Trees In Urban Design

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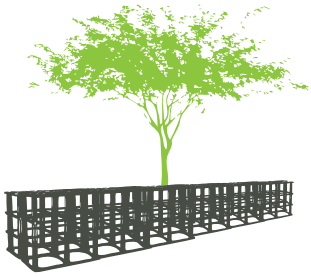
Introduction

Beautiful trees make great cities because a dynamic urban forest supports a healthy community, economy, and environment. In addition, trees are integral to the urban design of any city or town (Arnold, 1980). However, many urban design professionals lack the basic knowledge that underlie the science and art of incorporating trees into the urban fabric. As well, many urban designs, codes, and public works standards show that little is known about the basic needs of trees and the principles of tree planting. This lack of understanding is a major contributing factor to trees not surviving. The average street tree lives 7 to 10 years and provides a negative return on investment (Moll, 1989). Given the desire for urban living along with the growing importance of green infrastructure and complete streets, understanding how to properly design for trees is becoming increasingly vital to the prosperity of any city or town. Given that trees are living organisms, it can be a daunting task to figure out how to properly design a space that will support a resilient tree that will thrive in an urban environment. This paper blends a variety of principles together to provide a set of tools that can be used to develop cost effective designs that create beautiful urban places.

150 cubic feet of soil

Estimated lifespan: 7-10 yrs



1,000 cubic feet of soil*

Estimated lifespan: 50+ yrs

*This design utilities Silva Cells

Installation Costs	$5,000 (replanted 5 times)	Installation Costs	$14,000
Maintenance Costs	$1,211.99	Maintenance Costs	$2,341.75
Total Benefits	$2,717.66	Total Benefits	$41,769
Net Lifecycle Costs	$3,493.33	Net Lifecycle Costs	-$25,427.25

Planting a Liability or Growing an Asset











Understanding the Value of Urban Trees

Trees are living organisms and vital elements of a city's infrastructure that must be considered at every stage of planning, design and development. If designed properly trees can provide a significant return on investment and become assets that increase with value over time (Hall, Vonderscher & Adkins 2010). In order to properly design for trees it is important to understand the value that trees can provide to any project.

Economic

- Increase Property Values
- Enhances Sense of Place
- Reduce Cooling Costs
- Increase Economic Stability
- Reduce Expenditures on Gray Infrastructure
- Longer Pavement Life
- Reduces Stormwater Runoff

Health/Social

- Improve Human Health
- Provide Shade
- Create Visual and Sound Buffers
- Improve Neighborhoods
- Create Walkable Streets

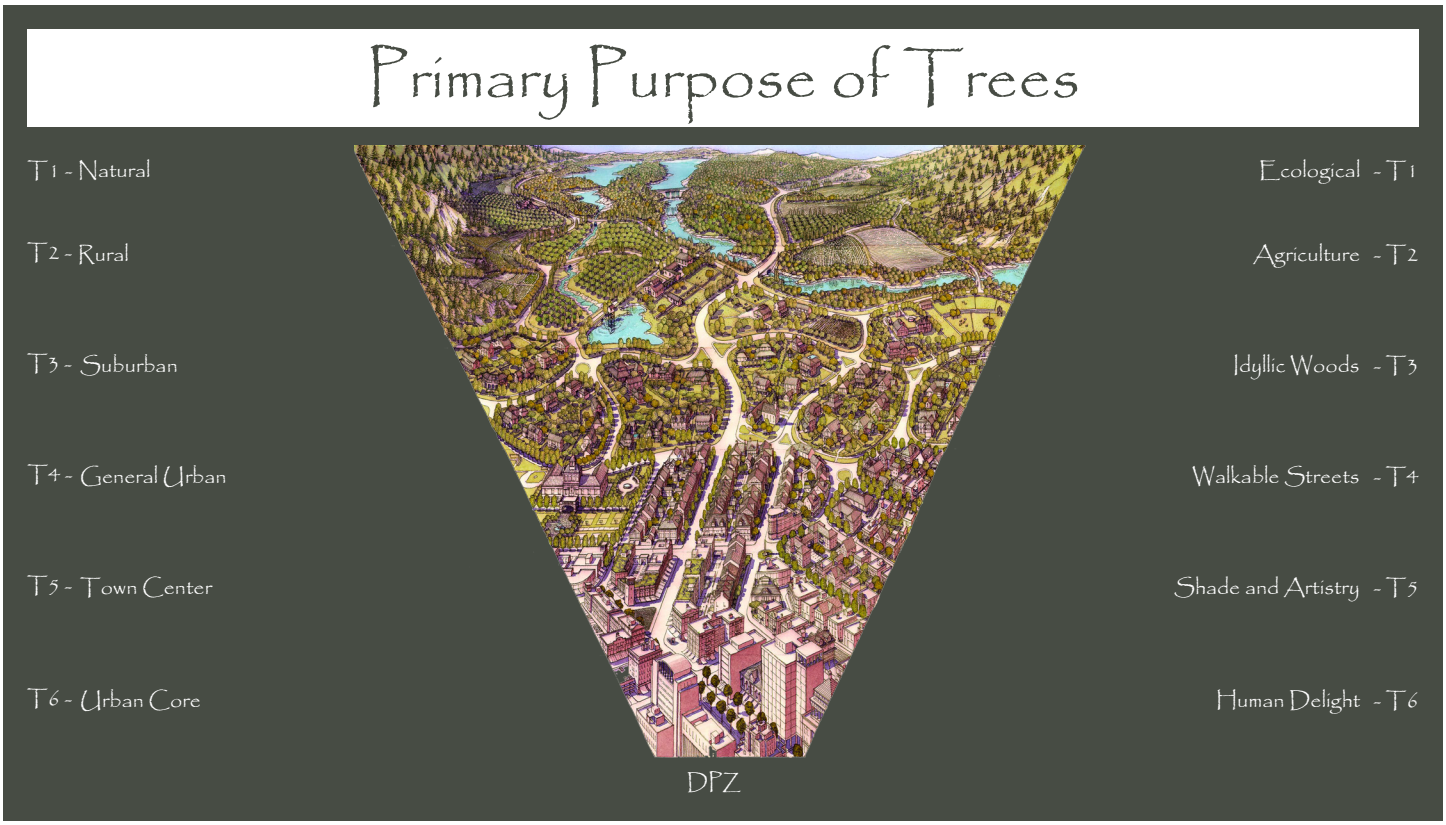
Environmental

- Reduce Greenhouse Gases
- Improve Air and Water Quality
- Decrease Urban Heat Island Effect
- Reduce Energy Consumption
- Decrease Top Soil Erosion
- Provide Wildlife Habitat

Source: Hall, Vonderscher & Adkins 2010

The Value of an Urban Tree

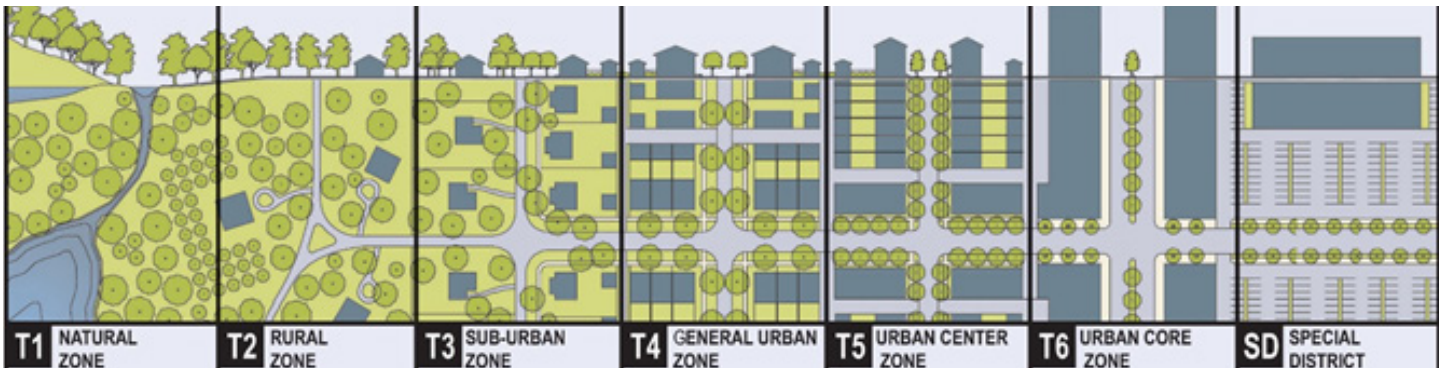
Fraxinus velutina 'Bonita', Bonita Ash	6" caliper | 30" caliper
Intercepted Stormwater	235 gallons | 1,833 gallons
Increased Property Value	$23 | $85
Conserved Energy	50 kilowatts | 320 kilowatts
Total Annual Benefits	$33 | $163



The Rural-to-Urban Transect as a Tool for Incorporating Nature into Urban Design

Not every benefit of a tree can be maximized in every design. Secondary benefits can be achieved but shouldn't be at the expense of the primary purpose. The context of the design determines the primary purpose for planting a tree and thus provides the framework for design. The Rural-to-Urban Transect (Transect) can be a very valuable tool in understanding the context. The Transect was developed by New Urbanist Andres Duany to help with the design and regulation of a city's urban form. The Transect is made up of six transect zones, T - zones, that represent a spectrum of environments from pristine nature to a dense urban core. The Transect is a valuable tool in understanding the context of any design and can be used to organize which principles should be applied. The Transect reminds us that a design in a rural community should not be the same as a dense downtown neighborhood. Thus the primary purpose of a tree in nature is not the same in an urban neighborhood.

The primary purpose of trees in urban neighborhoods is to enhance the habitat of people. This is environmentally sound because if people are happy in compact cities they will not be so inclined to sprawl into the countryside. In order to make people happy, trees in T – 3, T - 4, T - 5, and T – 6 are planted to create walkable streets, establish a sense of place, humanize the city and increase property values. The secondary benefits are managing stormwater, reducing the urban heat island, reducing energy costs and providing wildlife habitat. In the urban context the social and economic benefits outweigh the environmental benefits. However significant environmental benefits can be achieved by creating sustainable landscapes that support long-living trees. Nature belongs in a city but must be designed for people.



Rural-to-Urban Transect

Basic Principles of Trees in Urban Design

Urban Design (T-3, T-4, T-5, & T-6)

Trees are vital to the urban form of cities and function as living building materials that frame space and humanize the urban environment. The urban forest provides much needed order to the chaos of an urban environment. Trees are inseparable from the urban structure – trees are the only design element that can link an entire city together (Arnold, 1980).

1. Plant Large Trees. The purpose of planting trees in urban design is creating and reinforcing space not embellishing it. According to Arnold (1980) "the flowering trees (smaller trees) will never grow large enough to create the kind of shading canopy that all of this paved area needs for comfort and scale."

2. Limit Tree Species. The urban environment is a harsh environment and the vast majority of trees cannot survive with the concentration of car exhaust, poor drainage, disturbed and compacted soils, limited sun light, concentration of animal waste, polluted stormwater runoff and abuse from humans. "Forced diversity (of trees) results in planting unsuitable species of trees" (Arnold, 1980) that fail to survive, let alone thrive. In addition, attempting to incorporate a diversity of tree species into a design undermines the primary purpose.

3. Plant Trees Close Together Using a Geometric Grid. The value of a tree in a city is its contribution to the larger urban forest. Trees combine together "to form arcades that connect buildings, to separate areas with different scales or geometric configurations, and to create entrance canopies for buildings" (Arnold, 1980). A random planting pattern of trees contributes to the feeling of chaos. However, trees that are planted close together in a geometric pattern or grid becomes a pattern that "provides a visual syncopation that improves human comprehension of the space, just as metrical form in poetry guides a measurement and understanding" (Arnold, 1980).

Basic Principles of Trees in Urban Design

Arboriculture

Trees are living organism and require certain planting environments to survive and thrive. In order to properly design for trees, there must be a strong understanding of the biology of Trees and Soils. This understanding is needed for each tree "to live long enough with minimal maintenance so that its benefits are outweighed by the cost (Urban, 2008).

1. Design the Tree from the Roots Up. Urban streets have significant competition for space and if trees aren't designed in from the start of the project, the trees planted will not perform as desired. Trees need soil in order to grow and thrive, and this is especially true for the large shade trees. There are a variety of techniques to "Make Space for Roots" - some of them include root paths, soil trenches, soil vaults, engineered soil solutions, and suspended sidewalk systems (Urban, 2008). These solutions do increase costs on the front end but end up saving money over the long-term (Fowler, 2011).

2. Respect the Base of the Tree because Trees Grow. If designed properly a tree will grow and any design needs to accommodate the growth of the trunk flare and roots. The use of tree grates and trunk guards should be avoided since they are expensive and often end up girdling the tree. In order to design for the growth of the tree it is important to create an open area around the base of the tree that is fenced or surrounded by low seating walls. It is also a best practice to use flexible paving materials in conjunction with engineered soil designs (Urban, 2008).

3. Plant the Right Tree in the Right Place. Trees are living organisms and each species of trees has a variety of needs and abilities to adapt to various urban conditions. It is critical to understand these various requirements and adaptations of each tree species and take those into account when developing a tree palate for a project (Urban, 2008).

Rainwater Management

Managing stormwater is becoming increasingly critical as non-point-source pollution continues to degrade waterways and drought plagues arid cities. Large trees play an important role in rainwater capture but rainwater management is a secondary benefit of planting trees and shouldn't be at the expense of making beautiful and functional urban spaces.

1. Establish Good Place Making. Respect the transect! Rainwater management should help to enhance the livability and delightfulness of places for people. Bioswales and biorention basins should not disconnect people from on-street parking or buildings.

2. Investment in Solution Multipliers. Rainwater management design should stack functions and provide multiple benefits with a single investment. Done properly it will be cost effective, ecological, and provide a significant return on investment. An example of this is using engineered soil systems that make room for tree roots, increase stormwater retention capacity and allow durable hardscape surfaces to be used.

3. Design for Recognition. Low on the priorities is for people to be able to recognize and appreciate the environmental benefits of stormwater management practices. Yet, we can learn from the Romans to celebrate our vital infrastructure a la the fabulous fountains and aqueducts of ancient Rome.

Applying the Principles

	T - 3, Sub-urban	T - 4, General Urban	T - 5, Town Center	T - 6, Urban Core
Street Frontages	Common Yard, & Porch with Fence	Porch with Fence, Lightwell, Forecourt, Stoop, Shopfront, & Gallery	Lightwell, Forecourt, Stoop, Shopfront, Gallery, & Arcade	Forecourt, Stoop, Shopfront, Gallery, & Arcade
Street Tree Forms	Pole, Oval, Pyramid, Umbrella, & Vase	Pole, Oval, Pyramid, Umbrella, & Vase	Pyramid, Umbrella, & Vase	Pyramid, Umbrella, & Vase
Minimum Soil Volume	1,000 cubic feet	750 cubic feet	500 cubic feet	300 cubic feet
Planting Space	Open with wide tree planting strips	Open, & tree trenches	Open when possible, tree trenches, & engineered soil solutions	Tree trenches when possible, & engineered soil solutions
Rainwater Retention Form	Rain gardens, street tree bioswales, biorention basins & district parks	Rain gardens, street tree bioswales, biorention basins & district parks	Engineered soil, street tree biorention basins, & district parks	Engineered soil, street tree biorention basins, & district parks
Primary Purpose of Trees	Idyllic Woods	Walkable Streets	Shade & Artistry	Human Delight

Proposed street retrofit design for Van Buren Street, Phoenix. The wide barren street is put on a diet with bike lanes, parking lanes, and tree pockets. The trees provide a delightfully shaded outdoor room for people while intercepting and infiltrating rainwater

References

Image Credits & Notes

Image 1: Lysistrata “Lyssa” Hall, Phoenix Arizona.

Image 2: Lysistrata “Lyssa” Hall, the vast majority of trees planted are not designed to survive longer than 10 years, resulting in trees providing less benefits than it costs to plant and maintain (Fowler, 2011). Even an expensive proprietary soil matrix product provides a significant return on investment.

Image 3-14: Lysistrata “Lyssa” Hall & Jim McPherson

Image 15: Lysistrata “Lyssa” Hall, Portland Maine.

Image 16: Lysistrata “Lyssa” Hal, the value of the urban tree graphic is based on a velvet ash planted in a multiple family development in Phoenix Arizona. http://www.treebenefits.com/calculator/index.cfm.

Image 17: Duany Plater-Zyberk & Company, Crabtree Group, Inc., and Lysistrata “Lyssa” Hall, the primary purpose can be better understand by using the Rural-to-Urban Transect.

Image 18: Duany Plater-Zyberk & Company,Rural-to-Urban Transect.

Image 19: Lysistrata “Lyssa” Hall. Bryant Park New York, New York.

Image 20: Lysistrata “Lyssa” Hall, Brooklyn New York.

Image 21: Lysistrata “Lyssa” Hall, community constructed rainwater harvesting streetscape in Phoenix, Arizona.

Image 22: Watershed Management Group, Phoenix Arizona.

Image 23 & 23: Urban Advantage, Crabtree Group, Inc., and Duany Plater-Zyberk & Company for Reinvent PHX. Proposed street retrofit design for Van Buren Street, Phoenix. The wide barren street is put on a diet with bike lanes, parking lanes, and tree pockets. The trees provide a delightfully shaded outdoor room for people while intercepting and infiltrating rainwater.

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