



Greening Gardner

DOWNTOWN TREE INVENTORY & PLAN

DRAFT

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Front cover, Top: A view down Chestnut Street in 1906 reveals how Gardner's urban forest has changed over the past century, and helps to visualize how the city could once again have a thriving street tree canopy in its downtown neighborhoods. Bottom: recently planted trees in downtown Gardner, MA.

This spread: Maple leaf in rain (Image Source: Dimitar Bachvarov under a CC BY-ND 2.0 license)



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This project was funded by a planning grant from the Municipal Vulnerability Preparedness (MVP) Program of the Massachusetts Executive Office of Energy and Environmental Affairs (EEA)



Gardner's downtown trees provide significant benefits to the city. Expanding tree cover will make the City more comfortable, beautiful, and resilient.

EXECUTIVE SUMMARY

The City of Gardner recognizes that street trees help make the city comfortable, functional and attractive. Street trees have numerous benefits including, decreasing heat in summer, buffering wind, decreasing building energy costs, providing places for birds and other creatures to nest and food for them to eat, helping to manage stormwater, cleaning air, slowing climate change, slowing traffic, and increasing property values.

Despite the benefits of trees, some areas of Gardner lack adequate street tree cover. With this in mind, the City of Gardner undertook planning for its urban forest, funded by a grant from the Commonwealth’s Municipal Vulnerability Preparedness (MVP) Program. The City focused its work on the downtown and surrounding neighborhoods as this area is especially lacking tree cover, the city’s most densely settled area, and designated as an environmental justice and urban renewal area.

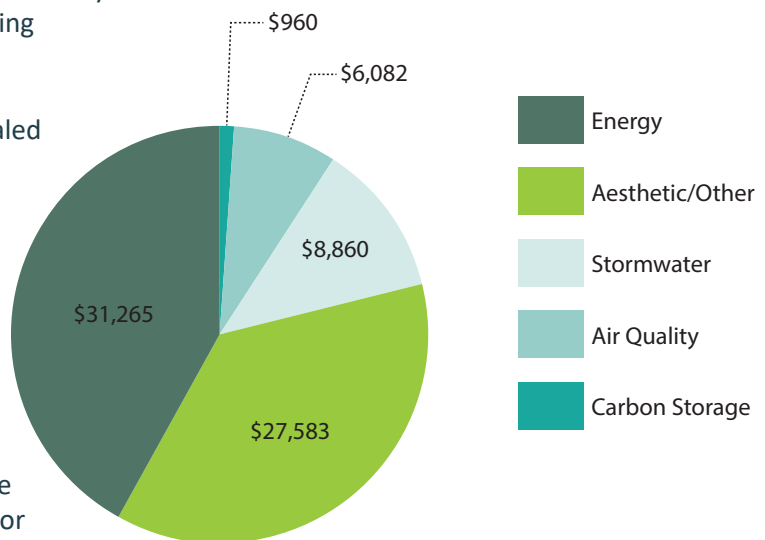
The project had two steps. First, existing street trees in the focus area were inventoried and the benefits of those trees was quantified. Second, a strategic plan was created for increasing tree cover in the focus area. These steps were led by Dodson & Flinker, consultants hired by the Gardner, with input from Gardner’s MVP Core Team, and the community more broadly through the City’s MVP planning project.

The inventory and analysis of benefits revealed the following key findings:

- There are three hundred and sixty-four trees in the study area.
- The vast majority of these are near the street, but on private property. There are few street trees within the public right of way.
- Nearly four out of ten trees in the study area are Norway Maple trees.
- Gardner’s downtown street trees provide almost \$75,000 in total annual benefits, or almost \$200 per tree each year.
- The majority of the benefits of street trees in the area come from reduced energy bills, and increased aesthetic/property values.

The strategic planning came to the following conclusions:

- Due to the existing build-out of streets, sidewalks and buildings in the study area, there are few “easy” locations for planting new street trees within the existing right of way.
- Despite the challenges of Gardner’s built environment, there are ample opportunities to plant new trees in the study area. The potential locations for new trees likely exceeds the city’s capacity to plant new trees for the foreseeable future.
- Settings in which new trees can be planted, include: existing and new tree belts, medians, curb bumpouts, tree pits and stormwater planters, parking lots, and on private property adjacent to the right of way (front yard trees).
- Of the potential planting locations, private property next to the right of way has the greatest potential. Planting in these locations will require cooperation from private property owners and thus public outreach is the crucial step for future tree planting efforts.
- In addition to planting new trees, Gardner can support its urban forest by incorporating consideration of trees into its ordinances and regulations, and ensuring adequate funding for tree planting and maintenance, including seeking grants and other funding sources.



\$74,749 in total annual benefits

Gardner’s downtown street trees provide almost \$75,000 in total annual benefits, or almost \$200 per tree each year.

TREE INVENTORY

OVERVIEW

As part of the Municipal Vulnerability Plan (MVP), the City of Gardner undertook an inventory and analysis of street trees within downtown and created a strategic plan for improving the area's urban forest, with a focus on actions the City can take to support the planting and maintenance of street trees. The underlying goal is to help increase downtown Gardner's street tree cover in ways that create a greener, more climate resilient, and more livable city for its residents.

The project's study area largely overlaps with an Environmental Justice population area, which encompasses most of downtown, as well as an urban renewal area. Expanding urban tree canopy in these areas is key strategy for making the area more comfortable, sustainable, and spurring economic development. The completion of this tree plan occurred in conjunction with Gardner's MVP planning so that opportunities to improve the city's urban forest could be identified and included in its overall climate resilience strategy. Because climate resilience and urban greening are both priorities for EEA, actions that address both of these at once are especially well suited for grant funding.

METHODS

The City hired Dodson & Flinker to conduct the inventory and analysis and lead strategic planning. Dodson & Flinker inventoried existing street trees within the study area downtown. Because few trees are clearly within the City-owned right of way (ROW), the inventory included trees that are large enough and close enough to the street to provide shade to the ROW. A majority of trees in the inventory are located on private property in front and side yards. Because Massachusetts allows municipal street trees to be planted on private property (with owners' permission), it was determined that these trees represented an important type of street tree and should be counted. Because locating property lines throughout the study area was beyond the scope of this project, street trees were counted as being on private property if they were outside the edge of

pavement (unless the parcel was City-owned). Some areas of trees along street edges were excluded if they were part of the edge of a larger forest, since these are not representative of a potential street tree planting typology and would have resulted in misleading data. Within the study area there are many more trees behind houses, in forested areas, and in other locations away from the street. The goal of this inventory was to record individually planted trees whose canopies extend over the right of way.

Trees were inventoried using iTree Streets' web-browser data entry system for mobile devices. Tree surveyors from the project team stood beside each tree and recorded its location using their mobile device's GPS, and entered data into the iStreets data entry system. The GPS level of precision was within several meters—enough to get a general

ENVIRONMENTAL JUSTICE NEIGHBORHOODS

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) designates census tracts as Environmental Justice populations if a certain percentage of households is below the poverty level, is a minority population, or does not have a proficient English speaker in the household. For much of the 20th century, real estate and planning policies nationwide forced people from these groups to live in less desirable areas that frequently had higher exposure to pollution and other environmental hazards. Today, high concentrations of historically-disadvantaged groups are usually indicative of these histories.

While overtly discriminatory planning practices often ceased decades ago, limited access to opportunities, lower property values, and higher exposure to environmental hazards often persist in these neighborhoods, keeping the people who live in them in a cycle of systemic disadvantage. To this day, these neighborhoods often lack sufficient resources, infrastructure, and amenities that other neighborhoods take for granted. EEA's Environmental Justice Policy helps address these disparities by calling attention to them and prioritizing them for certain kinds of funding.

sense of where the tree is located, but not fine-grained enough to determine ownership of trees. Information recorded for each tree included species, diameter, location type (yard, sidewalk, etc), and condition.

The points were then analyzed in iTree to estimate the economic benefits they provide to the city as well as distribution of species and other characteristics of this population of trees. The data points were also displayed on a map of the study area using GIS.

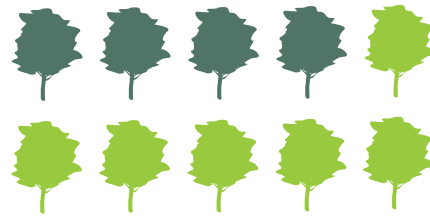
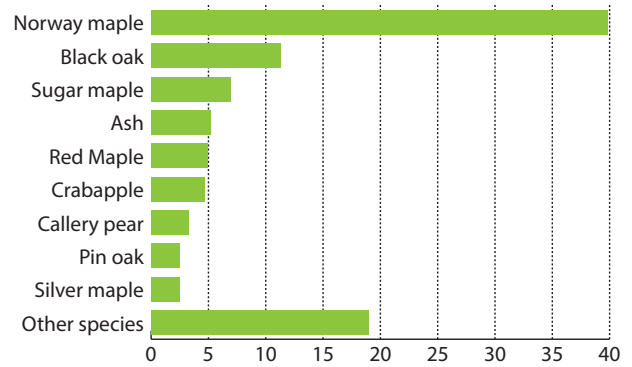
FINDINGS

Three hundred sixty-four (364) qualifying trees were inventoried in the study area. The majority of qualifying trees were on the private property side of sidewalks and streets and therefore most likely on private property. In a smaller number of instances, trees were located on municipal property, in tree belts or tree pits.

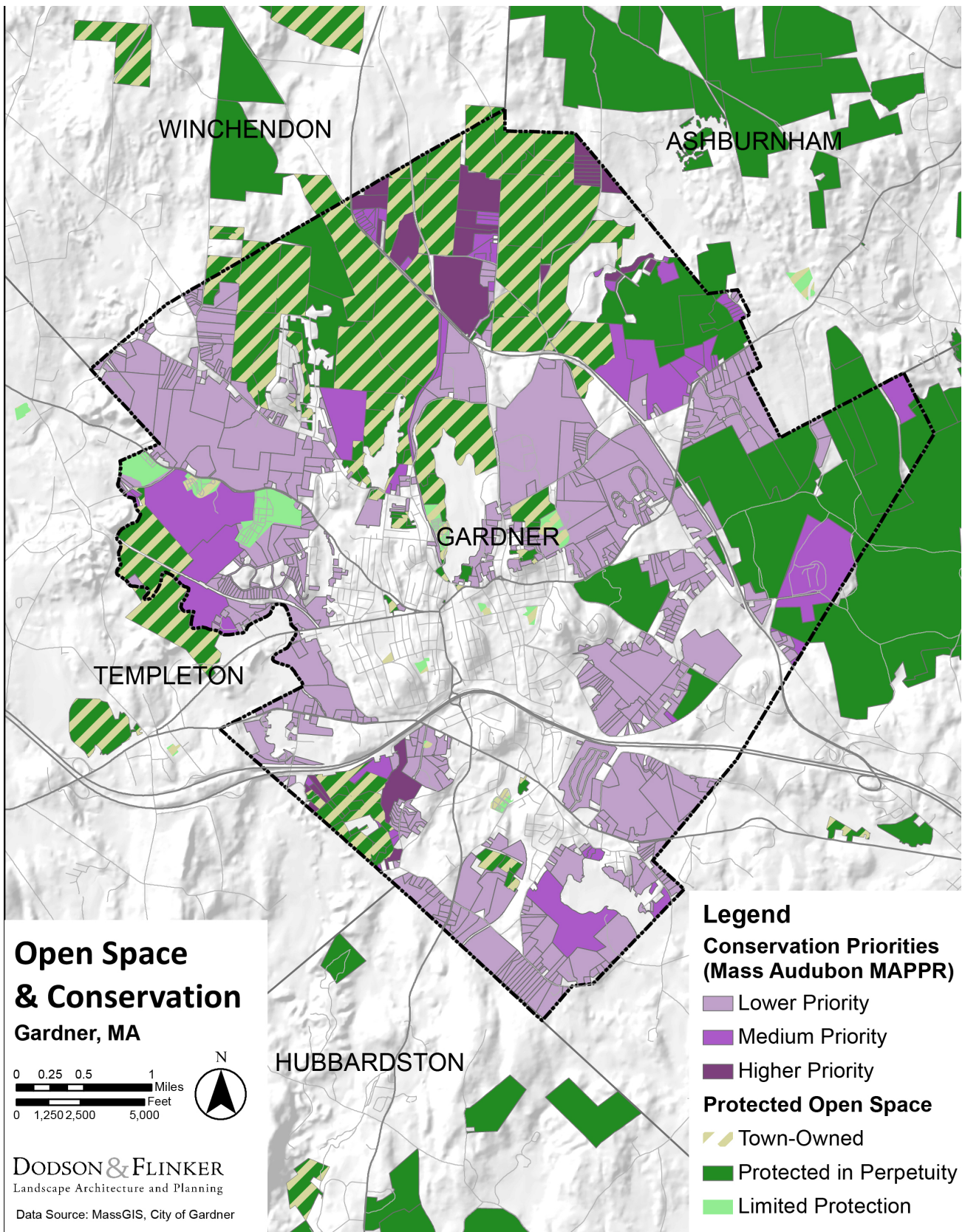
Main Street and the surrounding streets of the downtown core are noticeably lacking in street trees.



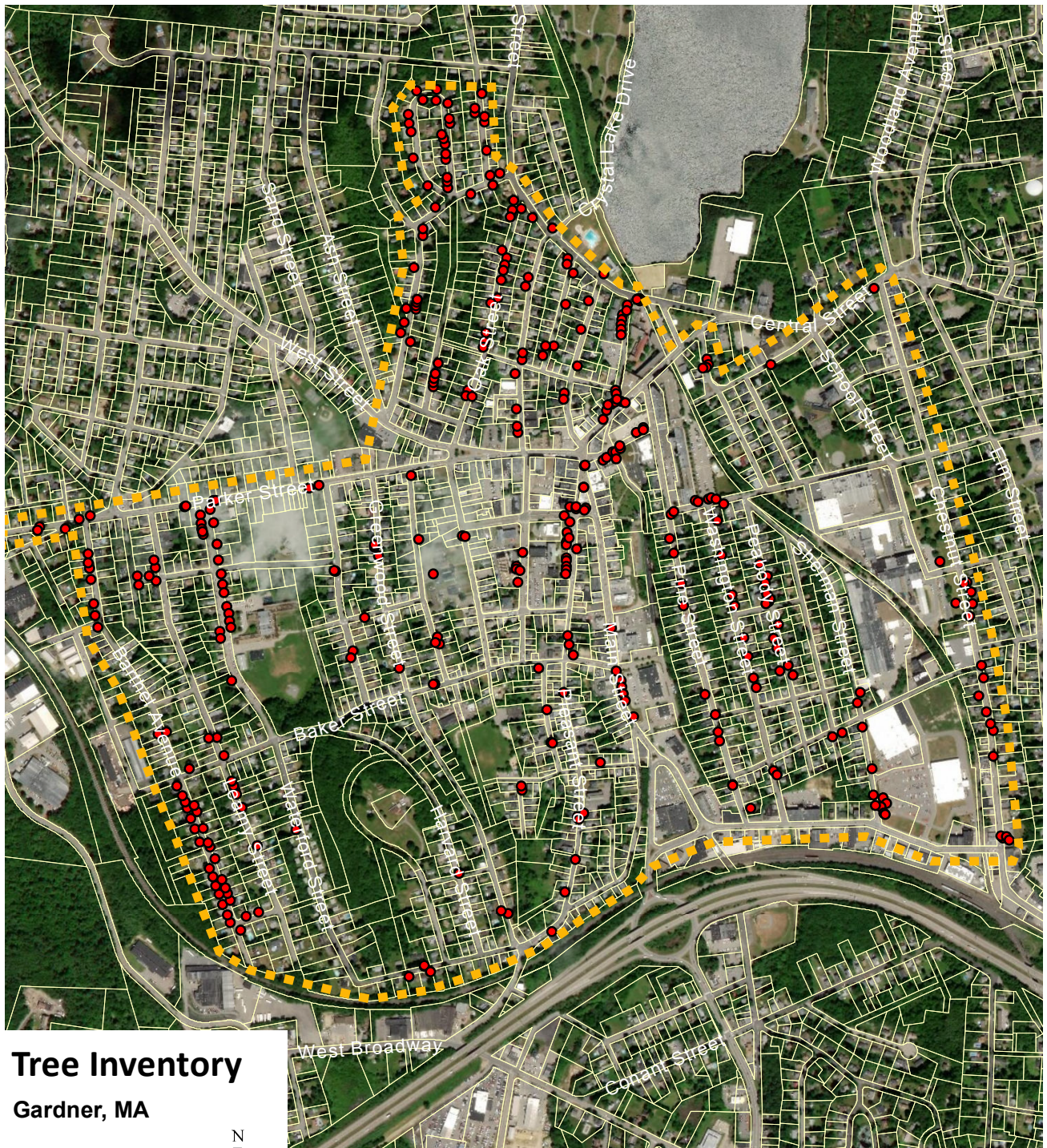
A typical neighborhood condition in downtown Gardner. The municipal right of way contains no tree pits or planting strips, and many houses are very close to the edge sidewalks. Nevertheless, there are opportunities for additional street trees in front yards where overhead wires and other infrastructure permits.



Nearly 4 out of every 10 street trees in the study area are Norway maples. Increasing the diversity of street tree species should be an important goal going forward.

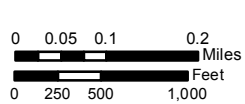


Downtown Gardner is surrounded by a significant amount of protected forests, wetlands and open space, as well as unprotected lands that are considered conservation priorities by Mass Audubon. With more street trees, the City could create appealing walking routes from downtown to these open spaces, encouraging outdoor activity and connection with the natural environment.



Tree Inventory



Gardner, MA



DODSON & FLINKER
Landscape Architecture and Planning

Data Source: MassGIS, City of Gardner

Legend

-  Tree Inventory Study Area
-  Street Trees (On or adjacent to right-of-way)

The locations of street trees mapped in this inventory are depicted in red. It is worth noting that higher concentrations of street trees are found in some of the neighborhoods at the outer edge of the study area, whereas the downtown core has significantly fewer trees.

Through most of this area, buildings are built close together and to the edge sidewalks. There are few tree pits in the sidewalks here, and little room for trees near the right of way elsewhere along Main Street's commercial core.

The residential neighborhoods surrounding downtown are noticeably lacking in street trees. Houses with frontage very close to the street, with small or nonexistent front yards and power lines overhead, leave little room for trees. Where trees over the street do occur, they are mostly in front or side yards. As a result, most of the trees shading the right of way throughout Gardner's downtown neighborhoods are a scattered variety of urban tolerant deciduous trees, both native and non-native.

The species with the most representation is **Norway maple** (*Acer platanoides*), a native to central Europe. In the northeast United States, Norway maples were very commonly planted in the 1950s and 60s as a fast-growing shade tree that is tolerant of urban conditions. Over time however, Norway maple has shown itself to be an aggressive volunteer in this region, propagating easily and casting a dark shade that outcompetes other plants. It is also a relatively weak wooded species. Storm damage from downed limbs can be a significant maintenance expense. For these reasons, it is no longer a recommended tree in this region.

One hundred forty-five (145) Norway maples were counted, comprising nearly 40% of all street trees in the study area. The Norway maples throughout downtown include plantings that appear deliberate along with many that appear to have established as volunteers. Forty five of the trees were 12"-18" diameter at breast height (DBH), and almost all the rest that were counted were larger than 18", up to 42" (and beyond in 5 cases). While future plantings of Norway maples should be discouraged, these existing trees are currently an important part of Gardner's street tree canopy and should be maintained.

The next most common species are native **black oak** (*Quercus velutina*) and the very similar **red oak** (*Quercus rubra*). For the purposes of iTree inventory and calculations, they were all recorded as black oak. 41 specimens were counted. These comprise

11% of downtown's street trees. Many of the largest street trees are black oaks: 10 black oak specimens are over 42" in diameter (the species with the next highest number of very large specimens is Norway maple, with 5 specimens over 42"). These large trees should be protected whenever possible. Pests that affect black and red oak include the gypsy moth, which can defoliate an oak tree during peak moth population years. While an oak can survive one year of defoliation, several successive years of defoliation can kill a tree. The health of Gardner's oaks should be carefully monitored due to recent moth outbreaks in Worcester county, and the more significant oak specimen trees should be protected from moth damage to the extent possible. Protection of these trees could be encouraged through the creation of a Significant Tree ordinance, described later in this report.

Sugar maple (*Acer sacharum*) is the third most common street tree species, with 25 specimens comprising nearly 7% of the study area's street trees. These native trees are an important and iconic species in New England, notable for their fall color and maple syrup production. While they can grow in certain urban conditions, they are intolerant of disturbances like root cutting, soil compaction, paving, and other impacts that are common in cities. Four (4) sugar maples are over 42" in diameter.

Ash trees, either green ash (*Fraxinus pennsylvanica*) or white ash (*Fraxinus americana*), together comprise about 5% of the street trees in the study area. These native trees are very susceptible to the emerald ash borer. There are no confirmed sightings of emerald ash borer in Gardner but it is present in nearby communities, and the entire state of Massachusetts is in a quarantine zone to prevent its spread. It is likely that emerald ash borer will find its way to Gardner in the future. Once ash borer exit holes are detected in a tree, it is likely that the insect did irreparable damage and the ash tree will usually die. Ash trees in Gardner's urban forest should be closely monitored and considered priority for replacement with more resilient species.

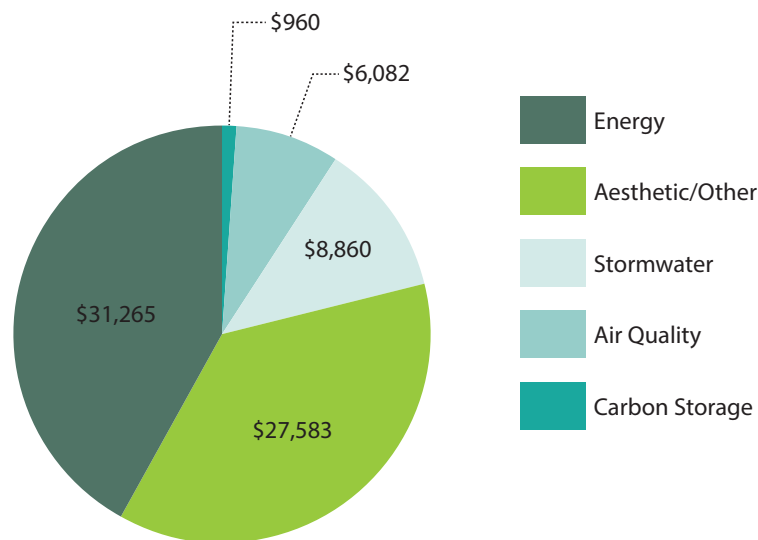
Red maple, crabapple, Callery pear, pin oak and silver maple each comprise less than 5% of Gardner's total street tree population. Five silver maples are over 42" in diameter.



Main Street's commercial core has very few street trees, with limited space for new trees. In most places, buildings come right to the edge of sidewalk and tree pits are nonexistent.



A front yard Norway maple that overhangs the right of way is a typical example of downtown Gardner's street trees. Paving and retaining walls at or close to the right of way (also pictured) is another typical condition found here.



\$74,749 in total annual benefits

Gardner's downtown street trees provide almost \$75,000 in total annual benefits, or almost \$200 per tree each year.

A variety of other species are present in the study area, with less than 10 specimens each, including: horse chestnut, cherry, Japanese maple, Camperdown elm, plum, dogwood, paper birch, honeylocust, black locust, black walnut, zelkova, sycamore, and various evergreens including white pine, spruce, balsam fir, Norway spruce, blue spruce, and eastern red cedar.

ANALYSIS

IStreets, the iTree data collection system that was used to record the tree inventory, quantifies various benefits of the study area's street tree population, including energy savings, carbon sequestration, stormwater absorption, and other benefits. ITree uses data from reference cities in different tree-growth zones throughout the country, including growth habits of typical tree species, energy cost and usage data from utility companies, property values, water costs, stormwater costs, and other data, and calculates the cumulative benefits of the street trees being surveyed in the project. Once the street trees in Gardner's study area were recorded in iTree, the software was used to generate a set of reports on the street trees' various benefits.

More information on how iTree quantifies the benefits of street trees is available here: <https://www.itreetools.org/support/resources-overview/i-tree-methods-and-files/general-information>

Cost Savings of Gardner's Street Trees

Air quality: The air filtration benefits of Gardner's street trees are valued at \$6,082.

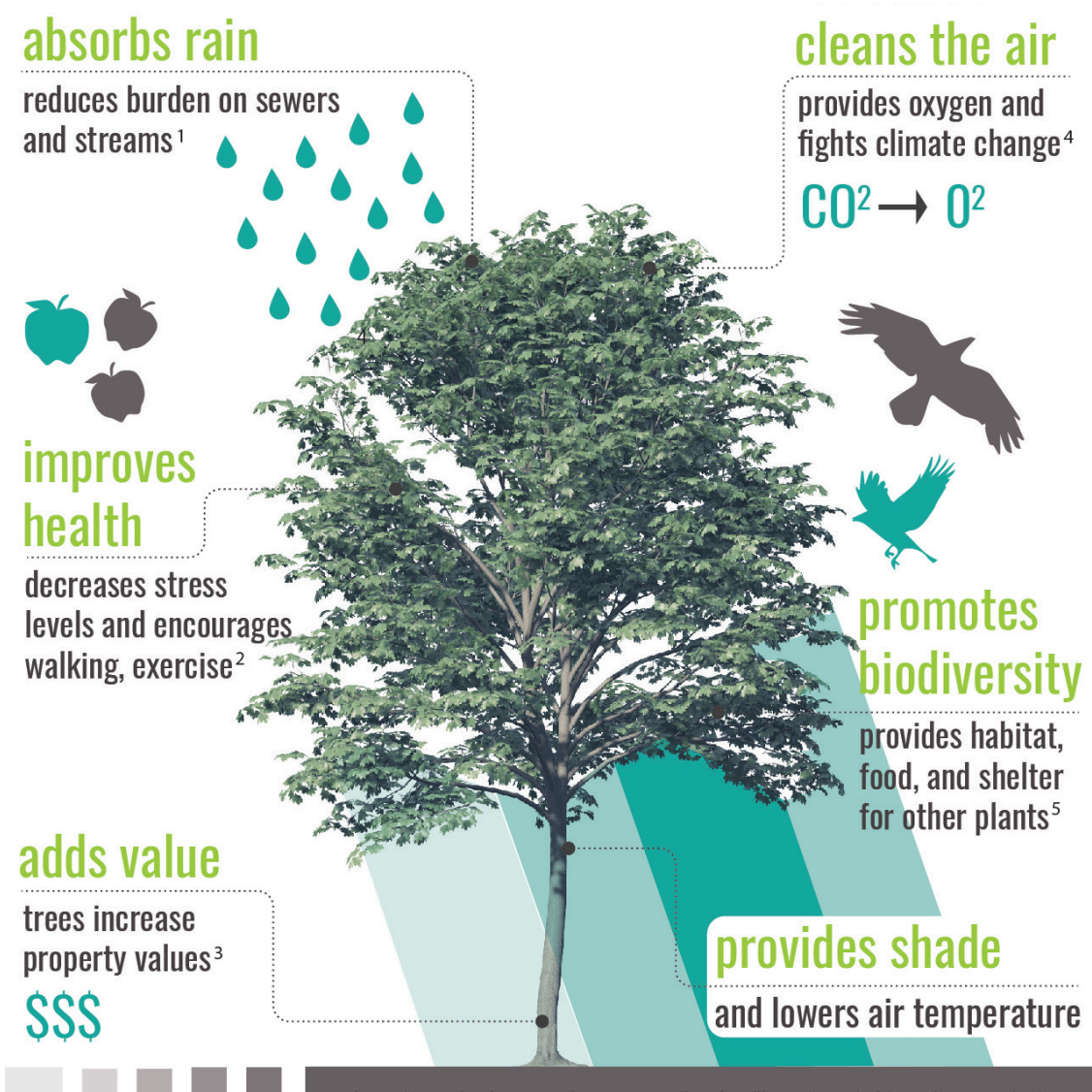
Carbon stored: The atmospheric carbon sequestration provided by Gardner's street trees is valued at \$14,762. 4,473,453 lbs of CO₂ are stored by Gardner's street trees. Annually it is calculated as \$960 for 174,278 lbs of carbon sequestered.

Energy: Between potential electricity and natural gas use, Gardner's street trees save \$31,265 annually. According to iTree the combined canopies of the 364 trees in the inventory cover an estimated 554,316 square feet, or 12.7 acres, providing shade and therefore a reduction in cooling costs.

Stormwater: The 1,107,459 gallons of stormwater intercepted by Gardner's street trees saves the City \$8,860 in stormwater treatment costs.

iTree also calculates "aesthetic/other" benefits of street trees, including raised property values, which in this case are valued at \$27,583 for Gardner's downtown street trees.¹

¹ https://www.itreetools.org/documents/419/Influence_of_Trees_on_Residential_Properties_Anderson_Cordell.pdf



The cost of planting and maintaining a tree is easily offset by its numerous long term benefits.

In total, the 364 trees in the study area provide Gardner the equivalent of \$74,749 in benefits annually, or \$205 per tree. A tree that lives 70 years would provide \$14,350 in benefits over its lifetime. In comparison with the costs of planting and maintaining trees over their lifetime, the benefits of having trees in neighborhoods can easily outweigh the costs.

ITree also calculates a replacement value for trees. Larger and older trees are considered more valuable because they take longer to get to the point where they provide their larger amount of benefits. The total replacement value of Gardner’s downtown street trees is calculated to be \$3,499,211. In other

words, if all the trees were replaced at once, the annual benefits provided by the trees would have to be paid for by other means until new plantings of trees reached equivalent maturity.

PLANTING CHALLENGES AND OPPORTUNITIES

PLANTING CHALLENGES

The streets, sidewalks, and private properties in the study area were built and designed in ways that makes planting new street trees more difficult.

Typically, street trees are planted in tree belts or tree pits. Tree belts are essentially long planting beds located between the street and the sidewalk. They are typical of residential neighborhoods. Tree pits are typically square or rectangular planters set into the sidewalk itself. They are typical of more urban environments, like downtowns.

Most of the streets and sidewalks in the study lack both tree belts and tree pits. Adding tree belts is often a politically-challenging and/or expensive undertaking because it often requires narrowing motor vehicle lanes or on-street parking and moving curbs and stormwater drainage infrastructure. Retrofitting sidewalks with tree pits can be less

challenging and expensive, but many sidewalks in the study area are too narrow to accommodate tree pits without infringing on space for pedestrians. Utilities buried under streets and sidewalks further limit planting space within the right-of-way.

Meanwhile, many buildings in the study area were built close to the sidewalk, limiting space for front yard tree planting on private property. On Gardner's hilly streets, retaining walls and steep slopes in front yards adjacent to sidewalks make it more difficult to plant and grow healthy trees.

PLANTING OPPORTUNITIES

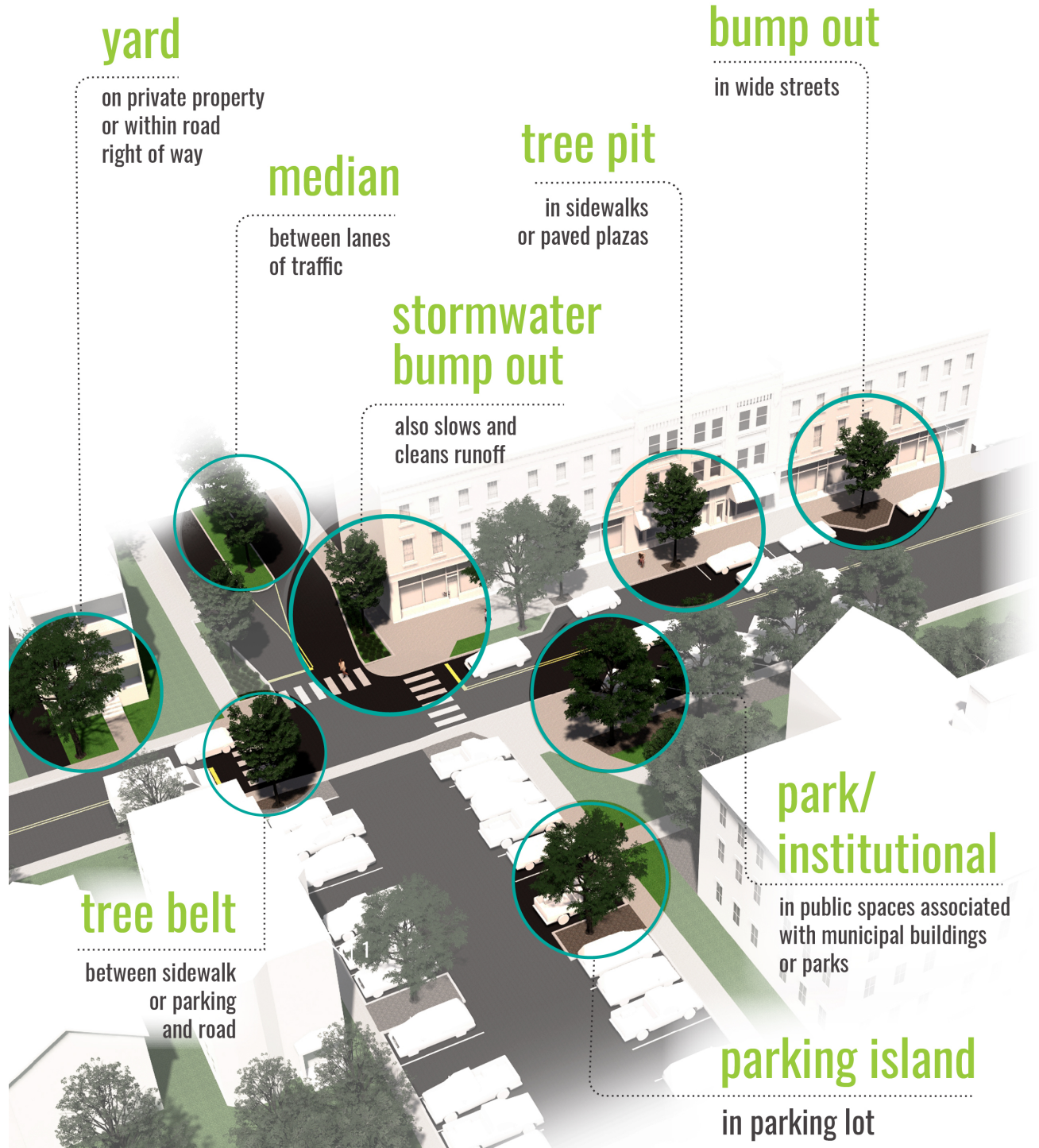
Though planting new trees in the study area is not easy, it is not impossible. There are still plentiful opportunities to plant more trees in the study area and reap the benefits of them.

Front Yards

As discussed earlier, the majority of street trees in the study area are located in front yards. Site visits revealed that there is room for still more trees on private properties adjacent to the public right



Where paving and zero-setback buildings leave no space for tree plantings, one way to add street trees would be to construct planted curb bump outs in priority locations.



yard

on private property
or within road
right of way

median

between lanes
of traffic

tree pit

in sidewalks
or paved plazas

bump out

in wide streets

**stormwater
bump out**

also slows and
cleans runoff

tree belt

between sidewalk
or parking
and road

**park/
institutional**

in public spaces associated
with municipal buildings
or parks

parking island

in parking lot

Where open soil space for trees does not exist, space can be created by constructing planted curb bump outs, rain gardens, planted medians, tree belts, tree pits, parking islands, and other features.

of way. Massachusetts allows cities and towns to plant public shade trees on private property within 20 feet of the ROW, with the property owner's permission (see [M.G.L. chapter 87 section 7](#)). Given these factors, a realistic strategy for planting more public shade trees would be to work with interested private property owners to plant trees on front yards—including both residential and commercial properties. A suggested outreach approach is described below in the section on Actions.

Existing Opportunities in the ROW

Though limited, there are underutilized areas within the City-owned ROW in which trees could likely be planted. This includes tree belts and medians that lack full tree cover, traffic triangles at street intersections, and areas where the right-of-way extends beyond the back of the sidewalk. Site visits to the study area shows that the City is actively planting trees in this type of opportunity area.

Creating New Opportunities in the ROW

In some priority locations, the City could create planting space for trees by reconfiguring streets and sidewalks. Curb bumpouts can be added at corners to provide a planting location for trees and improve pedestrian safety. Underutilized on-street parking spaces can be replaced with planting areas for street trees. Streets with excess paved width can be narrowed with the extra space dedicated to tree planting. In all of these situations, the planting areas can be used for rain gardens or stormwater planters to reduce the burden on the City's stormwater infrastructure. While the improvements in this category are often a substantial undertaking, they often have multiple benefits including improving pedestrian safety, slowing traffic, and improving stormwater treatment.

Any of these strategies would have to be implemented in a site specific manner. Overhead power lines could limit the range of suitable trees to small low-growing species, or to locations that are far enough away from the power lines. The same applies to underground utility lines. Utilities were not inventoried as part of this tree survey, but could be assessed on a case by case basis as property owners consider having street trees on their property. Intersection visibility is another important consideration. Trees that spread horizontally at eye



Tree belt and yard with space for trees on Chestnut Street



A potential planting location in a traffic island at Donlan Street and Timpany Boulevard



A tree belt on Waterford Street with room for additional trees



Opportunity for tree planting at the downtown Post Office

level for drivers should not be placed within the sight triangle at driveways and intersections, where a tree might block a driver's view of oncoming vehicles or pedestrians.

IDENTIFYING FRONT SETBACK PLANTING OPPORTUNITIES

Dodson & Flinker conducted GIS analysis to map potentially suitable locations for front yard street trees and to estimate the scale of opportunity in the study area. The analysis was used to identify property owners for outreach, estimate a number of trees that could be planted, and set a target for annual municipal tree planting.

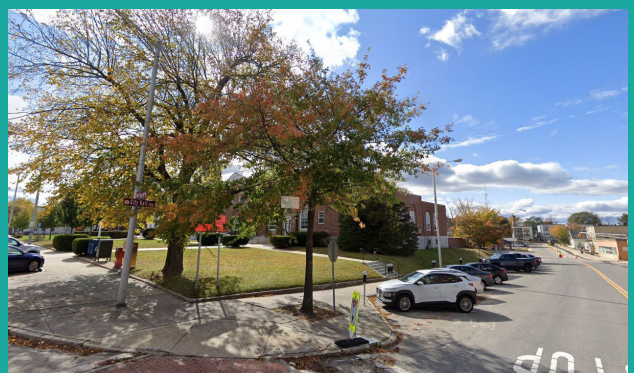
Using GIS, we created a buffer of 20 feet along the ROW which represents the zone in which trees could be considered street trees. From this area, we then removed building footprints, impervious surfaces,

areas within 20 feet of an inventoried street tree, and any resulting polygons less than 225 square feet in size (the minimum planting area for a tree). The resulting area represents possible spaces in front and side yard where tree planting could be considered. These locations could be prioritized for targeted outreach to property owners and/or more detailed planting suitability evaluation. See the map on the following page.

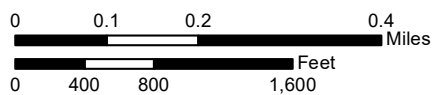
This analysis was then used to roughly estimate the number of new public shade trees that could potentially be planted on private property. By dividing the square footage of the resulting polygons in the planting zone by 600 (the approximate square footage required for a tree) and setting a cap of five new trees per property, the result is that about 2,800 trees could be planted along the frontage of private properties—about seven times the number of current street trees in the study area. Planting 2,800

EXAMPLES OF GARDNER'S TREE PLANTING EFFORTS

Gardner has been actively planting trees in public locations including in parks, at schools, and along streets. Site visits for this project revealed that trees had been recently planted in many of the "low hanging fruit" opportunities. The City and its residents can feel proud of the progress they are making.



Clockwise from top left: a new tree in a tree belt at the intersection of Central Street with Lynde and School Streets, recent trees in a traffic island at Main Street and Timpany Boulevard, a new tree in a tree pit on Central Street, a young tree in a curb bumpout at City Hall Avenue



DODSON & FLINKER
Landscape Architecture and Planning

Data Source: MassGIS,
2020 tree inventory by D&F



- Inventory Area
- Existing Inventoried Trees
- Priority Setback Tree Areas (Excluding Impervious & Structures)
- Priority Setback Tree Areas (Excluding Building Footprints)
- Buildings

A GIS analysis was used to identify potential zones where front yard trees could be planted. These are shown in green. An additional layer, shown in orange, represents zones where front yards may not be present but tree pits or curb bump outs in existing paving could be considered (this condition includes much of the area around Main Street). Property owners of parcels in these potential tree planting zones could be contacted with outreach materials and invited to have a street tree planted on their front lawn.



trees in thirty years would require setting a goal of planting about 100 trees per year.

It is likely that many parts of this calculated “front yard zone” for new trees would not be suitable for tree planting. It is likely that the presence of site features like retaining walls, power lines, and underground utilities, will rule out some locations for planting suitability. Unwillingness of property owners to plant—or allow the City plant—trees on their property is likely to be an even bigger limiting factor than site constraints. For this reason, effective outreach to property owners is crucial. Obtaining the resources to plant and maintain trees (materials and man hours) is another limiting factors. See the Actions section below for suggestions to overcome these challenges.

ANNUAL TREE PLANTING TARGET

Gardner’s core team—the city staff and other stakeholders that guided this project and the Municipal Vulnerability Preparedness report—worked together to determine a planting target for Gardner’s urban forestry efforts. The group considered factors including past history of tree planting efforts, the availability of resources, the analysis of planting opportunities, and on-the-ground knowledge of planting opportunities. The core team determined that planting 75 trees per year would be an ambitious but realistic goal for Gardner.

EXAMPLE

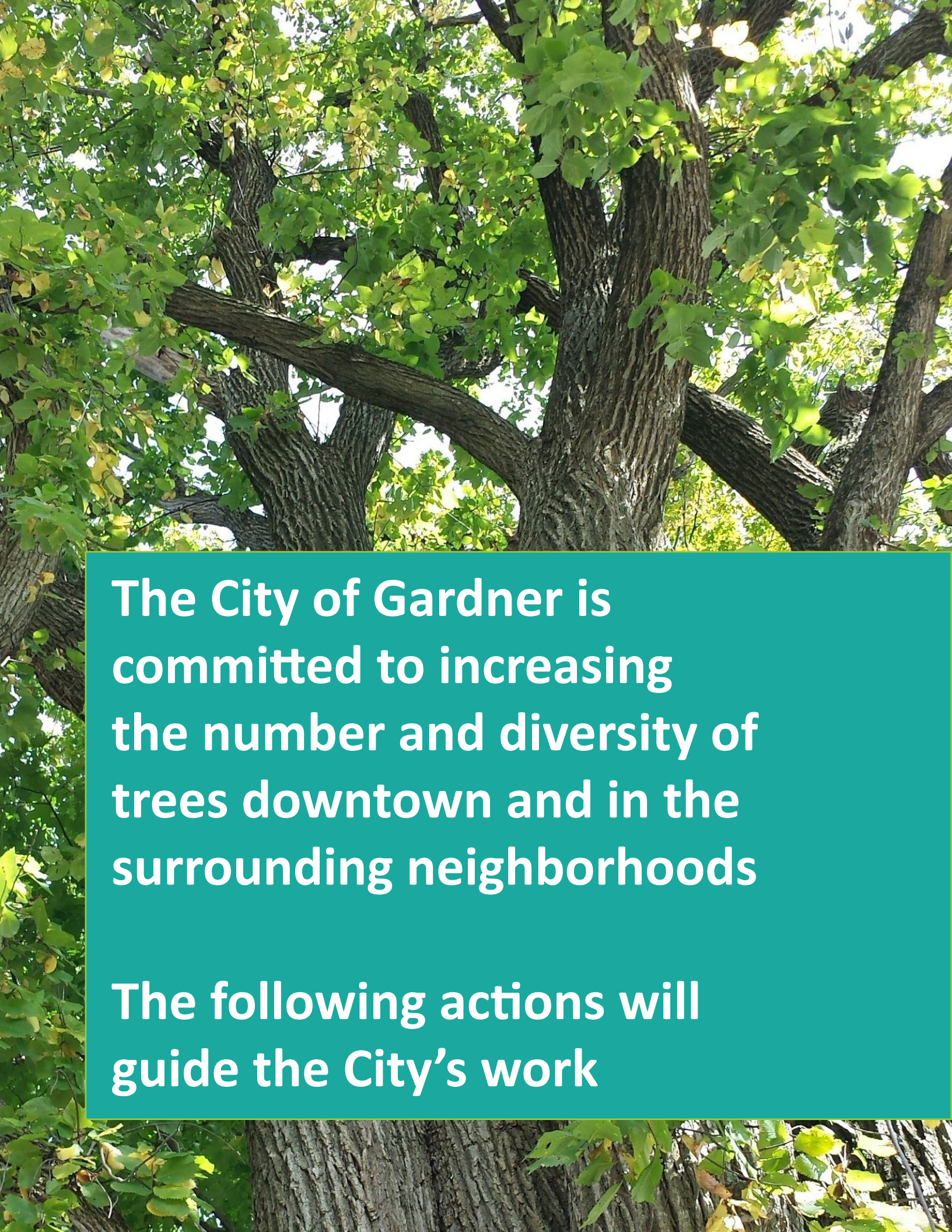
NORTHAMPTON TREE PLANTING PROGRAM

Northampton, MA has a neighborhood tree planting program that encourages neighborhoods to apply to receive 10 or more trees in their neighborhood to be maintained as public shade trees. The program planted 114 trees in 2016 and 250 trees in 2017. The city has a donation fund dedicated to purchasing trees.

The city also has a tree protection bylaw, and Northampton’s zoning and subdivision regulations include effective tree planting requirements. Northampton’s form-based zoning for its downtown, which is under development, includes detailed standards for tree planting.



Volunteers planting a tree. (Image Source: Tree Northampton)



The City of Gardner is committed to increasing the number and diversity of trees downtown and in the surrounding neighborhoods

The following actions will guide the City's work

PLANTING AND MAINTENANCE ACTIONS



ESTABLISH A PROGRAM TO PLANT PUBLIC SHADE TREE IN FRONT YARDS

To increase the number of street trees in Gardner’s downtown Environmental Justice area, the City could undertake an initiative to plant street trees in the front yards of private properties, including residential and commercial properties, where site conditions allow and the property owners have given their consent.

The GIS analysis described earlier in this report identified potential planting sites to evaluate further. Contact information for property owners could be extracted from the GIS data and used for targeted outreach. Outreach materials could include the graphics that were developed during this project, including information about the benefits of trees, factors to consider when siting and choosing a tree, how to plant a tree, and a list of suitable trees for Gardner’s conditions including various decision making criteria.

A volunteer group could lead, or assist the City with, outreach, tree planting, and tree maintenance. The Open Space and Recreation Plan (OSRP) committee could be reinvigorated to take on this role and others. The OSRP Committee has the expertise and likely the interest needed for this initiative. Activating a volunteer group is particularly important for outreach and tree maintenance. Both require mobilizing Gardner’s citizens to care about and care

for trees. A volunteer group can mobilize diverse social networks to take on time-consuming low-skill tasks, like watering trees.

Members of the core team of Gardner City staff guiding this project agreed that planting 75 trees per year would be an appropriate goal for this initiative. The 75 trees would be planted on private property within 20’ of the ROW and would be designated as public shade trees, with the City responsible for future maintenance.

EVALUATE EXISTING SPACES WITHIN THE RIGHT OF WAY FOR TREE PLANTING

Gardner’s ongoing tree planting efforts have utilized many of the “easier” planting locations in the study area. Moving forward, the City could prioritize planting trees in the few available locations within the right of way. Locations to evaluate further include:

- Tree belts with remaining space for trees, including those on Waterford Street and Chestnut Street
- Medians, including gaps on Temple Street (just outside of the study area)
- Traffic Islands, including Donlan Street at Main Street, Donlan Street at Timpany Boulevard, Oak Street and Parker Street, Parker Street and Robillard Street, West Street and Parker Street elevated planter, A Street at Coleman Street (just outside of study area), Elm Street at Central



Space for a public shade tree on Barthel Ave. Note the stump of the former tree.



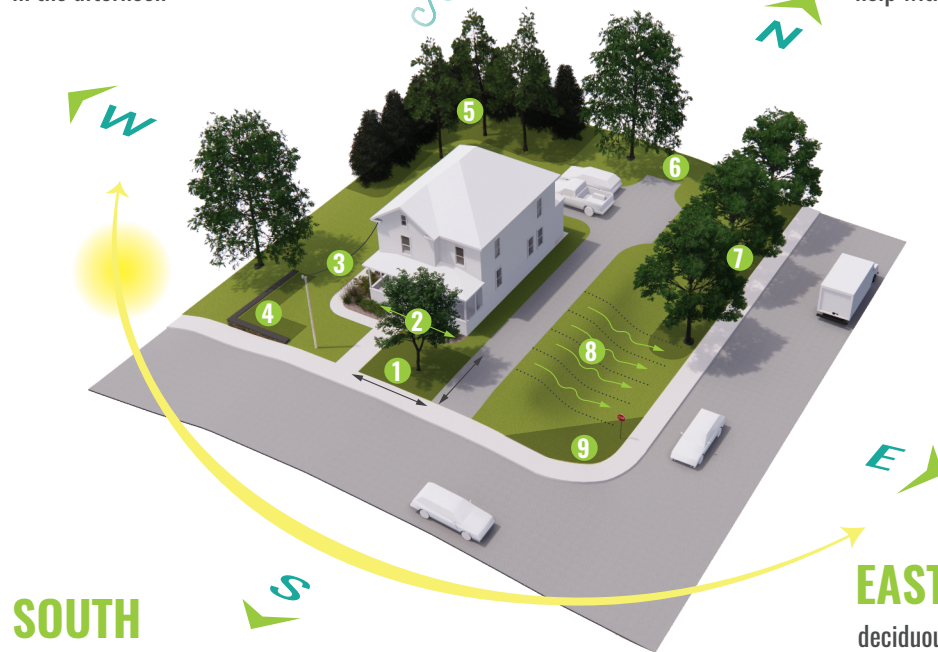
Space for a public shade tree at Baker Street and Pleasant Street

WEST

deciduous trees planted on this side of a building allow warm winter sun and provide cool summer shade in the afternoon

NORTH

shady areas north of a building may not have enough light for trees to thrive; deciduous trees planted here do little to help with heating/cooling



SOUTH

deciduous trees planted on this side of a building allow warm winter sun and provide cool summer shade that helps with heating/cooling

EAST

deciduous trees planted on this side of a building allow warm winter sun and provide cool summer shade in the morning

- 1 measure the width and length of the unpaved area where you want to plant a tree
- 2 think about the size of a mature tree and select a tree with a crown size that will fit in the space available:
 - avoid planting trees too close to buildings
 - trees can overhang driveways and sidewalks if pruned to remove lower branches
- 3 in areas with overhead wires, select a smaller tree with a mature height less than the wire height
- 4 avoid planting near top of retaining walls
- 5 evergreen trees planted to the northwest help to shield your property from prevailing winter winds
- 6 consider where you store snow, particularly if your winter salt use is heavy
- 7 in areas with frequent puddles or ponding, choose trees that can tolerate wet conditions
- 8 on steep slopes and other areas that are often very dry, choose trees that can tolerate dry conditions
- 9 avoid planting low-branching trees and shrubs where they could block the view for turning vehicles

This graphic provides a general guide for selecting a tree planting location on a residential site, and can be used as part of a suite of outreach materials that will be provided alongside this report.

- Street (just outside of study area)
- Unused right of way on the back side of sidewalks, or where there is no sidewalks. Because identifying these areas requires detailed understanding of property lines, it was beyond the scope of this project. Locations to evaluate further include Logan Street at Washington Street.
- Any wide sidewalks with room for tree pits

CREATE NEW SPACES FOR TREE PLANTING WITHIN THE RIGHT OF WAY AS PART OF STREET AND SIDEWALK IMPROVEMENT PROJECTS

Over time, the City could carve out new spaces for tree planting within the right of way. The City has an active Complete Streets program and already routinely removes excess pavement when it repaves a street. The City could incorporate tree planting into both of these efforts, and consider use of the following techniques on a case-by-case basis:

- Installing curb bumpouts with trees at appropriate intersections.
- Narrowing travel lanes and creating new tree belts
- Selectively replacing on-street parking spaces with tree planting areas
- Tightening overly generous curb radii and using the resulting land for planting trees
- Add tree pits to sidewalks and paved plazas, where possible.

The techniques described above have co-benefits: they reduce impervious surfaces, improve pedestrian safety, reduce vehicle speeds, and make places more aesthetically appealing. The multiple co-benefits can outweigh the larger investment per tree of these approaches.

PROVIDE ADEQUATE SOIL TO HELP TREES SURVIVE AND THRIVE

Trees in urban environments like Gardner’s downtown and the surrounding neighborhoods face numerous challenges to their long-term survival. One of the most fundamental is that planting areas often do not have an adequate volume of life-supporting soil. Without enough healthy soil, a tree’s roots can not spread and draw the nutrients, water and air the tree needs to grow. In recent years, new

techniques have been developed to help trees thrive in difficult conditions. Gardner could pilot test the following techniques and then adopt the ones that prove effective:

- Use suspended pavement systems to expand the size of tree pits while retaining adequate walkable sidewalk surfaces
- Create linear tree trenches. Linear tree trenches connect multiple tree pits together, either at grade or below. This enables multiple trees to share a larger volume of soil
- Connect tree pits to additional growing space at the back of the sidewalk (for example connecting a street side tree pit under the sidewalk to a front lawn). Structural soils can be placed under the sidewalk to enable tree roots to spread under the sidewalk
- Use permeable pavement to increase the amount of water that reaches tree roots
- Use tree box filters to increase the amount of water that reaches tree roots
- Ensure that tree pits have adequate drainage
- Where planting conditions are not ideal, plant bare root trees instead of balled and burlap trees. This decreases the cost of planting trees and increases long term tree health by decreasing transplant shock.
- Amend soils before planting new trees in urban conditions to ensure an appropriate pH, adequate nutrients, adequate organic matter, and minimal compaction
- Develop a soil testing program for Gardner’s public shade trees. Test for both chemical and biological properties. Adjust soils regularly with focus on developing a healthy soil food web. Explore the use of compost teas.

One of the practical challenges to adopting the practices described above is that Gardner, and especially the Main Street area, contains many buried utilities whose locations are not all well known due to the area’s long history. To make it easier to plan future planting efforts, the city can continue to document the locations of underground utilities and plan for their consolidation. Any municipal or private project that involves digging or other subsurface investigations is an opportunity to record the locations of utilities so that potential tree planting areas and appropriate techniques can be identified.

COMBINE TREE PLANTING WITH GREEN STORMWATER MANAGEMENT

Green stormwater management mimics natural processes to reduce the volume of water entering catch basins and storm sewers, clean stormwater, and increase infiltration of stormwater into the soil. The practices are becoming increasingly common across Massachusetts and the nation. Examples of green stormwater BMPs include rain gardens, stormwater planters, and tree box filters. Tree planting can be incorporated into these BMPs, increasing their effectiveness while providing healthy environments for trees that might not otherwise survive in dry urban conditions.

To expand the use of green stormwater management practices, the City of Gardner could analyze stormwater flow patterns in the focus area and prioritize locations for interventions with a focus on multiple benefits.

Many communities have found that incorporating green stormwater management and trees into curb bumpouts is especially powerful. Bump outs can also be designed as rain gardens, by creating a shallow depression in the planted area. Inlets cut into the curb allow stormwater to enter from the street and infiltrate into the soil. Rain gardens typically have an overflow drain that allows water to pond 3"-6" deep before spilling into a drain that directs overflow into the municipal storm system. In the meantime the ponded water has a chance to infiltrate naturally into the soil, with plant roots and microorganisms helping to filter the water as it infiltrates. Trees can easily be incorporated into the design of rain gardens by choosing species whose roots are tolerant of occasional inundation. Incorporating green stormwater management into curb bumpouts builds on their other advantages: improving pedestrian visibility and shortening crossing times for pedestrians at crosswalks, slowing traffic, and beautifying the city.

CONTINUE TO CONSIDER TREE PLANTING EARLY IN THE DESIGN OF ALL CITY PROJECTS

As this project's iTree tree-benefits calculations have shown, street trees have significant benefits that

EXAMPLE PITTSFIELD GREENING THE GATEWAY AND STREETSCAPES PROGRAMS

Pittsfield is an active participant in the Massachusetts Urban Forestry Program focused on Gateway Cities. Its streetscapes program has included stormwater planters with trees.



Pittsfield's streetscapes program includes creating stormwater planters with trees, within the right of way.

outweigh the costs of planting and maintenance. However, these benefits can be overlooked when trees are considered late in project design. To create a robust, resilient and thriving urban forest that quickly pays for itself while making Gardner a better place to live, trees should be considered early in the design of all City projects and given a central place in the design. A landscape architect should be included in the design team whenever possible. In projects that do not include a landscape architect, the City Tree Warden could provide input early in the design process and review plans along the way to ensure that trees are a priority and that the project is designed to help them thrive.

While Gardner already does an effective job of considering trees early in the design process for City projects, a formal policy statement from the City could further cement this. Ultimately, a dedicated and enthusiastic culture of tree advocates among City staff is the most certain way to ensure trees are always prioritized.

CONTINUE ARBOR DAY CELEBRATION AND HARNESS SAPLING GIVEAWAY PROGRAM

Every year, Gardner recognizes Arbor Day with a large celebration that teaches elementary school children about urban trees. As an Arbor Day tradition, the City gives away approximately two hundred tree seedlings to fourth grade students. Regardless of where these trees are planted, they will have benefits for Gardner. However, to help meet the City's street tree planting goal, the City could encourage students and their caregivers to plant the trees near the public right of way. Outreach materials developed for this project, including graphics about tree benefits, site analysis, and tree planting, could be distributed to students to increase the number of saplings that are planted and improve the survival rate of the saplings.

To keep the City's tree inventory current and continue public engagement about trees, the City could track where these seedlings are planted. Options include following up directly with families, or creating an online tool where a student or their caregiver could register the location where a sapling was planted. In addition, the city could establish a mechanism to obtain consent from the property owners to designate a sapling as a public shade tree when the sapling has been planted within twenty feet of the right of way. This would ensure that responsibility for maintenance of these trees is clear. Continuing and improving the seedling program will have a significant impact on Gardner's urban forest over the years.

DEVELOP A MUNICIPAL NURSERY

Establishing a municipal tree nursery would enable the City to keep a steady supply of new trees ready for routine planting each year. The city could prioritize growing a diversity of species that are tolerant of urban conditions, climate-resilient, and appropriate for the region. See the recommended tree list below.

FOCUS ON MAINTENANCE OF NEW TREES

The establishment period is crucial for a tree's long term survival. Ensuring that a new tree is adequately watered is essential. The city recently purchased thirty-five tree watering bags, using a TD North grant, bringing the City's supply to about 40 total bags. If the city intends to plant 75 trees a year, it may need 150 bags to leave on new trees for the first two years of establishment. Purchasing additional bags would enable the City to support additional trees during periods of drought.

Pruning new trees is another key step. Structural tree pruning establishes the tree's overall form. Effective pruning can make a tree more balanced, and eliminate weak branch angles. Long-term it reduces a tree's vulnerability to damage from storms, which are expected to increase in intensity due to climate change. Structural pruning can also prevent future conflicts between tree branches and structures like houses and overhead wires. Pruning early gets a tree headed in the right direction. It minimizes the need for what will be more expensive and more stressful cuts later.

MONITOR FOR PESTS AND DISEASE

Gardner's existing trees are an immense asset. Pest outbreaks appear to be increasing, driven by increasing international trade and exacerbated by climate change which makes trees more healthy and able to fight off infestations. Nearly every significant native shade tree faces threat of a pest or disease. Gardner can reduce the risk of catastrophic pest outbreaks by developing a systematic and robust program to monitor for pests and disease. Since the majority of trees are on private properties, the City could make arrangements with a representative sample of private property owners to monitor trees on private properties. Or it could partner with local arborists and landscapers to coordinate assessment and data sharing.



A comparison between an image of Chestnut Street in 1906 and a recent photo shows how Gardner’s urban forest has changed over the past century. All of the street trees shown in the historic image have died or been removed. The tree belt on the left side of the street has been reused for utility poles, limiting space for future trees. The tree belt on the right has been paved over. Changes in street design likewise impacts the survival of street trees. The historic image shows open drainage with no curbs and a street that was likely unpaved. These old-fashioned construction techniques, while they have disadvantages, allowed more space and water for tree roots, resulting in healthier and longer-lived trees. Despite the changes, the comparison of these images helps to visualize the transformative potential of a thriving urban canopy—a potential the city can achieve using the methods described in this report.

REGULATORY ACTIONS



Massachusetts laws and Gardner’s ordinances already regulate trees in the City. For example, street trees throughout Massachusetts are already protected by Massachusetts General Law Chapter 87, wherein all trees within the right of way are considered public shade trees and can not be removed without permission of the tree warden. Municipally planted trees that are planted within 20’ of the right of way on private property (with permission from the landowner) are also counted as public shade trees and given the same protections under this state law.

Gardner has tree requirements in its Open Space Subdivision Zoning sections and its Subdivision Regulations.

Gardner could expand tree protection and tree planting requirements in its regulations to protect and expand its urban canopy.

PROTECT EXISTING SIGNIFICANT TREES

Gardner could create a tree protection ordinance that applies to significant trees. Trees could be deemed “significant” due to their size, age, aesthetic value, ecological value and other criteria. The bylaw could require a permit for the removal of designated trees along with a replacement fee, as well as approval from the tree warden. The large oaks at the north end of Oak Street, for example, might be classified as “significant.” The bylaw could also require tree protection measures during construction, including specifications for fencing and root zone protection. Besides discouraging removal of these trees, this designation would bring attention to Gardner’s urban forest and foster a sense of pride in the City’s trees. Tree protection bylaws and ordinances have been enacted in numerous Massachusetts communities, typically as a standalone ordinance, or incorporated into zoning.

ENCOURAGE TREE PLANTING WHENEVER POSSIBLE

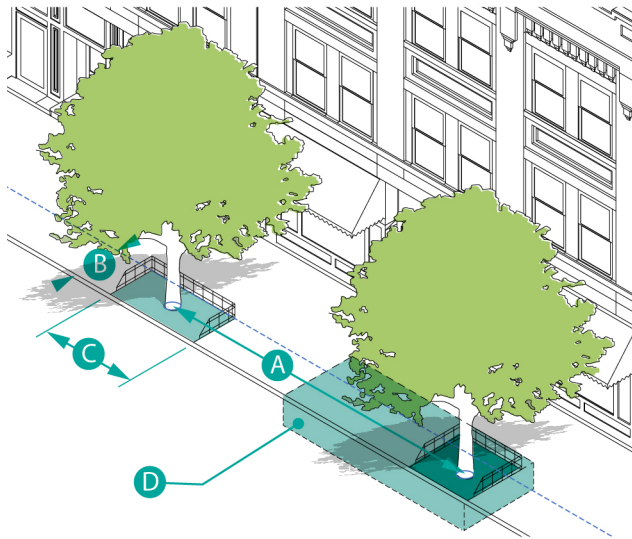
City ordinances and regulations could incorporate more detailed recommendations or requirements for tree planting. For example, zoning parking requirements could set a minimum threshold of canopy cover, or could specify a minimum number or minimum spacing of trees in planting strips between parking aisles and in buffer strips. Zoning standards, DPW specifications, and subdivision regulations could set minimum standards for soil volume and soil quality in tree planting areas, and recommended techniques for dealing with compromised planting conditions. Projects subject to a zoning special permit could be required to undertake more extensive improvements on site and in the adjacent right of way to facilitate tree planting including some of the innovative techniques to expand soil area described earlier.

ADOPT A RECOMMENDED TREE LIST AND DIVERSITY TARGET

The City could adopt a list of recommended street trees. The recommended tree list would both ensure that trees planted in Gardner are suitable for its conditions, and encourage greater diversity of tree canopy. The recommended tree list below in this report could be adopted as is, or modified to meet the City’s needs.

The street tree list could be incorporated by reference throughout City ordinances and regulations including zoning, subdivision regulations, and the stormwater bylaw. The trees could also be encouraged during municipal projects through a policy adopted by the Mayor or City Council.

Going a step further, the City could establish diversity goals for its urban canopy. This will minimize the risk of extensive loss of canopy if a pest or other stressor kills of a tree species. Currently, Gardner’s tree canopy is dominated by Norway Maples which puts Gardner at risk of significant canopy loss if a maple pest or blight invest the City. Worcester, for example, suffered



A	Tree spacing (recommended/max)	20-30'/40'
B	Tree Pit Width (recommended min)	5'
C	Tree Pit Length (recommended min')	10'
D	Recommended Soil Volume	600 cubic feet (min) for small tree or 1,000 cubic feet (min) for large tree
	Minimum soil surface area for alternate tree pit dimensions	≥50 square feet

This example zoning graphic shows a set of dimensional requirements for street tree plantings in downtown sidewalks (source: Dodson & Flinker).

extensive loss of maple trees due to the Asian long-horned beetle infestation. Further back in history, street tree populations in many cities were decimated by the loss of chestnuts and American elms.

A reasonable diversity target is for Gardner’s urban canopy is:

- no more than 10% of trees from a single species,
- no more than 20% of trees from a genus,
- and no more than 30% of trees from a family.



EXAMPLE GREENFIELD TREE COMMITTEE AND TREE ORDINANCE

Greening Greenfield is an effort the City of Greenfield, MA has undertaken since 1998. The City is a designated Tree City by the National Arbor Day Foundation. A tree committee was formed in 2008. The city completed a tree inventory in 2014. It adopted a tree ordinance in 2016.

Three hundred (300) trees have been planted in three years with Federal Funding.



Yes, I'd like a tree!

Name: _____

Address: _____

Email: _____ Phone: _____

Tree Type: _____

Tree Location: Tree Belt Front Yard Other

I rent my house I own my house I can help plant trees on June 4th

I can help water trees this year





Funded by a MA DCR Urban and Community Forestry Challenge Grant

Example of outreach materials used by Greenfield to help citizens request trees and volunteer (Image Source: City of Greenfield)

FUNDING ACTIONS



ADVOCATE FOR STABLE FUNDING FOR TREE PLANTING AND MAINTENANCE IN CITY BUDGET

Tree planting and maintenance could be added as a line item in the City budget. This would guarantee that the city has adequate funding for tree planting and maintenance over the long term. City staff would be better able to make long-term planting plans, and to coordinate year after year with volunteer efforts, resulting in increased efficiency.

The City could also establish a donation fund that is dedicated to tree planting and maintenance.

CONTINUE TO PARTICIPATE IN TREE CITY USA PROGRAM

The Arbor Day Foundation has given Gardner their Tree City USA designation because Gardner has met their fourfold criteria of: maintaining a tree board or department, having a community tree ordinance, spending at least \$2 per capita on urban forestry, and celebrating Arbor Day. The Tree City designation signifies that the city is on track to benefit from the many positive qualities and costs savings associated with having urban trees. The Arbor Day Foundation helps promote the efforts Tree City communities are making.

APPLY FOR GRANTS FOR URBAN FORESTRY

The Community Forest Program is a grant program by the U.S. Forest Service that awards grants up to \$600,000. The City of Greenfield is a recent recipient of this grant.

Urban and Community Forestry Challenge Grants are available from the State of Massachusetts and offer 50/50 matching grants and 75/25 matching grants in environmental justice neighborhoods. Greenfield was also a recipient of this grant, and its emphasis on environmental justice neighborhoods makes this grant well-suited to downtown Gardner.

Municipal Vulnerability Preparedness Action Grants are available from the State of Massachusetts' Executive Office of Energy and Environmental Affairs (EEA), and are awarded to municipalities like Gardner that have completed an MVP planning process. Since Gardner's MVP plan contains several action items that include urban forestry, implementation funding for this tree plan could easily be incorporated into Gardner's future MVP action grants. In 2019, Concord was awarded an MVP Action Grant which provided \$150,000 for 100 trees and evaluation of the feasibility of a tree nursery at Concord's Wastewater Treatment Plant.

The TD Green Space Grant provides up to \$20,000 for municipalities for local forestry in areas of greatest need. This is a reimbursement grant. No more than 50% of the funding can be used to purchase trees. Gardner was previously awarded a grant from TD Bank.

Heywood Hospital Community Investment Grant Program (Determination of Need program) gives grants of up to \$10,000. Priorities for the funding is based on Heywood's CHNA/CHIP. The CHIP includes the objective, "improve built environment to support physical activity." Planting street trees is a proven method for making the pedestrian environment more conducive to walking, and increasing walking a significant method for increasing daily physical activity. Gardner might need a 501c3 partner to apply for this grant.

CONCLUSION

Gardner’s history is intimately tied with trees; the city’s economy was powered for many years by the manufacture of chairs—chairs that were built from the wood of trees. Looking forward, trees will continue to have a central role in the city. This time can making Gardner more comfortable, beautiful, and resilient city. Working together, the City, residents, businesses, and institutions, can help line Gardner’s streets with healthy trees that cool and shade, that clean and absorb water, that give homes to birds and animals, that reduce heating and cooling bills, that slow climate change, that clean the air. Let’s plan and plant. Let’s amend the soil and water the saplings. Let’s watch for pests and prune. Let’s green Gardner.

Image Credits:

Dodson & Flinker unless otherwise noted

Page 12, 13, 17, 23: Google Streetview

Page 15, 25: Target by Hrbron from the Noun Project

Page 17: Shovel by Andi Nur Abdillah from the Noun Project

Page 24: Document by Jemis Mali from the Noun Project

Page 26: Money by Fariha Begum from the Noun Project-01



Appendices

APPENDIX A: TREE LIST

Scientific Name	Cultivar	Common Name	Size and Shape					Conditions			Tolerance				Design Goals							
			Form	Size	Mature Height (ft.)	Crown Spread (ft.)	Size of Planting Area	Sun/Shade	Moisture	Drought	Poor Drainage	Alkaline Soil	Salt	Air Pollution	Shade	Flower	Fruit	Fall color	Winter interest	Low Maintenance	Windbreak	Biodiversity
<i>Acer campestre</i>		Hedge maple	R	S	30	30	S	☀️	☀️●	●●	Y	Y	Y	OK	Y	OK		Y	Y	Y		
<i>Acer griseum</i>		Paperbark maple	O	S	25	25	S	☀️	☀️●	●●	OK	N	N	N	N	Y		Y	Y			
<i>Acer rubrum</i>		Red maple	O	L	75	40	M	☀️	☀️●	●●	●●●	N	Y	N	N	Y	Y			Y		Y
<i>Amelanchier arborea</i>		Downy serviceberry	O	S	20	15	S	☀️	☀️●	●●	OK	Y	OK	OK	Y	Y	Y	Y	Y			Y
<i>Amelanchier canadensis</i>		Shadblow serviceberry	O	S	20	15	S	☀️	☀️●	●●	OK	Y	OK	OK	Y	Y	Y	Y	Y			Y
<i>Amelanchier laevis</i>		Allegheny serviceberry	R	S	20	15	S	☀️	☀️●	●●	OK	Y	OK	OK	Y	Y	Y	Y	Y			Y
<i>Amelanchier lamarckii</i>	'Autumn Brilliance'	Apple serviceberry	R	S	25	20	S	☀️	☀️●	●●	OK	Y	OK	OK	Y	Y	Y	Y	Y			Y
<i>Betula nigra</i>	'Cully'	Heritage® river birch	P	M	40	30	S	☀️	☀️●	●●	●●●	Y	Y	N	OK	Y	OK			Y		Y
<i>Betula nigra</i>	'City slicker'	City Slicker® river birch	P	M	35	25	S	☀️	☀️●	●●	●●●	Y	Y	N	OK	Y	OK			Y		Y
<i>Carpinus betulus</i>	'Fastigata'	European hornbeam	O	M	35	20	S	☀️	☀️●	●●	OK	OK	Y	N	Y	OK			Y	Y		N
<i>Carpinus carolinana</i>		American hornbeam	O	M	30	25	S	☀️	☀️●	●●	OK	OK	Y	N	Y	OK			Y	Y		Y
<i>Carpinus carolinana</i>		American hornbeam	O	M	30	15	S	☀️	☀️●	●●	OK	OK	Y	N	Y	OK			Y	Y		Y
<i>Carya ovata</i>		Shagbark hickory	O	L	80	35	L	☀️	☀️●	●●	OK	OK	OK	N	Y	Y			Y	Y	Y	Y
<i>Catalpa speciosa</i>		Northern catalpa	O	L	60	40	L	☀️	☀️●	●●	●●●	Y	Y	Y	OK	Y	OK	Y	Y			
<i>Cercidiphyllum japonicum</i>		Katsura tree	O	M	60	35	M	☀️	☀️●	●●	N	OK	Y	OK	OK	Y			Y		Y	
<i>Cercis canadensis</i>		Redbud	S	S	25	25	S	☀️	☀️●	●●	OK	N	Y	OK	N	Y	Y	Y	Y			Y
<i>Chionanthus virginicus</i>		White fringetree	R	S	25	25	S	☀️	☀️●	●●	Y	Y	Y	N	Y	Y	Y	Y	Y			Y
<i>Cladrastis kentukea (lutea)</i>		Yellowwood	R	M	35	45	L	☀️		●●	OK	OK	Y	OK	OK	OK	Y	Y	Y	Y	Y	
<i>Cornus mas</i>		Cornelian cherry dogwood	R	S	20	20	S	☀️	☀️●	●●	OK	OK	Y	OK	OK	OK	Y	Y				Y
<i>Cotinus coggygria</i>		Common smoketree	R	S	15	15	S	☀️		●●	Y	N	OK	OK	OK	N	Y	Y	Y			
<i>Crataegus laevigata</i>	'Crimson Cloud'	Crimson cloud hawthorn	S	S	25	20	S	☀️		●●	Y	OK	Y	N	Y	N	Y	Y				
<i>Crataegus phaenopyrum</i>	'Presidential'	Washington hawthorn	R	S	20	20	S	☀️		●●	Y	OK	Y	N	Y	N	Y	Y				
<i>Crataegus phaenopyrum</i>	'Princeton Sentry'	Washington hawthorn	C	S	20	20	S	☀️		●●	Y	OK	Y	N	Y	N	Y	Y				

Notes

Good for lawns and streets. Can be sheared to form a high hedge. May need to be limbed up for clearance. Primary host of Asian longhorned beetle.

Specimen tree. Excellent fall color and heat tolerance. Copper orange to cinnamon red exfoliating bark. Primary host of Asian longhorned beetle.

Bright red fall color last longer than other species. Primary host of Asian longhorned beetle.

Not suitable for high stress conditions. Orange fall color.

Not suitable for high stress conditions. Orange fall color. Heavy fruit set.

Not suitable for high stress conditions. Scarlet fall color. Vigorous growth.

Not suitable for high stress conditions. Red fall color.

Exfoliating bark. Develops chlorosis in high pH. Most adaptable birch.

Exfoliating bark. Develops chlorosis in high pH. Most adaptable birch.

Tolerates heavy pruning. Urban tolerant. Good for screens, hedges, groupings, planter boxes, around buildings.

Tolerates pruning for hedge or screen. Slow to recover from transplanting.

Orange to red fall color. Tolerates pruning for hedge or screen. Slow to recover from transplanting.

Mature trees have shaggy bark. Yellow to brown fall color. Difficult to transplant.

White, orchid-like flowers in June. Coarse large leaves. Tough tree for large landscapes. Graceful branching pattern. Although native to U.S., but potential to spread rapidly.

Difficult to transplant. Water needed during establishment. Best in area protected from strong winds and afternoon sun.

Pea-like pink colored blooms in March/April. Avoid wet soils. Does not transplant well; plant when young and leave undisturbed.

Fragrant, clustered white flowers in May/June. Small specimen tree or shrub. Very adaptable.

Structural pruning needed to avoid poor branch attachment. Best protected from strong winds. Prune in summer to avoid bleeding (winter and spring).

Limb up to raise crown and expose exfoliating bark. Relatively adaptable but slow to reestablish. Heavy bloomer, but less cold hardy.

Fluffy smoke-like blooms.

Adaptable and tolerant of many conditions. Pruning lower limbs may be necessary for clearance.

Adaptable and tolerant of many conditions. Pruning lower limbs may be necessary for clearance. Thorns. Tree form.

Adaptable and tolerant of many conditions. Pruning lower limbs may be necessary for clearance. Almost thornless, can be pruned to single trunk for street tree.

APPENDIX A

Scientific Name	Cultivar	Common Name	Size and Shape					Conditions				Tolerance				Design Goals							
			Form	Size	Mature Height (ft.)	Crown Spread (ft.)	Size of Planting Area	Sun/Shade	Moisture	Drought	Poor Drainage	Alkaline Soil	Salt	Air Pollution	Shade	Flower	Fruit	Fall color	Winter interest	Low Maintenance	Windbreak	Biodiversity	Native
Ginkgo biloba	'Autumn Gold'	Ginkgo 'Autumn Gold'	O	L	50	30	S	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Ginkgo biloba	'Magyar'	Ginkgo 'Magyar'	O	L	50	25	S	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Halesia carolina		Carolina silverbell	R	M	35	25	L	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀				Y	
Hamamelis virginiana		Witchhazel	R	S	20	15	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀			Y	Y
Heptacodium miconioides		Seven-son flower	S	S	20	10	S	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Hydrangea paniculata		Panicle hydrangea	V	S	20	20	s	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Juniperus virginiana		Eastern red cedar	P	M	50	20	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀			Y	Y
Liriodendron tulipifera		Tulip poplar	O	L	90	50	L	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀				Y	Y
Maackia amurensis		Amur maackia	R	S	25	25	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Magnolia soulangeana		Saucer magnolia	P	S	25	25	M	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Magnolia stellata		Star magnolia	P	S	25	15	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Malus spp.	'Adams'	Adams' crabapple	R	S	20	20	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Malus spp.	'Royal Raindrops'	Royal raindrops crabapple	R	S	20	15	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Malus spp.	'Snowdrift'	Snowdrift' crabapple	R	S	20	20	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Malus spp.	'Pink Princess'	'Pink Princess'™ crabapple	R	S	8	12	S	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Nyssa sylvatica		Black tupelo	P	L	50	35	M	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀				Y	Y
Parrotia persica		Persian ironwood	O	M	30	20	S	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Parrotia persica	'Vanessa'	Persian ironwood	V	S	30	15	S	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Phellodendron amurense		Amur corktree	S	L	45	30	L	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Pinus thunbergii		Black pine	S	S	50	15	M	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Platanus occidentalis		American sycamore	R	L	100	80	L	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀				Y	Y
Platanus x acerfolia		London planetree	R	L	85	70	L	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀					
Prunus	'Okame'	Taiwan cherry	R	M	20	15	M	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					
Prunus x yedoensis	'Akebono'	Yoshino cherry	R	M	30	20	M	☀		☀	☀	☀	☀	☀	☀	☀	☀	☀					

Notes

Adaptable and tolerant. Golden yellow fall color. Fruitless. Prune in spring. Symmetrical, broad and rounded crown.

Adaptable and tolerant. Yellow fall color. Fruitless. Prune in spring. Upright, ascending branching.

Difficult to transplant. Chlorotic in high pH soils.

Prefers moist soil. Attractive fall colors and flowers.

White flowers at end of summer persist for over a month. Can be pruned into vase-like tree or kept as shrub.

Very adaptable, hardy, urban tolerant plant. Over 70 cultivars.

Tolerant of tough conditions. Good for hedges and screens.

Reserve for large growing areas. Prune in winter. Susceptible to scorch in poor, tight growing conditions.

Adaptable. White flowers in summer. Attractive bronze colored bark.

Showy flowers. Not suitable for extreme sites. Shallow rooting with fleshy roots, best planted in spring. Avoid windy sites.

Showy flowers. Not suitable for extreme sites. Shallow rooting with fleshy roots, best planted in spring. Avoid windy sites.

Pink flowers and reddish foliage that turns purple with age.

Bright pinkish red flowers. Orange red fall color.

White flowers and orange persistent fruit.

Rose pink flowers and purple foliage that becomes bronze.

Good for low spots subject to periodic flooding.

Specimen tree. Street tree. Mature trees have mottled "camo" bark that is white, gray, and green. Flowers attractive upon close inspection but generally insignificant.

Specimen tree. Street tree. Orange-red fall color. Mature trees have mottled "camo" bark that is white, gray, and green. Flowers attractive upon close inspection but generally insignificant.

Tolerant and adaptable. Prune in winter. Reserve for large areas.

Whitish terminal buds create interesting contrast to dark green foliage. Can tolerate some light shade.

Prefers moist, rich soils. Can get anthracnose in spring (a cosmetic leaf disease). Attractive exfoliating bark.

Attractive exfoliating bark. Similar appearance to American sycamore, but more tolerant of urban conditions.

Flowers best in full sun. Moderately fragrant rosy pink flowers with red calyces.

Drought tolerant once established but appreciates some watering during dry months.

APPENDIX A

Scientific Name	Cultivar	Common Name	Size and Shape					Conditions				Tolerance				Design Goals								
			Form	Size	Mature Height (ft.)	Crown Spread (ft.)	Size of Planting Area	Sun/Shade	Moisture	Drought	Poor Drainage	Alkaline Soil	Salt	Air Pollution	Shade	Flower	Fruit	Fall color	Winter interest	Low Maintenance	Windbreak	Biodiversity	Native	
Quercus alba		White oak	R	L	60	60	L	☀		●	●●	Y	OK	OK	OK	OK	OK	Y	Y	Y			Y	Y
Quercus bicolor		Swamp white oak	R	L	60	60	L	☀			●● ●●●	Y	Y	N	OK	OK	OK	Y						
Quercus coccinea		Scarlet oak	P	L	65	45	M	☀		●	●●	Y	OK	OK	Y	Y	N	Y	Y					
Quercus macrocarpa		Bur oak	P	L	70	50	M	☀		●	●● ●●●	Y	Y	OK	OK	OK	N	Y	Y	Y			Y	Y
Quercus palustris		Pin oak	P	L	65	55	M	☀			●● ●●●	OK	Y	N	N	N	N	Y	Y				Y	Y
Quercus robar		English oak	R	L	60	60	L	☀			●●	Y	OK	Y	OK	Y	N	Y	Y		y		Y	
Quercus rubra		Red oak	R	L	70	70	L	☀		●	●●	Y	N	OK	Y	Y	N	Y	y		Y		y	y
Sassafras albidum		Sassafras	O	L	60	40	M	☀	☀●		●●	Y	OK	N	OK	N	Y	Y	Y	Y	Y		Y	Y
Stewartia pseudocamelia		Japanese stewartia	P	S	30	20	S	☀	☀●		●●	Y	N	N	OK	Y	OK	Y		Y	Y	Y		
Styphonolobium japonicum		Scholar-tree	R	L	40	50	M	☀	☀●		●●	Y	Ok	Y	OK	Y	N	Y	Y					
Syringa reticulata		Japanese tree lilac	R	S	30	25	S	☀	☀●		●●	Y	Ok	Y	OK	Y	OK	Y	Y		Y			
Syringa reticulata	'Ivory Silk'	Japanese tree lilac	R	S	25	15	S	☀	☀●		●●	Y	Ok	Y	OK	Y	OK	Y	Y		Y			
Syringa reticulata	'Summer Show'	Japanese tree lilac	R	S	20	15	S	☀	☀●		●●	Y	Ok	Y	OK	Y	OK	Y	Y		Y			
Thuja occidentalis		White cedar	P	M	60	15	S	☀	☀●	●	●●	OK	Y	OK	N	Y	Y			Y		Y		
Tilia americana		American linden	P	L	60	45	M	☀	☀●		●●	OK	OK	Y	N	N	Y	Y	Y					Y
Tilia cordata		Little leaf linden	O	L	50	40	M	☀	☀●		●●	OK	OK	Y	N	OK	OK	Y	Y					
Tilia cordata	'Halka'	Summer sprite linden	O	S	20	15	S	☀	☀●		●●	OK	OK	Y	N	OK	OK	Y	Y					
Ulmus americana	'Princeton'	Amerian elm 'Princeton'	V	L	60	40	S	☀	☀●		●●	Y	Y	Y	OK	Y	OK			Y				
Ulmus americana	'Valley Forge'	American elm 'Valley Forge'	V	L	70	70	S	☀	☀●	●	●●	Y	Y	Y	OK	Y	OK			Y				
Ulmus parvifolia		Lacebark elm	P	L	50	30	S	☀			●●	Y	OK	OK	Y	Y	OK			Y	Y			
Viburnum dilatatum	'Michael Dodge'	Linden viburnum 'Michael Dodge'	S	S	10	8	S	☀	☀●		●●	Y	OK	Y	OK	OK	OK	Y	Y	Y			Y	
Viburnum prunifolium		Blackhaw	S	S	15	10	S	☀	☀●	●	●●	Y	OK	Y	OK	OK	OK	Y	Y	Y			Y	
Viburnum rhytidophylloides	'Allegheny'	Allegheny viburnum	S	S	10	10	S	☀	☀●		●●	Y	OK	OK	OK	Y	Y	Y	Y				Y	
Viburnum sieboldii		Siebold viburnum	S	S	20	15	S	☀	☀●		●●	OK	OK	Y	OK	OK	Y	Y	Y					
Viburnum x burwoodii	'Mohawk'	Burkwood viburnum 'Mohawk'	S	S	10	10	S	☀	☀●		●●	Y	OK	OK	OK	Y	OK	Y						
Zelkova serrata		Japanese zelkova	V	M	70	65	M	☀	☀●		●●	OK	N	OK	Y	Y	OK			Y	Y			

Notes

Difficult to transplant. Graceful branch structure, attractive bark. Growth is slow.

Easier to transplant than *Q. alba*. Fall color is tell to red. Good tree for wet or low ground.

Glossy green leaves that turn bright red in fall.

Adaptable. Difficult to transplant. More tolerant of urban conditions than other oaks.

Glossy green leaves that turn bright red in fall.

Adapts to a wide range of soil conditions.

Easily transplants and fast growing. Generally adaptable and long-lived tree.

Difficult to transplant. Prefers moist, rich acidic soils, but tolerates dry sandy soils. Remove suckers or tree will spread and take on multi-stemmed shrub.

Camellia-like flowers in June/July. Attractive exfoliating bark. Red, orange, purple fall color. Good for lawn or patio specimens. Prefers rich soil but can grow in well-drained rocky soil.

Adaptable and tolerant. Summer flowers. Fruit is poisonous; not suitable for schools/nurseries.

Showy white flowers in summer. Attractive bark. Prune after flowers to give next year's flower buds adequate time to form.

Showy, heavy bloom of white flowers in summer. Attractive bark. Prune after flowers to give next year's flower buds adequate time to form.

Showy, heavy bloom of white flowers in summer. Attractive bark. Prune after flowers to give next year's flower buds adequate time to form.

Adaptable and tolerant. Prefers moist, rich soils. Good for hedges and windbreaks. Heavy snow can cause damage.

Adaptable and tolerant. Prune for structure.

Adaptable and tolerant. Gets sooty leaf spot, not best for parking lots for this reason.

Semi-dwarf version of *T. americana*

Adaptable and tolerant. Developed before DED. Primary host of Asian longhorned beetle.

Adaptable and tolerant. Less cold hardy than other Elms. Notable DED resistance. Primary host of Asian longhorned beetle.

Rapid growth, good foliage, resistance to DED. Attractive mottled bark.

Showy white flowers that turn into red berries. Single plants do not fruit well.

White flowers with berries that turn blue-black. Can grow up to 30 ft.

Good drought tolerance once mature. Tolerant of urban conditions and fast growth rate.

Outstanding ornamental interest (branching structure, attractive flowers).

Fragrant showy blooms. Highly tolerant of urban conditions.

Good resistance to DED. Fast growth rate, attractive bark.

Let's Green Gardner!

Contact the Gardner Community Development and
Planning Department to get started

<https://www.gardner-ma.gov/225/Community-Development-Planning>

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