Lessons after Maui Hawai'i Wildfires

Andrew J. Whelton, Ph.D.

Purdue University

Thanks to many people

Paula Coelho, Purdue University

Christopher Shuler, Ph.D., University of Hawai‘i at Mānoa

Aurora Kagawa-Viviani, Ph.D., University of Hawai‘i at Mānoa

Kellie Cole, University of Hawai‘i Maui College

Stefanie Surdyka, Purdue University

Stephanie Heffner, Purdue University

Robby Seeger, Water People Collective

Autumn Ness, Maui Food Hub

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ACE24

Co-hosted By
American Water Works Association
California-Nevada Section

Wildfires Are Here: Learn What Utilities Should Expect and Do to Respond and Recover

AWWA'S 2024 Annual Conference & Exposition
Anaheim, California
1:30 pm PDT, Wednesday June 12, 2024, Room 204AB

The most destructive, costly, and deadliest wildfires have been recorded in recent U.S. history and these require an equally unprecedented response by water utilities. This session will share real-world lessons direct from impacted frontline utilities, offer a concept of operations plan (CONOPS) that all utilities can adopt, worker safety advice from California Department of Public Health, and researcher discoveries.

1:30 **The 2023 Maui Wildfires: Lessons from Water Systems in Hawai'i**

2:00 **Know When to Ask for Help, How and What to Expect**

2:30 **Facilitated Panel Discussion: Wildfire Lessons for Management, Operations, and Government Agencies**

3:30 **Education Stations and Discussion** (Participants will rotate around the room and meet with speaker groups: Directors vs. Operations vs. Customers/Agencies)

Featuring wildfire experts from:

American Water Works Association
JPIA
PURDUE UNIVERSITY
MAUI
City of Louisville
CDPH Public Health

Participants and knowledge supported by:

Water Research Foundation (www.waterrf.org), National Science Foundation (www.nsf.gov), CDPH, AWWA, and utilities.

National Science Foundation
Water Research Foundation

Learn from professionals who have firsthand experience with wildfire disasters that damage water systems.

John Stufflebean, P.E
Water Supply
Maui, Hawai'i

Kurt Kowar, P.E
Public Works
Louisville, Colorado

Kevin Morey, Ph.D.
AWWA
Washington, D.C.

Paula Coelho
Purdue University
West Lafayette, Indiana

Bill Taylor
Paradise Irrigation District
Paradise, California

Kevin Phillips
ACWA JPIA
Chico, California

Elon Ullman, California
Department of Public Health
San Francisco, California

Cory Peterson, P.E.
Public Works
Louisville, Colorado

Nikki Zavodny,
Purdue University
West Lafayette, Indiana

Kristofer Isaacson, Ph.D.
University of Southern California
Los Angeles, California

Shantanu Sonawane
Purdue University
West Lafayette, Indiana

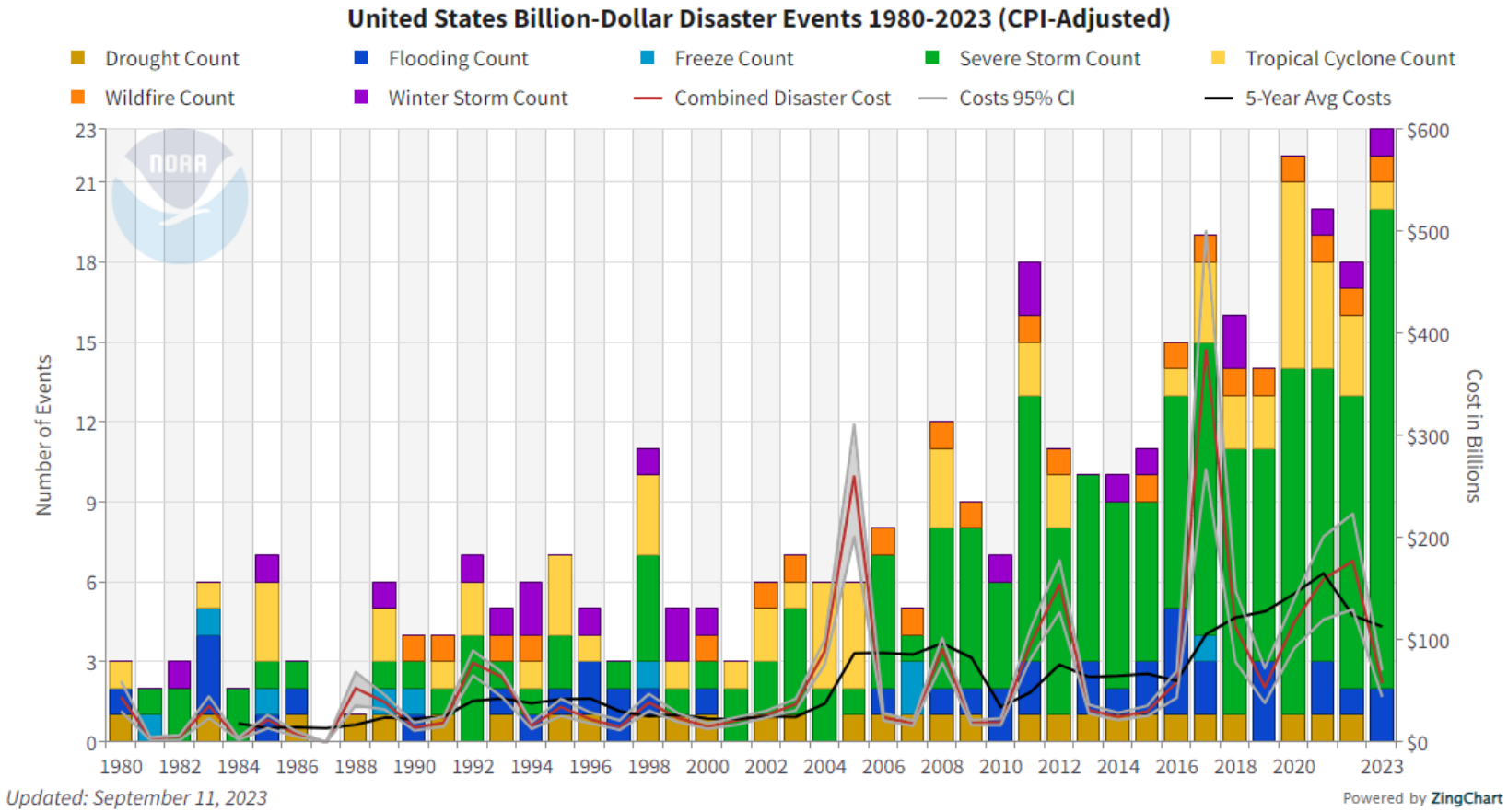
Samuel Spears
Purdue University
West Lafayette, Indiana

Andrew Whelton, Ph.D.
Purdue University
West Lafayette, Indiana

Questions?
Contact awhelton@purdue.edu

Resilience (n.)

The ability to bounce back from misfortune and change



National Interagency Fire Center (www.nifc.gov)

Current National Statistics

69 Incidents
Total Number of Large Fires

2 Total
New Large Fires

41,944 Incidents
Year-to-date Wildfires

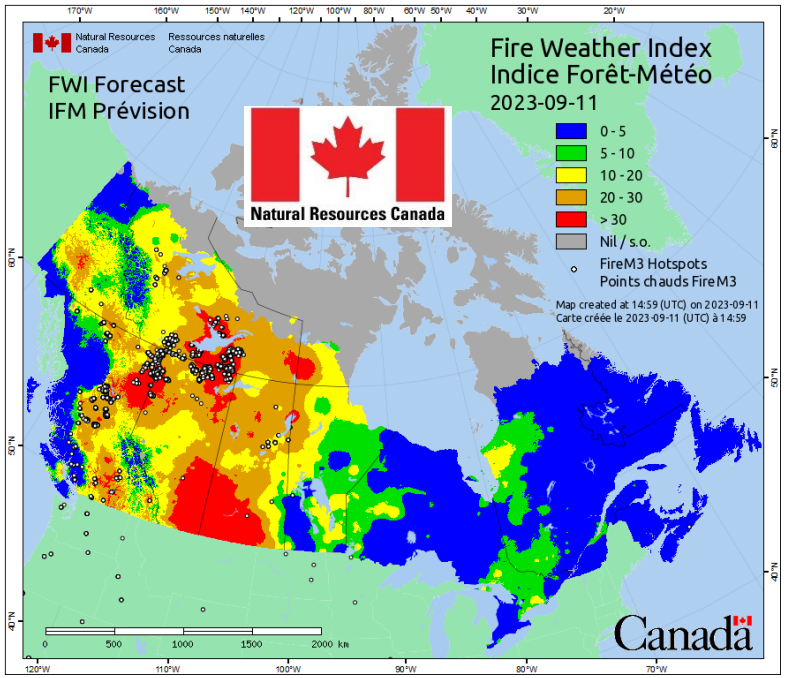
475,924 Acres
Acres Burned on Large Fires

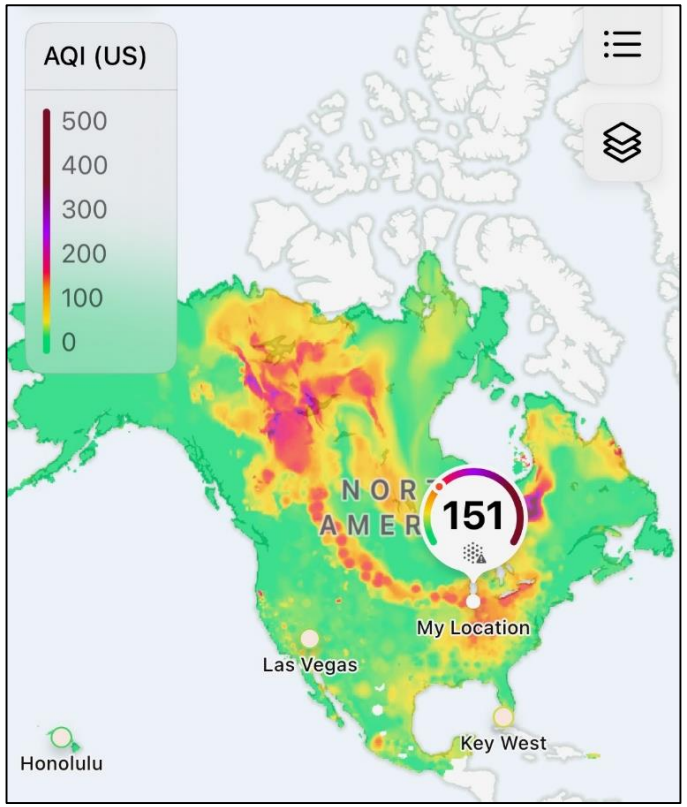
12,391
Personnel Assigned to Wildfires

2,191,140 Acres
Year-to-date Acres Burned

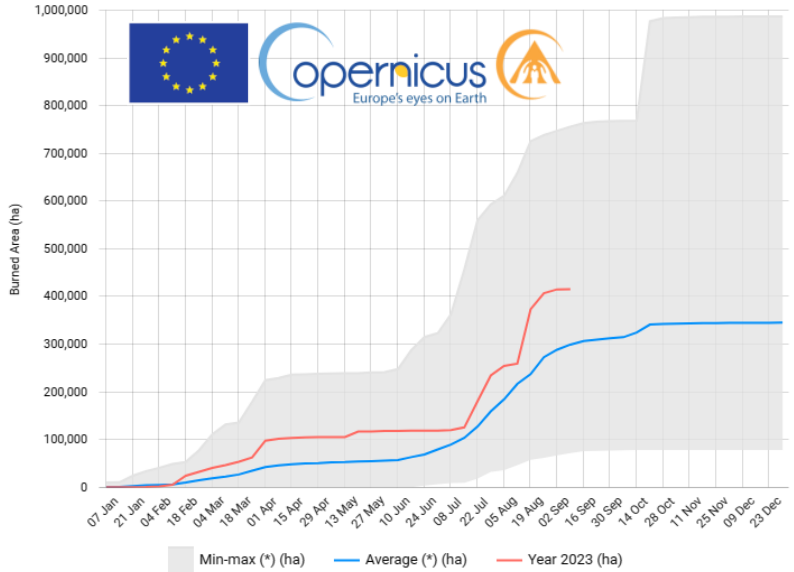
Last Updated: Monday, September 11, 2023 - 08:25

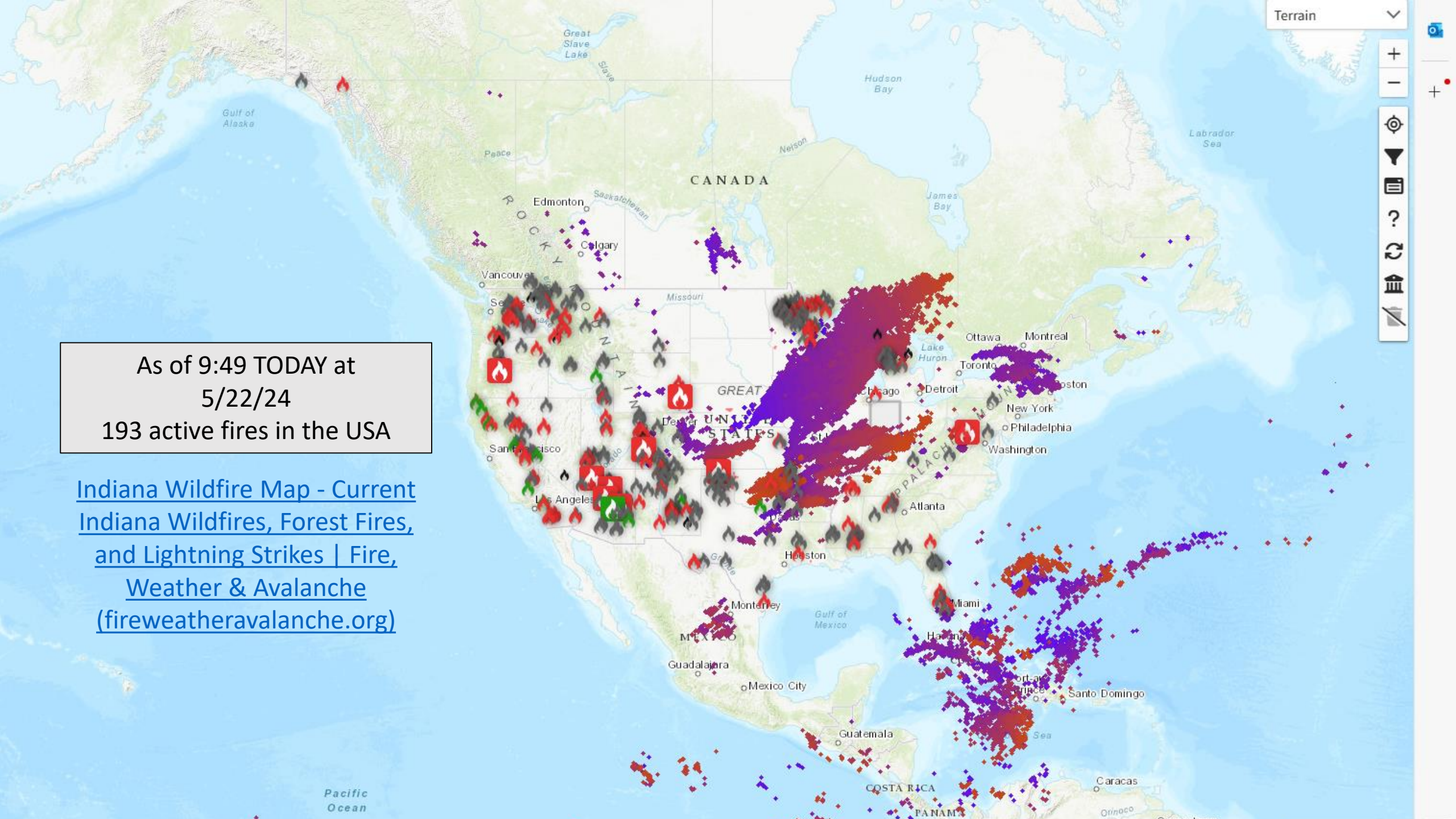
Wildland Fire Information System (nrcan.gc.ca)



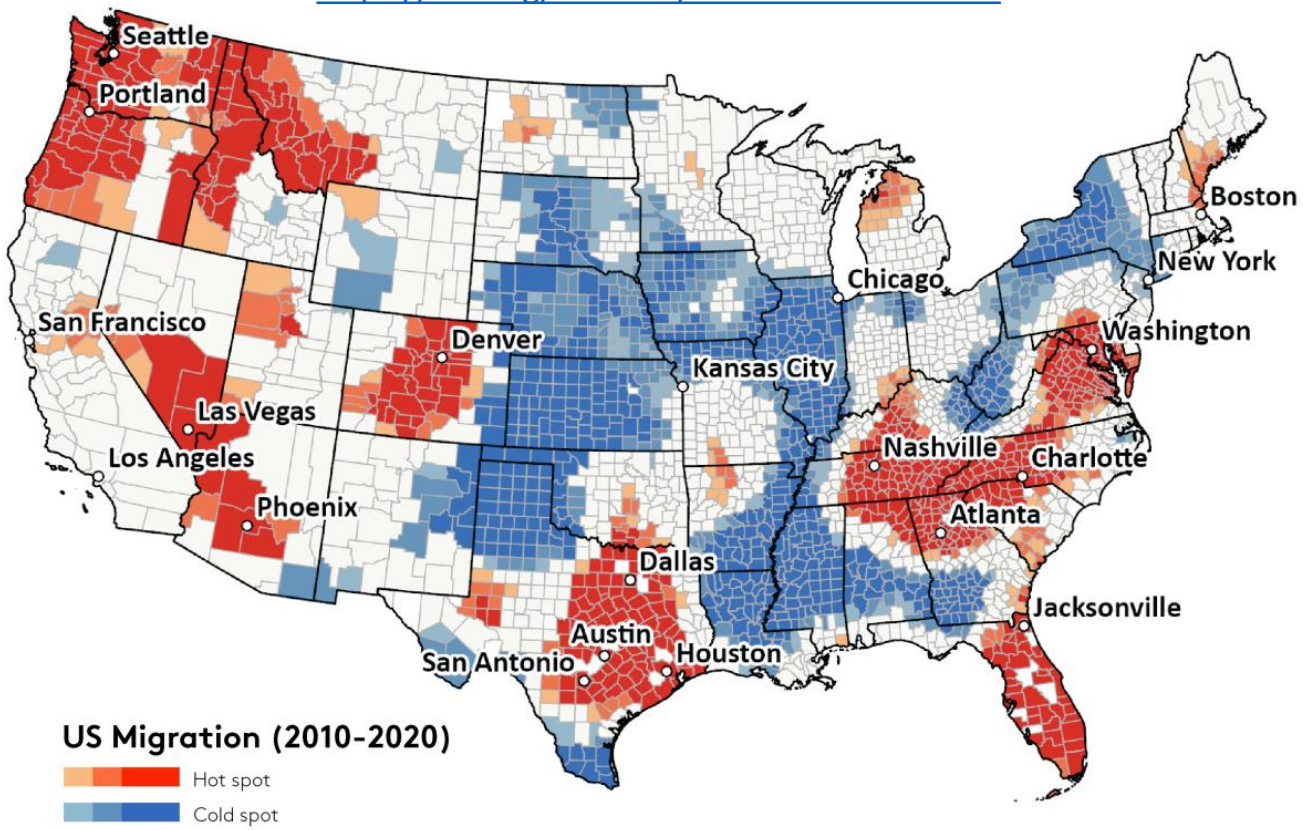


European Forest Fire Information System (EFFIS) (europa.eu)




As of 9:49 TODAY at
5/22/24
193 active fires in the USA
Indiana Wildfire Map - Current Indiana Wildfires, Forest Fires, and Lightning Strikes | Fire, Weather & Avalanche (fireweatheravalanche.org)
Terrain
CANADA
Edmonton
Calgary
Vancouver
Ottawa
Montreal
Toronto
Detroit
New York
Philadelphia
Washington
Atlanta
Houston
Miami
Monterrey
Guadalajara
Mexico City
Santo Domingo
Guatemala
COSTA RICA
PANAMA
Caracas
Gulf of Alaska
Hudson Bay
Labrador Sea
Gulf of Mexico
Pacific Ocean
Great Slave Lake
James Bay
Lake Huron

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)

The Hawaiian archipelago is the most isolated place on earth, more than 2,000 miles from the nearest continent.

2023 Maui Wildfires: August 8, 2023

Hurricane Dora offshore, 60-80 mph gusts onshore

Olinda Fire: 1,081 acres, 2 structures

Kula Fire: 202 acres, 544 structures

Lāhainā Fire: 2,170 acres, 2,207 structures

Puelho Fire: 5,300 acres, 0 structures

Deadliest wildfire incident in modern U.S. history: 114 dead + others missing


FRANKO MAPS
HAWAIIAN ISLANDS
ADVENTURE GUIDE
FRANKOMAPS.COM
Kauai, Oahu, Maui & Hawaii
Details on Side 2
NIIHAU
The Forbidden Isle
KAUAI
The Garden Isle
OAHU
The Gathering Place
MOLOKAI
The Friendly Isle
LANAI
The Pineapple Isle
MAUI
The Valley Isle
KAHOOLAWE
The Target Isle
HAWAII
The Big Island
Honolulu
Pacific Ocean
The Hawaiian Islands
N
S
E
W

Lāhainā was the traditional home of Maui royalty dating back to the 1500s, and later became the capital of the Hawaiian Kingdom in 1820.

January 16, 1893 – United States troops invaded the Hawaiian Kingdom

August 21, 1959 – Hawai'i became the 50th state of the United States

Whaling, sugar plantation, and most recently tourism reshaped the landscape and economy of the town and surrounding area.

Source: National Geographic

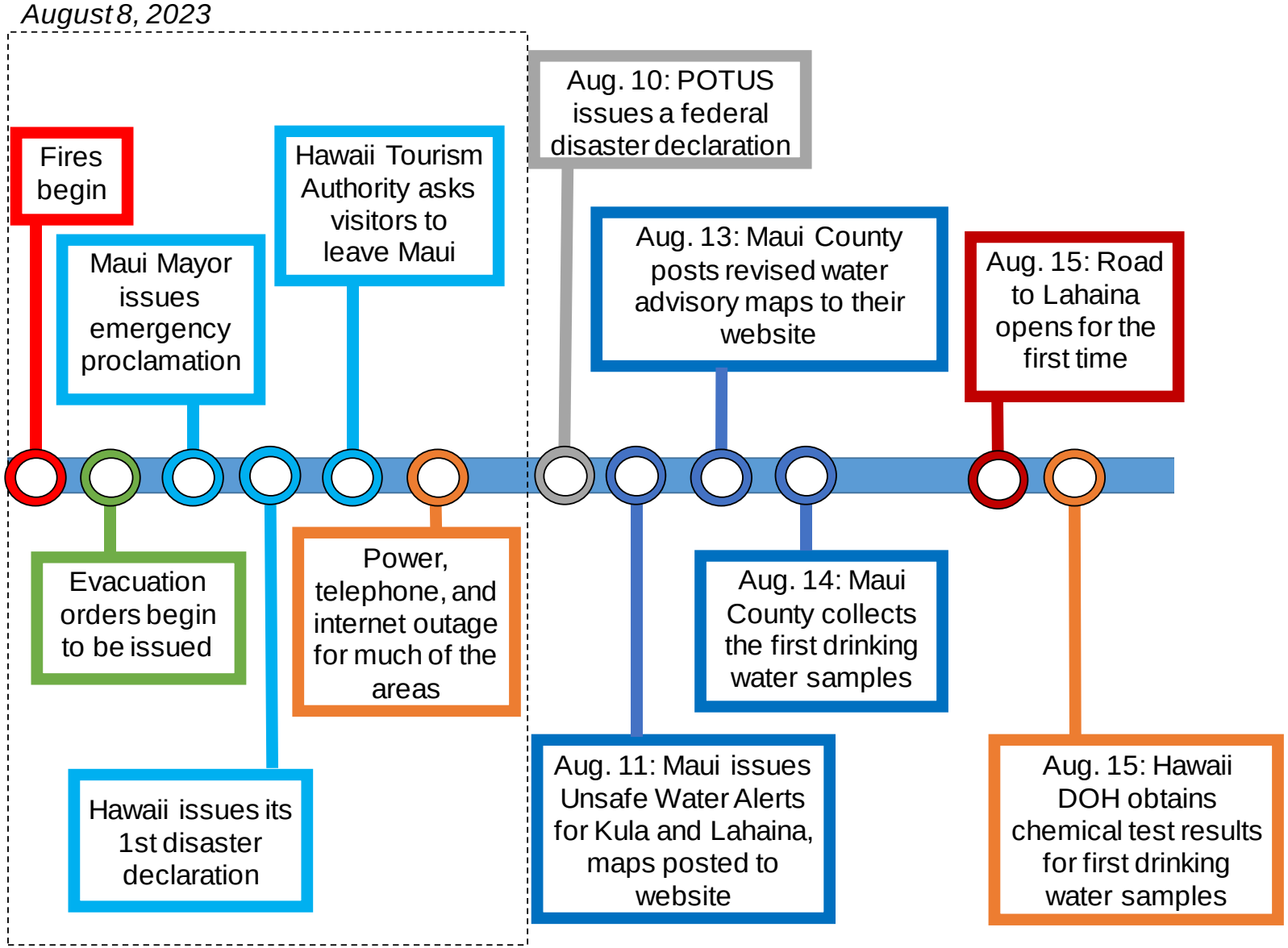

PURDUE
P


Lāhainā Sys. Pop. 20,065
Elev. 1 ft.
28% White alone
Median income: $80,035
Median-value home: $0.72M
Seat of Hawaiian Kingdom
2,207 structures destroyed

County Seat

Kula Sys. Pop. 7,686
Elev. 1,000-3,600 ft.
54% White alone
Median income: $86,938
Median-value home: $1.1M
20 structures destroyed
544 structures exposed

>58% lost their jobs post-fire and racial and ethnic minorities in the communities also experienced significant hardship – UHERO 2024



Damages
+$5.52 billion in Lāhainā,
+$434 million in Kula

20,000+ people evacuated
40,000+ flew out of Maui within days

Like prior U.S. wildfires, public drinking water systems, homes, and businesses were damaged

Upper Kula, 7,686 customers

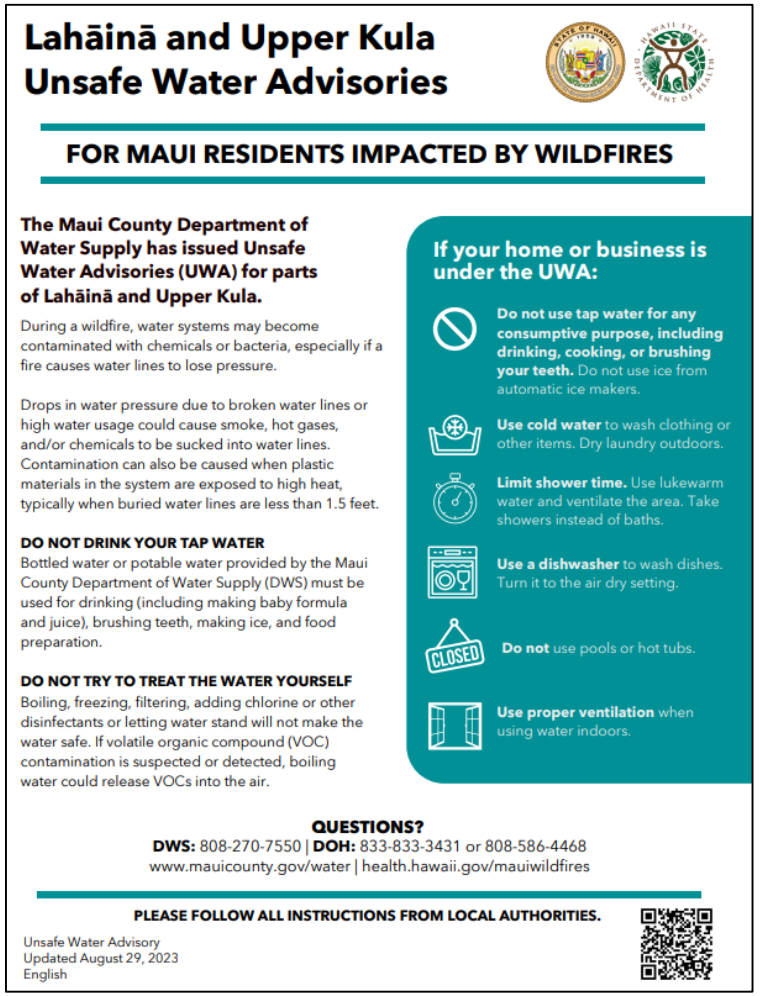
Lāhainā, 20,065 customers

Power loss, destroyed structures, water leaks, pressure loss

“Unsafe Water Advisories” issued due to chemical exposure concerns

Fires threatened the safety of several utility employees and their families, along with damaging or destroying their homes.

Parts of Maui were isolate from emergency response and without communications for days



Lahāinā and Upper Kula Unsafe Water Advisories

FOR MAUI RESIDENTS IMPACTED BY WILDFIRES

The Maui County Department of Water Supply has issued Unsafe Water Advisories (UWA) for parts of Lahāinā and Upper Kula.

During a wildfire, water systems may become contaminated with chemicals or bacteria, especially if a fire causes water lines to lose pressure.

Drops in water pressure due to broken water lines or high water usage could cause smoke, hot gases, and/or chemicals to be sucked into water lines. Contamination can also be caused when plastic materials in the system are exposed to high heat, typically when buried water lines are less than 1.5 feet.

DO NOT DRINK YOUR TAP WATER

Bottled water or potable water provided by the Maui County Department of Water Supply (DWS) must be used for drinking (including making baby formula and juice), brushing teeth, making ice, and food preparation.

DO NOT TRY TO TREAT THE WATER YOURSELF

Boiling, freezing, filtering, adding chlorine or other disinfectants or letting water stand will not make the water safe. If volatile organic compound (VOC) contamination is suspected or detected, boiling water could release VOCs into the air.

If your home or business is under the UWA:

- **Do not use tap water for any consumptive purpose, including drinking, cooking, or brushing your teeth.** Do not use ice from automatic ice makers.
- **Use cold water** to wash clothing or other items. Dry laundry outdoors.
- **Limit shower time.** Use lukewarm water and ventilate the area. Take showers instead of baths.
- **Use a dishwasher** to wash dishes. Turn it to the air dry setting.
- **Do not** use pools or hot tubs.
- **Use proper ventilation** when using water indoors.

QUESTIONS?

DWS: 808-270-7550 | **DOH:** 833-833-3431 or 808-586-4468

www.mauicounty.gov/water | health.hawaii.gov/mauiwildfires

PLEASE FOLLOW ALL INSTRUCTIONS FROM LOCAL AUTHORITIES.

Unsafe Water Advisory
Updated August 29, 2023
English

Our study: To better understand wildfire affect community experiences and needs with respect to drinking water.

Objectives

(1) 30 minute household interviews in neighborhoods affected by the Lāhainā Fire, Kula Fire, and Olinda Fire,

(2) Conduct site inspections at the households,

(3) Inspect 2 agricultural properties visited located in the burn areas that were served by their own private water sources.

(4) After field work, drinking water chemical testing results for the Upper Kula and Lāhainā public water systems by Maui County and UH were reviewed.

While working with local community members, we encountered multiple challenges due to the significance of the disaster and lack of awareness to the incident outside Hawaii

(1) At the time, no funding. Mainland orgs did not understand scope of damage and community need.

(2) Many households were still physically displaced two weeks after the incident

(3) Some spot fires were still burning aboveground and belowground where evacuation orders had been lifted,

(4) Law enforcement still had some fire impacted areas isolated, which inhibited some data gathering





1. Conduct free in-home drinking water testing for Lahaina, Kula, and Olinda households and survey needs

University of Hawai'i Mānoa

Purdue University

2. Advise Maui County Utilities on how to respond to and recover their damaged water systems

Purdue University

City of Louisville Colorado • Since 1878

ACWA JPIA

PID Serving since 1916

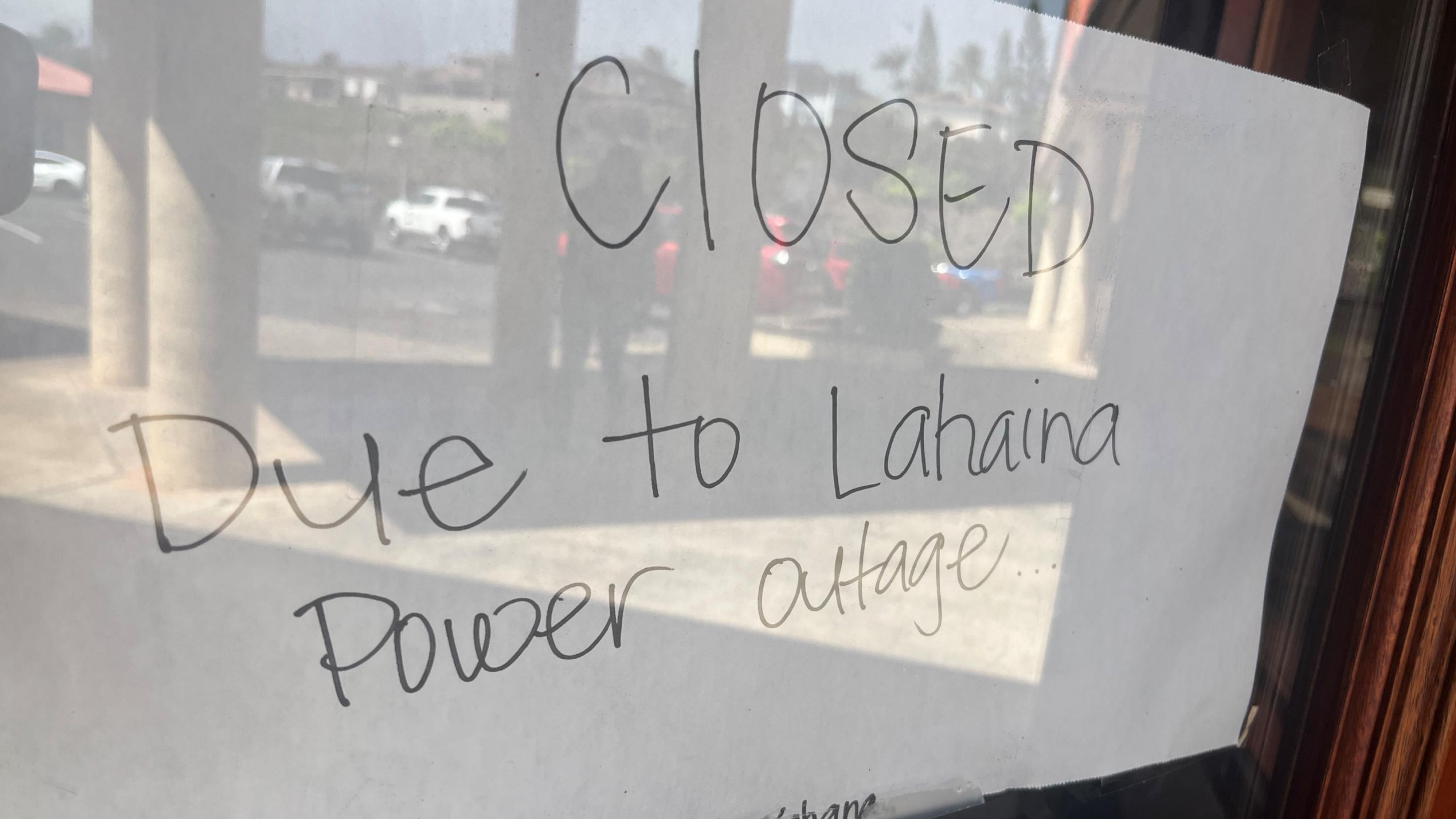
City of Santa Rosa

3. Assist the State of Hawai'i Veterinarian investigate damage and contamination of ranch water systems

Purdue University

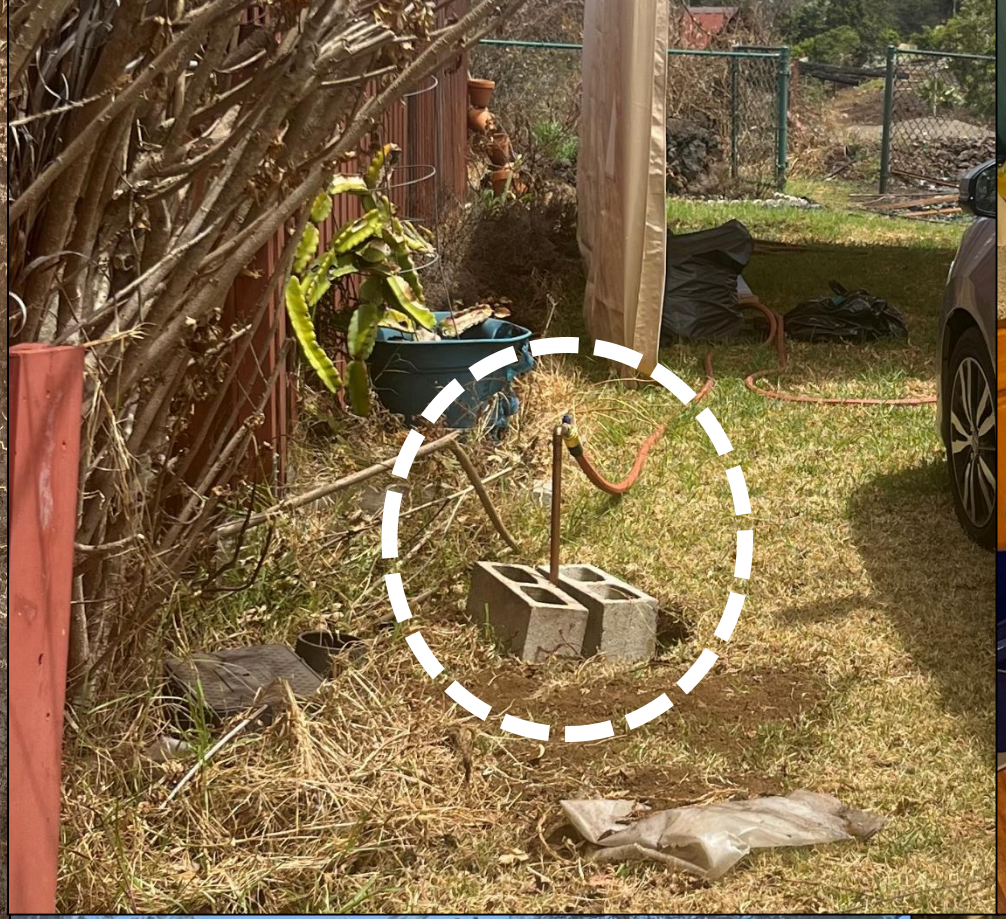
University of Hawai'i Mānoa

City of Louisville Colorado • Since 1878


CLOSED
Due to Lahaina
Power outage...


DO NOT DRINK
AND/OR BOIL
WATER UNTIL
FURTHER
NOTICE


414




U-HAUL

Results: Rapid Household Interviews 2 Weeks after the Wildfires to Ascertain Drinking Water Experiences and Needs

14 households, All in the Unsafe Water Alert zones

- ✓ Water systems: 2 Lahaina, 11 Kula, 1 cistern in Kula
- ✓ Property: 10 owned, 4 rent; All had insurance
- ✓ Average household lived in home for 12 years
- ✓ Average respondent age (51), min (26), max (75)

Findings

- 5 homes were less than 500 ft from a destroyed home; 7 had property damage
- 13 households used water before finding out it was potentially contaminated
- 10 households reported a drinking water taste, odor, color, or clarity problem
- 4 households visited water buffalos - 7 did not because of source/safety concern
- 42 questions - Households wanted officials to answer specific questions
- Cistern owner followed Unsafe Water Alert, no post-fire cistern safety advice
- And more…

2 Weeks After the Fire: The Most Important Questions per the Households

1. What is the benzene level now compared to after the fire?
2. What are the chemicals evident in the (drinking) water?
3. Will all homeowners need to filter their home?
4. What chemicals are in the (drinking) water?
5. Is the (drinking) water safe for family to bathe in? I just want it to be safe.
6. Can you (Maui County) send a regular water quality report (monthly) to be transparent?
7. Why does (drinking) water have a problem?
10. What chemicals are being found in the (drinking) water and what quantities?
11. Where is the water meter?
12. What is in the (drinking) water?
13. Is the (drinking) water at a safe level to drink and bathe in?
14. Is the (drinking) water unsafe?
15. What's the range of scope of (drinking water) testing?
16. Is the (drinking) water coming from the street potable, safe to use?
17. Can you explain what caused the (drinking) water problem in layman's terms?


UNITED STATES
POST OFFICE
LAHAINA, HAWAII
96761
RESERVED PARKING
VAN


POTABLE WATER
500 GALLONS


FREE
FOOD + WATER
Food
+
Drink
Kula
Strong

As of December 2023, drinking water had been found to be contaminated in both Lahaina and Upper Kula public drinking water systems

Most common chemicals	Lāhainā PWS	Upper Kula PWS
Benzene	40 (exceeded MCL)	3.8
Dichloromethane	3	3.8
Ethyl benzene	2.5	Not most common
Total xylenes	2.4	Not most common
Bis(2-ethylhexyl) phthalate	1.4	Not most common
Styrene	Not most common	1.8
Toluene	Not most common	1.6

During the initial response, Maui County and Hawai'i DOH screened for 21 VOCs (some fire-related), not the 51 fire-related VOCs. After we got involved and learned best practice, they adjusted their approach.

University of Hawai'i private property drinking water results were more expansive and indicated more MCLs were sometimes exceeded

Chemicals exceeded a drinking water exposure limit for at least 1 sample, maximum concentration in ppb	
Trichloromethane* (MCL 80 ppb TTHMs)	195
1,2,3-Trichloropropane (MCL 0.6 ppb)	11.2
1,2-Dibromoethane (MCL 0.04 ppb)	10.3
Carbon tetrachloride* (MCL 5 ppb)	10.0
1,2-Dichloropropane* (MCL 5 ppb)	10.0
Vinyl chloride* (MCL 2 ppb)	9.80
Methylene chloride* (MCL 5 ppb)	9.72
1,1-Dichloroethane* (MCL 5 ppb)	9.73
1,2-Dibromo-3-chloropropane (MCL 0.04 ppb)	9.62
1,2-Dichloroethane* (MCL 5 ppb)	9.50
Benzene* (MCL 5 ppb)	8.56

Percentage of water samples where a chemical was detected greater than 50% of the time, maximum concentration in ppb		
Acetone*	84%	178
Trichloromethane*	80%	195
Bromodichloromethane*	71%	19.3
Dibromochloromethane*	68%	23.0
Bromoform*	68%	33.9
1,2-Dichlorobenzene*	67%	10
Methylene chloride*	63%	9.72
Bromomethane	57%	10.4
1,3-Dichlorobenzene	56%	9.79
Iodomethane*	56%	8.50
Toluene*	56%	7.99
1,2,4-Trichlorobenzene*	55%	8.73
m-/p-Xylene*	54%	9.30

The top 5 chemicals detected at the highest concentrations found, in ppb	
Methyl ethyl ketone (MEK)*	293
Tetrahydrofuran*	217
Trichloromethane*	195
Acetone*	178
Bromoform*	33.9
Other notable chemicals detected for at least 1 sample, maximum concentration in ppb	
Bromoform* (MCL 80 ppb TTHMs)	33.9
Dibromochloromethane* (MCL 100 ppb)	23.0
cis-1,2-Dichloroethene* (MCL 70 ppb)	18.0
Bromomethane (MCL 80 ppb TTHMs)	10.4
1,1,2,2-Tetrachloroethane (HA 2,500 ppb)	10.3
1,1,2-Trichloroethane* (MCL 200 ppb)	9.48
trans-1,3-Dichloropropene (1,3-D) (RSL, 60 ppb)	9.39

Data as of December 2023

Asterix (*) indicates the chemical was found in wildfire damaged drinking water systems outside Hawai'i prior to the 2023 wildfires in Maui.

Some households sought out their own water test kits, but….

VOC	Chemical Screened for by the Organization		Home Test Kit Name, Cost, and Minimum Detection Limit for Chemical in ppb		
	State of Hawai'ii	University of Hawai'i	Safe Home ULTIMATE Drinking Water Test Kit, $379	City Check Deluxe, $329	Extended City Water Test, $675
[X]Acetone		**Yes**	**50**	**10**	
[X,*,Δ]Benzene	**Yes**	**Yes**	**1**		**1**
Bromochloromethane		Yes	1		0.5
Bromodichloromethane		Yes	1	2	1
Bromoform		Yes	1	4	1
n-Butylbenzene		Yes			0.5
sec-Butylbenzene		Yes			0.5
tert-Butylbenzene		Yes			0.5
Carbon disulfide		Yes	5		
*Carbon tetrachloride	Yes	Yes	1	1	0.5
*Chlorobenzene	Yes	Yes	1	1	0.5
Chloromethane		Yes	1	2	0.5
4-Chlorotoluene		Yes		1	0.5
Dibromochloromethane		Yes	1	4	0.5
*1,2-Dichlorobenzene	Yes	Yes		1	
*1,4-Dichlorobenzene	Yes	Yes		1	0.5
1,1-Dichloroethane	Yes		1		0.5
*1,2-Dichloroethane	Yes	Yes	1	1	0.5
1,1-Dichloroethene	Yes	Yes			0.5
1,2-Dichloroethylene		Yes	Not Screened By Any Kit		
*1,2-Dichloropropane	Yes	Yes	1	2	0.5
[X]Ethanol					
[X,]*Ethylbenzene	Yes	Yes	1	1	0.5


STATE OF HAWAII
DEPARTMENT
OF
AGRICULTURE

Recommendations from the Maui Wildfire Investigation

1. **State agencies**, under extreme incidents that debilitate water utilities, should take the lead on issuing initial drinking water use warnings.
2. **State agencies** and water utilities should prepare answers to FAQs about drinking water safety after wildfires. Distribute info on website, at public meetings, emergency supply distribution centers, and community organization events.
3. County and **state agencies** should notify households that current commercial drinking water testing kits do not screen for all fire-related chemicals.
4. **State agencies** and water utilities should post the list of fire-related chemicals they are testing for as well as the methods.
5. **State agencies** and water utilities should consider weekly community updates about drinking water safety and recovery actions, test results, and the expected next steps of the water system's recovery.
6. **State agencies** should notify laboratories about exactly which fire-related chemicals should be considered, should they be contacted by households and businesses for post-fire assistance.
7. **State agencies** should develop and issue post-wildfire inspection and testing guidance for private drinking water cistern systems.
8. Researchers should conduct post-fire case studies of agricultural water systems and cisterns.
9. Researchers and water utilities should conduct water system contamination prevention studies.
10. **State agencies** should prepare and issue post-wildfire guidance for ranches, farms, and other agricultural enterprises that have water systems threatened or damaged by fire.

Water Systems Face Multiple Challenges During Response

Pressure, utility network and building plumbing: Leaking, destruction

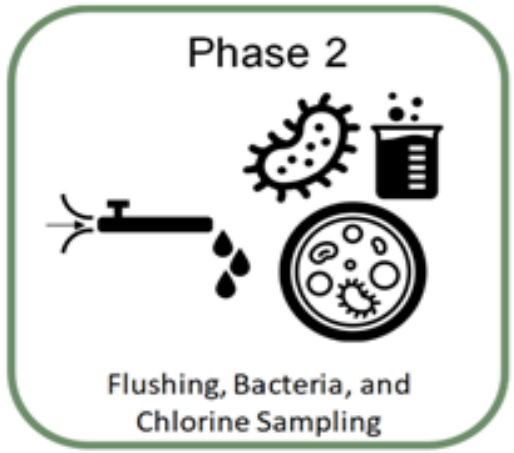
Power: Electric poles down, shutoff by provider, natural gas generators destroyed, lacking fuel

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

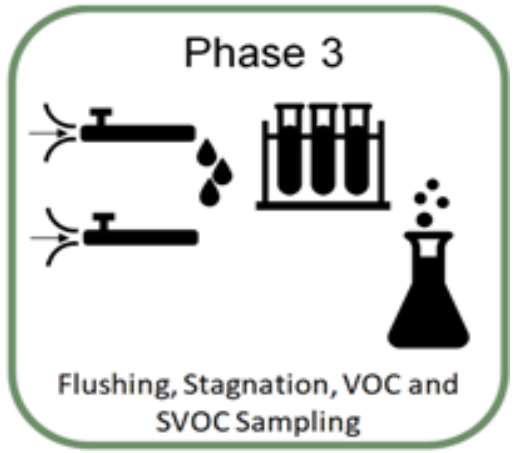
Personnel: Hazard situations, unable to respond due to staff availability

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

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

CONOPS Plan

Concept of operations plan for water systems and communities

Coming 2024

There are no doubt more systems that have been contaminated by wildfires.

Benzene is important, BUT not the sole indicator of contamination.

Unique sampling procedures have to be used to find contamination.

Maximum Benzene Conc, ppb	Event / Location	Population	System	Year
40	Lahaina Fire/ Hawaii	20,036	Maui County - Lahaina	2023
3.8	Kula Fire / Hawaii	7,686	Maui County - Lahaina	2023
5.1	Marshall Fire/ Colorado	500	East Boulder County Water District	2021
220	Marshall Fire/ Colorado	20,319	City of Louisville	2021
VC = 8	Beachie Creek Fire / Oregon	500	City of Gates	2020
MEK = 3,000	Echo Mountain Fire/ Oregon	1,300	Lyons Mehama Water District	2020
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

As of today..

Is ***benzene*** THE indicator of contamination?

--No

Is ***BTEX*** THE indicator of contamination?

--No

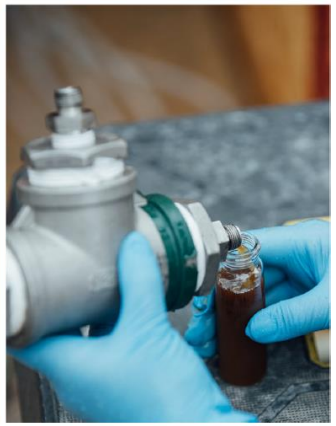
Is ***VOC*** THE indicator of SVOC contamination?

--No

Oregon 2021: MEK (138 ppm) exceeded the USEPA 1-day health advisory in the absence of benzene

No shortcuts to chemical contamination decisions

Pilot Study on Fire Effluent Condensate from Full Scale Residential Fires



Exp. #	Room 1		Room 2		
	1	2	3	4	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		Room 2		
	1	2	3	4	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*

(It wasn't just BTEX and they looked for a limited list of chemicals)

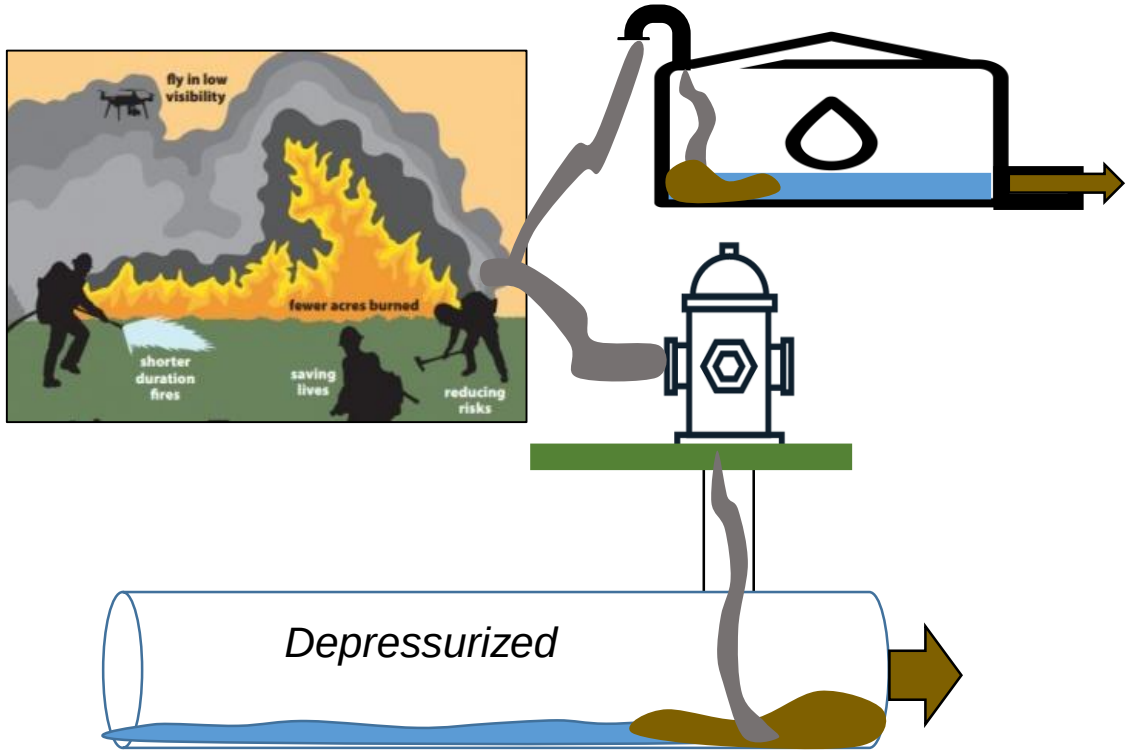
Horn et al. (2023) FSI https://doi.org/10.1007/s10694-023-01487-4

"Fire package" list of chemicals to screen – BOLD and RED exceeded health limit (list as of March 2024)

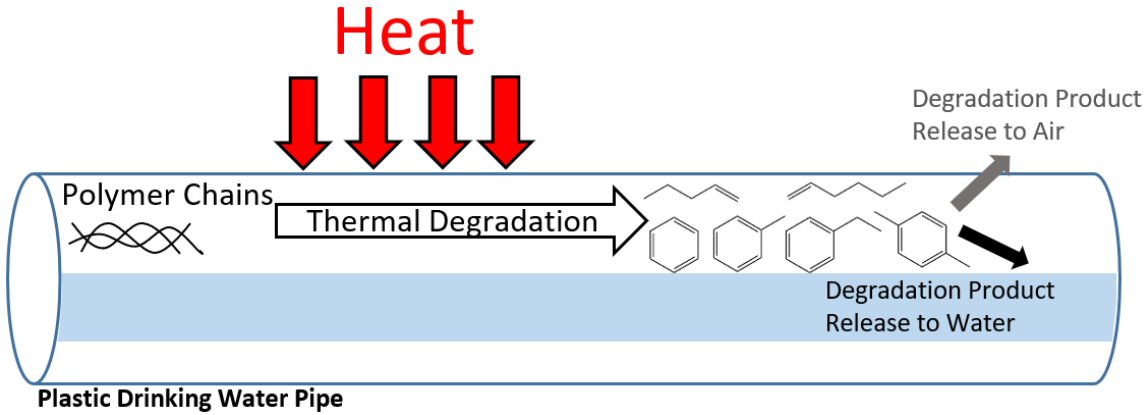
Acetonitrile	Chlorodibromomethane	Ethyl benzene	¥**Toluene****
¥Acetone	Chloromethane	**Ethylene dibromide (EDB) ****	1,2,3-Trichlorobenzene
Acrolein	4-Chlorotoluene	Ethyl-*tert*-butyl ether (ETBE)	1,2,4-Trichlorobenzene
Acrylonitrile	Dibromochloromethane	Iodomethane	1,1,1-Trichloroethane
¥**Benzene ****	**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

Potential PRIMARY Sources

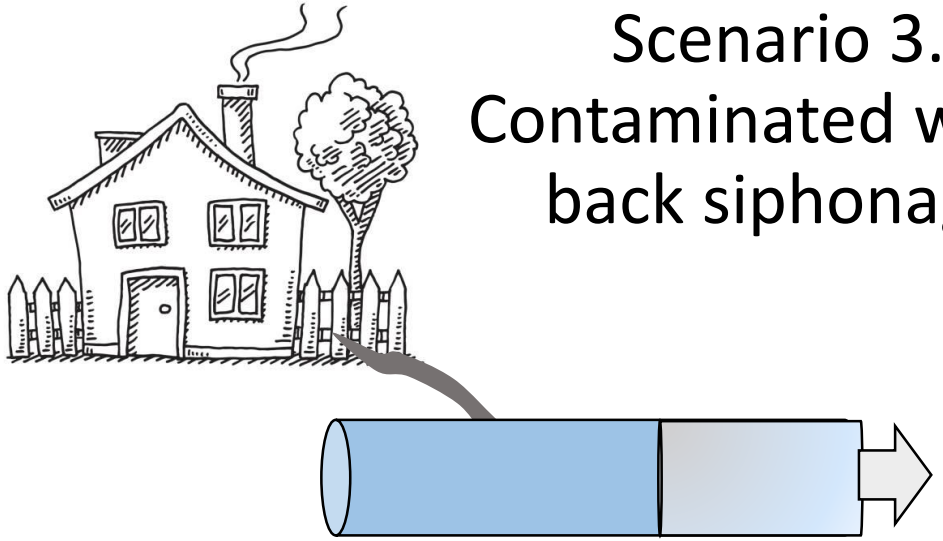
Scenario 1. Forest biomass or structure combustion



Scenario 2. Plastic thermal degradation



Scenario 3. Contaminated water back siphonage



Secondary Sources: Infrastructure desorption

Final Wildfire Mitigation and Management Report to Congress: Chapter 2. Safeguarding Community Water Supplies

37. Expedite funding to water utilities in both immediate and long-term wildland fire recovery to maintain water delivery to consumers.

38. Authorize and incentivize flood mitigation, water quality, and source water protection projects in existing wildfire mitigation and wildfire recovery programs to protect community water supplies

39. Increase funding and technical assistance to state, local, Tribal and territorial public health agencies and water provider partners to increase local capacity for wildfire preparedness and resilience planning

40. Equip state, local, Tribal and territorial public health agencies and water provider partners to provide resources and support to residents to ensure access to safe drinking water after wildfire

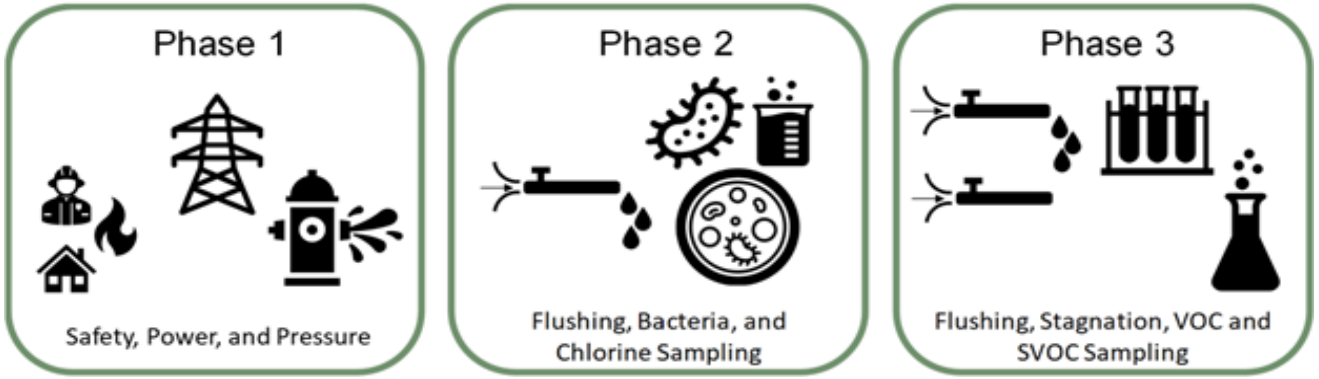
41. Support identification of public health risks associated with exposure to wildfire-contaminated water and development of evidence-based water use recommendations

Concept of Operations Plan (CONOPS) for Water Distribution Response and Recovery

[Coming 2024]

Water Research Foundation Project 5106: Post-Wildfire Distribution System Water Quality Impacts and Potential Responses

[DONE]

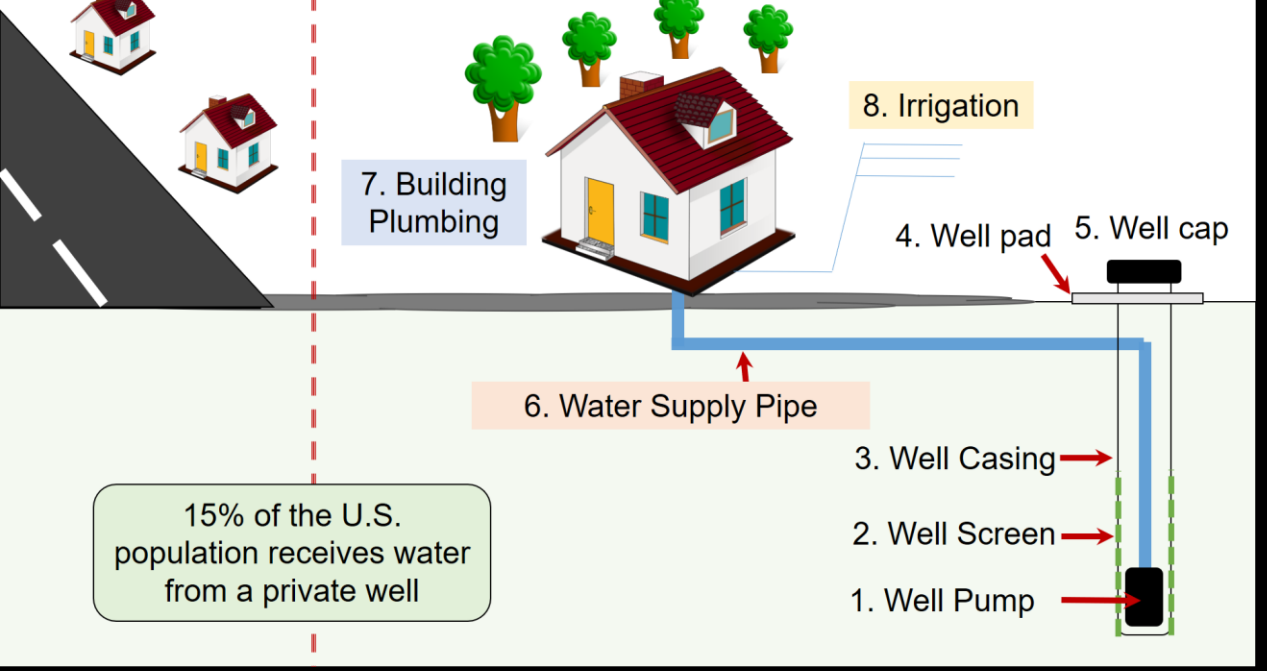


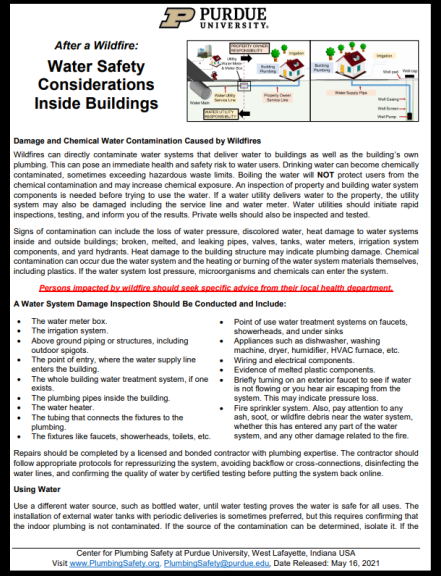
1. Roles and responsibilities (PWS, State, Fed, Customers)
2. Water contamination health threats by fire
3. Post-incident progression, phases 1-3
4. Immediate decisions (exposures; water use warning)
5. Emergency drinking water sources
6. Asset and private property damage assessment (risk)
7. Contaminant comparison health-based exposure limits
8. Post-incident chemical lists and laboratories
9. Post-incident water sampling (closed/open areas, priority customers, interpretation, action, mapping)
10. Communication considerations

1. ***Lessen the chance*** water production and pressure loss occurs
   - Establish emergency interconnections with neighboring utilities
   - Backup emergency power (and diesel fuel) for production capacity and pumps
   - Zone the water distribution system
   - Shutoff services for destroyed structures
2. ***Prevent the entry*** of contamination
   - Backflow prevention devices on all service lines
   - Automatic water meter shutoff capability
   - Water meter backflow detection
   - Zone the water distribution system
   - Shutoff services for destroyed structures
3. ***Lessen the chance*** thermal damage occurs
   - Bury assets > 1.5 m
   - 10 ft buried asset (i.e., meter boxes) setback distances from structures (wood) and vegetation
   - Use concrete meter boxes with concrete covers
   - Use metal water meters
   - Use metal pipe and metal fittings

What can we do now

to design and operate systems to better protect infrastructure and people from contaminated water?





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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 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 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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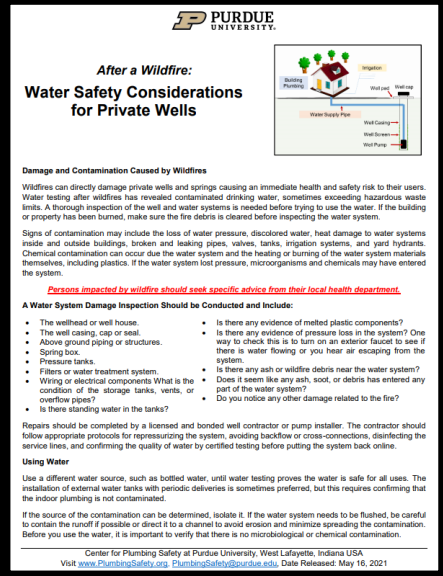

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After a Wildfire:

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 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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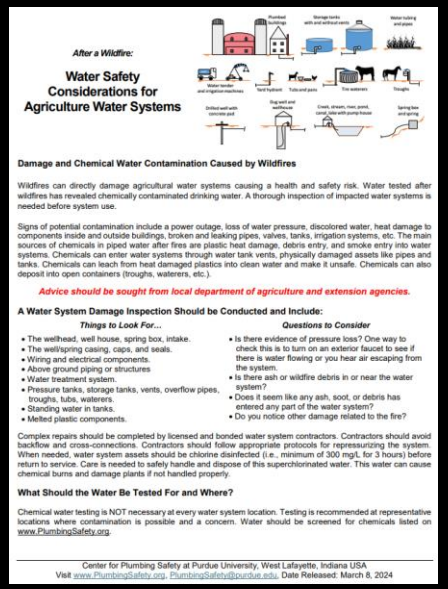

After a Wildfire:

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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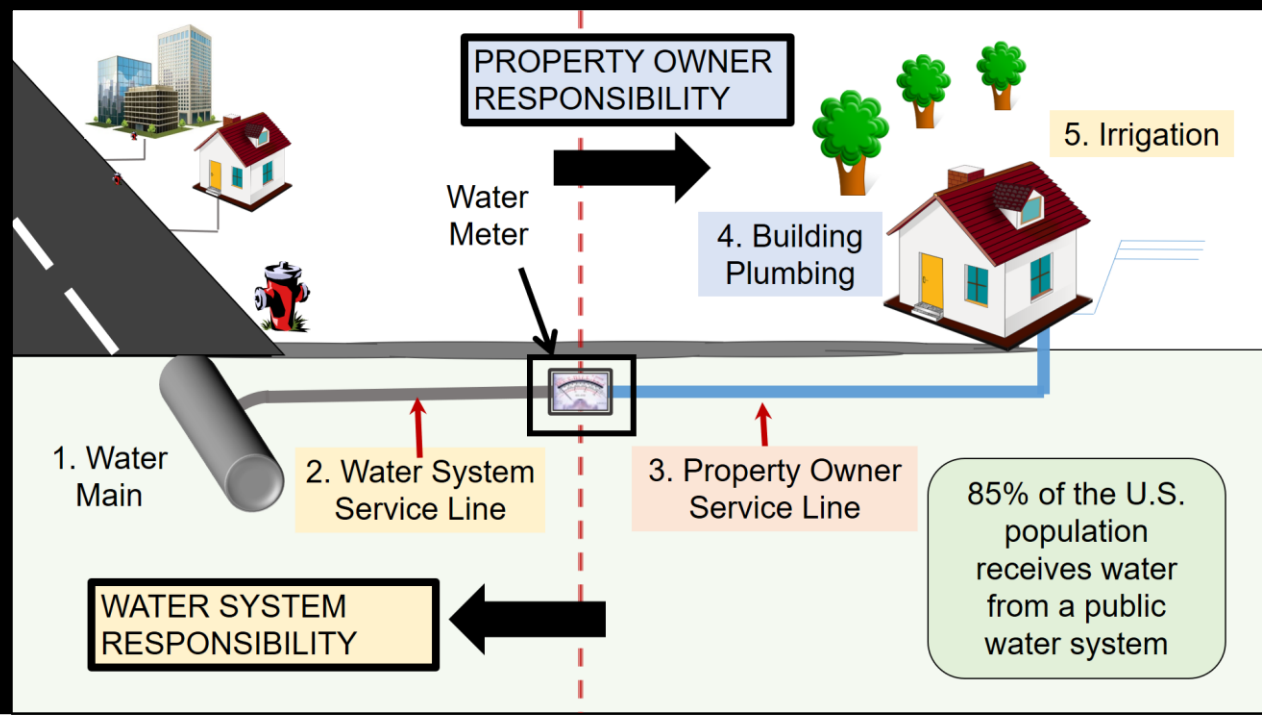

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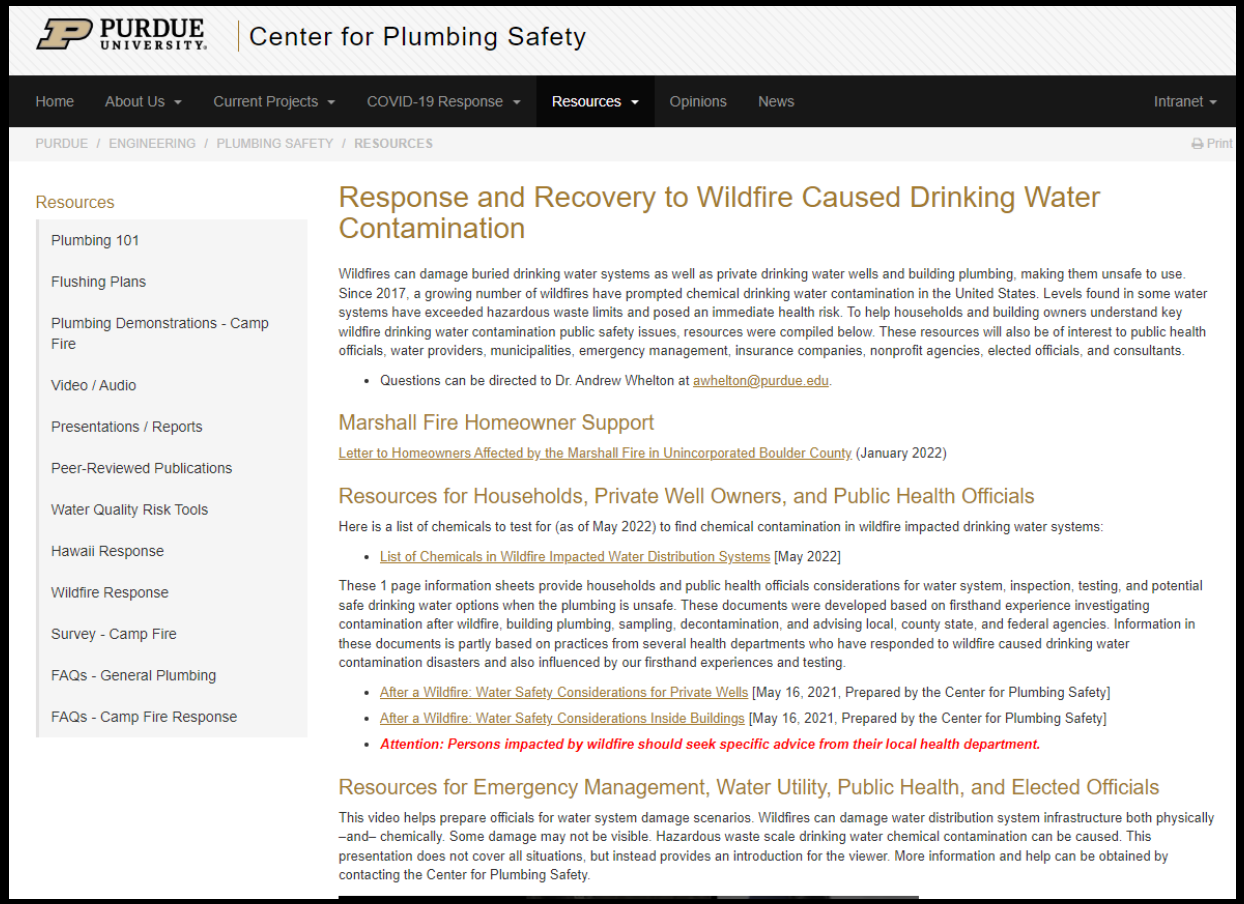
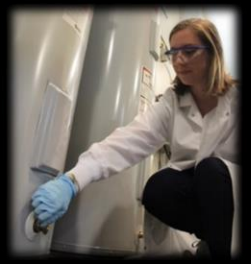
Andrew Whelton, Ph.D.
awhelton@purdue.edu

AWWA Annual Conference & Expo, Anaheim, CA
June 12, 2024, 1:30-4:30pm PST

www.PlumbingSafety.org
www.CIPPSafety.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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