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Water Use Monitoring and Education

EPA WaterSense

2.1 Introduction to Water Use Monitoring and Education

EPA WaterSense

Two key factors to properly managing and reducing facility water use are actively monitoring water use and effectively educating facility staff, building occupants, employees, and visitors about facility water use and water management planning goals. Monitoring and education are critical to the success of a facility's water management program because they provide the ability to track and measure progress, as well as increase awareness and build support for specific projects or user behavioral changes.

By routinely monitoring facility water use through existing water meters, building owners and operators can understand and manage facility water use. To monitor some specific activities more closely, some facilities install submeters on major end uses, such as irrigation systems and cooling towers. Metering allows a facility to quickly find and fix leaks or other unnecessary water use. It also has the added benefit of enabling the facility to identify cost-effective water use reduction opportunities and to track project savings.

Water meter

Leaks are water wasted with no intended use or purpose; once identified, leaks should be the first area to target from a water management perspective. Unfortunately, leaks often go undetected, particularly if a facility is not routinely monitoring its water use. On average, leaks can account for more than 6 percent of a facility's total water use. With a few simple steps, a facility can establish a comprehensive leak detection and repair program, which can save water, money, time, and expenses that would otherwise be associated with unmanaged leaks.

Once a facility has an accurate understanding of its water use and has taken steps to eliminate leaks and other unnecessary water waste, the next step is to educate building occupants, employees, and visitors about using water efficiently. Building owners and operators can raise awareness of water-efficiency efforts by communicating reduction goals to their employees, guests, and other stakeholders. Much of the water use within a facility is dependent upon user behavior and proper operation and maintenance of water-using products and equipment. Simple behavioral changes, such as taking shorter showers, running dishwashers only with full loads, or using a dual-flush toilet properly, can result in significant water savings. In addition, maintaining equipment and training staff to look for and report leaks can be a key component of a facility's leak detection and repair program, helping to ensure the long-term water savings associated with any water-efficient products or equipment installed.

Another aspect of water use education is to understand the impact of national, state, and local codes, standards, and voluntary water-efficiency programs. In many cases, building and plumbing codes and standards establish the baseline for how buildings use water and even the types of water-using products that can be installed. Voluntary programs such as the U.S. Environmental Protection Agency's (EPA's)

2.1 Introduction to Water Use Monitoring and Education

WaterSense® program and EPA and the U.S. Energy Department's ENERGY STAR® have emerged to help facilities more easily implement water-efficient practices, technologies, and products that go above and beyond the standards. Many water and energy utilities also offer rebates for water- and energy-efficient products, which can increase a project's cost-effectiveness. Facility managers can use this document as a starting point for finding information regarding the codes, standards, voluntary programs, and product rebates in order to better manage and more strategically employ successful water-efficiency measures and practices.

Section 2: Water Use Monitoring and Education of WaterSense at Work provides specific guidance on:

- Metering and submetering
- Leak detection and repair
- User education and facility outreach
- Codes, standards, and voluntary programs for water efficiency

2.2 Metering and Submetering

EPA WaterSense

Overview

An important rule in water management is that you can't manage what you don't measure. Tracking a facility's total water use, as well as specific end uses, is a key component of the facility's water-efficiency efforts. Source meters measure the amount of water being supplied to the facility, while submeters measure usage for specific activities, such as cooling tower, process, or landscape water use. Accurately measuring water use can help facility managers identify areas for targeted reductions and to track progress from water-efficiency upgrades. Submeters can also help identify leaks and indicate when equipment is malfunctioning.

Meters and submeters can be integrated into a centralized building management system, making it easy to track usage and implement a water management plan (see *Section 1.2: Water Management Planning*). These systems are capable of electronically storing data from meters and submeters, reporting hourly, daily, monthly, and annual water use. They can also trigger alerts when leaks or other operational anomalies are detected.

Installing the correct meter and ensuring it functions properly are critical to accurate water measurement. There are many types and sizes of meters intended for different uses, so it is important to choose the correct one. Improper sizing or type can cause problems for the building. For example, an undersized water meter can cause excessive pressure loss, reduced flow, and noise. Oversized meters are not economical and do not accurately measure minimal flow rates.[1] All utility-grade water meters manufactured and installed for domestic water service by a water utility in the United States must comply with American Water Works Association (AWWA) standards. Submeters that are installed for water management purposes and not used for revenue purposes are not subject to such standards.

Best Practices

There are several best practices for metering water use, including correctly choosing what to meter and submeter; selecting, installing, and maintaining meters; and reading and recording metered data to track water use and integrate it into the water management plan.

Determining What to Meter and Submeter

It's best to meter all water conveyed to the facility, regardless of source. For example, even if a building's water is solely supplied by an alternative source (e.g., municipally supplied reclaimed water), a source meter can still be installed to track and manage water use.[2] If multiple sources of water are provided to a facility, each source should be metered and tracked separately.

[1] Smith, Timothy A. Park Environmental Equipment Company, LTD. April 22, 2008. *Water-Meter Selection and Sizing.* www.park-usa.com/skins/park/standard.aspx?elid=71&arl=108.

[2] U.S. Green Building Council's LEED.® November 2010. *Building Design and Construction.* Page 151. www.usgbc.org/ShowFile.aspx?DocumentID=8182.

Building owners and operators should consider installing separate submeters to measure specific end uses that are permanently plumbed, as indicated in Table 2-1. For more information and additional recommendations on metering and submetering, review the U.S. Green Building Council's LEED® rating system[3] and the 2012 International Green Construction Code.™ [4]

Table 2-1. Submetering Recommendations

Submeter Application	Recommendation
Tenant Spaces	Meter all tenant spaces individually.
Cooling Towers	Meter cooling tower make-up water and blowdown water supply lines. A single make-up meter and a single blowdown meter can record flows for multiple cooling towers if they are controlled with the same system. Separately controlled cooling towers should have separate make-up and blowdown water meters.
Heating, Ventilating, and Air Conditioning (HVAC) Systems	Individually or collectively meter HVAC systems with aggregate annual water use of 100,000 gallons or more or if the facility has 50,000 square feet or more of conditioned space. Metered systems should include evaporative coolers, humidifiers, mist cooling devices, and recirculating water systems with a fill water connection, such as chilled water, hot water, and dual temperature systems.
Steam Boilers	Meter the make-up water supply line to steam boilers with a rating of 500,000 British thermal units per hour (Btu/h) or greater. A single make-up meter can record flows for multiple boilers.
Single-Pass Cooling Systems	Meter any systems or equipment that use single-pass cooling water and do not use a chilled water system or closed-loop recirculation.
Irrigation	Meter irrigation systems that are automatically controlled.
Roof Spray Systems	Meter roof spray systems for irrigating vegetated roofs or thermal conditioning.
Ornamental Water Features	Meter make-up water supply lines for ornamental water features with a permanently installed water supply.
Pools and Spas	Meter make-up water supply lines for indoor and outdoor pools and spas.
Industrial Processes	Individually meter industrial processes consuming more than 1,000 gallons per day on average.

(continued)

[3] *Ibid.*
[4] International Code Council. *2012 International Green Construction Code.™* www.iccsafe.org/Store/Pages/Product.aspx?id=3750S12.

Table 2-1. Submetering Recommendations (cont.)

Submeter Application	Recommendation
Alternative Water Sources	Meter water use from alternative water sources, such as gray water, rainwater, air handler or boiler condensate, or other sources discussed in *Section 8: Onsite Alternative Water Sources*.
Other Processes	Meter any other process with a projected annual water use of 100,000 gallons or more.

Meter Selection

The first step in choosing a meter is to determine its use and select the appropriate type of meter from the list below:[5]

- Positive displacement meters are best suited for small commercial or institutional applications because they have high accuracy rates at low flows and can precisely measure peak flows.
- Compound meters are a good choice for large commercial or institutional facilities because they accurately measure low flows and high flows with their multiple-measuring chamber design.
- Turbine and propeller meters are most appropriate for continuous, high-flow applications and are inaccurate at low flows. These types of meters are not usually recommended for commercial, institutional, or residential buildings because water flows are in constant fluctuation, with very low minimum flow rates.

Next, select the appropriate size of the meter. It is critical to understand the building's size, function, fixture types, usage occupancy, and peak population in order to select the appropriately sized meter. These statistics determine the minimum and maximum flow rates and will assist in the selection of a properly sized water meter.[6] AWWA Manual M22, *Sizing Water Service Lines and Meters*, provides additional guidelines for selecting and sizing utility-owned and installed water meters.[7]

Meter Installation and Maintenance

After selecting a meter, consider the following installation and maintenance best practices to ensure optimal meter operation:

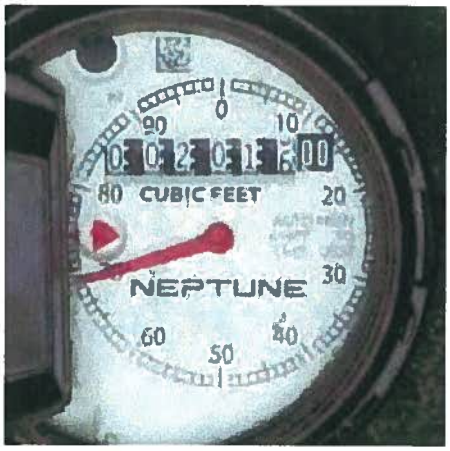
- When installing a meter, follow the manufacturer's instructions. Improper installation can lead to metering inaccuracies.
- Install meters in an accessible location to allow for reading and repair. In addition, ensure that the meter location is protected from potential damage.

[5] Smith, *op. cit.*
[6] *Ibid.*
[7] American Water Works Association (AWWA). 2004. *Sizing Water Service Lines and Meters* (AWWA Manual M22, Second Edition). apps.awwa.org/eBusMAIN/Default.aspx?TabID=401&ProductId=6711.

- To ensure uniform flow entering the meter, do not install the meter near pipe bends. In general, place the meter in a location where there is a space of straight pipe equivalent to at least 10 times the pipe diameter downstream of the meter and five times the pipe diameter upstream of the meter.[8]
- Create a map indicating the location of all water supply meters and submeters to be included in the facility water management plan.
- Include a strainer on all meters and submeters. Debris and sediment can enter a meter and have an adverse effect on accurate measurement. An inline strainer on the meter's inlet will collect debris and sediment and prevent them from entering the meter body.[9]
- Since meters deteriorate with age, test them for accuracy and calibrate them on a regular basis. AWWA recommends that utility-owned meters be tested, on average, as follows:[10]
  - Meter sizes 5/8 inch to 1 inch: Every 10 years
  - Meter sizes 1 inch to 4 inches: Every five years
  - Meter sizes 4 inches and larger: Every year
- Consider inspecting and calibrating submeters more frequently, depending upon the type and size of the meter and its application.

Water Use Tracking and Integration Into the Water Management Plan

Building owners and operators should consider installing a water meter data management system with remote communication capabilities that provides instant feedback on all metered water use in a central location. This type of system makes it easier for building managers to identify leaks or other abnormalities and better understand and manage water use at the facility.



A meter reads 201,670 cubic feet.

If the facility is not integrating metering data into a centralized data system, consider the following best practices:[11]

- Assign responsibility to track water use at least monthly.
- Ensure that staff understands how to read the meters and record data properly. Pay special attention to the units that the meter uses—gallons, cubic feet, and hundred cubic feet are common units for water meters. Also, ensure that staff record the numerical values properly. Meters often include one or more trailing zeros that must be added after the numerical dial reading.

[8] AWWA. 1999. *Water Meters—Selection, Installation, Testing, and Maintenance* (AWWA Manual M6, Fourth Edition). Pages 40-46. apps.awwa.org/eBusMAIN/Default.aspx?TabID=401&ProductId=28471.
[9] Smith, *op. cit.*
[10] Georgia Environmental Protection Division. August 2007. *Water Meter Calibration, Repair, and Replacement Program*. Page 7. www1.gadnr.org/cws/.
[11] U.S. Energy Department, Energy Efficiency & Renewable Energy, Federal Energy Management Program. Best Management Practice: Water Management Planning. www1.eere.energy.gov/femp/program/waterefficiency_bmp1.html.

- Plot total water use and submetered data monthly and examine data for unexplained fluctuations.
- Evaluate trends and investigate and resolve any unexpected deviations in water use.

Additional Resources

Alliance for Water Efficiency. www.allianceforwaterefficiency.org.

American Water Works Association (AWWA). 1999. *Water Meters—Selection, Installation, Testing, and Maintenance* (AWWA Manual M6, Fourth Edition). Pages 40-46. apps.awwa.org/eBusMAIN/Default.aspx?TabID=401&ProductId=28471.

AWWA. 2004. *Sizing Water Service Lines and Meters* (AWWA Manual M22, Second Edition). apps.awwa.org/eBusMAIN/Default.aspx?TabID=401&ProductId=6711.

International Code Council. *2012 International Green Construction Code.*™ www.iccsafe.org/Store/Pages/Product.aspx?id=3750S12.

Schultz Communications. July 1999. *A Water Conservation Guide for Commercial, Institutional and Industrial Users*. Prepared for the New Mexico Office of the State Engineer. www.ose.state.nm.us/wucp_ici.html.

State of California Department of Water Resources. October 1994. *Water Efficiency Guide for Business Managers and Facility Engineers*. www.water.ca.gov/wateruseefficiency.

2.3 Leak Detection and Repair

EPA WaterSense

Overview

Identifying and repairing leaks and other water use anomalies within a facility's water distribution system or from particular processes or equipment can keep a facility from wasting significant quantities of water. As described in Table 2-2, water leaks can add up over time.[12,13]

Table 2-2. Potential Losses From Water Leaks

Malfunction	Leaking Flow Rate (gallons per minute)	Water Loss	Estimated Cost of Water Loss
Leaking Toilet	0.5 gpm	21,600 gallons per month	$2,100 per year
Drip Irrigation Malfunction	1.0 gpm	43,200 gallons per month	$4,300 per year
Unattended Water Hose at Night	10.0 gpm	5,400 gallons per day	$16,000 per year
Broken Distribution Line for: One Day One Week One Month	 15.0 gpm 15.0 gpm 15.0 gpm	 21,600 gallons 151,200 gallons 648,000 gallons	Up to $64,000 per year
Tempering Water Line on a Steam Sterilizer Stuck in the On Position	2.0 gpm	86,400 gallons per month	$8,600 per year
Stuck Float Valve in a Cooling Tower	5.0 gpm	216,000 gallons per month	$21,000 per year

An aggressive leak detection and repair program can help facility managers better understand building water use and save money by avoiding water waste.

Best Practices

Reading meters, installing failure abatement technologies, and conducting visual and auditory inspections are important best practices to detect leaks. To reduce unnecessary water loss, all detected leaks should be repaired quickly.

[12] City of Poway, California. How to Detect a Water Leak. www.poway.org/Index.aspx?page=472.

[13] Estimated cost of water loss based on an average rate of $8.25 per 1,000 gallons for water and wastewater determined from data in: American Water Works Association (Raftelis Financial Consulting). 2010. *Water and Wastewater Rate Survey.*

2.3 Leak Detection and Repair

Reading Meters and Installing Failure Abatement Technologies

To reduce water loss, consider the following metering and leak detection methods:

- Read the facility water meter during off-peak hours when all water-using equipment can be turned off, and building occupants, employees, and visitors are not using sanitary fixtures. After all water uses have been shut off, read the meter; and then read it again an hour later. If the water meter reading significantly changed, this indicates there may be a leak somewhere within the distribution system or within the facility.
- Read water meters and water bills monthly. Pay close attention to water meter readings to ensure that they make sense and are consistent with expected water use trends. Compare monthly water bills to the previous month and to the same month of the previous year, keeping in mind expected seasonal water use increases (e.g., more water in the summer months for building cooling and landscape irrigation). If water use is unexpectedly high, a significant leak might be present in the distribution lines or within the facility. Install submeters on major water-using equipment (e.g., cooling tower make-up water lines, reverse osmosis system supply lines, and irrigation systems). See *Section 2.2: Metering and Submetering* for more information. Monitor the submeter readings to identify unexpectedly high water uses, which may indicate that equipment is malfunctioning or that a leak is present.
- Install failure abatement devices, or leak detection systems, on major water-using equipment. Failure abatement devices sense if equipment is malfunctioning or potentially leaking by detecting abnormal increases in water flow. The devices can alert a user if an issue is detected via alarm, flashing light, phone call, or other method, or they can automatically turn off the water supply to the equipment.

Visual and Auditory Inspection

In addition to metering, conduct visual and auditory inspections described in these best practices:

- Perform a water assessment of the facility once every four years, as outlined in *Section 1.2: Water Management Planning*. During a water assessment, all major water uses will be identified and estimated. If more than 10 percent of water use cannot be accounted for by the water assessment, the facility may have leaks in the distribution lines or from equipment, and further investigation is warranted.
- Select an irrigation professional certified through a program that has earned the U.S. Environmental Protection Agency's (EPA's) WaterSense® label[14] to audit the landscape irrigation system for outdoor water use leaks. All audits should be conducted according to the Irrigation Association's recommended audit guidelines.[15]

[14] U.S. Environmental Protection Agency's WaterSense program. Professional Certification Program. www.epa.gov/WaterSense/outdoor/cert_programs.html.
[15] Irrigation Association. Technical Resources: Irrigation Audit Guidelines. www.irrigation.org/Resources/Audit_Guidelines.aspx.

- Perform daily tours of the building, including mechanical spaces. Pay close attention to all water-using equipment indoors and outdoors by listening and looking for unexpected water use, such as:
  - Sanitary fixtures continuously flushing, leaking, or left running.
  - Unanticipated discharge to floor drains in mechanical spaces.
  - Wet spots in parking lots and grassy areas surrounding the facility. If soggy ground is unexpected, contact the water utility to determine if there is a leak in the distribution line.
- Train building occupants, employees, and visitors to report to facility maintenance staff any leaks that they detect in restrooms, kitchen areas, or any part of the facility. Building maintenance staff could complete these repairs without much extra effort. Immediate leak detection is vital to avoid water and monetary losses from unnecessary water waste. To encourage this feedback and build a culture of reporting leaks, be sure to repair leaks in a timely manner.

Leak Repair

If a plumbing fixture or other piece of water-using equipment is leaking, repair it according to manufacturer specifications. If necessary, replace it with new, properly functioning equipment; look for WaterSense labeled models where available.

For specific information on operation and maintenance, retrofit options, or replacement options, see the relevant sections for specific technologies within this document.

Finding and Fixing Leaks

EPA's WaterSense program sponsors Fix a Leak Week annually in March to remind Americans to find and fix household leaks. This week is the perfect time to educate employees about finding and fixing leaks at home, as well as at the facility.

The Southern Nevada Water Authority has several leak detection and repair videos[16] available on its website. Consider using these videos to further educate facility staff about identifying leaks.

Additional Resources

American Society of Heating, Refrigerating, and Air Conditioning Engineers. *Standard 189.1, Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings*. www.ashrae.org/publications/page/927.

American Water Works Association. Water Loss Control Basics. www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=47847.

DOE, Energy Efficiency & Renewable Energy, Federal Energy Management Program. January 2009. *Distribution System Audits, Leak Detection, and Repair: Kirkland Air Force Base—Leak Detection and Repair Program.* www1.eere.energy.gov/femp/program/waterefficiency_csstudies.html.

[16] Southern Nevada Water Authority. How to Find a Leak. www.snwa.com/3party/find_leak/main.html.

2.3 Leak Detection and Repair

EPA's WaterSense program. Fix a Leak Week.
www.epa.gov/watersense/our_water/fix_a_leak.html.

Irrigation Association. Technical Resources: Irrigation Audit Guidelines.
www.irrigation.org/Resources/Audit_Guidelines.aspx.

North Carolina Department of Environment and Natural Resources, et al. May 2009. *Water Efficiency Manual for Commercial, Industrial and Institutional Facilities.*
savewaternc.org/bushome.php.

Schultz Communications. July 1999. *A Water Conservation Guide for Commercial, Institutional and Industrial Users.* Prepared for the New Mexico Office of the State Engineer.
www.ose.state.nm.us/wucp_ici.html.

Southern Nevada Water Authority. How to Find a Leak.
www.snwa.com/3party/find_leak/main.html.

2.4 User Education and Facility Outreach

EPA WaterSense

Overview

Educating building occupants on using water efficiently at work is essential to any organization's water conservation efforts. This is especially true when new water-efficient technologies or methods are being implemented. Installing a retrofit device or replacing outdated technology or fixtures alone might not necessarily produce expected water savings. Operation and maintenance procedures, retrofits, and replacements are most effective when employees, contractors, and visitors all understand their role in using them properly. It is also important to offer building occupants simple, straightforward ways in which they can help reduce a facility's water use, along with good reasons for doing so. User education is a cost-effective way to enhance your facility's water-efficiency efforts—even small changes in user behavior can result in significant water savings.

Best Practices

To improve water efficiency outside and within a facility, there are a number of best practices to educate employees and other building occupants on water savings to promote success.

Employee and Occupant Education

Consider the following approaches when educating employees and building occupants on your water-efficiency initiative:

- Share management's commitment to water efficiency and the company's water management program through staff meetings, posters, emails, newsletters, and other communications. Include specifics on water-efficiency goals whenever possible.
- Graph and post monthly water use figures so that building occupants can stay informed about the facility's progress and become invested in water-efficiency efforts.
- Create point-of-use reminders to reinforce positive behaviors (e.g., place instructions next to dual-flush toilets).
- Include water-efficiency messages in facility-wide events, such as fairs, open houses, or Earth Day events.
- Train maintenance personnel, operators, and supervisors on any new or revised procedures involving water efficiency. Encourage relevant custodial, cleaning, and maintenance personnel, as well as everyday users, to identify and report leaks in accordance with *Section 2.3: Leak Detection and Repair*. Make it easy to report problems by setting up a user-friendly communication system such as a hotline. Be sure to repair leaks promptly.

2.4 User Education and Facility Outreach

Making Water Efficiency Fun

Following are some creative ways to get employees involved in recognizing the importance of water efficiency at work:

- Consider creating a "Green Team" responsible for environmental issues in and around the facility.
- Hold events related to water efficiency within the facility periodically throughout the year to educate building occupants and celebrate successes. Earth Day and Fix a Leak Week, which is sponsored by the U.S. Environmental Protection Agency's (EPA's) WaterSense® program, are good opportunities to bring attention to water efficiency.[17]
- Consider holding a contest to encourage water use reductions among building occupants. Acknowledge those who identify successful projects or provide group awards for major successes.
- Start a suggestion and incentive system to recognize and encourage water savings in the facility. For best results, include a mechanism to acknowledge submissions and provide information on how they were addressed.
- Provide incentives to building occupants to promote water-saving success. Consider rewarding guests for participating in towel and linen reuse programs at hotels or employees for meeting challenges to reduce building water use.

Providing Water-Efficiency Tips

Periodically remind building occupants and employees of common tips they can follow to help reduce water use, including some of the following, where relevant:

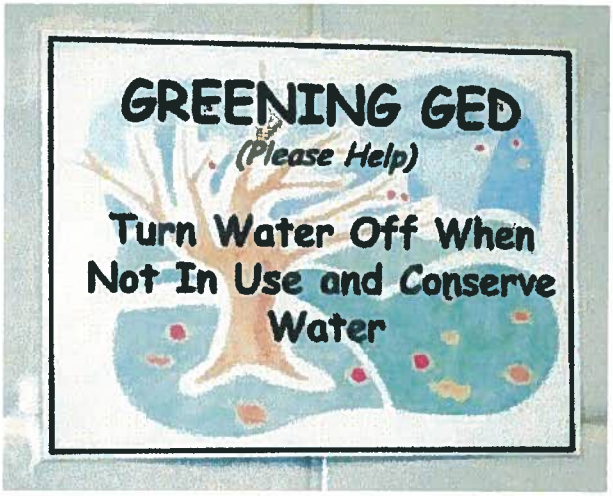
- Fill the sink and turn off the tap when washing dishes in community kitchen areas.
- When using the dishwasher, wash only full loads.
- Look for and report leaky bathroom and kitchen fixtures, or any other leaks, to the appropriate personnel.
- Sweep instead of rinsing off sidewalks, kitchen floors, or other areas.
- Report irrigation occurrences during less efficient times, including during the middle of the day or when it is raining.
- Report broken or improperly positioned irrigation sprinkler heads that spray water on sidewalks or pavement.
- To help building occupants learn more about how they can be water-efficient at work or at home, direct them to the EPA's WaterSense website[18] for more information.

[17] U.S. Environmental Protection Agency's (EPA's) WaterSense program. Fix a Leak Week. www.epa.gov/watersense/our_water/fix_a_leak.html.
[18] EPA's WaterSense program. www.epa.gov/watersense.

Outreach to Visitors and Audiences Outside the Facility

Consider the following when looking to broaden the outreach of your facility's water-efficiency efforts:

- Work with local utilities to participate in their commercial and institutional water conservation programs and to share success stories with other facilities.
- Create displays presenting facility water savings for the facility lobby and other public reception areas.
- Use signage, brochures, and other promotional materials to inform visitors, customers, and others about the facility's water-efficiency program and actions people can take in restrooms or other areas to save water.



Example signage at an EPA Gulf Ecology Division (GED) facility

Additional Resources

Alliance for Water Efficiency. Water Savings Tips: Commercial, Industrial, and Institutional Water Use. www.allianceforwaterefficiency.org/CII-tips.aspx.

Schultz Communications. July 1999. *A Water Conservation Guide for Commercial, Institutional and Industrial Users*. Prepared for the New Mexico Office of the State Engineer. www.ose.state.nm.us/wucp_ici.html.

State of California, Department of Water Resources. October 1994. *Water Efficiency Guide for Business Managers and Facility Engineers*. www.water.ca.gov/wateruseefficiency.

2.5 Codes, Standards, and Voluntary Programs for Water Efficiency

EPA WaterSense

Overview

Codes and standards are important mechanisms for addressing the efficiency of plumbing equipment, water-using appliances, and building water use. In addition, voluntary programs and guidelines have recently emerged as key market mechanisms, helping to assist facilities adopt water-efficient products and practices.

Standards

Standards specify uniform technical criteria, methods, processes, and practices by which performance is measured. In a strict sense, standards are created through a consensus-based development process. This process seeks agreement of most participants (i.e., more than a simple majority) and resolution of objections of the minority, but not necessarily unanimity.[19] Standards developed by organizations accredited through the American National Standards Institute (ANSI), for example, are considered consensus-based standards. Compliance with standards is considered voluntary unless they have been adopted into law through legislation or regulation.

Table 2-3 lists some of the organizations in the United States and internationally that develop standards related to commercial and institutional water-using products and equipment and water use in buildings.

Table 2-3. Select Standards Development Organizations

Standards Development Organization	Products or Equipment Addressed
American Society of Agricultural and Biological Engineers (ASABE)	Irrigation equipment
American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)	Buildings, water heaters, and humidifiers
American Society of Mechanical Engineers (ASME)	Plumbing products
ASTM International (formerly the American Society for Testing and Materials)	Food service equipment and medical equipment
Association for the Advancement of Medical Instrumentation (AAMI)	Medical equipment
Canadian Standards Association (CSA)	Plumbing products
International Association of Plumbing and Mechanical Officials (IAPMO)	Plumbing products and systems
International Code Council (ICC)	Buildings and plumbing systems
National Sanitation Foundation (NSF)	Commercial kitchen equipment and drinking water treatment units

[19] American Society of Mechanical Engineers. Standards & Certification FAQ. www.asme.org/kb/standards/about-codes---standards.

2.5 Codes, Standards, and Voluntary Programs for Water Efficiency

In 1992, Congress enacted the Energy Policy Act (EPAct)[20]—and later, EPAct 2005—both of which established maximum water consumption requirements for many plumbing products and water-using appliances sold in the United States. Where applicable, EPAct references relevant standards, making their compliance mandatory. The U.S. Energy Department (DOE) is responsible for implementing and enforcing the requirements established under EPAct.

The water-using products and appliances covered by EPAct 2005 include:

- Toilets
- Urinals
- Faucets (e.g., residential lavatory, kitchen, commercial lavatory)
- Showerheads
- Residential clothes washers
- Commercial clothes washers
- Residential dishwashers
- Commercial ice makers
- Pre-rinse spray valves

Codes

Codes provide the criteria necessary to protect public health, safety, and welfare related to building construction and occupancy. Codes can also be adopted into law through regulation, making their compliance mandatory. Codes often reference standards, which provide the details for how to comply with specific requirements.

Plumbing codes are the primary code mechanism governing how water is used in buildings. This includes provisions for supply, distribution, disposal, and water use of specific products or equipment. There are two primary plumbing code development organizations in the United States. IAPMO produces the *Uniform Plumbing Code*, and ICC produces the *International Plumbing Code*. These plumbing codes have no legal status in and of themselves, but they serve as models and, in many cases, have been adopted into law by state and local jurisdictions.

Water-Efficiency Codes, Standards, and Voluntary Programs

Historically, standards and codes have focused primarily on protecting public health and safety. However, in the past 20 years or so, water efficiency has emerged as a commensurate issue that has been incorporated into codes and standards in many places. More recently, voluntary programs have been created to specifically address water uses and water efficiency of products and buildings to go above and beyond federal law and the established codes and standards.

[20] U.S. Energy Department (DOE). Energy Policy Act of 1992. www1.eere.energy.gov/femp/regulations/epact1992.html.

2.5 Codes, Standards, and Voluntary Programs for Water Efficiency

Water-Efficient Products

Recently, voluntary programs have emerged that seek to leverage public/private partnerships and use market-based incentives (e.g., certification label) to further improve the water efficiency and performance of individual products and appliances beyond the requirements established by EPAct or the conventional products available in the marketplace. Notable national voluntary programs specifying product and appliance water efficiency include the U.S. Environmental Protection Agency's (EPA's) WaterSense® program, EPA and DOE's ENERGY STAR,® and the Consortium for Energy Efficiency (CEE):[21]

- WaterSense is a public/private partnership program that develops specifications for water-efficient, high-performing products. Products that are independently certified to meet WaterSense criteria earn the WaterSense label, which distinguishes them from standard products on the market. WaterSense has developed specifications for both residential and commercial products. For more information, visit the WaterSense website.[22]
- ENERGY STAR is a joint public/private partnership program sponsored by EPA and DOE that develops specifications for energy-efficient products and buildings. Products that meet ENERGY STAR criteria are qualified to earn the ENERGY STAR label, which distinguishes them from standard products on the market. ENERGY STAR has developed specifications for many water-using products. For more information, visit the ENERGY STAR website.[23]
- CEE is a non-profit consortium of efficiency program administrators that promotes the use of energy-efficient products, technologies, and services. Where there is significant opportunity and interest from its membership, CEE develops national initiatives that can be used as templates for individual energy-efficiency programs. Related to water efficiency, CEE has developed initiatives for commercial ice makers, residential and commercial clothes washers, residential dishwashers, and some commercial kitchen equipment.

The Alliance for Water Efficiency (AWE) maintains a list of current and proposed national efficiency standards and voluntary specifications for residential and commercial water-using fixtures and appliances.[24] This is a useful reference tool for understanding the types of water-efficient products and appliances that are available on the market and for determining their relative water savings potential.

To further encourage the adoption of water-efficient products and appliances, local jurisdictions or utilities may offer rebates or incentive programs. In many instances, the incentives are provided for products recognized or labeled by the national voluntary programs discussed above.

[21] Consortium for Energy Efficiency, Inc. www.cee1.org.
[22] U.S. Environmental Protection Agency's (EPA's) WaterSense program. www.epa.gov/watersense.
[23] EPA and DOE's ENERGY STAR. www.energystar.gov.
[24] Alliance for Water Efficiency (AWE). Green Building Guidelines & Standards. www.allianceforwaterefficiency.org/Background_on_Green_Building_Specifications.aspx.

Water-Efficient Buildings

As with products, substantial progress has been made to address water use and efficiency in building plumbing systems and whole buildings, primarily as part of a larger movement to improve the environmental performance of buildings. Traditionally, building and plumbing codes have addressed health and safety in plumbing and building water use. Now "green" building standards, codes, and voluntary guidelines are available that also address water-efficient design or construction practices, technologies, performance thresholds, and metrics.

In the world of green building, there is a distinction between green building standards and codes and green building guidelines. As with the discussion of standards above, green building standards and codes are written in language that is enforceable and ready for adoption into law by legislation or regulation, so that their compliance becomes mandatory. Green building guidelines, on the other hand, are not written in enforceable language and are usually intended to be voluntary. Both provide thresholds for efficiency that go above and beyond the established building and plumbing codes and standards.

Table 2-4 shows the prominent national green building codes, standards, and voluntary guidelines that address water efficiency in commercial and institutional buildings.[25] AWE also maintains a chart comparing the water-efficiency criteria of several of these national green building codes, standards, and guidelines.[26]

Table 2-4. National Green Building Codes, Standards, and Voluntary Guidelines

Primary Developing Organization	Title	Standard, Code, or Guideline
U.S. Green Building Council (USGBC)	LEED® Rating Systems[27]	Guideline
Green Globes Green Building Initiative (GBI)	ANSI/GBI 01-2010–Green Building Assessment Protocol for Commercial Buildings	Standard
ASHRAE	ASHRAE 189.1–Standard for the Design of High-Performance, Green Buildings	Standard
ASHRAE	ASHRAE 191–Standard for the Efficient Use of Water in Building, Site, and Mechanical Systems (in development)	Standard
IAPMO	Green Plumbing and Mechanical Code Supplement	Code
ICC	Green Construction Code	Code

[25] *Ibid.*
[26] *Ibid.*
[27] U.S. Green Building Council (USGBC). USGBC: Rating Systems. www.usgbc.org/DisplayPage.aspx?CMSPageID=222.

These green building programs typically address water use and efficiency in the following areas:[28]

- Plumbing fixtures and fixture fittings.
- Appliances (e.g., clothes washers, dishwashers).
- Water treatment equipment (e.g., softeners, filtering systems).
- Landscape and landscape irrigation.
- Pools, fountains, and spas.
- Cooling towers.
- Decorative and recreational water features.
- Water reuse and alternate sources of water (e.g., gray water, rainwater and stormwater, cooling condensate and cooling tower blowdown, foundation drain water).
- Specialty processes, appliances, and equipment (e.g., food service, medical, laboratories, laundries, etc.).
- Metering and submetering.
- Single-pass cooling.
- Vegetated green roofs.
- Building water pressure.

Water -Efficient Businesses

In addition to programs that incentivize green products and buildings, several initiatives recognize businesses for their efforts to reduce the company's impact on the environment. Many of these programs have a multi-media scope while others are specifically focused on water efficiency. These programs can help businesses meet stakeholder demand for transparency and accountability, often called corporate social responsibility. In fact, many companies are reporting their environmental impacts voluntarily to programs to demonstrate their commitment to the environment and goodwill toward the community in a more tangible way.[29] Resources are available at the national, state, or local level, which can assist companies or other organizations on the path to sustainability and reduced environmental impact.[30] Facility managers who actively track their water use, implement water-efficiency measures, and demonstrate savings can contribute to communicating their corporate commitment to sustainability.

[28] AWE. Green Building Introduction. www.allianceforwaterefficiency.org/Green_Building_Introduction.aspx.
[29] Pacific Institute. August 2012. The CEO Water Mandate: Corporate Water Disclosure Guidelines Toward a Common Approach to Reporting Water Issues. pacinst.org/reports/corporate_water_disclosure_guidelines/full_report.pdf.
[30] Ceres. Ceres Aqua Gauge. www.ceres.org/issues/water/aqua-gauge/aqua-gauge.

Several sector-specific programs are also available that focus on issues and challenges common across a particular sector. For example, green hospitality programs now exist in almost every state that provide recognition or facilitate information sharing between partners.[31] These networks can provide expert advice to find new ways to implement water-efficiency initiatives—saving water, energy, and resources at the same time.

Reference Resources

If installing new or replacing existing water-using products or appliances, consider referencing resources, such as the AWE's list of current and proposed national efficiency standards and voluntary specifications for residential and commercial water-using fixtures and appliances.[32] This list is updated on a regular basis to reflect the most recent standards and voluntary specifications. In addition, look for products that have the earned the WaterSense label or are ENERGY STAR qualified.

Check with local jurisdictions or utilities regarding any water-efficiency incentives or rebates they may offer. Both WaterSense[33] and ENERGY STAR[34] maintain lists of some utility partners' rebate programs.

For new construction or major renovation projects, consider following relevant portions of the national green building standards, codes, or voluntary guidelines. Compliance with these green building criteria can save water and be cost-effective. Some of these programs even offer certification or public recognition for conformance. For example, LEED certified buildings can be advertised and marketed with the LEED logo and appropriate rating (i.e., Certified, Silver, Gold, Platinum).

Additional Resources

Alliance for Water Efficiency (AWE). Green Building Guidelines & Standards. www.allianceforwaterefficiency.org/Background_on_Green_Building_Specifications.aspx.

American Society of Heating, Refrigerating, and Air Conditioning Engineers. www.ashrae.org.

American Society of Mechanical Engineers. Standards & Certification FAQ. www.asme.org/kb/standards/about-codes---standards.

AWE. Standards & Codes for Water Efficiency. www.allianceforwaterefficiency.org/Codes_and_Standards_Home_Page.aspx.

Ceres. Ceres Aqua Gauge. www.ceres.org/issues/water/aqua-gauge/aqua-gauge.

Consortium for Energy Efficiency, Inc. www.cee1.org.

[31] Florida Department of Environmental Protection. Green Lodging Designation Program. www.dep.state.fl.us/greenlodging/default.htm.
[32] AWE. Green Building Guidelines & Standards, *op.cit.*
[33] EPA's WaterSense program. WaterSense Rebate Finder. www.epa.gov/watersense/rebate_finder_saving_money_water.html.
[34] EPA and DOE's ENERGY STAR. Special Offers and Rebates from ENERGY STAR Partners. www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator.

DOE, Energy Efficiency & Renewable Energy, Federal Energy Management Program. Energy Management Requirements by Law and Regulation. www1.eere.energy.gov/femp/regulations/requirements_by_reg.html.

EPA and DOE's ENERGY STAR. www.energystar.gov.

EPA's WaterSense program. www.epa.gov/watersense.

Green Building Initiative. www.thegbi.org.

International Association of Plumbing and Mechanical Officials. *2012 Green Plumbing and Mechanical Code Supplement.* iapmomembership.org/index.php?option=com_virtuemart&page=shop.product_details&flypage=flypage_iapmo.tpl&product_id=213&Itemid=3.

International Code Council. *2012 International Green Construction Code.*™ www.iccsafe.org/Store/Pages/Product.aspx?id=3750S12.

Pacific Institute. August 2012. The CEO Water Mandate: Corporate Water Disclosure Guidelines Toward a Common Approach to Reporting Water Issues. pacinst.org/reports/corporate_water_disclosure_guidelines/full_report.pdf.

U.S. Green Building Council. www.usgbc.org.