Chapter 21
Best Management Practices (BMPs) for Landscape Water Conservation

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Best Management Practices (BMPs) for water conservation are practices that aid in water conservation and water use efficiency in every step of the landscaping process, from design to installation and management. They include thorough site analysis, careful plant selection according to site criteria, an understanding of plant adaptation, the use of efficient irrigation equipment and practices, and cultural/management practices that improve water-use efficiency. Basically, they focus on those aspects of our traditional landscape practices that result in water conservation and water-use efficiency. BMPs are designed to be economical, practical, and sustainable while maintaining a healthy, functional landscape.

The Southeast, like the rest of the United States, has a growing thirst for water. For example, during a 50 year period, from 1950 to 2000, water use in Georgia increased from 130 million gallons per day (Mgd) to more than 1,250 Mgd (Fanning).

Publicly supplied water is water withdrawn, treated, and distributed by public and private water suppliers for normal household uses, recreational uses, landscape maintenance, and commercial uses, including restaurants, hotels, retail stores, hospitals, prisons and colleges. Seventy-eight percent of the public supply water in Georgia comes from surface water, such as reservoirs and rivers, while 23 percent comes from ground water and aquifers.

The increase in demand for public water is directly related to increasing population. Table 1 shows population and water demand in 2000 and projected population and water demand in 2030 for five counties in northeast Georgia. Similar statistics can be obtained for most counties in and around urban areas throughout the Southeast.

Unlike arid regions of the United States where annual rainfall may be less than 5 inches, most areas of the Southeast receive

Table 1. Population and water demand projections for five northeast Georgia counties.

County	2000 Population (# people)	2030 Projected Population (# people)	% Change	2000 Water Demand (Mgd)	2030 Projected Water Demand (Mgd)	% Change
Barrow	46,144	173,750	+277	5.03	23.68	+371
Clarke	101,489	181,340	+79	13.67	25.26	+85
Jackson	41,589	138,480	+233	3.67	15.88	+333
Oconee	28,225	51,870	+84	2.46	9.56	+289
Walton	60,687	213,880	+252	7.17	27.91	+352
Total	**276,134**	**757,320**	**+174**	**31.00**	**102.29**	**+230**

Source: Northeast Georgia Regional Development Center.

45 to 55 inches of rain annually. However, summer drought is common in most areas of the Southeast, and significant rainfall events may be 30 or more days apart. These periods of limited rainfall increase demand on pubic water supply systems.

The purpose of this chapter is to provide an overview of BMPs for water conservation during the design, installation and management of landscapes. Collectively, they are an integrated approach to landscape water conservation. The BMPs presented are just a sampling of those included in a more detailed publication on the internet, which can be found at: http://pubs.caes.uga.edu/caespubs/pubcd/B1329/B1329.htm

Landscape Design BMPs for Water Conservation

Conserving water should be a goal, not only when establishing new landscapes, but also when retrofitting existing landscapes. When designing a new landscape, many decisions need to be made, including how the landscape will be used, how it should look, how much soil disturbance is necessary, and which plants are appropriate. These decisions will influence water use in a landscape.

A water-conserving landscape design should re-evaluate traditional landscape practices and incorporate sound water management practices. This does not require special skill or knowledge, only a new way of thinking that considers the overall effects of design decisions on water use. The goal is to reduce water use without sacrificing the quality or beauty of the landscape design.

Select plants that match the existing light conditions; they will grow better and require less water.

All plants require a certain amount of sunlight to grow properly and flower. Some require more than others. Full sun plants generally need 6 to 8 hours of full, direct sun. Sun-loving plants grown under shaded conditions tend to have bigger leaves, spindly stems, and fewer flowers. Likewise, plants adapted to full sun in cooler temperature zones often must have a certain amount of shade just to survive in warmer climates. A good example is rhododendron (*Rhododendron catawbiense*), which flourishes in full sun in the northern United States, but requires shade to grow well in the Southeast.

Shade-loving plants grown in full sun often require additional water to prevent wilting or leaf scorching. It's important to match the light conditions of the site to the light requirements of plants. Proper plant selection is the first step toward healthy, water-efficient plants.

Match surface and soil drainage conditions to plant moisture requirements.

Determining how water moves across the soil surface and into the ground is critical to plant selection. For instance, dry areas may benefit from water redirected from sidewalks, gutters, or foundation drains during rain, but using drought tolerant plants in dry areas may be the best solution.

If poor soil drainage is the problem, make corrections prior to planting. Soil drainage is determined by topography, soil texture, and the presence of sub-surface hardpans. If a hardpan below the surface is causing problems, mechanically breaking up the impermeable layer will improve drainage. Removing and replacing the existing soil is sometimes tried, but this often proves unsuccessful because quality topsoil is hard to find, and the interface of the new and existing soil is critical to drainage. For instance, amending a native clay soil with sand in an effort to improve drainage can actually reduce soil drainage unless the sand to soil ratio is greater than 70 to 1 and the soils are thoroughly mixed.

Mounding soil to create raised beds improves soil drainage, but if the drainage problem is caused by topography, a raised bed may not work. Subsurface drainage systems, or other engineered systems may be required to correct drainage problems. These practices can be incorporated into the design by means of a false creek bed or gravel walk, but they can add considerable expense to a landscape project. It is easier and cheaper to select plants adapted to specific drainage situations than to remedy serious drainage problems.

Select plants adapted to the temperature range of the area.

Cold and heat tolerance directly affect a plant's water requirement and water use. For example, a plant listed for hardiness zone 6 will survive in zone 8, but it will require more water and possibly more shade to survive. In a large parking lot, radiant heat from pavement causes temperatures to soar well above the average air temperature of the area. As a result, the rate of water loss from the leaf surfaces increases, and plants require more water than normal. Although most ornamental plants will tolerate high air temperatures, root growth is often stunted when soil temperatures rise above 85^{0}F. Stunted root growth translates into poor plant development and sensitivity to drought conditions.

Select regionally adapted plants

Every region of the country is known for growing certain plants. Some plants are native to the area, others are not. Some plants are salt tolerant. Others grow well in heavy clay soils. Plants well suited to the regional conditions of the site grow better and are more water efficient.

It's a common misconception that native plants are more drought tolerant than exotic species. In fact, some government agencies and municipalities have gone so far as to mandate the exclusive use of native plants on public lands. However, certain native plants, like Virginia Sweetspire, Inkberry, and Florida Anise, are native to moist sites, yet they are not drought tolerant. While there are many philosophical arguments for and against the use of native plants, from a water conservation point of view, a plant's origin is a poor indicator of its water use efficiency. Selecting the best plant for the specific site conditions, regardless of its origin, provides the best outcome.

Selecting regionally adapted turfgrasses is important in planning, planting, and maintaining a lawn for water conservation. A properly selected grass species or cultivar is more likely to thrive and require fewer inputs (e.g. water, fertilizer, pesticides, etc.).

Using grasses that have been genetically bred for an intended purpose or geographic region further enhances the turfgrass plant's ability to survive specific stresses. Through years of research, several turfgrass cultivars have been developed by The University of Georgia to suit Georgia's climate and conditions (e.g. 'TifSport' bermudagrass www.TifSport.com, and 'TifBlair' centipedegrass, www.TifBlair.com).

See the chapter on Turfgrass Selection, Establishment and Management for additional information on turfgrass selection. You may also visit www.georgiaturf.com .

Table 2. Hardiness and drought resistance level of cool-season turfgrasses relative to Georgia.

	Fine Fescue	Kentucky Bluegrass	Tall Fescue
Region Best Adapted:	Mountains & Piedmont	Mountains	Mountains & Piedmont
Heat hardiness	P - F	P – F	G
Cold hardiness	VG	VG	VG
Drought resistance	G	F – G	G

Key: E = Excellent, VG = Very Good, G = Good, F = Fair, P = Poor, VP = Very Poor

Table 3. Hardiness and drought resistance level of warm-season turfgrasses relative to Georgia.

	Bahiagrass	Bermuda-grass (common)	Bermuda-grass (hybrid)	Carpet-grass	Centipede-grass	Seashore Paspalum	St. Augustine-grass	Zoysia-grass
Region Best Adapted:	Statewide, excluding mountains	Statewide	Statewide	Coastal Plain	Statewide	Coastal Plain	Coastal Plain	Statewide
Heat hardiness	VG	E	E	E	G	E	E	E
Cold hardiness	F	P	F	VP	F	P	P	VG
Drought resistance	E	E	E	P	G	E	G	G

Key: E = Excellent, VG = Very Good, G = Good, F = Fair, P = Poor, VP = Very Poor.

Preserve established vegetation growing on a site; it has a well-established root system and requires less irrigation than newly planted trees and shrubs.

Whenever possible, preserve native vegetation and avoid disturbing it. Typically, existing plants have well-established root systems that have adapted to the moisture extremes of the site. Mature trees also provide immediate shade that would take newly planted trees years to provide. It is important to identify valuable plants prior to site work and to install protective barriers to preserve the native vegetation, which can later be incorporated into the new landscape design.

Space plants according to their mature size to reduce competition for water.

Densely planted shrubs not only are unattractive and require more maintenance; they also compete for available moisture. Additionally, their dense canopies reduce air circulation and foliar drying time after rain or irrigation, so insect and disease problems are more common.

Knowing a plant's mature size before it is planted, then providing it enough space to grow and achieve its full potential without competing with its neighbor for space, water, and nutrients, is an important step in designing a water-efficient landscape.

Concentrate annual flowers in small, high impact areas to reduce their water requirements.

Concentrating annual flowers in small, highly visible areas saves water, time, and money. An alternative to large in-ground flower beds is to use large containers placed in high impact locations. By using containers large enough for adequate root growth and by carefully selecting plants for container conditions, high-impact color can be provided with less water than ground beds.

Consider using herbaceous perennials or shrubs with colorful foliage instead of annual flowers. Herbaceous perennials and shrubs tend to have more extensive root systems than annuals, are less costly to maintain, and are more water efficient than shallow-rooted annuals.

Avoid designing raised beds under trees because it suffocates tree roots and results in root competition for moisture and nutrients.

A common remedy to not being able to grow turfgrass under trees is to create raised beds under the trees and to plant ground covers or colorful flowers in them. This practice is harmful to trees because it restricts the amount of oxygen and nutrients reaching the roots. Furthermore, the newly planted plants will eventually become stressed as the tree roots grow into the raised bed and compete with them for water and nutrients.

Develop a landscape plan BEFORE designing an irrigation system.

Irrigation systems work more efficiently and use less water when they are designed along with the planting plan or soon after the planting plan is developed. In the rush to complete a new home or commercial building, irrigation systems are often installed prior to developing a landscape plan. This is particularly true in subdivisions that have covenants requiring the installation of a certain amount of turfgrass, ornamental plants, and an irrigation system. The irrigation system should fit the landscape plan instead of dictating the landscape design.

Incorporate shade trees and turfgrass into the landscape to reduce run-off and evaporative water loss.

Shade trees and turfgrass offer many benefits for water conservation. They reduce stormwater runoff, stabilize the soil, reduce evaporative water loss from the soil surface, and reduce the need for summer air conditioning. On a hot summer day, a shaded landscape can be as much as 30 degrees cooler than a landscape in full sun.

Place shade trees on the south and west sides of a building to block sunlight, but at least 20-30 feet away from the building. Planting trees some distance from the building will help avoid future damage from falling limbs or limbs brushing against the building.

Consider grouping several shade trees together to create shaded beds. It may take several years to turn a sunny area into a shaded one, so it would be best to wait until the trees have grown enough to provide shade before planting underneath them.

Group plants according to their water needs and drought tolerance.

Grouping plants with similar water

requirements in the landscape allows more precise irrigation design and water management. All plants require a certain amount of water to grow to maturity. Some plants, such as yucca, can tolerate periods of limited rain-fall. Others, like viburnum, rhododendron, and impatiens require a steady supply of either rain or irrigation to survive dry periods. Other plants, such as bald cypress and Virginia sweetspire can tolerate standing water for extended periods. Look for alternatives when moisture-requiring plants are specified for non-irrigated areas. Understanding the individual needs and tolerances of plants will help in selecting and grouping plants in the landscape.

Divide the landscape into water-use zones.

Divide the landscape into three water-use zones: high, moderate, and low. High water-use zones are highly visible areas of the landscape, such as the entrance to the property or building. In these zones, plants are irrigated as needed to promote optimum growth and to improve their aesthetic appearance.

Moderate water-use zones are transition zones, bridging the high and low water-use zones. In these areas, established plants are watered only when they show signs of moisture stress. Plants that require some irrigation during periods of limited rainfall, such as dogwoods (Cornus florida), azaleas (Rhododendron sp.), hydrangeas (Hydrangea macrophylla), and several turfgrass species could be planted in moderate water-use zones.

Low water-use zones are low impact areas or background areas viewed from a distance. Beds of mulch or drought tolerant plants would be used in low water-use zones because they are not irrigated once established. Some turfgrass species can also be planted in low water-use zones.

Ideally, not over 10% of the landscape should be zoned for high water use, not over 30% for moderate water use, and 60% or more for low water use.

When designing irrigation systems, use appropriate applicators for the type of plants and the area to be irrigated within each zone.

Many kinds of irrigation applicators can be used in landscapes. Irrigation zones may be differentiated in the design process because different applicators or different management is needed from one area to the next.

The two main categories of irrigation applicators are sprinkling type applicators and micro-irrigation applicators. Sprinkling applicators spread water in a broadcast manner over the whole area to be irrigated, mimicking rainfall.

Micro-irrigation applicators include drip emitters, inline emitters in rigid lateral pipe, drip tape, micro-sprinklers, and micro-sprays. Drip emitters installed in rigid lateral pipe drip water over the root zones of individual plants. Drip tape is more flexible than rigid pipe and has emitters or perforations evenly spaced along the tape. Micro-sprays and micro-sprinklers have similar low volume application rates, but the low volume of water is spread out over a larger area than with drip emitters. Micro-sprinklers are similar to micro-sprays except they have moving parts and water streams.

Sprinkler irrigation is most often used on turfgrass areas, while micro-irrigation applicators are used on trees, shrubs and flower beds.

Keeping different kinds of applicators separated into different irrigation zones allows each zone to be operated efficiently.

Include a rain shutoff sensor on automated sprinkler systems to prevent them from operating during rainfall.

Any automated irrigation control system should have a rain shutoff sensor to stop irrigation when there is significant rainfall at the site.

Rain shutoff sensors are relatively inexpensive and can be easily installed in current automated irrigation systems and new irrigation system designs. Most can be adjusted for a certain amount of rainfall before the irrigation system is shut down.

Landscape Installation BMPs for Water Conservation

Fall and winter planting of woody ornamentals and herbaceous perennials results in less demand on the roots for water and nutrients, so energy can be directed to root growth and establishment.

Fall and winter are the most water-efficient times to plant most woody plants and herbaceous perennials. Air temperatures are lower and the above-ground portions of plants are not actively growing, so the demand for water is lower. Additionally, soil temperatures in the Southeastern U.S. are often warm enough during winter months for root growth to continue. Even though plant water demands are less during this time of year, it is important to maintain adequate soil moisture to establish a well-developed root system.

Minimize soil disturbance and root injury of existing plants during installation.

When planting around existing trees and shrubs, minimize soil disturbance because it can injure plant roots, cause plant stress and reduce water uptake. Digging, cultivating, and adding new soil to the site are all types of soil disturbance that can stress plants and reduce their ability to absorb water.

Amendments improve water retention, soil aeration, water and air movement, and enhance the microbial content of the soil.

Most soils are low in organic matter and will benefit from the incorporation of an organic amendment, such as compost, at planting time. Organic amendments improve the water retention, oxygen infiltration, and nutrient-holding capacity of a soil. They also provide a good environment for beneficial fungi and bacteria, earthworms, and other living organisms that improve nutrient availability and aeration of the soil.

There are two broad types of soil amendments: organic and inorganic. Organic amendments come from something that is or was alive. Inorganic amendments are either mined or man-made. Examples of organic amendments are compost, peat moss, manure, and biosolids. Examples of inorganic amendments are vermiculite, perlite, pea gravel, shale, and sand. They are typically used to improve soil drainage and have little nutritional value. Vermiculite also is used on sandy soils to help them hold nutrients.

To realize a benefit from organic matter, apply at least 4 inches on the soil surface and thoroughly incorporate it into the native soil to a depth of 12 inches.

Apply 3 to 5 inches of mulch on the soil surface after planting to prevent evaporative water loss from the soil.

Mulches have many benefits in the landscape. They hold moisture in the soil, prevent weeds, inhibit certain soil-borne foliar diseases, insulate the roots of plants from temperature extremes, and provide a protective barrier around the plant to decrease damage from lawn mowers or string trimmers. They also provide a pleasing background and contrast for the green foliage.

Common organic mulches used in the Southeast include pine straw, pine bark nuggets, hardwood chips, and cypress shavings. Fall leaves are also good as mulch, provided they are shredded prior to use. Shredded leaves stay seated better on the landscape and do not blow around like whole leaves.

Inorganic mulches, such as rock, gravel, or marble, are good soil insulators, but they are not good choices for southeastern landscapes because they absorb and re-radiate heat. Rising temperature encourages water loss from the foliage and increases plant stress on a hot, sunny day during the summer.

Apply mulches 3 to 5 inches deep. When mulching trees, remember that the root system of a mature tree may spread two to three times the canopy width, so mulch as large an area as possible.

Landscape Management BMPs for Water Conservation

Target irrigation to plants showing moisture stress.

The best indicator of water need is the plant itself. Wilting, or a pale grayish-green color, are the most common symptoms of moisture stress. Other moisture stress symptoms include marginal leaf scorching, leaf curl, and leaf drop. Targeting irrigation only to those plants that need it not only saves water but also results in a more water-efficient landscape.

Irrigating at night or early morning will minimize evaporative loss of water.

Significant amounts of water can be lost to evaporation when irrigation is applied during a hot, sunny day. Irrigating during mid-day can result in evaporative water loss and inefficient use of water. Irrigating between 9 P.M. – 9 A.M. helps minimize evaporative water loss from the soil and plant surfaces.

Deep watering encourages strong, healthy, water-efficient root systems.

When irrigating, apply enough water to wet the soil to a depth of 8 to 10 inches. This will promote deep root growth.

Frequent, light irrigations encourage

shallow rooting. As a result, the plants are more likely to show moisture stress during periods of limited rainfall.

Apply water at a rate the soil can absorb to avoid run-off and water loss

Some soils, like hard, compacted clays tend to repel water and must be watered slowly to avoid run-off, erosion and water loss. Apply water at a rate that can be absorbed by the soil, so run-off from the targeted site is avoided. In some cases, cyclic or pulse irrigation can be used to lower the precipitation rate to better match the infiltration rate of the site.

Slow-release fertilizers encourage a uniform growth rate and avoid water-demanding growth spurts.

Slow-release type fertilizers, such as micro-encapsulated granules, that release nutrients through their pores, or fertilizers containing slow-release forms of nitrogen, such as IBDU or sulfur-coated urea, release nutrients slowly. As a result, growth rate of plants is uniform, spurts of succulent new growth are avoided, and the plant becomes more water-efficient.

Reduce the duration and frequency of irrigation of plants in shaded areas.

Water usage of plants is substantially reduced in shaded environments. If the irrigation system covers areas partially shaded and partially in sun, consider removing the irrigation heads from the shaded areas and irrigating by hand when rainfall is inadequate.

Avoid fertilizing during periods of limited rainfall.

During periods of drought, reduce the amount of fertilizer applied and the frequency of application, particularly in non-irrigated areas. Most common forms of fertilizer are chemically salts and can dehydrate roots and enhance drought stress when little moisture is available to dissolve them into the soil solution.

Proper Mowing Height Improves Drought Tolerance of Turfgrasses

Proper mowing has a tremendous effect on the appearance and water use of a lawn. Good mowing practices enhance turfgrass density, texture, color, root development, and drought and wear tolerance. Height of cut, frequency of cut, and type of mower used are all important factors to consider when mowing.

As a general rule, mow turfgrass often enough so no more than one-third of the leaf blade is removed at any one mowing. For example, if a tall fescue lawn is mowed at a height of 3.0 inches, it should be mowed when it grows to a height of 4.0 to 4.5 inches. If the grass becomes too tall between mowings, raise the cutting height, then gradually lower it until the recommended height is reached.

In shaded areas, increasing the mowing height of turfgrasses provides more leaf area to intercept light for photosynthesis. Higher mowing heights also promote deeper rooting, which is one of the key mechanisms of stress tolerance for turfgrasses.

See the chapter on Turfgrass Selection, Establishment and Management for recommended mowing heights of turfgrases.

Vertical mowing, coring and topdressing of turfgrasses reduces compaction, improves water infiltration and promotes

healthy growth and a more water-efficient plant.

Vertical mowing, coring, and topdressing of turfgrasses reduce surface compaction and thatch accumulation, improve soil aeration and water infiltration, and promote root growth, which makes the plant more water efficient.

Vertical mowing or dethatching helps keep turfgrasses healthy by removing the dead vegetation from the thatch layer. This dead material is lifted to the surface by the blades of the vertical mower. Vertical mowing is best done when the grass is actively growing and soil temperatures are consistently above 65 degrees F.

Coring relieves soil compaction and increases air and water movement into the soil. This practice is beneficial for all soils, especially those with high clay content.

Study Questions

1. What are BMPs for water conservation?

2. How do light levels influence water conservation?

3. Are native plants more water-efficient and more drought tolerant than exotic species?

4. How does plant spacing influence water use by landscapes?

5. What are the three water-use zones in a water-wise landscape?
Give some examples of plants suited for each zone.

6. How does soil disturbance influence water use?

7. How are mulches beneficial to water conservation?

8. What are some plant symptoms of moisture stress?

9. What are some landscape management practices for water conservation in shaded landscapes?

10. What are some additional ways you save

water on the properties you manage?

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