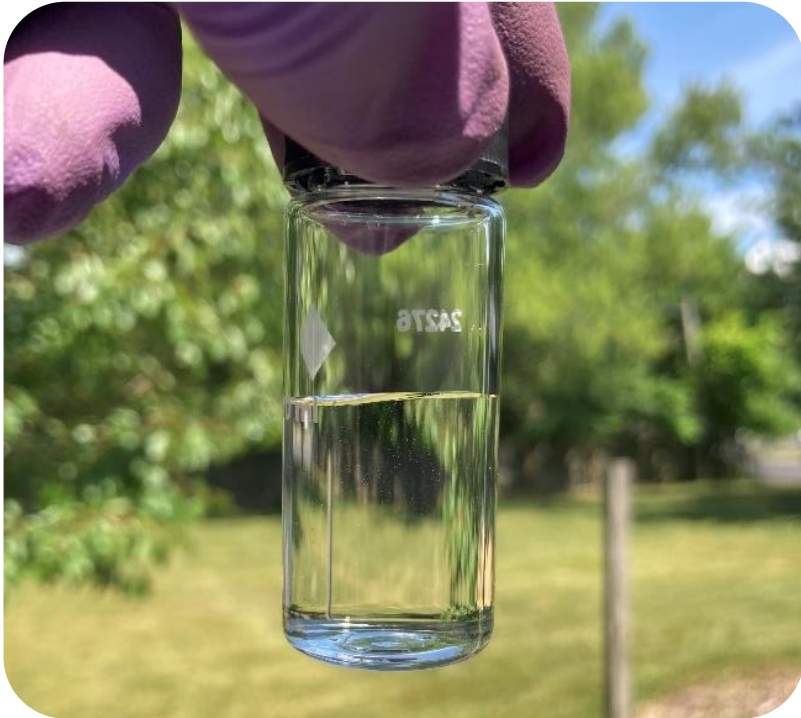


Water Bugs: Building Water Stagnation – Water Quality and Addressing Concerns



Andrew J. Whelton

Caitlin Proctor

Kyungyeon Ra

Danielle Angert

Elizabeth Montagnino

Christian Ley

Yoorae Noh

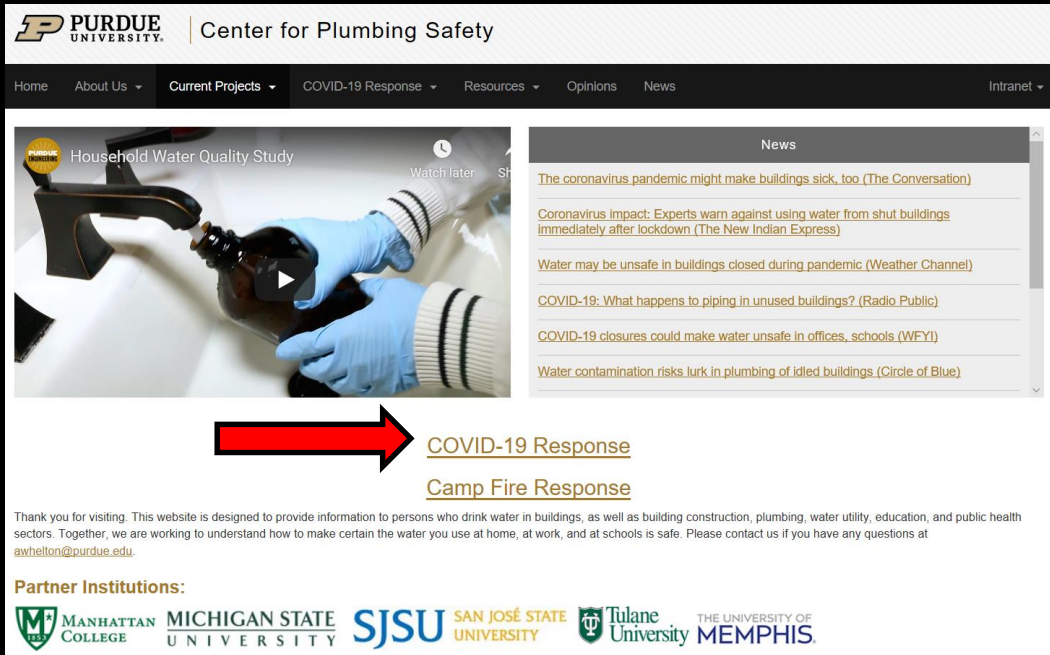
Maria Palmegiani

Civil, Environmental, and Ecological
Engineering

*Florida Section AWWA Seminar
August 5, 2020*



More information here... www.PlumbingSafety.org



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Home About Us Current Projects COVID-19 Response Resources Opinions News Intranet

Household Water Quality Study Watch later

News

- [The coronavirus pandemic might make buildings sick, too \(The Conversation\)](#)
- [Coronavirus impact: Experts warn against using water from shut buildings immediately after lockdown \(The New Indian Express\)](#)
- [Water may be unsafe in buildings closed during pandemic \(Weather Channel\)](#)
- [COVID-19: What happens to piping in unused buildings? \(Radio Public\)](#)
- [COVID-19 closures could make water unsafe in offices, schools \(WFYI\)](#)
- [Water contamination risks lurk in plumbing of idled buildings \(Circle of Blue\)](#)

COVID-19 Response

Camp Fire Response

Thank you for visiting. This website is designed to provide information to persons who drink water in buildings, as well as building construction, plumbing, water utility, education, and public health sectors. Together, we are working to understand how to make certain the water you use at home, at work, and at schools is safe. Please contact us if you have any questions at awhelton@purdue.edu.

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*Access to world-class expertise, capabilities,
and education in and outside Purdue*

A Resource for All

- ✓ Plumbing news
- ✓ Plumbing education videos
- ✓ Plumbing explainers
- ✓ List of projects
- ✓ Scientific opinions
- ✓ Resources → presentations
- ✓ Scientific reports
- ✓ External plumbing docs



*Many thanks to
Brad Caffery at
Purdue University*



Onsite Education & YouTube Channel



Nearby Innovation Partner with
Full-Scale Testing Facility



Plumbing Testing Facility at Purdue



Onsite Testing and Technical Support

COVID Specific Building Water Safety Support Resources

Restoring Water to Medical, Residential, and Commercial Buildings, Shutdowns, Unsafe Water

The COVID-19 pandemic has caused widespread building shutdowns, but also emergency restoration of water to previously closed medical facilities and homes. Several serious building drinking water safety risks exist. As people begin using the water again, they will encounter extremely stagnated water with excessive lead, copper, and bacterial concentrations, that may include harmful organisms like legionella that can cause disease outbreaks.

There are no national or industry guidelines for building reopening after extended shutdowns.

The [U.S. National Science Foundation](#) funded Purdue University researchers to rapidly address this serious public health concern. This rapid response effort involves partnerships with the [American Society of Plumbing Engineers](#) and [International Association of Plumbing and Mechanical Officials](#) and collaborations with other building water and public health experts from across North America.

[[NSF government website description of this rapid response grant](#)]

Questions

I am looking for...

- [A list of your rapid response efforts](#) in response to the COVID-19 outbreak
- [Advice on what I should do](#) as a public health official, building owner, or water utility
- [Download a copy of the Experts Building Water Safety Study](#) released April 7, 2020
- [Guidance on how to create](#) a building flushing plan
- [Brief educational videos](#) on building water safety topics

- ✓ Advice for building owners, health officials and utilities
- ✓ Building water safety education videos
- ✓ Guidance on how to create flushing plan
- ✓ Access to the Building Water Safety Study
- ✓ Guidance on building water safety from multiple nations and U.S. states



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2017
CMS Memo:
Legionella
Risk in
Healthcare
Facility
Water
Systems

2017
Plumbing Industry
Research Workshop:
Identify Knowledge
Gaps & Risks
Associated with
Premise Plumbing
Drinking Water Quality

2019
Rapid response to
the Camp Fire:
Widespread Water
System, Residential
& Commercial
Plumbing
Contamination

2019
Camp Fire
Building Water
System Testing
Guidance

2019
Camp Fire
Plumbing
Safety
Education
Workshop
for survivors

2020
NSF RAPID
response:
Building
water
system
stagnation
and recovery

2017
USEPA
funds 2
National
Priority
studies on
building
plumbing



2018
ASHRAE 188
Legionellosis:
Risk
Management
for Building
Water
Systems



2018
Measurement
Science Roadmap
Workshop for Water
Use Efficiency and
Water Quality in
Premise Plumbing
Systems



2019
Implications of the
California Wildfires
for Health,
Communities, &
Preparedness:
Proceedings of a
Workshop

The National
Academies of
SCIENCES
ENGINEERING
MEDICINE

2019
Mgmnt. of
Legionella
in Water
Systems

The National
Academies of
SCIENCES
ENGINEERING
MEDICINE

2020
COVID19: Impact of
prolonged
stagnation on
building water
quality and safety



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COVID-19 Response

Camp Fire Response

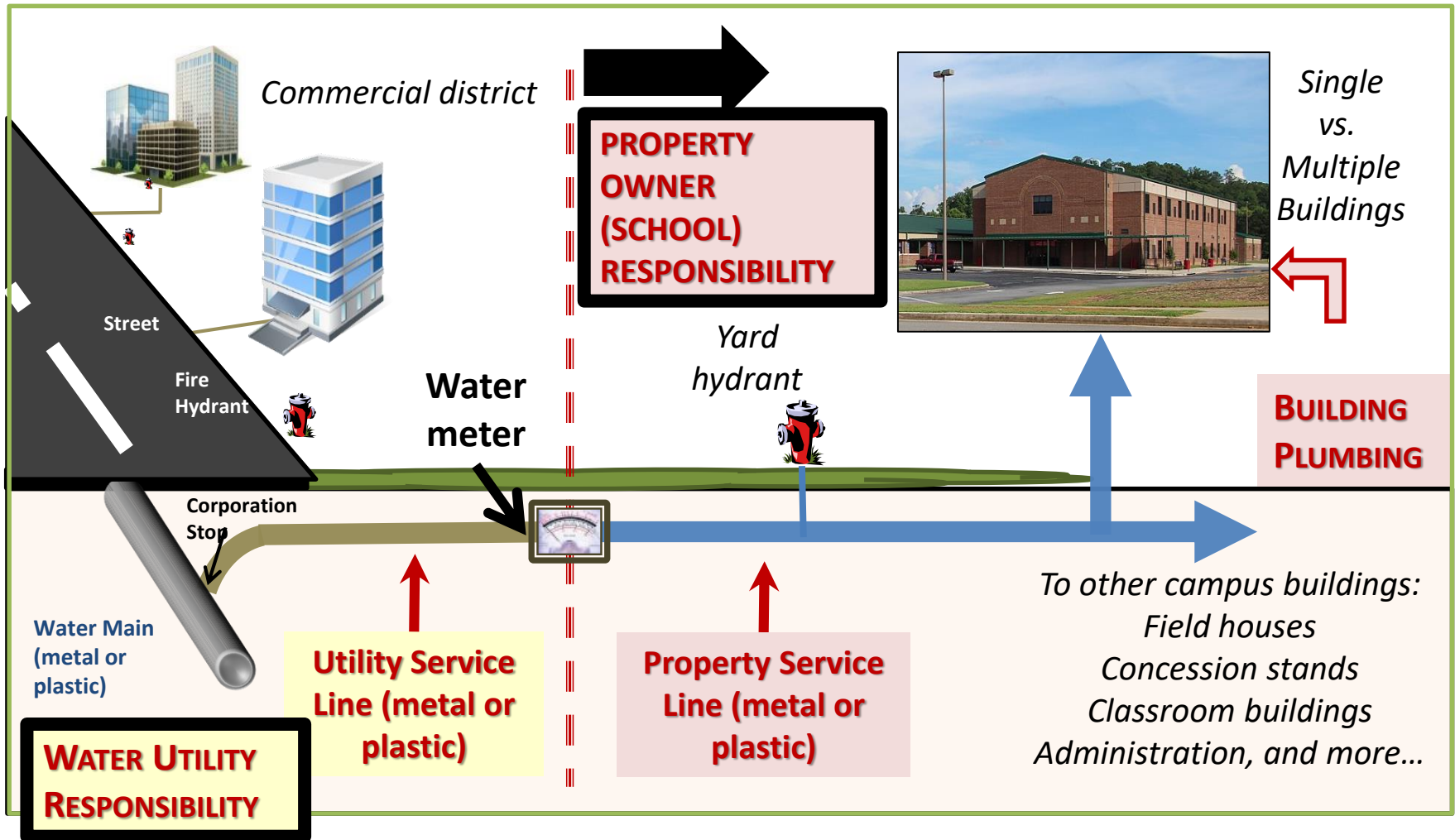
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Plumbing news
Plumbing explainers
Scientific opinions
Scientific reports

Plumbing education videos
List of projects (routine, disasters)
Resources ➔ presentations
External plumbing docs



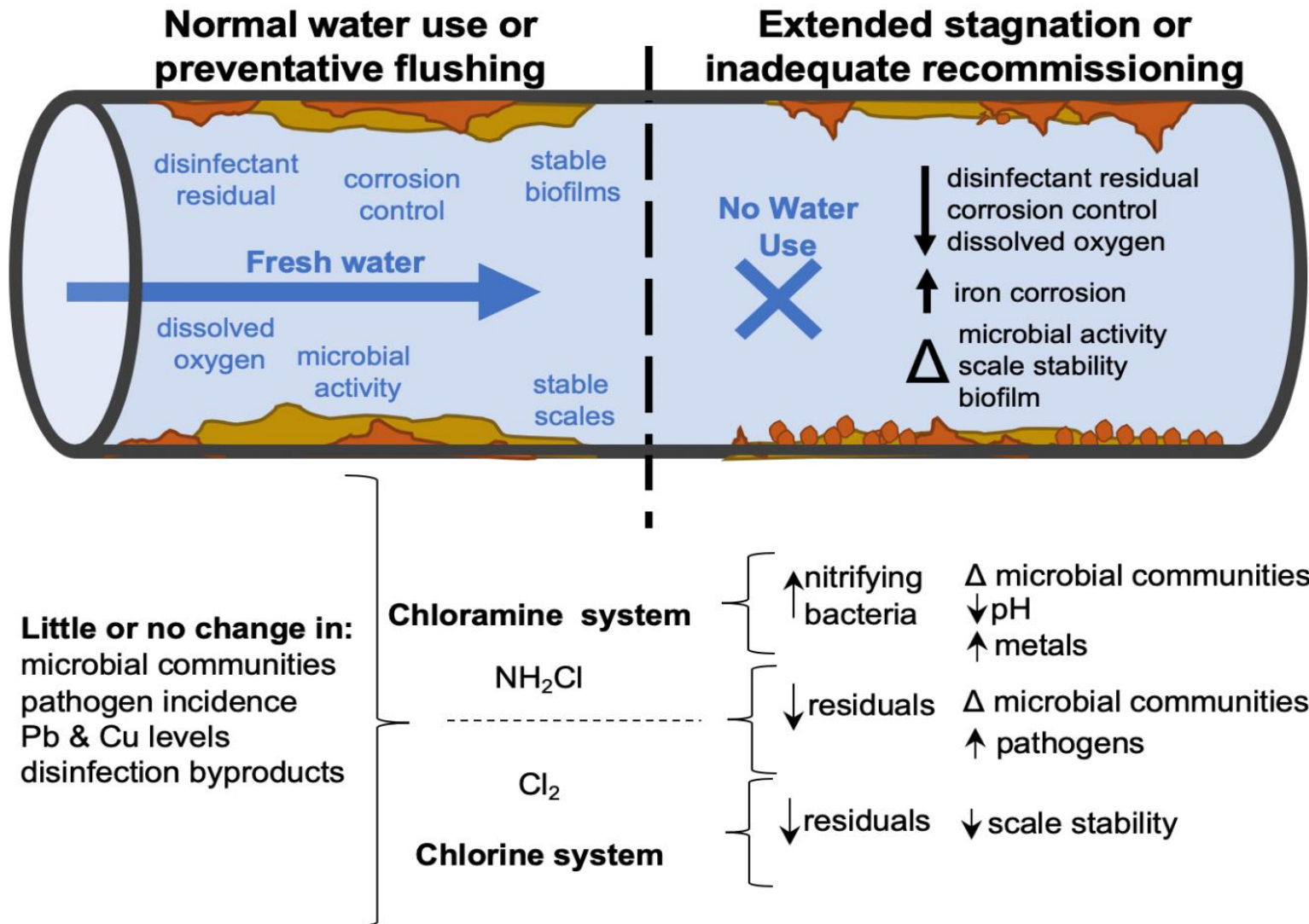
Sometimes there are other water sources like onsite wells....

Stagnation *noun*

stag·na·tion | \ stag-'nā-shən

a state or condition marked by
lack of flow, movement





Potential Water Quality Impacts Associated with Water Use Patterns

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

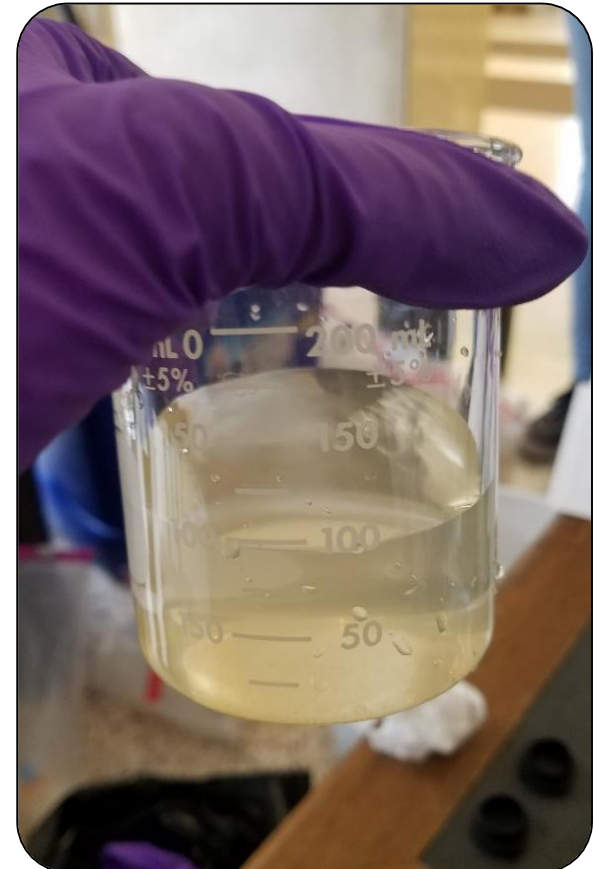
Stagnated water can poses health risks

Metals (Cu, Pb, others)

Copper (can exceed safe limits in just 48 hours sometimes): Nausea, vomiting, gastrointestinal distress

Lead : Developmental issues with children and acute effects

Harmful organisms e.g., *Legionella pneumophila* and other opportunistic pathogens: Many organisms cause respiratory illness, other infections can occur





U.S. National Science Foundation RAPID Award 2027049 *Shutdowns and Consequences - Extreme Plumbing Stagnation and Recommissioning*

1. State of science review of water stagnation with experts from 7 private and public sector organizations, *[done]*
2. Support to the plumbing and public health sectors on guidance and decisions, *ongoing*
3. Field testing to examine building water safety, *ongoing*
4. Lab testing to examine contaminated systems and devices, *planned*
5. Help transform public awareness, *ongoing*

U.S. National Science Foundation EAGER Award 2039498

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



1. Rapidly organize and lead a nation-wide Building Water Systems Research Collaborative with multiple institutions focused on generating and sharing new knowledge within the research community and with the public.
2. The collaborative will share cutting-edge knowledge, protocols, best analytical practices, big data, and field practices through a series of formal interactions amongst an interdisciplinary team with a common focus.

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



Review Article

 Open Access

Considerations for Large Building Water Quality after Extended Stagnation

Caitlin R. Proctor , William J. Rhoads , Tim Keane , Maryam Salehi , Kerry Hamilton , Kelsey J. Pieper , David M. Cwiertny , Michele Prévost , Andrew J. Whelton 

First published: 16 June 2020 | <https://doi.org/10.1002/aws2.1186> | Citations: 1

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/aws2.1186.



Northeastern
University



POLYTECHNIQUE
MONTRÉAL



Illnesses are here

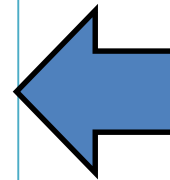


Indiana Health Alert Network Notification – July 10, 2020

Legionellosis Testing: Reminder for Seasonality and Building Reopenings

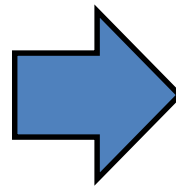
ISDH is alerting healthcare providers to an anticipated seasonal increase in *Legionella* infections combined with a potential increase in cases resulting from building re-openings. ISDH reminds all healthcare providers to test for *Legionella* when evaluating adults with symptoms of pneumonia, even during the COVID-19 pandemic.

Testing should include both urine antigen testing (UAT) and *Legionella* sputum/respiratory culture following these guidelines:



In the US, healthcare providers are being warned

We have already had confirmed illness during the pandemic



- ✓ Staff member died (2019), Legionnaires Disease
- ✓ Staff member sick (June 2020), Legionnaires Disease
- ✓ Found LP in aerators at select locations including janitor sink

Kettering schools taking safety measures after Legionella find in water at Fairmont High

July 10, 2020



Fairmont High School.

f Share

Share

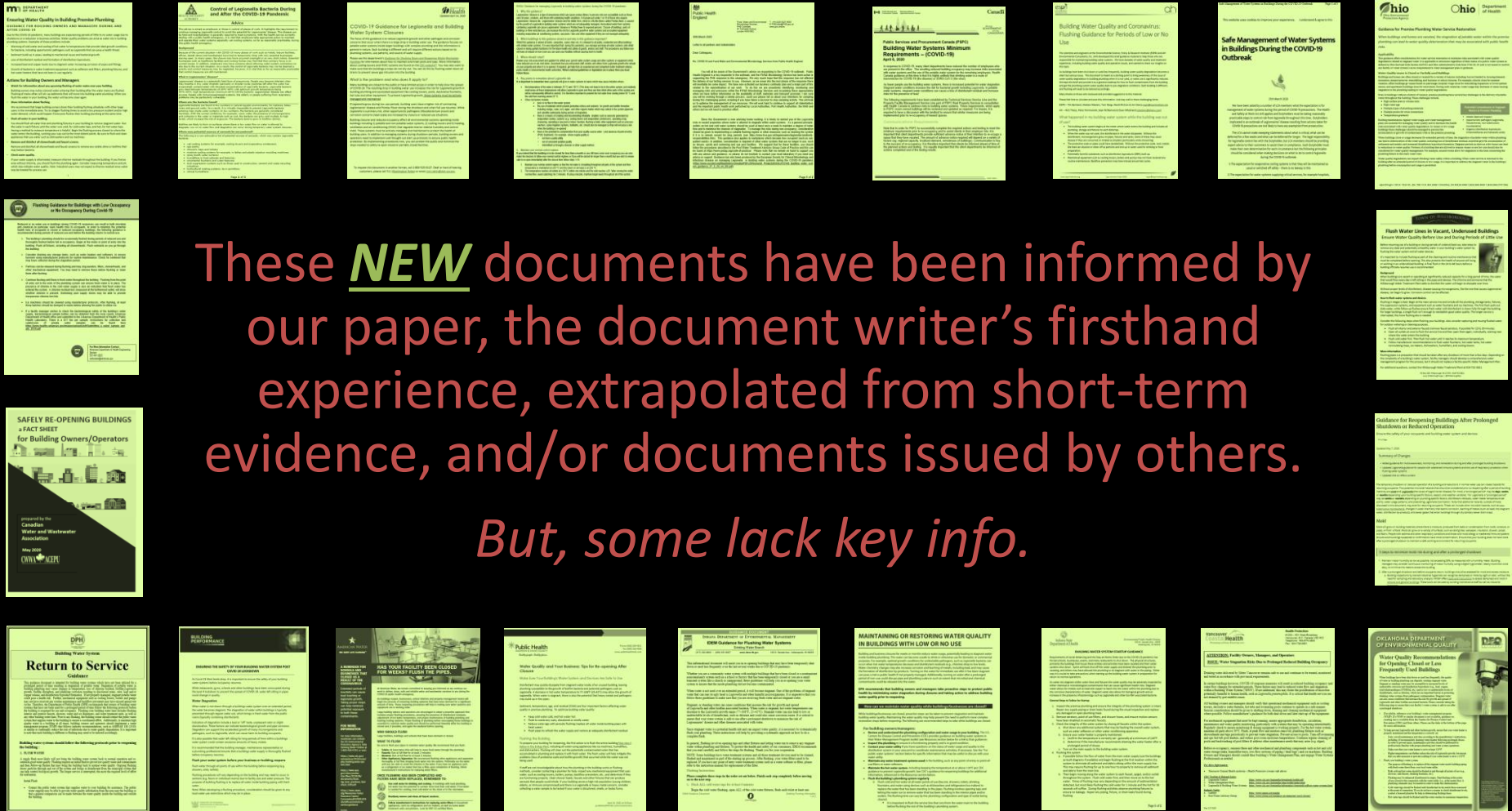
Share

By: WHIO Staff
Updated: July 10, 2020 - 11:22 PM

When the pandemic struck, *no* guidance documents about building plumbing stagnation and recommissioning existed.

These **NEW** documents have been informed by our paper, the document writer's firsthand experience, extrapolated from short-term evidence, and/or documents issued by others.

But, some lack key info.



Safety: Exposure to Contaminated Water during Flushing and Heat Exhaustion

Personal Protective Equipment

OSHA and other worker safety agencies recommend respirators (N95) if Legionella is suspected or possible

For respirators, medical clearance and a respiratory protection program is needed

Reduce exposure by applying controls

My personal warnings...

- ♦ Some people are sending workers to flush stagnant water that may have pathogens without any respiratory protection. Bad idea.
- ♦ Some people think “masks” are respirators. They are not.
- ♦ Persons with preexisting conditions should avoid this activity
- ♦ Getting a building flushed is a lot of work. Don’t do too much at once.

COVID-19 Lessons from a School, Indiana USA

Kyungyeon Ra et al. – In Progress



3 buildings on campus, built in the 1960s
3 months of low to no water use, little
irrigation use

Characteristics

- Public water supplier service area
chlorine residual range <0.2 to 1.3 mg/L
- Each building has 1 service line, 1 water
heater, no recirc loops
- Copper pipe, kitchen, classroom,
bathroom sinks, toilets, water
fountains; outdoor spigots;
refrigerators, dishwashers, coffeemaker
connected to the building water
system; ***no showers, no cooling towers***

COVID-19 Lessons from a Large Residential Building, Indiana USA

Proctor and Angert et al. – In Progress

Built in the 1940s

Zero water use during summer 2020

10,000 sqft,

Typically 20+ people living in the building

Characteristics

- Public water supplier service area chlorine residual
- The building has 1 service line, 1 water heater + extra tank, no recirc loops
- Water softener, Galvanized iron pipe + copper pipe,
- Kitchen, bathroom sinks, toilets, outdoor spigots; refrigerators, dishwashers, **YES showers**



COVID-19 Lessons from an Institutional Campus, Indiana USA

Kyungyeon Ra et al. – In Progress



4 buildings, various uses:
classroom, administrative,
laboratories, food
preparation, breakrooms,
bathrooms

Periodic flushing by owner
during the pandemic

Characteristics

Public water supplier, free chlorine

Each building has 1 service line, some have multiple water
heaters, and recirc loops, various ages

Building Water Stagnation Guide

In Development, To be released 2020

Lead By:



Supported By:



With Support From:



Tips: What does a building owner need?

Digital Disinfectant Residual Analyzer



HACH DR300
~\$500/each



Digital Thermometer



Thermapen
~\$90/each

Here are just 2 examples. NOTE: Do not use pool disinfectant test kits. Test strips can be misleading.

Tips: The Big Flush Out

Clean aerators



Address all
outlets



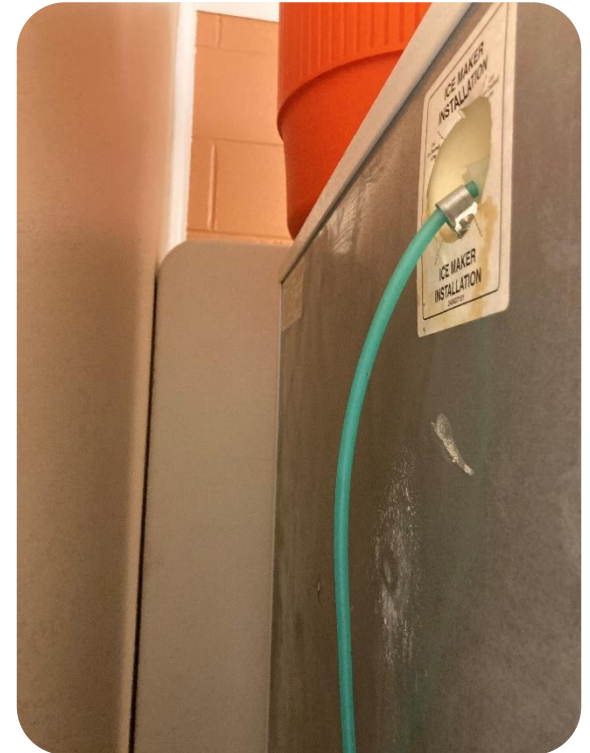
Clean them
well

Don't Forget !

Deal with water treatment

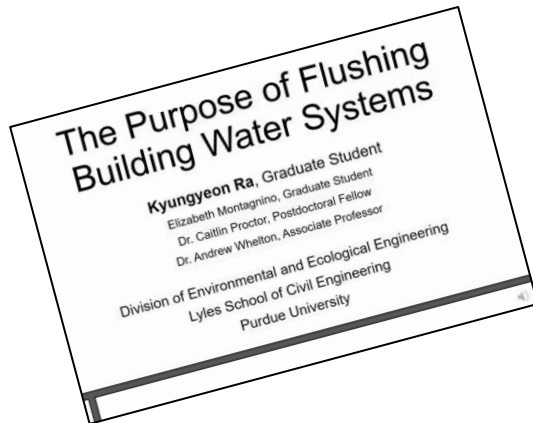


Tackle high risk
components

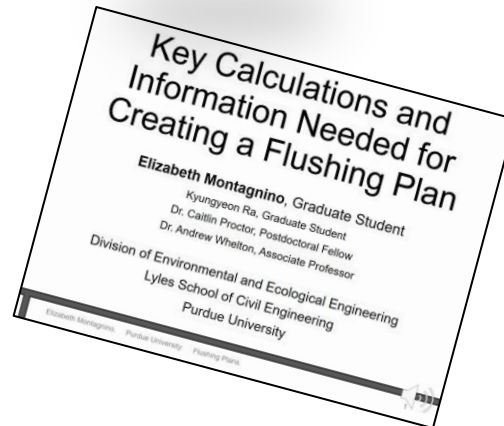


Flush appliances

Learn how to create a building flushing plan



Visit our
Plumbing Safety
YouTube
Channel for Short
Education Videos



Example Procedure for Flushing an Actual School Building

April 6, 2020, Version 1

I. Background

Sometimes buildings are shutdown or experience long-periods of low occupancy and the water inside the property plumbing stagnates. Water can stagnate inside the building pipes and tanks, but also in the buried water service line that transports drinking water from its source to the building. Stagnation allows for contaminant levels of metals such as lead and copper to increase in the water. Microbes are also likely to grow. Under routine building water use, the amount of contamination in water is not typically a problem, but long stagnation periods can cause water quality to deteriorate to unacceptable levels. To remove this water from the property plumbing, a procedure was developed based on as-built construction drawings and experience inside the building. The procedure below is provided to help demonstrate the steps needed to flush the stagnant water from the plumbing of a specific building and replace it with fresh water from the water utility main buried out in front of the property.

This guidance was developed using as-built drawings for an actual building where the characteristics were known. ***Factors of safety were not applied.*** Due to non-ideal flows commonly encountered in plumbing, stated flushing times may need to be increased. In a prior study for flushing home interior faucets the factory of safety applied was 10. So, all flushing times may need to be 10% longer. No safety factors were applied.

Building Characteristics

Year Built 2011

Size:

- 2 floors (1st floor: classrooms, auditorium, two gyms, and cafeteria; 2nd floor: mechanical attic)
- All water only located on first floor
- The building area is 200,000 square feet, while the total area for the property (including sporting fields) is 3,378,152 square feet
- There are 12 different building sections (A, B, C, D, E, F, G, H, J, L, K) and each has various uses.

Water Transport and Use on Property:

- A public water system (PWS) delivers chloraminated drinking water to the property through a buried service line.
- PWS water used for drinking, appliances, hot water, and irrigation.
- After passing through the water meter, an 8 inch PVC pipe service loop circles entire school campus [3,481 feet, volume 9,089 gallons]. Some branches exist that convey water to a field house, concession stand, and yard hydrants (a 2 inch existing fire hydrant branches off from the fire line around the building to near the concession stand, and few others are located outside the building).
- 4 inch irrigation pipe line also branches off from the fire line around the building. In this document, flushing of the irrigation line is not included. The building service line and building itself is only the focus.
- Water enters the school building by traveling through this loop, and then into a 4 inch ductile iron pipe [160 ft, volume 104 gallons]

Devices:

- Two point-of-entry water softeners (52.36 gallons each, one used at a time)
- Four water heaters (130 gallons each)
- Total four hot water recirculation loops, one heater for each loop (a 150°C loop for the kitchen and three 120°C loops for domestic water)

Questions?

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Household Water Quality Study

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Other Reports Coming Soon from Us in 2020:

Lessons learned: Camp Fire disaster water contamination:

<https://doi.org/10.1002/aws2.1183>

School water copper and legionella contamination investigation

Testing results of our ongoing rapid response water stagnation study

Define water testing considerations

Risk factors = Population, stagnation duration, building specific issues, exposure potential

Locations = At the POE, outlet type, distance from the POE, cold and/or hot systems

Level 1: Disinfectant residual and water temperature. *If not doing this now, please start.*

Level 2: Copper, lead for ingestion exposure locations – fountains, breakroom faucets, cafeteria faucets, etc.

Level 3: *Legionella* and other microorganisms. Applicable for inhalation (and dermal) exposure locations – showers, decorative fountains, cooling towers, etc.