Facility Review: The Keys to a Successful Water Savings Project

At some point in life, nearly everyone has heard about "the five Ps." Maybe it was a parent, a coach, a teacher or a boss who passed along the timeless advice that: "Proper planning prevents poor performance." And, as many contractors and building owners have learned over the years, perhaps nowhere is this concept more appropriate than when embarking on a commercial retrofit project to reduce water consumption.

Whether it's to gain LEED points, meet regulatory requirements, take advantage of rebate incentives, save on utility costs or contribute to a larger green initiative, there are multiple benefits to upgrading outdated plumbing fittings and fixtures.

Commercial plumbing technology has made significant improvements in terms of the amount of water used in flushing toilets—the fittings and fixtures used in today's commercial restrooms use only a fraction of the water compared to systems from decades past.

1880s	1920s	1974	1992	TODAY
High-tank toilets used around 10 gallons per flush (gpf)	Introduction of the standard tank toilet that used 5–7 gpf	The first 3.5 gpf toilet hit the market	Energy Policy Act mandated 1.6 gpf for toilets and 1.0 gpf for urinals going forward	Exceptional performance can be achieved with as little as 1.1 gpf

It can be tempting to simply specify the new high-efficiency equipment, calculate the gallons saved per fixture, count the fixtures and multiply to get the expected water savings. In a perfect world, that's all that'd be needed to get started.

But, that's where a lack of planning can cause problems. Big problems.

And those problems can cause delays, cost overruns, and round after round of finger-pointing when new components in an existing system don't perform as expected. The best way to avoid unexpected results is to do a thorough investigation of the existing plumbing system ***before*** specifying any components or making any calculations.

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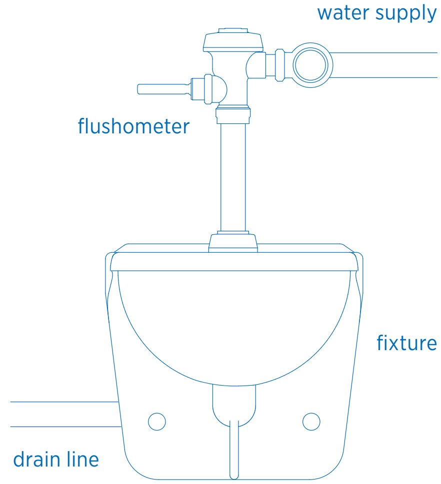
The risk of assumption.

Unlike new construction, retrofit projects don't have the advantage of having every detail of the plumbing systems meticulously documented in the mechanical plans. Retrofit projects mean installing new equipment with different specifications into existing (and often unknown) conditions, both upstream and downstream from the fittings and fixtures.



That's why it's important to talk to the people who know the system. Talk to building owners, facility managers, maintenance personnel—anyone and everyone who knows the history of the building's plumbing, quality of the potable water, any changes that have been made, maintenance practices and any chronic or recurring problems. Getting an honest appraisal of the current system can help avoid situations where the customer says, "Everything was working fine until you replaced the fittings."

Step #1: Conduct the assessment.

Conducting a thorough assessment means getting in there to inspect the plumbing system and measure as many performance variables as possible. Information needs to be gathered in three key areas:

Upstream

Pressure (static, dynamic, pressure over time)—Static pressure readings are a good starting point, but they're not the "tell-all" for the health of a system. Static pressure, working pressure and recovery (the time for the system pressure to return to the static readings) are vital to determining a system's response and capacity. Very high static readings (above 80 psi) can be a warning sign. This may be a result of failing pressure-reducing valves (PRVs) or, much more concerning, a volume/capacity problem. The building's maintenance people may have purposely increased the pressure beyond the recommendations of the plumbing code to help the system try to overcome problem areas in the building. (Keep in mind that while typical plumbing code specifies a maximum pressure of 80 psi at the fittings, branches along the system may be higher.)

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Piping diameter—It would seem logical that, by taking the fixtures from 3.5 gpf to 1.28 gpf, the demand on a water supply system would be reduced. However, the opposite is true: The same amount of waste must be evacuated through a new fixture with half the water volume; in many instances, a smaller water spot and trapway. Previously, water closets used up to 5 gallons in 90 seconds to flush and transport waste down the waste line. Now, 1.6 gallons is used in 20 seconds.

Plumbing layout/number of fixtures being fed by each line—Is the building plumbed correctly with main lines and all branch lines sized correctly to meet the demands of fixture counts?

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Past history of building expansion—Have there been additions to the building's footprint without increasing the water supply system capacity?

Water quality—Water quality is an often overlooked factor in water savings analysis. In piston valves, high amounts of sediment or sand shorten the life by wearing the lip seal. This results in a shorter flush cycle, making it necessary for a double flush to clear the bowl. Diaphragms with unprotected bypass holes may experience run-ons if the sediment clogs the bypass, or they may develop much greater flush volumes if the bypass is partially blocked. Also, water with high levels of chloramines attacks the natural rubber components found in some piston and diaphragm valves (although synthetic rubber diaphragms tend to be much more chloramine-resistant).

> "Failure to analyze the available water quality has led to many premature flushometer failures. Sometimes, shorter maintenance cycles, including the routine replacement of diaphragms, may be necessary."
> – Julius Ballanco

Fixtures and Valves

Document the manufacturer and model number of all the equipment to be replaced and assess the age and condition of the equipment:

- Flush volume rating
- Any signs of leaking from fitting or fixture
- Last maintenance/maintenance schedule

It's also important to remember that a flushometer's rated flush volume is *not* based on hard numbers each and every cycle. There is a tolerance of +/- 0.2 allowed. That means on a 1.28 gpf valve, the variance can be 1.08 gpf to 1.48 gpf. Other factors such as closet fixtures with extremely high back pressures or a fully opened control stop can push the variance even higher.

> Plumbing codes often specify at least one water-supplied fixture (e.g., a sink) be installed upstream from a waterfree urinal on the same drain line to help with drain line flow and rinsing.

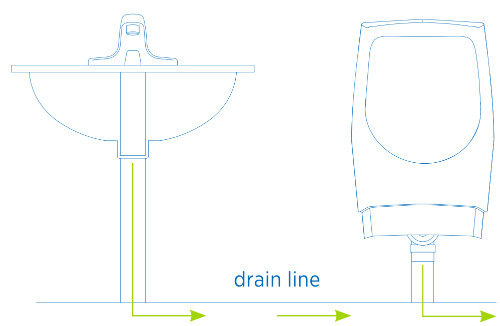
Downstream

The downstream side of the equation is just as important as the upstream. Depending on the age of the system, the original waste line carry calculations were probably based on 4.5 gpf. Through attrition, the original fixtures may have been replaced to 3.5 gpf or 1.6 gpf. Further reducing the water to 1.28 could result in downstream problems. Red flags include:

- Problem or chronic line blockages or toilet backups
- Poor pipe conditions including corrosion, leaks and cracks
- Long horizontal waste line runs
- Signs posted in restrooms warning what NOT to flush down fixtures
- Improper waste line slope

Other significant construction to the drain line exiting the building should also be examined.

The downstream situation is also extremely important when switching from washdown urinals to waterfree models. With no water following the liquid waste, drain lines are subject to the buildup of struvite (as opposed to calcite in the drain lines of water-flushing urinals).



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> "Downstream problems can also occur outside the building. In one example, a contractor replaced 4" sewer pipe with 6" pipe, causing stoppage that was corrected only after 4" pipe was reinstalled."
> – Julius Ballanco

Step #2: Determine the feasible options.

Once the assessment is complete, a more accurate picture of the available (and practical) options for the retrofit can be determined. Depending on the number of red flags raised, the scope of the project may need to be adjusted up or down, taking into account the expected cost and anticipated water savings for each option.

This may be a good time to consult with plumbing equipment manufacturers or plumbing engineers (assuming one wasn't involved with the assessment) to evaluate the feasibility of the possible paths. And it may turn out that going from 3.5 gpf to 1.1 gpf just isn't practical, but even achieving 2.4 gpf is still a savings. Possible upgrade options include:

- Minor upgrade: Change out diaphragm kits
- Intermediate upgrade: Change out flushometers
- Moderate upgrade: Change out flushometers and fixtures
- Major upgrade: Change out the entire plumbing system

Step #3: Prepare the estimate.

With the assessment complete, the most appropriate option can be selected and quoted to the customer. Then, it's time to start procuring materials.

Step #4: Test the solution.

Testing the planned savings strategy on one or two fixtures or bathrooms before converting the entire building can provide valuable insights into the expected performance of the system. Be sure to test the most extreme cases first (i.e., fixtures farthest from the water supply or situations with the greatest demand).

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Step #5: Expand the upgrade to the entire building.

If the test installation performs as expected, go forward with the project.

Proper planning prevents poor performance.

Commercial water savings projects are not only financially smart, they are environmentally responsible—and in some municipalities, legally mandated. Today's technology can help achieve real and meaningful savings, but the reduced water volume can have unintended consequences if the plumbing system isn't capable of adapting to the lower flow. With foresight and planning, risks can be avoided and the goal of water savings can be achieved.

Sloan wishes to acknowledge the editorial contributions made by Julius Ballanco, P.E., Editorial Director of *PM Engineer* and current president of ASPE.

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