

INDOOR WATER CONSERVATION

WATER CONSERVATION POTENTIAL



COST-EFFECTIVE WATER CONSERVATION OPTIONS



BEST PERFORMANCE FROM REPLACEMENT FIXTURES



HIGH-EFFICIENCY SAVES MORE WATER THAN LOW-FLOW



SENSOR-OPERATED FAUCETS



SENSOR-OPERATED TOILETS



DUAL-FLUSH TOILETS



WATER-SAVING URINALS



NOT JUST A DROP IN THE BUCKET: WATER CONSERVATION POTENTIAL AT FEDERAL FACILITIES

Civilian agencies use 47 billion gallons of water annually; “off the shelf” conservation measures could save \$35–\$50 million annually.

Over 400 billion gallons of water are used every day in the United States. Demand is increasing even though usable supply is decreasing. Civilian agencies in the federal government use 47 billion gallons of water per year, the equivalent of more than 70,000 Olympic-size swimming pools. Agencies could save 7.8–12.3 billion gallons (17–26%) annually just by using simple “off the shelf” water conservation measures, including replacing existing toilets, faucets, and showerheads with more efficient versions. In many cases, these measures could be sufficient to meet the indoor water consumption goals of Executive Order 13514.

Civilian agencies spend about \$135 million annually on water and sewer expenses. Installing high-efficiency fixtures can save significant money.

- If widely implemented, simple conservation measures could save an estimated \$35–\$50 million annually in water costs annually across federal civilian agencies – or more if water costs continue to rise in the future.¹
- High-efficiency faucets and showerheads save energy from reduced water heating. This could conserve 255–550 billion BTUs per year, producing additional savings of \$8–\$10 million.
- WaterSense products use at least 20% less water than standard code-compliant products.

High-efficiency fixtures make attractive investments once you decide to replace your existing fixtures. High-efficiency faucets, showerheads, and urinals do not cost more than standard ones, and savings are immediate. While high-efficiency toilets may have a slightly higher upfront cost, they pay for themselves quickly.

- A 1.0 gallon per flush (gpf) pressure assist toilet has a payback of 2.7 years when replacing a standard 1.6 gpf toilet.
 - Payback is faster for women’s restrooms than for men’s rooms due to different usage patterns.
 - Note: water savings may not be sufficient to financially justify replacing toilets not already slated for replacement. In addition, financial savings will vary depending on local water and sewer rates.

¹ These figures are based on nationwide averages among federal facilities. Thus, the effects of any variation in water and sewer rates from city to city are already incorporated. Reducing a \$135 million water bill by \$35–50 million is a reduction in cost of between 26–37%. This is larger than the corresponding water use reduction of 17 – 26%. All data cited in the first two paragraphs is from McMordie Stoughton, but the \$135 million estimate was not developed by them; it came from another source that McMordie Stoughton cited. The difference between percentage water savings and percentage financial savings is likely driven by differences in average and marginal water costs; however, this cannot be verified based on the information provided by the research.



COST-EFFECTIVE WATER CONSERVATION OPTIONS

Federal agencies can use 17–24% less water and meet conservation goals by using cost-effective “off the shelf” measures.

Federal agencies can save 17–24% of total (indoor and outdoor) water use annually by using cost-effective, “off the shelf” water conservation measures. Indoor water uses account for approximately 78% of total water consumption in a typical office building. Executive Order 13514 sets goals for federal agencies to reduce indoor water consumption 26% below 2007 levels by 2020. Off the shelf measures could be sufficient to meet the indoor water consumption goals of the Executive Order.²

Some water conservation options are more cost-effective than others. Conservation choices will depend on your particular circumstances; due to price variations, facilities in certain locations may find water conservation more financially appealing than in other areas.³

- 1. If you have already decided to replace your fixtures**, high-efficiency showerheads, faucets, and urinals do not cost more than standard ones and savings are immediate. While high-efficiency toilets may have a slightly higher upfront cost, they pay for themselves quickly. A 1.0 gallon per flush (gpf) pressure assist toilet has a payback of 2.7 years when installed instead of a standard 1.6 gpf toilet. Sensor-operated faucets may provide additional savings over manually-operated ones, but they have a much higher upfront cost and a payback period of eight years.
- 2. If you have older (pre-1992) fixtures and are considering replacing them** to realize water savings, high-efficiency faucets and showerheads are good options, with payback periods of just a few months. High-efficiency urinals (0.5 gpf) and toilets (1.0 gpf) both have payback periods of about six years when installed in place of standard options.
- 3. If you have newer standard fixtures that you are considering replacing solely to realize water savings**, high-efficiency faucets and showerheads are still good investments, with payback periods of a year or less. High-efficiency urinals have a much longer payback period of 13 years, while high-efficiency toilets will require 27 years to recover the upfront cost.

Facility managers can evaluate other site-specific water conservation options such as cooling towers, stormwater reuse, and replacing sensor-operated fixtures with manual ones.

² Assuming a split of 78% indoor water use and 22% outdoor water use (McMordie Stoughton et al., 2005, p. B.5), 17 - 24% of all water use would be equivalent to 22 - 31% of indoor water use.

³ Water prices vary by a factor of five from the most expensive (Santa Fe) to least expensive (Phoenix) cities included in an available compilation of water pricing.



GETTING THE BEST PERFORMANCE FROM REPLACEMENT PLUMBING FIXTURES

Federal facilities can achieve 25% of the EO 13514 water conservation goal by retrofitting facilities with high-efficiency toilets.

Federal facilities can achieve 25% of the EO 13514 water conservation goal by retrofitting restrooms with high-efficiency toilets.⁴ An office with 500 employees can save at least 80,000 gallons of water per year - more than 6% of total indoor water use - by replacing 1.6 gallon per flush (gpf) toilets with WaterSense models, which use 20% less water⁵

A successful retrofit requires more than just replacing old fixtures. Follow the tips below to ensure your new toilets perform well without introducing any unexpected problems:

1. Review the maintenance history of the plumbing in your facility.
2. Check for leaks before installing new fixtures. You will not see any substantial savings if your pipes are leaking.
3. Check the age of your building. For buildings with older infrastructure, installing high-efficiency toilets may create problems with drainlines since these systems were designed for higher water flows. Facilities built after 1992 or renovated since that time shouldn't have problems. For older facilities, have an expert inspect your drainlines for inadequate slope, defects, root intrusions, sagging, or other physical conditions that could result in clogging with lower flush volumes. For larger systems consider additional engineering analyses; for drainlines with combined flows, examine the impact of reduced flows from multiple sources.
4. Pay specific attention to isolated fixtures responsible for carrying solid waste down long horizontal drainline runs. If necessary, install higher-volume fixtures in these problem areas.
5. For systems prone to chronic blockages, use toilet paper that is readily dissolvable (i.e., safe for septic systems) to lower the risk of blockages.⁶

4 For a typical office, indoor water use constitutes 78% of total water use. Restrooms account for 40% of total water use, while toilets account for 61% of restroom water use. Thus, toilets use $40\% \times 61\% / 78\% = 31.3\%$ of indoor office water use (see McMordie Stoughton et al. 2005, p. B.5). With WaterSense toilets using 20% less water and accounting for 31.3% of indoor water use, $20\% \times 31.3\% = 6.3\%$ total savings or nearly a quarter of the 26% savings called for by Executive Order 13514.

5 Office employees typically use the restroom three times per day; women use the toilet for all three uses, while men use the toilet once and a urinal twice, resulting in an average of two flushes per employee per day (assuming a 50/50 male/female split) (see McMordie Stoughton et al. 2005, p. B.5). Annual water savings are calculated as 2 flushes/person/workday x 1.6 gallons/flush x 20% savings x 500 people x 250 workdays/year = 80,000 gallons.

6 Based on the literature and some preliminary examination, it seems that while there isn't a single clear terminology that consumers should look for, the best bets would be "rapid dissolving", septic safe, or something similar. It appears relatively easy to find both of these. Note also that based on the PERC 2012 article, it appears that single-ply paper is generally, but not always, better in this regard.

HOW LOW CAN YOU GO? HIGH-EFFICIENCY SAVES MORE WATER THAN LOW-FLOW

“High-efficiency” fixtures use less water than “low-flow.” Since 1992, “low-flow” toilets and urinals have been the highest volume allowed by law.

High-efficiency is preferable to low-flow. To meet the continuing demand for more efficient fixtures, manufacturers have developed “high efficiency” fixtures. These include 1.28 gallon per flush (gpf) toilets and 0.5 gpf urinals.

No matter the terms used, the key is understanding the volume of water per flush.

The term “low-flow” refers to the 1.6 gpf toilets and 1.0 gpf urinals that were made performance standards by the Energy Policy Act of 1992. These were “low-flow” compared to earlier “conventional” models, and the name stuck. Today the 1992 **“low-flow” fixtures are minimally code compliant** and represent the highest volume you are allowed to install. In many cases installing new “low-flow” fixtures won’t provide any additional water savings.

When evaluating existing fixtures and selecting new fixtures, consider the following:

- If your facility was built after 1992 or had a substantial renovation since 1992, it already has “low-flow” fixtures. If you install new “low-flow” fixtures you are not saving water; you are complying with basic code requirements.
- If your facility was built before 1992 and has not had a substantial renovation since then, it is likely that the fixtures in your facility use more water than the current code. Replacing your fixtures to meet current codes would save water, but installing “high efficiency” fixtures would save even more.

THE DEVIL'S IN THE DETAILS: GETTING WATER SAVINGS OUT OF SENSOR-OPERATED FAUCETS

Some sensor-operated faucets use more water than manually-operated ones. To save water, look for a 0.5 gpm flow rate and a 15-second shut-off time.

Sensor-operated faucets can deliver hygiene benefits and water savings compared to manually-operated faucets, while also mitigating potential vandalism. The level of water savings available depends on both the flow rate of the faucet and the timing of the automatic shut-off.

One year-long study found that replacing 1.32 gallon per minute (gpm) manual faucets with 1.21 gpm faucets resulted in a 30% increase in water use, although it isn't clear what sensor timing settings were used.

To ensure water savings, look for sensor-operated faucets with a flow rate of 0.5 gpm and a shut-off time of 15 seconds. A faucet with those characteristics produces water savings over a standard manual faucet, even if the sensor mistakenly turns on the faucet for one cycle more than desired for each hand-washing. Savings would even be greater with a more accurate sensor.⁷

⁷ Estimated savings under these circumstances are calculated as follows: The average hand-washing lasts 20 seconds (McMordie Stoughton et al. 2005, p. B.5). At the maximum flow rate, each hand-washing with a standard faucet would use 0.44 gallons of water: 1.32 gallons/minute x 20 seconds x 60 seconds = 0.44 gallons. For a sensor-operated faucet with a 15-second shutoff time, 20 seconds would require two cycles; one additional, undesired cycle would bring the total to three cycles or 45 seconds total per hand-washing. This would use 0.375 gallons of water: 0.5 gallons/minute x 45 seconds x 60 seconds = 0.375 gallons. This represents a savings of 14.8% over the manual faucet. Note that savings would be lower without the assumption that manual faucets always operate at their maximum flow rates.

This level of water savings from faucets would amount to 1.7% of indoor water use for a typical office building, calculated as follows: Indoor water use constitutes 78% of total water use; restrooms account for 40% of total water use, while faucets account for 22% of restroom water use; thus, restroom faucets use $40\% \times 22\% / 78\% = 11.3\%$ of indoor office water use (see McMordie Stoughton et al. 2005, p. B.5). $14.2\% \text{ savings} \times 11.3\% = 1.6\%$, which is 6.2% of the 26% savings required by Executive Order 13514. Across the entire federal government, this level of savings would conserve more than 2.3 billion gallons of water per year (see McMordie Stoughton et al. 2005, p. 5.2 for total consumption levels).



DOWN THE DRAIN: SENSOR-OPERATED TOILETS MAY WASTE WATER (AND MONEY)

Sensor-operated toilets can use more water than manually-operated ones. Consider dual-flush or high-efficiency toilets instead to achieve water savings.

Despite their reputation for being more environmentally friendly, some sensor operated toilets can use more water than manually-operated ones.

This is likely due to the phenomenon of “phantom flushing,” which typically happens when the movement of a person within a toilet stall triggers the sensor and activates the flush unnecessarily.

One year-long study found that replacing manual toilets with sensor-operated versions resulted in a 54% increase in water use. There may be reasons to use sensor-operated toilets other than water conservation, such as hygiene benefits, but decision-makers concerned primarily with water conservation should carefully examine the documented performance of the models they are considering. Look at other options such as dual-flush or high-efficiency toilets.

SMART DESIGN: ENSURING YOUR DUAL-FLUSH TOILET ACTUALLY SAVES WATER

The amount of water savings from a dual-flush toilet is driven by user behavior; choose a design that defaults to the reduced flush option. Changing behavior is hard. Changing hardware is easy.

Dual-flush toilets may or may not achieve their predicted savings. Manufacturers of dual-flush toilets claim substantial savings over standard toilets. Under the right conditions, facilities can see results in line with these predictions. One study found that a building with permanent occupants that installed dual-flush toilets had water savings of 32% over standard, 1.6 gallon per flush (gpf) toilets. For an office with 500 employees, this could save 128,000 gallons of water per year,⁸ or 10% of total indoor water use. This represents over one-third of the improvement called for under Executive Order 13514.⁹ Installing dual-flush toilets only in the women's restrooms would save 96,000 gallons annually, or 7.5% of indoor water use.

Savings are strongly influenced by user behavior, which determines the ratio of reduced flushes to full flushes. To maximize water savings, you should choose a design that defaults to the reduced flush option. Look for a design where the reduced-flush comes from pushing the handle down rather than pulling it up. People are more accustomed to pushing down to flush. This design also helps people who use their foot to flush, since it is easier to push a handle down with your foot than to pull it up. Alternately, instead of a traditional handle, a design with two separate, clearly-labeled buttons can eliminate any confusion.

If you do have a design where users pull the handle up for a reduced-flush, you should use visual cues that make people take notice of the toilet's water-saving features to help them overcome their ingrained behavior of pushing down to flush. A green handle can be a helpful reminder, as can signage communicating the savings possible from low-flow flushes.

Usage patterns of dual-flush toilets are different in restrooms with many transient users versus buildings where the same occupants use the toilets consistently. Dual-flush toilets may make more sense in facilities such as office buildings with a high proportion of permanent users than in buildings with high-visitor traffic.

⁸ Office employees typically use the restroom three times per day; women use the toilet for all three uses, while men use the toilet once and a urinal twice, resulting in an average of two flushes per employee per day (assuming a 50/50 male/female split) (see McMordie Stoughton et al. 2005, p. B.5). Annual water savings are calculated as 2 flushes/person/workday x 1.6 gallons/flush x 32% savings x 500 people x 250 workdays/year = 128,000 gallons/year.

⁹ For a typical office, indoor water use constitutes 78% of total water use. Restrooms account for 40% of total water use, while toilets account for 61% of restroom water use. Thus, toilets use $40\% \times 61\% / 78\% = 31.3\%$ of indoor office water use (see McMordie Stoughton et al. 2005, p. B.5). $32\% \text{ savings} \times 31.3\% = 10\%$, which is 38.5% of the 26% savings called for by Executive Order 13514.

BEST BETS FOR WATER-SAVING URINALS

High-efficiency urinals, including types saving 5,000 gallons per unit annually, are available for reducing water in existing buildings.

The baseline comparison for commercial urinals (per EO 13514) is 1.0 gallon per flush (gpf).

Option 1

The best choice to maximize water savings is to replace existing urinals with high-efficiency urinals (HEUs) that use 0.125 gpf (1 pint), a savings of 88%. This is not possible in all locations, since the replacement unit requires a particular plumbing arrangement: a distance of 31.5 – 34.5 inches between the waste outlet center line and the supply height and exposed plumbing which allows for easy replacement. According to one study, just 23% of urinals evaluated would qualify for this option.

Option 2

If installing 0.125 gpf urinals is not possible, the next-best option is to replace existing flush valves with adjustable piston-type valves. Adjustable valves should have a range of 0.3 – 1.5 gpf, and be set to optimum efficiency using conductivity measurements. This option is available in urinals with exposed, manually operated flush valves, which accounts for 72% of the market.

At typical usage levels, Option 1 would save over 5,000 gallons of water per year per urinal, while Option 2 would save 2,200 gallons of water per year per urinal – or 50,000 to 110,000 gallons for a 500-person office.¹⁰ For a typical office building, this reduction amounts to 3-8% of total indoor water use or 13-30% of the improvement called for under Executive Order 13514.¹¹

In some cases, waterless urinals may be another option. See www.sftool.gov for more information on plumbing fixtures and their comparative resource impacts.

10 A typical office building has one urinal per 11.5 employees; male office employees typically use a urinal twice per workday (see McMordie Stoughton et al. 2005, pp. B.5, C.1 and C.2). For 0.125 gpf urinals, annual water savings are calculated as 11.5 men/urinal x 2 flushes/man-workday x 250 workdays/year x 7/8 gallons saved/flush = 5,031.25 gallons saved per urinal per year. For adjustable piston-type valves, annual water savings are calculated as 11.5 men/urinal x 2 flushes/man-workday x 250 workdays/year x 0.39 gallons saved/flush = 2,242.5 gallons saved per urinal per year. The 0.39 gpf savings is based on 0.52 gpf savings x 74.1% of urinals, with zero savings for the other 25.9% of urinals (see SBW Consulting 2007, p. 28)

11 Assumes 22 urinals for 500 office workers, based on a ratio of 11.5 men per urinal and a 50/50 split between male and female office employees (see McMordie Stoughton et al 2005, pp. C.1 and C.2). For a typical office, indoor water use constitutes 78% of total water use. Restrooms account for 40% of total water use, while urinals account for 17% of restroom water use. Thus, urinals use 40% x 17% / 78% = 8.7% of indoor office water use (see McMordie Stoughton et al. 2005, p. B.5). The 87.5% savings (7/8) x 8.7% = 7.6%, which is 29.3% of the 26% savings called for by Executive Order 13514. Meanwhile, 39% savings x 8.7% = 3.4%, which is 13.1% of the 26% savings called for by Executive Order 13514.

WATER QUIZ



More than 400 billion gallons of water are used every day in the U.S. While water may appear to be an abundant resource, the usable supply is quite limited. Actually, only 1% of all water is suitable and available for human use. The global population is growing, and demand for water is increasing even though usable supply is decreasing.

We often take water for granted. How much do you really know? Test your water knowledge with the statements below:

1. Federal facilities could save more than 50 billion gallons of water – the equivalent of about 70,000 Olympic-size swimming pools – by employing simple fixes. [True](#) ~ [False](#) ~ [It Depends?](#)
2. Federal facilities would save \$211 million annually in water costs by employing simple fixes. [True](#) ~ [False](#) ~ [It Depends?](#)
3. Low-flow fixtures save more water than high-efficiency fixtures. [True](#) ~ [False](#) ~ [It Depends?](#)
4. Facility managers and designers should always do an infrastructure check-up before upgrading fixtures. [True](#) ~ [False](#) ~ [It Depends?](#)
5. To conserve water, federal facilities must upgrade their toilets. [True](#) ~ [False](#) ~ [It Depends?](#)
6. Dual-flush valves are best used in public restrooms. [True](#) ~ [False](#) ~ [It Depends?](#)
7. There are no good options for reducing water use from urinals in existing buildings. [True](#) ~ [False](#) ~ [It Depends?](#)
8. Sensor-operated toilets are more efficient than manually-operated flush toilets. [True](#) ~ [False](#) ~ [It Depends?](#)
9. Of all the fixture upgrades, showerhead and faucet replacements make the most sense. [True](#) ~ [False](#) ~ [It Depends?](#)



1. Federal facilities could save more than 50 billion gallons of water – the equivalent of about 70,000 Olympic-size swimming pools – by employing simple fixes. **TRUE**

Federal facilities could save 35 – 50 billion gallons (17 – 24 % of federal water use) by installing “off the shelf” water conservation measures.

- “Off the shelf” measures include replacing existing fixtures with high-efficiency versions such as WaterSense toilets, faucets, and showerheads.
- Most savings may be achieved by facilities that were built before 1992 and have not been renovated. Toilets manufactured before the Energy Policy Act (EPAAct) of 1992 typically use 3.5 gallons per flush (gpf) and urinals manufactured before 1992 use up to 3.0 gpf.
- Each year federal facilities (military & civilian) use about 210 billion gallons of water – enough to fill about 320,000 Olympic-size swimming pools.



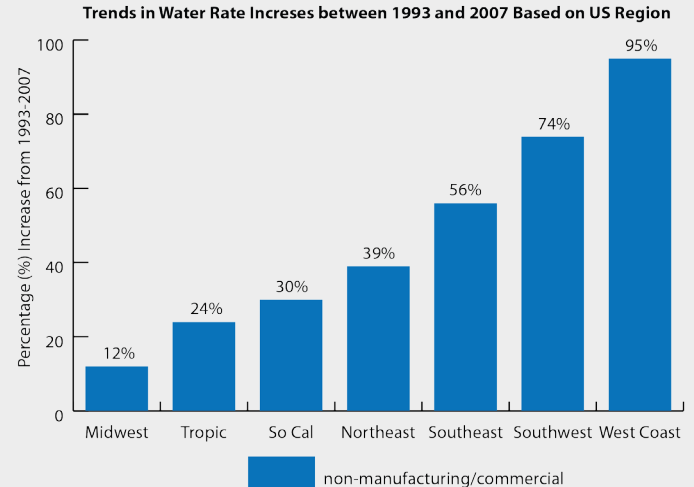
2. Federal facilities would save \$211 million annually in water costs by employing simple fixes. **IT DEPENDS**

Whether an individual project is worthwhile will vary depending on location, water rates, and plumbing needs. Financial justifications for fixture upgrades should first consider your particular project needs, including fixture age and water costs.¹

Water is relatively cheap in many places, but simple fixes, such as replacing existing fixtures with high-efficiency fixtures, can provide annual savings estimated at \$152 - \$211 million across the federal sector, even considering variations in water rates.

- If your facility has newer toilets and urinals, water savings (based on current water costs) may not be sufficient to financially justify replacing them. However, high-efficiency faucets and showerheads can still be good investments, with payback periods of one year or less.
- If your project is already upgrading fixtures, high-efficiency faucets, showerheads, and urinals do not cost any more than standard ones, so their savings are immediate. While high-efficiency toilets may have a slightly higher upfront cost, they pay for themselves quickly. For example, a 1.0 gallon per flush (gpf) pressure-assist toilet has a payback of 2.7 years when installed instead of a standard 1.6 gpf toilet.
- If your facility has pre-1992 fixtures, it may be worthwhile to upgrade the fixtures even if you hadn't already planned to replace them. High-efficiency faucets and showerheads are good options, with payback periods of just a few months. High-efficiency urinals (0.5 gpf) and toilets (1.0 gpf) both have payback periods of about six years compared to standard fixtures.

Financial justifications for fixture upgrades should also include consideration of your future water costs. Analysis of water rates across the U.S. from 1993 – 2007 show typical escalation rates of between 4% and 8%.² Depending on the region, escalation may be significantly higher.



¹ McMordie-Stoughton, Solana, Elliot, Sullivan and Parker (2005)

² Giever, McMordie-Stoughton, Loper (2010)



3. Low-flow fixtures save more water than high-efficiency fixtures. **FALSE**

People often use the term “low-flow” to describe any water-conserving fixture. However, the meaning of “low-flow” has changed over time. When the term originated in 1992, it referred to the most efficient fixtures you could buy. It was used to describe the 1.6 gallon per flush (gpf) toilets and 1.0 gpf urinals which were made the performance standard by the Energy Policy Act (EPAAct) of 1992. Relative to earlier fixture models, these were “low-flow” and the name stuck.

Since 1992, fixture design has improved. The EPAAct 1992 low-flow fixtures are now baseline plumbing code requirements, the largest flow you are allowed to install. Today, the most efficient fixtures are called “high-efficiency” fixtures.

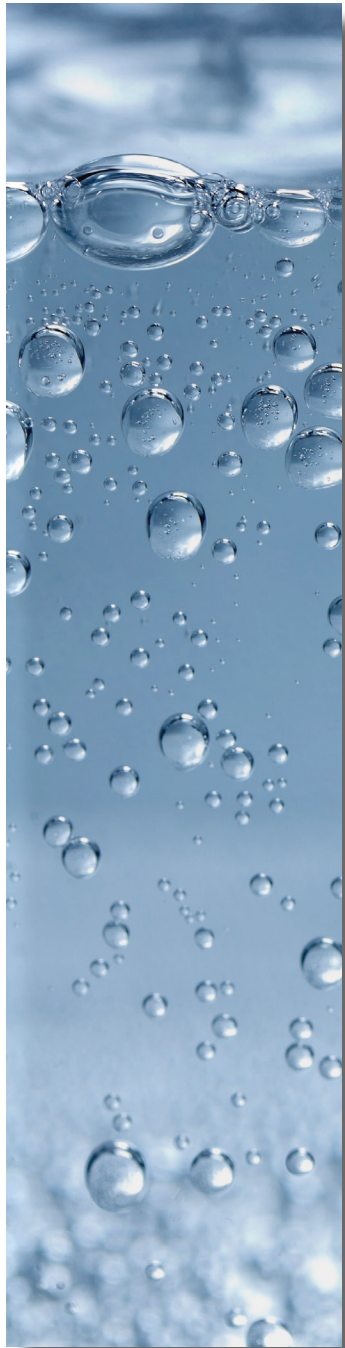
For a typical office building, 78% of total water consumption comes from indoor uses. Executive Order 13514 requires federal agencies to reduce indoor water use to 26% below 2007 levels by 2020. Depending on the type of fixtures currently installed, low-flow fixtures may save water.

- If your facility was built after 1992, or had a substantial renovation since 1992, it already has low-flow fixtures so you are complying with basic code requirements. To save even more water, consider high-efficiency fixtures.
- If your facility was built before 1992 and has not had a substantial renovation since 1992, then it is likely the fixtures in your facility use more water than the current code. Replacing with low-flow fixtures will save water, but you would save more water by installing high-efficiency fixtures.

<i>Comparisons of water use by fixture type from the 1980s to 2012.</i>						
fixture type	conventional		low-flow		high-efficiency	
	<i>1980's water use</i>	<i>1990 requirement</i>	<i>EPAAct** 1992 requirement</i>	<i>2009 plumbing code (IPC)**</i>	<i>2012 green code (IGCC)**</i>	<i>WaterSense</i>
toilet residential	5.0+ gpf**	3.5 gpf	1.6 gpf	1.6 gpf	1.28 gpf	1.28 gpf
toilet - commercial	5.0+ gpf	3.5 gpf	1.6 gpf	1.6 gpf	1.6 gpf	na
urinal	1.5 to 3.0+ gpf	1.5 to 3.0 gpf	1.0 gpf	1.0 gpf	0.5 gpf	0.5 gpf
lavatory faucet - residential	2.5+gpm**	2.5 gpm	2.2 gpm	2.2 gpm	1.5 gpm	1.5 gpm
lavatory faucet - commercial	3.5+ gpm	2.5 gpm	2.2 gpm	0.5 gpm	0.5 gpm	na
showerhead	3.5+ gpm	3.5 gpm	2.5 gpm	2.5 gpm	2.0 gpm	2.0 gpm
food service pre-rinse spray valve	5.0+ gpm	na	1.6 gpm (EPAAct 2005)	na	1.3 gpm	1.28 gpm

**EPAAct: Energy Policy Act; IPC: International Plumbing Code; IgCC: International Green Construction Code; gpm = gallons per minute; gpf = gallons per flush

Continued>



Old technology can still function and updates and accessories may improve performance but replacing systems with current technology typically provides optimum performance.

Consider this car analogy... Older cars don't tend to be fuel-efficient but they may still run. You might improve fuel efficiency through more frequent tune-ups, upgrading the carburetor, or converting the fuel system. But to get the most efficient performance you need to invest in a new car such as a hybrid, electric, compressed natural gas (CNG), or very high mpg model.

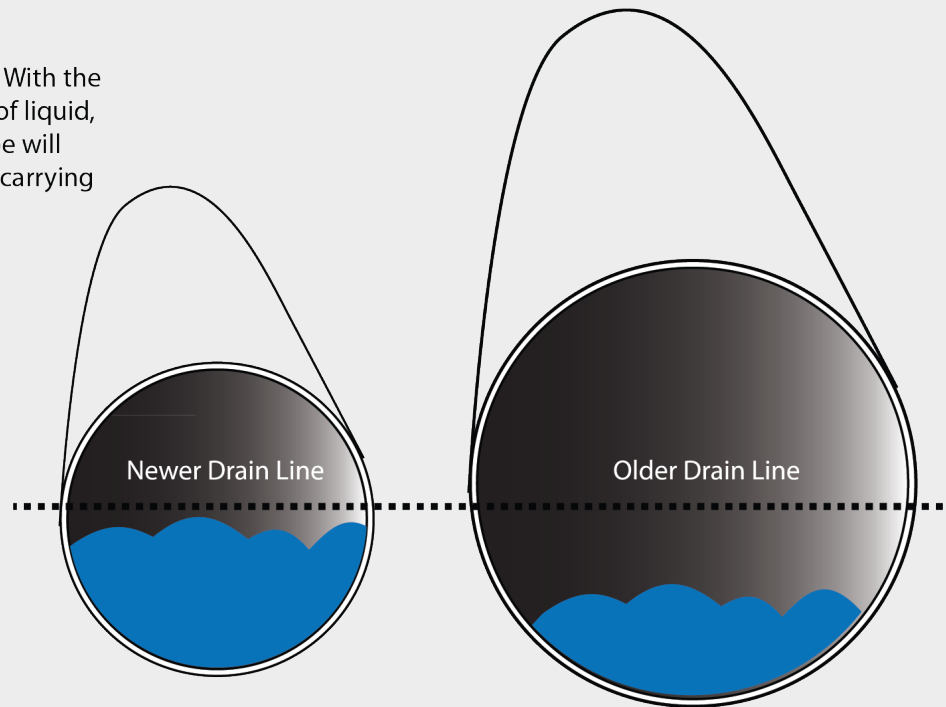
Similarly, older plumbing fixtures may still work. Upgrading flush valves and more frequent maintenance may improve their efficiency. But optimum water savings is likely to require replacing older fixtures with the best current technology and high-efficiency fixtures.

4. Facility managers and designers should always do an infrastructure check-up before upgrading fixtures. **TRUE**

Water infrastructure is a critical part of a successful upgrade. Drainlines are sized and sloped to accommodate a specified range of flow. That range varies with the age (and applicable code requirements) of the building. Older drainlines were sized to accommodate a greater volume of flow from less efficient fixtures. Their size is not usually a problem in carrying liquids even with the reduced flow of more efficient fixtures. However, the larger size of older drainlines may be a challenge in upgrading toilets to higher efficiency models since the reduced volume of liquids may not be sufficient to move solids.

A smaller pipe has greater carrying capacity with the same amount of liquid.

Fuller is better. With the same amount of liquid, the smaller pipe will have a greater carrying capacity.



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Aging infrastructure may have flow problems, such as root intrusion, developed over time.

Aging infrastructure may develop flow problems over time. For existing buildings, consider the following:

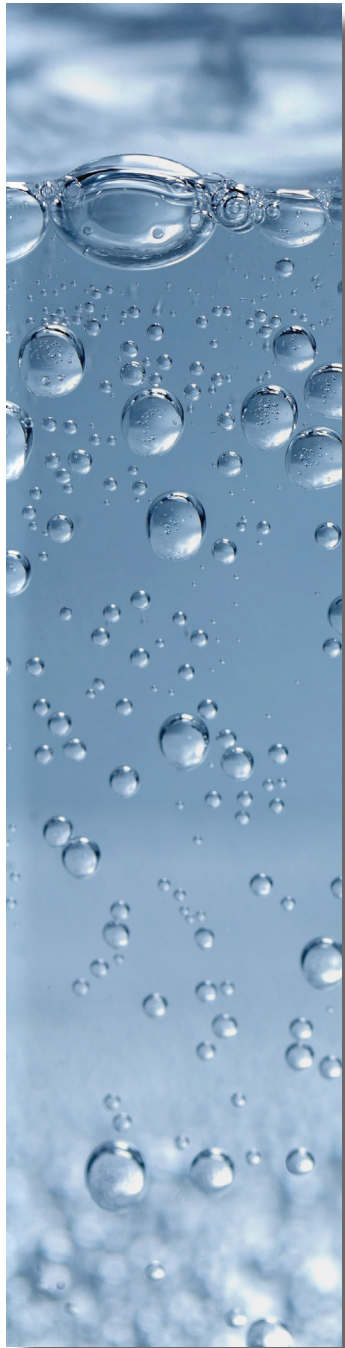
- Check drainlines in older buildings for defects, root intrusions, sagging, or other physical conditions that could result in clogging with lower flush volumes. Consider performing additional engineering analyses and re-commissioning for large systems.³
- Have plumbing designers and consultants review maintenance records and look for trends in equipment failures and problems. When viewed as a whole, these records may point to a systemic problem and reveal where the weak links lie. Identify these areas and make sure maintenance is done to prevent little problems from becoming big ones.
- Check for leaks before installing new water conserving fixtures.⁴ New fixtures will not reduce your water use and cost if pipes are leaking.
- Consider switching to toilet paper that is readily dissolvable to avoid toilet performance problems.⁵
- If additional drainline carry is needed in long drainline runs or trouble areas, the Green Plumbing and Mechanical Code Supplement allows installation of higher volume (1.6 gallon per flush) toilets.⁶

3 Plumbing Efficiency Research Council

4 Gauley and Koeller

5 Alliance for Water Efficiency

6 IAPMO Green Plumbing and Mechanical Code Supplement (2012)



5. To conserve water, federal facilities must upgrade their toilets. **IT DEPENDS**

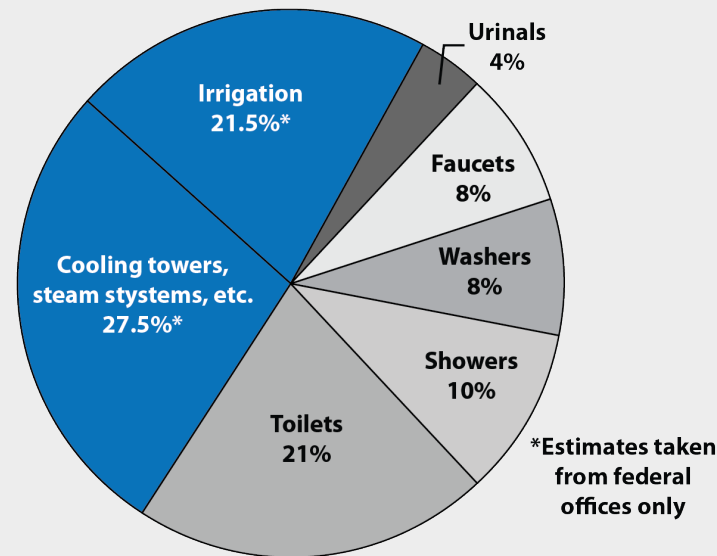
Toilets use the most water of all fixtures in federal facilities (DOD and civilian). Improving their efficiency is important and probably necessary to meet the 26% reduction in potable water use per Executive Order (EO) 13514. Facility managers need to evaluate water demands against the facility's current fixtures and possible upgrades.

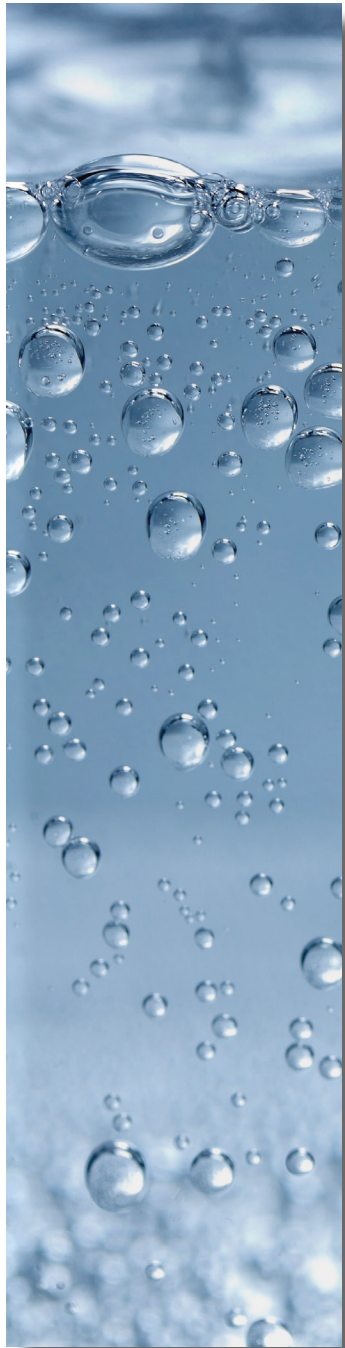
To help achieve federal water goals and reporting requirements, Federal Energy Management Program (FEMP) developed *Establishing Baseline and Meeting Water Conservation Goals of EO 13423* as supplemental guidance. This guidance includes:

- Baseline development
- Efficiency opportunity identification and implementation
- Reporting requirements

Federal Facilities' Estimated Water Use by Fixture Type

Each year civilian and military federal facilities use about 210 billion gallons of water - enough to fill about 320 olympic-size swimming pools.





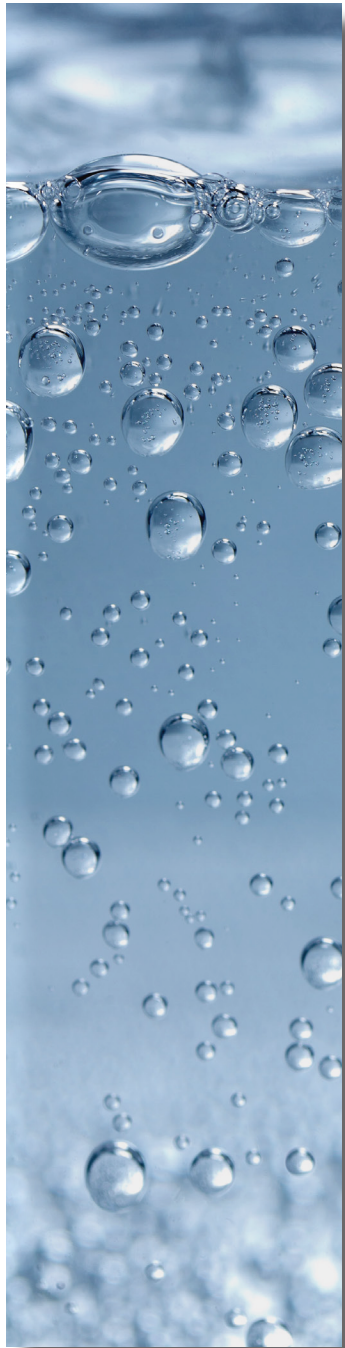
6. Dual-flush valves are best used in public restrooms. **FALSE**

Studies show usage patterns differ in public restrooms that serve many transient users as compared to those that serve regular building occupants.

Many commercial dual-flush valves operate with a down motion for solid waste (full flush) and up motion for liquid waste (reduced flush). However, most users are accustomed to push down to flush toilets. For most dual-flush valves to perform as designed, users need to change their typical behavior patterns. Thus, dual-flush toilets make more sense in buildings with a high proportion of regular users.⁷ To help users default to the reduced flush option try the following:

- Communicate the proper use of dual-flush valves through signage. In a building with regular occupants who understand the dual-flush difference, savings over conventional 1.6 gallon per flush (gpf) toilets were about 32%.
- Consider designs that makes people more likely to use the reduced flush option, such as a design in which the reduced flush comes from pushing the handle down rather than pulling the handle up or a design where flushing is controlled with buttons (large and small) instead of a traditional handle.
- Consider the different usage patterns between men's and women's restrooms. When urinals are available, men use toilets primarily for solid waste. This limits the water savings available from a dual-flush toilet. Thus, 1.28 gpf toilets may make more sense in a men's restroom.
- Consider the installation of electronic dual-flush valves for commercial toilets. However, the overall performance of these valves has not been researched to date.

⁷ Harrison (2010)



7. There are no good options for reducing water use from urinals in existing buildings.

FALSE

There are actually several good options for upgrading existing urinals.

- The best option is to replace existing urinals with 0.125 gallon per flush (gpf) high-efficiency urinals (HEU). However, this upgrade isn't possible for all urinals. Only 23% of urinals can be retrofitted in this way.
- The second-best option is to replace existing manual exposed flush valves with adjustable piston type flush valves with a range of 0.3 – 1.5 gpf, set to optimum efficiency. Approximately 72% of urinals can be retrofitted in this way.⁸
- Waterless urinals are another option, reducing water usage to zero. For more information on waterless urinals, refer to the SFTool <https://sftool.gov/material/2116/waterless-urinal>

⁸ SBW Consulting 2007



8. Sensor-operated toilets are more efficient than manually-operated flush toilets.

IT DEPENDS

Sensor-operated toilets, urinals, and sinks can use more water than manual fixtures because of the common occurrence of phantom flushing and faucet running. Additionally, the sensors draw electrical energy. While they may not require much energy, any amount will be an increase over manual operation. Manufacturers are addressing the performance issues that arose from early sensors, making them a more viable efficiency option.

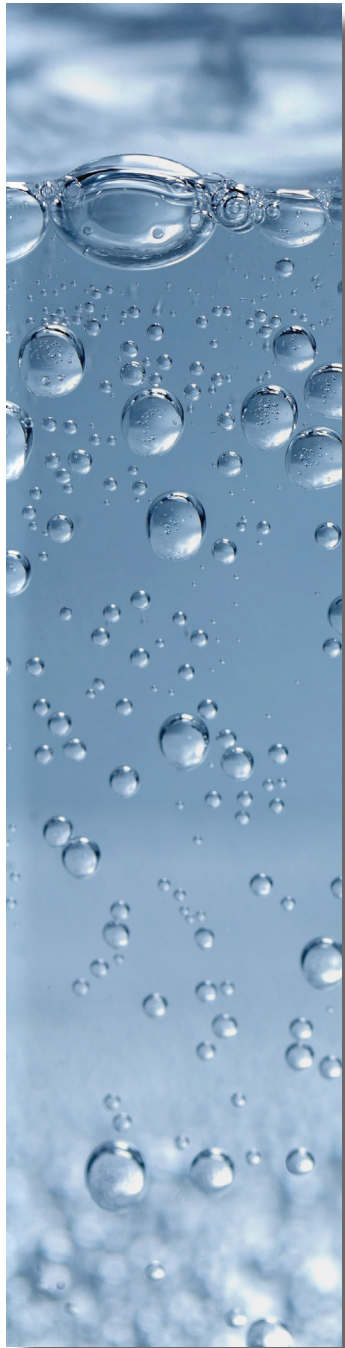
A year-long study⁹ found a 30% increase in water use after replacing manual faucets with sensor-operated versions.

The same study found a 54% increase in water use after replacing manual toilet flush valves with sensor-operated versions.

Sensor-operated toilets may be desirable for reasons other than water conservation, such as hygiene benefits, but decision-makers concerned primarily with water conservation should carefully examine the documented performance of the models they are considering, as well as other options such as dual-flush or high-efficiency toilets.¹⁰

⁹ Gauley & Koeller, 2010

¹⁰ Gauley & Koeller, 2010



9. Of all the fixture upgrades, showerhead and faucet replacements make the most sense. **TRUE**

High-efficiency faucets, showerheads, and urinals do not cost any more than standard, code-compliant ones, so in new construction (and in existing construction if you have already planned to replace fixtures), their savings are immediate. Additional considerations make showerhead and faucet replacement even more cost-effective.

- Installation time for replacing a typical showerhead averages about 15 minutes.
- Energy savings from hot-water-using fixtures (showerheads and faucets) makes the retrofits very cost-effective. In many cases, water savings are not even necessary to make the retrofit pay for itself. A high-efficiency showerhead can save an estimated 800,000 Btus annually, while a high-efficiency faucet can save 1.4 million Btus annually.¹¹
- Energy savings potential across the federal sector from reduction in hot water use in showerheads and faucets is estimated to be in the range of 600 to 1,550 billion Btus.¹²

11 McMordie-Stoughton, Solana, Elliot, Sullivan and Parker, (2005)

12 McMordie-Stoughton, Solana, Elliot, Sullivan and Parker, (2005)



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