Federal and state approaches to regulating PFAS in drinking water

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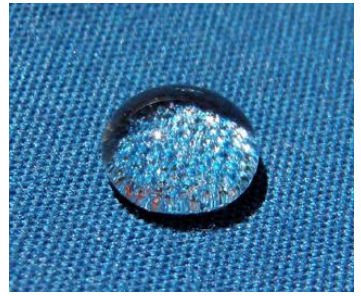
STEEP
Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

PFAS-REACH
PFAS Research, Education, and Action for Community Health

Overview

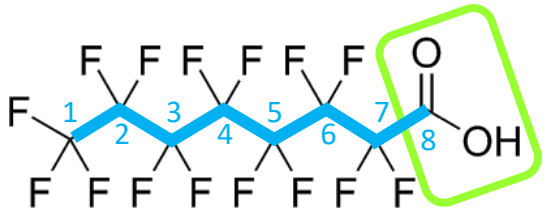


- What are PFAS?
- PFAS in drinking water
- Federal and state PFAS regulations

What are PFAS?
Per- and polyfluoroalkyl substances

- Class of over 9,000 compounds
- Chemical structures with C-F bonds
- Extremely resistant to degradation
- Used in consumer products since 1950s
- Emerged as drinking water pollutants around 2010-2015

PFOA ("C8")



8 carbon chain

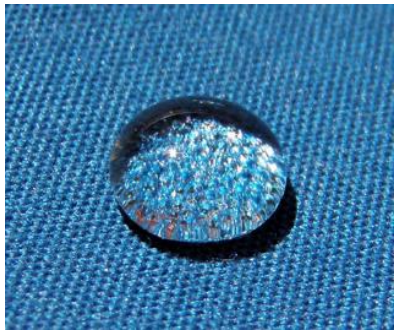
Unique properties of PFAS chemicals

- **Persistent**: "forever chemicals"
- **Mobile**: global pollutants
- **Bioaccumulative**: in people and wildlife
- **Toxic**: associated with adverse effects
- **Versatile**: many everyday uses

Other pollutants have some of these properties, but PFAS are unique in having them all

PFAS are common in everyday items

- Carpets & upholstery
- Waterproof apparel
- Non-stick cookware
- Waxes (floor, skis)
- Grease-proof food packaging
- Dental floss
- Paints



Silent Spring Institute studies

USA TODAY

NATION

Oral-B Glide floss tied to potentially toxic PFAS chemicals, study suggests

Ryan W. Miller USA TODAY

Published 8:25 p.m. ET Jan. 9, 2019 | **Updated 7:15 p.m. ET Jan. 10, 2019**

PFAS exposures are ubiquitous

- Over 99% of Americans have detectable levels of PFAS in blood (CDC)

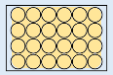
- Some PFAS are long-lived in the human body
  - Long-chain PFAS can stay in the body for years
  - Newer PFAS can stay in the body for weeks to months
  - Behavior of most PFAS in the body has not been studied

PFAS health effects

How do we learn about PFAS health effects


Studies in people (epidemiological)


Studies in lab animals (toxicological)

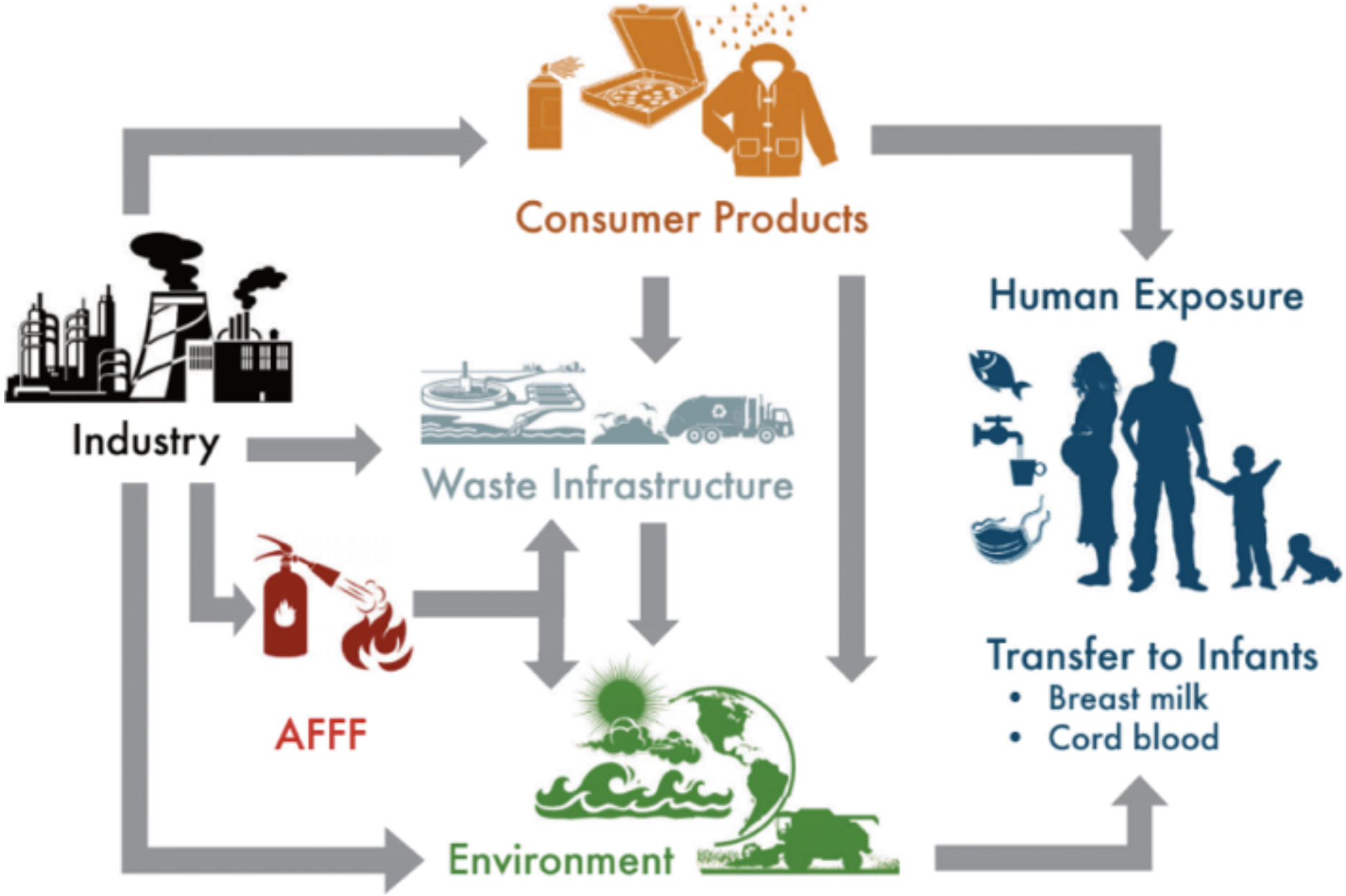

Other types of lab studies (in vitro testing)

Combining multiple lines of evidence strengthens our confidence

Harmful health effects associated with PFAS exposures

- Elevated cholesterol
- Cancer (kidney, testicular)
- Ulcerative colitis
- Thyroid disease
- Lower birth weight
- Preeclampsia
- Immune system toxicity, including decreased vaccine response

How are we exposed to PFAS?



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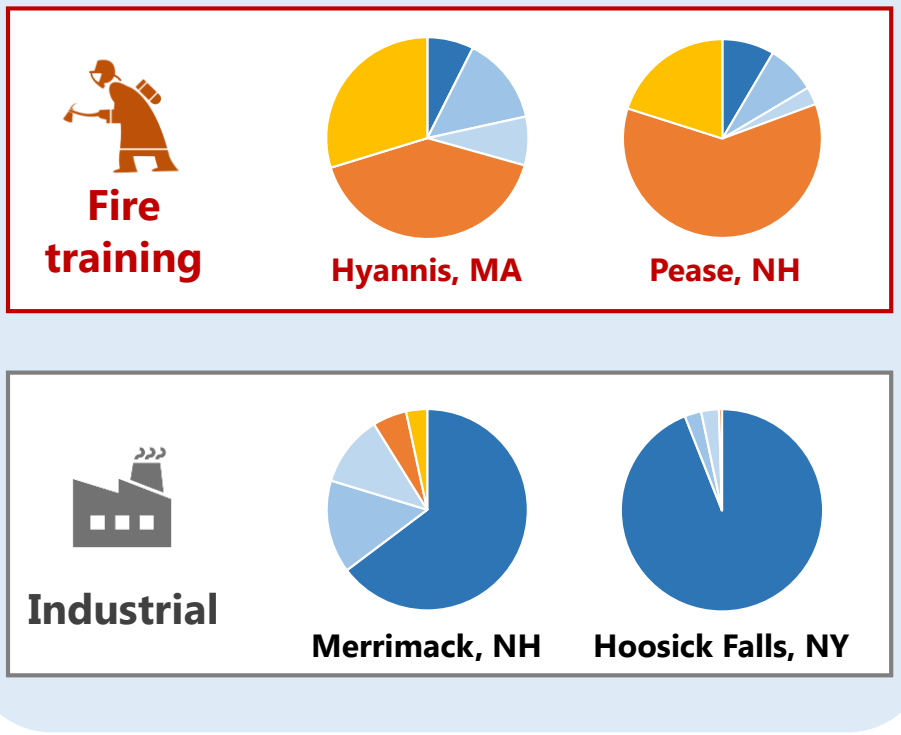
https://www.nature.com/articles/s41370-018-0094-1

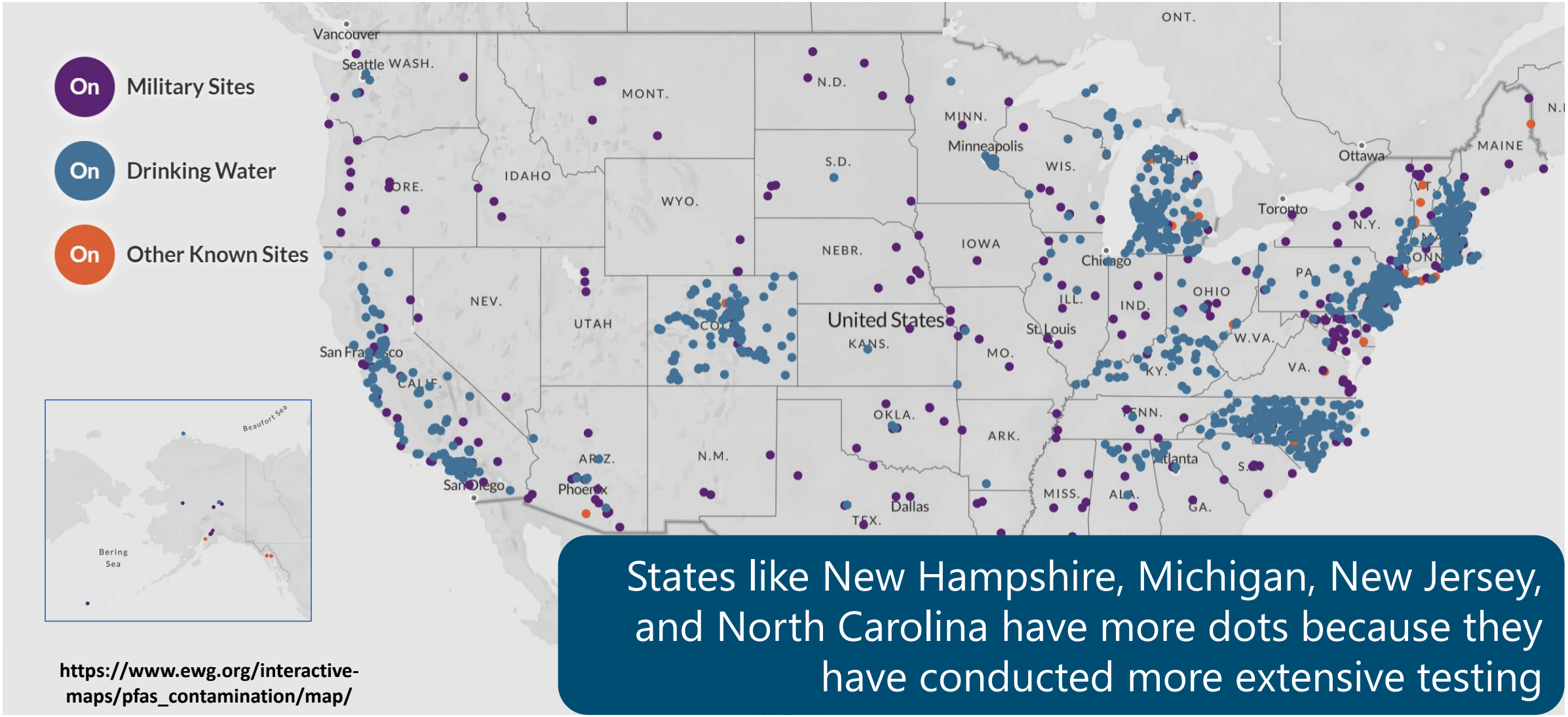
Sources of PFAS water contamination

- Aqueous film-forming foam (AFFF)
- Fluoropolymer production facilities
- Other industries
- Wastewater treatment plants
- Landfills
- Land-applied biosolids

Different sources have different chemical "fingerprints"



EWG: 2,230 contaminated sites in 49 U.S. states
Over 200 million Americans with PFAS in drinking water



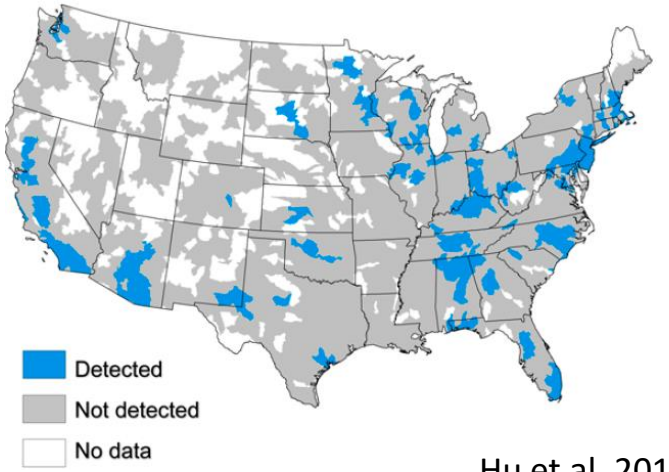
States like New Hampshire, Michigan, New Jersey, and North Carolina have more dots because they have conducted more extensive testing

https://www.ewg.org/interactive-maps/pfas_contamination/map/

PFAS monitoring in drinking water

- No ongoing drinking water testing required by US EPA
- EPA testing of large public supplies (UCMR3)
- Some states doing additional testing
- Routine monitoring limited by:
  - Cost
  - Sensitivity of lab testing
  - Range of PFAS included in current testing
  - Hard to measure "total" PFAS – how much are we missing?

UCMR3 (2013-2015)



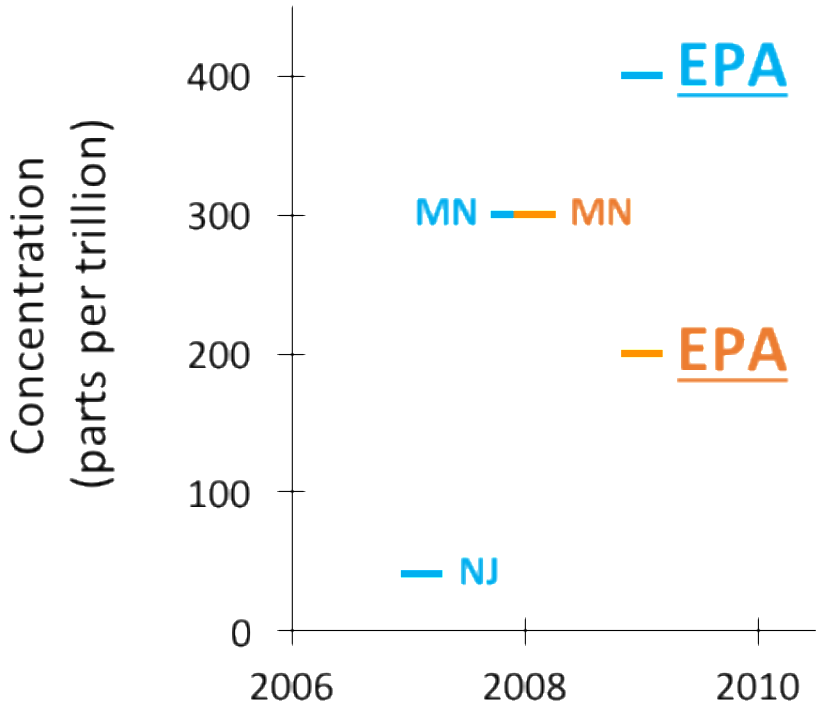
Hu et al. 2016. *ES&T Letters.* 3(10):344-50.

Drinking water regulations

We tend to think of drinking water standards as bright red lines…

…but determining standards is complex and knowledge is evolving

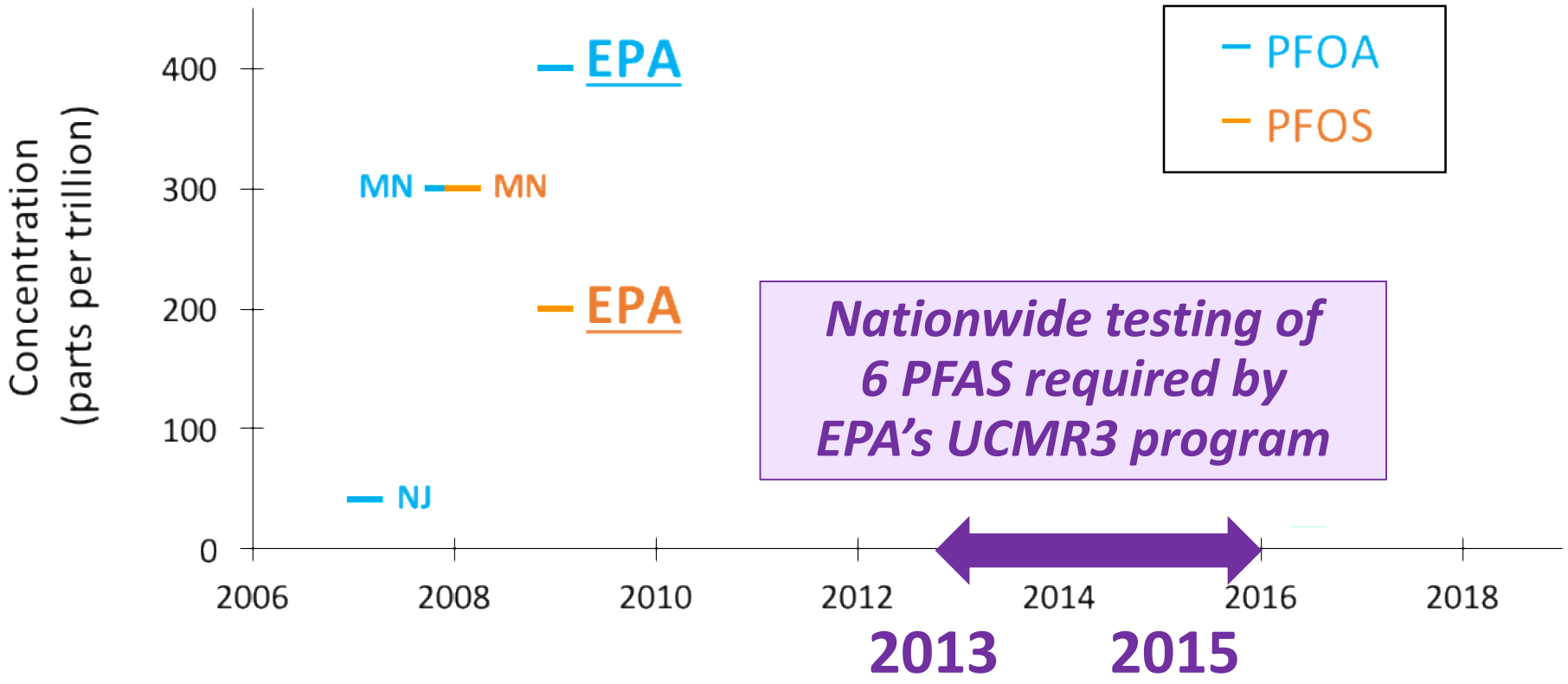
Evolving state & federal guidelines



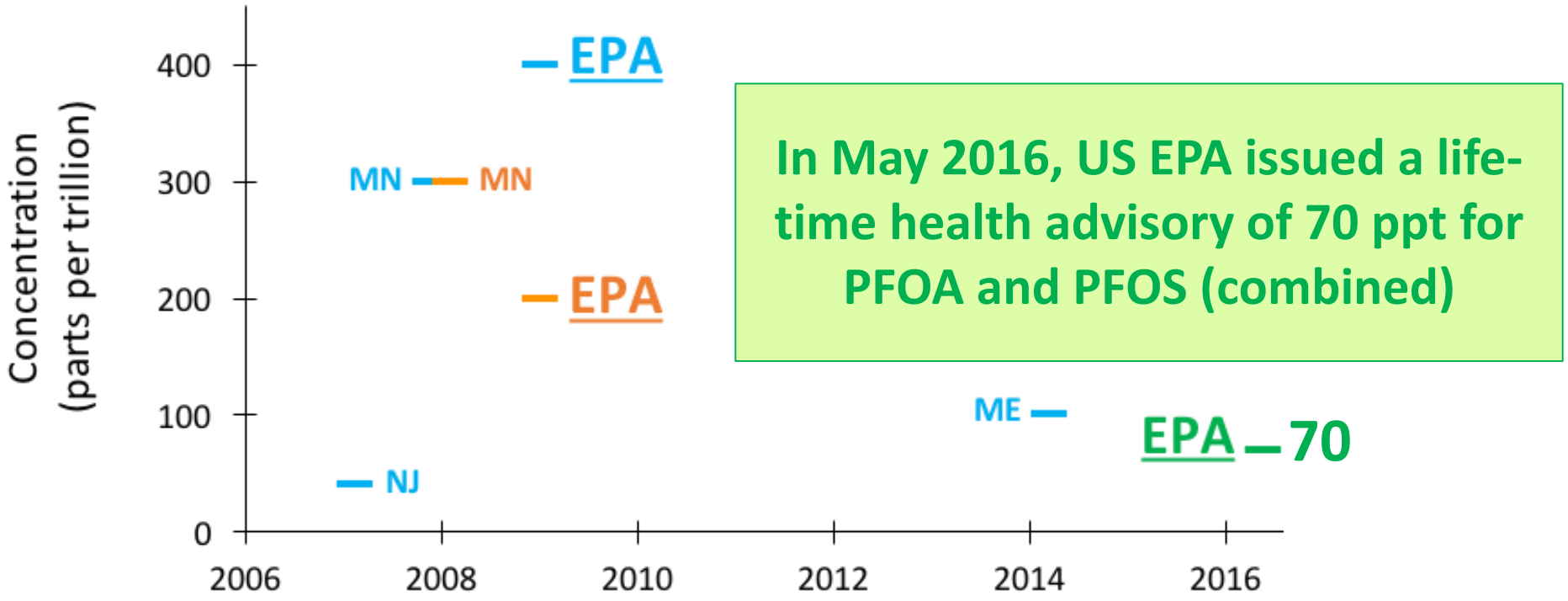
In May 2009, US EPA established provisional health advisories

- PFOA (400 parts per trillion)
- PFOS (200 parts per trillion)

Evolving state & federal guidelines

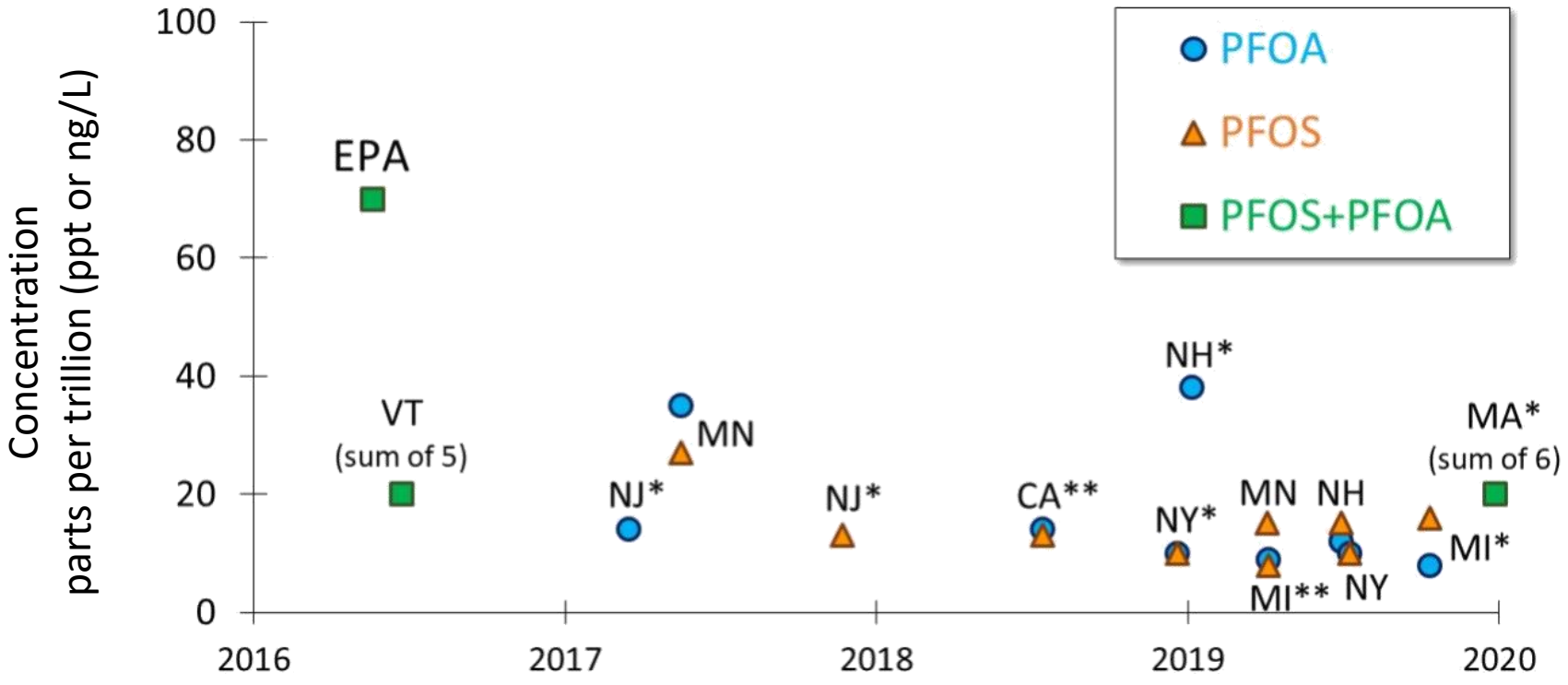


Evolving state & federal guidelines



In May 2016, US EPA issued a life-time health advisory of 70 ppt for PFOA and PFOS (combined)

Evolving state guidelines after 2016



- Guidelines declining over time
- Recent guidelines are mostly in range of 10-20 parts per trillion (ppt or ng/L)
- Additional PFAS addressed in combination or individually

	Included as individual chemicals or in combination						Total (*number of chemicals*)	Included as individual chemicals			
	PFOA	PFOS	PFNA	PFHxS	PFHpA	PFDA		PFBA	PFHxA	PFBS	GenX (HPFO-DA)
EPA	70	70					70 (*2*)				
CA	10	40									
CT	70	70	70	70	70		70 (*5*)				
MA	20	20	20	20	20	20	20 (*6*)			2,000	
MI	8	16	6	51					400,000	420	370
MN	35	15		47				7,000		2,000	
NH	12	15	11	18							
NJ	14	13	13								
NY	10	10									
NC											140
OH	70	70	21	140			70 (*2*)			140,000	700
VT	20	20	20	20	20		20 (*5*)				
WA	10	15	14	70						1,300	

Includes standards and guidelines (proposed, recommended, final)
Nanograms per liter (ng/L) or parts per trillion (ppt)
Adapted from Post 2020

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MA	20	20	20	20	20	20	20 (*6*)			2,000	
MI	8	16	6	51					400,000	420	370
MN	35	15		47				7,000		2,000	
NH	**12**	**15**	**11**	**18**							
NJ	14	13	13								
NY	10	10									
NC											140
OH	70	70	21	140			70 (*2*)			140,000	700
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Developing drinking water guidelines

- Determine most sensitive endpoint, often from animal studies
- Uncertainty factors to account for data gaps, extrapolating from animals to people, sensitive populations

- Incorporate drinking water consumption rate
- Account for other sources of exposure (Relative Source Contribution)

Journal of Exposure Science & Environmental Epidemiology
https://doi.org/10.1038/s41370-018-0099-9

ARTICLE

Guideline levels for PFOA and PFOS in drinking water: the role of scientific uncertainty, risk assessment decisions, and social factors

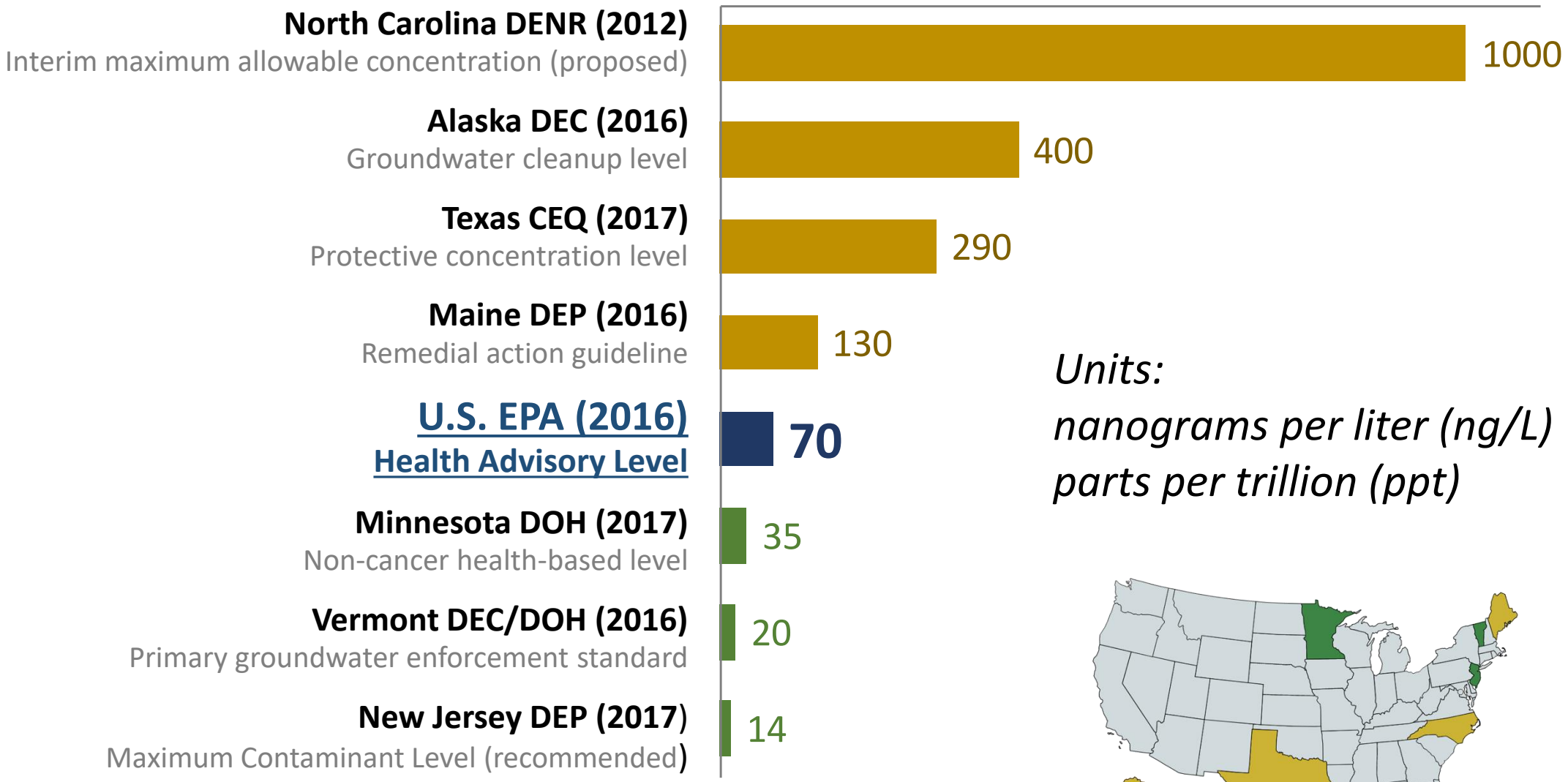
Alissa Cordner[1] · Vanessa Y. De La Rosa[2,3] · Laurel A. Schaider[2] · Ruthann A. Rudel[2] · Lauren Richter[3] · Phil Brown[3,4]

Available from *Journal of Exposure Science & Environmental Epidemiology*

https://www.nature.com/articles/s41370-018-0099-9

Published January 2019

PFOA Guideline Levels



Units:
nanograms per liter (ng/L)
parts per trillion (ppt)

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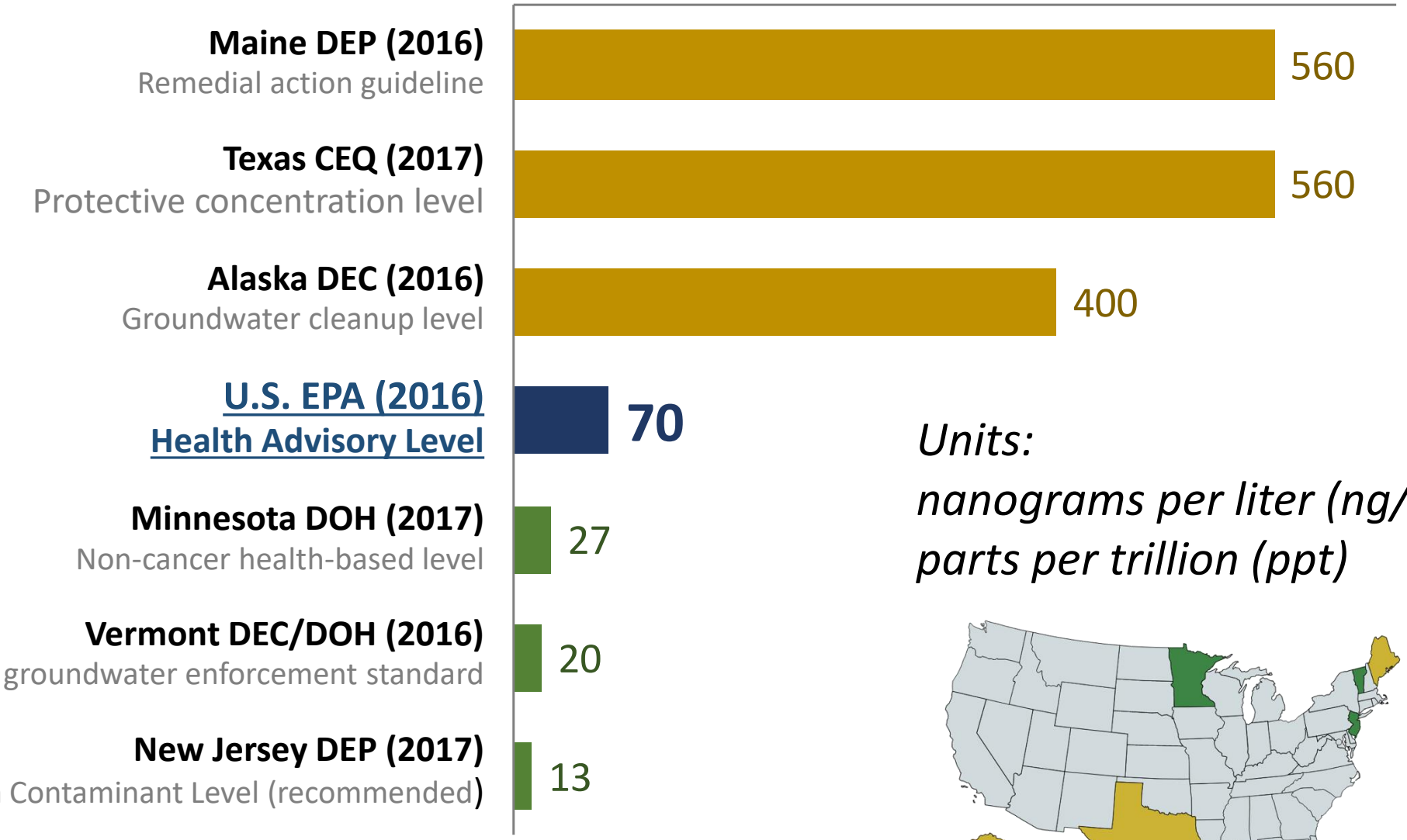
PFOS Guideline Levels



Units:
nanograms per liter (ng/L)
parts per trillion (ppt)

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PFOA Advisories	Advisory Level	Toxicological Endpoint	Reference Dose	Uncertainty Factors	
U.S. EPA (2016) Health Advisory Level	**70 ng/L**	**Developmental**	**20 ng/kg/day**	**300**	**Intraspecies 10 Interspecies 3 LOAEL to NOAEL 10**
N. Carolina DENR (2012) Interim maximum allowable concentration (proposed)	1,000 ng/L	Liver	N/A	30	Intraspecies 10 Interspecies 3
Alaska DEC (2016) Groundwater cleanup level	400 ng/L	Developmental	20 ng/kg/day	300	Intraspecies 10 Interspecies 3 LOAEL to NOAEL 10
Texas CEQ (2017) Protective concentration level	290 ng/L	Mammary Gland	15 ng/kg/day	300	Intraspecies 10 LOAEL to NOAEL 30
Maine DEP (2016) Remedial action guideline	130 ng/L	Liver	6 ng/kg/day	300	Intraspecies 10 Interspecies 3 Database 10
Minnesota DOH (2017) Non-cancer health-based level	35 ng/L	Developmental	18 ng/kg/day	300	Intraspecies 10 Interspecies 3 LOAEL to NOAEL 3 Database 3
Vermont DEC/DOH (2016) Primary groundwater enforcement standard	20 ng/L	Developmental	20 ng/kg/day	300	Intraspecies 10 Interspecies 3 LOAEL to NOAEL 10
New Jersey DEP (2017) Maximum contaminant level (recommended)	14 ng/L	Liver	2 ng/kg/day	300	Intraspecies 10 Interspecies 3 Database 10

PFOA Advisories	Advisory Level	Target Population	Water ingestion rate	Relative source contribution
U.S. EPA (2016) Health Advisory Level	**70 ng/L**	 **Lactating women**	**0.054 L/kg/day (=3.8 L for 70 kg body wt.)**	**20%**
N. Carolina DENR (2012) Interim maximum allowable concentration (proposed)	1,000 ng/L	 Adults	2 L/day (assumes 70 kg body wt.)	20%
Alaska DEC (2016) Groundwater cleanup level	400 ng/L	 Children (0-6 years) residential	0.78 L/day (assumes 15 kg body wt.)	100%
Texas CEQ (2017) Protective concentration level	290 ng/L	 Children (0-6 years) residential	0.64 L/day (assumes 15 kg body wt.)	100%
Maine DEP (2016) Remedial action guideline	130 ng/L	 Adults	2 L/day (assumes 70 kg body wt.)	60%
Minnesota DOH (2017) Non-cancer health-based level	35 ng/L	 Infants exposed from breastmilk	95th percentile water intake and upper percentile breastmilk intake	50%
Vermont DEC/DOH (2016) Primary groundwater enforcement standard	20 ng/L	 Infants (0-1 years)	0.175 L/kg/day	20%
New Jersey DEP (2017) Maximum contaminant level (recommended)	14 ng/L	 Adults	2 L/day (assumes 70 kg body wt.)	20%

Other considerations

- Growing body of evidence leads to lower levels over time
- Influence of EPA assessments
- Epidemiological evidence
- Guidelines not necessarily based on most sensitive endpoints (mammary gland and immunotoxicity)

Implications

- Assessments by multiple states and research scientists suggest that EPA's Health Advisories are not sufficiently protective
  - Lower risk levels from ATSDR and European Food Safety Authority
- Regulatory MCL has benefits and limitations
  - Other options: Listing under CERCLA and/or RCRA
- Patchwork of state levels and legislation leads to uneven protection

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RESOURCES:

- Silent Spring Institute
  www.silentspring.org
- URI STEEP Superfund Research Program
  web.uri.edu/steep
- PFAS Exchange, part of PFAS-REACH
  www.pfas-exchange.org