PFAS: Managing Risk & Uncertainty

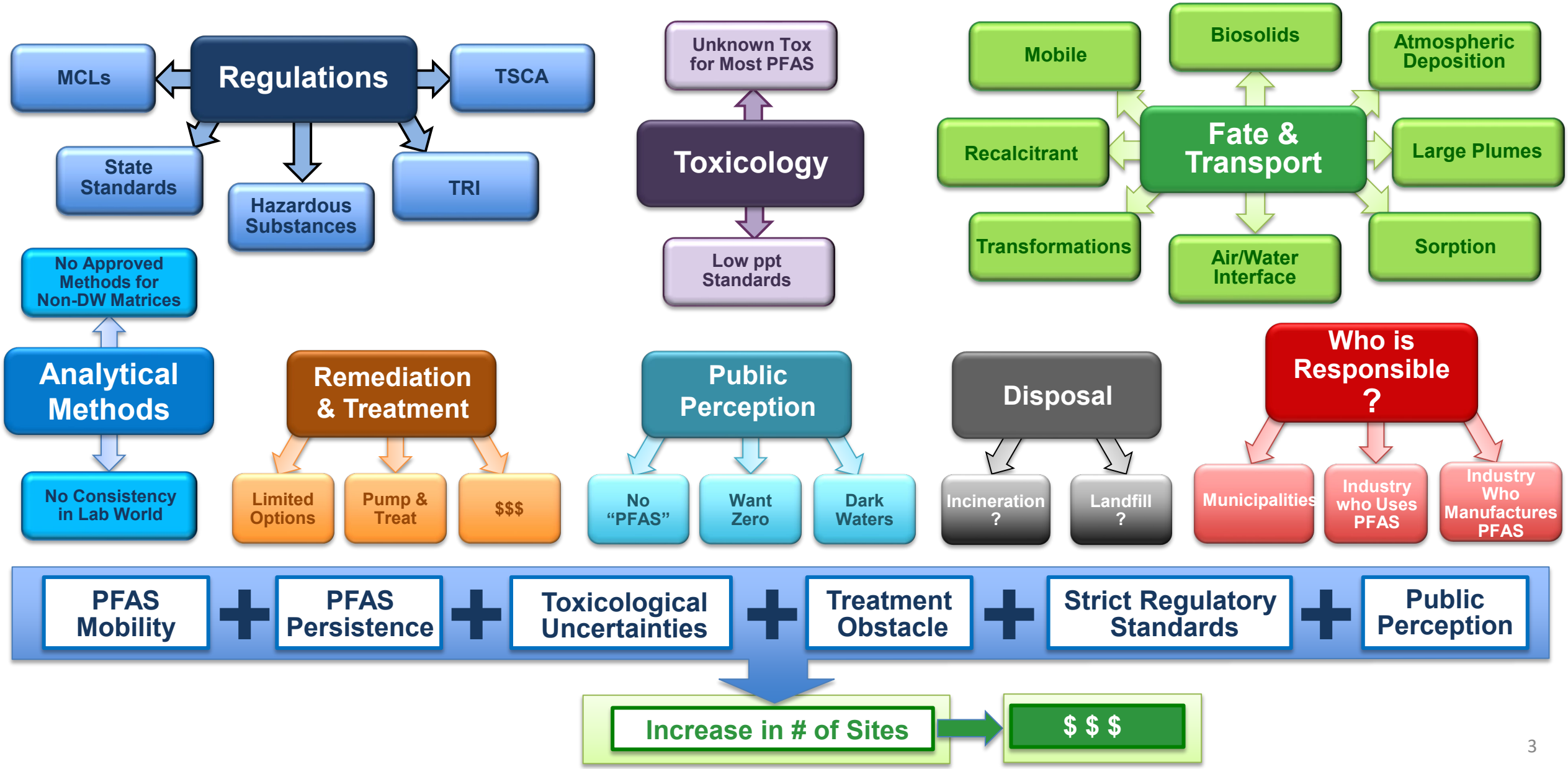
Elizabeth Denly, Vice President, PFAS Initiative Leader & Chemistry Director

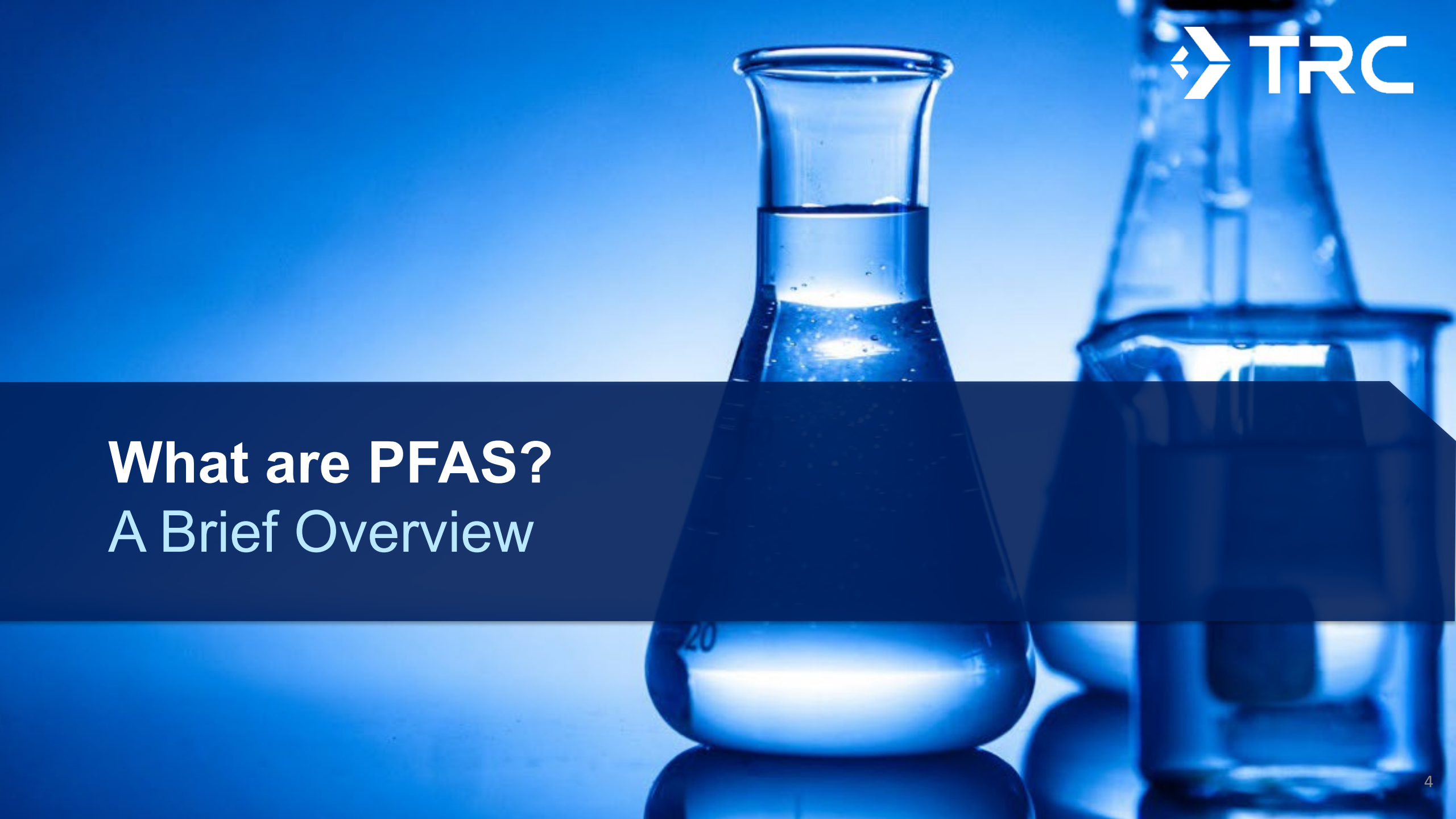
November 2, 2021

Today's Agenda

- What are PFAS?
- Sources of PFAS
- Fate & Transport of PFAS
- PFAS Sampling Challenges
- PFAS Regulatory Update
- PFAS Risk Management

PFAS Uncertainties / Challenges





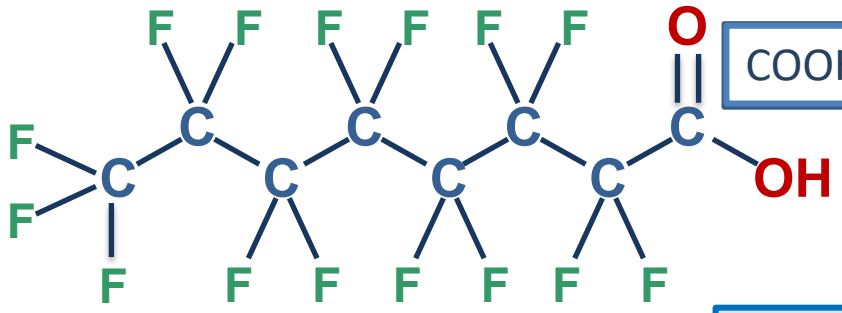
What are PFAS?
A Brief Overview

Quick Chemistry Lesson

PFAS = Per- and Poly-fluoroalkyl substances

Perfluoroalkyl substances: fully fluorinated alkyl tail

(PFOA)

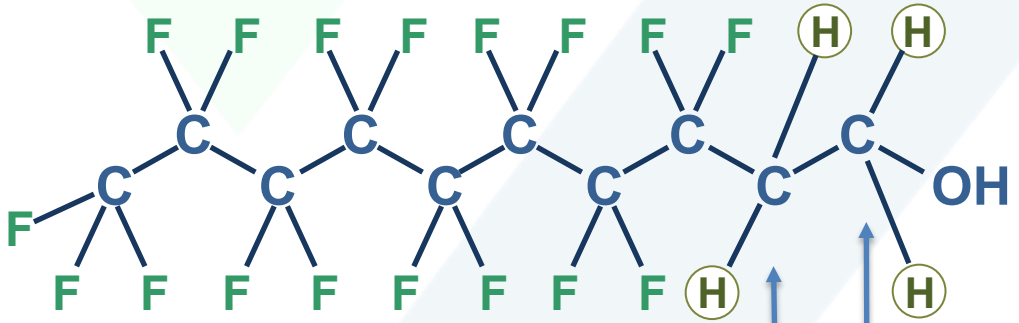


COOH = Head

Alkyl tail, fully fluorinated

Polyfluoroalkyl substances: non-fluorine atom attached to at least one carbon atom in the alkane chain

Fluorotelomer Alcohol (8:2 FTOH)



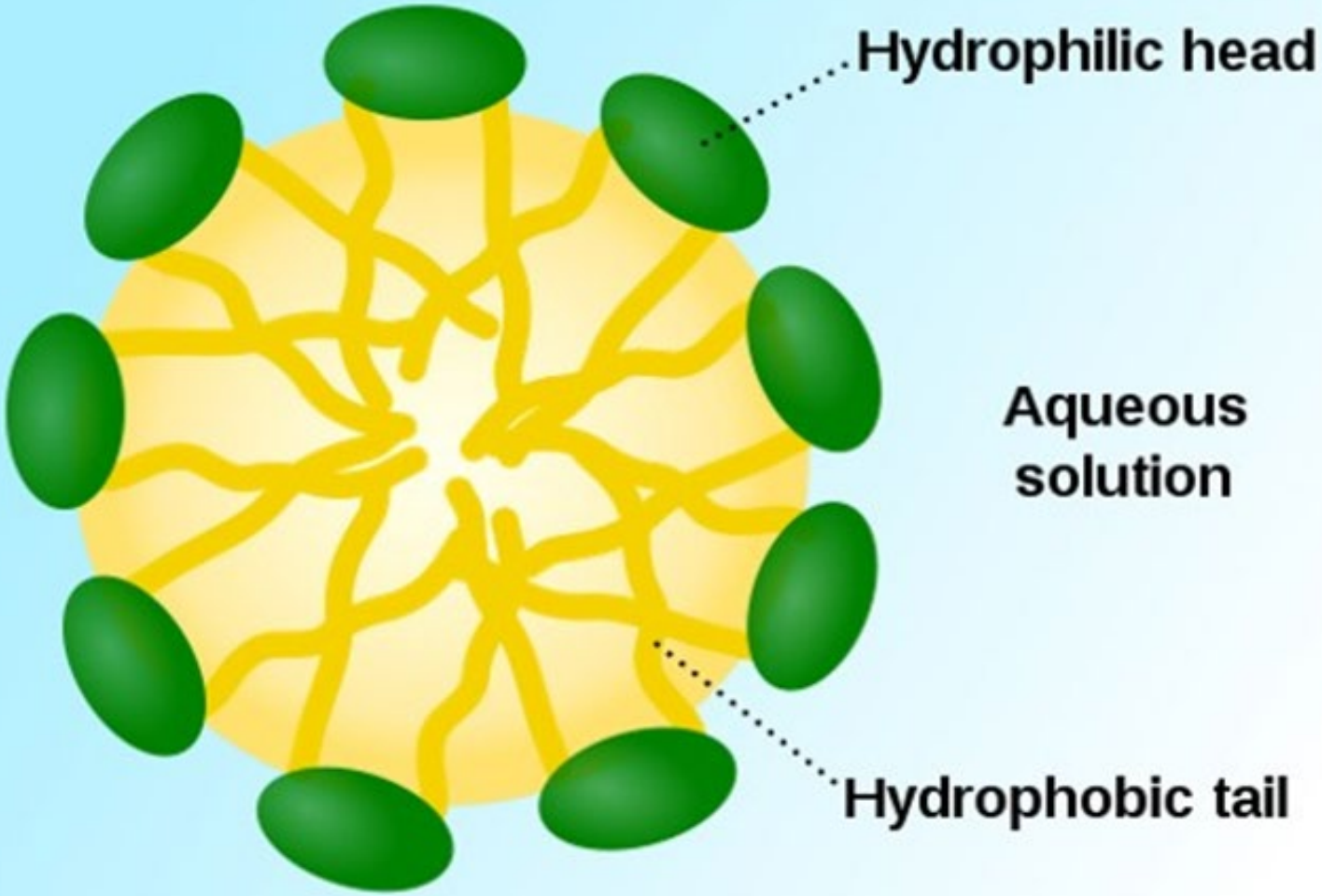
Non-fluorine atom on one or more carbons.

Polyfluoroalkyl substances may also be degraded to perfluoroalkyl substances (e.g., PFOS or PFOA): PRECURSORS

Chemical Properties of Perfluoroalkyl Substances

- C-F: Strong bond
- Chemically and thermally stable
- Water soluble and mobile in groundwater
- Surfactant properties
- Recalcitrant in environment

A PFAS Micelle



PFAS in the Metal Plating Industry

Sources, Fate & Transport

Sources of PFAS

Fire-fighting foams

Oil & Gas industry

Mining

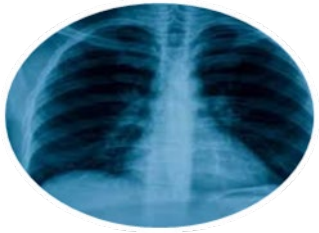
Metal plating

Paper & packaging

Electronics

Coatings: waxes, paints, inks, varnish

Textiles, leather & apparel



Photography

Pesticides

Personal care products

Plastics

Cleaning products

Medicine

Building & construction

Refrigerants

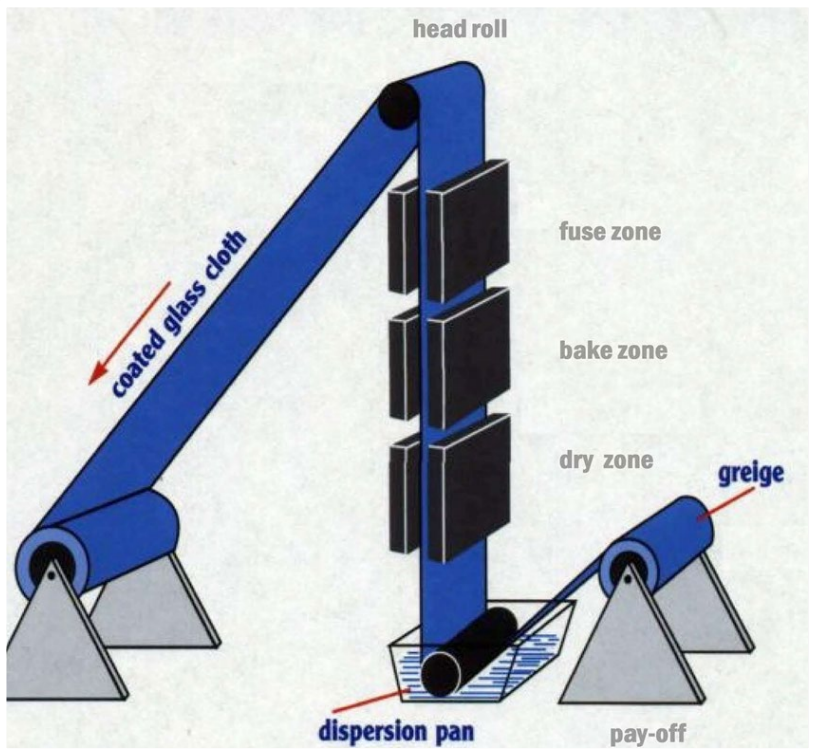
Explosives

Where are PFAS Used?

- A family of chemicals
- Used from 1940s to early 2000s to make products that resist heat, oils, grease, stains, and water
- Industries: aerospace, automotive, metal plating, construction, chemical, semiconductor, textile
- Most well-known & researched:
  - PFOA (perfluorooctanoic acid)
  - PFOS (perfluorooctane sulfonic acid)

But there are thousands of PFAS

What Facilities Emit PFAS Into Air?

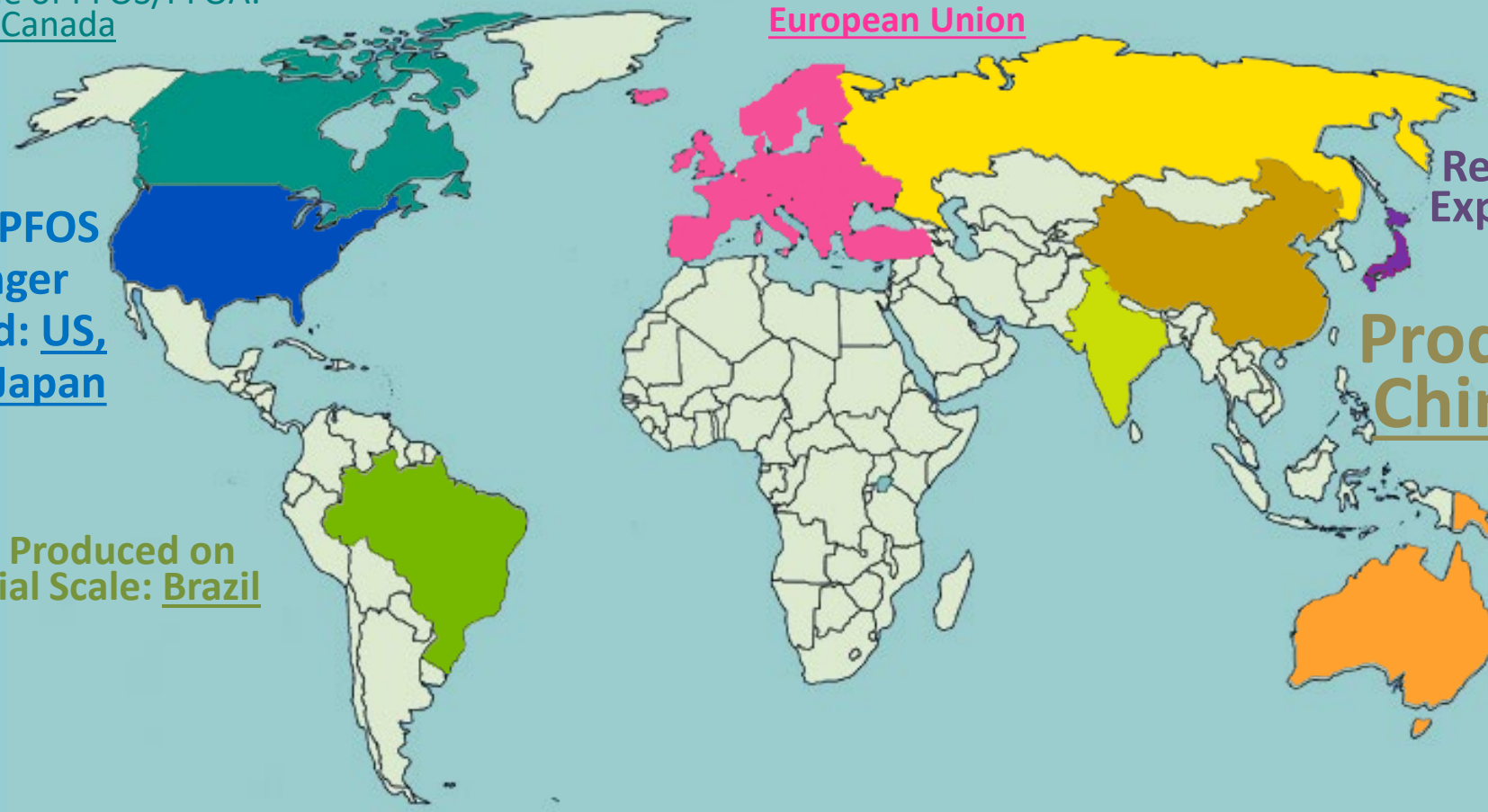


Uncontrolled emissions from a Teflon coating process at St Gobain in New Hampshire detected in surrounding soil and water

- Several industrial source categories have been identified as known or potential PFAS emitters
- PFAS/Teflon production plants (Chemours)
- Plants using PFAS in processes
  - Coating
  - Electroplating (dust suppression aid)
- Facilities where PFAS is present
  - Landfills
  - Waste-water treatment
- More potential sources need to be tested (sewage sludge and waste incinerators, paper mills, other manufacturing)

Global Manufacture and Use of PFAS

PFAS Manufactured Globally



Prohibits Import, Manufacture, Use & Sale of PFOS/PFOA: Canada

Banned Sale, Use and Import of PFOA: European Union

Restrict Manufacture, Import, Export, and Use of PFOS: Japan

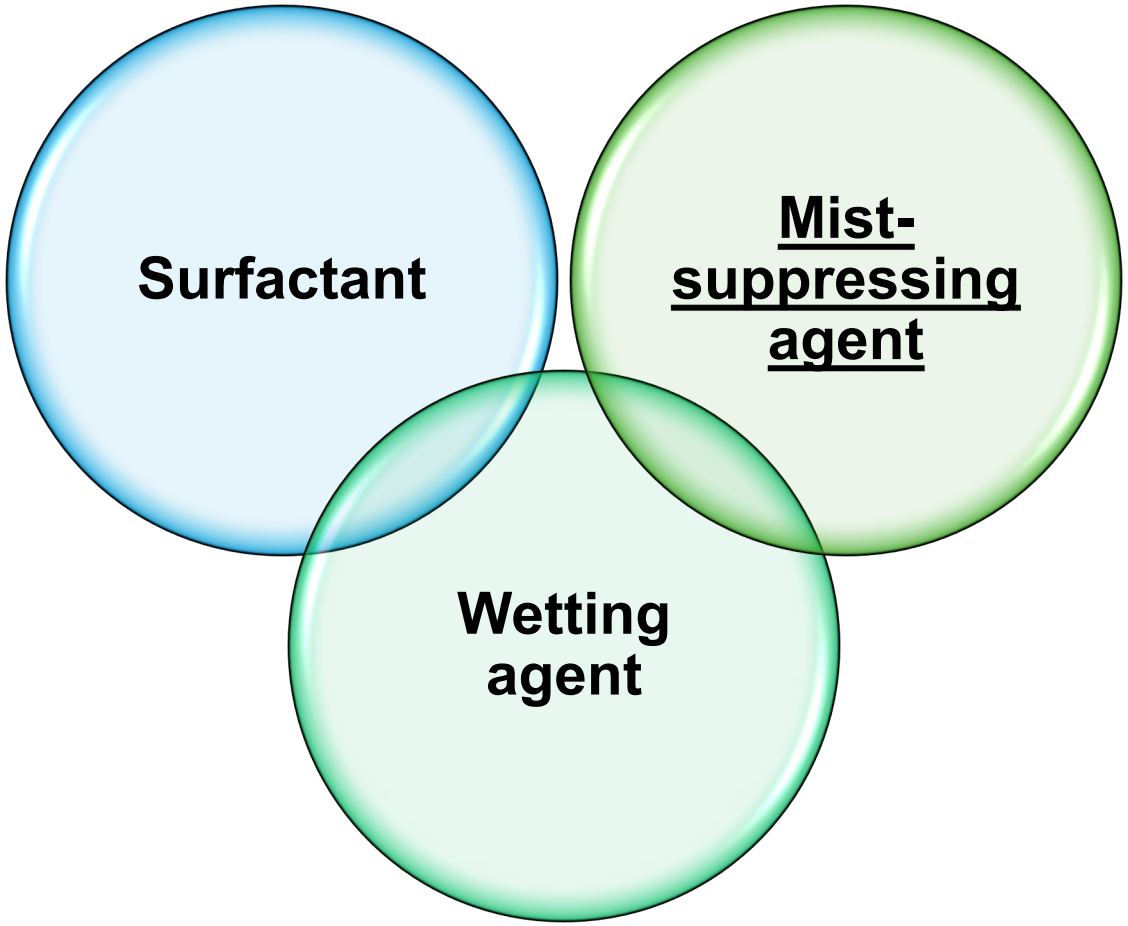
PFOA & PFOS No Longer Produced: US, Europe, Japan

Increased Production of PFOA: China, India, Russia

EtFOSA Produced on Industrial Scale: Brazil

Class B AFFF with PFAS Banned: South Australia

PFAS Use in the Metal Plating Industry



- **1954:** first reported use for chrome plating
- Common in chromium electroplating and anodizing
- PFOS was used at concentration of 5-10%
- NESHAP: phase-out of PFOS-based fume suppressants in Cr electroplating by 2015
- **2012:** EPA phased out PFOS from wetting agent/mist-suppressing agent, other PFAS not mentioned
- **2020**: Report by MI EGLE and EPA found only 6:2 FTS of 25 targeted PFAS in current wetting agent/mist-suppressing agent

PFAS associated with Cr, Cu, Ni, and Sn plating

PFOS replaced with short-chain PFAS chemistry: 6:2 Fluorotelomer sulfonate (6:2 FTS), F53B

PFAS & Metal Plating (from recent publication)

Electroplating (metal plating)		
- Chrome plating	Prevent the evaporation of chromium(VI) vapour	Lower the surface tension of the electrolyte solution, very stable in strongly acidic and oxidizing conditions
- Nickel plating	Non-foaming surfactant	Low surface tension
- Nickel plating	Increase the strength of the nickel electroplate by eliminating pinholes, cracks, and peeling	Low surface tension
- Copper plating	Prevent haze by regulating foam and improving stability	Low surface tension
- Tin plating	Help to produce a plate of uniform thickness	Low surface tension
- Alkaline zinc and zinc alloy plating		
- Deposition of fluoropolymer particles onto steel	Supported by fluorinated surfactants	Cationic and amphoteric fluorinated surfactants impart a positive charge to fluoropolymer particles which facilitates the electroplating of the fluoropolymer

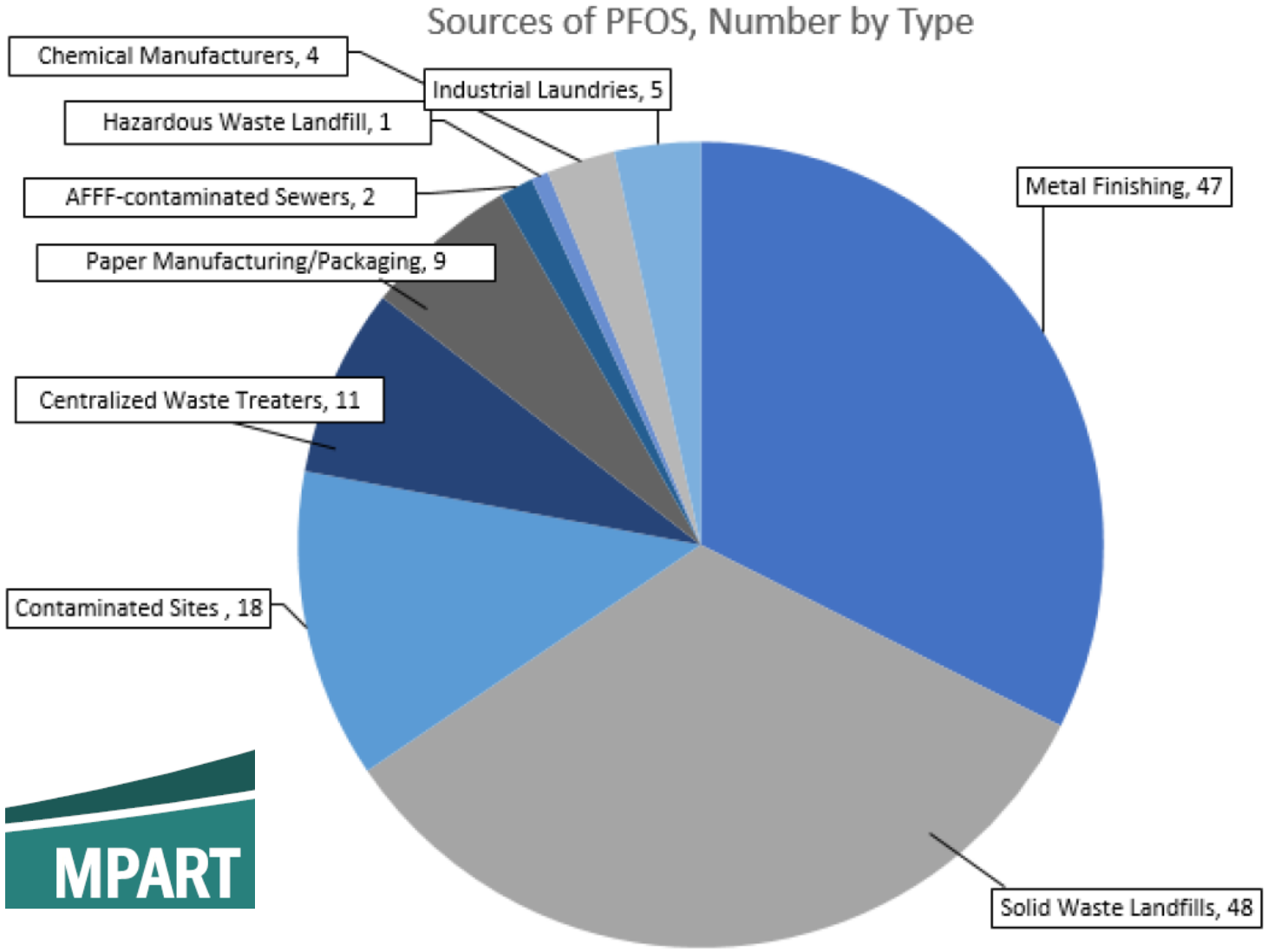
An overview of the uses of per- and polyfluoroalkyl substances (PFAS)†

Juliane Glüge, *[a] Martin Scheringer, [a] Ian T. Cousins, [b] Jamie C. DeWitt, [c] Gretta Goldenman, [d] Dorte Herzke, [ef] Rainer Lohmann, [g] Carla A. Ng, [h] Xenia Trier [i] and Zhanyun Wang [j]

EPA/EGLE Study: Sources of PFOS to WWTPs

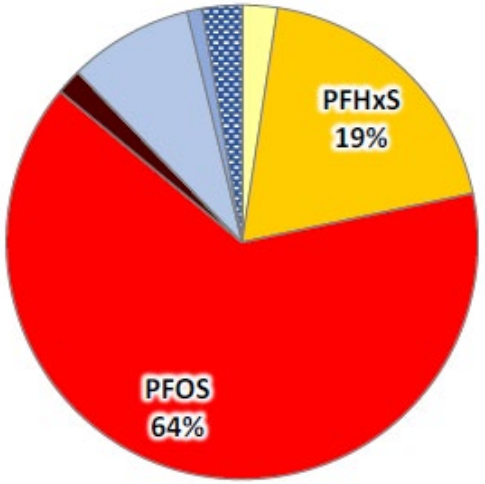
Where is PFOS coming from in metal finishing?

- No PFOS in mist suppressants
- 6:2 FTS breaks down to PFPeA, PFHxA, and 5:3 FTCA
- PFOS residuals at facility from prior to replacement with 6:2 FTS

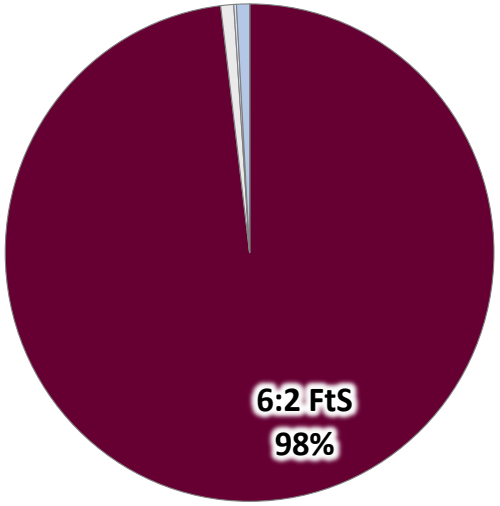


Source: EPA/EGLE Fume Suppressant Study, July 9, 2020 Webinar

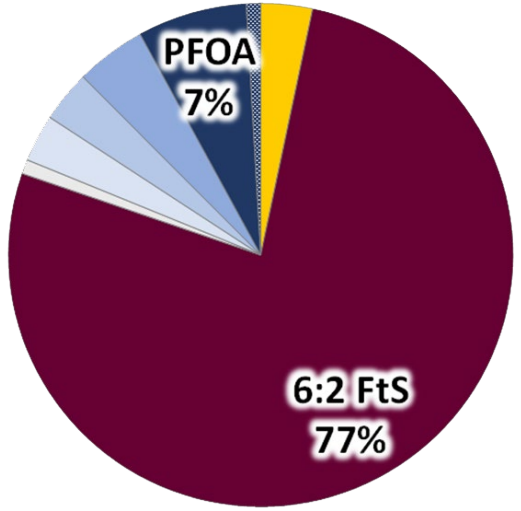
PFAS Source Signature Differentiation



1st Generation AFFF (PFOS-Based)

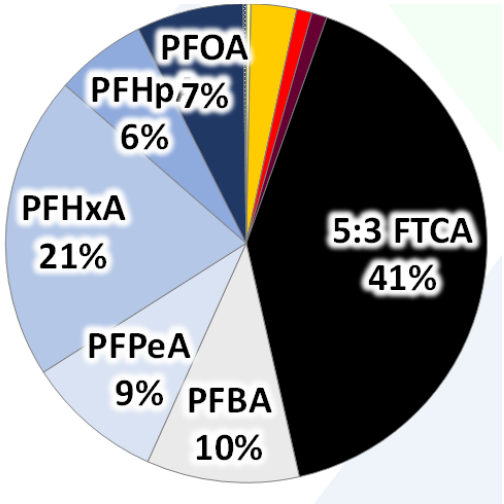


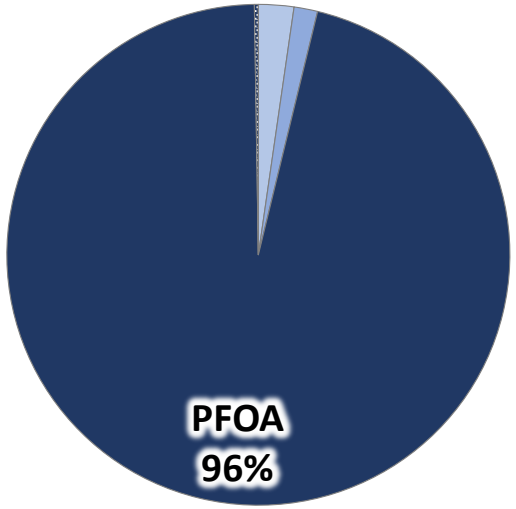
Modern Fluorotelomer AFFF



WWTP Effluent from Chrome Plater

Landfill Leachate





Plastics Manufacturing

Conceptual Site Model for Industrial Sites

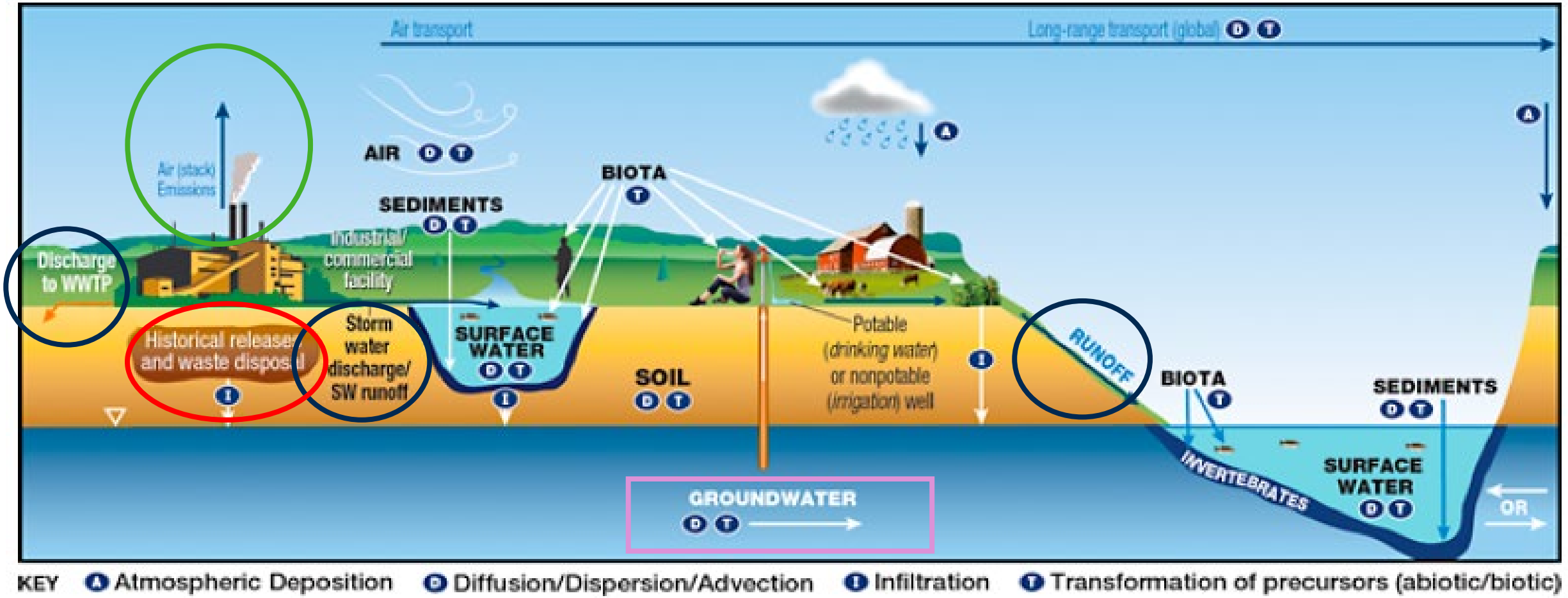
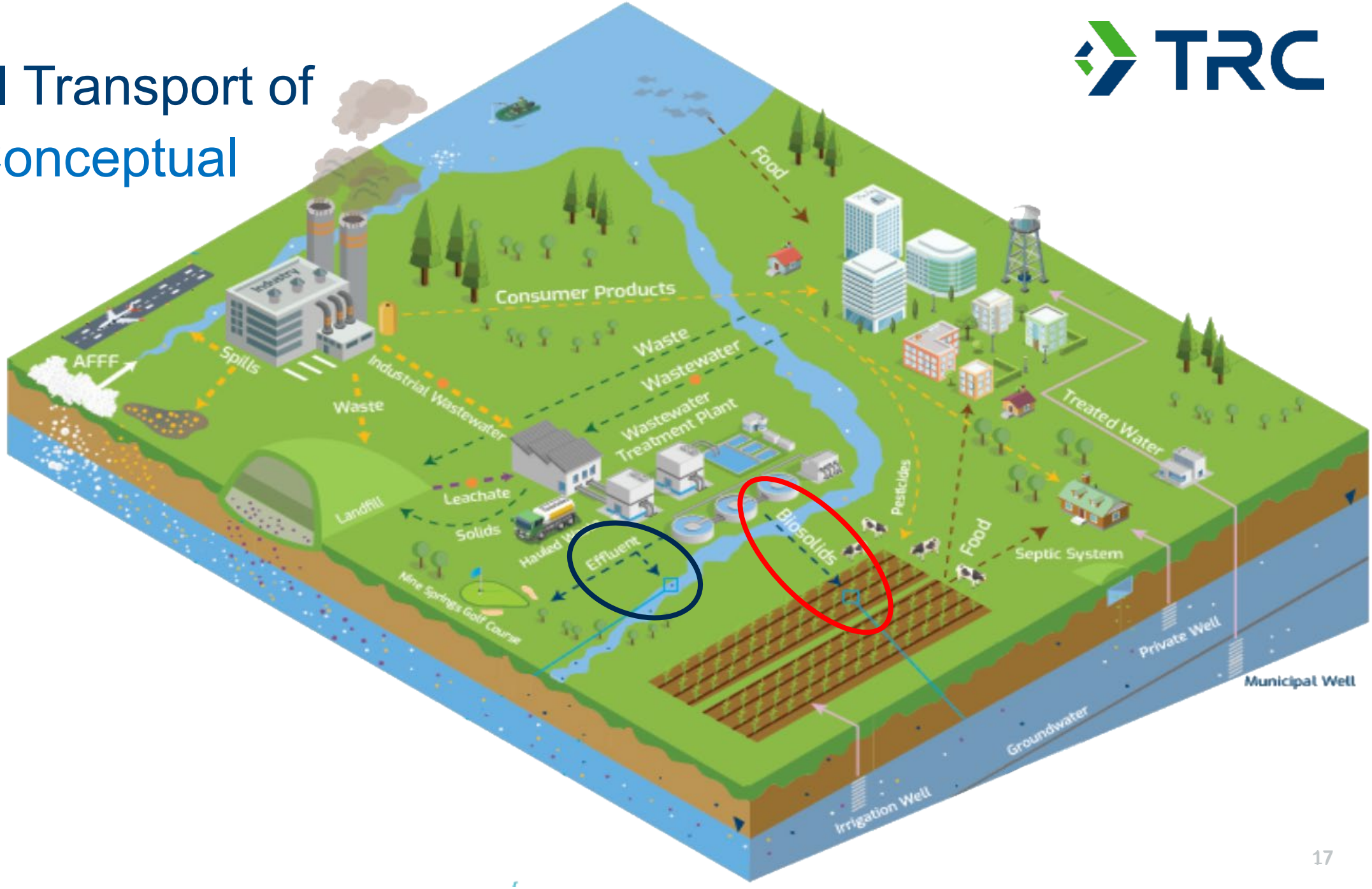


Figure 2-16. CSM for industrial sites.

Source: Adapted from figure by L. Trozzolo, TRC, used with permission.

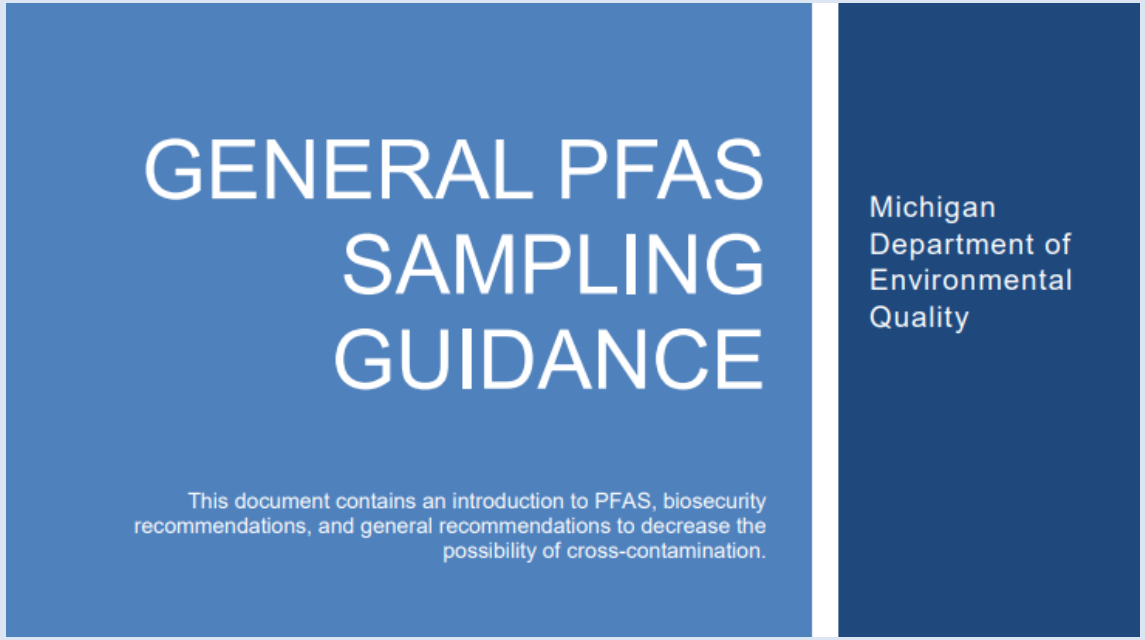
Regional Transport of PFAS: Conceptual Model



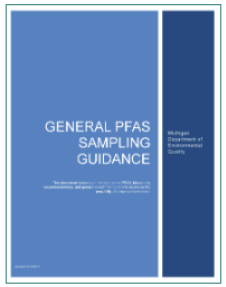
PFAS
Sampling Challenges

How Do We Sample PFAS?

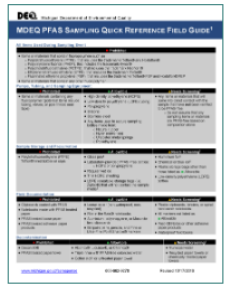
- Similar to conventional sampling (e.g., low-flow techniques, direct push, etc.)
- Special care required to prevent cross contamination
- Use of and exclusion of specific sampling equipment and materials



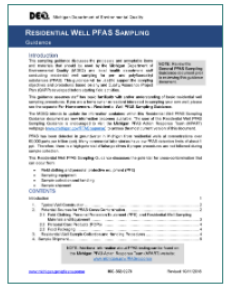
Technical Guidance Documents



General PFAS Sampling Guidance
Revised October 16, 2018



PFAS Sampling Quick Reference Field Guide
Revised October 17, 2018



Residential Well PFAS Sampling Guidance
Revised October 11, 2018

Groundwater PFAS Sampling Guidance
Uploaded October 2018

Wastewater PFAS Sampling Guidance
Revised October 11, 2018

Surface Water PFAS Sampling Guidance
Revised November 28, 2018

Soil PFAS Sampling Guidance
Revised November 28, 2018

Fish Tissue PFAS Sampling Guidance
Uploaded January 2019

PFAS Sampling Dos and Don'ts

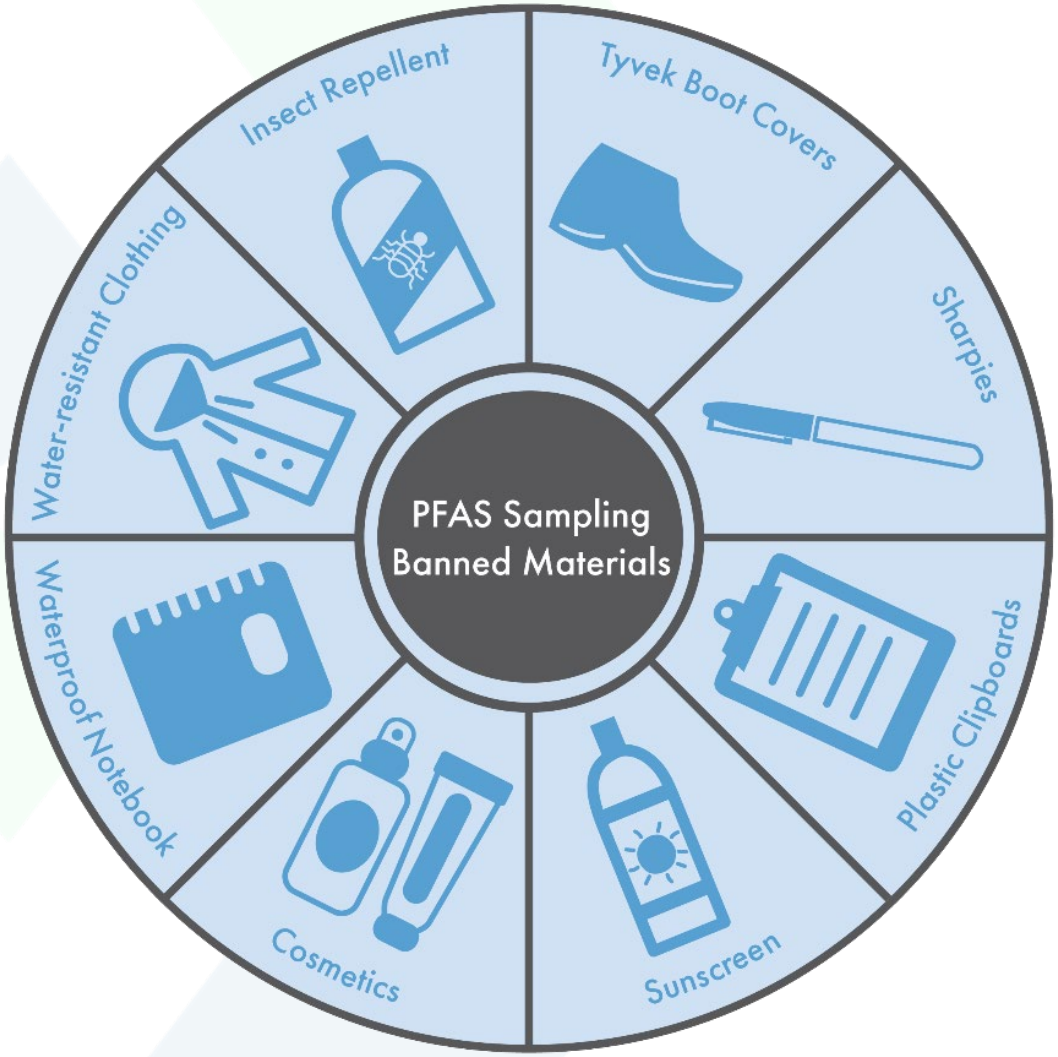
WHAT SHOULD I AVOID?	USE INSTEAD
Passive diffusion bags (PDBs)	
LDPE Hydrasleeves	✓ HDPE Hydrasleeves
Post-It notes during sample handling	
Blue Ice® (chemical ice packs)	✓ Regular ice in Ziploc® bags
Waterproof field books, plastic clipboards and spiral bound notebooks	✓ Field notes recorded on loose paper ✓ Field forms maintained in aluminum or Masonite clipboards
Unnecessary handling of items with nitrile gloves	✓ Personnel collecting and handling samples should wear nitrile gloves at all times while collecting and handling samples or sampling equipment

PFAS Sampling Dos and Don'ts

WHAT SHOULD I AVOID?	USE INSTEAD
Equipment with **Teflon®** (e.g., bailers, tubing, parts in pump) during sample handling or mobilization/demobilization	✓ High density polyethylene (HDPE) or silicone tubing/materials in lieu of Teflon®
Low-density polyethylene (LDPE) or glass sample containers or containers with Teflon-lined lids	✓ HDPE or polypropylene containers for sample storage ✓ HDPE or polypropylene caps
Tyvek® suits and waterproof boots	✓ Clothing made of cotton preferred ✓ Boots made with polyurethane and polyvinyl chloride (PVC)
Waterproof labels for sample bottles	✓ Paper labels with clear tape
Sunscreens, insect repellants	✓ Products that are 100% natural, DEET
Sharpies	✓ Ballpoint pens
Aluminum foil	✓ Thin HDPE sheeting

Other Special Considerations

- Field QC
- Decontamination of sampling equipment
- No pre-wrapped food or snacks
- Avoid cosmetics, moisturizers, hand creams on day of sampling.
- Visitors to site must remain at least 30 feet from sampling area.
- Wash hands with water after leaving vehicle before setting up on a well.

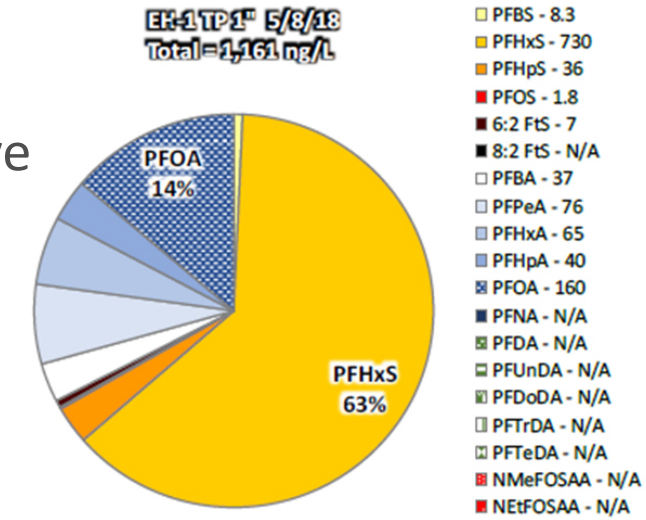


- **Partitioning of PFAS to surface in wells and reservoirs**

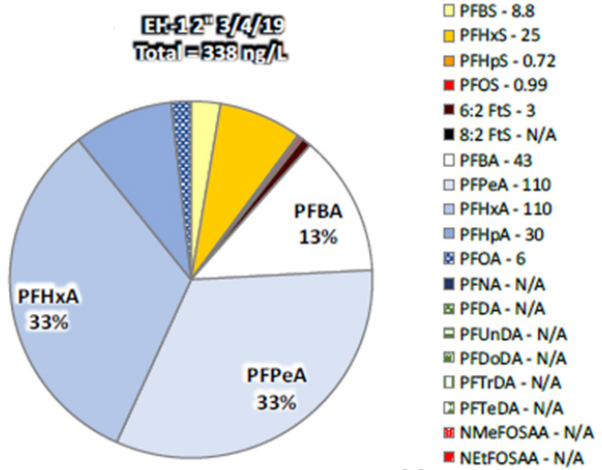
How Do Labs Deal With Solids in Aqueous Samples?

- The following samples *contain* non-settleable particulate matter which plugged the solid-phase extraction column.
- The following samples *were decanted* prior to preparation due to excessive sediment in bottle.
- The following sample *was decanted* prior to preparation due to having floating sediment particles and also some wood material.
- The following sample *was centrifuged* prior to spiking and the extraction due to the color being a dark yellow with floating material instead, which we cannot decant.
- Samples have fine sediment at the bottom of the bottle *and mixed in with the sample water.*
- *Due to residual amounts of sediment in the sample, the sample container was placed in the oven and dried after extraction, and the weight was then recorded. The container was then extracted per the SOP.*

Sample from 1" temporary well turbid



Sample from 2" developed MW clear



PFAS
Regulatory Update

What is Happening in Our States?

- As of August 2021, **27 states** have developed draft, proposed, or final health-based regulatory and/or guidance values for several PFAS compounds in drinking water, groundwater, or surface water (ITRC August Tables).
- **6 states have promulgated MCLs**
  - MI, NJ, NH, NY, VT, MA
  - All are significantly below the EPA LHA of 70 ppt
  - 2 of them (MA & VT) promulgated standards as a sum of compounds (up to 6): VT is sum of 5 and MA is sum of 6
  - 6 additional states are in the pre-proposal phase of MCL development

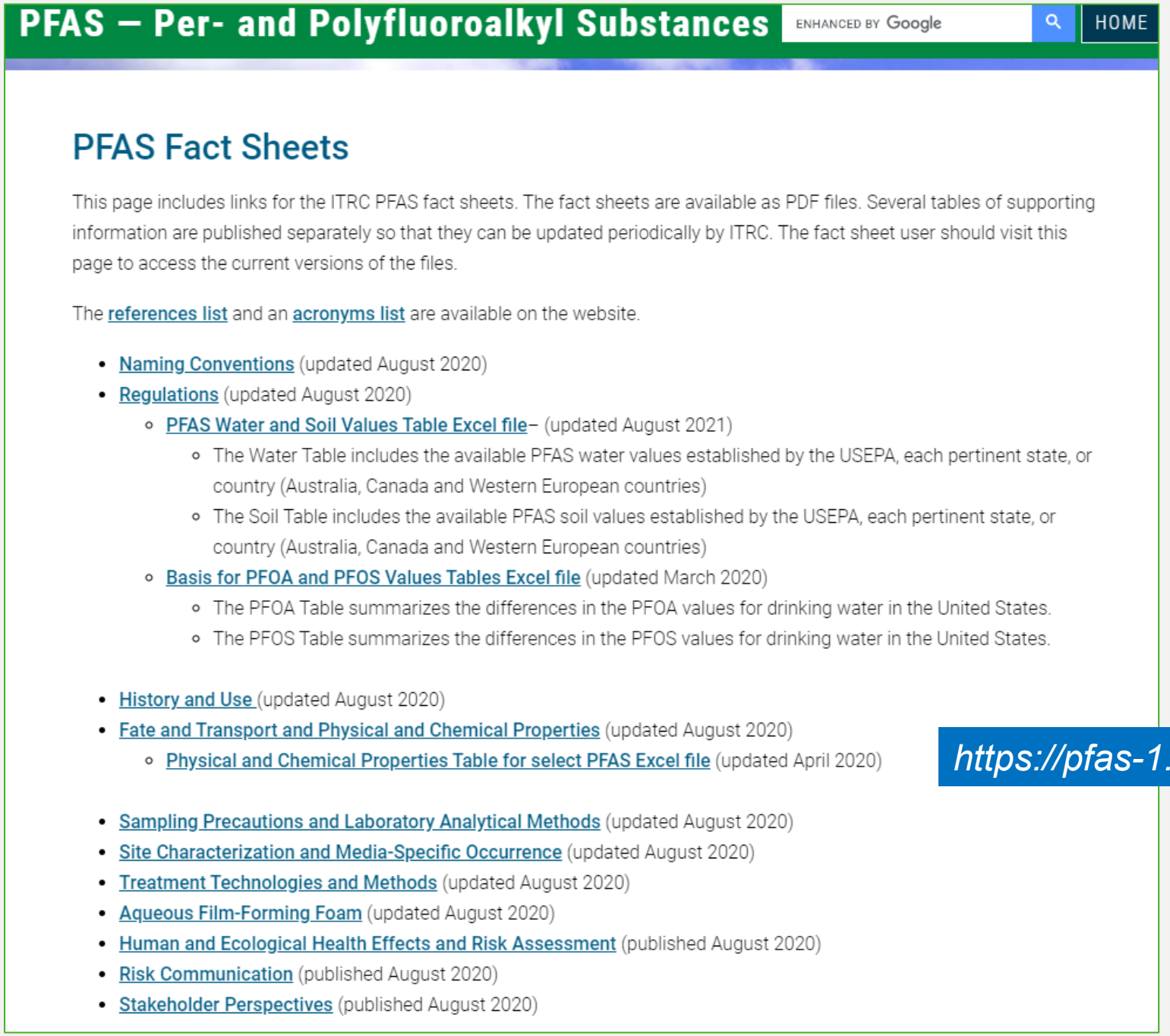
- **12 states** have developed drinking water guidelines for PFOA and PFOS in groundwater or surface water **that are lower than the EPA's LHA** due to considerations of more recent scientific information, more sensitive toxicological endpoints, and/or more stringent exposure parameters.
- **19 states** have developed guidelines for PFAS compounds in addition to PFOA and PFOS.
- **11 states** have adopted the EPA's LHA for PFOA and PFOS in drinking water and/or groundwater to guide their efforts upon detection of contamination.

Variability of PFAS Regulations

Units (ng/L)		PFOA	PFOS	PFHxS	PFNA	PFHpA	PFDA	
Massachusetts	GW	20	20	20	20	20	20	Sum of 6 (GW-1)
	DW	20	20	20	20	20	20	Sum of 6 (MCL)
Connecticut	GW	70	70	70	70	70	-	Sum of 5 (Drinking Water Action
	DW	70	70	70	70	70	-	Level)
Michigan	GW	8	16	51	6	-	-	GCC (PFBS 420; PFHxA 400,000)
	DW	8	16	51	6	-	-	MCL (PFBS 420; PFHxA 400,000)
New Hampshire	GW	12	15	18	11	-	-	AGQS
	DW	12	15	18	11	-	-	MCL
Wisconsin	GW	20	20	40	30	-	300	Proposed Enforcement Standards for 16 PFAS
New York	GW	10	10	100	100	10	100	Other PFAS <100; Total PFAS <500
	DW	10	10	-	-	-	-	MCL
Maine	GW	400	400	-	-	-	-	RAGs (Residential) plus PFBS (400,000)
	DW	70	70	-	-	-	-	Use EPA HAL

PFAS Strategic Road Map

ITRC PFAS Fact Sheets



PFAS — Per- and Polyfluoroalkyl Substances

ENHANCED BY Google

HOME

PFAS Fact Sheets

This page includes links for the ITRC PFAS fact sheets. The fact sheets are available as PDF files. Several tables of supporting information are published separately so that they can be updated periodically by ITRC. The fact sheet user should visit this page to access the current versions of the files.

The references list and an acronyms list are available on the website.

- Naming Conventions (updated August 2020)
- Regulations (updated August 2020)
  - PFAS Water and Soil Values Table Excel file– (updated August 2021)
    - The Water Table includes the available PFAS water values established by the USEPA, each pertinent state, or country (Australia, Canada and Western European countries)
    - The Soil Table includes the available PFAS soil values established by the USEPA, each pertinent state, or country (Australia, Canada and Western European countries)
  - Basis for PFOA and PFOS Values Tables Excel file (updated March 2020)
    - The PFOA Table summarizes the differences in the PFOA values for drinking water in the United States.
    - The PFOS Table summarizes the differences in the PFOS values for drinking water in the United States.
- History and Use (updated August 2020)
- Fate and Transport and Physical and Chemical Properties (updated August 2020)
  - Physical and Chemical Properties Table for select PFAS Excel file (updated April 2020)
- Sampling Precautions and Laboratory Analytical Methods (updated August 2020)
- Site Characterization and Media-Specific Occurrence (updated August 2020)
- Treatment Technologies and Methods (updated August 2020)
- Aqueous Film-Forming Foam (updated August 2020)
- Human and Ecological Health Effects and Risk Assessment (published August 2020)
- Risk Communication (published August 2020)
- Stakeholder Perspectives (published August 2020)

https://pfas-1.itrcweb.org/fact-sheets/

PFAS
Risk Management

Avoid Surprises

- Don't have a regulator or third party identify a previously unknown contaminant of concern like PFAS.
  - For example: **In October 2019**, the California State Water Board issued Investigative Orders to Chrome Plating Facilities (271) that may have stored or used fume suppressants or other substances that may have contained PFAS. These Orders included the required sampling for 25 PFAS compounds.
- Recognize that PFAS are likely being used at metal plating facilities.
- Recognize potential for risk: Know which sites have high or low risk.
  - Actively manage sites with high risk:
    - Sites in areas with sensitized population or regulatory groups
    - Near sensitive receptors – water supplies
    - Potential for high concentrations
  - Watch sites with lower risk.

Create a Risk Management Plan

- Develop a protocol to evaluate the risk posed by your facility or facilities.
  - Provide ways to prioritize and focus your resources on both external and internal issues.
- Develop a conceptual site model.
  - Potential sources at your facilities
  - Potential routes of migration and exposure pathways
  - Receptors of concern
  - Track PFAS from your facility and from your upstream supplier
- Conduct a Paper Audit.
  - Identify on site sources that may cause PFAS migration
  - Identify upgradient sources or sites that may cause PFAS migration
  - Understand human and ecological receptors on site
  - Understand any potential downgradient liabilities
  - Review your insurance provisions

Create a Risk Management Plan *(continued)*

- Review potential impacts of PFAS contamination.
  - Potential exposures
  - Contaminated media on site
  - Regulatory requirements in affected state
  - Potential lawsuits

- Create a sampling strategy for water, soil, products at your facility.
  - Examine operations and upstream/downstream supply chain
  - When would sampling be required? (e.g., state requirement, POTW requirement, high-risk setting?)
  - Forensics analysis
- Evaluate source reduction and mitigation alternatives, depending on source of PFAS contamination (e.g., alternative products, treatment of wastewater).
- Create a Communication Plan.

Manage Risks

- Manage Sites Proactively
  - Develop a plan prior to a site becoming an emergency.
- Understand what constituents might become an issue.
- Understand what regulatory limits are being considered or implemented.
- Minimize potential PFAS contamination
  - Re-structure/re-engineer the plating process
  - Understand alternative products and the supply chain
- Maintain a Balanced Approach
  - Is there a regulatory requirement to fix contamination?
  - Understand the fate & transport of PFAS at your site; create a conceptual site model

Questions?

Elizabeth Denly, ASQ CMQ/OE
Vice President, PFAS Initiative Leader & Chemistry Director
P: (978) 656-3577 | **E:** EDenly@TRCcompanies.com
www.TRCcompanies.com