



Greening Tree Ordinances **Building Sustainability into Local Green Laws**

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“The idea of wilderness needs no defense, it only needs defenders.”
The Journey Home, 1991 Edward Abbey

Green Cities

Frederick Law Olmsted (1822-1913), writer, urban visionary, park planner and landscape architect realized early in his career that for a city to be sustainable, it must have adequate open spaces, clean air and a wholesome environment flanked by trees, meadows, streams and opportunities for recreation and social gathering. In Olmsted’s time people looked at trees differently than they do today. Preceding 19th century America, the forests was looked at as something to remove, clear and exploit for natural resources, agriculture and commodities useful to mankind.

Yet Olmsted clearly recognized that if cities are to be sustainable, they must be designed with urban forests using native materials and natural processes that will stand up to time and the temptation of age to weather and fail. He relied upon

trees and the forests in his parks and principal urban spaces of cities across the nation to provide elements of nature that are truly sustainable. Historians would admit that Olmsted recognized that nature provides ecosystem services to those living in cities. Central Park (1858) in New York City is seen as the first experiment with urban forest sustainability practices and as such has survived most buildings and social institutions of its age. The forest in the city is a sustainable feature if properly planned, designed, built and managed.

Sustainability as we know it today is defined as “practices that meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable urban forests are the key to preserving nature in the city. Green infrastructure as noted in Olmsted lifetime work is the key to building green cities. The urban forest is one of the tools needed to sustain the city and keep it green. For it is this tool that preserves the soil, native vegetation, wildlife populations and provides other services such as water conservation, air quality improvements, climate moderation, energy recycling and improvements in human well being through public interaction. The other tool needed, is a set of community green laws and ordinances. These are public policy that preserve, protects, and rebuilds nature in the city. But these tree and landscape regulations must be developed around sustainability principles, particularly those principles of urban forest sustainability as mentioned by James Clark (Clark 1997). Most contemporary tree ordinances do not do this.

This paper sits forth some basic principles of sustainability that must be included within the articles, clauses and points of modern tree ordinances. This paper gives some examples of community tree ordinances and landscape codes that are looking toward sustainability as a basis of their public policy toward trees. The paper also describes sustainability practices that should be part of every community’s policy toward trees.

Sustainability in the Urban Forest

New Yorkers realize the future of this great American city is based on making the city livable while meeting the challenges posed by an environment under stress due to growth and development. To meet these challenges New York City has adopted sustainability plan, dubbed *Planyc*. Mayor Michael Bloomberg's sustainability advisory board has prepared a plan to green the city and urban forestry plays a significant role in carrying out this plan. This is a plan looks at the city's urban green infrastructure and related human impacts to land, water, air, energy, transportation and climate change and sets forth practices, principles and methods that will allow the city to sustain itself long into the future.

Some 127 new initiatives are underway including several that will produce a sustainable urban forest. These initiatives include greening parking lot, incentives for green roofs, protecting wetlands, and using storm water BMP's to clean urban runoff.

“To green urban forestry, community tree ordinances, landscape codes and tree preservation ordinances must be tailored to illustrate that the urban forest and its green infrastructure system it provides a range of fundamental ecosystem services that will not only green a community but will help to sustain it.”

The lesson learned from *Planyc* is that if the city is to achieve this sustainable plan they must green the city's various codes including building codes, energy codes, drainage codes and their tree and landscape codes. To become a sustainable city, the codes have to be changed.

The Sustainable City

Cities must not only have sustainability programs as we have seen in New York City but must adopt community policy by ordinance as well. In this regard, there may be no better

city to examine than *Santa Monica, California* a city of 84,000 people to determine how urban forestry is central to a sustainable city.

Santa Monica's community forest is comprised of 33,500 trees located in public areas throughout the community. Two hundred different species are present with the most prevalent species being *Washingtonia* sp and *Ficus* sp. Trees in this community include broadleaf evergreens, broadleaf deciduous, conifers and palms. The latter contributes most significantly to the urban forest canopy of this 8.3 square mile community. The urban forest is measurable so in this community there is one public tree for every two and one half citizens. Thousands of other trees grow on privately owned land in back yards and commercial properties. Forest management in Santa Monica includes tree planting, inspection, trimming and removal. The existing tree ordinance provides technical information to developers and builders for tree protection during construction on private property.

Community education is an important part of the program to encourage public stewardship of public and private trees in Santa Monica. Through educational programs, the city is able to tell citizens of the importance of the urban forest as one of the important aspects of sustainability in the community. Citizens husband their privately owned trees because they do understand the importance of shade in this sun washed beach community.

This community forest--providing the benefits of shade in the summer, sanctuary for urban wildlife, reductions in air and water pollution and increased property values is central to achieving the objectives of the Sustainable City Program.

“Sustainability is defined as practices that meet the needs of the present without compromising the ability of future generations to meet their own needs.”

San Monica that touts itself as the sustainable city has been working to make itself impact neutral for several decades. This community has set a variety of policies that will lead the city to a sustainable future. Among other initiatives, this community has policy that implements the ***Santa Monica Sustainable City Plan*** that is founded on nine Guiding Principles from which effective decisions can be made and individual policy can be managed. The plan consists of several areas of interest to urban forestry. They include policy for *resource conservation; environmental and public health; open space and land use*. Principles dealing with *transportation, economic development; housing; community education; and human dignity* supplement the program but are not central to urban forestry. Policy and administrative procedures for urban forestry practices will be found under the topics resource conservation, open space and land use. With each sustainable topic, the city has established goals, indicators and targets for performance. They have developed a sustainability plan and monitor success on a periodic basis.

The sustainable urban forestry goal in this west coast city is to develop and maintain a sufficient open space system so that it is diverse in uses and opportunities and includes natural function/wildlife habitat as well as passive and active recreation with an equitable distribution of parks, trees and pathways throughout the community. The key to having a successful urban forest is having ample public open space supplemented by private wooded lands. Tax incentives could be used to allow land along streams, on steep slopes and in other sensitive environmental areas to remain undeveloped.

The city measures the percent of tree canopy coverage by neighborhood and by land use category. This inventory is essential in understanding the composition and management needs of the urban forest. Public officials also measure the percent of newly planted and total number of trees that meet defined sustainability criteria. The target for tree canopy is to have an upward trend in the percentage of tree cover throughout the community and to reach a minimum goal of 18% canopy coverage within residential areas and 25% canopy coverage within commercial areas of the city. Some parts of the city now have 50% canopy coverage and several residential districts have canopy coverage exceeding 30%. These areas are much higher than the recommended minimum so the sustainability

program seeks to protect all of the existing trees from damage during construction with the use of Tree Protection Guidelines. Preserving the existing trees while planting young trees should be a common goal of a sustainable tree ordinance.

Presently 88% of the public tree stock is planted on parkways and medians. The remaining 12% of public trees are located in parks. The City Manager presents to the City Council annually a recommended tree planting program for its consideration. The City will bear the expense of tree maintenance from the date of planting for any trees planted within residential districts on public streets. Tree species are selected on a street by street basis with one tree species being the ‘official tree’ for that street. This ensures a varied and even distribution of species across the city and avoids ‘urban tree monoculture’ that can be a problem in some communities. According to their tree law, Sec. 7.40.010 (qcode.us/codes) A minimum of two canopy trees shall be provided in the front yard setback and three canopy trees shall be provided in the side yard.

Urban Forestry sustainability metrics are built around several factors that include green building; tree protection; tree canopy standards; site clearing controls; connectivity and accessibility to open space, parks, and trees; storm water management; irrigation controls; use of regionally appropriate vegetation; and management of the urban forest.

The community landscape code, Part 9.04.10.04 (qcode.us/codes), is a second measure of urban forestry sustainability and is an important tool for creating a sustainable landscape within the community. All areas of a development site not covered by buildings, driveways and sidewalks must be landscaped. This code sets design standards for drought tolerant landscaping and the use of appropriate plants based upon adaptability of the climate and topographical conditions of the building site. Plant materials used in design

must be grouped by hydrozones to conserve the use of potable water. Turf grass is limited to no more than 20% of the landscape area and should be reserved for functional use as a ground cover in highly visual areas. Turf grass must be low water use grasses and warm season grasses that will survive during drought period. Turf grass is not to be used to carpet the ground and when used soil moisture sensors are required for any turf plantings greater than 1000 square feet.

Santa Monica's Sustainable City Plan provides a roadmap to ensure that the city meets its current environmental, economic and social needs without impacting the ability of future generations to do the same. This program is managed by the city's Environmental

The Green Factor

Seattle, Washington is one of the leading sustainable cities in the United States and their codes reflect their leadership. In addition to a community landscape code and tree ordinance, this community has adopted sustainability design requirements for most commercial neighborhood business districts within the built up sections of the city.

Known locally as the "***Green Factor***" the code requires that landscape plans for development or redevelopment in commercial areas must meet new landscaping requirements based upon sustainability. This program, adopted in January 2007 requires landscape plans for neighborhood business to address ecological function and aesthetic principles to meet a proscribed number of points. These points are derived using a menu of green landscaping strategies.

Compliance with this code recognizes and rewards good design in several ways. The design is rated by points if the landscape plan preserves trees, installs green roofs, green walls and irrigation systems that reduce the use of potable water. Points are awarded for the use of drought tolerant plants in spite of Seattle's reputation as a rainy city. Bonus points are received for layering of plant materials across the property for increased visibility for pedestrians while encouraging the use of larger trees and taller shrubs.

But perhaps more importantly, the *Green Factor Landscape Code* recognizes and supports sustainability. The code recognizes that increased tree canopy coverage, supports the Cool Cities Program, absorbs carbon, produces oxygen, cleans the air, muffles urban noise, and reduces storm water run off. Porous pavers, rain gardens, and water harvesting are all recognized in this code. All of these design strategies rewarded with points are sustainable factors that will make a city more livable. The design of green roofs and green walls are used to shade buildings and reduce the use of energy and provide habitat for urban wildlife. As Seattle continues to update and refine the regulations, it will serve as a model for other cities considering adopting sustainability policy.

Green Building Irvine

Irvine California is one of the nation's largest planned communities that consisting of an area of land more than fifty-five (55) square miles. Irvine has developed a series of environmental programs and ordinances to assist the city on its path to sustainability. Citizens in the community have embraced a variety of programs that include building green, waste reduction, recycling, air and water pollution programs and energy conservation. There are also state statutes such as the California Solar Control Acts that also support sustainability. Most of these programs involve trees and landscape to some extent.

Tree policies are located in two places in the Irvine code. The landscape code, found in the *Zoning Ordinance*, (Chapter 3-15. Landscaping Standards Sec. 3-15-1-Sec. 3-15-10), sets design standards for building sites. Included in the Irvine code are standards for lot perimeter boundaries; 30 foot streetscape master plan landscaped setback area, planting and screening of parking lots; parking structures; and plant material standards. In addition, the code sets a minimum percentage of the amount of the site that must be landscaped, permeable, irrigated and shaded. These latter technical requirements are aimed squarely at sustainability.

The Irvine tree ordinance, titled the *Urban Forestry Ordinance*, Title 5, Planning, Division 7, Sustainability in Landscaping, Chapter 4 Urban Forestry is found in the municipal code rather than the zoning ordinance. The stated purpose of this ordinance is “protect and enhance the existing urban forest resource by application of sustainability in landscaping policies” and good urban forest management.

Sustainability in Irvine is based upon the *Irvine Build Green Program* in which the community is encouraged to utilize sustainable practices for residential and commercial land uses. Of particular importance are practices associated with site development, landscaping and land management. These practices are summarized **Figure no. 1**.

A LEED type rating system has been developed to help the city build a greener more sustainable future. Among these methods are practices directly affecting the landscape and the urban forest of the community. Examples include using recycled materials, waste diversion, minimize turf, treat storm water, reduce exterior lighting illumination, use reclaimed water, plant shade trees for shade in parking areas (one tree/four spaces), install a water efficient irrigation system, encourage bike riding and build a California Friendly landscape based upon the *Bay Friendly Landscape Scorecard*.

This is a LEED style point system that lists many ways that landscapes can be designed for sustainability. This rating system can be used by landscape architects, horticulturists, arborist and urban foresters to devise sustainability requirements for urban forests as well, since a garden and an urban forest are only a matter of scale.

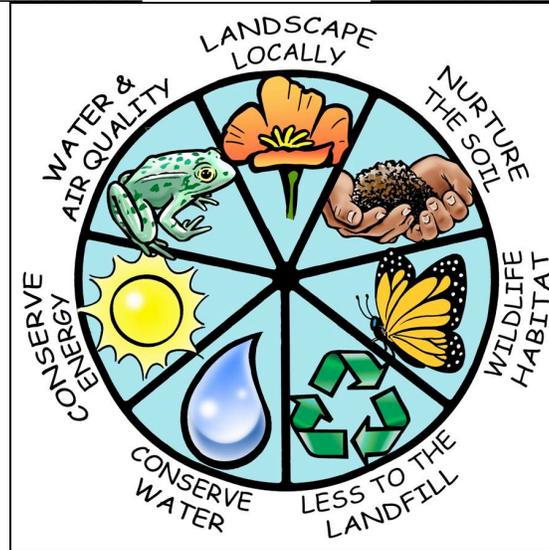


Fig. no. 1 Bay Friendly Sustainable Practice, Bay Friendly.org

Visit the *Bay Friendly Score Card* at <http://www.stopwaste.org/home/index.asp?page=8>
These sustainable practices set forth by the Alameda County Waste Management Authority help local communities meet agency initiatives to reduce green house gas emissions, conserve water, reduce storm water run off, reduce air pollution, reduce waste & increase recycling and design healthier communities. The *Civic Green Building & Bay Friendly Landscaping Model Ordinance* is available to assist communities in drafting new legislation.

Canopy Conscience Georgia

The first sentence of the first paragraph of the landscape manual for Miami-Dade Counties Florida states the issue perfectly when thinking about the importance of the urban tree canopy in the South. “The importance of landscaping, and in particular the amount of tree canopy coverage, is basic to a sub-tropical environment”. From Florida to Louisiana to North Carolina the urban tree canopy is one of the most sustainable and needed natural elements to promote livable cities where people can enjoy living, playing and working out of doors.

However, this all important tree canopy, that provides so many ecoservices for towns and cities will not last if codes, tree ordinances, land development regulations and other green laws are not drafted to ensure its survival. As American Forests and others have repeatedly pointed out, the leafy shade producing, climate modifying, habitat producing canopy, is an important and beloved asset of a city that must be managed.

American Forests have found that community forests in the Southeast have declined by thirty (30) percent over the last twenty (20) years as suburban development has increased by twenty (20) percent. To reverse this trend American Forests has developed canopy coverage standards as can be seen in **Figure. no. 2.**

For metropolitan areas east of the Mississippi and in the Pacific Northwest:

Average tree cover counting all zoning districts	40%
Suburban residential zones	50%
Urban Residential zones	25%
Central business districts	15%

For metropolitan areas in the Southwest and dry West:

Average tree cover counting all zoning districts	25%
Suburban residential zones	35%
Urban Residential zones	18%
Central business districts	9%

Fig. 2 Recommended Tree Canopy Coverage Standards, American Forests 2008

There are several good examples or cutting edge tree ordinances that can be given in the Atlanta metropolitan area. These counties including Fulton, Dekalb, Fayette, Forsyth, Henry, Clayton, Rockdale and Cobb all have tree ordinances and landscape codes that seem more complete than in other parts of the nature. But perhaps the best set of codes can be found in rapidly expanding Gwinnett County that has some of the most recent codes in the Atlanta area.

The *Gwinnett County, Georgia* tree ordinance, referred to locally as the BLT Ordinance (Buffer, Landscape & Tree Ordinance) is one of the best and clearly one that is in the

rank of the “super tree laws.” The BLT Ordinance. (Gwinnett Municipal Code, Chapter 118, Vegetation, Sec. 118.1, 1987, amended 2001, 2003, 2007.

This code consists of nine articles, three appendix and three amendments. The three most important articles are 3,4, & 5 that consist of regulations for buffers, landscaping and tree preservation and replacement. The Gwinnett code recognizes tree coverage, landscaping and buffers and their importance in “shading and cooling, noise and wind reduction, prevention of soil erosion, production of oxygen, dust filtration, fostering air quality through carbon dioxide absorption, providing wildlife habitat, and contributing to the aesthetic and economic value of real property.” This code is aimed at sustainable practices yet does not recognize sustainability as such. Or recognize the sustainability issues of the community forest. The foundation of the ordinance is built around three main purposes including “preserve and enhance the County's natural environment; the preservation, protection and planting of trees; and the provision of natural and/or planted buffers” between dissimilar land uses and zoning districts.

These goals are accomplished by use of some innovative tree canopy sustainability tools including five (5) types of buffers (natural, enhanced, landscaped, construction, and stream, The code had defined “*critical root zones*”, “*tree protection areas*” “*tree density standards*” (16TDU/Acre) , “*tree density units*” (CRZ, TPA, TDU, TDS) ,within designated and mapped “*tree save areas*” and “*specimen tree stands*”. “*Tree credits*” for specimen trees and *caliper counts* are other tools used for preserving tree canopy. A *tree bank program* is also available for use to restock and *tree replacement* for the community forest. The program quantifiably rests on tree calculations where diameter in inches is converted to tree density units (TDU). Trees are desired and protected in Gwinnett County Georgia. Where “*No Entrada*”, and “*Salve un Arbol*” is the rule of the day.

Another well thoughtout tree ordinance is recently enacted on in *Athens/Clark Count, Georgia* in the Atlanta area. Therefore, the purpose of this ordinance is to sustain and enhance the functions and benefits of trees and the community forest for the citizens of Athens-Clarke County and to utilize trees for their value and positive effects on air

quality, water quality, storm water runoff, local climate, environmental health, property values, business revenues, scenic quality, urban design, human health and well-being, outdoor recreation, forest products, and wildlife. (Title 8, entitled “Planning,” Code of Athens-Clarke County, Chapter 8-7, entitled “Community Tree Management, ”September 1, 2005).

This ordinance creates a community tree program featuring a community tree council whose duty it is to set up a urban forest management system and develop a tree management plan. This ordinance establishes protected trees (land mark, champion) classifies tree (conserved trees, planted trees, tree stands/ groves, forested areas, regeneration areas, future forest, preservation areas) and regulates trees on public property, street trees, parking lot trees and minimum tree canopy coverage. There minimum tree canopy coverage is based upon both conserved trees and planted trees and varies by zoning district. On average, this code calls for 45% of the county to be the minimum canopy coverage. Canopy coverage can range from 30% to 60% on zoned land.

Solar California

Davis, California is but one community that has adopted the California Solar Control Acts. (Assembly Bill 2321, the Solar Shade Control Act. 1978) (The Solar Rights Act, 1978 adopted in 1979 was amended four times in recent years: AB 1407, 2003; and AB 2473 2004 and again in 2005 (California Civil Code 714). AB 1920, the California Solar Surplus Act of 2008 takes California into the nations lead when it comes to solar energy sustainability. This act sets the course to a million solar roofs over the next ten years.

These acts have been written over the past few decades as one of the pioneering sustainable energy practices having a direct effect upon the urban forest.

The "Davis Solar Shade Control Act" (Ord. No. 1239, § 1 (part).) policy of the city promotes “all feasible means of energy conservation and all feasible uses of alternative energy sources.” To help implement this act the city encourages the planting and maintenance of trees and shrub. They believe and rightly so, that vegetation “creates

shading, moderate outdoor temperatures, and provides various economic and aesthetic benefits.” In certain situations alternative energy devices, such as solar collectors, requires specific and limited controls on trees and shrubs. Minor ordinances have been drafted to prevent neighbor’s trees from blocking access to solar power. Frequently you will hear of law suits between neighbors requiring the cutting and removal of trees that block access to solar energy.

Solar control and energy sustainability has also lead to parking lot planting requirements in Davis. According to Section 40.25.100 of the Davis Municipal Code and the *parking* lot shading guidelines, fifty percent of the paved *parking* lot surface shall be shaded with tree canopies within fifteen years of the acquisition of a building permit. (Ord. 2099 § 1, 2002, 37.04.020 *Parking* lot shading tree selection and shading plan.)

The parking lot shading ordinance influences tree selection and the preparation of landscape plans. All trees must be selected in accordance with the provisions of the “*parking* lot shading guidelines” and the “city master tree list;” only trees identified as *parking* lot shade trees may be planted unless otherwise approved by the city. Planting requirements are also influenced by the this green law. Tree species must be varied, but are not required to be, planted throughout the parking lot. They can be selectively planted where they will provide maximum shade.

To determine locations for planting trees, a parking lot shading plan and related shade calculations must be prepared and submitted to the city. The planning and building department reviews the plan and issues building permit or discretionary project permit for all new and/or reconstructed parking lots. (Ord. 2099 § 1, 2002)

Water Wise South Florida

Lee, Collier, Miami-Dade, Monroe and Broward counties, Florida are all water wise when it comes to community green laws. And because of this their landscape and tree codes are reflective of water and storm water sustainability.

These Florida counties and the municipalities within them understand that water is at a premium and resource to be carefully used in the state due to Florida's island like landscape and underground geology. Clean potable water is a rare resource in Florida. It is said that in Florida it rains from the ground up simply because artificial irrigation is required to keep lawns, leafy plants and flowers growing wonderfully. To sustain the fresh water supply it is a necessity to conserve and reduce the use of water for Florida yards and gardens.

Xeriscape™ landscaping has been developed as a sustainable practice to conserve and protect water resources across the state.

Xeriscaping is an approach to sustainable landscaping that develops drought tolerant landscapes that needs less water and less artificial chemicals for proper plant growth. The xeriscape program supported by the South Florida Water Management District and other water districts through out Florida put forth seven principles that should be followed when designing sustainable landscapes these include, 1. proper design, 2, understanding the soil, 3. choosing native plants, 4. restrict the use of water gulping turf grass, 5. irrigate efficiently by using low flow systems and zoning for water usage, 6. mulching, and limited and proper maintenance built around natural gardening methods. If these seven common landscape best practices are followed Floridian' can have their gardens and their water too.

Homestead, Florida heavily damaged by Hurricane Andrew in 1992 is located in Miami-Dade County, Florida. This community has one of the first landscape codes written with sustainability in mind. Of the factors in this code the most sustainable principles include designing for Xeriscape, tree preservation, water preservation, storm water harvesting and the creation of wildlife habitat. In addition, this innovative code provides some earth friendly landscape best management practices (LBMP's) that restrict the use of lawn grass, removes exotic invasive plants, and choosing low maintenance plants and

restricting the use of lawn chemicals, agricultural fertilizers and chemical compound pesticides. Further, this code protects riparian buffers.

Details of the code are based upon two local sources. Design use of plant materials and landscape design components come directly from the Miami-Dade County Landscape Manual. This document sets standards for buffers, street trees, parking lots, view triangles and energy conservation. In addition, the manual sets standards for plant material, planting operations, pruning and recommended plants. Planting inspiration within the manual takes a decided native plant community approach citing the eleven (11) natural eco-systems in Miami-Dade that would be appropriate. Ecosystem reestablishment is a wonderful sustainable practice because it tends to preserve native plants, animal life all of which will allow a landscape to be self maintaining.

The second inspiration for this code is the *Florida Yards and Neighborhood Program* sponsored by the University of Florida, Cooperative Extension Service. This program was created to determine environmentally sustainable landscape best management practices that would protect Florida's natural habitats, water supply and promote urban forestry and yard waste recycling. Nine principles, from mulching to pest management are set forth that have been incorporated into the Homestead landscape code. This code sets technical standards for most of the common design components found in community landscape codes, buffers, open space, parking lot interiors, parking lot screening, plant material standards, irrigation, landscape plans, tree surveys, and permits but goes beyond that to ensure sustainability. It is exciting to see a community landscape code protect natural forests, reduce the use of lawn grass, manage on-site storm water, require that on-site detentions be designed and landscaped and support earth friendly landscaping.

The Homestead, Florida landscape code is truly a model that can be used to for the design of other sustainable green laws.

Tree Ordinances Based Upon Sustainability .

Any tree ordinance should be structured around three related but administratively different parts that together provide the complete contemporary tree ordinance. (Abbey 1998) Most contemporary tree ordinances dating back to the 1970's include context, technical requirements and administrative procedures. These three elements are the all important parts of a well-crafted tree ordinance. *Context* sets forth the reasons for enactment of any public ordinance as well as its applicability. This part often contains technical definitions allowing readers to understand special meaning written into the ordinance. The *technical requirements* that generally pertain to urban forestry operations comprise the body of the regulations and provide information concerning compliance. Arborists, urban foresters, landscape architects, contractors and others generally follow the specifications of this part of the ordinance. Administrative procedures apply to the agency that enforces or expedites the ordinance. The rules they follow help to administer the ordinance and make it perform as intended. Generally this part involves process procedures such as plan review, permits, inspection, penalties, fees and the first step of an appeal procedure.

Occasionally special technical topics, administrative rules and specifications are drafted and contained within a design or technical supplement called the tree manual. The tree manual of *Palo Alto, California* and the BLT Manual from *Gwinnett County, Georgia* are very good examples. The Miami-Dade County, Florida Landscape Manual written in 2002 and republished in 2007 is another example of a community that writes sustainability into their ordinance. Since all tree ordinances cover three elements this discussion will not delve into context and administrative procedures but concentrate only on the technical requirements where the ideas of sustainability will be evolved.

A good place to start a discussion of sustainability principles is with the tree ordinance of *San Antonio, Texas*.

San Antonio, Texas Tree Ordinance.

Green laws are continuing to evolve and the San Antonio tree ordinance is a good example of the direction that tree regulations are moving. San Antonio tree regulations,

one of the noted super tree laws, can be found in the Unified Development Code under Development Standards and specifically as Division 3, Landscaping and Tree Preservation and Division 5, Natural Resource Protection. The two chapters of the UDC is where designers and arborists and urban foresters will find public policy toward trees and the urban forestry of this communities.

This code sets several sustainability standards that can be seen in [Appendix A](#) attached. Foremost of these issues include preservation of existing trees and proper selection, installation, and maintenance of plant materials. Other sustainability goals set forth in this code include reduction in soil erosion; increased infiltration; manage storm water for aquifer recharge; mitigate air, dust, noise, heat and chemical pollution as well as glare; and reduce the "heat island" effect of impervious paved surfaces. This will lead to cooling and shading parking lots, preserving existing native vegetation as wildlife habitat and incorporating native plants and ecosystems into landscape design. Other sustainable practices in this code include xeriscape™ planting techniques; energy conservation measures; water conservation strategies, and efficient irrigation design.

The San Antonio code is a point based code system that can be used to quantify application to sustainable principles. Although, not the best code, this code shows promise toward leading San Antonio to a sustainable future in regard to their community landscape.

Articles of Sustainability

A contemporary tree ordinance based upon sustainability should set forth guiding principles based upon environmental improvements, public policy toward the environment and shared values toward the city and its resources. These principles must carry through to all actions and decisions in regard to urban forestry and sustainability.

Important sustainability tools highlighting ecosystems services provided by the urban forest should be written into the ordinance to preserve the urban forest canopy, set

standards city wide according to zoning or land use for establishing the percentage of the urban forest that must be preserved for posterity. Ecosystem services provide benefits to society but are often not considered as an asset in current developmental economic accounting methods. (SSI ASLA 2007) Habitat preservation, particularly for wetlands, groves, specimen forests, stream banks, steep slopes and transitional meadows should be a major factor in this ordinance as well. Urban forestry derives its position of sustainability by its ability to protect and preserve unique and important environment resources. Tree protection during construction, setting a minimum area of site permeability and placing emphasis on the use of native plants and water conservation are other important articles that should be included of this ordinance.

The ordinance should address related issues concerned with open space, wildlife habitat and proximity to parks, trails and forested land. The urban forest must be seen as something that is used for recreation and pleasure in order to help citizens see the values and advantages it preservation.

The technical standards of a sustainable tree ordinance may be written to convey three points. They include guiding *principles*, *sustainability tools*, and a program for *monitoring and assessment*. Figure 1 below shows a list of these three points. Communities should select the principles, tools and monitoring procedure that are most relevant to their community conditions.

I. Guiding Principles

Management of the Urban Forest- planning, design, maintenance, financing

Habitat preservation-wetlands, groves, forests, transition meadows, steep slopes
wildlife corridors etc.

Tree Protection During Construction- three inches for one inch replacement

Minimum Area of Site Permeability-

Native Materials and Ecological Conformity-native plants, exotic plants and lawn grass
minimization.

Water Management –storm water control, water conservation, water harvesting, irrigation design

and control.

II. Urban Forest Sustainability Tools (ordinance articles)

- Minimum Canopy Standards
- Tree Preservation, Preserved Groves and Forest Remnants
- Screening, Buffering and Green Connectivity to Parks & Open Space
- Green Parking
- Appropriate Plant Materials
- Locally Produced Construction Materials
- Nutrient Cycling
- Photosynthesis and the Carbon Sink
- Soil Structure
- Solar Energy Orientation
- Urban Heat Island Effect
- Water Balance
- Storm Water BMP's
- Wetlands
- Windbreaks
- Steep Slope Protection
- Human Health and Well Being

III. Monitoring and Assessing Sustainability

- Community Sustainability Plan
- Sustainability Director & Staff
- Inventory; Mapping; Monitoring; Arboricultural Management.
- Setting Sustainability Principles, Goals, and Measurable Results
- Progress Reports-indicators, activity, milestones, targets report to the citizens

Fig. no. 3. Sustainable Components of Urban Forestry

From the above discussion, one may conclude that a sustainable tree ordinance is one that places emphasis on protecting the green infrastructure of a community. Green infrastructure, including related natural features such as topography, soils, water, climate, air quality and visual beauty, is consistent to the definition developed by the American Society of Landscape Architects for their *Sustainable Sites Initiative Program*. The ASLA defines green infrastructure as “ a strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for communities.” This is certainly a definition that could be used for the public urban

forest. The use of “soil, trees, vegetation, wetlands, and open space (either preserved or created) in urban areas to capture rain while enhancing wastewater and stormwater treatment is also mentioned.

Green infrastructure should be planned, designed and maintained in conjunction with the traditional hard infrastructure of a community. Many communities only think of the hard infrastructure such as streets, drains, water supply, power, retention basins, and treatment facilities. Green and gray infrastructure together is necessary to build and sustain a contemporary city. Some communities, corporations and universities are hiring sustainability directors to oversee sustainable development. Communities are adhering to green building standards as promulgated by such organizations as the ASLA SSI program (Sustainable Sites Initiative), USGBC (Green Building Council, LEED Rating Program) or the Florida Green Building Coalition or the NHBA (National Home Builders Association). Sarasota, Florida dubs itself the Green City due to its involvement in meeting green building standards. Some of the ideas of these programs pertain to urban forestry and have been documented here. It is time that tree ordinances be adapted to urban forest sustainability.

Some ideas and thoughts contained in this Paper were presented at American Forests, National Conference on Urban Ecosystems, Orlando, Florida, May 2008.

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Greening Tree Ordinances, v4 10.17.08

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Appendix A – Greening Your Tree Ordinance

Greening Your Ordinance For Sustainability .

To implement a change to a community tree ordinance or landscape code to reflect the concept of sustainability will be much easier than committing to become a sustainable city. Adopting a sustainable way of living will certainly require a change in mind set for most communities. Making the decision to go green will require that the community revise their tree policies, codes and ordinances to reflect this decision.

From a tree ordinance writing perspective it is relatively easy to modify an existing ordinance. The first step is to change the purpose of a communities tree policy and this is very simple to do from an ordinance writing perspective. Simply make changes to one of the three main parts of a tree ordinance as explained above. The main part to be revised

will be the *context* of the ordinance. Some changes or minor revisions to the technical standards and administrative procedures maybe needed to move toward sustainability but to begin start with making adjustments to the context. This will necessitate change to the short title, Scope, Purpose and Objectives three very common articles found in community tree ordinances or landscape codes. For example, the following code language may be used as a guide.

Sec. 17-1. Short title.

This chapter shall be known and may be cited as the "Urban Forest Sustainability Ordinance of the City of Baton Rouge, Louisiana."

Sec. 17-2. Scope.

The provisions of this chapter apply within the entire corporate area of the city to the use of all lands both public and private within such area by any person, corporation, other entity or public agency, including the city itself. Property outside the corporate city limits, but adjacent to the city limits, shall be provided protection from the impacts of development in the city as if it were in the city. This ordinance brings the concept of sustainability and green building to the existing and future forested areas within this city.

Sec. 17-3. Purpose.

This chapter is created to implement the City of Baton Rouge *Horizon Plan* (comprehensive plan) adopted December 17, 2007, as amended from time to time. It is also the intent of this chapter to encourage and promote the safety, health, order, convenience, prosperity and general welfare of the citizens in accordance with the comprehensive plan. It is also the intent of this chapter to move the city toward a sustainable future in regard to its urban forest, opens space, park lands and adjacent private property by adopting 'guiding principles,' 'sustainability tools' and 'monitoring and assessment practices' as set forth in the *Guide to Sustainability*, Baton Rouge, Louisiana published and accepted by the Metropolitan Council on June 5, 2008.

Sec. 17-4. Objectives.

This chapter is prepared in accordance with and for the promotion of the goals, objectives and policies of the comprehensive plan. The regulations herein are designed to conserve the value of land, building and natural resources; protect the character and maintain the stability of residential, commercial and industrial areas; and provide for efficiency and economy in the process of development through:

- (1) Establishment of Minimum Canopy Standards
- (2) Promote Tree Preservation, Preserved Groves and Retention of Forest Remnants
- (3) Increase Screening, Buffering and Green Connectivity to Parks & Open Space
- (4) Convert Non-productive Parking Lots to Green Parking
- (5) Use Only Appropriate Plant Materials for Restocking The Urban Forest
- (6) Encourage the Use of Locally Produced Construction Materials
- (7) Provide for Nutrient Cycling Within The Urban Forest
- (8) Allow for Increased Photosynthesis and the Carbon Sequestration within Forests

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- (9) Protect and Husband Soil Structure, Prevent Erosion and Increase Fertility of Soil
- (10) Maximize Solar Energy Orientation with the Siting of all Buildings within the Forest
- (11) Reduce the Urban Heat Island Effect by Shading all Parking Lots and Streets
- (12) Maintain a Water Balance by Proper Irrigation Design and the use of Xeriscaping
- (13) Manage On-site Storm Water with the use of BMP's and Water Harvesting Methods
- (14) Preserve and Reconstruct Wetlands
- (15) Provide Appropriate Windbreaks to Modify and Ameliorate Climate
- (16) Provide Tree Preservation as a Means of Steep Slope Protection
- (17) Protect Human Health And Well Being by providing a sustainable urban forest.

Sec. 17-5. Design Manual.

(a) *Intent; adoption of manual.* The *Urban Forest Sustainability Design Manual* is intended to provide detailed design guidelines and specifications for construction of physical improvements to the urban forest to allow the achievement of the previously mentioned objectives. The design manual shall be adopted by resolution of the Metropolitan Council and kept on file in the Public Works Department and displayed on the city web site for use by the design community, citizens and organizations who are working to go green. . The design manual shall address the following:

- (1) Selection of environmentally sound practices for the planting, protection and preservation of trees and the urban forest canopy as well as management of storm water, irrigation water, landscape design, and control of erosion and sedimentation as well as construction specifications for tree management, storm water facilities, buffers, screens, bikeways, sidewalks, and other physical improvements that may be needed to implement the sustainability plan.

Appendix B – Sustainability In Landscaping Ordinance Irvine, California

City of Irvine, California
Municipal Code
Title 5 Planning
Division 7 Sustainability in Landscaping (abbreviated by author)

CHAPTER 1. TITLE, PURPOSE AND INTENT

Sec. 5-7-101. Title.

This division shall be known and cited as the "Sustainability in Landscaping Ordinance."
(Code 1976, § V.G-100; Ord. No. 90-12, § 2, 6-26-90)

Sec. 5-7-102. Purpose and intent.

The purpose of this division is to provide policies, standards, procedures, and guidelines to achieve long-term levels of sustainability in landscapes.

Sec. 5-7-103. Policies.

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The following policies are established to achieve the purpose and intent of the Sustainability in Landscaping Ordinance:

- A. To develop and maintain landscapes that conserve, recycle, and reuse resources to achieve optimum levels of sustainability.
- B. To develop and maintain landscapes with increasing levels of conservation and efficiency in energy use.
- C. To develop and maintain landscapes upon principles of water conservation and to optimize the use of reclaimed water resources.
- D. To develop and maintain landscapes towards optimum levels of biomass storage which provides increased storage of carbon and production of oxygen.
- E. To design landscapes comprised of associations of plant which have similar climate, water, soil, sun exposure and maintenance needs.
- F. To design and maintain landscape for optimum levels of micro-climate benefit to reduce urban heat build-up and energy demand for heating and cooling.
- G. To design and maintain landscapes with reduced levels of turfgrass.
- H. To design and maintain landscapes with incorporate organic soil management practices and which will accommodate composted landscape trimmings.
- I. To encourage the minimum use of inorganic fertilizers, herbicides, and pesticides in the development and maintenance of landscapes.
- J. To design and maintain landscapes which are supportive of the conservation and open space element with particular reference to enhancement and preservation of significant biotic resources.
- K. To develop and maintain landscapes which, to the greatest extent possible, incorporate a balance in regards to function and aesthetics to achieve optimum levels of sustainability of the landscape.
- L. To develop and sponsor activities and programs to educate residents to the ideas and benefits of sustainable landscapes.

(Code 1976, § V.G-102; Ord. No. 90-12, § 2, 6-26-90)

CHAPTER 2. SUSTAINABLE LANDSCAPING GUIDELINE MANUAL

Sec. 5-7-201. Sustainable landscaping guideline manual.

The Director of Community Development shall formulate such rules, procedures, and interpretations as may be necessary or convenient to administer this division. Such rules, procedures, and interpretations shall be referred to as the "City of Irvine Sustainable Landscaping Guideline Manual"

CHAPTER 3. APPLICATION AND PROCEDURES

Sec. 5-7-301. New development.

This division shall apply to all discretionary and nondiscretionary development case applications and when landscape permits are required. Single-family home lots and agriculture are exempt.

(Code 1976, § V.G-301; Ord. No. 90-12, § 2, 6-26-90)

Sec. 5-7-302. Approved projects.

Approved landscape plans for discretionary and nondiscretionary development case applications which are valid on the effective date of this division shall remain valid. Landscapes for these projects may be built in accordance with the development standards and landscape standards in effect at the time of approval provided that the development case or nondiscretionary approval is valid at the time landscape permits are issued.

Sec. 5-7-303. Projects in progress.

Discretionary development case applications which have been received by the City, but have not been publicly noticed for the approval hearing by the effective date of this division, shall be subject to the provisions of this division unless waived by the Director of Community Development.

(Code 1976, § V.G-303; Ord. No. 90-12, § 2, 6-26-90)

Sec. 5-7-304. Conceptual landscape plan.

Conceptual landscape plans as defined in the sustainable landscaping guideline manual shall be approved by an approval body in conjunction with discretionary and nondiscretionary development case applications. The approval body for development cases may impose conditions and may require evidence that such conditions are being or will be complied with in the form of subdivision agreements and security as it deems necessary to satisfy the intent of this division.

(Code 1976, § V.G-304; Ord. No. 90-12, § 2, 6-26-90)

Sec. 5-7-305. Landscape permits.

A. A landscape permit shall be required for the installation of all landscape planting and irrigation.

CHAPTER 4. URBAN FORESTRY

ARTICLE a. GENERAL PROVISIONS

Sec. 5-7-401. Title.

This chapter shall be known and cited as the "Urban Forestry Ordinance."

(Code 1976, § V.G-400; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-402. Findings.

A. There are over 30,000 trees on public landscapes. This represents approximately one-fifth of the total urban forest resource.

B. These trees provide shade thereby reducing the use of fossil fuels for cooling buildings. Research has demonstrated that trees can reduce the energy used for cooling buildings by as much as 35 percent.

C. These trees absorb pollutants generated by the burning of fossil fuels, thereby cleaning the air. Research has demonstrated that trees absorb and store carbon dioxide, the most pervasive air pollutant.

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D. These trees provide beauty to the community, thereby increasing the marketability and value of property. Research has demonstrated that mature trees can contribute five to 20 percent to property value.

E. The estimated value of these and other benefits for trees on public landscapes is \$25,000,000. It is expected that the total value of the urban forest resource in Irvine is greater than \$100,000,000.

(Code 1976, § V.G-401; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-403. Purpose and intent.

The purpose of this chapter is to protect and enhance the existing urban forest resource by application of sustainability in landscaping policies and through the provision of professional management.

(Code 1976, § V.G-402; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE b. DEFINITIONS

Sec. 5-7-404. Definitions.

The following words, terms and phrases when used in this chapter shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

City Arborist: The Director of Community Development or his or her authorized representative.

Significant tree:

1. All trees located within public or private landscapes cited in section 5-7-407.
2. All trees in eucalyptus windbreaks or any tree included in a remnant of a eucalyptus windbreak. A remnant of a eucalyptus windbreak is any tree or trees of the species *Eucalyptus globulus* that are approximately the same age as other known windbreak trees in the City.

Topping: This definition also refers to the terms "heading," "dehorning," "pollarding," and "hatracking." Topping is defined as any pruning cut that removes a branch to a stub, a bud, or a lateral branch not large enough to assume the terminal role. A lateral branch is large enough to assume the terminal role when it is at least one-half the diameter of the branch that is removed.

Tree: Any woody plant species that can typically grow with a single trunk and a distinguishable crown and have a height of 15 feet or greater at maturity.

Urban forest: A natural resource composed of all trees on public and private property within the City limit and sphere of influence.

(Code 1976, § V.G-500; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE c. RESPONSIBILITY

Sec. 5-7-405. Urban Forestry Guideline Manual.

A. Rules, procedures, and interpretations shall be formulated as may be necessary or convenient to administer this ordinance. Such rules, procedures, and interpretations shall be referred to as the "Urban Forestry Guideline Manual." The Urban Forestry Guideline Manual may be amended by the administrative authority, providing such amendments are consistent with the purpose and intent of this division.

B. In the event of any conflict between said manual and this chapter, the provisions of this chapter shall govern. Copies of the Urban Forestry Guideline Manual shall be on file

in the office of the City Clerk and be made available to the public at a fee sufficient to recover costs.

(Code 1976, § V.G-600; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-406. Reserved.

Sec. 5-7-407. Jurisdiction.

This chapter shall apply to all trees defined as and located within:

- A. Public trees in the right-of-way of public streets.
- B. Public trees located in and around public parks and other public facilities.
- C. Trees in common areas located in village edges and landscape or parking lot setbacks on arterial streets.
- D. Private trees on nonresidential properties to the extent zoning ordinance requirements are effective. The zoning ordinance does not restrict tree removal, but does imply tree replacement in order to maintain specific ratios of trees to parking stalls and linear boundary.
- E. Significant trees as defined in section 5-7-404.

(Code 1976, § V.G-601; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE d. GOALS

Sec. 5-7-408. Goals.

The following goals are established to achieve the purpose and intent of Urban Forestry Ordinance:

- A. To protect trees for their historical, biological, or aesthetic value including but not limited to native oaks, native sycamores, and eucalyptus windbreaks.
- B. To sustain and improve the integrity of the design character for Irvine villages.
- C. To ensure that tree management decisions are made with the assistance of qualified professionals.
- D. To encourage long-range planning for urban and community forest management.
- E. To encourage proper tree selection where consideration is given to available growing space, soil suitability, and desired effect.
- F. To encourage tree species diversity at the village and City level.

(Code 1976, § V.G-700; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE e. REQUIREMENTS

Sec. 5-7-409. Topping prohibited.

As defined in section 5-7-404, topping is prohibited except in cases where a tree removal permit has been issued or in cases of emergency where immediate threat to persons or property is posed.

(Code 1976, § V.G-800; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-410. Tree removal.

- A. *Permits for tree removal.* A permit shall be required to remove any significant tree on public or private land to which this chapter applies. Permits which do not specifically show or list trees to be removed shall be assumed to not permit tree removal.
- B. *Criteria for permits.* The City Arborist shall use the following criteria to grant approval for tree removal permits pursuant to this section:

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1. Trees that are dead or in significant and irreversible decline. Significant decline is defined as dead limbs composing more than one-third of the tree crown.
2. Trees that have a potentially hazardous and incorrecable structure.
3. Trees that are stunted or malformed due to crowding from adjacent trees or structures.
4. Trees that have an insect or disease infestation that is not treatable and could cause tree mortality.
5. Trees that are causing damage to structures as follows:
 - a. *Sidewalks, curbs, drives, buildings, and other structures.* Removal shall be granted if the cost to repair the damage exceeds the appraised value of the tree (using the method established by the International Society of Arboriculture for tree appraisal), if the process of repair will compromise the health and safety of the tree, or if the tree is determined to be incompatible with the growing space available.
 - b. *Sewer, gas, electrical, water and other utilities.* Removal shall be granted if it can be determined that the tree caused the damage to the utility. If the center of the tree trunk is located within three feet of a utility line, it is assumed to have caused the damage. It will be the applicant's responsibility to demonstrate cause if the tree is beyond three feet from the utility line.
6. Trees that have yet to cause damage to structures, but are determined to be incompatible with the growing space available as follows:

The applicant shall complete a comprehensive management plan through the City's Community Forests Program or equivalent to address phased removals and appropriate replacement prior to approval of a tree removal permit.
7. Trees that are significantly inhibiting the utilization of the property and removal can be determined to provide public benefit. The Planning Commission will evaluate permits submitted under this criterion.
8. Trees on nonresidential property shall only be subject to the replacement criteria in section 5-7-410C.2.

C. *Replacement.*

1. Trees removed shall be replaced at a one-for-one ratio either on site in a similar location, onsite in a different location, or off site as prescribed in the Urban Forestry Guideline Manual Based on the determination of the City Arborist.
 2. Trees removed on nonresidential property shall be replaced at a one-for-one ratio in conformance with the most current landscape plan approved by the City based on the determination of the City Arborist. Trees removed on nonresidential property where existing tree density does not comply with that specified in the most current landscape plan shall be replaced at a ratio not to exceed the tree density specified in that plan based on the determination of the City Arborist. In either case trees may be replaced either on site in a similar location, on site in a different location, or offsite as prescribed in the Urban Forestry Guideline Manual based on the determination of the City Arborist.
- D. *Fee.* Each applicant shall pay a fee in an amount to be set by resolution of the City Council to cover the costs of administering this ordinance.

(Code 1976, § V.G-801; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE f. PENALTY AND APPEAL

Sec. 5-7-411. Penalty for violation.

Any property owner or his or her agent that violates section 5-7-409 or 5-7-410 shall be guilty of a misdemeanor and shall be subject to a fine of not less than the

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assessed tree value lost as determined by the City Arborist using the method established by the International Society of Arboriculture for tree appraisal.
(Code 1976, § V.G-900; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-412. Reserved.

Sec. 5-7-413. Appeal.

Any decision made by the City Arborist may be appealed by the applicant or any affected resident or property owner in the City of Irvine. Such appeal shall be made in accordance with the zoning code of the City.
(Code 1976, § V.G-901; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE g. PERFORMANCE EVALUATION

Sec. 5-7-414. Performance evaluation.

The City Arborist shall collect and maintain all records and data necessary to objectively evaluate whether this chapter is accomplishing its stated purpose and shall prepare an annual evaluation and report to the City Council if any modifications are recommended.
(Code 1976, § V.G-1000; Ord. No. 94-8, § 2, 6-14-94)

ARTICLE h. LIABILITY, EXEMPTION AND SEVERABILITY

Sec. 5-7-415. Liability.

The person with maintenance responsibility for any public property or the owner of private property shall have a duty to keep trees in a safe and healthy condition. Nothing in this chapter shall be deemed to impose any liability for damages or a duty of care and maintenance upon the City or upon any of its officers or employees.
(Code 1976, § V.G-1100; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-416. Exemption from Solar Shade Control Act.

The City is exempt from the provisions of the California Public Resources Code § 25980 et seq., known as the Solar Shade Control Act.
(Code 1976, § V.G-1101; Ord. No. 94-8, § 2, 6-14-94)

Sec. 5-7-417. Severability.

Should any part or provision of this chapter be declared by a court of competent jurisdiction to be invalid, the same shall not affect the validity of the chapter as a whole or any part thereof other than the part held to be invalid.
(Code 1976, § V.G-1102; Ord. No. 94-8, § 2, 6-14-94)

Appendix C - Tree And Landscape Ordinance- Purpose Statement San Antonio, Texas

Unified Development Code Development Standards

Division 3, Landscaping and Tree Preservation

Division 5, Natural Resource Protection

STATEMENT OF PURPOSE

The purpose of these landscaping, street tree, screening, and buffer requirements is to provide standards that will protect the health, safety and general welfare of the public, enhance property values, and improve the appearance of the community through preservation of natural resources, trees, and native plants and maintaining the ecological balance of the area.

These minimum requirements will:

(Sustainable Practices in Green Ink)

- Safeguard and enhance property values and protect public and private investment.
- Encourage preservation of existing trees and other significant vegetation.

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- Encourage proper selection, installation, and maintenance of plant materials that result in the conservation of natural resources, including water.
- Reduce the negative environmental effects of development while protecting and enhancing the value of developed properties and the surrounding area.
- Reduce soil erosion and increase infiltration in permeable land areas essential to stormwater management and aquifer recharge.
- Mitigate air, dust, noise, heat and chemical pollution and glare and other adverse environmental effects of development.
- Reduce the "heat island" effect of impervious surfaces, such as parking lots, by cooling and shading the surface area and breaking up large expanses of pavement.
- Establish a landscape theme including street trees and streetscape designs to be used throughout the city to promote the overall character and identity of the community.
- Address the design of entryways into the city to express the community's values.
- Preserve existing native vegetation as an integral part of the wildlife habitats, and incorporate native plants and ecosystems into landscape design.
- Promote innovative and cost-conscious approaches to the design, installation, and maintenance of landscaping while encouraging xeriscape planting techniques, water and energy conservation.
- Screen unsightly equipment or materials from the view of persons on public streets or adjoining properties and buffering from uncomplimentary land uses.
- Maintain and increase property values by requiring site appropriate landscaping to be incorporated into development that is designed and installed by a qualified landscape professional.
- Promote walkable, pedestrian-scale streetscapes, traditional neighborhoods, and compact centers by exempting uses which relate to each other functionally and visually from certain requirements of this section.
- Promote water conservation through efficient landscape and irrigation design.
- To promote and protect the health, safety, and welfare of the public by creating an urban environment that is aesthetically pleasing and that promotes economic development through an enhanced quality of life.

Appendix D – Sustainability Metrics

Sustainability Metrics

It was previously stated that the forest in the city is a sustainable feature if properly planned, designed, built and managed. These four elements are the basics of sustainability based tree ordinance. To preserve the urban forest resources into the future it is important for tree ordinances to address these elements that are essential to developing sustainability metrics by which the success of a sustainable program may be measured.

Forestry sustainability metrics are built around several factors that include green building; tree protection; tree canopy standards; site clearing controls; connectivity and accessibility to open space, parks, and trees; storm water management; irrigation controls; use of regionally appropriate vegetation; and management of the urban forest. The latter factor includes proper inventory control and measurement with computer based GIS systems by an urban forestry management office guided by a citizen tree board or landscape commission. In addition a community must have a well staffed and experienced urban forestry crew that is well equipped to plant, manage, maintain and remove trees and related landscape features found within the urban forest.

To implement this systematic way of husbanding the tree resources of a community it is important for a community to state its tree policy within the community tree ordinance or landscape code. Sustainability metrics must be included in the ordinance as goals or forestry mandates to accomplish the purpose of sustaining the urban forest. Based upon the case studies and ordinance presented here the following sustainability metrics should be built into every community tree ordinance and landscape code with appropriately written code language.

Metric one: Define the forest

The first measure of a sustainable tree ordinance is to support a local urban forest is that the entire natural system is seen as one unit. The urban forest includes not only public treed areas like streets, parks, and preserves but private lands as well. Large institutions, big land owners and even the person growing oranges in the back yard contribute to the urban forest and its connectivity across the community. Connecting yards, gardens, the corporate campus, forest preserves and wetlands as one linked system of walkable or bike riding urban forest experience is necessary to fully appreciate exactly what will make the urban forest unique. For this reason, the connecting of parts, no two urban forests are the same. This is what will make each community unique.

Metric two: Tree Protection & Healthy Environment

Tree protection language included in any tree ordinance or landscape code necessary in any community that wants to draft a sustainable urban forest ordinance. Each and every tree should have some protection but the most important trees and special groves need additional support by stiffer regulations or special forest management. As Santa Monica has demonstrated, drafting local tree protection measures and writing a tree protection manual will help all citizen's, builders and developer see the worth of all trees from pioneer tree growth to a climax forest.

Representative Urban Forest Sustainability Standard: Trees, shrubs, ground covers within urban forests promote healthy environments. Examples include cleaner air, purer water, productive soils, ameliorated climate, and healthy wildlife and human habitat as well as a potential for food crop production. The urban forest sequesters carbon, produces oxygen, recycles biomass and utilizes the sun for it energy potential. All of these chemical actions make for a sustainable community.

Metric three: Minimum Tree Canopy Standard

American Forests, the nation's oldest conservation organization, as we have seen provide a set tree canopy standards that are reasonable for communities across the county. This part of a sustainable tree ordinance is one of the most critical decisions a community must make to ensure a stable, healthy urban forest for generations yet not born. A community must determine what percent of the community must be covered with tree canopy. A goal should be set that is politically acceptable, affordable and that citizens will work to achieve. Baton Rouge, Rouge for instance currently has forty-two (42) percent canopy coverage on average. Residential areas are higher and commercial and industrial areas are much lower. Perhaps they should adopt standards to bring that average up to fifty-five (55) percent by planting hundreds of young trees each year to replace the ones that are removed or die from natural causes. Eventually by staying ahead of the mortality rate, managing the urban forest properly Baton Rouge will achieve its goal.

Representative Urban Forest Sustainability Standard: Minimum tree canopy standard for each unit of the urban forest shall be no less than forty (40) percent and the average minimum canopy for the community of the whole shall be minimum canopy standards per zoning district as recommended by the American Forests as measured by either canopy coverage, trees per acre, or caliper inches per acre or by permeability ratio of the development site.

Metric four: Site Clearing Standards

Site clearing controls are often a bug-a-boo with private land owners. Rightly so, since in this country private land ownership is a natural right. Happily, there are more citizens that buy into planting and preserving trees than those that do not want one within sight. For this reason each community should commit its sustainable landscape code or land development regulations to finding better way to clear land. Two approaches are common and both may work for a community. Method one is to move development around existing trees and the other is to replant after development. A good tree or landscape ordinance should recognize each. In addition, there are other strategies that can be added to the ordinance to make it work better with developers and home owners alike. These might include a tree credit system, incentives, envelope clearing standards, tunneling, tree welling, tree banking, and tree removal mitigation. Many communities across the country already use some of these methods to replace the old fashioned “slick off the land” method.

Representative Urban Forest Sustainability Standard: Site clearing shall be conducted so that in each particular development site all specimen trees are identified, located and protected and that all other native trees are mitigated at a proscribed caliper replacement rate. In all instances of clearing, envelope clearing must be used that will retain a minimum fifteen (15) foot width of natural non-disturbed top soil buffer.

Metric five: Green Building

Green building is a term that often applied to designing architecture to be green. Green roofs or green walls designed to cut down on energy use in Seattle is one example of a green building practice applied to buildings. But the concept of green building is also applicable to planting and caring for an urban forest. An urban forest is naturally

sustainable and that forest's provides ecoservices needed by society for a cleaner, healthier environment. Building a green forest, preserving wetlands or managing storm water in buffers are all forms of green building with trees, shrubs and natural ground. Cover. As noted in the discussion of Gwinnett County the urban forest provides a range of natural services including oxygen manufacture, carbon uptake, shade production or nutrient recycling all sustainable practices. Tree ordinances and landscape codes can be greened up by dedicating the ordinance to the concept of green building as a way of informing, that the urban forest is one of the main ways that a city will go green.

Representative Urban Forest Sustainability Standard: All public buildings and parking areas within the urban forested or any forested unit of the urban forest shall have buildings and parking lots designed using the latest 'green building' standards such as green roofs, permeable paving, on-site storm water practices as promulgated by such green building programs as sponsored by the NHBA, LEED, ASLA or other such approved local green building programs or building code associations.

Metric six: Water Management

Irrigation controls is a common metric west of the Mississippi River and in Florida. But even in a wet of state like Louisiana where monsoon type rainfall amounts can reach seventy-five inches of rain a year clean, pure, water from underground sources is not to be wasted but should be seen as a valuable resource. Water harvesting as practiced in Irvine, Homestead or Santa Monica should be used where ever potable water is being pumped to irrigate a garden. Native forests have adopted regionally significant species to survive under native rainfall amounts. Irrigation is a convenience that if use, should be a system based upon water harvesting, recycling, reclaiming or through Xeriscape design practices as we have noted in the communities cited in this paper.

Better irrigation technology and storm water harvesting technology along with the reduction in turf grass planting will easily allow a sustainable community to reduce its irrigation water by at least fifty (50) percent. All communities should draft a sustainable tree ordinance or landscape code that rewards citizens for reducing the amount of grass in a community which in most instances will be covered with trees, shrubs and ground

covers that need little of any supplemental watering. It is clearly a sustainable practice to reduce the amount of grass and the use of potable water.

Representative Urban Forest Sustainability Standard: All water used for irrigation purposes shall be grey water or water that is harvested from surface water storm water supplies.

Metric seven: Planting, Management, Removal & Recycling

The use of regionally appropriate vegetation is also a metric of a sustainable landscape law. Many community green laws already recognize the importance of native plants. However, when greening a community landscape ordinance it helps people to understand that using native plants, especially plants that do not need supplemental water, agriculture chemicals and excess maintenance is a sustainable practice. Like wise, limiting the use of exotics to a marginal amount does allow a little flexibility for landscape design. Invasive plants, are very aggressive exotic plants that get out of control as they do frequently in the Homestead area of Florida. A reasonable sustainable practice calls for their elimination simply because they can outcompete native plants and push them aside. Using native plants that are grow locally, support the local economy and reduce transshipment charges is much better practice than growing them at distant locations. Experience with plants teaches horticulturists that the same species of plant grown in different states or regions will react to transplanting in foreign soil and unfamiliar climate. It is clearly a sustainable practice to use native plant and limit the use of exotics.

A community forest is relatively stable ecologically and can sustain itself for generations to come. However urban forests can be made to be even more ecologically productive by the assistance of mankind. Communities across the nation understand to have the most productive and most diverse urban forest it is well worth the cost to organize a community forestry program based upon sound urban forest management principles and arboricultural practices. A managed urban forest can result in the many sustainable ecoservices we have mentioned in this paper. . It is clearly a sustainable practice that should be codified in communities green laws to manage the urban forest.

Taken together, these sustainability metrics including green building; tree protection; tree canopy standards; site clearing controls; storm water management; irrigation use conservation; regionally appropriate vegetation; and management of the urban forest can be used to craft a sustainable tree ordinance. The following sustainability issues are worth thinking about by any community wishing to revise their green laws to being in the concept of sustainability.

Representative Urban Forest Sustainability Standard: Ninety (90) percent of all trees, shrubs and ground covers used in the urban forest shall be native plants genetically suited to the community forest and its natural resource base. The remainder shall be fully adaptive to the site and non invasive, nor toxic to local wildlife or other plants.

Representative Urban Forest Sustainability Standard: One hundred (100) percent of all biomass generated in the urban forest shall be recycled within the urban forest. All trees, tree parts and leaves shall be chipped, composted and recycled into natural planting areas or used for the production of natural fertilizers or energy.

Representative Urban Forest Sustainability Standard: Ninety (90) percent of all trees used as replacement trees in the urban forest shall be geminated and grown as saplings under natural forest conditions, transferred to nursery grounds for further development and then replanted within the urban forest as replacement trees. Excess seedlings not to exceed thirty (30) percent of the developing forest crop may be sold off to commercial tree nurseries for distribution to owners of private properties.

Representative Urban Forest Sustainability Standard: Planting, pruning, removal and management procedures shall be used to ensure a layered urban forest containing ground covers, shrubs, small trees, medium size understory trees and forty (40) percent overstory canopy with a minimum of thirty (30) percent juvenal over tree distribution.

Tree Ordinance Sustainability Issues.

Traditional tree ordinance provisions as described by Wolf (2004), Swiecki (2001), McPherson (2001), Abbey (1998), and Hoefler-Himelick-DeVoto (1990) and others describe that most tree ordinances written prior to the year 2000 were written for several basic purposes. These include ordinances to manage public trees, provide for street tree plantings, successful tree planting & maintenance, tree removal restrictions, landscaping

and to organize community forestry programs. Occasionally a tree ordinance was written for some local special purpose such as viewshed protection, designating landmark trees, or to initiate an annual arbor day programs. Others might be written to regulate licensing and arboricultural services.

Tree ordinances have not been written to promote urban forest sustainability but the seeds of this program have been sown in places like *New York City, Atlanta, Charleston, San Antonio, Santa Monica, Irvine, Orlando, and Chicago*, as well as in *Gwinnette County, Georgia, Volusia County, Florida and Mathews, North Carolina*.

Some of these newer ordinances can be casually referred to as ‘*super tree laws*’ due to the fact that the ordinances contain both tree standards, landscape design requirements and habitat preservation standards. Many of them set goals or provide specific requirements based upon sustainable practices. Common sustainability practices contained within ordinances such as these include community education, species selection, minimum canopy requirements, storm water management, solar control, energy production and basic ecosystem services such as oxygen manufacture, carbon sequestration, and shade control. Emphasis on the latter brings the question of sustainability to the front of this discussion. Sustainability and quality of life are inextricable issues and often mean green communities and communities that are healthy and more livable.

Sustainable tree ordinances can become the means to bring emphasis to the sustainable nature of the urban forest. The development of these new hybrid, or harmonized tree laws, has been predicted in the recent writings of Chris Duerksen and Suzanne Richman (Duerksen1993). Wolf, has also written about sustainability strategies particularly in regards to parking lots that offer opportunities to do environmental work in the city. (Wolf 2004). But perhaps the best discussion on sustainability and the legal issues associated with tree conservation can be found in the White Paper on Local Ordinance Approaches written for the Montgomery Tree Committee. (Nichols 2007) This paper sets forth some of the baseline ordinance clauses that might be inserted to local ordinances to

define the sustainability metrics and permit requirements that might be included in local ordinances. But the gist of this paper suggests that if a community is to regulate trees it is important to base regulations upon environmental concerns that allows a community to side step the vexing ‘takings’ issue. When trees are looked at as common property and trees can be proven to provide ecoservices benefiting the entire community then the regulating of trees on private property becomes much more defensible.

Work such as climate modification, air and water quality improvements, pollution removal, tree preservation as well as buffering, screening and perimeter plantings can all be a result of an innovative tree ordinance. For some time now visionary communities such as Broward and Collier Counties in Florida, Raleigh, Durham and Chapel Hill in North Carolina, Mandeville and Covington in Louisiana and Southlake, Denton and Conroe, Texas understand that the urban forest and green infrastructure of a community is indeed one of the sustainable elements of a green community. Forsythe, Gwinnett and Fulton Counties Georgia also understand this. San Antonio, Texas recently amended their zoning code and in the statement of purpose mentions eight (8) sustainable practices that are expected as a result of compliance with the tree ordinance. (San Antonio, Texas Municipal Code 2008) They mention for instance tree preservation, water conservation, air cleansing, heat island reduction, native vegetation protection and drought tolerant design. Olmsted recognized urban forest sustainability in the 1850’s. He noted how the London Parks seemed to be the ‘lungs of London.’ He brought this knowledge to United States when he founded the American Parks movement and the profession of landscape architecture in the 1860’s. (Stevenson 1977).

With the development of sophisticated forestry departments, and the use of tree technical manuals and advances in urban forestry research a new era of municipal tree law is on the horizon. This new era beckons sustainability to preserve urban forests for all of the important environmental assistance that a well-treed town can provide to its citizens. It is time that all community’s realize that tree ordinances, landscape codes and land development regulations, must be rewritten to include sustainability criteria. Sustainability leads to green communities. Green communities are clean, healthy

communities and lead to quality of life. The communities that will be successful in the 21st century will be those with an exceptional quality of life.

The twin concepts of sustainability and environmental balance leading to green communities are a natural addition and useful complement to any tree regulations or urban forest management practices.

Scientists can now measure, the environmental effects of a well diversified and maintained urban forest, it is worth thinking about what a sustainability based tree ordinance actually looks like. How would it be structured?

Appendix E – Sustainability Standards

A Sustainable Tree Ordinance.

Ideas and conversations about what comprises a sustainable trees ordinance and how the codes should be greened up is a timely topic. Community, after community are going green and to do that they must build sustainability into their codes. But how to do that is a question few people or communities have taken time to determine. It has been written that sustainable urban forestry practices consist of four principles. These include “species selection and diversity,” “inventory and landscape planning,” “tree care and wood utilization” and “public relations and support.” (Thompson 1994). Many would agree but others think that to green urban forestry, community tree ordinances, landscape codes and tree preservation ordinances must be tailored to illustrate that the urban forest and its

green infrastructure system it provides a range of fundamental ecosystem services that will not only green a community but will help to sustain it.

Clark, Matheny, Cross and Wake (1997) in their paper *A Model of Urban Forest Sustainability* have written that urban forestry sustainability must consist of several characteristics that will preserve the green infrastructure of a city for generations not yet born. They point out that the environmental functions of an urban forest are key to its ability to remain stable over a long period of time. They also mention that urban forests provide services and not goods as do normal forests that are used to grow timber and other products. Green infrastructure includes the plants and landscapes of a community and as such they provide ecosystem services that green communities. Ecosystem services provide benefits to society such as oxygen production, air cleansing, water purification, climate modification, food, medicine and organic material production, waste decomposition, soil stability and health, genetic resources, and biological habitat for both trees and living creatures.

They conclude that several ideas must be included in any plan to make urban forests sustainable. First, communities must acknowledge that city trees provide a range of benefits, they must be managed and therefore require interaction with people. Finally they point out several factors that can be used to measure urban forest sustainability. They include canopy coverage, age of tree distribution, species mix of native vegetation, forest management at the local level and cooperation between land owners, government and citizens. The latter involves the adoption of an urban forestry plan. This plan would naturally be implemented by changes to the city code.

The following are suggested elements or sustainability provisions as seen in Fig. 3 above that might be incorporated into an existing tree ordinance to evolve it into a sustainable ordinance.

One or more of these provisions as each city would see as appropriate could be written into their tree ordinance or landscape code. By doing so, the rewritten ordinance and the

practices that result from them would bring emphasis to the importance of the urban forest as a community resource to be managed toward making a more sustainable community.

These provisions are derived from some current work, research activity and organizational programming that has been or is being developed by several organizations concerned with green building, smart growth, planned development and sustainable site development. Primary leaders of the green building movement include the US Green Building Council, American Society of Landscape Architects and the Environmental Protection Agency. Other national based organizations are involved but will not be mentioned in this paper with regrets.

The LEED (Leadership in Energy and Environmental Design) Rating System developed for the design of green architecture addresses six major areas one of which is sustainable site development. (LEED 2008) One program, the LEED for Neighborhood Development is particularly important to this discussion. The American Society of Landscape Architects an organization long involved in site sensitive land planning and development is establishing a Sustainable Sites Initiative (SSI) there work is developing many of the tools below to allow design professional to design “sustainable landscapes” to supplement green buildings. (ASLA 2007) The NHBA (National Home Builders Association) also has a green building program that recommends best practices for site planning and land development that utilize principles of resource, water and energy efficiency to reduce the impact of site development and home construction.

Sustainability provisions with community tree ordinances should address the issues defined by these organizations by including reference to the following tree ordinance sustainability issues.

Minimum Canopy Standards. Perhaps the most important concern of a sustainable tree ordinance is to set canopy standards. These standards can be set for the city as a whole, by zoned land use type or by each lot that is developed. It would not be uncommon for standards to address all three. Canopy standard can be measured in one of four ways.

Greening Tree Ordinances

These include canopy coverage area, percent of lot or numbers of tree per development site or caliper inches per lot. One community uses a tree density standard (TDS) based upon caliper inches of the diameter of a tree as well as a site density factor (SDF) which is the number of tree density units per acre. (Forsyth Co. Georgia 2008) City planners, arborists or landscape architects that craft these standards need to keep in mind that quantity is but one metric but that the true controlling factor is root space, not canopy coverage. One is necessarily related the other but this too is dependent upon the root character of any individual species. Having canopy standards as part of a sustainable tree ordinance such as these will allow a community to have a mitigation program to ensure that when existing trees are removed, they get replanted somewhere in the city. Each community should inventory their tree stock periodically to measure canopy coverage and ascertain the composition, health, texture (deciduous vs evergreen, size, height, and age and caliper inches per acre) and economic value. Minimum canopy standards should be set locally based upon each community's specific mix of resource patterns such as climate, topography, rainfall, soil type, land cover, land use patterns and zoning intensity.

American Forests, is one of America's oldest citizen's conservation organizations and a pioneer in science and practice of urban forestry. This organization has set standards for urban canopy coverage based upon zoning and land use. The following numbers are recommended and have been supplemented by the Author. The first number applies to the arid west and the later number applies east of the Mississippi River and in the Pacific Northwest.

Average tree cover all zoning districts	40% to 25%
Suburban residential zoning districts	35% to 50%
Urban Multi-family residential zoning districts	18% to 25%
Central Business District and commercial zoning districts	9% to 15%
Natural Preserved Woodlands in any zoning district	40% to 90%

It is important to set tree canopy goals because most communities have lost tree cover over the last 30 years due to new urban development. American Forest reports that it is

not unusual to see a 30% decline in urban forests in some communities. (American Forests 2008)

To achieve a minimum canopy standard it is necessary for a community to determine the proper balance between green and grey necessary according to local conditions. To sustain this level of canopy it will be necessary to have in place a series of controls to ensure that each development site provides its share of the community wide canopy coverage. These controls might include preservation, replacement or mitigation standards. All standards might be based upon tree species mix, tree counts by acre, DBH counts by building site or canopy coverage or root space availability. Once the minimum canopy is achieved, it is only a matter of replacing every tree that is removed.

Tree Preservation and Preserved Groves and Forest Remnants. Similar to minimum canopy standards but at a smaller scale is the preservation of an individual specimen tree, tree groves and remnant forest floor. Many communities recognize landmark, historic, ancient, unique trees and or protected species of a proscribed size because they understand that these trees provide something special from an environmental or scenic perspective. Forest floors for instance are wonderful storm water traps since a deep rich forest duff developed over many years will infiltrate storm water quickly. Communities such as Mandeville, Louisiana have established within their tree ordinance a mechanism to protect them during construction and preserve them as important site features. (Mandeville, Louisiana 2008)

Urban Afforestation and Land Stocking of Streets, Parks, Private Land. The planting, maintenance and removal of urban forest trees is an important function of community forestry. It is a well known fact of botany that natural forest lands have a life cycle. This life cycle begins when land is cleared as result of fire, wind, floor or the activities of development. Pioneer species will soon invade the land as a result of seed dispersal or the activation of seeds that have laid dormant in the soil awaiting ample day lighting. The site is colonized by these fast growing plants consisting of grasses, sedges and rushes, shrubs and fast growing evergreen trees. These early succession species

provide habitat for the other plants that will follow the succession cycle through several phases. Quick growing pines provide shade that allows hardwoods to germinate and the growing hardwoods provide shade and filtered light that will allow an understory of highly productive shrubs and small trees to increase the productivity of the forest. Eventually natural selection will thin out and weaken the primary succession materials and replace them with the species that will reach the forest's climax stage many, many years later. With additional sunlight the biodiversity index rises considerable as more species of plants, animals, insects are able to find habitat to their liking. A young growth forest is much more biologically productive than an old growth forest. With age, the forest loses some of its variability to be replaced with older, larger trees that are much more suited to the site and can provide essential environmental services that clean the air, clean the water and stabilize soil and moderate the climate.

Even urban forests have a life cycle. Since this forest also contains the living environment of mankind man rather than nature must the engine of succession. A sustainable urban forest must be managed by the planting and restocking of trees. These trees should be native occurring trees that exhibit the best characteristics of living within urban environment where roots space is at a minimum, soils are poor, moisture is not consistent and human impacts are expected.

Not only is it important to stock the urban forest with replacement trees but it is a necessary function to maintain it through beneficial horticulture and arboricultural practices. Appropriate tree management will allow better growing conditions and structural modifications through pruning that will strengthen the tree which in turn strengthens the urban forest. The forest can also benefit by tree removal and recycling activities. It is important within urban areas to remove trees when they become a liability or health safety issue. Within a natural forest a tree may be allowed to stand until it eventually falls. Within urban areas this is not possible due to injury to person or property. An active program of tree removal and replacement is necessary.

A diverse, mixed age urban forest provides maximum ecoservices. To get the most productive urban forest, a community needs an actively managed urban tree program where all phases of the life cycle of the urban forest are husbanded for maximum productivity.

Screening, Buffering and Green Connectivity. Since well written tree ordinances must be part of a community's zoning ordinance the importance of screening and buffers becomes apparent. Physical, visual or intensity conflicts between land uses are resolved with the use of buffers or screens. These planting or natural preserved buffer areas can add a significant amount of canopy coverage on private land and private upkeep to any city. Having standards for buffers within the landscape code or tree ordinance for defined jurisdictional areas (riparian, zoning, visual etc) species, size, spacing and growth cycle for these plants is a necessity.

Buffers within a community serve several environmental purposes. First buffers reduce land use conflicts between zoning districts of divergent land use and intensity. Zoning has long upheld the right of property owners to be sheltered from noise, congestion, and unpeaceful disturbance from adjoining parcels of land. Zoning buffers make better neighbors due to the oft quoted rule attributed to Robert Frost that "good fences make good neighbors" by "walling in or walling out" such distractions as smell, sight, sound and commotion all of which can change the character of someone's private property. Buffers within built up areas in a city can be used for tree preservation, providing habitat for local wildlife and as a genetics bed for the seeds and other reproductive parts of native plants. Planted or preserved buffers between properties serve as wildlife corridors that can allow creatures access to huge areas of a community where they might find shelter, food, water and the cohorts of others of their species.

Since some buffers between zoned districts can zig zag across the community these buffer and screen planting areas form a pattern of green connectivity. This pattern, planted with trees and shrubs, which is not only functional and visual, but will support the movement of urban wildlife and will link other parts of the urban forest together.

Secondly, buffers are often used along man made systems within the city for aesthetics, screening or to improve public safety. Stream bank buffers for instance protect fresh water supplies from sediments and urban water borne pollutants. Buffers along major arterial streets in the community help shield passersby from the distraction of parking lots and curb cuts both of which decrease public safety along roadways. Powerline buffers keep trespassers at bay while street tree buffers simply improve the view of the public roadway and increase curb appeal of fronting properties. A system of wetland buffers or forest preserves not only provide tremendous environmental services to a community, they provide identity and special character to neighborhoods that are lucky enough to have them nearby.

Community landscape codes provide several kinds of site buffers and screens all of which designate specific site areas that will provide some environmental service to the property owner or the general public.

Buffers used as storm water buffers increase a site's permeability ratio that will allow the infiltration, detention or filtering of storm water run off. Also, these buffers can serve urban run off requirements as well by detaining storm run off thereby reduce the time of concentration and peak flow of storm water. If they are properly graded, and the proper species of plants are used, each buffer can also act as a micro-detention area, infiltration zone or storm water management facility. The urban forest and its trees needs water, cities must manage their urban run off not merely speed it movement to the sea. Buffers and screens provide the land area necessary to do this.

Green Parking. Green parking lot design means designing, constructing and operating parking lots to be environmentally supportive, healthy for people and wildlife and low in energy impact.

Green parking lots do environmental work that eliminate or reduce impact to site resources including vegetation, soil, climate and water while optimizing resource

efficient materials, minimizing waste, and improving ecosystem biodiversity. Parking lots as we know them do not environmental work. They should be looked at as an opportunity to do one or more environmental services that will improve the climate, infiltrate storm water or remove water carried pollutants from downstream flow. Modifying a tree or landscape code to be more sustainable might be as simple as adding slotted curb concave tree planters, interior bioswales, exterior storm water buffers, porous paving or enhanced shade canopy coverage. Interior rain garden tree groves within parking lots could do multiple environmental services from storm water capture, nutrient cycling, air filtering to carbon sequestration. Each of these tree ordinance ideas could add to the sustainability of a development site by making the parking lot do environmental work.

The best way to make improvements to the environment of any large city is rethink automobile parking lots. If additional green space is desired there are two places to look in order to acquire more. They include rooftops and parking lots. Parking lots must be rethought if a community wants more open space and greening of their community.

Appropriate Plant Materials. Species selection refers to the use of native plants, use of drought tolerant plants, and banishment of invasive plants is an important accord of a sustainable tree ordinance. Native plants are well adapted to the climate, soil, moisture and temperature of many micro climates and are very sustainable. These plants provide birthing habitat, shelter, food and other ecosystem services without any influence of mankind. Native plants that are adaptable to climate, drought, heat and cold need little if any support by mankind for their survival. They certainly do not need artificial irrigation, cold protection or fertilization to survive in their native habitat. To introduce exotic plant materials will just require additional energy use, husbandry and cost and often will lead to the failure of the plant anyway. Many plants will not flower if not given a happy mate or a willing propagator. White pine in Wisconsin, cabbage palm in South Carolina, canyon live oak in California or grizzly bear prickly pear cactus in Arizona are all well adapted to their climate and should be used in landscape design rather than the exotics, many of which can be cheaply imported to

national chain retail plant outlets. Native habitat and native plants are protected as a result of land clearing standards that protect site areas that are to be undisturbed in communities such as Orlando, Florida. (Orlando, Florida Code 2008)

Locally Produced Construction Materials. One often overlooked sustainable practice is the use of locally produced construction materials, especially if they come from unlimited sustainable resources. There are several reasons why this is so but one of the most obvious is transportation. Modern methods of building material commerce often will use products that are harvested in one location. These products have value added by being transported to one or more locations where they are enhanced, fabricated, sized and finished. From this location they are often sent to distribution points and from here can be transported to just about any place in the world. The market place has come to prefer this system because it builds economic value usually at the expense of the environment. The carbon footprint of these various transactions can add up and the environmental costs of these products are borne by taxpayer and not the buyer.

Locally produced materials often will have a longer life span, reduce maintenance and are more acclimated to its native environment. Granite rock being used in New England, Texas Pearl limestone in Texas, sugar sand in Florida, glacial stone in Michigan and red cypress in Louisiana makes a lot of practical sense from a sustainability point of view. Recycling of construction materials, such as wood products from the urban forest is a variation of this component. Using materials over and over is a sustainable practice that can be implemented in community tree ordinances.

Nutrient Cycling. This occurs in all urban forest and is necessary and desirable for both growth and biological development. Nutrient cycling is the transformation of chemical elements from inorganic form in the environment to organic form in living organisms, and then back to inorganic forms. It includes the exchange of elements between the biotic and abiotic components of a healthy ecosystem. Plants, animals, soils and nutrients all connected.

Closely related to this is recycling of any material. This may take the form of composting organic matter, recycling yard waste or storm damage material into garden mulch or forest enrichment products. The recycling of captured storm water from roofs or parking lots has been mentioned. This when filtered tanked and mixed with household wash water (not sewage water) creates what is called gray water that can be recycled in an irrigation system to water lawns, trees, shrubs and ground covers. Most plants will soak up soapy water and readily accept it phosphorus content. When domestic washing water is mixed with roof water and parking lot water the concentration of soap chemicals, preservatives and stabilizers become non harmful to plants. The main ingredients of body soap such as manufactured by the Dial Corporation consist of water, water vapor, tallow, coconut and vegetable product and this is quite agreeable with plants. Anti-bacterial agents in soap is suspect however due to triclocarbons that may concentrate in fish and bio-accumulate in the food chain. Studies are on going at this time to determine if this is so.

We have mentioned that storm water collected from rooftops and parking lots can be recycled through an irrigation system to prevent the use of potable water. Clean, clear, pure potable water that has taken hundreds or thousands of years to be made in underground reservoirs should not be used to water the grass. This is not a sustainable practice.

Recycling is a sustainable practice that could be included within any urban forestry program and the nutrient matter so collected could be placed back within the urban forest itself to enrich the soil, capture the energy produced by the sun and to provide organic matter for a growing forest.

Photosynthesis and the Carbon Sink. One of the most sustainable ideas in urban forestry occurs with every tree. That is every tree in a community forest is involved with providing ecosystem services. The primary service is

photosynthesis where trees manufacture carbohydrates from carbon dioxide and water. The reaction is driven by energy from sunlight, catalyzed by chlorophyll and releases oxygen as a byproduct. The oxygen is needed by most life forms, yet many people do not realize this. A well layered urban forest can produce a sustainable supply of oxygen.

In addition, urban forests become carbon sinks, places where carbon is trapped and stored. Carbon dioxide, which is one of the green house gases and is a suspect agent of global warming is pulled from the atmosphere by trees Urban forests over American cities proved many services for a healthy planet.

Soil Structure. The way soil particles are organized into aggregates and held together is called soil structure. Urban soils can be a real limiting factor in the quality of an urban forest. Soils in most cities are classified by the Natural Resources Conservation Service (NRCS) formerly the Soil Conservation Service (SCS) as urban soils. Urban soils often have poor structure, less organic matter, manufactured chemicals including compounds that might be called pollutants.

According to the NRCS horizons in urban soils may not be fully related to the natural soil-forming factors but are often manmade layers formed by the deposition of dredge, pump sand fill, and/or mixed materials. Human debris, such as broken brick, fractured bottle glass, chunks of concrete, and remnant plastics, traces of pesticides, petroleum derivatives, chemical compounds, other pollutants, and human garbage are components of urban soils.

Urban soils are not the same as natural soils because they have been altered. Urban soils may have been excavated, compacted, disturbed, and mixed and may no longer possess their natural soil properties and features. Normal soil horizons O, A, B, C and R may not exist in urban soils.

Many highly disturbed soils may be contain salts or be acidic and will often lack organic matter.

In some urban areas former construction site soils may have been in place long enough for soil forming factors to significantly change them almost to the point of forming soil horizons.

Most urban soils must be amended to get proper drainage and nutrients needed for plant growth. Healthy urban forests need rich, clean soil with the best tilth possible. This structuring of the soil gives it the ability to drain and hold air and water in the proportions needed for plant and animal life.

Solar Energy Orientation. Energy derived from the radiant energy of the sun can be converted into other forms of energy, such as heat or electricity. Therefore, a sustainable tree ordinance must address this tool so that access to sun is not totally denied by high level canopy trees. A certain percentage of canopy space must be made available through the ordinance to allow solar penetration to solar power converter panels.

Urban Heat Island Effect. A measurable increase in ambient urban air temperatures results from the replacement of vegetation and native soils with buildings, roads, and other heat-absorbing urban structures. The heat island effect results in significant temperature differences between rural and urban areas. Even within urban sites a temperature variation exists between shady areas and paved areas fully exposed to the sun. A sustainable tree ordinance must encourage the replanting of shade trees within urban areas, especially parking lots and urban plazas. Green roofs can be used to reduce reflectivity and heat gain in those locations where tree planting is not practical.

Water Balance. An accounting of the inflow to, outflow from, and storage in a hydrologic unit should be a standard tool of any sustainable tree ordinance. A

complete tree ordinance must be concerned with water flows, water capture, permeability and infiltration of water into the ground where trees and other vegetation can use it. Rooftop water, captured and recycled through an irrigation system is a sustainable tree practice. Water collected in this manner will not only feed the plants but will disconnect from the storm water flows a proscribed percentage of rainfall that under normal conditions would carry non-point pollutants downstream.

Studies using a mass and energy balance rainfall interception model from Santa Monica's urban forest show that trees intercept rainfall and reduce run off and reduce the cost of water management by a factor of \$3.60 per tree. Quantitative analysis show interception rates vary based upon tree species, size, leaf, twig structure and rainfall event. For example this study indicated that rainfall interception varied from 15% to 80% in two different storm based upon seasonal weather conditions. (Xiao, Q. & McPherson, E.G. 2003)

Storm Water BMP's. Storm Water Best Management Practice (BMP) means a structural device or nonstructural practice using vegetation in many instances designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution, and provide other amenities. (State of Maryland 2000) Storm water BMP's treat water in a various way. These decentralized storm water facilities can infiltrate, filter, slow, detain, retain, disconnect, recharge, clean, evaporate, transpire, capture, collect, store, pump, sprinkle and dispose rainwater. BMP's go by such names as rain gardens, vegetated swales, bio-swales, micro-detentions, detention ponds, wet ponds, constructed wetlands, sand filters and riparian buffers. In all instances drainage facilities are designed to modify the actions of water in such a manner that water quality is increased. Storm water BMP's treat water as a resource and are used to capture rainwater to sustain pure water from human kind. Tree ordinances can be crafted to recognize the importance of water and how water is important to both plants and people.

Wetlands. Urban wetlands, especially wooded wetlands, such as swamps, and stream banks must be protected by the tree ordinance. These special habitats may be protected and preserved not only for the trees that grow within them, but for their storm water processing and water quality cleansing abilities. Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, a prevalence of vegetation typically adapted for life in saturated soil conditions makes a wonderful urban forest. Wetlands may include marshes, bogs, flooded grassed meadows, wet ponds, constructed wetlands and similar water infiltration features within a community.

Windbreaks. One or more rows of trees or shrubs planted in such a manner as to provide shelter from the wind and to protect soil from erosion. If designed properly, windbreaks around a home can reduce the cost of heating and cooling and save energy. Windbreaks are also planted to help keep snow from drifting onto roadways and even yards. Other benefits include providing habitat for wildlife and in some regions the trees are harvested for wood products.

Steep Slope Preservation. Steep slopes provide special habitats for specific biology's. Preserving natural steep slopes, and the plants and creatures that live there provide is important. So to is the value of having topographic and orientation variation on a development site. steep slopes have their purpose in complex urban forest and help define spaces for people in a way unmatched by any other means.

Open Space For Human Well Being and Health. Planted open spaces not only serve nature and sustainability but serve the needs of mankind as well. Society in most climates spend a great deal of their time out of doors. Outdoor spaces sustain the relationship between humans and more importantly, sustain the relationship between humans and their environment.

Sustainable Sites and Sustainable Tree Ordinances

The American Society of Landscape Architects (ASLA) Sustainable Sites Initiative (SSI) Program is being developed the landscape architecture profession to guide “sustainable land development and management practices” that will support sustainable building sites, opens spaces and preserved natural areas like buffer zones, parks, conservation preserves.

The SSI will provide design and land management tools for landscape architects and others who influence land development who shall address environmental concerns such as “climate change, loss of biodiversity, and resource depletion.” These SSI tools can also be used by planners, engineers, developers, horticulturists and local governments all of who offer or promulgate green building standards, codes and ordinances affecting the environment.

During the next few years as this program is developed in full, the leaders of the Initiative will provide “standards and guidelines”, a LEED style site performance “rating system”, and a testing “pilot program” to compile, analyze, and refine best practices for sustainable site planning, construction and management. The rating system may even be folded into the present LEED® (Leadership in Energy and Environmental Design) program that issues certification or silver, gold and platinum ranking for environmentally well designed projects.

This sustainability focused program will also provide a “reference guide” that will assist designers and builders in understanding the program. The reference guide will help them convert guideline information about hydrology, soils, vegetation, construction materials and human well being into usable into built landscapes that respect the earth and allow people to live without causing substantial change to the earth’s ecosystems for those generations who will follow.

Community planners are very likely to use the SSI reference guide to modify local tree, landscape, storm water, irrigation, construction material utilization and recycling codes. This information that brings science to planning, design, and art must be codified within community ordinances to guide the way we will build and sustain the places where we live.

