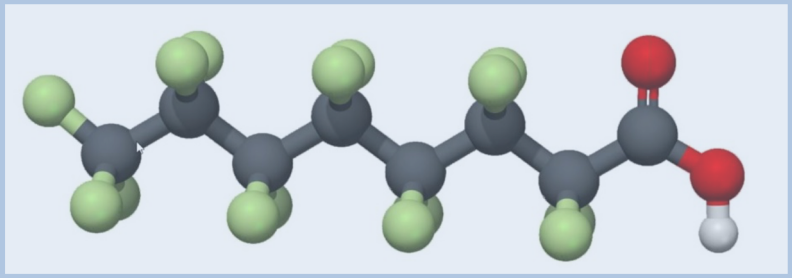
Biosolids, Composts, PFAS



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Presentation to Washington Organic Recycling Council (WORC)
August 2, 2022

Slides adapted from NEBRA presentations. Thanks to

Why biosolids are used

NEBRA's PFAS page:
https://www.nebiosolids.org/pfas-biosolids

Includes "PFAS & Biosolids & Septage on NE Farms" and lit. reviews (click at bottom of page)

nebra
North East Biosolids & Residuals Association

Recycled organics: Tools for sustainability.

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PFAS in Biosolids ("sludge") and Residuals

Recycling organic "wastes" benefits society and the environment.

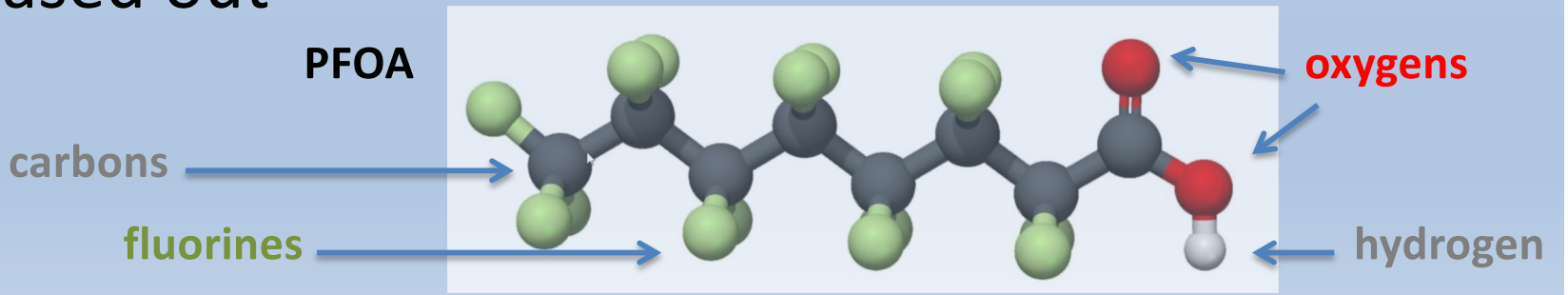
Throughout the U. S. and Canada, biosolids (treated and tested sewage sludge), septage, paper mill residuals, composts, and other organic residuals are commonly recycled to soils. This recycling does amazing things:

- enhances soil health
- recycles nutrients
- sequesters carbon (mitigating climate change)
- reduces fertilizer & pesticide use
- strengthens farm economies (thousands of farmers choose to use biosolids, because they work)
- restores vitality to degraded lands
- puts to productive use residuals that every community has to manage.
  (Wastewater treatment is a vital public health service, and it creates residual solids that have to be managed!)

"Let's move fast to stop non-essential uses of PFAS. Then let's work carefully and more slowly on research and balanced regulation."
— Dr. Linda Lee, Professor of Agronomy, Purdue University, MI WEA Biosolids Conference, Aug. 2020

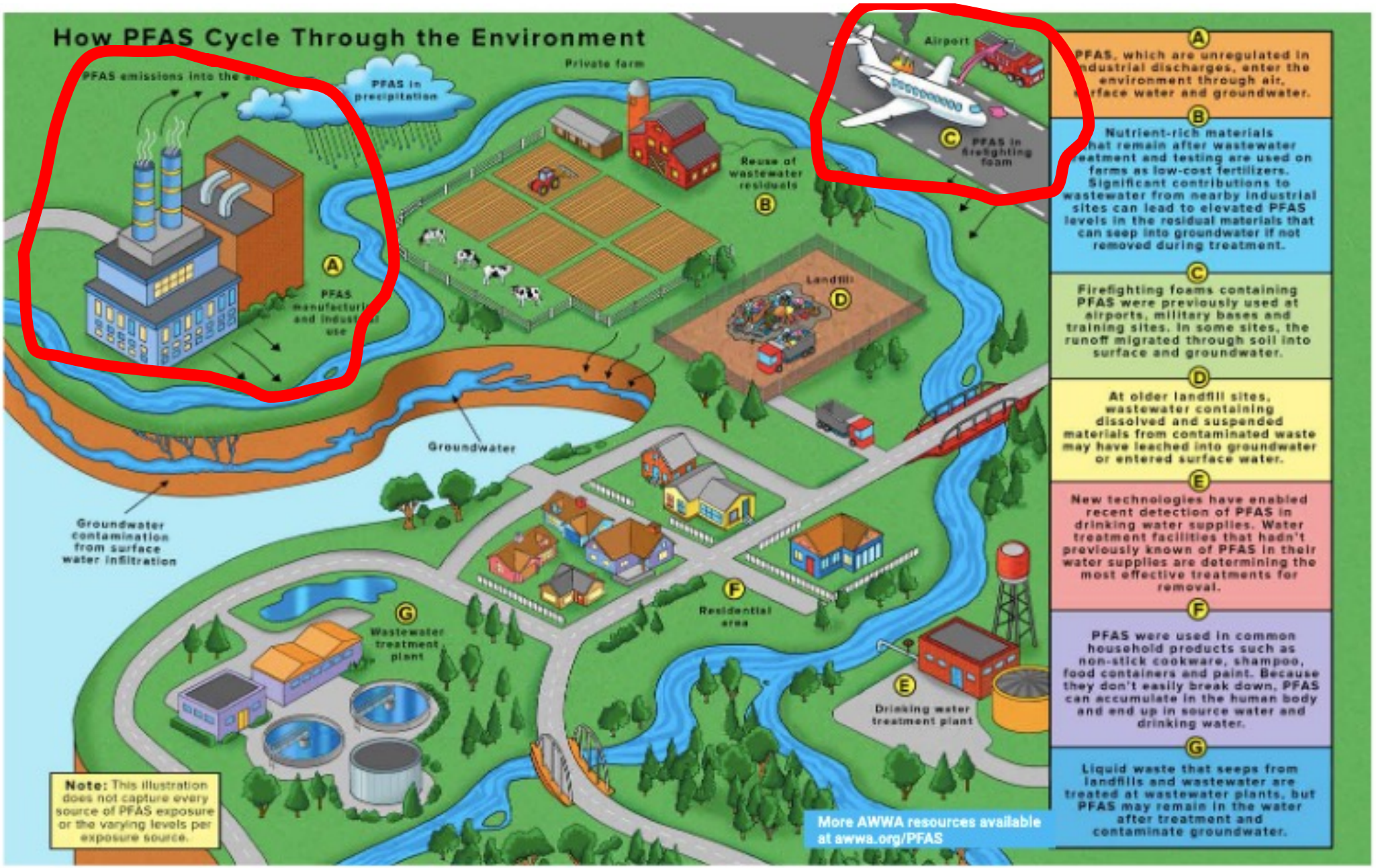
What are PFAS?

- Per- and polyfluorinated alkyl substances
- Maybe 9,000 in the PFAS family; widely used
- Water soluble, water resistant, grease resistant, bind to proteins
- Persistent – the defining fluorocarbon tail does not degrade. C-F bond is strong!
- Stable - don't break down in soils, waters
- PFOA and PFOS most studied & understood – and are phased out



How PFAS are used

PFAS are widespread from decades of use – including in water, soil, and human blood



https://www.awwa.org/Portals/0/AWWA/ETS/Resources/15683PFAS_web.pdf?ver=2019-11-12-133836-883

How people are most exposed to PFAS:

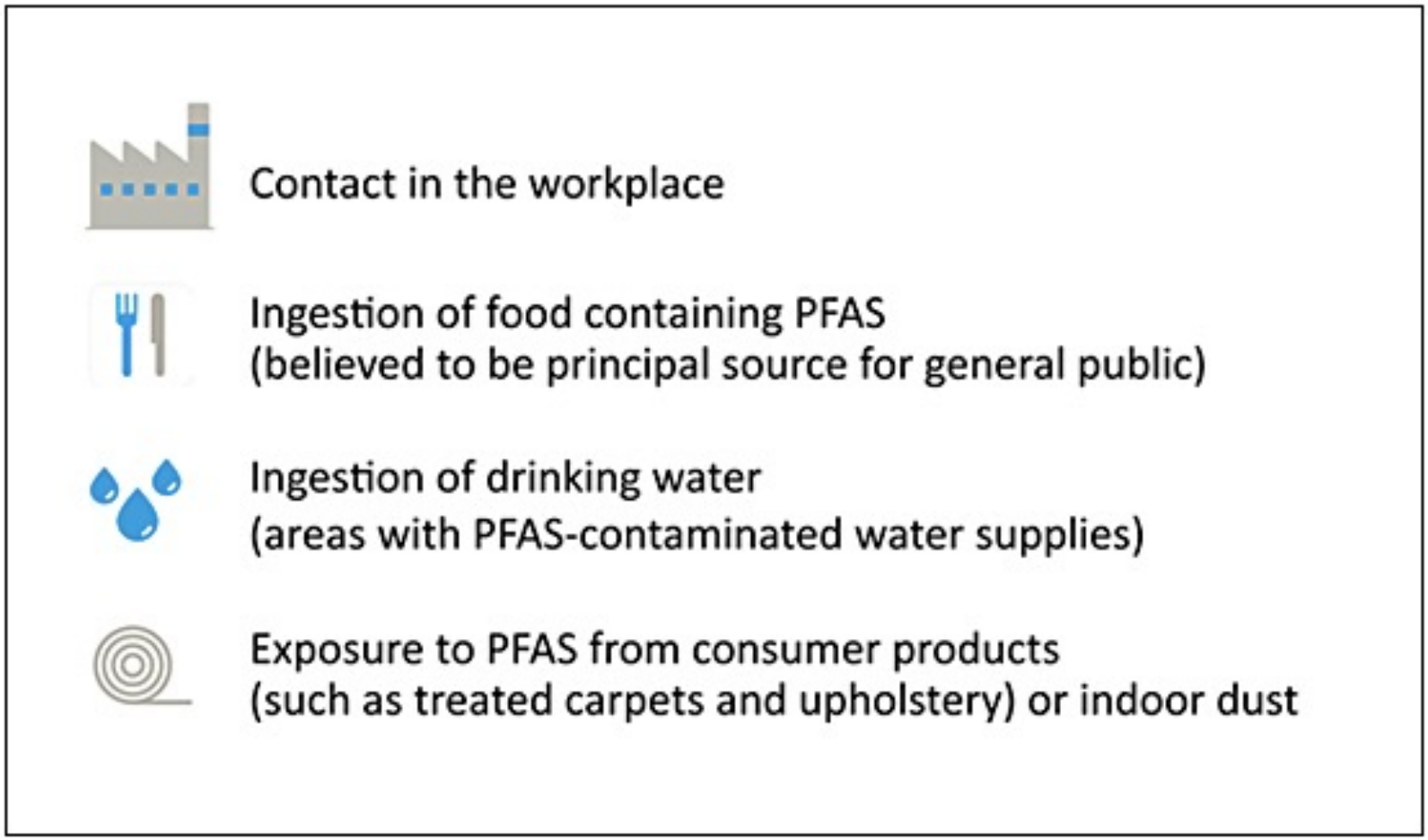


Figure 9-5. Predominant human exposure pathways.

https://pfas-1.itrcweb.org/9-site-risk-assessment/

Relative concentrations matter

- **Biosolids**: 35 – 200 ppb
- **Fast food trays, wrappers** - Range from 7,000 – 876,000 ppb total organic F *Consumer Reports* (May 2022) – Of 118 paper wrapper products tested, 37 were above 20,000 ppb and 22 were above 100,000 ppb. Only 37 products were below detection limits. Quote: "We know that these substances migrate into food you eat,…."
- **Cosmetics** in the U. S. – *Environmental Science & Technology* – June 15, 2021
  - Foundation – 147,000 - 10,500 ppb (Sum of 53 PFAS)
  - Lipstick – 216,000 – 1,560 ppb (Sum of 53 PFAS)
  - Mascara – 215 – 894 ppb (Sum of 53 PFAS)
- **Carpets and dust** in California Child Care Facilities (2018 data) – May 14, 2020 in *Chemosphere*. Median results: Carpet – 471 ppb; Dust – 523 ppb
- **Food products** - Schecteret al. 2010. *Environ Health Perspect* 118(6):796-802: Butter – 1.07 ppb; Olive Oil – 1.8 ppb

Previous and Current Uses: Industrial and Consumer Products

Perfluorooctanoic Acid (PFOA)

- Cooking surfaces
- Fire fighting foams
- Toothpaste, shampoos, cosmetics
- Semiconductor industry
- Polishes and waxes
- Electronics
- Lubricants/surfactants/emulsifiers
- Pesticide
- Plumbing tape
- Food containers and contact paper
- Textiles and leather
- Paints, varnishes, sealants
- Cleaning products
- And more…

***NOTE*: GenX chemicals replaced PFOA**

Perfluorooctane Sulfonic Acid (PFOS)

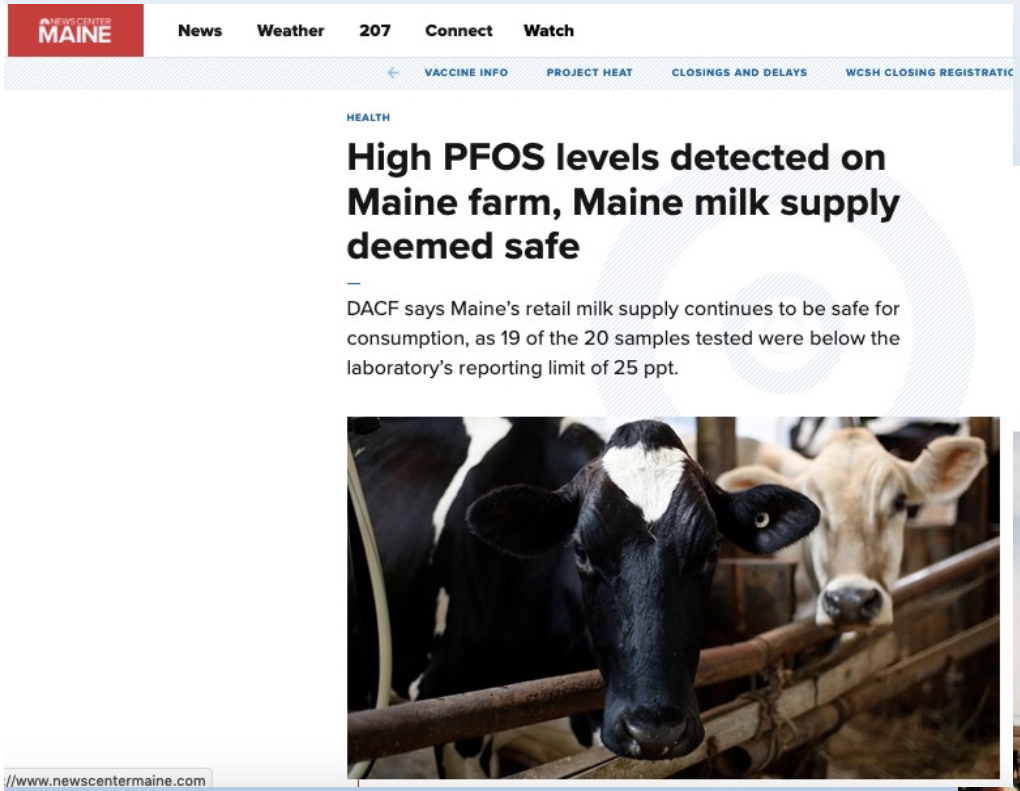
- Metal plating and finishing
- Fire fighting foams
- Photograph development
- Semiconductor industry
- Aviation fluids
- Flame repellants
- Packaging papers
- Oil and mining
- Stain repellants on carpets and upholstery
- Cleaning products
- Paints, varnishes, sealants
- Leathers, textiles
- And more…

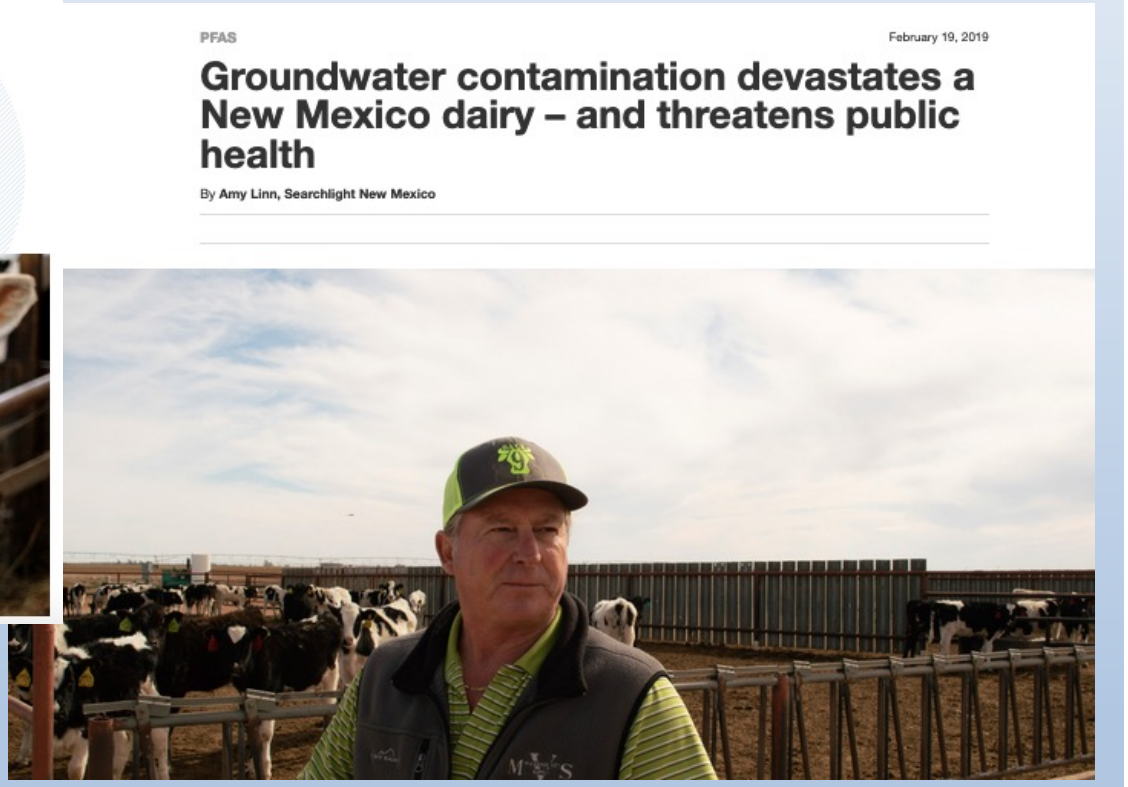
***NOTE*: PFBS replaced PFOS**

Slide from Betsy Behl, EPA Office of Water, presentation to Ntl. Drinking Water Advisory Council, April 2022

From Mitchell Center, Univ. of ME, PFAS project presentations, April 4 2022, https://www.youtube.com/watch?v=zB9879XIswA

In the news...





https://www.newscentermaine.com/article/news/health/high-pfos-levels-detected-on-maine-farm-maine-milk-supply-deemed-safe/

https://nmpoliticalreport.com/2019/02/19/groundwater-contamination-devastates-a-new-mexico-dairy-and-threatens-public-health/

In the ne

- MI – beef advisory: https://www.michigan.gov/mienvironment/0,9349,7-385-93395-576530--,00.html
- Potatoes seem not to be affected: https://bangordailynews.com/2022/04/04/news/aroostook/potatoes-may-be-safer-from-pfas-than-other-crops-joam40zk0w/

https://www.newscentermaine.com/health/high-pfos-levels-detected-on-maine-milk-supply-deemed-safe/

ALL SEWAGE SLUDGE recently tested by the Maine Department of Environmental Protection was contaminated with PFAS chemicals, according to documents obtained by The Intercept. The state tested the sludge, solid waste that remains after the treatment of domestic and industrial water, for the presence of three "forever chemicals": PFOA, PFOS, and PFBS. Of 44 samples taken from Maine farms and other facilities that distribute compost made from the sludge, all contained at least one of the PFAS chemicals. In all but two of the samples, the chemicals exceeded safety

roundwater-
y-and-threatens-public-

Many unknowns; research ongoing.

- Exposure for most of us is through use of consumer products (e.g. food packaging, textiles, lubricants, etc.).
- FDA testing shows little current concern for overall food quality.
- Concern if drinking water and food are contaminated at high levels because of nearby industry or fire-fighting activity, etc.
- Fate in soil: long-chain PFAS migrate less than short-chain
- Plant uptake: not likely in corn; some in grass
  Seems minimal in vegetables, except leafy greens
- Precursors play important role & evolve over time

Health impacts – some risk, but uncertainty

https://www.atsdr.cdc.gov/pfas/health-effects/index.html

A large number of studies have examined possible relationships between levels of per- and polyfluoroalkyl substances (PFAS) in blood and harmful health effects in people. However, not all of these studies involved the same groups of people, the same type of exposure, or the same PFAS. These different studies therefore reported a variety of health outcomes. Research involving humans suggests that high levels of certain PFAS **may** lead to the following:

Increased cholesterol levels

Changes in liver enzymes

Small decreases in infant birth weights

Decreased vaccine response in children

Increased risk of high blood pressure or pre-eclampsia in pregnant women

Increased risk of kidney or testicular cancer

At this time, scientists are still learning about the health effects of exposures to mixtures of different PFAS.

One way to learn about whether PFAS will harm people is to do studies on lab animals.

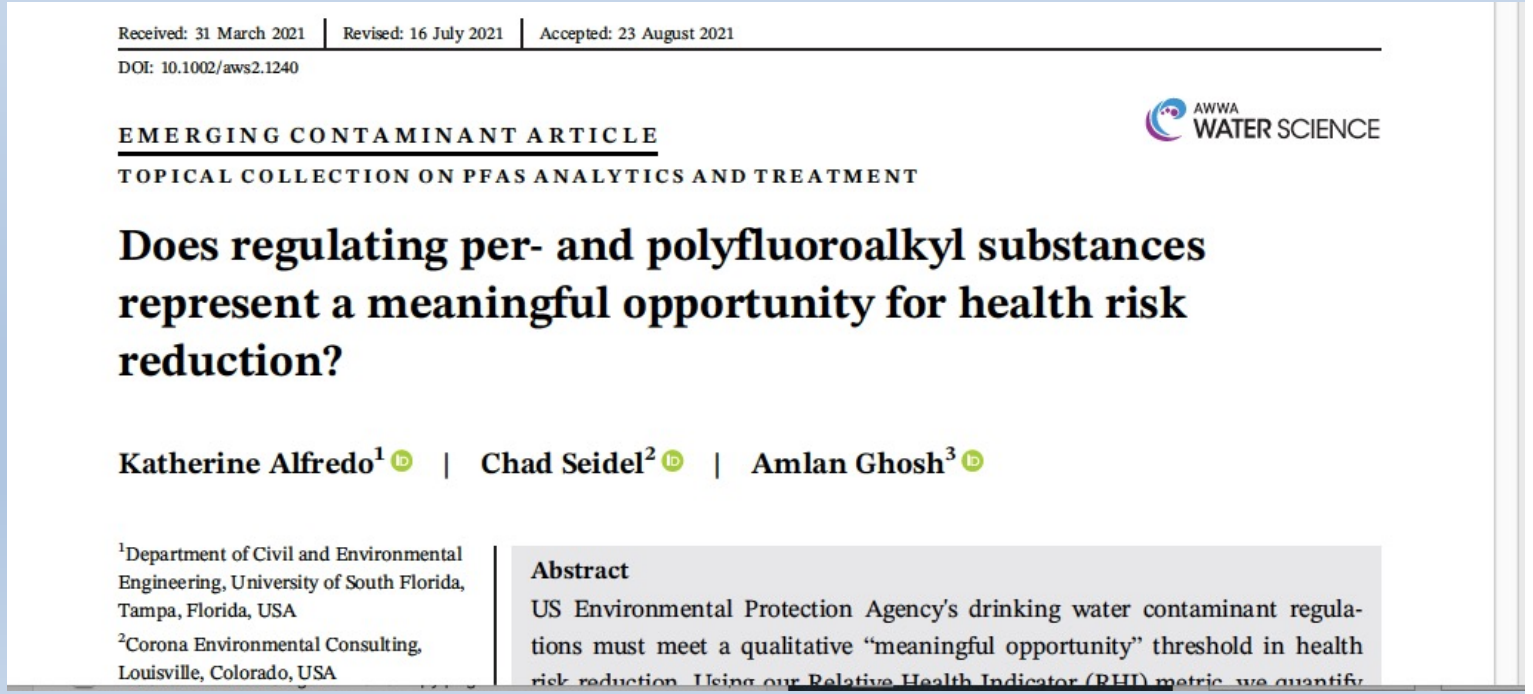
- Most of these studies have tested doses of PFAS that are higher than levels found in the environment.
- These animal studies have found that PFAS can cause damage to the liver and the immune system.
- PFAS have also caused birth defects, delayed development, and newborn deaths in lab animals.

Humans and animals react differently to PFAS, and not all effects observed in animals may occur in humans. Scientists have ways to estimate how the exposure and effects in animals compare to what they would be in humans.

Additional research may change our understanding of the relationship between exposure to PFAS and human health effects.

Wide variations in regulatory reactions

AWWA analysis: "Despite little change in toxicological studies, endpoint health reference levels and established regulatory thresholds are vastly different depending on location." *–Alfredo et al., 2021*



Received: 31 March 2021 | Revised: 16 July 2021 | Accepted: 23 August 2021
DOI: 10.1002/aws2.1240

AWWA WATER SCIENCE

EMERGING CONTAMINANT ARTICLE

TOPICAL COLLECTION ON PFAS ANALYTICS AND TREATMENT

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

Katherine Alfredo[1] | **Chad Seidel**[2] | **Amlan Ghosh**[3]

[1]Department of Civil and Environmental Engineering, University of South Florida, Tampa, Florida, USA

[2]Corona Environmental Consulting, Louisville, Colorado, USA

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

Changing thinking on the toxicity of PFAS

Andrew Smith,
Slide presentation,
January 2022

EFSA* - Human data, immune system toxicity, sum of PFOA, PFOS, PFNA, PFHxS
CA** - Human data, changes in cholesterol, proposed

THERE ARE 2 MAJOR SOURCES OF PFAS IN THE ENVIRONMENT:

- industrial discharges
- fire-fighting (including training,
  e.g. at military sites)

These cause 1,000s to 1,000,000s+
of ppt in waters.

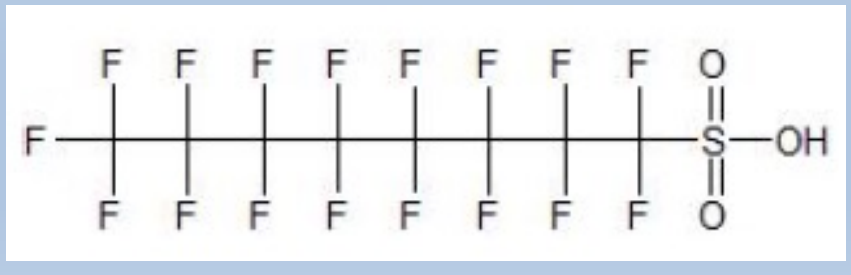
**1 ppt = 1 ng/L = 1 ng/kg =
1 second in 31,700 years.**

PFAS contamination at industrial site...

Example:
Wolverine Worldwide Kent County tannery dump sites, Rockford, MI

-Highest concentration is **76,000 PPT** (PFOA+PFOS)

Suspected source: This area consists of a former licensed disposal facility owned and operated by Wolverine… and several unregulated dump sites across three townships in northern Kent County.



https://www.ewg.org/research/update-mapping-expanding-pfas-crisis

...AND THEN THERE IS AMBIENT BACKGROUND PFAS,...

...including most wastewater and biosolids and other residuals (e.g. food waste compost, paper mill residuals), septic (onsite) systems, solid waste management activities – these are all receivers of PFAS, not original sources.

When any of these are recycled, the background PFAS go with them.

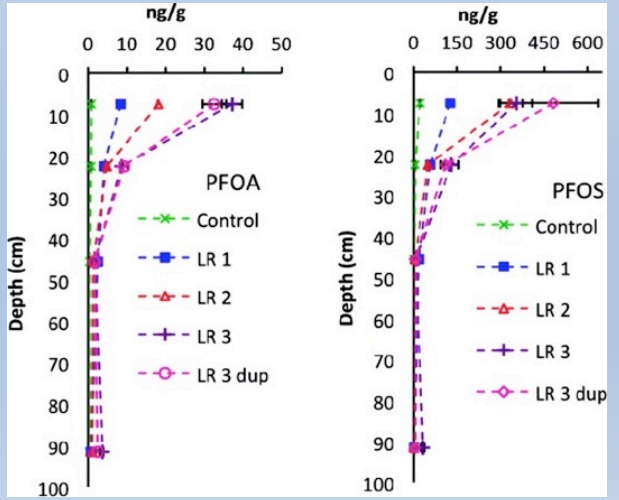
These may cause 10s to 100s of ppt in waters.

Background PFAS are in wastewater/biosolids/composts because they reflect modern life.

- Even small-town wastewater & composts have PFAS, because PFAS comes from common products.
- We are more aware now because of advances in analytical chemistry.

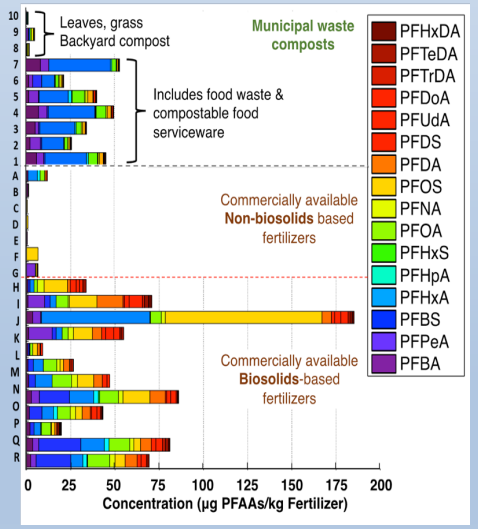
What are the concerns when biosolids & composts are applied?

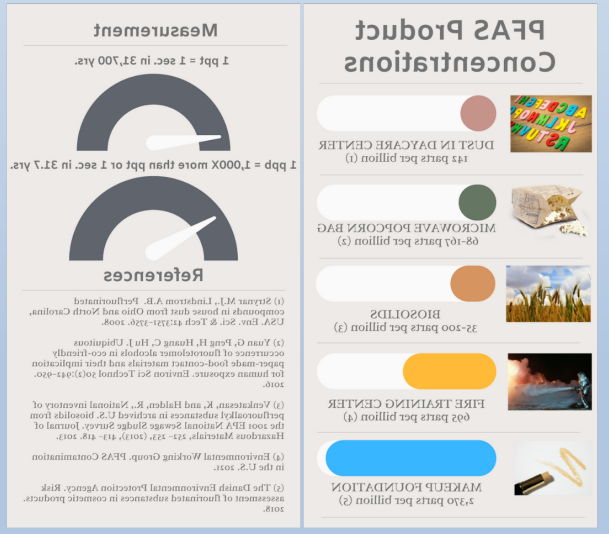
1. Leaching to groundwater, causing impacts to human & animal drinking water
2. Some risk of plant uptake in some crops (e.g. hay, leafy greens, but not corn)
3. There may be other sources of PFAS on farms: firefighting foam, past chemicals (surfactants), cleaners, waxes..., but manufacturer secrecy makes it hard to know. Biosolids are probably largest source in most cases.



Sepulvado et al; Environ. Sci. Technol. 2011, 45, 8106-8112

Data & details matter.





Measuring & talking about PFAS

In waters: in parts per trillion

1 ppt = 1 second in ~32,000 years

In soils/solids: in parts per billion

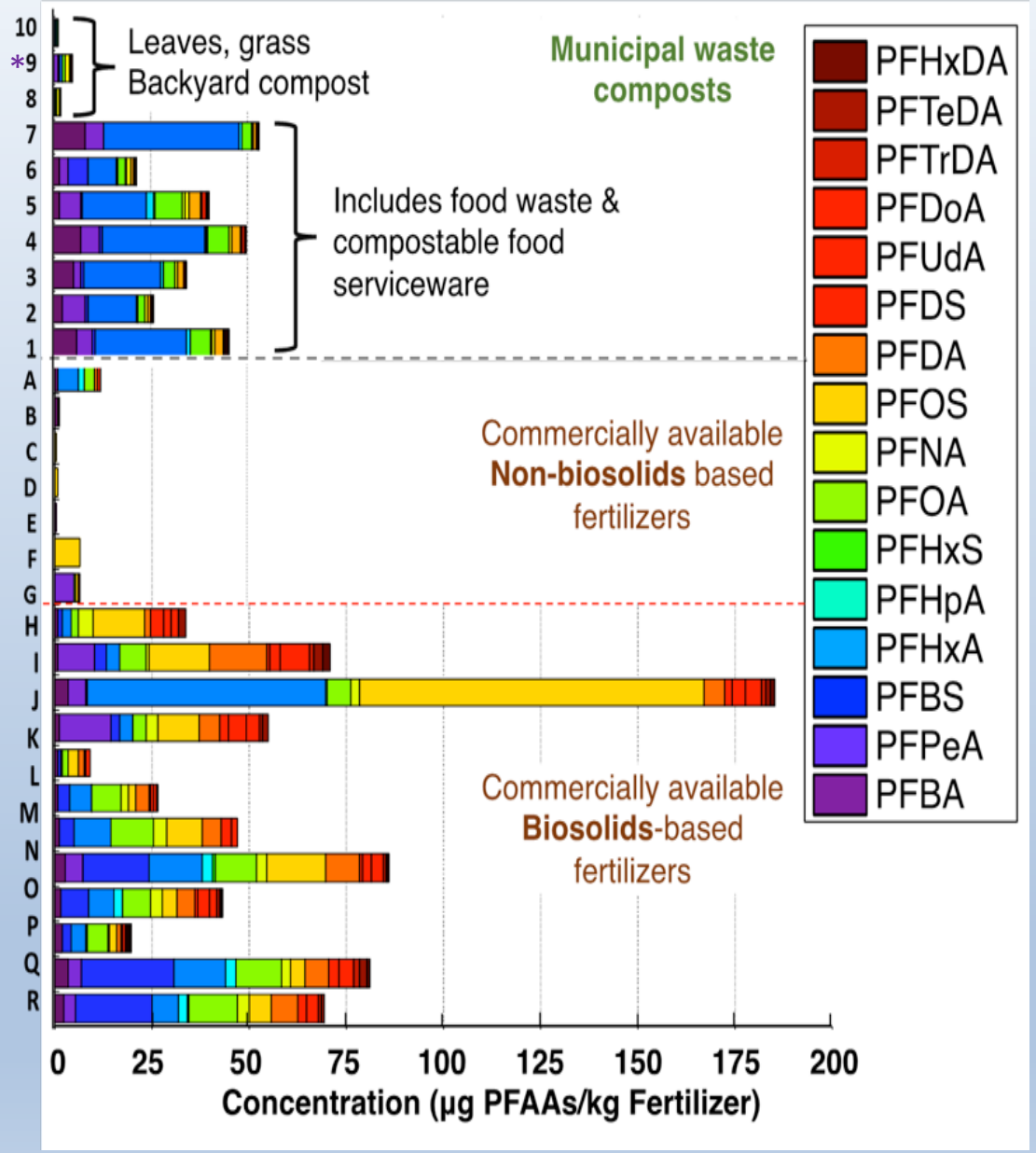
1 ppb = 1 second in 32 years

Limited analytical methods:

- EPA Method 537/537.1 (& 533) – for drinking water only
- EPA Method 8327, for non-drinking water, direct injection
- Draft EPA Method 1633 (with DoD) for solids & non-drinking water, using isotope dilution
- Others in development stages

https://www.epa.gov/water-research/pfas-analytical-methods-development-and-sampling-research

PFAS in Biosolids-based products & composts



- Higher PFAA loads in biosolids-based products
- Range for the biosolid-based products: 30 – 185 µg/kg (ppb)
- Longer chains ($CF_n \geq 6$) dominant in 2014 biosolid-based products versus $CF_n \leq 6$ in 2017 food waste composts
- Higher [PFAA] in food waste composts with compostable food packaging (#1-7)
- * #9 included food wastes, coffee grounds, unbleached coffee filters
- Background levels include atmospheric deposition, contaminated water.

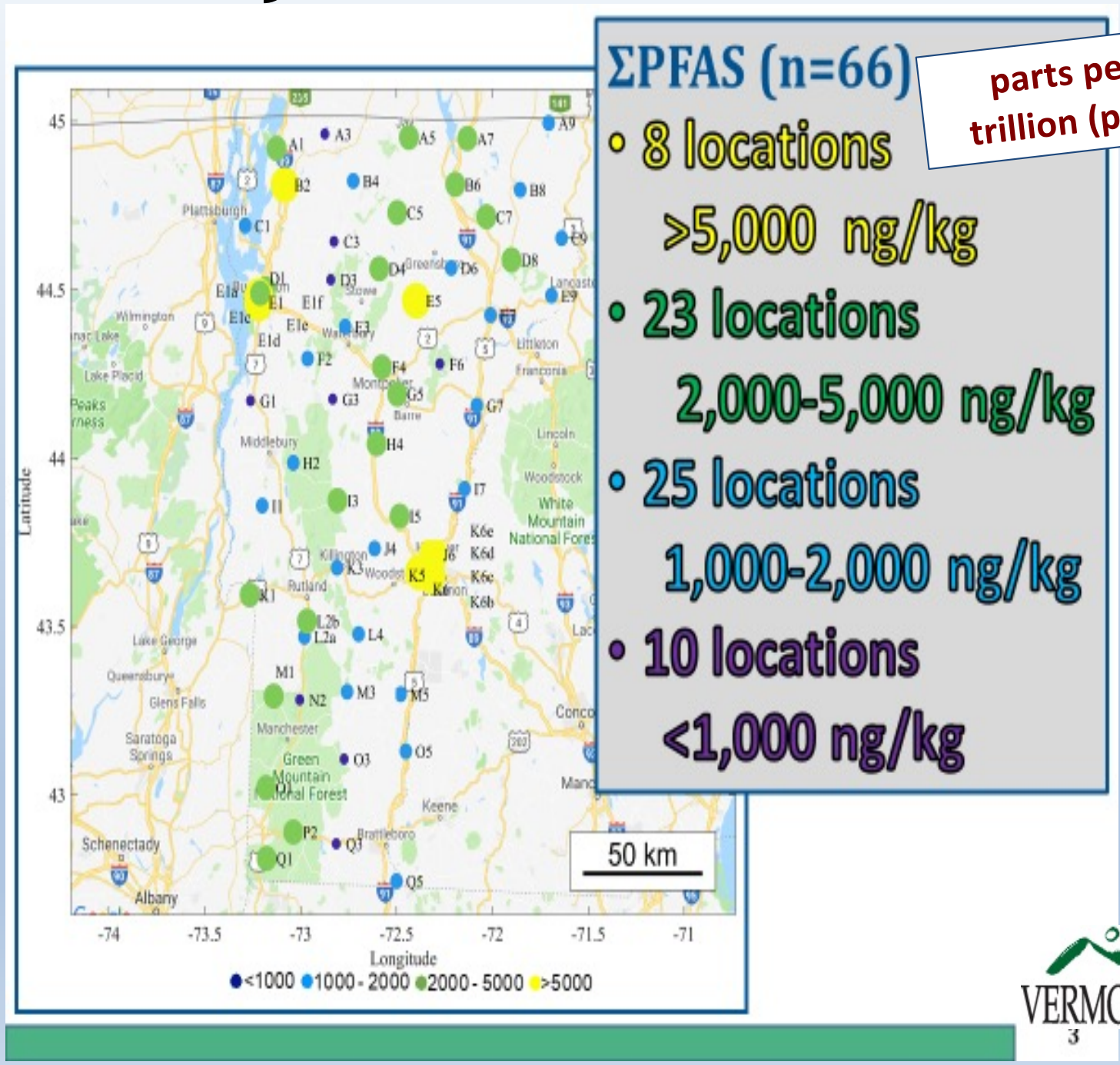
Choi, Lee et al. *ES&T Letters*, 6 (6):372–377 https://doi.org/10.1021/acs.estlett.9b00280
Kim-Lazcano, Lee et al. *ES&T* 54(14):8640-8648. https://doi.org/10.1021/acs.est.9b07281

PFAS are widely found.... In soils:

Study for
VT DEC 2018

PFAS measured in randomly-selected sites with no obvious PFAS sources.

PFOS found in every sample



Biosolids not industrially-impacted: Maine

Biosolids-Amended Soil Sampling Data

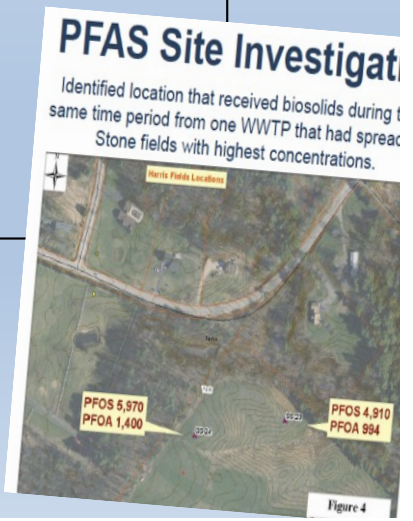
Maine, 2019

29 fields, 1 sample each, multiple years of biosolids application

ug/kg (ppb)

Biosolids = typical, not-industrially impacted

	Mean	Maximum	Minimum	ME DEP Screening #
PFOA	3.06	12.90	1.05	2.5
PFOS	8.76	20.90	2.13	5.2



Slide courtesy of Northern Tilth

Industrially-impacted biosolids farm...
Wisconsin

- **April 15, 2020: PFAS found in 7 of 98 drinking water wells near Marinette, WI where industrially-impacted biosolids were applied...**
- **But...**
  only 1 result is above EPA health advisory (70 ppt):

  - https://www.wbay.com/content/news/More-wells-in-Marinette-County-test-positive-for-elevated-levels-of-PFAS--569683041.html
    Milwaukee Journal Sentinel: https://www.jsonline.com/story/news/local/wisconsin/2020/04/14/forever-chemicals-johnson-controls-ordered-deliver-more-homes/2989330001/
    Wisconsin Public Radio: https://www.wpr.org/listen/1625136
    Wisconsin DNR info: https://dnr.wi.gov/topic/Contaminants/Marinette.html

EPA PFAS Soil Clean-up Screening Numbers (RSLs)

May 2022

Analyte	U. S. EPA RSLs Target Health Quot. = 0.1* (ppb, except tapwater)					
	Resident soil: child dermal contact	Resident soil: child ingestion	Resident Soil ug/kg (ppb)	Industrial Soil ug/kg (ppb)	Tapwater ng/L (ppt)	Groundwater Protection Risk-based soil SL (ug/kg)
~Hexafluoropropylene oxide dimer acid (HFPO-DA) – (GEN-X)		23	23	350	6	
~Perfluorobutanesulfonic acid (PFBS)	9,900	2,300	1,900	25,000	600	0.1900
~Perfluorohexanesulfonic acid (PFHxS)	660	160	130	1,600	39	0.0170
~Perfluorononanoic acid (PFNA)	99	23	19	250	6	0.0250
~Perfluorooctanesulfonic acid (PFOS)	66	16	13	160	4	0.0038
~Perfluorooctanoic acid (PFOA)	99	23	19	250	6	0.0910
~Potassium perfluorobutanesulfonate	9,900	2,300	1,900	25,000	600	0.3000
~Potassium perfluorooctanesulfonate	66	16	13	160	4	

* THQ = 0.1 is used in site clean-up when it is expected that multiple similar chemicals are present, creating an add-on impact. THQ = 1.0 numbers are 10 times higher and would be used if the chemical is thought to be alone.

So, what happened in Maine?

A really unfortunate story of an anomalous industrially-impacted biosolids mixed with political pressures.

https://www.washingtonpost.com/nation/2022/04/11/pfas-forever-chemicals-maine-farm/

Farms receiving industrially-impacted biosolids

PFOS – a legacy issue - is what stands out...

- **Maine Stoneridge Farm, 2017:**
  - Soil – PFOS stands out at high level, up to 878 ppb
  - Milk – 176 – 1,420 ppt (but PFOA = ND); likely from soil ingestion, some plant uptake?
- **2nd Maine Farm, 2020:**
  - Soil – hundreds of ppb Hay – some PFOS uptake Corn - minimal
  - Milk – up to 32,000 ppt (!) - likely from industrially-impacted biosolids and possible industrial residuals applied in the 1980s – 1990s

For comparison: other New England farms using typical biosolids for many years:

- Soil: <10 ppb PFOS
- Milk <100 ppt, compared to ME conservative standard of 210 ppb

Other Maine farms impacted by same industrial discharge as Farm #2, into WRRF & land application in 1980s, 1990s

- Albion organic dairy where biosolids applied decades ago:
  - Soil not too high: ~30 ppb
  - Forage grown on this farm: minimal PFAS levels
  - But Unity farm hay (round bales) fed to cows on this farm: 45 ppb
  - Milk: 1,690 - 2000 ppt (ME screening level = 210 ppt)
- Albion vegetable farm / CSA
  - Irrigation water: ~9,000 ppt (ME groundwater = 20 ppt,sum of 6 PFAS)
  - Drinking water: ~800 ppt (ME groundwater = 20 ppt,sum of 6 PFAS)
  - Soils <10s ppb
  - Microgreens: 10 ppb
- PFOS is greatest issue, again.

Maine DACF PFAS webpage (https://www.maine.gov/dacf/ag/pfas/index.shtml)

Maine milk is safe.

https://www.maine.gov/dacf/ag/pfas/index.shtml

PFAS Round Two Retail Milk Testing Results 2020, Vista Labs (ND= Not Detected)
Samples of Maine milk processed either: 1) in-state or 2) out-of-state (but sold in Maine)

Sample Number	Sample Date	State in Which Milk was Processed	PFOS Results with Reporting Limit at 25ng/L Method Detection Limit 5.04 ng/L	PFHxS Results with Reporting Limit at 25ng/L Method Detection Limit 5.92 ng/L	PFOA Results with Reporting Limit at 25ng/L Method Detection Limit 4.07 ng/L	8:2 FTS Results wi Reporting Limit at 25ng/L Method Detectio Limit 12.9 ng/L
1	2/10/2020	ME	10.1 J	21.3 J, Q	ND	ND
1-retest	4/01/2020		*ND*	*ND*	*4.95 J*	ND
2	2/10/2020	ME	10.8 J, Q	10.7 J	ND	ND
3	2/10/2020	ME	65.7 Q	ND	ND	ND
3-retest	4/01/2020		*55.4*	*ND*	*6.06 J*	*22.6 J*
4	2/10/2020	ME	ND	ND	*ND*	ND
5	2/10/2020	ME	5.55 J, Q	ND	ND	ND
6	2/11/2020	ME	ND	ND	ND	ND
7	2/10/2020	ME	11.9 J, Q	11.3 J	ND	ND
8	2/11/2020	ME	9.02 J, Q	9.50 J, Q	ND	ND
9	2/12/2020	ME	12.2 J, Q	11.0 J	ND	ND
10	2/10/2020	NY	ND	ND	ND	ND
11	2/10/2020	NH	ND	ND	ND	ND
12	2/10/2020	MA	ND	ND	ND	ND
13	2/10/2020	MA	26.7 Q	ND	ND	ND
13-retest	4/01/2020		*24.6 J,Q*	*ND*	*ND*	ND
14	2/11/2020	ME	ND	ND	ND	ND
15	2/11/2020	ME	ND	ND	ND	ND
16	2/10/2020	ME	8.72 J, Q	ND	ND	ND
17	2/10/2020	ME	ND	ND	ND	ND
18	2/18/2020	VA	ND	ND	6.27 J	ND
19	2/18/2020	VA	ND	10.9 J	5.55 J	ND
20	2/18/2020	NY	ND	11.6 J, Q	ND	ND

J Result qualified by the laboratory as detected below the laboratory reporting limit.

Q Results further qualified by the laboratory as not meeting laboratory analytical criterion.

Maine ban is like using a chain saw for surgery to remove an abcess.

Product Testing PFAS Results 2022

Sampled by Katahdin Analytic Services, Scarborough, ME

Date Updated: 4/5/2022

Bold - exceeds screening level

Most Limiting Compound - ME DEP

				1900	5.2	2.5 ME DEP CH. 418 App. A Screening Levels (ng/g; ug/kg; ppb)					
Sample Type	**Lab**	**Sample Date**	**T.S. (%)**	**PFOS (ng/g)**	**PFOA (ng/g)**	**PFHpA (ng/g)**	**PFNA (ng/g)**	**PFDA (ng/g)**	**PFHxS (ng/g)**	**Other PFAS?**
Commercial Organic Products										
Seafood Compost	Eurofins LLE	3/16/2022	56.7							Yes
Seafood Compost	Eurofins LLE	3/16/2022	65.9	0.35J						Yes
Seafood Compost - nothing detected	Eurofins LLE	3/16/2022	23.5							No
Leaf & Yard Waste Compost	Eurofins LLE	3/16/2022	65	0.78J	0.46J			0.32J		Yes
Seafood Compost	Eurofins LLE	3/16/2022	45.5	0.90J	0.63J					Yes
Commercial Fertilizer - nothing detected	Eurofins LLE	3/16/2022	88.1							No
Bone Meal	Eurofins LLE	3/16/2022	93.3	0.81						No
Organic Fertilizer	Eurofins LLE	3/16/2022	92.1	15cn						No
Organic Fertilizer	Eurofins LLE	3/16/2022	98.6	0.41J		0.34JI				Yes
Liquid Organic Fertilizer	Eurofins LLE	3/16/2022	21.4	4.6cn	0.96Jcn		3.0cn	2.0Jcn		Yes
Dried Hen Manure	Eurofins LLE	3/16/2022	88.9	33cn						No
Hen Manure, Fresh	Eurofins LLE	3/16/2022	32.6	1.4J						Yes
Food Waste Compost	Eurofins LLE	3/17/2022	57	0.83J	4.1	0.76J	0.47J	1.9		Yes
Food Waste Compost	Eurofins LLE	3/17/2022	45.4		5.2	0.93J		1.6		Yes

cn - Refer to Case Narrative for further detail

J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

I - Value is EMPC (estimated maximum possible concentration).

Method PFC_IDA: The recovery for the labeled isotope(s) in the following sample(s): FERT-GT (410-76696-8) and FERT-DHM (410-76696-11) is outside the QC acceptance limits. Since the recovery is high and the native analyte(s) is not detected in the sample, the data is reported.

Method PFC_IDA: The sample injection standard peak areas in the following sample: FERT-NHL (410-76696-10) is outside of the QC limits for both the initial injection and the re-injection. The values here are from the initial injection of the sample.The recovery for the labeled isotope(s) in the following sample(s): FERT-NHL (410-76696-10) is outside the QC acceptance limits. Since the recovery is high and the native analyte(s) is not detected in the sample, the data is reported.

From McBurnie, Casella Organics, letter to ME DEP Commissioner, April 2022

Maine is spending $millions

PFAS Staffing and Funding

- 11 NEW Full Time Equivalents; 6 NEW Limited Period Positions
- Several existing staff also still working on PFAS; impacting other programs
- $20M from General Fund for the sampling, treatment, remediation, and monitoring of PFAS
- $5M from Maine Jobs and Recovery Plan* (still working on obtaining this!)
- Additional Infrastructure money **may** become available relating to remediation of PFAS in drinking water and wastewater *

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION www.maine.gov/dep

January 2022 Maine State Agency PFAS Update https://www.youtube.com/watch?v=EjmPicZT-uk

How to proceed?

Uncertainty in the biosolids & compost marketplace is disconcerting.

MICHIGAN shows how to address PFAS in biosolids:
FOCUS ON INDUSTRIAL SOURCE CONTROLS / PRETREATMENT

- PFAS source control upstream of wastewater plants has reduced PFAS levels 90+% in biosolids.
- Smart focus on source control & pretreatment = biggest risk reduction for the cost. Good INTERIM STRATEGY.
- Collaborative effort of Michigan EGLE & MPART (ag dept.), et al.

NEBRA coverage:
https://www.nebiosolids.org/michigan-shows-effective-approach-to-pfas-in-wastewater-biosolids

Michigan EGLE:
https://www.michigan.gov/pfasresponse/0,9038,7-365-88059_91299---,00.html

Municipal WWTP	PFOS, Effluent (ppt, most recent**)	PFOS Reduction in Effluent (highest to most recent)	Actions Taken to Reduce PFOS
Ionia WWTP*	<14.96	99%	Treatment (GAC) at source (1)
Lapeer*	20	99%	Treatment (GAC) at source (1)
Wixom*	36	99%	Treatment (GAC) at source (1)
Howell	6	95%	Treatment (GAC/resin) at source (1)
Bronson*	13	96%	Treatment (GAC) at source (1)
Kalamazoo	3.1	92%	Treatment (GAC) at source (2), change water supply
K.I. Sawyer*	18	83%	Eliminated leak PFOS-containing fire-fighting foam
GLWA (Detroit)	5.7	62%	Treatment (GAC) at sources (8)
Belding	7.2	49%	Restricted landfill leachate quanitity accepted

***as of October 15, 2019*
**Effluent exceeds WQS of 12 ng/L or ppt*

Concerns

- Where PFAS regulatory numbers & expectations are set will determine whether biosolids and composts are accepted.
- Options for PFAS destruction: not practical or cost-effective, except possibly gasification/pyrolysis, HTL. And it makes little sense to treat at the ”end of the pipe.”
- Will AD & composting investments be stranded?
- What would we do with organics? Non-food-chain uses perhaps? Forestry? Concrete?
- Maine is slowly phasing out PFAS in consumer products by 2030 – and that is where our exposure is greatest; meanwhile biosolids were banned immediately, although the risk from them is much lower.

What To Do?

This is not an immediate dire health threat.
Unfortunately, you and all of us have had PFAS in us for years or decades. Any health impacts to long-term, low-level exposures are subtle and chronic. Some PFAS (PFOA & PFOS) have declined in us, because of phase-outs in products. So it does go away if we reduce exposures. Take thoughtful steps to reduce exposures and any potential risks:

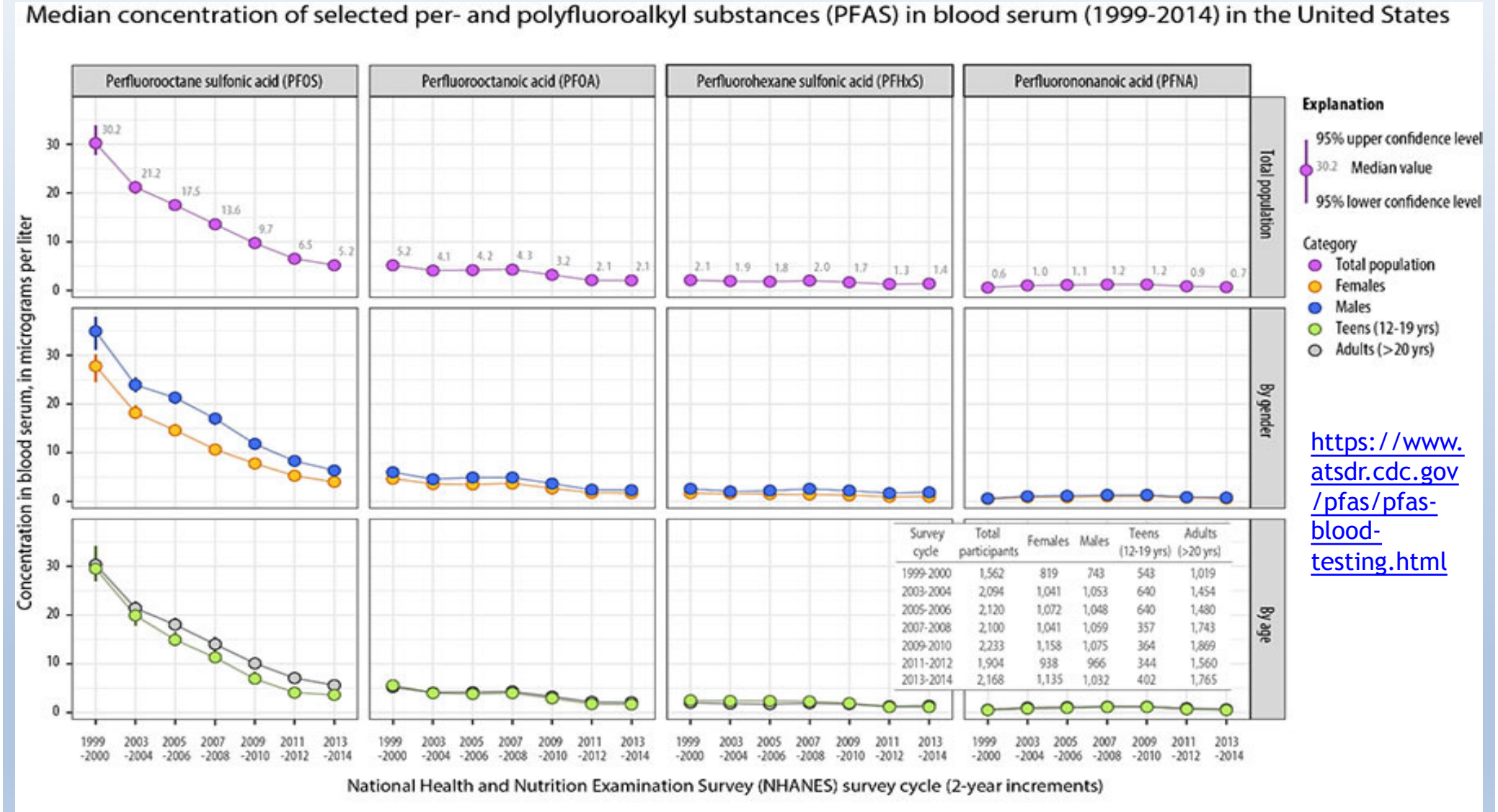
1. **Evaluate and reduce exposure sources in your life**: consumer products (carpets, furniture, waxes, cleaning products, dust, food, water). Know the level in your drinking water and treat or find different source if necessary. Avoid food packaging and other products that may contain PFAS.
2. **If you are worried, test soil and possibly hay, leafy greens, etc.** (corn seems to have little uptake) and/or milk or other farm products – for peace of mind.
3. **If elevated levels are found** (rare situations with industrial or firefighting foam impacts), adjusting management practices can help reduce risk. Consult with experts – Extension, USDA programs, etc.

Summary

Research and experience about PFAS in typical modern biosolids and septage shows:

- There is no significant PFAS risk from applying, touching, ingesting, or inhaling biosolids and septage.
- Sites that have, for decades, received typical biosolids (that reflect PFAS use in our daily lives and have not been industrially impacted) have measurable levels of PFAS in the soil - levels that are somewhat higher than background PFAS soil levels. But they present minimal risk to soil health, groundwater, and plant quality.
- Limited data show no significant impacts on the quality of farm products from PFAS at typical, multi-year biosolids application sites.
- However, there are a few cases where industrially-impacted biosolids & other residuals have caused impacts above regulatory limits resulting in harm to farm businesses.
- If regulatory limits are even lower, as in Maine, then many activities might be impacting groundwater, etc., such as septic systems, small businesses, etc.

Phasing out PFAS use is the best solution long-term.



https://www.atsdr.cdc.gov/pfas/pfas-blood-testing.html

Data source: Centers for Disease Control and Prevention. Fourth Report on Human Exposure to Environmental Chemicals, Updated Tables, (January 2017). Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. https://www.cdc.gov/exposurereport/.
Note: In January 2006, the eight major PFAS manufacturing companies in the U.S. voluntarily committed to a 95% reduction of emissions and product content for PFOA and selected related PFAS species by 2010 and a complete elimination of these chemicals from emissions and products by 2015 (USEPA. 2010/2015 PFOA Stewardship Program). The major US producer of PFOS phased out production of PFOS precursors by 2002 (Prevedouros et al. ES&T 2006, 40:32-44) .

Science Support Branch

Thank you.

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Biosolids compost for my raspberries… I still use it, knowing it has PFAS in it. I believe the benefits outweigh risks :)

More Resources:

PFAS & Biosolids: https://www.nebiosolids.org/pfas-biosolids
Summary article in *Country Folks*:
https://countryfolks.com/pfas-and-agriculture-what-it-means/
"We can never get to zero…"
https://www.wastedive.com/news/pfas-chemicals-organics-recycling-compost-biosolids/587044/

Slides adapted from NEBRA presentations. Thanks to

Acknowledgements & Sources of NEBRA PFAS slides

Inclusion on this list does not imply endorsement.
Views expressed are those of the presenter & NEBRA only.

- Linda Lee and Rooney Kim Lazcano, Purdue University
- Stephen Zemba and Harrison Roakes, Sanborn Head Assocs.
- Sarita Croce, Merrimack, NH
- Shelagh Connelly and Charley Hanson, Resource Management, Inc.
- Jeff McBurnie, Casella Organics
- Lawrence Zintek, U. S. EPA Region 5
- Andrew Carpenter and Leigh Dorsey, Northern Tilth

And many others (apologies for any omissions):

- Sally Brown, Univ. of WA
- NH DES staff– esp. R. Gordon, A. Drouin
- VT DEC staff – esp. Eamon Twohig
- Mike Person, MI DEQ
- Mark Russell, formerly Chemours
- ME DEP staff- K. Malinowski, C. Hopkins
- Layne Baroldi, Synagro
- Sally Rowland, NY DEC
- Barbara Reid, NH Municipal Association
- Lakhwinder Hundal, formerly Chicago WRRF
- Jennifer Palmiotto,GS Rural Water (NH)
- Rufus Chaney, USDA (retired)
- Scott Firmin, Portland Water District
- Ed Topp, Agriculture & Agrifood Canada
- Charles Neslund, Eurofins
- Matt Berg & Sherri van der Wege, WEAT
- Tiffany Skogstrom, Mass EEEA

***AND* many organizations across North America who funded NEBRA's PFAS work in 2018 – 2020.**

THANK YOU!

DEPARTMENT OF ECOLOGY
State of Washington

PFAS and Organics

Mary Harrington
Organic Materials Management Lead

PFAS Technical Definition

From RCW 70A.222.010:

"Perfluoroalkyl and polyfluoroalkyl substances" or "PFAS chemicals" means, for the purposes of food packaging, **a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom.**

In plain talk, it's a chemical that resists heat, oil, stains, and water. Due to the strong molecular bond, it is very hard to break down so is considered a "forever" chemical and is "persistent" in the environment.

Washington's PFAS Chemical Action Plan

- Identifying products that contain PFAS
- Research into safer alternative products
- Doing environmental assessments
- Strengthening community relationships
- Identifying public health impacts
- Supporting safe drinking water
- Safer options for fresh food packaging
- Establishing clean-up standards for water and soil
- Reducing PFAS releases to the environment
- Studying impacts of PFAS on landfills, biosolids, compost

Per- and Polyfluoroalkyl Substances
Chemical Action Plan

Hazardous Waste and Toxics Reduction Program

Washington State Department of Ecology

Olympia, Washington

November 2021, Publication 21-04-048

- From 2018 – 2022 a series of reports and recommendations published

Firefighting Foam

- Main concern: Contaminating drinking water sources
- 2018: RCW 70A.400 - firefighting foam and PPE changes
- Reducing impacts of PFAS containing firefighting foam:
  - Implementing contained firefighting foam testing at airports
  - Fire departments participate in firefighting foam disposal program

  Clean Production Action has reviewed foams, their list can be found here
    - https://www.greenscreenchemicals.org/certified/products/category/firefighting

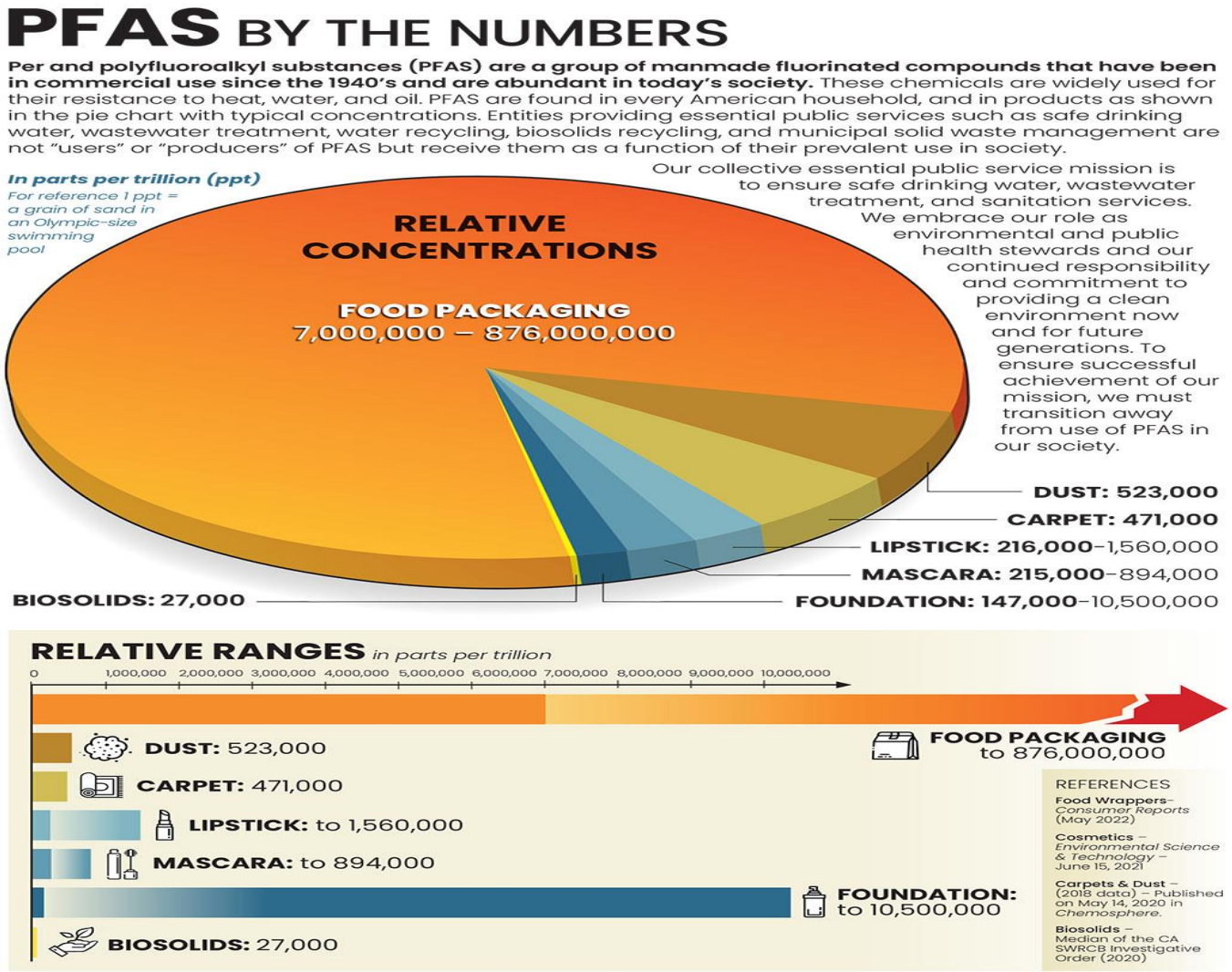
  - Ecology has not tested the products on this list, but staff do share the list with fire departments

PFAS and Food packaging

- FDA approves PFAS coating in food packaging in 1967
- WA efforts to improve diversion from landfill disposal takes hold in the 1990's
  - Organics diversion programs (COMPOSTING!) grow
  - Push to send paper products, including food packaging, to the composter gains traction
- PFAS in packaging identified as problematic

- 2018: RCW 70A.222 – food packaging changes

Graphic Courtesy California Association of Sanitation Agencies



WA Actions to Reduce PFAS in Packaging

- RCW 70A.222 “Packages Containing Metals and Toxic Chemicals” amended in 2018 and 2020
  - Definition for PFAS added
  - Updated Certificate of Compliance from manufacturers
  - Beginning in 2022, allows Ecology to prohibit sale of packaging if alternatives are identified
  - Alternatives for some food packaging have been identified

Food Packaging Alternatives

- Focus on fresh food packaging:
  - The following food package types have safer alternatives:
    * Food contact paper: Wraps & liners; Bags & sleeves.
    * Dinnerware: Plates; Bowls; Food boats; Flat serviceware
    * Take-out Containers: Pizza boxes; French fry cartons; Clamshells; Interlocking folded containers (also called food cartons or food pails).

Ecology used assessment modules (hazard, exposure, performance, cost and availability) to identify safer alternatives

* ***NOTE: end-of-life management is not considered***

PFAS in Biosolids

Per- and Polyfluoroalkyl Substances Chemical Action Plan

Hazardous Waste and Toxics Reduction Program

Washington State Department of Ecology

Olympia, Washington

November 2021, Publication 21-04-048

No known industrial PFAS production in WA (discharge by secondary manufacturing using PFAS may occur); impacts to biosolids primarily from homes via consumer products

Reducing PFAS in consumer products will lower PFAS concentrations in biosolids.

> "Worldwide monitoring data show that PFOA and PFOS concentrations in biosolids are trending downward, likely due to less production of the compounds."

At this time, there are no tests for determining PFAS in Washington's biosolids. (**EPA has evaluated a test it developed in 2021, now recommend inclusion in NPDES lists**)

CAP recommendations include establishing biosolids and soil sampling and handling methods for PFAS analysis.

PFAS Impacts on Compost

- Current research suggests that plant uptake of PFAS is minimal, except in a few rare cases of soil with high PFAS due to industrial discharges. At this time, firefighting foam appears to be the main source of drinking water contamination in WA.

- No issues with inhalation, ingestion, or dermal contact of compost containing PFAS

- No national PFAS threshold identified for biosolids, compost, or soil

PFAS Impacts on Compost, continued

- Generally acknowledged that inclusion of food scraps, food packaging, and biosolids in composting operations will introduce PFAS

- PFAS may transfer to contact water at compost facilities

- "Adoption of extremely low regulatory limits for soil PFAS could have adverse consequences for organics and residual recycling, and may not provide demonstrated risk-reduction for human health and the environment." Appendix 8, in the 2021 Chemical Action Plan

Safer Products for Washington

- Ecology and Department of Health are helping businesses transition away from toxic chemicals, including PFAS
- Publications available to help consumers make safer purchases
  - Product Registry - Cradle to Cradle Products Innovation Institute (c2ccertified.org)
  - Per- and Polyfluoroalkyl Substances Chemical Action Plan (wa.gov)
  - TCO Certified Product Finder
  - Search Products that Meet the Safer Choice Standard | US EPA
  - EWG Skin Deep® Cosmetics Database
  - Safer Alternatives to PFAS in Food Packaging (wa.gov)
  - Per- and Polyfluoroalkyl Substances in Food Packaging Alternatives Assessment (wa.gov)
  - Department of Ecology - Committees, Boards, and Workgroups (wa.gov)
  - https://www.greenscreenchemicals.org/certified/products/category/firefighting

SUMMARY

- Many groups are working on reducing PFAS in the environment (there is a lot going on!)
- Testing has so far been focused on water, but soil tests are coming
- The Chemical Action Plan recommends establishing biosolids and soil collection and handling methods
- Reducing PFAS in personal care products has resulted in lower PFAS in biosolids
- Reducing PFAS in food packaging will reduce the presence in compost that was made using food packaging (and the food it held).

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QUESTIONS?