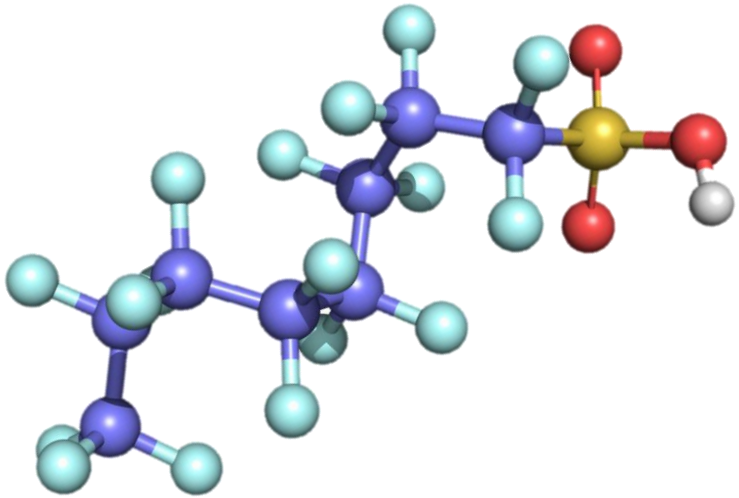
AECOM Imagine it. Delivered.

PFAS - Emerging Contaminant Issues in Michigan

John Cuthbertson
AECOM Central Region PFAS Practice Lead

What is an Emerging Contaminant?

Chemicals and materials that have pathways to enter the environment and present real or potential unacceptable human health or environmental risks…

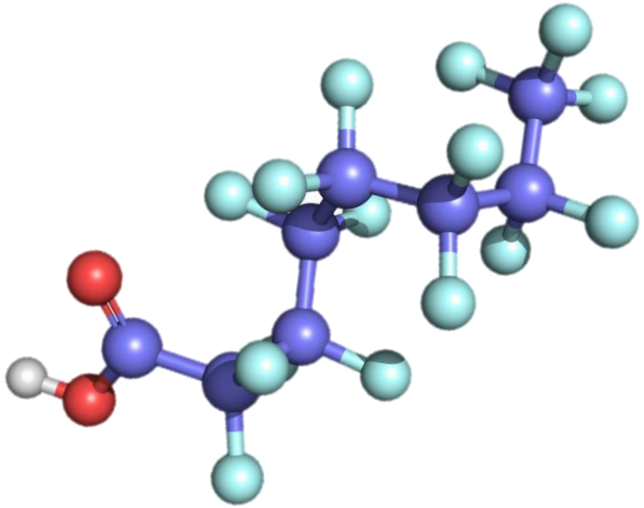


and either

Do not have peer-reviewed human health standards

or

Standards/regulations are evolving due to new science, detection capabilities or pathways

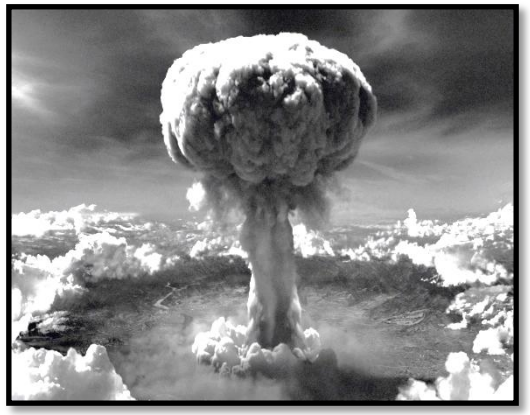


PFAS Development….

1930's

Teflon accidentally discovered in 1938

1940's



DOD Research (Uranium Enrichment)

1950's

Consumer products

1960's

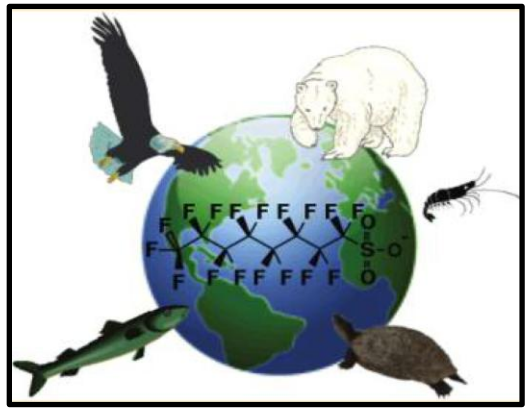
Aqueous Film Forming Foam (AFFF) is developed

… and Evolution

1970's

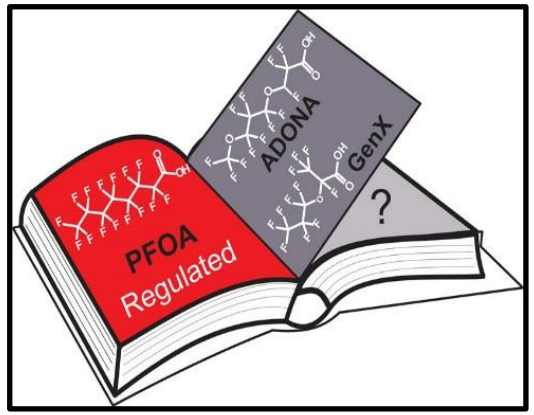
Product enhancement expands

2000's



Global distribution of certain PFAS in biota

Current



Public scrutiny
Changing regulatory climate
Lawsuit settlements
Development of new PFAS

Use of PFAS

Aerospace

Apparel

Building and Construction

Chemicals and Pharmaceuticals

Electronics

Oil & Gas

Energy

Healthcare and Hospitals

Aqueous Film Forming Foam

Semiconductors

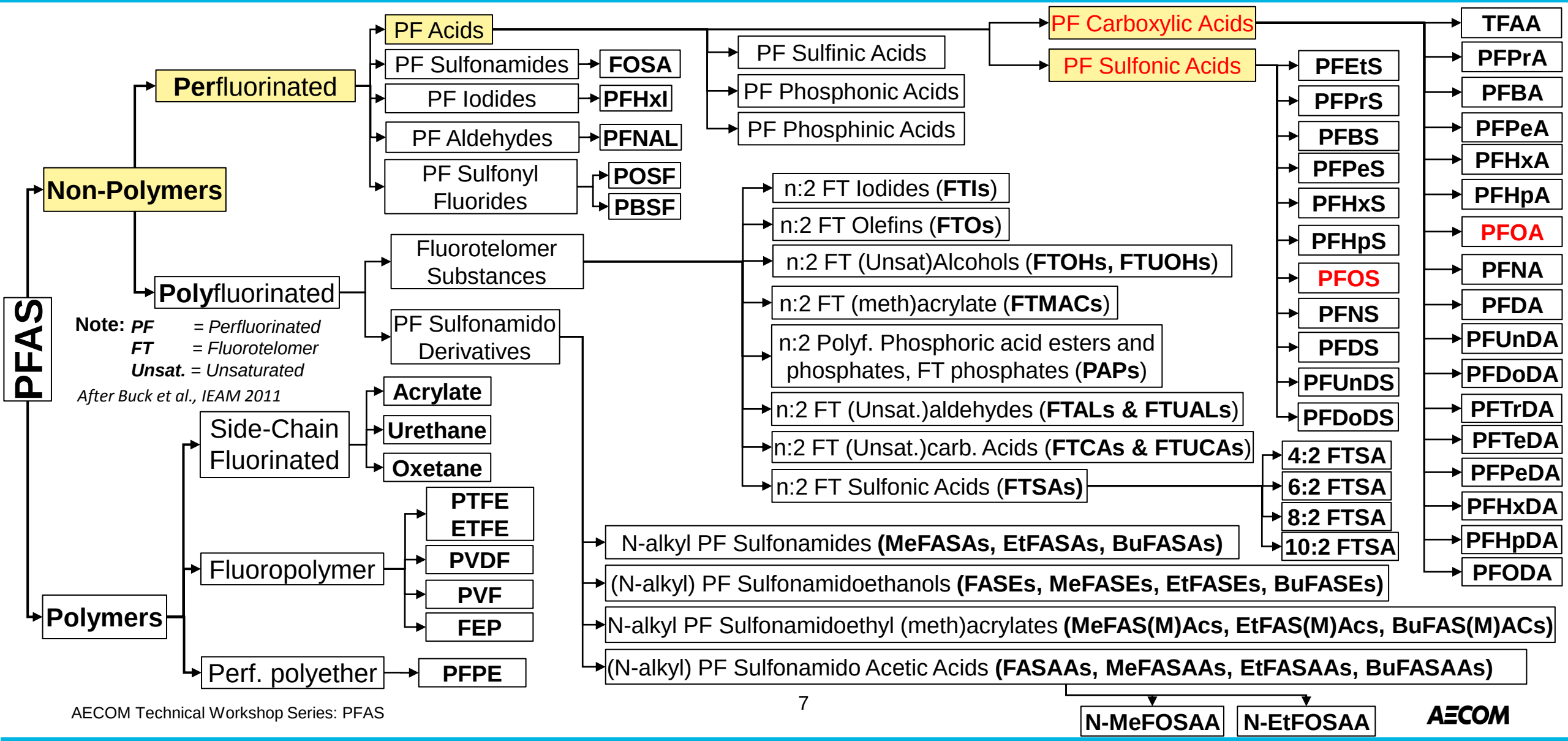
Terminology Evolution: PFCs vs. PFAS

The terminology and classifications of these compounds has evolved

- Perfluorinated Compounds (PFCs) – **Past**

- Per- and Polyfluoroalkyl Substances (PFAS) - **Current**

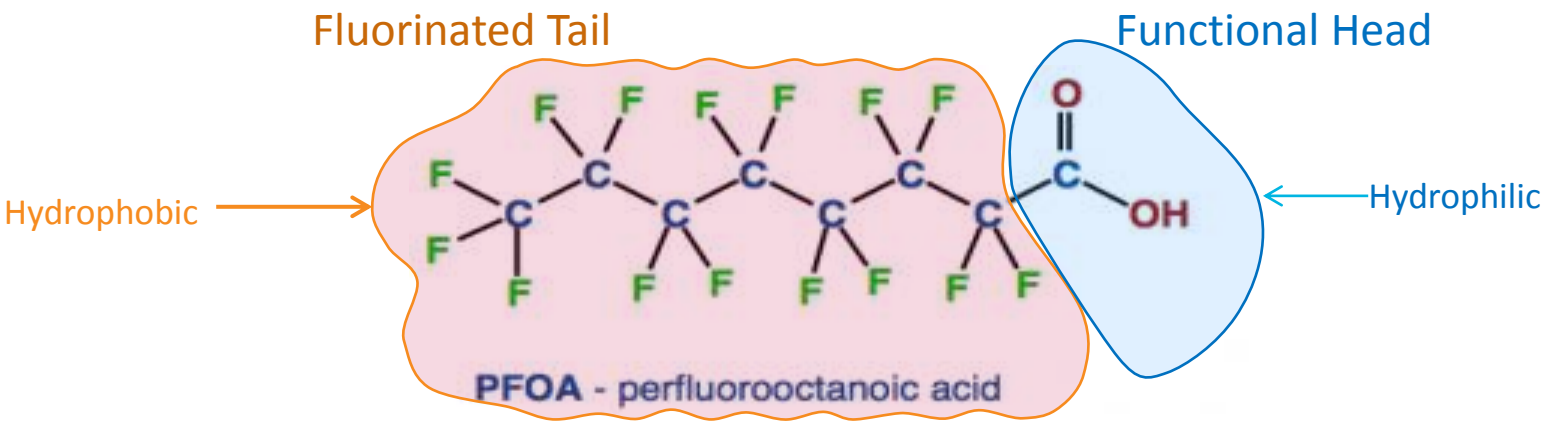
PFAS Family Tree



Chemical Properties

Carbon-fluorine bonds:

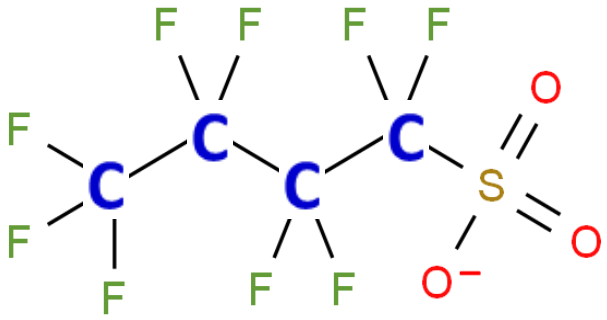
- The H is replaced with a F
- Very strong, inert
- Resists thermal, chemical, and biological degradation
- Surfactant, reduced surface tension
- Hydrophobic(repels water) *and* oleophobic (repels oil/fat/grease)



Chain Lengths

Short-chain

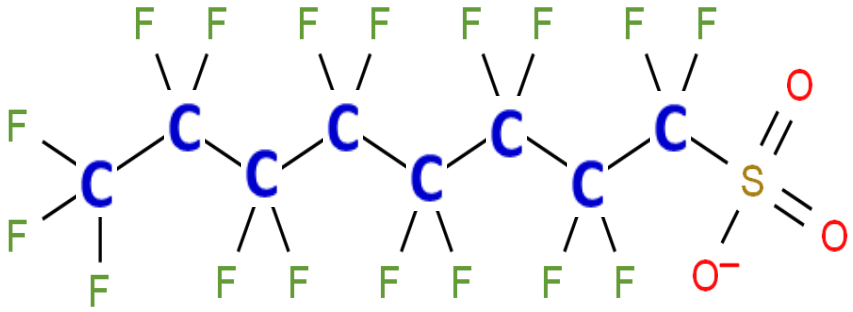
PFBS n = 4
PFPeS n = 5



PFBS

Long-chain

PFHxS n = 6
PFHpS n = 7
PFOS n = 8



PFOS

Environmental Fate of PFAS

Atmosphere

Lakes and Rivers

Biosolids

Sediment

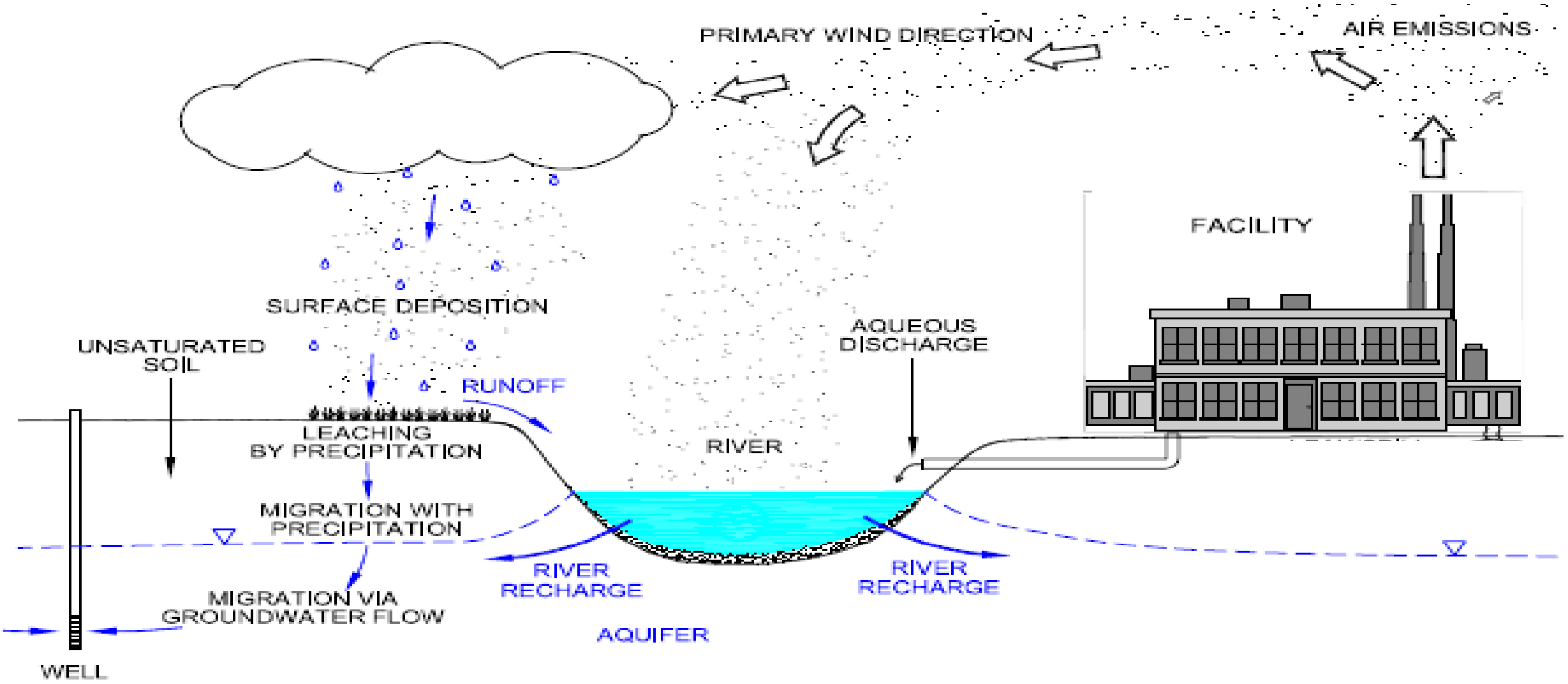
Dust

Groundwater

Soils

Biota

PFAS Emissions at a Manufacturing Facility CSM



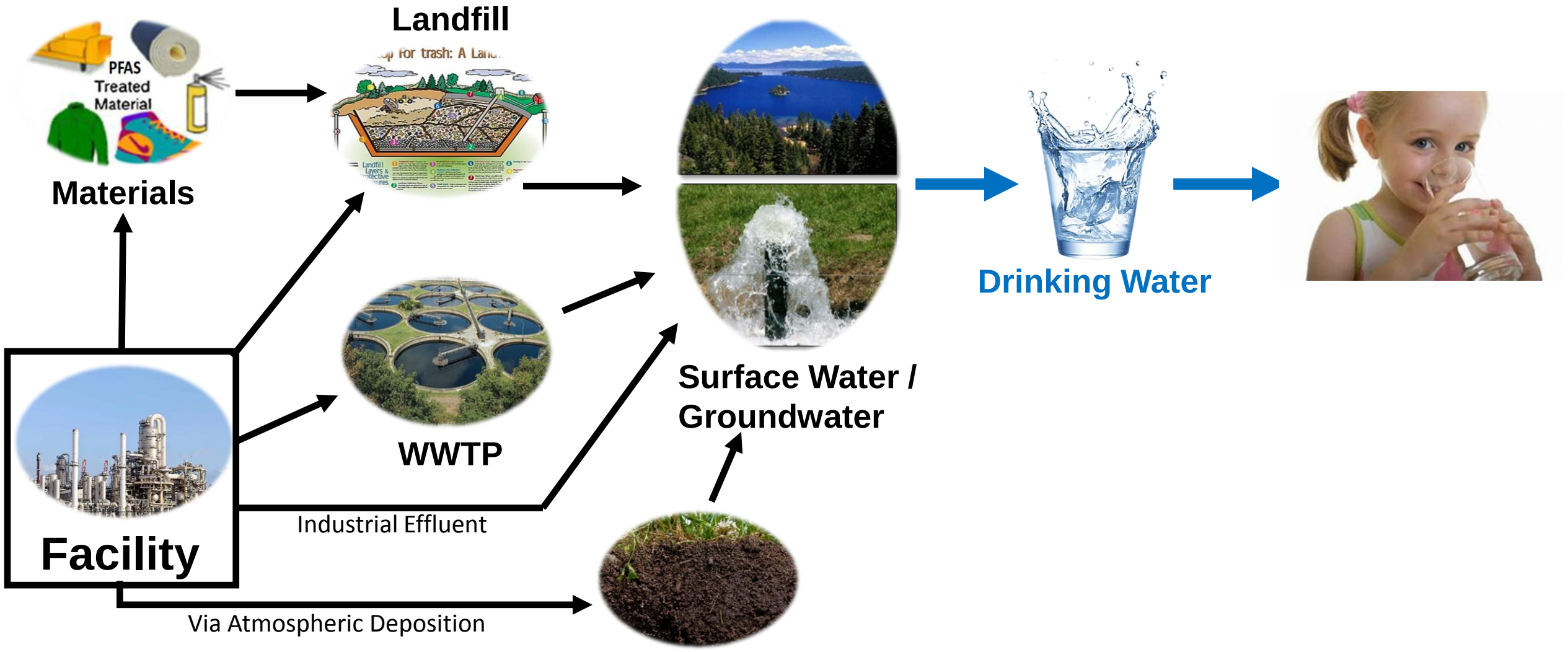
Daily Consumer Exposure

Direct Contact

Food Ingestion

Treated Materials

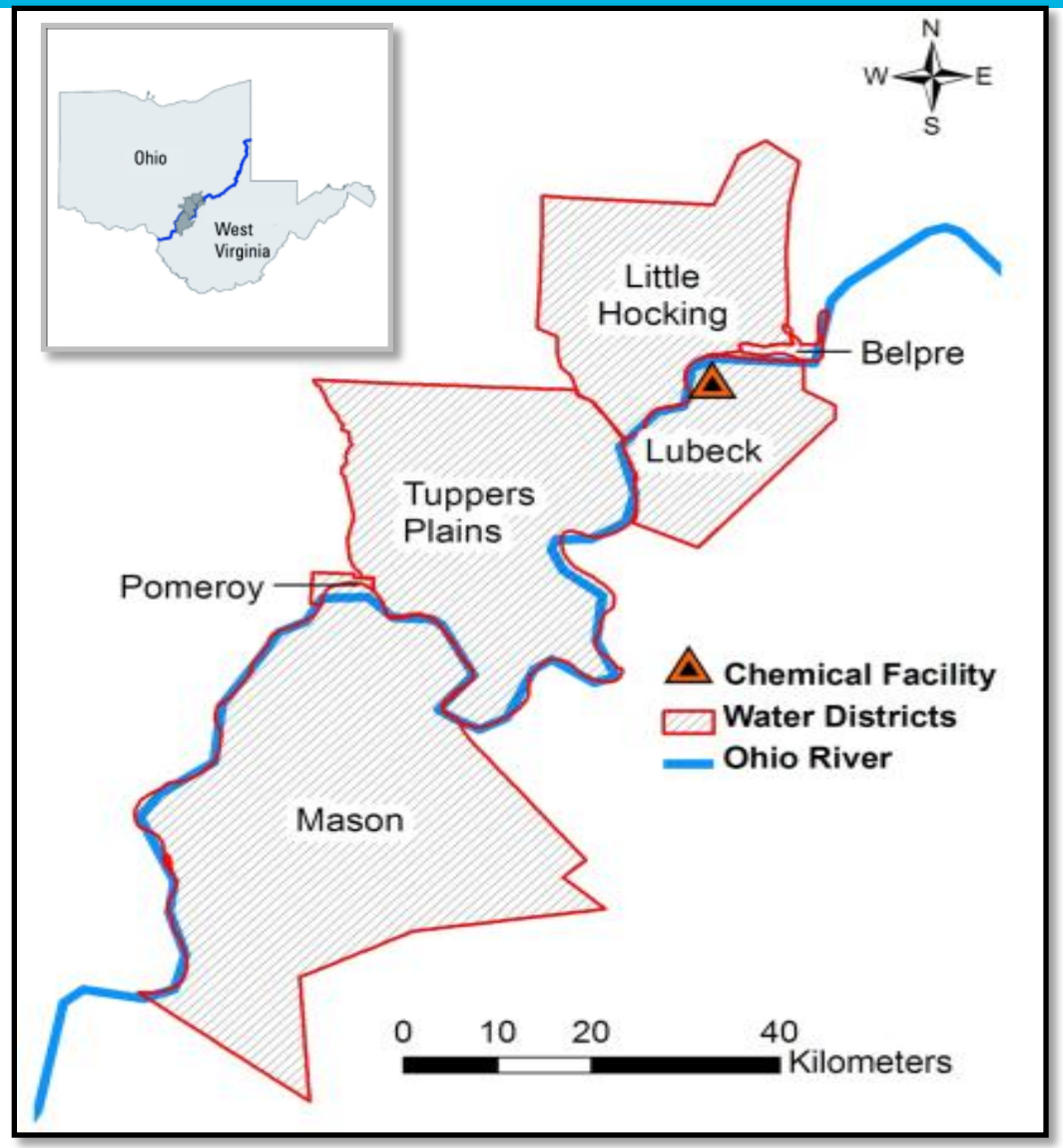
Drinking Water Exposure



C8 Study Overview

– Primary Sources:
  - Industrial discharge (Ohio River)
  - Stack particulates during drying process

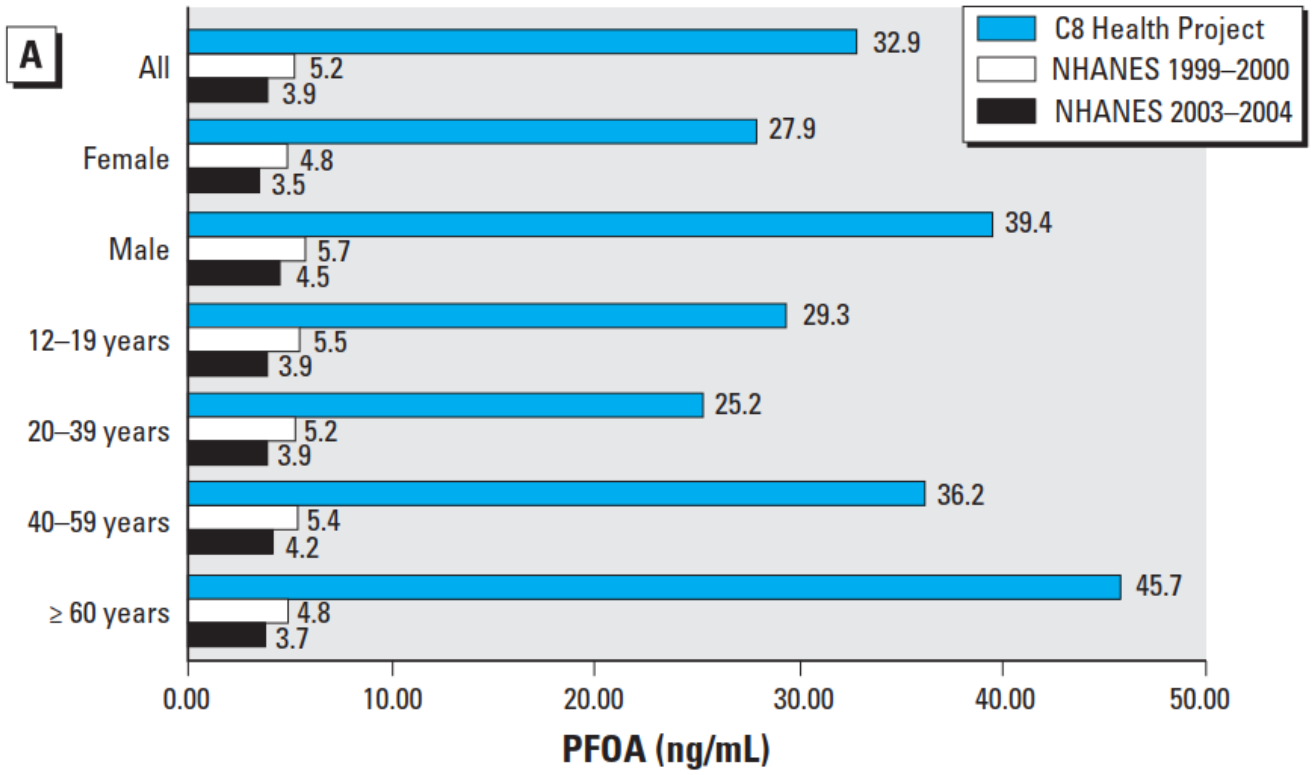
– Largest PFAS epidemiological study
  - PFOA study
  - ~70,000 Ohio and West Virginia
  - Residents of all ages (infants to very elderly)
  - Exposure to PFOA from drinking water sources with concentrations between 50 to 3,500 ng/L
  - Included 6 Water Districts



C8 Study PFOA Results

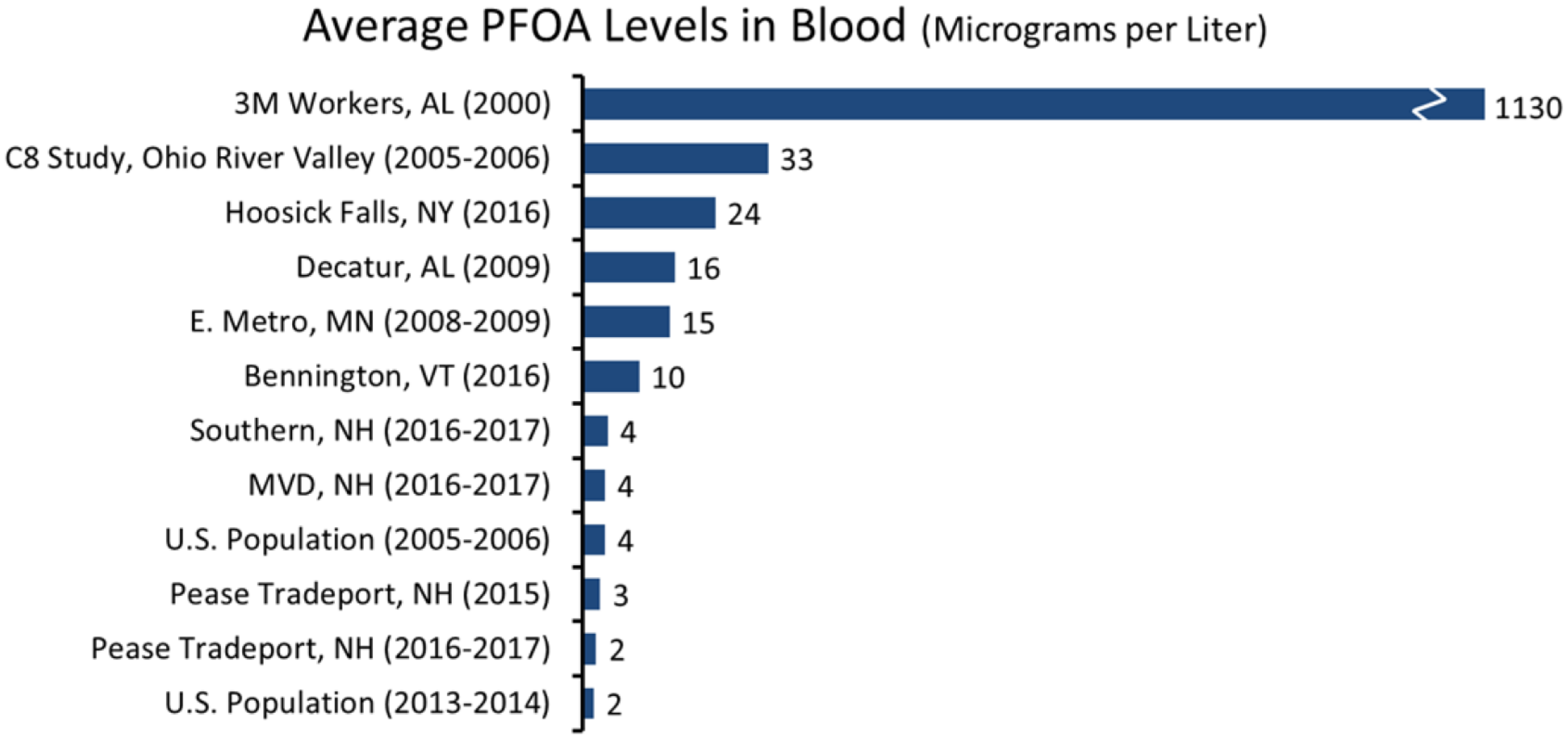
“Probable Link” (more likely than less likely)

1. High cholesterol
2. Thyroid disease
3. Ulcerative colitis
4. Testicular cancer
5. Kidney cancer
6. Pregnancy-induced hypertension

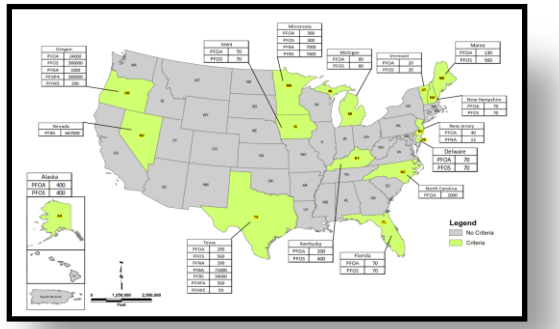


* 15 Conditions were found to have No “Probable Link”

PFOA Blood Concentrations Nationally



Regulatory Climate



1930's – 1990's

- No regulatory or environmental concerns

1990's - 2009

- Initial environmental concerns documented
- US EPA Provisional Health Advisory (HA)
  (PFOA = 400 ppt, PFOS = 200 ppt)

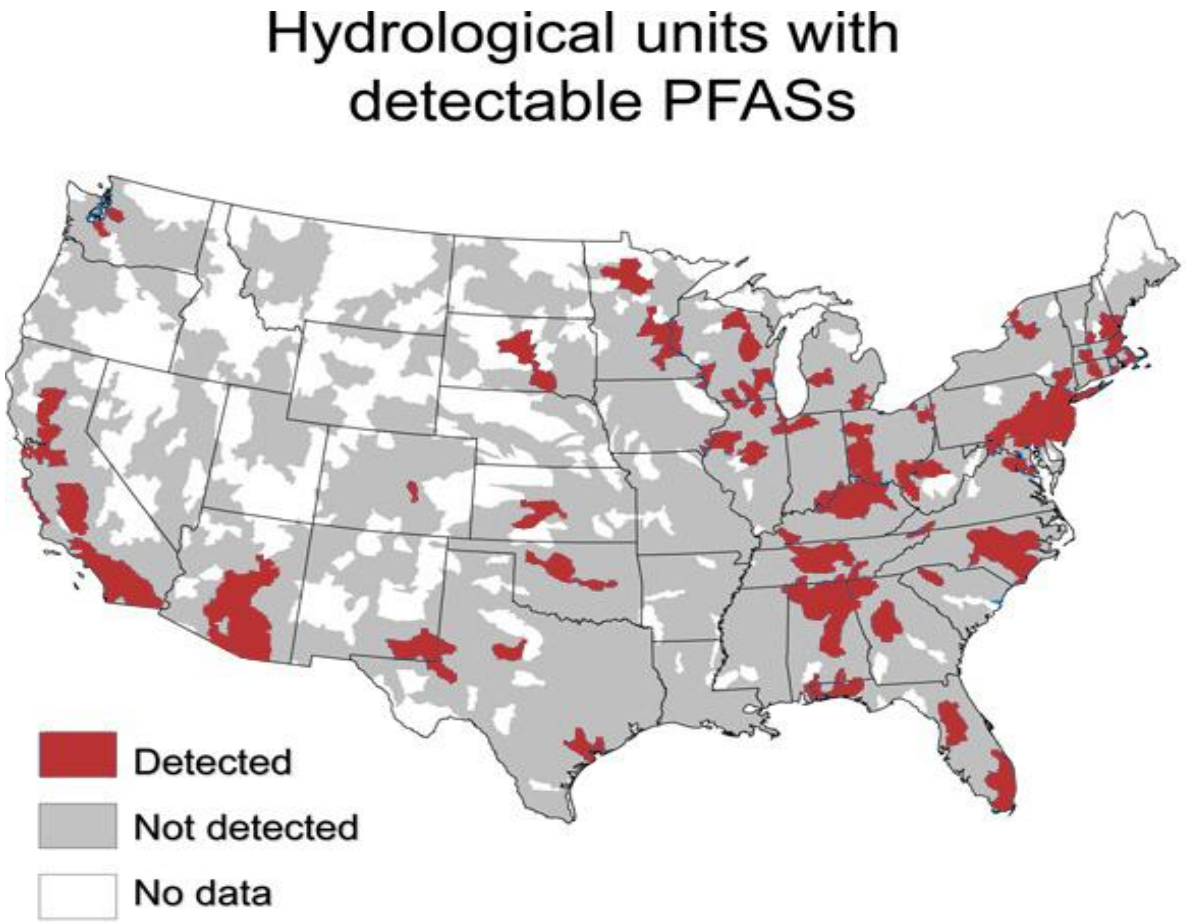
2010 - 2017

- Individual States developing criteria
- US EPA Lifetime HA
  (PFOA, PFOS, or PFOA + PFOS = 70 ppt)

Unregulated Contaminant Monitoring Rule 3 (UCMR3)

PFAS	UCMR 3 MRL (ng/L) (2013-2015)	USEPA Method 537 MRL (ng/L) (2009)
PFHpA	10	3.8
PFOA	20	5.1
PFNA	20	5.5
PFBS	90	3.7
PFHxS	30	8.0
PFOS	40	6.5

MRL = Method Reporting Limit



- 6 million US Residents were drinking water above the Health advisory

Downward Trend in Regulatory Guidance/Standards

RISK = HAZARD + OUTRAGE

- USEPA - Drinking Water
  - 70 ppt – PFOA, PFOS, PFOA + PFOS
- Connecticut
  - Total of PFHxA, PFHpA, PFOA, PFNA, PFOS
  - Screening Tool
- Minnesota
  - 35 ppt PFOA ; 27 ppt PFOS
- Vermont
  - 20 ppt PFOA

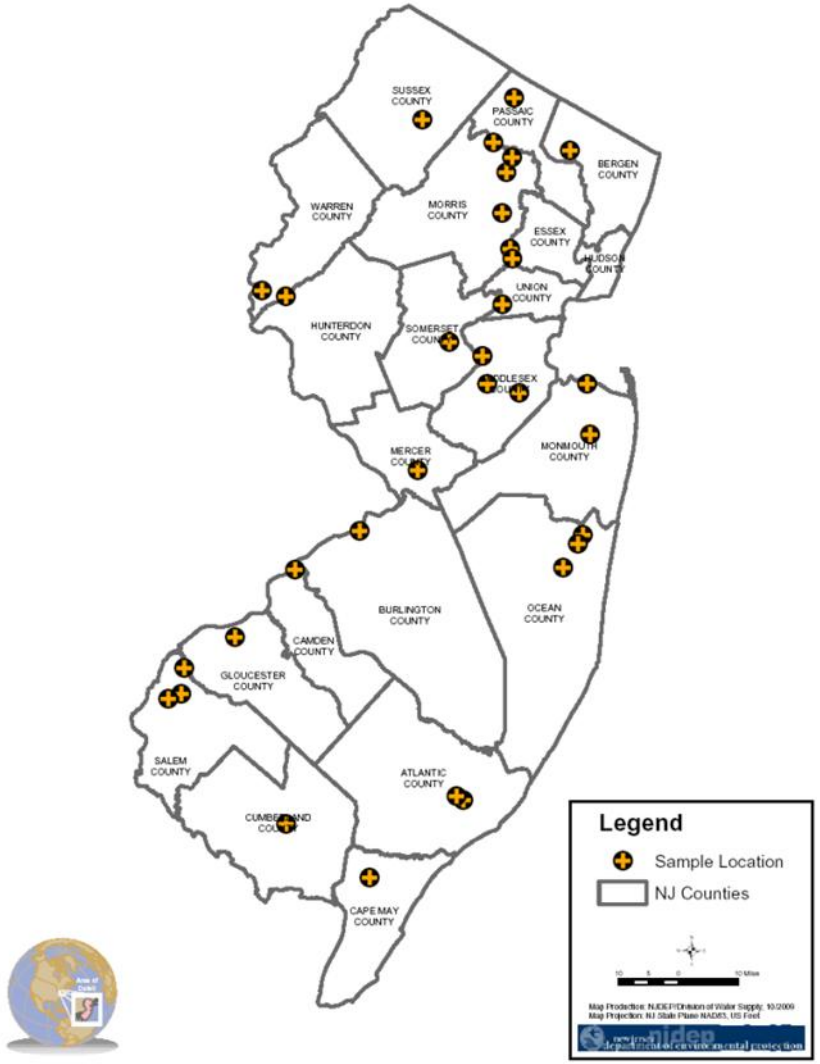
States with PFAS Criteria

New Jersey Establishing MCL

– Current Criteria
  - 14 ppt PFOA – MCL*
  - 13 ppt PFOS – Draft MCL Nov. 15, 2017
  - 13 ppt PFNA – Proposed MCL

*Maximum Contaminant Level (MCL) : Enforceable standard for public water systems regulated under Safe Drinking Water Act

**USEPA has not set MCLs for PFAS



New Hampshire - Requests for PFAS Analysis

Required PFAS Sampling at:

- Groundwater Release Detection Permits
- Landfills
- All active sites which:
  - PFAS-containing products were used and release in the environment
  - AFFF was release in the environment

NHDES

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

November 22, 2016

Subject: **Sampling for Per- and Polyfluoroakyl Substances/Perfluorinated Chemicals (PFASs/PFCs) at Contaminated Sites**

EMAIL ONLY

May 18, 2017

Subject: **Inclusion of Per- and Polyfluoroalkyl Substances (PFAS) as Contaminants of Concern at New Hampshire Waste Sites**

EMAIL ONLY

October 19, 2017

Subject: **Inclusion of Per- and Polyfluoroalkyl Substances (PFAS) as Contaminants of Concern at New Hampshire Waste Sites**
Clarification to May 18, 2017 Letter

Michigan PFAS Action Response Team (MPART)

Michigan Governor Executive Directive No. 2017-4

- ❖Establish a strategic and proactive approach
- ❖Identify Impacted Sites
- ❖Develop long-term Mitigations Plan

Michigan Promulgates Criteria

	Drinking Water	Surface Water
PFOA	70	12,000
PFOS	70	12

Units : Water = ng/L (ppt)

ITRC – PFAS Direction for Regulators and Industry

2017 Fact Sheets

- ✓ Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS)
- ✓ History and Use of Per- and Polyfluoroalkyl Substances (PFAS)
- ✓ Regulations, Guidance, and Advisories for Per- and Polyfluoroalkyl Substances (PFAS)
- 90% Environmental Fate and Transport
- 90% Site Characterization Tools, Sampling Techniques, and Laboratory Analytical Methods
- 90% Remediation Technologies and Methods

2018 Technical Document

Regulatory Direction

Initial

- PFAS Manufacturers

Secondary

- Department of Defense (AFFF)

Next

- Potential Sources

Potential PFAS Sources in Industry

Refineries

Emergency Response

Wastewater Treatment Plants

Biosolids Application

Metal Platting

Manufacturing

Landfills and Waste Disposal Areas

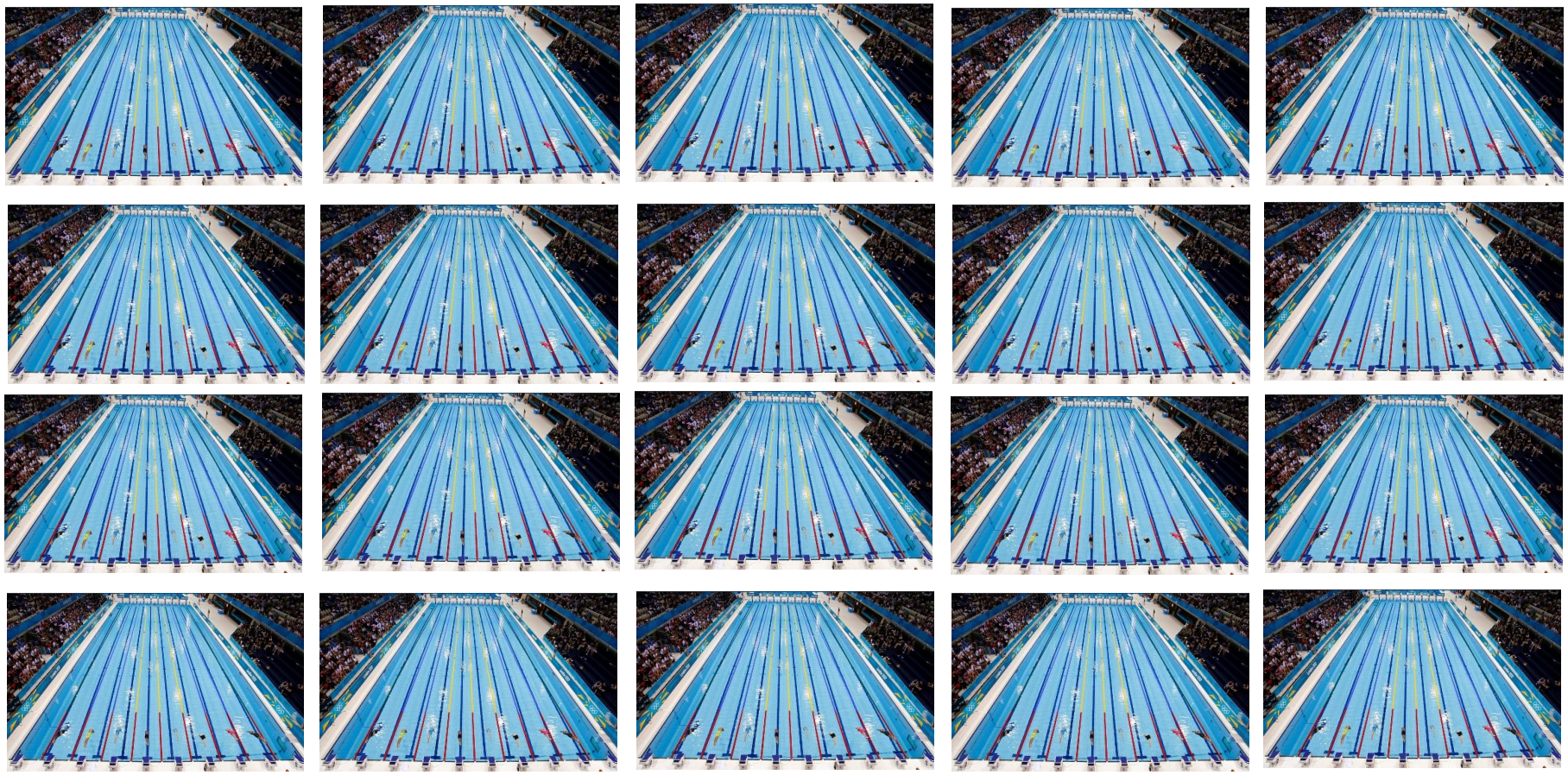
Airports

Analytical Challenges

- Methodology
  - Which method to run
  - What lab to use
  - List of constituents
- Cost of analysis
- Turnaround times
- Detection limits
- How to handle low level detections

Dealing with Part Per Trillion Levels

1 ppt = 1 drop (0.05mL) in 20 Olympic Swimming Pools



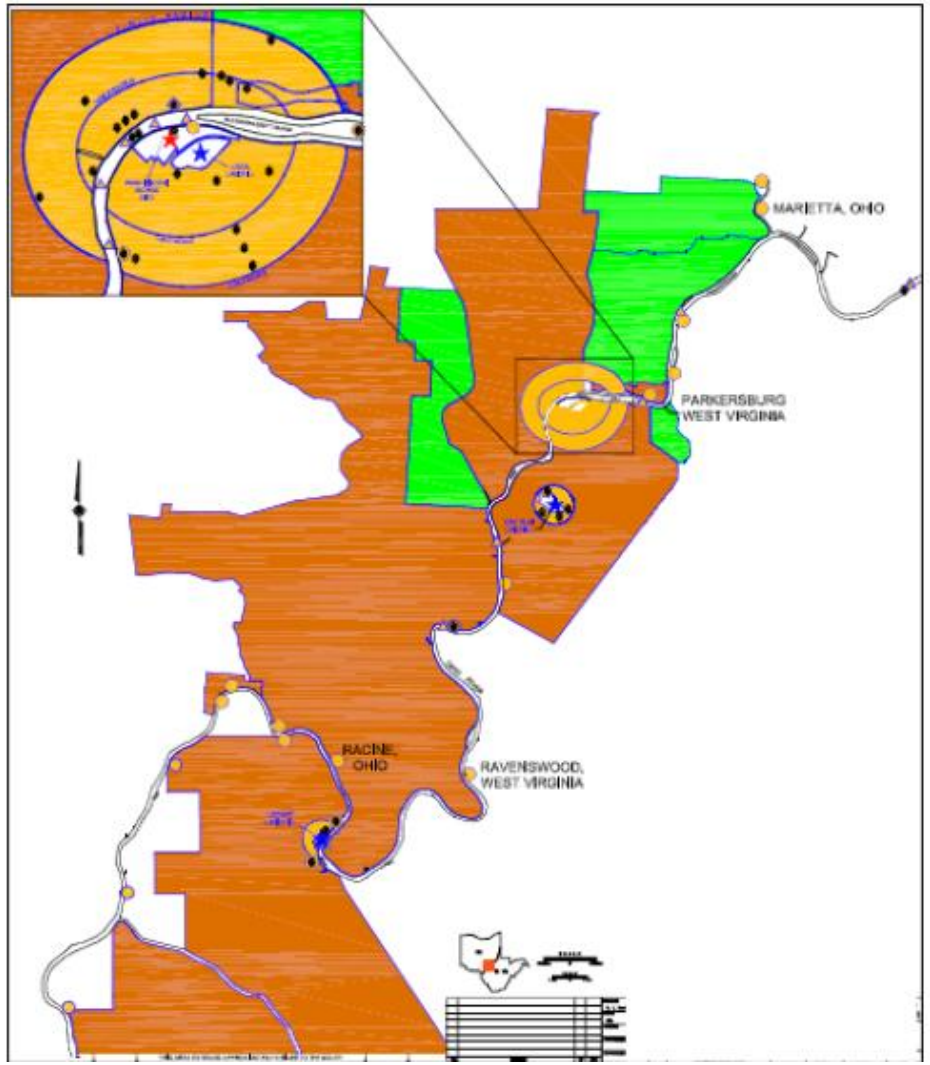
Note: 1 Olympic Pool = 660,000 gallons

Sample Collection Challenges

- Stringent SOPs
  - Proper staff training
  - Focusing on materials to avoid
- Cross contamination
- Decon water
  - Sample prior to work?
- Waste generation
  - Public perception
  - Who will take waste

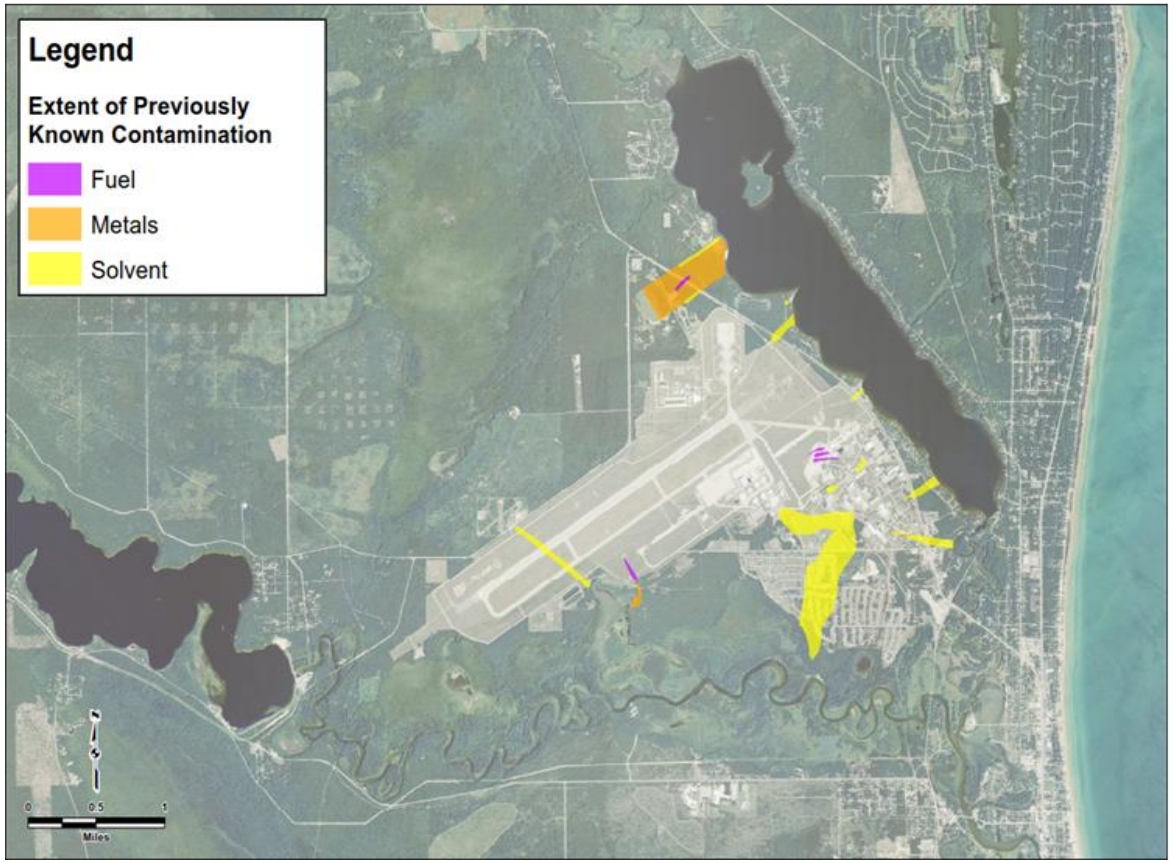
Investigation Challenges

- ❑ Change in approach
  - ❑ Change in how we approach problem
  - ❑ Receptor driven
  - ❑ Solution driven
- ❑ Widespread in Groundwater
- ❑ Limited understanding of Fate and Transport
- ❑ Potential Reopener

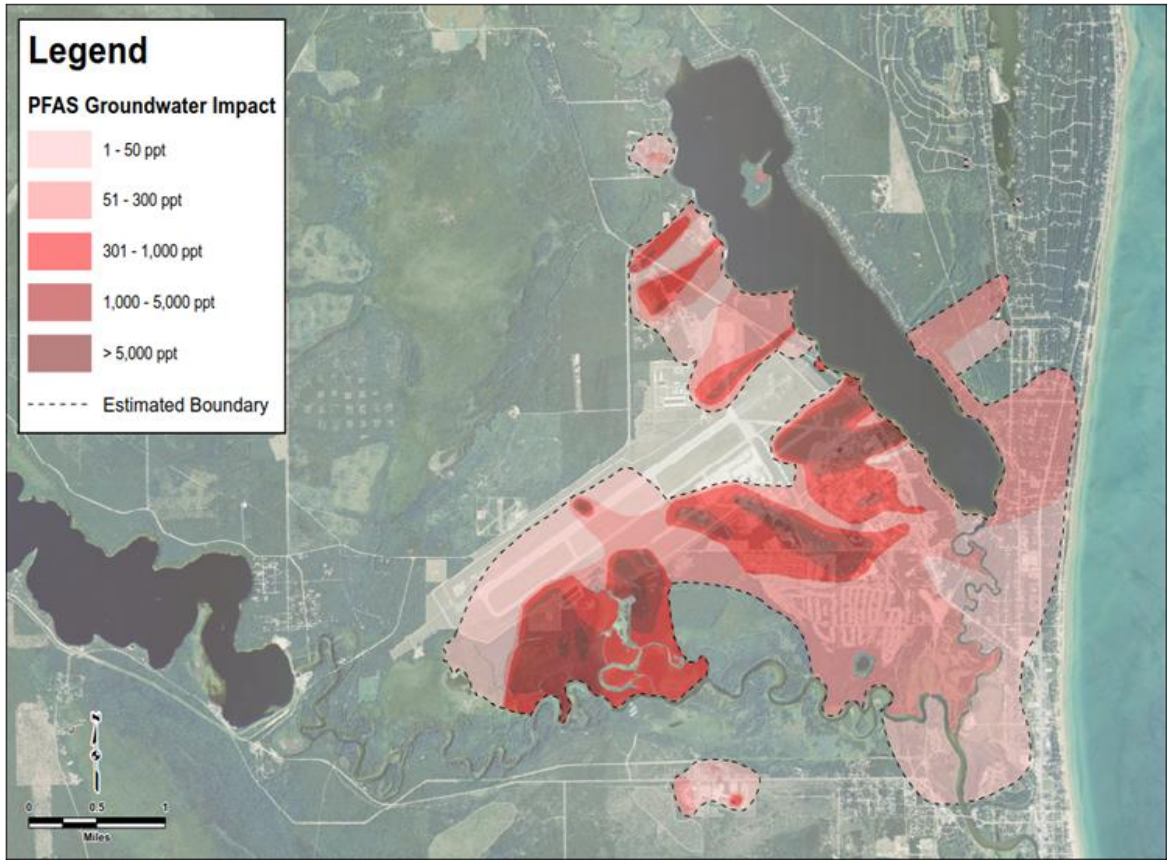


Investigation Challenges – Potential Reopener

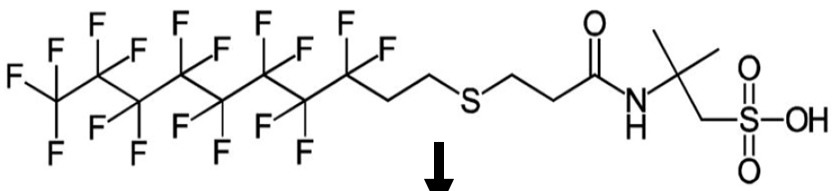
Extent of Non-PFAS Impact



Extent of PFAS Impact

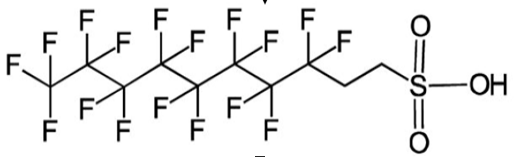


Investigation Challenges - Degradation to PFOA and PFOS



8:2 FtTAoS

Various PFAS Intermediates



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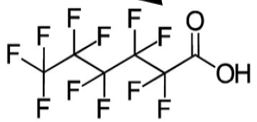
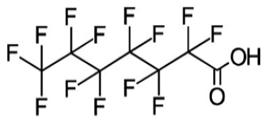
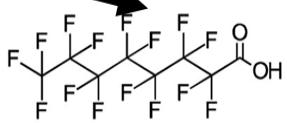
Various PFAS Intermediates



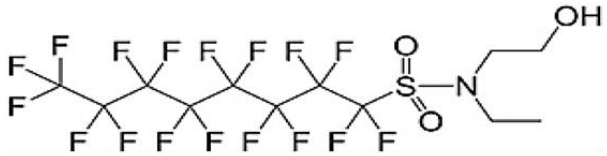
PFHxA



PFHpA

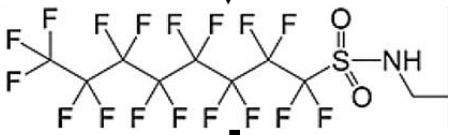


PFOA



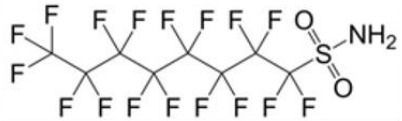
EtFOSE

Various PFAS Intermediates

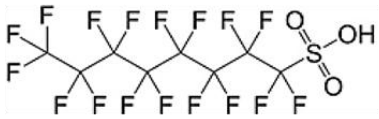


EtFOSA

Various PFAS Intermediates



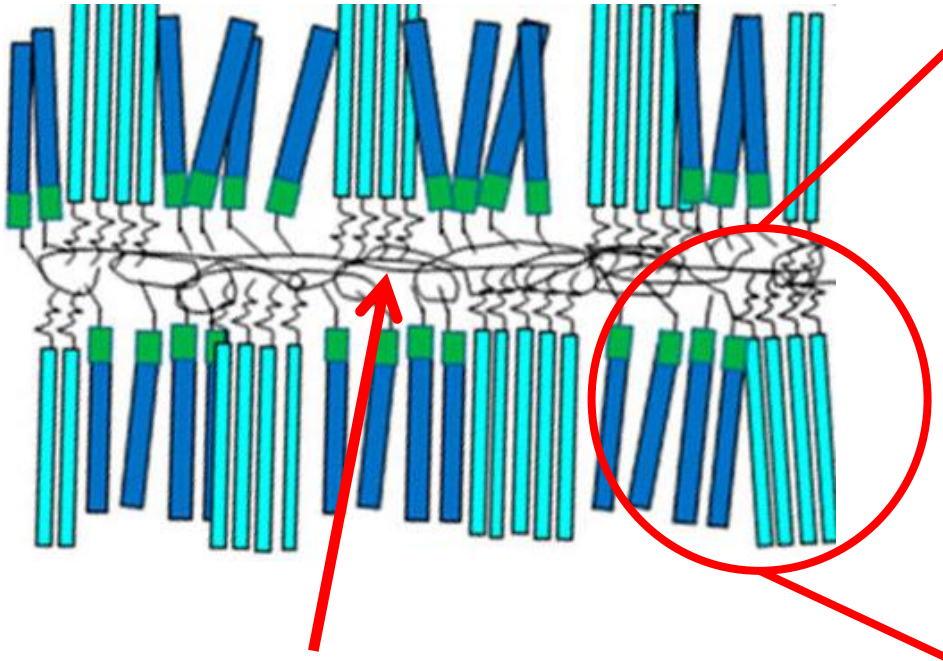
FOSA



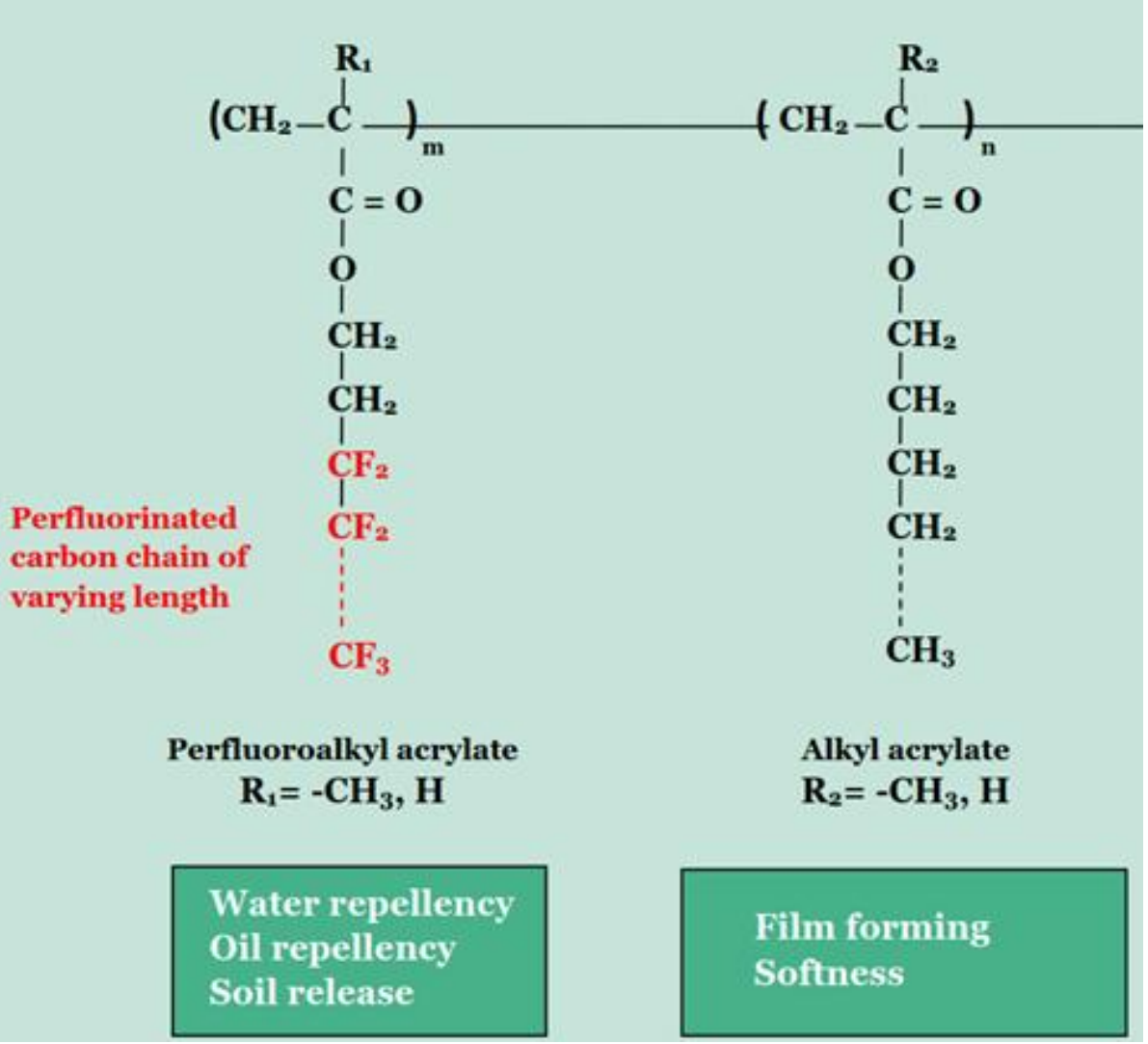
PFOS

Investigation Challenges - Example Side-Chain Polymer

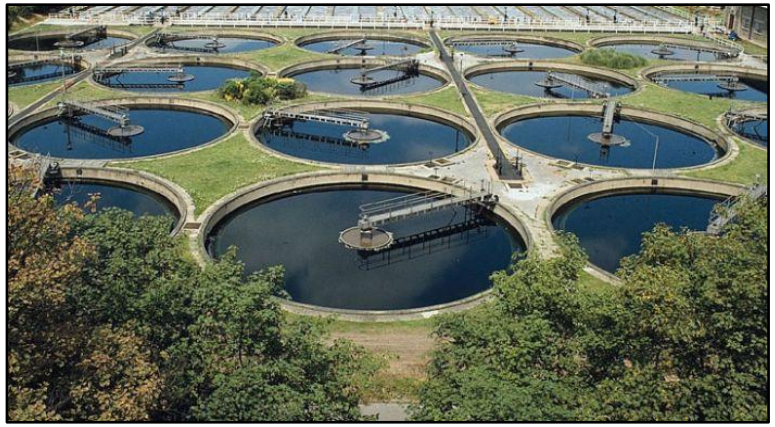
Protective Coatings
(e.g. textile, leather, paper)



Non-Fluorinated Backbone



Remediation Challenges – Limited Groundwater Options



Biological Treatment

Air Stripping

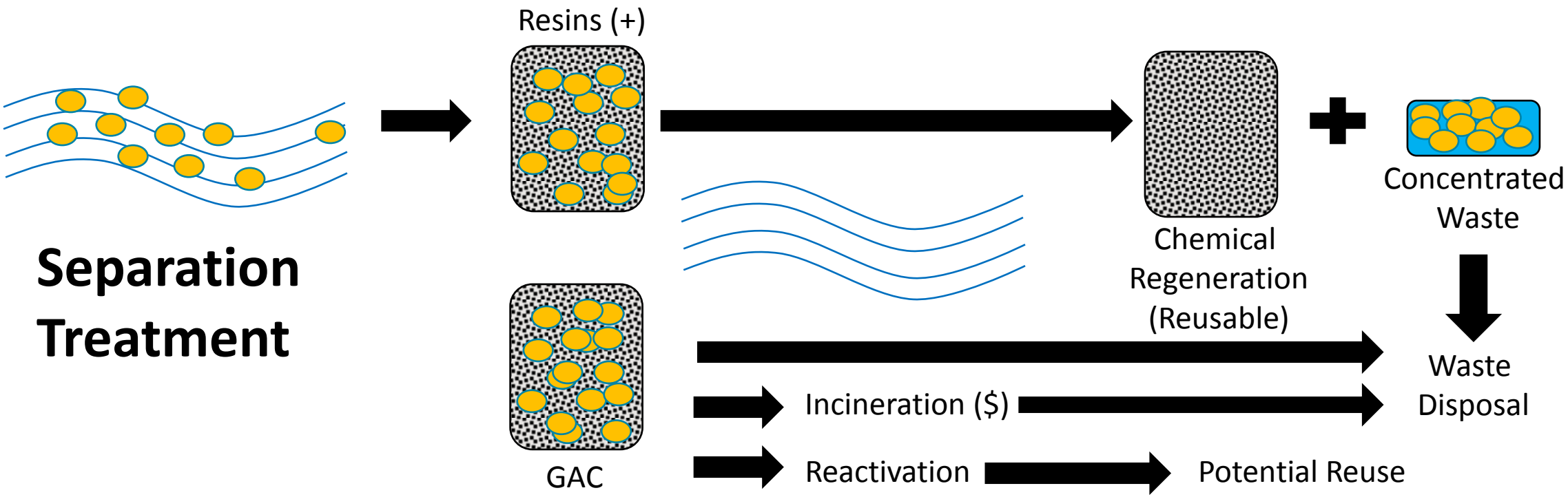
Granular Activated Carbon

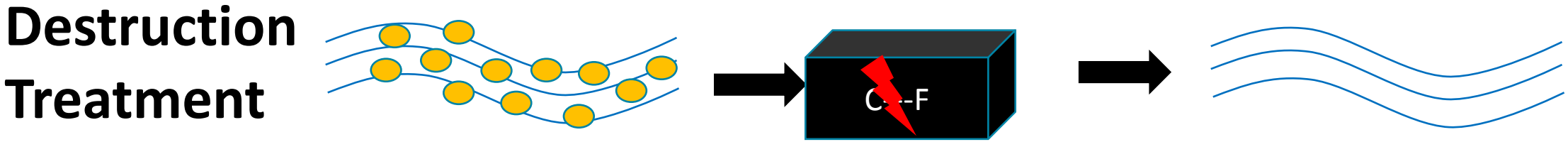
Synthetic Media (Resin)

Reverse Osmosis

Advance Oxidation

Remediation Challenges - Separation and Destruction Technologies





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Key Take Away Points

Unlike contaminants we're familiar with

- Widespread / mobile
- Potential health risks
- Challenging to remediate

Science Evolving Rapidly

- Regulations, policy, laboratory analysis, toxicity, fate & transport, treatment technologies

Other Considerations

- Media / Residents / Public perception

AECOM Imagine it. Delivered.

Thank You!

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