PFAS in Coastal and Freshwater Ecosystems

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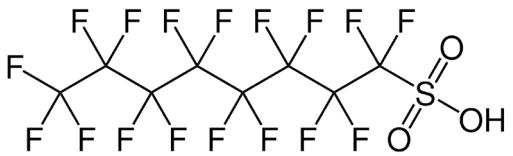
What are Per- & Polyfluoroalkyl Substances?

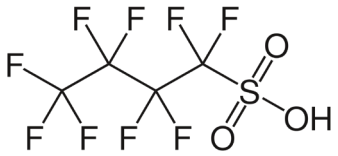
- **Per- and polyfluoroalkyl substances (PFAS)** are a large class of fluorinated organic compounds.
- *Depending on your definition(s),* PFAS are a **family of >10,000 chemicals**.
- Specific PFAS and their properties vary based:
  - Long- versus short chain PFAS
  - Functional group(s)
  - Extent of fluorination (per- versus polyfluorinated)
- **A lot of "PF…" acronyms, and it's OK to ask for clarification.**

Example PFAS Chemistries



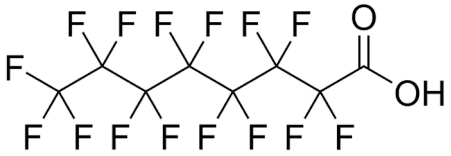
PFOS
Perfluorooctane sulfonic acid

Different Carbon Chain Length



PFBS
Perfluorobutane sulfonic acid
(4 carbons versus 8)

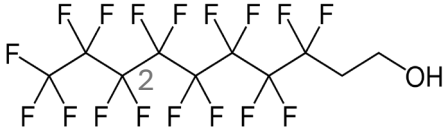
Different Functional Groups



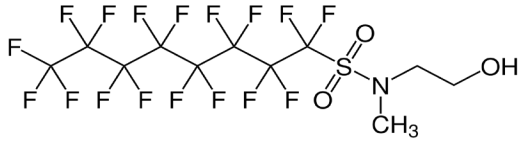
PFOA
Perfluorooctanoic acid

Other Novel Chemistries and Precursors

8:2 FTOH
8:2 Fluorotelomer alcohol

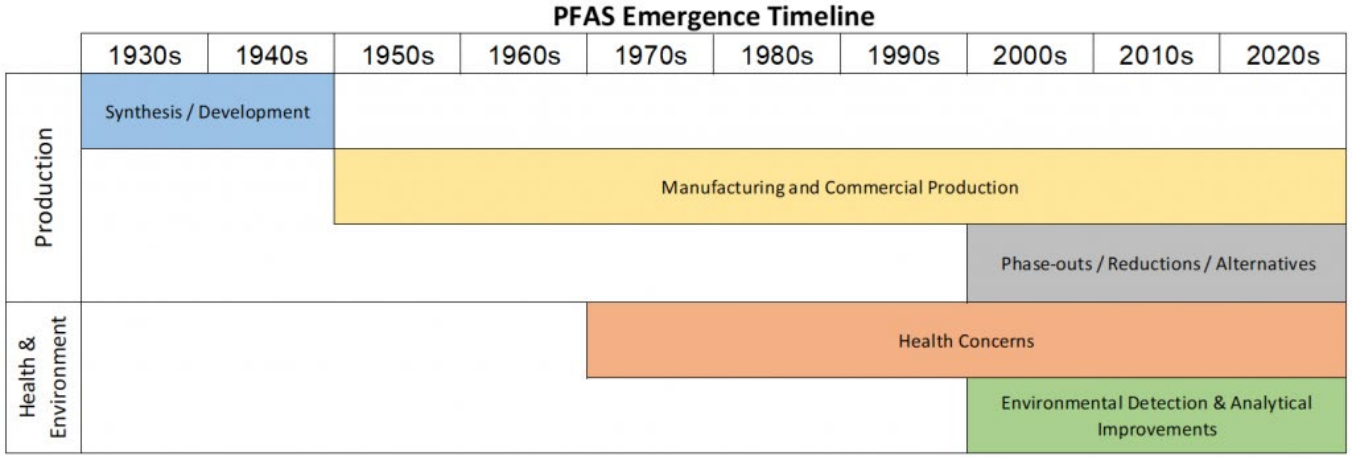


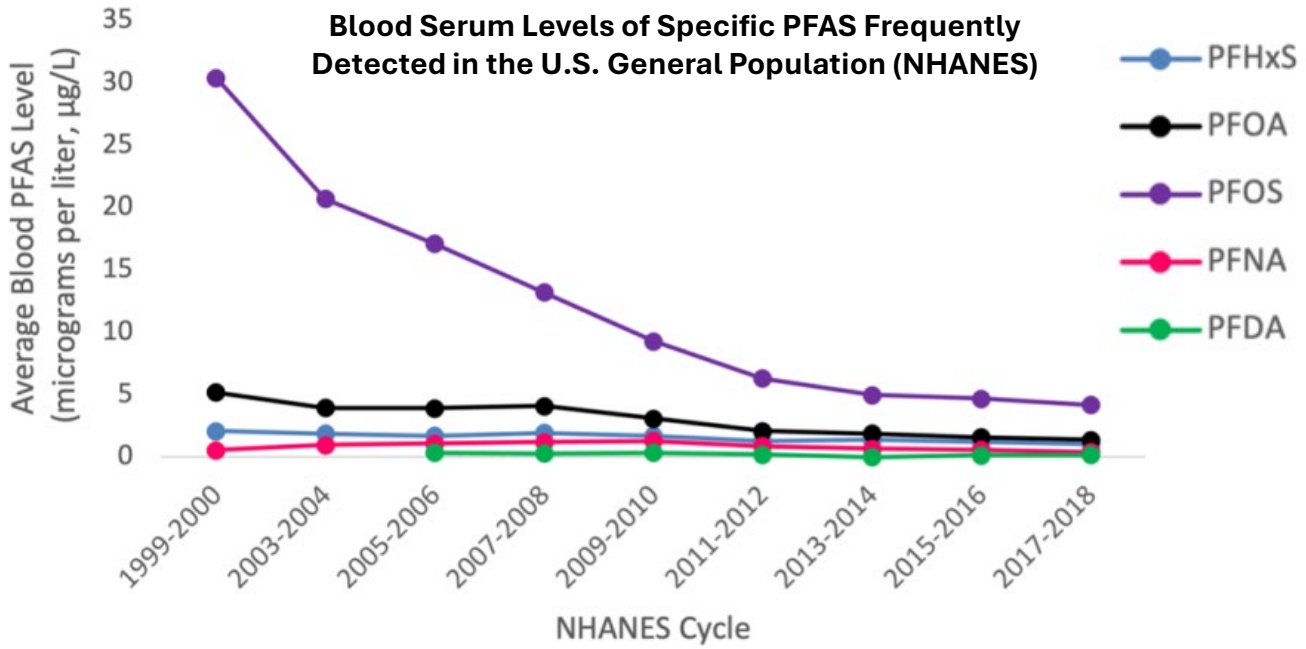
N-MeFOSE
N-methyl perfluorooctane sulfonamidoethanol



Why Study PFAS?

- Certain PFAS present in blood of most people in the US and globally
- Human health effects are a recognized concern
- Evolving science regarding impacts on terrestrial and aquatic biota
- Nearly ubiquitous in the environment
  - Groundwater, surface water, soils, sediments and air (emerging)
- Growing list of sources and conveyers:
  - Industrial Sites, Wastewater Treatment Plants, Landfills, Fire Training Areas, Airports and more





Both Figures from the Interstate Technology Regulatory Council (ITRC) PFAS Technical and Regulatory Guidance Document

Per- and Polyfluoroalkyl Substance Toxicity and Human Health

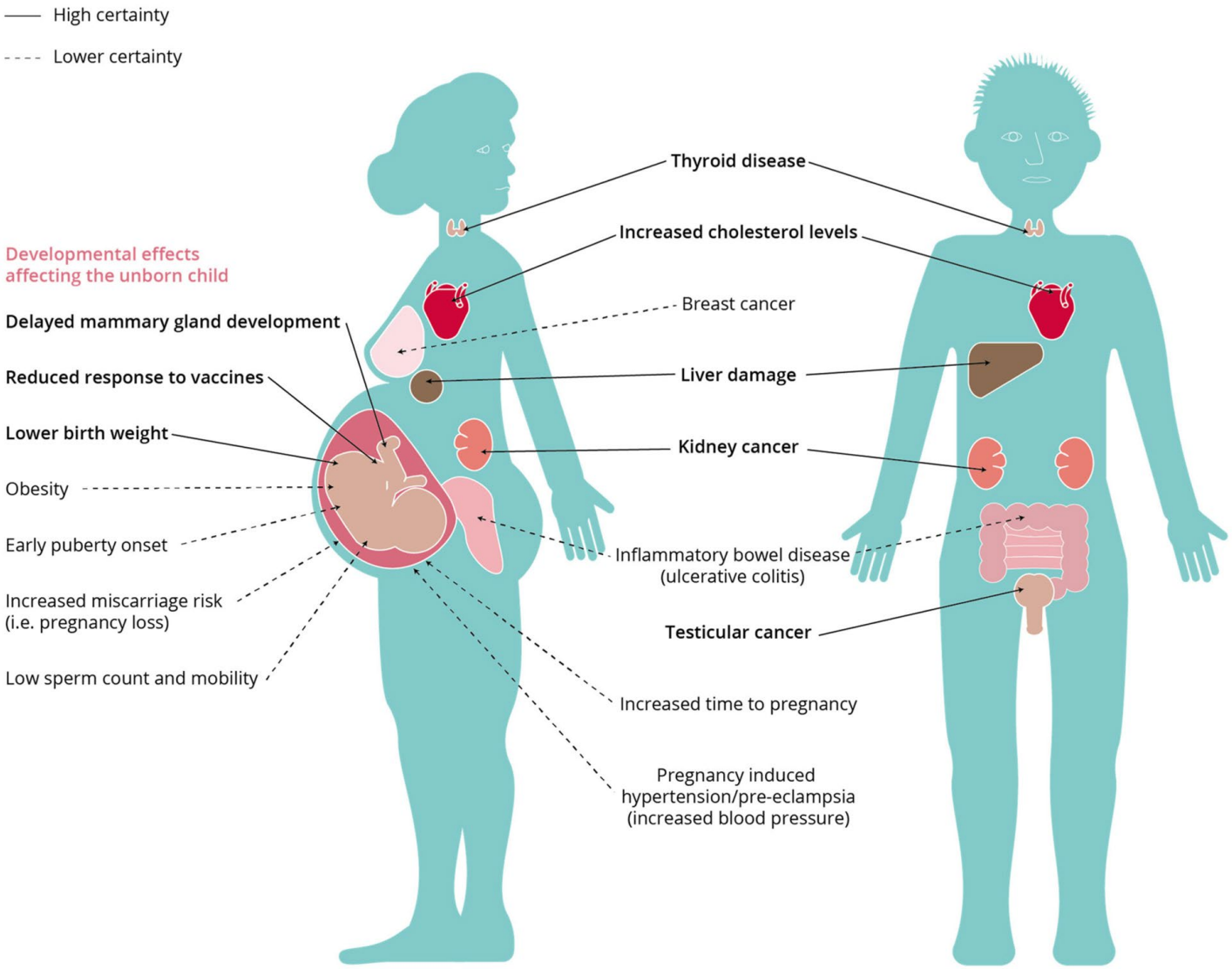
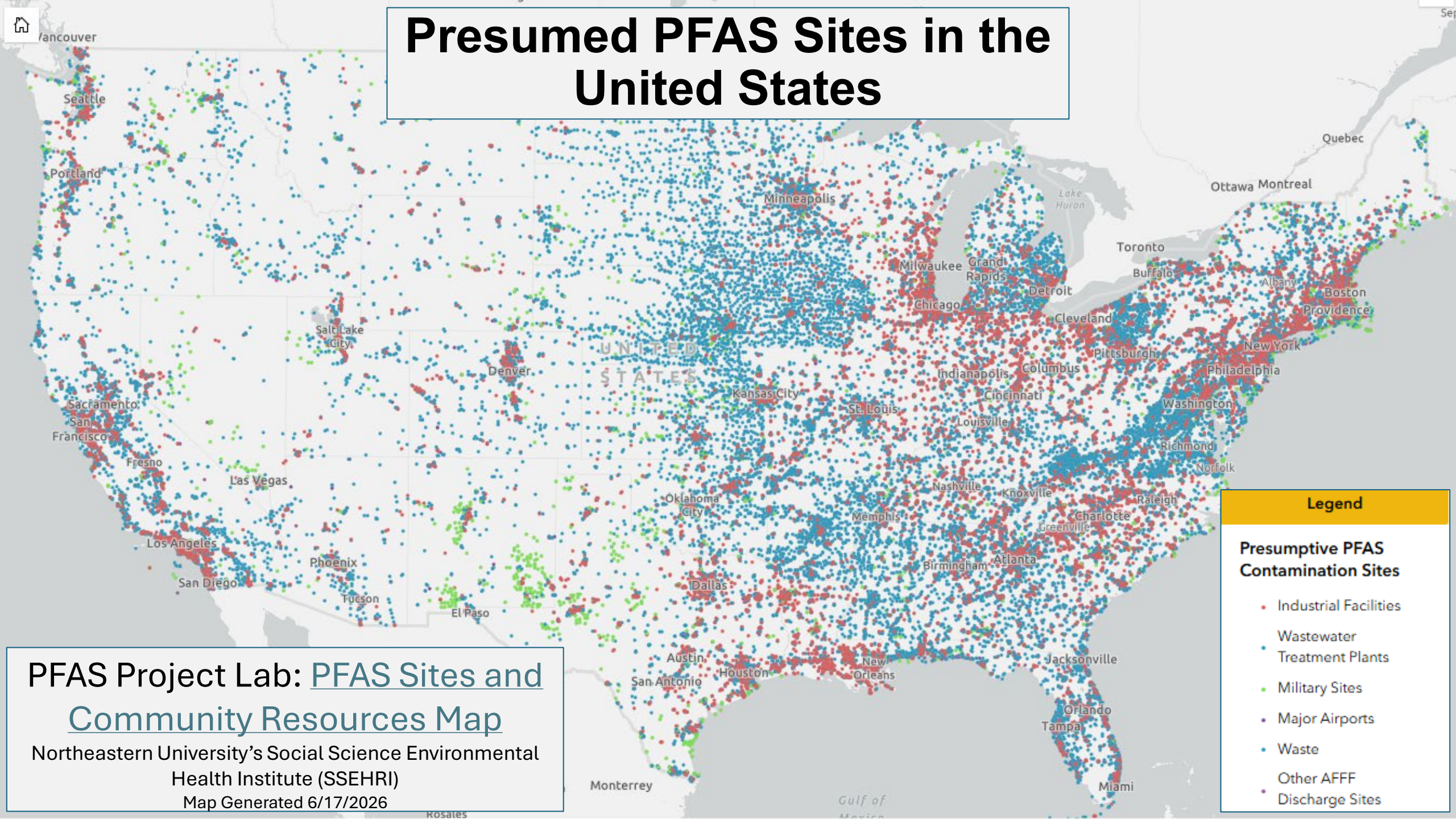


Image Source: Fenton et al. 2021. Per- and Polyfluoroalkyl Substance Toxicity and Human Health Review: Current State of Knowledge and Strategies for Informing Future Research. *Environmental Toxicology & Chemistry*. doi: 10.1002/etc.4890.

- Chronic exposure to legacy PFAS has been studied for decades.
  - i.e., PFOA, PFOS, PFNA, PFHxS, PFBS, PFBA
- Associated with increased risks of:
  - Altered markers of liver, kidney, and thyroid function
  - Altered immune system function
  - Suppressed antibody response to vaccines
  - Developmental delays in infants and children
  - Increased risks for certain cancers (i.e., PFOA and kidney cancer)
- Extensive review conducted by the **Agency for Toxic Substances and Disease Registry (ATSDR), 2021**
- Less is known about newer PFAS and their replacement chemistries.
- **This is an evolving area of science.**

Presumed PFAS Sites in the United States



Legend

Presumptive PFAS Contamination Sites

- Industrial Facilities
- Wastewater Treatment Plants
- Military Sites
- Major Airports
- Waste
- Other AFFF Discharge Sites

PFAS Project Lab: [PFAS Sites and Community Resources Map]

Northeastern University's Social Science Environmental Health Institute (SSEHRI)

Map Generated 6/17/2026

Potential Sources of PFAS to the Environment and Exposure

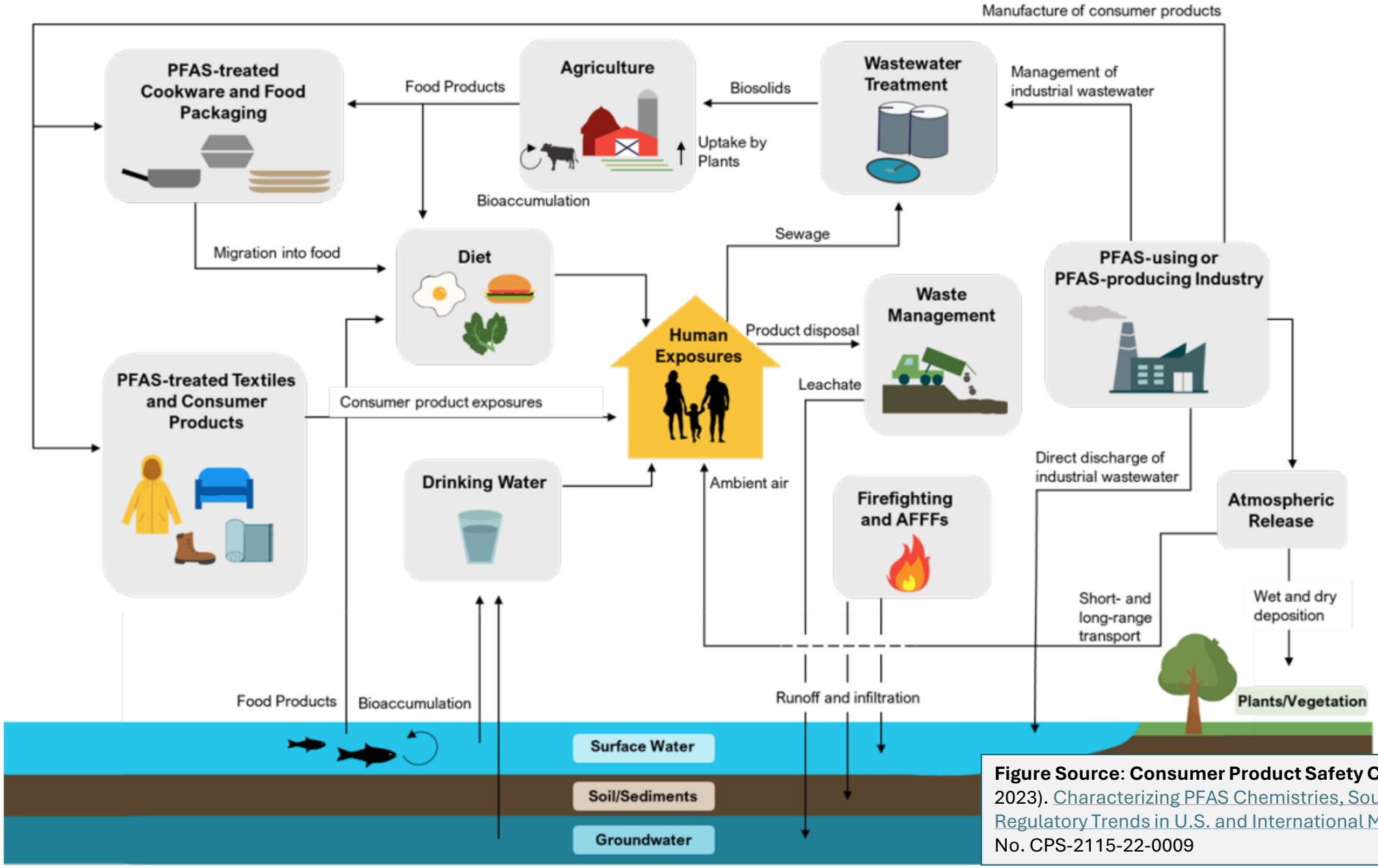
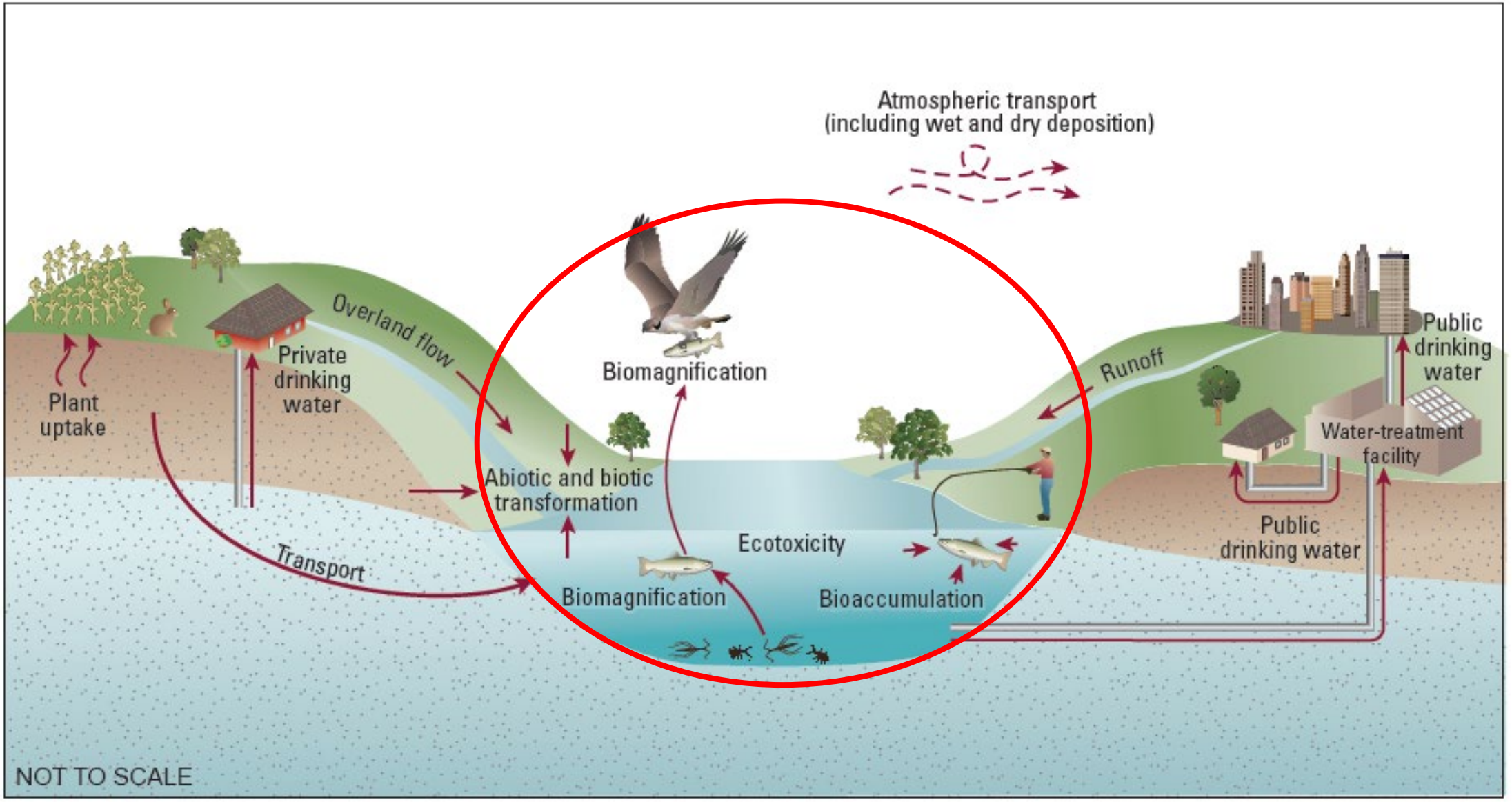


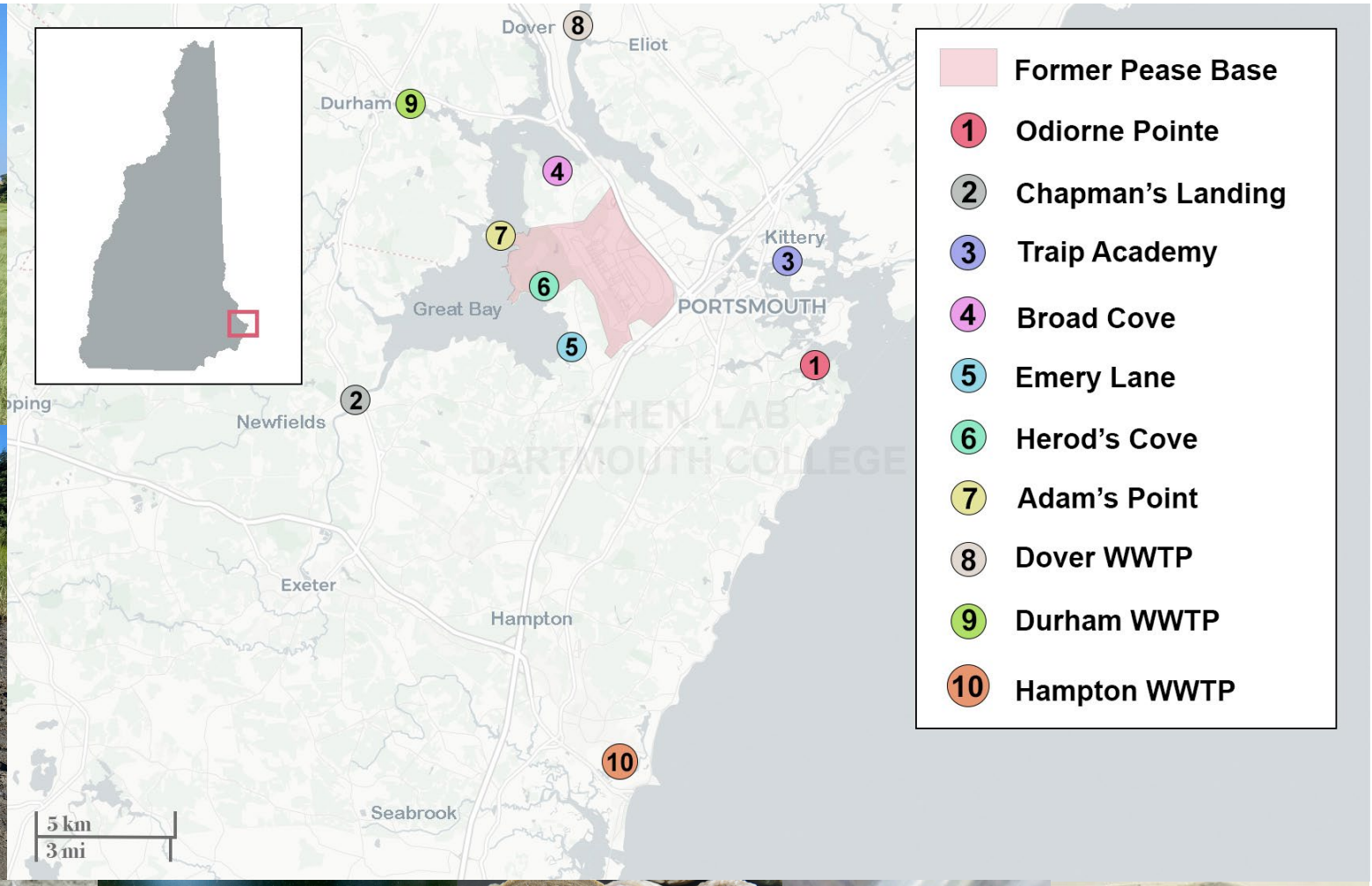
Figure Source: Consumer Product Safety Commission (RTI, 2023). Characterizing PFAS Chemistries, Sources, Uses, and Regulatory Trends in U.S. and International Markets. CPSC RFP No. CPS-2115-22-0009

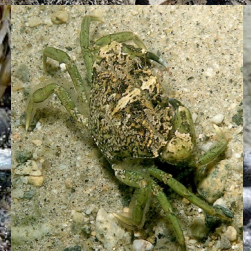
PFAS Sources, Transport and Bioaccumulation



Tokranov et al. 2021 USGS

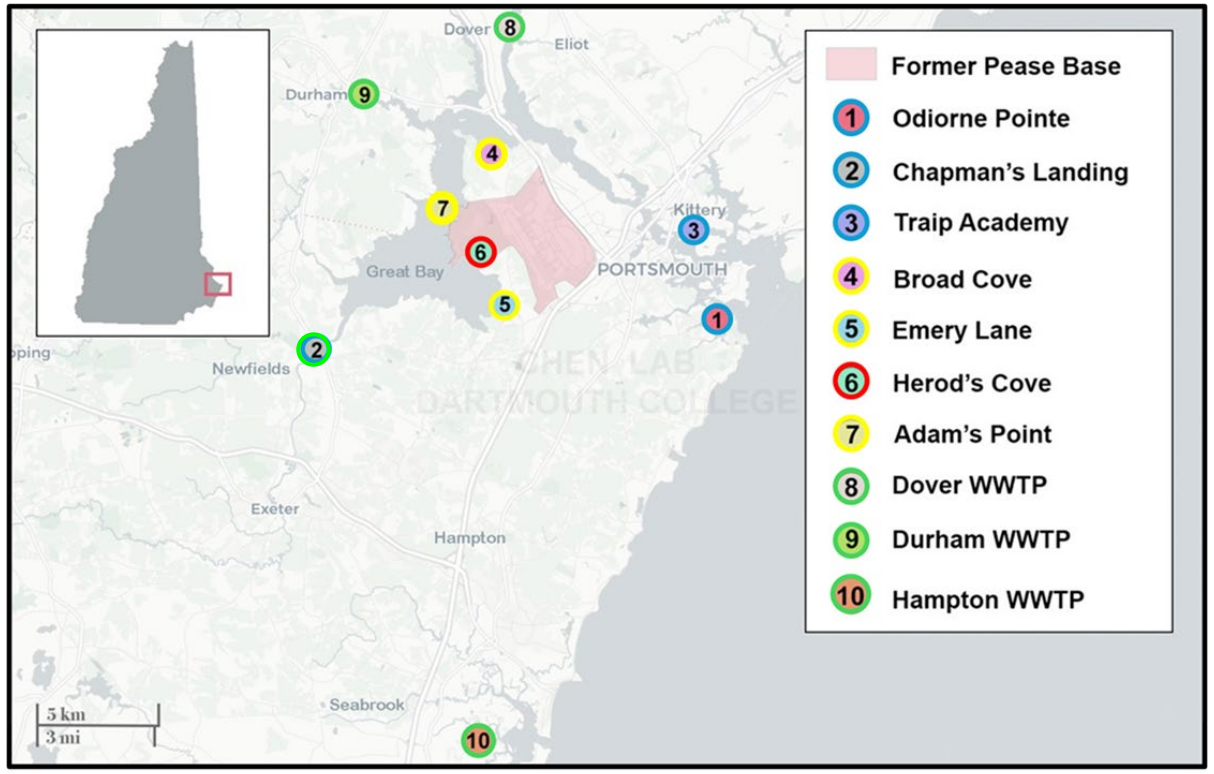
Field Work in Great Bay





Total PFAS Concentrations in Surface Water and Sediment

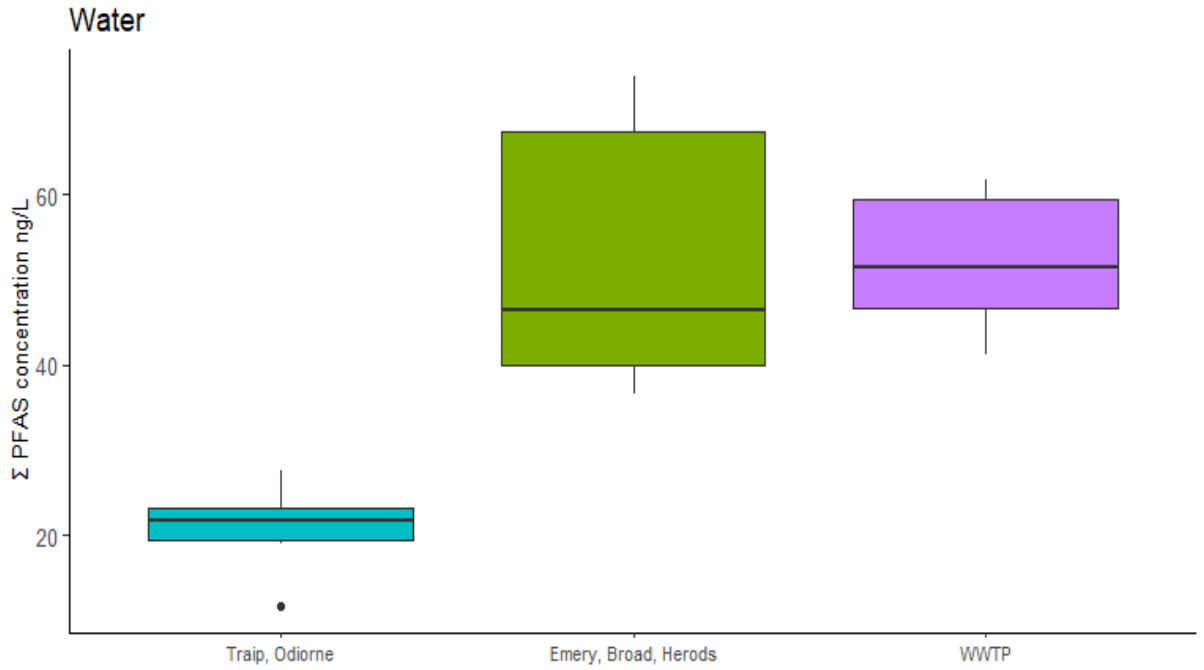
∑ PFAS = Total of 26 PFAS analytes measured

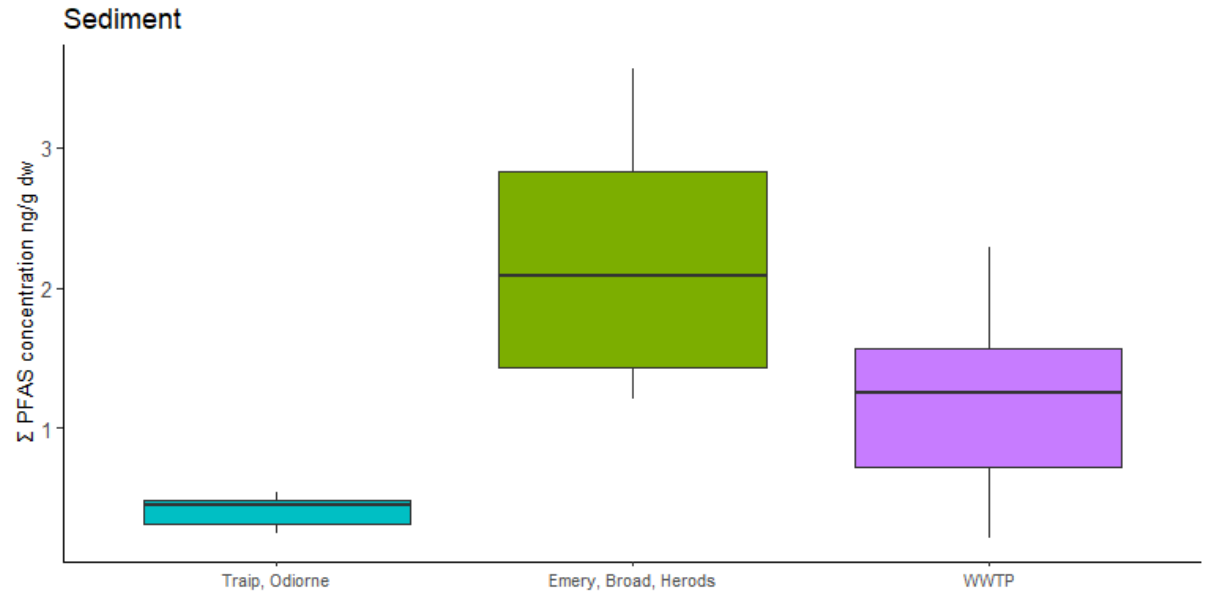


= far from AFFF site = AFFF site

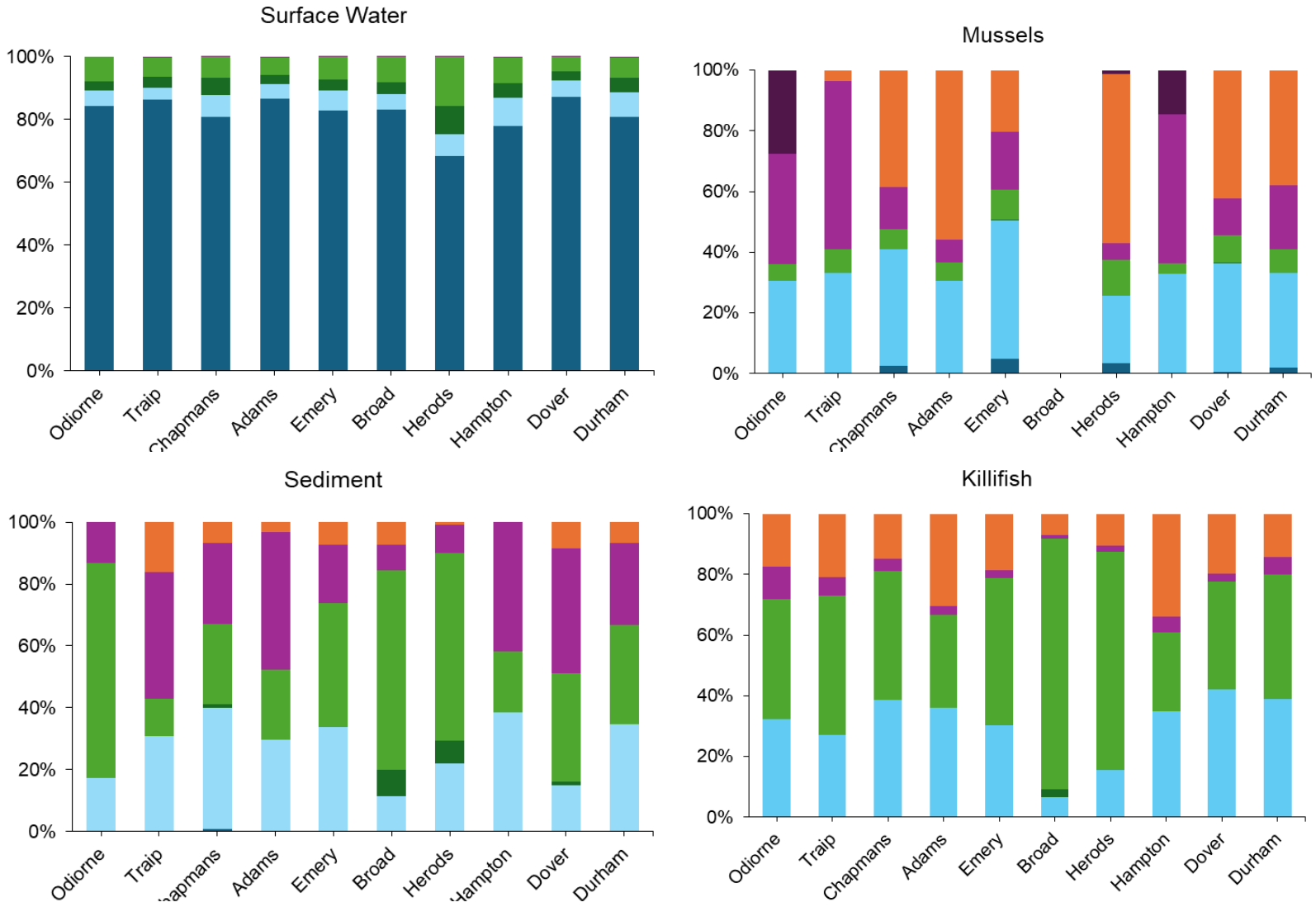
= near to AFFF site = WWTP site

Non-point source areas Near AFFF areas Near WWTP areas





PFAS Compound Profiles

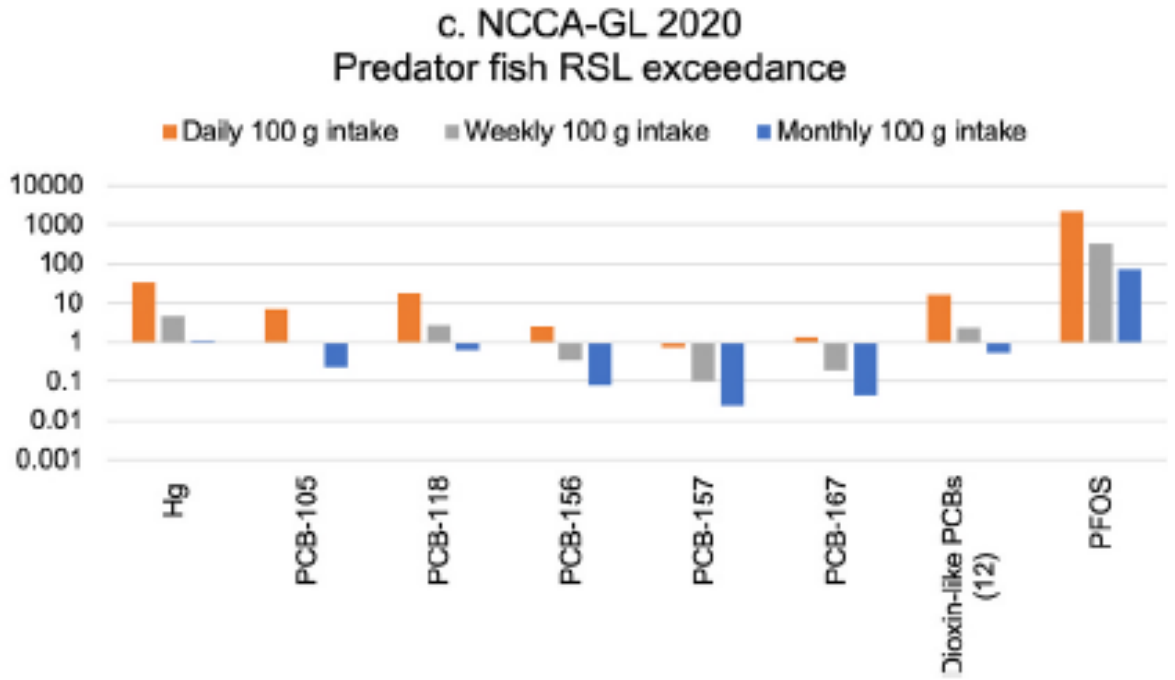


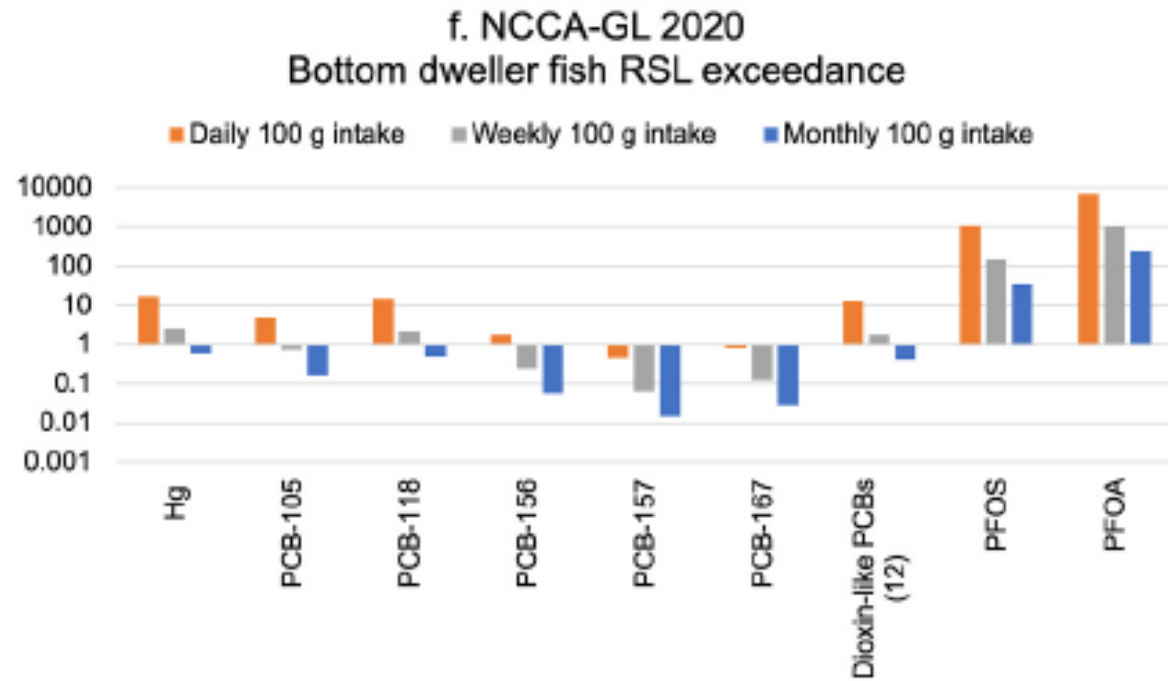
Key points

- **Water dominated by short-chained carboxylates**
- **Sediments dominated by long-chained sulfonates and carboxylates**
- **Biota profiles similar to sediments but precursors are prevalent**

PFAS Co-Occur in Fish with Other Harmful Contaminants

- Data from USEPA National Coastal Condition Assessment – Great Lakes
- Contaminants from predator and bottom dweller fish
- PFAS levels in predator fish decline over time (2010, 2015, 2020) but not in bottom dwellers
- Exceedances of chemicals in fish over RSL (100 g) at daily/weekly/monthly vary across chemicals
- PFAS present health risks for any consumption of fish





Figures from: Wu P, Foley C, Heiger-Bernays W, Chen C. (2025). Chemical mixtures of mercury, PCBs, PFAS, and pesticides in freshwater fish in the US and the risks they pose for fish consumption. Environ Res. 266:120381. doi: 10.1016/j.envres.2024.120381.

Summary of Background

- The chemistry, analytical capabilities, and health effects for PFAS are continuing to evolve
- The number and location of presumed PFAS sites continues to grow; AFFF sites and wastewater treatment plants are significant sources
- PFAS compound profiles from Great Bay estuary in sediments, water and biota differ
- PFOS in Great Lakes fish are declining but still present risks to human health at all levels of consumption