

Some results and reflections:

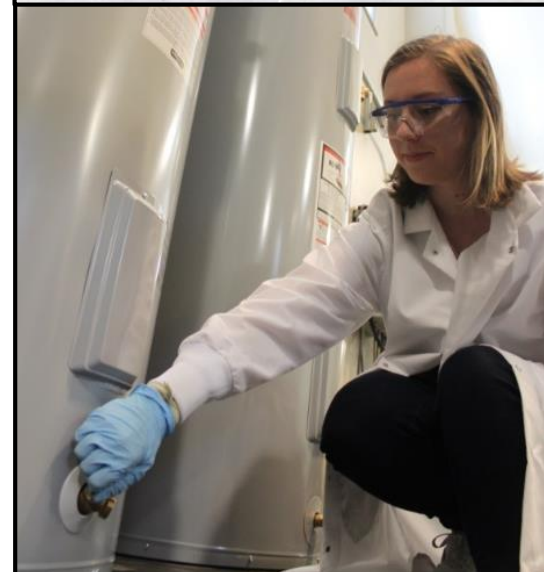
Water quality during reduced occupancy due to COVID-19 and select intervention methods

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 [@TheWheltonGroup](https://twitter.com/TheWheltonGroup)
www.PlumbingSafety.org

Thanks to



Some of our efforts involved testing building water systems in response to the pandemic

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



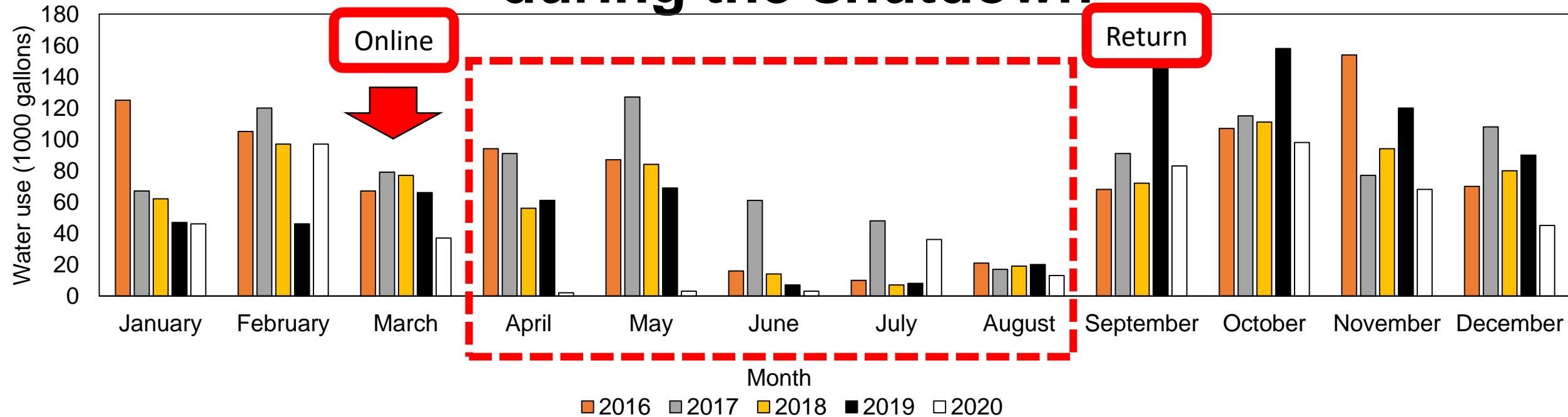
1. Elementary school, Indiana (Ra et al.)
2. Large residential building, Indiana (Angert et al., led by Proctor, Ph.D.)
3. Institutional buildings, Indiana (Ra et al.)
4. Elem/mid/high school, Ohio (Ley et al.)

In Ohio, a utility and an 8 year old LEED K-12 school reached out for assistance.

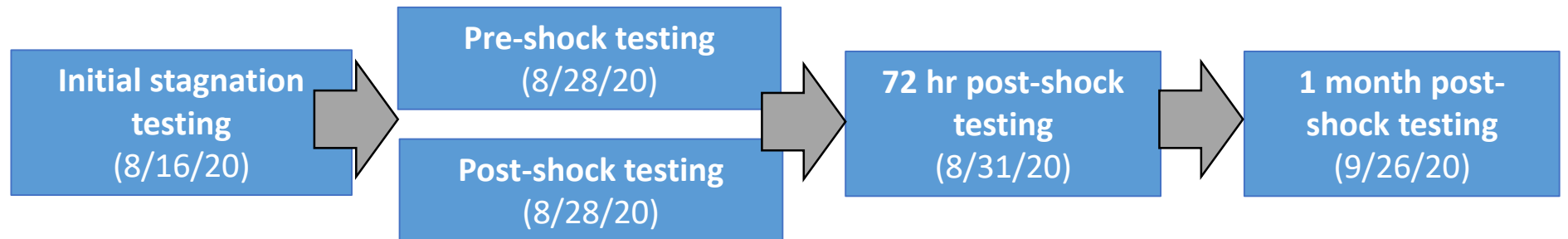
- Utilities across the U.S. saw increased residential demand (+43%) and reductions in commercial (-46%) and industrial (-21%) demands (Faust et al. 2021)
- 1 water utility found that after 6 months of low water use, free chlorine levels were not detectable after the school building had been flushed
- We set out to examine water quality in the 2 story building
 - No water management program or flushing plan
 - 220 sinks, 31 water fountains, 30 showers, and 1 hydrotherapy spa in the facility's athletic training room.
 - Water heating set at 140° F (60° C). 2 boilers with a 500 gallon hot water storage tank. No recirculation system.
 - Rainwater used for toilet flushing – NOT potable water –

Ley et al. (In preparation)

The school had a >95% reduction in water use during the shutdown



Approach



Ley et al. (In preparation)

Metal levels were not consistent across the school, were impacted by flushing, and the 8 year old hot water system was excessively corroding

Some **Cu** levels exceeded the acute health-based limit of 1,300 $\mu\text{g/L}$, while others did not

Zn exceeded the USEPA health advisory level at 1 cafeteria soup filling station because of nonuse and stainless steel piping

Nonpotable fixtures used for potable purposes

Hot water system had excessive corrosion.
Discolored water was observed

1,641 Fe	223 Fe	21,759 Fe	1,851 Fe
155 Zn	18 Zn	1,303 Zn	243 Zn
544 Cu	63 Cu	6,301 Cu	1,319 Cu
20 Pb	3 Pb	248 Pb	24 Pb
15 Al	3 Al	235 Al	129 Al



1st draw

10 min.

12 min.

20 min.

Ley et al. (In preparation)

Legionella was detected before and immediately after the shock disinfection + flushing intervention

Sample type	Fixture type	<i>L. Pneumophila</i> conc., MPN/100 mL	Exceeded suggested <i>L. pneumophila</i> Limit, 106 CFU/mL
Initial stagnation	Water fountain	239.6	Yes
	Staff sink (cold)	1,289.6	Yes
	Cafeteria sink (cold)	3.5	No
	Cold faucet (distal end)	1	No
	Cold faucet (central)	1.1	No
Pre-shock chlorination	Various	0	No
Immediately after shock	Various	0	No
	<u>Fountain</u>	<u>3.9</u>	No
	<u>Bathroom sink</u>	<u>7.9</u>	No
72 hr post-shock	Various	0	-
1 mo. post-shock	Various	0	-

Stagnation:

5.3% (n=5 of 94 total) of sampled fixtures tested positive for *L. pneumophila*.

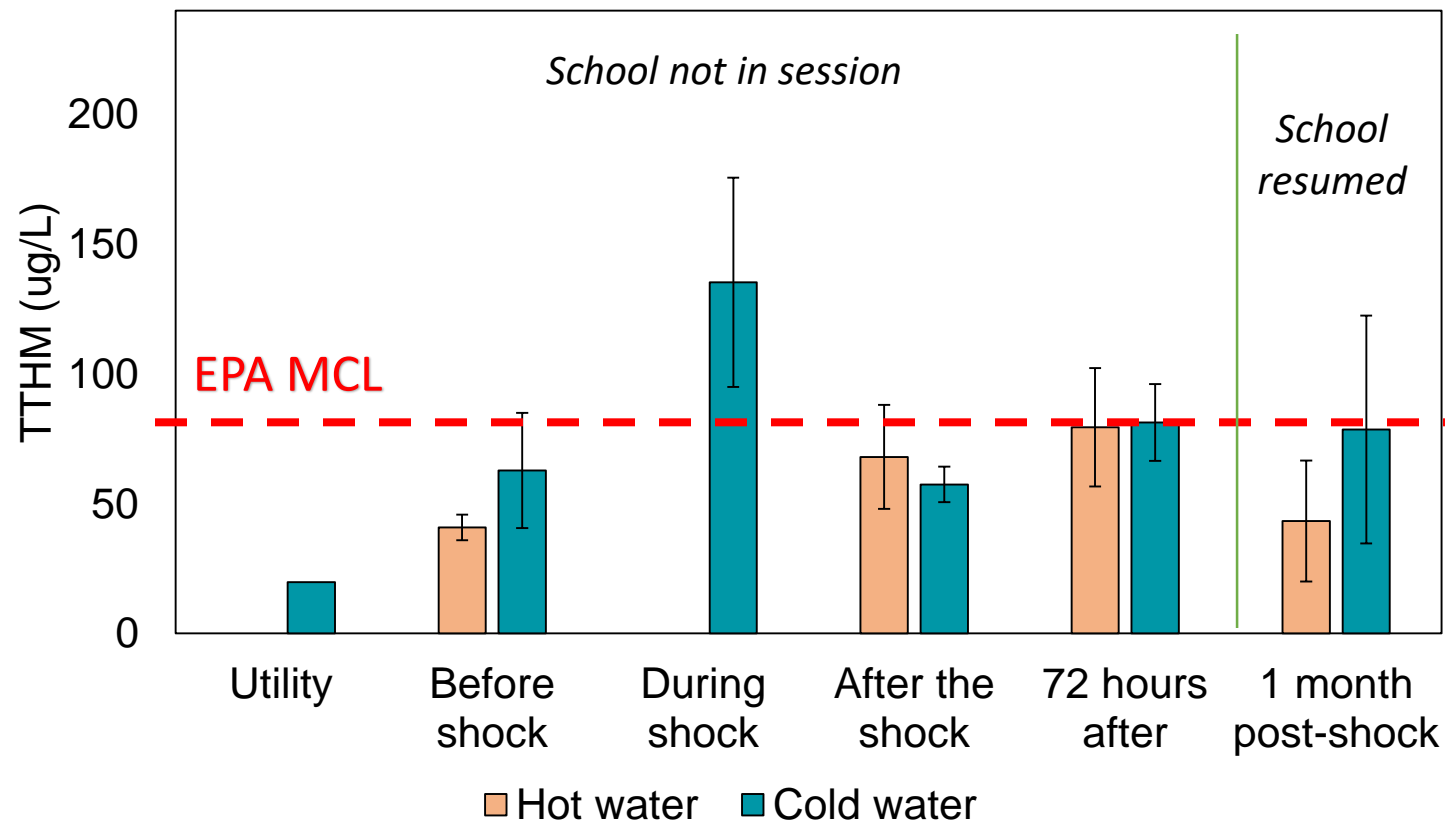
After shock:

L. pneumophila was detected in 2 fixtures (drinking water fountain, sink thermostatic mixed valve)

One month after shock:

L. pneumophila not detected 1 month after the shock disinfection

TTHM and copper levels were affected by the shock disinfection and flushing procedure



TTHM levels in plumbing >> water utility's distribution system

Highest TTHM levels: Shock chlorination (mean: 135.3 $\mu\text{g/L}$).

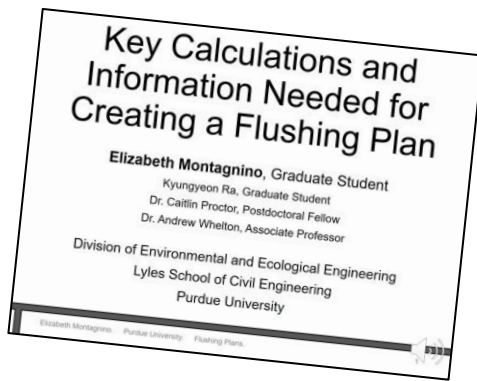
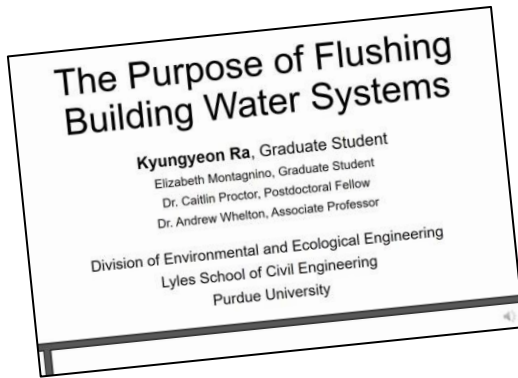
Highest number of exceedances: 72 hours after the shock + flushing, 7 / 15 samples

Some samples had copper levels exceed 1.3 mg/L post-shock, while lead was unaffected.

Hypochlorite shock disinfection levels varied 160-340 mg/L+

Ley et al. (In preparation)

An Indiana School: 3 buildings and a 3 month shutdown



- Little to no chlorine found at stagnant fixtures
- Ni exceeded the health based limit in 3 month stagnant water before flushing, but other metals were okay. Cu did not exceed safe limits. Pb found at a maximum of 3.5 ug/L.
- *L. pneumophila* detected in all buildings, but not at all locations (1.1 to 188 MPN/100mL): bathroom sinks, class sinks, water fountains.
- After complete building flushing and 2 weeks later, the pathogen was not detected.

Ra et al. (In preparation)

The pandemic put a spotlight on plumbing safety...



health officials, industry, governments, institutions, and more responded.

To Address the Public Health Knowledge Gap

Building Water Essentials – Public Health

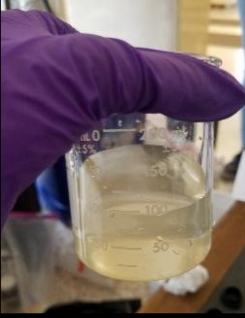
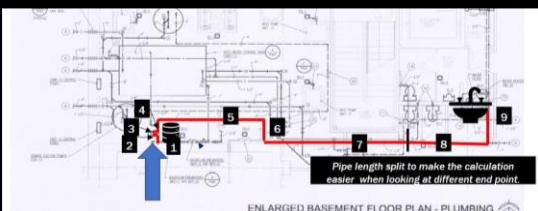
10 Hour, Online Short-Course

Input from practicing engineers, scientists, utilities and public health officials.

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

Modules do not have to be taken in sequence.

If interested e-mail EngrOnline@purdue.edu
Info and registration: <https://cutt.ly/Sg4RXJv>



Plumbing Safety Decision Support Tool Coming Soon: Right Sizing Tomorrow's Water Systems for Efficiency, Sustainability, and Public Health, 2016-2021

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



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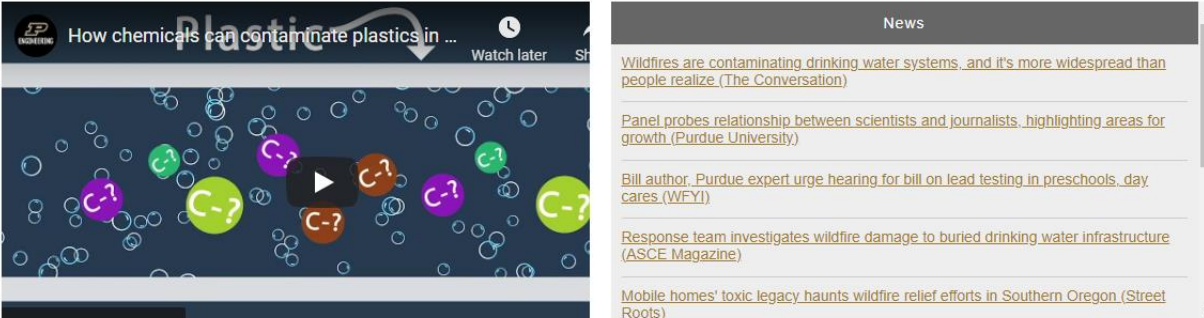
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Thank you.

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The screenshot shows a Purdue University website. On the left, there's a video player with a play button and a title "How chemicals can contaminate plastics in ...". On the right, there's a "News" section with several headlines: "Wildfires are contaminating drinking water systems, and it's more widespread than people realize (The Conversation)", "Panel probes relationship between scientists and journalists, highlighting areas for growth (Purdue University)", "Bill author, Purdue expert urge hearing for bill on lead testing in preschools, day cares (WFYI)", "Response team investigates wildfire damage to buried drinking water infrastructure (ASCE Magazine)", and "Mobile homes' toxic legacy haunts wildfire relief efforts in Southern Oregon (Street Roots)".

[COVID-19 Response](#)







[Wildfire Response](#)

[Enroll in the self-paced, online 10-hour Building Water Essentials course for CEUs](#)

[Missed the Journalism, Science, and Policy Conversation? Watch it here](#)

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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