EPA's Strategy for Addressing PFAS: Expanding the Scientific Foundation for Action

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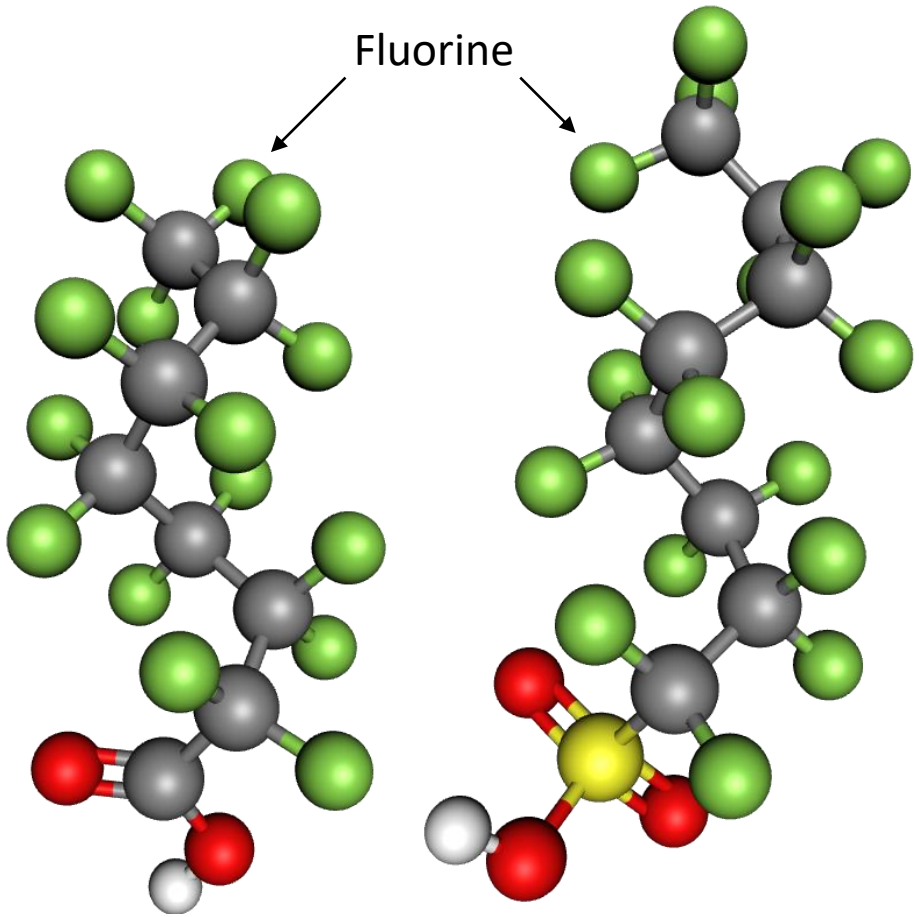
Per- and Polyfluoroalkyl Substances (PFAS)



Perfluorooctanoic acid (PFOA)

Perfluorooctanesulfonic acid (PFOS)

A large class of synthetic chemicals

- Features chains of carbon atoms surrounded by fluorine atoms
- Wide variety of chemical structures, from single molecules to polymers

Used in homes, businesses and industry for decades

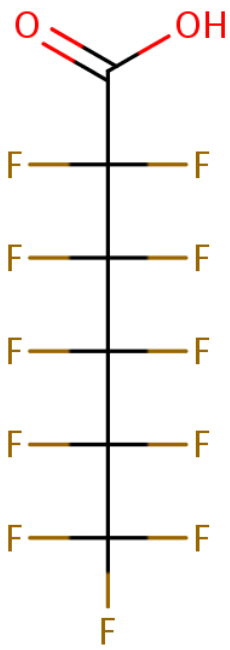
- Have been detected in soil, water and air samples
- Most people have been exposed to PFAS

Some PFAS are known to be PBT

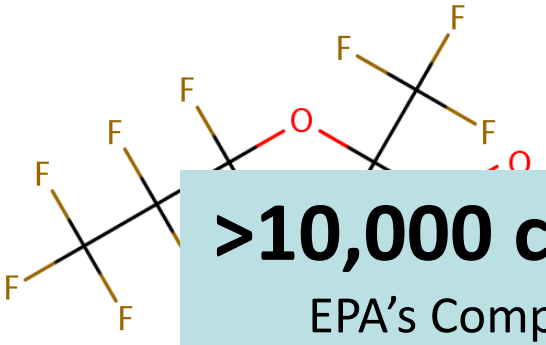
- P = Persistent in the environment
- B = Bioaccumulative in organisms
- T = Toxic at relatively low levels (ppt)

More than PFOA and PFOS

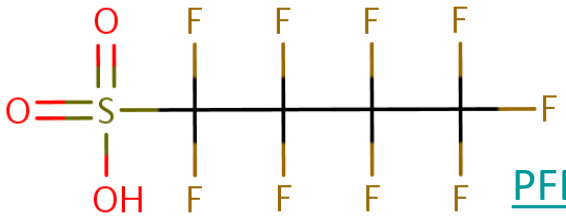
Perfluorinated Examples



PFHxA

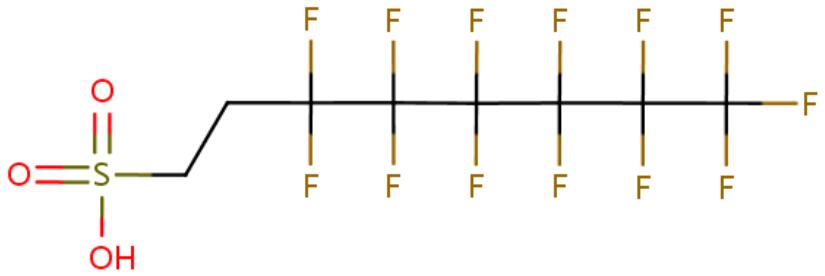


HFPO-DA

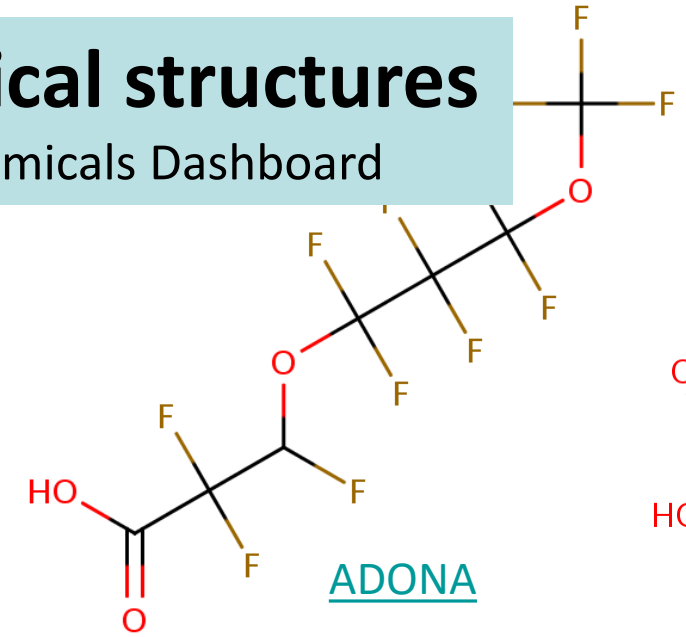


PFBS

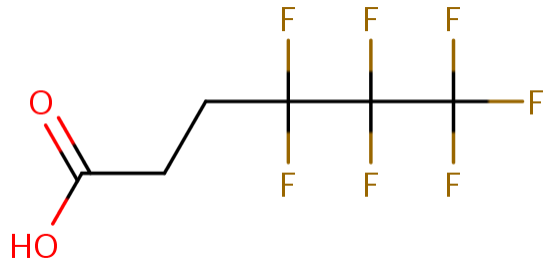
Polyfluorinated Examples



6:2 FTSA



ADONA



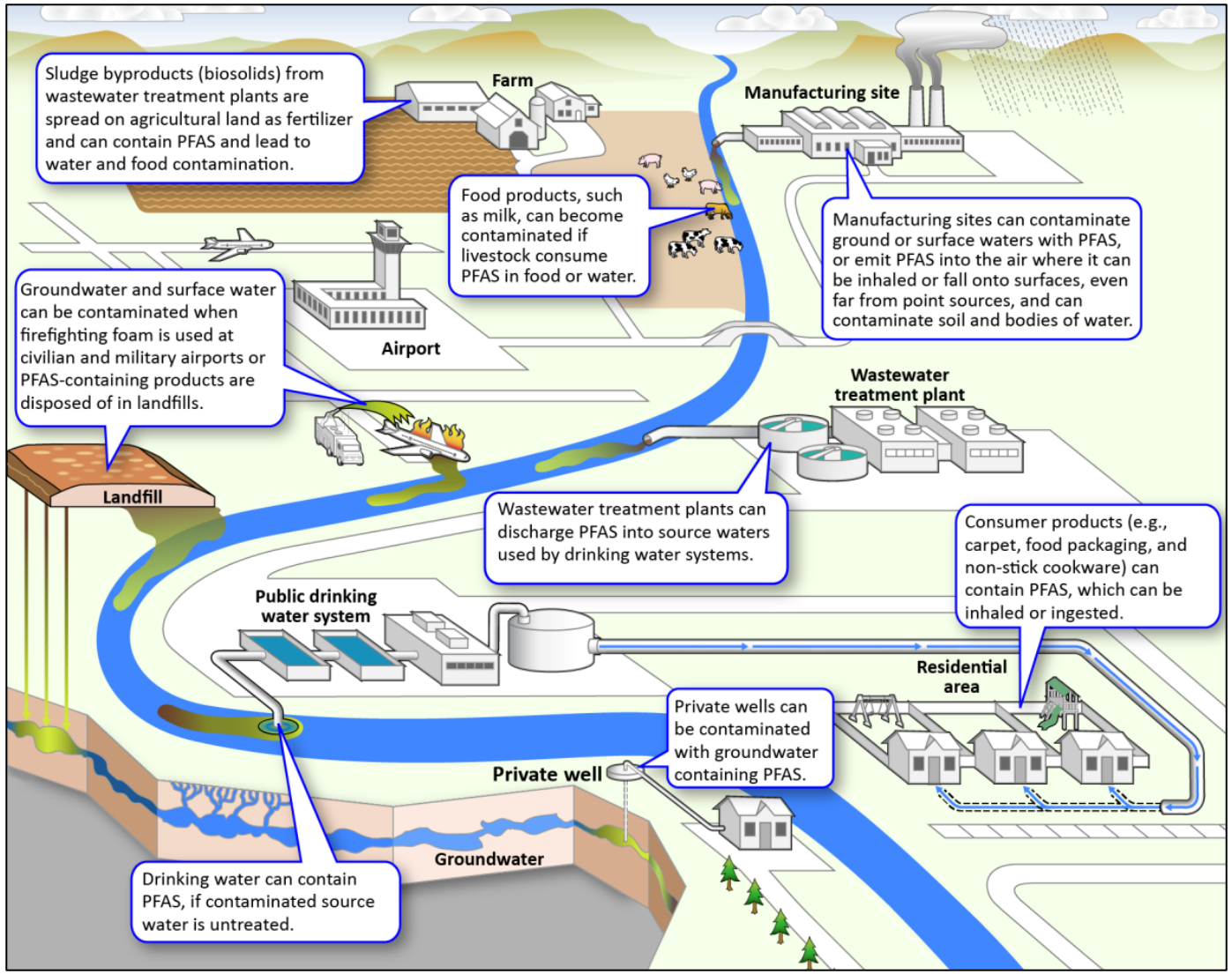
3:3 FTCA

>10,000 chemical structures

EPA's CompTox Chemicals Dashboard

Links to EPA's CompTox Chemicals Dashboard

Sources of PFAS in the Environment



Source: GAO | Technologies for PFAS Assessment, Detection and Treatment (GAO-22-105088)

- Direct release into the environment
  - Use of aqueous film-forming foam (AFFF) in training and emergency response
  - Release from industrial facility
- Landfills and leachates from PFAS-containing products
- Wastewater treatment discharge and biosolids

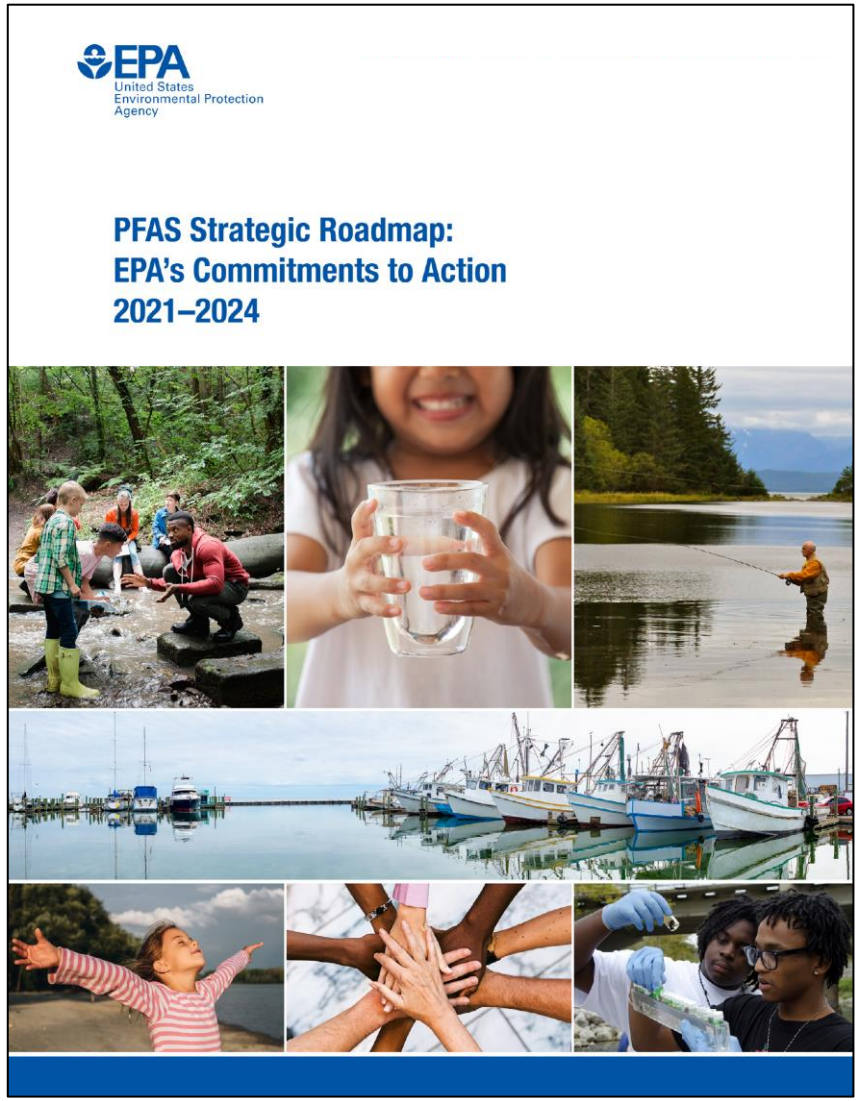
EPA PFAS STRATEGIC ROADMAP

EPA Council on PFAS

- Established in April 2021 by EPA Administrator Michael Regan
- Charged with developing a whole-of-EPA strategy to protect public health and the environment from PFAS
- Released EPA's PFAS Strategic Roadmap in October 2021
- The roadmap:
  - Describes EPA's principles and goals for addressing PFAS
  - Identifies concrete actions EPA is taking to address PFAS

EPA PFAS Strategic Roadmap: Principles

- PFAS contamination presents unique challenges
- EPA's approach to addressing PFAS is centered around the following principles:
  - Consider the lifecycle of PFAS
  - Get upstream of the problem
  - Hold polluters accountable
  - Ensure science-based decision making
  - Prioritize protection of disadvantaged communities



EPA PFAS Strategic Roadmap: Goals

RESEARCH

Invest in research, development and innovation to increase understanding of:

- PFAS exposures;
- Human health and ecological effects; and
- Effective interventions.

RESTRICT

Pursue a comprehensive approach to proactively prevent PFAS from entering air, land and water at levels that can adversely impact human health and the environment.

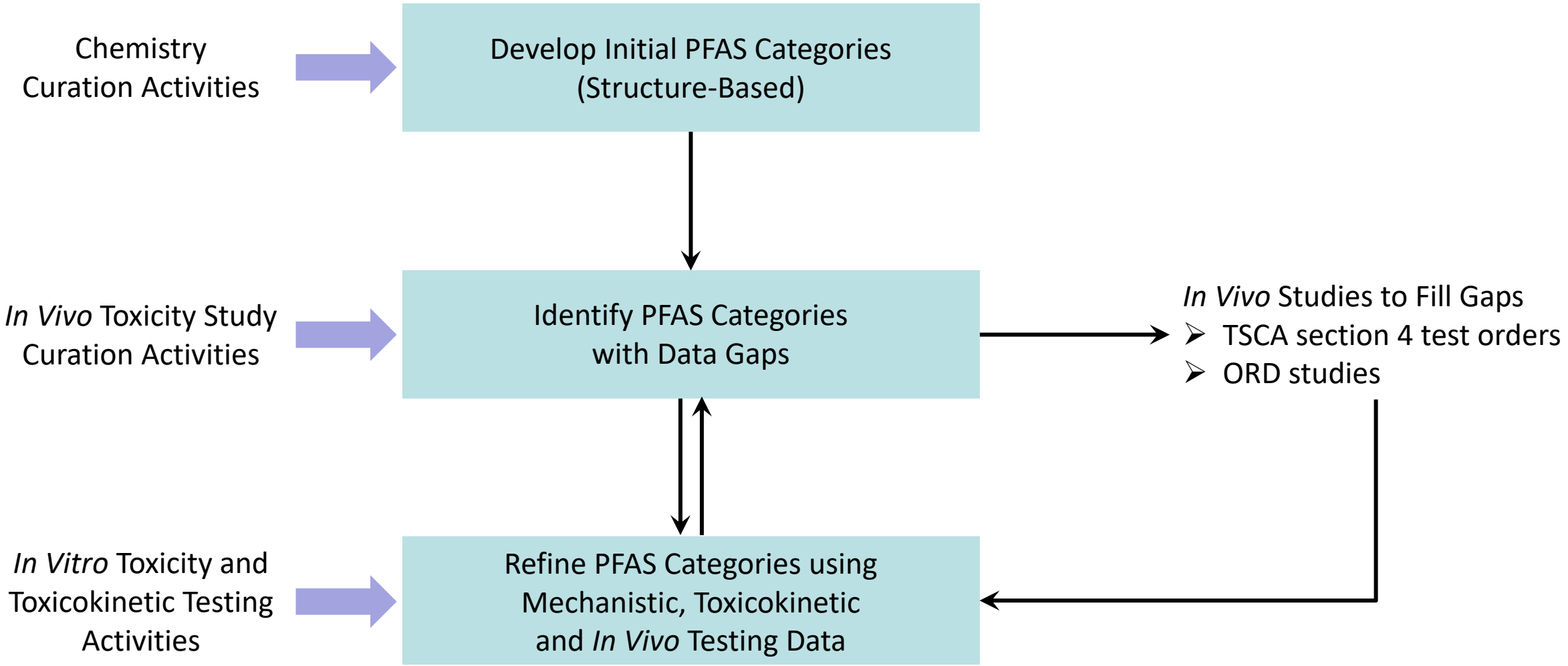
REMEDIATE

Broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems.

Key Actions: Ensuring Chemical Safety

Deepen our understanding of PFAS categories through the National PFAS Testing Strategy – *released October 2021*	**RESEARCH** **RESTRICT**
Strengthen EPA oversight over both new and existing PFAS – *summer 2022 and ongoing*	**RESTRICT**
Collect data and improve reporting of how PFAS are used and released – *winter 2022*	**RESEARCH** **RESTRICT**
Establish a PFAS voluntary stewardship program – *ongoing*	**RESTRICT**
Reduce PFAS in federal procurement – *ongoing*	**RESTRICT**

PFAS Categories for Toxicity Testing



Key Actions: Protecting Our Water

Set enforceable limits for PFOA and PFOS in drinking water – *proposed rule fall 2022*	RESTRICT
Improve PFAS drinking water data and information through monitoring and health advisories – *ongoing*	RESEARCH
Develop technology-based PFAS limits for industrial dischargers – *ongoing*	RESTRICT
Address PFAS in Clean Water Act permitting, analytical methods, water quality criteria, fish advisories – *ongoing*	RESEARCH RESTRICT
Evaluate risks of PFAS in biosolids – *2024*	RESEARCH

Environmental Measurement

Reliable analytical methods are needed to identify and measure PFAS in air, water and land

Recent Accomplishments

Air

- OTM-45 (air emissions; 2021)

Water

- EPA Method 533 (drinking water; 2019)
- EPA Method 537.1 (drinking water; 2018/2020)
- SW-846: Method 8327 (wastewater, groundwater, surface water; 2021)
- Draft Method 1633 (water, solids, tissue; 2021)

"Total PFAS"

- Draft Method 1621 (wastewater; 2022)

Current & Ongoing Efforts

Air

- Develop methods for additional PFAS in air emissions

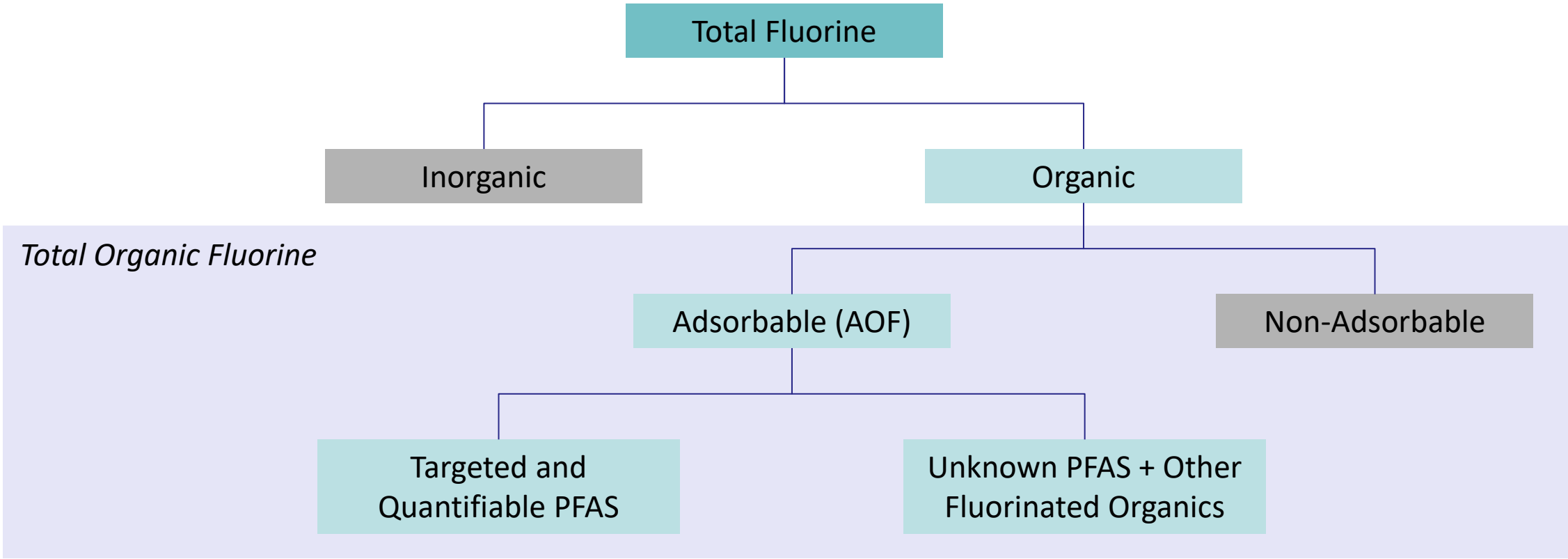
Water / Solids / Tissue

- Support multi-laboratory validation of Draft Method 1633 and Draft Method 1621
- Initiate multi-laboratory validation of draft PFAS leaching methods

Other Methods

- Develop "total PFAS" methods
- Refine non-targeted analysis methods

“Total PFAS:” Adsorbable Organic Fluorine



- Targeted PFAS methods need commercially-available standards; thus, not all PFAS in samples may be detected
- “Total PFAS” methods may be useful in screening samples for PFAS

Key Actions: Cleaning Up Contamination and Addressing Air Emissions

Develop regulations to designate PFAS as CERCLA hazardous substances – *proposed rule soon*	REMEDIATE
Take regulatory action to tackle PFAS under RCRA – *ongoing*	RESTRICT REMEDIATE
Update guidance on PFAS destruction and disposal – *fall 2023*	RESEARCH RESTRICT
Build the technical foundation for potential Clean Air Act regulation – *ongoing*	RESEARCH RESTRICT

Destruction and Disposal

Data on end-of-life management approaches are needed to inform risk management decisions

Recent Accomplishments

Thermal Destruction

- PFAS Thermal Treatment Database (2022)
- Low temperature thermal treatment of gas-phase fluorotelomer alcohols by calcium oxide (2021)

Innovative Destruction Approaches

- Developing innovative treatment technologies for PFAS-containing wastes (2022)
- Supercritical water oxidation as an innovative technology for PFAS destruction (2022)

Current & Ongoing Efforts

Thermal Destruction

- Evaluate destruction efficacy
- Identify products of incomplete combustion

Innovative Destruction Approaches

- Evaluate destruction efficacy of innovative approaches
- Identify products of incomplete destruction

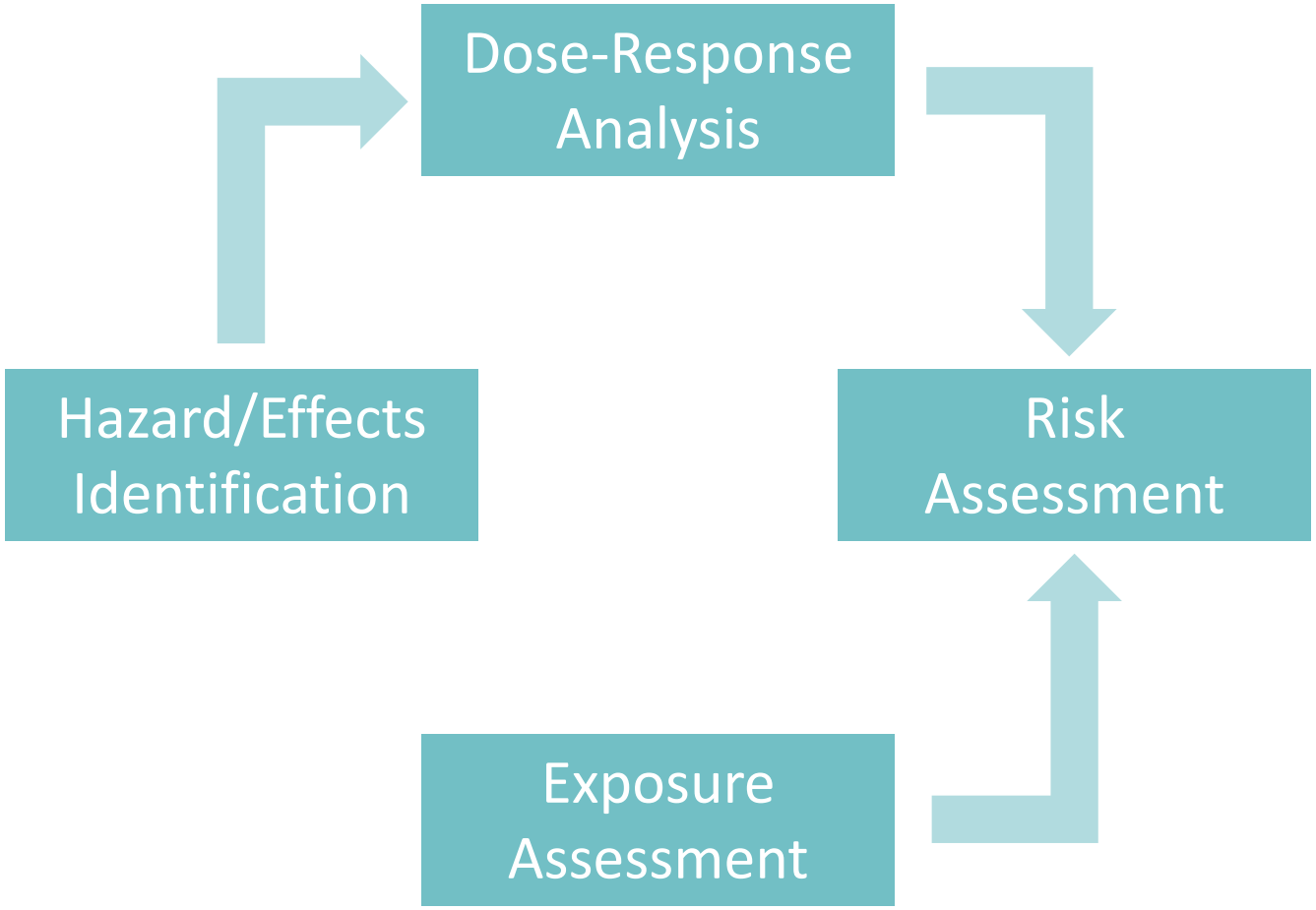
Landfills

- Evaluate PFAS in landfill leachate

Key Actions: Research and Development

Develop and validate methods and approaches to detect and measure PFAS in the environment – *ongoing*	**RESEARCH**
Advance the science to assess human health and environmental risks from PFAS – *ongoing*	**RESEARCH**
Evaluate and develop technologies for reducing PFAS in the environment – *ongoing*	**RESEARCH**

Understanding PFAS Risk



Research Needs

- Human health toxicity and toxicokinetic studies
- Ecotoxicity and bioaccumulation studies
- Occurrence studies
- Fate and transport studies
- Exposure studies

Research Approaches

- Data curation
- Toxicity testing
- Toxicity assessments
- Modeling

Human Health Effects: Assessments

Toxicity values are needed to inform risk analysis, risk management decisions and risk communication

CARBOXYLIC ACIDS
Increasing chain length ↓

SULFONIC ACIDS
Increasing chain length ↓

GEN-X →

PFAS	Chemical Formula	Toxicity Value?
PFBA	C_3F_7COOH	Draft
PFHxA	$C_5F_{11}COOH$	Draft
PFOA	$C_7F_{15}COOH$	Yes (2016)
PFNA	$C_8F_{17}COOH$	2023*
PFDA	$C_9F_{19}COOH$	2022*
PFBS	$C_4F_9SO_2OH$	Yes (2021)
PFOS	$C_8F_{17}SO_2OH$	Yes (2016)
PFHxS	$C_6F_{13}SO_2OH$	2023*
HFPO-DA	$C_3F_7–O–C_2F_4COOH$	Yes (2021)

** Estimated timing for draft assessment*

Updates underway to inform drinking water regulation

Ecological Effects

Bioaccumulation and ecotoxicity data are needed to inform ecological hazard assessments and benchmark development

Recent Accomplishments

Bioaccumulation

- Evaluation of published bioconcentration and bioaccumulation factors (2021)
- Integrative computational approaches to inform relative bioaccumulation potential of PFAS across species (2021)

Ecotoxicity

- Understanding the dynamics of physiological changes, protein expression and PFAS in wildlife (2022)
- Tissue-specific distribution of legacy and novel PFAS in juvenile seabirds (2021)

Current & Ongoing Efforts

Bioaccumulation

- Evaluate and develop approaches and data (e.g., partitioning, metabolism) to predict bioaccumulation

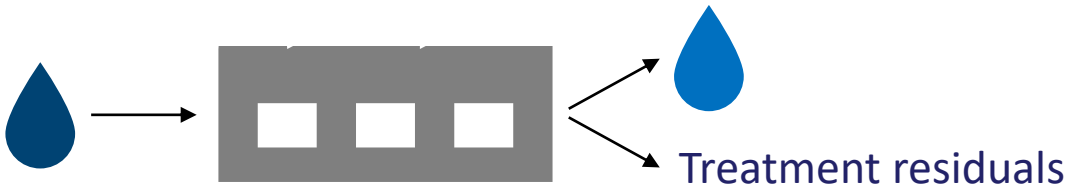
Ecotoxicity

- Update the ECOTOX Knowledgebase
- Use new approach methods (NAMs) to prioritize and categorize data-poor PFAS for further toxicity testing
- Develop approaches to support predicting effects of untested PFAS in different species (e.g., adverse outcome pathways)

Reducing PFAS in the Environment

Water Treatment

Goal: Remove or reduce PFAS in drinking water and wastewater



Example Technologies

Drinking water – Granular activated carbon (GAC), ion exchange resin, reverse osmosis (RO)
Wastewater – Sedimentation/partitioning, GAC

Recent Accomplishments

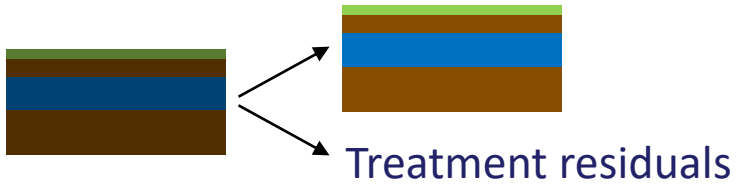
- Modeling PFAS removal using GAC for full-scale system design (2022)

Ongoing Efforts

- Update the Drinking Water Treatability Database
- Determine fate and transformation in conventional wastewater treatment

Site Remediation

Goal: Remove or reduce PFAS at contaminated sites (e.g., in soil, sediment, groundwater)



Example Technologies

Soil excavation, stabilization, pump and treat

Recent Accomplishments

- Remediation and mineralization processes for PFAS in water: A review (2021)
- Investigation of an immobilization process for PFAS contaminated soils (2021)

Ongoing Efforts

- Identify approaches for site characterization and remediation

Cross-Program Actions

ENGAGE

Engage directly with affected communities in every EPA region to hear how PFAS contamination impacts lives and livelihoods.

ENFORCE

Use enforcement tools to identify and address PFAS releases, limit future releases, require actions by responsible parties, and address existing contamination.

COMMUNICATE

Report on EPA's progress and educate the public about PFAS risks.

COORDINATE

Coordinate with federal partners on policy strategies.

Open funding opportunity under SBIR (until Aug. 23): Sensors to detect high-priority contaminants of emerging concern (including PFAS)

EPA SBIR
AMERICA'S SEED FUND FOR ENVIRONMENTAL INNOVATION

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U.S. Environmental Protection Agency

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QUESTIONS?

EPA PFAS Activities – www.epa.gov/pfas

PFAS Research and Development – www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas