

The Benefits of Trees

Too often, walking along a street or driving down a road, we barely notice the healthy trees we pass. We may briefly appreciate a spot of cool shade, an eye pleasing color, or a graceful leaf blowing in the breeze, but rarely do we think about the broader benefits of trees. When an unhealthy tree falls or a storm blows a branch down we do think about the immediate inconvenience or cost, but again, we don't think about the decades worth of benefits that this tree has already provided.

Such benefits of public and privately managed trees are well documented by the Urban and Community Forestry Division of the USDA Forest Service. The three primary sources used for this report are the "Northeast Community Tree Guide: Benefits, Costs, and Strategic Planning"; "Planning the Urban Forest: Ecology, Economy, and Community Development"; and a USDA Forest Service brochure entitled "Trees Pay Us Back"².

Several well-documented benefits from healthy trees follow:

Healthy Trees, Lower Energy Bills: Trees planted strategically for shade or windbreaks can result in significant energy savings. Shade trees can save up to 56% on annual air-conditioning costs, and evergreens that block winter winds can save up to 30% on heating. The benefits of trees occur over multiple seasons. For example, a deciduous tree can provide cool shade during the summer and admit light for warmth in the winter. Reduced heating and cooling costs are matched by fewer emissions being created from power generation.

Healthy Trees, More Valuable Homes and Commercial Space: On average, each large front yard tree adds 1% to the house sales price, and large specimen trees can add 10-15% to a property's value. Apartments and offices in wooded areas rent more quickly, have higher occupancy rates, and retain tenants longer. Also, businesses leasing office space in wooded developments find their workers are more productive and absenteeism is reduced.

Healthy Trees, Healthy Economy: Tree care is directly tied to jobs performed by arborists, landscapers, and other "green" professionals, as well as sales for nurseries and other businesses. At the same time, trees give, economically, more than they take. The Forest Service reports that the considerable economic benefits generated by trees are an average of three times greater than tree care costs.

² Each of these publications are available by means of download from the USDA Forest Service website. The first is available as a General Technical Report (GTR 201) at www.fs.fed.us/psw/publications. The other two publications may be found by visiting na.fs.fed.us/urban/index.shtm.

Healthy Trees, Better Business: In tree-lined commercial districts, shoppers report more frequent shopping, longer shopping trips, willingness to pay more for parking, and willingness to spend 12% more for goods.

Healthy Trees, Fewer Floods and Less Erosion: Trees reduce flooding, stormwater runoff, and erosion problems. Trees increase soil permeability (the ability of the soil to hold water), help recharge drinking water aquifers, and tree roots serve as anchors that reduce erosion and sediment flowing into our streams and Long Island Sound. 100 mature trees will catch about 139,000 gallons of rainwater per year. Looking at this another way, without trees, towns might need to increase stormwater drainage channels and/or waste treatment capacities to handle increased water runoff.

Healthy Trees, Healthy Air: Trees provide great benefits to human health by improving air quality. Trees trap and hold pollutants like dust, ash, pollen and smoke that damage human lungs. One hundred trees will remove 430 pounds of these pollutants each year. Also, on average, an acre of trees will produce enough oxygen for 18 people every day, and will absorb 2.6 tons of carbon each year (enough CO₂ to offset driving a car for 26,000 miles).

Healthy Trees, Healthy People: Trees directly influence human health by providing us with clean air, clean water, reduced exposure to damaging sunlight and a generally more hospitable environment. They also improve people's outlook, uplifting us as we move through our busy days simply by their presence. Studies have shown the many positive effects of trees on people's mental and physical well-being.

Healthy Trees, Less Noise: Thick strips of vegetation can reduce noises, such as road noise, by 6 to 15 decibels. Plants absorb more high-frequency noise than low frequency, which is advantageous since higher frequencies are most distressing to people with noise sensitivities.

Healthy Trees, Healthy Streets: Trees casting shade on streets can help extend the life of asphalt by protecting pavement from weathering in direct sun. Tree lined streets also have a traffic calming effect, helping to reduce traffic speed.

Healthy Trees, Safer Communities: Tree-filled neighborhoods have been documented to have lower levels of domestic violence as well as being safer and more sociable. This is not surprising because, in general, trees create feelings of relaxation and well-being, provide privacy and a sense of solitude and security while also encouraging people to engage with their neighbors, and (when well managed) contribute to a sense of community pride.

Healthy Trees, Healthy Wildlife: Trees and associated vegetation are fundamental to local ecosystems that provide habitat and food for birds and animals. Trees can also offer suitable "mini-climates" for biodiversity that could otherwise be absent from urban areas.

Many of these benefits of healthy trees are viewed as “free” benefits to society because they lack a formal market like more traditional “goods and services.” Unfortunately, we tend to take trees for granted and can forget that healthy trees and forest ecosystems are literally life-support systems that help sustain our well-being. Forests, even the subset that we refer to as roadside forests, provide a rich suite of goods and services that are vital to human health and livelihood. Trees cannot be neglected on Connecticut’s “balance sheet” any longer.

This healthy, tall elm tree in West Hartford (below) provides benefits worth approximately \$150 every year. These benefits³ include:

- \$12.31 in reduced heating costs, due to the tree being a wind break
- \$31.10 in reduced cooling costs, from the shade cast
- \$59.12 in reduced storm water processing costs
- \$41.70 in air pollutants removed
- \$5.93 in removed carbon dioxide

Of this \$150 total, the first \$42.41 is money saved directly by the homeowner, \$59.12 is money saved by the town, and \$47.63 are general environmental benefits translating into reduced medical expenses within the citizenry at large.



Clearly, with a tree such as this elm, there are expenses associated with its maintenance, and so the benefits must be balanced against the cost. However, the authors of the Northeast Community Tree Guide⁴, published by the US Forest Service, estimate the annual net benefits of an average large tree in the northeastern US is between \$85 and \$113 per year.

³ Benefits are derived through the i-Tree Design application within the i-Tree Tools software package. These tools may be downloaded without charge from www.iTreeTools.org.

⁴ *Northeast Community Tree Guide: Benefits, Costs and Strategic Planting*, by E. Gregory McPherson, James R. Simpson, Paula J. Peper, Shelley L. Gardner, Kelaine E. Vargas, and Qingfu Xiao. US Department of Agriculture, Forest Service, Pacific Southwest Experiment Station, August 2007

The Importance of Large Trees

There is a concern that large trees, simply because of their sheer size and mass, present a significantly greater danger to people and to infrastructure, and so should not be allowed to grow alongside streets and roads. It is true that the larger and heavier a tree is, the greater capability it has to cause injury or damage should it fail. It is also true that, given the large potential for destructive violence in any extreme weather event, no tree is fully protected from failure in a storm. No tree is ever absolutely safe. No matter how old a tree is, how significant it is as a specimen, or how healthy it appears to be, all trees will eventually decline.

At the same time, the discussion regarding the use of large trees along roadsides should not turn solely on considerations of the potential for damage from large trees when they eventually fail or must be removed before failing. Other important aspects of the discussion ought to be the relative health and stability of the tree, how well it has been maintained and will be maintained in the future, and the contributions that a tree makes to the well-being of those who live in the vicinity of that tree, who travel the nearby streets, and who have benefitted from what that tree has provided over the decades of its life.

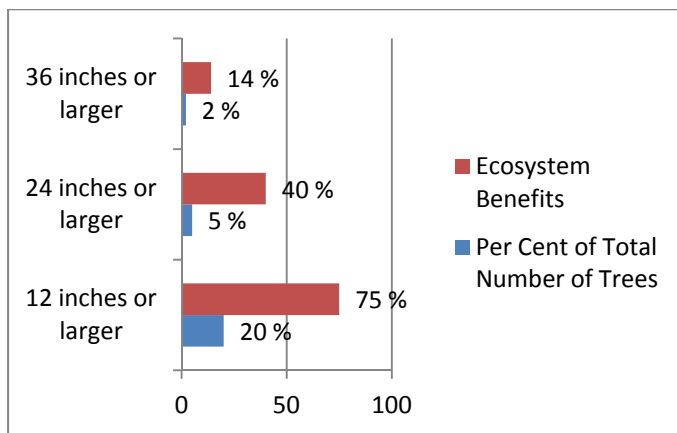
Trees provide many ecosystem benefits including cleaner air, cleaner water, the sequestration of atmospheric carbon, and enhanced nutrient cycling, that promote biodiversity and a more stable environment. What is not always noted is that these ecosystem services are almost always directly related to the volume of a tree's crown and the area of leaf surface within that crown. The more leaf surface area, the more photosynthesis that can occur, the more water that the tree will transpire from its leaves, the more carbon it will pull from the atmosphere, and the more surface area for certain atmospheric pollutants to settle out upon.

As a measure of tree size, diameter of the trunk as measured at 4-1/2 feet off of the ground (diameter at breast height, or dbh) is one-dimensional. The volume of the crown of the tree is three-dimensional. When looking at tree sizes and the ecosystem services they provide, increases in ecosystem services will be roughly geometric in proportion to increasing trunk diameter. This is because the volume increase of the crown is three-dimensional as compared to diameter increase of the trunk. This comparison of increasing crown volume to increasing trunk diameter is approximate because, of course, the change in crown volume is not always directly proportional to the change in the tree's trunk diameter.

The basic point is made, however, that large, healthy trees contribute much more in ecosystem services than do even an equivalent number of smaller trees whose trunk diameters add up to be the same as that of a single large tree.

A better way to illustrate this might be to look at Hartford’s tree population, as sampled during a survey completed in 2007⁵. In this study, the researchers found that 20% of Hartford’s trees are 12 inches in diameter (dbh) or greater, 5% of Hartford’s trees are 24 inches in diameter or greater and 2% of Hartford’s trees are 36 inches in diameter or greater. Their study also showed that 75% of the leaf area of Hartford’s trees are in trees 12 inches in diameter or greater, 40% of the leaf area of Hartford’s trees are in trees 24 inches in diameter or greater and 14% of the leaf area of Hartford’s trees are in trees 36 inches in diameter or greater. In other words, the largest 5% of the trees in Hartford contribute 40% of the ecosystem service benefits, while the largest 2% contribute 14% of the total benefits. This last figure relates to about 11,000 trees citywide, among a total tree population of about 568,000.

Comparison of Percentage of Trees by Size (dbh) and Contributed Ecosystem Service Benefits, Hartford Study - 2007

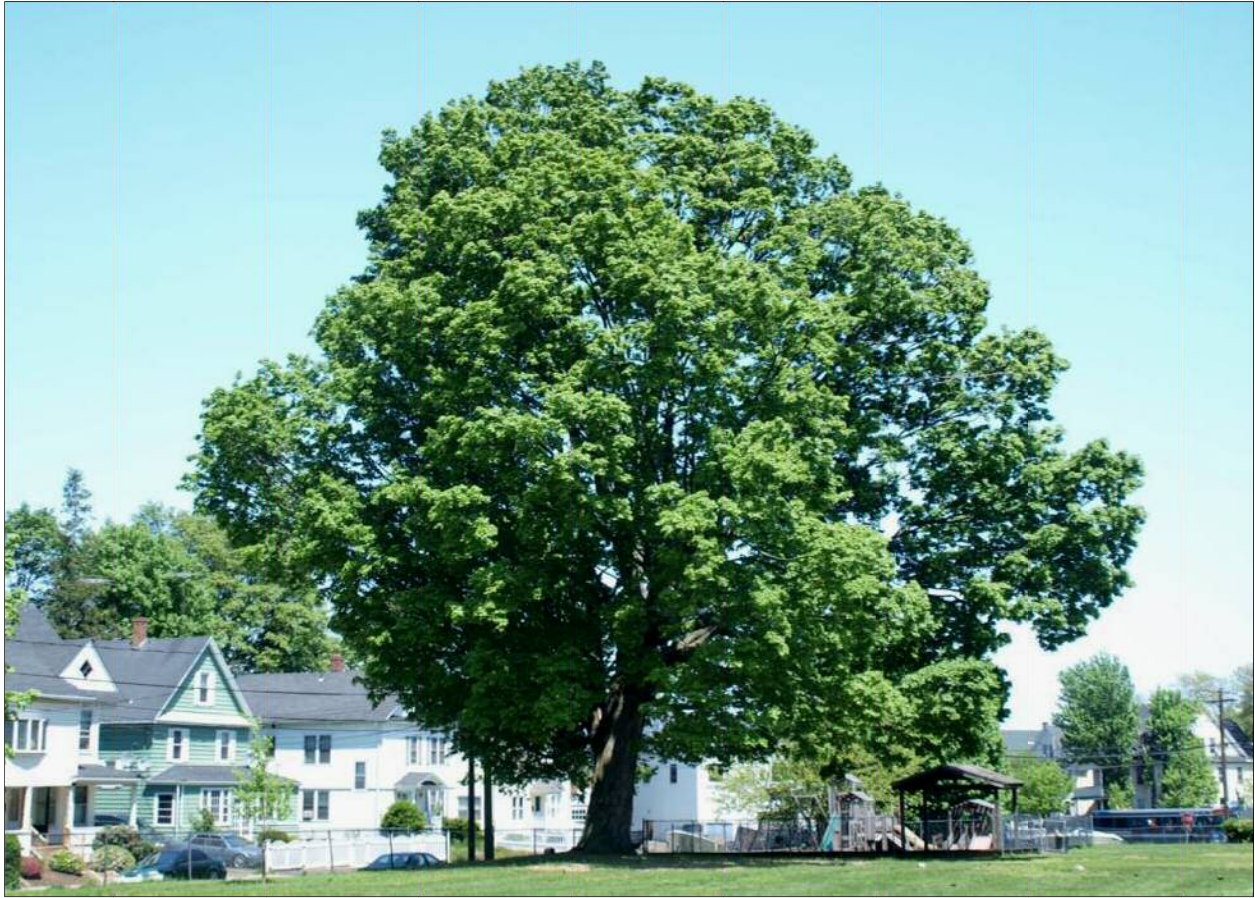


In cities, the relationship between tree size and tree benefits becomes especially important due to the relatively fewer trees there are in cities and the greater need for the ecosystem service benefits that they provide. Additionally, large trees in cities provide shade for walkers and buildings alike, reduce the amount of ozone found in congested streets, and can greatly enhance the quality of life in urban neighborhoods.

These larger trees do come with greater responsibilities and expenses. Indeed, larger trees, should they fail, can cause proportionally much greater damage than smaller trees. Therefore, it is our responsibility to plant and grow trees in places where there is adequate space, both above- and below-ground, to support their size, and with a careful view toward what sort of damage they would cause should they fail. Roadside and urban trees need to be well-maintained, with dead limbs regularly removed and with regular monitoring of their overall health and structural stability. Certain species, known for their proclivity to unpredictable failure or messy habits should be avoided. Owners of large trees, or tree wardens when the tree is under the responsibility of the municipality, should be especially vigilant regarding large trees, and should be quick to take action when circumstances warrant. Any tree that appears

⁵ See "Hartford's Urban Forest - the Challenge" to be found on the Urban Forestry page of DEEP's Forestry web site- www.ct.gov/deep/forestry.

to be in a condition where it is likely to fail in the near term should be immediately removed or the problem should be remediated.



Sugar Maple in Bridgeport (center)

The Costs of Municipal Trees

The benefits of trees have been well-established. Also well-proven is that, under most circumstances, the benefits of trees outweigh their costs. Trees are a net positive to the community in terms of benefit/cost ratio, often by a wide margin.

However, sometimes overlooked in this discussion is the way the costs of municipal trees are borne by the city or town in which they are located. Even in circumstances in which trees save the municipality money, such as when trees reduce stormwater treatment costs, the manager of an individual town or city department often sees trees only as line-items on his or her budget, and as so, expenses in the budget. As a result, and as the benefits accrue to others, it can sometimes be difficult to convince a manager or financial control officer that trees are indeed a net positive.

The USDA Forest Service has produced figures on average tree costs for both public and private trees. For the Northeast, the annual costs for public trees, presented in the Northeast Community Tree Guide,⁶ are as follows:

Costs per year	small tree	medium tree	large tree	pine tree
planting costs	\$10.00	\$10.00	\$10.00	\$10.00
pruning	\$3.26	\$7.69	\$11.60	\$6.40
removal and disposal	\$1.28	\$1.62	\$2.06	\$1.47
pest and disease	\$0.09	\$0.13	\$0.17	\$0.11
infrastructure repair	\$1.13	\$1.55	\$2.06	\$1.37
clean-up	\$0.26	\$0.35	\$0.46	\$0.31
admin and inspect	\$3.96	\$5.42	\$7.21	\$3.10
Total	\$19.98	\$26.76	\$33.56	\$22.76

These numbers are based on the expected cost of a tree for the first 40 years after planting. In other words, during the first 40 years \$400 will be spent on planting the tree, \$130.40 on pruning a small tree, \$464 on pruning a large tree, and so on. One disadvantage of this approach is that it only considers the costs associated with relatively young trees, and not those associated with very large, very old specimens, which would present significantly greater pruning and removal costs on an annual basis. Also, the approach used assumes that 34% of the trees planted will die during this first 40 year period. This presents an additional

⁶ *Northeast Community Tree Guide: Benefits, Costs and Strategic Planting*, by E. Gregory McPherson, James R. Simpson, Paula J. Peper, Shelley L. Gardner, Kelaine E. Vargas, and Qingfu Xiao. US Department of Agriculture, Forest Service, Pacific Southwest Experiment Station, August 2007

underestimation of the removal and disposal costs for the municipal tree population as a whole.

Regardless, these numbers provide a useful framework for considering trees costs. They may not represent the true, typical costs of tree planting in a particular community, for example, if that community is hampered by having numerous undersized and heavily compacted tree pits in the downtown area. Alternatively, it is difficult to plan for emergency work, where cleanup and infrastructure repair costs can rise rapidly. Even in a relatively minor event, calling out a crew would likely mean paying at least 3 people time-and-a-half for a minimum 4 hour shift.

It is not our recommendation that these numbers be used directly to determine a tree budget. Given the limitations mentioned earlier, using these numbers as the basis for 'per tree' costs that can be extrapolated to the tree population of a community as a whole would likely not adequately represent the annual tree budget needs for that community. Also, these numbers likely underestimate equipment and personnel costs, such as the highly important investments that should be made in employee education and training. These numbers, however, are a start, and they serve to reinforce the notion that, for municipalities, the bottom line is the bottom line. For most managers, the costs for trees need to be accounted for as expenditures, regardless of what additional benefits might accrue to the community at large or show up as cost savings in other areas of the municipal budget.