Landscape Design for Energy Efficiency

Mary Taylor Haque
Lolly Tai
Don Ham

Follow this and additional works at: https://tigerprints.clemson.edu/cudp_environment

Recommended Citation
LANDSCAPE DESIGN
FOR ENERGY EFFICIENCY

Made possible by:
South Carolina Energy Office
South Carolina Forestry Commission
Clemson University
Clemson University Cooperative Extension Service

Written by:
Mary Taylor Haque, Lolly Tai, and Don Ham
Acknowledgement

This material was funded by the USDA Forest Service and awarded through the SC Forestry Commission. It also received support from the U.S. Department of Energy Grant No. DE-FG44-00R410766, State Energy Program, administered by the South Carolina Energy Office. Such support does not constitute an endorsement by the Department of Energy of the views expressed in the Guide.
LANDSCAPE DESIGN
FOR ENERGY EFFICIENCY

Made possible by:
South Carolina Energy Office
South Carolina Forestry Commission,
Clemson University
Clemson University Cooperative Extension Service

Written by:
Mary Taylor Haque, Lolly Tai, and Don Ham
Credits

Illustrated by:
Students of Department of Planning and Landscape Architecture, Clemson University
Elliot Buff, Albert Lynn, and Marshall Giles

Layout by:
Lolly Tai, Professor, Department of Landscape Architecture and Horticulture, Temple University

Photographs by:
Mary Taylor Haque, Professor, Department of Horticulture, Clemson University
Lolly Tai, Professor, Department of Landscape Architecture and Horticulture, Temple University
Don Ham, Professor, Department of Forest Resources, Clemson University
Darryl Glubczynski, Communications and Marketing Services, Clemson University

Architecture on cover page by:
Joseph Michael Kelly, Architect

Copyright © 2004 by:
Clemson University Digital Press
All rights reserved.
ISBN: 0-9741516-7-X
2004 Second Edition
Table of Contents

Preface  The Level and Impact of Energy Consumption in South Carolina  1

Chapter 1  Landscape Design for Energy Efficiency Through Climate Control  3

Chapter 2  The Landscape Design Process for Energy Efficiency and Aesthetics  17

Chapter 3  Landscape Design for Low Maintenance  35

Chapter 4  Protecting Existing Trees During Home Construction or Landscape Renovation  43

Conclusion  49

Bibliography  51

About the Authors  53
Preface

The Level and Impact of Energy Consumption in South Carolina

South Carolina’s energy supply is somewhat diverse, with nuclear energy providing almost three-fifths of the total electricity generated. The state ranks second in the nation in dependence on nuclear energy. However, South Carolina imports virtually all of its primary energy resources from both foreign and domestic sources, making it highly vulnerable to occurrences in national and global energy markets. Energy consumption is increasing very rapidly, and the state must be prepared to meet these rising demands with minimum negative impact on the state’s environment and economy.

In 2000, South Carolina spent more than $10.2 billion on energy. The U.S. Department of Energy estimates that 70 to 80 cents of every energy dollar spent in South Carolina immediately exits our state’s economy and is never regained by the consumer. Not only is this a drain on the state’s economy, it is also detrimental to the environment.

For example, South Carolinians consume approximately 75 billion kilowatt hours of electricity each year. As a result, South Carolinians produce 130 billion lbs. of carbon dioxide (CO2), a primary greenhouse gas that can contribute to global warming, each year. We also facilitate the development of harmful ground-level ozone (smog) by creating 310 million lbs. of sulfur dioxide (SO2), and 262 million lbs. of oxides of nitrogen (NOX) each year.

South Carolina ranks 24th in the nation in total energy consumption per capita and consumed much more than the United States average in the 1990s. In the past thirty years, South Carolina has greatly surpassed the national average in end-use energy consumption, with the state’s residential sector seeing an increase of 91.2 percent compared with an average national increase of only 32.6 percent.

South Carolina ranks 24th in the nation in total residential energy consumption. Natural gas accounts for 21.7 percent, and petroleum and biofuels each comprise 14 percent of residential energy consumption in South Carolina. Electricity accounts for the majority (62.7 percent) of residential consumption in the state. Residential statistics for investor-owned electric utilities show that the average annual electric bill for South Carolina residential electric customers increased by $403.94 in the past twenty years, compared with an increase of $363.87 on the national level. (The South Carolina Energy Office, 2000)
The amount of money you choose to spend on energy is a decision which becomes even more important as we begin to address public policy issues such as utility deregulation, sustainable development, and environmental protection. As you beautify and landscape your home, you can mitigate environmental degradation and the loss of energy dollars by landscaping with energy efficiency in mind. Landscape design for energy efficiency is not only a way to stimulate the economy while minimizing negative effects on the environment. It also helps ensure that our state’s future energy needs will be met. While creating a more comfortable and affordable home in which to live and work, you will also help develop a safe, viable, and environmentally responsible energy future.

It’s Easy

Using the measures outlined in this booklet as a “system” is easy. Planting trees on the east and west sides of your home, installing pavements that are reflective and porous, and redirecting winter winds are all ideas that can be implemented for new homes as well as for retro-fitting existing homes. By incorporating these cost effective and innovative approaches to energy efficiency around your home, you can simultaneously reduce energy costs and create a more pleasant environment.

"One of the first steps in sustainable design is not to consume new resources but rather reuse existing ones.” (EnvironDesign 4, 2000)

"All site and architectural spaces of excellence are weather-responsive; their form, materials of construction, and even colors are all climate-related.”

John Simonds

"If society is paralyzed today it is not from a lack of means, but from a lack of purpose.”

Lewis Mumford

Figure 1: Landscaping for energy efficiency can help mitigate environmental degradation and the loss of energy dollars while beautifying the landscape around your home.
Chapter One

Landscape Design for Energy Efficiency Through Climate Control

The cost of heating and cooling represents one of the biggest household expenses for any homeowner. High energy use for indoor climate control is not only expensive but also strains the regional and national resources required for energy production and contributes excessive amounts of CO₂ and other pollutants to the atmosphere. Various approaches can reduce energy consumption, but thoughtful landscaping can and should make homes more energy efficient.

Proper landscaping around a home can save as much as 30 percent on heating and cooling costs. According to computer models generated by the U.S. Department of Energy, the appropriate addition of just three trees will save the average household between $100 and $250 annually in energy costs. A well-designed landscape provides energy savings and returns initial investment in less than eight years. For example, an 8-foot deciduous tree can save hundreds of dollars in reduced air conditioning while reducing heating and lighting costs by admitting winter sun. Conserving energy not only saves money, but also helps protect the environment since fewer natural resources are used. Specific design approaches will vary according to regional climatic conditions and the microclimate immediately surrounding your home.

Climate

The United States is divided into four very general climatic regions: temperate, hot arid, hot humid, and cool. South Carolina is located in the hot humid zone. Landscape strategies for this zone are outlined below:

- Summer breezes should be channeled toward the home if the air conditioner is not used often;
- Summer shade should be maximized with trees that still allow penetration of low-angle winter sun;
- Planting beds near the house should be avoided if they require frequent watering.

“According to Worldwatch, home heating is responsible for spewing 350 million tons of carbon into the atmosphere every year—which means over a billion tons of the most prevalent greenhouse gas, CO₂.” (The Earthworks Group, 1989).

“A sustainable community is one whose energy economy does not use more energy in a given time than falls on its hinterlands as sunlight in that time, and in which the material economy is circular rather than linear.”

Richard Risemberg
Microclimate

Microclimate is the immediate climate around a home. If you live in a cool region and your home is located on a sunny southern slope, it may have a warm microclimate. If you live in a hot humid region and your home is situated amidst abundant shade and dry breezes, it may have a comfortable microclimate. Nearby bodies of water may increase your site’s humidity or decrease its air temperature.

Different from average local conditions, a home’s microclimate may be more sunny, shady, windy, calm, rainy, moist, snowy or dry, influencing the type of plants that may or may not grow in your home’s microclimate.

Orienting a New House for Solar Gain

For maximum solar benefit, a new house should be oriented properly on the site. Typically, a rectangular home should be positioned with its short sides facing east and west, exposing the longer side with the most windows to the south. North and west-facing walls should have fewer windows since they usually face prevailing winter winds. North-facing windows receive little direct sunlight. Breaking away from the traditional arrangement of orienting homes along the grid system of the streets can be difficult, but with proper planning and design, a non-traditional orientation can be used.

The Effects of Landforms and Topography on Climate Control

Landforms can be used to control and direct wind. When siting a home, keep in mind the principle that cold air sinks and warm air rises. Do not locate the home on top of a hill where wind speeds are often 30 percent higher, or in the bottom of a valley where cold air pockets exist. These high and low points should be left as natural areas, creating wildlife corridors and beautiful environments for scenic views and shared recreation. To avoid flooding problems and ensure better water quality and less siltation in nearby waterways, avoid building adjacent to rivers and streams.
Figure 4: Winter winds may be as much as 30 percent stronger at the crest of a hill. Building your house below the crest of a hill will protect it from winter winds while preserving views on top of the hill for others who can view the natural beauty of the hilltops. Reduce the risk of flooding your home by building away from waterways. A natural buffer on either side of the waterway protects water quality and provides wildlife corridors and recreation areas.

In mountainous or hilly areas, the “military crest” concept can be used. A sentry on a hilltop is exposed to others’ view and to cold winds. If he moves just over the crest, he can still see long distances without being easily spotted, since he blends into the hillside. A house similarly located can offer prime views without cluttering the view of the hilltops for other homeowners in the region. Further, the owner can enjoy significant energy savings by avoiding the high winds associated with hilltops.

Locating homes on gentle slopes between high and low points preserves views throughout the region. With proper planning, biking and walking trails can flow through these green corridors, providing an energy-efficient alternative to automobiles and recreation opportunities for children and adults. Green corridors along waterways also protect water quality and wildlife.

Figure 5: House located just over the crest can benefit from energy savings by avoiding exposure from high winds.
Using Plants for Climate Control

The best of all solar radiation control devices, plants play a significant role in helping to achieve energy efficiency. Trees, shrubs, groundcover, or a combination of these effectively reduce direct and reflected solar radiation.

As solar radiation penetrates the atmosphere, it is received either as direct solar radiation or as reflected radiation from atmospheric particles or from materials on or near the earth’s surface. A single plant may be effective in controlling both direct solar radiation and reflected radiation from a nearby surface.

![Figure 6: Plants and trees absorb both direct and reflected radiation, reducing glare and heat buildup.]

Depending on the density of the foliage, solar radiation can be filtered or completely blocked, preventing buildings and other surfaces from heating up beyond the ambient air temperature. Plant foliage provides shade for walls and ground surfaces by absorbing, reflecting, and transmitting solar radiation.

Protecting Your Home from Summer Sun

Plants absorb the sun’s heat during the day and create cooler microclimates by using the heat to evaporate water (evapotranspiration), thus cooling daytime temperatures. During the night, plants create warmer microclimates by blocking the return of heat back to cold night skies. You can see this when frost forms on exposed grassy areas but not under trees.

Energy use during warm months can be reduced by 40 percent or more by shading windows, walls, and roofs. Vines are an inexpensive way to provide quick and effective shade. To avoid moisture problems on wooden walls, train twining vines on a trellis or other support attached to the wall. Appropriately located trees, fences, and hedges can also prevent winter heat loss by providing areas of insulated air next to walls.

“If each U.S. household lowered its average heating temperatures by 6½°F over a 24-hour period, we’d save the energy equivalent of 500,000 barrels of oil every day.” (The Earthworks Group, 1989)

“About 12 percent of U.S. emissions of sulfur dioxide and nitrogen oxide—both key causes of acid rain—come from home heating.” (The Earthworks Group, 1989)
"Nearly half of all the energy used in our homes is wasted. It goes 'out the window,' or through the attic, cracks, or other leaks in the form of heat—or, in summer, air conditioning—lost to the outside." (The Earthworks Group, 1989)

"Light filtered through leaves or tracery is wonderful. It lends excitement, cheerfulness, gaiety, and we know the that areas of uniform lighting create dull, uninteresting spaces." (Alexander, 1977)

"The existing delicately balanced order of nature within the biosphere, or protective envelope of the planet, is being disturbed by the activities of man, and it seems that only his own exertions can restore a balance and ensure survival." Geoffrey and Susan Jellicoe

Place tall shrubs so that when they mature, air circulates between the plants and building to avoid moisture problems. You can also train vines on a trellis to provide direct shade.

The most cost-effective way to reduce cooling demands is to reduce solar heat gain through windows. Plants work exceptionally well for seasonal shading, as do man-made devices such as trellises and overhangs (see page 11). Window films and interior curtains also work well. New construction can accommodate a variety of advanced window technologies and coatings. In a SC Institute for Energy Studies analysis of two Clemson, SC, houses, unshaded windows accounted for about 45 percent of the summer cooling load. Shading the windows reduced that figure to about 25 percent of the summer cooling load, a total reduction of approximately 20 percent. In a larger custom home, unshaded windows accounted for about 70 percent of the summer cooling load, while shaded windows accounted for only 45 percent of the cooling load.

Shading an outdoor air conditioning unit has been shown to be only marginally effective (Parker et al, 1996). Wind will affect the microclimate, so it may take many trees or very little wind to make any significant impact. In fact, inadvertent blockage of the required air flow across the coils can easily degrade efficiency. A preferred strategy may be to locate AC condensers in an unobstructed location on the shaded north side of the building.

If you really want a landscape-friendly air conditioning system, install a geothermal or ground source heat pump. These systems exchange heat through pipes buried in the ground rather than through a conventional outside fan system.

Figure 7: Vines are an excellent alternative to trees for shading walls.

Figure 9: Street trees provide ambience and shade on the sidewalk.
“One of the largest single factors affecting building energy consumption is the location and size of windows. Windows placed without consideration for the amount of sunlight they admit will usually be an energy drain on the building. During the summer, windows need to be shaded from direct sunlight so that heat gains are kept to a minimum.” (Mazria, 1979)

Controlling Solar Radiation with Trees

The specific placement of plants directly affects temperature control, making the process very important. An effective practice is to plant trees so that when they mature their limbs will shade west and east walls and windows. Be certain to allow adequate space for the mature size of the tree.

Trees cool buildings not only by shading, but also by cooling the air around them through a process called evapotranspiration.

“Shading and evapotranspiration, or the process by which a plant actively moves and releases water vapor from trees, can reduce surrounding air temperatures as much as 9°F. Since cool air sinks to the ground, air temperatures under trees can be as much as 25°F cooler than air temperatures above asphalt paving nearby. Further, studies by the Lawrence Berkeley Laboratory found summer daytime air temperatures to be 3° to 6° F cooler in tree-shaded neighborhoods vs. treeless areas.” “A consciously well-planned landscape can reduce an unshaded home’s summer air-conditioning costs by 15 percent to 50 percent. In the case of a small mobile home in Pennsylvania, a study reported air-conditioning savings of as much as 75 percent.” (http://www.eren.doe.gov/erec/factsheets/landscape.html)

It is important to remember that the improper placement of trees can actually increase energy costs. For example, during the winter, coniferous trees on the south side of a building can be a liability by not allowing the sun to warm the building. When placing a tree on the south side, be sure to allow winter sun to reach your house by planting the tree twice as far from the house as the anticipated mature height of the tree. For example, a tree which will grow 50 feet tall should be planted 100 feet south of the house.
On the east and west sides, use deciduous trees, which drop their leaves during winter and allow the sun’s rays to filter through the branches. Plant trees on the east and west sides closer than on the south side, but consider safety and avoid brittle trees that may break in a storm and fall on the house. Screening sun on the north side is not a concern since the north side is shady year round.

Using Plants for Wind Control

Wind speed can influence perceived air temperature in both summer and winter. For example, a 10 mph northwesterly wind can make an air temperature of 44 degrees Fahrenheit feel like 32 degrees Fahrenheit. Wind can also accelerate the rate of air exchange between outdoors and indoors, resulting in an increased demand for heating in a home. Properly placed landscape plants can influence air infiltration by redirecting, slowing or increasing the velocity of winds near the house.

Blocking Winter Winds

Evergreen or coniferous trees and shrubs can lessen the influence of cold winter winds and reduce heating bills when planted on the windward side of the house. Make sure, however, that evergreen trees do not block winter sunlight.

Each time you open a door in winter, a large quantity of cold outdoor air enters your home. The edges around all entrances leak air through cracks, which allows warm indoor air to be exchanged with cold outdoor air. According to home energy expert Edward
Mazria, this infiltration of cold air coupled with the conduction loss through a door with no weather stripping can account for as much as 10 percent of a small residence’s total heat loss.

To minimize this loss, add weather stripping and a storm door to the outside of your home, and orient the entrance away from the prevailing winter winds. If it’s too late to change the orientation of your entrance, you can plant a windbreak to reduce the wind’s velocity.

Summer Breezes

To avoid using your air conditioner excessively during hot weather, direct breezes to cool your house in the summer. Planting trees to funnel prevailing winds into the house can help keep the house cooler. However, if air conditioning is used often during warm months, as is the case in most South Carolina homes, directing wind flow towards the house could actually increase energy costs since warm breezes increase warm air infiltration, thus heating the home’s interior.

Prevailing winds often differ during summer and winter months. For example, they may come from the northwest in the winter and the southeast in summer. In such cases, you can plant deciduous trees along the southeast portion of the building to direct wind flow to the house in the summer and place evergreen species along the northwest portion of the house to block winter winds. If air conditioning is used often during warm months, plant trees to block summer as well as winter winds. Consult the local weather bureau for accurate information on prevailing wind directions.

Figure 13: Evergreen screen to divert winter wind.
Man-made Shading Devices and Materials for Climate Control

Overhangs

An overhang can be added above south-facing windows to reduce solar gain in summer while maximizing solar gain in winter. Exact dimensions according to latitude can be obtained from books like Edward Mazria’s *The Passive Solar Energy Book*. The length of the horizontal overhang in southern latitudes should be equal in length and roughly one-fourth the height of the window.

An even better choice is a vine-covered overhang. Since deciduous plants follow climatic variations, the vine will be covered with shady leaves in summer but bare in winter, providing a self-adjusting device that changes with the seasons.

Other man-made shading devices include adjustable vertical louver, awnings, or retractable exterior curtains, all useful methods for shading east and west windows.

Dark and Light-Colored Surfaces

The built environment includes many surfaces such as roofs, walls, and pavement. Dark elements absorb heat; conversely, light surfaces reflect heat and stay cooler.

For example, asphalt absorbs heat while concrete reflects heat. Dark-colored surfaces such as roofs, patios and driveways contribute to a phenomenon known as the heat island effect (see Figure 17 on page 12). Such materials should be shaded when possible. Using deciduous trees allows you to capture the warmth from the sun’s heat in retaining walls and pavements during cool seasons while still shading and cooling during the summer.

Using light-colored surfaces can significantly lower temperatures and energy consumption during warm months. When using light-colored surfaces, however, be sure to consider glare problems. Glare can be reduced when designing with concrete, for example, by texturing the surface, which disperses light rays in several directions. Use a balance of trees and selected surface colors in order to obtain the most energy-efficient living environment.
Recycled, Renewable, and Low Energy-Consuming Materials

Ideally, construction materials for your home and landscape should be biodegradable, recycled, and low energy-consuming materials that are produced locally. For example, recycled concrete sidewalks make attractive retaining walls. Local municipalities can save money and space in local landfills by letting you have large blocks of concrete from demolition activities. Soil, cement, brick and stone are also good materials for thermal mass; meaning they will absorb heat during the day and radiate heat at night. Outdoor patios of such materials can often be used comfortably day and night in both winter and summer if shaded by deciduous trees.

Because of the mining and manufacturing processes associated with steel, aluminum, and plastic, they are considered energy-intensive materials and should therefore be used in moderation or when they have been recycled. Using renewable materials extends our ability to adequately maintain our resources for future generations. Also, by purchasing locally-produced building materials, you will save transportation costs involving both money and energy, and support the local labor market.

Porous Paving Materials

Driveways and parking areas can get very hot. Asphalt parking areas can reach 195º F in the summer. Rain falling on such hot surfaces can warm to 90 ºF before running off into creeks or lakes where it harms temperature–sensitive species of plants and ani-

Sketch of an Urban Heat-Island Profile

Figure 17: Urban Heat Islands
“Urban summers are hot and getting hotter. Data collected over the last century clearly show an increase in inner cities’ temperatures since buildings and pavement began replacing agricultural land near urban areas.” (http://www.ghcc.msfc.nasa.gov/urban/urban_heat_island.html)
Figure 18: Cream colored gravel provides an attractive porous paving material for walkways and driveways.

“Therefore, let us build houses that restore to man the life-giving, life-enhancing elements of nature. This means an architecture that begins with the nature of the site. Which means taking the first great step toward assuring a worthy architecture, for in the rightness of a house on the land we sense a fitness we call beauty.”

Frank Lloyd Wright

Figure 19: Consider siting your home into a south-facing slope and berming earth against the north wall to reduce the cold shadow cast by the building on the north side.

mals. Such runoff also carries toxic pollutants. Cars parked on hot pavement are not only uncomfortable to get into, but also leak oil and other petroleum fluids onto the pavement. These fluids then vaporize and contribute to air pollution.

Porous pavings allow 15 to 25 percent of rainwater to seep through tiny holes in the pavement. The holes act as a filter, catching oils and chemical pollutants while also allowing cooler earth temperatures from below to cool the pavement. Light colors can be used to make porous paving more reflective, further reducing temperatures.

An exciting example of a more sustainable landscape paving material, porous paving is strong, durable, and less susceptible than traditional concrete to freeze-thaw cracking because of its built-in open spaces. What an innovative way to cool temperatures around your cars and home while improving water quality in your neighborhood.

**Insulating Walls from the Outside with Soil**

If you are building a new home, you may want to consider siting your home into a south-facing slope and berming earth against the north wall. Bering the north wall with earth will reduce heat loss through the wall in winter and prevent heat gain in summer. Ground temperatures, like large bodies of water, are usually warmer in winter and cooler in summer than the outdoor air. Burying the north wall also protects the building from northerly winter winds. Be sure to use proper waterproofing techniques and grading to avoid moisture in your home.
Extra Energy Savings for Manufactured Homes

“Manufactured homes often have higher energy bills than comparably sized site-built homes. Many of these homes have less insulation than site-built homes, allowing easy entering of the sun’s heat through conduction. The lower profile of manufactured homes makes it easier to shade walls and roofs than for site-built homes.” (http://southface.org)

To save money on heating bills, orient the short sides of your manufactured home to face east and west. A home aligned along the east-west axis exposes more surface area to the south during winter to collect solar radiation. Face the side with the most windows to the south to take advantage of winter sun, which stays low in the south sky during winter months. This is the most efficient orientation for minimizing heating requirements in winter and cooling requirements in summer.

Plant fast-growing deciduous trees to shade the east and west sides of your home. East and west walls get the most sunlight in summer, and shading them will reduce the need for air conditioning. The cost of a few trees is easily offset in financial savings for the homeowner, who enjoys other benefits from the trees as well.

Figure 20: Manufactured homes often have higher energy bills than comparably sized site-built homes. Unnecessary mass clearing of existing trees contributes significantly to the problem.

Figure 21: Studies have found that proper landscaping around manufactured homes can save as much as 75 percent—even more than savings on site-built homes. (http://www.eren.doe.gov/cities_counties/coolcit.html)

Figure 22: Shading reduces the need for air conditioning.
Checklist: Landscape Design for Energy Efficiency through Climate Control

- House is positioned with short sides facing east and west and the long side with the most windows facing south for maximum solar benefit.

- House is not positioned on a hilltop where wind speeds are high.

- House is not positioned on a low point where cold pockets exist.

- Plants are placed on east and west sides of house to block hot sun. Plants shade windows, walls and roof.

- Plants are used to decrease winter wind velocity around the house. Evergreen plants are placed on northwest side of the house to buffer cold winter winds.

- Plants are used to direct summer breezes into windows if home is not air conditioned.

- Vines are used to provide shade on walls.

- South side of house receives winter sun and is not blocked by evergreen trees.

- Light-colored building materials are used to reflect sunlight from walls and roof.

- Light-colored paving material is used on patios, driveway, and parking areas.

- Textured paving surfaces are used to reduce glare.

- Porous paving materials are used to cool temperatures and reduce water run-off.

- Locally produced, biodegradable, recycled, and low energy-consuming building materials have been utilized.

*Figure 23: Vines shade walls.*
Chapter Two

The Landscape Design Process for Energy Efficiency and Aesthetics

Houses relate to the land in different ways; some are raised above it, some sit firmly on it, and others nestle into it. As you begin to landscape an existing home or before beginning construction of a new home, consider all components including land, building, pavement, and plants. Arranging these elements to be both functional and beautiful will benefit you and the environment.

A site design does not have to be complex. It can be simple but should enhance the appearance and environmental quality of the land. When building a new home, the optimum time to begin the site design is at the very beginning before any building or site work is started. If your project is complex, consult a landscape architect, arborist and wildlife biologist or ecologist to begin the process.

Proper site design can ultimately increase property values. Landscape planning is a cost-effective and aesthetically pleasing way to lower energy bills. Well designed landscapes can reduce summer and winter energy bills by providing protection from winter wind and summer sun as noted in Chapter 1. They can also conserve water, reduce pesticides and fuel for landscape and lawn maintenance, and alleviate noise and air pollution. Trees help minimize erosion, protect water supplies, provide food, create wildlife habitat and clean the air by absorbing carbon dioxide and releasing oxygen. Thus, landscape designs incorporating tree plantings and climate control measures provide many environmental benefits.

The eight phases of the landscape design process:
What are the steps to designing an energy-efficient landscape?

Step 1: Research
Why should I find out more about this topic?

Step 2: Base Map and Site Inventory
Where are my property lines and what do I already have on site?

Step 3: Site Analysis and User Needs Analysis
How do existing features of the site affect me and my home?
What would I like in my landscape?

Step 4: Design Drawings
What do I need to create the best design for my landscape?
Step 5: Types of Construction Drawings
What kind of drawings do I need in order to build my landscape?

Step 6: Cost Estimate
How much will it cost to install my design?

Step 7: Construction Implementation
How can I get my design installed?

Step 8: Landscape Maintenance
How can my landscape continue to look good and function efficiently?

The first three of these steps, research, site inventory, and site analysis, are critical to understanding the issues and conditions of the site in both new and existing projects. In new construction, these steps may even help in the site selection process, before negotiation of the final purchase of the land.

Step 1: Research
Why should I find out more about this topic?

The first step in any building project is research, which involves collecting as much information as possible about the project’s goals. Research on an energy conservation project includes understanding the principles of energy conservation and efficient maintenance. You are involved in research as you read this publication. The information found here will help you become more knowledgeable as you strive to design an energy-efficient landscape.

Step 2: Base Map and Site Inventory
Where are my property lines and what do I already have on site?

You will need a base map to begin making notes for your site inventory. A base map property boundary survey usually comes with the purchase of a land parcel or a house and lot. Typically prepared by a licensed land surveyor, a survey plan is drawn to scale and often shows the relationship between the property boundary lines, topographic contour lines, and the location of structures, large trees, and easements. A topographic survey locates the site’s elevations and can be commissioned through a land surveyor. A tree survey inventories the existing trees including type, size and location and should be done by a surveyor at this stage.

Notes on the existing site inventory can be documented on the base survey map. For example, arrows can be drawn to show sun angles and prevailing winds for summer and winter conditions. Note problem areas such as low wet spots or hot areas with reflective glare. Draw circles to show the location of trees, and note the type and size of shrubs and other vegetation. Try to note all of the existing features of the site on one drawing. Your base map be-

“One cool judgment is worth a thousand hasty councils. The thing to do is to supply light and not heat.”

Woodrow Wilson
Before beginning the design, it is important to become familiar with the site so you can maximize advantages and minimize disadvantages. Take note of the site’s existing climatic influences including: the path of the sun; prevailing wind direction; available water; the location and proximity of nearby buildings, fences, water bodies, trees, pavement, slopes and landforms—and their possible climatic effects. Take notes and delineate them on the base map.

Existing features affect climatic conditions. Trees, buildings, fences and walls provide shade, windbreaks or wind channels. Water bodies moderate temperature but can increase humidity and produce glare. Light-colored pavement reflects heat while dark-colored pavement absorbs heat.

Additional features to note in your inventory include: geology, soils, drainage, utilities, property lines, wildlife habitat, neighboring land use, traffic patterns, views, and man-made structures such as utility rights of way or easements.

**Step 3: Site Analysis and User Needs Analysis**

*How do existing features of the site affect me and my home? What would I like in my landscape?*

Different from a site inventory, the site analysis evaluates and assesses a site after the inventory is complete. Through analysis, you can determine the opportunities and constraints that may affect the project design. For example, your inventory may show that prevailing winter winds come from the northwest. Your analysis of that information may include a note to block or redirect winter winds around the house.

Site analysis observations can be documented on the base survey map together with the site inventory or, for clarity, they can be drawn on a separate tracing paper overlay. A separate overlay is sometimes needed if there are many plants on your site. Include a certified arborist or urban forester at this stage in planning to analyze the condition of trees on the site, to determine those that are worth saving, and to develop proper protection plans. See Chapter 4 on tree protection.
A vegetation analysis may indicate that a group of trees shades a parking area and should therefore be protected. Your analysis may also indicate the need to remove diseased or dying trees to enhance safety or the need to plant a “living fence” of dense trees or shrubs to screen a dog pen or buffer a patio area from noise. A thorough analysis includes observations about areas where tree height or width may be restricted, such as under utility lines or along sidewalks.

When analyzing your lawn, note unnecessary areas not used for activities. For example, you may want to convert parts of your existing lawn into planting beds or wildlife habitat if your children no longer play ball in those areas.

A site analysis can also include surrounding land use. In urban areas where properties can be small and neighbors close, your neighbor’s property may actually be the best place for trees to shade your west-facing windows while your property may be the best location for their windbreak. Collaborating could benefit everyone involved.

Multiple layers of the site analysis will clearly show the potential of the site. Identify your goals and understand existing and proposed features, to increase success with your landscape project.

**User Needs Analysis**

Determine your interests, needs, and capabilities early in the design process. You may want a large vegetable garden for food or a small flower garden to attract butterflies. However, a vegetable garden would not fare well between the house and a tree shading the east side of the house because it would be in shade most of the day. Also consider outdoor activities like cooking, entertaining, gardening, reading, and relaxing. Don’t forget to provide space for children’s play, sports, or hobbies.

*Figure 29: Use colored pencils or markers on drawings so it is easier to see.*
Site Analysis

The site analysis provides information on existing conditions. This information aids in the design process by locating atmospheric conditions, as well as man-made obstacles. This analysis helps prevent problems and situations that may present themselves later.

Wind Direction

Wind direction can affect the efficiency of a dwelling’s heating and cooling system. Prevailing winds are typically northwest for fall and winter and south to southwest for spring and summer.

Site Analysis
Horticulture 308 & 208
Drawn by: Bryan Shumpert

Sun Analysis

This graphic shows the path of the sun during the longest and shortest times of the year. This is helpful when deciding locations for plant materials, especially around the dwelling.

Wildlife

Songbirds such as robins, cardinals, sparrows, finches and mockingbirds are present. Ideal habitat exists for squirrels, rabbits, and other small mammals. Reptiles such as snakes and turtles may be present. Appears to be a good haven for insects. Thick brush is a good habitat for deer.

Figure 30: Inventory and site analysis plan.
# Checklist: What do I Need?

Check Yes or No and add comments where appropriate.  

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Family activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor cooking or dining area</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Areas for specific children's activities</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Swimming or wading area</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Private sitting area</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Work area</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Laundry drying area</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Optional area for a specific sport</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>2. Entertaining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General type</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Usual number of guests</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Parking capacity</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>3. Gardening</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flower beds</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Vegetable garden</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Compost bin</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Greenhouse</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Herb garden</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Fruit trees or vines</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Water garden, pond or fountain</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>4. Animals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pets (number and type)</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Any housing or special fencing needed for pets</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Interest in birds, butterflies or other wildlife</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Bird houses, feeders or baths</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Plants with berries, seeds or nectar for birds and butterflies</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>5. Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the care of your garden of interest to you?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Would you prefer to minimize maintenance?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Do you have specific watering plans?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Are there existing natural areas that could be preserved and protected as “no maintenance areas” for wildlife habitat?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td><strong>6. Storage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you need to store:</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Trailers?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Boats?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Garden Equipment?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Toys?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Cooking equipment?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Outdoor furniture?</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
</tbody>
</table>
Checklist: Site Analysis Questions

Check Yes if you need to give consideration to an element of your landscape.

<table>
<thead>
<tr>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Do you feel that any slopes are too steep?</td>
</tr>
<tr>
<td>□ Are there any sunken areas that need to be filled?</td>
</tr>
<tr>
<td>□ Does water drain onto walks and drives?</td>
</tr>
<tr>
<td>□ Does water stand on paved areas?</td>
</tr>
<tr>
<td>□ Is drainage poor from the house or other structures?</td>
</tr>
<tr>
<td>□ Are there drainage problems from or onto neighbors’ property?</td>
</tr>
<tr>
<td>□ Is septic tank drainage a consideration?</td>
</tr>
<tr>
<td>□ Does drainage from roof adversely affect ground drainage or plantings?</td>
</tr>
<tr>
<td>□ Are there eroded areas on the site?</td>
</tr>
<tr>
<td>□ Are there any areas that cause dust problems?</td>
</tr>
<tr>
<td>□ Do any trees or shrubs need to be removed?</td>
</tr>
<tr>
<td>□ Does the lawn need improvement?</td>
</tr>
<tr>
<td>□ Are there any trees or shrubs which you feel are particularly outstanding or of special interest?</td>
</tr>
<tr>
<td>□ Are there bodies of water or rock outcroppings that you want to feature?</td>
</tr>
<tr>
<td>□ Do you feel a general need for more protection from sun or wind outdoors?</td>
</tr>
<tr>
<td>□ Do unshaded paved areas increase the temperature of your yard in the summer?</td>
</tr>
<tr>
<td>□ Are there any areas like doorways that are a problem in the winter?</td>
</tr>
<tr>
<td>□ Could the “climate” within your home and garden be improved by shade to decrease heat or by wind protection to protect from cold?</td>
</tr>
<tr>
<td>□ Are there specific good or bad views?</td>
</tr>
<tr>
<td>□ Are there any bright lights or signs that you find disturbing?</td>
</tr>
<tr>
<td>□ Are there any noises from a nearby road, school, etc. that are a problem?</td>
</tr>
<tr>
<td>□ Are there any views that your neighbors have of your property that you want to change?</td>
</tr>
<tr>
<td>□ Is there a problem with people trespassing through your yard?</td>
</tr>
<tr>
<td>□ Would you like to invite neighborly visits?</td>
</tr>
<tr>
<td>□ Do any walks or drives need to be changed?</td>
</tr>
<tr>
<td>□ Do you have adequate space for parking?</td>
</tr>
<tr>
<td>□ Are any walks or drives inconvenient (do not lie where everyone tends to walk, dangerous intersection between drive and road, etc.)?</td>
</tr>
<tr>
<td>□ Is the pavement or gravel material unsatisfactory (too much heat or glare, slippery in the rain, not in harmony with the materials used in the house, etc.)?</td>
</tr>
<tr>
<td>□ Are you capturing the breezes by utilizing open planning, decks, and balconies?</td>
</tr>
<tr>
<td>□ Are you maximizing ventilation by the use of breezeways, screened patios and louvered walls?</td>
</tr>
</tbody>
</table>
Step 4: Design Drawings
What do I need to create the best design for my landscape?

Before you start landscape implementation, you must first develop a plan. During the design phase, relationships between elements such as buildings, roads, pavement, etc. should be explored. Layouts of proposed alternative arrangements with the best functional and aesthetic relationships should be generated. This ensures that you have considered all design options and will be satisfied with the final design.

The data gathered from step 1: research, step 2: inventory, and step 3: analysis will then be used to shape the design that best incorporates measures for energy efficiency. One or more design alternatives can be drawn on tracing paper and superimposed in order to evaluate each alternative. It is important to make sure the sketches are drawn to scale and fit within the property lines. Frequently, the best ideas from each of the alternatives can be combined to make up the final design.

Your design drawings will help you plan before you plant around your existing home or before you begin construction on a new house. Begin drawing the design on a tracing paper overlay on top of the base map, site inventory and site analysis layers. Use colored pencils or markers so it is easier to see. Draw new areas of improvement such as planting beds, patios, vegetable gardens, new walkways, play areas, etc. and check to be sure they work with the site inventory and site analysis. Potential components of your plan could include deciduous and coniferous trees and plants, earth berms, walls, fences, sheds, paths, garages, etc.

Figure 31: A design drawing will help you to plan before building or planting around your house.

Step 5: Types of Construction Drawings
What kind of drawings do I need in order to build my landscape?

On small projects, such as the addition of a small planting area around a house, it is often unnecessary for a homeowner to do any more than a simple layout sketch drawn to scale. When drawn to scale, the quantity of plants and construction materials, mulch, top-soil amendment, fertilizer, edging material, etc. can easily be estimated.

In a more extensive or complex home improvement project, however, necessary design drawings include the construction documents that contractors will use to bid on and build the project. This set of technical drawings is typically prepared by a landscape architect and is composed of:

A. Layout plan: showing the location and dimensions of all existing and proposed site improvements.
B. **Grading plan:** illustrating the manipulation of contours on the site to accommodate appropriate drainage and contouring of the project site.

C. **Planting plan:** showing proposed trees and shrubs drawn at their mature size. This also includes a plant list describing the names of plants, their sizes, quantities and spacing to ensure that the correct amount of plants is ordered to complete the project. In many instances, a project will also call for an irrigation and lighting plan, which is usually a separate drawing.
D. Planting details: drawings that show proper planting methods for trees, shrubs, groundcovers, etc.

E. Site details: drawings that show details of proper construction and installation for elements such as site paving and furnishings (benches, planters, garden ornaments, etc.), as well as specification of products produced by a particular manufacturer.

Also included in the construction documents is a set of written construction specifications, a legal document specifying building or landscape standards and methods of construction.

A. The Grading Plan: Alteration of the Land

Proper grading is imperative for achieving the best results in any design, including energy conservation. Improper grading or grading as an afterthought creates many problems including:

- tree destruction from cutting of roots during earth removal (this destroys shade trees which increases energy costs),
- tree suffocation from filling over roots,
- added cost for tree removal,
- loss of wildlife habitat,
- unnecessary grading and destruction of the site,
- added cost and time in excess earth moving,
- moisture and water in basements,
- insects attracted by moisture,
- need for expensive structures such as retaining walls.

A grading plan is a technical drawing, thus it is wise to retain a professional such as a landscape architect to prepare the plan. The grading plan gives instructions as to the proposed shaping of the site and the method to be used: cut, fill or a balance of both.

It is important to understand the basic principles of grading so you can observe your construction job site with confidence and know when something is not right. Remember that water must drain away from the house to prevent moisture problems or flooding in the basement. The best grading designs preserve trees and minimize cut and fill, conserving energy in the long run.

When grading, it is important to conserve existing topsoil. Topsoil should be safely stockpiled in designated areas away from trees so it will not be lost during the earth-moving process. This valuable resource can be re-spread over appropriate areas to provide suitable planting conditions at the end of grading, saving on the cost of topsoil and reducing energy use associated with transportation.
1. Grading: Common Problems
How do I minimize grading and avoid destroying my trees?

A common problem in new construction is the concept of mass clearing, a grading process that involves bulldozing the site to clear it of all plant materials.

The general loss of trees and other vegetation through poor grading is a pervasive problem that warrants serious attention. It is evident that mass clearing unequivocally works against energy conservation, contributes to soil erosion, and increases storm water run off. Many contractors view trees as obstacles, looking at the short-term layout costs of tree surveys and tree protection as opposed to the long-term monetary benefits of enhanced property value, increased marketability and environmental quality. If you have ever watched a bulldozer, you know it can do a lot of damage in a matter of minutes. To avoid losing valuable trees to grading, be on site and monitor bulldozer work.

Recent research indicates other problems associated with mass clearing. A high percentage of homes in the Southeast have significant moisture problems, many of which could be prevented through proper grading and drainage. Problems range from water in basements after heavy rains to allergies triggered by mildew and mold growing in overly damp crawl spaces. To correct home moisture problems related to landscaping, begin at the foundation. The land around your home should usually slope away from the foundation of the building.
“The National Academy of Sciences (NAS) estimates that urban America has 100 million potential “tree spaces” (i.e. spaces where trees could be planted). NAS further estimates that filling these spaces with trees and lightening the color of dark, urban surfaces would result in annual energy savings of 50 billion kilowatt-hours—25 percent of the 200 billion kilowatt-hours consumed every year by air conditioners in the United States. This would reduce electric power plant emissions of carbon dioxide by 35 million tons (32 million metric tons) annually and save users of utility-supplied electricity $3.5 billion each year (assuming an average of $0.07 per kilowatt-hour).” (http://www.eren.doe.gov/erec/factsheets/lansdcape.html)

At sites that slope down toward the house, trench drains or PVC piping may be used to divert water through underground channels. Downspouts should not empty close to foundations.

2. Grading: Using Berms
What difference can a mound of earth make?

Berm is the term used to describe the earthen mounds which have become so popular on golf courses in recent years. Berms are a wonderful way to add vertical dimension and visual interest to a boring landscape. Using berms, designers can sculpt the land to create interesting and rhythmic forms. Berms can also provide protection from winter winds and are useful to minimize noise. When used in combination with evergreen plantings, appropriate heights can be attained to create the most effective buffer.

The secret to creating beautiful berms is to make them look natural by making gradual transitions. Too often berms look artificial, as though a dump truck simply dumped a pile of soil and drove away. Natural looking berms can be used to screen unattractive views. Because of their three dimensional form, they can be shaped effectively to control pedestrian or vehicular traffic flow.
When planting on berms, remember that water runs off the top and sides of berms, creating dry conditions. Moisture loving plants should therefore be reserved for the base of berms. Drainage of the area around berms must also be considered, as improperly designed berms can act like dams and block surface water drainage. When creating drainage swales (constructed or natural grassed channels), soil is often removed and used to construct berms, efficiently balancing cut and fill. Berms can be grassed, but attention must be given to keep the slope gentle enough for mowing.

B. The Planting Plan: Tips for Drawing a Functional and an Aesthetically Pleasing Planting Design

How do I achieve beauty and function?

Drawing a detailed planting design helps ensure that the landscape will be properly designed and installed. Following is a list of tips for drawing a plan which will be both beautiful and useful. Combine these ideas with tips for creating an energy-efficient design found in Chapter 1.

1. Strive for balance. For example, if the house has a front-facing gable on one side of the roof, use a larger mass of planting on the other side of the house.

2. Maintain a sense of scale. Keep in mind that larger plants are appropriate for large houses and smaller plants for small houses.

3. Use a variety of plant materials. Choose plants that provide colorful flowers, leaves, or fruit at various times throughout the year to ensure there will always be color in the landscape to add seasonal interest.

4. Complement the home. Remember that areas around the home have various functions. The front is usually the public area of welcome while the back is a pleasant private area for family recreation, but the front can be useful for recreation, too.
The planting plan will show existing and proposed plant materials. When creating the plan, consider the many ways plants are used in the landscape, including functional, architectural, engineering, climatological and aesthetic uses.

Trees, shrubs, vines, groundcovers, grasses, perennials, and annuals are represented on the planting plan with different symbols designated in a key. A plant list or plant schedule is typically included on the drawing, showing the following: botanical name, common name, quantity, size, ball and burlap (B&B), container or bare root, and other comments. Notes are also incorporated on the planting plan to indicate specific instructions such as existing underground utilities, the use of topsoil, mulch, and fine grading.

5. Use foundation plantings when appropriate. Plants placed around the house will soften hard lines and corners, create balance where needed, accent certain features of the house, and help blend the house with its surroundings.

6. Avoid over-planting. Landscaping is more successful if kept simple.

7. Take into account the mature size of a plant. One of the biggest mistakes made by homeowners is selecting plants that grow too big for the intended space. Know how tall and wide a plant will become with age, and place plants so they will not spill over into the doorway or grow over the windows, blocking views.

8. Tie plant beds together. Repeating the use of the same plants around the house will help visually tie plant beds together. Using mulch or a particular variety of groundcover can unify the entire landscape.

The planting plan should create an attractive environment with seasonal interest that will also attract wildlife and incorporate principles of water and energy conservation. Use plants native to the region and remember the basic principals of design—unity, balance, scale, proportion, variety, rhythm, and accent.
Figure 43: Planting Plan. When working with existing homes that have not been ideally sited for solar orientation, designers can utilize plants to modify the effects of climate, thereby saving energy. River birches and red maples, both deciduous native trees, provide summer shade on the east and west sides of this house. Yaupon hollies and waxmyrtles, both native evergreens, provide protection from winter winds. They also provide food, shelter, and nesting sites for wildlife and buffer the lights and noise coming from a nearby highway. Large mulched areas and a wildflower meadow reduce the lawn area by two thirds, thereby reducing the mowing, raking, fertilizing, and watering required to maintain turfgrass. Centipede, a slow growing and drought tolerant species of grass, was selected as a play surface for children where needed. A compost bin made from recycled wooden pallets placed next to the vegetable garden will reduce energy costs associated with transporting organic waste to landfills and will also provide a place to create a renewable source of mulch and soil for the garden. Perennial flowers, herbs, and shrubs throughout this design provide seasonal color, fragrance, and food for both the homeowners and the birds and butterflies they like to attract. Attention to issues of energy conservation, water conservation, low maintenance, and wildlife habitat make this a sustainable landscape design.
C. Drawing the Planting Details
How do I specify proper planting techniques?

Plant materials come in different types and sizes, and proper planting details should be followed to ensure successful growth. Instructions regarding soil mixture, mulching, pruning, etc. should also be followed. An appropriate specification for a tree is detailed below.

![Diagram of tree planting details]

- Prune damaged branches
- Place 1/3 of rootball above existing grade
- 2” - 3” of organic mulch
- Peel back 1/3 of burlap
- Backfill with native soil
- Undisturbed earth

Figure 45: When planting trees in poorly drained soils, plant the tree “high,” with one-third of the rootball above the existing grade. Place the ball on undisturbed soil to prevent settling and allow water to drain away from the root ball. Cover with a 2 to 3 inch layer of organic mulch and pull the mulch away from the base of the trunk to prevent decay.

D. Detail Drawings
How do I specify proper construction techniques?

Site elements such as walkways, roads, retaining walls, and decks come in different materials, sizes, shapes and colors. Choose the materials you want to use. Consider using recycled materials where possible. On a complex project, consult a landscape architect and/or a contractor to work out the details. Drawings are necessary to specify the construction details and installation guidelines so you can obtain the materials and the desired “look” for your project.

Figure 44: There are many uses of plants in the landscape. For example, they provide shade, spatial definition, windscreen, sound attenuation, and aesthetics.
“Beware of little expenses; a small leak will sink a great ship.”

Benjamin Franklin

Figure 46: Stone columns with integrated trellis detail.

Figure 47: Trellis with integrated stone columns. Joseph Michael Kelly, Architect.

Step 6: Cost Estimate
How much will it cost to install my design?

During the design phase, preliminary cost estimates should be generated. This will determine whether the project is on budget or if adjustments need to be made. Obtain an itemized cost estimate. Once the drawings are complete, a final cost estimate can be tallied.

Step 7: Construction Implementation
How can I get my design installed?

If you are implementing the construction yourself, you should be able to observe progress, make adjustments as needed, and proceed if there are no necessary changes. On a large project, a general contractor or equivalent would be responsible for coordinating and scheduling the project. At the completion of the project, conduct a final check to ensure that everything has been completed as shown on the plans.

Step 8: Landscape Maintenance
How can my landscape continue to look good and function efficiently?

Once your design is completed, it must be properly maintained to live, grow, and, over time, acquire the look that you envision. Because landscapes are constantly changing as they grow and mature, maintenance is critical to ensure that you attain a look and function consistent with your design intent. See Chapter 3 for specific tips on how to reduce maintenance and energy consumption through design.
Chapter Three

Landscape Design for Low Maintenance

Save Energy by Designing for Low Maintenance

Landscape maintenance usually includes pruning, mowing, watering, weeding, and controlling insects and diseases. Following are ideas to make maintenance more efficient for homeowners.

To Reduce Pruning

A well-designed landscape should require minimal pruning. Select plants with an ultimate height and spread that fits the space for which they are intended. Far too often, people plant small shrubs from one gallon pots without realizing that they may grow a foot or more a year and soon cover the driveway or front door. Such plants will either have to be pruned every year or replaced with appropriate-sized specimens.

Choose plants with a natural form (i.e. columnar, rounded, vase shaped, weeping, etc.) appropriate for its spot. For example, a graceful forsythia will not have to be pruned into an ugly round “meatball” if given plenty of room to spread out.

The natural look is popular and easy. Design with informal balance rather than formal balance so that plants do not have to “mirror” each other in the design, and much less pruning will be necessary.

To Reduce Watering

Select plants that can adapt to the available soil moisture and are drought tolerant if necessary. Plants native to the area are often appropriate. Be especially careful when selecting plants for south- or west-facing slopes where water runs off and sun is intense.

Avoid containers and planter boxes that collect little natural rainwater. Containers are exposed to drying wind, sun, and heat. If planters are used, leave the bottom open to the ground so plant roots can access water tables and water pulled by capillary action.

If plants are to be surrounded by paving materials, specify porous paving or a material such as brick laid on sand so water can seep through cracks and provide plants with more moisture.

Since rainwater does not fall under roof overhangs, this area is often too dry to support plants. Materials such as attractive river
stones or a simple mulch can add texture and interest while reducing the amount of soil moisture lost through evaporation.

**To Reduce Weeding**

Use 2 to 3 inch thick organic mulches of a coarse texture to shade out weeds and provide a dry surface that discourages germination of weed seeds that may blow into a bed. Select plants that are aggressive enough to compete with weeds and that will shade them out as much as possible. Landscape fabrics which allow water percolation and air exchange may be used under mulches to discourage weeds in particularly difficult areas.

**To Eliminate Spraying for Insects and Diseases**

Design with plants that have as few pest problems as possible. When locating plants, pay particular attention to details such as sun, drainage, moisture and climatic requirements, so that they will not be exposed to stress conditions which increase susceptibility to disease and insect infestation.

Hire trained integrated pest management (IPM) personnel who can detect pest problems in your landscape. A good professional reduces the necessity of preventive spray programs which often call for unnecessary applications. If problems are discovered, ask for natural pest controls.

Children and adults enjoy bird houses for insect-eating birds like purple martins. Their flight is delightful to watch and they consume many unwanted insects.

**To Reduce Mowing**

Reduce turf areas and replace them with groundcovers, mulch, natural wooded areas, or meadows that do not require constant mowing. Where turf is necessary, specify slow growing species. Use groundcovers or mulches instead of grass around trees to reduce hand edging and trimming and to protect trees from mechanical damage and the future disease or insect infestation that often results. When laying out borders between lawn areas and shrub beds, woods, or meadows, design with lines that allow mowers to negotiate smoothly without having to back up. Remember, designs that reduce the need for power maintenance equipment also reduce the use of fossil fuels.

**Miscellaneous Tips for Low-Maintenance Design**

In high-use areas where turf is difficult to maintain, use an inexpensive alternative like mulch. If the budget allows, porous pav-

---

“Homeowners use up to 10 times more toxic chemicals per acre than farmers.”

“The average homeowner uses 5 to 10 pounds per lawn—for a national total of some 25 to 50 million pounds! Many scientists believe these chemicals endanger the songbird population (by contaminating the worms they eat), as well as polluting groundwater.”

“If even 10 percent of lawnmowers began using organic pesticides, it would remove 2.5 to 5 million pounds of toxic chemicals from the environment every year.” (The Earthworks Group, 1989)

“Cut it high and let it lie.” During dry periods, leave grass cuttings on the lawn. This works well if you keep grass long and cut small amounts each time. Cuttings will serve as a moisture-retentive mulch and a natural fertilizer.

“At other times, use grass clipping and other lawn and garden wastes to make a compost pile. It will provide your garden with natural mulch and fertilizer—and help reduce contributions to your local landfill.” (The Earthworks Group, 1989)
ing may be used on pedestrian areas in heavy shade where grass is difficult to grow.

Some trees produce fruit which may be beautiful on the tree. However, when the fruit drops, it can cause “litter” problems on lawns, sidewalks, or patios. Sweet gum and crabapple trees are examples of plants which should not be placed over grassy or paved areas where litter would be considered a maintenance problem. When designing around existing plants with such litter problems, incorporate a deep ground cover that will absorb fallen fruit, twigs, etc.

Some plants, like southern magnolia and American holly, have low-growing limbs that reach the ground and cover up any fruit or leaf drop. Specify that such plants be placed so they can keep their limbs to the ground, hiding fallen fruit, leaves, and twigs.

When designing and implementing a new landscape, use proper planting and installation techniques. A high-quality implementation job reduces stress on plants and encourages a vigorous, healthy landscape that requires less maintenance.

Native Plants

If you like nature and want to select low-maintenance plants that are well adapted to your climate, soils, and available water, choose native plants. Natives provide an ecosystem-friendly habitat for birds and butterflies, which add color, movement, and song to your landscape. Native plants restore a sense of place, providing relief from the homogenous landscapes seen wherever you go. They offer a wide array of color, texture, form, and fragrance to stimulate your senses and add beauty to your home.

Using a diverse selection of plants will give you seasonal interest through the year. Spring, summer, fall, and winter will each hold a special charm, and you can marvel at the changing seasons. Diversity also brings stability, and reduces the likelihood of losing a large section of your plants to insects or disease.

Do not destroy wild stands of native plants by digging them from the woods or meadows. Many native plants are available commercially. They should be bought from reputable nurseries where they have been propagated or grown without damage to wild habitats.

On the following page is a list of some commercially available native South Carolina plants in different size categories to get you started. Ask a local landscape architect, urban forester, grower, extension agent, or member of the South Carolina Native Plant Society for help with native plants that perform well in your area.
## Selected Native Plants Suitable for Landscaping in South Carolina

### Large Trees Taller than 40 Feet

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>American beech</td>
<td><em>Fagus grandifolia</em></td>
</tr>
<tr>
<td>Baldcypress</td>
<td><em>Taxodium distichum</em></td>
</tr>
<tr>
<td>Black tupelo</td>
<td><em>Nyssa sylvatica</em></td>
</tr>
<tr>
<td>Carolina hemlock</td>
<td><em>Tsuga caroliniana</em></td>
</tr>
<tr>
<td>Eastern hemlock</td>
<td><em>Tsuga canadensis</em></td>
</tr>
<tr>
<td>Eastern red cedar</td>
<td><em>Juniperus virginiana</em></td>
</tr>
<tr>
<td>Live oak</td>
<td><em>Quercus virginiana</em></td>
</tr>
<tr>
<td>Loblolly pine</td>
<td><em>Pinus taeda</em></td>
</tr>
<tr>
<td>Palmetto</td>
<td><em>Sabal palmetto</em></td>
</tr>
<tr>
<td>Pecan</td>
<td><em>Carya illinoensis</em></td>
</tr>
<tr>
<td>Red maple</td>
<td><em>Acer rubrum</em></td>
</tr>
<tr>
<td>River birch</td>
<td><em>Betula nigra</em></td>
</tr>
<tr>
<td>Scarlet oak</td>
<td><em>Quercus coccinea</em></td>
</tr>
<tr>
<td>Southern catalpa</td>
<td><em>Catalpa bignonioides</em></td>
</tr>
<tr>
<td>Southern magnolia</td>
<td><em>Magnolia grandiflora</em></td>
</tr>
<tr>
<td>Southern sugar maple</td>
<td><em>Acer barbatum</em></td>
</tr>
<tr>
<td>Sweetbay magnolia</td>
<td><em>Magnolia virginiana</em></td>
</tr>
<tr>
<td>Sweetgum</td>
<td><em>Liquidambar styraciflua</em></td>
</tr>
<tr>
<td>Sycamore</td>
<td><em>Platanus occidentalis</em></td>
</tr>
<tr>
<td>Tulip popular</td>
<td><em>Liriodendron tulipifera</em></td>
</tr>
<tr>
<td>White oak</td>
<td><em>Quercus alba</em></td>
</tr>
<tr>
<td>Willow oak</td>
<td><em>Quercus phellos</em></td>
</tr>
</tbody>
</table>
**Small Trees Less Than 40 Feet**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>American holly</td>
<td><em>Ilex opaca</em></td>
</tr>
<tr>
<td>Devilwood</td>
<td><em>Osmanthus americanus</em></td>
</tr>
<tr>
<td>Dogwood</td>
<td><em>Cornus florida</em></td>
</tr>
<tr>
<td>Fringe tree</td>
<td><em>Chionanthus virginicus</em></td>
</tr>
<tr>
<td>Hornbeam</td>
<td><em>Carpinus caroliniana</em></td>
</tr>
<tr>
<td>Red buckeye</td>
<td><em>Aesculus pavia</em></td>
</tr>
<tr>
<td>Redbud</td>
<td><em>Cercis canadensis</em></td>
</tr>
<tr>
<td>Sassafras</td>
<td><em>Sassafras albidum</em></td>
</tr>
<tr>
<td>Serviceberry</td>
<td><em>Amelanchier canadensis</em></td>
</tr>
<tr>
<td>Shining sumac</td>
<td><em>Rhus copallina</em></td>
</tr>
<tr>
<td>Smooth sumac</td>
<td><em>Rhus glabra</em></td>
</tr>
<tr>
<td>Southern wax myrtle</td>
<td><em>Myrica cerifera</em></td>
</tr>
<tr>
<td>Sourwood</td>
<td><em>Oxydendron arboreum</em></td>
</tr>
</tbody>
</table>

**Shrubs**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrowwood viburum</td>
<td><em>Viburnum dentatum</em></td>
</tr>
<tr>
<td>Beautyberry</td>
<td><em>Callicarpa americana</em></td>
</tr>
<tr>
<td>Blueberry</td>
<td><em>Vaccinium ashei</em></td>
</tr>
<tr>
<td>Cherry laurel</td>
<td><em>Prunus caroliniana</em></td>
</tr>
<tr>
<td>Coastal leucothoe</td>
<td><em>Leucothoe axillaris</em></td>
</tr>
<tr>
<td>Flame azalea</td>
<td><em>Rhododendron calendulae</em></td>
</tr>
<tr>
<td>Hearts-a-bustin’</td>
<td><em>Euonymus americanus</em></td>
</tr>
<tr>
<td>Inkberry holly</td>
<td><em>Ilex glabra</em></td>
</tr>
<tr>
<td>Mountain laurel</td>
<td><em>Kalmia latifolia</em></td>
</tr>
<tr>
<td>Oakleaf hydrangea</td>
<td><em>Hydrangea quercifolia</em></td>
</tr>
<tr>
<td>Piedmont azalea</td>
<td><em>Rhododendron canescens</em></td>
</tr>
<tr>
<td>Pinxterbloom azalea</td>
<td><em>Rhododendron nudiflorum</em></td>
</tr>
<tr>
<td>Rhododendron</td>
<td><em>Rhododendron sp.</em></td>
</tr>
<tr>
<td>Spanish bayonet</td>
<td><em>Yucca aloifolia</em></td>
</tr>
<tr>
<td>Sweetshrub</td>
<td><em>Calycanthus floridus</em></td>
</tr>
<tr>
<td>Virginia sweetspire</td>
<td><em>Itea virginica</em></td>
</tr>
<tr>
<td>Winterberry</td>
<td><em>Ilex decidua</em></td>
</tr>
<tr>
<td>Witchhazel</td>
<td><em>Hamamelis virginiana</em></td>
</tr>
<tr>
<td>Yaupon holly</td>
<td><em>Ilex vomitoria</em></td>
</tr>
</tbody>
</table>

**Vines**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native wisteria</td>
<td><em>Wisteria frutescens</em></td>
</tr>
<tr>
<td>Trumpet honeysuckle</td>
<td><em>Lonicera sempervirens</em></td>
</tr>
<tr>
<td>Virginia creeper</td>
<td><em>Parthenocissus quinquefolia</em></td>
</tr>
<tr>
<td>Yellow jessamine</td>
<td><em>Gelsemium sempervirens</em></td>
</tr>
</tbody>
</table>
### Herbaceous Perennials and Groundcovers for Shady Areas

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloodroot</td>
<td>Sanguinaria canadensis</td>
</tr>
<tr>
<td>Blue woodland phlox</td>
<td>Phlox divaricata</td>
</tr>
<tr>
<td>Christmas fern</td>
<td>Polystichum acrostichoides</td>
</tr>
<tr>
<td>Crested iris</td>
<td>Iris cristata</td>
</tr>
<tr>
<td>Fire pink</td>
<td>Silene virginica</td>
</tr>
<tr>
<td>Foam flower</td>
<td>Tiarella cordifolia</td>
</tr>
<tr>
<td>Green and gold</td>
<td>Chrysogonum virginianum</td>
</tr>
<tr>
<td>Green dragon</td>
<td>Arisaema dracontium</td>
</tr>
<tr>
<td>Indian pink</td>
<td>Spigelia marilandica</td>
</tr>
<tr>
<td>Jack-in-the-pulpit</td>
<td>Arisaema triphyllum</td>
</tr>
<tr>
<td>Lizard’s tail</td>
<td>Saururus cernuus</td>
</tr>
<tr>
<td>Maidenhair fern</td>
<td>Adiantum pedatum</td>
</tr>
<tr>
<td>Marginal shieldfern</td>
<td>Dryopteris marginalis</td>
</tr>
<tr>
<td>Pachysandra</td>
<td>Pachysandra procumbens</td>
</tr>
<tr>
<td>Partridgeberry</td>
<td>Mitchellella repens</td>
</tr>
<tr>
<td>Royal fern</td>
<td>Osmunda regalis</td>
</tr>
<tr>
<td>Running cedar</td>
<td>Lycopodium flabelliforme</td>
</tr>
<tr>
<td>Solomon’s seal</td>
<td>Polygonatum biflorum</td>
</tr>
<tr>
<td>Wild bleeding heart</td>
<td>Dicentra eximia</td>
</tr>
<tr>
<td>Wild red columbine</td>
<td>Aquilegia canadensis</td>
</tr>
</tbody>
</table>

### Herbaceous Perennials and Groundcovers for Sunny Areas

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beebalm</td>
<td>Monarda didyma</td>
</tr>
<tr>
<td>Blackeyed susan</td>
<td>Rudbeckia fulgida</td>
</tr>
<tr>
<td>Butterflyweed</td>
<td>Asclepias tuberosa</td>
</tr>
<tr>
<td>Cardinal flower</td>
<td>Lobelia cardinalis</td>
</tr>
<tr>
<td>Eared coreopsis</td>
<td>Coreopsis auriculata</td>
</tr>
<tr>
<td>Goldenrod</td>
<td>Solidago sp.</td>
</tr>
<tr>
<td>Ironweed</td>
<td>Veronica noveboracensis</td>
</tr>
<tr>
<td>Joe-pye weed</td>
<td>Eupatorium fistulosum</td>
</tr>
<tr>
<td>Moss pink</td>
<td>Phlox subulata</td>
</tr>
<tr>
<td>Obedient plant</td>
<td>Physostegia virginiana</td>
</tr>
<tr>
<td>Purple coneflower</td>
<td>Echinacea purpurea</td>
</tr>
<tr>
<td>Spiked gayfeather</td>
<td>Liatris spicata</td>
</tr>
<tr>
<td>St. John’s wort</td>
<td>Hypericum frondosum</td>
</tr>
<tr>
<td>Stokes aster</td>
<td>Stokesia laevis</td>
</tr>
<tr>
<td>Swamp sunflower</td>
<td>Helianthus angustifolius</td>
</tr>
<tr>
<td>Switch grass</td>
<td>Panicum virgatum</td>
</tr>
<tr>
<td>Yarrow</td>
<td>Achillea millefolium</td>
</tr>
</tbody>
</table>
Checklist: Ideas to Help You Design for Low Maintenance

- Use plants whose ultimate height and spread will fit the space available.
- Use an informal design.
- Use plants whose natural forms (i.e., columnar, rounded, vase shaped, weeping, etc.) are appropriate for the space.
- Use plants that are drought tolerant, particularly on south- or west-facing slopes.
- Do not use containers and planter boxes that collect little natural rainwater unless they are open from the bottom so roots can penetrate the soil below.
- When paving around plants, use porous paving materials such as brick laid on sand so water can seep through cracks.
- Use thick organic mulches 2 to 3 inches deep.
- Use plants that are aggressive enough to compete with weeds.
- Use landscape fabrics under mulch.
- Use plants with minimal pest problems.
- Use plants that are adapted to local climatic conditions.
- Use trained personnel to scout for pest problems.
- Use ground covers, woodlands, meadows, and/or mulches to replace unnecessary turf.
- Use slow-growing species of turf when possible.
- Use ground covers or mulches near trees.
- Use smooth bed lines to allow mowers to negotiate easily.
- Use low-maintenance alternatives such as mulch or porous paving for high-use or shady areas.
- Avoid using plants with litter problems.
- Around existing plants with litter problems, incorporate mulch or a deep ground cover to absorb fallen fruit and twigs, etc.
- Use proper planting and installation techniques.
- Use native plants.
Chapter Four

Protecting Existing Trees During Home Construction or Landscape Renovation

Benefits of Preserving Existing Trees

Whether you are building a new home, adding to your home, or installing new landscaping near existing trees, proper protection from devastating construction damage is crucial.

Deciduous trees can make your home more energy efficient by providing shade in summer while allowing sunlight to warm your home in winter. If you are fortunate enough to already have large or medium-sized trees on your property, you begin to benefit from those energy savings immediately instead of waiting many years for newly planted trees to reach a similar size. Large existing trees could save you as much as $5,000 to $10,000 over a twenty-year period.

Saving trees during construction not only requires the right attitude, but also the right actions. Everyone on the planning, design, and construction teams must understand the techniques that can save such valuable assets from the bulldozer and other equipment. Both the pre-construction and construction phases are critical to properly protecting existing trees. By remaining healthy, they provide immediate benefits to you and your neighborhood.

Pre-construction Phase

Evaluation

The team working on your home or landscape project should include a professional arborist, horticulturist or other natural resource expert who understands tree biology, health, and protection techniques. Don’t wait until after the project is built to bring in the experts; the process of saving trees must begin during the planning and design process, which can start as early as one growing season before construction activities begin. The site should be inventoried and analyzed (see Chapter 2) with special attention to existing trees and related site features. An arborist or urban forester may assist in the inventory to determine tree numbers, species, sizes, and locations. Analysis of the tree inventory data by your tree professional is critical to determine trees worth saving and methods to assure success.
If your site contains many trees, consider preserving the natural, forest-like setting as a very low maintenance alternative to open lawns. Identify the species of trees on the site and strive for variety. If species choices must be made, discriminate against those species with known pest, maintenance, or structural problems.

While larger trees provide more immediate benefits, a variety of tree sizes and ages is desirable. A mix of large, medium, and small trees ensures more seasonal interest and varied wildlife habitat. As older trees decline, younger, more vigorous trees can eventually take their place.

Study the condition of the trees on your site to determine if they are worth retaining. Evaluate all parts of the tree, including the crown (all of the above ground parts except the trunk), the trunk, and the roots. Ideally, the living crown should comprise at least 35 percent of tree height, since trees with large crown volumes tolerate the insults of construction more successfully. If the proportion of living branches or crown along the trunk is less than 10 percent of the total tree height, the tree should probably be removed before construction begins because it may not survive or be a healthy specimen.

Inspect the trees for damage which may have resulted from previous construction, storms, grading, logging, or traffic. When machinery is used between and around trees, soil compaction and mechanical damage to trunks and roots often occur. These stresses make a tree more susceptible to pest problems and can eventually lead to decline, decay, and death. Trees already in decline or having mechanical injury around more than one-third of the trunk’s circumference or root system are less likely to survive construction trauma and should usually be removed prior to construction.

Planning and Action

Many construction activities can severely damage or kill trees. Conducting the inventory and analysis of trees on the site and implementing the following actions before construction begins is critically important to minimize damage. After reviewing your construction plans, do the following:

1. Lay out utility and equipment access corridors and prune lower branches if necessary for vehicle clearance. If possible, use a single corridor for underground and overhead utilities and equipment access. Locate trenches in non-tree areas, such as along driveways and sidewalks, or no closer to the trunks of adjacent trees than suggested in the guidelines in Figure 50. Work with utility companies to design corridors that curve away from trees or to tunnel under trees.
when necessary. Allow for two access points (in and out), so that large utility trucks will not have to turn around in critical root zones.

2. Avoid soil compaction. Soils can be easily compacted by the movement of vehicles or by stockpiling materials on site. Increasing the bulk density of soil (compaction) by one-third can limit a tree to one-half of its root and shoot growth. Tree roots have difficulty penetrating soils without the proper proportion of airspace, and compacted construction sites, which often have 50 percent or greater bulk density than the native soil, do not support vigorous tree growth.

3. Construct tree protection barriers of sturdy fencing material (preferably six-foot chain link fence) to restrict all activity and access over the critical root zone of individual trees to prevent soil compaction, as well as to protect the trunk and canopy. Construct the barrier as far from the trunk of the tree as possible in accordance with distances suggested in Figure 48. Erecting protection barriers around groups of trees is preferable and involves less work than fencing individual trees. Remember, distances for placing protective barriers are only guidelines. The ability of specific trees to tolerate construction insults depends on tree species, health, and other factors. Tree protection should be designed and implemented based on professional experience.
Figure 52: Trees and their root systems need to be protected on construction sites. A 6 foot chain link or wood fence should be placed at or beyond the edge of the tree canopy.

4. Apply 3 to 5 inches of organic mulch (preferably wood chips or bark) over the root zone of trees within the protective barriers. Mulching areas outside of protective barriers will help to minimize compaction from construction traffic adjacent to sensitive root zones.

5. Designate and post signs in non-tree areas for construction machine access, vehicle parking, material storage, soil storage, and chemical or cement rinsing. The shade of large trees is an attractive place to locate a temporary office or to park during hot summer months. This should not be allowed since it damages soil structure in the root zone. Remember, up to 95 percent of tree roots are in the top eight inches of the soil. They are very sensitive to change and are very easily damaged by changes in soil grade, trenching for underground utilities, and soil compaction.

6. Determine if proposed paving or site grading will raise or lower soil surfaces in a way that will destroy roots or change water flow patterns. Altering drainage can cause excessively wet or dry soil, either of which will kill existing trees. Professionals can design and implement treatments to eliminate or mitigate these problems.

7. Identify situations where roots of protected trees are likely to extend into areas that need to be trenched for a utility line, dug for a footer or foundation, or have soil or paving added above the existing soil surface. Tree roots typically extend a distance equal to 1.5 to 2 times the height of the tree. As a result, they commonly extend well beyond protec-
When pruning is needed or appropriate, remove branches at lateral branching points. Do not cut branches in a way that leaves stubs (heading or topping), as seen at far right.

The interdependence between trees and human and animal life could not be more fundamental: We require oxygen and produce carbon dioxide (CO₂); trees and other plants require CO₂ and produce oxygen. Any significant loss in forested land directly affects the Earth’s atmosphere for other forms of life.” (The Earthworks Group, 1989)

“Unpruned tree” "Properly pruned tree" "Improperly pruned tree"

When pruning is needed or appropriate, remove branches at lateral branching points. Do not cut branches in a way that leaves stubs (heading or topping), as seen at far right.

8. Avoid pruning live branches from trees, especially mature trees, unless they are broken or would be damaged during construction. Trees need all of their live branches so that the leaves will produce sufficient carbohydrates (food) to help them tolerate the construction process.

9. Conduct educational/training sessions for all contractors or others assisting with the project to help them understand why the trees are important, why protecting the root systems is essential for tree survival, and why observing all tree protection barriers and rules is mandatory.

Construction Phase

If the tree and site inventory, analysis, pre-construction planning and treatment have been properly conducted and implemented, your primary responsibility during construction will be to monitor all activities. Ensure that tree protection barriers are maintained and that protection zones are not entered. If violations occur, the situations must be corrected immediately and the level of monitoring increased as deemed necessary. Tree protection requires professional expertise, planning, implementation of appropriate treatments, monitoring, and vigilant enforcement of protection zones. Although it might seem a daunting task, tree protection is vital to the health of your landscape.
Conclusion

Climate is a fundamental consideration when creating home environments that are comfortable and livable. From the selection of the property on which you build your home to site design choices, you can respond to your local climate and modify its effects on your home and landscape. John Simonds outlines the following microclimatic principles that can be applied to your advantage:

- **Eliminate the extremes of heat, cold, air movement, and exposure.** This can be achieved by intelligent site selection plan layout, building orientation, and creation of climate responsive spaces.

- **Provide direct structural protection against the discomfort of solar radiation, precipitation, wind, storm, and cold.**

- **Adjust community, site, and building plans to the movement of the sun.** The design of living areas, indoors and out, should ensure that the favored type and amount of light are received at the favored time.

- **Use the sun’s radiation and solar panels to provide supplementary heat and energy for cooling.**

- **Consider the wind also as a time-tested source of energy.**

- **Utilize the evaporation of moisture as a primary method of cooling.** Air moving across any moist surface, be it masonry, fabric, or foliage, is thereby made cooler.

- **Maximize the beneficial effects of adjacent water bodies.** These temper the atmosphere of the warmer or cooler adjacent lands.

- **Introduce water.** The presence of water in any form, from film to waterfall, has a cooling effect both physically and psychologically.

![Figure 55: Water has a cooling effect in summer and a warming effect in winter.](image-url)
Preserve the existing vegetative cover. It ameliorates climatic problems in many ways:

- It protects the soils and environs from the freezing winds.
- It cools and refreshes heated air by evapotranspiration.
- It provides sunscreen, shade, and shadow.
- It helps prevent rapid runoff and recharges the water-bearing soil strata.
- It blocks the wind.

Install new plantings where needed. They may be utilized for various types of climate control. Windscreens, shade trees, and heat-absorptive ground covers are examples.

Consider the effects of altitude. The higher the altitude and latitude (in the northern hemisphere), the cooler or colder the climate.

Avoid undrained air catchment areas and frost pockets.

Reduce the humidity. Generally speaking, a decrease in humidity effects an increase in bodily comfort. Dry cold is less chilling than wet cold. Dry heat is less oppressive than wet heat. Humidity can be decreased by increased air circulation and the drying effects of the sun.

Avoid winter winds, floods, and the paths of crippling storms. All can be charted.

Explore and apply all natural forms of heating and cooling before turning to mechanical (energy-consuming) devices.

Bibliography


*Don’t Turn Up the Heat!* Georgia Power, Cool Communities Program. Rome, Georgia.


http://www.eere.energy.gov/consumerinfo/factsheets/landscape.html

http://www.ghcc.msfc.nasa.gov/urban/urban_heat_island.html

http://www.sc.edu/sustainableu

Southface Energy Institute
http://www.southface.org

**Where can I get more information?**

Publications links
http://www.ems.org

U.S. Environmental Protection Agency
http://www.energystar.gov/

Information on climate change
http://www.epa.gov/globalwarming

U.S. Department of Energy
http://www.eren.doe.gov
Mary Taylor Haque, RLA, ASLA, is a professor and registered landscape architect who has been teaching in the Department of Horticulture at Clemson University since 1978. Professor Haque serves on numerous committees and is an active member of the American Society of Landscape Architects (ASLA), the American Society of Horticultural Science (ASHS), the National Association of Colleges and Teachers of Agriculture (NACTA), the Associated Landscape Contractors of America (ALCA), and the Council of Educators in Landscape Architecture (CELA). She and her students have received regional and national awards for their work on sustainable landscape design, and she was recognized as the 1993 South Carolina Governor’s Professor of the Year. A strong advocate of the concept of community service and environmental stewardship, Professor Haque and her students have designed energy-efficient landscapes including residential, business, institutional, recreational and urban restoration projects across the state.

Lolly Tai, Ph.D., RLA, FASLA, is Professor and Chair of the Department of Landscape Architecture and Horticulture at Temple University. She taught in the Department of Planning and Landscape Architecture at Clemson University from 1988-2002. Her philosophy is to design with an environmentally sensitive approach. She believes in the importance of responsible stewardship and designing for and not against the land. Her private practice is characterized by projects with a diversity of scope and scale ranging from residential estate, commercial development, resort, community planning, recreational facility, botanical garden and xeriscape designs. Her work has been recognized through design awards, publications, exhibits and presentations at national, regional and local levels. Tai, who received her Ph.D. from Heriot-Watt University/Edinburgh College of Art, MLA from Harvard University and BSLA from Cornell University, has enriched her career with projects where design is essential. She served as President of the South Carolina American Society of Landscape Architects and Chair of the South Carolina Landscape Architecture Advisory Council. She is a Fellow of the American Society of Landscape Architects. A registered landscape architect in Connecticut, New Jersey, New York, North Carolina, Pennsylvania, and South Carolina, she is also a member of the Council of Educators in Landscape Architecture and Environmental Design Research Association.

Donald L. Ham is a professor in the Department of Forest Resources at Clemson University. He has worked in both the commercial and academic areas of arboriculture and urban forestry since completing his graduate degrees at Duke University. He has been with Clemson since 1975 and is responsible for Extension, teaching, and research programs in arboriculture and urban forestry. Dr. Ham is also active nationally and internationally in his field. He is a Visiting Lecturer in Arboriculture at Myerscough College (UK) and has served as a member of the National Urban and Community Forestry Advisory Council to the Secretary of Agriculture, the President of the International Society of Arboriculture (ISA), and Chair and Vice Chair of the ISA Research Trust.