Reducing Potable Water Use Technical Brief

***Green Guide for Health Care* Version 2.2 Water Efficiency Prerequisite 1, Credit 2.1, 2.2, 2.3, 2.4, 2.5 (*Construction* Section)**
***Green Guide for Health Care* Version 2.2 Water Conservation Prerequisite 1, Credits 2.1, 2.2, 2.3, 2.4, 2.5 & Credit 3 (*Operations* Section)**

Overview

According to the Massachusetts Water Resources Authority (MWRA), health care institutions consistently fall within the top ten water consumers in their communities, with up to 20% of a typical Boston area hospital's total utility bill attributed to water and sewage conveyance alone. MWRA's water conservation initiatives demonstrate that increased awareness coupled with modest financial investment can result in a 19% average annual reduction in water usage.

Water use in hospitals reflects the services they provide, and varies by as much as 40 to 350 gallons per capita per day, depending on the facility type. Using the Massachusetts data as a representative example, the percentage of water dedicated to specific uses falls into the following categories: 42% Sanitary, 23% HVAC, 14% Medical Processes, 9% Food Service, 5% Laundry.

The *Green Guide for Health Care* offers credit for reducing domestic potable water use in fixtures such as toilets and lavatories (referred to as *domestic* water), and for reducing potable water use in mechanical and medical equipment (referred to as *process* water).

Because process water comprises a majority of most health care facilities' total annual water budget – about 70% – the *Green Guide* specifies three groupings of water efficiency strategies applied inside the facility corresponding to five possible points: one for measurement and verification, two for domestic water, and two for process water. A prerequisite requires eliminating potable water use for once through cooling in heat-rejecting medical equipment.

The *Green Guide's* potable water use credits simplify compliance by targeting specific water use strategies, such as low-flow and sensor faucets. This methodology is effective both in reducing facility water use and in eliminating the complexity of a calculation that, to be accurate, separates water usage into functional area categories.

The Challenges

Infection control concerns and potential contamination of potable water supplies pose the strongest challenges to domestic water conservation in hospitals, leading to regulations such as prohibiting piped, non-potable water systems. In addition, some conservation technologies, such as sensor controls for faucets and flush valves, have higher first costs (though are often favorable relative to life cycle costs) and may require an aggressive education campaign to address infection control and time management concerns with facility managers, regulators, and other concerned parties.

Best Practices

Potable Water Conservation Best Practices for Domestic Applications

Implementing a water management plan that encompasses both domestic and process water use is the first step in any water conservation strategy. Staff awareness and a clear action plan can save hundreds of thousands of gallons of water per year and substantial dollar savings as well.

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The following sample water management plan was adapted with permission from the Massachusetts Water Resources Authority website, http://www.mwra.state.ma.us.

1. Develop a Water Management Plan

- Investigate the current facility's water uses and categorize into focus areas.
- Estimate the water used in each category. Identify conservation measures and solicit water savings and cost information from professional associations, trade groups, vendors, etc.
- Set goals. Prioritize which measures to implement based on capital budgets, paybacks, percentage reductions, cost-benefit analysis.

2. Present to Administration & Finance

- Make detailed cost-benefit proposals of projects to administrators illustrating a reasonable payback period.
- Make the business case to financial administrators using vendor quotes, contractor bids, approximate man-hours, project scheduling, and an estimated timeline for savings.
- Include provisions for water efficiency savings to fund future water conservation projects.

3. Implement the plan

- Implement projects with significant payback first. Use the savings and support generated from early projects to fund future projects and prove the overall plan's credibility.
- Implement a continuous education program for all levels of staff.
- Make an ongoing commitment to continuous improvement. Track improvement and savings over time as well as water use throughout the facility through measurement and verification. Spikes in metering data will often point to a leak or other malfunction in the system.

Low-Flow Fixtures

- **Low-flow and sensor faucets.** Sensor faucets result in a 20% savings in water consumption by reducing the amount of time the faucet runs with each use. Low-flow faucets are available at flows as low as 1.5 gallons per minute. 0.5 gpm laminar flow aerators are available that address both water conservation and infection control priorities.
- **Dual-flush flushometers.** Dual-flush flushometers (1.6/1.1 gallons per flush) can be retrofitted using low consumption valve kits. One year paybacks for new equipment are customary. Paybacks as short as one month are possible for retrofitted parts.
- **Dual-flush water closets.** Dual-flush water closets are typically able to flush at 0.8-1.0 gallons per flush for liquid waste and 1.6 gallons per flush for liquids plus solid waste. Many hospitals are resistant to dual-flush water closets due to their newness in the marketplace and the concern that users and maintenance personnel will not understand how they operate. However, the ease, cost-effectiveness, and demonstrated savings associated with retrofitting dual-flush flushometers have led to a higher level of use in existing healthcare facilities.
- **Low-flow and waterless urinals in mens' public restrooms.** Installation of non-water using urinals requires positive slope on waste lines. Some first cost savings can be realized if domestic water is not roughed in to the fixture location, but some facilities insist on "hedging their bets" just in case they ever have to install conventional fixtures. If non-water using urinals are not an option (as is the case in some jurisdictions that prohibit them), specify reduced flow urinals (below 1.0 gallon per flush), which have been proven in the marketplace for several years. One pint flush urinals are new entries to the marketplace.
- **Low-flow and soap-valve showerheads.** Low-flow showerheads are available at flows as low as 1.0 gallon per minute. A showerhead with a soap valve typically results in 20% water savings. Hospitals are generally more receptive to installing reduced flow showerheads (1.8 gallons per

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minute) and sensor faucets than other technologies that are newer to the marketplace due to concerns about water pressure and aerosolization.

Food Service Areas

- Eliminate the use of a garbage disposal or reduce the flow of water to the disposal. Reuse rinse water from the dishwasher for the garbage disposal or for the pre-wash cycle.
  Install low flow spray rinsers with foot pedals in hospital food service areas.

Green Housekeeping

- Cleaning water can average 10% of all domestic water use in a hospital. Following green housekeeping protocols, such as microfiber mops and non-toxic cleaning chemicals, can help reduce water use in housekeeping activities. Specifying finish materials that preclude the use of chemicals for cleaning – such as linoleum and rubber flooring that avoid strip and wax regimens – simplifies the cleaning process and saves water while reducing chemical use.

Potable Water Conservation Best Practices for Process Applications

- **Water metering:** (GGHC v2.2 Water Efficiency Credit 2.1) is the first step in process water conservation. Metering allows systems to be monitored, to indicate when they are not performing as designed and make appropriate adjustments, and to track improvement over time.
- **Cooling towers:** (GGHC v2.2 Water Efficiency Credit 2.4 & 2.5) Reduce excessive cooling tower blowdown by installing automatic controls and conductivity meters. Install a chemical-free cooling tower system. Reuse air handler condensate as cooling tower blowdown makeup.
- **Closed loop systems:** (GGHC v2.2 Water Efficiency Credit 2.4) Return steam condensate to boiler equipment. Install or retrofit closed loop systems on water-cooled refrigeration and air-conditioning units.
- **Equipment:** Install or retrofit automatic shut-off valves on equipment that uses water for processing or sterilization.
- **Film processing:** Eliminate water used for film processing by installing computerized radiology equipment.
- **Equipment cooling:** (GGHC v2.2 Water Efficiency Prerequisite 1) Install a closed loop system for cooling water runoff on sterilizers and autoclaves. Cool sterilizer condensate using draining technology or holding tanks rather than potable water.
- **Medical air compressors and vacuum pumps:** (GGHC v2.2 Water Efficiency Credit 2.4) Eliminate the water seal and cooling water system or install a recirculating seal and cool water loop. Set water flow to surgical vacuum pumps to the acceptable minimum level.
- **Laundry:** Install laundry facilities with a rinsewater reclamation system.

Benefits

Health

Clean water is intimately connected with human health. According to the US EPA[1], 97.2% of the Earth's water is in the world's oceans and not available for human use. The majority of the remaining fresh water is trapped in the polar ice caps, icebergs, and glaciers. Worldwide demand for water continues to grow alongside growth in population and expansion in agricultural and industrial demands, drawing from a finite

[1] http://www.epa.gov/reg5rcra/wptdiv/p2pages/water.pdf

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source. Potable water treatment systems require significant community infrastructure, investment, and maintenance. Processing potable water is energy intensive and thus contributes to air emissions associated with fossil fuel energy generation (for the treatment, pumping, and maintenance of the potable water systems). (In some municipalities, water treatment systems represent the highest energy demand over all other municipally-controlled energy use categories.) In addition, potable water processing often includes the use of toxic disinfection chemicals such as chlorine. Only about 20% of water used in urban areas in the U.S. is used for drinking and sanitary purposes, while the other 80% does not require treatment to potable standards. As significant consumers of potable water, health care facilities can spur the market to conserve potable water and to start depending on non-potable water sources for process uses.

Ecologic

According to the Organisation for Economic Co-operation and Development (OECD) the U.S. uses more water per person than any other country. High consumption rates of potable water places stress on lakes, aquifers, and waterways and can alter an entire ecosystem's functioning through the construction of dams or drawing so much water out of a river that it is unable to reach its natural terminus. The discharge of polluted water into these waterways can also seriously disrupt aquatic ecosystems. Sewage and wastewater effluent can pollute local ecologies through non-point sources (e.g., use of fertilizer and pesticides in landscaping), sanitary sewer overflows, stormwater sewer overflows, and hydrologic modifications (e.g., erosion or dredging). In 2000, the U.S. EPA's National Water Quality Inventory Report found that 39% of river and stream miles, 45% of lake acres, and 51% of estuarine square miles did not meet the ambient water quality standards required by the Clean Water Act.

Economic

Proven conservation measures can result in a 25% domestic water savings. The following example illustrates the resulting economic savings for a typical medium size 200-bed hospital:

> If the domestic potable water use is 30% of 200 gal/bed/day (60 gal/bed/day), a 25% reduction equals 3,000 gal/day or approximately 1 million gallons per year.
>
> A typical municipal water charge is $2 per 100 cubic feet (0.25 cents/gal), although water rates can vary dramatically in certain regions of the country. Sewage charges are typically at least equal to, if not more than the metered water charge. Savings of 1 million gallons would equal at least $500,000 annually, or approximately $7 per day per bed.

Some water conservation strategies may increase first cost. However, these measures have the potential to reduce a facility's operational or life cycle costs as well as enhance relations with the surrounding community. A hospital that does not burden the local utilities demonstrates environmental and community stewardship, and is viewed as a desired neighbor. These funds can be reinvested into further conservation strategies or diverted to upgrade equipment or hire staff, a health care institution's largest annual expenditure.

Case Studies

Dartmouth-Hitchcock Medical Center, Lebanon, NH

Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire, invested $350,000 in a series of water conservation retrofits in both the domestic and process water systems. The retrofits resulted in a three and a half year payback period.

The domestic water conservation strategies included installing low flow water closets and flow restrictors on sink faucets in clinical areas as well as in the food service area, subject to staff approval. The flow restrictors in the food service area were set to design flow levels that approximate the optimal operating condition for each device.

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On the process water side, the hospital installed tempering systems on the autoclaves and boilers to temper blow down water to maintain appropriate wastewater temperatures while minimizing the amount of cold water injected into the system for temperature control. Closed loop recirculating systems and heat exchangers were installed on medical air and vacuum pumps to eliminate once through use of potable water. The hospital also installed a recirculation system for the reverse osmosis and de-ionization systems, which recirculates approximately 50% of the rejected water back through the system.

The hospital attributes its success to researching the way water moved through the building before designing the retrofit and the early involvement of all affected departments. Backup processes were installed to limit disruption to the daily operation of the facility during construction. The design team worked with equipment manufacturers to reduce water consumption without affecting the optimal operation of equipment or water quality. Finally, the hospital educated users about the retrofit equipment and technologies. For instance, some users initially double flushed the low flow toilets until informational posters explained how the different technology functioned.

For more information, see http://www.des.state.nh.us/studies/dhmc.htm.

Tufts-New England Medical Center, Boston, MA

Tufts-New England Medical Center reduced total water use by 24% (18 million gallons per year) through a retrofit project carried out by consultant H2O Matrix on a variety of systems. They reduced water use in sterilizers by 85% by installing a steam condensate tempering system (CTS) that uses a temperature sensing probe to inject the minimum amount of cold water required to reduce the temperature of water leaving sterilizers to regulated levels. Low voltage electric vacuum pumps were installed on vacuum sterilizers to replace a water seal that lost 9 gallons of water per minute. Processor flow control units were installed on film processing machines to stop water flow when the equipment is not in use. A condensate receiver reclamation tank in the building's basement receives water from the reject side of the linear accelerator heat exchangers and from the reverse osmosis system. Water from the tank is piped to the facility's cooling towers to be used for evaporative cooling or into the building's non-potable water supply, depending on water pressure. The facility's flushometers were calibrated to 1.6 gal/flush. They had previously varied up to 3 gallons per flush.

Resources

In addition to the resources noted in the Green Guide for Health Care, the following may offer additional guidance:

Dartmouth-Hitchcock Medical Center, http://www.des.state.nh.us/studies/dhmc.htm

Hospitals for a Healthy Environment, http://www.h2e-online.org

Massachusetts Water Resources Authority, http://www.mwra.state.ma.us/

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