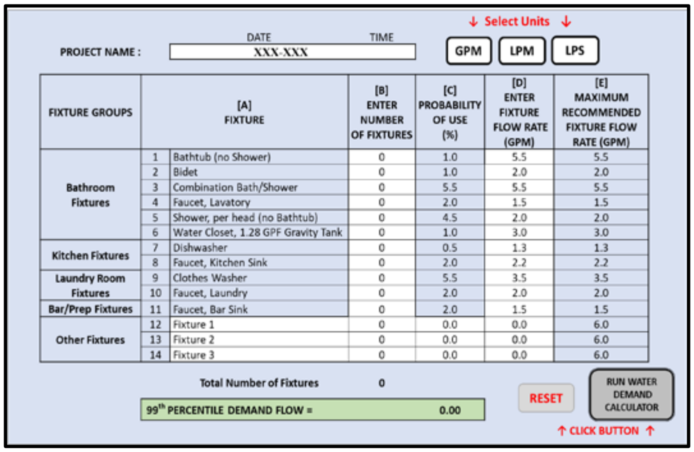
Dr. Steven Buchberger, Professor and Head of the Department of Civil Engineering, Architectural Engineering, and Construction Management at the University of Cincinnati completed an Ohio Water Resources Center funded project via Ohio Water Development sub-award. The project, **"Improved Estimates of Peak Water Demand in Buildings: Implications for Water-Energy Savings"**, aims to quantify water and energy savings resulting from hot water use in residential plumbing systems serving households with efficient fixtures. A key step in the analysis involved development and application of a novel Water Demand Calculator (WDC, see Figure 1) by graduate student Toritseju Omaghomi.



↓ Select Units ↓

PROJECT NAME : DATE XXX-XXX TIME

GPM LPM LPS

FIXTURE GROUPS		[A] FIXTURE	[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
Bathroom Fixtures	1	Bathtub (no Shower)	0	1.0	5.5	5.5
	2	Bidet	0	1.0	2.0	2.0
	3	Combination Bath/Shower	0	5.5	5.5	5.5
	4	Faucet, Lavatory	0	2.0	1.5	1.5
	5	Shower, per head (no Bathtub)	0	4.5	2.0	2.0
	6	Water Closet, 1.28 GPF Gravity Tank	0	1.0	3.0	3.0
Kitchen Fixtures	7	Dishwasher	0	0.5	1.3	1.3
	8	Faucet, Kitchen Sink	0	2.0	2.2	2.2
Laundry Room Fixtures	9	Clothes Washer	0	5.5	3.5	3.5
	10	Faucet, Laundry	0	2.0	2.0	2.0
Bar/Prep Fixtures	11	Faucet, Bar Sink	0	2.0	1.5	1.5
Other Fixtures	12	Fixture 1	0	0.0	0.0	6.0
	13	Fixture 2	0	0.0	0.0	6.0
	14	Fixture 3	0	0.0	0.0	6.0

Total Number of Fixtures 0

99^{th} PERCENTILE DEMAND FLOW = 0.00

RESET

RUN WATER DEMAND CALCULATOR

↑ CLICK BUTTON ↑

Figure 1 Input Template for Water Demand Calculator

An estimate of peak water demand is the most crucial factor for sizing a building's water distribution system. Hunter's design curve has been used for this estimation since 1940. However, with changes in fixture performance and consumer water use habits over time, Hunter's iconic design curve significantly over-estimates peak water demand for indoor hot and cold-water uses. Buchberger and Omaghomi compared peak water demand in a 2-bath home and the resulting pipe sizes from the WDC against the traditional Hunter's curve. They simulated instantaneous indoor hot water use and evaluated the energy delivered and lost within the household distribution system for a one-year operating period. Results show that premise plumbing systems with efficient water fixtures can be substantially smaller in scale (i.e., reduced pipe diameters, meters, heaters, softeners) than the plumbing systems serving standard less efficient water fixtures. Simulation of instantaneous water and energy consumption in a typical 2-bath residential unit shows that annual savings for both water and energy can approach 30 percent each when rightly-sized plumbing is coupled with efficient fixtures (Figure 2).

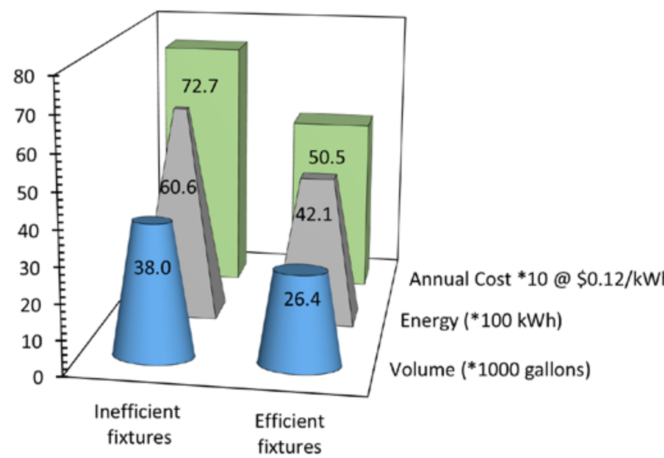


Figure 2 Annual hot water volume, energy consumed and energy cost in a 2-bath home with inefficient and efficient water fixtures

The overriding importance of this project is the verification that reduced pipe sizes provide safe, sustainable and efficient premise plumbing to complement water conservation and promote energy savings in modern buildings. It is expected that results from the new approach of estimating peak water demand will lead to significant water and energy savings without loss of performance in the water delivery system. The WDC has been incorporated into the 2018 Uniform Plumbing Code. The WDC app is available free of charge from IAPMO: http://www.iapmo.org/Pages/WaterDemandCalculator.aspx

Researcher Profile: Professor Buchberger's teaching interests include surface water hydrology and reliability-based design. His research interests include mathematical modeling of water demands and water quality in municipal distribution systems; estimating peak water demands in buildings; characterization and control of nonpoint pollutants; water and energy management for sustainable urban environments.