

Trees and Sidewalks: Infrastructure Coexisting Side by Side

By Gordon Mann

Trees and sidewalks are community infrastructure elements that generally exist in similar areas within the public right-of-way, providing valuable services to the public. Sidewalks are intended to provide a safe walking surface for the public, separated from the vehicular traffic by curbs and occasionally landscape strips. Trees are intended to provide a variety of services and benefits including shade, neighborhood character, screening, and canopy cover. While the trees serve these capacities, they also provide valuable ecosystem and social services to the adjacent property and community where they grow. The trees' services produce benefits that can be quantified.

Although it is difficult to quantify exactly the value each individual tree provides, average costs for representative tree species have been calculated by the USDA Forest Service researchers. Benefits from trees to communities include: enhanced air quality; stormwater interception; energy conservation; shade; reduced crime, stress, and sun exposure; improved student learning; wildlife habitat; traffic calming; increased property values; and increased retail revenues. While most trees in the past were not planted with the intent of these benefits, future trees are being planted in locations to maximize the different services and benefits.

Occasionally, when trees and sidewalks are not spaced well, or trees grow in confined soils and limited rooting area, conflicts may arise. The conflicts can offset a sidewalk and create potential liability for pedestrians. Repairs to resolve the conflicts have been observed to occur in 3 general sequences:

- The trees are impacted to restore the sidewalk in the exact same original position, basically ignoring the conflict, the growth of the tree, and the high potential that the same conflict will repeat.
- The tree is removed, the existing design is retained and a new tree may be planted, which unless it is a smaller tree that will provide less benefits, has a high potential that the same conflict will repeat.
- The site is re-designed to retain the existing tree and avoid repeat conflicts, or if the tree has to be removed, avoid repeat conflicts with a new tree of similar future size.

Considerations on determining which infrastructure element to rate higher in the final decision often do not consider the following facts and too many trees are removed:

- The sidewalk can be re-built in kind in a day or three, the tree may take at least 30 years to grow to a similar height
- The tree roots when severely cut to provide the space for the concrete repair may reduce the vigor of the tree, and may reduce stability
- The sidewalk material can be different than concrete and still provide a safe walking surface
- The sidewalk can usually be easily re-designed to provide more space for the tree and reduce future conflicts
- If the site design is not modified, and the tree is retained, the same conflict is likely to re-occur
- The value of a concrete sidewalk usually is reduced with age. There is deterioration.
- The value of a tree usually increases with age and canopy spread. Besides difficult in-kind replacement, a large tree that might be damaged or removed will provide greater services and benefits than a newly planted tree for many years until the new tree equals the existing tree size.

Consider the direct in-kind replacement cost which ranges from approximately \$1,500 per site for the sidewalk and curb repair and \$3,000 to \$10,000 per tree for in-kind replacement. Additionally, in order to replace a tree in-kind, the necessary root system has to be moved and placed in the ground. In most populated areas, the hole cannot be dug without encountering conflicts with underground utilities including water, sewer, stormwater, electrical, gas, cable and internet connections, and phone.

The three to ten thousand dollar tree cost calculation does not include the cost to remove and replace the required infrastructure to install the tree. The actual installed cost of an in-kind tree replacement may be 2 to 5 times, or more, than the purchase price of the tree.

Changing the consideration of trees from nicety to necessity supports the infrastructure discussion. The approach to selecting trees for a sustainable urban forest should include selecting **the right tree for the right place for the right purpose**. The phrase order is reversed to select the benefits of an infrastructure element, followed by the proper site design for planting. This aligns with other design functions. The site or building use is considered before the site or building is designed.

The purpose or objective for planting the tree is the first step. What key benefits are we planning on receiving from the street or landscape tree? Trees have many characteristics from evergreen/deciduous; leaf size, texture, shape and color; fruit and flowers, male and female or both; fall color; foliar crown size, shape, and density; branching patterns and structure; and size. Research shows that larger trees provide greater benefits. The benefit list is long and varied. The purpose of the growing leads to the best possible species choices to receive the key benefits. Other benefits trees provide are also enjoyed alongside the key benefits.

An effective method of calculating tree benefits is the i-Tree software, available free at www.itreetools.org . Although benefits for individual trees are challenging to be precisely accurate, a site specific general benefits calculation can be obtained using the i-Tree design application found at: <http://www.itreetools.org/design.php>. Street tree benefit values can be estimated using the Regional Tree Guides for each particular climate zone. There are 16 regional guides developed by the US Forest Service that correspond the benefits and calculations based on studies performed in each climate zone. The guides are available at: http://www.fs.fed.us/psw/programs/uesd/uep/tree_guides.php.

Once the purpose and services of the desired trees have been determined, the potential trees that can provide those benefits can be selected. There are many potential trees that can provide the desired benefits. Species diversity is a basic tenet of sustainable urban forestry. Designs must shift from monocultures to remain sustainable. The decimation from Dutch Elm Disease, Chestnut Blight, and most recently Emerald Ash Borer demonstrate the potential losses from monoculture planting.

The selected palate of trees will have space requirements above and below ground. Select trees that match the form and aesthetic value, and possess the attributes to meet the desired purpose. Considering the necessary growing space and site needs must be incorporated into the design to avoid future infrastructure conflicts. If trees are grown in substandard sites, there will be conflicts, damage, and costs to repair. The factor least often considered is the time and growth of the tree that cannot be easily replicated. The benefits from trees come from the leaf canopy. It is not a stem count, rather a canopy cover that provides the benefits to a community. Verify the mature size can be accommodated by the site.

Once the space requirements of the desired tree species are known, the site design can be completed. The need to provide the adequate soil volume and soil quality will lead to more successful plantings with reduced infrastructure conflicts and damage. Sufficient maintenance funds should be available.

An important approach in determining what trees to plant, and where, is to have a community tree management plan. An inventory is important, because we can't manage what we don't know about. Once we learn the population variables, we can plan age and species diversity, plan for full stocking levels, and track our progress. It is valuable to include information on health, condition, and risk management in the inventory.

Full stocking is a tactical approach to determining what trees will be planted where, and when, based on existing circumstances, the need to add diversity, the resources available, and the specific places in the community we should address first. Details include how many vacant sites we have, the resources we have to plant, and the range of time to achieve the goal. Additionally, as our trees grow, some will die and need replacement. All the replanting can be guided by the full-stocking plan.

We don't solve our problems or accomplish our tree canopy goals by planting trees. We have to grow trees! Let's promote tree growing events! If we plant poor quality nursery stock with faulty roots or branch structure, even with proper space the lifespan of the trees will be limited. If we plant the trees improperly, too deep, or don't properly mitigate rootball issues, the lifespan of the trees will be shortened. If we allow trees to grow over time with poor structure, we can experience pre-mature failures and the time invested in growth is lost; and the benefits we receive from the tree is reduced or limited. If we bury trees with mulch collars or plant them too close together where their growth is conflicted, we limit the lifespan and benefits of the trees. We can do better!

Most new landscape designs are overplanted. Because of the small size of new plants, a landscape would look barren and incomplete if final mature spacing distances were used in the planting scheme. The trees and some shrubs will need to be thinned to achieve the desired spacing at maturity. The irrigation system needs to be adjusted to match the enlarging root systems on the remaining plants. Removal of healthy plants is frowned upon and may not be allowed if the final spacing plan is not included in the original approved design.

The strategies to reduce infrastructure conflicts include:

- Adopt and promote the tree care industry standards. In the US, the ANSI A300 Standards
- Create the site designs that provide adequate space for trees to reduce infrastructure conflicts
- Practice and require well-written specifications for all work and nursery purchases
- Require long-term management plans as a component of all landscape designs and planting events
- Educate that the cost to plant a tree is only about one-tenth of the establishment costs. The planting is only the first step in the life of growing a tree.

Growing sites can be a major challenge for the arborist working in an urban environment. We may have heard the answer is simply planting the right tree in the right location. Picking a tree to avoid conflicts does not address the infrastructure benefit contributions trees are grown to provide. Prior to selecting the right tree, we have to understand the purpose for planting the tree – the objective.

The revised mantra is: ***grow the right tree in the right place for the right purpose***. This requires working backwards first defining the purpose, understanding the necessary planting space to achieve those benefits, and selecting from an appropriate palate of trees. Then the site is designed so trees can be grown alongside other community infrastructure with minimal conflicts. If designed properly, the tree should be the longest lasting of all other infrastructure, outlasting the built and human community.

There are many options to design sidewalks that accomplish a safe walking surface for pedestrians in a tree-lined environment. The failure to consider different designs that enlarge the space and soil area for a tree, different materials to separate the concrete from the tree roots, and the ultimate size the tree will grow contribute to future conflict issues. Development decisions that fail to include the future conflicts that occur with poor design result in expensive repairs, loss of large trees before they reach the desired size shown in the development brochure, and changes to the community design.

During infrastructure damage retrofits, the decision to revert back to the original insufficient design instead of re-designing the site with the trees' needs in mind will result in: weakened or more failure-prone trees, and repeat infrastructure damage. Isn't the definition of insanity doing the same things over and over and expecting different results?

Review the Art and Science of Sidewalk Repair at www.mannandtrees.com for more detailed information about the options to retrofit and re-design sidewalks around trees.