MONTROSE ENVIRONMENTAL

THE PREMIER PROVIDER OF ENVIRONMENTAL SOLUTIONS

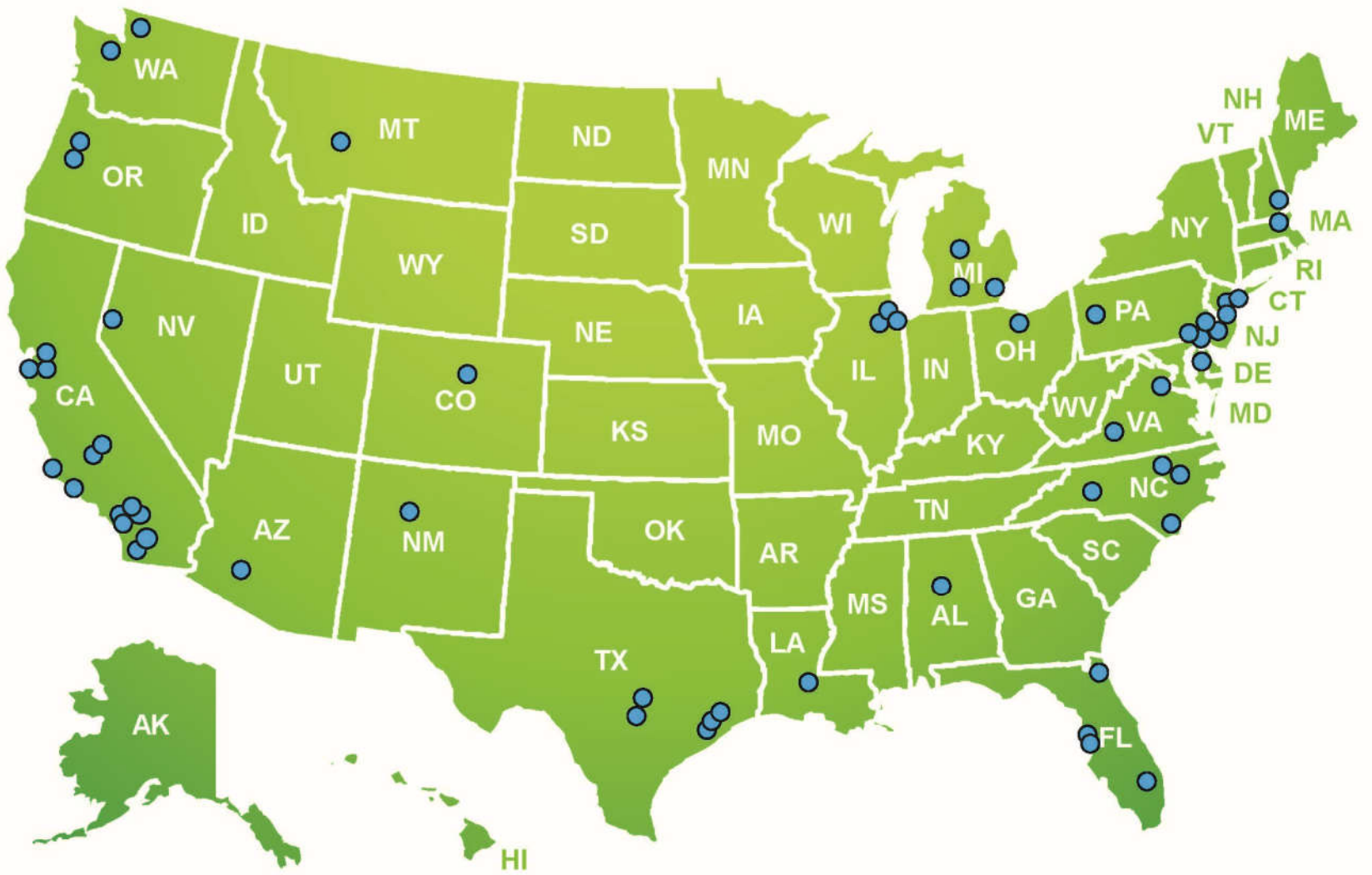
PFAS & BROWNFIELDS REDEVELOPMENT

Air & Waste Management Association
Mid-Atlantic States Section
Rutgers EcoComplex, Bordentown, NJ
January 22, 2020

AIR & WASTE MANAGEMENT ASSOCIATION

ADVANCED GeoServices
a Montrose Environmental Group company

Office Locations



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Redevelopment

- Redevelopment

- Brownfield Redevelopment

- Brownfield Redevelopment With PFAS

Landowner Liability Protections (CERCLA)

- Bona fida prospective purchasers (BFPPs)
  - Purchase property **with** knowledge of Historic on-site contamination
- Innocent landowners (ILOs)
  - Purchase property **without** knowledge of historic on-site contamination, but historic contamination is later identified
- Contiguous property owners (CPOs)
  - Purchase property **without** knowledge of contamination on-site emanating solely from an *adjacent property*, but contamination is later identified

Other Commercial Protections - Insurance Coverage - Unknowns, Regulatory Changes, Pollution Liability and Remediation Coverage

ASTM ESA E1527- 13

- Purpose - Satisfy one of the landowner protections
- Identify recognized environmental concerns (RECs)
- REC means the presence or likely presence of any *hazardous substances* or *petroleum products* in, on, or at a *property*
- PFAS is <u>not</u> a CERCLA *Hazardous Substance*

New Jersey Preliminary Assessment

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF SOLID AND HAZARDOUS WASTE

- NJAC 7:26B Industrial Site Recovery Act-ISRA
- NJAC 7:26E Preliminary Assessment -PA
  - Adds "pollutant" to list of items to be investigated
- NJAC 7:26C Administrative Requirements for the Remediation of Contaminated Sites -ARRCS
- NJAC 7:26D Comply with Remediation Standards
  - NJDEP Adds PFNA, PFOS and PFOA as "pollutants" with standards

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Discovery & Manufacturing History

Table 2-1. Discovery and manufacturing history of select PFAS

PFAS[1]	Development Time Period							
	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
PTFE	Invented	Non-Stick Coatings			Waterproof Fabrics			
PFOS		Initial Production	Stain & Water Resistant Products	Firefighting foam				U.S. Reduction of PFOS, PFOA, PFNA (and other select PFAS[2])
PFOA		Initial Production		Protective Coatings				
PFNA					Initial Production	Architectural Resins		
Fluoro-telomers					Initial Production	Firefighting Foams		Predominant form of firefighting foam
Dominant Process[3]		Electrochemical Fluorination (ECF)						Fluoro-telomerization (shorter chain ECF)
Pre-Invention of Chemistry /			Initial Chemical Synthesis / Production			Commercial Products Introduced and Used		

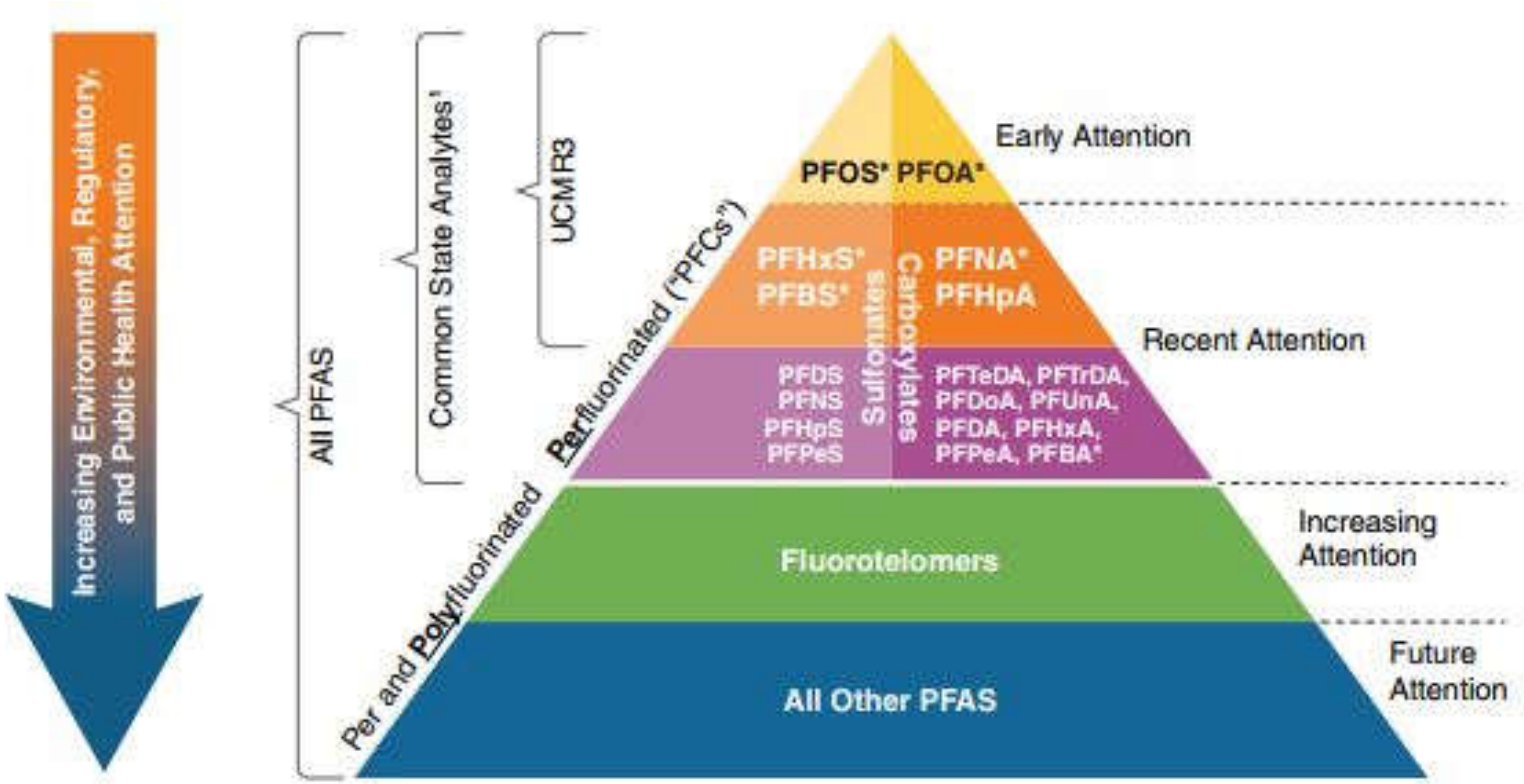
Notes:
1. This table includes fluoropolymers, PFAAs, and fluorotelomers. PTFE (polytetrafluoroethylene) is a fluoropolymer. PFOS, PFOA, and PFNA (perfluorononanoic acid) are PFAAs.
2. Refer to Section 3.4.
3. The dominant manufacturing process is shown in the table; note, however, that ECF and fluorotelomerization have both been, and continue to be, used for the production of select PFAS.

Sources: Prevedouros et al. 2006; Concawe 2016; Chemours 2017; Gore-Tex 2017; US Naval Research Academy 2017

PFCs- Good Properties

PFOS	• Surfactant or emulsifier; used in fire-fighting foam, circuit board etching acids, alkaline cleaners, floor polish, and as a pesticide active ingredient for insect bait traps; U.S. manufacture of PFOS phased out in 2002; however, PFOS still generated incidentally
PFOA	• Per fluorinated aliphatic carboxylic acid; used for its emulsifier and surfactant properties in or as fluoropolymers (such as Teflon), fire-fighting foams, cleaners, cosmetics, greases and lubricants, paints, polishes, adhesives and photographic films
PFNA, PFHxS, PFHpA & PFBS	• Manmade chemical; used in products to make them stain, grease, heat and water resistant

Emerging Awareness of PFAS Occurrence



*Common regulatory criteria or health advisories
¹Sum of informal poll (NJ, NH, MN)

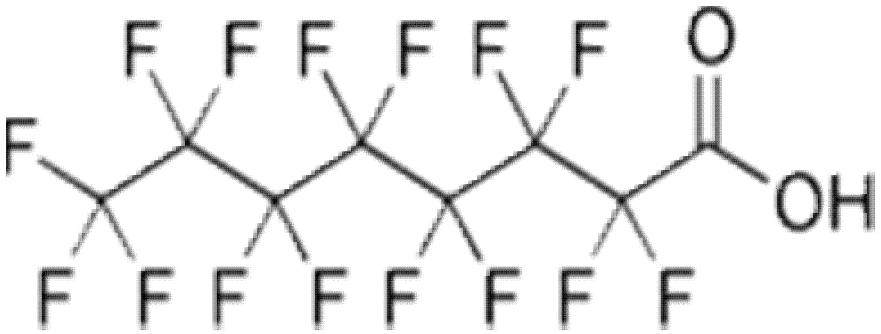
Thematic and not proportional.
Bottom of triangle indicates additional number of compounds; not a greater quantity by mass, concentration, or frequency of detection.

Figure 3-1. Emerging awareness and emphasis on PFAS occurrence in the environment
(Source: J. Hale, Kleinfelder, used with permission)

PFCs

Perfluorooctanoic acid

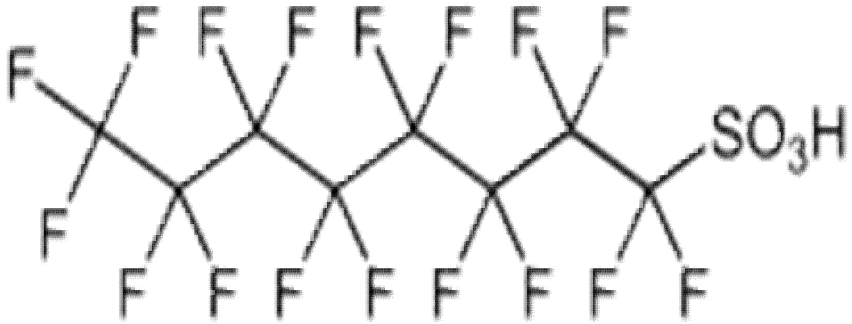
(also known as PFOA)



- However, there are over 4,500 PFCs
- UCMR 3- Included 6 PFCs (PFOS, PFOA, PFNA, PFHxS, PFHpA & PFBS)

Perfluorooctane sulfonic acid

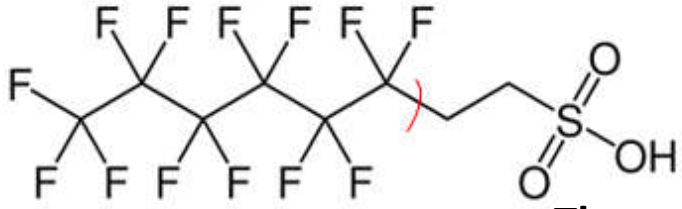
(also known as PFOS)



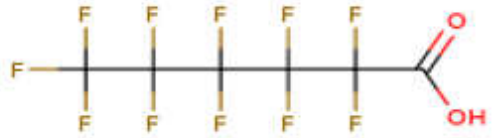
- Federal Health Advisory Level (70 total for PFOS/PFOA)
- Many sites identifying 15-20 PFCs and the PFOA/PFOS is less than 50% of total PFCs

Degradation Products

These Do Not Bioaccumulate

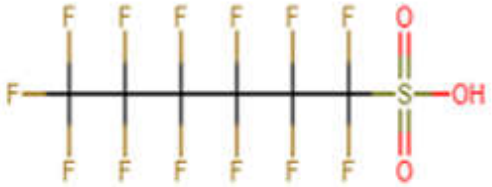


6:2 FTS (C8)



PFHxA (C6)

These Do Not Bioaccumule



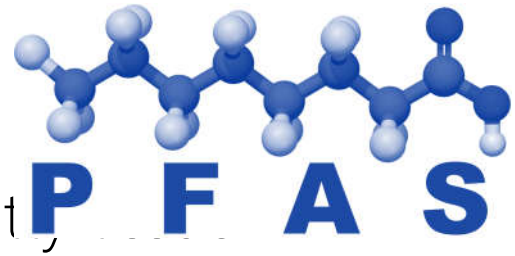
PFHxS (C6)

Liver and Kidney Toxicity
Skin Irritation

https://nasf.org/wp-content/uploads/2019/04/Summary-of-Toxicology-Studies-on-6-2-FTS-and-Detailed-Technical-Support-Documents.pdf

PFAS Chemical Property Generalities

- Not volatile - but can be transmitted through the air
- Adsorption to soils and sediment poor- PFAS specific
- Water solubility varies - PFAS specific
- Very stable - linear and branch forms can act differently
- Short Chain PFAS have shorter half-life than long-chain in humans and other species
- Short Chain harder to treat
- PFAS bioaccumulates in muscle verses fat



Health Effects

PFOA and PFOS

Potential Adverse Health Effects

- Developmental effects to fetuses
- Developmental effects to breastfed infants
- Cancer- testicular, kidney
- Immune effects
- Thyroid effects

- Based on both:
  - Laboratory studies, best-available, peer reviewed
  - Epidemiological studies, human populations

PFAS Exposure Routes

- Number 1 route ingestion
- Predominant sources entering the environment AFFF and Industry Plants Discharge Air Stack and Wastewater, and Landfilling of Waste Products
- Blood Serum Analysis 98% of Humans have detectable PFAS
- EPA Health Risk 20% from Drinking Water- 80% Other Residual Ingestion

EPA HAL 2009 - 2016

Three Factors That Affect Standards:
Reference Dose, Relative Source Contribution & Consumption Rate

Health advisory timeline for PFAS

Change in Reference Concentrations: PFOS and PFOA

- ***EPA Provisional*** **Health Advisory**, 2009
  - *Short-term* adverse health effects
  - PFOS: 200 ppt PFOA: 400 ppt

- **EPA Health Advisory**, May 19, 2016
  - *Long-term* adverse health effects
  - PFOS + PFOA: 70 ppt

EPA United States Environmental Protection Agency

FACT SHEET
PFOA & PFOS Drinking Water Health Advisories

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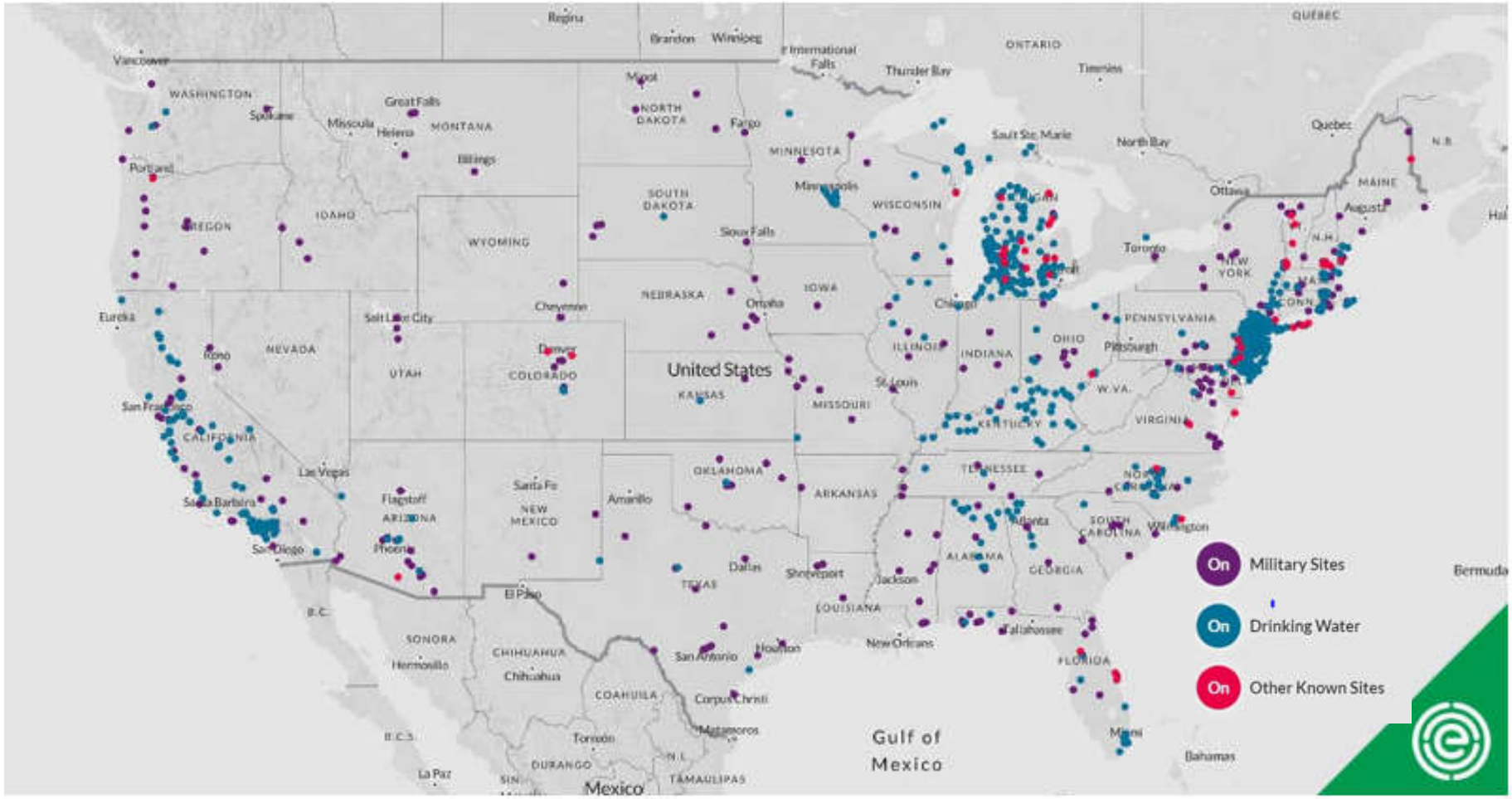
PFOA PFOS Hits USA



EWG 2019 1400 sites in 49 states

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EPA's PFOA/PFOS Health Advisory

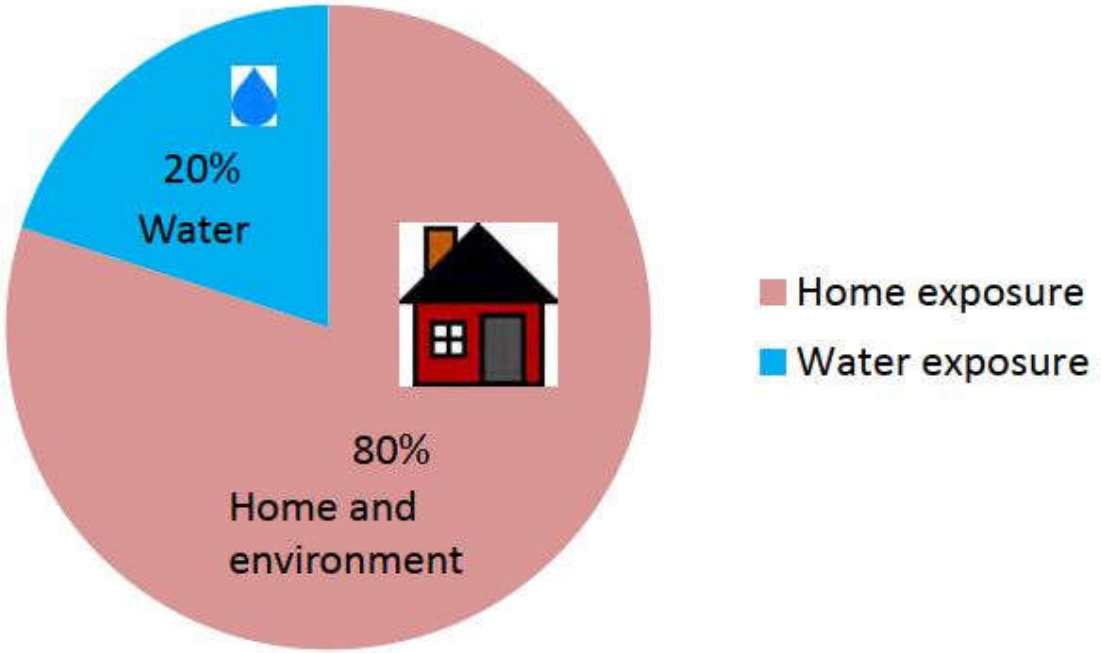
EPA's PFOA/PFOS health advisory: 70 ppt = 70 ng/L

Protective Factors

- 80% home/environment exposure
- 20% water exposure

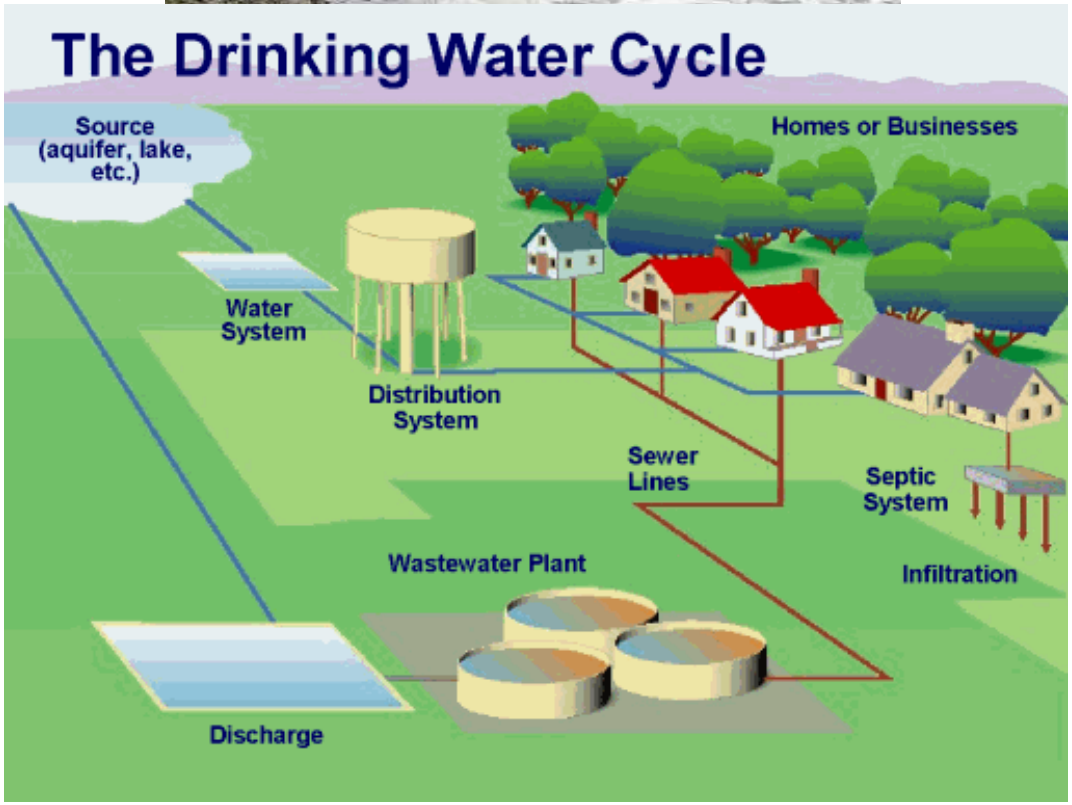
- Over 70 year lifetime
- 2 liters per day consumption

- Lactating women and children



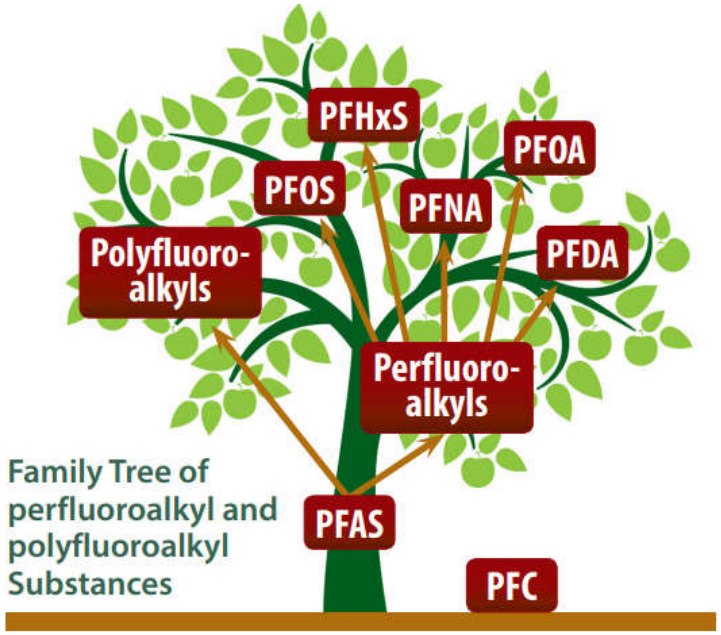
98% of U.S. has detected blood levels of PFCs

Drinking Water Vs. Wastewater Challenges



Investigative Challenges

- Industry/Site History usage of PFAS
- Sampling Location & Media
- Sampling Methods
- Analytical Methods
- Masked Source Areas
- Regulatory Standards
- Defensible Reliable Data
- Inconsistent & Changing Regulatory Enforcement



Unregulated Means No MCL

Unregulated just means no MCL

- Hexavalent chromium
- Perchlorate
- Pharmaceuticals & personal care products
- MTBE
- PFAS

No relationship to:

- ***media attention***
- ***controversy***
- ***public expectations***

Remediation Options

- Water Treatment-
  - GAC, IX-Resin, RO, Phytoremediation
- Groundwater Treatment-
  - P&T, In-situ adsorption, impermeable barriers, in-situ thermal, phytoremediation
- Soil Treatment-
  - Excavation, Thermal Destruction
- Sediment-
  - Dredging, Encapsulation
- Waste Disposal-
  - Incineration (hazardous & cement kilns), Landfill, Regeneration, Plasma

PFAS Redevelopment Perspectives

- Regulatory protections for proper due diligence
- Insurance policies covering unknowns & changing regulatory standards
- Exposure- ingestion – most sites on public water
- No Vapor Intrusion
- Soil exposure low risk
- PFOA & PFOS no longer produced in US
- Remediation techniques available GW & Soils & Air

Conclusion-

- Brownfield Redevelopment & PFAS can co-exist
- Challenges
  - Where to investigate
  - How to investigate
  - Producing accurate data that can be reproduced
  - Determining cleanup standard

Thank You For Your Time

Questions?

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