Monitoring and Action for PFAS-Impacted Biosolids and Foods

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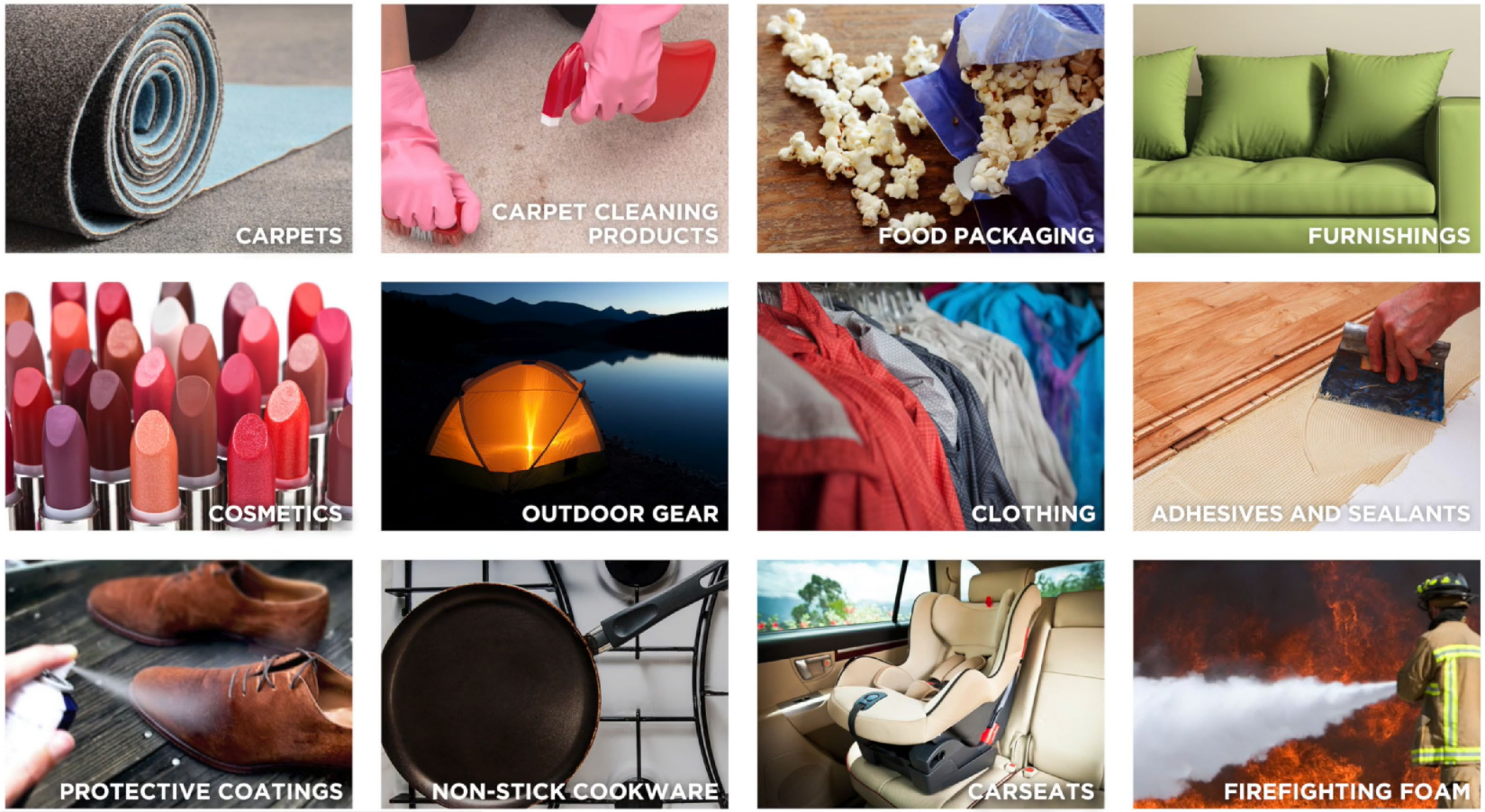
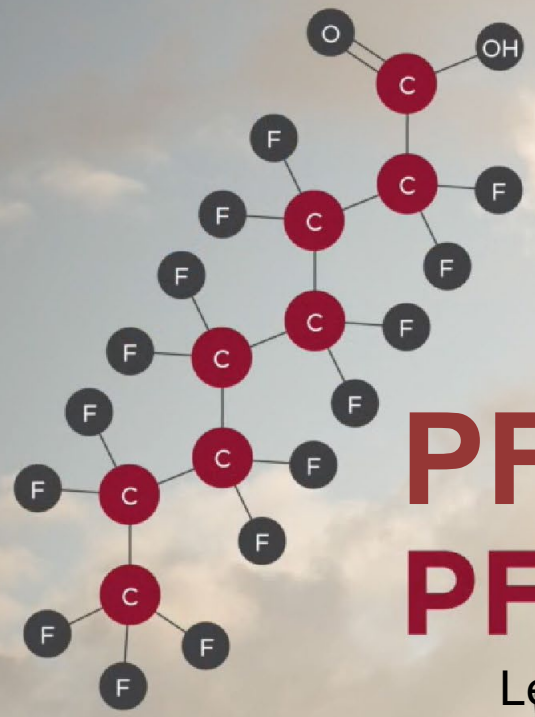
Association of Food and Drug Officials
June 8, 2024
*Updated 6/21/24 to improve clarity and include captions

Provide Stain, Grease, Water and Fire Resistance



https://www.youtube.com/watch?v=imZUJJ8keBE

SIXCLASSES.ORG
GREEN SCIENCE POLICY INSTITUTE



‘Forever Chemicals’ Perfluoroalkyl Substances (PFAS)

C6 | C4 | C3

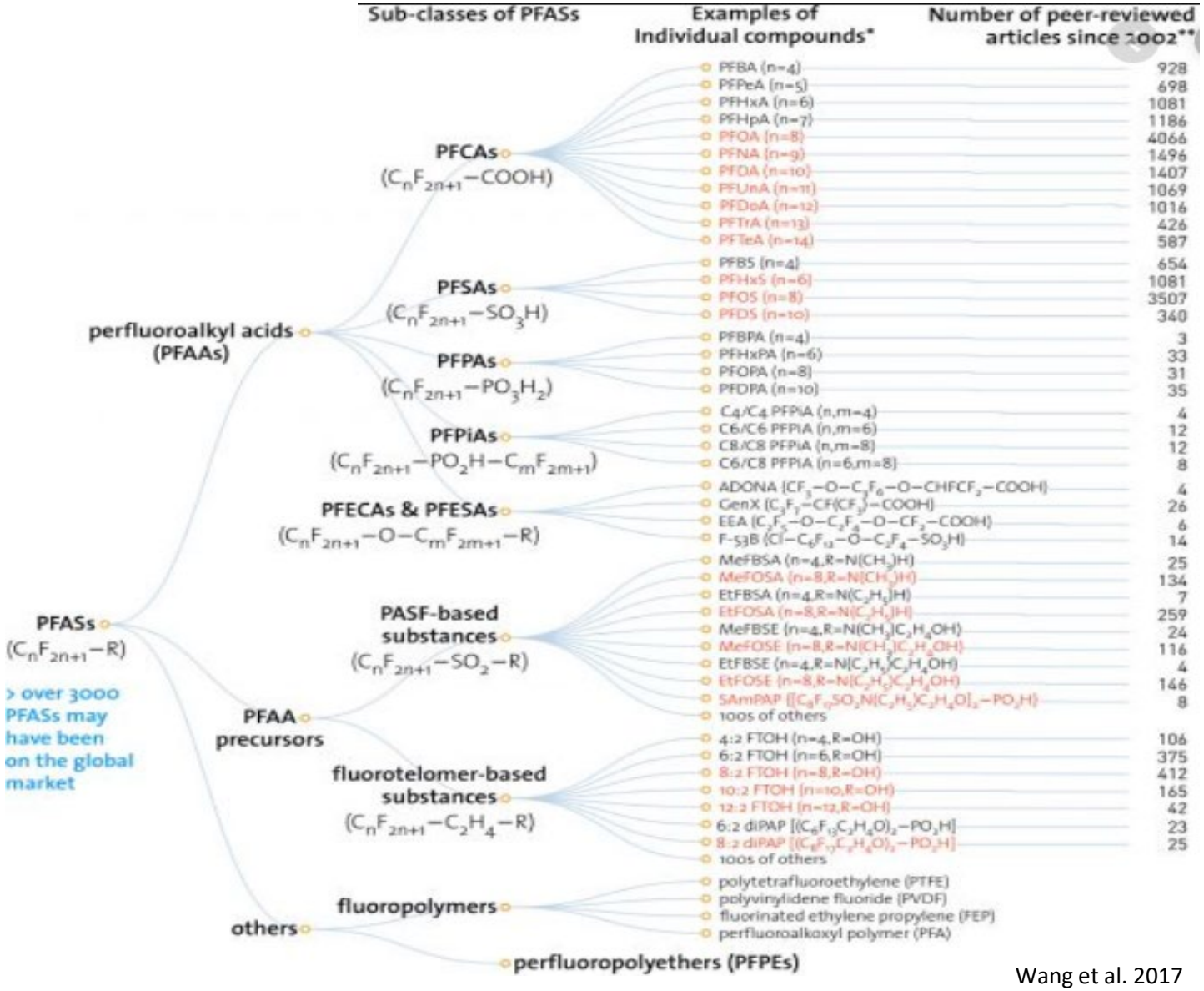
Current Use
‘Short Chain’

C8

PFOS
PFOA

Legacy
‘Long Chain’

https://www.youtube.com/watch?v=jmZUJJ8keBE

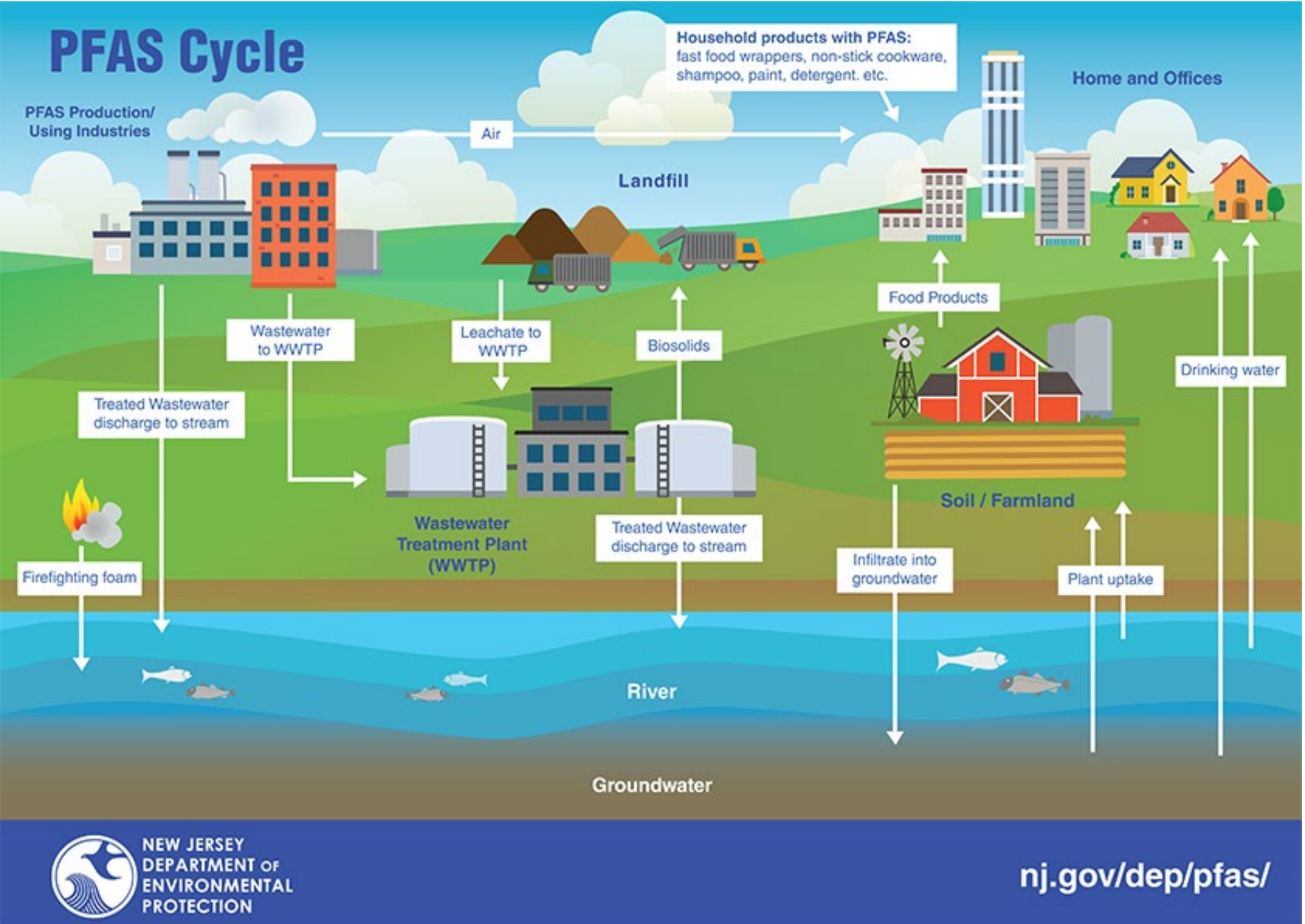


Wang et al. 2017

Thousands of PFAS

This shows major categories

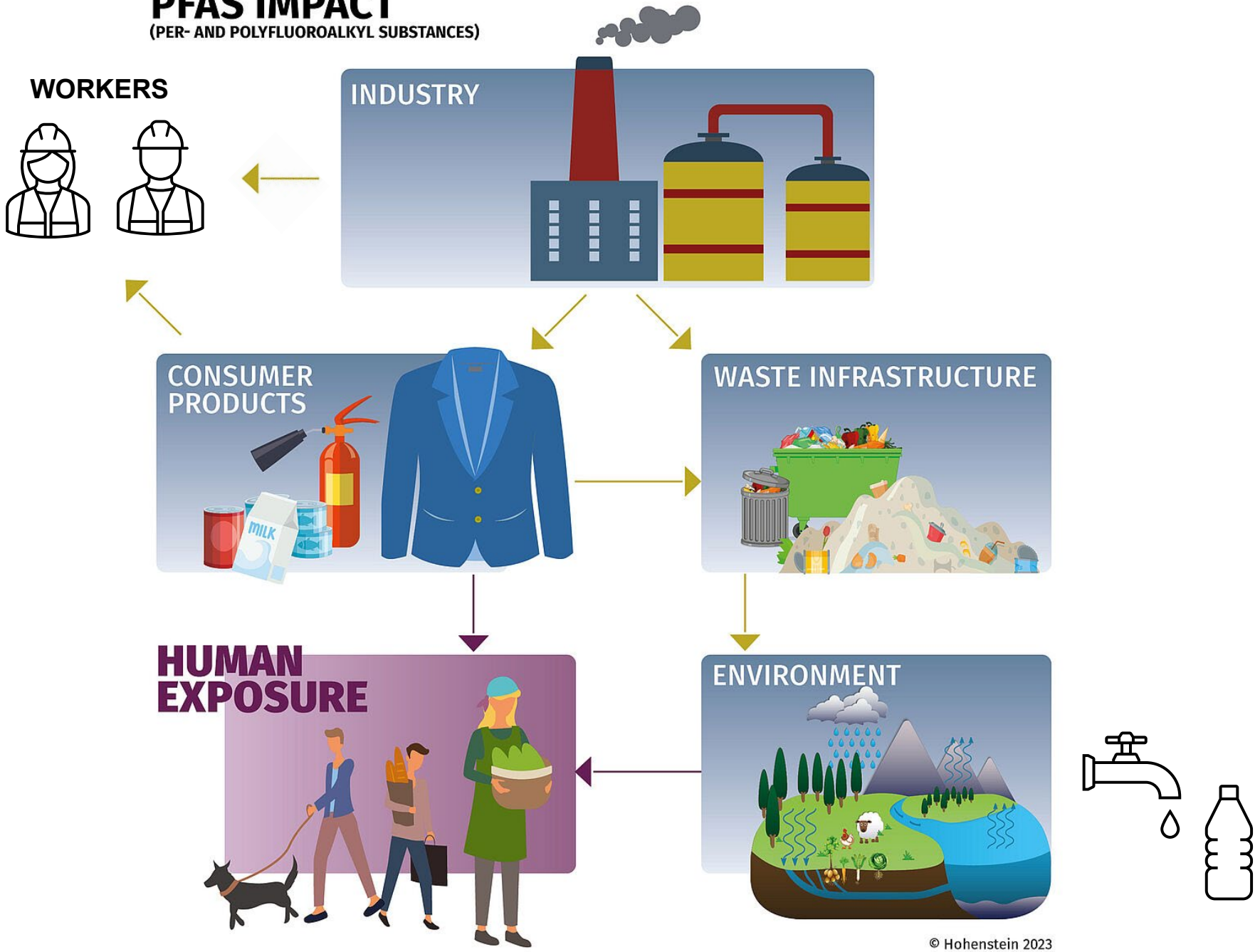
Many ‘short chain’ PFAS are *precursors*, which means they can transform into the ‘long chain’ PFAS

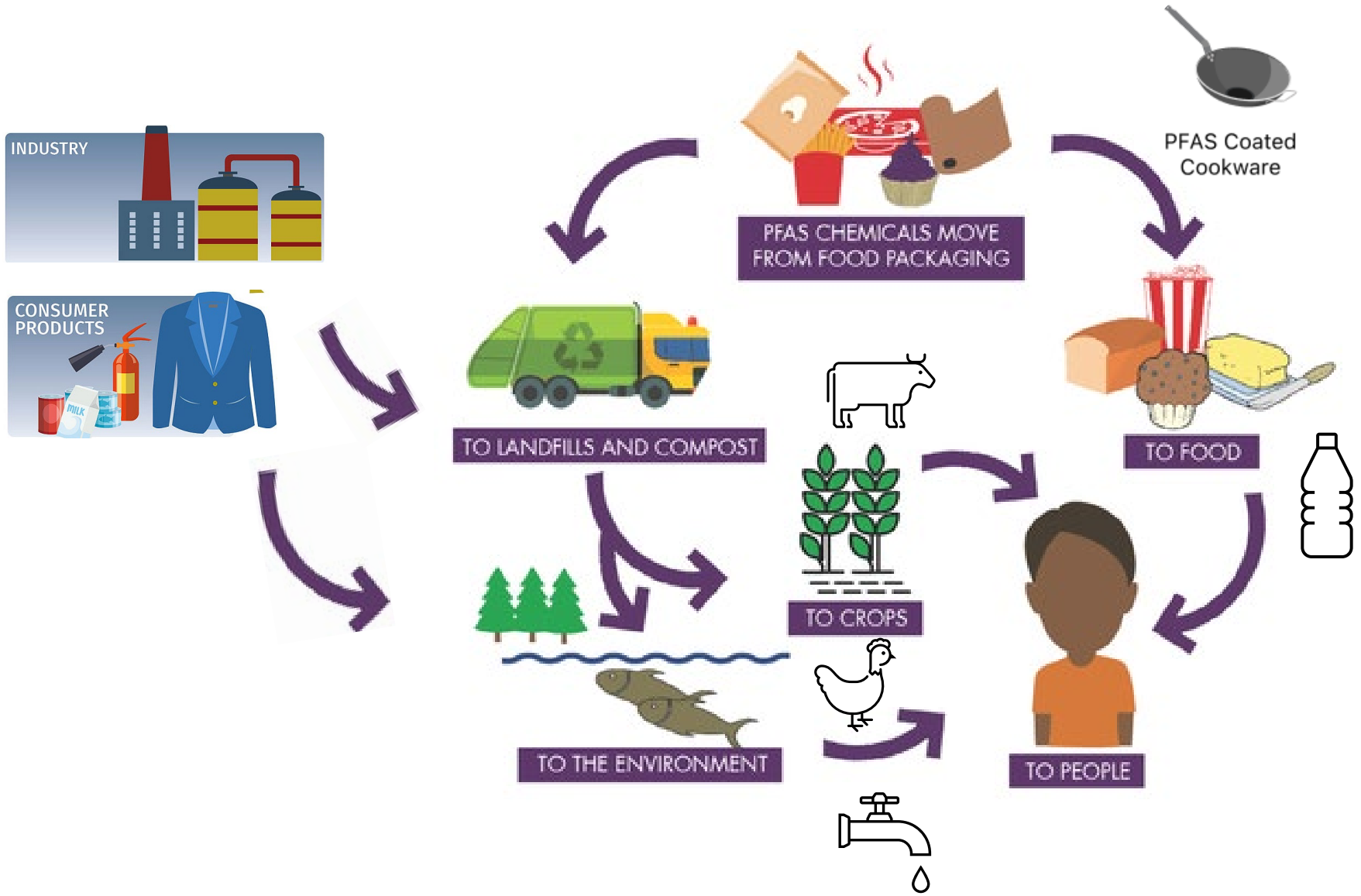


Migrate easily from industrial plants and products

PFAS IMPACT

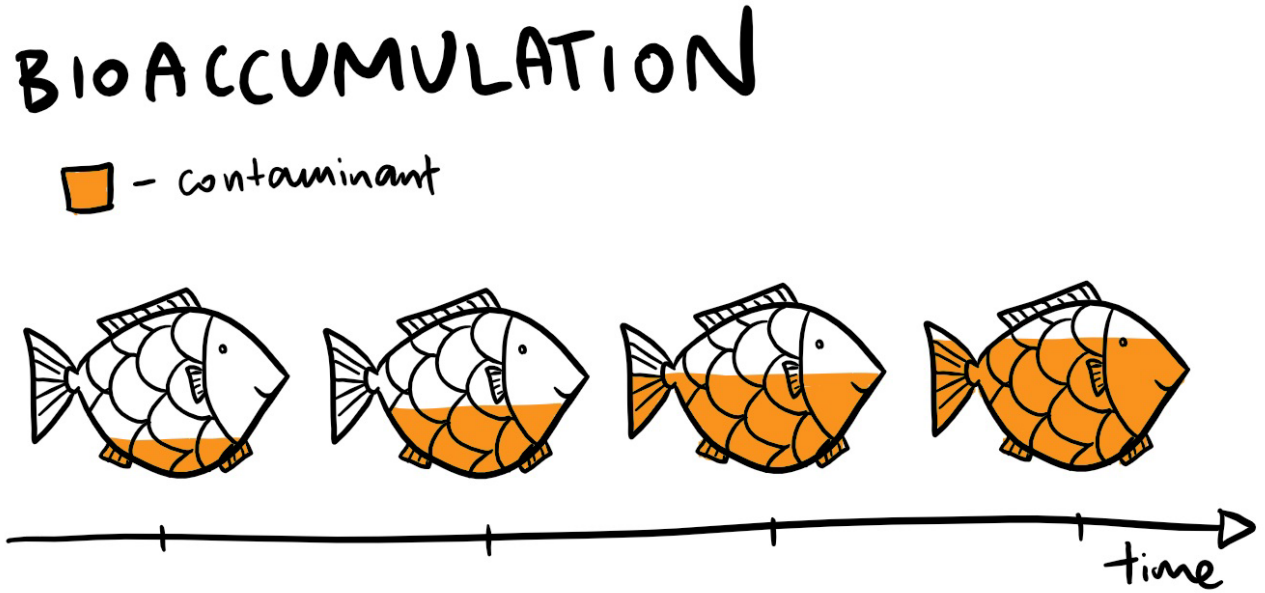
(PER- AND POLYFLUOROALKYL SUBSTANCES)



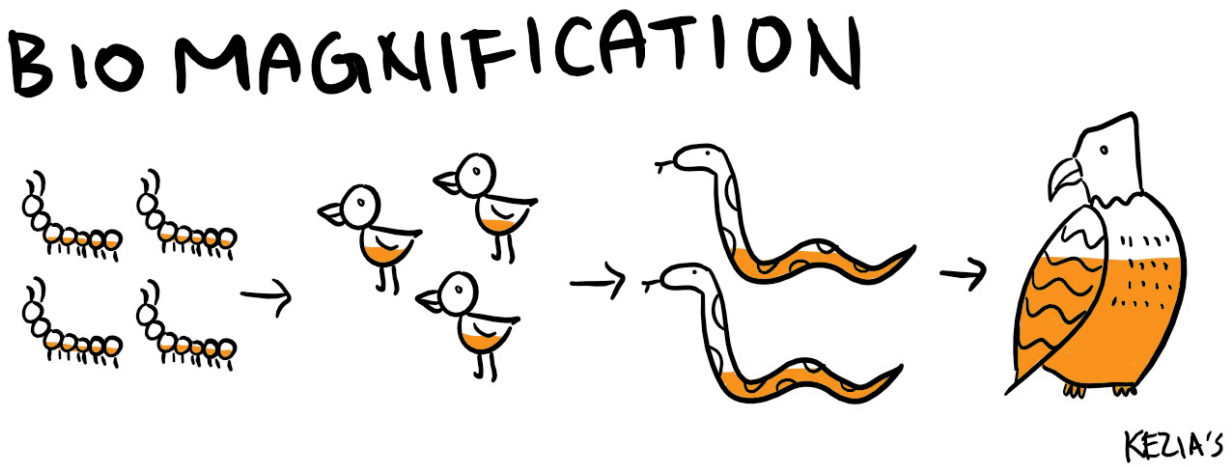


Diet is believed to be the primary PFAS contributor for the general population.

There are many pathways via food contact materials and the environment



Bioaccumulate in animals over time



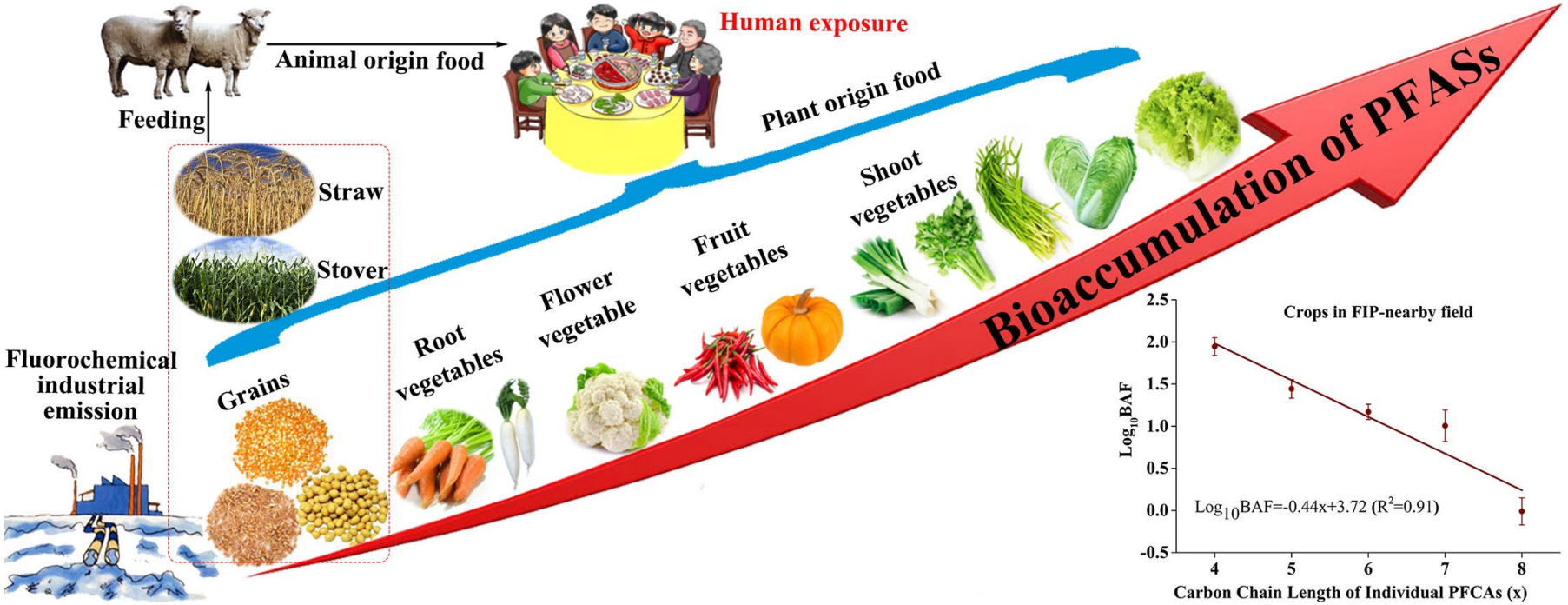
Biomagnify up the food chain

Extremely persistent

Transported all over the world

Accumulate in animals and up the food chain

Legacy (long-chain) PFAS bioaccumulate in animals

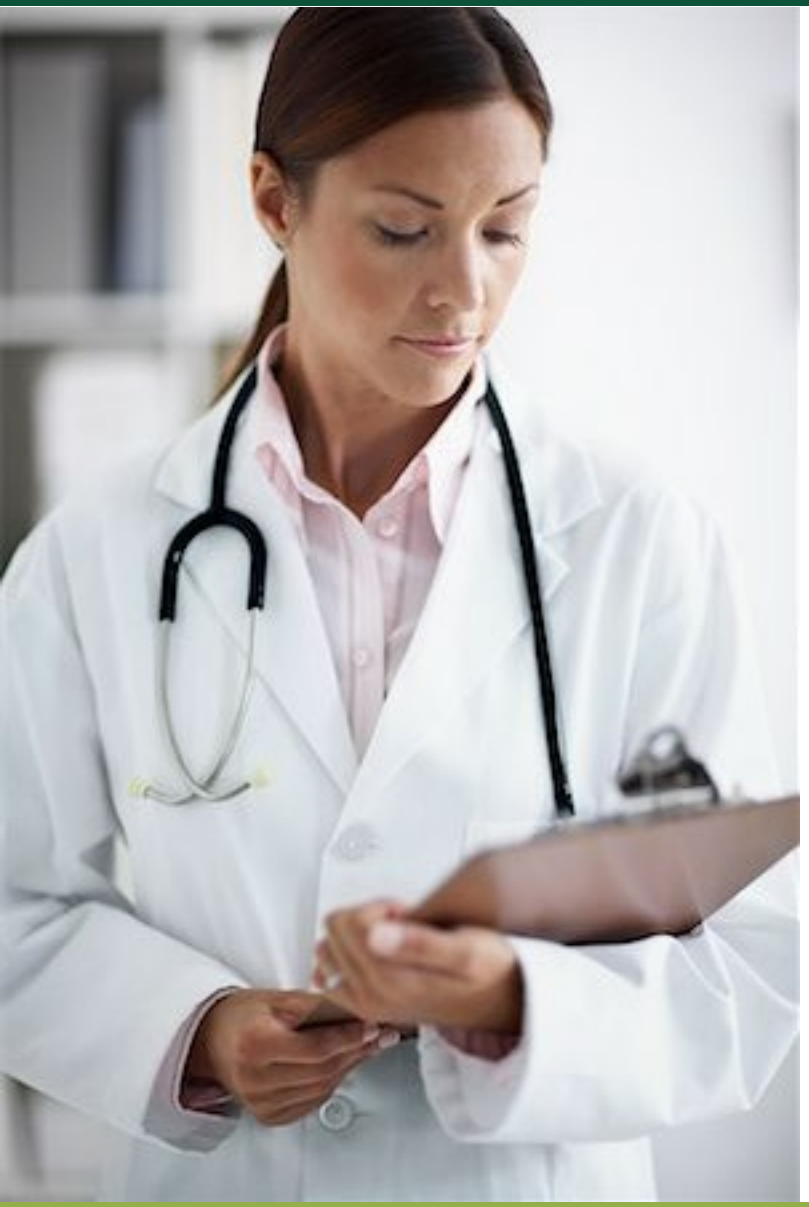


Current use (short-chain) PFAS are taken up into produce

Liu et al 2019

Found in the bodies of most Americans

Born exposed



Health Concerns:

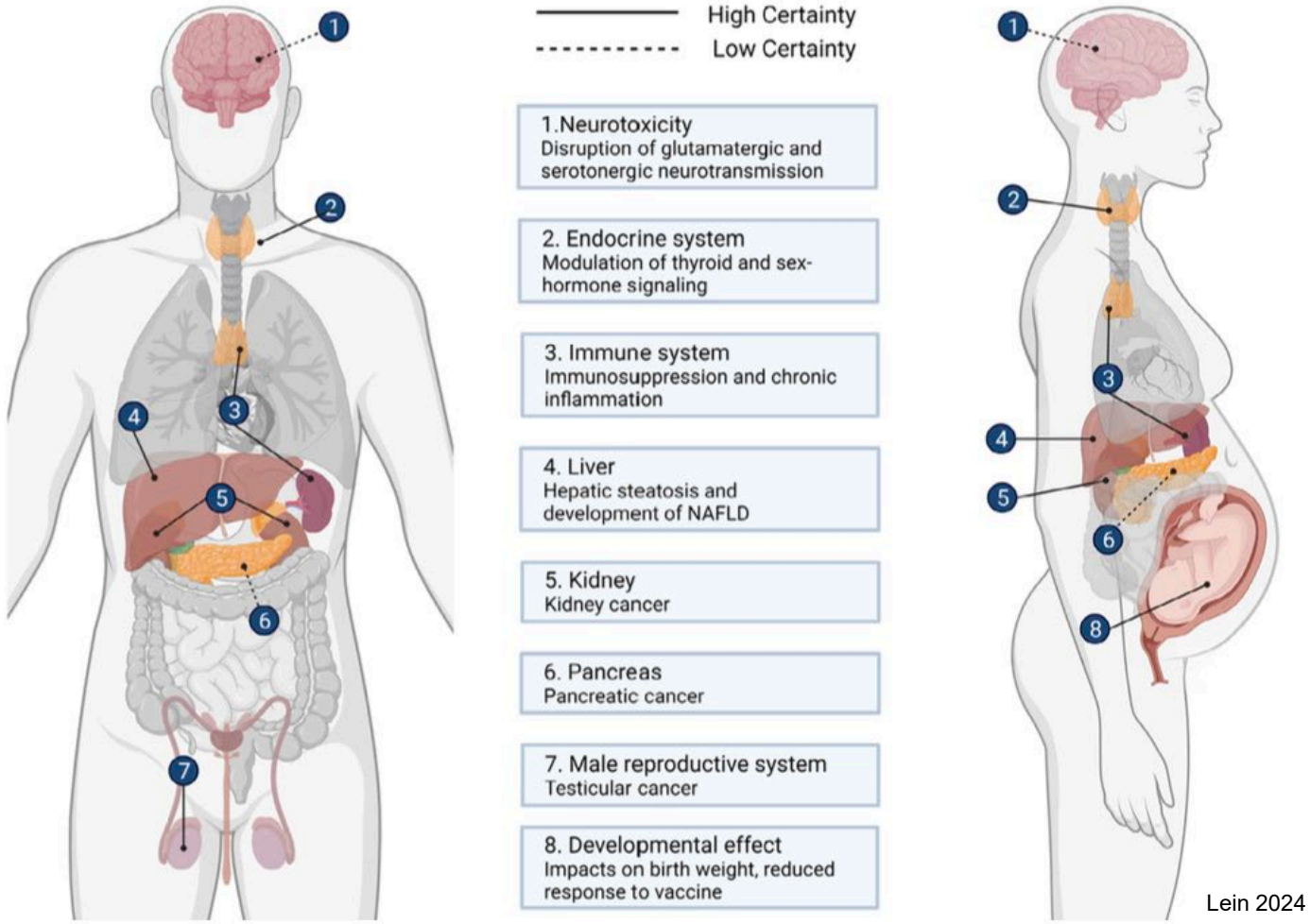
- High cholesterol
- Immune effects (e.g., reduced antibody response)
- Decreased infant and fetal growth
- Certain cancers (kidney, testicular, breast)
- Pregnancy induced hypertension
- Thyroid disease and dysfunction
- Autoimmune disease (e.g., ulcerative colitis)

https://www.nationalacademies.org/our-work/guidance-on-pfas-testing-and-health-outcomes

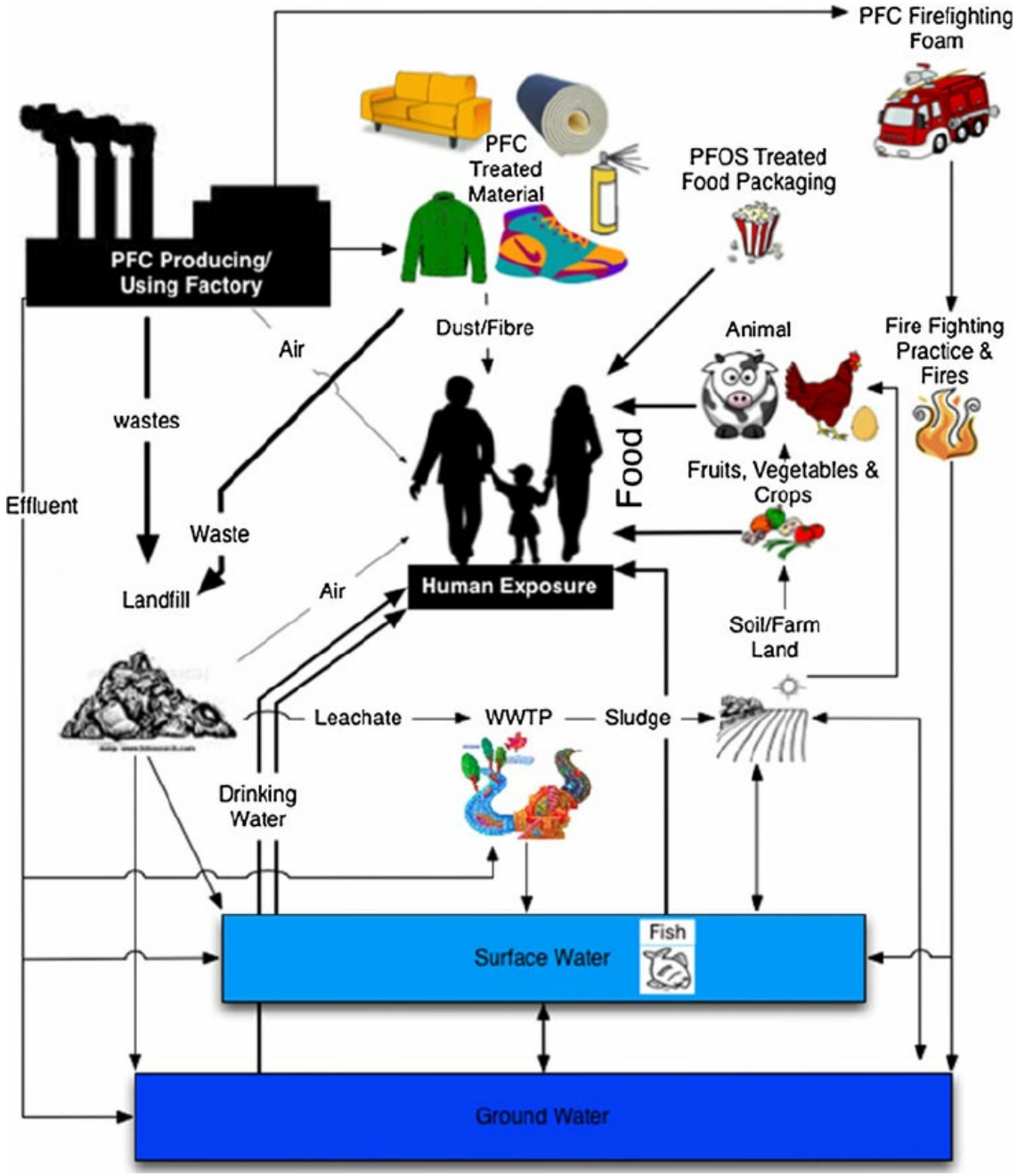
Figure 2: *Toxicological effects of PFAS on human biology. Solid lines indicate biological effects for which there is strong evidence; dashed lines, biological effects for which there is more limited evidence.*

Effect multiple systems of the body.

Sensitive endpoints are developmental and immune.



Lein 2024



Oliaei et al. 2012

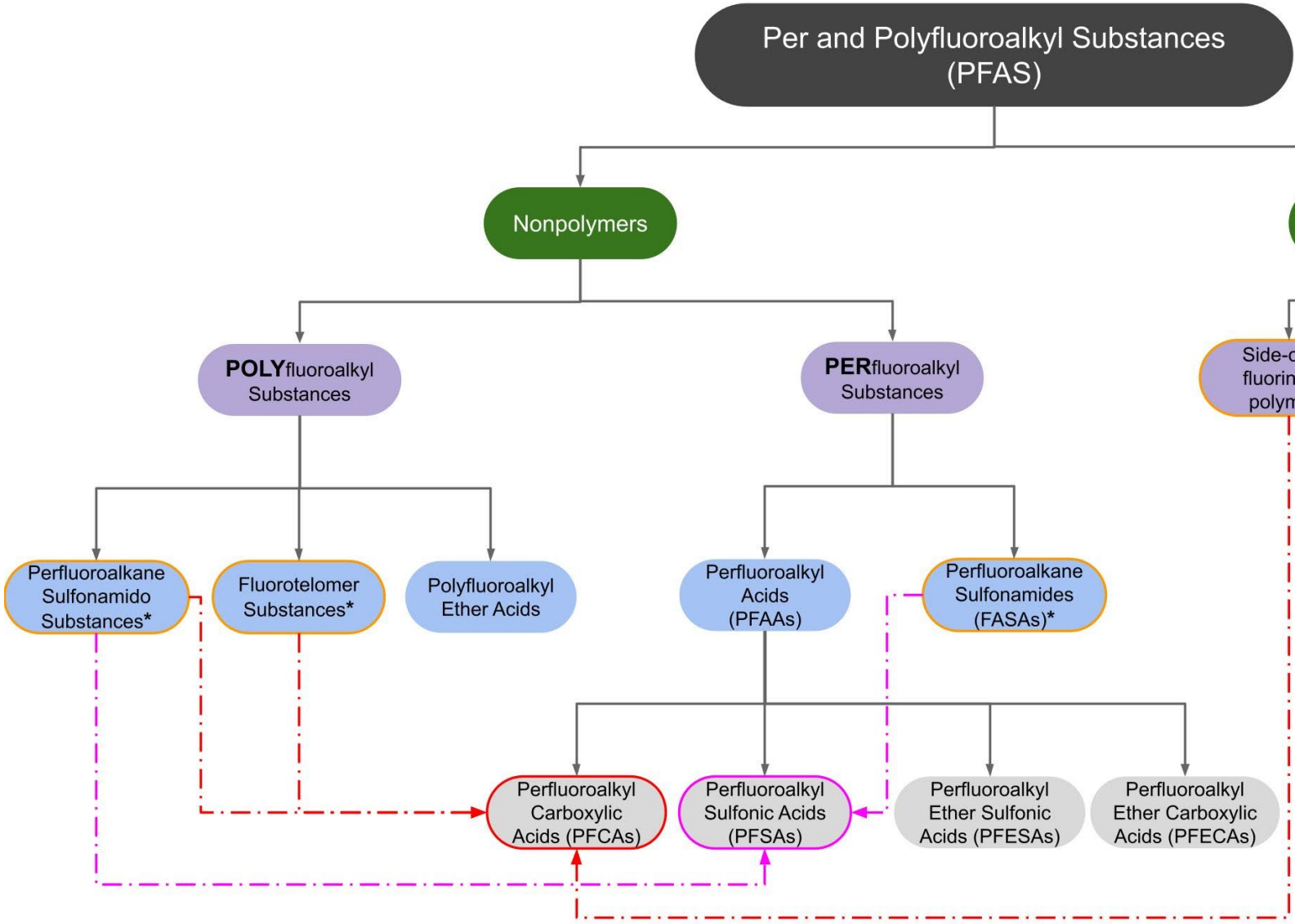
Based on Schaider et al. ES&T Letters 2017

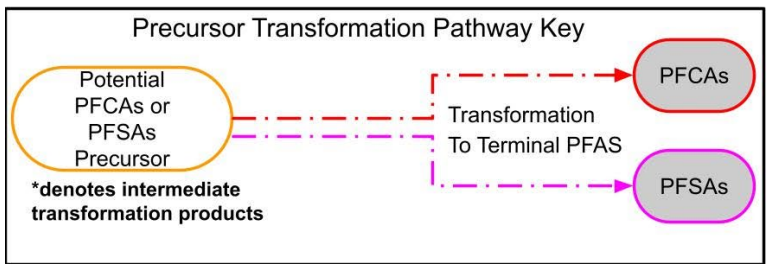
Food Contact Materials

- Applied to paper food packaging for grease resistance
- Migrates from packaging into foods
- People who eat more popcorn have higher PFAS levels in their blood
- Transitioned from long-chain (PFOA) to short-chain (6:2 FTS)
- FDA announced in 2024 that grease-proofing materials containing PFAS are no longer being sold for use in food packaging in the U.S.

Phased out (not regulated) domestically

Still FDA authorized for limited use in cookware, food packaging and food processing equipment





POLYfluoroalkyl substances contain a carbon alkyl backbone, attached to a functional group(s), with *at least* one hydrogen bonded to carbon replaced with fluorine

PERfluoroalkyl substances have a carbon alkyl backbone, attached to a functional group(s), with *only* fluorine atoms replacing *all* hydrogens

Adapted from Interstate Technology & Regulatory Council (2022)

Family tree of PFAS sub-groups

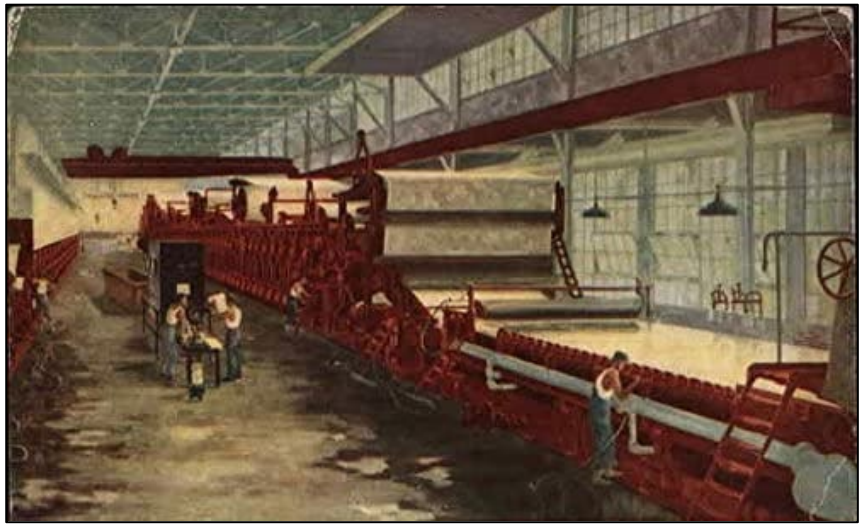
Large class of over 20,000 chemicals

Include many ‘precursors’ that transform to PFCAs and PFSAs in the environment and our bodies

Total organic fluorine tests can help identify how much PFAS is not identify by standard method

https://www.sfei.org/projects/pfas

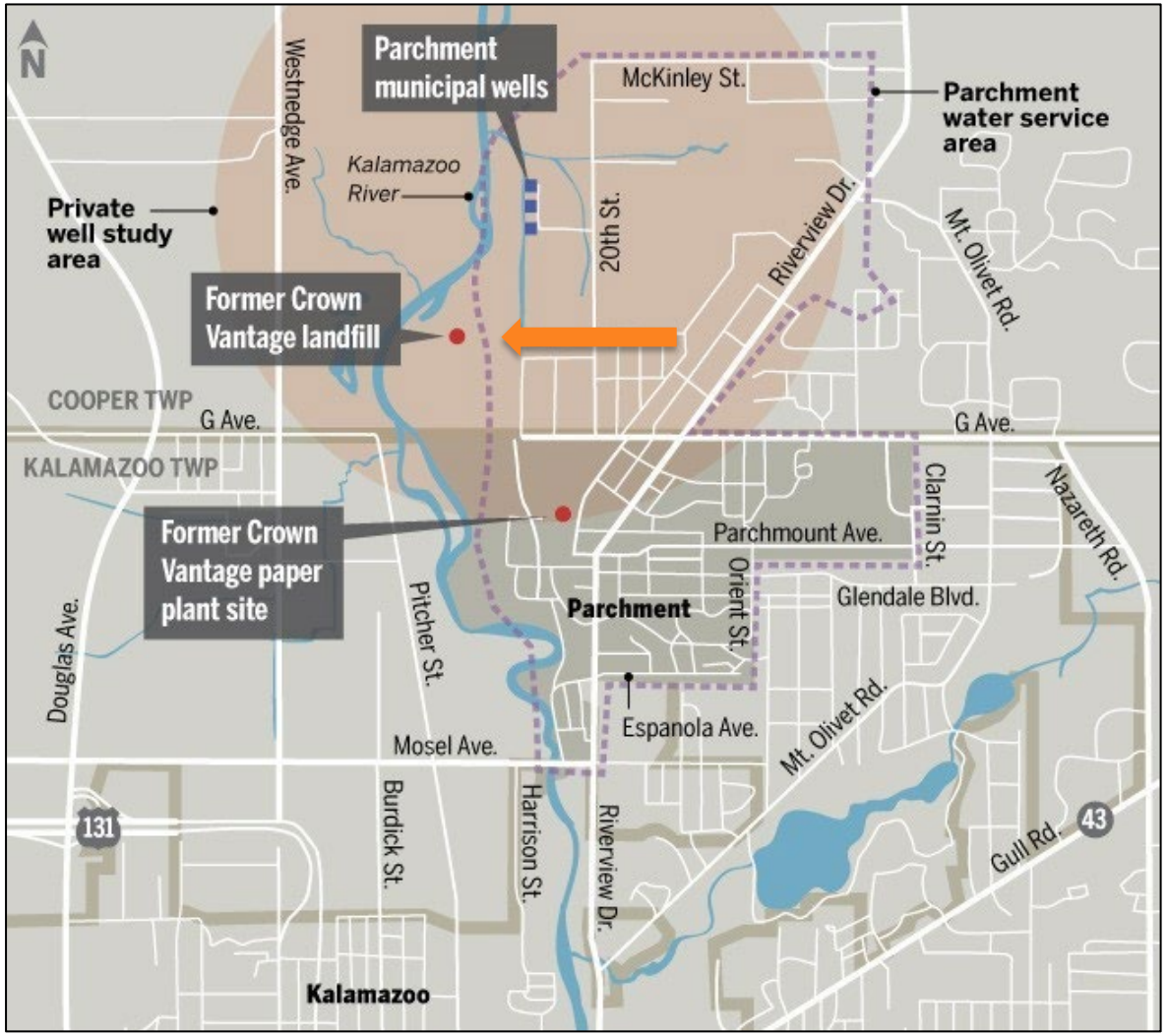
Former Crown Vantage Paper Mill
Parchment, MI



Used in grease resistant paper food packaging

Paper making waste disposed in nearby landfill

PFAS from the landfill contaminated the groundwater and the nearby municipal wells

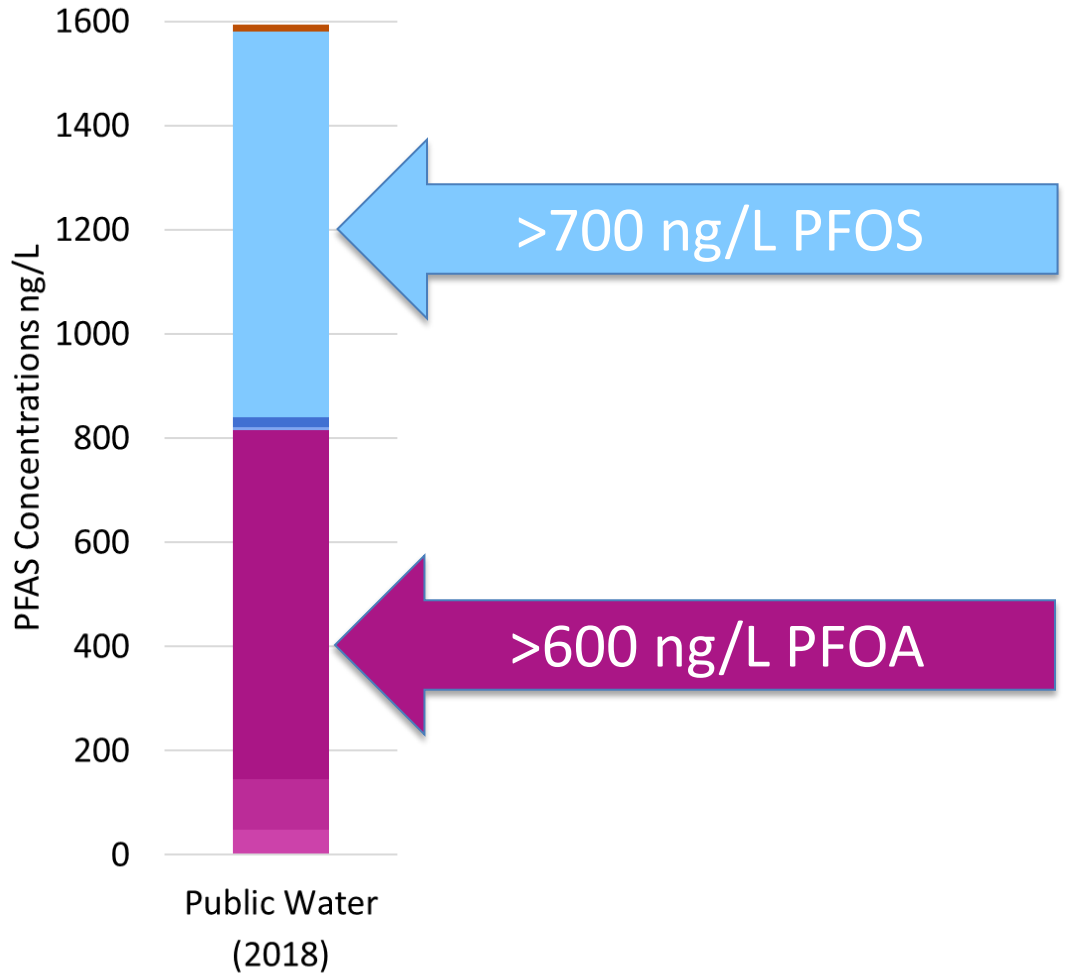


Milt Klingensmith | MLive.com

PFAS Concentration (ng/L)

High PFAS Concentrations in Municipal Water

1600 ng/L (parts per trillion)



>700 ng/L PFOS

>600 ng/L PFOA

4 ng/L for PFOS

Maximum Contaminant Levels (MCLs)

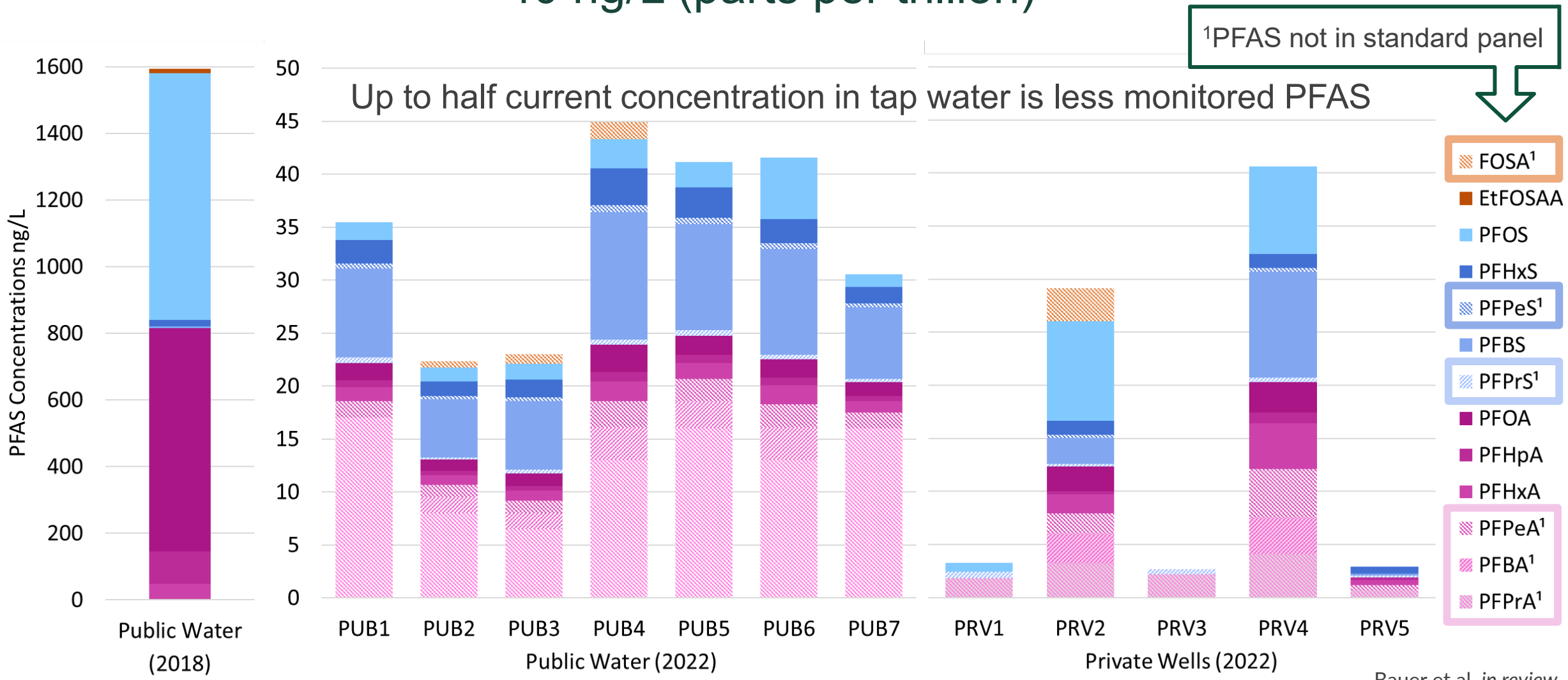
4 ng/L for PFOA

Bauer et al. *in review*

Drinking Water Interventions

Lower PFAS Concentrations in Current Tap Water

<40 ng/L (parts per trillion)



Bauer et al. *in review*

Local and Home Produced Foods

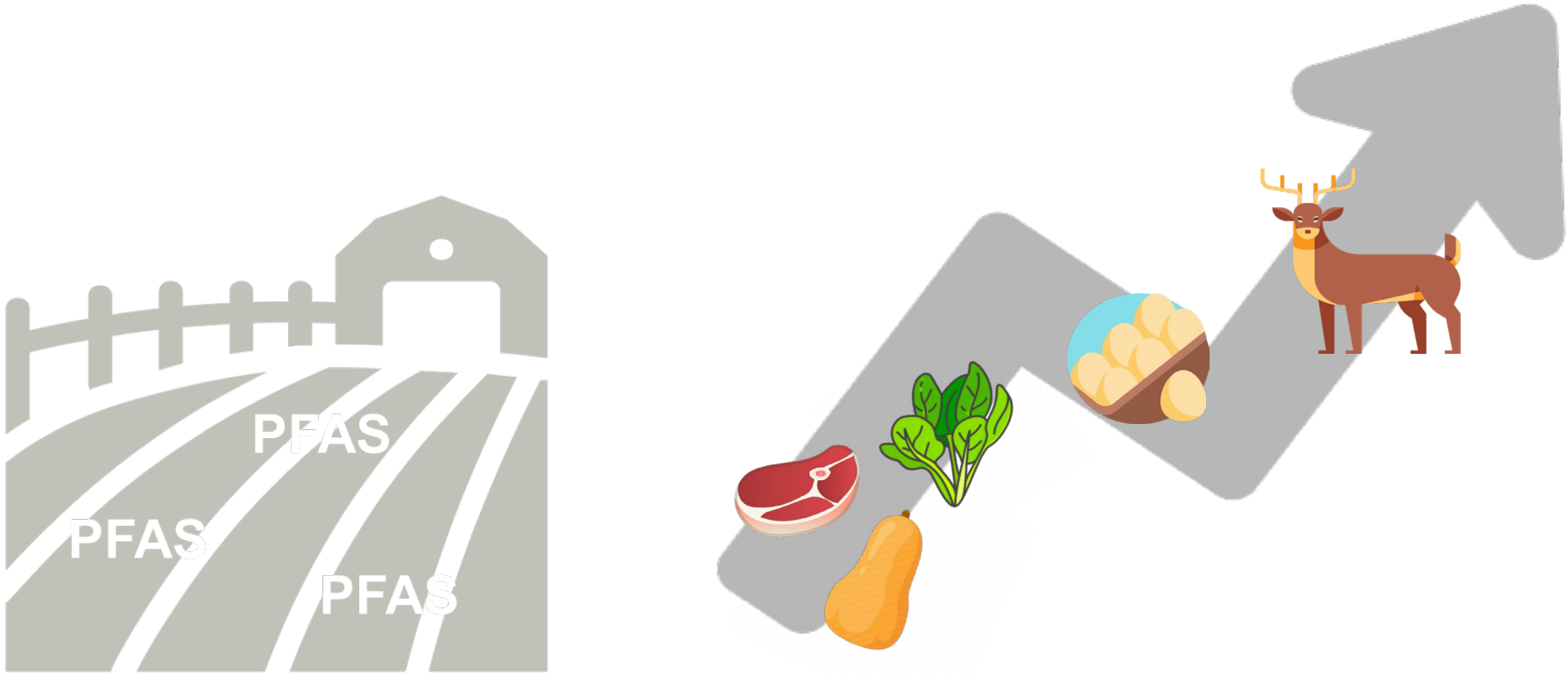
Local Fish


Home Grown Produce


Home Produced Eggs


Local Venison

Elevated PFAS in animal products and some produce contribute to local dietary exposure

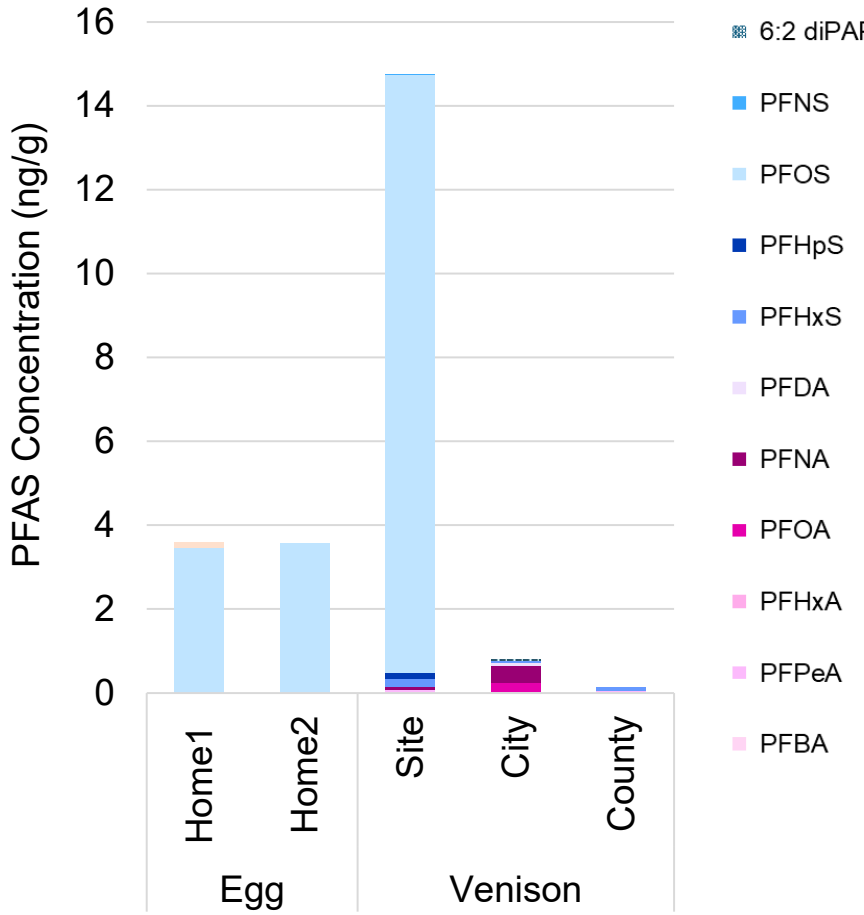


Credit: A. Bhattacharya

PFAS in home/local foods 3 years after the intervention

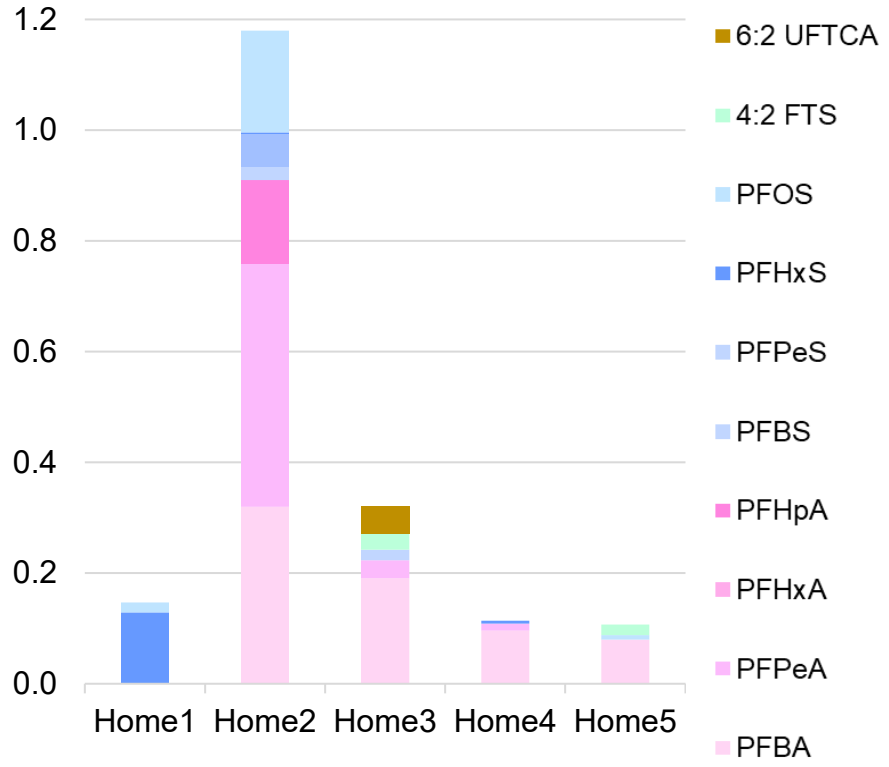
Eggs & Venison

(ppb)



Garden Produce

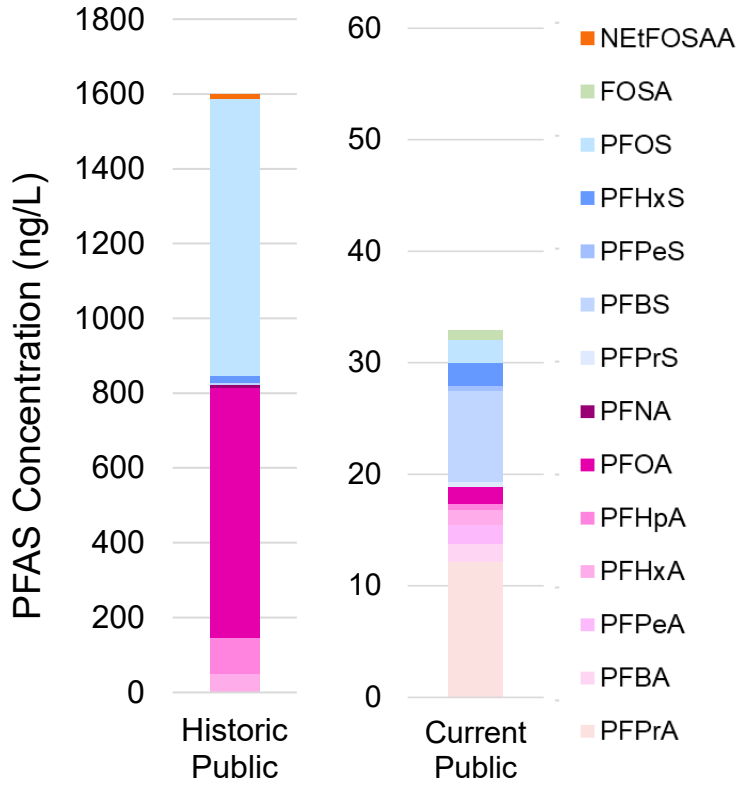
(ppb)



Levels in water pre- and post intervention

Tap Water

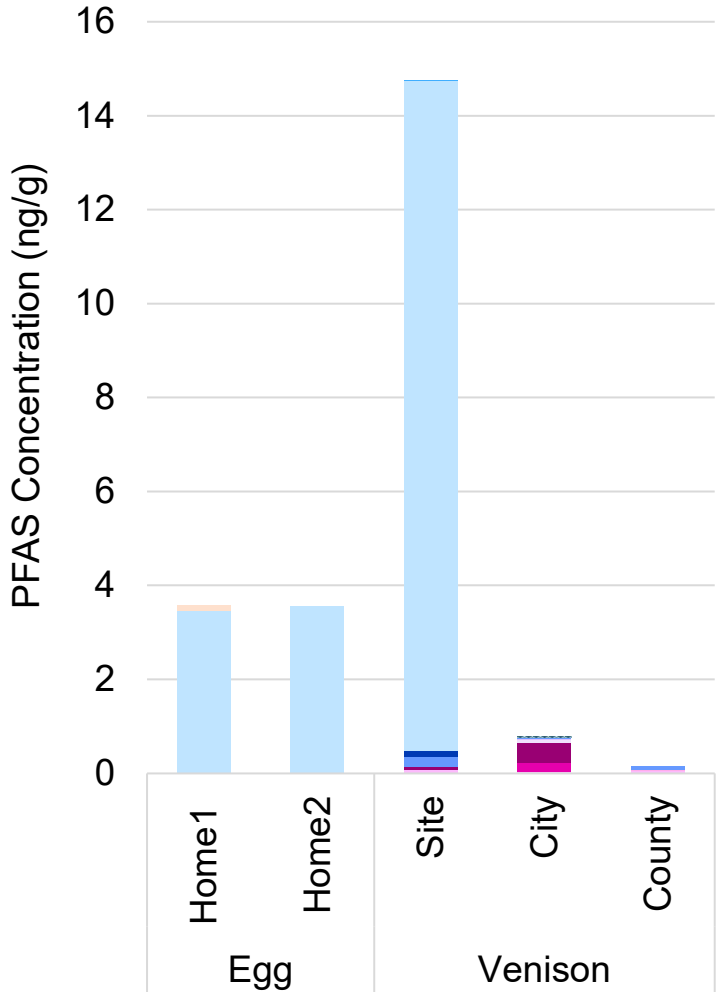
(ppt)



Bhattacharya et al. *in review*

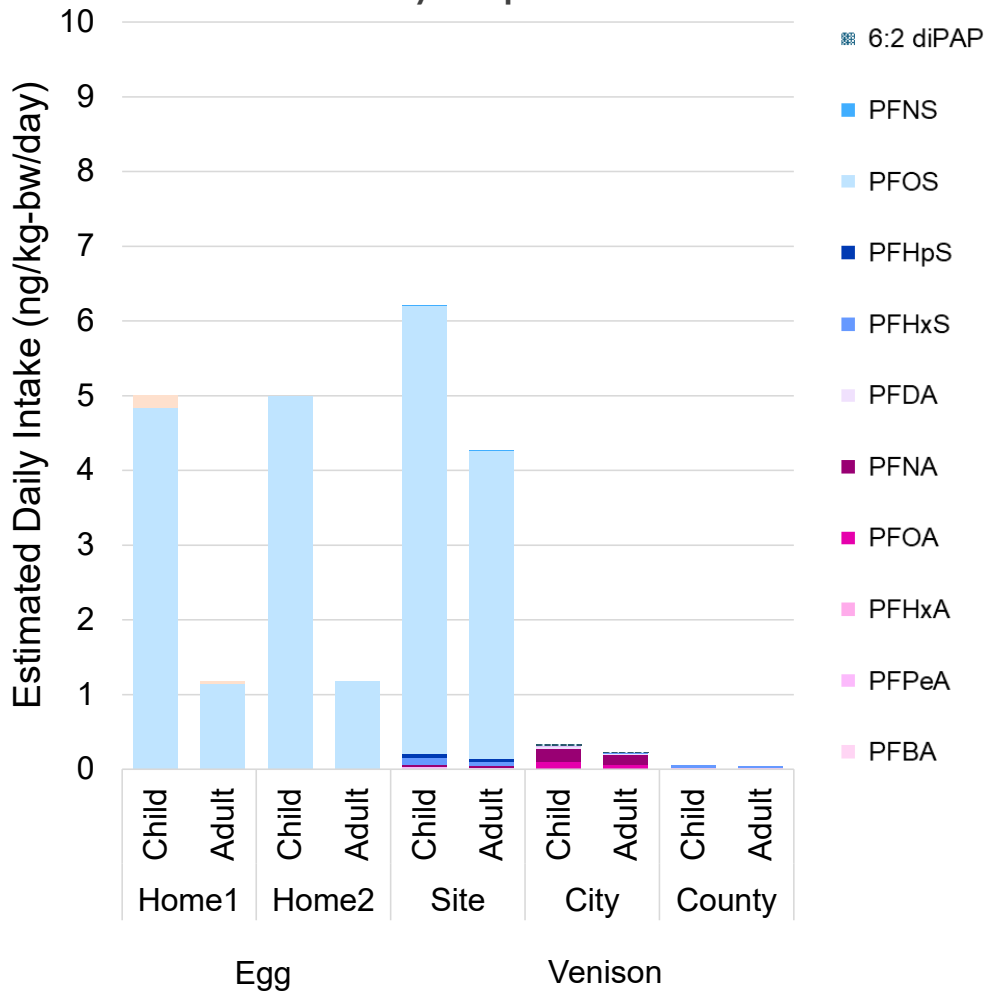
Eggs & Venison

Concentration



Eggs & Venison

Dietary Exposure



PFOS exposure from typical consumption of Site eggs and venison exceeds RfD

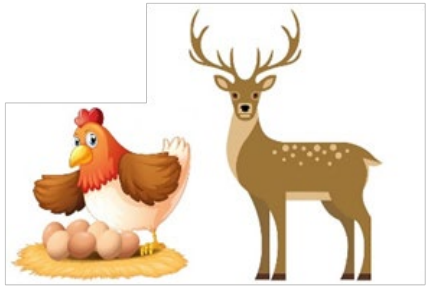
0.1 for PFOS

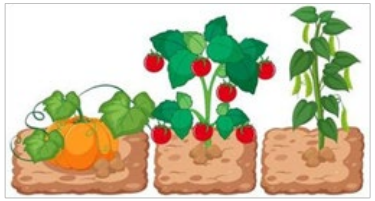
U.S. EPA Reference Doses (ng/kg-bw/day)

0.03 for PFOA

Bhattacharya et al. *in review*

Elevated PFAS in Eggs, Venison and some Produce in/near Site





Our recent findings:

- Highest levels in home produced eggs and locally captured venison (2-14 ppb)
- Eggs and some produce higher from farms near the site (3-4 ppb)
- While soils are highest for PFOS, it is low in produce

Sources of PFAS to Chickens/Eggs

Contamination of:

- Drinking water
- Soil & Invertebrates

Presence in:

- Bedding (certain recycled papers)

Often contains PFOS:

- Fish meal

Eggs can be a considerable source of dietary PFAS exposure for home produced eggs in communities with PFAS contamination.

Levels in eggs can be elevated even with low concentrations in drinking water.

Monitoring is useful and wise, as interventions can be simple and quickly effective as chickens eliminate PFAS much faster than people.

Fish meal feed can substantially increase PFAS in eggs.

Elevated PFAS in Chicken Eggs from Fish Meal

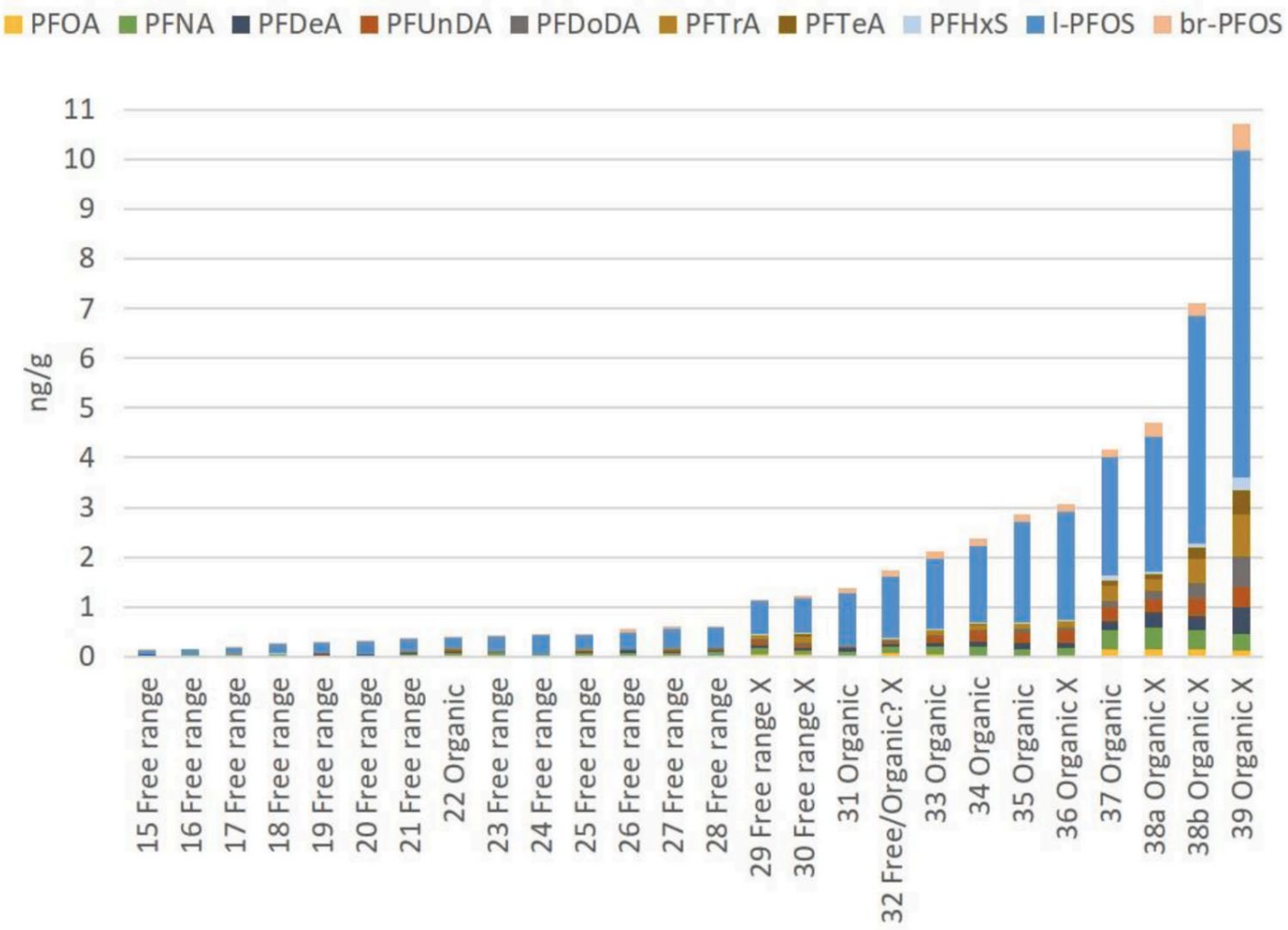
Per- and poly-fluoroalkyl substances in commercial organic eggs via fishmeal in feed

Kit Granby [a,*], Bjarne Kjær Ersbøll [b], Pelle Thonning Olesen [a], Tue Christensen [a], Søren Sørensen [c]

[a] *Technical University of Denmark, National Food Institute, Kemitorvet 4, DK-2800, Kgs. Lyngby, Denmark*
[b] *Technical University of Denmark, Department of Applied Mathematics and Computer Science, Richard Petersens Plads, Building 324, DK-2800, Kgs. Lyngby, Denmark*
[c] *Danish Veterinary and Food Administration, Division of Residues, Søndervang 4, DK-4100, Ringsted, Denmark*

Chemosphere 346 (2024) 140553

PFAS in Egg Yolks from Small Danish Farms

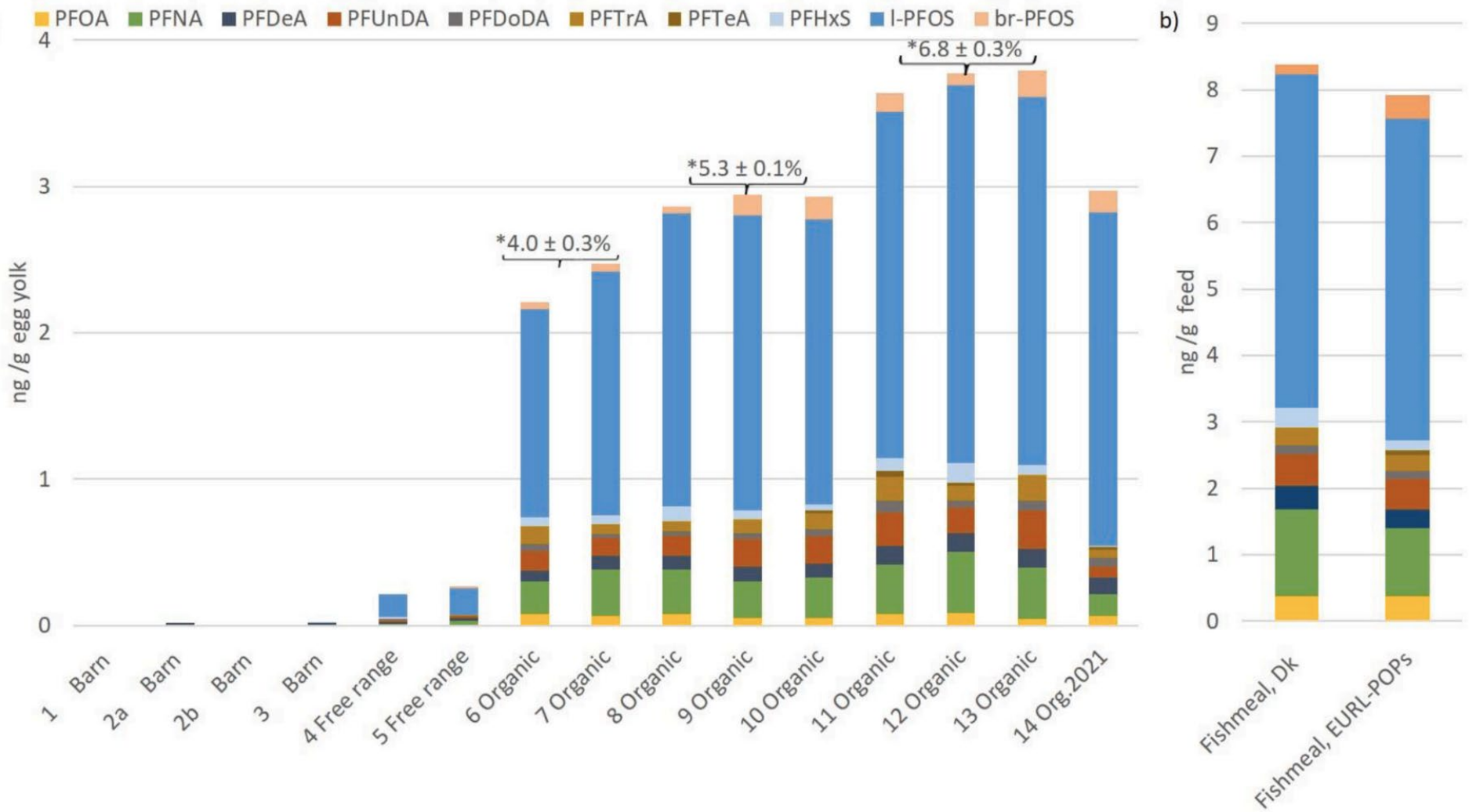


X indicates closed production

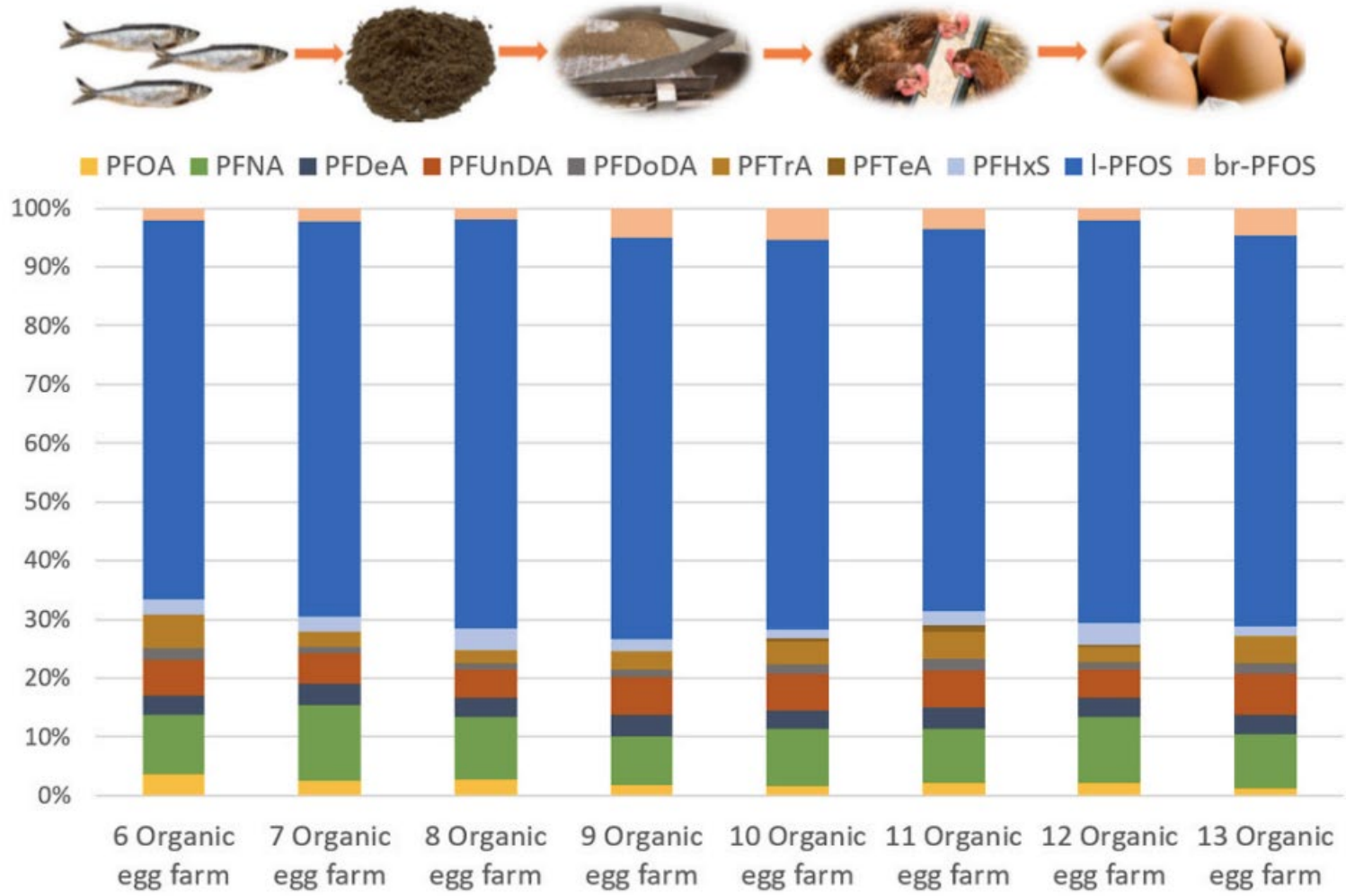
Farms with <500 chickens

Granby et al. 2023

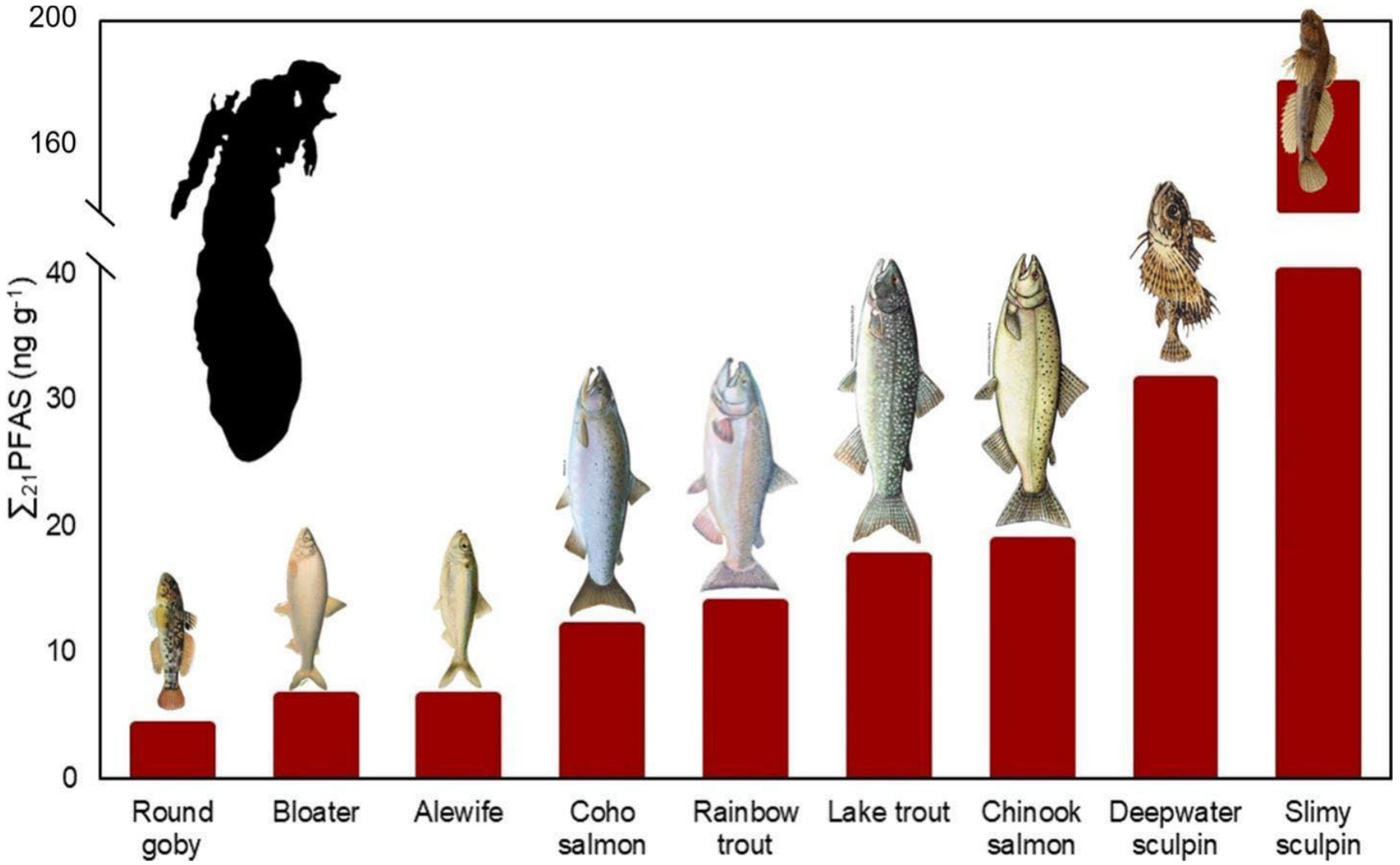
PFAS in Egg Yolks from Large Danish Farms



Granby et al. 2023



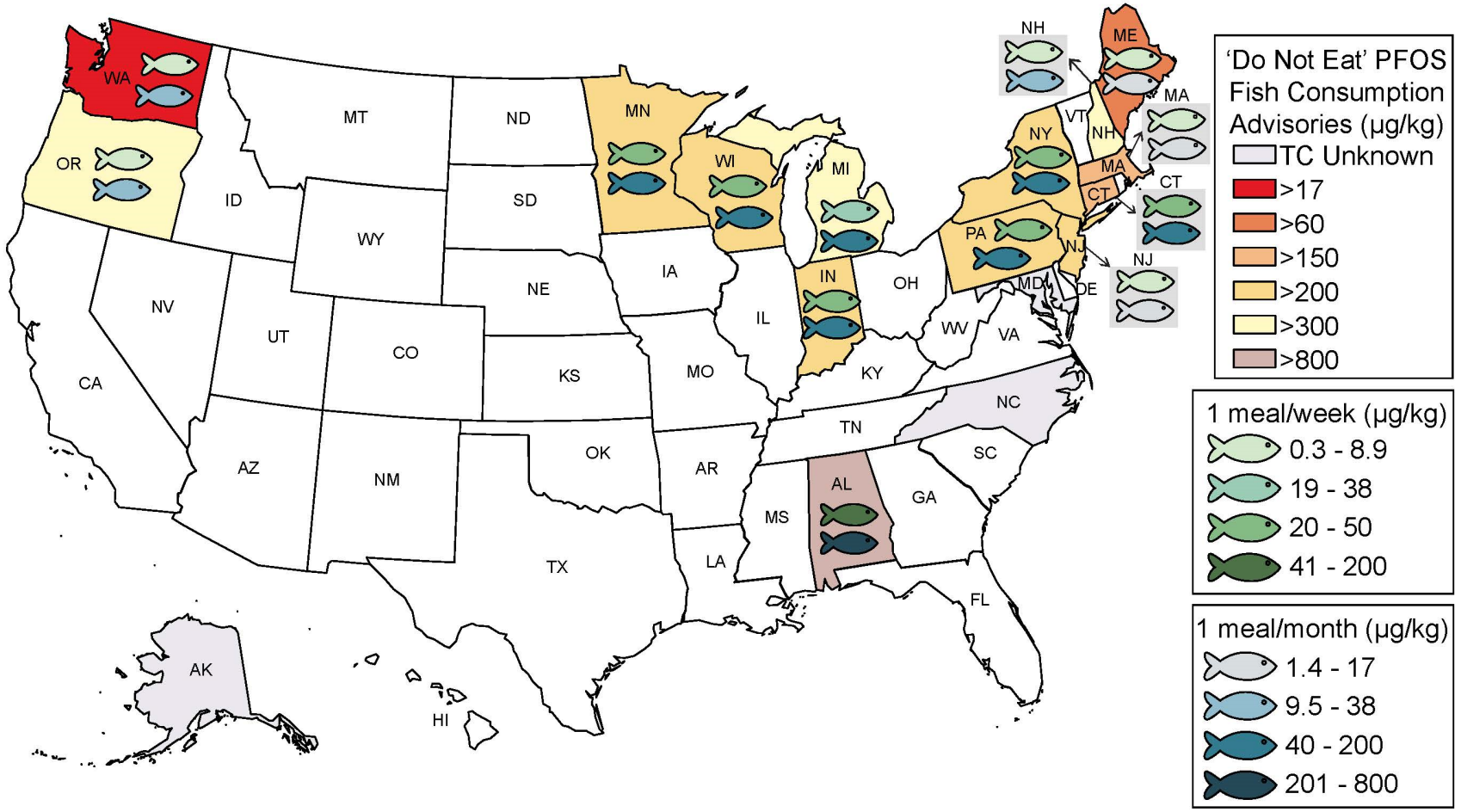
Granby et al. 2023



Miranda et al. 2023

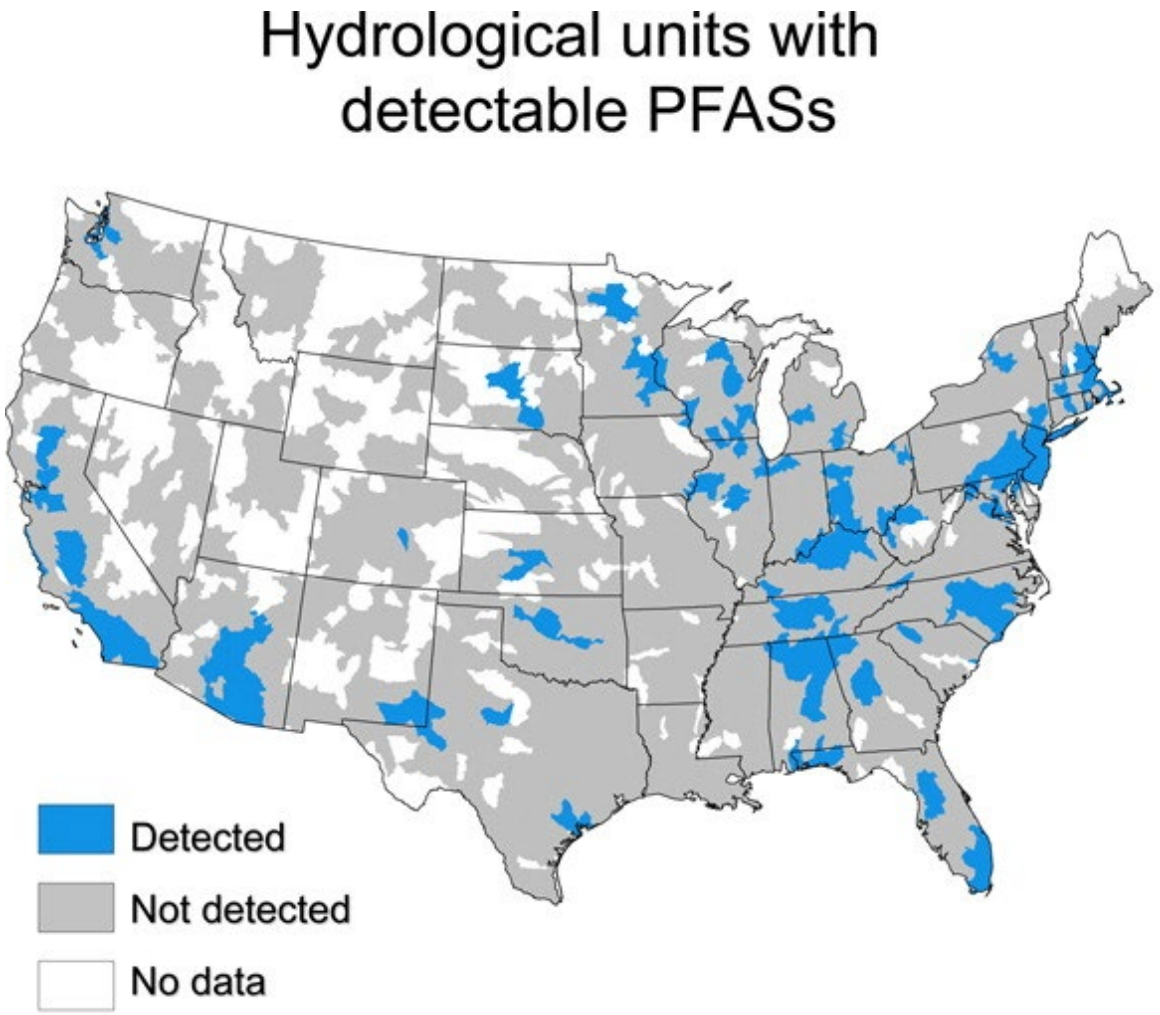
Fish can be a notable source of PFAS exposure

PFOS Consumption Advisories Vary by State



Petali et al 2024

110 Million Americans with Impacted Water

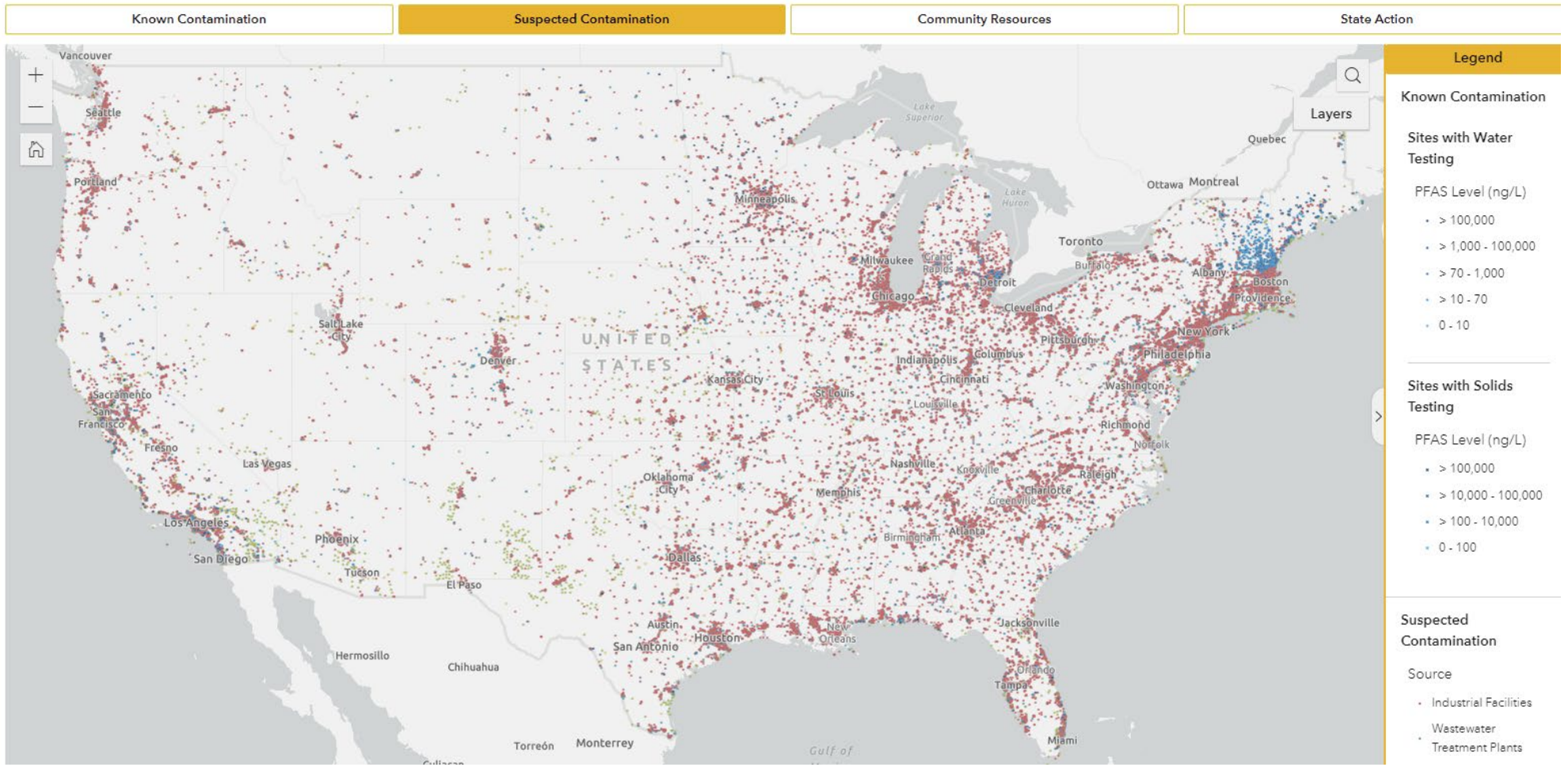


Hu et al. ES&T Letters 2016

Public water system contamination more likely with closer proximity to:

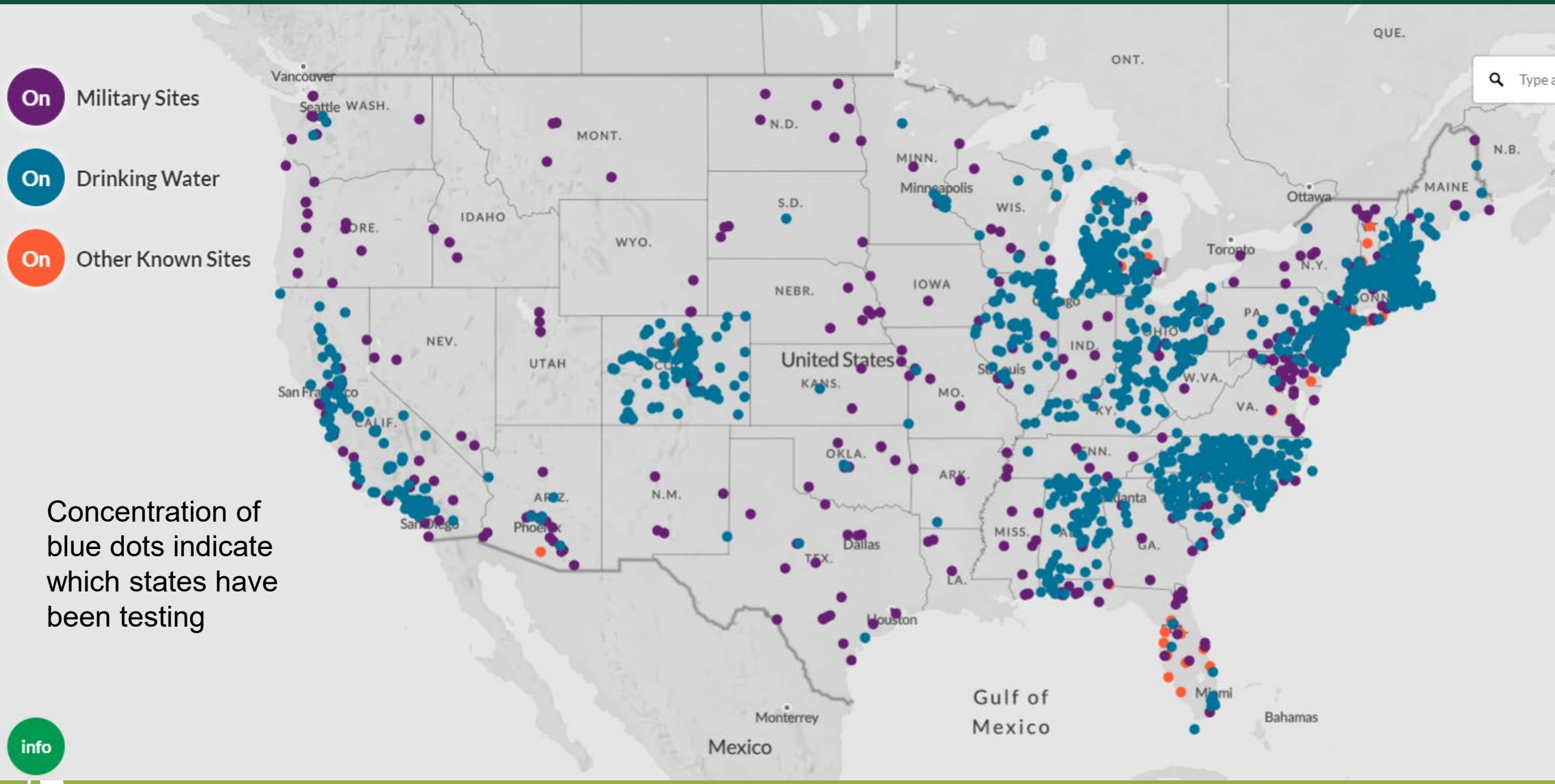
- PFAS industrial sites
- Military fire training areas
- AFFF certified airports
- Wastewater treatment plants

Presumptive Sources



https://pfas-exchange.org/connecting-communities/

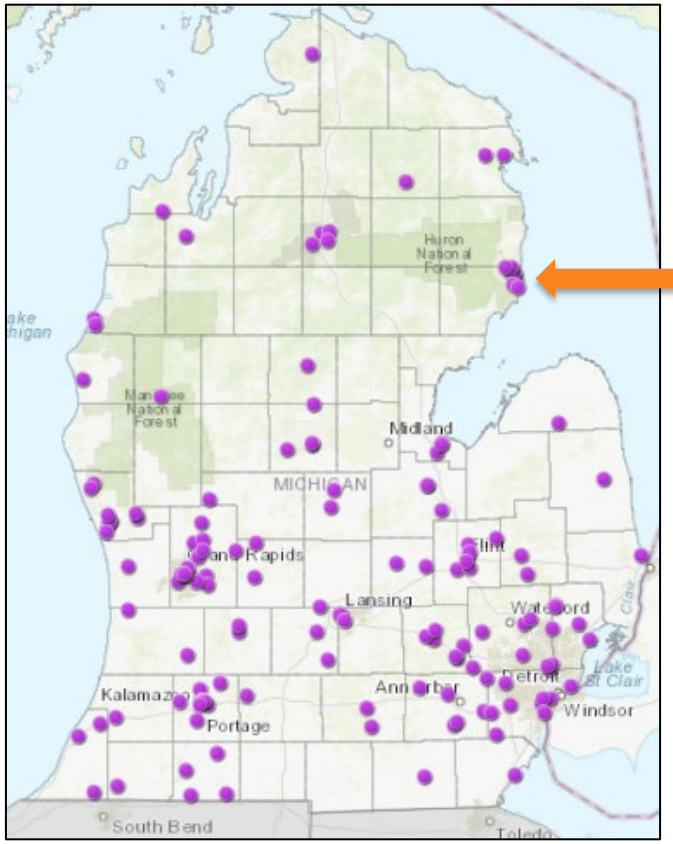
Red dots show where PFAS is likely used



Concentration of blue dots indicate which states have been testing

info

Former Wurtsmith Air Force Base
Oscoda, MI



PFAS contamination discovered over 15 years ago

Aqueous Film Forming Foam (AFFF)

Used to fight fuel fires

Hangar Suppression Systems

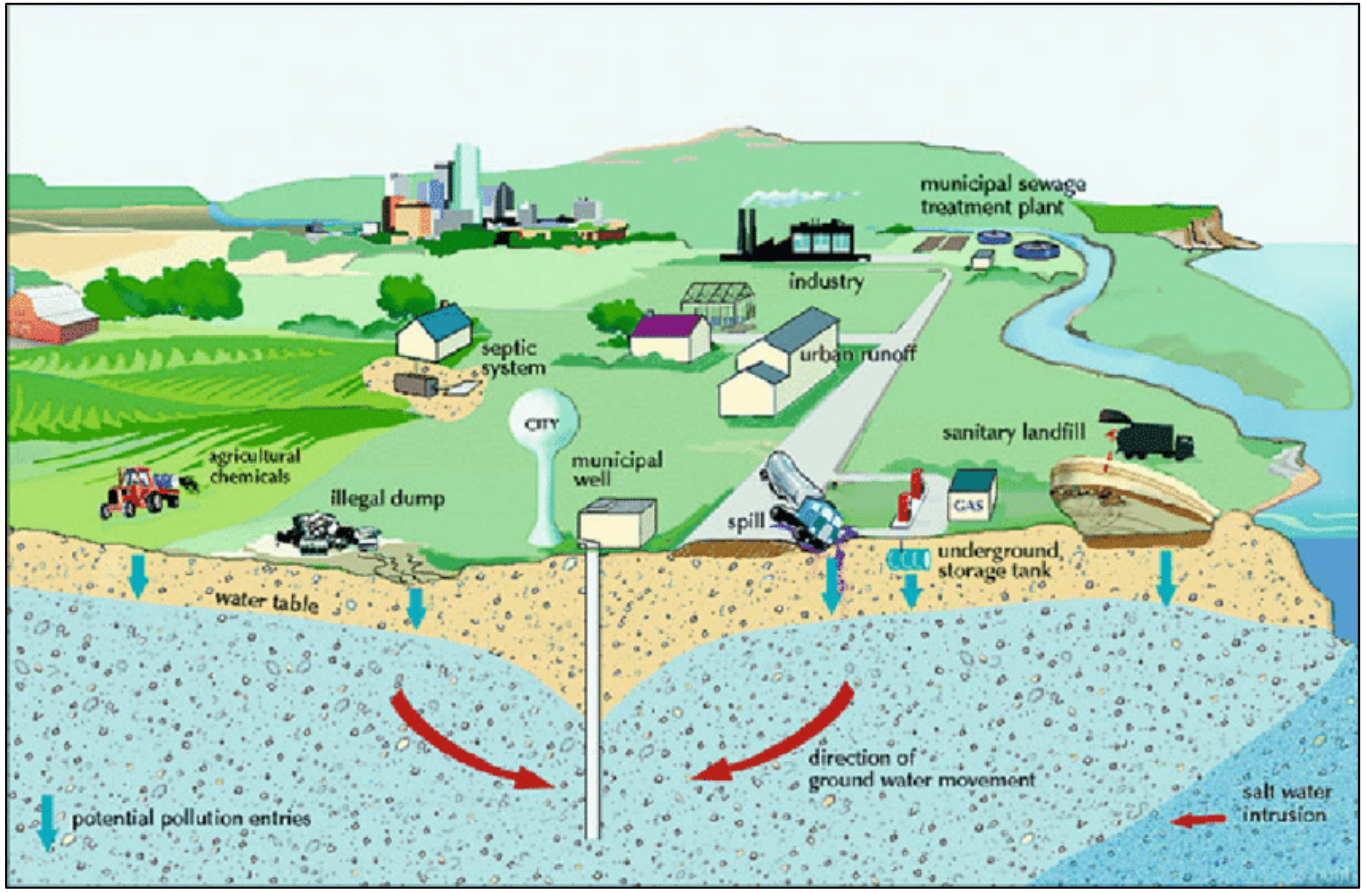
Aqueous Film Forming Foam (AFFF)

Firefighter Training

Vehicle Fires

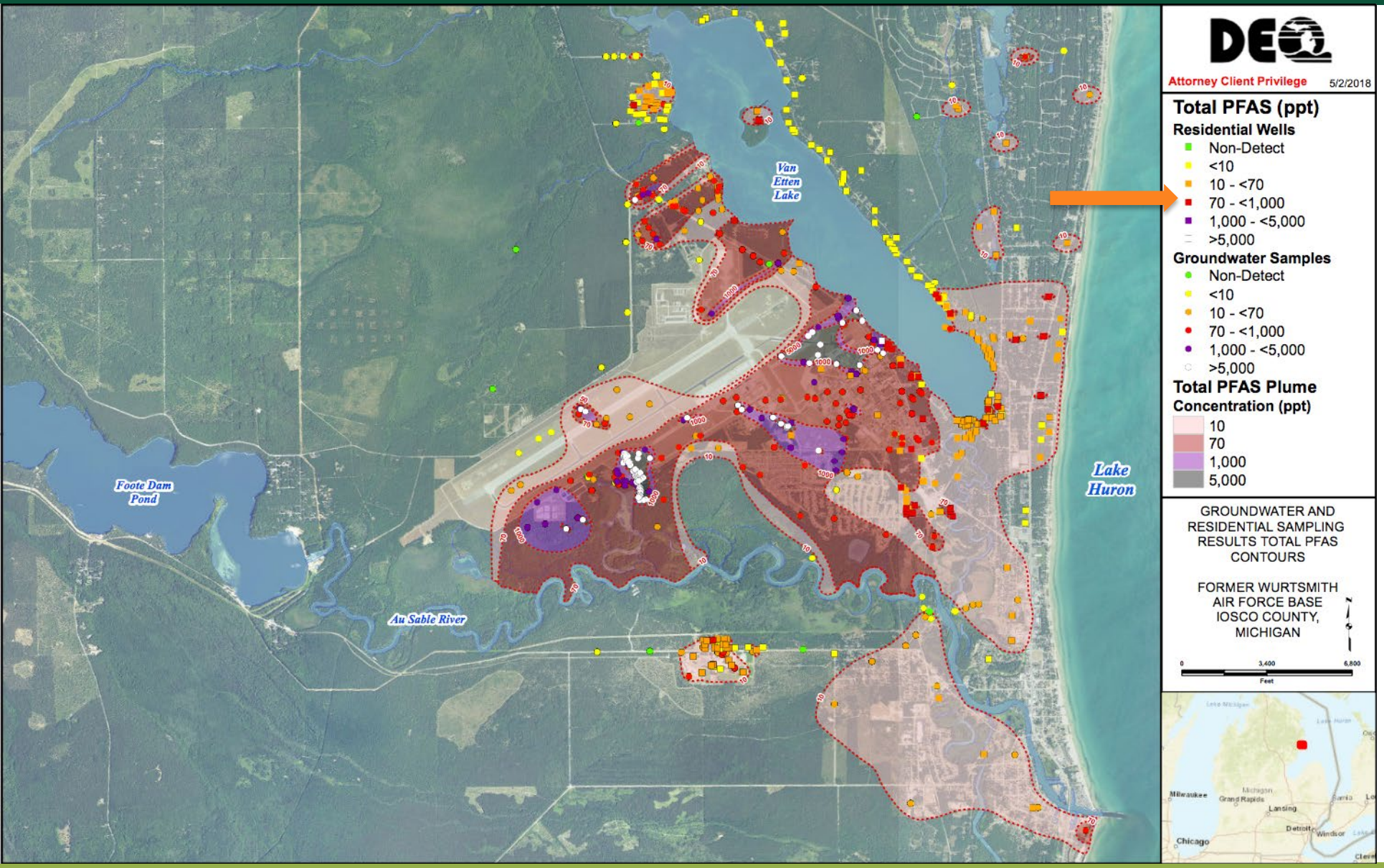
Firefighters were told it was as
‘safe as soap and water’

PFAS Easily Migrate into Groundwater



Zeidan et al. 2016

Groundwater is commonly used for **drinking water** by cities, towns and individual homes



DEQ

Attorney Client Privilege 5/2/2018

Total PFAS (ppt)

Residential Wells
- Non-Detect
- <10
- 10 - <70
- 70 - <1,000
- 1,000 - <5,000
- >5,000

Groundwater Samples
- Non-Detect
- <10
- 10 - <70
- 70 - <1,000
- 1,000 - <5,000
- >5,000

Total PFAS Plume Concentration (ppt)
- 10
- 70
- 1,000
- 5,000

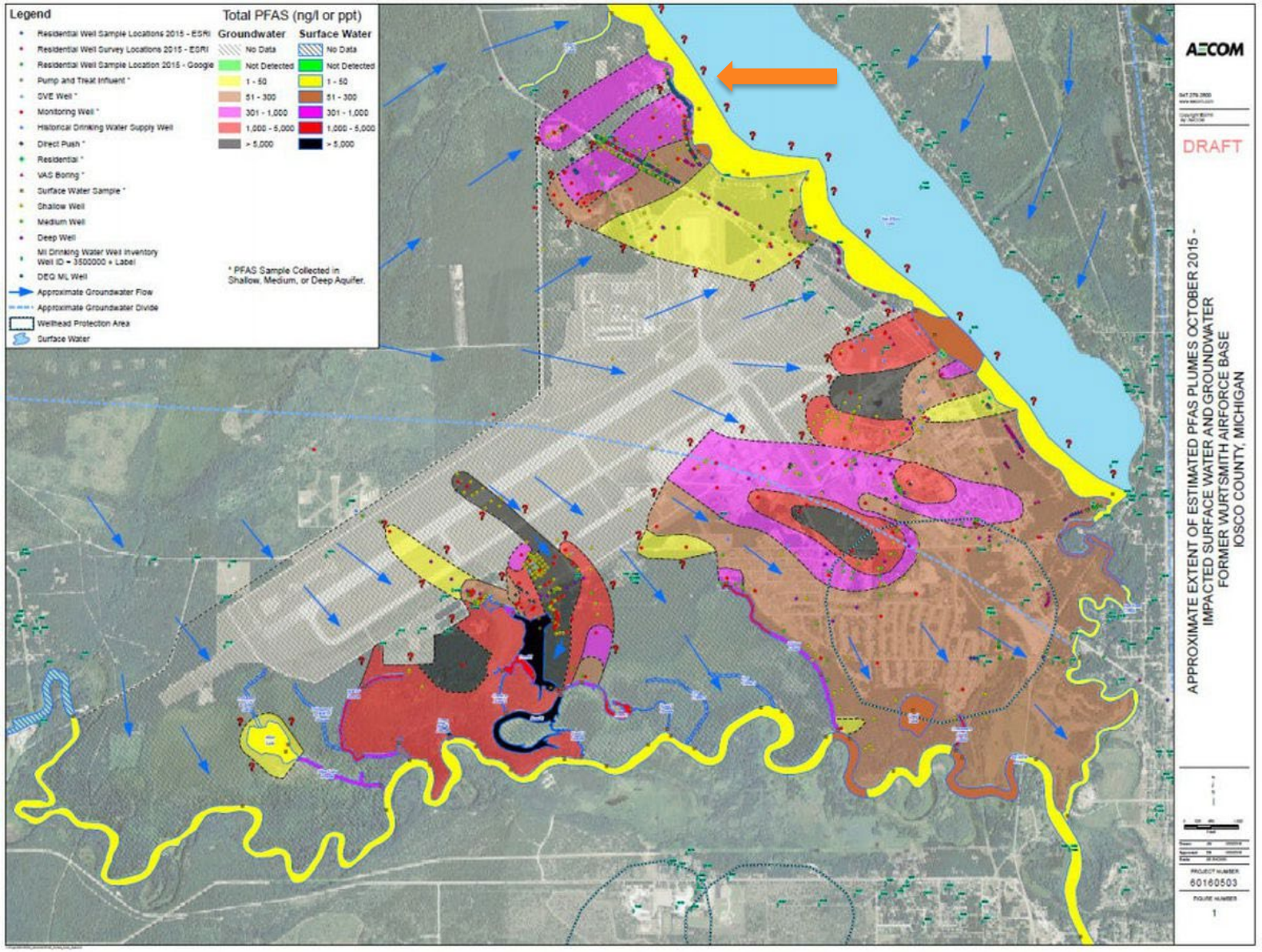
GROUNDWATER AND RESIDENTIAL SAMPLING RESULTS TOTAL PFAS CONTOURS

FORMER WURTSMITH AIR FORCE BASE IOSCO COUNTY, MICHIGAN

N

0 3,400 6,800
Feet

High levels in drinking water and groundwater



PFAS migrate into surface water:

Van Etten Lake

Clarks Marsh → Au Sable River → Lake Huron

Advisories for:

- Drinking water
- Fish
- Deer
- Foam

Elevated PFAS in Surface Water Foam

Elevated Exposure to PFAS in Surface Water Foam

Surface Water Foams

- Accumulate PFAS
- Contained 16 different PFAS
- PFOS Max=97,000 ppt (ng/L)
- PFOS Enrichment factor = 2830
- Exposure estimate for children ingesting the foam exceeds health-based guideline

Schwichtenberg et al. 2020 (Enviro Sci Technol)

Wolverine Worldwide former Tannery Rockford, MI

Poor disposal of tannery waste at dumping sites across town

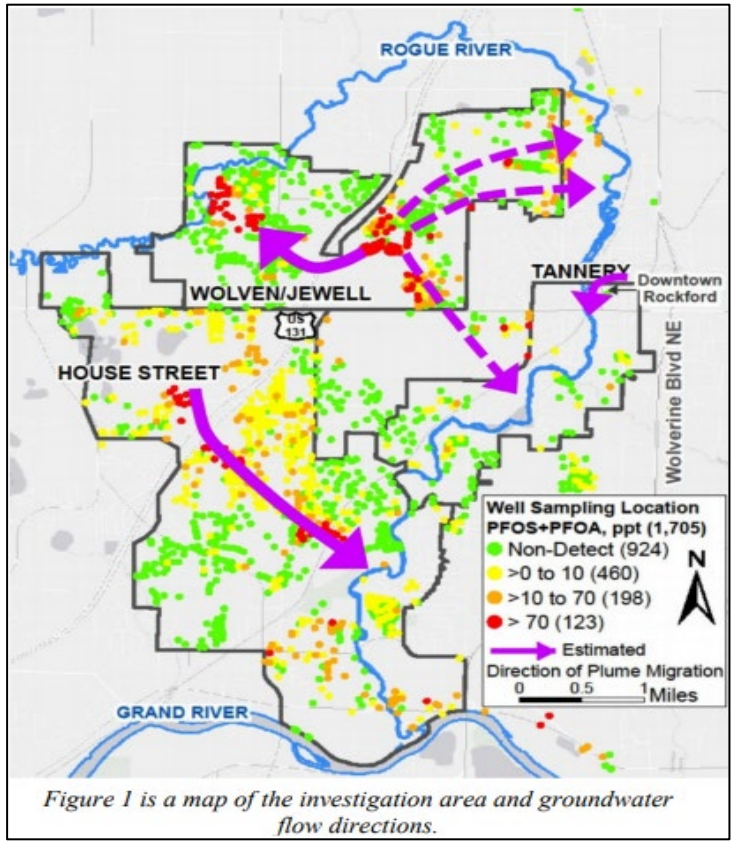


Figure 1 is a map of the investigation area and groundwater flow directions.

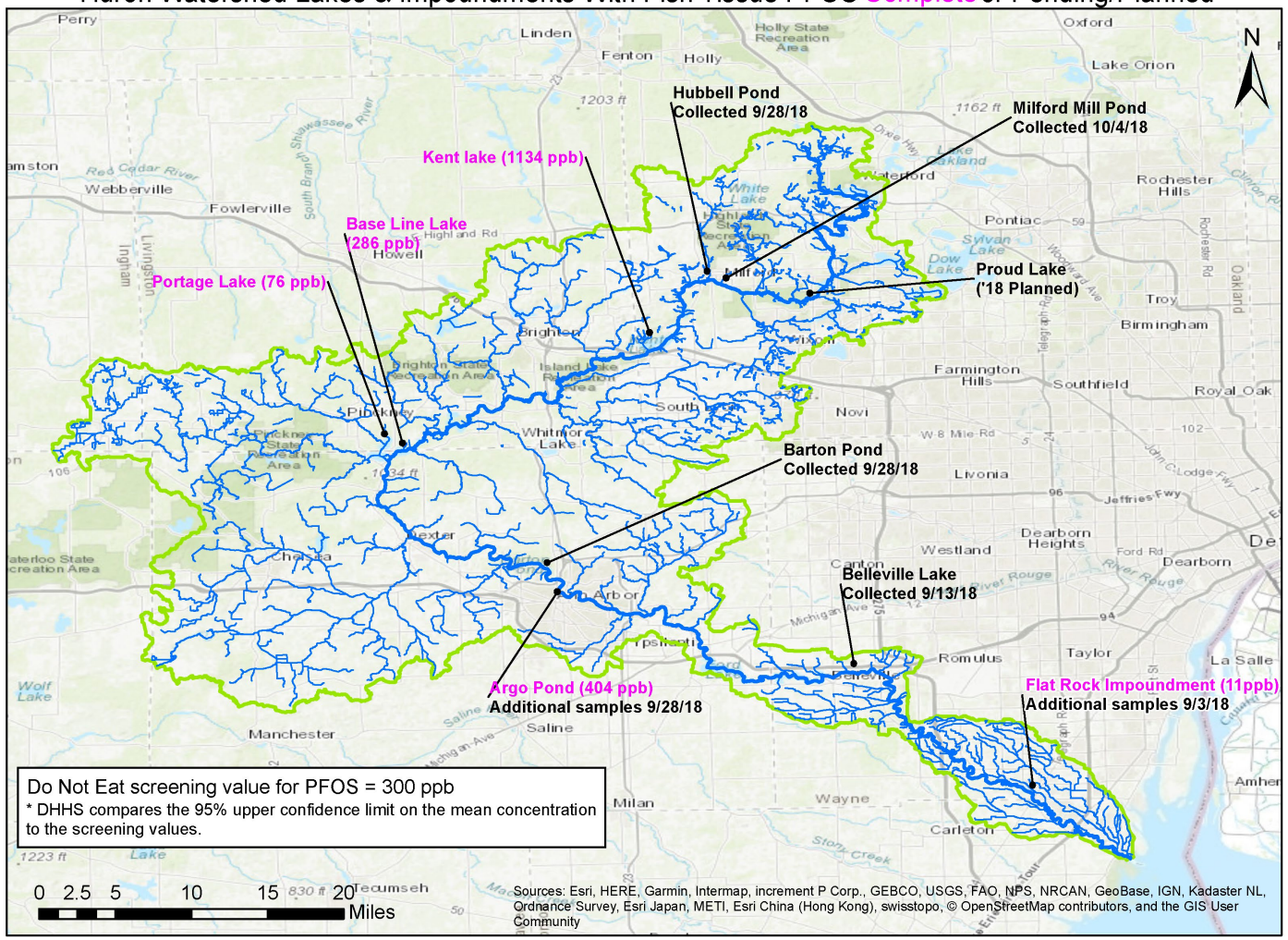
Chrome Plating
Huron River

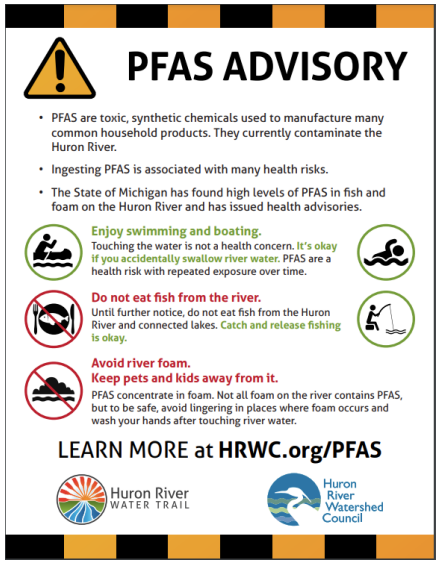
https://finishingandcoating.com/index.php/plating/224-epa-michigan-find-that-pfos-suppresants-work

PFAS used as fume suppressant in chrome plating

PFAS discharge from chrome plating facilities to waste-water treatment plants

Huron Watershed Lakes & Impoundments With Fish Tissue PFOS Complete or Pending/Planned





PFAS in Biosolids ⇨ Soil ⇨ Crop ⇨ Livestock/People

Concerns grow over PFAS-tainted sewage sludge spread on croplands

Source: MI sewage sludge application

Michigan beef found to contain dangerous levels of 'forever chemicals'

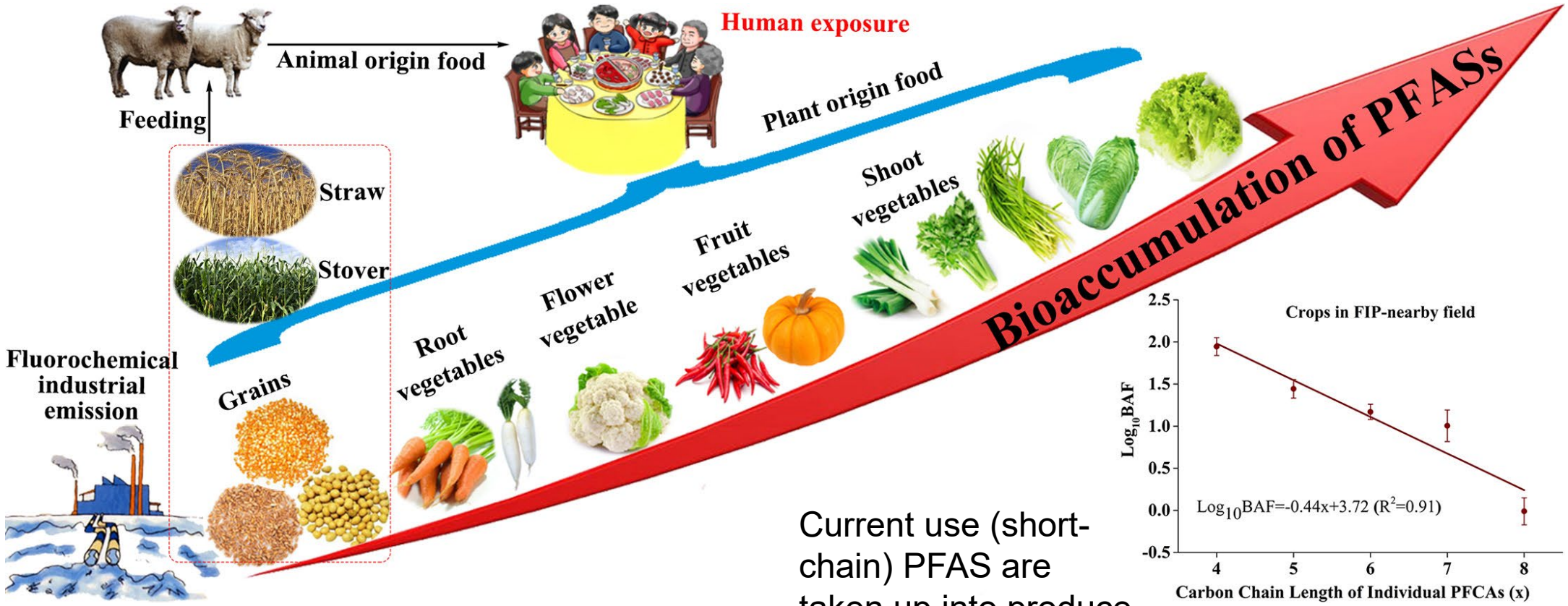
Contamination at a small farm discovered after sewage sludge was tested for PFAS, but officials downplayed incident as 'isolated'

Source: MI cattle farm news

Discoveries over past decade include WV, AL, CO, NM, ME, MI. Need to be able to discover and act.
National support is urgently needed for farmers and regulators.

Legacy (long-chain) PFAS bioaccumulate in animals

Diet is the primary exposure pathway for general population



Current use (short-chain) PFAS are taken up into produce

Liu et al 2019

PFAS in Biosolids ⇨ Soil ⇨ Crop ⇨ Livestock/People

Our recent finding (unpublished):

- Kernels non-detect despite high PFOS in soil ~500 ppb

Silage is known to take up PFAS more readily

Current use short-chain PFAS are taken up into crops

PFAS in Compostable Bowls

Preventable. Sustainability claims need to consider contaminants as well.

PFAS in Compost ⇨ Soil ⇨ Crop ⇨ Livestock/People

Maine PFAS Screening Levels

Fish Tissue Action Level (ng/g wet weight)	
Compound	Action Level
PFOS	3.5

Milk[4] (ng/l or ppt)	
Compound	Action Level
PFOS	210

Beef[5] (ng/g)	
Compound	Action Level
PFOS	3.4

Dairy[6] - PFOS Crop-Specific Soil Screening Levels (ng/g dry weight)			
	Soil to Hay to Milk Screening Level	Soil to Corn-Silage to Milk Screening Level	Soil to Hay and Corn-Silage to Milk Screening Level
Grass-Based Farm	6.8	120.0	6.4
Average Maine Farm	13.8	54.8	11.0

Maine DEP (2023)

Maine has helpful guidance and has been more proactive than most states.

MAINE PFAS SCREENING LEVELS

December 2023

Soil Remedial Action Guidelines[1] (mg/kg dry weight)						
Compound	Leaching to Groundwater	Residential	Commercial Worker	Park User	Recreator Sediment	Construction Worker
PFBS	0.11	26	340	74	85	230
PFBA	0.36	110	1,600	300	350	2,000
PFHxS	0.00047	1.7	22	4.9	5.7	5.1
PFHxA	0.13	43	560	120	140	130
PFNA	0.0046	0.26	3.4	0.74	0.85	0.77
PFOS	0.001	0.17	2.2	0.49	0.57	0.51
PFOA	0.017	0.26	3.4	0.74	0.85	0.77

Soil Beneficial Use[2] (ng/g dry weight)	
Compound	Beneficial Use
PFBS	1,900
PFOS	5.2
PFOA	2.5

Interim Drinking Water Standard[3] (ng/l or ppt)	
Compound	Residential
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	20

Maine DEP (2023)

PFAS
- Response
- Assistance
- Fund to Address PFAS Contamination

PFAS Response

The Maine Department of Agriculture, Conservation and Forestry (DACF) is committed to ensuring a safe food supply in Maine and supporting our vibrant agricultural community. DACF is taking a leading role in responding to the chemicals known as per- and polyfluoroalkyl substances (PFAS) in agriculture.

On this Page:

What is PFAS?

PFAS refer to a group of man-made chemicals known as Per- and Polyfluoroalkyl Substances. There are thousands of varieties of these chemicals that repel oil, grease, water, and heat. They became widely used in household products and industrial settings as early as the 1940s and have been used in firefighting foams due to their effectiveness at quickly extinguishing petroleum-based fires.

PFAS have been used to make a host of commercial products including non-stick cookware, stain-resistant carpets and furniture, water-resistant clothing, coated oil resistant paper/cardboard food packaging (like microwave popcorn and pizza boxes), and some personal care products.

EDUCATION & RESOURCES

- UMaine Cooperative Extension PFAS Resources
- Dairy Risk Management (PDF)
- Hay Farmer Recommendations (PDF)

PFAS OVERVIEW PRESENTATIONS

- PFAS Overview Presentation (PDF)

CONTACT US

PFAS Response Program
Email: pfas.dacf@maine.gov
Phone: (207) 287-4514

Get AG Resources & Event Updates!

Enter your email below:

Go

https://www.maine.gov/dacf/ag/pfas/pfas-response.shtml

Collecting Samples for PFAS Testing

Follow ITRC Sampling Guidance

- Take care to minimize background contamination
- Collect into PFAS-free container (e.g., zip bag)
- Transport in cooler on ice
- Freeze at -20C until shipment

ITRC Guidance Website: https://pfas-1.itrcweb.org/11-sampling-and-analytical-methods/#11_1

Analytical Challenges

- Matrix effects
- Interference
- Background contamination

Contract Labs

- Axys Environmental
- Eurofins Test America
- Vista

Typically costs hundreds of dollars per sample.

Inexpensive screening methods are needed

Analytical Methods

- HPLC-MS/MS
- UPLC-MS/MS
- LC-QTOF-MS

U.S. FDA: https://www.fda.gov/food/process-contaminants-food/testing-food-pfas-and-assessing-dietary-exposure

ITRC: https://pfas-1.itrcweb.org/11-sampling-and-analytical-methods/#11_2

Peng et al. 2022 for novel PFAS https://pubs.acs.org/doi/abs/10.1021/acs.jafc.1c07665

Cost

- Contract labs typically charge hundreds of dollars per sample.
- Effected by rising costs of both analytical standards and labor.
- Inexpensive comprehensive screening methods are needed.

Outside the Safe Operating Space of a New Planetary Boundary for Per- and Polyfluoroalkyl Substances (PFAS)

Ian T. Cousins*, Jana H. Johansson, Matthew E. Salter, Bo Sha, and Martin Scheringer

Cite this: *Environ. Sci. Technol.* 2022, 56, 16, 11172–11179
Publication Date: August 2, 2022
https://doi.org/10.1021/acs.est.2c02765

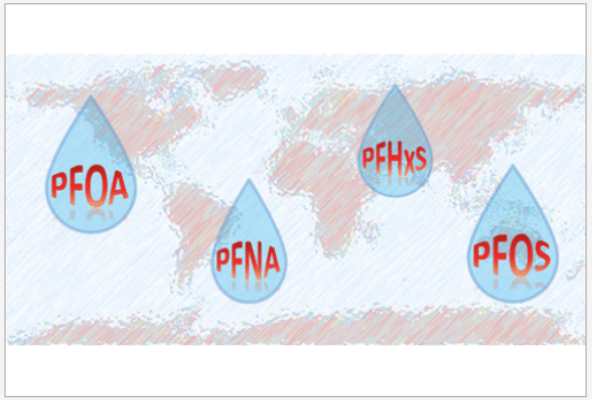
Environmental Science & Technology

PDF (3 MB) | SI Supporting Info (1) »

SUBJECTS: Deposition, Drinking water, Environmental pollution, Soils, Toxins

Abstract

It is hypothesized that environmental contamination by per- and polyfluoroalkyl substances (PFAS) defines a separate planetary boundary and that this boundary has been exceeded. This hypothesis is tested by comparing the levels of four selected perfluoroalkyl acids (PFAAs) (i.e., perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexanesulfonic acid (PFHxS), and perfluorononanoic acid (PFNA)) in various global environmental media (i.e., rainwater, soils, and surface waters) with recently proposed guideline levels. On the basis of the four PFAAs considered, it is concluded that (1) levels of PFOA and PFOS in rainwater often greatly exceed US Environmental Protection Agency (EPA) Lifetime Drinking Water Health Advisory levels and the sum of the aforementioned four PFAAs (Σ4 PFAS) in rainwater is often above Danish drinking water limit values also based on Σ4 PFAS; (2) levels of PFOS in rainwater are often above Environmental Quality Standard for Inland European Union Surface Water; and (3) atmospheric deposition also leads to global soils being ubiquitously contaminated and to be often above proposed Dutch guideline values. It is, therefore, concluded that the global spread of these four PFAAs in the atmosphere has led to the planetary boundary for chemical pollution being exceeded. Levels of PFAAs in atmospheric deposition are especially poorly reversible because of the high persistence of PFAAs and their ability to continuously cycle in the hydrosphere, including on sea spray aerosols emitted from the oceans. Because of the poor reversibility of environmental exposure to PFAS and their associated effects, it is vitally important that PFAS uses and emissions are rapidly restricted.



Unaffordability of PFAS cleanup from wastewater

The full report will be of interest to the wastewater management and scientific communities. Key findings of broader interest include:

- Removing and destroying PFAS from water and biosolids leaving Minnesota's wastewater treatment facilities could cost between **$14 billion and $28 billion over 20 years.**
- **PFAS can be bought for $50 - $1,000 per pound** (according to MPCA estimates), **but costs between $2.7 million and $18 million per pound to remove and destroy from municipal wastewater,** depending on facility size.
- **Small wastewater treatment facilities would face per-pound costs over six times greater than large facilities**, due to economies of scale.
- **New "short-chain" types of PFAS are more difficult and up to 70% more expensive to remove and destroy** compared to old "long-chain" PFAS.

Cost estimates are based on the required upgrades to Minnesota's existing wastewater infrastructure to treat and destroy PFAS using current commercially available technologies and PFAS levels. In total, 13 PFAS removal and destruction technologies passed a screening on their real-world effectiveness and the most cost-effective technology was selected for statewide cost development. Complete details and additional findings are found in the full report.

New technology that reduces costs to remove and destroy PFAS from wastewater is in development, but the MPCA believes that without an alternative source of funding, PFAS removal and destruction from municipal wastewater will be unaffordable for the foreseeable future. In contrast, emerging biosolids technologies capable of destroying PFAS can be cost-competitive with current practices.

Societal cost of 'forever chemicals' about $17.5tn across global economy - report

Chemicals yield profit of about $4bn a year for the world's biggest PFAS manufacturers, Sweden-based NGO found

A woman wears a waterproof coat in the rain. PFAS are commonly used as waterproofing agents in clothing and textiles. Photograph: Edward Berthelot/Getty Images

The societal cost of using toxic PFAS or "forever chemicals" across the global economy totals about $17.5tn annually, a new analysis of the use of the dangerous compounds has found.

Meanwhile, the chemicals yield comparatively paltry profits for the world's largest PFAS manufacturers - about $4bn annually.

While PFAS are profitable to industry the cost to society due to health effects, testing and treatment are enormous.

Is a Seismic Shift in the Landscape of PFAS Uses Occurring?

Martin Scheringer*, Ian T. Cousins, and Gretta Goldenman

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Publication Date: April 11, 2024
https://doi.org/10.1021/acs.est.4c01947

PDF (2 MB)

SUBJECTS: Fluoropolymers, Gases, Industrial manufacturing, Materials, Redox reactions

We argue that a seismic shift in the landscape of per- and polyfluoroalkyl substances (PFAS) uses can be observed. From conversations with representatives of the fluorochemical industry and of large brands of consumer products; from recent statements made in the general discussion among industry, consumer groups, environmental NGOs, and academic scientists; from various analyses of the availability of alternatives to PFASs in many use areas, including our own work; (1−4) and from the decision of a major PFAS manufacturer (3M) to leave entirely the production of PFAS, (5) we conclude that in many PFAS use areas, the transition to nonfluorinated alternatives is underway and is gaining more and more momentum.

Transition to PFAS-free Alternatives Occurring/Needed

- Food-contact materials
- Textiles
- Carpets
- Leather
- Metals
- Cookware
- Lubrication
- Personal care products
- Cosmetics
- Firefighting foams
- Electrical device components (e.g.,fuel cells)
- Ski waxes
- Cleaning products
- Building materials
- Refrigerants
- Etc.

Drinking Water Protections

- New Federal MCLs for some PFAS
- Nationwide testing of public water systems
- Federal funding to help support treatment of public water systems
- Many polluter pay type lawsuits settled/ongoing to support treatment

Protections for Food

- Reducing/eliminating production, use and disposal of PFAS will reduce migration pathways to food
- Many states have fish advisories
- PFAS added to FDA's Total Diet Study (ongoing with lower MDLs)
- Michigan implemented a pre-treatment program to reduce the biosolids pathway
- Maine has guidance for irrigation water, soils and foods – and has banned application of biosolids or sludge on agricultural fields

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Andrew Patterson

Michigan State University
Rachel Bauer
Ankita Bhattacharya
Ying Guo

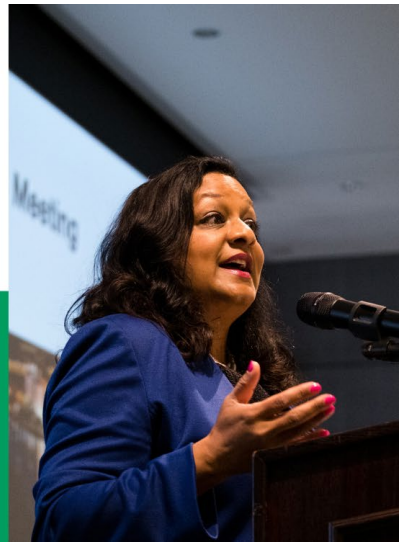
Study Participants

NATIONAL PFAS CONFERENCE

June 10 -12

Ann Arbor, MI

nationalpfasconference.org



3 DAYS OF POWERFUL TALKS

WHERE SCIENCE MEETS COMMUNITY

This conference series is uniquely designed to exchange information, provide support to PFAS-affected communities, and facilitate engagement across diverse sectors involved with PFAS to accelerate the protection of health and the environment.

Supporting Impacted Communities

Protecting Environmental Public Health

Visit the Conference Website

nationalpfasconference.org

Sessions on Dietary Sources, Human Rights, etc. – recordings post soon

nationalpfasconference.org

Declarations

I currently am funded to investigate PFAS exposure pathways and effects on reproductive and child health (sources of funding: NIH, EPA, USDA).

I have served as an external peer-reviewer for agency PFAS documents.

I have served as a plaintiff's expert witness for two PFAS cases.

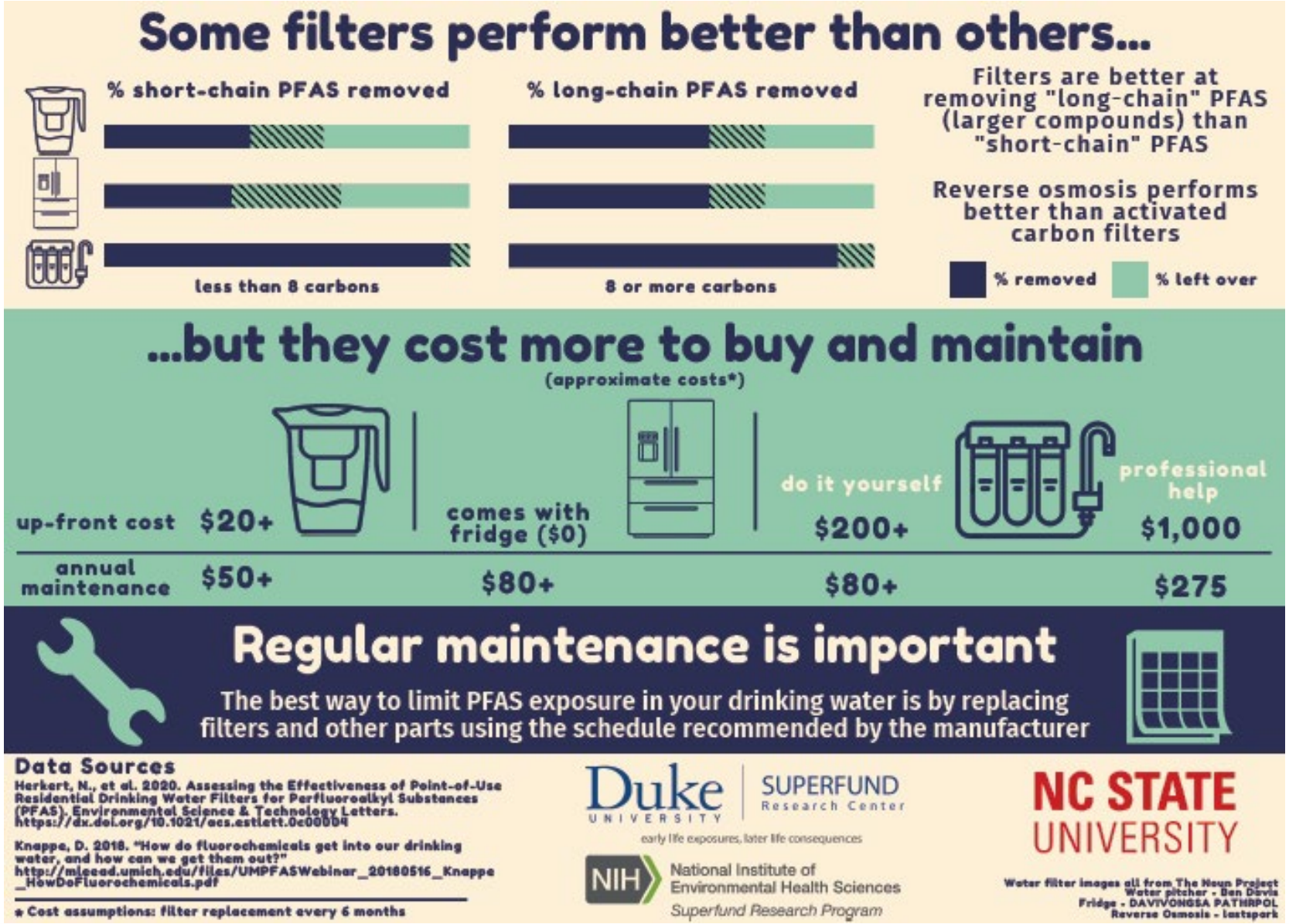
I am supported in part by the National Institute of Environmental Health Sciences, National Institutes of Health, USEPA National Priorities Program, and USDA National Institute of Food and Agriculture. This document has not been formally reviewed by the funding agencies. The views expressed in this presentation are mine and do not necessarily reflect those from the funding agencies. The agencies do not endorse any products or commercial services mentioned.

Thank You!

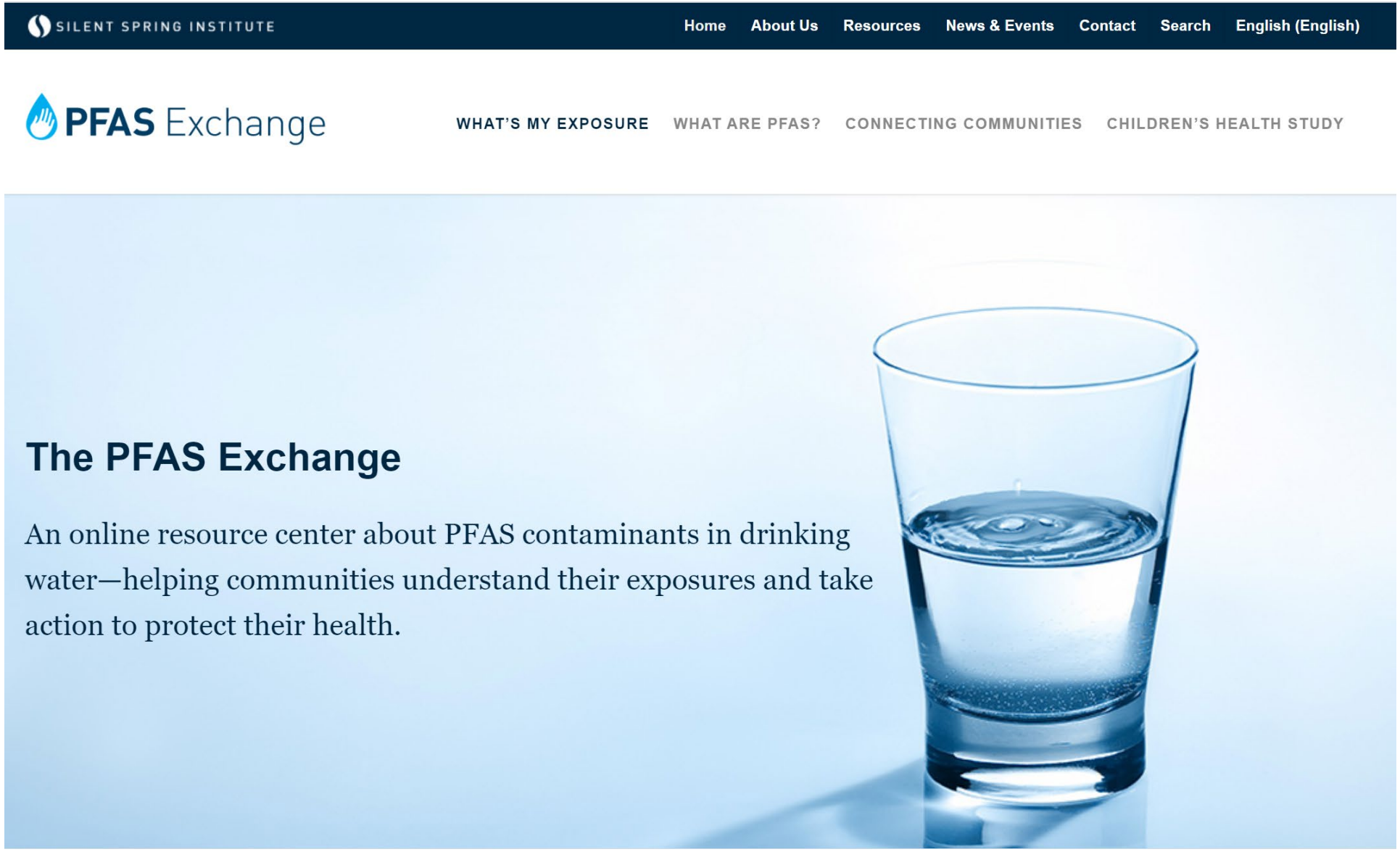
carigna4@msu.edu

Check out our website with tools/resources for communities:

pfas-exchange.org

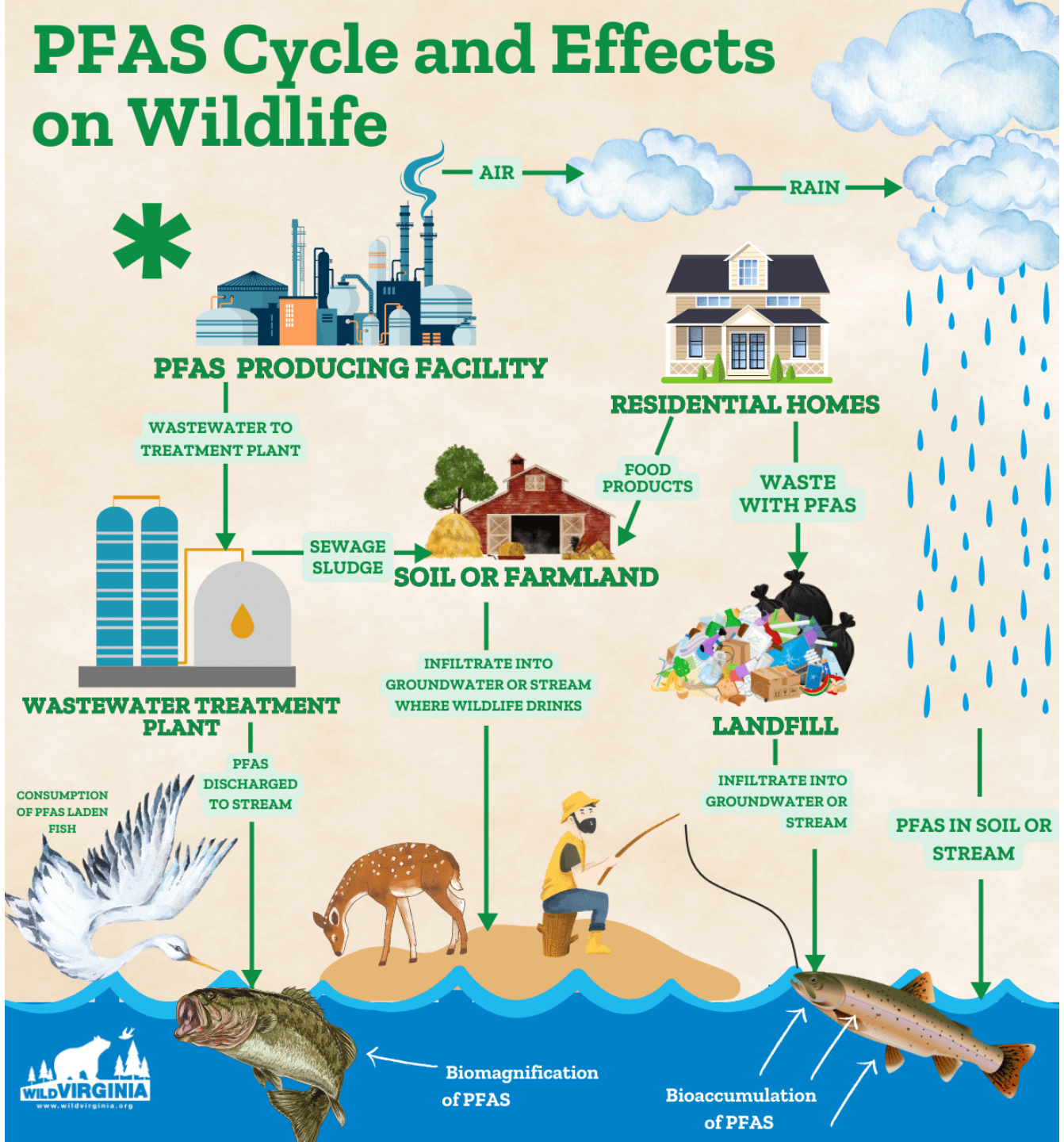


https://sites.nicholas.duke.edu/pfas/files/2020/09/PFAS-and-Water-Filtering-fact-sheet.pdf

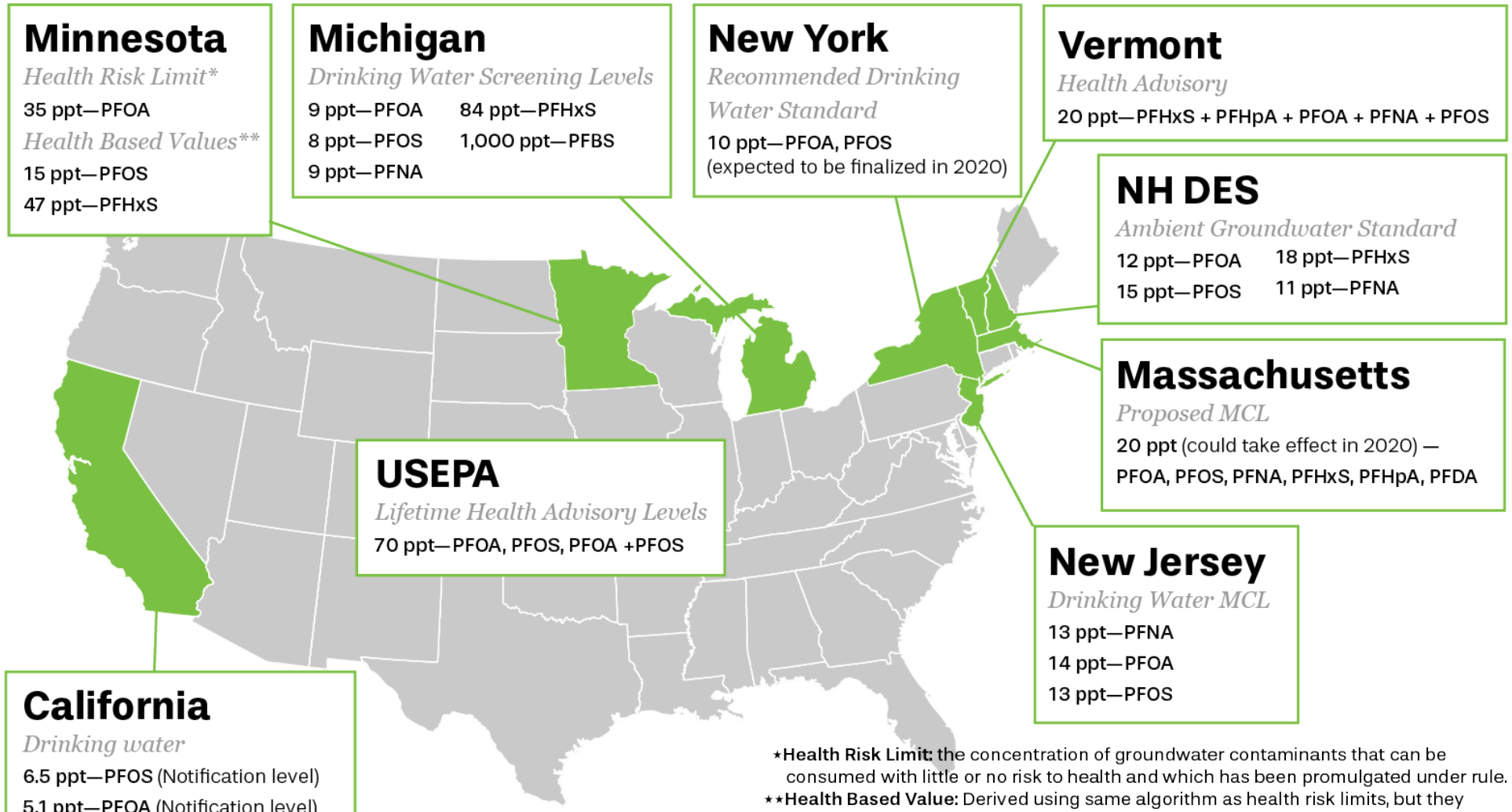


www.pfas-exchange.org

PFAS Cycle and Effects on Wildlife



Enforceable Standards: Maximum Contaminant Levels (MCLs)



⋆**Health Risk Limit:** the concentration of groundwater contaminants that can be consumed with little or no risk to health and which has been promulgated under rule.

⋆⋆**Health Based Value:** Derived using same algorithm as health risk limits, but they have not been promulgated and have not undergone peer review.

CDM Smith (2020)

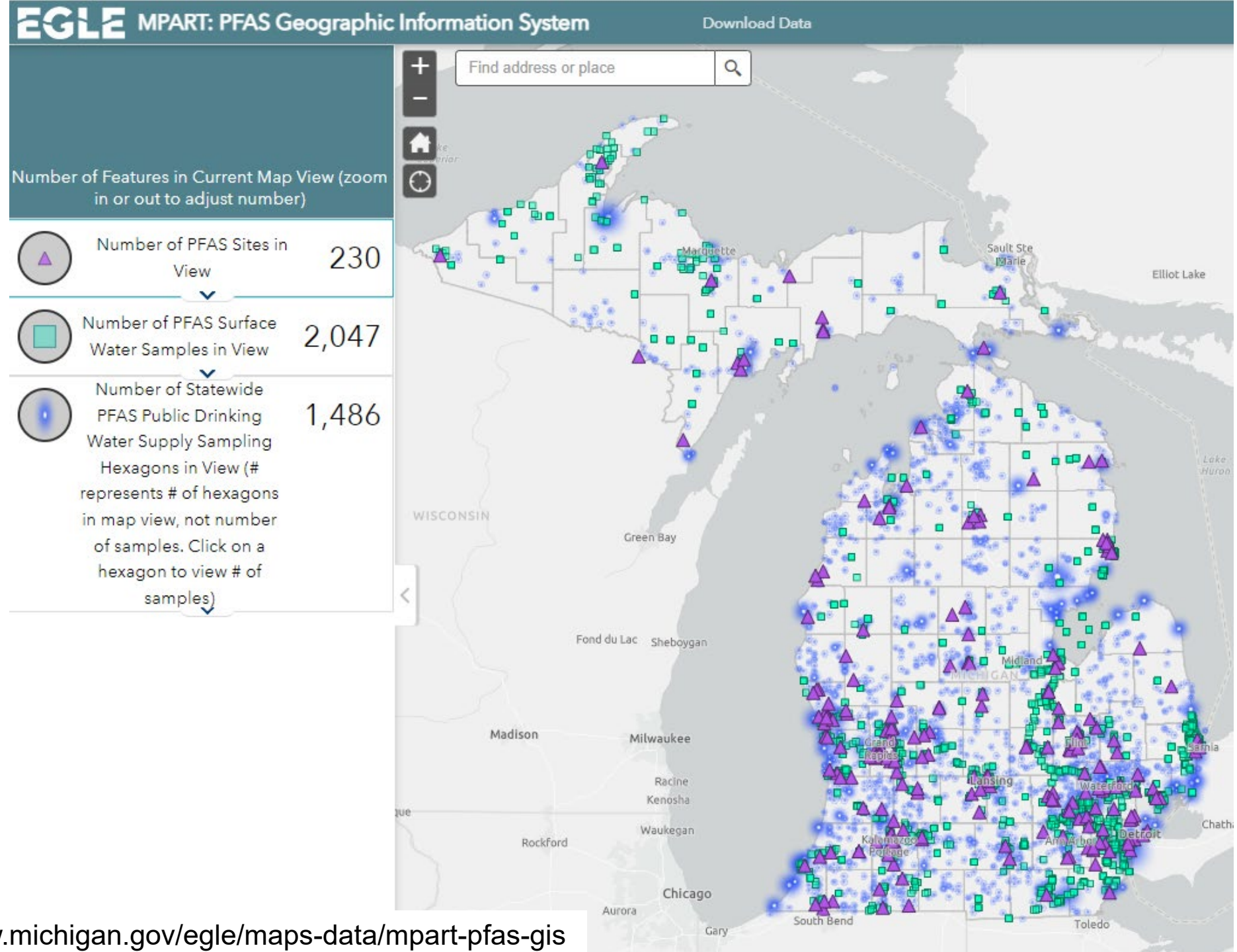
U.S. EPA Federal Drinking Water Standards

PFAS Compound	Maximum Contaminant Level Goal (MCLG)	Enforceable Maximum Contaminant Level (MCL)
PFOA	0	4.0 parts per trillion (ppt)
PFOS	0	4.0 ppt
PFNA	10	10.0 ppt
PFHxS	10	10.0 ppt
HFPO-DA (GenX Chemicals)	10	10.0 ppt
Mixture of two or more: PFHxS, PFNA, HFPO-DA (GenX), and PFBS	Hazard Index of 1	Hazard Index of 1

Historic enforceable MCLs for PFAS

Goal (MCLG) is no detectable PFOA or PFOS.

MCL is based on feasible detection limit for most labs.



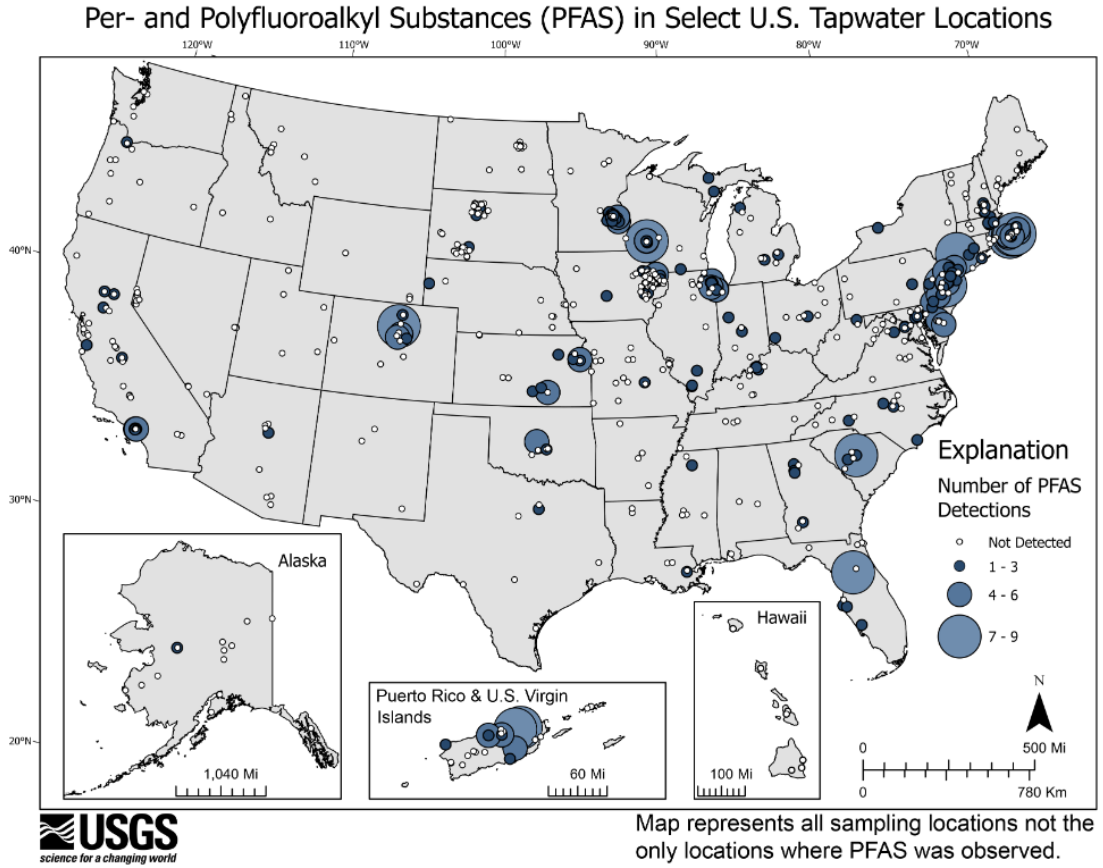
Can look up test results across much of Michigan

https://www.michigan.gov/egle/maps-data/mpart-pfas-gis

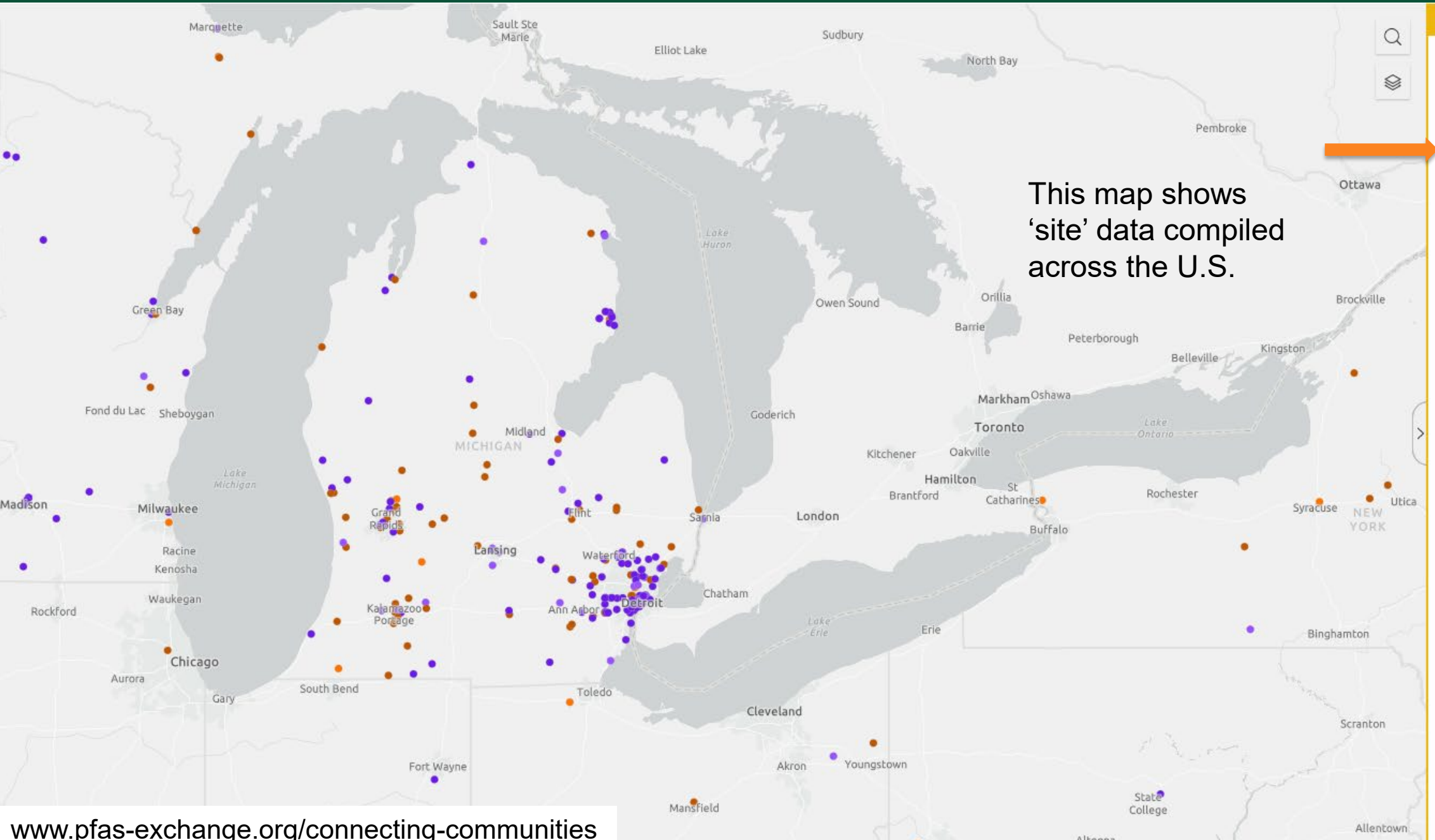
PFAS contamination and exposure

Drinking Water (2023 Study)

- USGS estimated that at least 45% of the nation's tap water contains measurable levels of PFAS
- Concentrations were similar between public supplies and private wells



https://www.usgs.gov/news/national-news-release/tap-water-study-detects-pfas-forever-chemicals-across-us



www.pfas-exchange.org/connecting-communities

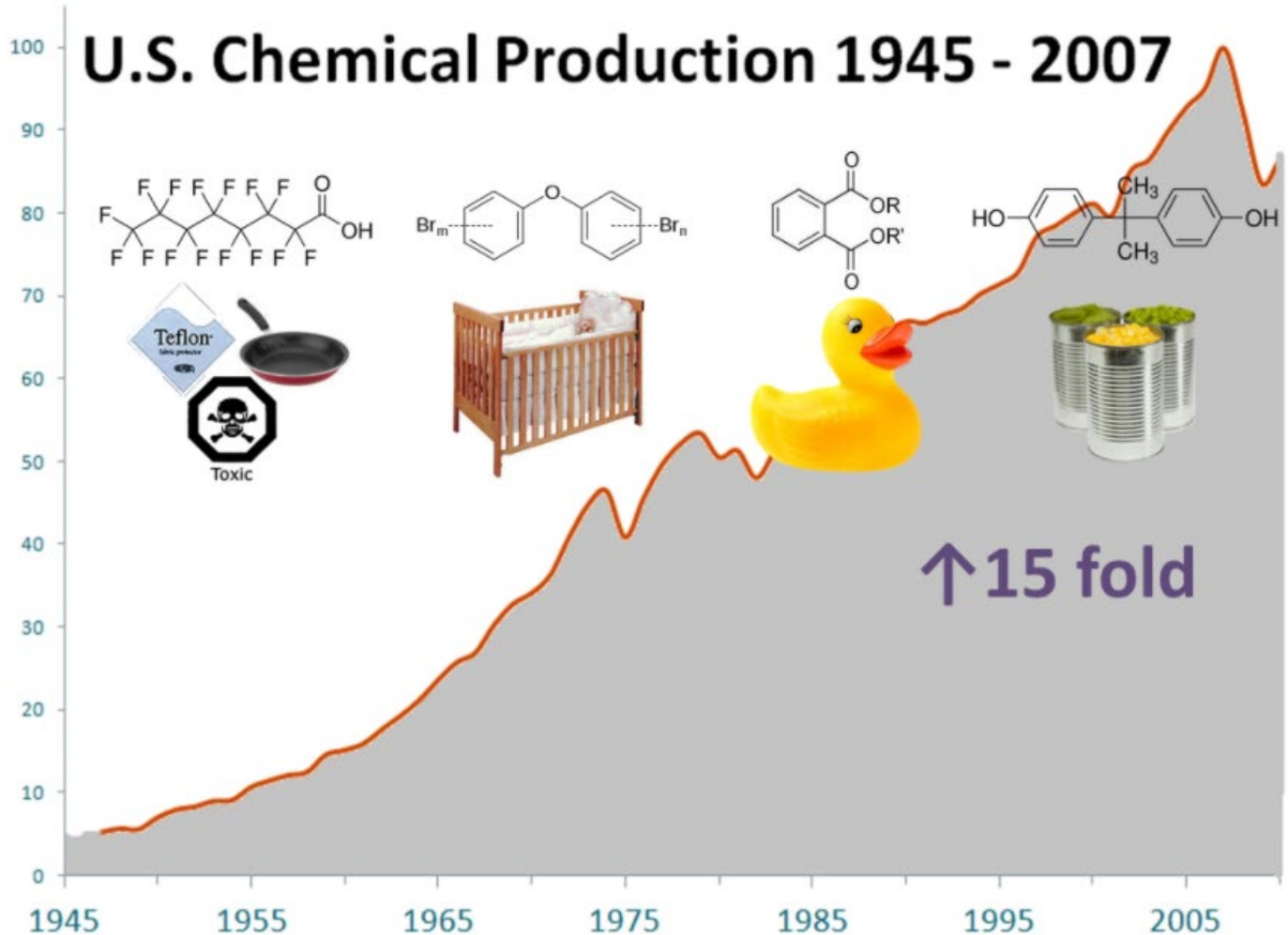
Industrial Chemicals in Virtually Every U.S. Pregnant Woman

43

industrial chemicals found in pregnant women

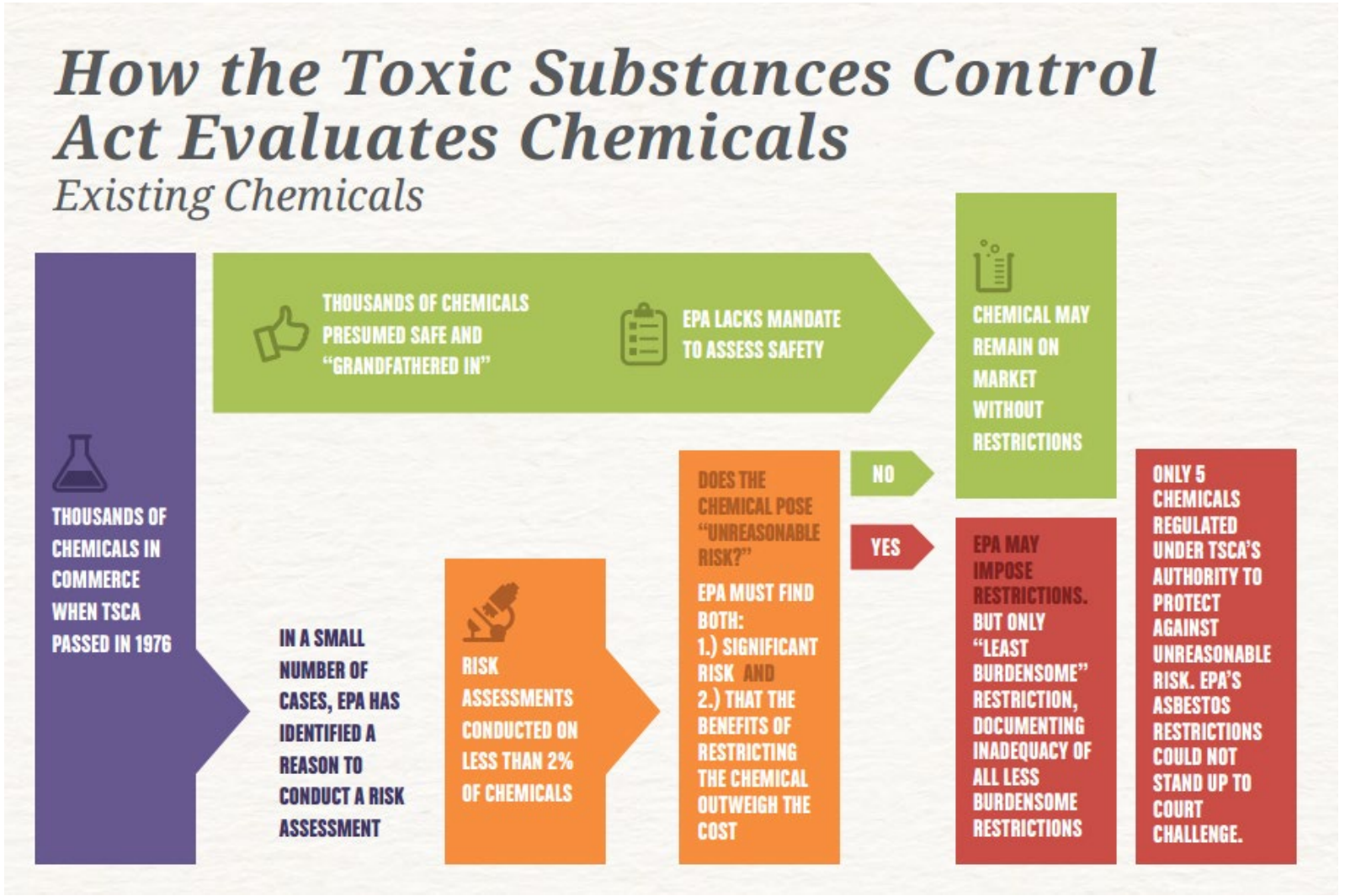
- Perchlorate
- 1-Hydroxypyrene
- 3-Hydoxyphenanthrene
- 2-Hydocyphenanthrene
- 1-Hydocyphenanthrene
- 1-Napthol
- 2-Napthol
- 2-Hydroxyfluorene
- 3-Hydroxyfluorene
- 9-Hydroxyfluorene
- Mono-(3-carboxypropyl) phthalate (MCPP)
- Mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP)
- Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)
- Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)
- Mono-ethyl phthalate (MEP)
- Mono-n-butyl phthalate (MnBP)
- Mono-isobutyl phthalate (MiBP)
- Mono-benzyl phthalate (MBzP)
- Benzophenone-3
- Hexachlorobenzene
- p,p' - Dichlorodiphenyldichloroethene (DDE)
- 1,2,3,4,6,7,8-Heptachlororodibenzo-ρ-dioxin (HpCDD)
- PCB-170
- PCB-153
- PCB-146
- PCB-118
- PCB-110
- PCB-105
- PCB-101
- PCB-99
- PCB-74
- PCB-66
- PCB-52
- PCB-49
- PCB-44
- PCB-28
- PBDE-153
- PBDE-100
- PBDE-47
- Perfluorononanoic acid (PFNA)
- Perfluorooctane sulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)
- PCB-138 and -158

Source: University of California, San Francisco, Program on Reporoductive Health and the Environment

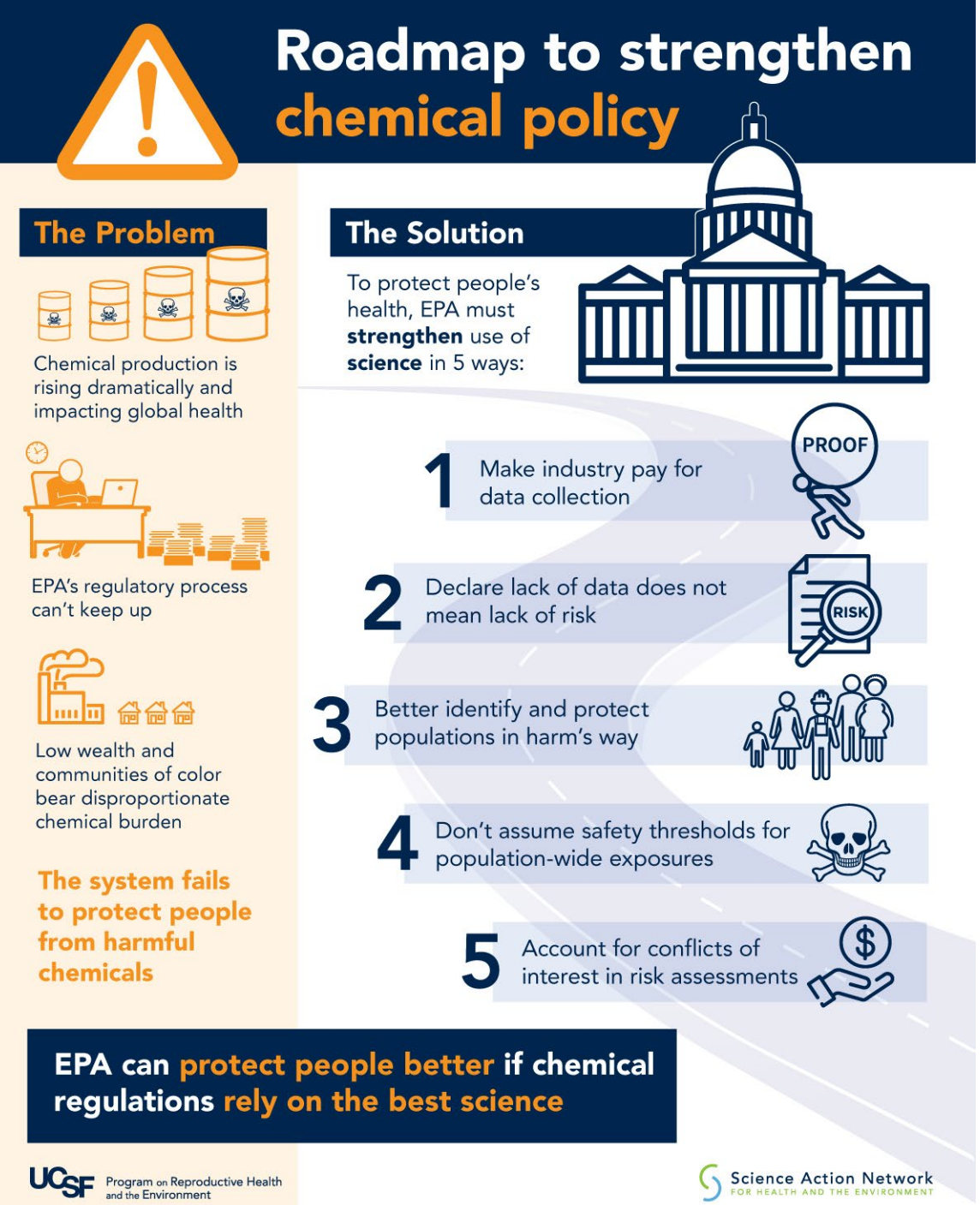


Federal reserve data on chemical production is only offered as relative production, which is unit-less. A specific reference year is chosen and values are calculated relative to that year's production. In this particular data set 2007 is the reference year and is assigned a value of 100.

Data from: U.S. Federal Reserve Board, Division of Research and Statistics



Pre-TSCA Reform



Effective chemical policy is needed to help protect food supply.

Scientists need your help.

Share concerns with legislators.

This is a bipartisan issue.

https://prhe.ucsf.edu/strengthening-chemical-regulatory-process