Lessons for Improved Wildfire Disaster Response and Current Knowledge Gaps

March 26, 2024

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PlumbingSafety.org CIPPSafety.org

The National Academies of
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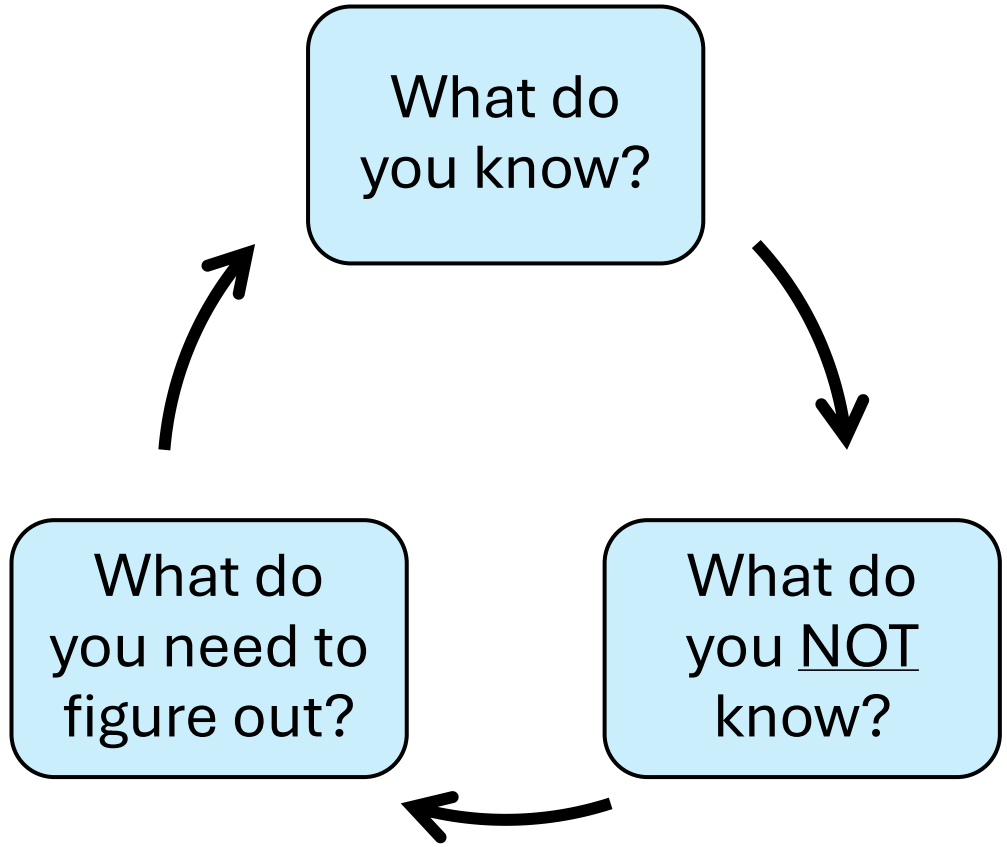
Forum on Medical & Public Health Preparedness for Disasters and Emergencies. Washington, D.C.

Pacific Palisades, California

Public Health and Safety Questions Should Drive Decision Making

Big Picture Guiding Questions

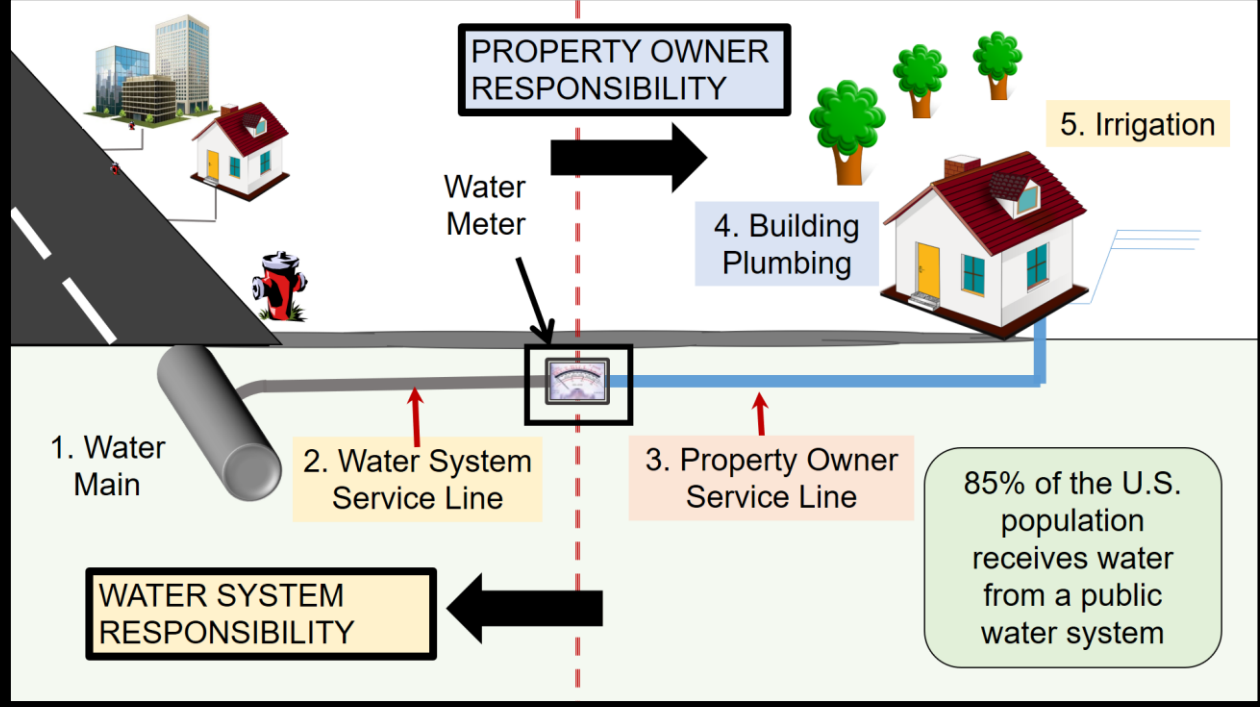
1. What chemicals and magnitudes are present?
2. Where did they go?
3. What is the health risk?
4. How do we return infrastructure to safe use?

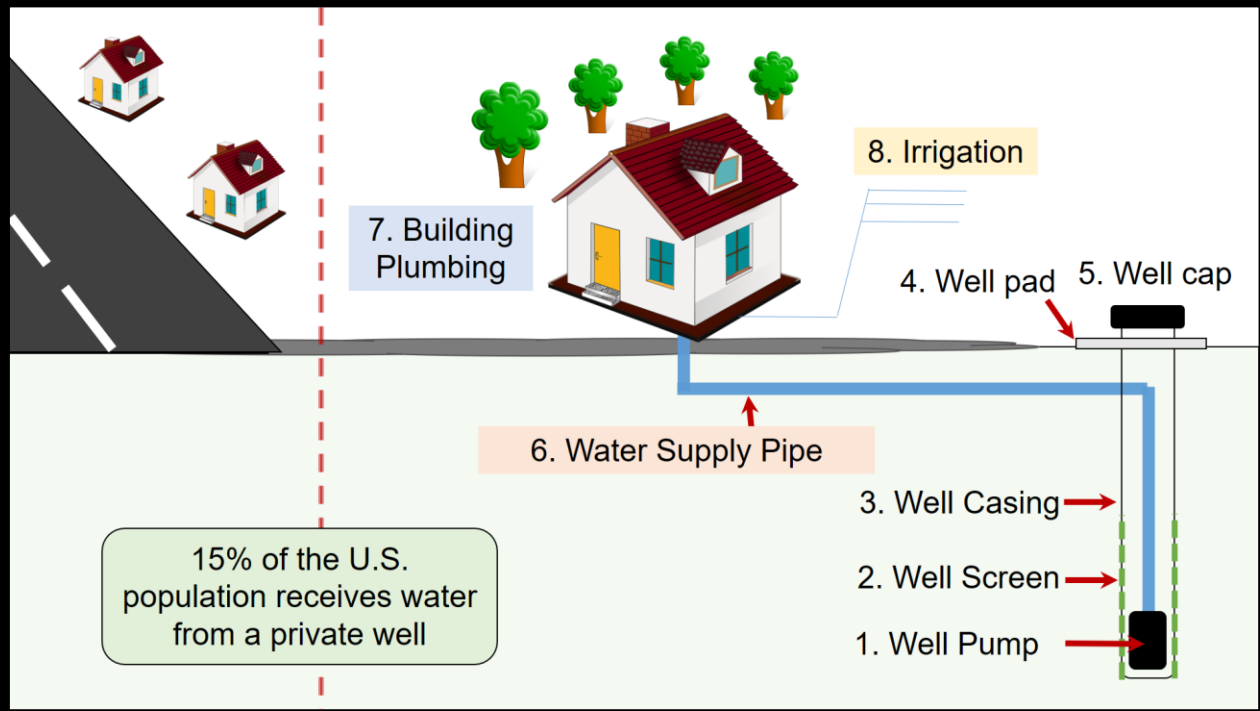


Applies to residential, farmers, ranchers, businesses

Wildfires threaten the health, safety, and economic security of communities

Video: 2023 Kula Fire in Maui, Hawai'i













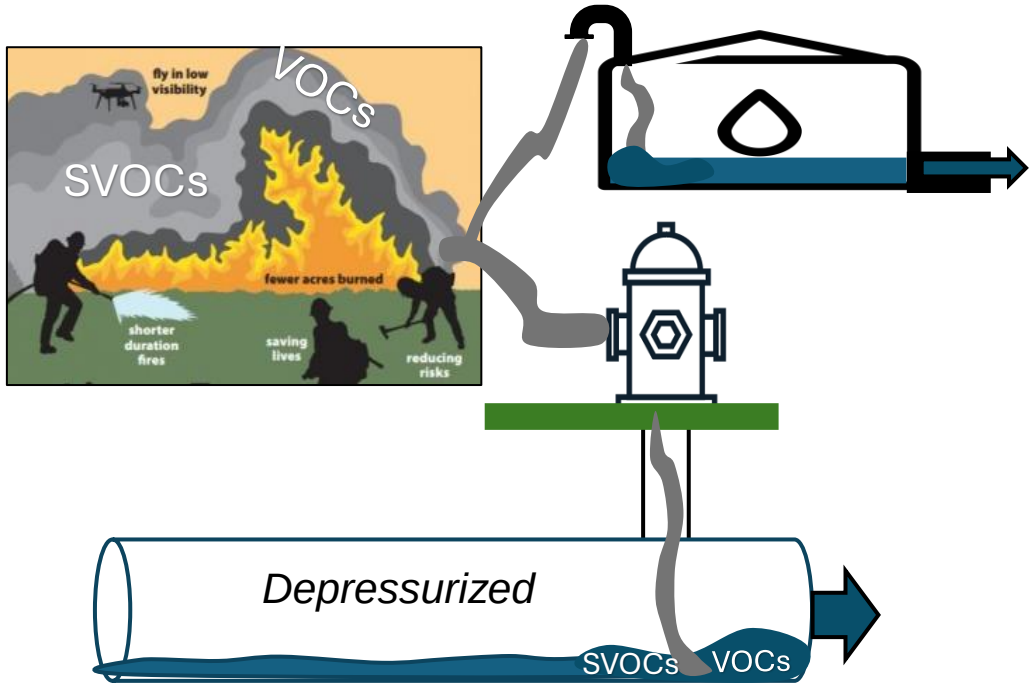




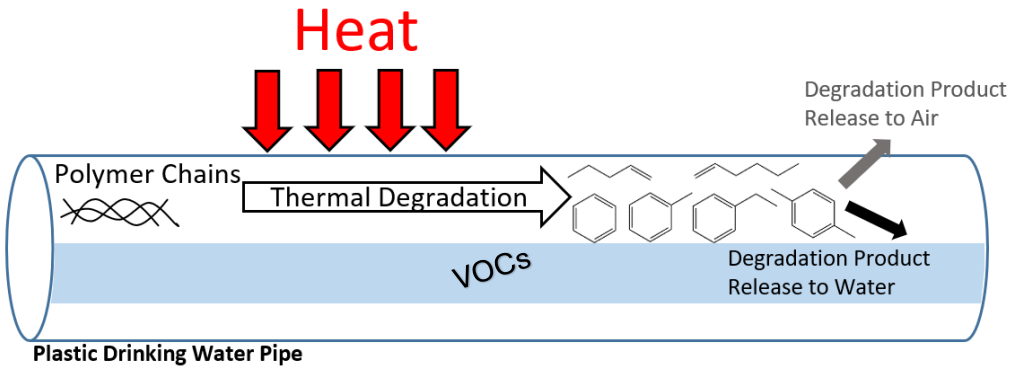
California · Colorado · Hawai'i · New Mexico · Oregon : 2017 Tubbs Fire · 2018 Camp Fire · 2020 Bear Fire · 2020 Oregon Fires · 2021 Marshall Fire · 2021 Lytton Fire · 2022 CC/HP Fire · 2023 Maui Wildfires · 2025 Los Angeles Fires

There are 3 ways water distribution systems become contaminated after a wildfire

1. Biomass and structure combustion



2. Plastic thermal degradation



3. Contaminated water and material back siphonage

Secondary Sources: Infrastructure desorption

Whelton et al. 2025.

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ORIGINAL RESEARCH

AWWA WATER SCIENCE

Wildfire caused widespread drinking water distribution network contamination

Caitlin R. Proctor[1,2,3,4] | Juneseok Lee[5] | David Yu[4,6] | Amisha D. Shah[3,4] | Andrew J. Whelton[3,4]

Natural Hazards (2021) 108:947–975
https://doi.org/10.1007/s11069-021-04714-9

ORIGINAL PAPER

Check for updates

Water safety attitudes, risk perception, experiences, and education for households impacted by the 2018 Camp Fire, California

Tolulope O. Odimayomi[1] · Caitlin R. Proctor[2] · Qi Erica Wang[1] · Arman Sabbaghi[3] · Kimberly S. Peterson[4] · David J. Yu[5] · Juneseok Lee[6] · Amisha D. Shah[7] · Christian J. Ley[1] · Yoorae Noh[8] · Charlotte D. Smith[9,10] · Jackson P. Webster[11] · Kristin Milinkevich[12] · Michael W. Lodewyk[12] · Julie A. Jenks[13,14] · James F. Smith[15] · Andrew J. Whelton[7]

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Drinking water contamination from the thermal degradation of plastics: implications for wildfire and structure fire response†

Kristofer P. Isaacson,[a] Caitlin R. Proctor,[ab] Q. Erica Wang,[a] Ethan Y. Edwards,[a] Yoorae Noh,[c] Amisha D. Shah[ac] and Andrew J. Whelton[ab]

ACS ES&T Water

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Article

Prediction of Water Distribution System Contamination Based on Wildfire Burn Severity in Wildland Urban Interface Communities

Stefanie S. Schulze* and Erica C. Fischer

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Two weeks after the 2023 Maui wildfires: drinking water experiences and needs†

Andrew J. Whelton, Paula D. Coelho, Christopher Shuler, Aurora Kagawa-Viviani, Kellie D. P. Cole, Stefanie Surdyka and Stephanie Heffner

ORIGINAL RESEARCH

AWWA WATER SCIENCE

The Marshall Fire: Scientific and policy needs for water system disaster response

Andrew J. Whelton[1] | Chad Seidel[2] | Brad P. Wham[3] | Erica C. Fischer[4] | Kristofer Isaacson[5] | Caroline Jankowski[5] | Nathan MacArthur[2] | Elizabeth McKenna[2] | Christian Ley*

ACS ES&T Water

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Article

Organic Chemical Contaminants in Water System Infrastructure Following Wildfire

William M. Draper, Na Li, Gina M. Solomon, Yvonne C. Heaney, Reese B. Crenshaw, Richard L. Hinrichs, and R. Esala P. Chandrasena*

Oregon State University

Fire Technology, 58, 1889–1915, 2022
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https://doi.org/10.1007/s10694-022-01232-3

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Simulation of Heat Transfer Through Soil for the Investigation of Wildfire Impacts on Buried Pipelines

UCSF

ACS ES&T Water

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Article

Fire and Water: Assessing Drinking Water Contamination After a Major Wildfire

Gina M. Solomon,* Susan Hurley, Catherine Carpenter, Thomas M. Young, Paul English, and Peggy Reynolds

FIRE SAFETY RESEARCH INSTITUTE UL

Fire Technology, 60, 1–18, 2024
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https://doi.org/10.1007/s10694-023-01487-4

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Pilot Study on Fire Effluent Condensate from Full Scale Residential Fires

Gavin P. Horn and Nicholas W. Dow, Fire Safety Research Institute, UL Research Institutes, Columbia, MD 21045, USA*
Danielle L. Neumann, Enterprise Sustainability, UL Solutions, Brea, CA 92821, USA

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Environmental Science & Technology

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Residential Water Soft… Require Remediation a…

Caroline M. Jankowski, Lauren A. Aliya B. Ehde, Madeline B. Larsen, William J. Schmidt, Amisha D. Sh…

ORIGINAL RESEARCH

AWWA WATER SCIENCE

Plastic water supp… contamination, an…

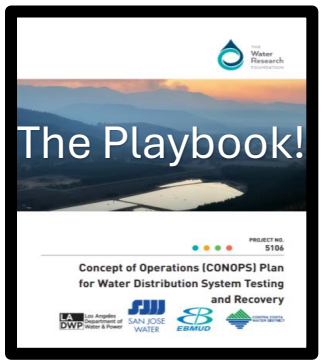
Kristofer P. Isaacson[1] | … Amisha D. Shah[1] | Andr…

ORIGINAL RESEARCH

AWWA WATER SCIENCE

Wildfire damage and contamination to private drinking water wells

Caroline Jankowski[1] | Kristofer Isaacson[1] | Madeline Larsen[1] | Christian Ley[2] | Myles Cook[1] | Andrew J. Whelton[1]



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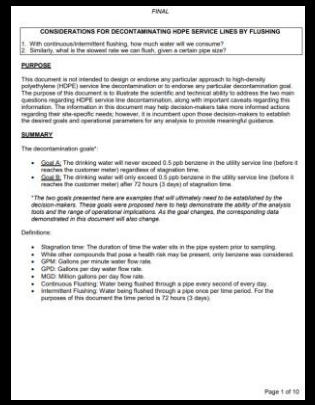
Policy Impact

Post-Fire Sampling...



FINAL

CONSIDERATIONS FOR DECONTAMINATING HDPE SERVICE LINES BY FLUSHING

1. With continuous/intermittent flushing, how much water will we consume?
2. Similarly, what is the slowest rate we can flush, given a certain pipe size?

PURPOSE

This document is not intended to design or endorse any particular approach to high-density polyethylene (HDPE) service line decontamination or to endorse any particular decontamination goal. The purpose of this document is to illustrate the scientific and technical ability to address the two main questions regarding HDPE service line decontamination, along with important caveats regarding this information. The information in this document may help decision-makers take more informed actions regarding their site-specific needs; however, it is incumbent upon those decision-makers to establish the desired goals and operational parameters for any analysis to provide meaningful guidance.

SUMMARY

The decontamination goals*:

- Goal A: The drinking water will never exceed 0.5 ppb benzene in the utility service line (before it reaches the customer meter) regardless of stagnation time.
- Goal B: The drinking water will only exceed 0.5 ppb benzene in the utility service line (before it reaches the customer meter) after 72 hours (3 days) of stagnation time.

*The two goals presented here are examples that will ultimately need to be established by the decision-makers. These goals were proposed here to help demonstrate the ability of the analysis tools and the range of operational implications. As the goal changes, the corresponding data demonstrated in this document will also change.

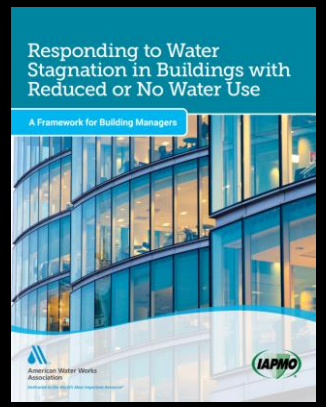
Definitions:

- Stagnation time: The duration of time the water sits in the pipe system prior to sampling.
- While other compounds that pose a health risk may be present, only benzene was considered.
- GPM: Gallons per minute water flow rate.
- GPD: Gallons per day water flow rate.
- MGD: Million gallons per day flow rate.
- Continuous Flushing: Water being flushed through a pipe every second of every day.
- Intermittent Flushing: Water being flushed through a pipe once per time period. For the purposes of this document the time period is 72 hours (3 days).

Page 1 of 10

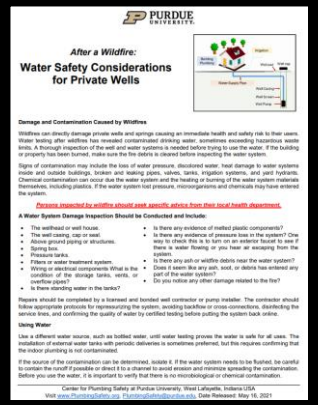
2019

Inside Buildings...



2020

Private wells...



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After a Wildfire:

Water Safety Considerations for Private Wells

Damage and Contamination Caused by Wildfires

Wildfires can directly damage private wells and springs causing an immediate health and safety risk to their users. Water testing after wildfires has revealed contaminated drinking water; sometimes exceeding hazardous waste limits. A thorough inspection of the well and water systems is needed before trying to use the water. If the building or property has been burned, make sure the fire debris is cleared before inspecting the water system.

Signs of contamination may include the loss of water pressure, discolored water, heat damage to water systems inside and outside buildings, broken and leaking pipes, valves, tanks, irrigation systems, and yard hydrants. Chemical contamination can occur due the water system and the heating or burning of the water system materials themselves, including plastics. If the water system lost pressure, microorganisms and chemicals may have entered the system.

Persons inspected by wildfire should seek specific advice from their local health department.

A Water System Damage Inspection Should be Conducted and Include:

- The wellhead or well house.
- The well casing, cap or seal.
- Above-ground piping or structures.
- Spring box.
- Pressure tanks.
- Filters or water treatment system.
- Wiring or electrical components What is the condition of the storage tanks, vents, or overflow pipes?
- Is there standing water in the tanks?
- Is there evidence of melted plastic components?
- Is there any evidence of pressure loss in the system? One way to check this is to turn on an exterior faucet to see if there is water flowing or you hear air escaping from the system.
- Is there any ash or wildfire debris near the water system?
- Does it seem like any ash, soot, or debris has entered any part of the water system?
- Do you notice any other damage related to the fire?

Repairs should be completed by a licensed and bonded well contractor or pump installer. The contractor should follow appropriate protocols for repressurizing the system, avoiding backflow or cross-connections, disinfecting the service lines, and confirming the quality of water by certified testing before putting the system back online.

Using Water

Use a different water source, such as bottled water, until water testing proves the water is safe for all uses. The installation of external water tanks with periodic deliveries is sometimes preferred, but this requires confirming that the indoor plumbing is not contaminated.

If the source of the contamination can be determined, isolate it. If the water system needs to be flushed, be careful to contain the runoff if possible or direct it to a channel to avoid erosion and minimize spreading the contamination. Before you use the water, it is important to verify that there is no microbiological or chemical contamination.

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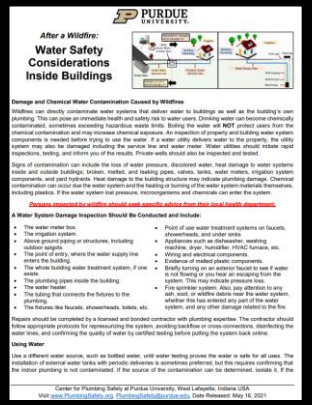
Visit www.PlumbingSafety.org, PlumbingSafety@purdue.edu, Date Released: May 16, 2021

2021

Inside Buildings...



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After a Wildfire:

Water Safety Considerations Inside Buildings

Damage and Chemical Water Contamination Caused by Wildfires

Wildfires can directly contaminate water systems that deliver water to buildings as well as the building's own plumbing. This can pose an immediate health and safety risk to water users. Drinking water can become chemically contaminated, sometimes exceeding hazardous waste limits. Boiling the water will **NOT** protect users from the chemical contamination and may increase chemical exposure. An inspection of property and building water system components is needed before trying to use the water. If a water utility delivers water to the property, the utility system may also be damaged including the service line and water meter. Water utilities should initiate rapid inspections, testing, and inform you of the results. Private wells should also be inspected and tested.

Signs of contamination can include the loss of water pressure, discolored water, heat damage to water systems inside and outside buildings, broken, melted, and leaking pipes, valves, tanks, water meters, irrigation system components, and yard hydrants. Heat damage to the building structure may indicate plumbing damage. Chemical contamination can occur due the water system and the heating or burning of the water system materials themselves, including plastics. If the water system lost pressure, microorganisms and chemicals can enter the system.

Persons inspected by wildfire should seek specific advice from their local health department.

A Water System Damage Inspection Should Be Conducted and Include:

- The water meter box.
- The irrigation system.
- Above-ground piping or structures, including outdoor spigots.
- The point of entry, where the water supply line enters the building.
- The whole building water treatment system, if one exists.
- The plumbing pipes inside the building.
- The water heater.
- The tubing that connects the fixtures to the plumbing.
- The fixtures like faucets, showerheads, toilets, etc.
- Point of use water treatment systems on faucets, showerheads, and under sinks
- Appliances such as dishwasher, washing machine, dryer, humidifier, HVAC furnace, etc.
- Wiring and electrical components.
- Evidence of melted plastic components.
- Briefly turning on an exterior faucet to see if water is not flowing or you hear air escaping from the system. This may indicate pressure loss.
- Fire sprinkler system. Also, pay attention to any ash, soot, or wildfire debris near the water system, whether this has entered any part of the water system, and any other damage related to the fire.

Repairs should be completed by a licensed and bonded contractor with plumbing expertise. The contractor should follow appropriate protocols for repressurizing the system, avoiding backflow or cross-connections, disinfecting the water lines, and confirming the quality of water by certified testing before putting the system back online.

Using Water

Use a different water source, such as bottled water, until water testing proves the water is safe for all uses. The installation of external water tanks with periodic deliveries is sometimes preferred, but this requires confirming that the indoor plumbing is not contaminated. If the source of the contamination can be determined, isolate it. If the

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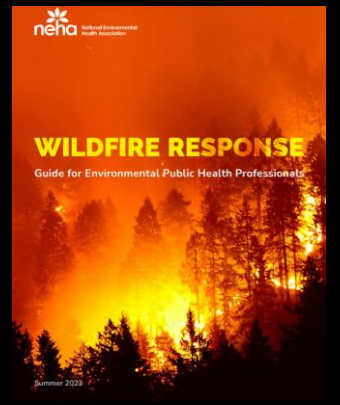
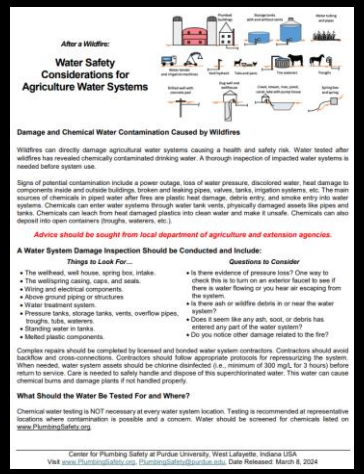
2021

Environmental health basics...



2023

Agricultural water systems...



After a Wildfire:

Water Safety Considerations for Agriculture Water Systems

Damage and Chemical Water Contamination Caused by Wildfires

Wildfires can directly damage agricultural water systems causing a health and safety risk. Water tested after wildfires has revealed chemically contaminated drinking water. A thorough inspection of impacted water systems is needed before system use.

Signs of potential contamination include a power outage, loss of water pressure, discolored water, heat damage to components inside and outside buildings, broken and leaking pipes, valves, tanks, irrigation systems, etc. The main sources of chemicals in piped water after fires are plastic heat damage, debris entry, and smoke entry into water systems. Chemicals can enter water systems through water tank vents, physically damaged assets like pipes and tanks. Chemicals can leach from heat damaged plastics into clean water and make it unsafe. Chemicals can also deposit into open containers (troughs, waterers, etc.).

Advice should be sought from local department of agriculture and extension agencies.

A Water System Damage Inspection Should be Conducted and Include:

Things to Look For...	*Questions to Consider*
• The wellhead, well house, spring box, intake. • The well/spring casing, caps, and seals. • Wiring and electrical components. • Above ground piping or structures • Water treatment system. • Pressure tanks, storage tanks, vents, overflow pipes, troughs, tubs, waterers. • Standing water in tanks. • Melted plastic components.	• Is there evidence of pressure loss? One way to check this is to turn on an exterior faucet to see if there is water flowing or you hear air escaping from the system. • Is there ash or wildfire debris in or near the water system? • Does it seem like any ash, soot, or debris has entered any part of the water system? • Do you notice other damage related to the fire?

Complex repairs should be completed by licensed and bonded water system contractors. Contractors should avoid backflow and cross-connections. Contractors should follow appropriate protocols for repressurizing the system. When needed, water system assets should be chlorine disinfected (i.e., minimum of 300 mg/L for 3 hours) before return to service. Care is needed to safely handle and dispose of this superchlorinated water. This water can cause chemical burns and damage plants if not handled properly.

What Should the Water Be Tested For and Where?

Chemical water testing is NOT necessary at every water system location. Testing is recommended at representative locations where contamination is possible and a concern. Water should be screened for chemicals listed on www.PlumbingSafety.org

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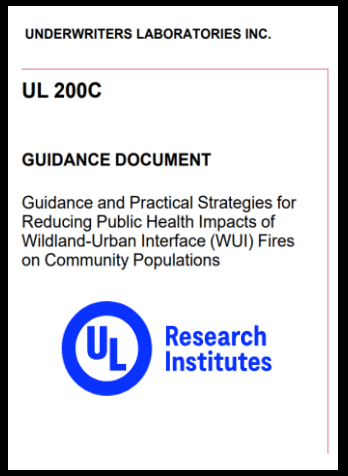
Visit www.PlumbingSafety.org, PlumbingSafety@purdue.edu, Date Released: March 8, 2024

2023

Bipartisan Commission report...

2023

Public health basics...



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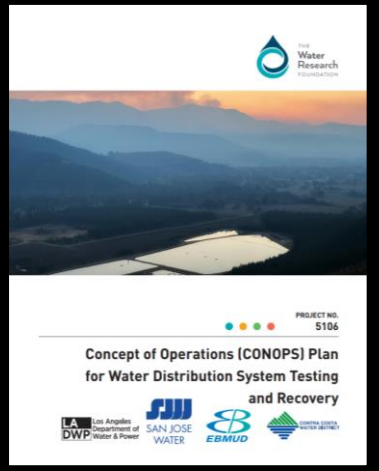
GUIDANCE DOCUMENT

Guidance and Practical Strategies for Reducing Public Health Impacts of Wildland-Urban Interface (WUI) Fires on Community Populations

UL Research Institutes

2024

Post-fire utility and health decisions



2024

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Enabling households and businesses to be proactive recovery partners

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1. Home Soil Study

2. Home Swimming Pool Study

3. Household Survey

1. Home Environmental Test Result Review
2. 1-on-1 Interviews of Household Experiences & Needs
3. Online REBUILD Survey of Experience & Needs

The REBUILD Survey

Recovery Efforts By Uniting Individuals, Listening, and Discovery

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This ONLINE survey is designed to better understand the experiences associated with households affected by the Eaton Fire & Palisades Fire.

Property impacts
Property cleanup experiences
Insurance experiences
Your unanswered questions
Thinking of the future

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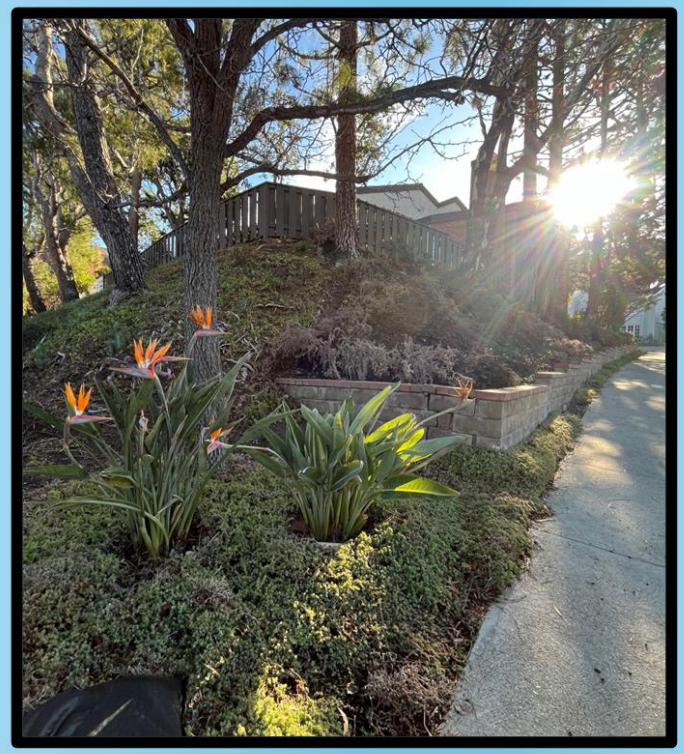
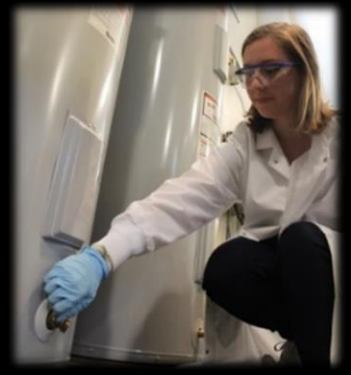


... in direct response to the Eaton Fire and Palisades Fire

Thank you

Special thanks To…

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Visit our wildfire response and recovery resources page at www.PlumbingSafety.org

- ✓ Post-fire chemicals to test for
- ✓ Brief videos for emergency managers and health officials
- ✓ Guidance for private well owners
- ✓ Guidance for building owners
- ✓ Government agency resources
- ✓ FEMA mitigation guidance
- ✓ Other training resources

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Water & Infrastructure Resilience: Public Health & Extreme Events

March 14-23, 2025

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