



ADVANCING FEDERAL INFRASTRUCTURE THROUGH INNOVATION



CINCINNATI, OHIO
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USEPA Research on Premise Plumbing Infrastructure Decontamination

Increasing the resilience of home and building owners after water
system contamination events



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Homeland Security Research Program (HSRP)

United States Environmental Protection Agency

EPA's Homeland Security Research Program

Vision

Federal, state, tribal, and local decision makers have timely access to information and the tools they need to ensure community resilience to catastrophes involving environmental contamination that threatens public health and welfare.

Program Objectives



Advance EPA's capabilities and those of our state, tribal, and local partners to respond to and recover from wide-area contamination incidents



Improve the ability of water utilities to prevent, prepare for, respond to and recover from water contamination incidents that threaten public health

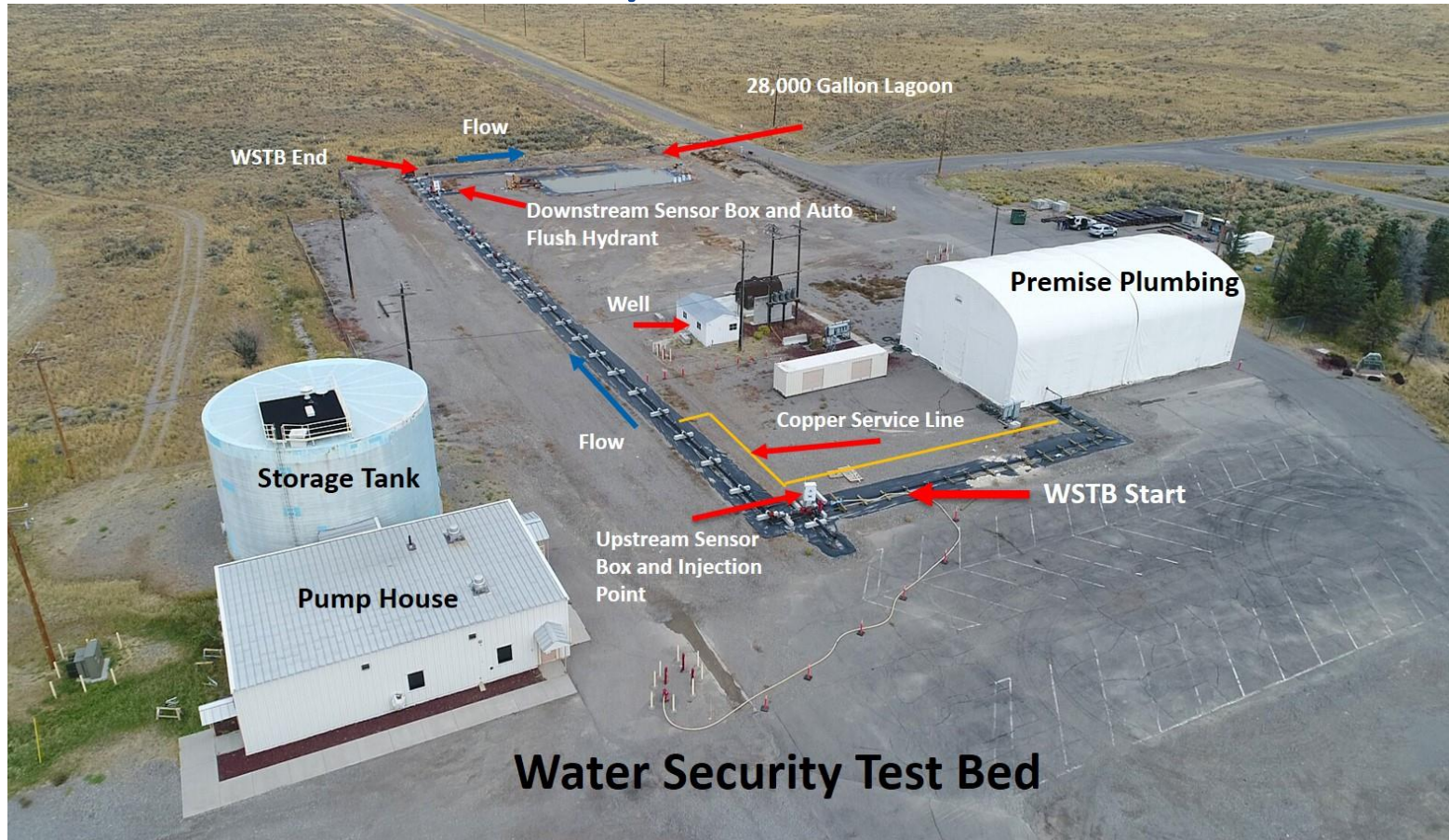
Why premise plumbing research in HSRP

- Historically, HSRP water decontamination research has focused on “big” utility infrastructure under the street
- Contamination events affect home and building plumbing too
- Home and building plumbing is the responsibility of the home or building owner
- Many unknowns about how contaminants persist in plumbing systems and how to effectively decontaminate
 - Pipes
 - Appliances
 - Hot water heaters

Research Planning

- Over the last year, ORD had been engaging with partners and planning future research
- Research plans will be summarized in the forthcoming [ORD Strategic Research Action Plan](#) (StRAP version 4, or StRAP 4)
- Research efforts will cover FY23 to 26 (Oct. 1, 2022 to Sept. 30, 2026)
- Premise plumbing falls under Research Area 4 in the Homeland Security Research Program
- Research initiative include
 - Water quality and chemical, biological and radiological persistence
 - Infrastructure decontamination
 - Wildfire impacts
- Today's talk will give an overview of full scale systems and research plans

Water Security Test Bed at the INL



Water Security Test Bed

WSTB Premise Plumbing



Premise Plumbing Decontamination



WSTB Premise Plumbing Decontamination

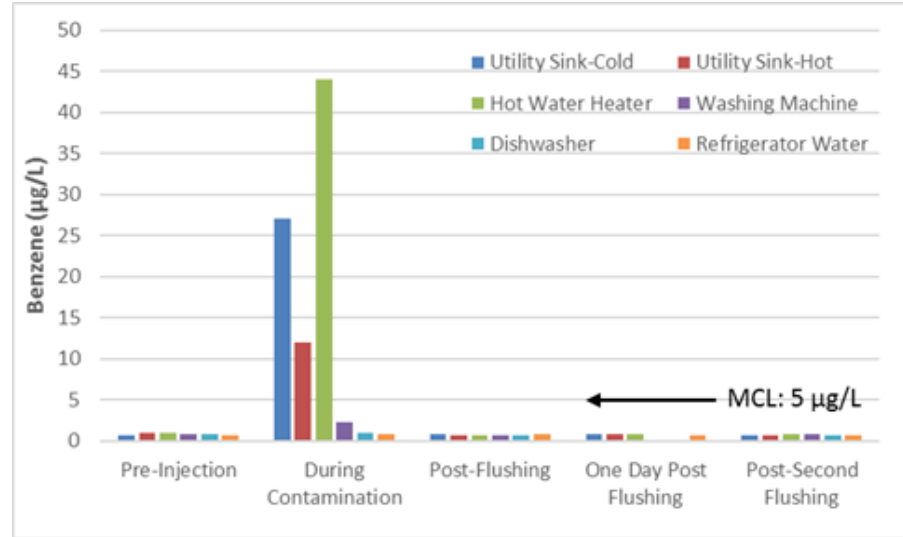
■ Contaminants

- *Bacillus* spores
- Bakken crude oil
- Aqueous film forming foam*

■ Decontamination

- Flush pipes
- Running appliances
- Empty & fill hot water heater
- Chlorination
- Surfactant

- Reports available: <https://www.epa.gov/emergency-response-research/water-security>



EPA Full Scale Premise Plumbing Facility: Cincinnati, OH



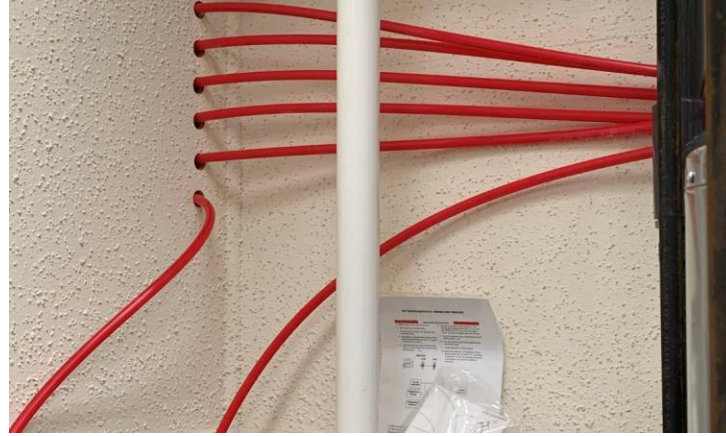
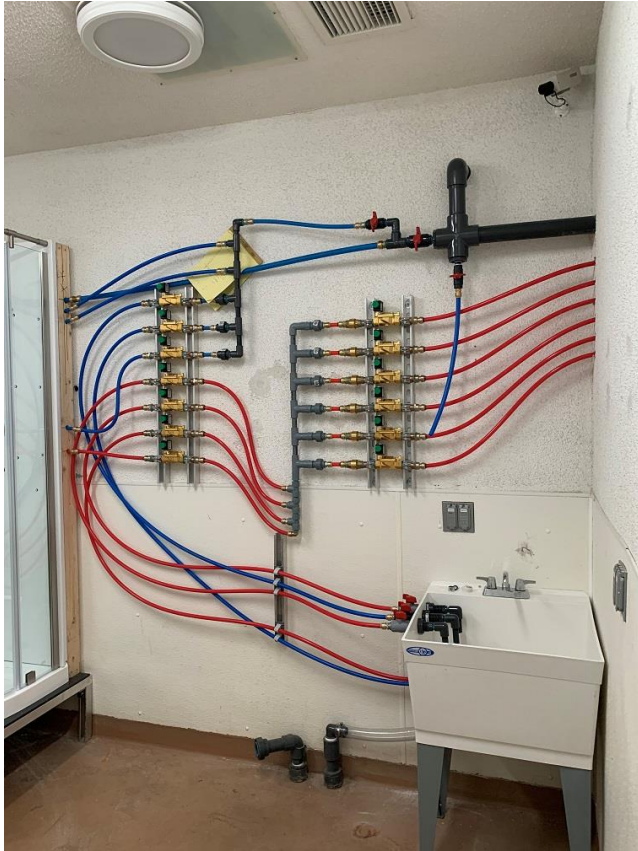
Hot Water Heaters



Piping, Sinks and Control Valves



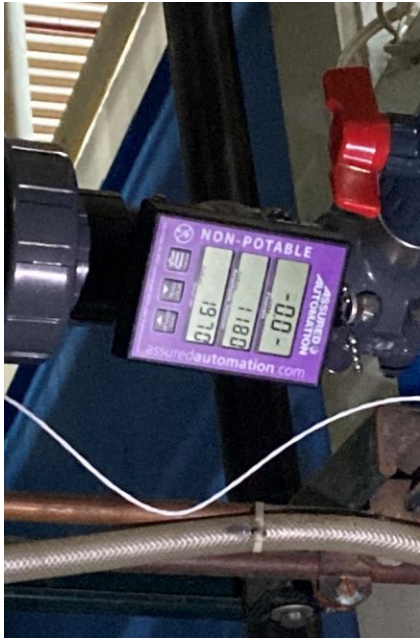
Inlet, Shower and Toilet Connections



Shower and Toilets



Online Monitoring



Water Usage

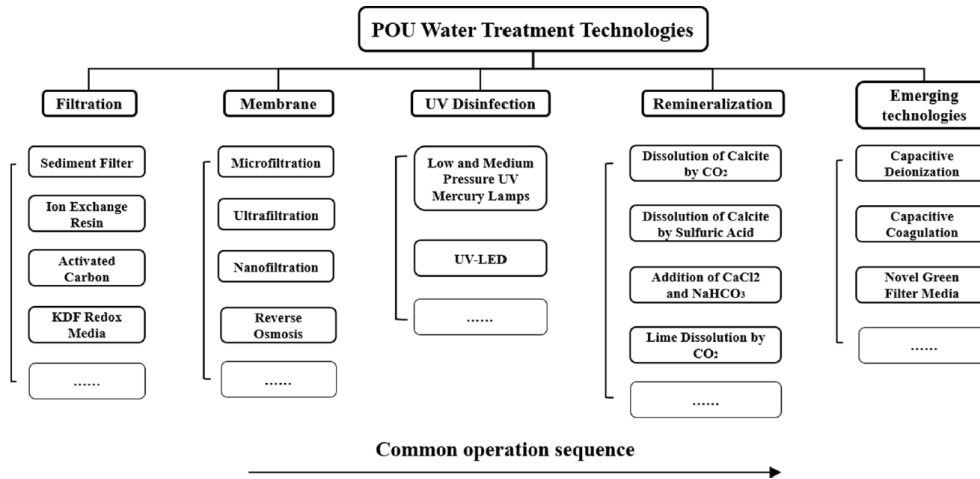


Energy Usage



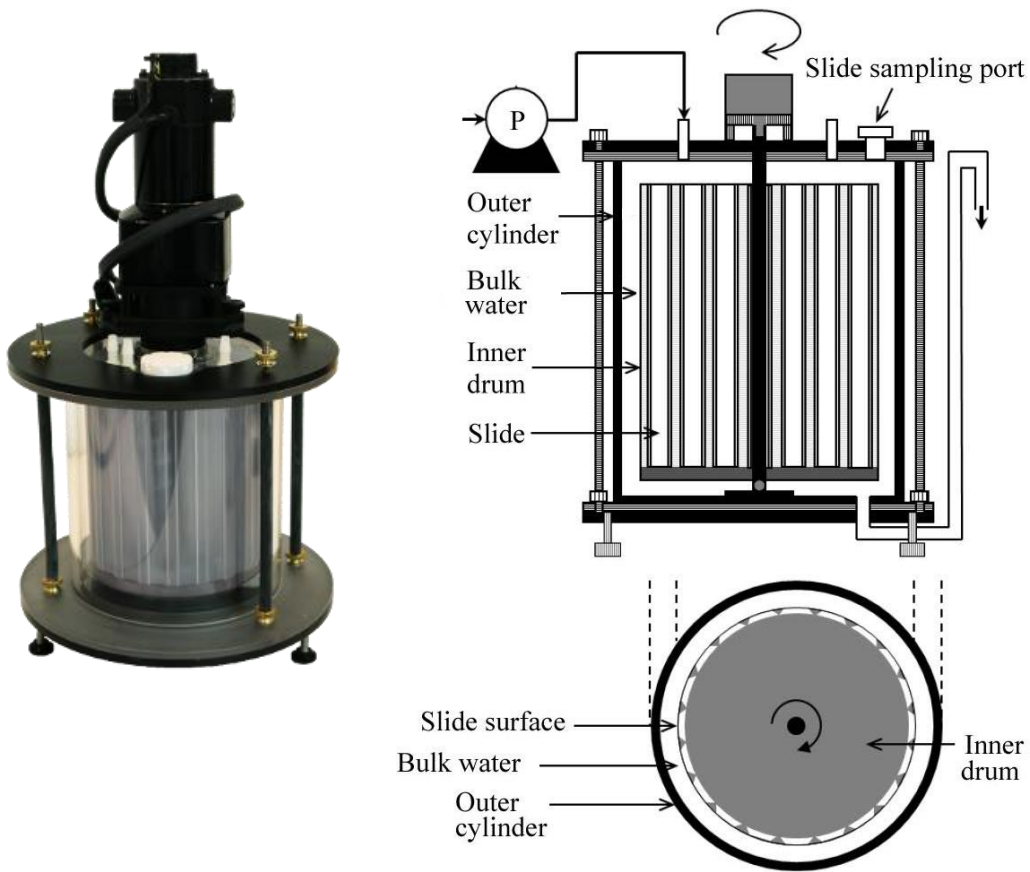
Pipe Temperature

Decon and Evaluation of Water Treatment Devices

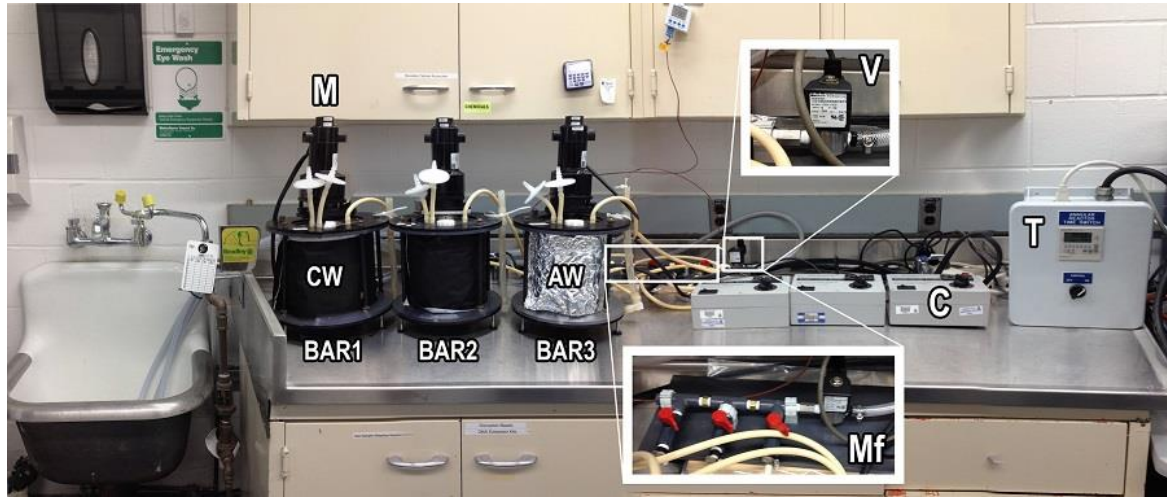


- Decontamination of the plumbing system
 - Flushing pipes
 - Draining the hot water heaters
- Treatment efficacy of POU devices
- Performance
- Unintended consequences
- Other impacts to WQ
- Aerosolization from the taps, toilets and showers

Bench Scale Infrastructure Decon



Bench Scale Infrastructure Decon



BAR – biofilm annular
reactor (1, 2, and 3)

M – motor

CW – cloth wrap

AW – aluminum wrap

Mf – manifold

V – valve

C – controller

T – timer

- Developed mature (1.5-2 year old) drinking water biofilms on infrastructure surfaces
 - Cu and PVC for plumbing, which are smoother and easier to decon
 - Unlined iron and cement-mortar for distribution systems, which are rougher and harder to decon
- Inject with CBR contaminants (various chemicals, *Legionella*/*Bacillus* spores for bio, stable Cs, Sr, Co for rad)
- Flushing (spinning the inner drum faster), disinfection, addition of decon agent

Pilot scale decontamination research



- Historically, the pilot scale decon loop has been used for distribution system decontamination research
 - Bio (spores) and rad surrogates
- In recent years, the focus has been on premise plumbing, with copper and PVC coupons being used
- Determining the effectiveness of metal ions and various water quality parameters on *L. pneumophila* inactivation
- Focus has been on copper-silver disinfection systems

Uptake and Release of Wildfire-Associated Organics from Polyethylene Pipes

- Hazardous organic chemicals, including benzene, were found in drinking water systems affected by wildfires.
- Some Examples in California:
 - Santa Rosa (2017-2018)
 - Paradise (2018-2019)
 - Riverside Grove (2020)
- High density polyethylene (HDPE) service lines and crosslinked polyethylene (PEX) pipes in buildings are permeable to benzene.
- Permeated pipes can complicate sampling and decontamination strategies



Forest fire: Cameron Strandberg 2009. Creative Commons 2.0 License: <https://creativecommons.org/licenses/by/2.0/deed.en>

Thank you!



EPA Homeland Security Research Program

<https://www.epa.gov/emergency-response-research/water-security>

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