



MUNICIPALITY'S GUIDE TO PFAS CONTAMINATION AND TESTING

THE PROBLEM WITH PFAS

Per- and polyfluoroalkyl substances (PFAS) are a diverse group of synthetic compounds known for their resistance to heat, water, and oil. These properties have made PFAS ideal for use in industrial applications and consumer products, such as food packaging, fire-fighting foams, carpeting, apparel, and upholstery.

Highly stable, PFAS do not readily biodegrade, and they are bioaccumulative, meaning they can build up in the bloodstream and organic tissues. These characteristics can be problematic for human health and the environment. Some PFAS have been linked to adverse health issues, such as low birth weight, hormonal imbalances, and certain types of cancers.

PFAS can have a significant effect on community health. In addition, many current and future PFAS regulations impact municipal operations, including drinking water treatment, wastewater treatment, solid waste management, and more. In this guide, we provide municipalities with vital information to help them keep up to date on the regulatory landscape and the science of PFAS testing and analysis. Here's what you'll find in these pages:

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COMMON ACRONYMS

AFFF – Aqueous Film-Forming Foam (fire-fighting foam)

CERCLA - Comprehensive Environmental Response,
Compensation, and Liability Act

CWA – Clean Water Act

DOD – Department of Defense

EPA – Environmental Protection Agency

FRB – Field Reagent Blank, synonymous with Field Blank (FB)

ITRC – Interstate Technology Regulatory Council

MCL – Maximum Contaminant Level

NPDES – National Pollutant Discharge Elimination System

NPDWR – National Primary Drinking Water Regulations

PFAS – Per- and Polyfluoroalkyl Substances

PFAA – Perfluoroalkyl Acids

PFOA – Perfluorooctanoic Acid

PFOS – Perfluorooctane Sulfonate

PWS – Public Water System

RCRA – Resource Conservation and Recovery Act

SDWA – Safe Drinking Water Act

UCMR – Unregulated Contaminant Monitoring Rule



HOW DO I KNOW IF I HAVE A PFAS PROBLEM?

To understand the potential for PFAS contamination, it's important to understand the sources of PFAS.

INDUSTRY is one of the most common sources of PFAS contamination for most municipalities. At the top of the cycle (Figure 1) are the chemical producers of the PFAS compounds themselves. In the next level down are the many manufacturers who use those compounds in production of their industrial and consumer products.

While chemical companies have voluntarily stopped production of several PFAS in the U.S., such as PFOA and PFOS, thousands of others are still in production. Because PFAS do not break down naturally, contamination can persist in the surrounding area for decades after a plant closes.

AQUEOUS FILM-FORMING FOAM (AFFF) is used to fight chemical fires on ships and in airports, refineries, and other industrial sites. This makes many military installations and commercial airports a common source of PFAS contamination. These sources can also impact downstream vectors such as groundwater.

MUNICIPAL LANDFILLS can be a source of contamination. Since PFAS are unregulated, companies producing PFAS chemicals and manufacturers using them in their production environment have been disposing of contaminated waste from their facilities into municipal landfills for decades. The same is true for consumers who have been using and disposing of products containing PFAS.

Leachate can be a source of PFAS contamination when sent to municipal wastewater treatment plants that are unequipped to remove PFAS.

In addition, municipalities searching for the source of PFAS contamination should look closely at unlined construction and demolition landfills with no leachate collection systems.

WASTEWATER TREATMENT does not typically remove or destroy PFAS and can convert PFAS precursors into PFOA and PFOS. If it receives industrial discharge containing PFAS, a treatment plant not equipped with specialized PFAS treatment technology will pass that contamination through the plant and into its receiving water. In addition, this is especially an issue if the sludge/biosolids produced by these plants are applied for agricultural purposes as fertilizer since PFAS are bioaccumulative.

If your area is or has been home to any of the numerous types of manufacturers that produce or use PFAS, chances are you have some level of contamination in your soil and water supply.

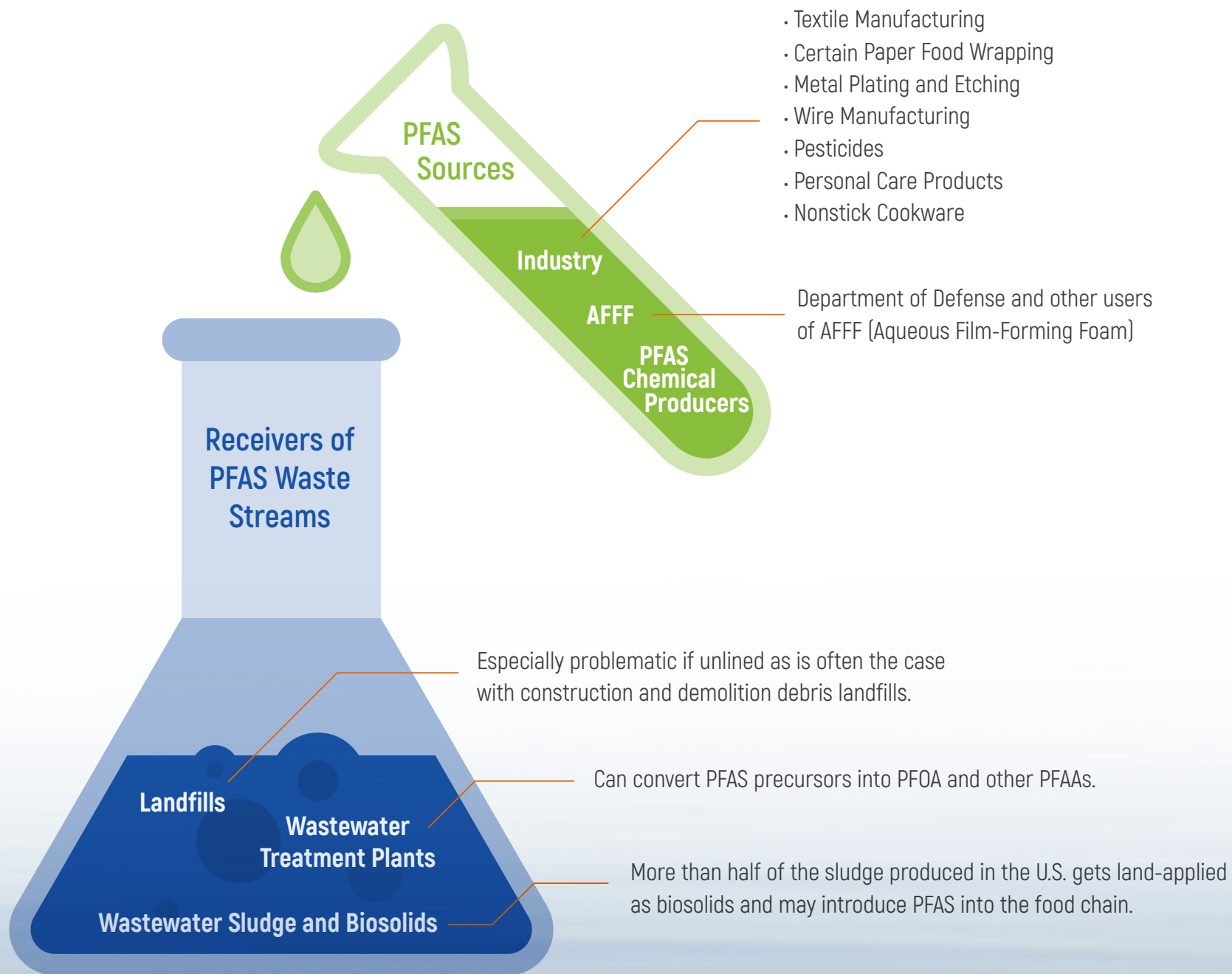


Figure 1 Sources of PFAS Contamination

PFAS RULEMAKING AND REGULATIONS IMPACTING MUNICIPALITY-

The U.S. EPA has prioritized addressing PFAS contamination. The Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) and the National Primary Drinking Water Regulations (NPDWR) are two primary programs impacting community drinking water systems.

UCMR 5

UCMR 5 requires all Public Water Systems (PWS) serving 3300 customers or more, as well as 800 randomly selected smaller systems, to begin testing for 29 PFAS plus lithium in 2023. This more than doubles the number of water systems required to participate compared to previous UCMR requirements. Sampling schedules are based on the number of people served and the source water used.

EPA Test Methods 537.1 and 533 are required to analyze for all 29 PFAS. See the Test Methods section of this guide for more information on these methods. Pace® is an EPA-approved lab for UCMR 5.

National Primary Drinking Water Regulations (NPDWR)

In April of 2024, the EPA announced the first-ever NPDWR limits on six PFAS in the nation's public drinking water systems. Unlike previously issued health advisories, NPDWR limits are legally enforceable.

PFOA and PFOS Maximum Contaminant Levels (MCLs) remain at 4 ppt (parts per trillion) with Maximum Contaminant Level Goals (MCLGs) of zero ppt. PFNA, PFHxS, and HFPO-DA (GenX) now have individual MCLs set at 10 ppt. In addition, PFNA, PFBS, PFHxS, and GenX are assessed using a Hazard Index (HI) calculation that considers the relative toxicities of the various compounds and their combined concentration.

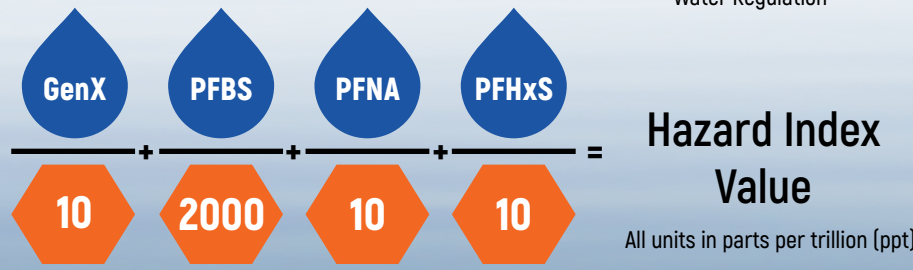
In the graphic below, the water drop represents the concentration of each PFAS in the sample. If the total of all the fractions is equal to or greater than one, the water system exceeds the Hazard Index value. To be considered in violation, the running average of all samples taken in the past twelve months must also be equal to or greater than one.

Chemical	Maximum Contaminant Level Goal (MCLG)	Maximum Contaminant Level (MCL)
PFOA	0	4.0 ppt
PFOS	0	4.0 ppt
PFNA	10 ppt	10 ppt
PFHxS	10 ppt	10 ppt
HFPO-DA (GenX chemicals)	10 ppt	10 ppt
Mixture of two or more: PFNA, PFHxS, HFPO-DA, and PFBS	Hazard Index of 1	Hazard Index of 1
Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.		

The Hazard Index is a tool used to evaluate potential health risks from exposure to chemical mixtures.

*ppt = parts per trillion (also expressed as ng/L)

Source: EPA Fact Sheet, PFAS National Primary Drinking Water Regulation



Source: EPA General Overview Webinar, March 2023



Other Rulemaking Impacting Communities Nationwide

EPA also has a number of other programs focused on PFAS that have the potential to impact communities across the country. A summary of some of the primary actions is provided here, but more details may be found on [PFAS.com/resources/](https://www.epa.gov/pfas/pfas-resources).

CERCLA

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, gives the U.S. EPA broad authority to respond directly to releases or threatened releases of chemicals and compounds that may endanger public health or the environment.

Once a substance is designated hazardous under CERCLA, facilities must report releases that meet or exceed the reportable quantity assigned to these substances. CERCLA grants the EPA the authority to respond directly to these releases. CERCLA also grants the EPA the power to address existing contamination through the Superfund program.

On April 19, 2024, the EPA finalized the rule designating PFOA and PFOS as hazardous substances under CERCLA. In a separate **Enforcement Discretion Policy** document, the agency said it intends to exempt Passive Receivers, those who did not manufacture the PFAS or functionally benefit from it, from enforcement. This includes:

- Community water systems
- Publicly owned treatment works (POTWs)
- Municipal separate storm sewer systems (MS4s)
- Publicly owned/operated municipal solid waste landfills
- Publicly owned airports and local fire departments
- Farms where biosolids are applied to the land

Download our [CERCLA Info Sheet](#) for more details.

Effluent Guidelines Program

In EPA Effluent Guidelines Program Plan 15, the agency announced its intention to set PFAS ELGs (Effluent Limitation Guidelines) for landfill leachate. Plan 15 also calls for a detailed study of PFAS discharge associated with textile mills and on industrial discharges sent to publicly owned treatment works (POTW).

RCRA

The Resource Conservation and Recovery Act (RCRA) focuses on the ongoing management of hazardous waste at currently operating facilities, including the correct treatment, storage, and disposal of hazardous waste to prevent environmental contamination. In February of 2024, the EPA proposed designating nine PFAS as hazardous constituents under RCRA: PFOA, PFOS, PFBS, HFPO-DA (GenX), PFNA, PFHxS, PFDA, PFHxA, and PFBA.

Once finalized, this rule could have a transformative impact on municipal solid waste management operations. For instance, waste facilities may be required to conduct enhanced monitoring of PFAS concentrations, leading to potential changes in waste handling procedures and reporting obligations. Municipal solid waste facilities may also face a greater scrutiny regarding landfill leachate, which often contains PFAS.

NPDES Permitting

The National Pollutant Discharge Elimination System is designed to monitor and control pollutants discharged in the nation's waterways. The majority of states are authorized by EPA to administer their own NPDES permitting program. EPA guidance issued to the states encourages the inclusion of PFAS in wastewater discharge and biosolids in NPDES permitting.

SAMPLE MATRICES

While drinking water has long been the focus of state and federal regulatory action, other matrices are receiving increased attention. Pace® provides testing services for a wide variety of matrices to help its customers assess and mitigate risks as well as remain compliant with new rules and regulations.

 Drinking water

 Surface and storm water

 Groundwater

 Treated and untreated wastewater

 Biosolids/wastewater sludge

 Landfill leachate

 Solid waste

 Soil & sediment

 Ash

 Stack emissions

 AFFF

 Industrial and consumer products

PFAS TEST METHODS

There are numerous PFAS test methods available from various agencies and organizations. Here are some of the most common methods used for compliance as well as forensic studies.

EPA 533

MATRIX: DRINKING WATER

EPA 533 expanded the number of PFAS compounds that can be analyzed in drinking water samples. Unlike the 537 series, this method utilizes isotope dilution, providing additional quality control for accuracy of reporting, especially at ppt (parts per trillion) levels. EPA 533 does not replace EPA 537.1, but together, the tests can be used to analyze for 29 PFAS compounds. EPA 533 is also commonly used for drinking water compliance, and both EPA 533 and EPA 537.1 are required for UCMR 5 compliance.

EPA 537.1

MATRIX: DRINKING WATER

An EPA validated method, EPA 537.1 was developed to replace EPA 537 and is commonly used for drinking water

compliance. In addition to analyzing for the 14 compounds covered by the original EPA 537, EPA 537.1 also analyzes for four replacement PFAS: 11CI-PF3OUdS, 9CI-PF3ONS, ADONA, and HFPO-DA (also known as Gen X).

EPA 1633

MATRICES: WASTEWATER, SURFACE WATER, GROUNDWATER, SOILS, BIOSOLIDS, BIOLOGICAL TISSUES, LANDFILL LEACHATE, SEDIMENT, AND AFFF

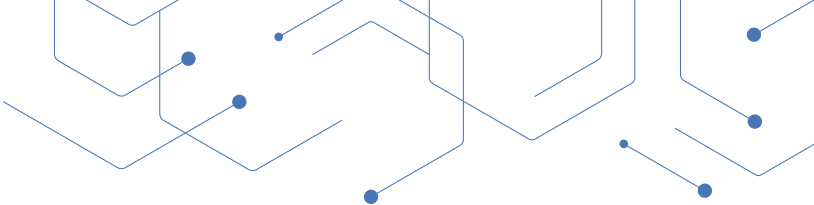
Method 1633 closely resembles PFAS by Isotope Dilution/"537M" SOPs and can quantitate PFAS compounds across a wide range of solid and aqueous matrices. EPA 1633 will replace all laboratory-specific SOPs over time. EPA 1633 will also play a vital role in the EPA's efforts to study, monitor, and regulate PFAS in nearly all matrices and regulatory programs except drinking water. Pace®

participated in the multi-lab validation of this method. This method will be adopted into SW-846 for the RCRA program and will soon be promulgated in 40 CFR Part 136.

AOF/EPA 1621

MATRICES: AQUEOUS

AOF/EPA 1621 measures adsorbable organic fluorine in non-potable water. Similar to other organofluorine-based methods, EPA 1621 utilizes combustion ion chromatography (CIC). The EPA intends EPA 1621 to be utilized as a screening tool to assess organic fluorine concentrations in non-potable water, which often contains many PFAS compounds not detectable by targeted methods such as EPA 1633. The EPA Office of Water describes EPA 1621 as a "Screening Method for the Determination



of Adsorbable Organic Fluorine (AOF) in Aqueous Matrices by Combustion Ion Chromatography (CIC)." Its reporting limit is in the single-digit parts-per-billion range. Pace® was chosen to perform the single-lab validation for EPA 1621.

ASTM D8421/ASTM D8535/EPA 8327

MATRICES: GROUND & SURFACE WATERS, WASTEWATER, LANDFILL LEACHATE, BIOSOLIDS, SOIL & SEDIMENT

ASTM D8421 and D8535 are PFAS methods developed by the American Society for Testing and Materials (ASTM) to provide a definitive method for PFAS analyses in aqueous and solid matrices, respectively. ASTM D8421/D8535 utilizes Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), with optional uses of Isotope Dilution (ID) to minimize the impacts of sample matrix interference on quantification and thus improve data quality. Technically similar to EPA 8327, Pace® can cite either EPA

8327 or ASTM D8421/D8535.

ASTM D8421/D8535 and EPA 8327 offer several advantages over other methods. Turnaround time (TAT) is faster than other published methods that are more procedurally challenging. With optimized procedural requirements, ASTM D8421/D8535/EPA 8327 can also be delivered at a lower price point than other PFAS methods. Finally, ASTM D8421/EPA 8327 only requires 15 mL of water volume to be collected. This saves significant field collection time and shipping costs compared to other methods, such as EPA 1633, which require higher sample volumes.

Consumer and Industrial Products

MATRICES: TEXTILES, FOOD CONTACT MATERIALS, AND MANY OTHER CONSUMER AND INDUSTRIAL PRODUCTS

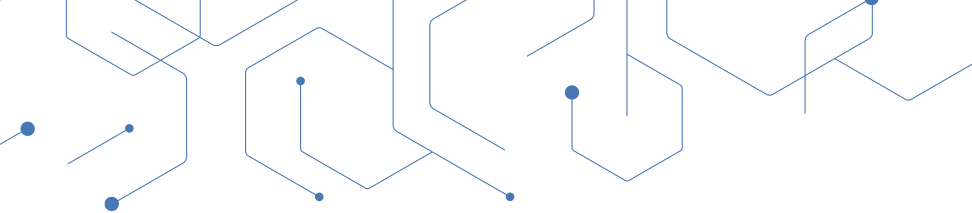
PFAS is often an ingredient in consumer products and other materials used for

packaging and in many commercial and industrial applications. It is also a concern in the container industry and chemical formulation. Pace® utilizes EPA Method 1633 with cryomilling to analyze for 40 common PFAS compounds in consumer and industrial products. We also offer Total Fluorine by CIC for these products.

PFAS by Isotope Dilution

MATRICES: GROUND & SURFACE WATERS, WASTEWATER, LANDFILL LEACHATE, WASTEWATER SLUDGE & BIOSOLIDS, SOIL & OTHER SOLIDS, BIOTA, AFFF

Like many commercial labs, Pace® developed and validated an isotope dilution method based on EPA 537 to apply for non-drinking water matrices such as non-potable water, solids, biota, and biosolids. Able to quantitate 40 PFAS compounds, this method is widely applicable to both DOD and commercial/industrial applications. Furthermore, Pace® has been audited



and certified to the accreditation standards of DOD, TNI NELAC, and state accreditation bodies for this method.

TOP Assay

MATRICES: AQUEOUS AND SOLIDS

PFAS precursors, both known and unknown, are a class of PFAS compounds that can degrade to terminal PFAS compounds (i.e., perfluoroalkyl substances) under the right environmental circumstances. TOP Assay oxidizes PFAS precursors, most of which are compounds not currently measured by targeted techniques, converting them into their terminal PFAS compounds that can then be measured. The increase in PFAS measured after the TOP Assay oxidation relative to pre-oxidation levels is a gross estimate of the total concentration of PFAS precursors present in a sample. PFAS analysis by TOP Assay is particularly useful in forensic studies designed to identify the source of elevated PFAS levels in all matrices.



WHAT ARE REPLACEMENT PFAS?

The production of PFOA and PFOS was voluntarily phased out in the United States years ago. However, there are other PFAS that have been developed to replace them. GenX, for example, is a trade name for a PFAS chemical used to make high performance fluoropolymers (e.g., some nonstick coatings) without the use of perfluorooctanoic acid (PFOA). GenX has been found in surface water, groundwater, finished drinking water, rainwater, and air emissions in some areas. Although questions about the toxicity of these compounds remain, some states have begun to collect data on their prevalence in local drinking water sources as well as all other matrices.

CASE STUDY

FLORIDA KEYS AQUEDUCT AUTHORITY REMOVES PFAS COMPOUNDS IN ITS RAW WATER SUPPLY

Recently, there has been more attention paid to the potential impacts of trace per- and polyfluoroalkyl substances (PFAS) in drinking water due to studies suggesting adverse health effects. PFAS chemicals have useful properties not found in other substances. However, they are persistent in the environment and not easily removed by conventional water treatment technologies. To solve this problem, some municipalities have decided to add PFAS removal processes to their water treatment plants. Two common methods of treatment are granular activated carbon (GAC) and reverse osmosis (RO).

The primary water supply for the Florida Keys is freshwater from the Biscayne Aquifer. The location of the wellfield near Everglades National Park, along with restrictions enforced by state and local regulatory agencies, contribute to the unusually high quality of the raw water. Even though this wellfield contains some

of the highest quality groundwater in the country, the Florida Keys Aqueduct Authority (FKAA) detected PFAS compounds in the Biscayne groundwater. The measured values for combined PFOS and PFOA ranged between 45 and 54 ppt, which is below the current health advisory limit (70 ppt combined) but higher than the proposed limits being considered by some states.

The FKAA originally planned to use finished water for the pilot study but decided to use its raw water source because the water treatment plant adds chlorine upstream of the gravity filters. The FKAA did not want to dechlorinate the water entering the pilot unit but was concerned that the chlorine would interfere with the efficacy of the GAC. The pilot unit was designed with (3) three feet of Calgon's Filtrasorb 400 GAC to provide 15 minutes of empty bed contact time

(EBCT) at a flow rate of 0.86 gpm. The water leaving the pilot unit was measured using both an ultrasonic flow meter for observations/adjustments and a water meter to measure the total volume of water through the filter. The pilot was made of a 12-inch diameter schedule 40 clear PVC pipe so the water level could be observed.

Since August 2019 the FKAA has been collecting influent and effluent samples every month. Based on the results of the first two months of data collection, the pilot unit has removed all PFAS compounds and total organic carbon (TOC) to non-detectable levels. The FKAA plans to continue to run the pilot until the GAC is no longer effective.

PFAS FAQs

ARE WE REQUIRED TO INCLUDE FIELD QC SAMPLES IN OUR SAMPLING PROGRAM FOR PFAS?

Due to the potential for cross-contamination during sampling for PFAS the inclusion of Field Reagent Blanks (FRBs) or Field Blanks (FBs) and other field QC samples are written into every available PFAS sampling SOP issued by various states and other organizations, such as the ITRC. The inclusion of appropriate field QC samples is advisable due to the prevalence of PFAS-containing materials used in sampling and very low laboratory PFAS detection levels.

SHOULD WE TEST OUR FIREFIGHTING FOAMS FOR PFAS?

Many municipalities and businesses are switching to fluorine-free firefighting foams (FFF). However, while the FAA allows FFF to be used for training purposes, it has not yet been approved for actual aviation emergencies. Aqueous film-forming foam (AFFF) also has a long shelf life, and the ingredients are not always clearly marked. Furthermore, tests performed on some fluorine-free foams have shown that, although the foams do not contain PFOA or PFOS, they may not be completely fluorine-free. Pace® offers testing services for FFF that can determine which PFAS compounds are present, and if so, at what level. We also offer testing services for legacy AFFF. This data can be used to inform your disposal strategies.

SHOULD WE TEST BOTH WASTEWATER INFLUENT AND EFFLUENT?

This is a common question we get from industry and wastewater professionals. Testing effluent is clearly vital if it is being directly released into the environment and impacting drinking water sources. However, if effluent levels are elevated, testing influent can provide a clearer picture as to the source of the PFAS. For example, TOP Assay can detect PFAS precursors that may degrade into terminal PFAS during treatment.

WHY SHOULD WE CONSIDER TESTING FOR TOTAL ORGANIC FLUORINE?

There are ongoing discussions in the scientific and regulatory communities about regulating PFAS as a class of chemicals. Testing for total organic fluorine (TOF) can give you a clearer picture of total PFAS contamination as it enables detection of the total of all PFAS present as a single number versus the total level of individual PFAS compounds. For businesses concerned about future legal liabilities, testing for TOF can also inform your risk mitigation strategies.

SHOULD PFAS TESTING BE INCLUDED IN OUR SITE ASSESSMENT BEFORE WE ACQUIRE A BUSINESS OR PROPERTY?

Now that PFOA and PFOS have been declared Hazardous Substances under CERCLA, including PFAS in your pre-acquisition Environmental Site Assessments (ESAs) is more important than ever. PFAS compounds do not break down naturally, so contamination that occurred on a site decades ago may still remain and can create liability issues for a new owner. If the site history shows that the land was used by a business that manufactured PFAS or used PFAS in its processes, testing of soil, groundwater, and surface waters may be warranted. Also, remember to look for past use of AFFF on-site to fight fires involving flammable liquids, as runoff may have been allowed to seep into the local soil and groundwater.



WHAT'S THE DIFFERENCE BETWEEN AN MCL AND AN MCLG?

Under the National Primary Drinking Water Regulations (NPDWR), MCLs or Maximum Contaminant Levels are the legally enforceable limits. These limits consider factors such as the detection limits of current test methods, the reporting limits of most water labs, current remediation technologies, and the costs associated with remediation.

MCLGs are Maximum Contaminant Level Goals. Since PFOA and PFOS were deemed likely cancerous, the goal is to have zero ppt (parts per trillion) of these two compounds in drinking water. However, EPA felt it wasn't feasible to set an MCL of zero at this time.

CAN PACE® DETECT BELOW THE MCL VALUES SET BY THE EPA?

Yes, our reporting limit for both approved drinking water test methods, EPA 537.1 and 533 is 2.0 ppt. However, our detection limits are even lower – sub 1 ppt for both PFOA and PFOS.

For a more complete assessment of EPA actions impacting your industry or organization, reach out to our emerging contaminants team for a **Technical & Regulatory Briefing**.



ABOUT PACE®

Pace® Analytical has been an industry leader in persistent organic pollutant testing for over three decades and was one of the first commercial laboratories to analyze for PFAS compounds. We maintain certifications across all matrices in every state which offers or requires them. We have also received accreditation from all national and federal bodies with PFAS regulatory requirements, including the DOD, DOE, NELAC, and ISO.

As regulatory requirements and methodologies have evolved, we have responded. Today, Pace® has the capabilities to analyze for PFAS through our in-house national network of labs.

PFAS RAPID RESPONSE TEAM

Pace® can quickly mobilize and dispatch a team in response to an environmental disaster. Leveraging our national lab network, we work around-the-clock, often providing results in 24-hours or less.

CERTIFIED AND ACCREDITED

Pace® Analytical is certified in every state and territory requiring certification for PFAS analysis. Additionally, we are accredited by all national and federal bodies with PFAS regulatory requirements.

ON-SITE PROJECT MANAGEMENT

To save time, Pace® can dispatch a team to your site to handle bottles, collect samples, and process paperwork.

PACE® SCIENTIFIC LAB STAFFING SERVICES

Pace® can augment your lab staff with experienced contractors - available to support anything from routine project work to new product development.



LOCATIONS

Convenient, accessible locations throughout the United States

Pace® Analytical customers value laboratory and service center proximity for convenience, quick turnaround times, and when needed, deployment of field service technicians. Our localized level of service backed with our broad capabilities, provides great customer value. As such, we continually analyze customer and market opportunities against our laboratory footprint to ensure we are where you need us. Get the quality results you require; at the Pace® you need. Visit [PFAS.com](https://www.pacelabs.com) for additional resources on PFAS or **contact us** to schedule a briefing or request a **quick quote** on Pace® PFAS services.



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