2050 PARTNERS
DECARBONIZATION EXPERTS

# Right-Sizing Water Distribution Pipes and Water Heating Systems to Save Energy and Reduce Building Costs

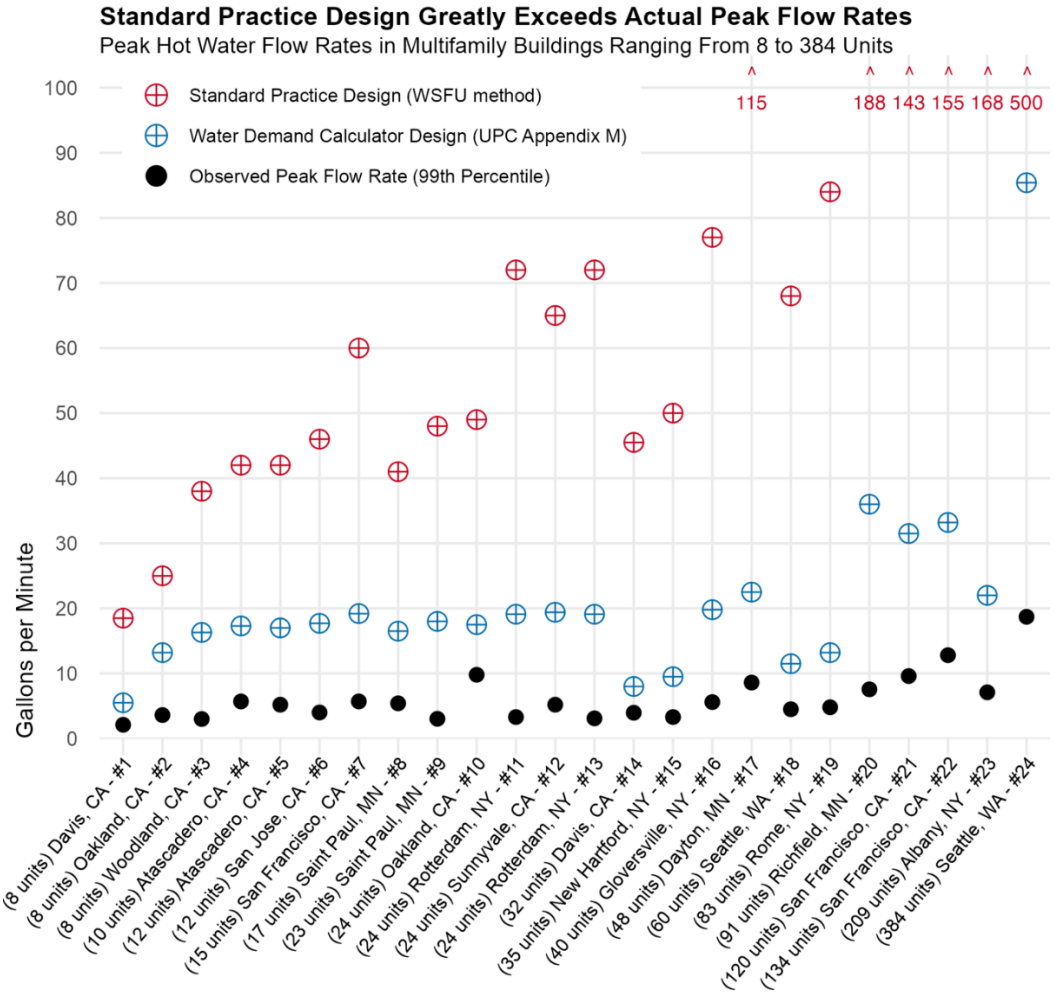
The Minnesota Department of Commerce, Division of Energy Resources, recently supported a CARD project to study water supply pipe and end use sizing to investigate opportunities to reduce energy use and construction costs in new residential buildings. The "Right-Sizing Water Distribution Pipes and Water Heating Systems to Save Energy and Reduce Building Costs" project focused on validating an alternative plumbing design method and assessing current water heater sizing guidance.

The project evaluated the Peak Water Demand Calculator (WDC) from the 2024 Uniform Plumbing Code (UPC) Appendix M, comparing its performance against the traditional water supply pipe-sizing method in four Minnesota multifamily buildings. Results showed that the WDC method consistently designed for water demand flow rates much closer to actual usage than the traditional method, which overestimated flow rates by up to 25x.

The WDC is the first major, peer-reviewed update of peak water demand sizing in buildings in over 80 years. It is the culmination of a multi-year project (2011-2017) sponsored by the International Association of Plumbing and Mechanical Officials (IAPMO), and was initially adopted into the UPC as Appendix M in the 2018 version of the UPC. In all known applications, using the WDC to size water pipes results in:

- Construction cost savings due to smaller diameter pipes and fittings, less pipe insulation material, and reduced water service entrance size.
- Ongoing cost savings to occupants and homeowners from water and energy savings
- Faster delivery of hot water to occupants.
- Water and embedded energy savings due to faster hot water delivery times.
- Additional energy savings due to decreased heat loss in the hot water distribution system, particularly in multifamily buildings with a recirculation system.
- Reduced carbon emissions due to material savings and energy reductions.
- Reduced public health and safety risk and improved water quality due to shorter water dwell times in premise plumbing systems.

The Project Team 2050 Partners, Center for Energy and Environment, and Gary Klein and Associates found that the design flow rates calculated using the WDC method (blue crosshairs in the figure below) are 2 to 6 times larger than the observed peak flow rate (black dots) for the four Minnesota buildings. This finding is consistent with out of state buildings analyzed previously. As an additional comparison, the Project Team found that the design flow rates using the traditional method (red crosshairs) are 8 to 25 times larger than the observed peak flow rates for the four Minnesota buildings. For the previously analyzed buildings, the design flow rates using the traditional method are 8 to 27 times larger than the observed peak flow rates. This validation supports the adoption of WDC as a more accurate and cost-effective design tool.




*Credits: Observed peak flow rate data was collected and provided by the Association for Energy Affordability, Center for Energy and Environment, E2G Solar, Ecotope, Frontier Energy, and the University of California Davis Western Cooling Efficiency Center. This project was supported in part by a grant from the Minnesota Department of Commerce, Division of Energy Resources through the Conservation Applied Research and Development (CARD) program.*

Using data from monitored buildings, the team estimated significant construction cost saving and modest energy, water, and carbon savings.

- Water: 345 gallons/year per unit
- Natural Gas: 6.6 therms/year per unit
- Construction Costs: $618 saved per unit
- Recurring Costs: $14/year per unit
- Carbon Emissions: 0.035 metric tons $CO_2e$/year per unit

If water supply plumbing for 30% of new multifamily units (approx. 4,000 annually) use the WDC method, Minnesota could save 1.4 million gallons of water, 26,535 therms of natural gas, $2.5 million in construction costs, and 141 metric tons of $CO_2e$ each year.

The project team provided study information to Saint Paul Regional Water Services to submit a formal request (RFA PB0176) to the Minnesota Plumbing Board to adopt UPC Appendix M into the Minnesota Plumbing Code (MPC). The proposal received support from key industry organizations and was accepted by the 2024 UPC Ad Hoc Rulemaking Committee. Final recommendations from the Rulemaking Committee on adoption are expected in Fall 2025, with full adoption of approved updates to the MPC anticipated by 2027.

The team also assessed ASHRAE's water heater sizing methods, finding that the Average Sizing Method with low-use assumptions most accurately predicted hot water needs, even though high-use assumptions are recommended for multifamily buildings. This insight will inform updates to ASHRAE Guideline Project Committee 47P's recommendations, expected to be presented at the 2026 ASHRAE Summer Conference.

To ensure the successful implementation of the UPC Appendix M (if adopted into the MPC), the project team recommends:

- Monitor ongoing updates to the MPC and provide support as needed.
- Launch education and outreach for plumbers, plumbing engineers, builders, architects, building developers, building owners, building managers, Chief Building Officials, plumbing plan checkers, plumbing inspectors, and water utilities.
- Consider incentive programs bundling the WDC demand sizing measure with HPWH installations.
- Include the 2027 IECC WDC energy credits in Minnesota Energy Codes.
- Fund a research project evaluating the plumbing systems into which HPWHs are installed to help specifiers, suppliers, and installers better understand sizing HPWHs.

This initiative marks a significant step forward towards establishing right-sizing plumbing practices in Minnesota which would provide benefits to Minnesotans.