

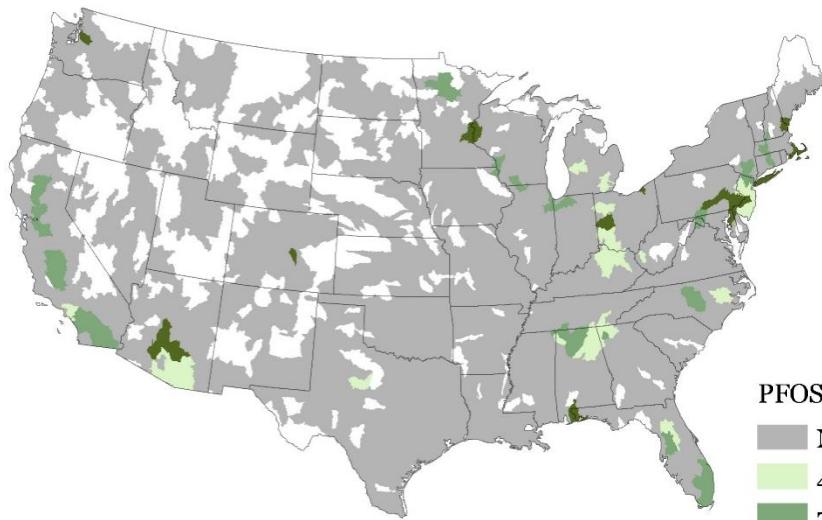


**Andy Eaton, PhD, BCES**  
**Technical Director**

# **A Further Examination Of A Subset Of UCMR 3 PFAS Data Demonstrates Wider Occurrence**

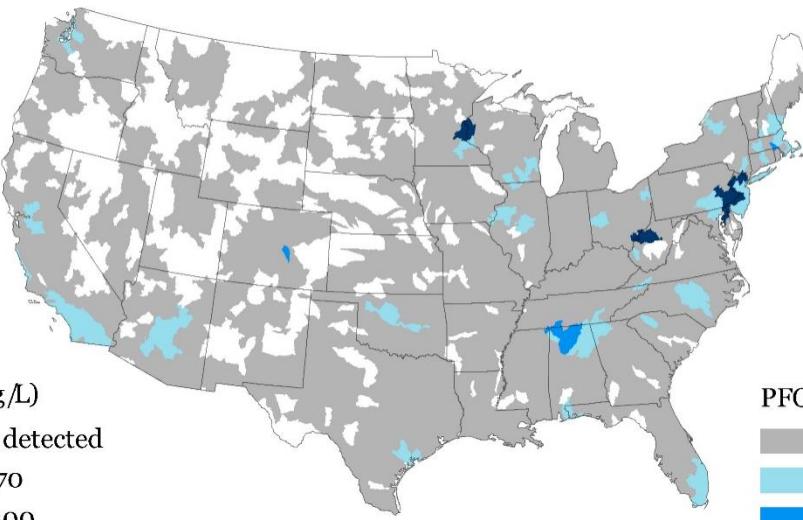


# Are PFAS Compounds A national issue? UCMR 3 Data Imply NOT...



PFOS (ng/L)

- Not detected
- 40-70
- 71-200
- 201-1800



Hydrologic unit codes (HUCs) used as a proxy for watersheds

PFOA (ng/L)

- Not detected
- 20-70
- 71-100
- 101-349

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Letter

[pubs.acs.org/journal/estlcu](https://pubs.acs.org/journal/estlcu)



## Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants

Xindi C. Hu,<sup>\*†‡</sup> David Q. Andrews,<sup>§</sup> Andrew B. Lindstrom,<sup>||</sup> Thomas A. Bruton,<sup>⊥</sup> Laurel A. Schaider,<sup>#</sup> Philippe Grandjean,<sup>†</sup> Rainer Lohmann,<sup>@@</sup> Courtney C. Carignan,<sup>†</sup> Arlene Blum,<sup>⊥,†</sup> Simona A. Balan,<sup>●</sup> Christopher P. Higgins,<sup>○</sup> and Elsie M. Sunderland<sup>†‡</sup>



Eaton Analytical

Slide courtesy of C. Higgins (CSM) and J. Field (OSU).

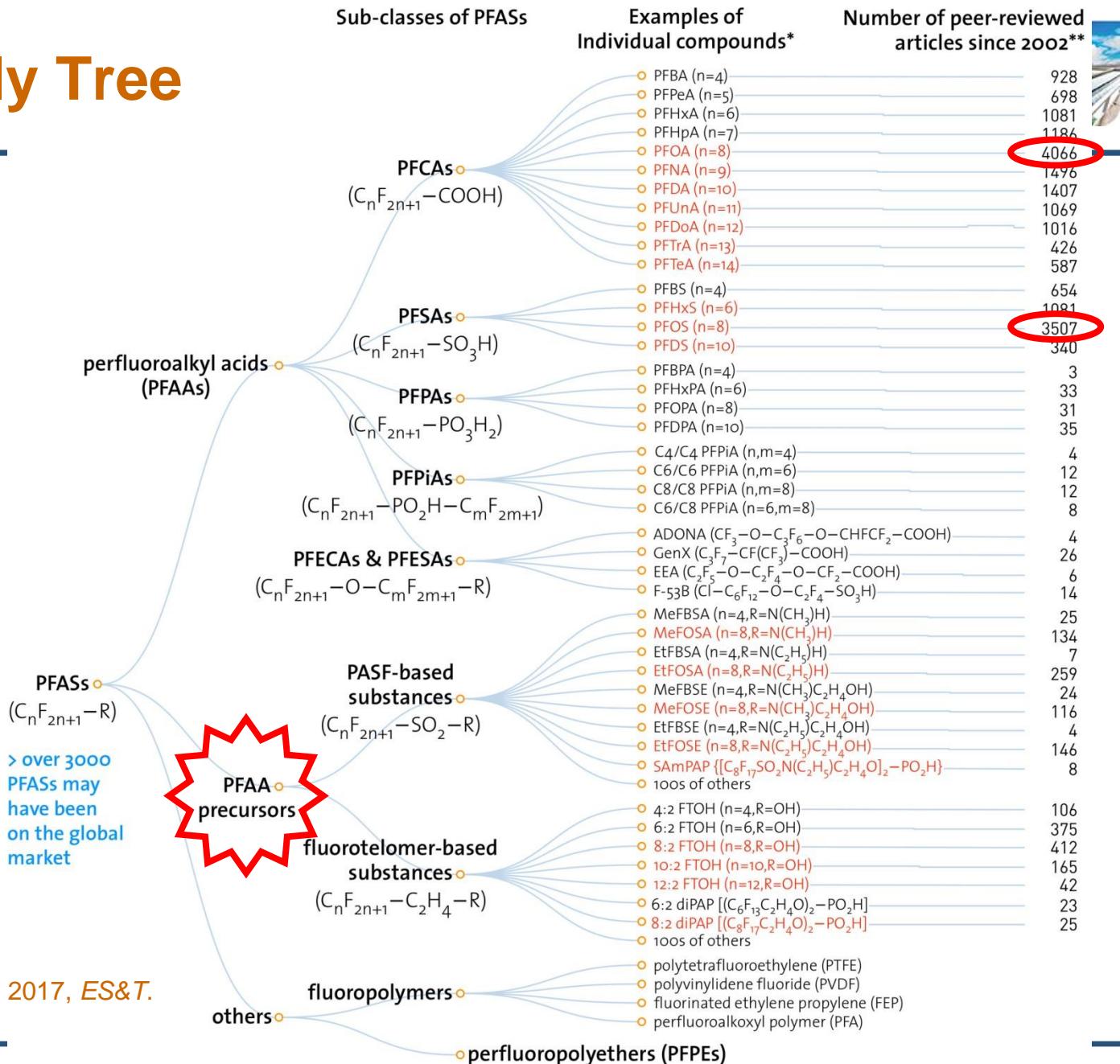
# So Is That Really the Case?



- We will re-examine UCMR 3 data from a different perspective.
- We will look at monitoring that has been conducted since the end of UCMR 3.
- We will recommend strategies to examine PFAS compounds in drinking water.

# PFAS Family Tree

It's not just  
PFOS and  
PFOA



Wang et al. 2017, ES&T.

Slide courtesy of C. Higgins (CSM) and J. Field (OSU).

# It's Also Not Just A Legacy PFAS Issue

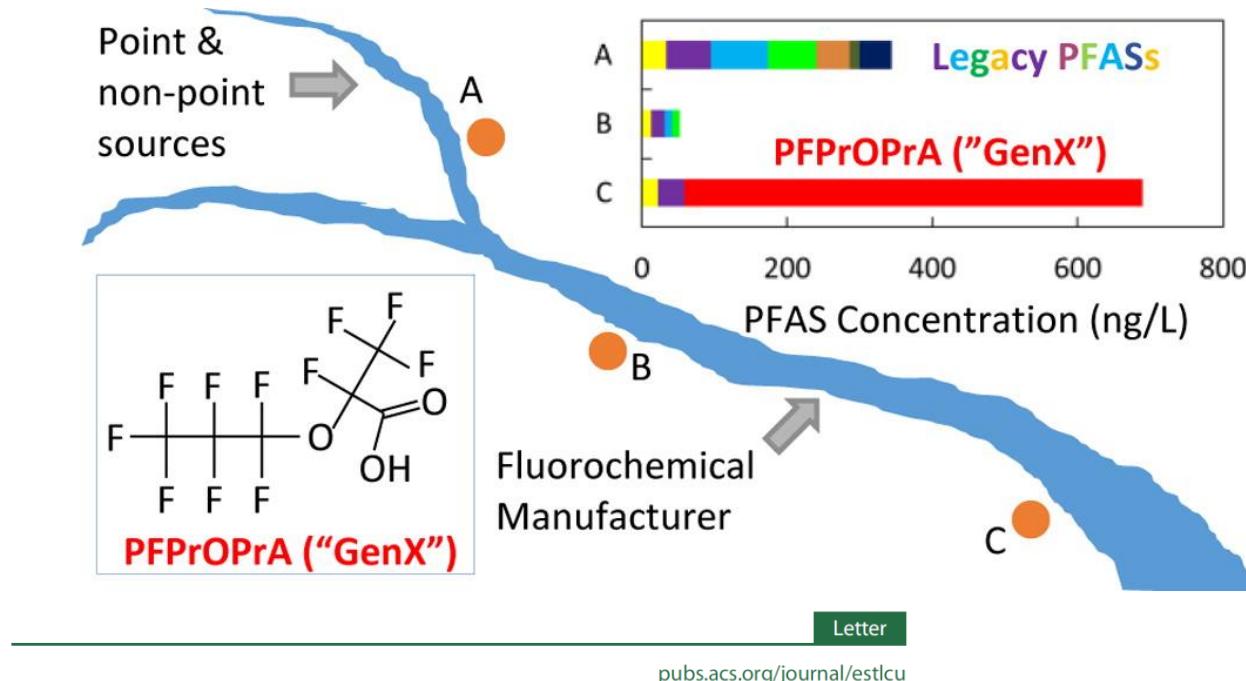


Absence of legacy PFASs (PFOS, PFOA) **does not mean no PFASs are present**



## Legacy and Emerging Perfluoroalkyl Substances Are Important Drinking Water Contaminants in the Cape Fear River Watershed of North Carolina

Mei Sun,<sup>\*,†,‡,§,¶</sup> Elisa Arevalo,<sup>‡</sup> Mark Strynar,<sup>§</sup> Andrew Lindstrom,<sup>§</sup> Michael Richardson,<sup>||</sup> Ben Kearns,<sup>||</sup> Adam Pickett,<sup>‡</sup> Chris Smith,<sup>#</sup> and Detlef R. U. Knappe<sup>‡</sup>



[pubs.acs.org/journal/estlcu](https://pubs.acs.org/journal/estlcu)

Essentially every utility on the Cape Fear River is impacted by PFAS compounds.

Sun *et al.*, 2016, *ES&T Letters*.

Modified from Slide courtesy of C. Higgins (CSM) and J. Field (OSU).

# How Do You Evaluate PFAS Occurrence (e.g. UCMR 3 Data)?



- You can focus only on **exceedances** of Health Advisory Levels (HAs).
- You can focus on **overall frequency of detection by count or PWS** because you are dealing with a **strictly anthropogenic contaminant** and you don't know when a detection is part of a plume.
- You can focus on either **only PFOS and PFOA** or a **broader suite**.
- And this is to help you make educated decisions about any non-UCMR monitoring and/or treatment.

# Lets Look at Data



- The UCMR 3 program generated more than 35,000 data points for **some** PFAS compounds in drinking water.
- The UCMR 3 reporting limits were **relatively** high.
- But we can provide some additional insights into the data.

# UCMR 3 Monitoring Potentially Underestimates PFAS Occurrence



- UCMR 3 reporting limits were determined based on a simulation from data from only a few labs (see next slide) back in 2008 (multi generations in terms of LC-MS-MS technology).
- Method 537 **was/is** capable of reliably measuring:
  - Levels that are 10-20X lower than UCMR 3,
  - A much longer list of PFAS compounds than the UCMR 3 list only.

# LCMRLs from Multiple Labs in Initial Method Validation (2008)



Analyte	Method 537		Lab A		Lab B		Overall range		UCMR 3 MRL
	DL (ng/L)	LCMRL (ng/L)	DL (ng/L)	LCMRL (ng/L)	DL (ng/L)	LCMRL (ng/L)	Multi lab DL range	Multi lab LCMRL range	
PFBS	3.1	3.7	4.1	16	ND <sup>b</sup>	72 <sup>c</sup>	<1 to 4.1	3.7 to 72	90
PFHpA	0.5	3.8	1.2	8.1	ND	0.82	<1 to 1.2	3.8 to 8.1	10
PFHxS	2	8	3.9	3.3	ND	40 <sup>c</sup>	<1 to 3.9	3.3 to 40	30
PFOA	1.7	5.1	1.3	14	ND	0.33	<1 to 1.7	0.33 to 14	20
PFNA	0.7	5.5	1.7	12	ND	0.68	<1 to 1.7	0.68 to 12	20
PFOS	1.4	6.5	3.5	11	ND	45 <sup>c</sup>	<1 to 3.5	6.5 to 45	40

Note: the DL variation is not nearly as great as the LCMRL variation.

The large variation in LCMRLs among labs results in a high “national” MRL for UCMR 3 because these data are used for the simulation to determine the national UCMR MRL.

The combined PFOS-PFOA UCMR 3 MRL is 60, just below the HA level.

# Consider Some of The Monitoring Option Decisions



- How many PFAS compounds should you look for?
  - 2 (PFOS/PFOA)?
  - 6 UCMR compounds?
  - Up to the 14 that are in EPA 537?
  - 24 that DOD is now targeting?
  - More? Precursors?

Clearly there are options to consider.

# Consider More of The Monitoring Option Decisions



- How low should you look?
  - UCMR 3 limits?
  - Levels that the method can reliably measure?
- Although EPA set the reporting limits for UCMR 3 at “relatively high” levels (because of the way the MRL is established), many states have pushed limits much lower, as shown in a later slide.

# How Can We Determine If There Are Significant Underestimates?



- EEA accounts for ~30% of the UCMR 3 PFAS data.
- EEA's in-house MRLs for the 6 UCMR 3 PFAS compounds were already significantly lower than the UCMR 3 required reporting limits.
- We re-examined all of our data, censoring at 5 and 2.5 ng/L for all 6 UCMR 3 PFAS compounds.
- We then compared detection frequencies, and states where there is significant detection.

# How Representative Are Our Data of the Whole UCMR 3 Database?



Factor	Overall UCMR 3 NCOD	EEA UCMR 3 Data (UCMR 3 MRLs)
# of Samples	~37,000	~10,500
# of PWS	~4920	~1100
% of PWS with UCMR 3 detection	3.3%	5.3%
% of PWS with HA Exceedances	1.5%	1.8%
# of States/Territories with samples	All	All
# of states/territories with detection	32	27
# of states/territories with HA Exceedances	24	18

NCOD = National Contaminant Occurrence Database

# Here's the Bottom Line: If You Look Lower You See a Lot More Detection



Compound	Official NCOD Database samples with detection (UCMR 3 MRLs)	EEA Subset of Samples with detection using UCMR 3 MRLs	EEA Subset of Samples with detection using 5 ng/L MRL	EEA Subset of Samples with detection using 2.5 ng/L MRL
N	~37,000	~10,500	~10,500	~10,500
PFOS	0.8%	1.3%	11.5%	20.5%
PFOA	1.0%	1.8%	12.5%	23.5%
PFNA	0.1%	0.1%	0.6%	1.9%
PFHxS	0.6%	1.0%	6.0%	12.3%
PFHpA	0.6%	1.5%	3.3%	8.8%
PFBS	<0.1%	0.2%	5.3%	11.9%

# What if we Start Looking at Frequency by State?

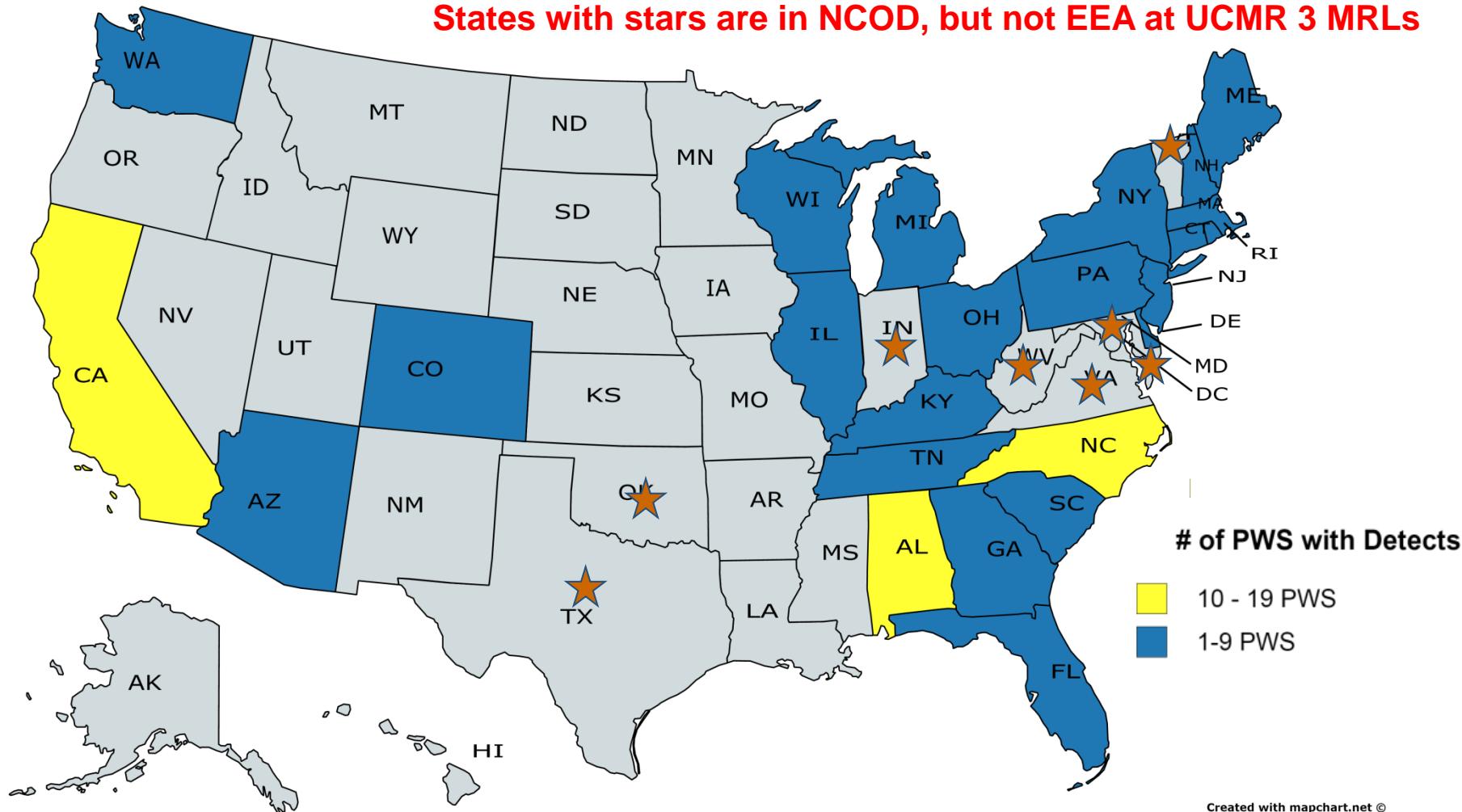


- We can look at PFOS/PFOA alone.
- We can compare the frequency of occurrence in different states by # of PWS and % of PWS.
- We can drill down to see how the EEA database compares.
- Most significantly, we can see how the pattern changes in states when we reduce the reporting limit.

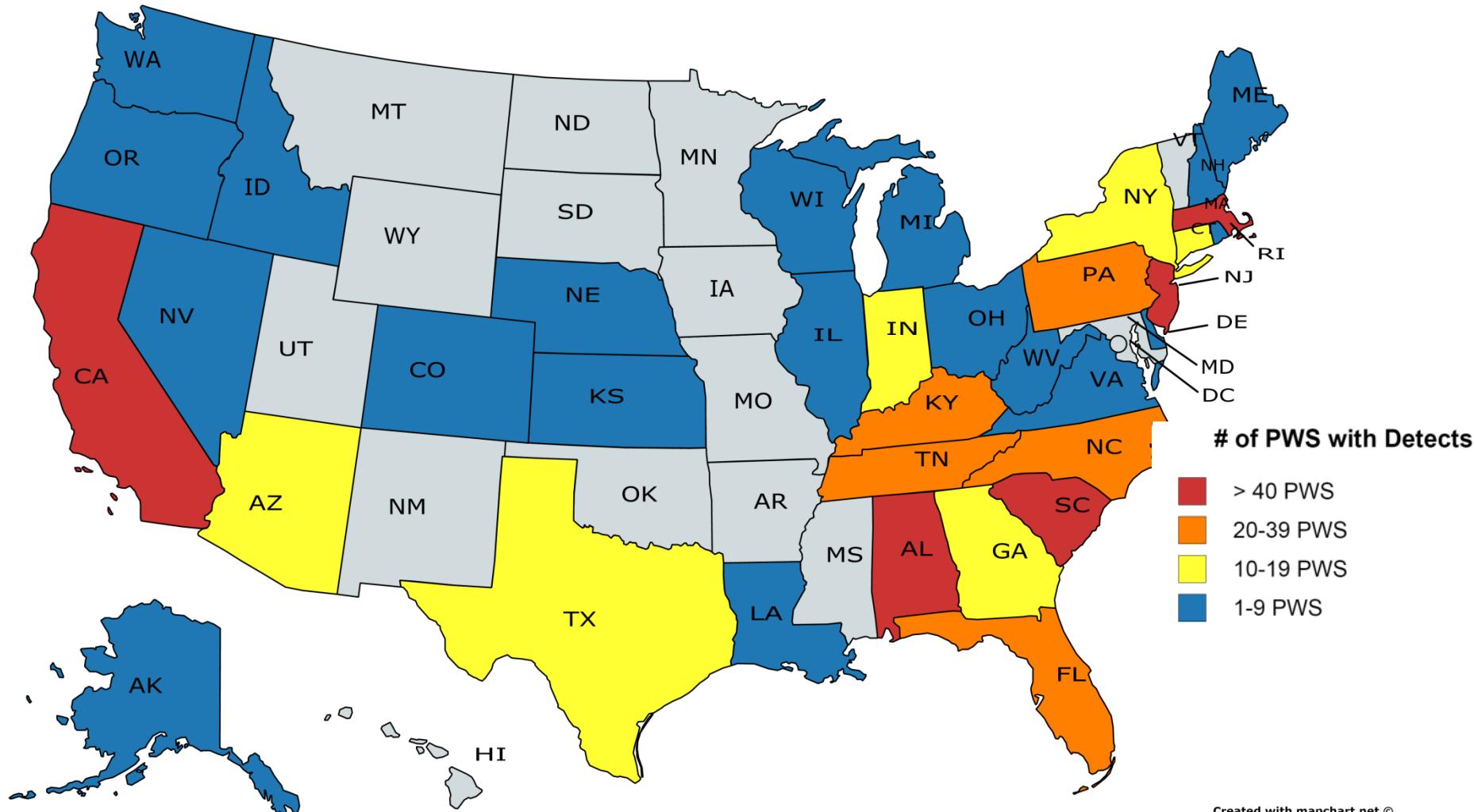
# EEA Data - 27 States with PFOS/PFOA Detections based on UCMR 3 MRLs



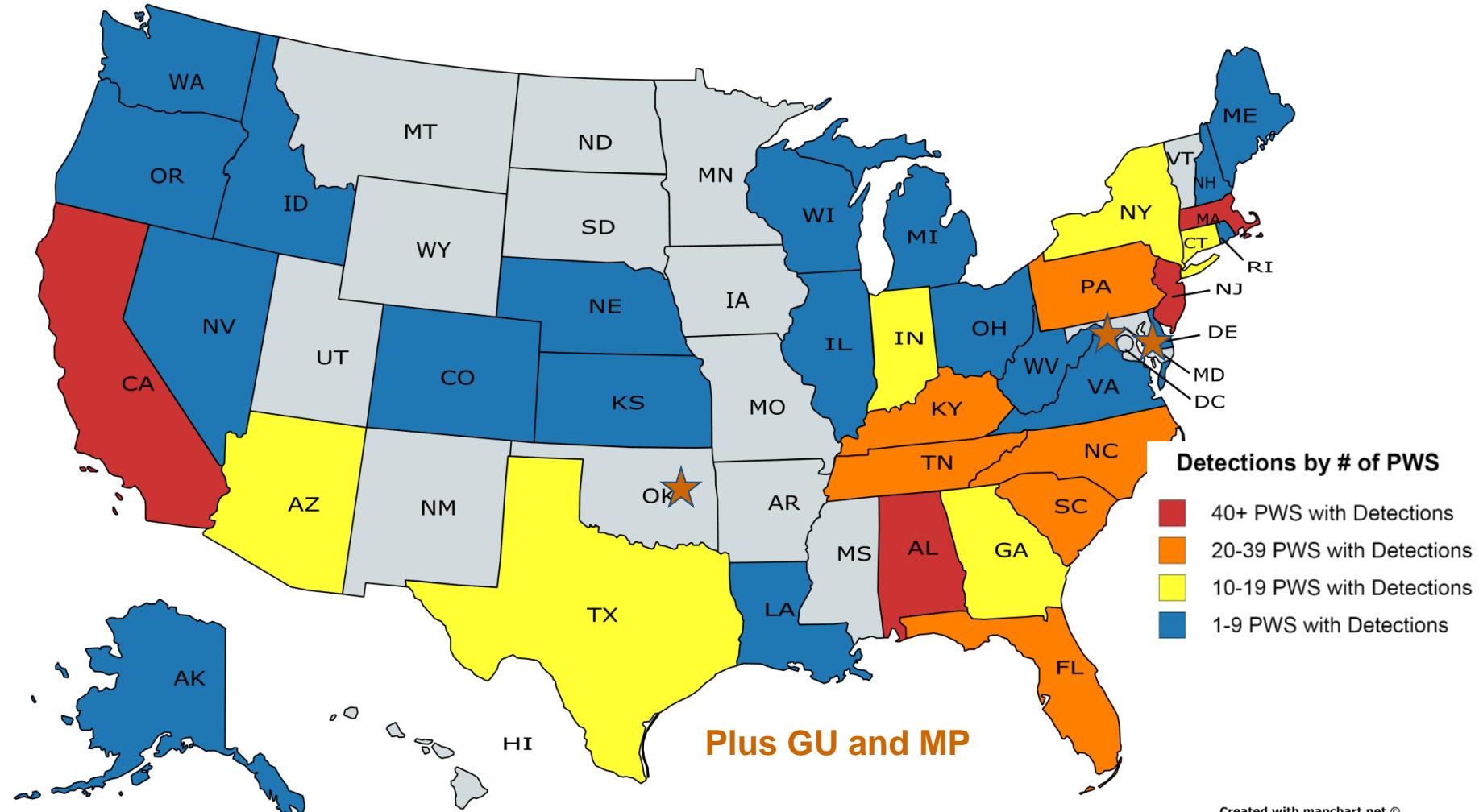
States with stars are in NCOD, but not EEA at UCMR 3 MRLs



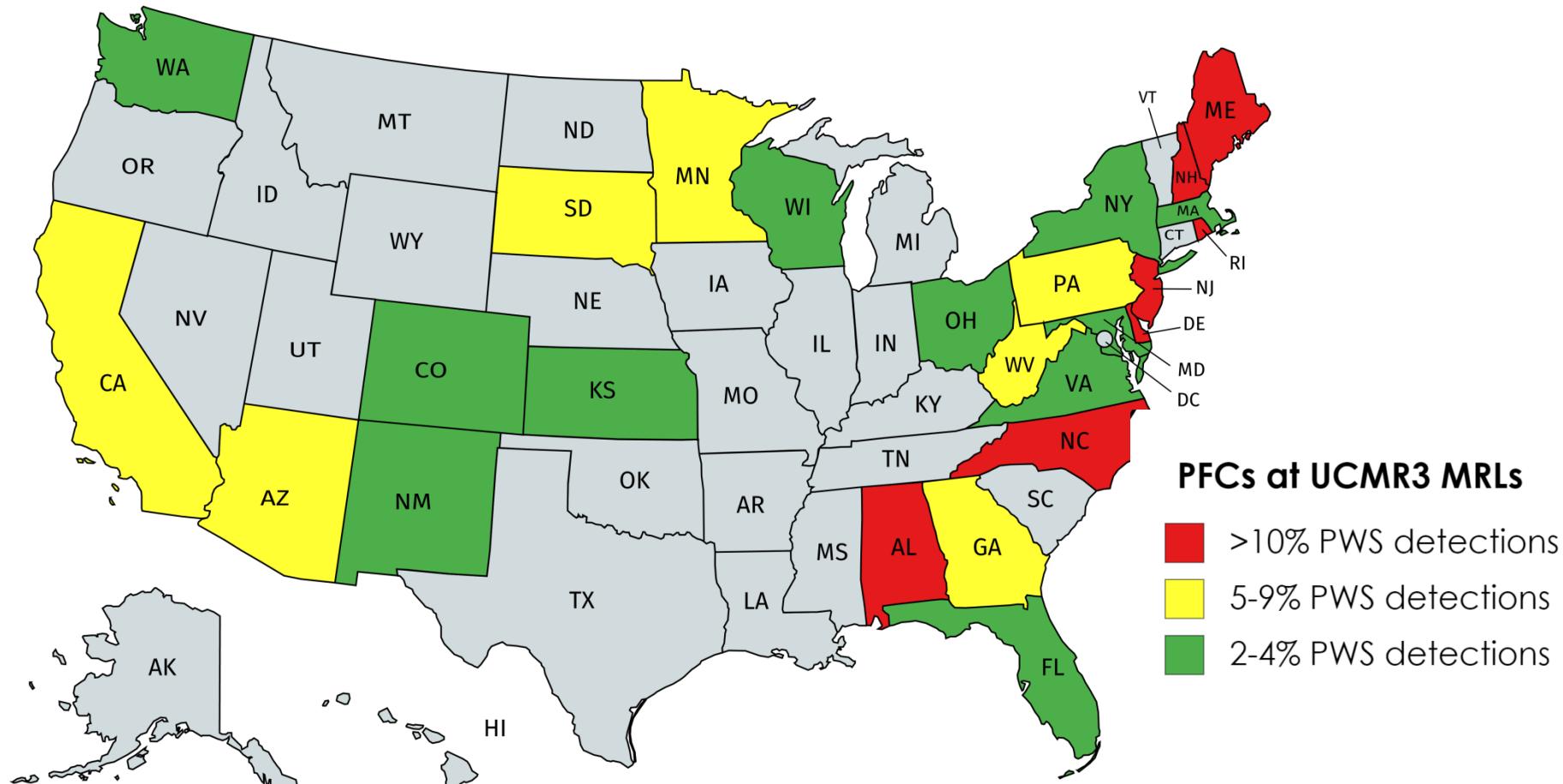
# EEA Data Only: 37 States/Territories have PWS with PFOS-PFOA Detects at 5 ng/L MRL



# EEA Data – Nearly 30% of the PWS We Tested in UCMR 3 Have at Least 1 PFAS at 5 ng/L or More

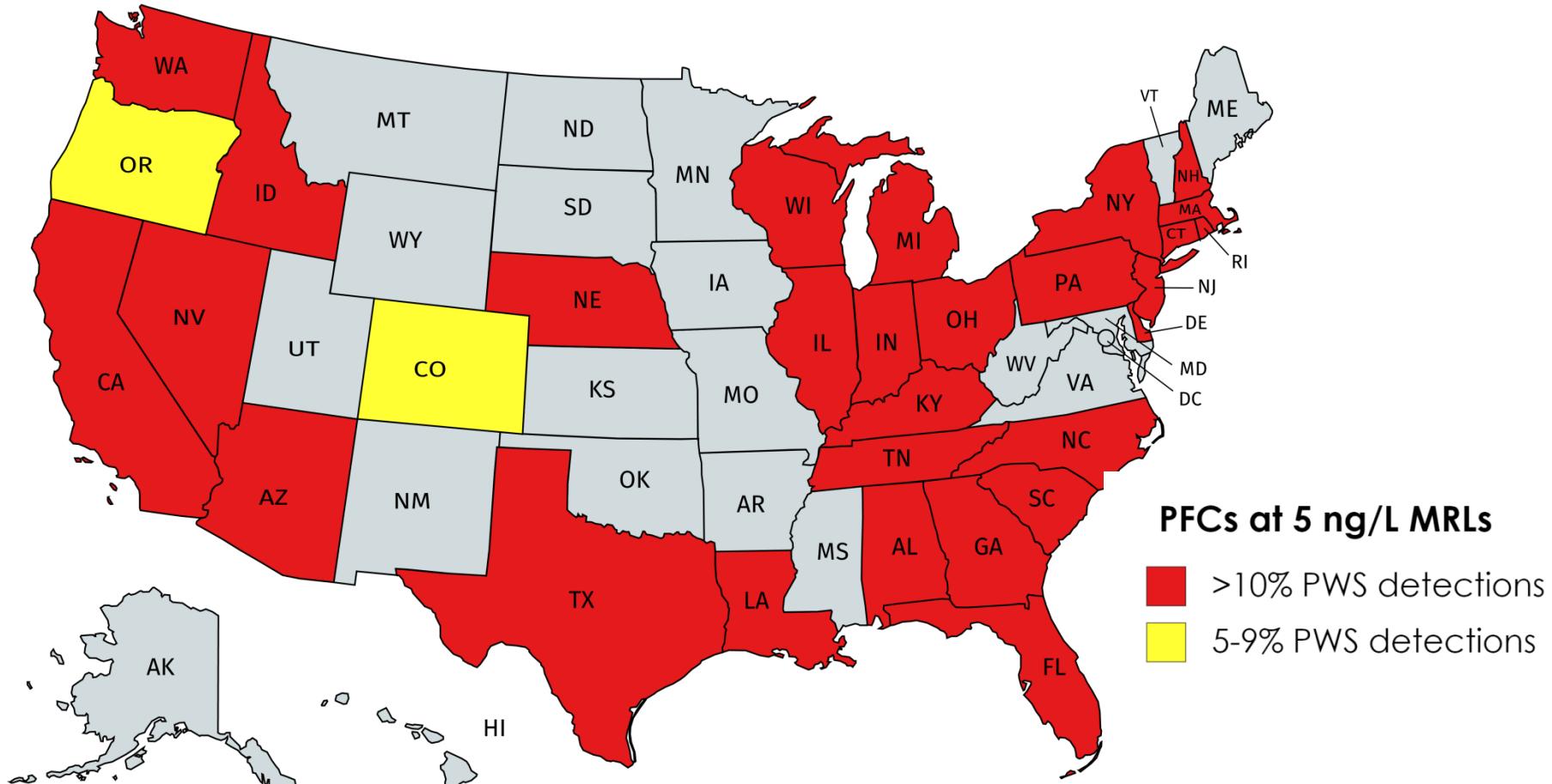


# UCMR 3 Database— States with Significant Frequencies of PFAS Detection (% of PWS)



25 states plus 3 territories with >2% of PWS with PFAS detection at UCMR 3 MRLs (181 PWS - ~4% of PWS)

# EEA Data – States with Significant Frequencies of PFAS Detection at 5 ng/L



**30 states plus 3 territories with >2% of PWS with PFAS detection at 5 ng/L MRLs (217 PWS - >30% of PWS)**

# What About Post UCMR 3 Monitoring?



- Since UCMR ended, EEA has received in excess of 3,000 municipal samples for PFAS compounds, with more than **half now looking for 12 of the PFAS** in method 537. Note that this is a biased sample, because it is mainly utilities who already know they have PFAS issues.
- In response to pushes from many states for lower MRLs (remember earlier slide) these have all been screened at **levels as low as 2 ng/L** for 12 of the PFAS in method 537.

# We Can Look At These Results By Overall Detection Frequency



	Compound	Detection Frequency
UCMR 3 PFAS	PFBS	>30%
	PFHpA	>30%
	PFHxS	>30%
	PFNA	10%
	PFOS	>40%
	PFOA	>45%
Other 537 Analytes	PFDA	2%
	PFDoA	trace
	PFTA	0%
	PFUnA	trace
	PFHxA (Perfluorohexanoic acid)	>30%
	PFTrDA	0%

# Conclusions



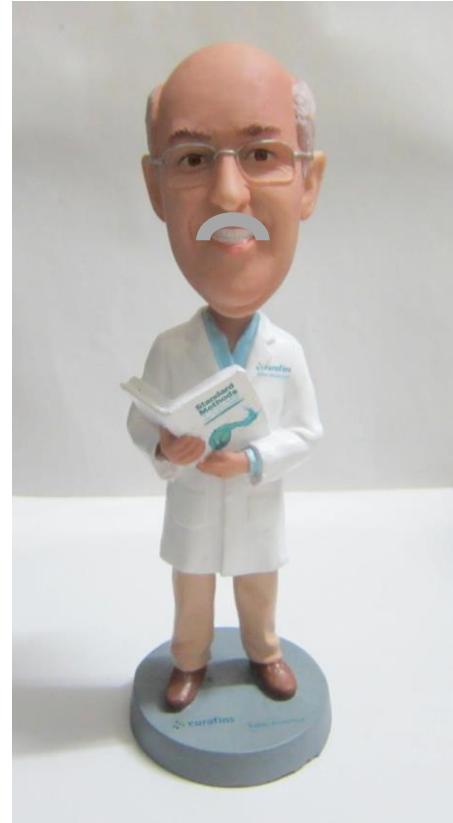
- The UCMR 3 database significantly underestimates the occurrence of PFAS compounds in municipal waters because of MRLs that were inadvertently too high.
- The high frequency of 5 ng/L detection of any PFAS compound (~30% of tested PWS) suggests that utilities should proactively consider monitoring (at low levels) to check for potential plumes, even if the UCMR 3 database showed no detection.
- Some of the other UCMR 3 PFAS compounds (besides PFOS/PFOA) are frequent, as are some non UCMR 3 PFAS compounds.

# Any Questions?



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# ADDITIONAL INFORMATIONAL SLIDES

# The World Changed on May 19, 2016



EPA US Environmental Protection Agency

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## Ground Water and Drinking Water

You are here: EPA Home » Ground Water and Drinking Water » Drinking Water Health Advisories for PFOA and PFOS

# Drinking Water Health Advisories for PFOA and PFOS

### Health Advisories

EPA has established health advisories for PFOA and PFOS based on the agency's assessment of the latest peer-reviewed science to provide drinking water system operators, and state, tribal and local

**non-enforceable and non-regulatory**

they can take the appropriate actions to protect their residents. EPA is committed to supporting states and public water systems as they determine the appropriate steps to reduce exposure to PFOA and PFOS in drinking water. As science on health effects of these chemicals evolves, EPA will continue to evaluate new evidence.

To provide Americans, including the most sensitive populations, a lifetime of exposure to PFOA and PFOS from drinking water, EPA has established health advisories for PFOA, PFOS, and PFOA + PFOS at levels at 70 parts per trillion.

› What's a health advisory?

**Additional Information**

PFOA 70 ng/L

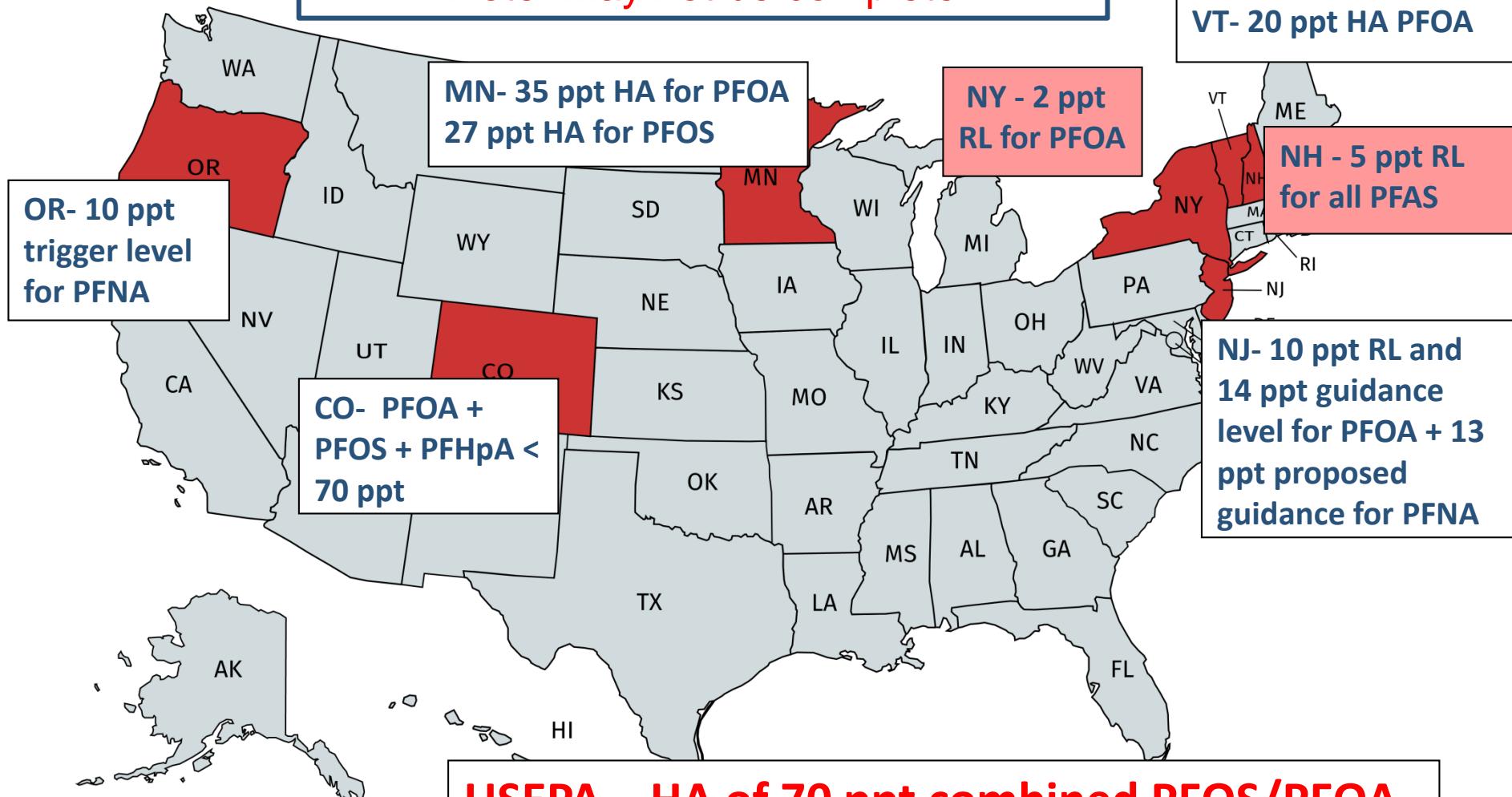
PFOS 70 ng/L

PFOA + PFOS 70 ng/L

# States are Already Deviating from the EPA HA/RL Guidance (as of 11/17)



Note: May not be complete



# EEA Standard 537 List



## Standard List – Method 537

Parameter	CAS #	Reporting Limit	Parameter	CAS #	Reporting Limit
N-ethyl Perfluorooctanesulfonamido-acetic acid (NEtFOSAA)	2991-50-6	2 - 2.5 ng/L	Perfluorolauric acid (PFDoA)	307-55-1	2 - 2.5 ng/L
N-methyl Perfluorooctanesulfonamido-acetic acid (NMeFOSAA)	2355-31-9	2 - 2.5 ng/L	Perfluoromyristic acid (PFTA)	376-06-7	2 - 2.5 ng/L
Perfluorobutanesulfonic acid (PFBS)	375-73-5	2 - 2.5 ng/L	Perfluorononanoic acid (PFNA)	375-95-1	2 - 2.5 ng/L
Perfluorodecanoic acid (PFDA)	335-76-2	2 - 2.5 ng/L	Perfluorooctane sulfonate (PFOS)	1763-23-1	2 - 2.5 ng/L
Perfluoroheptanoic acid (PFHpA)	375-85-9	2 - 2.5 ng/L	Perfluorooctanoic acid (PFOA)	335-67-1	2 - 2.5 ng/L
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2 - 2.5 ng/L	Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2 - 2.5 ng/L
Perfluorohexanoic acid (PFHxA)	307-24-4	2 - 2.5 ng/L	Perfluoroundecanoic acid (PFUnA)	2058-94-8	2 - 2.5 ng/L

# EEA Extended 537 List Includes Other Compounds But Still Follows 537

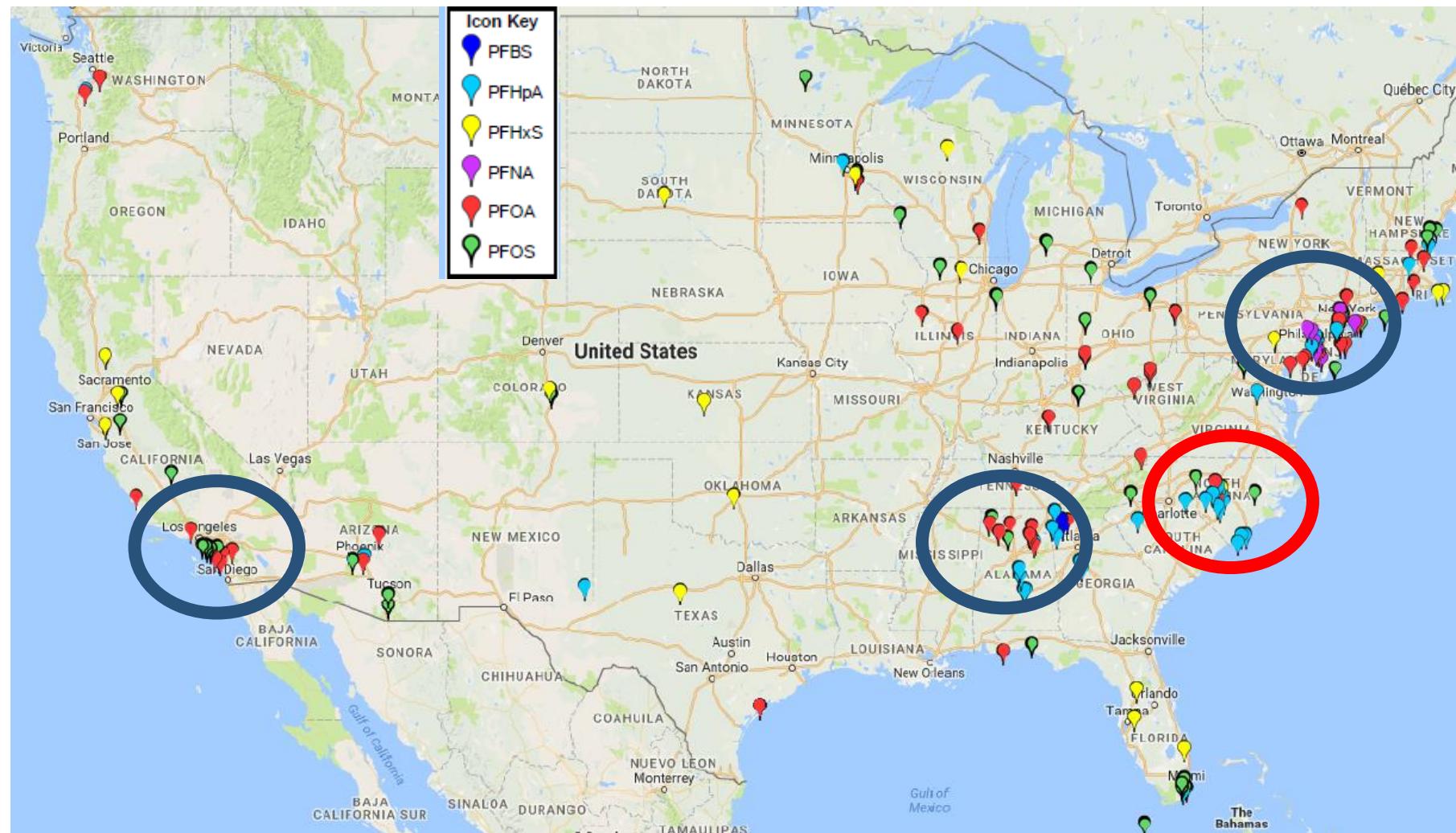


## Extended List – Method 537

Parameter	CAS #	Reporting Limit	Parameter	CAS #	Reporting Limit
ADONA	958445-44-8	2 - 2.5 ng/L	Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2 - 2.5 ng/L
F-53B Major	73606-19-6	2 - 2.5 ng/L	Perfluorohexanoic acid (PFHxA)	307-24-4	2 - 2.5 ng/L
F-53B Minor	83329-89-9	2 - 2.5 ng/L	Perfluorolauric acid (PFDa)	307-55-1	2 - 2.5 ng/L
GenX	13252-13-6	5.0 ng/L	Perfluoromyristic acid (PFTA)	376-06-7	2 - 2.5 ng/L
N-ethyl Perfluorooctanesulfonamido-acetic acid (NEtFOSAA)	2991-50-6	2 - 2.5 ng/L	Perfluorononanoic acid (PFNA)	375-95-1	2 - 2.5 ng/L
N-methyl Perfluorooctanesulfonamido-acetic acid (NMeFOSAA)	2355-31-9	2 - 2.5 ng/L	Perfluorooctane sulfonate (PFOS)	1763-23-1	2 - 2.5 ng/L
Perfluorobutanesulfonic acid (PFBS)	375-73-5	2 - 2.5 ng/L	Perfluorooctanoic acid (PFOA)	335-67-1	2 - 2.5 ng/L
Perfluorodecanoic acid (PFDA)	335-76-2	2 - 2.5 ng/L	Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2 - 2.5 ng/L
Perfluoroheptanoic acid (PFHpA)	375-85-9	2 - 2.5 ng/L	Perfluoroundecanoic acid (PFUnA)	2058-94-8	2 - 2.5 ng/L

*Due to occurrence information that is emerging as a result of post UCMR monitoring, there is now much more interest in compounds not on the original EPA 537 list.*

# UCMR 3 Detections – It's Not All PFOS and PFOA



## UCMR 3 NCOD - 36 States with Detections of PFOS and/or PFOA at UCMR3 MRLs

