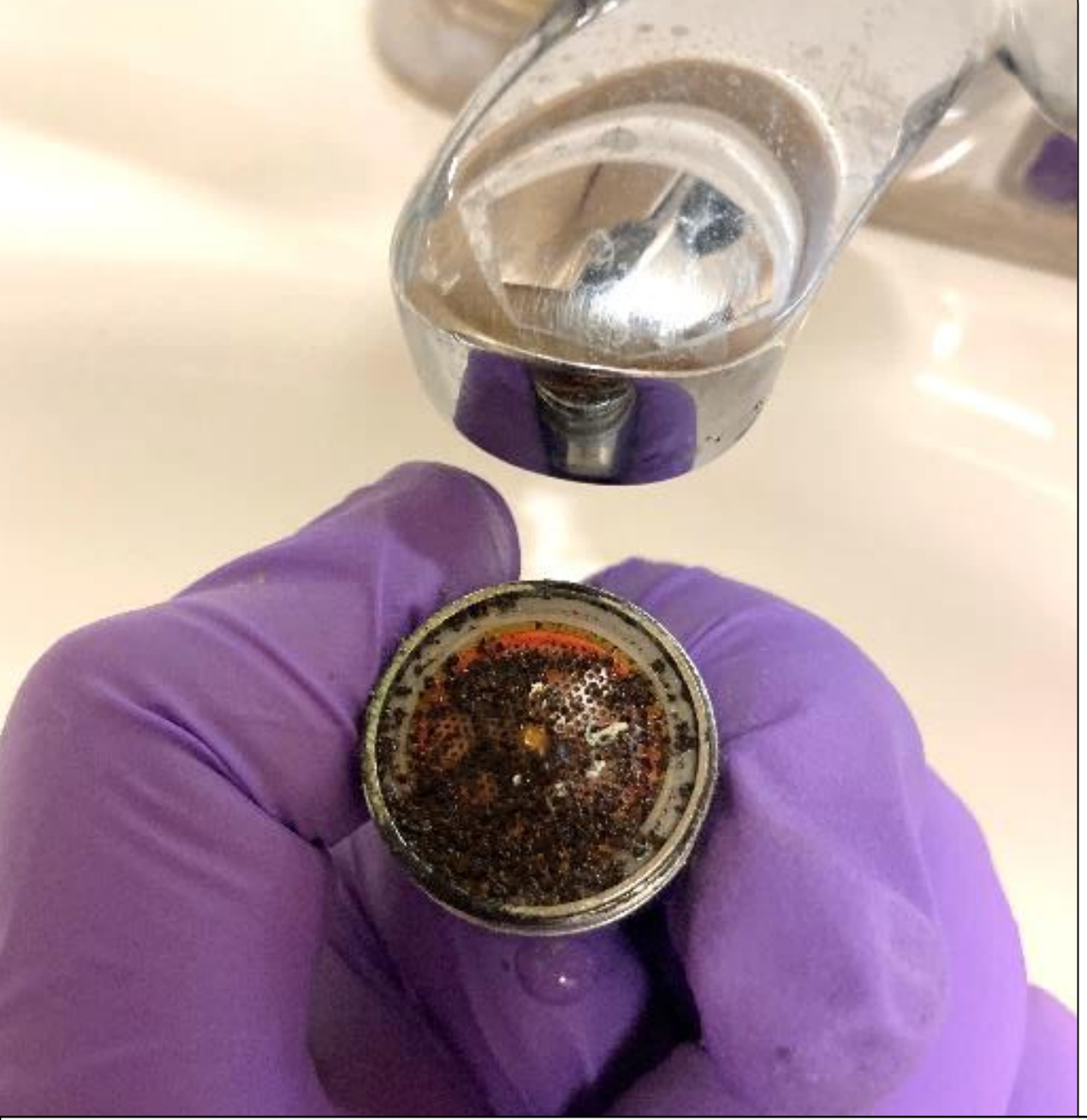


COVID-19 and Building Water Systems

Large Buildings, Standards, Considerations, and Gaps

Andrew J. Whelton, Ph.D.
Civil, Environmental, and Ecological Engineering

Caitlin R. Proctor, Ph.D.
Agricultural, Biological, Environmental, and Ecological Engineering

1. Water safety issues for large buildings
2. Developments since the pandemic began
3. Gaps and moving forward
4. Other information that's new and coming soon

More Information at www.PlumbingSafety.org

- ✓ Plumbing education videos
- ✓ Flushing plans
- ✓ Plumbing explainers
- ✓ List of projects
- ✓ Scientific opinions
- ✓ Resources ➔ presentations
- ✓ Scientific reports
- ✓ External plumbing docs
- ✓ YouTube Channel

Commercial district

Street

Fire Hydrant

PROPERTY OWNER RESPONSIBILITY

Single vs. Multiple tenants

BUILDING PLUMBING

Water meter

Corporation Stop

Water Main (metal or plastic)

WATER UTILITY RESPONSIBILITY

Utility Service Line (metal or plastic)

Property Service Line (metal or plastic)

[sometimes other water sources]

Stagnation *noun*

stag·na·tion | \ stag-ˈnā-shən

a state or condition marked by lack of flow, movement

When water does not flow well; areas of stagnant water encourage biofilm growth and reduce temperature and level of disinfectant

Prior to the pandemic, stagnation posed health **risks**

The time scale of concern can sometimes be just a few days

Copper can leach

- Nausea, vomiting, diarrhea, abdominal cramps

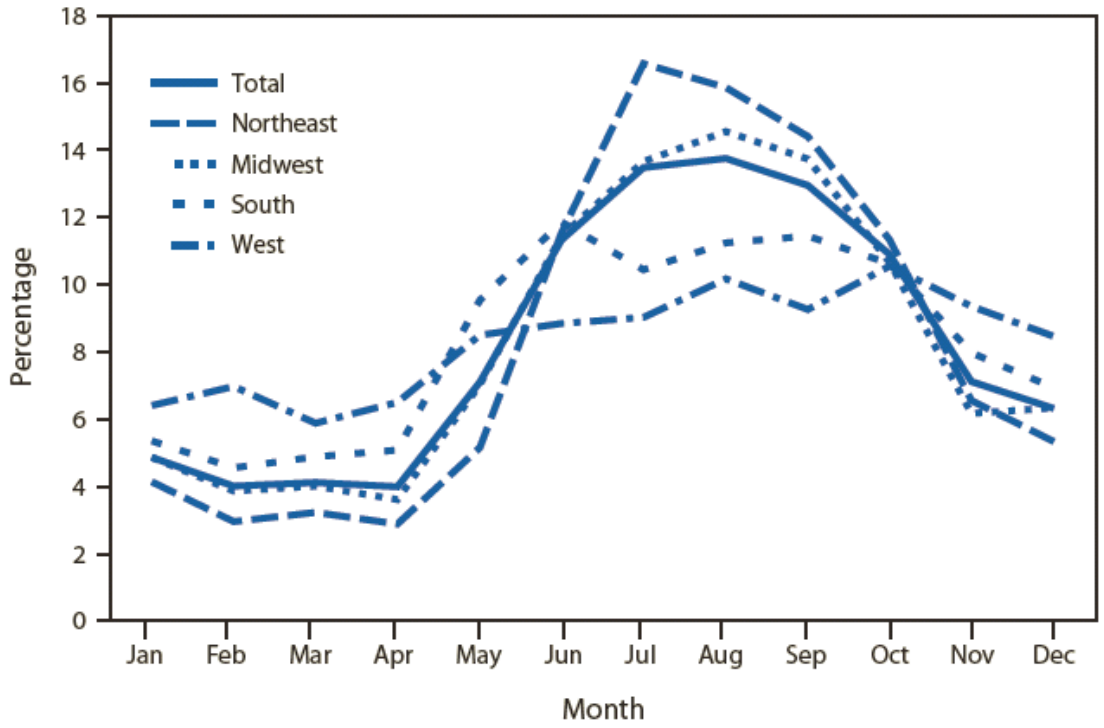
Lead can leach

- Nausea, vomiting, diarrhea, abdominal cramps, longer-term developmental issues with children

But other metals too! Scale can be suspended.

Harmful organisms (e.g., *Legionella pneumophila* and other opportunistic pathogens) can grow - better

- Many organisms cause respiratory illness, and other infections can occur



Exposure Routes of Concern: Ingestion, Dermal, Inhalation

There's Little Public Understanding and Awareness about Building Water Safety and Contamination

For example, all legionella detections (and investigations) are not being publicly reported

August	The Netherlands, gym Pennsylvania, 4 schools Ohio, 8 schools Texas, healthcare building Canada, hospital Georgia, CDC office buildings UK, office building UK, hospital
July	UK, Buckingham Palace California, hotel UK, 3 schools Ohio, 1 school, LD illness (yr ago LD **fatality**) UK, university campus
June	Michigan, nursing home Illinois (LD misdiagnosed as COVID) UK, 1 school

August Snapshot

U.S. National Science Foundation RAPID Award 2027049

Shutdowns and Consequences - Extreme Plumbing Stagnation and Recommissioning

1. Support to the plumbing and public health sectors on building water safety guidance and decisions, ***ongoing***
2. Building water safety review due to prolonged stagnation with experts from 7 private and public sector organizations, ***complete***
3. Field testing to determine how impacted building water safety is in actual large buildings, ***complete***
4. Bench-/pilot-scale testing to determine how to fully recover contaminated building water system devices and equipment, ***ongoing***
5. Help transform public awareness, ***ongoing***

Helping

IAPMO

American Water Works Association

astho™

SLOAN

Whirlpool Corporation

NRDC

Washington State Department of Health

ASDWA

Ohio Environmental Protection Agency

ASPE American Society of Plumbing Engineers

NEHA Training

SAFE WATER ENGINEERING

U.S. National Science Foundation EAGER Award 2039498

Initiating a Transformative Building Water System Research Collaborative in Rapid Response to the COVID-19 Pandemic

And more…

1. Host 3 formal collaborative workshops on building water safety, ***2 left***
2. Determine the practices applied across select institutions nationwide that address building water system safety, ***ongoing***
3. Conduct a meta-analysis of studies at the end of the 1-year effort and identify new prioritized research and innovation needs influenced by the multiple independent studies and collaborative workshops, ***planned***

NEW: State-of-the-knowledge review about water safety impacts of prolonged stagnation

Collaborative effort

Caitlin R. Proctor, Ph.D., Purdue University
William Rhoads, Ph.D., Virginia Tech
Tim Keane, Legionella Risk Management, Inc.
Maryam Salehi, Ph.D., University of Memphis
Kerry Hamilton, Ph.D., Arizona State University
Kelsey J. Pieper, Ph.D., Northeastern University
David R. Cwiertny, Ph.D., University of Iowa
Michele Prévost, Ph.D., Polytechnique Montreal
Andrew J. Whelton, Ph.D., Purdue University

AWWA WATER SCIENCE

Considerations for Large Building Water Quality after Extended Stagnation

Download FREE here:

https://doi.org/10.1002/aws2.1186

PURDUE UNIVERSITY VIRGINIA TECH

LEGIONELLA RISK MANAGEMENT

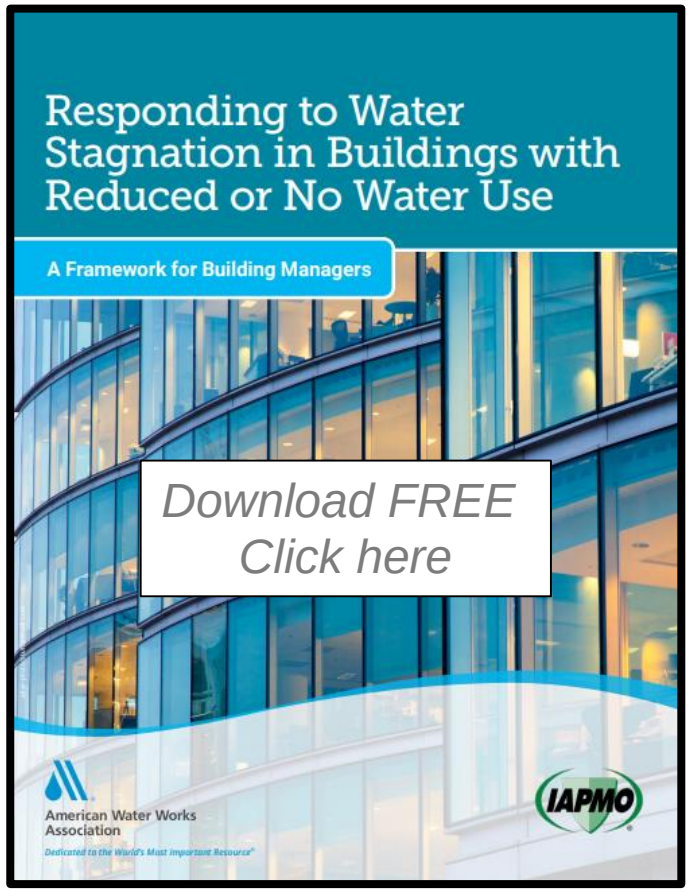
THE UNIVERSITY OF MEMPHIS

Arizona State University

Northeastern University

THE UNIVERSITY OF IOWA

POLYTECHNIQUE MONTRÉAL



NEW: A Building Manager "How To"

Collaborative effort

William Rhoads, Ph.D., Virginia Tech

Michele Prévost, Ph.D., Polytechnique Montreal

Kelsey J. Pieper, Ph.D., Northeastern University

Tim Keane, Legionella Risk Management, Inc.

Andrew J. Whelton, Ph.D., Purdue University

Franziska Rölli, Lucerne University of Applied Sciences & Arts

Caitlin R. Proctor, Ph.D., Purdue University

Marianne Grimard-Conea, École Polytechnique de Montréal

American Water Works Association

IAPMO

VIRGINIA TECH

POLYTECHNIQUE MONTRÉAL

Northeastern University

LEGIONELLA RISK MANAGEMENT

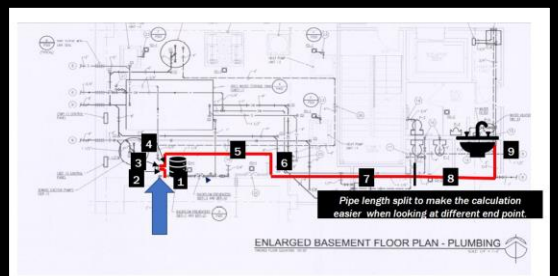
PURDUE UNIVERSITY

Lucerne University of Applied Sciences and Arts

ÉCOLE POLYTECHNIQUE MONTRÉAL

NEW: Building Water Essentials

Research Backed Online Short-Course for Public Health Professionals



A training tool, an encyclopedia, and an extensive FAQ, with information designed to be immediately applicable in the field.

A series of modules that take approximately 7-10 hours total to complete. Modules do not have to be taken in sequence.

Beta tested in 2020 by practicing epidemiologists, sanitarians, engineers and scientists.

PURDUE UNIVERSITY

Info and registration page here:
https://cutt.ly/Sg4RXJv

If interested e-mail EngrOnline@purdue.edu

Some Recent Initiatives

11 buildings across 4 studies

All free chlorine disinfectant

3-5 months of low/no water use

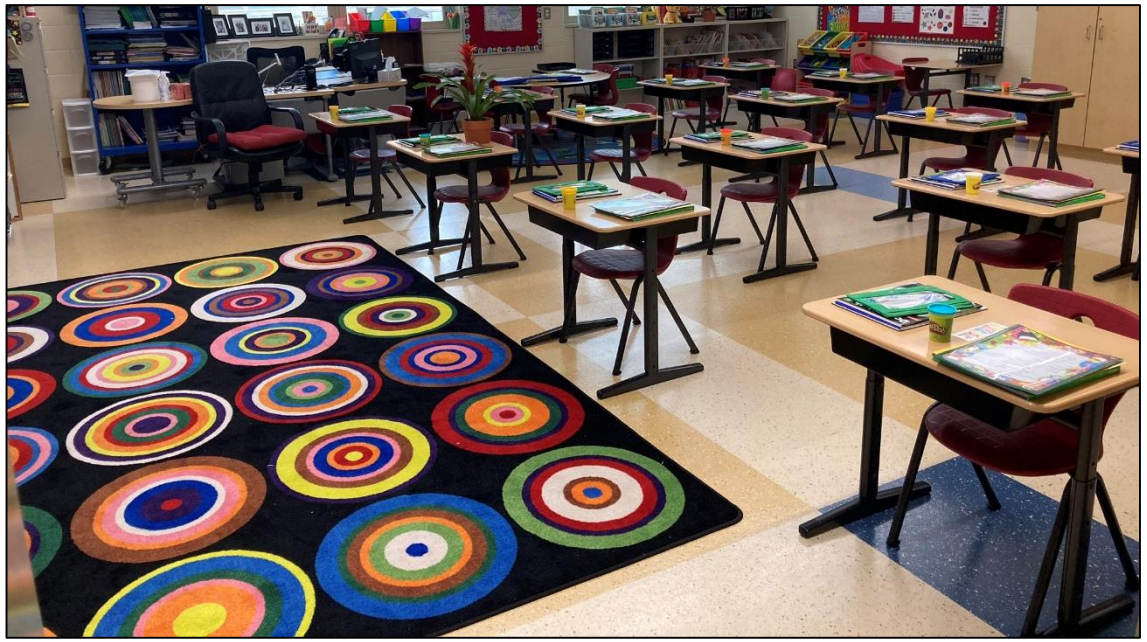
Some served by the same utility

Some have recirculation loops, in-building storage, showers

All had indoor copper pipe

Up to 400 water outlets/building

Not all had as-built drawings

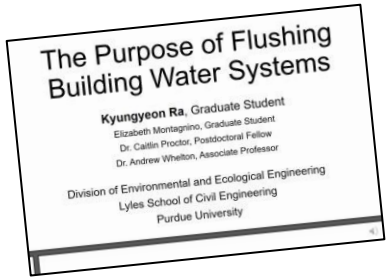


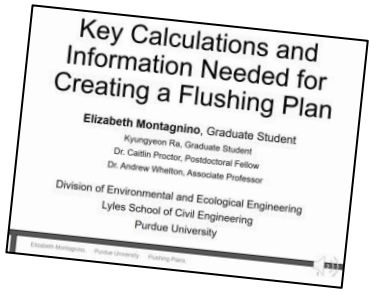
1. Elementary school, Indiana (Ra et al.)
2. Large residential building, Indiana (Angert et al., led by Proctor, Ph.D.)
3. Institutional buildings, Indiana (Ra et al.)
4. Elem/mid/high school, Ohio (Ley et al.)

Preliminary Findings

YouTube

Click here for the Plumbing Safety Channel





Water management programs basically nonexistent at daycares, schools, colleges, and universities

Metal (Cu, Pb, Ni, Zn) exceedances. Don't just look at water fountains.

Legionella pneumophila detected in 3 of 4 studies

- 2 buildings where flushing applied, no legionella detected after flushing, 2 weeks later low levels (<10 MPN/100 mL)
- Highest levels found in cold water *not* hot water. Water fountain hot spots.

Hypochlorite disinfection levels varied (est. 160-340 mg/L+ for 3 hours). Likely due to ineffective mixing, reactions, and/or decay

Preliminary Field Observations: A Few Gaps

Lack of clear **Go/No-Go** levels for *Legionella pneumophila* and other pathogens

- Some consultants invoke the zero MCLG, others invoke different numbers
- One health department invoked a conversation with CDC that zero is only acceptable
- CDC doesn't have explicit **Go/No-Go** levels for buildings
- Risk-based levels can range from 1 to 1000s CFU/100mL depending on exposure route

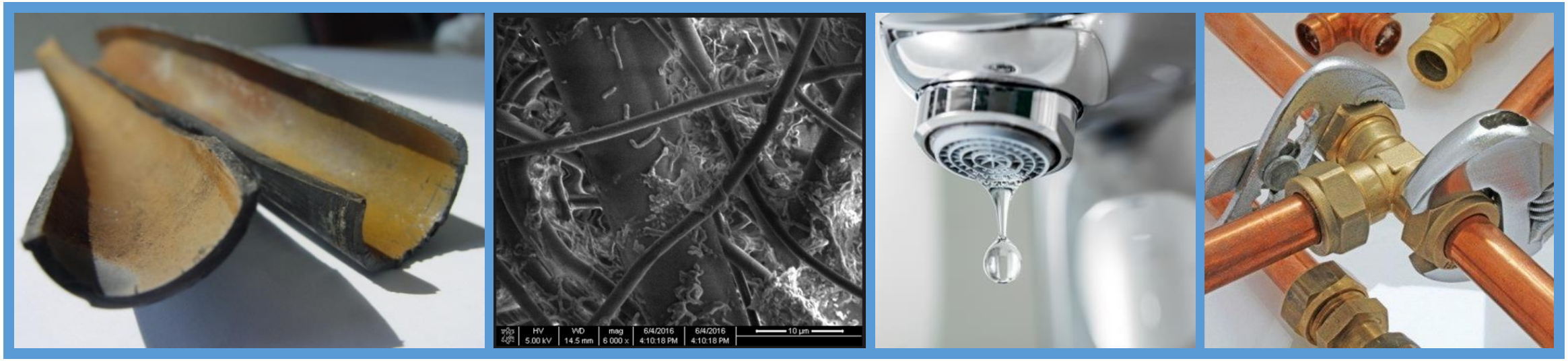
Most of the time other pathogens are not being examined

Some health departments discourage school water testing (lead, copper, legionella, etc.) because they claim CDC discourages water testing unless there's a suspected outbreak

Many health officials and primacy agency staff lack familiarity of building water systems

Local, state, and federal government agencies issue sometimes vague statements. Some consultants then implement what they want (i.e., qPCR testing for legionella only ➔ followed by thermal disinfection ➔ then a 36 hr qPCR test only, not other follow-up)

USEPA Plumbing Safety Grant Annual Report Coming Soon: Right Sizing Tomorrow's Water Systems for Efficiency, Sustainability, and Public Health, 2016-Present



Andrew Whelton, Jade Mitchell, Joan Rose, Juneseok Lee, Pouyan Nejadhashemi, Erin Dreelin, Tiong Gim Aw, Amisha Shah, Matt Syal, Maryam Salehi

Manhattan College

Michigan State University

Purdue University

Tulane University

The University of Memphis

Thank you…

www.PlumbingSafety.org

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- ✓ Scientific reports
- ✓ External plumbing docs
- ✓ YouTube Channel

Andrew Whelton, Ph.D. awhelton@purdue.edu

@TheWheltonGroup

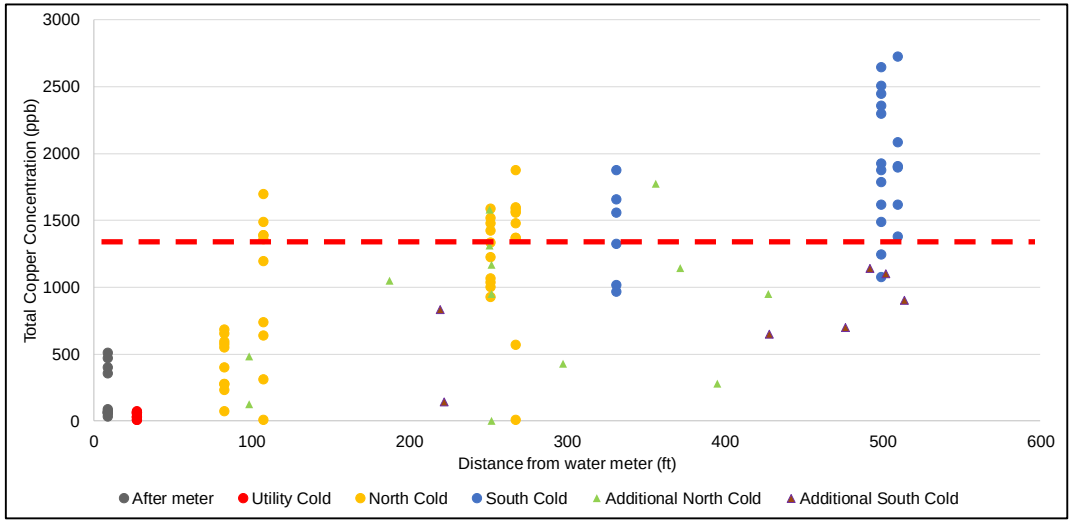
Extra slides

NEW: School Water Safety, Summer vs. Fall

Finding Contaminated Water in a 7-Year Old Green School

Download here:

https://doi.org/10.1039/D0EW00520G



Discovered school wide copper contamination, and multiple claims by agencies proven incorrect

- ✓High alkalinity groundwater is a copper leaching problem
- ✓Spot flushing does not guarantee water will have < 1.3 mg/L copper
- ✓Only options: In-building whole or POU treatment
- ✓Consultant recommended activated carbon filters (bad) not ion exchange
- ✓Lack of prior testing at schools indicates larger problem likely exists

NEW: Fires cause water infrastructure contamination, wider implications are significant

AWWA WATER SCIENCE

Wildfire caused widespread drinking water distribution network contamination

Download FREE here:
https://doi.org/10.1002/aws2.1183

VOCs and SVOCs present, levels can exceed hazardous waste limits (40 ppm benzene, etc.)

Do Not Use water order should be issued

Protect homeowners and their plumbing


THE SEAL OF THE GOVERNOR OF WEST VIRGINIA


ZONE 5