



Does regulating PFAS represent a meaningful opportunity for health risk reduction in drinking water?

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Washington, D.C.

Safe Drinking Water Act

“meaningful opportunity for
health risk reduction”



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EMERGING CONTAMINANT ARTICLE

TOPICAL COLLECTION ON PFAS ANALYTICS AND TREATMENT



Does regulating per- and polyfluoroalkyl substances represent a meaningful opportunity for health risk reduction?

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Abstract

US Environmental Protection Agency's drinking water contaminant regulations must meet a qualitative "meaningful opportunity" threshold in health risk reduction. Using our Relative Health Indicator (RHI) metric, we quantify the ranges of potential health risk reductions that could be achieved from state and federal per- and polyfluoroalkyl substances regulatory levels (proposed or finalized) and compare them with previous regulatory determinations of other contaminants to create a quantifiable, comparable scale of "meaningful opportunity" justifications. If perfluorooctanoic acid (PFOA) and perfluorooctyl sulfonate (PFOS) were present in 100% of water systems, contaminant concentrations of 227 ng/L PFOS and 2295 ng/L PFOA would be needed to exceed the minimum threshold of percent population*RHI (PopRHI) to justify "meaningful opportunity," based on the current regulatory levels of uranium; these concentrations exceed any levels being proposed. Using this comparison

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US Environmental Protection Agency's drinking water contaminant regulations must meet a qualitative "meaningful opportunity" threshold in health risk reduction. Using our Relative Health Indicator (RHI) metric, we quantify the ranges of potential health risk reductions that could be achieved from state and federal per- and polyfluoroalkyl substances regulatory levels (proposed or finalized) and compare them with previous regulatory determinations of other contaminants to create a quantifiable, comparable scale of "meaningful opportunity" justifications. If perfluorooctanoic acid (PFOA) and perfluorooctyl sulfonate (PFOS) were present in 100% of water systems, contaminant concentrations of 227 ng/L PFOS and 2295 ng/L PFOA would be needed to exceed the minimum threshold of percent population*RHI (PopRHI) to justify "meaningful opportunity," based on the current regulatory levels of uranium; these concentrations exceed any levels being proposed. Using this comparison metric, our results demonstrate that the regulatory levels for PFOA and PFOS alone will not achieve a national meaningful health risk reduction as compared with previously regulated contaminants.

Addressing risks that matter most

1. What's the concern?
 2. What's there?
 3. What can be done about it?
- 
- A decorative wavy line in shades of blue and grey curves along the bottom of the slide.

What's the concern?



Unknown,
unregulated risk

Unidentified DBPs,
chemicals, microbes, PFAS

Known,
unregulated risk

PFAS, chlorate, CCL contaminants,
nitrosamines, unregulated DBPs

Known,
regulated risk

Arsenic, Nitrate, TTHMs, etc.
Cryptosporidium, Giardia, etc.

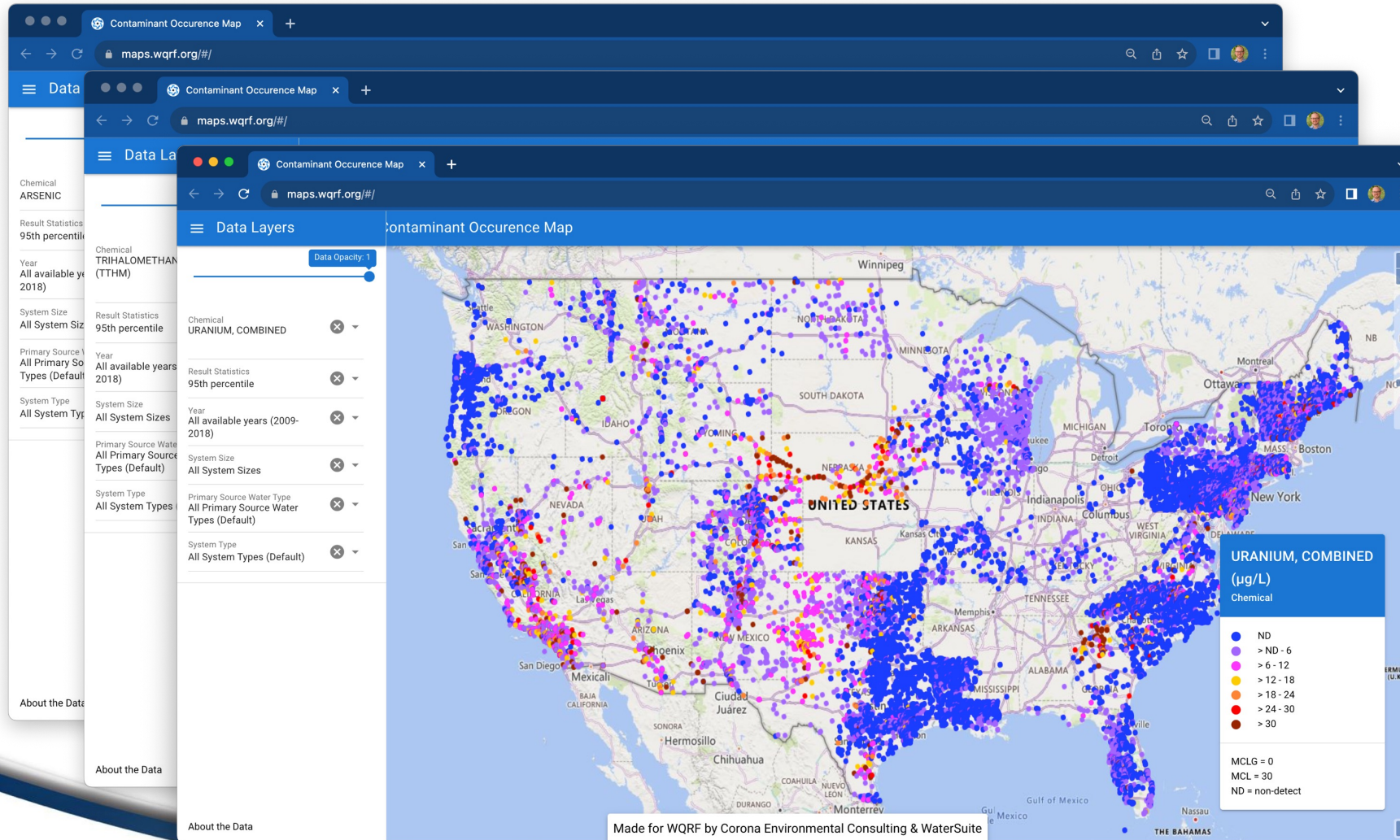
What's there?

95th Percentile Values
by PWSID

Arsenic ($\mu\text{g/L}$)

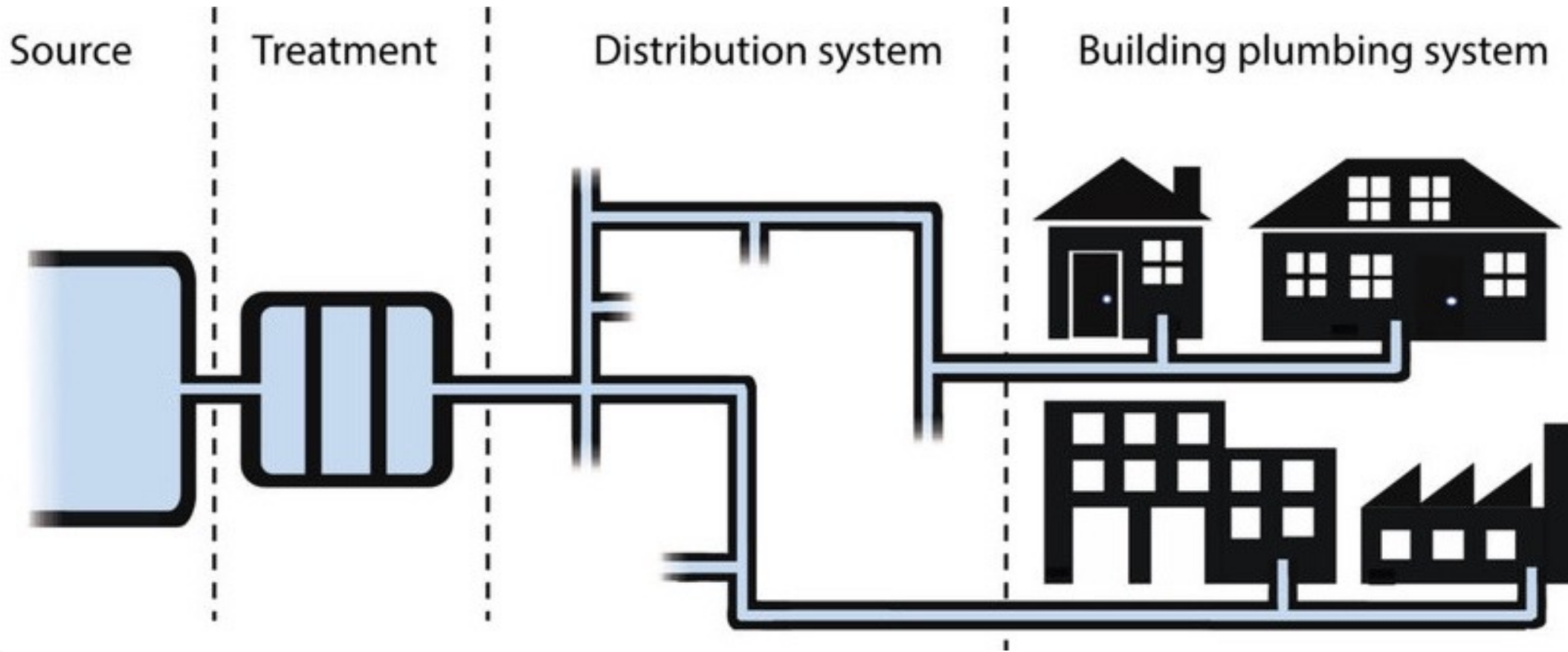
TTHM ($\mu\text{g/L}$)

Uranium ($\mu\text{g/L}$)



WQRF Contaminant Occurrence Map prepared by Corona: <https://www.wqrf.org/map.html>

What can be done about it?



Feeding the Building Plumbing Microbiome: The Importance of Synthetic Polymeric Materials for Biofilm Formation and Management - Scientific Figure on ResearchGate.

Available from: https://www.researchgate.net/figure/Drinking-water-from-source-to-tap-highlighting-key-differences-between-the-main_fig1_342435101

Relative Health Indicator (RHI)

- Cumulative Risk Assessment Methodology
- Risk metric is a **Relative Health Indicator (*RHI*)**
 - **Non-cancer RHI** = Non-cancer Toxicity X Non-cancer Severity X Exposure
 - **Cancer RHI** = Cancer Slope Factor X Non-cancer Severity X Exposure
 - **Microbial RHI** = TCR risks + (Source water + Treatment risks)
+ Distribution system risks
 - Seidel et al., *Identifying Meaningful Opportunities for Drinking Water Health Risk Reduction in the United States*, WRF 4310, 2014
 - Alfredo et al., *Using a relative health indicator (RHI) metric to estimate health risk reductions in drinking water*, *Environ Monit Assess*, (2017) 189:124

Building Blocks for RHI Calculations

- Non-cancer RHI = Non-cancer Toxicity X Non-cancer Severity X Exposure
- Non-cancer Toxicity = $(0.01 \times 2 \text{ (L/d)}) / (70 \text{ (kg)} \times \text{Reference Dose (RfD)} \times \text{Uncertainty factor(UFc)})$
 - Non-cancer RfDs from USEPA IRIS database
 - When not available in IRIS database, surrogate values developed
 - Uncertainty factors modified from IRIS database

Building Blocks for RHI Calculations

- Cancer RHI = Cancer Slope Factor X Cancer Severity X Exposure
 - Cancer Slope Factor from USEPA IRIS database
 - All forms of cancer assumed to be equally severe, and assigned the same severity score

So, is PFAS meaningful? (2021 paper)

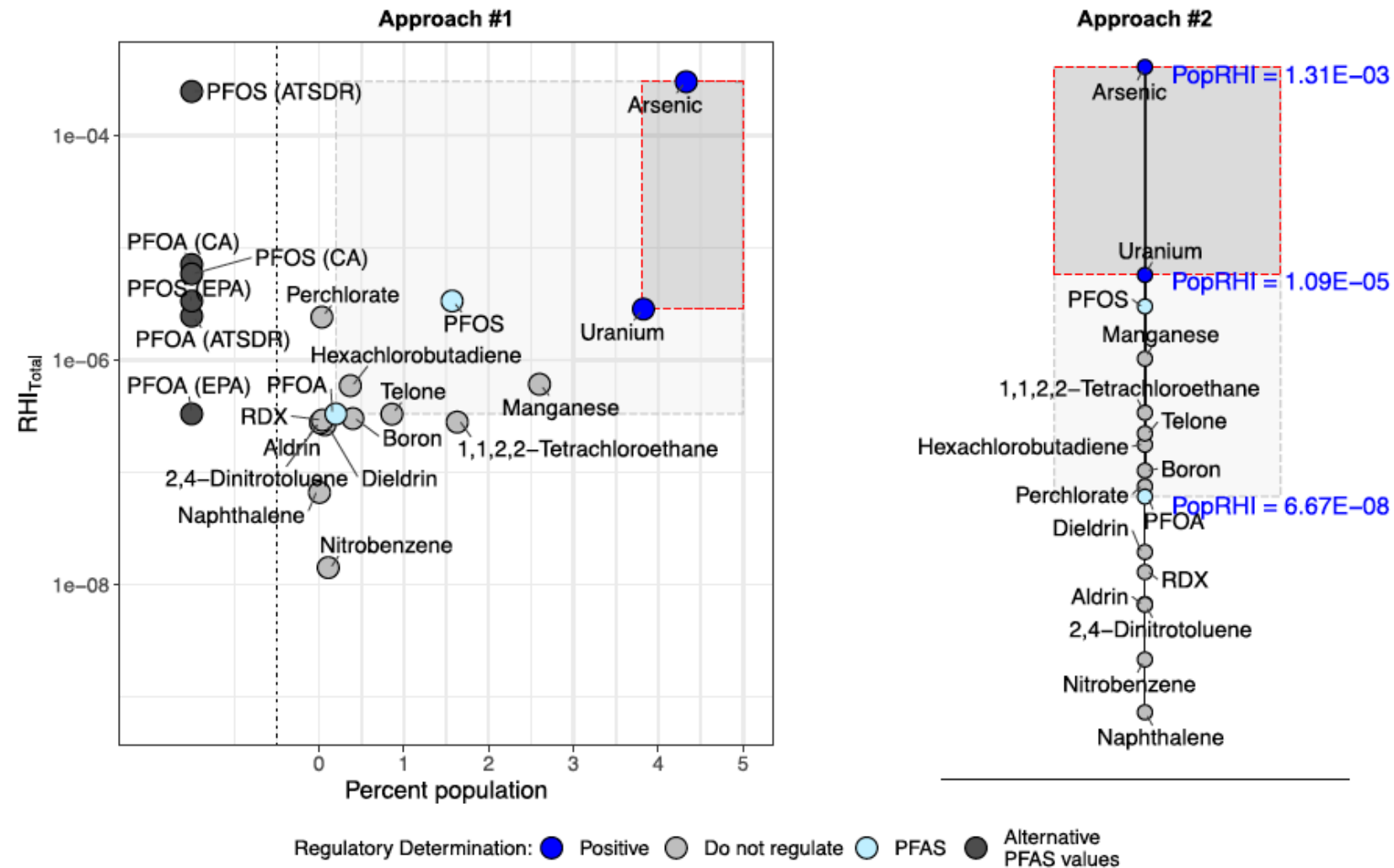


FIGURE 2 Approach #1: creating a zone of meaningful health risk reduction using RHI_{Total} (dimensionless) and occurrence (percent of the population exposed) as separate parameters. The left side of the graph (left of the dotted line, without an x-axis label) shows the alternate PFAS RHI values representing the varying proposed regulatory limits for PFOA and PFOS and the corresponding RHI_{Total} concentrations. Approach #2: calculating a threshold PopRHI value by multiplying health impact and occurrence (percent population exposed * RHI). Both models include all contaminants with sufficient data that have regulatory determinations. The PFOS and PFOA RHI calculations based on the concentrations currently set by EPA (70 ng/L each) are included as pending to assist in determining corresponding regulatory zones. EPA, Environmental Protection Agency; PFOA, perfluorooctanoic acid; PFOS, perfluorooctyl sulfonate; RHI, Relative Health Indicator

What's changed since the 2021 paper?

- Toxicity estimates / Health reference levels
- Evolving occurrence understanding

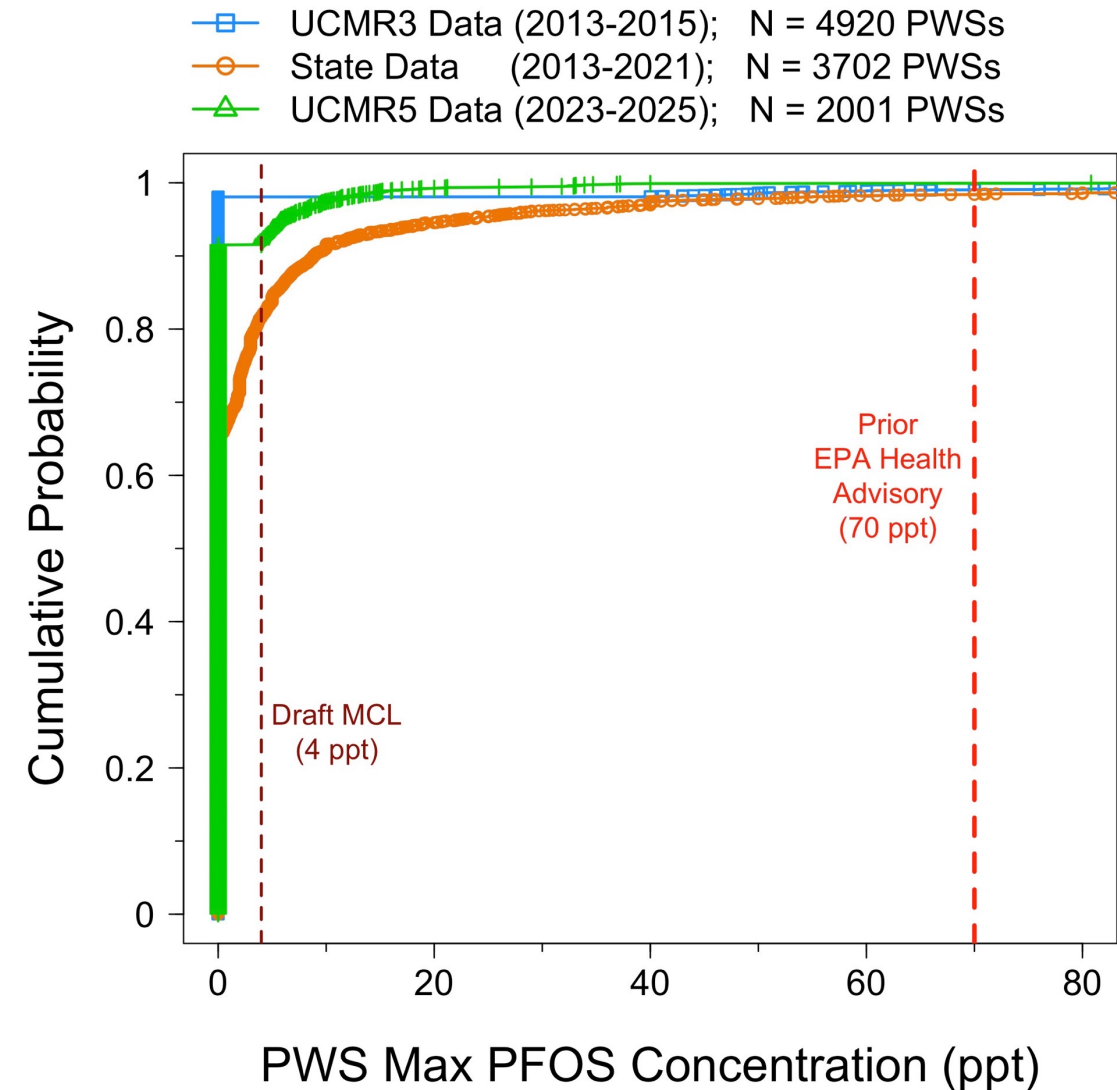
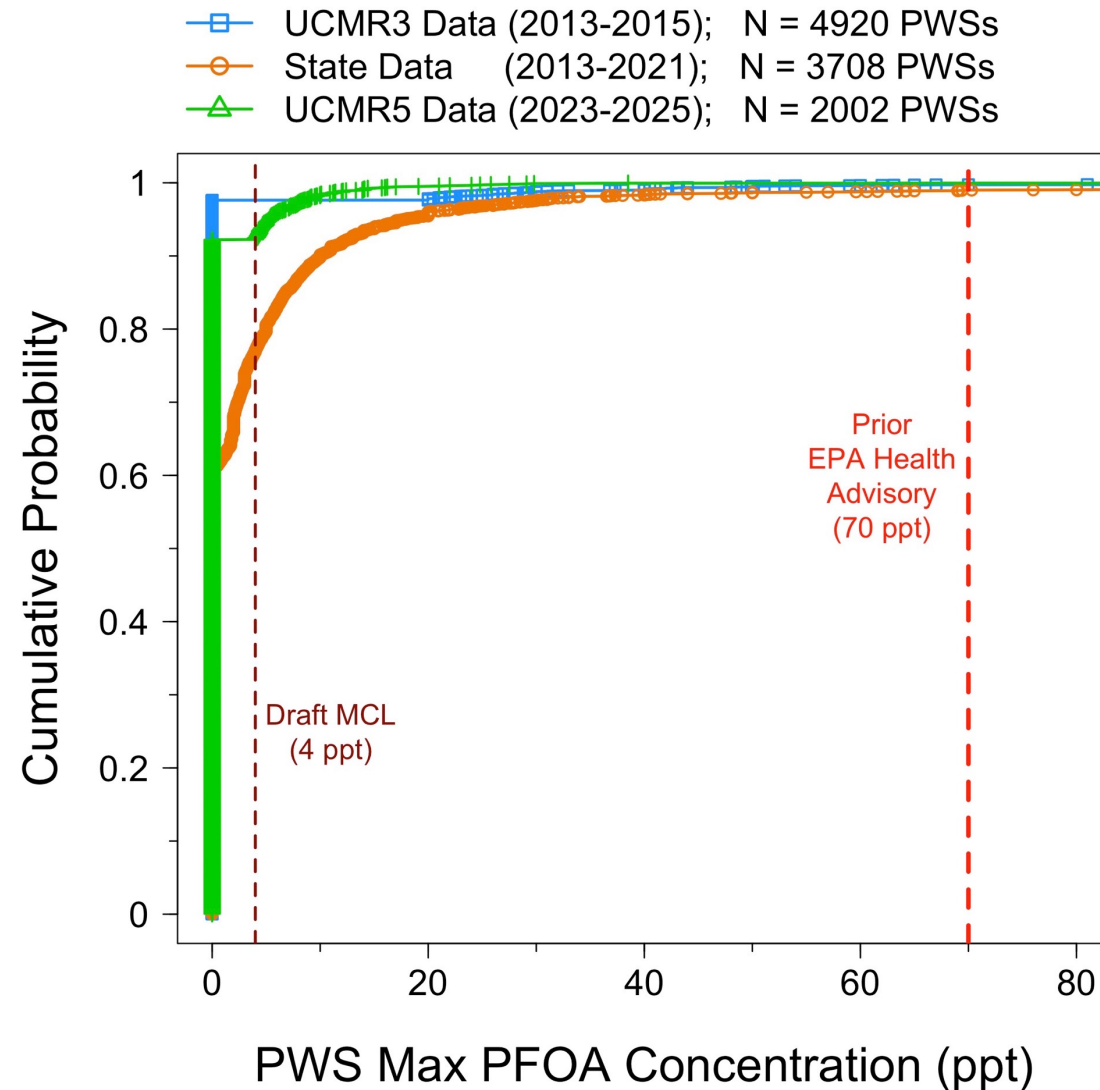
PFOA: Toxicity Estimates

PFOA	2016	2022
Lifetime Health Advisory (ng/L)	70	0.004 (interim)
Reference Dose (RfD, mg/kg/day)	0.0002	1.5 E-9
Basis of RfD	Mice decreased pup ossification, increased male puberty	Suppression of tetanus vaccine response in 7-year-old children
DWI/bw (L/kg-day)	0.054	0.0701
Basis of DWI/bw	90 th %-ile estimate of direct and indirect water ingestion for lactating women	90 th %-ile estimate of direct and indirect water ingestion for children aged 0 to < 5 years
Relative Source Contribution from Water	20%	20%

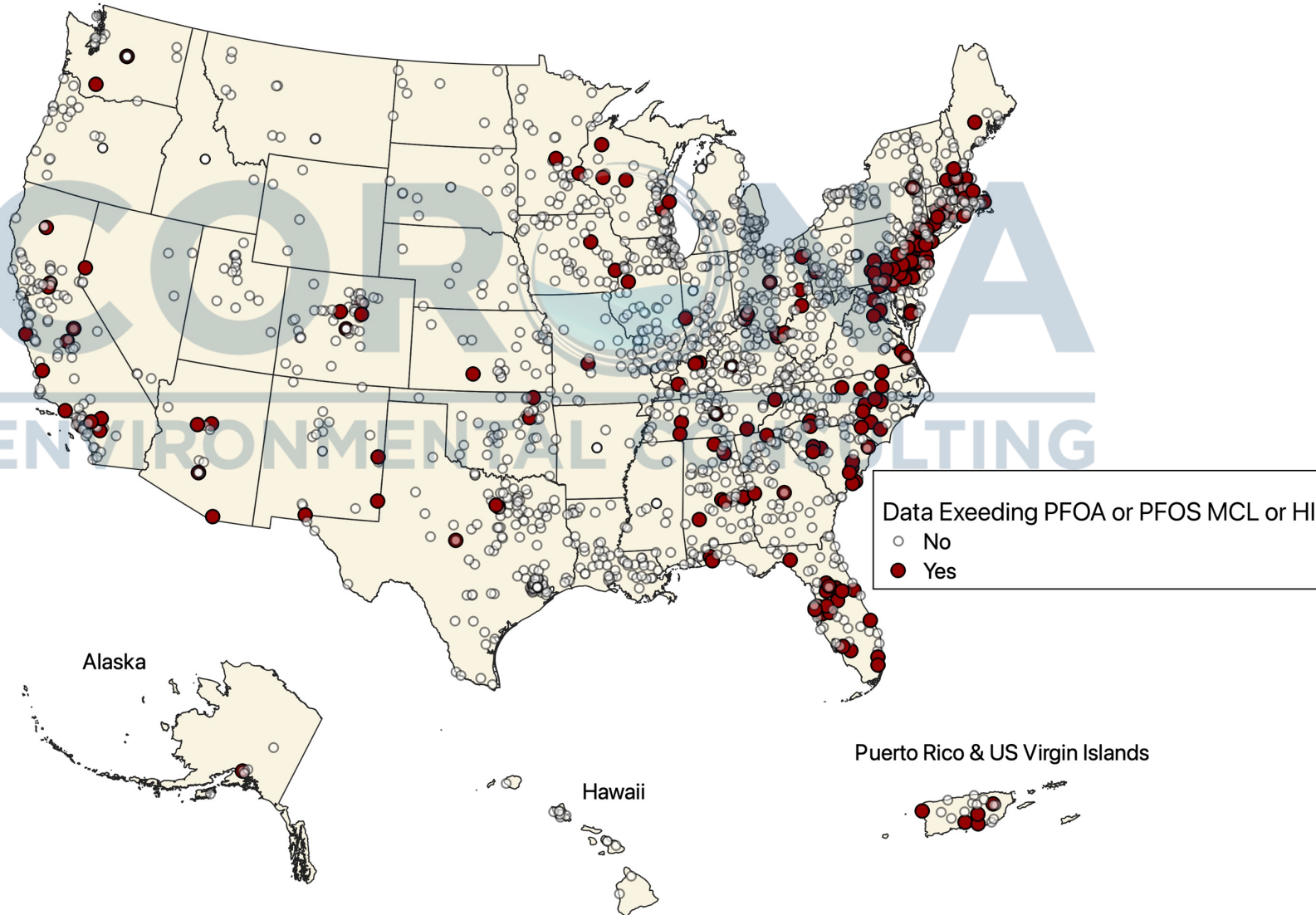
PFOS: Toxicity Estimates

PFOS	2016	2022
Lifetime Health Advisory (ng/L)	70	0.02 (interim)
Reference Dose (RfD, mg/kg/day)	0.0002	7.9 E-9
Basis of RfD	Reduced pup body weights in rats	Suppression of diphtheria vaccine response in 7-year-old children
DWI/bw (L/kg-day)	0.054	0.0701
Basis of DWI/bw	90 th %-ile estimate of direct and indirect water ingestion for lactating women	90 th %-ile estimate of direct and indirect water ingestion for children aged 0 to < 5 years
Relative Source Contribution from Water	20%	20%

Evolving Occurrence Understanding



First results from UCMR5 monitoring: Impacted water systems

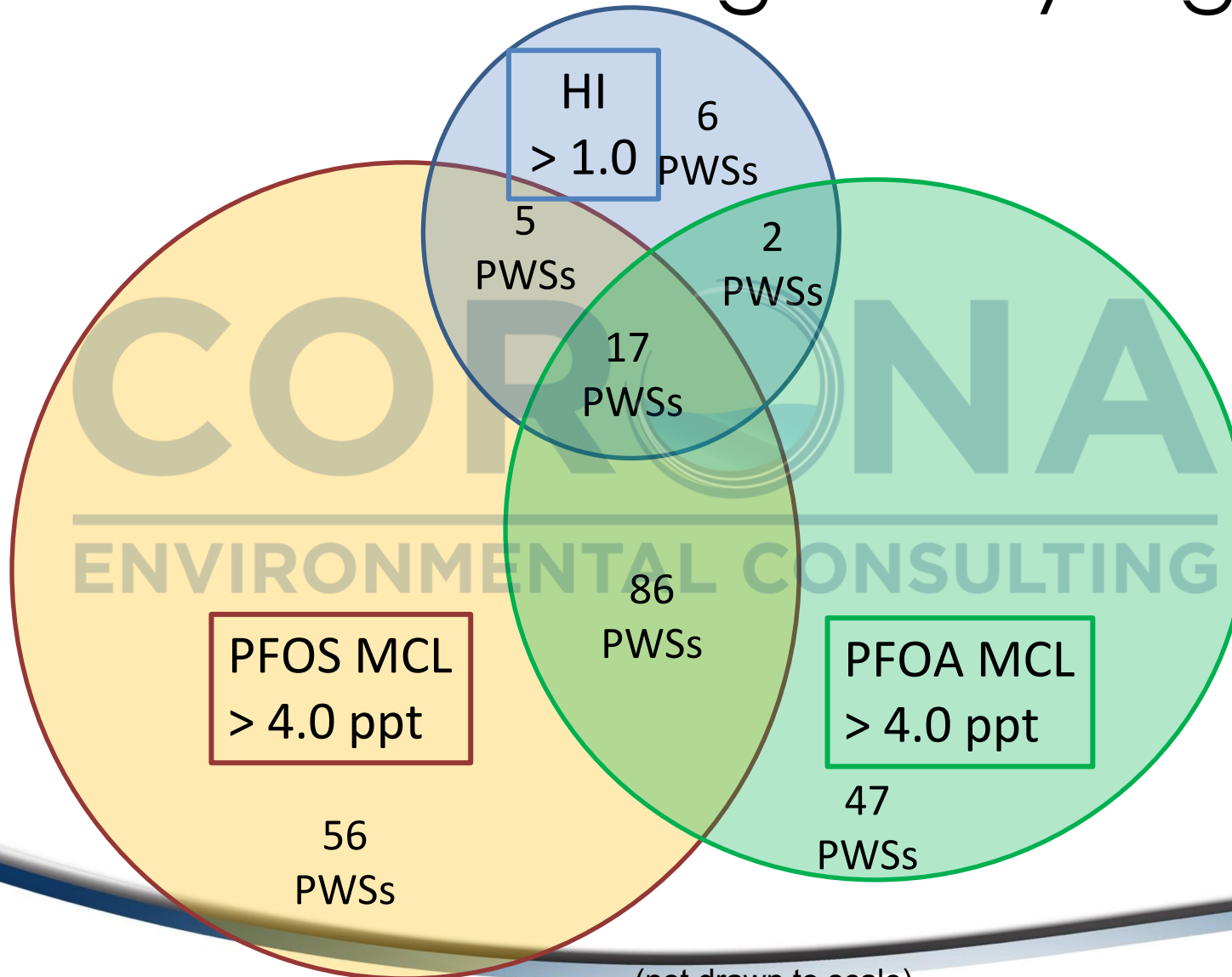


8/17/2023 UCMR5 Data Summary:

219 PWSs (10.9%) with max values exceeding USEPA proposed PFAS regulation

- “Yes” indicates:
 - PFOA > 4.0 ppt,
 - PFOS > 4.0 ppt, and/or
 - Health Index > 1.0
- Calculations based on max concentration reported

First results from UCMR5 monitoring: Regulatory triggers

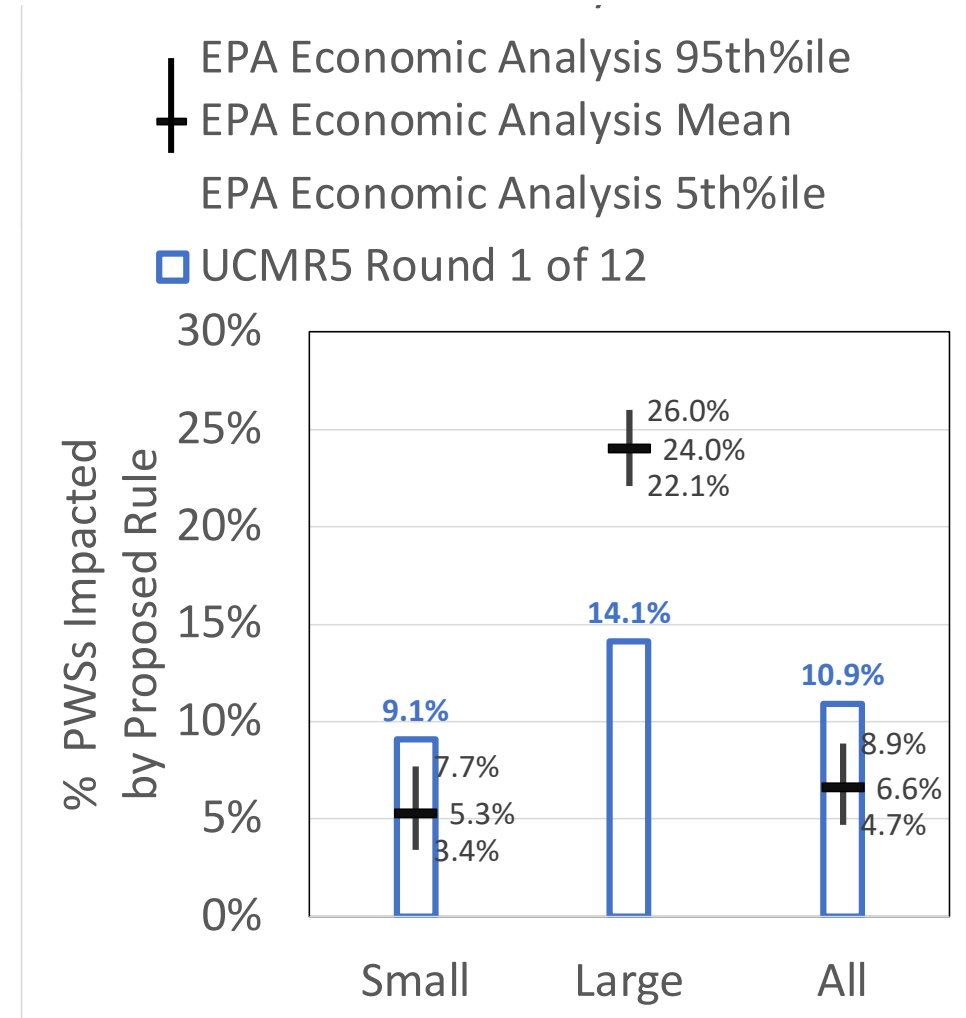


8/17/2023 UCMR5 Data Summary:

- 2,193 PWSs reporting any PFAS results
- 431 PWSs with detectable PFAS
- 2,003 reporting PFAS of interest (EPA Method 533)
- 219 PWSs with PFAS exceeding USEPA proposed PFAS regulation
- 206 PWS with detectable PFAS but not exceeding USEPA proposed PFAS regulation

Comparing EPA Estimate with UCMR5 Data

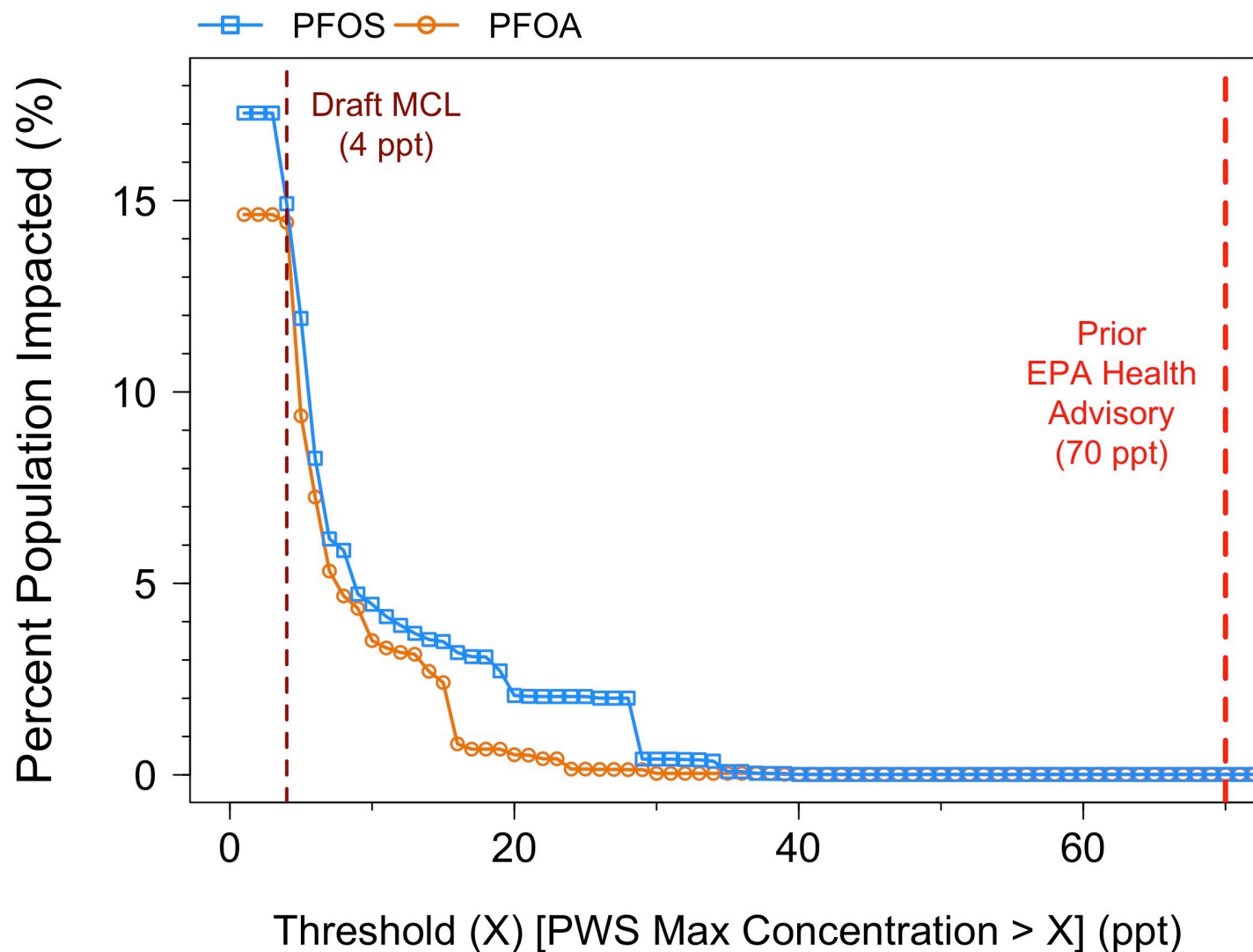
- EPA overestimated large water systems, and underestimated small water systems impacts
- Likely increases realized costs and decreases realized benefits
- More to be learned from continued monitoring; real data should be used in regulation



U.S. Population Impacted by PFAS estimated from UCMR5 August 2023 Data

Subset	PWSs	% of PWSs	Population	% of Population
Reporting data of interest (using EPA Method 533)	2,003	100%	69,210,944	100%
PFOA MCL > 4.0 ppt	152	7.6%	9,933,468	14.4%
PFOS MCL > 4.0 ppt	164	8.2%	10,261,907	14.8%
HI > 1.0	30	1.5%	4,391,839	6.4%
Any exceeding USEPA proposed PFAS regulation	219	10.9%	13,352,355	19.3%

U.S. Population Impacted by PFAS estimated from UCMR5 August 2023 Data



So, is PFAS
meaningful?
(202X paper?)

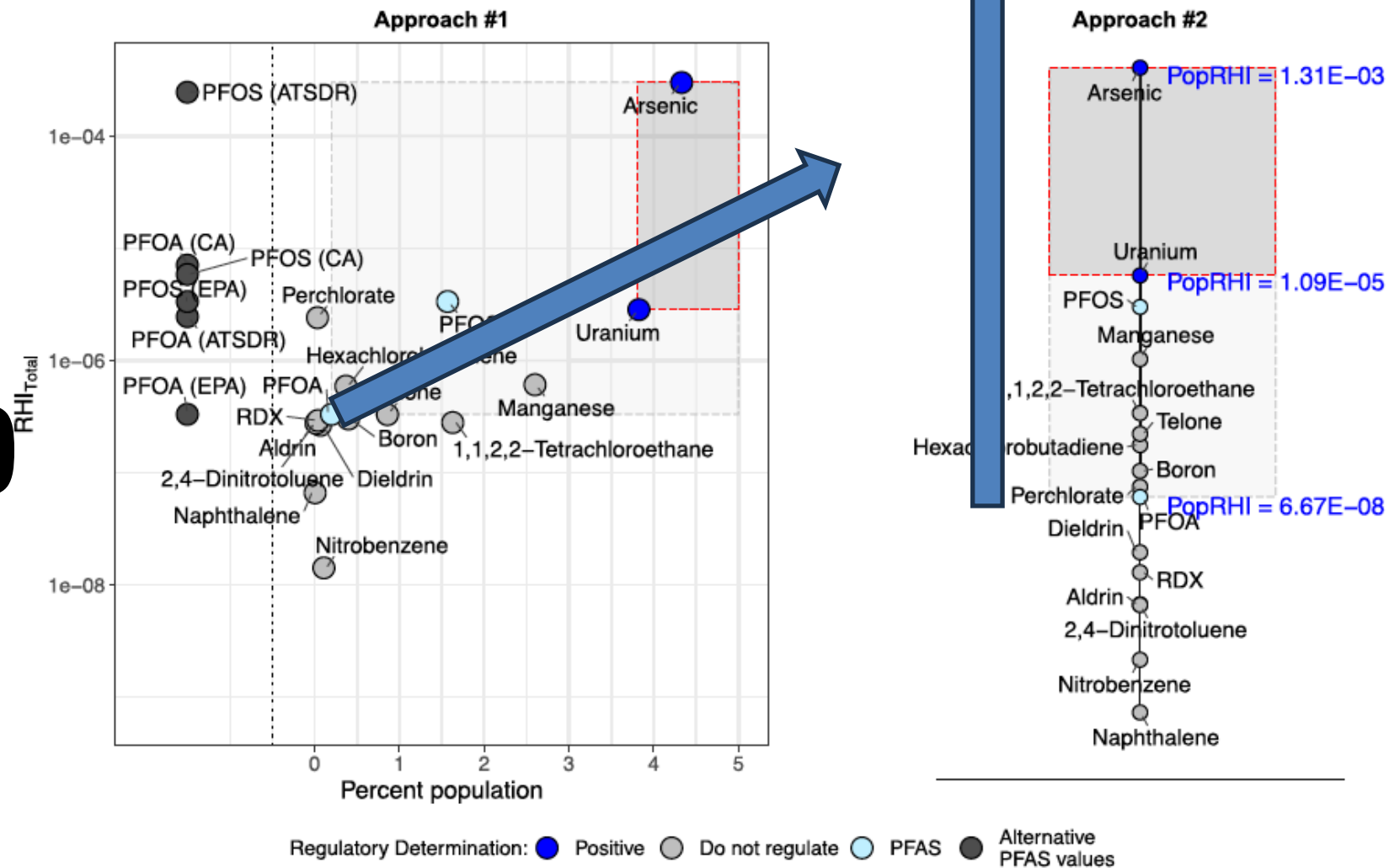


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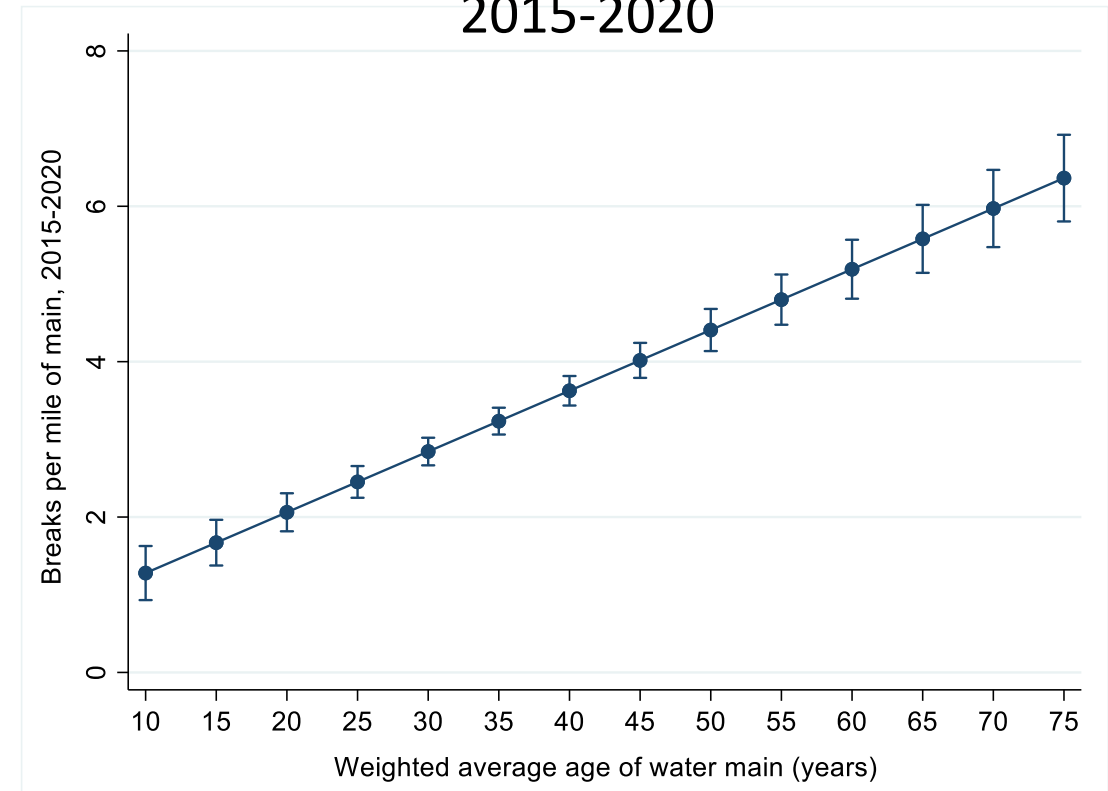
Not having water...

- Infrastructure failure
- Workforce limitations
- Natural disasters
 - Drought
 - Wildfires
 - Flooding

Closing Thoughts

- Limited funding and competing priorities
- Prioritize risks to be efficient with our limited funding and achieve the greatest health benefit
- Invest resources to address most pressing needs!

Total main breaks by diameter-weighted
avg. age of water main,
2015-2020



Source: Wisconsin Public Service Commission. Statistical model with controls for system size and source water. Thin bars = 95% confidence intervals.

Courtesy of Manny Teodoro, University of Wisconsin

Questions?

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