PFAS and New Mexico

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PFAS Primer

- Developed in the 1940’s for industrial and consumer use.
- Carbon-fluorine (C-F) is the strongest single bond in nature.
- Long Chain PFAS (8–7> C-F bonds) typically industrial types
  - Typically utilized in specialized settings (e.g. fire fighting foams)
- Short Chain PFAS (7–6< C-F bonds) typically consumer types
  - Typically persistent and ubiquitous (e.g. everyday items and exposure)

PFAS Primer, PFAS Family

“Overview of the major families of PFAS (per- and polyfluoroalkyl substances), including: PFAAs (perfluoroalkyl acids),

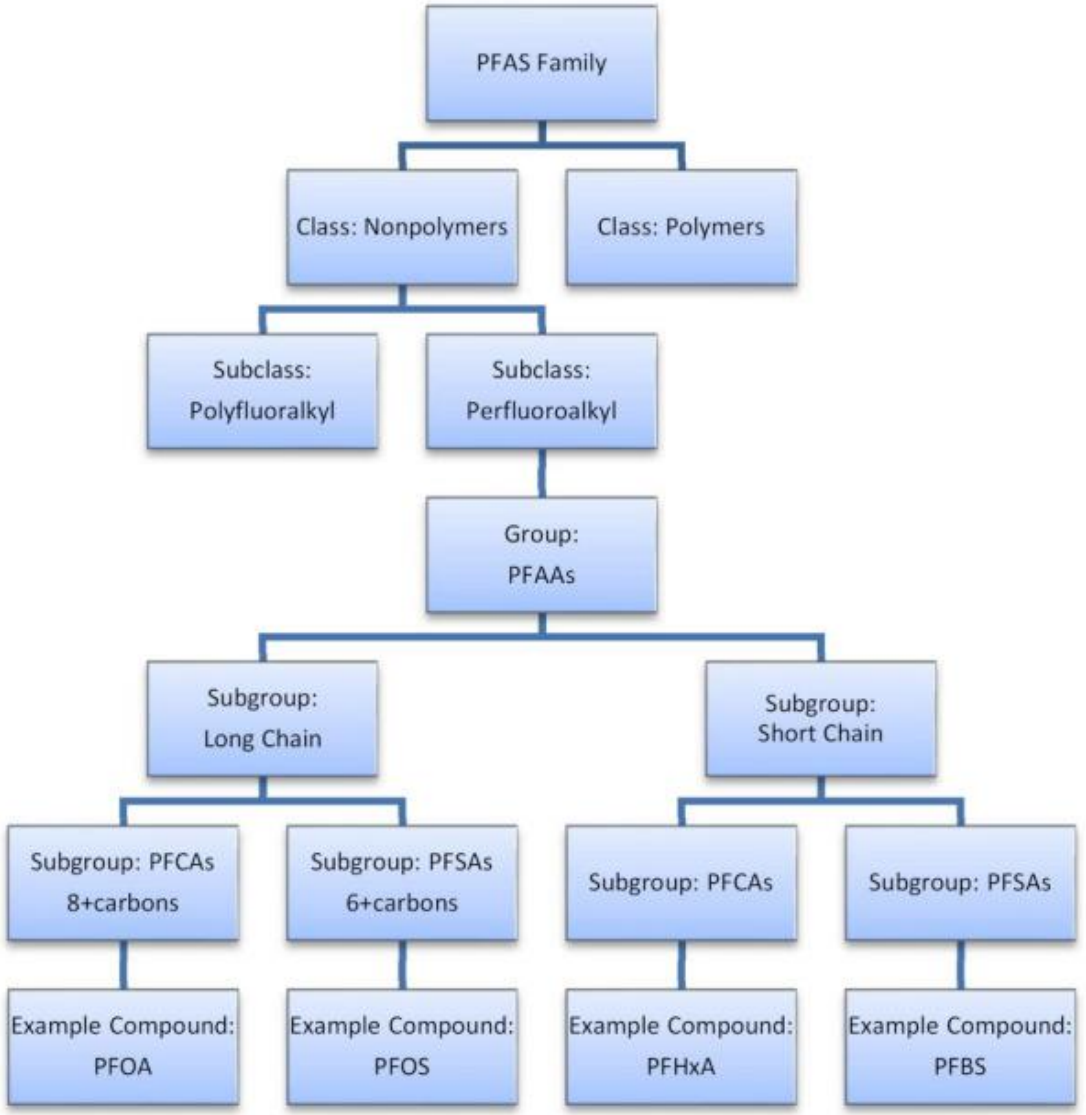
8 or more carbon PFCAs (perfluoroalkyl carboxylic acids/perfluoroalkyl carboxylates), PFOA (perfluorooctanic acid),

6 or more carbon PFSAs (perfluoroalkane sulfonic acids/perfluoroalkyl sulfonates), PFOS (perfluorooctane sulfonate/perfluorooctane sulfonic acid),

6 or fewer carbon PFCAs (perfluoroalkyl carboxylic acids/perfluoroalkyl carboxylates), PFHxA (perfluorohexanoate/perfluorohexanoic acid),

5 or fewer carbon PFSAs (perfluoroalkane sulfonic acids/perfluoroalkyl sulfonates), and PFBS (perfluorobutane sulfonate/Perfluorobutane sulfonic acid).”

(Brennan, et al., 2021)



Where are PFAS found?

Nearly everywhere:

- Waterproof products.
- Oil proof products.
- Non-stick products.
- Textiles including carpets and clothing.
- Health and beauty products such as dental floss, shampoos, lotions.
- Medications and medical devices, etc. (Personal Risk/Cost Benefit Analysis- does the benefit outweigh the risk?)
- Food wrappers, compostable bags, freshwater fish.
- Significant repercussions for the recreation industry given the prevalence of PFAS on textiles and gear and their toxic loading into the environment.

Where are PFAS found?

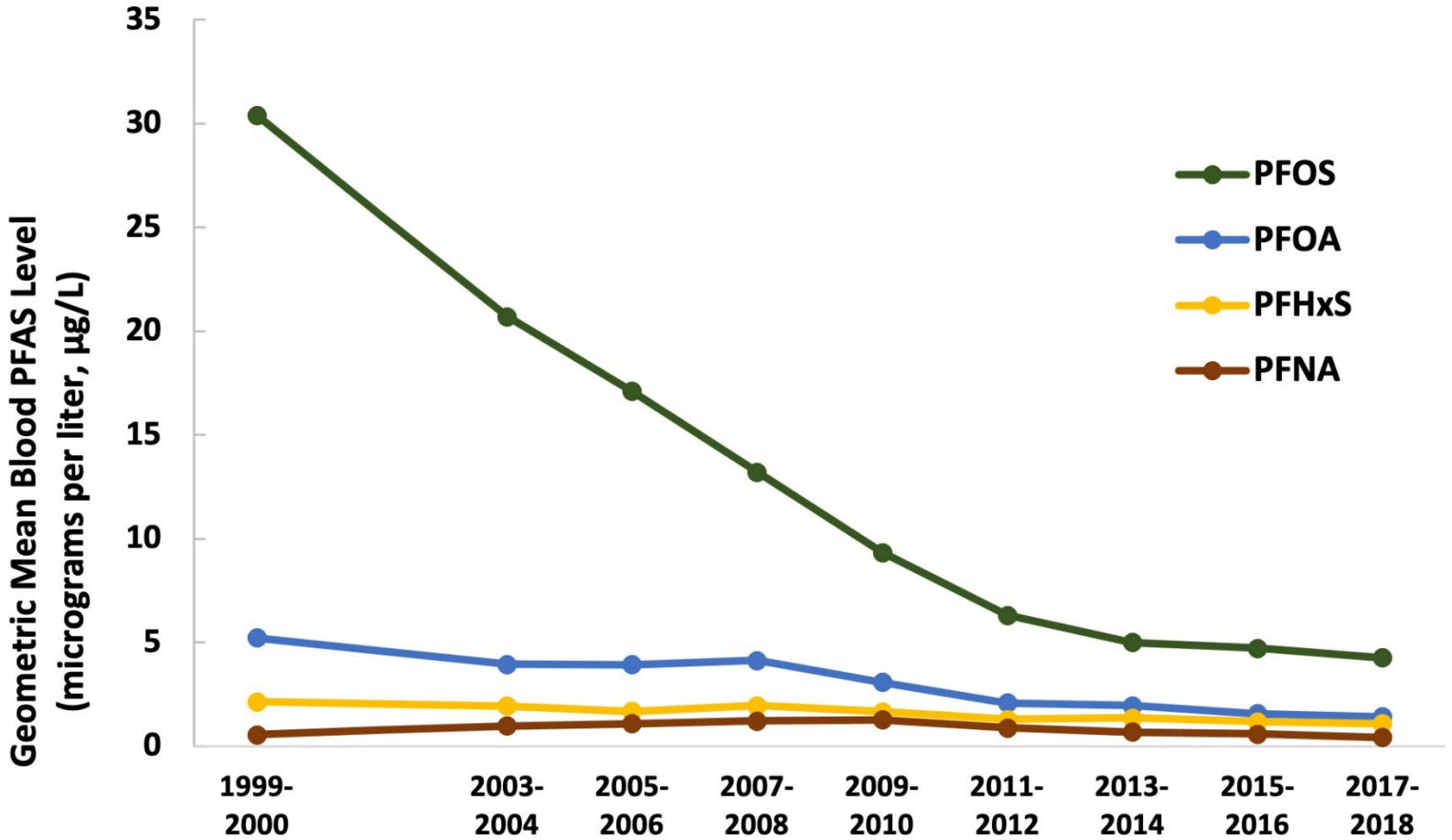
Nearly everywhere:

- Firefighting foams.
- Protective gear.
- Electronics.
- Industrial applications.
- Agriculture.

Where are PFAS found?

In over 90% or more of U.S. Citizens

- Be aware of types and levels of PFAS.
- Numbers are decreasing nationally as PFAS are being phased out.

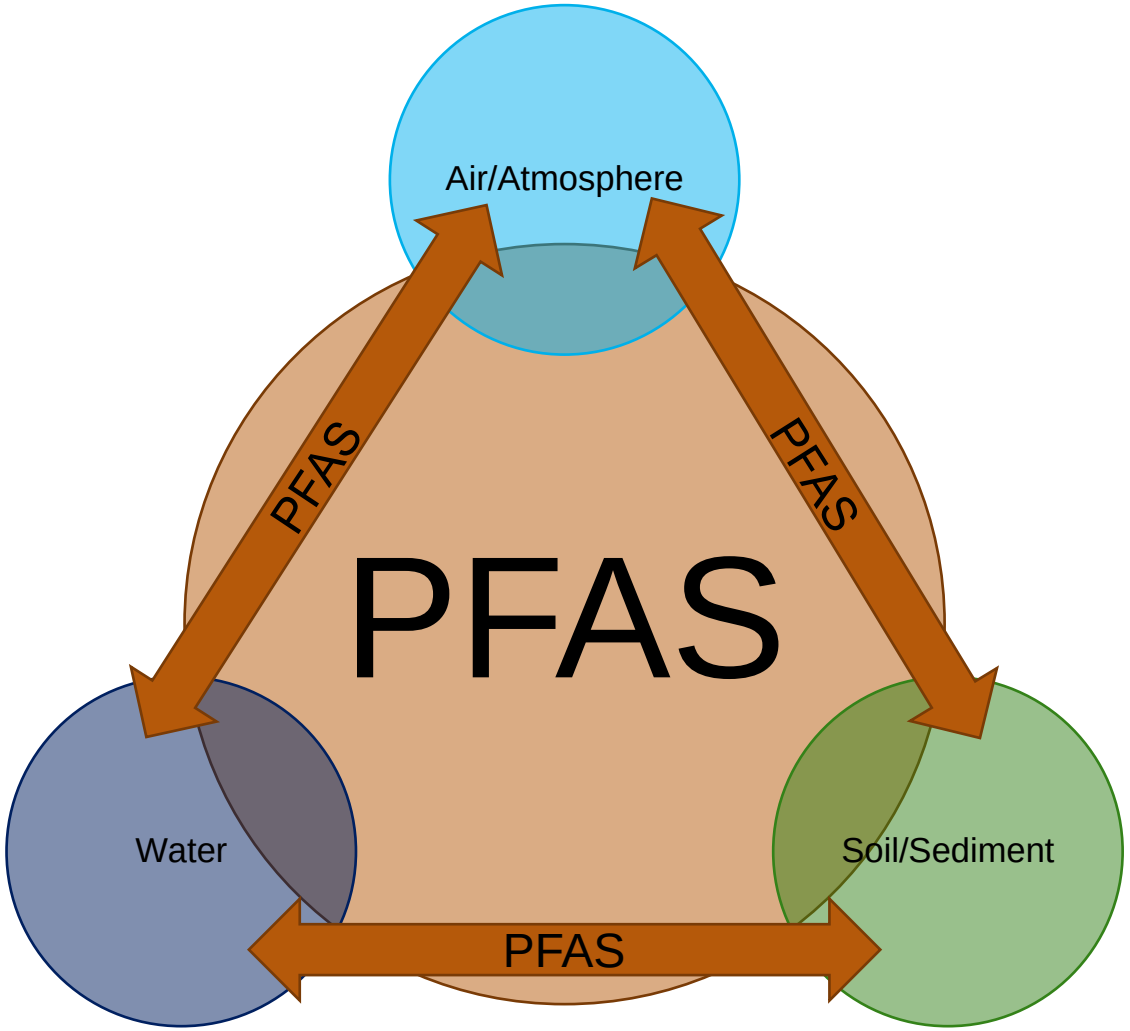


Data Source: Centers for Disease Control and Prevention. National Report on Human Exposure to Environmental Chemicals, Biomonitoring Data Tables for Environmental Chemicals

PFAS Environmental Cycling, Fate & Transport

"The physical and chemical properties of PFAS, along with biogeochemical conditions of soil and aquifer systems, control fate and transport of these substances in surface and subsurface environments. Fate and transport of PFAS is complex due to their surfactant nature."

(Longmire, 2023)



PFAS Primer, Fate & Transport

- “Carbon-fluorine (C-F) is the strongest single bond in nature.
- Small, highly electronegative F atoms effectively shield C atoms from chemical reactions.
- No biotic and abiotic degradation of perfluoroalkyl acids (PFAAs) under natural conditions.
- PFAAs thermally dissociate only under high temperatures (>500^{o}C).
- Anions of PFAAs are stable under very acidic to circumneutral pH.
- Anions of PFAAs interact and adsorb onto positively-charged adsorbents under acidic pH.
- Transport of PFAAs in groundwater is controlled by pH, redox, organic carbon content, chain length, and hydrophilic functional groups (sulfonate, carboxylate).”

(Longmire, 2023)

PFAS Fate and Transport

"The physical-chemical properties of PFAS, and the influence of these properties on PFAS fate and transport within environmental media, are critical in determining how these compounds behave after they are released. To date, our understanding of PFAS fate and transport has relied largely on assumptions based on these physical-chemical characteristics, even though the specific parameter values have proven challenging to estimate; however, there is an increasing amount of lab- and field-derived data that has improved the empirical basis for understanding PFAS fate and transport."
(ITRC, 2024b)

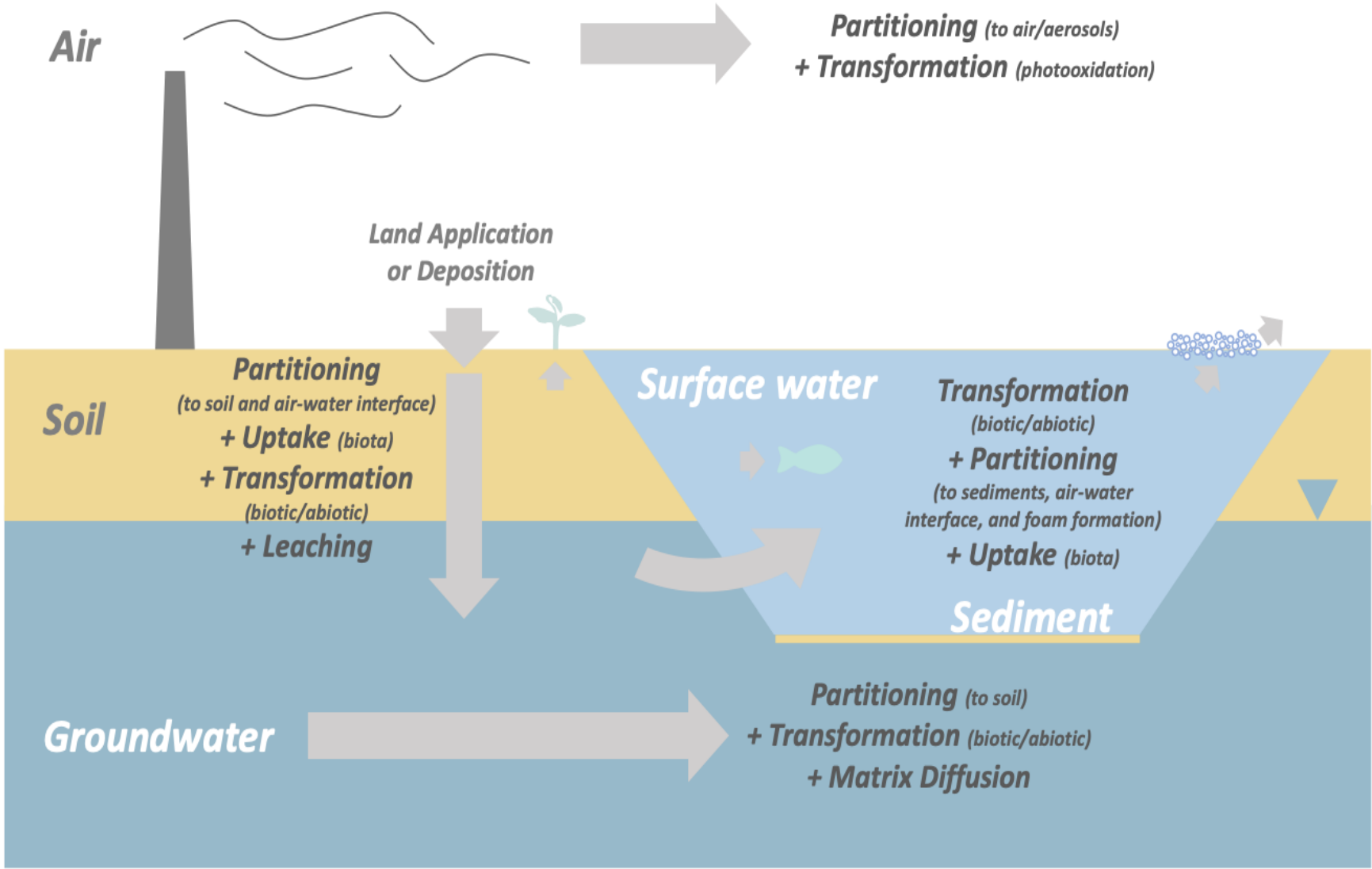


Image: Fate and transport processes relevant for PFAS.
Source: *D. Adamson, GSI. Used with permission by ITRC and members.*

Exposure Pathways

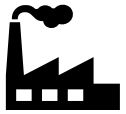
Ingestion and Inhalation:

- Water

- Food

- Air particles

- Aerosolized soils and dust

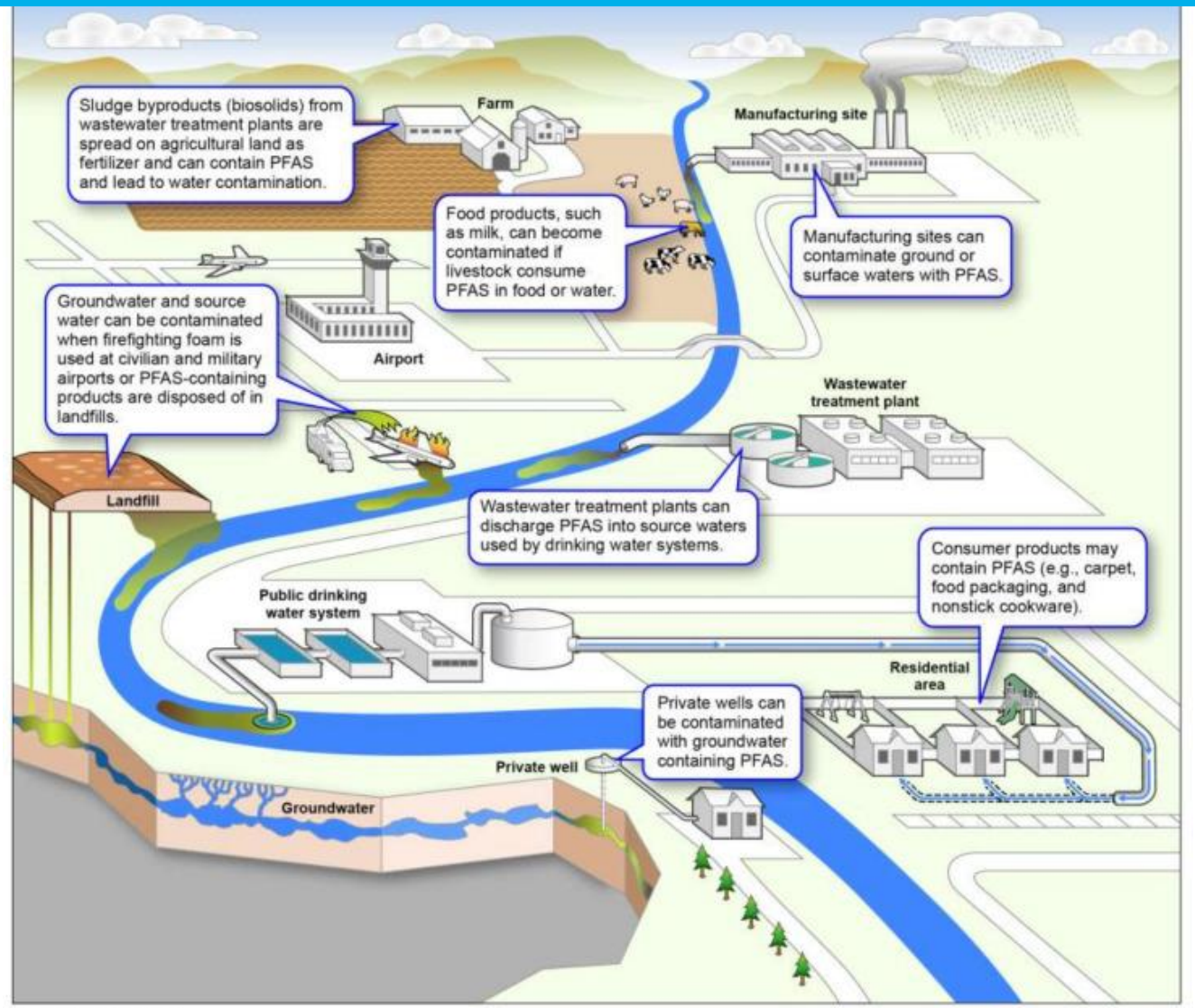


- Industrial emissions

Exposure Pathways

Common pathways PFAS may enter the environment:

(Government Accountability Office, 2021)



Federal and State Regulations

- Hazardous Substance under CERCLA/Superfund
  - Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), codified in 42 U.S.C. Chapter 103
- Safe Water Drinking Act
  - National Primary Drinking Water Act 40 CFR Parts 141 and 142
- Clean Air Act
  - Request from several states to include PFAS in Section 112 for PFOA, PFOS, GenX, PFNA
- Toxic Substances and Reporting Act (TSCA) Section 8(a)7
  - Manufacturers and importers of PFAS and PFAS-containing articles from any year since 2011 must electronically report information on PFAS uses, production volumes, disposal, exposures, and hazards.
- New Mexico Administrative Code (NMAC) 20.6.2
  - Ground and Surface Water Protection Regulations

2024 EPA Safe Water Drinking Act Regulations

Compound	Final MCLG	Final MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (ppt) (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFHxS	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
HFPO-DA (commonly known as GenX Chemicals)	10 ppt	10 ppt
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index	1 (unitless) Hazard Index

Public and Environmental Health Concerns

- Blood testing
  - To understand the types and levels, and to establish a baseline within a community.
- Clinical guidance
  - National Academies of Sciences, Engineering, and Medicine. (2022). *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up*
- There is not currently a 1:1 cause and effect of the type of PFAS and their direct effects.
  - Those studies are ongoing.
- Agency for Toxic Substance and Disease Registry
- Cancer studies
  - University of New Mexico Tumor Registry and the New Mexico Department of Health
- Biouptake studies
  - Fish study **(Pickard, et al., 2022)**

La Cieneguilla, New Mexico

- Industrial PFAS found in private ground water wells used for:
  - Drinking and cooking
  - Agriculture
  - Other household use
- NMED is conducting an investigations near:
  - Santa Fe National Guard
  - Santa Fe Airport Aviation and Support Facility.

La Cieneguilla, New Mexico

- Amigos Bravos has been granted funding from the Santa Fe Community Foundation to aid the investigation where those funds are to be applied directly and solely in those untested wells in the community of La Cieneguilla.
  - This funding will aid the public and NMED in understanding more about where the PFAS plume is within the ground water. These funds will only cover about 20 wells.
- Illness and Disease in La Cieneguilla
  - Small community, and a high rate of illness and disease
  - Have requested a cancer study with the NMDOH and UNM Tumor Registry.
    - They will begin research on the entire census tract for the La Cienega Valley.
  - The community can petition the ATSDR to do a public health survey
    - The public has since 2023 but so far it hasn’t been successful.
  - Blood testing similar to that of the Clovis community would be of help to understand:
    - types and levels of PFAS
    - establish a baseline
    - help to inform/develop next steps

How are they removed or destroyed?

Various Ways:

- Home filtration systems (can be expensive to install, and filters expensive to replace)
  - Sources: Environmental Working Group
  - Sources: Consumer Reports
- Granular activated carbon treatment and filtration.
  - More effective with long-chain PFAS
  - Short-chain PFAS can escape the capture system
- High pressure systems
  - Can remove many types of PFAS
  - According to the EPA, it is better for smaller streams such as home use
- Upgraded Waste-Water Treatment systems with filtration for both long and short chain PFAS

PFAS Destruction Methods

- **Free Radical Gasification:**
  - Responsible Energy Inc. (Canada): Combines thermolytic, photolytic, and free radicals for PFAS destruction.
- **Incineration:**
  - Veolia North America (France): Provides hazardous waste incineration services that can handle PFAS.
  - Clean Harbors (USA): Offers incineration solutions for PFAS-contaminated materials.
- **Electrochemical Oxidation:**
  - AECOM/Aquatech (USA): Provides electrochemical oxidation services for PFAS destruction.
  - Aclarity (USA): Specializes in electrochemical oxidation technologies for PFAS remediation.
  - Axine Water Technologies (Canada): Offers electrochemical oxidation solutions for destroying PFAS.
  - Ovivo (Canada): Markets electrochemical oxidation systems for PFAS destruction.
  - Gradiant (USA): Markets advanced oxidation processes and electrochemical oxidation for PFAS destruction.

- **Supercritical Water Oxidation (SCWO):**
  - 374Water (USA): Markets SCWO technology specifically designed to destroy PFAS.
  - General Atomics (USA): Develops and markets SCWO systems for PFAS destruction.
  - Revive Environmental/Battelle (USA): Markets the PFAS Annihilator, which uses SCWO technology for PFAS destruction.
- **Thermal Plasma:**
  - Synergen Met (Australia): Provides thermal plasma solutions for PFAS destruction.
  - Heartland Water Technology, Inc. (USA): Develops thermal plasma technology for PFAS destruction.
- **Cold Plasma:**
  - Onvector LLC (USA): Specializes in cold plasma technology for PFAS remediation.
  - DMax Plasma (USA): Develops cold plasma solutions for PFAS destruction.

- **Photolytic Degradation**
  - Claros Technologies Inc. (USA): Specializes in UV-photochemical methods for PFAS destruction.
  - Coflux Purification (USA): Develops photolytic degradation technology for PFAS remediation.
- **Sound Waves:**
  - Arcadis (Netherlands): Utilizes sound wave technology for PFAS remediation.
  - RemWell (USA): Develops sound wave technology for PFAS destruction.
- **Hydrothermal Alkaline Treatment (HALT):**
  - Aquagga Inc. (USA): Engages in research and application of hydrothermal alkaline treatment for PFAS destruction.
- **Electron-Beam:**
  - Fermilab (USA): Involved in the research and application of electron-beam technology for PFAS destruction

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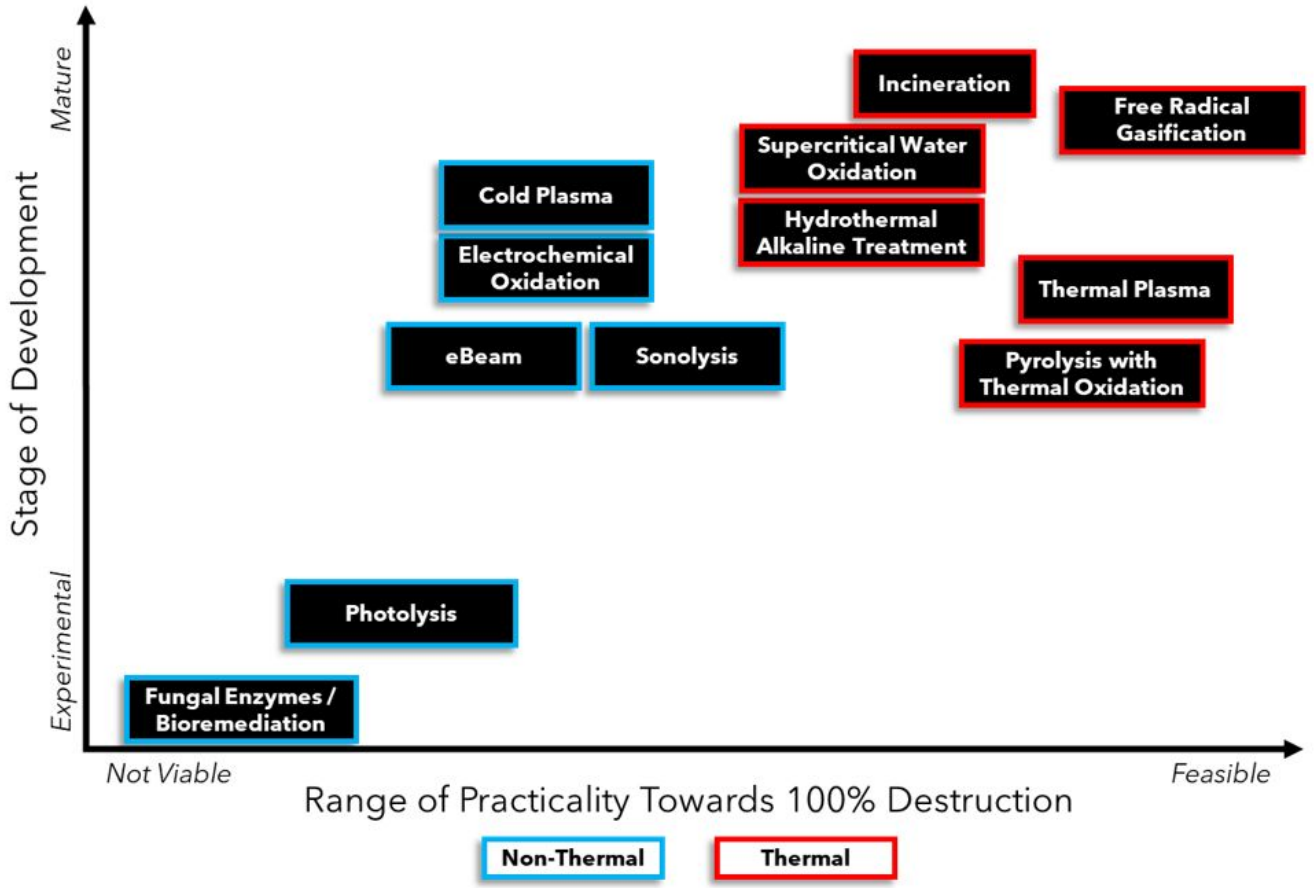
PFAS Destruction Methods

Depending on the process temperature, PFAS destruction technologies can be classified into:

- Thermal Destruction
- Non-Thermal Destruction



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New Mexico Pathways to Regulation

- New Mexico Toxic Pollutant Working Group
- New Mexico Administrative Code 20.6.2 (NMAC)
  - Surface and Water Quality Regulations
  - Cancer Risk
    - More protective
    - Petition change from 10^{-5} to 10^{-6}
  - Narrative Standards
    - More protective
    - The narrative standards instead of numerical standards allow NM regulations to be more flexible in consideration of new scientific evidence and primes NM to pivot in the face of those changes.

Thank you.

Resources

- Environmental Working Group (EWG)
  - https://www.ewg.org/areas-focus/toxic-chemicals/pfas-chemicals
- EWG Interactive Map: PFAS Contamination
  - https://www.ewg.org/interactive-maps/pfas_contamination/
- Interstate Technology and Regulatory Council (ITRC)
  - https://pfas-1.itrcweb.org/
- EPA
  - https://www.epa.gov/pfas
- Agency for Toxic Substances and Disease Registry (ATSDR)
  - https://www.atsdr.cdc.gov/pfas/index.html
- NAS Guidance on PFAS Exposure, Testing, and Clinical Follow-Up

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