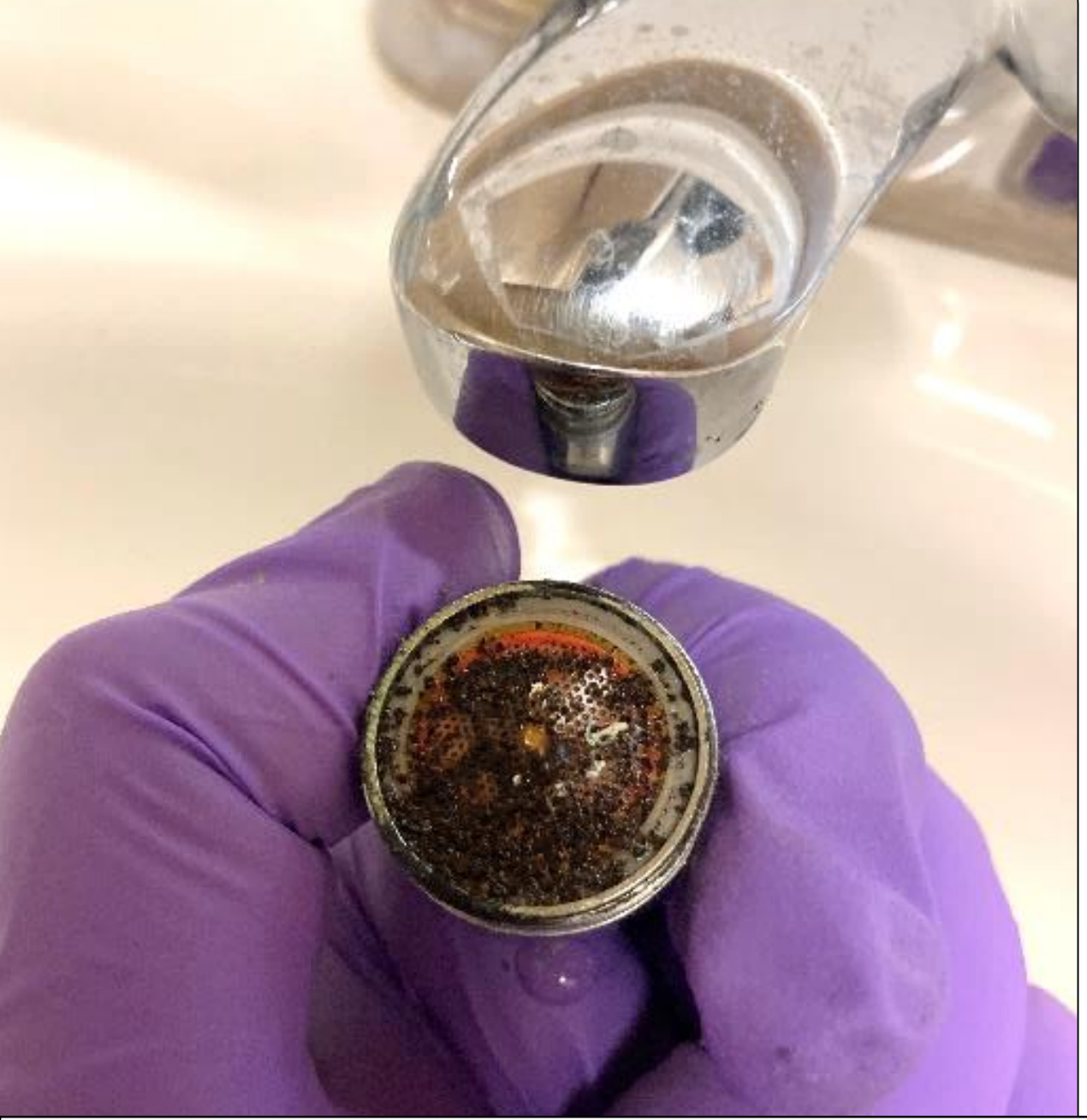

Returning Plumbing to Safe Use After Extended Shutdowns or Low Occupancy:

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

Special Thanks to…

Purdue University

Christian Ley

Kyungyeon Ra

Elizabeth Montagnino

Yoorae Noh

Maria Palmegiani

Danielle Angert

Nadya Zyakyina, Ph.D.

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Ryan Day

Additional thanks to collaborators

Building owners, school administrators, water utilities, state and county health departments, and plumbing technology innovation companies

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U.S. National Science Foundation RAPID award 2027049

U.S. National Science Foundation EAGER award 2039498

U.S. Environmental Protection Agency award R836890

Purdue University Lilian Gilbreth Postdoctoral Fellowship program

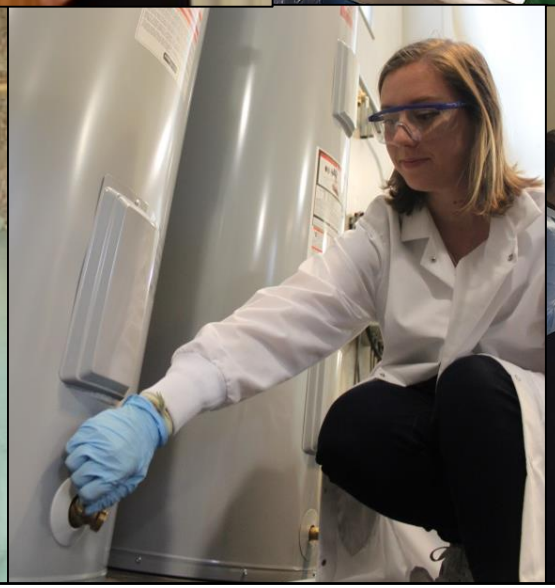
Purdue University Ross Graduate Fellowship program

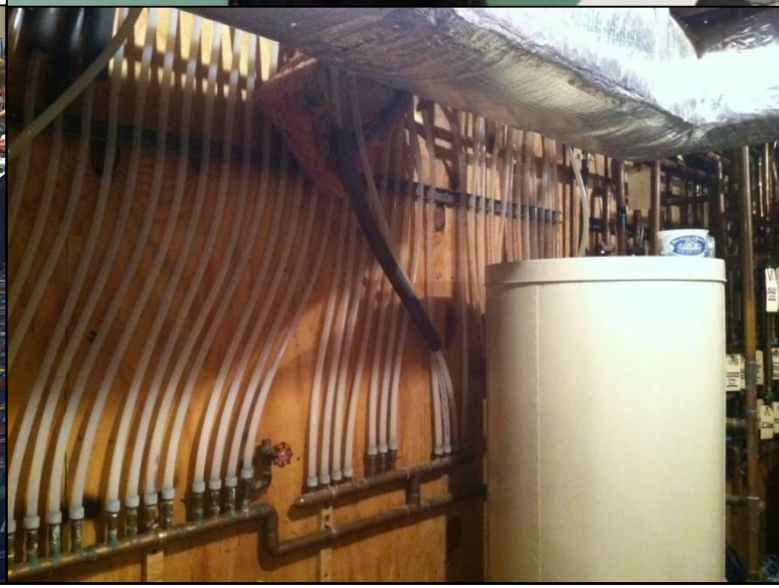
Purdue University Andrews Graduate Fellowship program

1. Water safety issues for large buildings
2. Standards and guidance
3. Gaps and moving forward
4. Other information that's new and coming soon


THE SEAL OF THE GOVERNOR OF WEST VIRGINIA

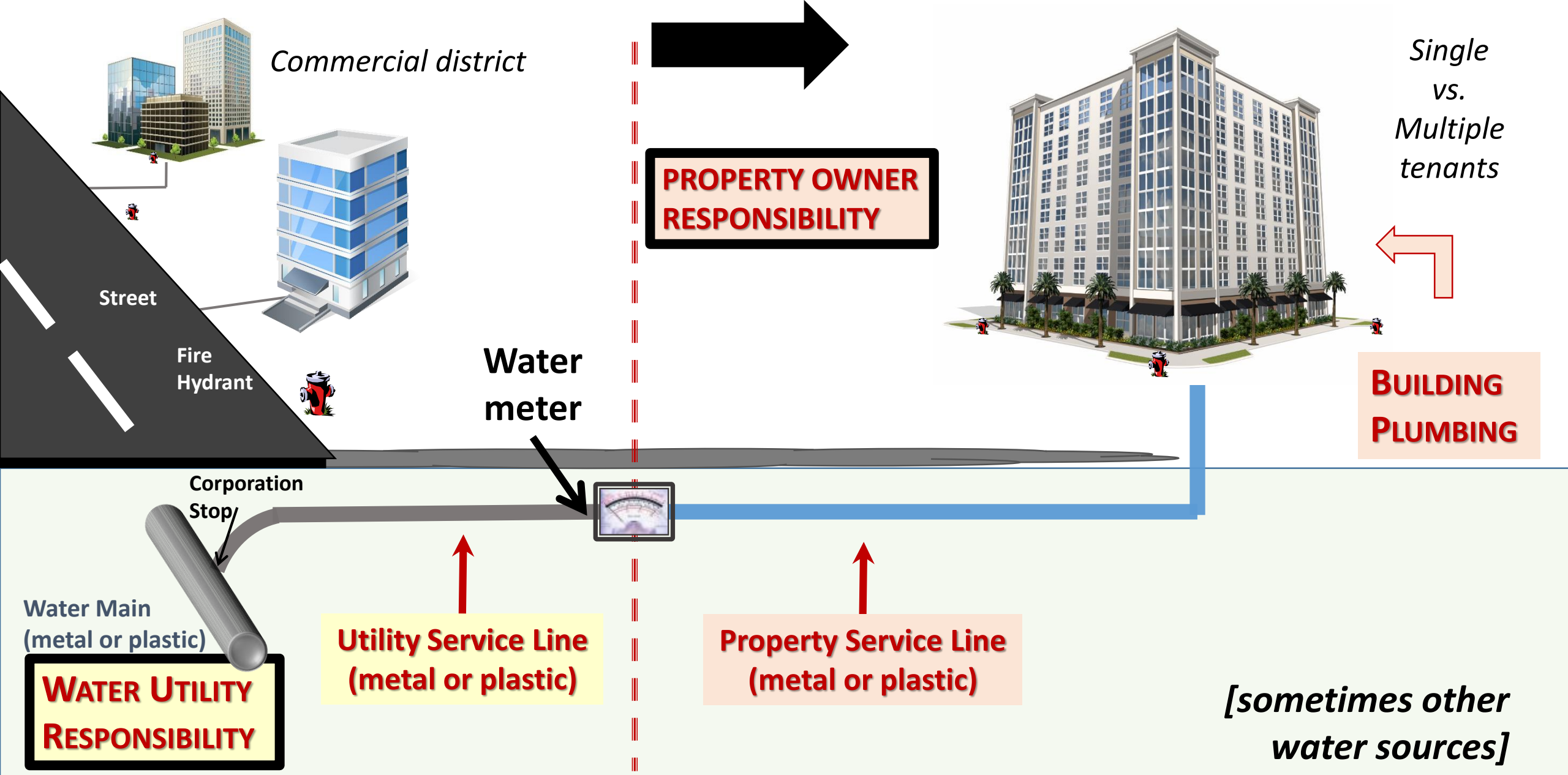

ZONE 5





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
Single vs. Multiple tenants
PROPERTY OWNER RESPONSIBILITY
Street
Fire Hydrant
Water meter
BUILDING PLUMBING
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

Merriam-Webster®

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

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

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

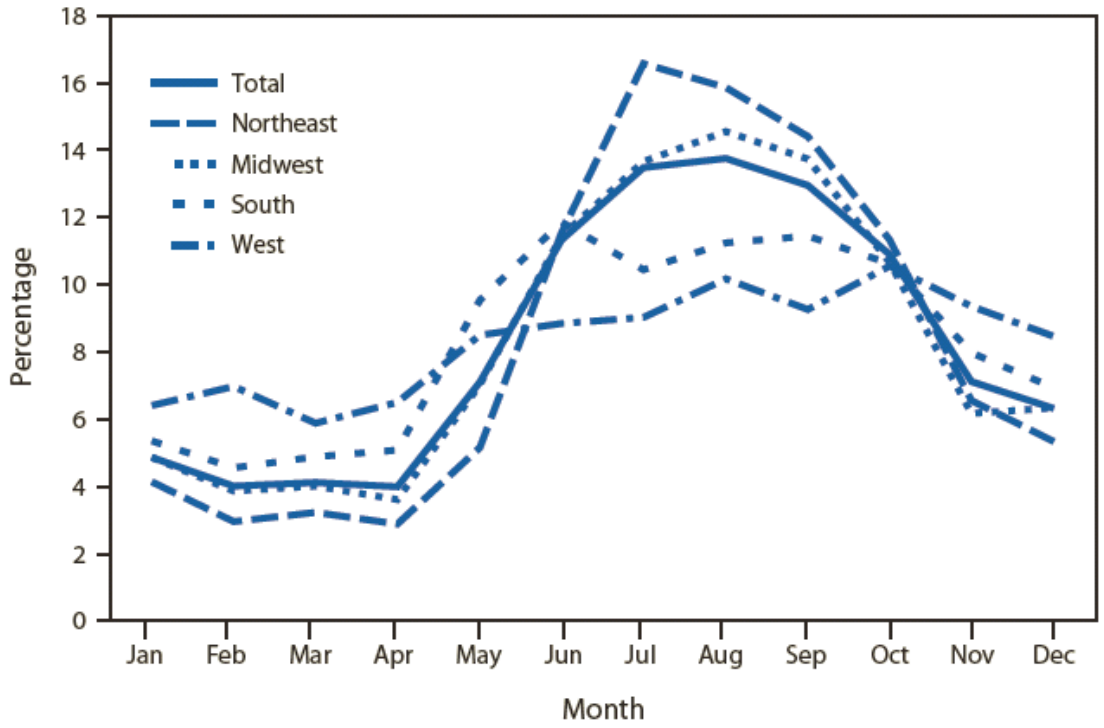
Lead can leach

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

Most recent *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

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, ***ongoing***
4. Bench-/pilot-scale testing to determine how to fully recover contaminated building water system devices and equipment, ***planned***
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

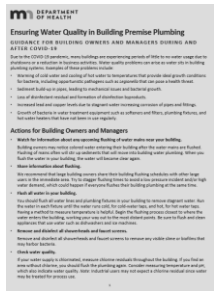
SAFE WATER ENGINEERING

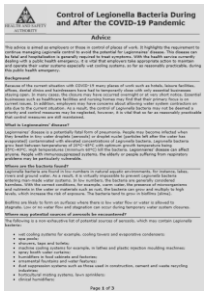
U.S. National Science Foundation EAGER Award 2039498

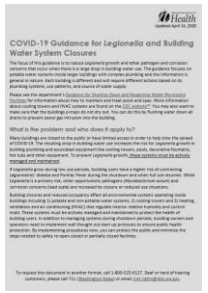
Initiating a Transformative Building Water System Research Collaborative in Rapid Response to the COVID-19 Pandemic

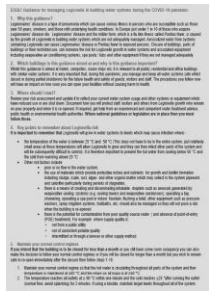
And more…

1. Host 3 formal collaborative workshops on building water safety, ***planned***
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***

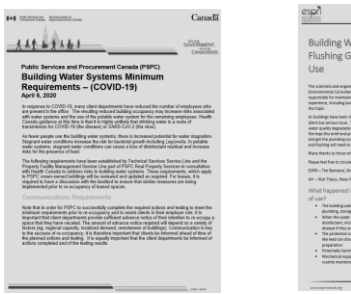

Ensuring Water Quality in Building Premise Plumbing

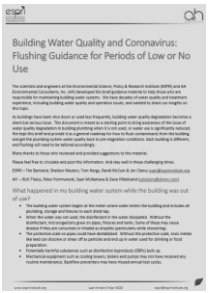

Control of Legionella Bacteria During and After the COVID-19 Pandemic

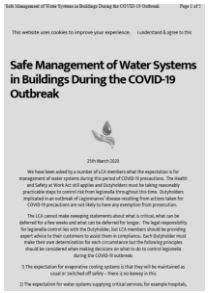

COVID-19 Guidance for Legionella and Building Water System Closures




Public Health England

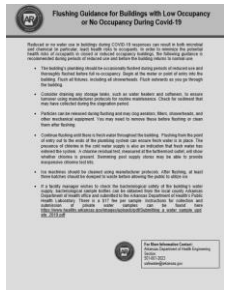

Public Services and Procurement Canada (PSPC)
Building Water Systems Minimum Requirements – (COVID-19)

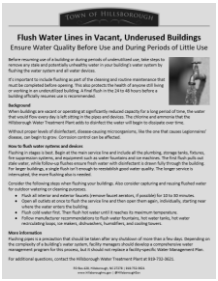



Building Water Quality and Coronavirus: Flushing Guidance for Periods of Low or No Use


Safe Management of Water Systems in Buildings During the COVID-19 Outbreak

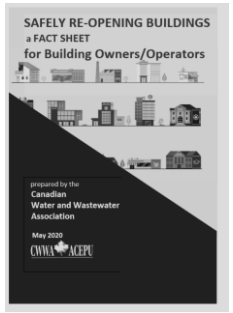
Ohio Department of Health
Guidance for Premise Plumbing Water Service Restoration

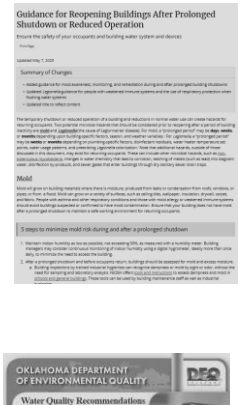

Flushing Guidance for Buildings with Low Occupancy or No Occupancy During Covid-19

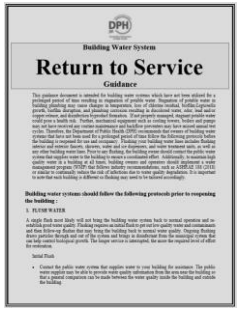

Flush Water Lines in Vacant, Underused Buildings
Ensure Water Quality Before Use and During Periods of Little Use

Since March 2020, there have been more than ***63+*** guidance documents telling building owners what they could do to prevent and deal with stagnation situations.

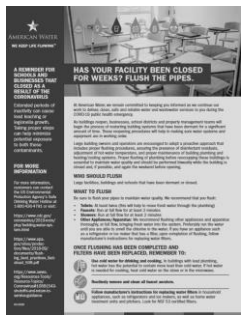
Many differ quite dramatically. Some lack key info (safety, devices, sensitive population, etc.).


SAFELY RE-OPENING BUILDINGS
a FACT SHEET
for Building Owners/Operators
prepared by the
Canadian Water and Wastewater Association
May 2020
CWWA ACEPU

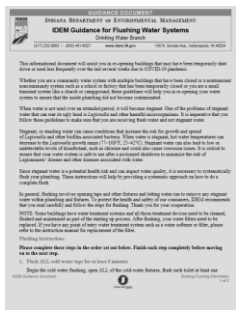

Guidance for Reopening Buildings After Prolonged Shutdown or Reduced Operation
Summary of Changes
5 steps to minimize mold risk during and after a prolonged shutdown
Mold

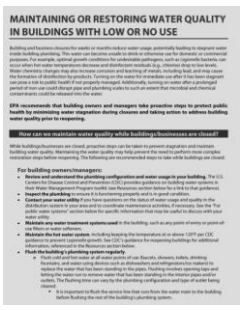

Building Water System
Return to Service
Guidance

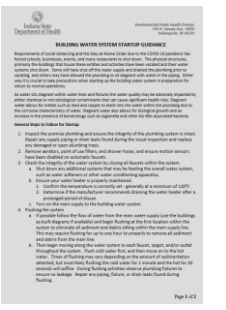

BUILDING PERFORMANCE
ENSURING THE SAFETY OF YOUR BUILDING WATER SYSTEM POST COVID-19 LOCKDOWN

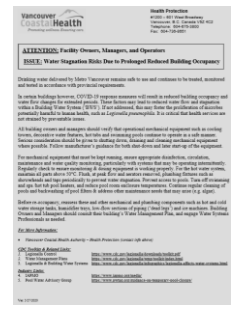

HAS YOUR FACILITY BEEN CLOSED FOR WEEKS? FLUSH THE PIPES.
A REMINDER FOR SCHOOLS AND BUSINESSES THAT CLOSED AS A RESULT OF THE COVID-19 PANDEMIC
WHO SHOULD FLUSH
WHAT TO FLUSH
HOW TO FLUSH
ONCE FLUSHING HAS BEEN COMPLETED AND FILTERS HAVE BEEN REPLACED, REMEMBER TO:

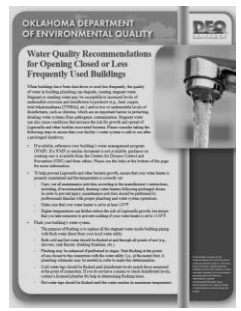

Public Health
Water Quality and Your Business: Tips for Re-opening After Closure
Make Sure Your Building's Water System and Devices Are Safe to Use
FOR MORE INFORMATION


INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
IDEM Guidance for Flushing Water Systems
Drinking Water Branch


MAINTAINING OR RESTORING WATER QUALITY IN BUILDINGS WITH LOW OR NO USE
For building owners/managers:
How can we maintain water quality while building/businesses are closed?


Indiana State Department of Health
BUILDING WATER SYSTEM STARTUP GUIDANCE


Vancouver Coastal Health
Health Protection
ATTENTION: Facility Owners, Managers, and Operators
ISSUE: Water Stagnation Risks Due to Prolonged Reduced Building Occupancy


OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
Water Quality Recommendations for Opening Closed or Less Frequently Used Buildings

Why are they so different?

Different perspectives - *sides of the elephant*

Different starting information about water safety or plumbing

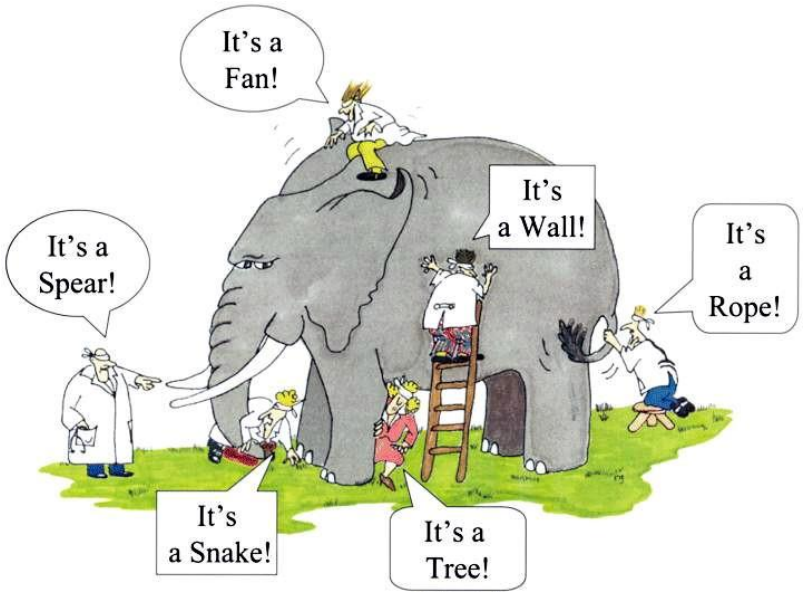
Guidance targeted for different readers

Deliberate step-by-step documents vs. general advice

Some are derivatives of others, & others… & others!

Some have been revised (version 3 since March 2020)

Media, water utilities, & associations making even brief(er) messages



Document objectives: Awareness vs. Informational vs. Warnings vs. Actions

ANSI/ASHRAE Standard 188-2018, Legionellosis: Risk Management for Building Water Systems

[NEW] ASHRAE Guideline 12-2020, Minimizing the Risk of Legionellosis Associated with Building Water Systems

[NEW] ASSE/IAPMO/ANSI 12080, Professional Qualifications Standard for Legionella Water Safety and Management Personnel

Non-enforceable standards and guidelines exist… but focus only on legionella

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

Coming Soon: Evidence informed guidance for reduced and no building water use

American Water Works Association

IAPMO

Document Title TBD

Expected Fall 2020

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

VIRGINIA TECH

POLYTECHNIQUE MONTRÉAL

Northeastern University

LEGIONELLA RISK MANAGEMENT

PURDUE UNIVERSITY

Lucerne University of Applied Sciences and Arts

ÉCOLE POLYTECHNIQUE MONTRÉAL

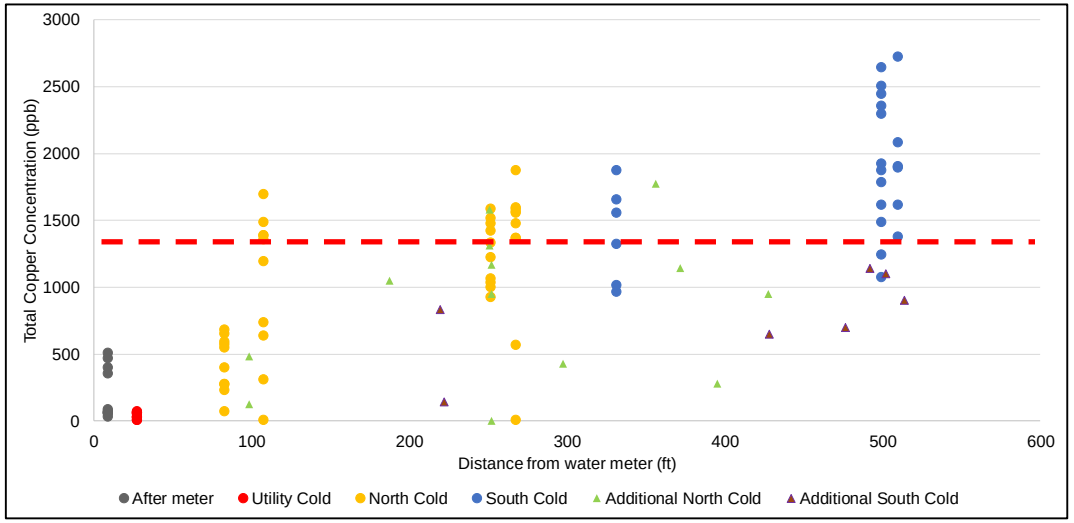
Coming Soon: COVID-19 inspired building water safety testing results from many others

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

Some Ongoing Initiatives

11 buildings across 4 studies

All free chlorine disinfectant

3-5 months of low/no water use

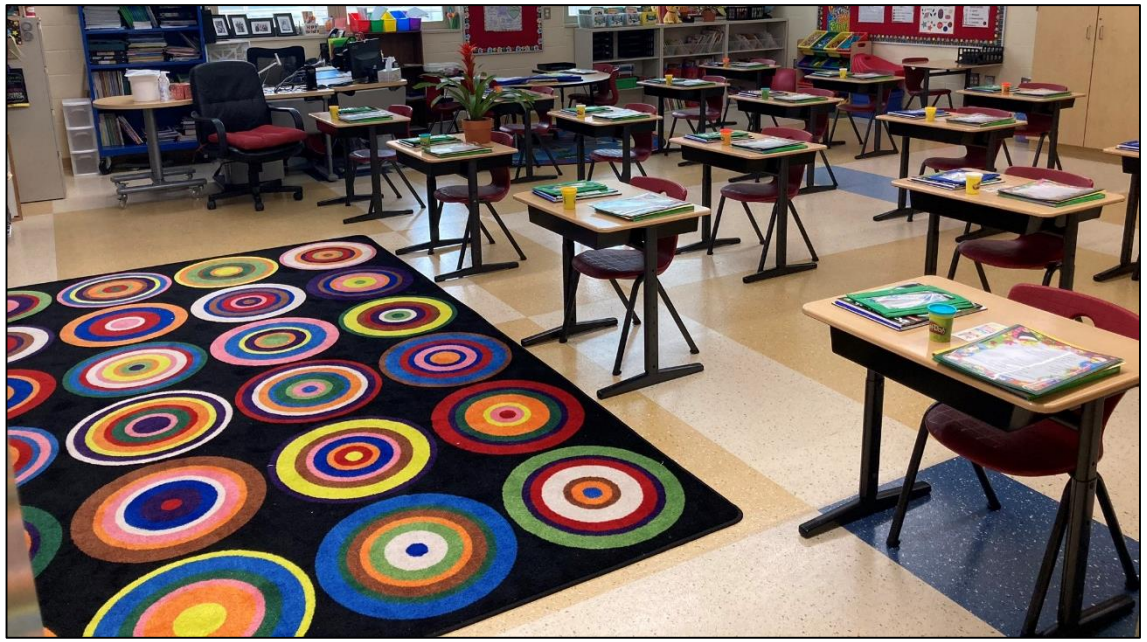
Some served by the same utility

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

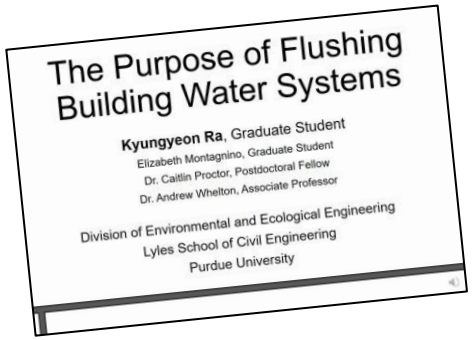


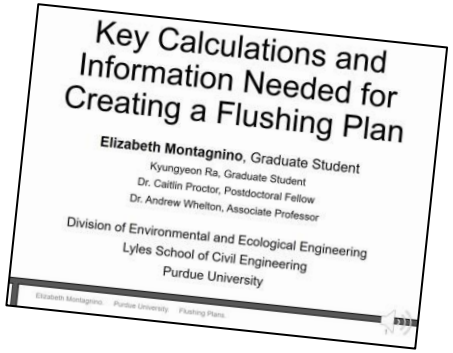
1. Elementary school, Indiana (Ra et al.)
2. Large residential building, Indiana (Angert et al., led by Proctor, Ph.D.)
3. Institutional buildings, Indiana (Ra et al.)
4. Elem/mid/high school, Ohio (Ley et al.)

Preliminary Findings

YouTube

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)

NEW: Fires cause water infrastructure contamination, wider implications may be significant

AWWA WATER SCIENCE

Wildfire caused widespread drinking water distribution network contamination

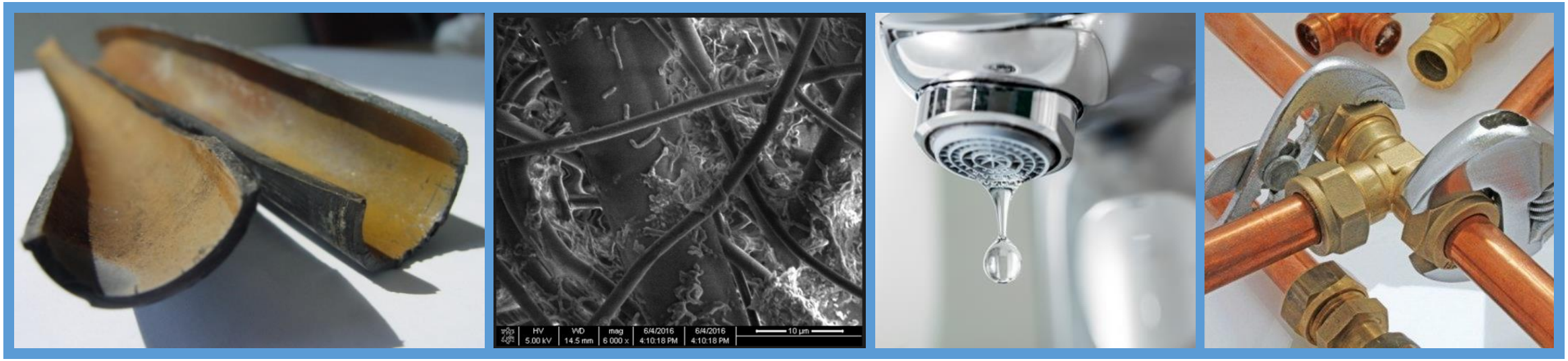
Download FREE here:
https://doi.org/10.1002/aws2.1183

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

More Results of this USEPA Grant 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

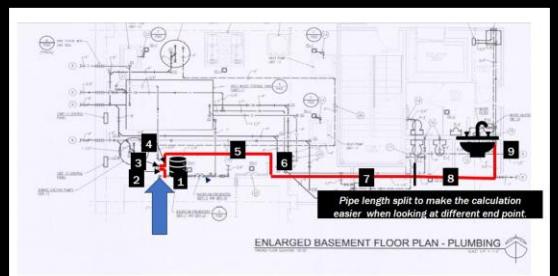
Tulane University

The University of Memphis

Building Water Essentials
Online Short-Course for Public Health Professionals







COMING SOON!

PURDUE UNIVERSITY




Fall 2020, If interested e-mail
awhelton@purdue.edu

Thank you…

www.PlumbingSafety.org

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

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