US EPA’s Research on PFAS

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US EPA Cincinnati Facility
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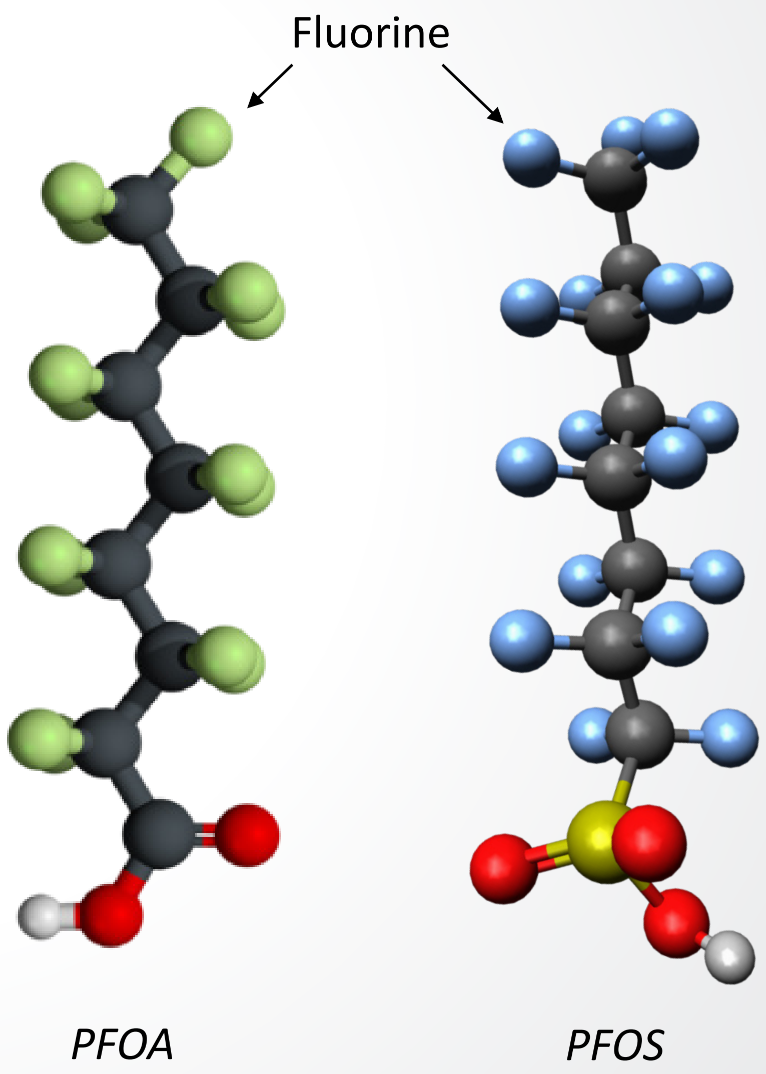
Presentation Overview

- Analytic Methods
- Drinking Water
- Landfills
- Biosolids
- Incineration
- Technical Support



Drinking Water Sample Methods

Method 537.1

- Covers 18 PFAS analytes
- Posted November 2018
- https://www.epa.gov/water-research/epa-drinking-water-research-methods

Method 533

- Covers 25 PFAS analytes: 14 of the 537.1 analytes and 11 unique to this method
- Second laboratory review in progress
- Expected publishing date: October 2019

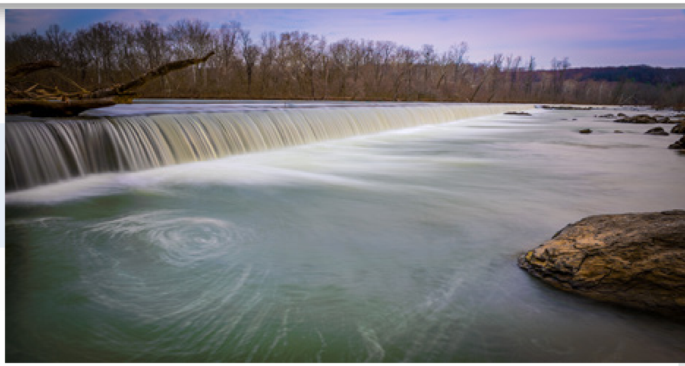
Non-Drinking Water Sample Methods

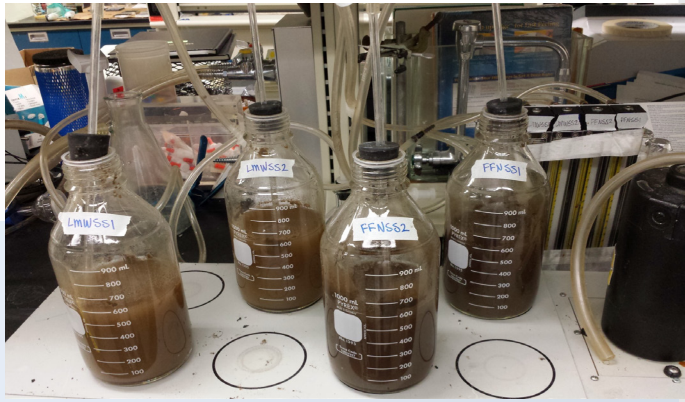
SW-846 Draft Method 8327—Direct Injection

- 24 PFAS (including all 18 target analytes in EPA Method 537.1)
- EPA is currently reviewing public comments along with Prep Method 3512
- https://www.epa.gov/hw-sw846/validated-test-method-8327-and-polyfluoroalkyl-substances-pfas-using-external-standard

CWA 1600 Draft Method
SW-846 Draft Method 8328—Isotope Dilution

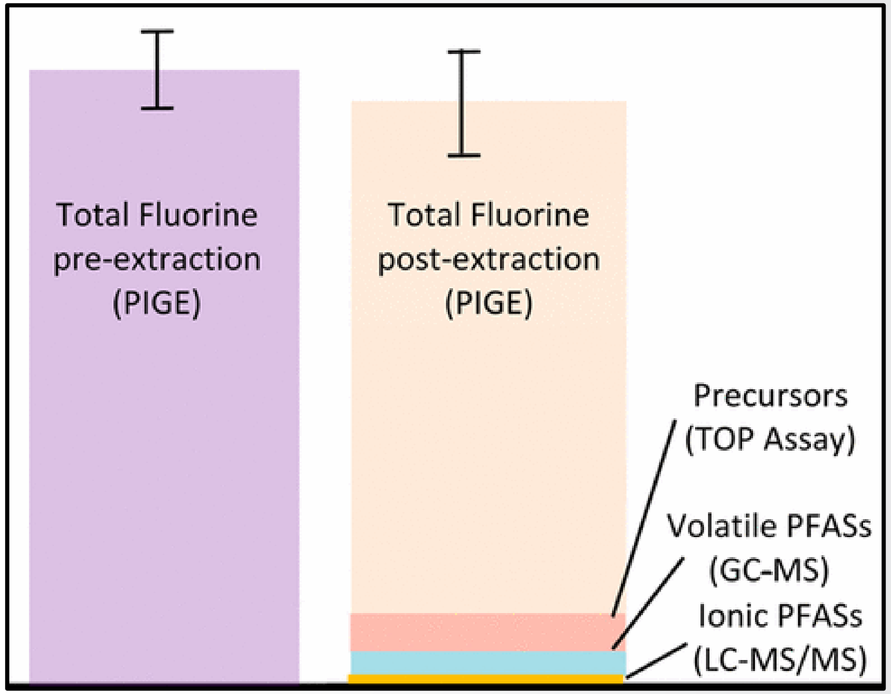
- Same 24 PFAS as 8327 plus Gen-X
- Undergoing single lab validation
- Multi-lab validation and public comment to follow





Emerging Techniques for "Total" PFAS

- Total oxidizable Precursor Assay (TOP Assay)
- Total Organofluorine analysis using combustion ion chromatography (TOF-CIC)
- Particle induced gamma-ray emission (PIGE)
- Suspect Analysis using LC-Quadrupole Time of Flight MS (LC-QToF-MS)



Drinking Water Treatment

Problem: Utilities lack treatment technology cost data for PFAS removal

Action:

- Gather performance and cost data from available sources (DOD, utilities, industry, etc.)
- Conduct EPA research on performance of treatment technologies including home treatment systems
- Update EPA's Treatability Database and Unit Cost Models
- Connect EPA's Treatability Database to EPA's Unit Cost Models for ease of operation
- Model performance and cost, and then extrapolate to other scenarios
    - Variable source waters
    - Variable PFAS concentrations in source water
    - Different reactivation/disposal options
    - Document secondary benefits
    - Address treatment impact on corrosion
- Evaluate reactivation of granular activated carbon (GAC)

Impact: **Enable utilities to make informed decisions about cost-effective treatment strategies for removing PFAS from drinking water**

Drinking Water Treatment

Publically Available Drinking-Water Treatability Database

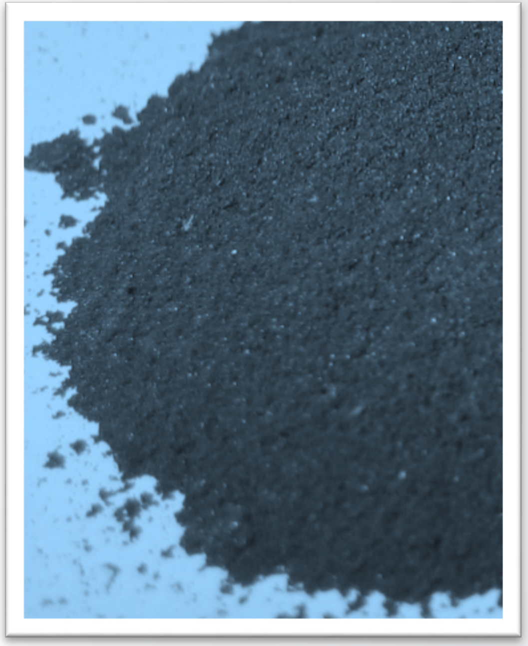
Interactive literature review database that contains over 65 regulated and unregulated contaminants and covers 34 treatment processes commonly employed or known to be effective (thousands of sources assembled on one site)

Currently available:

- Nitrate
- Perchlorate
- Microcystins
- All PFAS found in the literature including PFOA, PFOS, Gen-X

http://iaspub.epa.gov/tdb/pages/general/home.do

Future Work: Activated Carbon Reactivation



Problem: There is a liability concern regarding the reactivation of spent granular activated carbon (GAC)

- What percentage of the adsorbed PFAS are released from the carbon and how much remains after reactivation?
- What conditions are optimal for reactivation (temperature, time, reactor configuration)?
- What impact does reactivation have on the performance of off-gas incineration treatment?
- Are PFAS released after reactivation with incineration off-gas treatment?

Action: Conduct bench- and full-scale research on reactivation processes

- Impact of time and temperature
- PFAS reactions during reactivation
- Impact of post incineration
- Post GAC evaluations to determine PFAS remaining on carbon (fate)

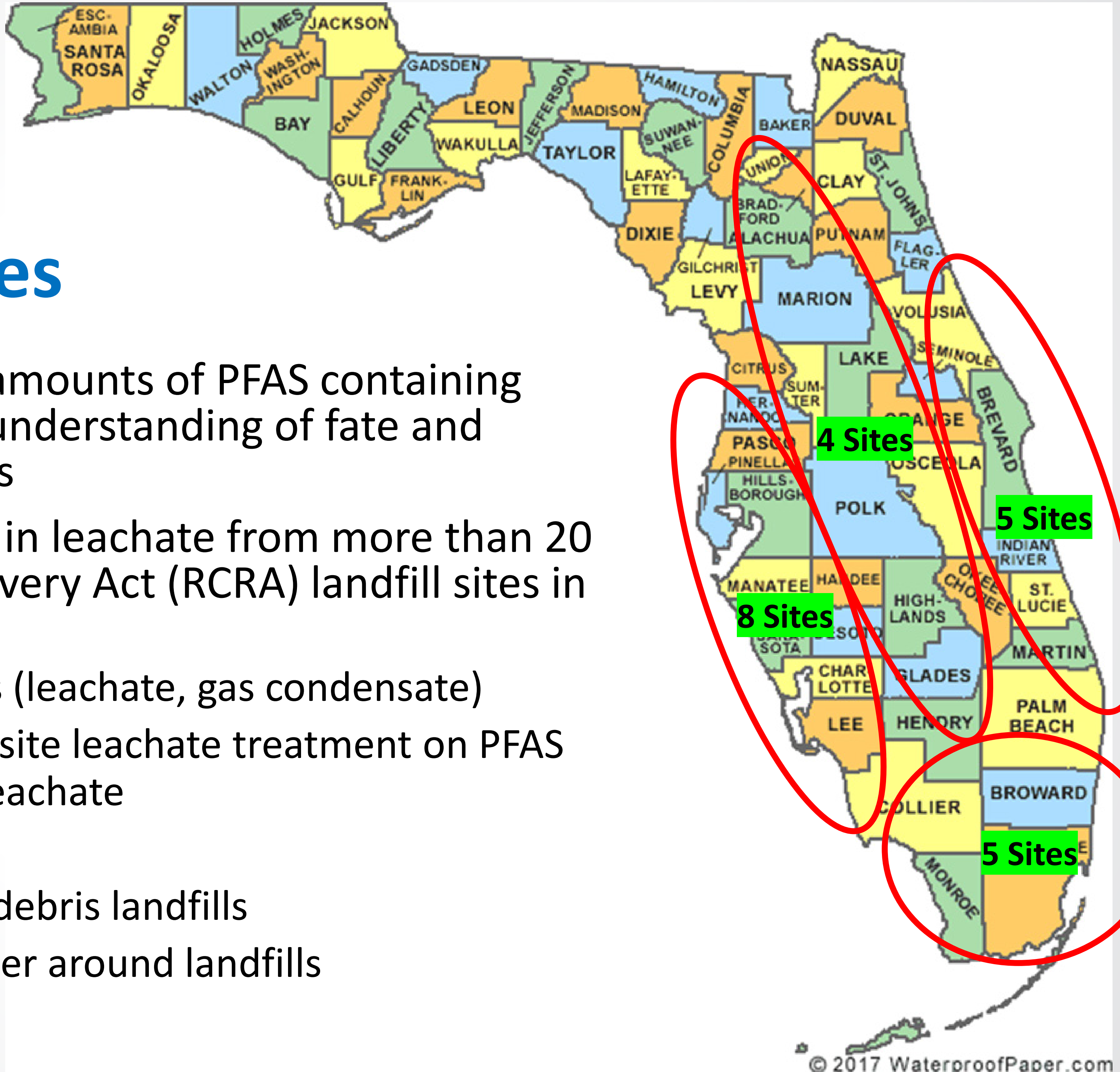
EPA

RCRA Waste Facilities

Problem: Landfills receive large amounts of PFAS containing waste, there is a general lack of understanding of fate and transport in landfill environments

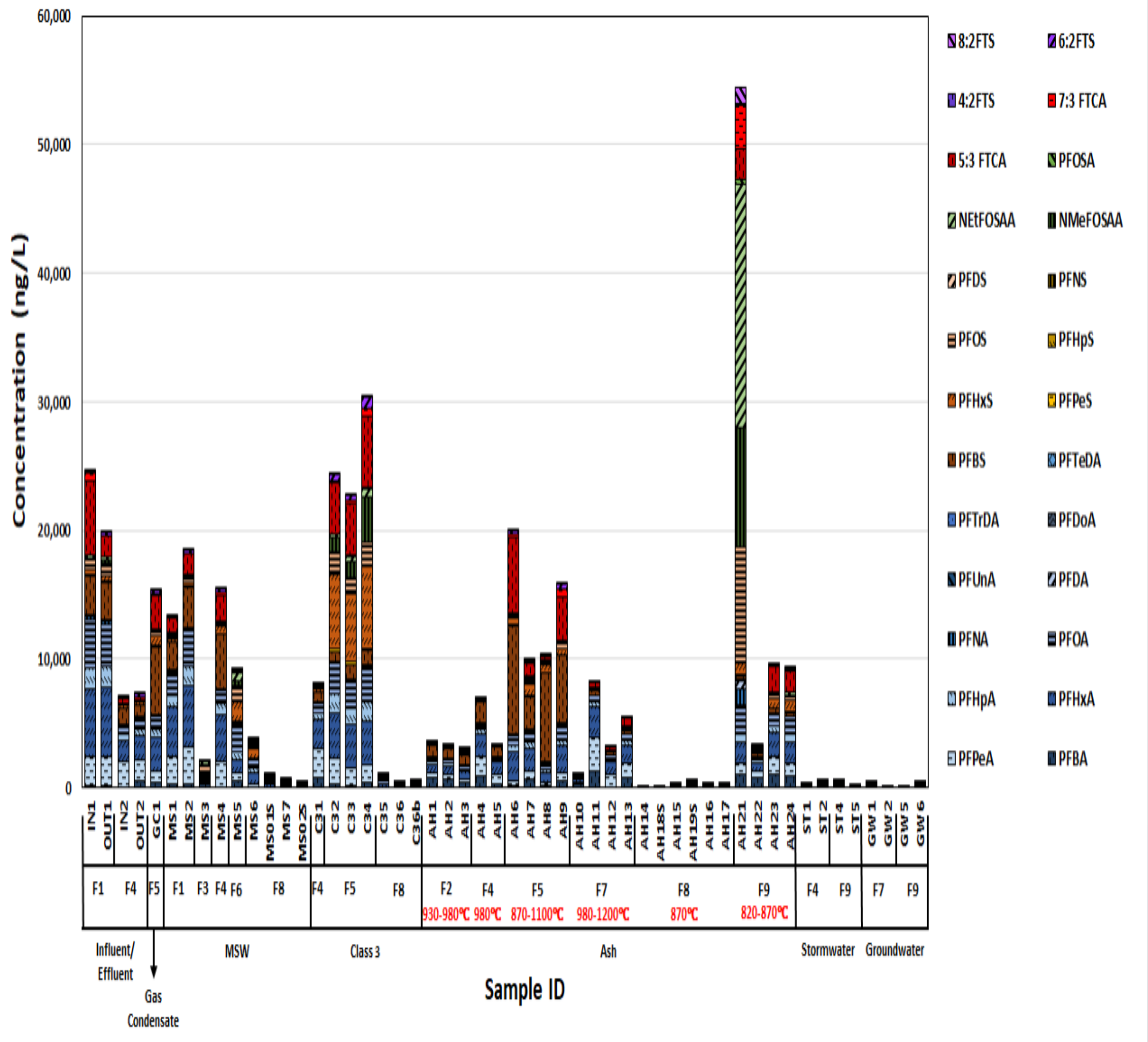
Action: Collect and analyze PFAS in leachate from more than 20 Resource Conservation and Recovery Act (RCRA) landfill sites in Florida. The sites include:

- Municipal solid waste landfills (leachate, gas condensate)
    - Examine the impact of onsite leachate treatment on PFAS concentration in landfill leachate
- Ash monofills (leachate)
- Construction and demolition debris landfills
- Groundwater and surface water around landfills



PFAS in Florida RCRA Waste Facilities

- On average, PFAS are more than an order of magnitude higher than 70 ng/L (highest samples were 20-50 ppm)
- Only covers 22 sites to date - there are more than 1,800 solid waste landfills in the U.S.
- Onsite leachate treatment (aeration) was ineffective, as expected
- Other trends are difficult to discern and are dependent on accurate description of what is contained in each cell



Future Work: RCRA Waste

- Leachate sampling to expand to other regions of the U.S.
  - In discussion with Waste Management Inc. and the Solid Waste Association of North America (SWANA) to provide site access for sample collection
  - Include total oxidizable precursors analysis
- Fate, transport and transformation of PFAS in simulated landfill environments
- PFAS transport through earthen and man-made liners
- PFAS concentration in municipal solid waste (MSW) ash
- PFAS flow and concentrations through the MSW recycling processes including composting

Land Application of Biosolids

Problem: Lack of knowledge regarding end-of-life management of PFAS-containing consumer and industrial products

Action:

- Characterize end-of-life PFAS disposal streams (e.g. municipal, industrial, manufacturing, recycled waste streams)
- Evaluate efficacy of materials management technologies (e.g. land application, landfilling, incineration) to manage end-of-life disposal
- Evaluate performance and cost data with collaborators to manage these materials and avoid environmental PFAS releases

Results: Provide technologies, data and tools to manage end-of-life streams

Impact: Responsible officials will be able to manage effectively end-of-life disposal of PFAS-containing products

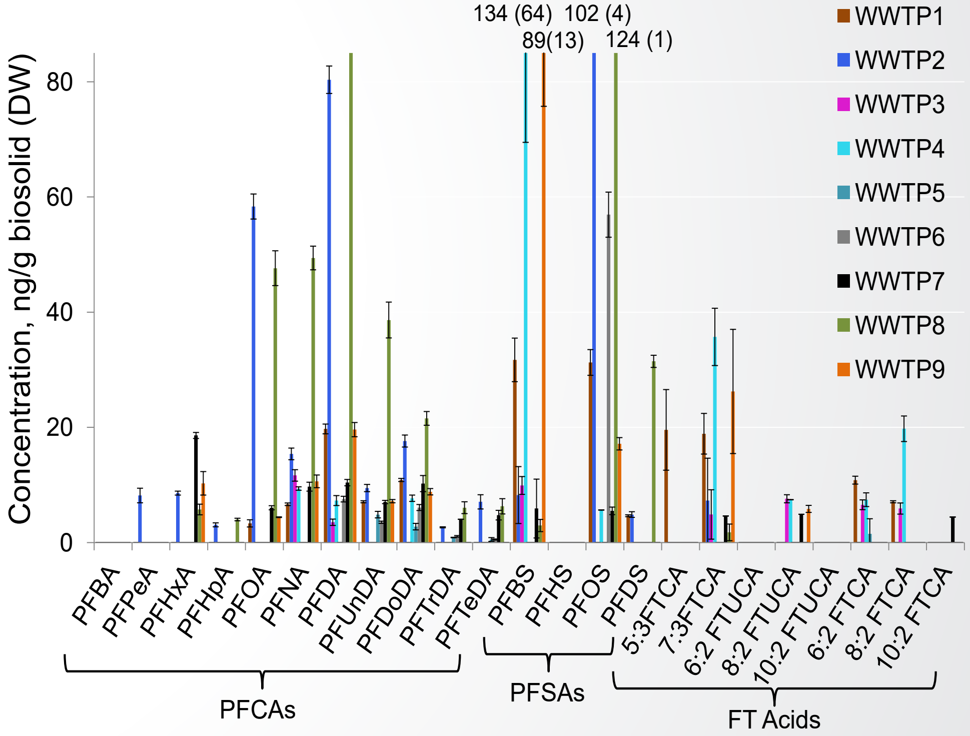
PFAS in Wastewater Residuals

In collaboration with EPA Region 6 (South Central)

Action: Nine wastewater treatment plants were sampled seasonally

- The solids treatment included anaerobic digestion and aerobic digestion
- Solid residuals and effluent were analyzed for PFAAs, precursors, and transformation products.

Results: PFAS and PFAS precursors of varying distributions were found



PFAAs concentrations in biosolids collected during Fall sampling

Land Application of Biosolids:
PFAS uptake into edible parts of plants

In Collaboration with EPA Region 5

Action: A variety of food crops were grown in soil amended with biosolids

- The biosolids contained PFAAs
- PFAA concentrations in edible portion of the plant were measured

Results

- The edible portion had measurable levels of PFOA, among other PFAS
- Data shows that edible crops grown in soil conventionally amended with municipal biosolids uptake selected PFAS to varying degrees but further research is needed to put potential risk in context of all exposures routes

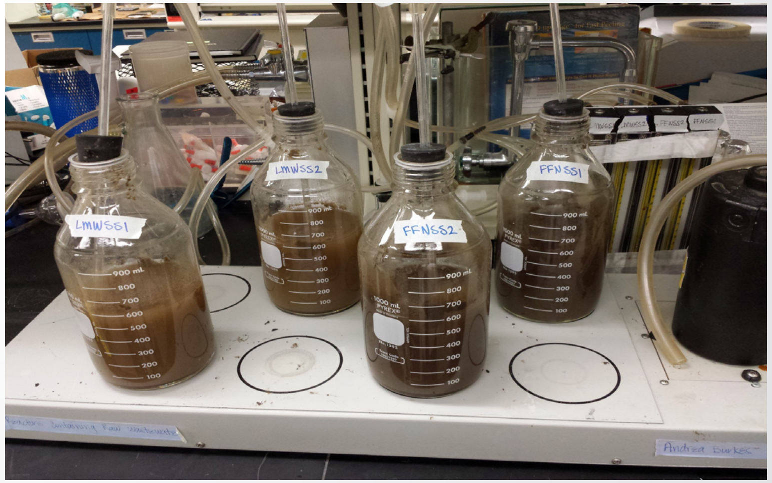
- Blaine, et al (2013). ES&T 47(24): 14062-14069
- Blaine, et al (2014). ES&T 48(14): 7858-7865.

Future Work: Wastewater Treatment

Problem: Wastewater Treatment Plants are a source of PFAS

Action: Develop research to support:

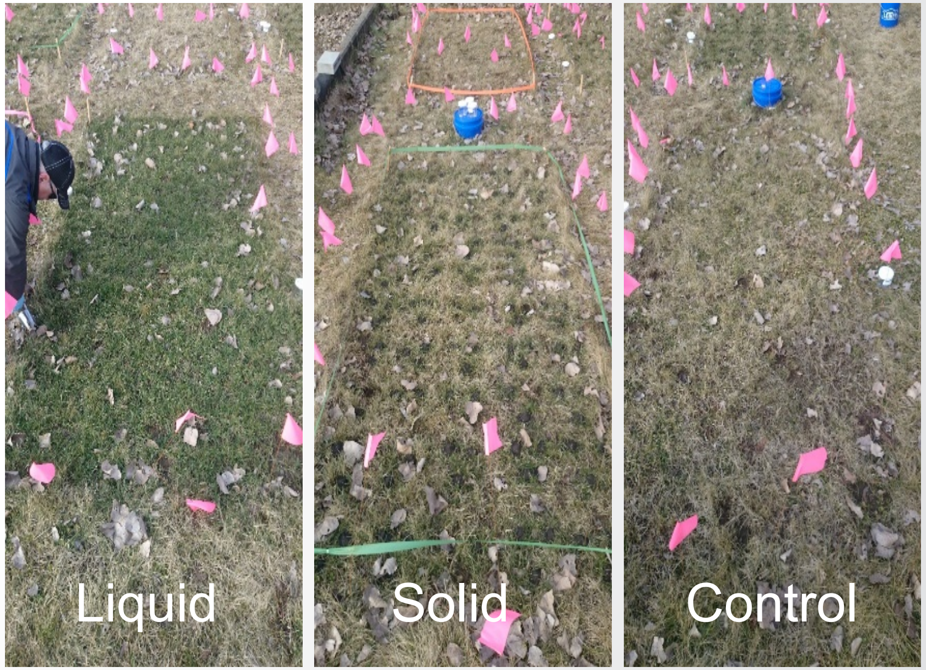
- Analytical methods for the compounds of interest
- Bioassays to better understand if treatments are effective and to identify risks
- Evaluation of WWTP conventional and advanced unit operations to manage contaminants
- Evaluate air emissions from:
    - Activated sludge processes
    - Biosolids heat drying operations
    - Air emissions from incineration processes
- Evaluate wastewater treatment and biosolids treatment.
- Evaluate pretreatment technologies to address “sources”



Future Research: Land Application of Biosolids

Evaluation of land application of biosolids

- Comparisons of biosolids application method (e.g. wet cake, dried solids, liquid, surface or subsurface injection)
- Changing industry and pre-regulation applications
- Operations of the land application sites
  - History of biosolids loading to the land application site
  - Agricultural practice vs. land reclamation sites (high rates of application to fractured soils)
  - Drain tile discharge
  - Plant uptake
- Operational history of facility
- Soil type and depth to groundwater
- Land use changes (e.g. many farm fields have been converted into residential areas and school sites as cities grow)



Incineration Research

Problem: There are many sources of materials that may need to be incinerated

- Manufacturing wastes
- Biosolid sludges
- Municipal waste
- Obsolete flame retardants
- Spent water treatment sorbents - in conjunction with reactivation

What minimum conditions (temperature, time) are needed to adequately destroy PFAS and what are the products of incomplete combustion?

Action: Conduct bench- and full-scale incineration studies and modeling to evaluate:

- Impact of source material
- Impact of temperature on degree of destruction
- Impact of calcium
- PFAS releases from incineration systems

Technical Support

ORD is a resource for regions, states and tribes for the analyses and treatment of PFAS in different media.

Examples:

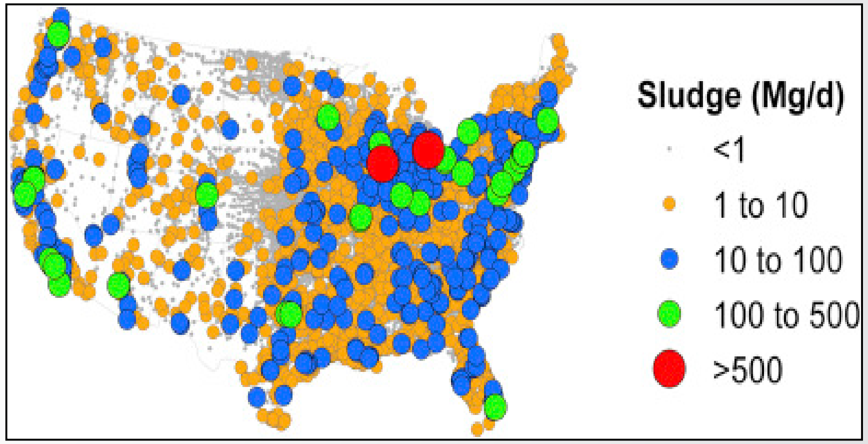
National Sludge Survey and PFAS – Research needs to prepare for the next survey include:

- Improved analytical methods for biosolids and sludges
- Preliminary research to evaluate critical variables: facility size, treatment type, biosolids product methods, wastewater sources – domestic, commercial, industrial, potential PFAS sources

Workshops for Biosolids coordinators from EPA regions, states and tribes. Common questions asked about how PFAS should be handled under CWA include:

- How are PFAS managed during wastewater treatment?
- What technologies are effective for pretreatment of wastewater containing PFAS?
- What levels of PFAS are safe for human and ecological receptors?

ORD Groundwater and Engineering Technical Support Centers – provide technical input to a variety of Superfund sites regarding PFAS issues



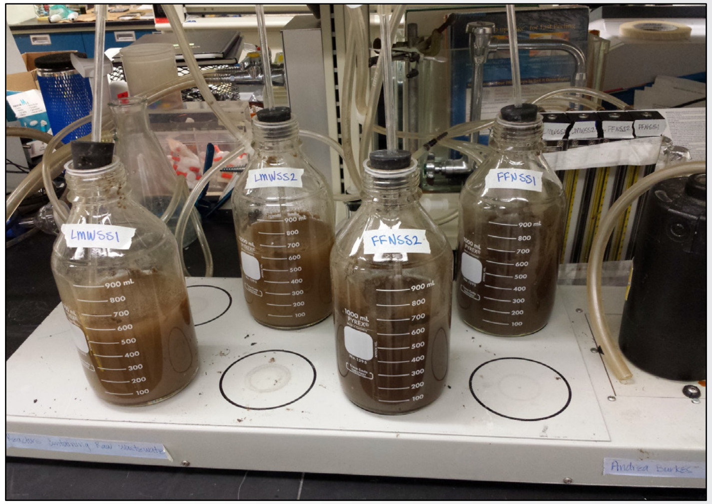
EPA PFAS Data and Tools

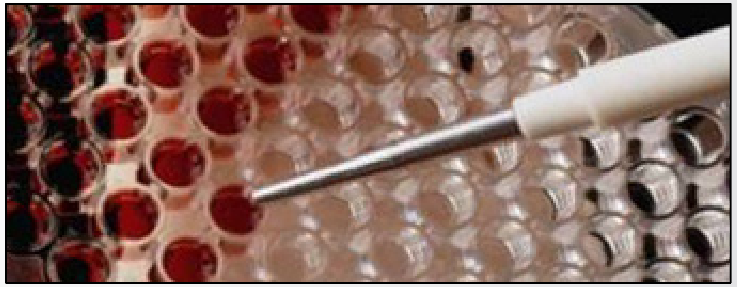
EPA PFAS Data and Tools including the Drinking Water Treatability Database and the CompTox Chemicals Dashboard available:

https://www.epa.gov/pfas

https://www.epa.gov/pfas/epa-pfas-data-and-tools

The EPA PFAS Chemical Library is now available for state partners. The Library is a collection of 430 PFAS, listed here: https://comptox.epa.gov/dashboard/chemical_lists/epapfasinv





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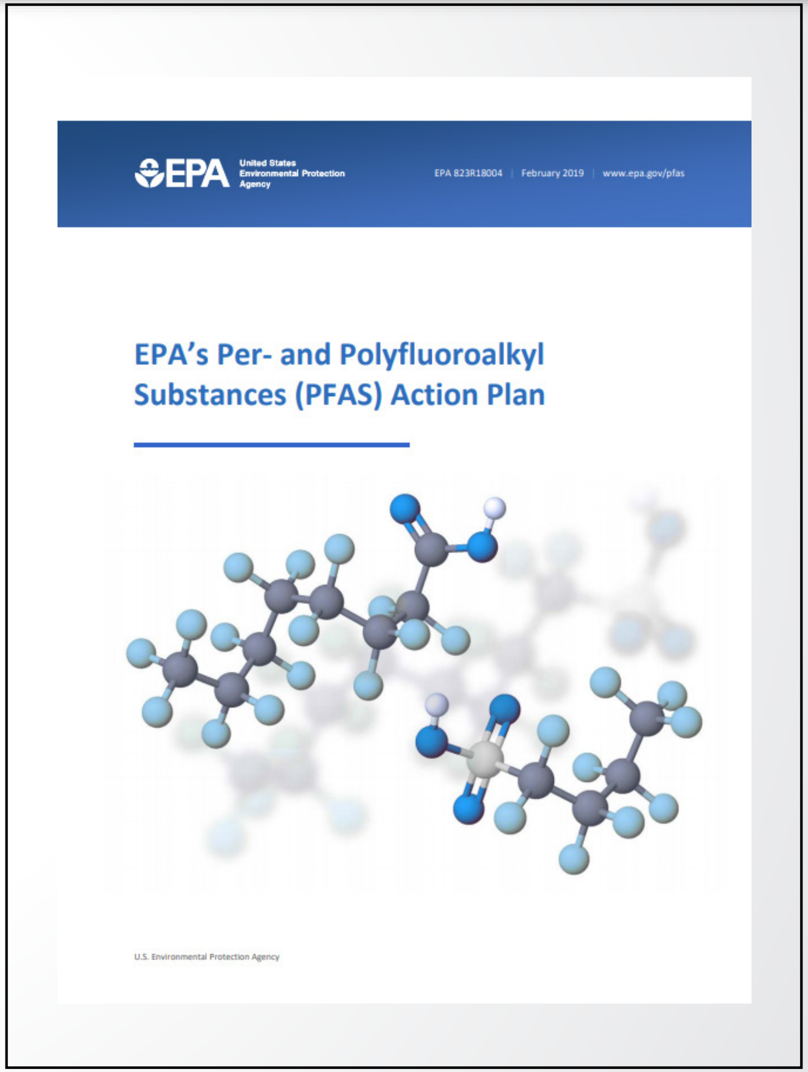
EPA United States Environmental Protection Agency
EPA 823R18004 | February 2019 | www.epa.gov/pfas

EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan

U.S. Environmental Protection Agency