INFORMED INFRASTRUCTURE

VOL. 10 NO. 3
SMART ENGINEERING ISSUE 2024

The magazine for civil & structural engineers

CELEBRATING 10 YEARS

SIXTH ANNUAL SMART ENGINEERING ISSUE

Water Utilities Tackle PFAS Remediation

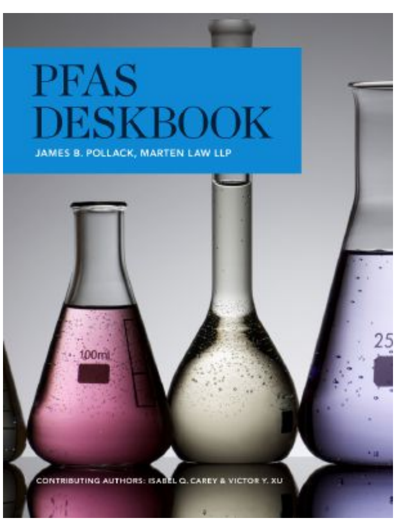
BY CAROL BRZOZOWSKI

According to the National Academies of Sciences, Engineering and Medicine, exposure to per- and polyfluoroalkyl substances (PFASs) is linked to increased risk of a variety of health concerns to humans and other mammals, including some cancers. Many PFASs were used in the mid-20th century in products and on materials due to their enhanced water-resistant properties, such as within Teflon or aqueous film forming foam (AFFF) used to fight fires.

Much is still being learned about PFAS, but these "forever chemicals" are so widespread that they have been found in most water sources worldwide, including rainwater, and have become permanently embedded in the human bloodstream.

Legal Landscape for PFAS

The Environmental Law Institute (ELI) recently published the *PFAS Deskbook* to help attorneys navigate the legal landscape driven by a growing scientific recognition that many PFASs come with a cost to public health and the environment. The book offers readers a comprehensive, nonpartisan, objective overview of the PFAS journey from their inception to today, in both supply chains and regulatory frameworks.



"Our hope is that by looking at the entirety of where the laws and regulations are today, the *PFAS Deskbook* will provide clarity about the areas of greater and lesser certainty in the current legal landscape," notes Jordan Diamond, ELI president. "By understanding the legal context that got us here, we can more easily determine how we can improve it and get us out of a PFAS-dependent society."

James Pollack, an associate at Marten Law in Seattle and the book's author, notes that "our understanding of PFAS—as well as the regulatory landscape governing PFAS—is evolving quickly. Civil engineers are uniquely positioned to identify potential PFAS impacts in water systems, industrial processes, infrastructure and other applications. They can provide visibility on PFAS uses and risks to key stakeholders—including legal and management—before an issue arises."

Work for Water Utilities

To provide guidance for U.S. water utilities working to address the challenges and financial implications of PFAS, Stantec Institute for Applied Science, Technology, and Policy researchers conducted a PFAS cost study in 2023 for the National Association of Clean Water Agencies (NACWA), updating a 2020 study to better understand the cost impacts of PFAS on U.S. biosolids management.

"As passive receivers of PFAS, utilities are grappling with a challenge they were not designed to handle," says Joan Oppenheimer, Stantec vice president and environmental scientist. "Despite that, utilities across the country are stepping up to figure out their role in mitigating PFAS release to the environment and, in lieu of readily available treatment technology, what costs are associated with different containment measures."

Of the 103 completed surveys from utilities representing 30 percent of NACWA members in 40 states, 90 percent indicated concerns about anticipated changes to their biosolids treatment capabilities due to PFAS. However, 58 percent of those respondents indicated they're not monitoring for PFAS in their influent, effluent or biosolids—most likely due to a lack of regulatory requirements to sample.

The study also found most clean-water utilities haven't yet taken on capital-improvement projects in response to PFAS in wastewater and biosolids, which Stantec attributes to a lack of regulatory drivers and low technology readiness in PFAS destructive technologies.

The Sanford Sewerage District serves the town of Sanford, Maine, (inset) and its surrounding areas. Sanford Sewerage District was mandated to sample its compost facility (bottom images) for PFAS.

Sanford Sewerage District

A Common Case

The Sanford Sewerage District (SSD) in Maine was featured in the NACWA survey. According to Andre Brousseau, superintendent of the SSD, the Maine Department of Environmental Protection (DEP) placed an immediate moratorium on all beneficial use of solids waste (i.e., compost) programs due to PFAS concerns on March 22, 2019.

"That date was significant to existing programs because spring is when most compost sales take place," says Brousseau. "Fortunately, the Sanford Sewerage District had an onsite landfill licensed for biosolids. We had an outlet to dispose, but the revenue was halted."

The district also had sent information informing compost customers that its product contained PFAS and to be conscientious of its end use, and customers were informed to not use the compost on vegetable gardens.

"For the next few years, DEP performed a statewide study to see where the contamination of groundwater was according to past spreading of biosolids," says Brousseau. "Unfortunately, some tracks of land which had previously benefited from the positive side of beneficial reuse exceeded groundwater exceedance.

"The positive side was not all parcels that had residuals applied to the land had contaminated groundwater," he explains. "The legislators were gaining momentum on a complete ban of biosolids spreading, which came in April 2022 under Maine's Legislative Document (LD) 1911, 'An Act to Prohibit the Contamination of Clean Soils with the So-Called Forever Chemicals.' The only disposal option was landfills, which is not great because of the hauling distance and lack of space for sustaining future disposal."

To mitigate the challenges, a new secondary plant incorporated a biological nutrient-removal (BNR) process, a BNR oxidation ditch, which used the septage as a carbon source to biologically remove phosphorus.

The SSD also completed a facilities study, with a portion of the study focusing on centrifuges, its current dewatering system. The study investigated screw-type presses tied into a few different dryers. Preliminary estimates came in between $8 to $12 million, depending on the type of press and dryer.

"We are patiently waiting for the technology to evolve for PFAS treatment/destruction," says Brousseau. "Will the technology be scalable to certain-size treatment plants? Will PFAS source control/elimination/reduction be beneficial to a point PFAS is no longer prevalent?"

The biggest challenge the SSD faces is the unknown: where is PFAS coming from, and how can it be controlled?

"If we had an industry discharging PFAS, then that is the low-hanging fruit and an easy fix," says Brousseau. "We

REGENESIS

REGENESIS Remediation Services mix and monitor remedial amendments in a services trailer onsite (top). Then the remedial amendments are placed in situ using a GeoProbe (bottom).

would be forced to work with them in hopes of convincing them to change chemicals in their production.

"With PFAS coming from every user of our system, that's where we see challenges," he adds. "Educating our customers to change their habits is an uphill battle. Completely shutting off the septage haulers is not a great option for the environment. Future rate increases to cover new technology to destroy PFAS will be the most difficult due to the expense."

Brousseau's advice to others engaged in efforts to mitigate PFAS concerns is to be mindful of the costs. "The cost to remove PFAS from wastewater is immense," he adds. "The technology chosen must be properly vetted with thought in lifecycle expenses, parts availability and redundancy planning."

Steps Toward Remediation

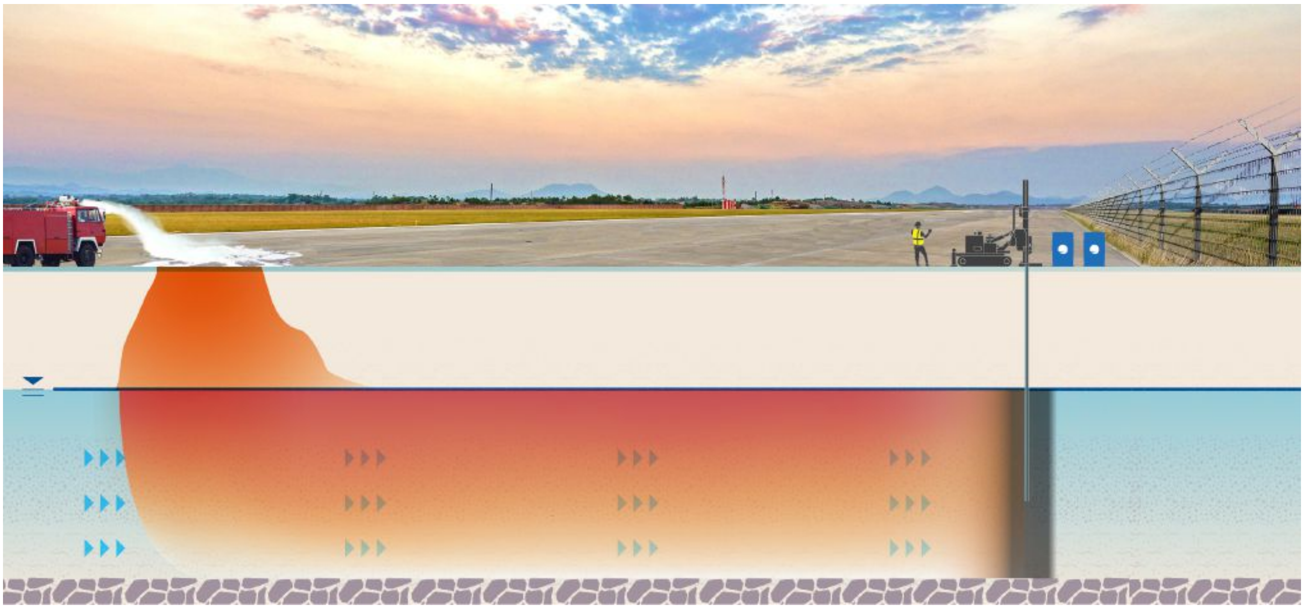
Addressing how to shape a sustainable future as well as the future of public health in the battle against the deepening PFAS crisis, Ryan Moore, REGENESIS program director for PFAS remediation, notes that although PFAS contaminants have emerged as a global concern, a recent survey conducted by a Texas A&M University researcher shows 77 percent of the general public had either never heard of PFAS or doesn't know what they are.

"This will likely change as public drinking-water sources are now being sampled for PFAS for the first time in communities across the United States," says Moore. "As more people learn that PFASs are polluting the water they drink, they will begin to also be concerned about the potential health effects. Awareness will increase as those affected become upset, realizing how little is being done to prevent these drinking-water impacts."

Public awareness and education must continue to elevate health concerns surrounding PFAS, with increased pressure applied to prevent further impacts on drinking-water sources, the food supply chain and the environment.

"PFAS contaminants are not only in our consumer goods but in the environment as far-reaching as the Antarctic after decades of uncontrolled use and disposal," adds Moore. "Consequently, almost everyone has been exposed to PFAS—to the degree that these contaminants permanently reside in our bloodstream. So there's a baseline of environmental contamination and PFAS exposure in the general population causing unknown consequences that we must contend with long-term.

A field application on a U.S. airport uses a colloidal activated carbon (CAC) barrier to address PFAS groundwater impacts caused by an aqueous film forming foam (*AFFF*) concentrate, a firefighting foam being phased out of use due to its high levels of PFAS.



REGENESIS

A graphic depicts a PFAS plume in groundwater due to a fire-training exercise as well as the application of a colloidal activated carbon (CAC) barrier at a downgradient plume boundary to effectively contain the plume from moving offsite.

"However, a basic tenet of toxicology is 'the dose makes the poison,'" he explains. "Right now, there is a much higher level of potential PFAS exposure and associated health risks for communities and individual homeowners living near high-concentration sources of PFASs leaking out of airports, military bases, landfills and many industries."

Moore notes that in the United States alone, two teams of researchers identified between 57,000 and 120,000 PFAS-contaminated sites, most of which are polluting groundwater, which represents 40 percent of all drinking-water resources.

"Preventing further damage to our drinking-water resources and public health from these sites needs to be a top priority in addressing PFAS," says Moore. "Trying to fix the problem after communities become exposed is much too late."

Fortunately, there's a lot of research into developing technologies and approaches to effectively treat PFAS in the environment.

"Most of the technologies available to be deployed in the field at scale rely on pumping the PFAS-contaminated groundwater above the surface for treatment through advanced filtration and separation, thermal destruction or a combination of methods," notes Moore.

"The approach referred to as 'pump-and-treat' is costly, creates additional PFAS waste products, expends significant amounts of CO_2 into the atmosphere, and has proven to be ineffective," he adds.

REGENESIS relies on colloidal activated carbon (CAC) material injected into the ground to create a PFAS contaminant filter in the subsurface. The CAC filter holds PFAS in situ, removing contaminants from groundwater before impacting water wells or surface-water bodies downstream, explains Moore, adding “this below-ground filtration approach is field-scalable and being used at more than 50 PFAS-contaminated sites worldwide, with several hundred more in the planning stages.”

CAC belowground filtration treatment is more than 65 percent cost-effective; reduces greenhouse gas emissions by 98 percent; and reduces the energy, waste and raw-materials footprint by 95 percent, according to a recent independent sustainability analysis conducted by Ramboll, a global environmental consulting and engineering firm.

Steps You Can Take

As drinking-water systems work to understand how PFAS contamination may impact their systems, according to Pollack, there are some practical steps to take that include the following:

• Consider engaging in testing for PFAS in the drinking-water system or source waters.

• Make a plan to respond to potential contamination through treatment or acquisition of alternative drinking-water sources.

• Evaluate potential sources of PFAS contamination to reduce PFAS inputs and seek funds for remediation.

• Keep appraised of evolving regulatory requirements that may implicate any of those steps, from mandatory testing to mandatory cleanup.

Stantec researchers offer three key recommendations for utilities trying to develop a plan to treat PFAS:

1. Clean-water utilities should evaluate potential options for diversifying their biosolids-management strategies. Voluntary diversification was the only change to biosolids management identified in the survey that, on average, produced cost savings to overall biosolids-management costs.

2. Utilities should begin high-level planning for changes to treatment technologies that may be required by future PFAS regulations.

3. Utilities—with continued NACWA support—should engage regulators, key stakeholders and their communities to understand the role publicly owned treatment plays in the beneficial reuse of water and nutrients. They also should help educate these groups on how as passive receiver entities—rather than generators of PFAS pollution—the burden of compliance should be driven toward elimination of PFAS source inputs to their treatment facilities.

Carol Brzozowski is a freelance journalist specializing in technology, resource management and construction topics; email: *brzozowski.carol@gmail.com.*