Water Supply Systems and Wildfires

Challenges & Opportunities

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PlumbingSafety.org CIPPSafety.org

2023 Kula Fire in Maui, Hawai'i

National Interagency Fire Center (www.nifc.gov)

Current National Statistics

10 Incidents
Total Number of Large Fires Being Suppressed

8 Total
New Large Fires

24,415 Incidents
Year-to-date Wildfires

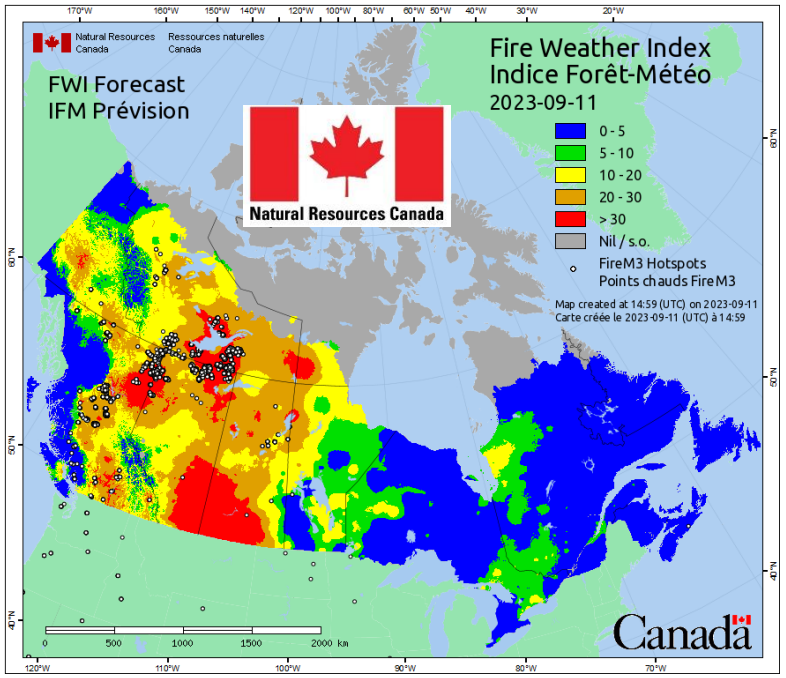
31,288 Acres
Acres Burned on Large Fires

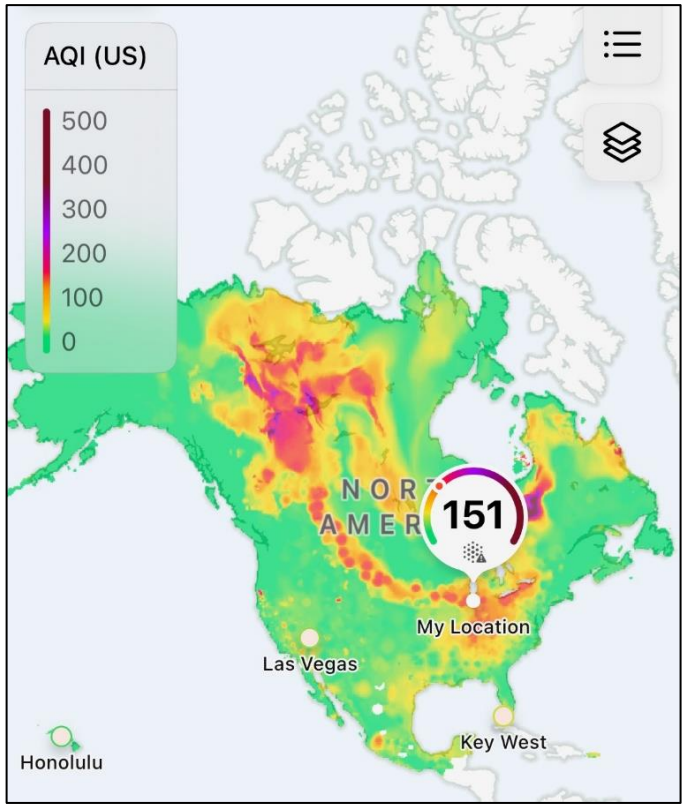
943
Personnel Assigned to Wildfires

1,018,298 Acres
Year-to-date Acres Burned

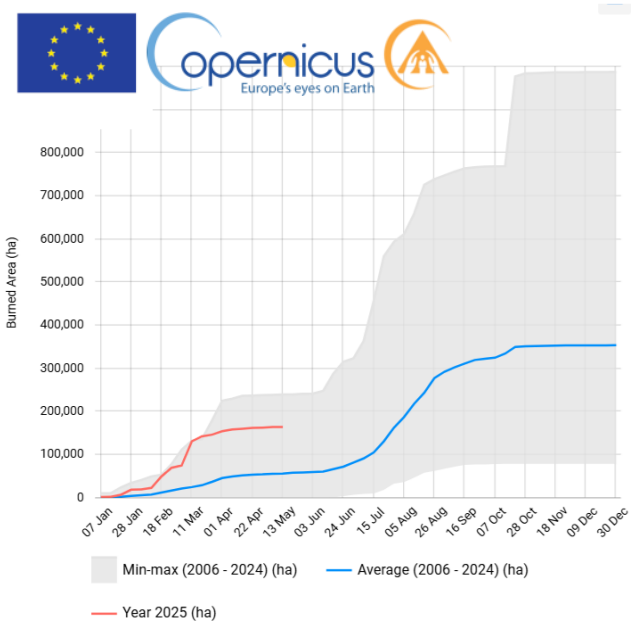
Last Updated: Friday, May 9, 2025 - 07:12

Wildland Fire Information System (nrcan.gc.ca)

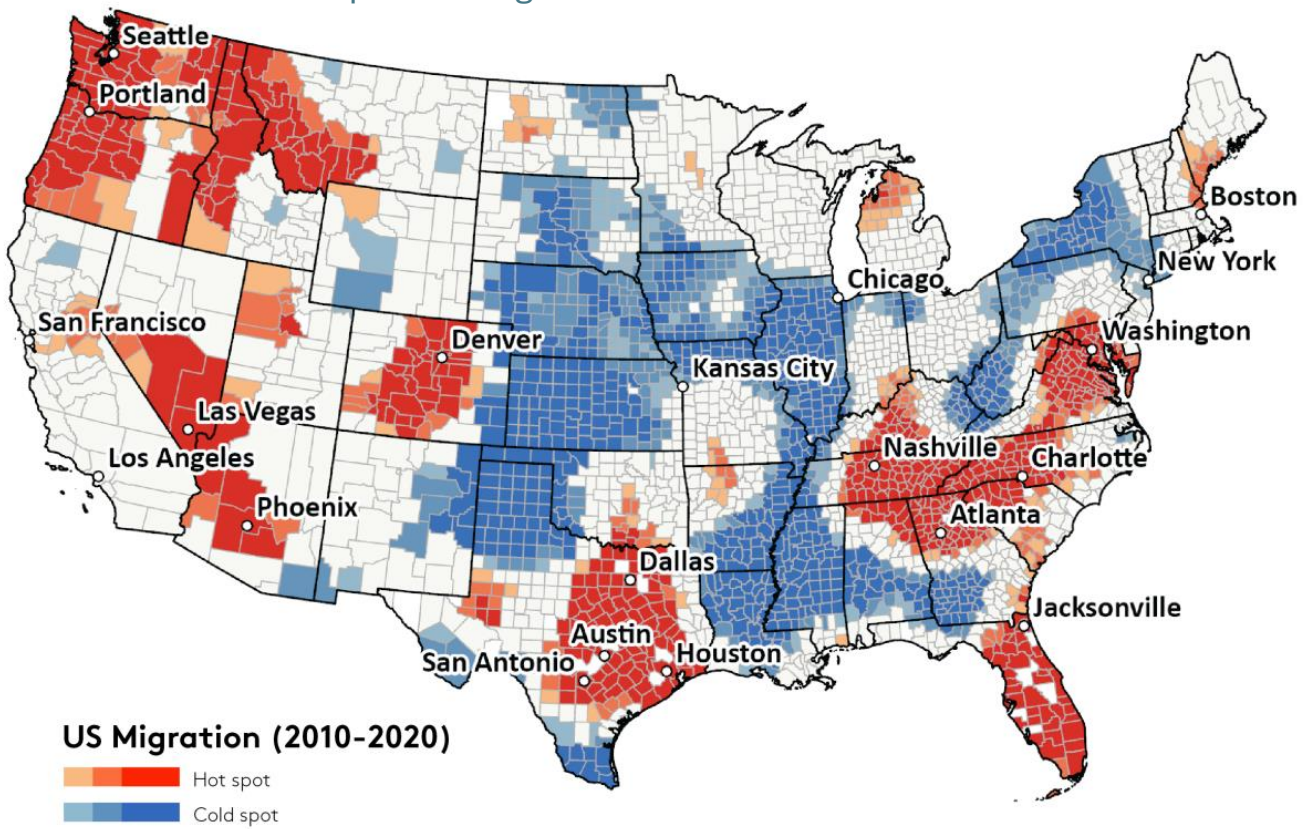




European Forest Fire Information System (EFFIS) (europa.eu)



Clark et al. 2022. *Frontiers in Human Dynamics*.
https://doi.org/10.3389/fhumd.2022.886545



Wildfires cause health and safety risks, and are increasing in intensity as well as the number of acres burned (UNEP 2022)

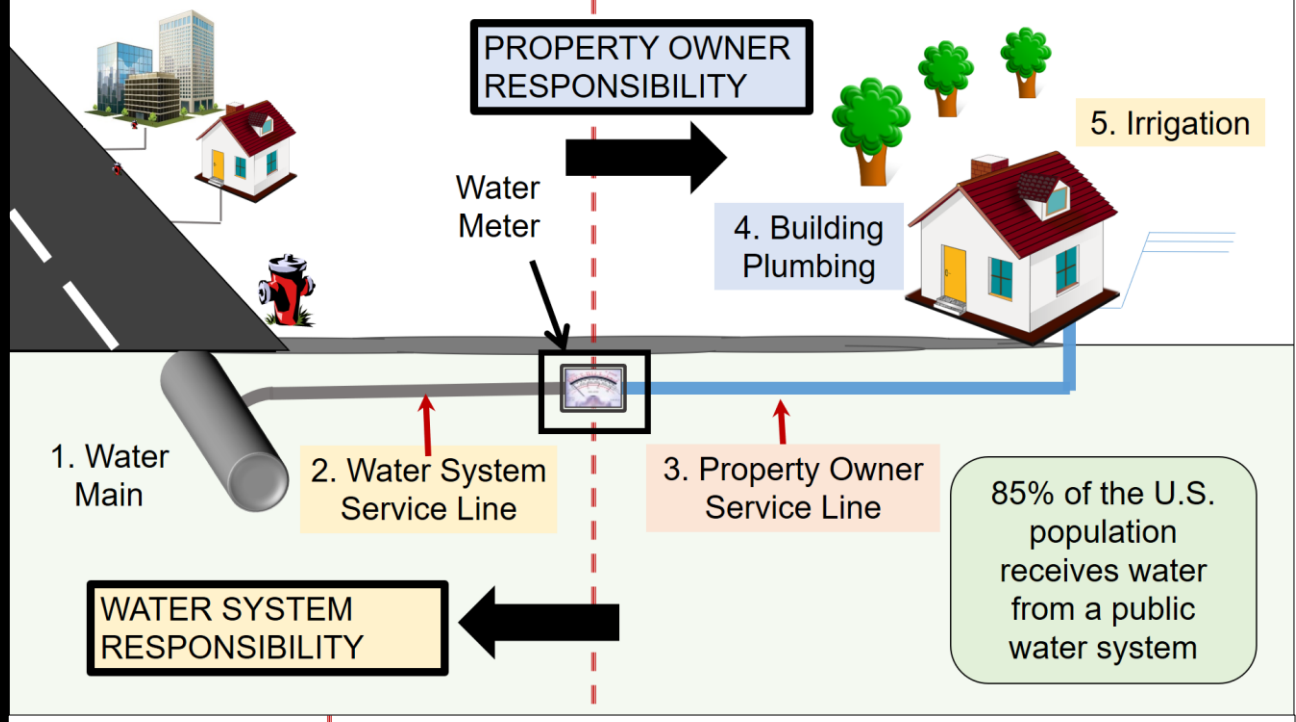
U.S. Fire Administration
Working for a fire-safe America

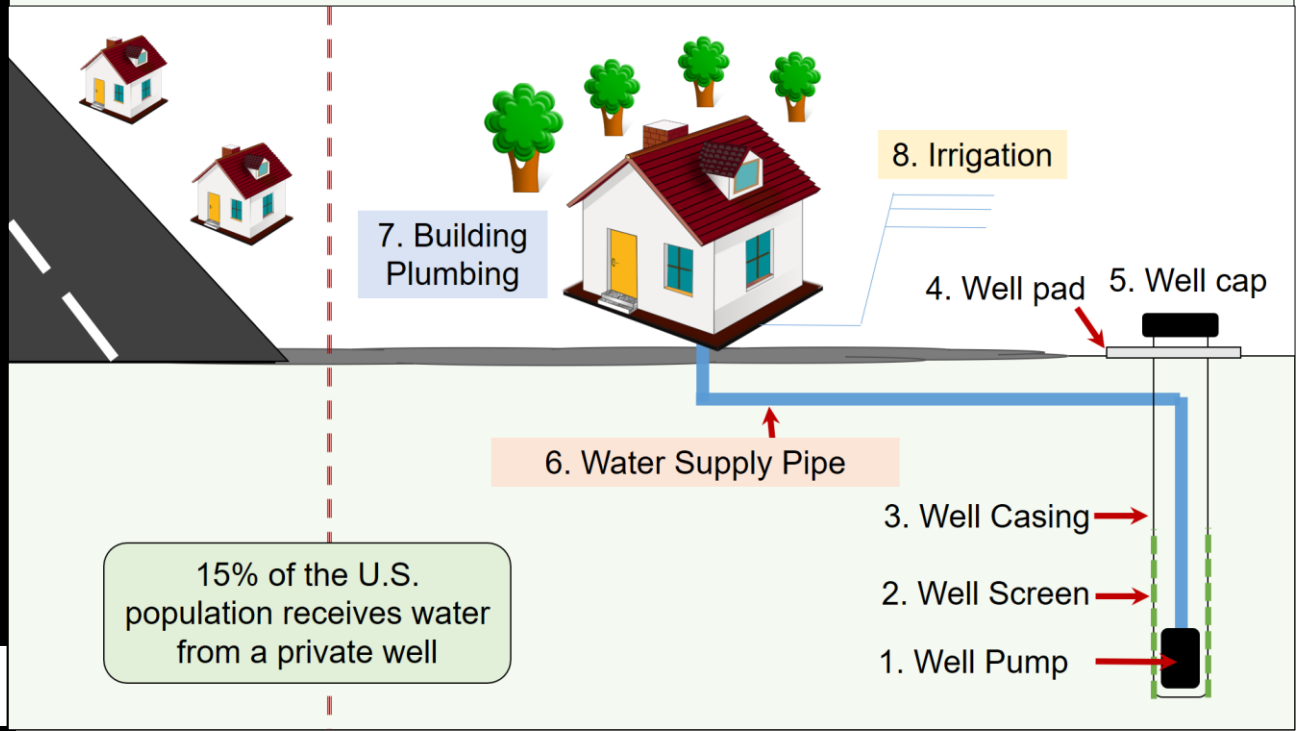
In the U.S. more than 46 million residences in 70,000 communities are at risk (USFA, 2022)

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

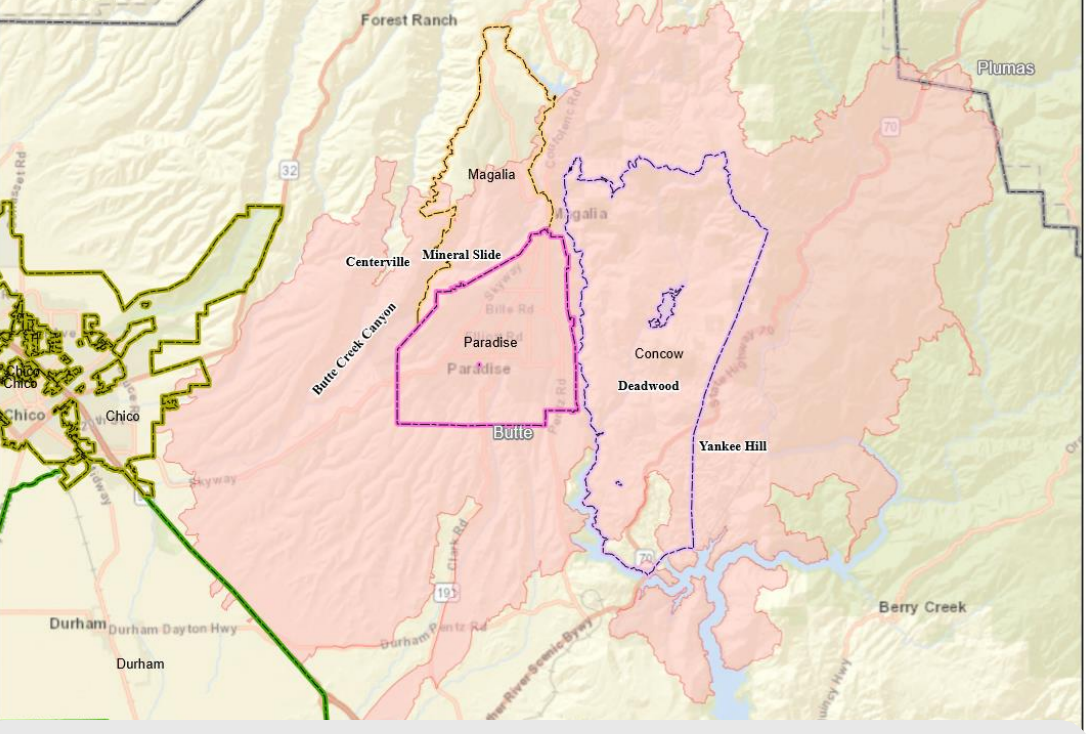
Water System Purpose

- ✓ Fire-fighting
- ✓ Hygiene, sanitation
- ✓ Healthcare
- ✓ Education
- ✓ Business
- ✓ Recreation
- ✓ Agriculture
- ✓ Industry





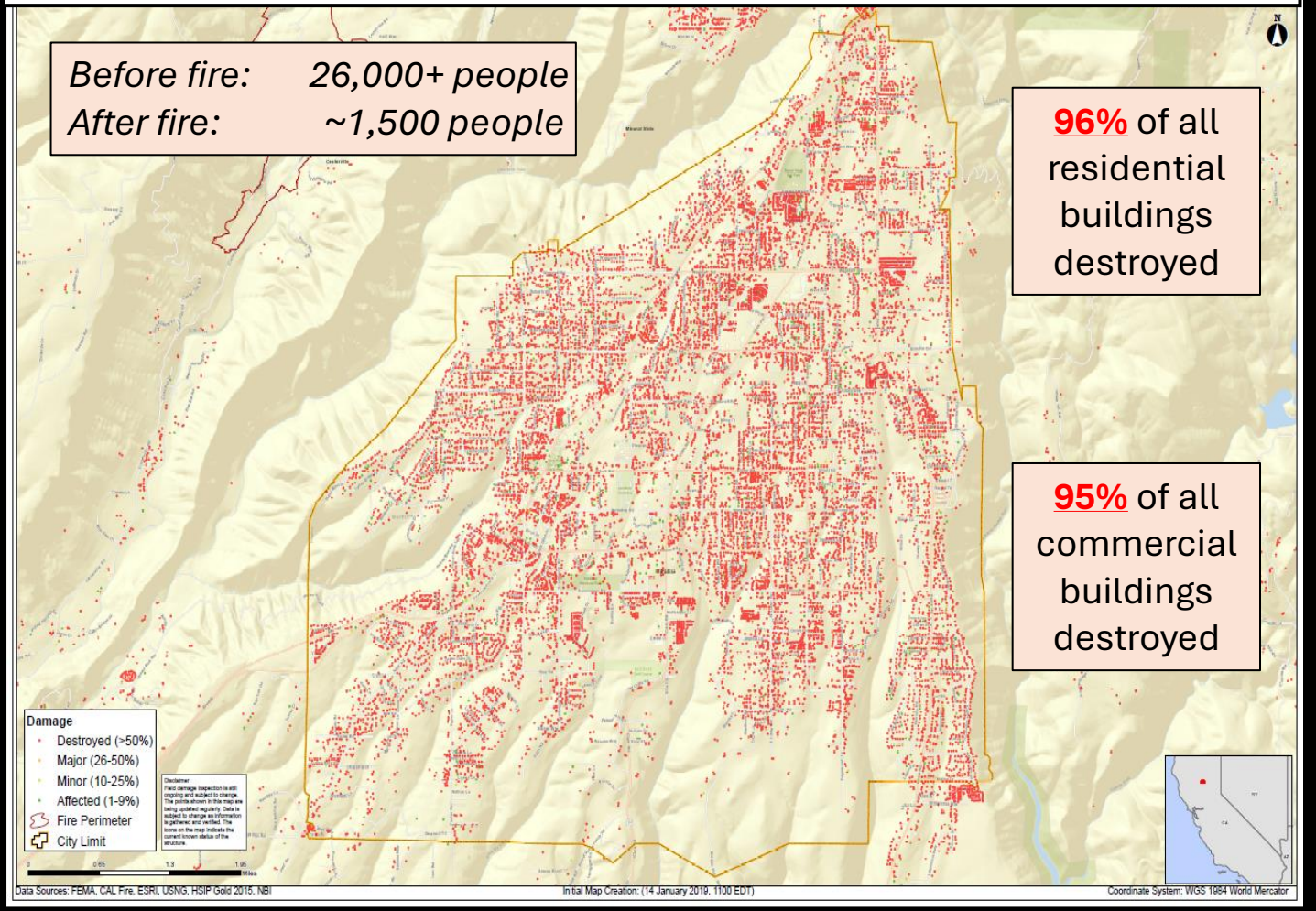
The 2018 Camp Fire in Paradise, California



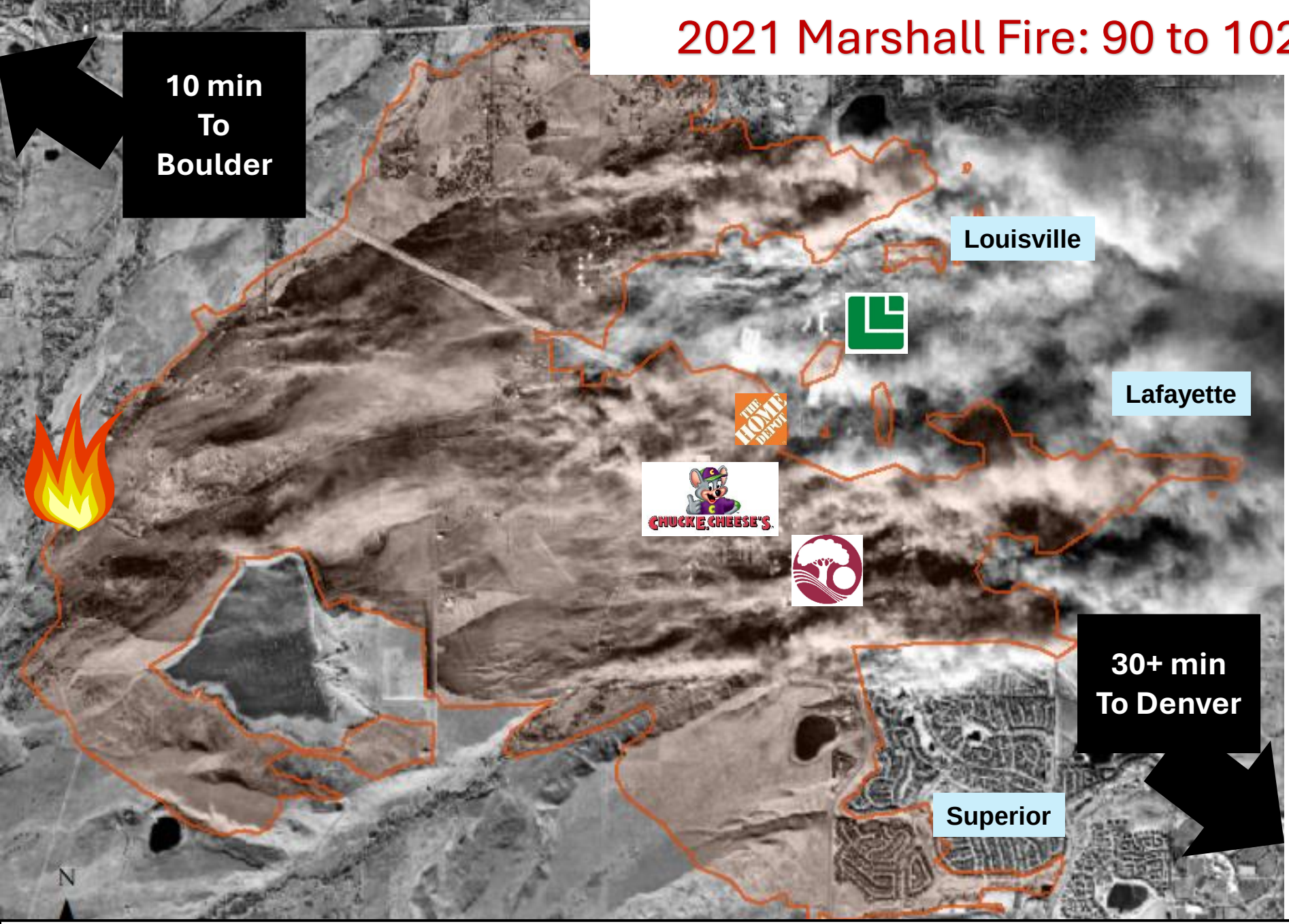
153,336 acres
86 fatalities

~13,972 residences destroyed
14,793 structures destroyed
3 firefighters injured

Town of Paradise Limits



2021 Marshall Fire: 90 to 102 mph wind gusts



December 30, 2021

11:06 am, Fire in Boulder Co.
12:10 pm, Fire in Superior
12:50 pm, Fire in Louisville
1:00pm, 1,000 acres

60,000+ evacuation ordered

The 3 largest communities
Louisville: 21,266
Superior: 13,094
Lafayette: 30,411

6 regulated water systems impacted and private wells

Image source: Fischer et al. GEER. The 2021 Marshall Fire, Boulder County, CO.

Hurricane Dora

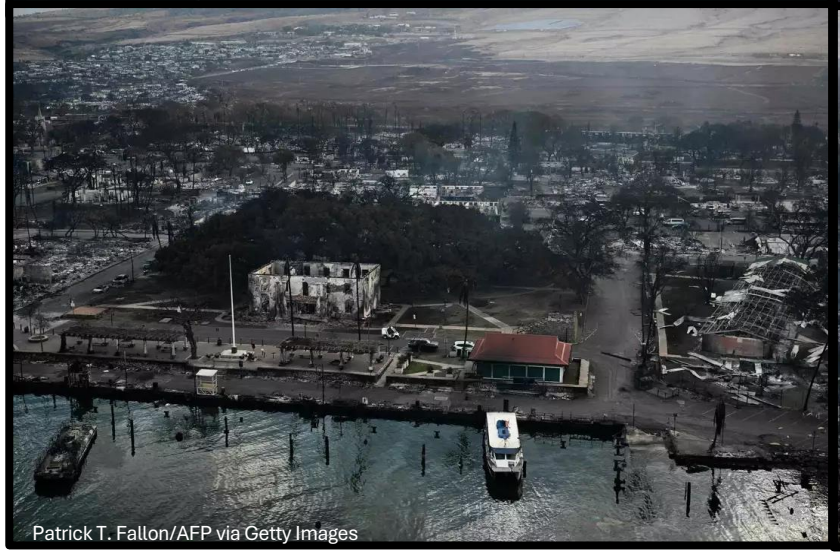
60-80 mph gusts onshore

Olinda Fire: 1,081 ac, 2 structures

Kula Fire: 202 ac, 544 structures

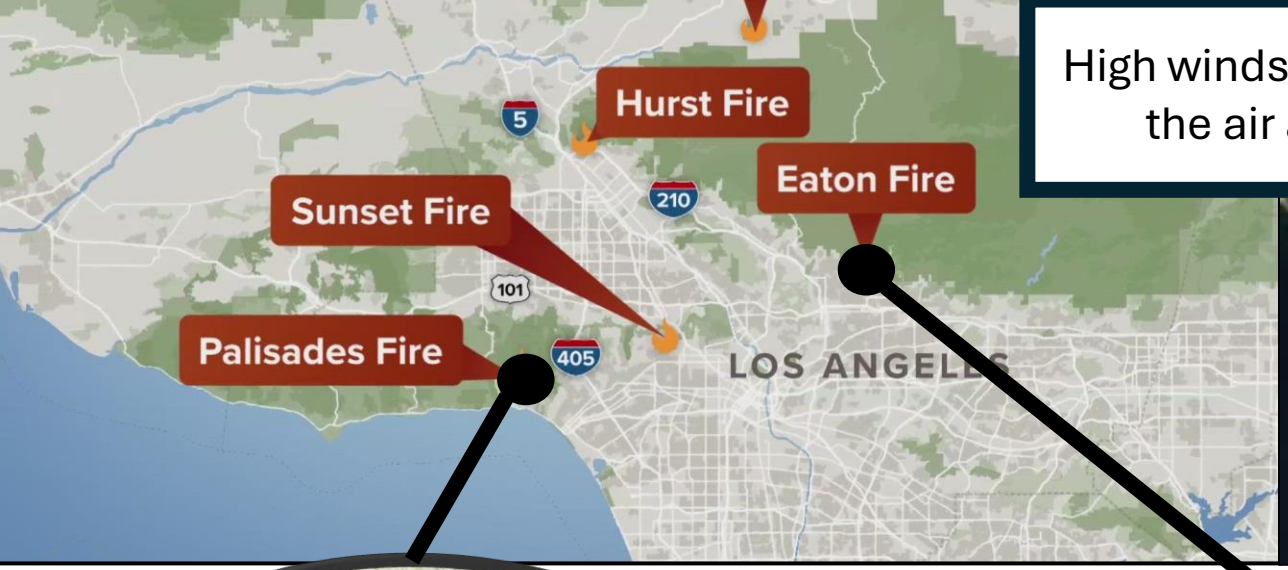
Lahaina Fire: 2,170 ac, 2,207 structures

Puelho Fire: 5,300 ac, 0 structures

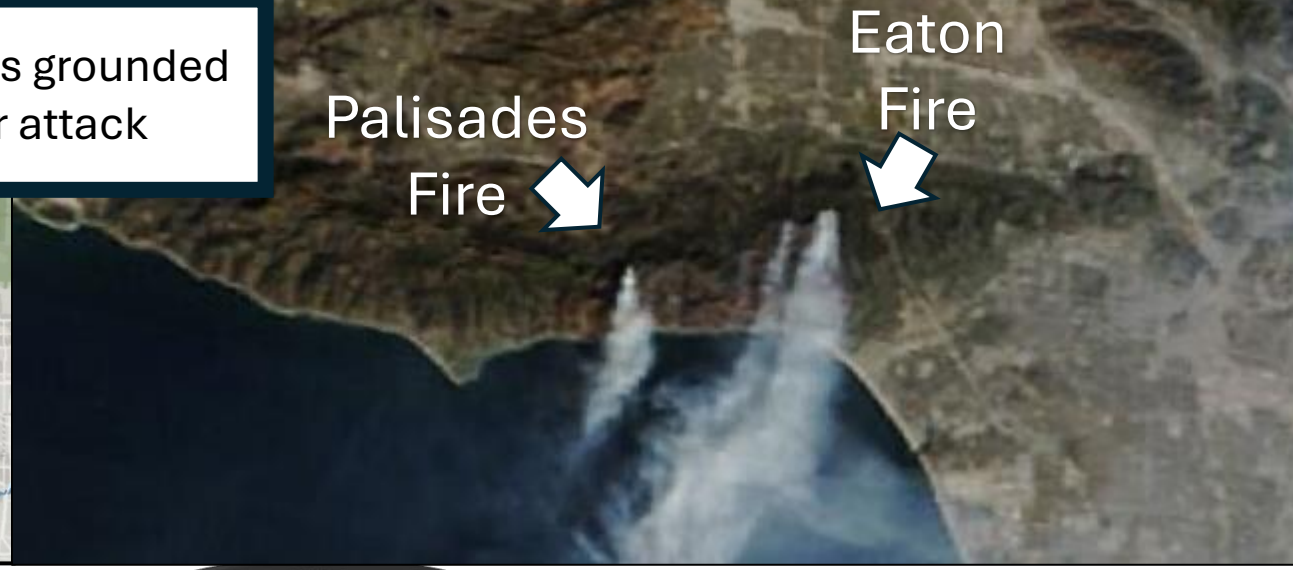


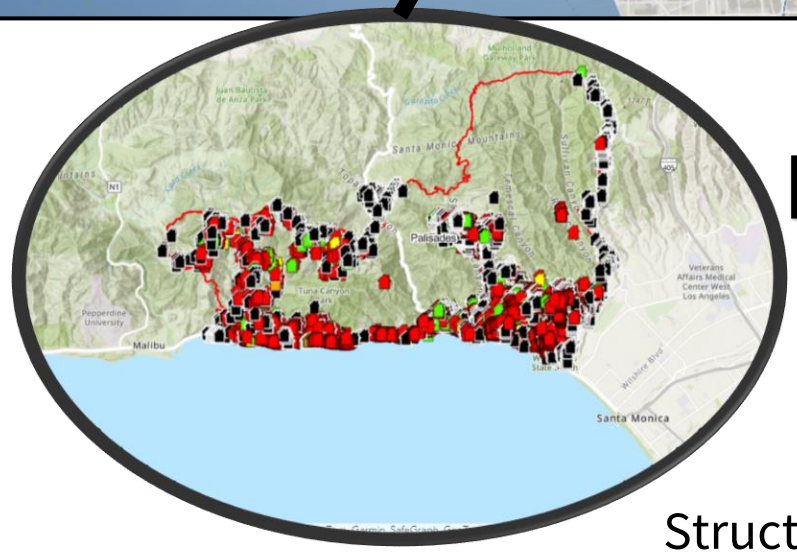
Deadliest wildfire incident in modern U.S. history

Maui Wildfires
August 8, 2023



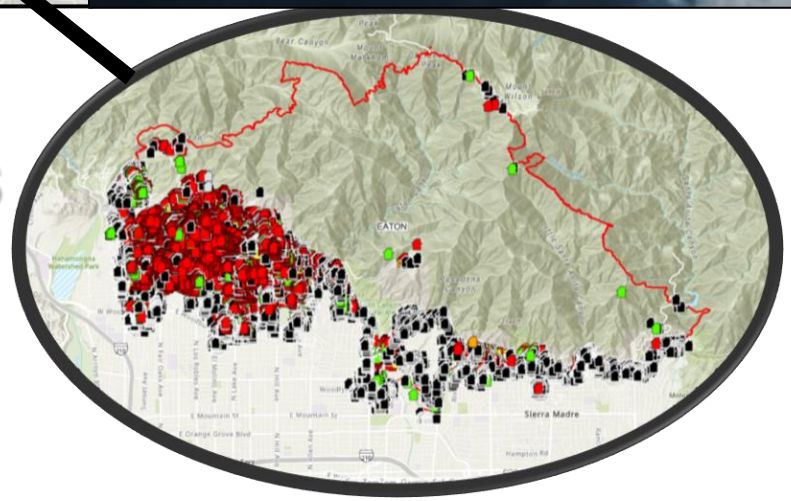
High winds grounded the air attack





Palisades Fire

23,707 acres
12 Fatalities
Structures Destroyed = 6,833
Structures Damaged = 973



Eaton Fire

14,021 acres
17 Fatalities
Structures Destroyed = 9,418
Structures Damaged = 1,073

January 7, 2025: 180,000+ people were under evacuation in L.A. County.

Pressure

Asset and structure destruction, leaks

Power

Electric poles/lines, power and gas shutoff by provider, generators destroyed, fuel lacking

Telecommunications

Outages inhibit tank level, pressure, chemical feed, and pump status monitoring

Personnel

Hazardous situations, staff availability

Contamination

Chemicals and microbiologicals drawn into the water system, immediate health risk

AWWA Wat. Sci. 2020. *AWWA Wat. Sci*. 2023. *Env. Sci.: Wat. Res. Technol*. 2024.

Challenge: Water and pressure to protect lives and property

Today's systems are not designed for wildfires

Building sprinkler systems enable evacuation

Residents run lawn sprinklers to wet their property

Hydrants opened and left

Power lost, water production and pumping impacted

Fires damage and destroy structures prompting uncontrolled water and pressure loss

For example....

500 structures x 13 GPM/each x 60 min =

390,000 gallons of water loss in 1 hour

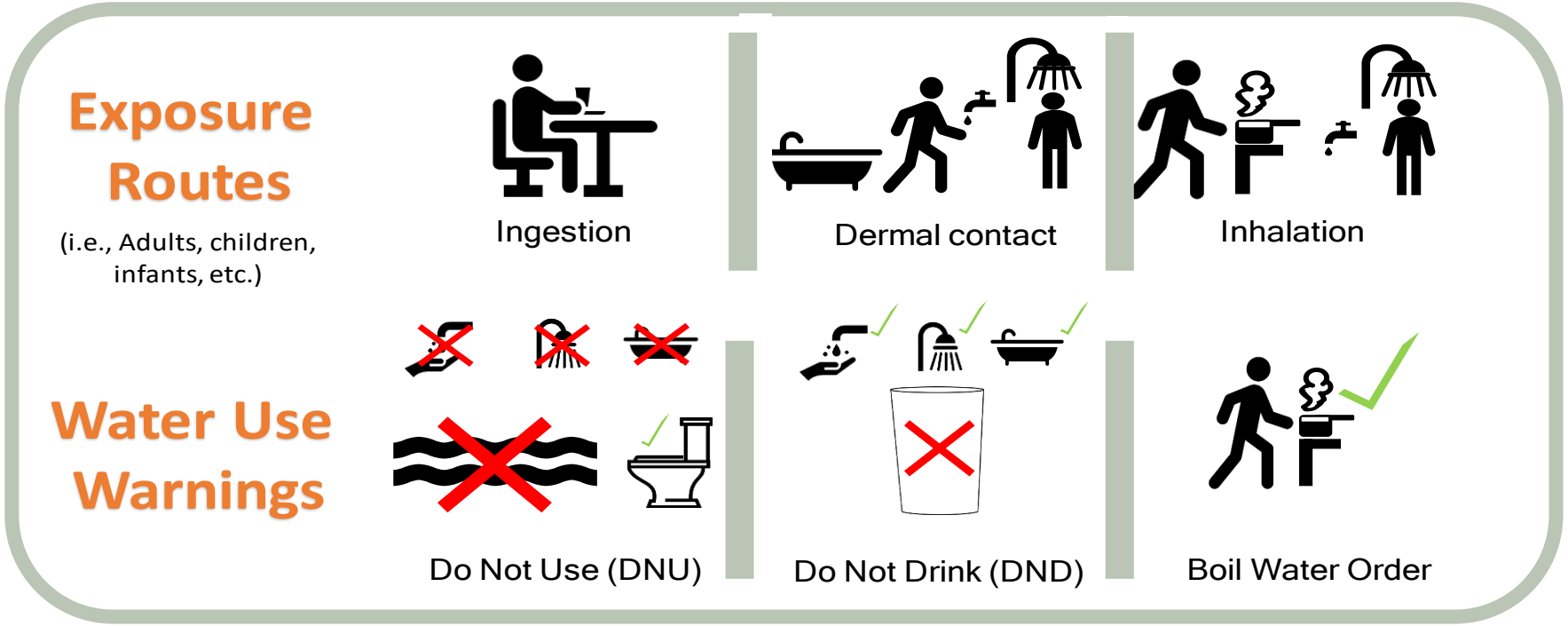
NFPA

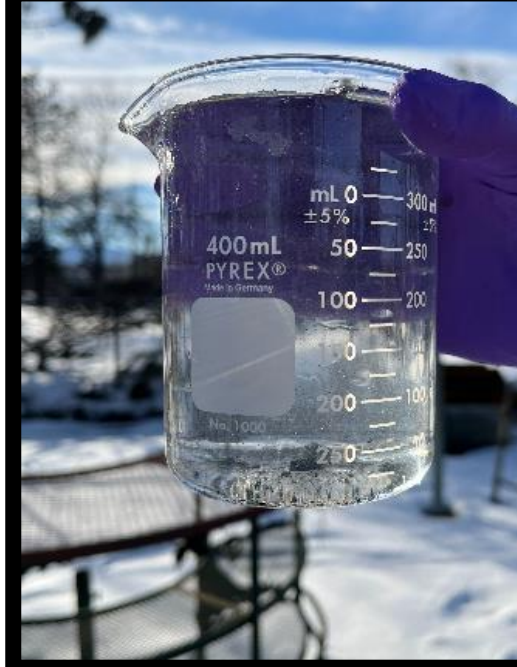
Challenge: Extreme drinking water contamination has occurred

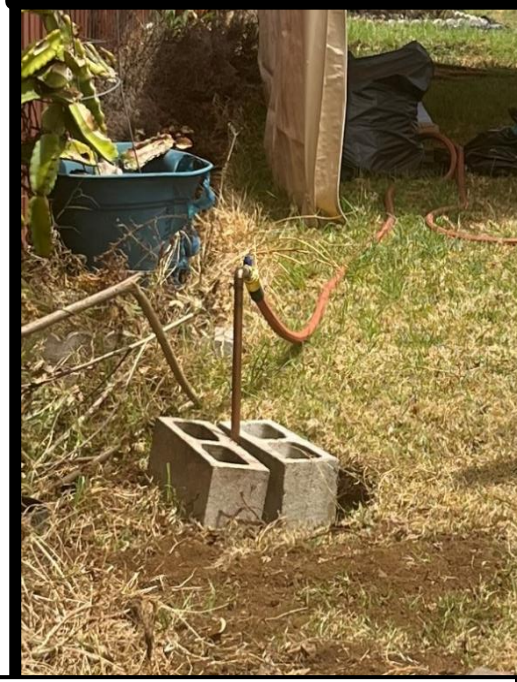
Immediate vs. long-term health risk

VOCs and other organic chemicals

Burned properties: Cross connections







Max. Benzene, ppb	Event / Location	Pop.	System	Year
440	Eaton Fire/ California	4,847	Las Flores Water Co.	2025
31	Eaton Fire/ California	16,126	Lincoln Ave. Water Co.	2025
22.5	Palisades Fire/ California	3,856,043	Los Angeles Dept. Water & Power	2025
40	Lahaina Fire/ Hawai'i	20,036	Maui County – Lahaina	2023
3.8	Kula Fire/ Hawai'i	7,686	Maui County – Upper Kula	2023
5.1	Marshall Fire/ Colorado	500	East Boulder County Water District	2021
220	Marshall Fire/ Colorado	20,319	City of Louisville	2021
5.5	Echo Mountain Fire/ Oregon	120	Whispering Pines Mobile Home Park	2020
11.3	Echo Mountain Fire/ Oregon	362	Hiland WC -Echo Mountain	2020
1.1	Echo Mountain Fire/ Oregon	760	Panther Creek Water District	2020
76.4	Almeda Fire/ Oregon	6,850	City of Talent	2020
44.9	Lionshead Fire/ Oregon	205	Detroit Water System	2020
1.5	North Complex Fire/ California	297	Lake Madrone Water District	2020
1.8	CZU Lightning Complex Fire/ California	1,650	Big Basin Water Company	2020
42	CZU Lightning Complex Fire/ California	21,145	San Lorenzo Valley Water District	2020
>2,217	Camp Fire/ California	26,032	Paradise Irrigation District	2018
38.3	Camp Fire/ California	924	Del Oro Water Co.-Magalia	2018
8.1	Camp Fire/ California	1,106	Del Oro Water Co.-Lime Saddle	2018
530	Camp Fire/ California	11,324	Del Oro Water Co.-Paradise Pines	2018
40,000	Tubbs Fire/ California	175,000	City of Santa Rosa	2017

Oregon 2020 Fires - Regulated Contaminants

At least 7 PWSs contaminated in Oregon as of May 10, 2021

VOCs were the sole focus; EPA method 524.2 for VOCs was applied for all samples

[redacted]

Vinyl chloride and MTBE exceeded federal MCLs in water samples when there was NO benzene.

Methylene chloride was not reported above the 5 ppb MCL

Volatile Organic Compound	Maximum Concentration of Contaminant (ppb)							Exposure Limits (ppb)		
	Detroit Water System	City of Gates	Whispering Pines Mobile Home Park	City of Phoenix	City of Talent	Hiland WC-Echo Mountain	Panther Creek	Federal MCL	CA MCL	USEPA 1-day Health Advisory (for 10kg child)
Benzene	**44.9**	ND	**5.5**	ND	**76.4**	**11.3**	**1.1**	5	1	200
Vinyl Chloride	**0.6**	**8.2**	ND	ND	ND	ND	ND	2	0.5	3,000
Chlorobenzene	**127**	ND	6.08	ND	ND	4.6	ND	100	70	4,000
Dichloroethane	ND	ND	**1.05**	ND	ND	ND	ND	5	0.5	700
1,4-dichlorobenzene	**9**	ND	**10.8**	ND	ND	ND	ND	75	5	11,000
Methyl-*tert*-butyl ether (MTBE)	**358**	ND	ND	589	ND	3.17	ND	N/A	13	N/A
Service Population	205	490	120	4,630	6,850	362	760	___	___	___

Is benzene only testing appropriate?

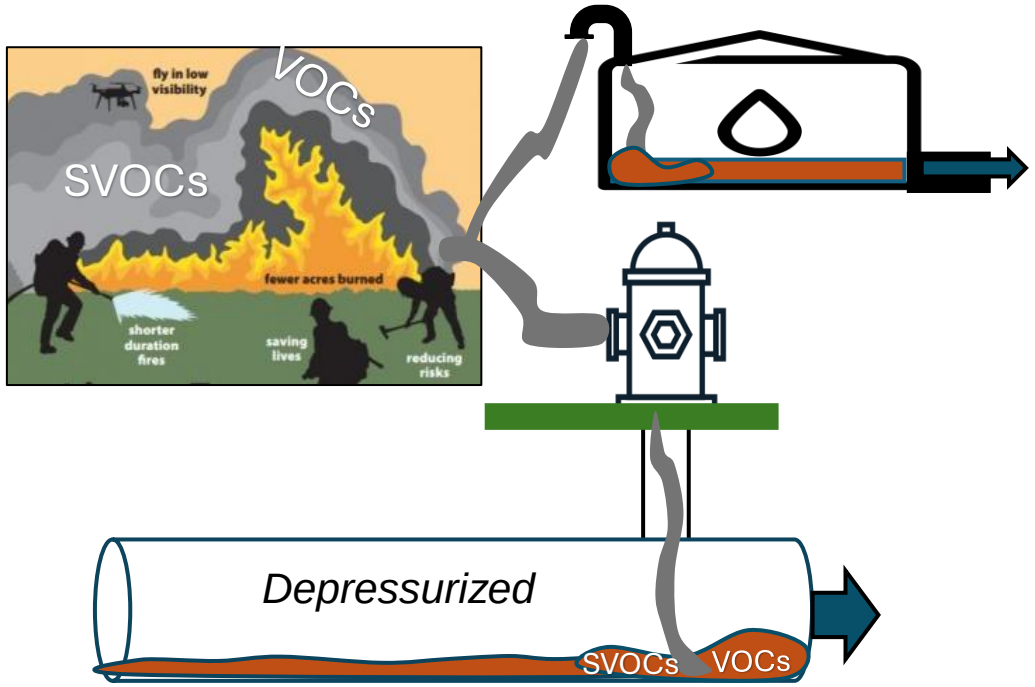
Not if you want to know if the water is safe.

***BOLD and RED* exceeded a health-based drinking water limit in a wildfire impacted water system as of March 2024**

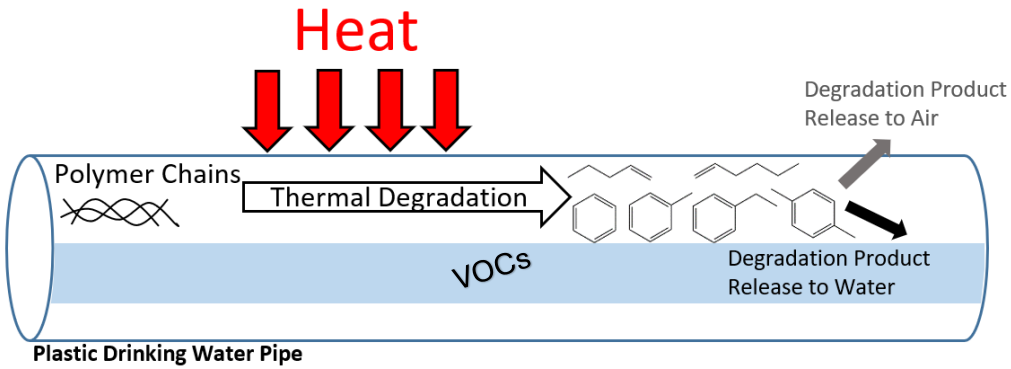
Acetonitrile	Chlorodibromomethane	Ethyl benzene	¥**Toluene****
¥Acetone	Chloromethane	**Ethylene dibromide (EDB) ****	1,2,3-Trichlorobenzene
Acrolein	4-Chlorotoluene	Ethyl-*tert*-butyl ether (ETBE)	1,2,4-Trichlorobenzene
Acrylonitrile	Dibromochloromethane	Iodomethane	1,1,1-Trichloroethane
¥**Benzene ****	**1,2-Dibromo-3-chloropropane (DBCP) ****	Isopropylbenzene	1,1,2-Trichloroethane
Bromochloromethane	1,2-Dichlorobenzene	**Methylene chloride****	Trichloroethylene
Bromodichloromethane	1,4-Dichlorobenzene	¥**Methyl ethyl ketone (MEK) ****	**Trichloromethane ****
Bromoform	1,1-Dichloroethane	Methyl iso butyl ketone (MIBK)	**1,2,3-Trichloropropane (TCP) ****
n-Butylbenzene	**1,2-Dichloroethane ****	**Methyl-*tert*-butyl ether (MTBE) ****	1,2,4-Trimethylbenzene
sec-Butylbenzene	1,1-Dichloroethene	¥**Naphthalene****	1,3,5-Trimethylbenzene
tert-Butylbenzene	*cis*-1,2-Dichloroethene	¥**Styrene****	**Vinyl chloride ****
Carbon disulfide	*trans*-1,2-Dichloroethylene	***tert*-Butyl alcohol (TBA) ****	¥*ortho*-Xylene
Carbon tetrachloride **	**1,2-Dichloropropane ****	Tetrachloroethylene	¥*meta*-Xylene
Chlorobenzene	¥Ethanol	**Tetrahydrofuran (THF) ****	¥*para*-Xylene

There are 3 ways water distribution systems become contaminated

1. Biomass and structure combustion



2. Plastic thermal degradation

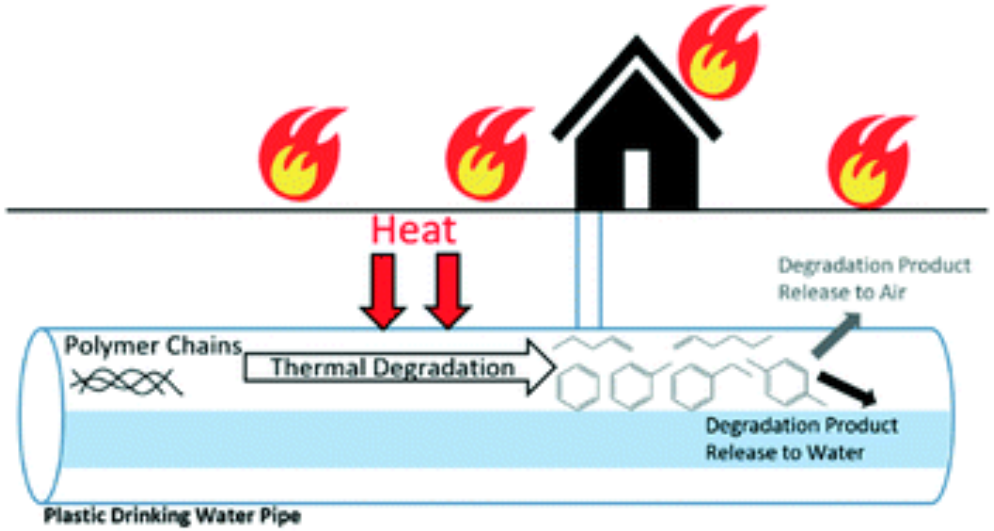


3. Contaminated water and material back siphonage

Secondary Sources: Infrastructure desorption

Whelton et al. 2025. Water Research Foundation. Denver, CO.

Thermally damaged plastic drinking water pipes can be a source of drinking water contamination



Heating at 200-400°C for new HDPE, PEX, PVC, CPVC, & PP pipes generated VOCs & SVOCs

Benzene generated by heating all pipes except PP

Once plastic cooled, chemicals leached into water

	Confirmation of BTEX Components in Water				Number of TICs in extract[a]	
Material	B	T	E	X	Water	*n*-Hexane
Cold water pipes						
PVC	✓	✓	–	–	4	41
HDPE	✓	✓	✓	✓	14	100
Hot and cold water pipes						
CPVC	✓	–	–	–	3	32
PEX-a1-a	✓	✓	✓	✓	19	123
PEX-a1-b	✓	✓	✓	✓	16	122
PEX-a2	✓	✓	✓	✓	22	117
PEX-b	✓	✓	✓	✓	18	127
PEX-c1-a	✓	✓	✓	✓	19	133
PEX-c1-b	✓	✓	✓	✓	17	134
PEX-c1-EVOH	✓	✓	✓	✓	20	109
PP	–	✓	–	–	6	95

Isaacson et al. 2020. Env. Sci. Wat. Res. & Technol

Wildfires can contaminate drinking water systems both by thermal damage to *plastic pipes and intrusion of smoke*

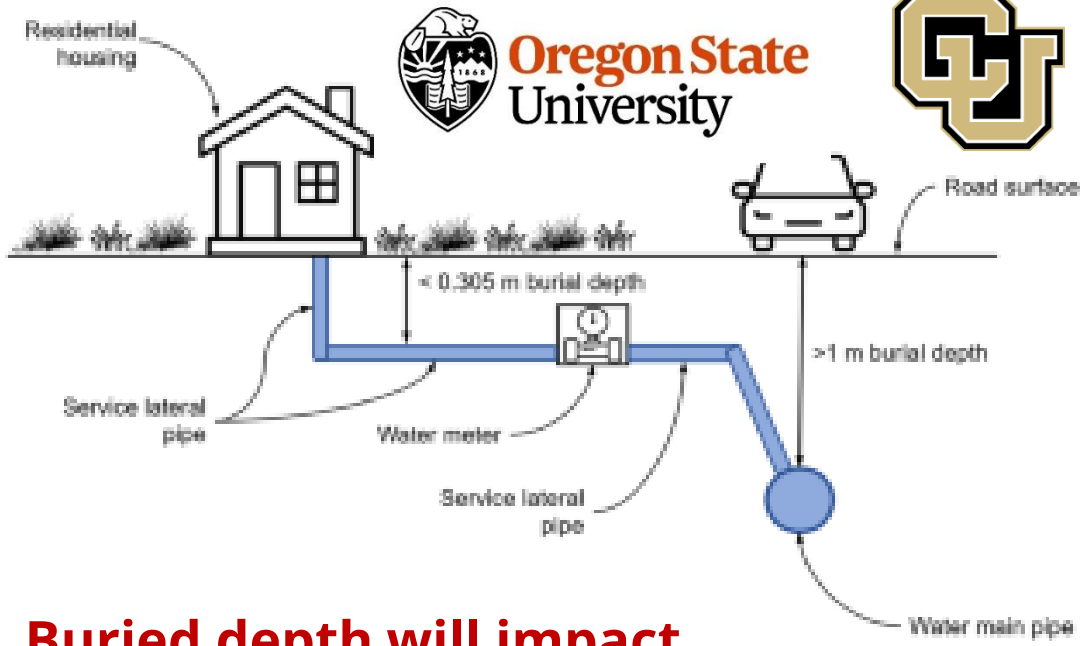
Characterized target and nontarget VOCs and SVOCs in water from **1** contaminated service line after the Camp Fire.

New PVC, PEX, and HDPE pipe **heating experiments** conducted

Results

PVC pipe heating: 32 compounds
HDPE/PEX pipes heating: 28 compounds
Service line: 55 compounds for uncontrolled burning of biomass and waste materials.

Draper et al. 2022. ACS EST Water.



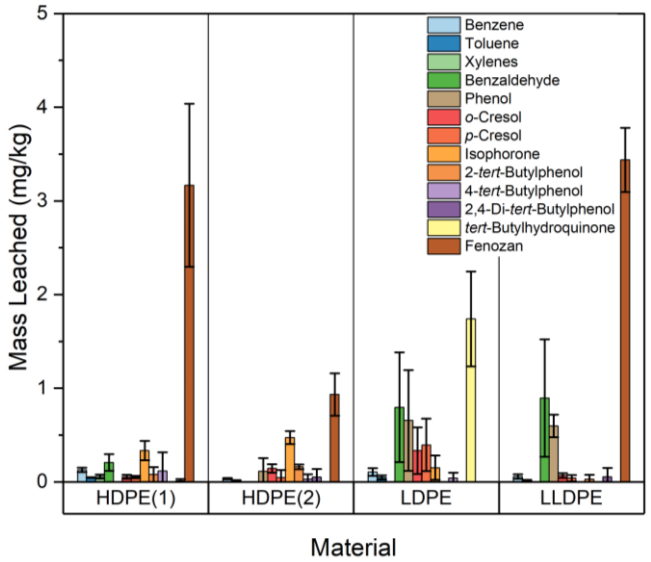
Buried depth will impact thermal vulnerability

Mathematical Thermal Modeling Results

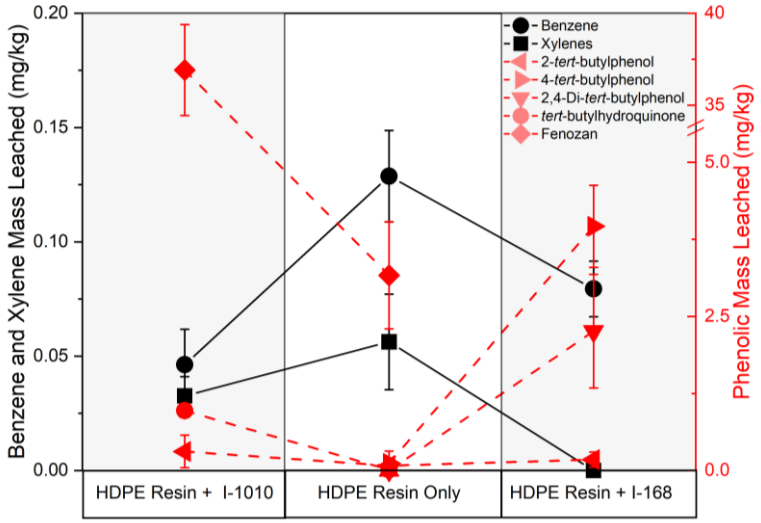
- Upper limit temperature for pressure service of the pipelines was exceeded at depths up to 0.45 m (1.5 ft).
- Upper limit temperature will be exceeded at least 50% of the time at depths up to 0.19 m (0.6 ft).

Metz et al. 2022. Fire Technology.

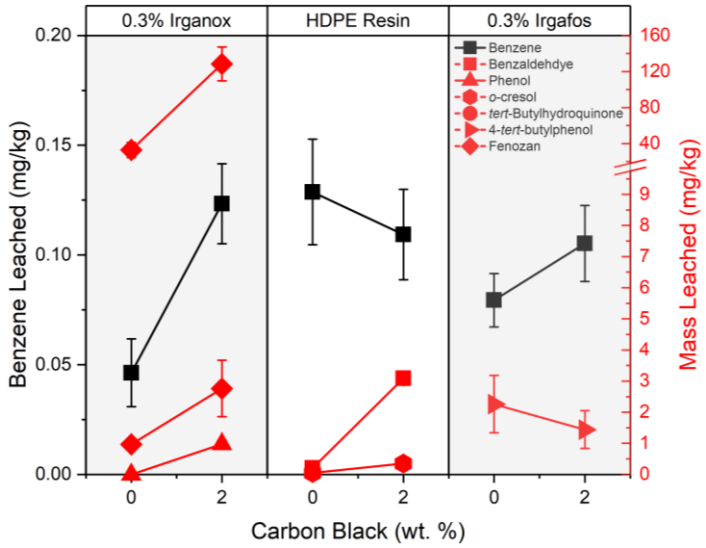
PE resin type, antioxidant loading, and carbon black influenced VOCs found in water



The type of virgin PE resin used impacts VOCs found in water



The presence of AOX decreased VOCs released but increased levels of AOX degradation products detected

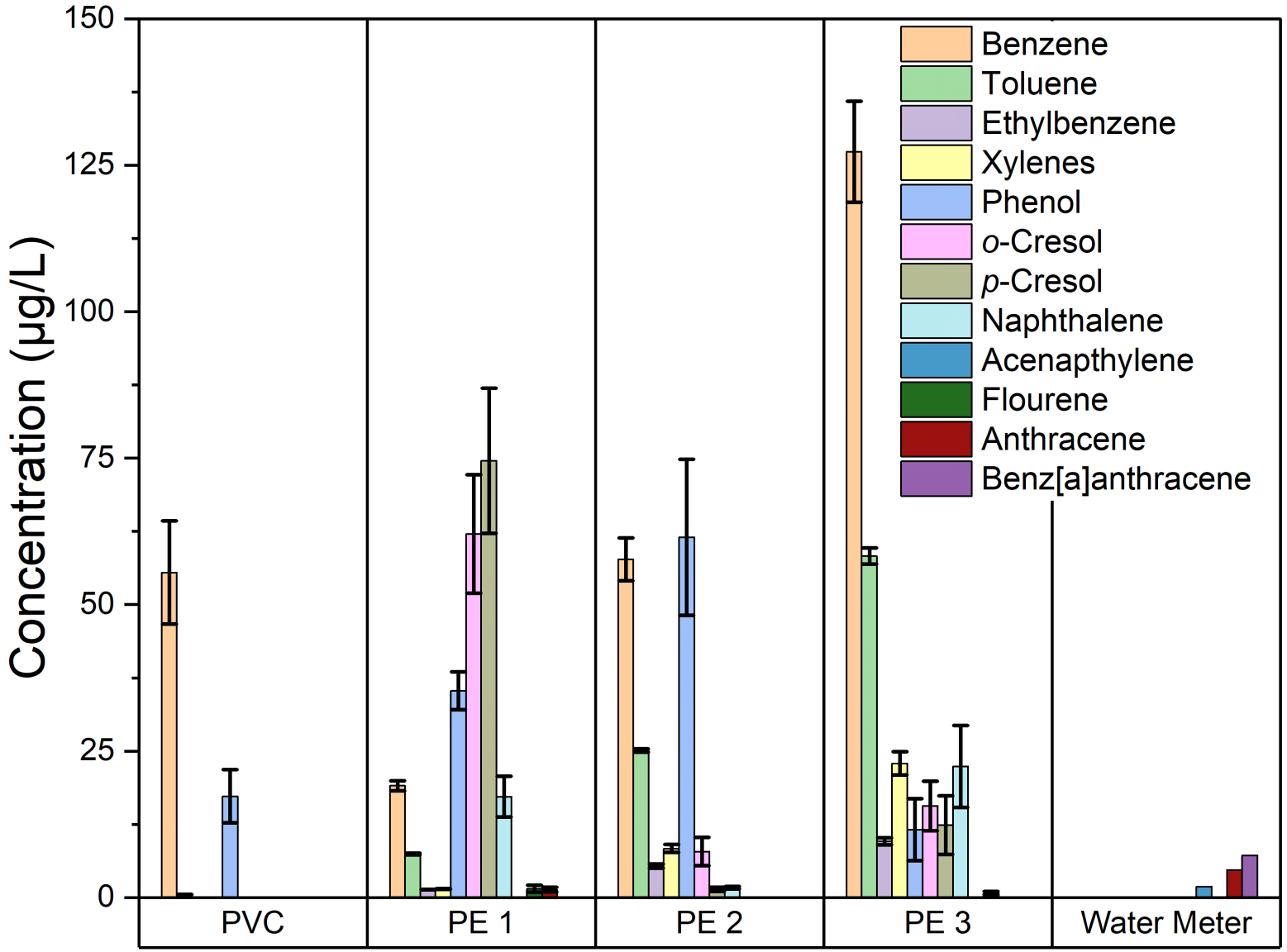


CB had complex impacts on VOCs found in water

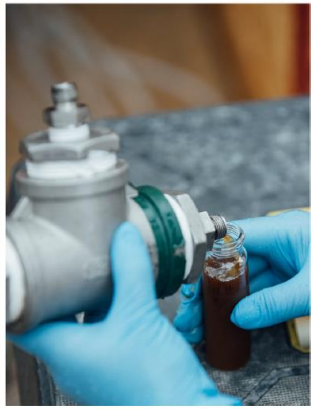
When CB ↑, benzene ↓
When AOX1 ↑, benzene ↓
When AOX2 ↑, benzene ↓
When CB + AOX, benzene =

Isaacson et al. 2025. *J. HAZMAT.* https://doi.org/10.1016/j.jhazmat.2025.137562

Some Exhumed Materials Leached VOC *and SVOCs*



Pilot Study on Fire Effluent Condensate from Full Scale Residential Fires



Exp. #	Room 1: 1	Room 1: 2	Room 2: 3	Room 2: 4	Room 2: 5
pH	2.56	1.10	1.93	1.96	1.59
Bromide	<3.0	5.5	6.6	9.8	13
Chloride	270	39,000	3,000	2,400	4,700
Nitrate	13	2.4	5.7	<1.0	6.4
Sulfate	330	9,200	2,700	2,100	2,300

ppb

Exp. #	Room 1: 1	Room 1: 2	Room 2: 3	Room 2: 4	Room 2: 5
Benzene	1,100	6,400	2,600	3,600	33,000
Styrene	<400	1,200	470*	1,400	1,800
Toluene	180*	1,000	<340	660	3,900
Xylenes	<290	110*	<740	153	910*
Naphthalene	2,700*	8,100	7,400*	8,100	10,000
2-Butanone	2,100*	3,600*	7,300*	13,000	31,000
Acetone	57,000	31,000	74,000	110,000	250,000
Ethanol	<40,000	<40,000	67,000*	49,000	61,000*

Chemicals often not looked for in water systems

Horn et al. 2023. *Fire Technology.*

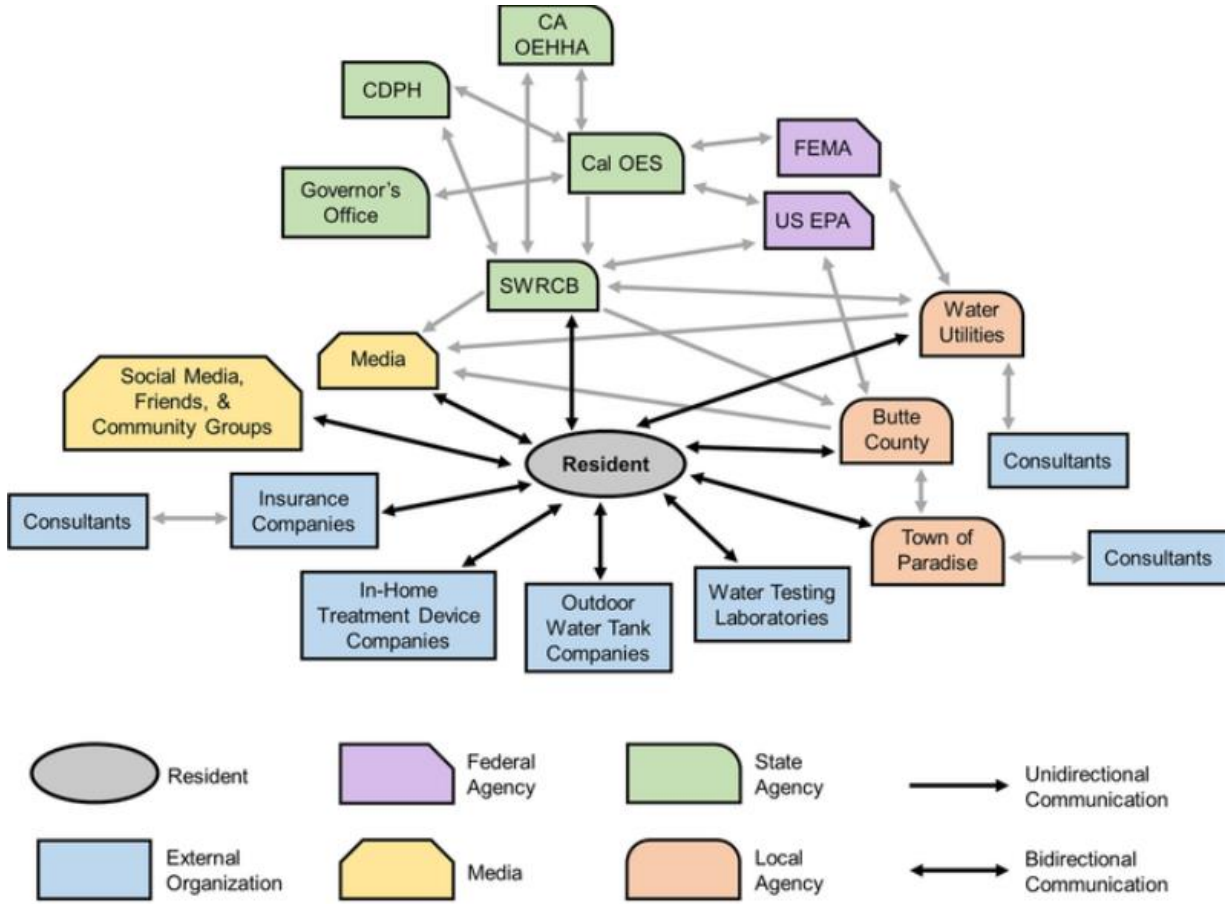
Water safety attitudes, risk perception, experiences, and education for households impacted by the 2018 Camp Fire

Natural Hazards, Published May 2021

https://doi.org/10.1007/s11069-021-04714-9

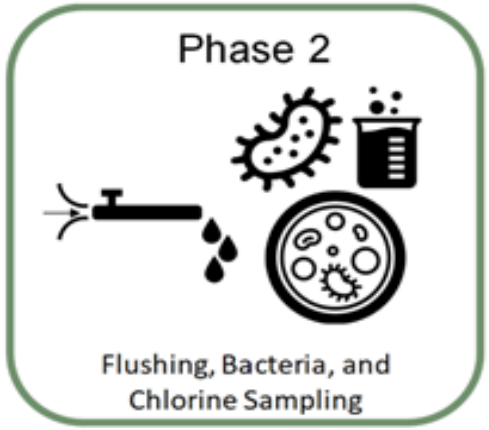
Households Require Support

1) Water use restrictions
2) **Plumbing** sampling and testing
3) **Plumbing** decontamination methods and validation,
4) Water tank selection and maintenance
5) In-home treatment device selection and maintenance
6) **Plumbing** design and material selection for property repairs and new construction

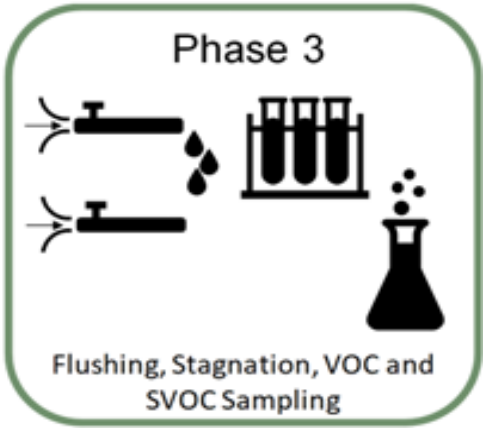


Challenge: Restoring Service for Public Safety, Health, and Economic

Support firefighting
Isolate damage
Maintain pressure
Water use warnings



Personnel surge
Restore control, pressure
Repeated sampling
Laboratories

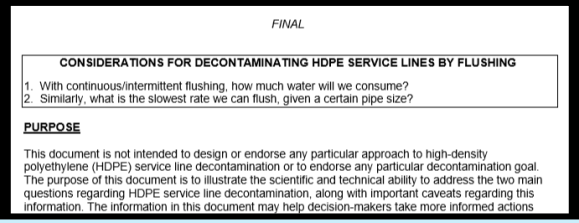


Personnel surge
Repeated sampling
Laboratories
Decon, remove, replace

Inspection, Testing, and Repair vs. Replace

Water Meters vs. Hydrants vs. Water Quality

Challenge: DECONTAMINATION


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

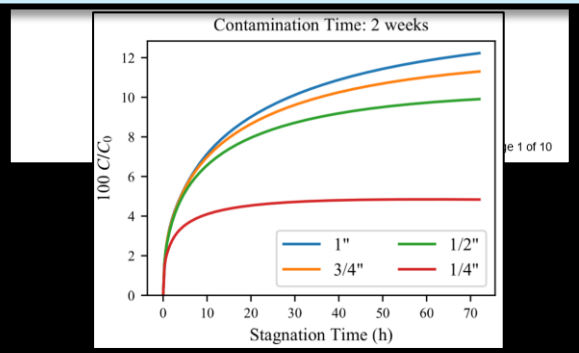
Water Distribution System Decontamination

Collaboration between Us & USEPA

Hydraulics

Polymer Science

Environmental Engineering



Numerical modeling:

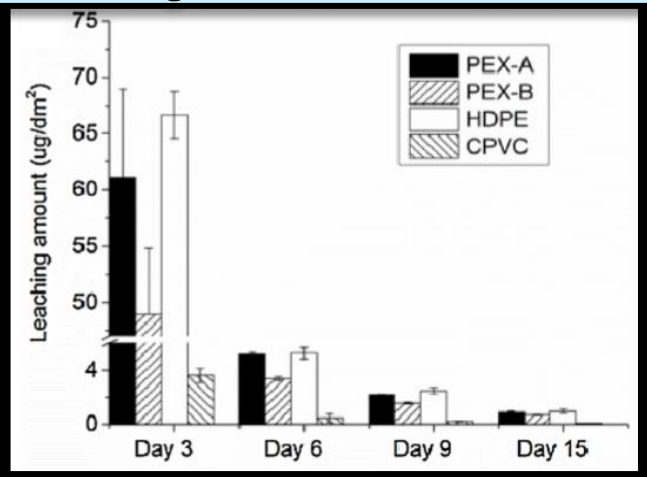
Greater than 286 days vs. less than 64 days of continuous water flushing for 1-inch HDPE service line

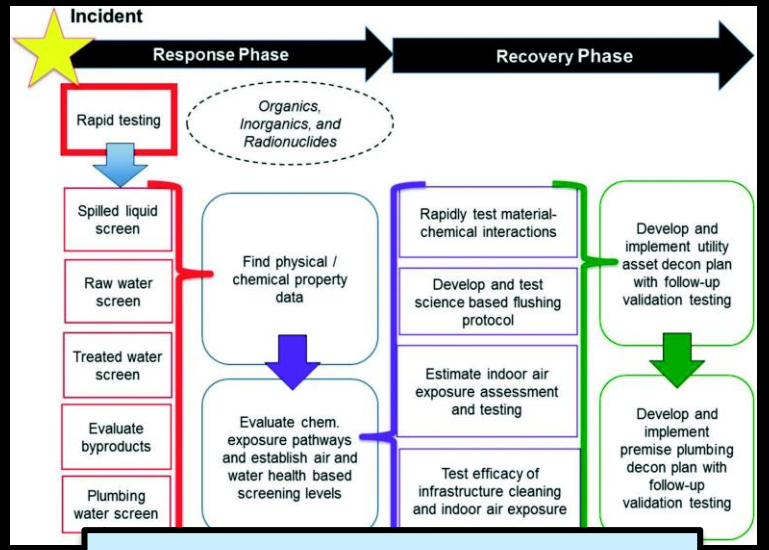
(Haupert et al. 2019)

Stagnation needed to find contamination

Different plastic pipes uptake and leach different amounts of VOCs and SVOCs

Huang et al. 2017. J. HazMat.





There is a step-wise process for responding to and recovering from contamination

Whelton et al. 2017. ES: WR&T.

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California State University Chico

Butte College

School of Public Health, University of California, Berkeley

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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]

Environmental Science Water Research & Technology

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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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HAWAI'I

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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

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CORONA ENVIRONMENTAL CONSULTING

Oregon State University

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*

UCSF

CDPH

California Water Boards

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

Check for updates

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 …

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…

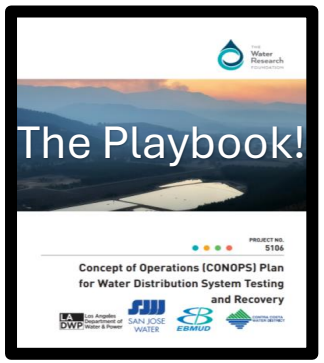
Kristofer P. Isaacson[1] | … Amisha D. Shah[4] | Andr…

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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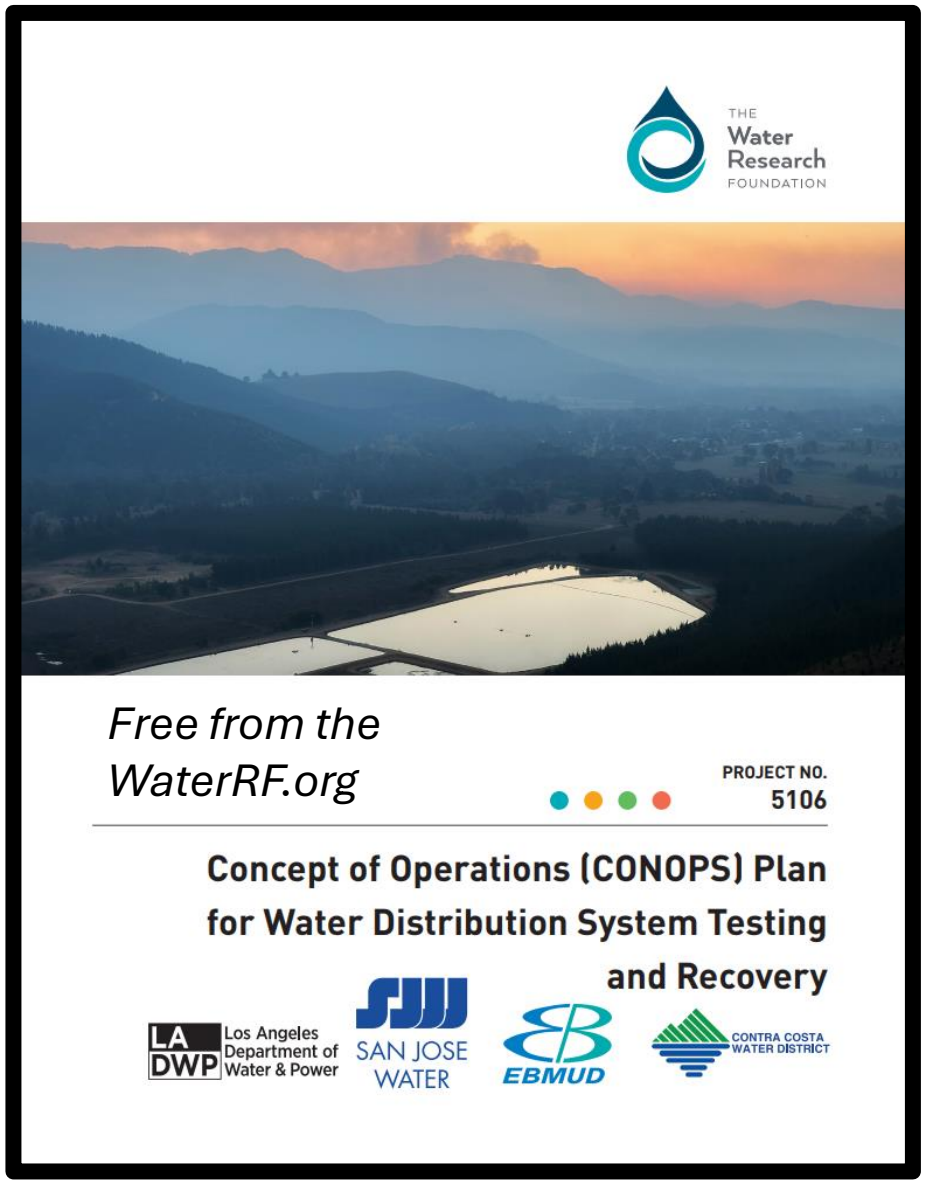


Opportunities for Prevention and Recovery:

Lessen the consequences of wildfires

- ✓ Adopt fire safe setback distances
- ✓ Lessen power loss: Backup power, emergency generators
- ✓ Evaluate hydraulic models for fire flow vulnerability
- ✓ Install emergency connections to neighboring water systems
- ✓ Protect or minimize using plastics where vulnerable
- ✓ Have raw water sources and treatment plant bypass capability
- ✓ Zone the water distribution system to prevent backflows
- ✓ Adopt service line backflow prevention devices/check valves
- ✓ Adopt remote automatic shutoffs
- ✓ Develop and issue evidence-based drinking water use warnings

Opportunities: Lessen the time to restore safe water service

Establish and strengthen mutual aid networks

Develop evidence-based physical damage assessments

Identify chemical source profiles

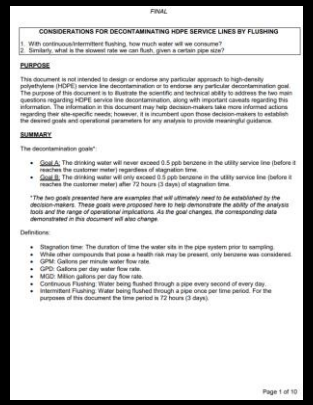
Innovate more effective infrastructure decon technologies

Share knowledge and evidence-based mitigation methods and practices nationwide

Create evidence-based asset repair vs. replacement decisions

Support small water systems who do not have technical expertise or personnel to recover

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).

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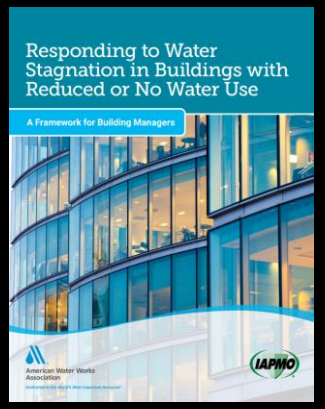
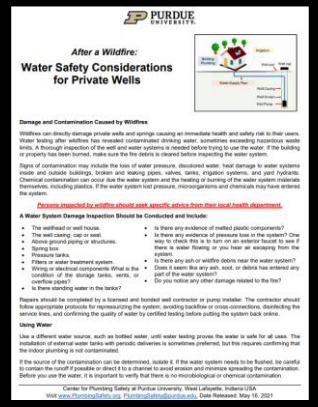
2019

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 impacted 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 any 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 representing 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

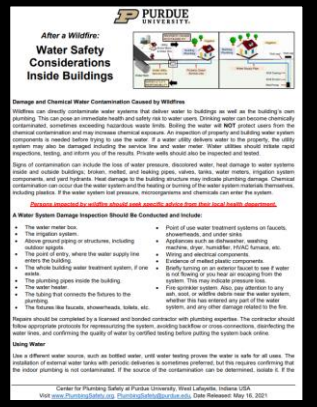
Use a different water source, such as bottled water, until water testing proves the water is safe for all uses. The installation of external water tanks with periodic deliveries is sometimes preferred, but this requires confirming that the indoor plumbing is not contaminated.

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.

Center for Plumbing Safety at Purdue University, West Lafayette, Indiana USA
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 indicating 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 may 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 impacted 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.

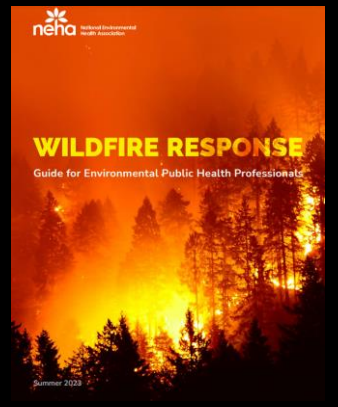
Repairs should be completed by a licensed and bonded contractor with plumbing expertise. The contractor should follow appropriate protocols for representing the system, avoiding backflow or cross-connections, disinfecting the water lines, and confirming the quality of water by certified testing before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

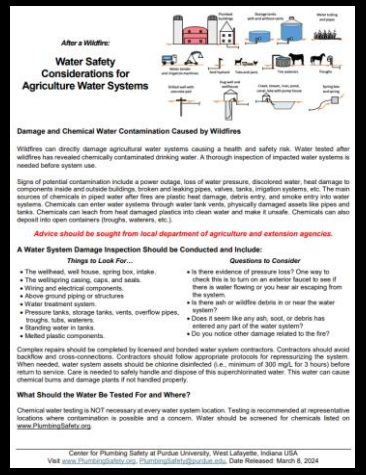
2021

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 wellspring 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 representing 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

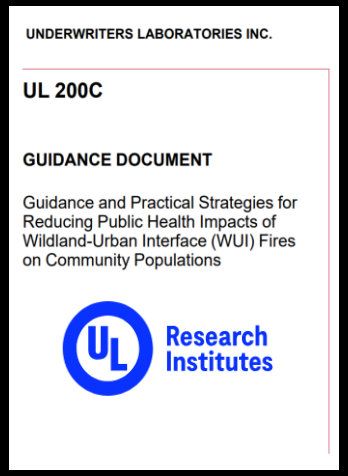
Center for Plumbing Safety at Purdue University, West Lafayette, Indiana USA
Visit www.PlumbingSafety.org PlumbingSafety@purdue.edu Date Released: March 8, 2024

2023

Bipartisan Commission report...

2023

Public health basics...



UNDERWRITERS LABORATORIES INC.

UL 200C

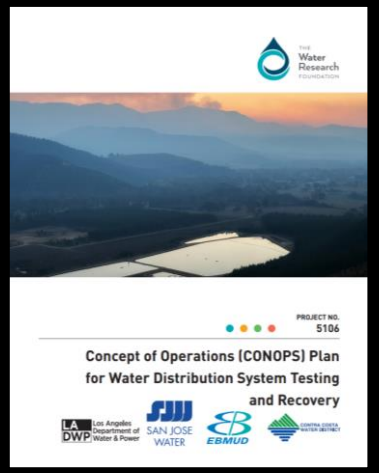
GUIDANCE DOCUMENT

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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- Flushing Plans
- Plumbing Demonstrations - Camp Fire
- Video / Audio
- Presentations / Reports
- Peer-Reviewed Publications
- Water Quality Risk Tools
- Hawaii Response
- Wildfire Response
- Survey - Camp Fire
- FAQs - General Plumbing
- FAQs - Camp Fire Response

Response and Recovery to Wildfire Caused Drinking Water Contamination

Wildfires can damage buried drinking water systems as well as private drinking water wells and building plumbing, making them unsafe to use. Since 2017, a growing number of wildfires have prompted chemical drinking water contamination in the United States. Levels found in some water systems have exceeded hazardous waste limits and posed an immediate health risk. To help households and building owners understand key wildfire drinking water contamination public safety issues, resources were compiled below. These resources will also be of interest to public health officials, water providers, municipalities, emergency management, insurance companies, nonprofit agencies, elected officials, and consultants.

- Questions can be directed to Dr. Andrew Whelton at awhelton@purdue.edu.

Marshall Fire Homeowner Support

Letter to Homeowners Affected by the Marshall Fire in Unincorporated Boulder County (January 2022)

Resources for Households, Private Well Owners, and Public Health Officials

Here is a list of chemicals to test for (as of May 2022) to find chemical contamination in wildfire impacted drinking water systems:

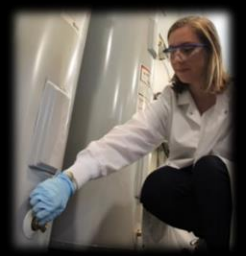
- List of Chemicals in Wildfire Impacted Water Distribution Systems [May 2022]

These 1 page information sheets provide households and public health officials considerations for water system, inspection, testing, and potential safe drinking water options when the plumbing is unsafe. These documents were developed based on firsthand experience investigating contamination after wildfire, building plumbing, sampling, decontamination, and advising local, county state, and federal agencies. Information in these documents is partly based on practices from several health departments who have responded to wildfire caused drinking water contamination disasters and also influenced by our firsthand experiences and testing.

- After a Wildfire: Water Safety Considerations for Private Wells [May 16, 2021, Prepared by the Center for Plumbing Safety]
- After a Wildfire: Water Safety Considerations Inside Buildings [May 16, 2021, Prepared by the Center for Plumbing Safety]
- ***Attention: Persons impacted by wildfire should seek specific advice from their local health department.***

Resources for Emergency Management, Water Utility, Public Health, and Elected Officials

This video helps prepare officials for water system damage scenarios. Wildfires can damage water distribution system infrastructure both physically –and– chemically. Some damage may not be visible. Hazardous waste scale drinking water chemical contamination can be caused. This presentation does not cover all situations, but instead provides an introduction for the viewer. More information and help can be obtained by contacting the Center for Plumbing Safety.



- ✓ 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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