WHITE PAPER / **PFAS MONITORING AND TREATMENT**

ADVANCING PFAS MITIGATION THROUGH NEW FUNDING OPPORTUNITIES

BY Nathan Dunahee, PE

The presence of per- and polyfluoroalkyl substances (PFAS) in drinking water is driving new funding opportunities for utilities. Now is the time for water utilities to develop plans for PFAS monitoring and treatment.

Per- and polyfluoroalkyl substances (PFAS) are a complex group of human-made compounds, which are water- and oil-repellent and resistant to thermal and chemical degradation. Companies have used PFAS in a variety of products and materials, including nonstick cooking surfaces, waterproof outdoor fabric and firefighting foam.

Certain PFAS are nonbiodegradable, mobile, persistent and bioaccumulate. Referred to as forever chemicals, PFAS do not degrade in the bodies of humans, animals or in the environment.

PERSISTENT PFAS CHALLENGES

Companies have used PFAS in manufacturing processes since the 1940s; studies in the 1970s found PFAS in the blood of occupationally exposed workers. In the 1990s, researchers found trace amounts of PFAS in the blood of the general public. Since the early 2000s, researchers have documented PFAS in the environment as the methods used to detect the substance at low levels have advanced.

PFAS include thousands of separate compounds, including perfluoroalkyl acids (PFAA) such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFOA and PFOS are the two most widely detected PFAS compounds in human blood, wildlife, sediment, and surface and groundwater.

Due to the Toxic Substances Control Act (TSCA) and voluntary actions, U.S. manufacturers have phased PFOA and PFOS out of production, but these substances remain in legacy products that have not yet been used and in the ecosystem. While the production of PFOA and PFOS has been largely curtailed in the U.S., other countries may not have implemented similar restrictions, so these compounds may still be used in manufacturing around the world.

Exposure to PFAS at certain levels has been associated with adverse health risks in humans. Studies have indicated PFOA and PFOS can cause increased cholesterol, liver and kidney issues, reproductive problems, developmental concerns in children, immunological effects, thyroid disruption and cancer. Additional studies are underway to evaluate the effects of other PFAS on human health.

PFAS are a topic of growing public concern. Water utilities are actively developing policies and procedures to protect drinking water sources and address existing and upcoming regulatory requirements. Various funding initiatives have been approved that should continue to spur action.

FUNDING FOR PFAS MONITORING AND TREATMENT

In an infrastructure and renewal program announced in March 2021, the American Jobs Plan committed $111 billion for safe drinking water and infrastructure projects, including $10 billion specifically identified to monitor and treat PFAS in drinking water.

The Drinking Water and Wastewater Infrastructure Act was passed by the Senate in April 2021 authorizing $35 billion in new investment in water infrastructure, with funding to address PFAS in drinking water. States are also taking action to earmark PFAS funding with hundreds of proposed bills in state legislatures related to PFAS.

Utilities that previously tested for PFAS probably used testing techniques and analysis that are now dated. New testing and analysis methods can detect PFAS at lower levels or identify additional PFAS. To take full advantage of funding opportunities, water utilities and operators should consider developing plans to effectively monitor, identify and treat PFAS. Utilities can proactively prepare PFAS plans and ideally position themselves for funding opportunities by:

- Identifying appropriate analytical sampling methods.
- Characterizing the PFAS that are present in a drinking water source and evaluate whether treatment is needed.
- Evaluating available data and identifying potential and historical PFAS sources in the area.
- Identifying points within the water treatment system to monitor for PFAS.
- Developing sampling plans to routinely monitor for PFAS.
- Determining how results will be interpreted.
- Selecting the most appropriate treatment methods based on results and their current system.

IDENTIFYING PFAS IN DRINKING WATER

As presented above, PFAS are found in many consumer products and in the environment, which has resulted in multiple potential routes of exposure to humans. However, a common route of exposure to PFAS compounds is through drinking water. Analytical techniques to identify PFAS are being developed as the U.S. Environmental Protection Agency (EPA) works to certify additional testing methods.

TESTING GUIDANCE

Under the Safe Drinking Water Act, EPA monitors unregulated contaminants in drinking water and adds new pollutants to the list of priority contaminants every five years. The Unregulated Contaminant Monitoring Rule (UCRM) requires systems to identify and collect data for drinking water contaminants in public water systems that do not have health-based standards. The EPA testing guidance supports the generation of data collected to determine exposure levels and inform regulatory needs.

In 2012, EPA published the third UCMR (UCMR 3) and listed PFAS, including PFOA and PFOS, as priority contaminants.

Prior to this, EPA announced the third Drinking Water Contaminant Candidate List (CCL 3) in February 2008 and included PFAS compounds.

UCMR 5 was published on March 11, 2021, and listed 30 chemical contaminants to be sampled between 2023 and 2025: 29 of the 30 chemicals included on UCMR 5 are PFAS. The proposed UCMR 5 will provide new data to improve EPA's understanding of the frequency that PFAS are found in the nation's drinking water systems and at what levels. Regarding the UCMR, EPA Assistant Administrator Radhika Fox said, "All people need access to clean and safe drinking water. One way that EPA is committed to keeping our communities safe is by addressing PFAS."

On Oct. 18, 2021, EPA announced its comprehensive Strategic Roadmap to confront PFAS contamination. This Strategic Roadmap is centered on three main strategies:

- Increase investment in PFAS research.
- Leverage authorities to prevent the release of PFAS into the environment.
- Accelerate cleanup of PFAS contamination.

As PFAS are detected, EPA continues to advance its analytical methods. Method 537.1, published in 2018, guides the measurement of 18 PFAS in drinking water. Short-chain — carbon chain lengths of four to six —

PFAS present physiochemical differences. In 2019, EPA introduced Method 533, a complement to 537.1, focusing on short-chain PFAS, bringing the total identifiable PFAS to 70 chemicals. Method 533 also analyzes for certain replacement PFAS that were used to replace PFOA and PFOS following their phase out.

TESTING TECHNIQUES

When used together, EPA standards and recent laboratory methods can identify more than 70 PFAS compounds in drinking water. The two methods differ in the type of solid-phase extraction media used:

- Method 537.1 uses styrene-divinylbenzene (SDVB) media.
- Method 533 uses polystyrene divinylbenzene with a positively charged diamino ligand and isotope dilution.

The two methods also stipulate different holding times for the samples:

- Method 537.1 provides a 14-day time frame to extract the sample and 28 days for analysis.
- Method 533 provides 28 to extract the sample and 28 days for analysis.

Both techniques are analyzed using liquid chromatography-tandem mass spectrometry (LC-MS/MS) and Method 533 leverages MS/MS in multiple reaction monitoring (MRM) mode for enhanced selectivity.

Drinking water testing is complex, and the different methods require precision and skill. The analytical methods being used are Method 537.1, Method 533, total organofluorine and non-target analytical methods, such as liquid chromatography coupled to high resolution quadrupole time-of-flight mass spectrometry. Given the robust and comprehensive approaches to PFAS testing, EPA guidance provided is intended for use by skilled analysts.

TREATING PFAS IN DRINKING WATER

EPA is committed to developing enforceable limits for PFAS compounds in drinking water. EPA's new Strategic Roadmap will also include a timeline for action with regard to data collection and setting regulatory limits. Some states are suggesting 2 parts per trillion (2 ng/L) for PFOA. More than $10 billion in funding has been proposed to address PFAS contamination through the Bipartisan Infrastructure Deal.

Treating PFAS is challenging with limited treatment technologies available. EPA has identified the following commercially available technologies that are found to be effective. Each technology has advantages and disadvantages that should be considered with variable removal efficiencies based on source water quality, flow rate and individual compounds to be removed.

- **Granular Activated Carbon:** PFAS are adsorbed to the activated carbon contained within a vessel.
- **Powdered Activated Carbon:** PFAS compounds stick to powdered carbon added into the water.
- **Ion Exchange Resins:** PFAS chemicals adhere to a specifically engineered resin contained within a vessel.
- **Nanofiltration and Reverse Osmosis:** Membrane technologies provide the ultimate barrier for removing PFAS compounds. These technologies are able to achieve high removal efficiencies.

For water utilities, identifying the most effective technology to remove PFAS requires a close examination of the advantages and disadvantages of each approach. A process evaluation is required to develop a practical approach so water providers can meet finished water goals, maintain regulatory compliance and avoid creating other treatment challenges. Issues may arise if the water provider selects the wrong technology.

CONCLUSION

The identification and management of PFAS continue to evolve every year. This has resulted in regulatory and community pressures on water providers with a specific focus on removing PFAS from drinking water to reduce exposure to these compounds. Monitoring techniques and treatment methods are available so utilities can better understand these emerging contaminants and plan for regulatory demands on their operations. With funding opportunities emerging and public awareness growing, now is the time for water utilities to act.

BIOGRAPHY

NATHAN DUNAHEE, PE, is a lead process engineer with Burns & McDonnell. He has experience in drinking water evaluation, optimization and design. Nathan serves on two of the American Water Works Association's technical committees that focus on emerging water quality concerns, taste and odor, and optimization.

ABOUT BURNS & McDONNELL

Burns & McDonnell is a family of companies bringing together an unmatched team of engineers, construction professionals, architects, planners, technologists and scientists to design and build our critical infrastructure. With an integrated construction and design mindset, we offer full-service capabilities. Founded in 1898 and working from dozens of offices globally, Burns & McDonnell is 100% employee-owned. For more information, visit **burnsmcd.com**.

24432-PMT-1221