WaterSense at Work

Outdoor Water Use
5.1 Landscaping

Best Management Practices for Commercial and Institutional Facilities

EPA WaterSense

November 2023

WaterSense® is a voluntary partnership program sponsored by the U.S. Environmental Protection Agency (EPA) that seeks to protect the nation's water supply by transforming the market for water-efficient products, services, and practices.

WaterSense at Work is a compilation of water efficiency best management practices intended to help commercial and institutional facility owners and managers from multiple sectors understand and better manage their water use. It provides guidance to help establish an effective facility water management program and identify projects and practices that can reduce facility water use.

An overview of the sections in *WaterSense at Work* is below. This document, covering water-efficient landscaping, is part of **Section 5: Outdoor Water Use**. The complete list of best management practices is available at www.epa.gov/watersense/best-management-practices. WaterSense has also developed worksheets to assist with water management planning and case studies that highlight successful water efficiency efforts of building owners and facility managers throughout the country, available at www.epa.gov/watersense/commercial-buildings.

- **Section 1. Getting Started With Water Management**
- **Section 2. Water Use Monitoring**
- **Section 3. Sanitary Fixtures and Equipment**
- **Section 4. Commercial Kitchen Equipment**
- **Section 5. Outdoor Water Use**
- **Section 6. Mechanical Systems**
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- **Section 8. Onsite Alternative Water Sources**

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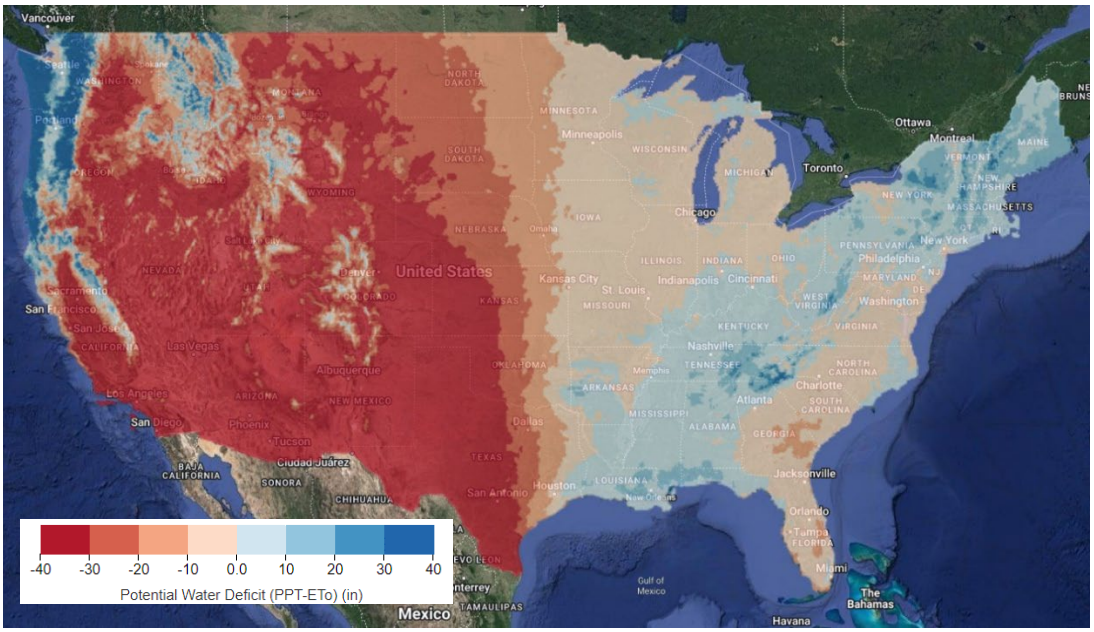
This document is one section from *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* (EPA-832-F-23-003). Other sections can be downloaded from www.epa.gov/watersense/best-management-practices. Sections will be reviewed and periodically updated to reflect new information. The work was supported under contract 68HERC20D0026 with Eastern Research Group, Inc. (ERG).

Overview

Water applied to a landscape can account for a significant portion of a commercial or institutional property's overall water use, particularly for buildings or campuses with large, manicured landscapes. Typically, a landscape is watered to supplement natural precipitation based on a plant's water needs. The amount of water theoretically needed to keep a landscape healthy is equal to the amount of water lost due to evapotranspiration—the sum of water lost by evaporation from the soil and transpiration from plants. In some areas of the United States with more frequent rainfall, precipitation can replace evapotranspiration, eliminating the need for irrigation. However, in other areas of the country, such as the arid Southwest, the gap in the evapotranspiration needs of plants and precipitation can be significant, and irrigation water may need to be applied. Figure 1 shows a map of the United States illustrating the average difference in inches per year of precipitation and evapotranspiration from 1981 to 2022. Blue areas are areas where precipitation exceeds evapotranspiration. Darker orange and red areas show where annual evapotranspiration more substantially exceeds precipitation and, therefore, irrigation may be needed within landscaped areas.

Figure 1. Average Annual Potential Water Deficit (Precipitation Minus Reference Evapotranspiration in Inches) in the U.S. from 1981 to 2022[1]



[1] Climate Engine. 2023. Desert Research Institute and University of Idaho. Accessed on August 8, 2023. https://climateengine.org/, version 2.1.

The difference between precipitation and evapotranspiration is not the only thing that will impact whether or not a landscape may need irrigation. Landscape design, soil conditions, plant choice, and maintenance all affect the amount of water a landscape will use.

A well-designed landscape should be supported by healthy soils with appropriate grading, mulches, regionally appropriate plant choices, appropriately-sized turf areas, and hydrozones. Consider the following information for a well-designed landscape:

- Healthy soils allow water to infiltrate properly and hold onto it longer, allowing the development of healthy plant root systems. Soil should be viewed as a living part of the landscape and can be maintained with a combination of aeration and applying compost or mulch to help the soil retain its nutrients while supporting plant growth.
- Mulches on landscaped beds and around trees can help keep soils cool and minimize evaporation. If organic mulches such as wood chips or shredded leaves are used, they can add nutrients to the soil as they decompose.
- Appropriately graded sites with gentle slopes allow water to infiltrate the soil where it is applied. Water is therefore available to the root zone of the plants, instead of becoming runoff.
- Trees and shady areas incorporated into the landscape help to dissipate heat and reduce evaporation.

Turf areas replaced with plantings

- It is possible in many parts of the country to design a landscape that does not require irrigation. A plant palette consisting of drought-tolerant, native, or regionally-appropriate species lays a solid foundation for a water-efficient landscape, reducing water requirements, as well as the time and cost associated with maintaining the landscape.
- A smaller turf area can reduce resources and costs associated with watering, mowing, fertilizing, and removing debris. The use of turfgrass in the landscape should serve a specific functional purpose, such as recreational spaces.
- Hydrozoning, or grouping plants according to their water needs, will promote efficient irrigation in those zones that require supplemental water.
- If a water feature (e.g., pond or ornamental pool) is included in a landscape, it should provide a beneficial use, such as a wildlife habitat or stormwater management. In addition, the feature should recirculate water instead of serving in a single-pass capacity, which can waste significant amounts of water.

- Irrigation system efficiency is another important factor that affects landscape water use. For information on efficient landscape irrigation systems, refer to *WaterSense at Work Section 5.2: Irrigation* at www.epa.gov/watersense/best-management-practices.

WaterSense offers tips for maintaining an aesthetically pleasing landscape while reducing—or eliminating entirely—the need for irrigation. Where irrigation is still necessary, WaterSense labels products and professional certification programs to make it easier to design and maintain a more efficient system. Learn more on the WaterSense Outdoors web page at www.epa.gov/watersense/outdoors.

Many of the actions that can be taken to improve a landscape's water efficiency can have the co-benefit of reducing stormwater runoff. EPA's Green Infrastructure program (found at www.epa.gov/green-infrastructure) focuses on solutions to reduce runoff, such as rain gardens and permeable pavements. Building owners and facility managers should research local stormwater programs, as many local water utilities or municipal governments offer incentives or other technical assistance related to green infrastructure practices that reduce stormwater runoff while also improving landscape water efficiency.

Additional EPA Resources

In addition to WaterSense, EPA has other programs that address the intersection of water management, efficiency, and landscape design.

EPA's Green Infrastructure program encourages stormwater management practices to help improve the quality and reduce the quantity of stormwater runoff during rain, snow, and other precipitation. Learn more on EPA's Green Infrastructure web page at www.epa.gov/green-infrastructure.

EPA's Nonpoint Source Program has resources to encourage low-impact development practices that look to manage stormwater by preserving or recreating natural landscapes that better absorb water and reduce runoff during storms. Learn more at www.epa.gov/nps/urban-runoff-low-impact-development.

Because commercial and institutional buildings are also part of a community, owners and operators should consider how they can develop and maintain sustainable landscapes that serve to beautify the community and provide other benefits, such as reducing the urban heat island effect, improving air quality, and providing habitat.

Operation, Maintenance, and User Education

To optimize a landscape's water efficiency, look for a landscape professional who has a demonstrated knowledge of water-efficient landscape design and maintenance practices. Be sure to maintain the quality of soil and existing plants, and minimize water used for other purposes with respect to the overall landscape design.

Hiring a Landscape Professional

When selecting or employing a landscape professional or firm, consider the following management strategies:

- Consider selecting landscape professionals trained and certified in water-efficient or climate-appropriate landscaping. Existing professionals can attend courses or seminars to learn water-efficient techniques.
- Regularly review all landscape service and maintenance agreements to incorporate requirements, standards, and/or performance targets pertaining to water efficiency, energy efficiency, and use of fertilizer, herbicides, and pesticides.
- Encourage landscape professionals to report and/or fix irrigation system problems. Many landscape professionals not only install and maintain plants in your landscape, but also install and maintain the irrigation system. These professionals can identify and report leaks or other inefficiencies over time.

Maintaining Soil Quality

Consider the following maintenance tactics to ensure healthy soil quality:

- Maintain a sufficient quantity of good topsoil—four to six inches deep—to capture precipitation as it falls. Healthy soils can hold onto infiltrated water for longer periods of time, making water more available for plants and reducing irrigation requirements.
- Consider incorporating soil amendments into water-logged or fast-draining soils to attain proper soil water holding capacity. For soils with poor drainage (i.e., clay soils) or soils that drain too quickly (i.e., sandy soils), consider incorporating topsoil or compost to balance soil composition and restore nutrients.
- For areas that undergo regular foot or vehicular traffic, aerate the soil annually to alleviate compaction and improve water infiltration rates.
- Add approximately 3 inches of mulch to plant beds and around trees to cover bare soil. Mulch helps retain water by minimizing evaporation, reducing weed growth, moderating soil temperatures, and preventing erosion. Re-mulch areas annually to maintain soil coverage.

Remember that soil and dirt are not the same thing—soil has organic matter, living organisms, and nutrients that work together to promote healthy plants. To learn more about the health of a property's soil, consult with the local U.S. Department of Agriculture (USDA) or University Cooperative Extension Service, which can recommend soil tests that analyze pH and nutrient levels and identify the soil texture. Extension services can often

recommend strategies to improve the soil's ability to support plants and retain water. The USDA website can help you find your local cooperative extension office.[2]

Maintaining Existing Plants

When maintaining existing plants, consider the following water-efficient tips:

- Keep the irrigated landscape free of weeds so that water is available for the decorative landscaping. Pull weeds manually instead of using herbicides, which can contaminate local water sources.
- Allow grass to grow 2 to 3 inches tall before cutting it. Raise the blade on mowers to allow grass to grow longer. Longer grass promotes deeper root growth and more drought-resistant turf.
- Some species of turfgrass go dormant during dry periods. Consider letting the grass turn brown during these times. It will recover when rainfall returns.
- Include shaded areas that dissipate heat and reduce evaporation. Consider planting additional trees and shrubbery to increase the amount of shaded area in the future.

Dormant turfgrass

Minimizing Water Used for Other Purposes

To minimize the amount of water used for other outdoor-related purposes, consider the following:

- Recirculate water in decorative fountains, ponds, and waterfalls. Shut off these features when possible to reduce evaporation losses. Check water recirculation systems annually for leaks and other damage. Consider using non-potable water in these systems (refer to *WaterSense at Work Section 8: Onsite Alternative Water Sources* at www.epa.gov/watersense/best-management-practices for additional information).
- Do not use water to clean sidewalks, driveways, parking lots, tennis courts, pool decks, or other hardscapes. Sweep these areas instead. If sweeping large areas is impractical, use a water-efficient water broom instead of a traditional hose and

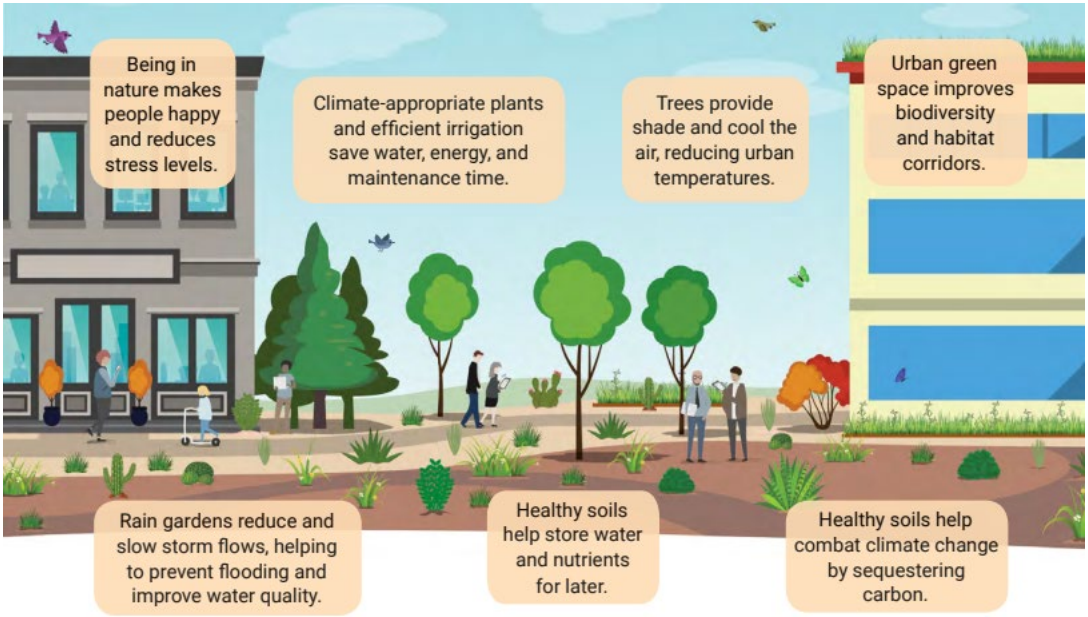
[2] U.S. Department of Agriculture (USDA). College Partners Directory. www.nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory?state=All&field_map_filter_value=Extension.

nozzle. Select water brooms that use less than or equal to 0.10 gallons per minute per linear inch of spray area.

Retrofit and Replacement Options

Many of the actions that might be undertaken to retrofit or replace a landscape are similar, so consider undertaking a transformation project to create a water-efficient and sustainable landscape. The goals for either retrofitting or replacing landscaping should be to hold water in the soil rather than allowing it to run offsite and reduce the need for irrigation while maintaining an aesthetic appearance. Differences in practices and options are primarily those of scale. Additionally, take into consideration other benefits that the landscape can provide for your business and community (see Figure 2).

Figure 2. Benefits Offered by Water-Efficient, Sustainable Landscapes[3]



Design

Because replacing a commercial or institutional landscape can be expensive, it is important to ensure that the landscape is properly designed from the start. Consider hiring a licensed landscape architect or a qualified site planner/designer to assist. Local botanical gardens and cooperative extension offices may also have information on how to design a landscape that is beautiful, functional, and water-efficient.[4] For example, the Conservation Garden Park developed by the Jordan Valley Water Conservancy District in

[3] Abraham, Sonali, et al. August 2020. *Sustainable Landscapes in California: A Guidebook for Commercial and Industrial Site Managers*. Prepared for the Pacific Institute. https://pacinst.org/publication/sustainable-landscapes-guidebook/.
[4] USDA, *op. cit.*

West Jordan, Utah, has a wealth of information and virtual tours demonstrating water-smart landscaping provide trips to residents in the area.[5] In fact, many WaterSense partners offer smart landscape tours or demonstration gardens with water-efficient design and native plants.[6]

Because your landscape may have been designed years or even decades in the past, consider how the local climate and weather patterns may have changed. Is your area subject to more frequent, long-lasting, and intense periods of heat or drought? Is it subject to more frequent and intense rain events that create flooding? If so, the landscape may need to be redesigned to respond to these changes.

- Some local jurisdictions and states are implementing restrictions on non-functional turfgrass to manage water demand. But even where there are no local requirements, it makes sense to use turfgrass only in areas where it serves a beneficial purpose. Even golf courses are replacing turfgrass with other plantings in areas that are out of play. To evaluate your property, walk the landscape and identify areas where it may be best to replace turfgrass because of maintenance challenges or issues ensuring efficient irrigation. For example, it may be better to avoid turfgrass in islands within parking lots, park strips between the road and sidewalk, and strips alongside buildings.

Avoided strip grass

- In areas where there is risk of wildfire, consider integrating defensible spaces that will improve resilience to wildfire.[7] Defensible space is the area between a building and the surrounding vegetation.
- If stormwater or urban runoff is a challenge on the site, consider low-impact development and green infrastructure options to hold or filter water on the site, reduce hard surfaces, and minimize stormwater runoff.[8]

Site Preparation

How the site is prepared has a significant impact on the ability for the landscape to retain moisture and limit the need for irrigation. Before retrofitting, replacing, or installing a new landscape, consider the following site preparation tips:

[5] Conservation Garden Park. Landscaping Help. https://conservationgardenpark.org/landscapinghelp.
[6] To find a local WaterSense partner that may have water-efficient landscape tours or demonstration gardens, visit www.epa.gov/watersense/partners-directory.
[7] Cal Fire. Prepare for Wildfire. www.readyforwildfire.org/prepare-for-wildfire/get-ready/defensible-space/.
[8] U.S. Environmental Protection Agency (EPA). Urban Runoff: Low Impact Development. www.epa.gov/nps/urban-runoff-low-impact-development.

- To the extent feasible, limit the removal of native vegetation and soils.
- Minimize soil compaction in the construction phase by limiting areas that require heavy equipment.
- Install temporary protective fencing around trees to protect their root zones.
- Reduce runoff from steep slopes in the landscape by either grading appropriately or terracing. If slopes cannot be avoided in landscape design, install plants with deeper root zones to provide stabilization and prevent erosion.
- Before the landscape is installed, ensure that the soil is properly amended, tilled, and contoured to hold water. Where turfgrass is used, the area should include at least 6 inches of well-amended soil capable of easily absorbing and holding water in the root zone.

Plant Selection

Plant selection can make all the difference in a water-efficient landscape. Consider the following when redesigning a landscape:

- Evaluate site conditions and plant appropriately. Areas of the same site may vary significantly in soil type or exposure to sun and wind, as well as evaporation rates and moisture levels. Be mindful of a site's exposure to the elements and choose plants that will thrive in those conditions.

Climate appropriate plants

- When replanting landscaped areas, select drought-tolerant or regionally appropriate turfgrass, trees, shrubs, and ground cover that are adapted to the local climate. Information about climate-appropriate plants may be available through your local cooperative extension office[9] or on the WaterSense website.[10,11] To provide multiple benefits, consider plants that can serve as habitat for pollinators and other wildlife.
- Incorporate shade trees into your landscape. Shaded areas typically require less water than areas exposed to direct sun. Additionally, shade trees and other vegetation placed strategically to shade the south-facing wall of a building can eventually help to reduce energy costs. When selecting trees, which have a long life

[9] USDA, *op. cit.*
[10] EPA's WaterSense program. What to Plant. www.epa.gov/watersense/what-plant.
[11] EPA's WaterSense program. Turfgrass and Water Efficiency. www.epa.gov/watersense/turfgrass-and-water-efficiency.

relative to other plants in the landscape, consider how anticipated changes in local climate may impact the ability of different tree species to thrive. Select species that can tolerate the expected changes.

- Consider reducing the area of turfgrass in the landscape, as most turf requires more water than planted beds. Plant turfgrass where it will be used for activities such as recreation. Where turfgrass is used, select species that are climate-appropriate and more resilient to drought.[12]
- Use mulch in planted beds to minimize evaporation and use drip irrigation as an alternative to spay irrigation.
- Consider installing rain gardens throughout the landscape. These excavated, shallow depressions should include native plantings designed to capture rainwater runoff from roofs, driveways, and sidewalks. These gardens can keep water on the property and reduce runoff volume by up to 90 percent.

Rain garden

Irrigation System Efficiency

Although it is possible in many parts of the country to design a landscape that can thrive on rainfall alone, some irrigation may be needed to ensure landscape health. There are many factors that should be taken into account to ensure that an irrigation system is well designed, operated, and maintained. More detailed information about irrigation systems is available in *WaterSense at Work Section 5.2: Irrigation* at www.epa.gov/watersense/best-management-practices, but following are a few tips:

- Consider selecting an irrigation professional certified by a WaterSense labeled program. These professionals have demonstrated their knowledge of how to design, install, maintain, repair, and/or audit efficient irrigation systems. To find a local irrigation professional certified by a WaterSense labeled program, visit the WaterSense Find a Pro web page at www.epa.gov/watersense/find-pro.
- Use the technique of hydrozoning to group plants with similar irrigation needs together.
- Consider how the interplay between the types of plants and irrigation components can affect the volume of water needed to sustain the landscape. Drip irrigation (also known as microirrigation) can be a great way to reduce water use in planted

[12] *Ibid.*

beds. Review WaterSense's guides on microirrigation at www.epa.gov/watersense/microirrigation to learn more about this irrigation option.

- EPA's WaterSense Water Budget Tool found at www.epa.gov/watersense/water-budget-tool can be used as a guide to see how plant types and irrigation methods affect the ability of a landscape to meet a water budget based on the local climate. The Water Budget Tool is not intended to estimate actual savings, but it is a tool to help evaluate the relative water savings that can be achieved with different plant palette and technology choices.
- Consider installing a separate meter to measure the volume of water applied to the landscape. Separately metering irrigation systems can reduce wastewater costs in some jurisdictions and can help to identify leaks more quickly (see *WaterSense at Work Section 2.1: Metering and Submetering* at www.epa.gov/watersense/best-management-practices).
- Install WaterSense labeled irrigation products, such as spray sprinkler bodies[13] and irrigation controllers.[14] These products are independently certified to be more water-efficient and perform as well or better than standard products.

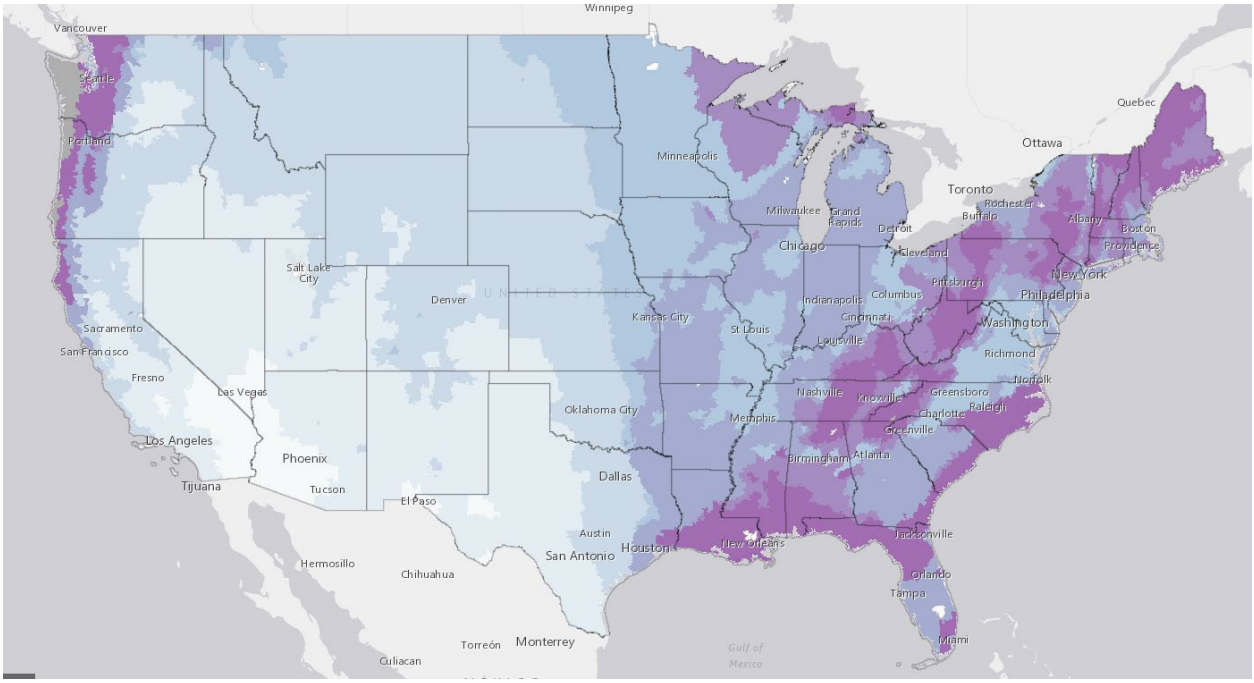
Look for WaterSense Labeled Irrigation Products

When designing a new irrigation system or making upgrades to improve water efficiency and performance, look for the WaterSense label. A product that has earned the label uses at least 20 percent less water than standard models and is independently certified for performance. WaterSense labels irrigation controllers and spray sprinkler bodies. Facilities can use WaterSense's Product Search Tool to find labeled models. Go to www.epa.gov/watersense/product-search to get started.

- Consider where alternative water sources can be used as a substitute for potable water sources for irrigation. The Federal Energy Management Program (FEMP) has developed tools to evaluate rainwater harvesting potential from rooftops or other hard surfaces.[15] Figure 3 on the next page shows areas with potential to use rainwater for irrigation. EPA's Green Infrastructure program web page at www.epa.gov/green-infrastructure and *WaterSense at Work Section 8: Onsite Alternative Water Sources* at www.epa.gov/watersense/best-management-practices have additional information.

[13] EPA's WaterSense Program. Spray Sprinkler Bodies. www.epa.gov/watersense/spray-sprinkler-bodies.
[14] EPA's WaterSense Program. WaterSense Labeled Controllers. www.epa.gov/watersense/watersense-labeled-controllers.
[15] U.S. Department of Energy (DOE), Federal Energy Management Program (FEMP). Water-Efficient Technology Opportunity: Rainwater Harvesting Systems. www.energy.gov/femp/water-efficient-technology-opportunity-rainwater-harvesting-systems.

Figure 3. Map From FEMP's Rainwater Harvesting Tool[16]



Purple areas show locations where there is the highest potential to collect rainwater for irrigation. Light blue and white areas show where potential is lowest.

Other Features

When planning hardscape retrofits, consider the following to enhance water efficiency:

- If replacing sidewalks or parking lot pavement, consider installing permeable surfaces (e.g., permeable pavement) rather than impermeable hardscape.
- Use bushes, mulch, rain gardens, permeable hardscape, or curb cuts in parking lot islands or in the areas between sidewalks and the roadway. These should be at a lower elevation than surrounding hardscape so that runoff flows into them.
- While water features are common in many landscapes, consider the annual water use of the specific feature before installing one. Ideally, these features should provide a beneficial use, such as a wildlife habitat, stormwater management, and/or noise reduction. Recirculate water within water features to reduce the amount of potable water used. Smaller pumps, lower pumping rates, and/or pressure-reducing valves can help reduce water flow. Where feasible, use alternative water sources to make up water lost to evaporation, and place the water feature in a shady location with less breeze to limit evaporation.[17]

[16] DOE, FEMP. Rainwater Harvesting Tool. www.energy.gov/femp/rainwater-harvesting-tool.
[17] Oppedahl, Rachel. *Water-Wise Water Features*. Prepared for Tuolumne County Master Gardeners. https://ucanr.edu/sites/tuolumne_county_master_gardeners/files/148198.pdf.

Savings Potential

Landscape water use is largely dependent on climate, landscape size, plant type, and an irrigation system's efficiency. Soil health, grade, and maintenance also play a role. In order to evaluate landscape improvements and their associated savings, one must first know how much water is being applied to the landscape. Dedicated irrigation meters or meters on water feature make-up lines can be used to track landscape water use and document savings from various measures.

Savings for converting high water-using landscapes to low water-using landscapes vary by plant type and climate. Keep in mind that calculations for these landscape transformation projects are property-specific. For example, the Southern Nevada Water Authority estimates that a business in the Las Vegas area would save 825,000 gallons of water per year by converting a 15,000-square-foot landscape to water-smart landscaping.[18] As part of a rebate program, the Municipal Water District of Orange County (California) found that large commercial properties reduced their water use by approximately 31 percent by replacing turf with climate-appropriate landscapes or permeable surfaces.[19] The Village at Stone Oak, a shopping mall in San Antonio, Texas, reduced their water consumption by approximately 60 percent by converting turf to xeriscape and modifying their irrigation system.[20] A more water-efficient landscape can also provide ancillary benefits in reducing the need for maintenance, fertilizer application, and fuel use.[21]

Case Studies and Webinars Demonstrate Real-World Savings

Additional case studies from WaterSense on how commercial and institutional building owners have effectively reduced outdoor water use can be found at www.epa.gov/watersense/case-studies.

WaterSense holds regular webinars for commercial and institutional building audiences, including a series that focuses on outdoor water use. Recordings can be found at www.epa.gov/watersense/webinars.

Additional Resources

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[18] Southern Nevada Water Authority. Water Smart Landscapes Rebate. www.snwa.com/rebates/wsl/index.html.
[19] Municipal Water District of Orange County. March 2015. *CII Performance-Based Water Use Efficiency Program Final Project Report*. www.usbr.gov/lc/socal/reports/CIIPerformance-BasedWaterUse.pdf.
[20] EPA's WaterSense Program. February 2017. "Texas Shopping Mall Buys Into Outdoor Water Savings." www.epa.gov/sites/default/files/2017-05/documents/ws-casestudy-villageatstoneoak-508.pdf.
[21] Rosenberg, David E., et al. June 2011. *Value Landscape Engineering: Identifying Costs, Water Use, Labor, and Impacts to Support Landscape Choice*. Journal of the American Water Resources Association (JAWRA). 47(3):635-649.

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