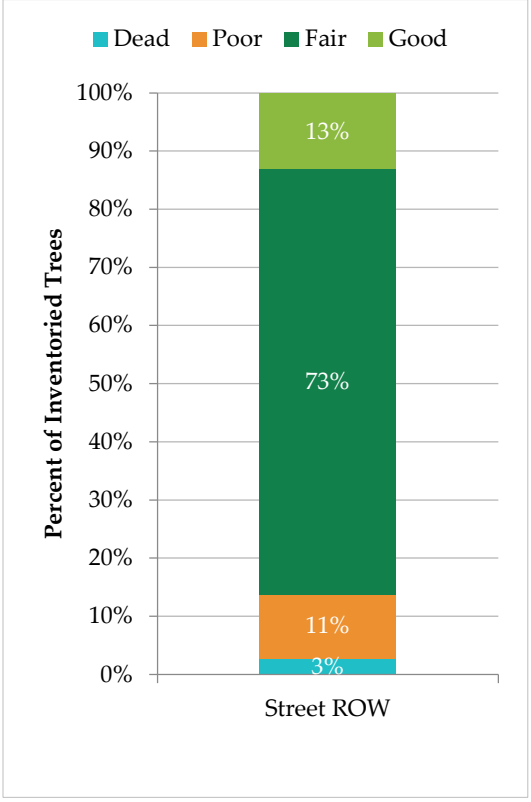


Figure 6. Condition distribution of Broadview's tree resource.

Size Distribution

Richards' ideal size distribution for a tree population is that the largest proportion (approximately 40%) should be young trees while the smallest proportion (approximately 10%) should be mature trees (Richards 1983). Broadview's public tree resource is comprised by only 13% young trees (1–8" in diameter), 58% established and maturing trees (9–24" in diameter), and 29% mature trees. It is more important to spend most resources maintaining the condition of existing trees, but it is also important to plant new trees in canopy gaps to replace removed trees and stabilize canopy.

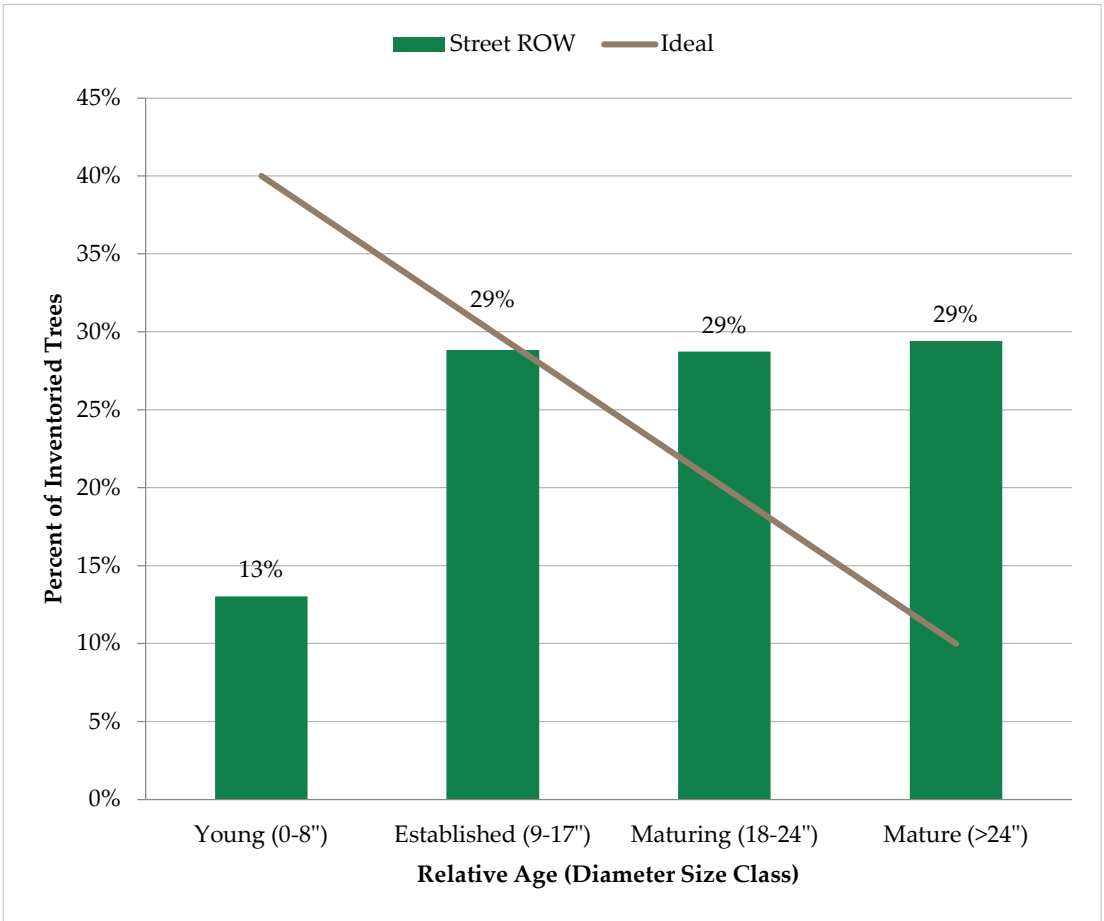


Figure 7. Size distribution of Broadview's public tree resource.

Condition by Size Class

Figures 8 cross-analyzes the condition of Broadview's public tree resource with its trunk diameter size class distribution.

The proportion of young trees (1–8″ DBH) in Good condition (42%) is almost double the proportion of established trees (9–17″ DBH) rated Fair condition (68%). This trend indicates that a significant number of trees have declining condition by the time they become established, which emphasizes the importance of training young trees.

Broadview's public tree resource consists of 2% and 6% mature and maturing trees in Good condition, and 15% and 14% mature and maturing trees in Poor & Dead condition. These trends emphasize the importance of need for an improved routine tree care so their health is maintained in Good and Fair conditions as they age.

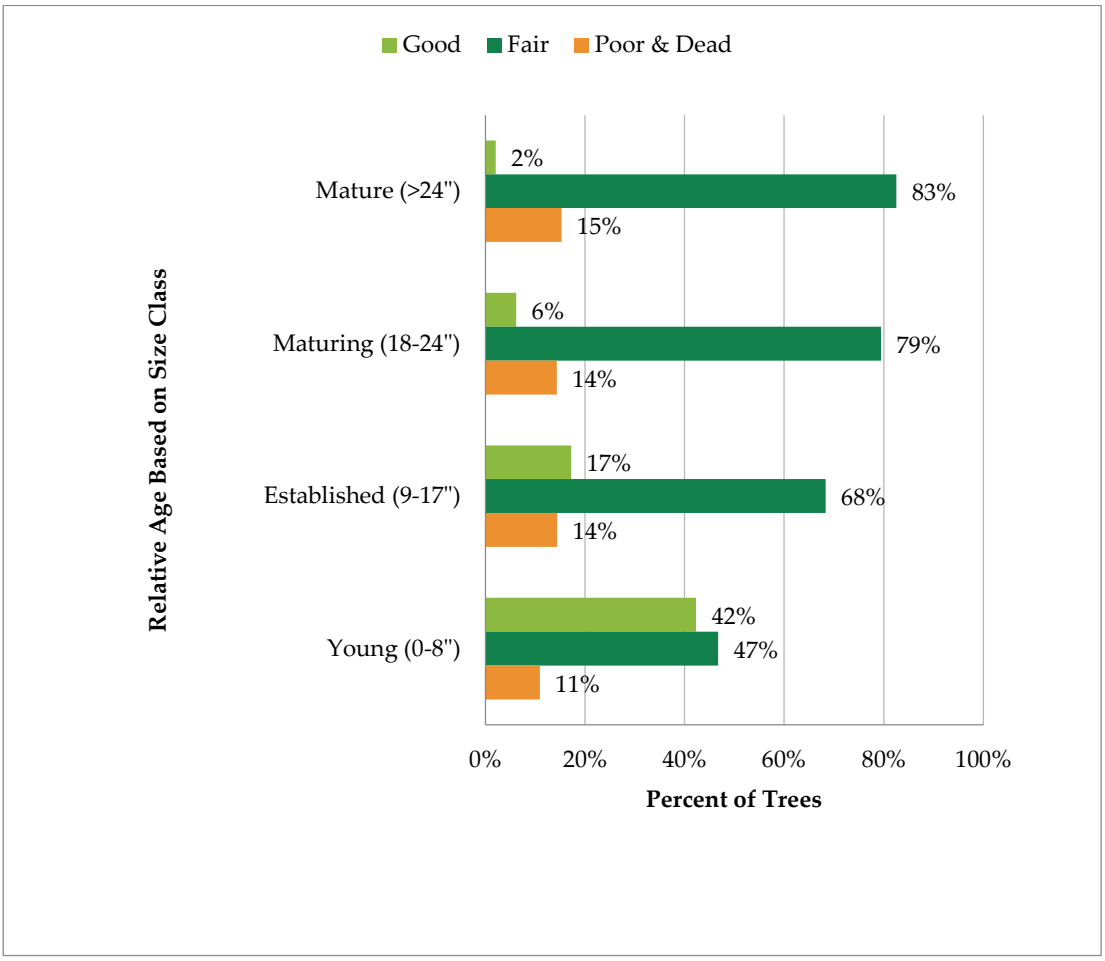


Figure 8. Condition by size class of Broadview's tree resource.

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 utilities above a tree or planting site was noted; it is important to consider these data when planning pruning activities and selecting tree species for planting.
- *Hardscape Damage*—The presence of hardscape damage greater than 1" caused by a nearby tree was noted. 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.

Table 2 shows the number of trees where overhead utilities are present and are either conflicting or not and the number of trees where overhead utilities were not present. There are 103 trees (3%) that have overhead utilities conflicting with their canopy. There are 74 trees (2%) that have overhead utilities present and not conflicting with their canopy. The remaining 3,292 trees are not in conflict with overhead utilities.

Also shown in Table 2 is the number of trees that have or haven't caused hardscape damage. 88 trees (3%) were found to have hardscape damage greater than 1".

Table 1. Overhead utility and hardscape conflicts

Conflict	Street Trees	Percent of Street Trees
Overhead Utilities		
Present and Conflicting	103	3%
Present and Not Conflicting	74	2%
Not Present	3,292	95%
Total	3,469	100%
Hardscape Damage		
Yes	88	3%
None	3,381	97%
Total	3,469	100%

Recommendations

The above sections summarized the diversity, size, and condition of the inventoried tree resource. With a baseline of information about the village's trees, Broadview can set goals concerning population resilience and sustainability. DRG recommends the village consider the following industry guidance:

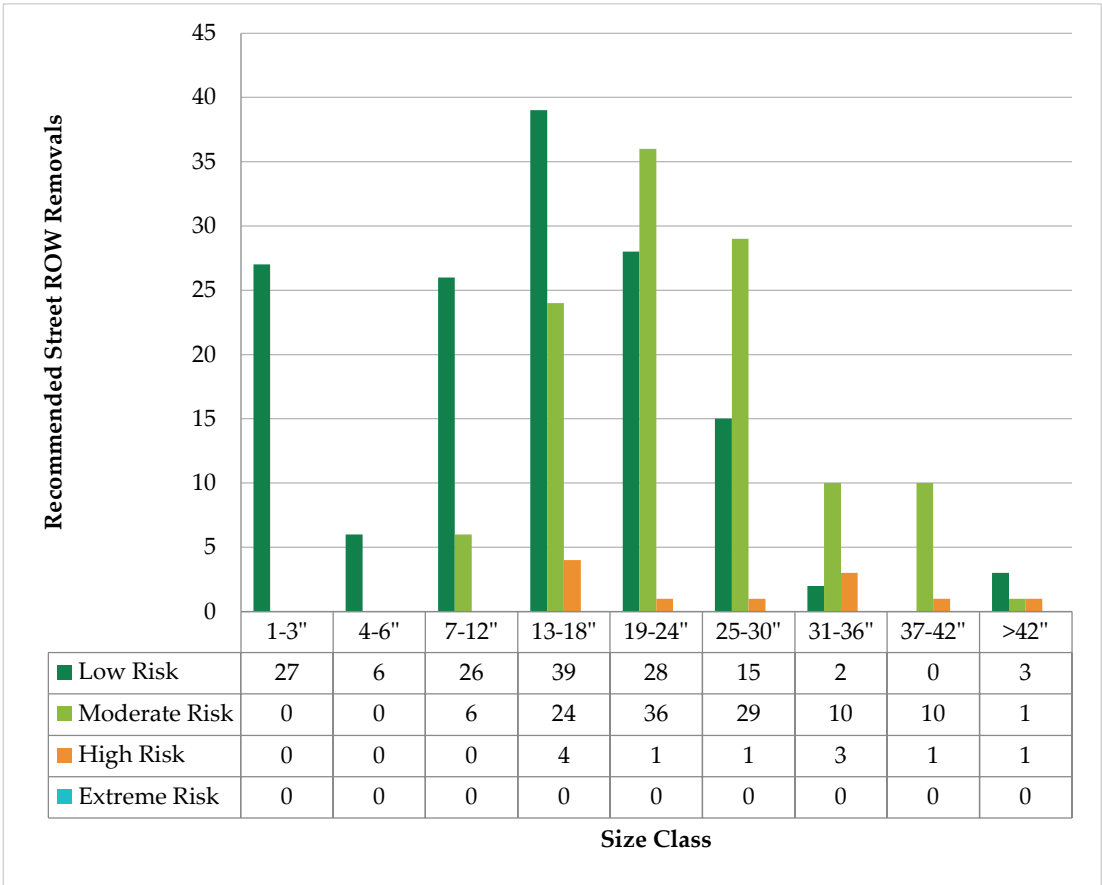
- Improve species and genus distribution with future planting plans using the 10-20-30 threshold or similar threshold so susceptibility to pests with a regional presence is minimized.
- Develop a recommended species planting list for easier species selection during planning.
- Develop a strategy for how to maximize Good condition trees and minimize Poor and Dead trees.
- Create a routine inspection schedule for inventoried trees for early diagnosis of pest and diseases infestations.
- Minimize future conflicts with overhead utility lines, DRG recommends planting only small-growing species within 20 feet of overhead utilities, medium-growing species within 20–40 feet, and large-growing trees outside 40 feet. This prevents the health impacts of unnecessary pruning and reduces the costs of maintaining trees near overhead utilities.
- 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.
- Make data collection, such as measuring DBH and assessing condition, and data entry into TreeKeeper® the standard procedure for all tree work and routine inspections so changes over time can be monitored. This empowers Broadview to self-assess the village's progress over time and set goals to strive toward by following the adaptive management cycle.

PART 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 has analyzed the data to show prioritization among recommended maintenance activities.

PRIMARY MAINTENANCE: REMOVE

Shown in Figure 9, the inventory identified a total of 127 High and Moderate Risk trees in Broadview's tree population. Zero Extreme Risk trees needing removed were identified within tree population at the time of the inventory. The figures also show there is a total of 146 Low Risk trees.



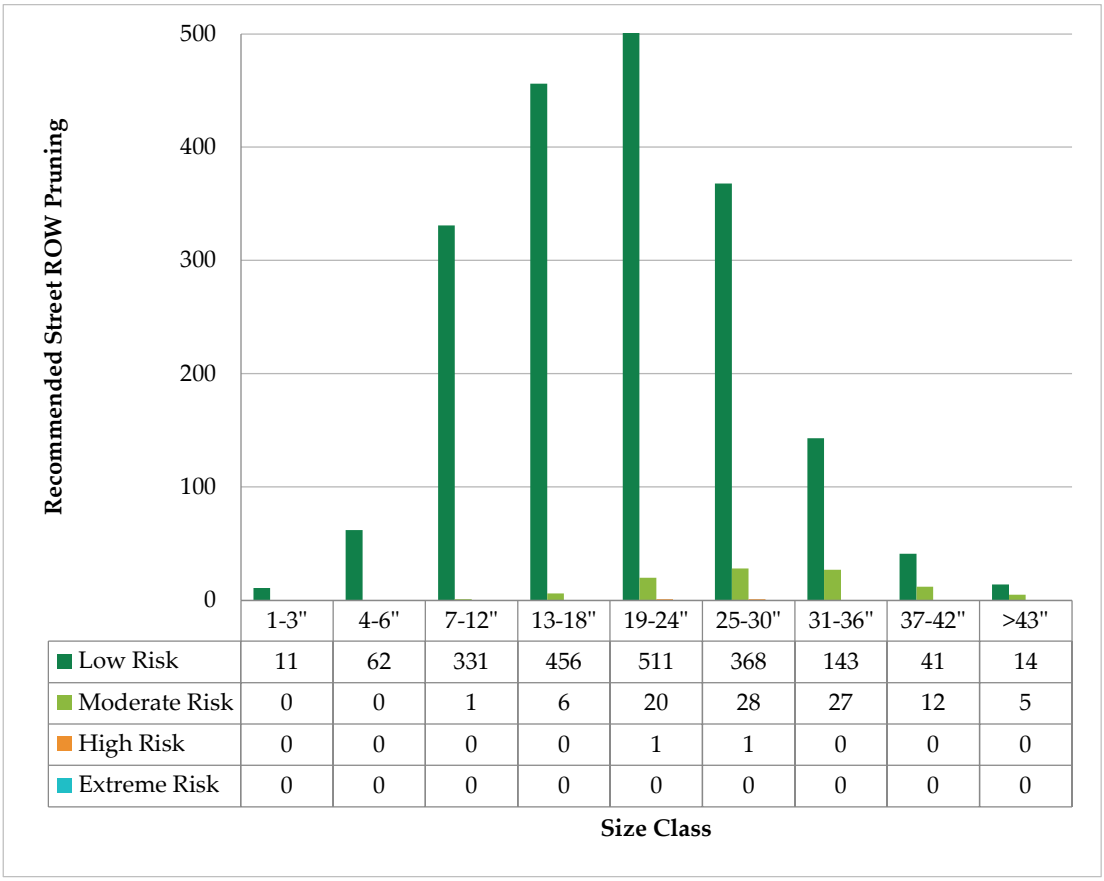
	1-3"	4-6"	7-12"	13-18"	19-24"	25-30"	31-36"	37-42"	>42"
Low Risk	27	6	26	39	28	15	2	0	3
Moderate Risk	0	0	6	24	36	29	10	10	1
High Risk	0	0	0	4	1	1	3	1	1
Extreme Risk	0	0	0	0	0	0	0	0	0

Figure 9. Recommended removals prioritized by risk rating and size class.

PRIMARY MAINTENANCE: PRUNE

The best approach for Broadview would be pruning the 4 High Risk trees immediately and then pruning the 23 Moderate Risk trees after.

Shown in Figure 10, the inventory identified a total of 27 High and Moderate Risk trees. Zero Extreme Risk trees needing pruned were identified at the time of the inventory. The figure also shows there is a total of 48 Low Risk trees.



	1-3"	4-6"	7-12"	13-18"	19-24"	25-30"	31-36"	37-42"	>43"
Low Risk	11	62	331	456	511	368	143	41	14
Moderate Risk	0	0	1	6	20	28	27	12	5
High Risk	0	0	0	0	1	1	0	0	0
Extreme Risk	0	0	0	0	0	0	0	0	0

Figure 10. Recommended pruning prioritized by risk rating and size class.

Recommendations

The above sections summarized the risk rating and recommended maintenance activity assigned to each tree during the inventory. With this collection of information about the village's trees, Broadview can set goals concerning tree health, safety, and longevity. DRG recommends the village consider the following industry guidance:

- Develop a tree maintenance program focused on the elimination of high priority or elevated risk trees. DRG recommends the Village of Broadview prune or remove all Extreme, High, and Moderate Risk trees as soon as possible or as resources allow.
- Develop a work priority policy for how to determine what tree receives maintenance before the others. DRG recommends the Village of Broadview utilize Risk Rating and the order of concern be Extreme, High, Moderate, and then Low.
- Use TreeKeeper® to locate concerning trees, plan and schedule work, and keep records of completed work to improve the ease and efficiency of tree maintenance.
- Develop a routine inspection schedule of the inventoried trees for the purpose of monitoring defects, prescribing work, and keeping an up-to-date inventory of the resource to make informed decisions related to diversity, size, condition, and value of the inventoried park tree resource.
- Develop a multi-year projected budget demonstrating needed funding and resources to prune and remove high priority or elevated risk trees, remove stumps, training prune young trees and structurally prune aging trees to support Good tree health throughout the life of the tree, replant trees that have been removed, plant new trees, project future removals, and routinely inspect the tree resource.

PART 3: TREEKeeper® RESOURCE BENEFITS ANALYSIS

Davey's TreeKeeper® continually estimates tree-related benefits by analyzing public tree resource inventory data. TreeKeeper® uses the species composition and size structure to estimate the functional contribution and monetary value of the environmental services performed by the inventoried trees. Using the i-Tree eco model, developed and peer-reviewed by the USDA Forest Service, 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 RETURN ON INVESTMENT FROM THE PUBLIC TREE RESOURCE

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

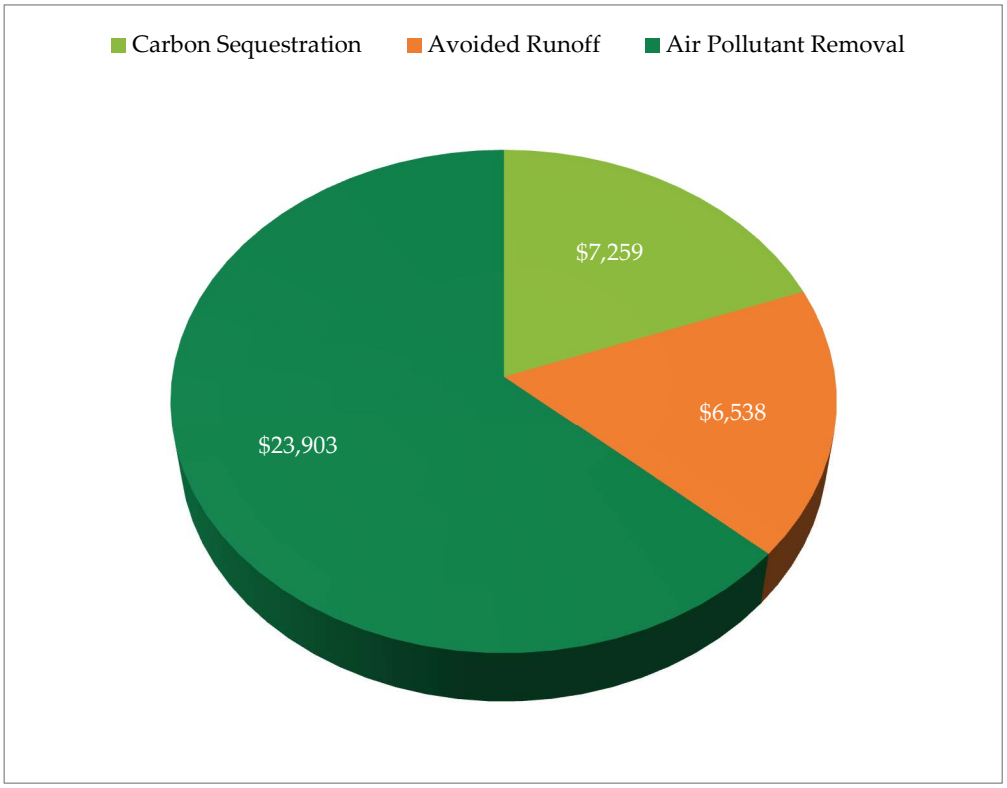


Figure 11. Estimated annual value of the inventoried tree resource functional benefits.

Urban environments have unique challenges that make the estimated $37,700 of functional benefits provided by Broadview's inventoried tree population an essential asset to the village (Figure 11). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area, valuing the 4,120 lbs. of airborne pollutants removed by Broadview's tree resource at an estimated $23,903. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment, valuing the 731,620 gals. of runoff avoided with Broadview's tree resource at an estimated $6,538. Carbon dioxide ($CO_2$) also impacts people, property, and the environment as the primary greenhouse gas driving climate change, valuing the 43 tons sequestered by Broadview's tree resource at an estimated $7,259.

Recommendations

It is important to remember that trees provide the most benefits when they are mature, and their care is an investment of both time and money. Therefore, routine tree care that maintains their condition is essential to maximize the benefits received from the inventoried tree resource.

It is also important to plant large-growing tree species wherever growing space allows, because they provide the most benefits by having significantly more leaf surface area.

CONCLUSION

It is important to maintain the tree inventory using TreeKeeper® as tree maintenance activities are completed. Species distribution for planting initiatives, maintenance needs for improving tree health, and tree benefit estimates will be ready for Broadview's use as the program engages needed funders and community support. An accurate inventory empowers Broadview to self-assess the village's progress over time and set goals. A well-maintained inventory is a cost savings tool in the Village of Broadview's track for sustainable growth.

This *Tree Inventory Summary Report* can help advocate for proactive urban forestry activities to implement the recommended maintenance activities. As the urban forest is actively maintained, the benefits enjoyed by the Village of Broadview and its residents will increase as well.

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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/Location
- Comments
- Condition
- Defects
- Date of Inventory
- Future Inspection
- Maintenance Recommendation
- Multi-stem Tree
- Risk Assessment and Rating
- Size*
- Species
- Utility Interference
- Hardscape Damage
- 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 Client Given	2021	NAD 1983 StatePlane Illinois East FIPS 1201 Feet
Aerial Imagery Cook County GIS	2022	NAD 1983 StatePlane Illinois East FIPS 1201 Feet

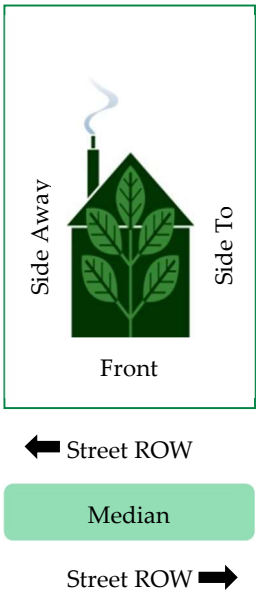
STREET ROW SITE LOCATION

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

Address Number and Street Name

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

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



Side Value

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

PARK AND PUBLIC SPACE SITE LOCATION

Park and/or public space site locations were collected using the same methodology as street ROW sites, however all of them have the "Park Name" data field filled in based on their corresponding location.

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 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 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 United States, 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 accidently 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 vine 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

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 Village, 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*).

EASTERN TENT CATERPILLAR

Eastern tent caterpillar (*Malacosoma americanum*) was first observed in the United States 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)

EUROPEAN GYPSY MOTH

The gypsy moth (GM, *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. GM caterpillars defoliate trees, which makes the species vulnerable to diseases and other pests that can eventually kill the tree.

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

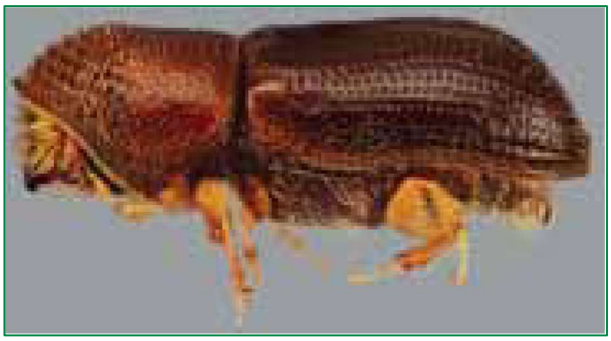
Photograph courtesy of USDA APHIS (2019)

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*).

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.



Side view of a walnut twig beetle.

Photograph courtesy of the USFS (2011)

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, *Juglans* (walnut) 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.

The tree species preferred as hosts for TCD are walnut.

OAK WILT

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of the USFS (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.

HEMLOCK WOOLY ADELGID

Hemlock woolly adelgids on a branch.

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

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.

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.

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)

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APPENDIX C
SUGGESTED TREE SPECIES

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is offered to assist all relevant campus 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 majority of soil and climate conditions throughout Zone 5 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 rubrum	red maple	Red Sunset®
Acer nigrum	black maple	
Acer saccharum	sugar maple	'Legacy'
*Aesculus flava**	yellow buckeye	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Castanea mollissima**	Chinese chestnut	
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	(male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans regia**	English walnut	'Hansen'
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	Cherokee™
Liriodendron tulipifera	tuliptree	'Fastigiatum'
Maclura pomifera	osage-orange	'White Shield','Witchita'
*Magnolia acuminata**	cucumbertree magnolia	(numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
Platanus × acerifolia	London planetree	'Yarwood'
*Platanus occidentalis**	American sycamore	
Quercus alba	white oak	
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus ellipsoidalis	northern pin oak	

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

Scientific Name	Common Name	Cultivar
Quercus frainetto	Hungarian oak	
Quercus imbricaria	shingle oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	
Quercus montana	chestnut oak	
Quercus muehlenbergii	chinkapin oak	
Quercus phellos	willow oak	
Quercus robur	English oak	Heritage®
Quercus rubra	northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Quercus texana	Texas oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
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	
Cladrastis kentukea	American yellowwood	'Rosea'
Eucommia ulmoides	hardy rubbertree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	eastern hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	amur corktree	'Macho'
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
Sorbus alnifolia	Korean mountainash	'Redbird'

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer buergerianum	trident maple	Streetwise®
Acer campestre	hedge maple	Queen Elizabeth™
Acer cappadocicum	coliseum maple	'Aureum'
Acer ginnala	amur maple	Red Rhapsody™
Acer griseum	paperbark maple	
*Acer pensylvanicum**	striped maple	
Acer truncatum	Shantung maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(numerous exist)
Amelanchier laevis	Allegheny serviceberry	
Carpinus caroliniana	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Chionanthus virginicus	white fringetree	
Cornus 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'
*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'
Styrax japonicus	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Note: * denotes species **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'
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
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	
Psedotsuga menziesii	Douglasfir	
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	
Thuja occidentalis	eastern arborvitae	(numerous exist)

Small Trees: 15 to 30 Feet in Height at Maturity

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

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