Water Conservation Best Management Practices for Sports Facilities

The demand for potable water for agricultural, residential, and industrial use is expected to increase in the future while our supply of naturally occurring water will remain essentially unchanged and some rivers and lakes will continue to decrease in size.

When rainfall is insufficient and water resources become limited, supplemental irrigation required to sustain plantings, such as turfgrass and other landscaping plants, is often the first to be placed on water use restrictions. When managing turfgrass and other landscaped areas, reduce water use to the lowest possible level to conserve and protect our most precious natural resource. Water conservation should be implemented for both economic and judicious reasons. Always comply with local and state water use regulations and restrictions.

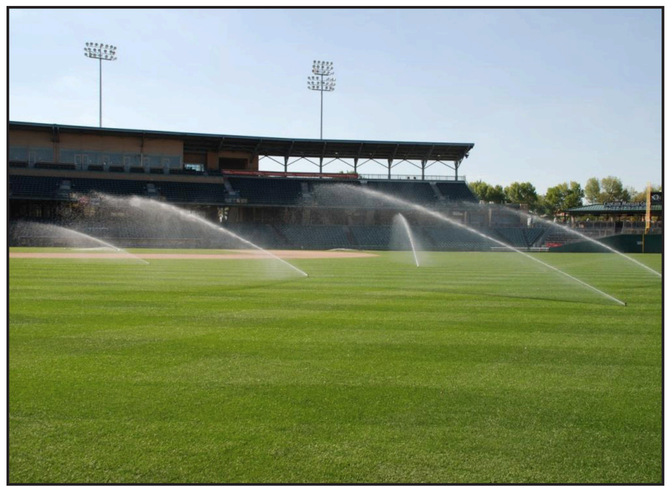

Photo courtesy of Cale Bigelow, Ph.D., Gregg Munshaw, Ph.D.

The following provides various best management practices (BMPs) regarding water conservation that can be easily applied at sports and recreation facilities. Applying water responsibly can conserve resources and save money while still maintaining a healthy, safe turfgrass surface and aesthetically pleasing landscape.

Selecting Turfgrasses to Reduce Water Use

Turfgrass species vary in terms of appearance, appropriate uses, cultural requirements, pest resistance, and stress tolerance. Individual cultivars or varieties within species provide additional options for effectively matching grasses with growing conditions and desired performance. By knowing the strengths and weaknesses of potential species and cultivars, you can select grasses adapted to your site and management program. Turfgrass planted in its' appropriate environment ultimately conserves water.

Best Management Practices When Selecting Turfgrasses:

Consider the following when choosing a turfgrass species for your site:

- **Desired performance and characteristics of the turfgrass** – Select turfgrass species that exhibit the growth necessary for your site. Choosing a turfgrass species that is well adapted to the site and the associated environmental conditions will help conserve water. Visit the National Turfgrass Evaluation Program's (NTEP) website. NTEP provides extensive, reliable information about the performance and quality of turfgrass species and cultivars in specific regions of the country. NTEP information is free and can be accessed at www.ntep.org. Information is also available through the Turfgrass Water Conservation Alliance (http://www.tgwca.org/index.php). This site provides information for various turfgrass varieties exhibiting higher drought tolerance with water conservation as a goal.
- **Intended level of cultural intensity** – Select the turfgrass species for your area based on required management inputs, habit, recuperative potential, leaf texture, shoot density, establishment rate, appropriate mowing height, etc. Turfgrasses used for sports fields typically require higher levels of management inputs, such as irrigation and fertilization, to perform adequately. In lower maintenance areas, such as roadsides or industrial complexes, select turfgrass species that are adapted to reduced inputs. Proper selection will reduce water application to unnecessary areas.
- **Irrigation requirements** – Select turfgrass species or cultivars that exhibit drought resistance and/or demonstrate water use efficiency. Many turfgrass varieties have been developed to perform well with reduced water input. Using grasses with low water requirements or superior drought resistance can postpone turfgrass stress and decline in quality during extended periods of little to no water.

Figure 1:

Relative ranking of evapotranspiration rates for the most commonly used cultivars of the major cool- and warm-season turfgrasses.*

		Turfgrass	
Relative Ranking	**ET Rate (mm/day)**	**Cool-season**	**Warm-season**
Very low	< 6		Buffalograss
Low	6 – 7		Bermudagrass hybrids Centipedegrass Bermudagrass Zoysiagrass Blue Gramma
Medium	7 – 8.5	Hard fescue Chewings fescue Red fescue	Bahiagrass Seashore paspalum St. Augustinegrass Zoysiagrass, Emerald
High	8.5 – 10	Perennial ryegrass	
Very high	> 10	Tall fescue Creeping bentgrass Annual bluegrass Kentucky bluegrass Italian ryegrass	

*Grown in their respective climatic regions of adaptation and optimum culture regime. Cultural or environmental factors that cause a drastic change in leaf area or shoot density of a given species may result in a significant shift in its relative ranking compared to the other species.

Beard, J. and Kim K. 1989. Low water-use turfgrasses. USGA Green Section Record. 27(1):12-13.

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Cultural Practices to Increase Water Efficiency

Maintenance practices should be carried out with responsible water use as a priority. Smart cultural practices minimize supplemental irrigation to the lowest level while still maintaining acceptable turfgrass function and quality.

Best Management Practices For Annual Maintenance:

Consider the following when managing your site:

- **Mowing Height** – Raise the mowing height, especially in the summer. Longer grass promotes deeper root growth and increases drought resistance because roots can access more soil water. Keep in mind that a high height of cut increases leaf area which increases evapotranspiration losses during hot, dry weather. Irrigated turfgrasses may be able to withstand lower height of cut in summer than non-irrigated turfgrasses.
- **Soil and tissue testing** – Soil and tissue testing will analyze the current health of soils and plants. Soil test results provide the best guide to fertilization amounts and frequency to maintain or achieve a healthy field. Turfgrass and landscaped areas that are in optimum health will better withstand reduced water inputs. Soil tests should be conducted on a routine basis – every one to three years is recommended. Contact local Cooperative Extension or your state university for a soil/tissue test kit or soil/tissue testing services.
- **Nitrogen fertility** – Minimize fertilizer use where possible. Nitrogen encourages new growth which increases leaf area and can temporarily reduce rooting depth. Additional water is needed to sustain new growth because shallower roots result in reduced access to water deep in the rootzone. If nitrogen fertilization is necessary, use products that have slow release ingredients or keep water soluble nitrogen to the lowest possible level while still sustaining turfgrass function.
- **Grasscycling** – Leave grass clippings on the turfgrass surface after mowing. The clippings quickly decompose and release nutrients back into the soil, which reduces the need for supplemental nitrogen.
- **Aeration** – Aeration is critical for improving water, air, and nutrient movement within a turfgrass rootzone. Aeration relieves soil compaction. Compaction can inhibit root growth and restrict access to plant-available water deep in the rootzone. Compaction also inhibits water infiltration, promotes water runoff, reduces irrigation efficiency, and increases environmental impact. Aeration is also effective for managing thatch. When thatch accumulates to levels over 1/3-1/2 inches, roots may be restricted to the poor water holding environment of the thatch. Thatch can also promote runoff, which reduces irrigation efficiency and increases environmental impact. Frequent aeration practices are effective at reducing water runoff, promoting water infiltration, and encouraging deep percolation within the rootzone to produce a healthier and deeper turfgrass root system. Athletic surfaces should be aerated on a frequent basis, with some areas receiving aeration up to twice per month during the playing season.

Core aeration – Photo courtesy of Mike Goatley, Jr., Ph.D.

- **Herbicide applications** – Plant root growth should be encouraged in an effort to reduce water use. Preemergence herbicides can reduce root activity; therefore, apply herbicides only as needed. Use split applications or spot treat for weeds when possible. Avoid blanket applications of herbicides when air temperatures exceed 85 degrees Fahrenheit.
- **Wetting agents** – Apply a wetting agent to assist water infiltration on a turfgrass stand that is hydrophobic and repelling water.

- **Soil Amendments and Conditioners** – Soil amendments and conditioners, such as calcined clay and calcined diotomatious earth, have been shown to hold water in the turfgrass rootzone and reduce the need for irrigation. In addition, when used as topdressing, soil amendments and conditioners may improve footing as well as field safety and conditions by reducing standing water that may contribute to muddy, wet areas.

Irrigation Practices to Improve Water Efficiency

Irrigation is supplemental water that must be added to make up the difference between plant water requirements and the natural precipitation in your area. Smart watering practices can maintain healthy turfgrass and landscaped areas while conserving water and reducing runoff and environmental impacts.

Best Management Practices When Irrigating Plants:

Consider the following when applying water to turfgrass areas:

- **Water availability** – Consider a number of water resources including existing surface water from ponds and lakes, stormwater detention ponds, wells, reclaimed water sources, and effluent sources. When available, use effluent or other non-potable water for irrigation. Be sure to choose a water source that is reliable and offers sufficient resources to accommodate turfgrass needs.
- **Water quality** – Water quality must be suitable for plant growth and pose no threat to public health. Due to constantly changing environments, a water quality analysis should be performed regularly to check for potential problems due to changes in pH, salinity, heavy metals, bicarbonates, micronutrients, and suspended solids. Water department or board of health results can often be accessed for this information.
- **Deep and infrequent irrigation** – Deep and infrequent delivery of water promotes deep rooting, gas exchange in the rootzone, and soil temperature moderation. Applying too much water frequently can result in shallow root systems, reduced drought resistance, weeds, diseases, and storm water runoff. When determining the amount of water to apply, consider soil type, turfgrass species, effective rootzone depth, and estimated evapotranspiration demand. Water should be applied to fully recharge the plants' available soil moisture pool and ensure soil is wet to the maximum rooting depth. The site should not be irrigated again until surface moisture has been depleted to near the wilting point. Allowing for mild drought stress between irrigation events promotes deeper rooting and drought resistance.
- **Evapotranspiration** – Evapotranspiration (ET) is the sum total of water lost to the atmosphere due to evaporation from the soil surface plus transpirational water loss associated with turfgrass leaf surfaces. ET increases with increasing solar radiation, high temperatures, wind, and decreasing relative humidity. ET requirements vary based on location, turfgrass species, maintenance conditions, and time of year. See Figure 1. For example, Kentucky bluegrass will lose more than 0.4 inches of water per day due to evapotranspiration during July and August. In comparison, warm season grasses typically lose 0.2 inches of water per day during the summer. Plant-water requirements are based on local potential evapotranspiration, which is the environmental demand for ET of a short green crop, completely shading the ground, of a uniform height,

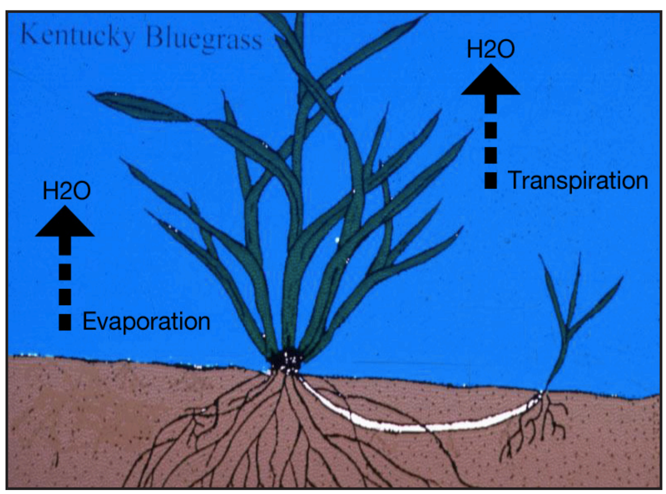

Photo provided by Jack Fry, Ph.D.

and with adequate water in the soil. By monitoring ET, water application can be adjusted based on water loss and plant requirements. Additional water conservation will be realized if irrigation practices can return less than 100 percent of ET and still maintain sufficient turfgrass quality.

- **Timing** – The best time to water is between 4:00 – 9:00 am because there is reduced water lost to evaporation due to lower temperatures, less sunlight, and lower wind velocity. Lower wind velocities in the morning also provide better distribution patterns. Water application should be avoided midday because water lost to evaporation is at its greatest potential. Irrigation should also be avoided in the evening/night because leaf wetness is prolonged and can create a favorable environment for fungal diseases.
- **Weather conditions** – Adjust the irrigation program according to weather conditions. During high temperatures and humidity in the summer, rooting depth may decrease and soil temperatures may increase creating the need for more frequent irrigation. During rainy seasons, adjust the system to apply less water.
- **Drought** – Plants enter dormancy if they do not receive sufficient water. If dormancy is the desired goal, manage for drought dormancy where the management program and user expectations allow by limiting mowing, restricting foot and vehicular traffic, monitoring and managing pest infestations, and discontinuing fertilizer applications. Growth will resume with the onset of cooler weather and moisture.
- **Handwatering and syringing** – Incorporate handwatering and syringing into the irrigation program to reduce water waste. Most irrigation systems are designed to apply a uniform depth of water and a turf system rarely dries uniformly. Handwatering saves water by spot treating dry areas during high temperatures. Syringing effectively cools turfgrass leaf surfaces and gets plants through the hottest part of the day. Syringing conserves water by only applying a very light application of water instead of turning the irrigation system on for an extended period of time and losing water via evaporation.

Handwatering – Photo provided by Andrew McNitt, Ph.D.

Conserving Water with Use of an Irrigation System

The purpose of an irrigation system is to apply supplemental water when rainfall is not sufficient to maintain the turfgrass and landscape for its intended purpose. Irrigation systems should be designed to be efficient, distribute water uniformly, conserve and protect water resources and the environment, and meet state and local code and site requirements. Design, install, and maintain an irrigation system in a manner that allows for efficient application of water.

Best Management Practices For Irrigation Systems:

Consider the following in regards to irrigation systems:

- **Design** – Specific criteria should be considered before and during the design of an irrigation system to maximize water and irrigation system efficiency. This includes:
  - **Hiring a professional** – Use an IA certified design professional (CID) for all irrigation system designs.
  - **Soil type** – Determine if your soil is predominantly sand, silt, or clay. Sandy soil does not have good water holding capacity compared to finer textured soils such as silt and clay. The infiltration rate of sandy soils can be anywhere from 2-20 inches per hour. A rootzone with a high percentage of sand will require

more frequent irrigation. In contrast, soils with a high percentage of organic matter and/or clay will have infiltration rates from 0.25-1 inch per hour and will retain water for longer periods of time compared to sandy soils. Design your irrigation system based on the uniformity, infiltration rate, and percolation rate of your rootzone.

– **Rooting depth** – Ensure the soil that constitutes the turfgrass rootzone is at the appropriate depth. Soil type and effective rootzone depth together are used to estimate the soil water holding reservoir available to the plant root system. Uniform soil at a depth of four or more inches will provide the best soil water holding reservoir for plant roots and increase the efficiency of your irrigation system.
– **Slope and topography** – Evaluate the topography of the area being irrigated. Sites with steep banks will need to be irrigated differently than athletic playing surfaces.
– **Plant materials** – Consider the plants in each irrigation zone and plan the irrigation method accordingly. For example, landscaped areas may be watered more effectively using drip irrigation. An athletic surface may function better with the use of installed sprinkler heads.
– **Environmental characteristics** – Local climate, microclimates at different areas of the facility, and weather data patterns should all be considered during the design of an irrigation system. In addition, exposure to elements such as wind, sun, and shade should be considered.
– **Water source information** – During irrigation system design, consider the water source. Evaluate water quality, quantity, and pressure to determine if the source can accommodate site needs.
– **Design elements** – Determine what needs to be included or considered in the design of the irrigation system. For example, consider design features and concepts such as fertigation as well as planned or existing drain systems.
– **Application uniformity** – Design the irrigation system to maximize water application efficiency. This includes spacing sprinkler heads so there is head-to-head coverage and ensuring matching precipitation rates between sprinklers.

Results of poor head-to-head coverage – Photo courtesy of Jeff Gilbert

- **Installation** – Install the irrigation system to meet design criteria. To conserve and protect water resources, the irrigation system designer should select appropriate equipment components that meet state and local code requirements and site requirements. Installation should result in an efficient and uniform distribution of water.
- **Maintenance** – The irrigation system should be regularly maintained to sustain efficient operation and ensure water is not wasted. Inspect irrigation systems monthly and be aware of the following to help maximize water efficiency and application:
  – **Damaged sprinkler heads** – Check for broken or missing sprinkler heads. Identify any sprinklers that may have been damaged as a result of turf maintenance or other causes. When replacing sprinkler heads, make sure the models and nozzles match existing sprinkler heads to assure uniformity throughout the system. Different brands of sprinkler heads and sometimes different models within a manufacturer's line can vary hydraulically. Differences in sprinkler heads can affect system performance and overall water usage.
  – **Clogged nozzles** – Depending on available water quality and filtration methods, debris may clog nozzles. Clogged nozzles should be cleared or replaced.
  – **Leaks** – Examine where sprinkler heads connect to pipes or hoses. If water is pooling, or there are large wet areas, there could be a leak in the system. A leak as small as the tip of a ball point pen (1/32nd of an inch) can waste about 6300 gallons of water per month.

– **Direction** – Make sure sprinklers are facing the appropriate direction and hitting the target areas. Water is wasted by poorly designed and neglected sprinkler systems that spray sidewalks, driveways, the street, and other impervious surfaces. Redirect sprinklers to apply water only to the landscape.

Make sure sprinklers are adjusted to hit landscaped areas – Photo courtesy of Bernd Leinauer, Ph.D.

– **Arc alignment** – Make sure sprinklers have proper arc alignment. Sprinklers may have had their arc altered as a result of tampering, damage from maintenance equipment, or sprinkler mechanism failure.

– **Level** – All sprinklers should be level to the finished grade with the body of the sprinkler and splice completely buried. Adjustments are necessary if the sprinklers are tilted, below the finished grade, or higher than the finished grade. Settling of soil may also impact sprinklers in relation to the finished grade. Sprinklers that are not level unintentionally alter the original performance of the trajectory arc, impacting efficiency and potentially damaging turf.

– **Pressure** – Pressure tests should be conducted at normal operating conditions at the sprinkler using the appropriate pressure testing device. Sprinkler heads are designed to operate within specific operating pressures. A pitot tube can be used to measure the sprinkler's operating pressure as the water exits the sprinkler. The operating pressure can be compared to the operating pressure recommended by the manufacturer. When purchasing valve-in-head sprinklers and remote valves, consider if they have pressure regulator valves or valves that can be retrofitted to pressure regulation. Providing pressure regulation at each valve-in-head sprinkler and each remote control valve may be desirable. However, pressure regulation can rob up to 10 pounds of pressure from the dynamic operating pressure; therefore, on lower pressure systems, it can adversely affect sprinkler performance.

Pressure test – Photo courtesy of Jeff Gilbert

– **Uniformity** – Ensure that all sprinklers within a zone are distributing water head-to-head. All sprinklers within a zone should also have matched precipitation rates.

– **Sprinkler type** – Use the proper sprinkler for the proper application. Sprinklers, drip irrigation, and spray or bubbler emitters are options for reducing waste while delivering appropriate amounts of water to plants. Avoid sprinklers that throw water high in the air or release fine mist. The most efficient systems release large droplets close to the ground.

– **Valves** – Develop a routine checklist of frequently and infrequently used valves and inspect each one to determine if any are unintentionally closed. Closed valves impact the overall design flow characteristics of the irrigation system, likely impacting sprinkler base pressures and altering or eliminating portions of the piping network, thereby increasing velocities throughout the remainder of the system.

- **Audits** – Conduct monthly area audits and an annual audit on the entire system to evaluate sprinkler performance. It is recommended that a Turf Irrigation Audit be performed by a Certified Auditor (CLIA).

Audits can provide information to managers unfamiliar with their irrigation system, assess application rates and external factors such as supply pressures, and provide direction on improving/fixing the system and conserving water resources. If an audit is not done correctly, the information is suspect and can lead to unwarranted extra work with no improvement in system performance.

- **Scheduling** – The irrigation schedule should be managed to maintain a healthy and functional landscape with the minimum required amount of water. Manage the irrigation system to respond to the changing requirement for water in the landscape. Schedule each individual zone in the irrigation system to account for the type of sprinkler, sun or shade exposure, and type of plants and soil in the specific area. Consider applying water using multiple cycling so irrigation amounts are applied using short, repeated cycles. Multiple cycling increases water infiltration, prevents runoff and erosion, and reduces waste.

Irrigation Audit – Photo courtesy of Jeff Gilbert

Best Management Practices For Irrigation Technology:

Consider the following technological advancements to improve irrigation efficiency:

- **Evapotranspiration (ET) controllers** – ET controllers can operate based on signals, historical data, or on-site weather measurement. Signal based controls operate on local meteorological data. The ET controller adjusts the irrigation run times or watering days according to climate throughout the year. Historical data uses a pre-programmed crop water use curve. The curve may be modified by a sensor such as temperature or solar radiation sensor that measures on-site weather conditions. On-site weather measurement uses measured weather data at the controller to calculate ET continuously and adjust irrigation times according to weather conditions. Fitting irrigation systems with ET controllers can save an additional 20% of water.
- **"Smart" controllers** – The Environmental Protection Agency (EPA) has labeled irrigation controllers to indicate it as a type of "smart" irrigation control technology. These controllers conform to seasonal weather conditions by using local weather data to determine whether sprinkler systems need to turn on. They help save water, time, and money when compared to use of a conventional controller.
- **Rain water collection** – Rain barrels and cisterns can be used to harvest rain water for irrigation and other outdoor water uses such as ornamental beds.
- **Soil moisture sensors** – Soil sensor technologies can monitor soil moisture, salinity levels, and soil temperature levels in real time. The sensors connect to irrigation controllers and apply water when the soil becomes too dry or prevent irrigation cycles if the soil is

Drip irrigation system – Photo courtesy of Bernd Leinauer, Ph.D.

too wet. Soil moisture sensors allow for microclimate-specific water applications and can provide excellent water resource conservation.

- **Micro- or drip irrigation systems** – Micro- or drip irrigation systems are effective for trees, shrubs, turfgrass, and other landscaped areas. These systems are generally more efficient than conventional sprinklers because they deliver low volumes of water directly to plant roots, minimizing water lost to wind, runoff, evaporation, or overspray. Micro-irrigation systems have been shown to use 20-50% less water than conventional pop-up sprinkler systems. Drip systems use about 70% less water.
- **Weather stations** – Onsite weather stations collect data that can be used to determine actual site ET rates. The data is logged and interfaced with irrigation central control software to aid in determining water applications.
- **Rain sensors** – Rainfall shutoff devices can help decrease water wasted in the landscape by turning off the irrigation system when it is raining. Systems that include rain sensing override devices eliminate unnecessary irrigation.

Drip irrigation system – Photo courtesy of Bernd Leinauer, Ph.D.

Landscaping to Increase Water Efficiency

Traditional landscapes require supplemental water to thrive in most locations. If designing a new landscape or renovating an existing area, consider designing a landscape that requires minimal supplemental water. Xeriscaping is a method of landscaping that promotes water conservation. Water efficient landscapes use native and other climate-appropriate materials that can better withstand drought, reduce drought loss or damage, and require less time and money to maintain.

Best Management Practices For Landscaped Areas:

Consider the following for landscaped areas at your facility:

- **Topsoil** – Maintain a sufficient quantity (4-6 inches) of topsoil rich in organic matter to capture rain and irrigation water. The composition of the soil allows moisture to be stored and released back to plants over time.
- **Aeration** – Aerate soil seasonally in landscape beds to introduce oxygen into the soil's deep layers and break up compacted soil. This allows plant roots and water to penetrate more deeply into the soil.
- **Plants** – The use of trees, shrubs, and other ornamental plantings in the landscape does not automatically suggest low water use or minimal maintenance. Studies show that trees and shrubs have regularly been found to be higher water users than turfgrass due to greater leaf canopy surface area exposed for evapotranspiration to occur. Select native, drought-tolerant, or climate-appropriate trees, shrubs, and ground cover when planting or replanting landscaped areas. Native plants are adapted to local soils and climatic conditions. Therefore, they may not require supplemental irrigation or fertilizer and are often more resistant to pests and diseases.
- **Turfgrass replacement** – Eliminate strips of grass that are common in parking islands, between sidewalks and the roadway, and other narrow strips. Turfgrass areas irrigated on narrow strips are difficult to water efficiently without promoting wetting of impervious surfaces. Design irrigation systems so water can be applied

without waste or consider planting shrubs, mulching, or installing permeable hardscape.

- **Hydrozones** – Different areas at your site are subject to varying evaporation rates and receive different amounts of light, wind, and moisture. To minimize water waste, group plants into hydrozones so plants with similar light and water requirements are grouped together. Grouping plants according to needs protects plants from underwatering or overwatering and provides adequate water according to each zone's specific needs.
- **Mulch** – Adding mulch to plant beds decreases water lost from the soil through evaporation, reduces weed growth, keeps plant roots cool by moderating soil temperatures, prevents the soil from crusting, and prevents erosion. Organic (bark chips, wood grindings, etc.) and inorganic (rocks, gravel, etc.) mulches are available. If using inorganic mulches, keep in mind that rocks and/or gravel retain and radiate heat.
- **Slopes** – Minimize steep slopes in landscaped areas as they can contribute to the potential for erosion and runoff.
- **Hardscapes** – Clean up sidewalks, parking lots, tennis courts, and other paved areas following maintenance by sweeping instead of spraying with water.

Landscaping alternative to narrow strip of turfgrass – Photo courtesy of Kevin Mercer

Conclusion

Efficient water use is essential to conserve and protect water resources, abide by local and/or state regulations, and maintain a healthy, safe athletic or recreational facility. As the focus on environmental protection grows, sports turf managers are under increasing pressure to reduce inputs on turfgrass and landscaped areas. With this in mind, it is essential to consider and implement best management practices regarding water conservation. Even small changes, such as raising the mowing height during hot summer temperatures or adjusting the irrigation schedule to water during early morning hours instead of midday, can go a long way in reducing water usage. Evaluate what changes could be made or what could work best at your facility. Document and promote your water conservation practices to athletes, coaches, parents, supervisors, and the general public. Be a leader in your community by exhibiting commitment to the goal of a healthier, more sustainable environment.

Resources:

Contributions made by the 2013 STMA Environmental BMP Subcommittee and 2013 STMA Information Outreach Committee

Beard, J. and Kim K. 1989. Low water-use turfgrasses. USGA Green Section Record. 27(1):12-13.

Best Management Practices for Lawn and Landscape Turf – University of Massachusetts Extension Turf Program - http://extension.umass.edu/turf/sites/turf/files/pdf-doc-ppt/lawn_landscape_BMP_2013_opt.pdf

Denver Water - http://www.denverwater.org/

Environmental Best Management Practices for Virginia's Golf Courses – Virginia Golf Course Superintendents Association - http://www.vgcsa.org/sites/images/373/VirginiaBMP.pdf

Smart Irrigation Controllers: What Makes an Irrigation Controller Smart? – University of Florida IFAS Extension - http://edis.ifas.ufl.edu/ae442

WaterSense: An EPA Partnership Program - http://www.epa.gov/watersense/outdoor/index.html