

DUAL-FLUSH TOILET FIXTURES - Field Studies and Water Savings

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Do dual-flush toilet fixtures save more water than standard 1.6-gallons per flush (gpf) fixtures? To date, five independent studies have been completed and published, each of which deals to some degree with this topic. This paper summarizes the results of each of those studies as presented in their final reports.

1) Canada - Evaluation of Dual Flush Fixtures

The Canada Mortgage and Housing Corporation (CMHC) and Veritec Consulting of Ontario, Canada, completed a comprehensive evaluation¹ of dual flush fixtures installed by 13 agencies in seven provinces across Canada. In that study, pre- and post-retrofit flush volume characteristics were as follows:

Average flush volume:

Before: Inefficient fixtures (average)	3.72-gpf
After: Dual-flush fixture-commercial	1.22-gpf
Dual flush fixture-residential	1.11-gpf

The water savings resulting from the replacement of the inefficient fixtures was due nearly entirely to the "liquid-only" flush, known also as the short flush, which amounted to approximately 0.9 gallons. In all cases, the number of short flushes by the users exceeded the number of full (1.6-gallon) flushes. Ratios of short to long were as follows:

Commercial office building	1.7 to 1.0
Commercial restaurant	1.3 to 1.0
Residential - single family	1.6 to 1.0
Residential - multi-family	4.0 to 1.0

Study findings revealed no significant increase in flushing frequency with the installation of the dual-flush fixtures. Nearly all customers (92 percent) reported that they experienced less or the same double-flushing frequency as they did with their old 3.5- and 5.0-gpf toilet fixtures.

A component of this extensive study included the retrofit of a 15-unit Toronto apartment building with dual-flush fixtures. The replacement of existing high-volume fixtures (average 3.9-gpf) with dual flush units yielded a water savings rate of nearly 12,000 gallons per year per apartment.

Finally, the study also compared dual-flush fixtures with new 1.6-gpf fixtures and showed that the dual flush fixture used 23 to 32 percent less water than these conventional 1.6-gpf fixtures.

¹ Canada Mortgage and Housing Corporation and Veritec Consulting, 2002. *Dual-flush Toilet Project*, by Veritec Consulting, April 2002.

2) Seattle - Residential Fixtures and Appliances

In the Seattle study², water use patterns in 37 homes in the city were evaluated before and after the retrofit of existing plumbing fixtures and appliances with high-efficiency models, including toilet fixtures, showerheads, faucets, and clothes washers. In total, 40 new dual-flush fixtures were installed in 20 homes, and 34 new conventional 1.6-gpf toilets were installed in the remaining 17 homes. Flushing frequency and flush volumes were measured; the following was found:

Average flush volume:	
Before: Inefficient fixtures	3.61-gpf
After: Conventional 1.6-gpf fixtures	1.54-gpf
Dual flush fixtures - 1.6/0.8-gpf	1.25-gpf
Flushes per capita per day:	
Before: Inefficient fixtures	5.17-fpcd
After: Conventional 1.6-gpf fixtures	5.50-fpcd
Dual-flush fixtures - 1.6/0.8-gpf	5.40-fpcd

In this study of the 20 residences, the ratio of “short” liquid-only flushes to “long” full flushes was approximately 0.8 to 1.0.

The total water savings resulting from the dual-flush fixture installation amounted to 10,600 gallons per year per home, while replacement with a conventional 1.6-gpf fixture amounted to 9,000 gallons per year. The very small increase in average flushing frequency was not enough to diminish the water savings accomplished through the installation of the efficient fixtures.

3) Oakland – Residential Fixtures and Appliances

A study³ similar to the Seattle work was completed in 2003 at the East Bay Municipal Utility District (EBMUD) in Oakland, CA. This study also included the retrofit of a sizable number of residential dwellings, 33 in this case. Included within the retrofit program were 35 Caroma Caravelle dual-flush fixtures, 32 Niagara Ultimate Flush flapperless fixtures, and 7 other fixtures. Results were as follows:

Average flush volume:	
Before: Inefficient fixtures	3.88-gpf
After: Flapperless 1.6-gpf fixtures	1.70-gpf
Dual flush fixtures - 1.6/0.8-gpf	1.34-gpf
Flushes per capita per day:	
Before: Inefficient fixtures	5.74-fpcd
After: Flapperless 1.6-gpf fixtures	5.00-fpcd
Dual-flush fixtures - 1.6/0.8-gpf	6.40-fpcd

² Aquacraft, Inc., 2000. *Seattle Home Water Conservation Study, The Impacts of High Efficiency Plumbing Fixture Retrofits in Single Family Homes*, Seattle Public Utilities and The U.S. Environmental Protection Agency, December 2000.

³ Aquacraft, Inc., EBMUD, and the U.S. EPA, 2003. *Residential Indoor Water Conservation Study; Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in the East Bay Municipal Utility District Service Area*, July 2003.

4) Oregon - Save Water and Energy Education Program (SWEEP)

In 1999 and 2000, in response to a significant water shortage, two of Oregon's fastest growing cities, Lafayette and Wilsonville, volunteered to be "test communities" for a study of innovative approaches to saving water and energy⁴. In addition to the two cities, program partners included such organizations as the U.S. Department of Energy, the Pacific Northwest National Laboratory (PNNL), Portland General Electric (the serving electric utility), Energy Technology Laboratories, the Oregon Office of Energy, and numerous others.

Participating appliance and fixture manufacturers donated the water and energy-efficient devices for installation in the 50 test homes, 25 in each community. The equipment included clothes washers, clothes dryers, dishwashers, toilets, showerheads, and faucet aerators. All homes received the new appliances and toilets.

PNNL evaluated the water and energy savings achieved in these homes. Data were collected over a two-month baseline period (before SWEEP was implemented) and then again over a two-month retrofit period (after the new equipment was installed).

The following results are from the end-use metering of the 50 test homes. The aggregated per-home data indicate a mean annual savings of about 18,600 gallons. These savings represent a 25% reduction in mean per-home indoor water use over the baseline. Of this, the new clothes washer showed a savings of over 6,300 gallons per home. The replacement toilets saved over 11,550 gallons per year per home, with individual fixture savings averaging as follows:

Average flush volume:

Before: Inefficient fixture	3.9-gpf
After: Conventional 1.6-gpf fixture	not measured
Dual flush fixture-residential	1.3-gpf

In the study of the 50 residences, the ratio of "short" liquid-only flushes to "long" full flushes was approximately 1.9 to 1.0.

5) Jordan Valley, Utah – Residential Toilet Fixtures

The Jordan Valley Water Conservancy District installed 275 new toilet fixtures in residential dwellings and then measured the water savings and customer satisfaction. The new fixture models included the Caroma Tasman dual-flush (61 units), Niagara Flapperless (120 units), and the Gerber Aquasaver (94 units). This excellent study⁵ carefully documents a detailed comparison among the three quite different toilets:

Average flush volume:

Before: Inefficient fixture	4.16-gpf
After: Conventional 1.6-gpf fixture (Gerber)	1.80-gpf
Flapperless 1.6-gpf fixture (Niagara)	1.69-gpf
Dual flush 1.0/0.8-gpf fixture (Caroma)	1.20-gpf

For the 61 Caroma dual-flush fixtures, the ratio of "short" liquid-only flushes to "long" full flushes was 1.48 to 1.0.

⁴ Pacific Northwest National Laboratories, 2001. *The Save Water and Energy Education Program: SWEEP - Water and Energy Savings Evaluation*, Prepared for the U.S. Department of Energy, May 2001.

⁵ Jordan Valley Water Conservancy District, 2003. *Residential Ultra-Low-Flush Toilet Replacement Program*.

Copies of the final reports for each of the five studies may be obtained from the sponsoring organization and/or the authors.

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