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

Supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources, through the Conservation Applied Research and Development (CARD) program.

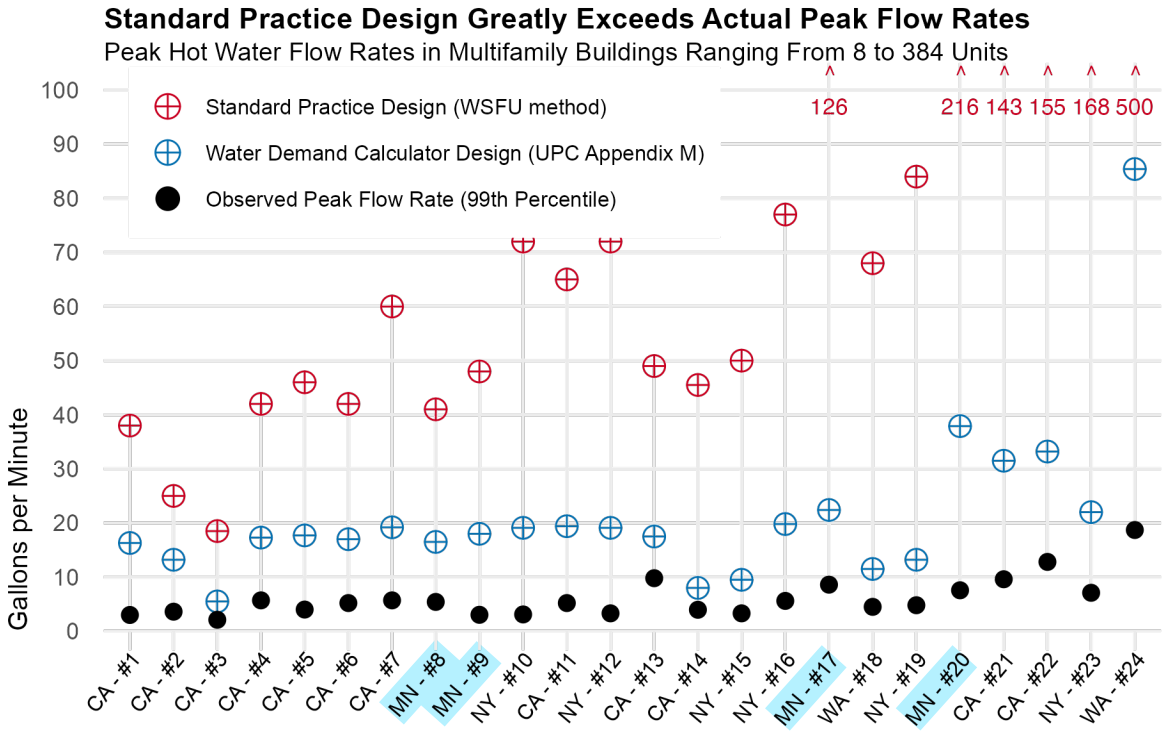
Project Goals

1. Validate the Peak Water Demand Calculator (WDC)[1] for water supply pipe sizing in Minnesota multifamily buildings.
2. Estimate potential water, energy, cost, and carbon savings from the use of the WDC.
3. Inform a code change proposal to start the adoption of UPC Appendix M into the Minnesota Plumbing Code (MPC).
4. Evaluate water heater sizing guidance to avoid costly oversizing of heat pump water heaters (HPWHs).

Key Findings

1. WDC Validation

WDC design flow rates (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 analyzed in this project. The traditional method (red crosshairs) overestimated peak flow by up to 25x, leading to oversized pipes. This is consistent with other out of state buildings previously analyzed.



[1] the WDC is an excel-based, peer reviewed tool update of peak water demand sizing in buildings that is a culmination of a multi-year project (2011-2017) sponsored by the International Association of Plumbing and Mechanical Officials (IAPMO) with initial adoption as Appendix M in 2018 UPC.

2. Estimated Savings	
Estimated Per Dwelling Savings • Water: 345 gallons/year • Natural Gas: 6.6 therms/year • Construction Cost: $618 saved • Recurring Cost: $14/year • Carbon Emissions: 0.035 metric ton CO_2e/year	**Statewide Impact** *Assuming WDC used by 30% of New Multifamily Dwellings.* • Water: 1.4 million gallons/year • Natural Gas: 26,535 therms/year • First Construction Cost: $2.5 million saved • Carbon Emissions: 141 metric tons CO_2e/year
3. Code Advancement	**4. Water Heater Sizing Insights**
RFA PB0176 was submitted to request the adoption of the UPC Appendix M into the MPC. Supported by industry groups; accepted by the 2024 UPC Ad Hoc Rulemaking Committee. Final decision expected in Fall 2025 at the earliest; current MPC update cycle expected to conclude in 2027.	ASHRAE's Average Sizing Method with low-use assumptions described in ASHRAE Handbook Chapter 51 Service Water Heating produced the most accurate estimates of needed water heating capacity and storage, even though high-use assumptions are recommended by ASHRAE for multifamily buildings. Findings will inform ASHRAE Guideline Project Committee 47P's efforts.

Recommendations

- 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.

Full Report: https://mn.gov/commerce/energy/conserving-energy/applied-research-development/
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2050 PARTNERS DECARBONIZATION EXPERTS

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Gary Klein and Associates, Inc. "Where water and energy connect"

[2] Credits for Figure on Page 1: Observed peak flow rate data were 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. Data collection for the Minnesota buildings was supported by this grant from the Minnesota Department of Commerce, Division of Energy Resources, through the Conservation Applied Research and Development (CARD) program.