A SEDIMENT NEWSLETTER FROM INTEGRAL CONSULTING, INC.

The Benthic Zone

October 2022

integral consulting inc.

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PUBLISHED
October 19, 2022

Following EPA's PFAS Roadmap to Human Health Ambient Water Quality Criteria

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Per- and polyfluoroalkyl substances (PFAS) are a synthetic class of chemicals comprising thousands of fluorinated compounds used in a myriad of consumer products including food wrappers, cookware, and fabrics. Significant regulatory changes related to PFAS continue to be made as the science related to the toxicology, fate and transport, and occurrence of these compounds advances and as public concern grows. The potential impacts to industrial and public entities resulting from regulatory changes are likely to result in significant modifications to wastewater treatment processes and surface water source control efforts as these entities comply with the future PFAS regulatory landscape.

In October 2021, the U.S. Environmental Protection Agency (EPA) released its comprehensive plan, referred to as the *PFAS Strategic Roadmap*, to address PFAS in the nation's water, soil, and air. The *Roadmap* outlines EPA's planned actions to manage PFAS, including monitoring and regulation, through 2024. Since EPA's issuance of the *Roadmap*, the U.S. government has taken many actions related to PFAS, such as adding PFAS to the Toxics Release Inventory Program (TRI); updating health effects levels for certain PFAS; proposing the designation of PFAS compounds, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), as hazardous substances under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA); and proposing recommended aquatic life ambient water quality criteria (AWQC) for PFOA and PFOS.

As discussed further below, future changes could lead to the development of freshwater human health AWQC in the very low parts per quadrillion range. AWQC have implications for permitted dischargers and their upstream inputs, fish consumption advisories or 303(d) listing of waters, and CERCLA or state sediment remediation.

Looking Down the Road to Additional Water Quality Criteria

While the actions taken by EPA have importance in their own right, the information underlying those actions can be used to prognosticate about future *Roadmap* destinations.

EPA's stated goal to develop national recommended AWQC for PFAS to protect human health by the fall of 2024 will require that EPA develop parameters to model PFAS intake through water and fish consumption.

Human health AWQC are specific concentrations of chemicals or conditions in a water body computed by EPA below which adverse effects to human health are not expected. Typically, EPA computes recommended human health AWQC for freshwater or marine/estuarine water, with the distinction being that exposure to chemicals in freshwater could occur from both the consumption of water and the consumption of aquatic organisms (e.g., fish and shellfish), whereas in a marine/estuarine environment, exposure is limited to consumption of organisms.

The primary considerations in developing a human health AWQC include the drinking water rate, the organism (or fish) consumption rate, the chemical bioaccumulation factor, the chemical's toxicity, the relative source contribution (i.e., the percent of chemical exposure from other sources), and the risk threshold (in the case of PFOA and PFOS, a noncarcinogenic hazard quotient of 1 would be used).

The idea of exposure to chemicals in water through consumption of water is straightforward, but the concept of being exposed to chemicals in water via consumption of fish and shellfish is more complex; it is chemical-specific. For some chemicals, there is little to no exposure through fish consumption, yet for others, greater exposure occurs through eating fish than drinking water. All other factors being equal, the exposure to waterborne chemicals through aquatic organism consumption is dependent upon a chemical's bioaccumulation factor (BAF). From a relational standpoint, chemicals with higher BAFs (more uptake into fish) will have lower AWQCs (lower criteria are needed to protect humans consuming fish).

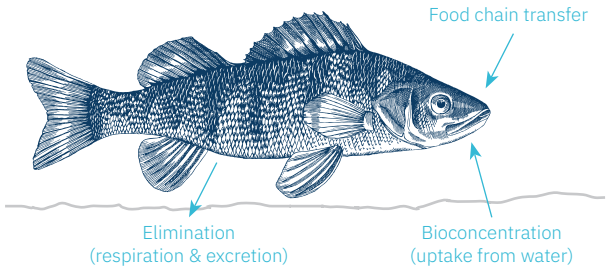
EPA's recent actions for PFOA and PFAS contain information that can be used to estimate the potential human health AWQC for PFOA and PFAS. For example, toxicity information can be gleaned from EPA's June 2022 Interim Updated Health Advisories Levels (HALs) for PFOA and PFAS, and BAFs for these compounds are included in the April 2022 Draft 2022 Aquatic Life Ambient Water Quality Criteria for PFOA and PFAS.

Extremely Low Calculated Water Quality Criteria

Relying on EPA's information, much of which is undergoing review and comment and thus may change, human health AWQC for PFOA and PFOS could be in the single digit parts per quadrillion (pg/L) range. Using standard risk assumptions (a relative source contribution of 20%, a fish consumption rate of 17.5 g day, and a water consumption rate of 2 L/day) and the median BAF for whole body fish published by EPA for the determination of tissue-based aquatic life criteria, the calculated freshwater human health AWQC for PFOA and PFOS could be as low as 4 pg/L and 1 pg/L, respectively. For PFOA, the estimated freshwater human health AWQC is similar to EPA's proposed HAL (due to a lower BAF), but for PFOS, the estimated AWQC is 20 times lower that its respective HAL.

The implications of such low AWQC for PFOA and PFOS could, at a minimum, result in issuance of new National Pollutant Discharge Elimination System (NPDES) permit limits, as well as additional 303(d) listings for impaired waters. Permit limits could pose increased costs to treat and monitor effluent and possibly impact a discharger's ability to comply with its permit. Such low criteria would also influence sediment remediation projects that are targeting PFOA, PFAS, or both. The practicality of such low AWQC is questionable given that detection levels for approved analytical methods are higher than the concentrations that EPA may derive. However, this would not be a situation unique to PFAS. Ultimately, should we reach this destination on the *Roadmap* and find that the AWQC proposed by EPA are as low as that suggested here, new treatment options and effective risk management efforts will be needed to navigate these regulatory waters.

PFAS uptake and elimination in aquatic biota:



Bioaccumulation = bioconcentration + food chain transfer - (elimination + growth dilution)

PUBLISHED
October 19, 2022

Integral Uses EPA's Scribe to Streamline Data Collection

By Carolyn Huynh, *Senior Scientist, Integral*
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Under typical sampling scenarios, key sample identification information is handwritten in multiple places: on sample labels and containers, in field notebooks and logging sheets, and on chain-of-custody forms delivered to the analytical laboratory. This manual process is time-consuming, is prone to transcription error, and presents handwriting legibility issues.

In summer 2021, Integral field staff successfully completed two large-scale river sediment and sampling events for remedial design, accompanied by collection of soil and groundwater data for source control evaluations. Overall, Integral collected more than 7,000 samples. A customized version of the U.S. Environmental Protection Agency's (EPA) Scribe software was used to manage environmental data from planning to laboratory delivery, generating container labels and chain-of-custody forms for multiple laboratories. Scribe is a database developed by EPA's Environmental Response Team to assist in the management of environmental data. It is free to download from EPA's website and can be run locally on any field laptop, allowing for remote use where an internet connection may not be available. Through the use of Scribe, Integral's workflow is automated, and the potential for errors is greatly reduced.

Integral's in-field Scribe set up includes the usage of a ruggedized laptop and label printer with waterproof labels.

Prior to field deployment, Integral staff uploaded planned sample IDs and associated analyses for each sample into Scribe. Field staff are able to maintain and keep the Scribe file up to date as they collect and process samples. In the field, staff entered sample coordinates, collection times, and other information into the office-prepared tables. Sample container labels were printed in the field as sample jars were filled: on the boat for surface sediment grabs or in the processing facility for sediment cores, soil samples, and groundwater samples. Integral's Scribe database was backed up nightly to a centralized location available to in-office staff for metadata quality review.

Scribe outputs useful for Integral's field efforts include printing sample container labels, creating automated chain-of-custody forms, and storing streamlined sample information in a centralized database. Printable labels were more durable and easier to generate and read than traditional handwritten labels, especially for thousands of samples.

Building upon its strong quality management program, Integral continues to employ Scribe in its field programs. Automating sample collection reduces the need for certain manual quality assurance checks and reduces transcription errors, saving our clients time and money. Field data management procedures, as detailed in the field sampling work plans, are transcribed into the Scribe database to ensure that all samples are given a unique identifier and are associated with the correct analyses, that field quality assurance and quality control samples are identified for collection, and that all samples collected are transported under chain of custody control.

Integral selected Scribe for field sampling software because it is an open-source software that can be customized to our needs. Integral added additional data fields to the Scribe Access database to fit Integral's database model. The flexibility of Scribe made these fields easy to add and available for use by Integral's data management team. A customized script translates the Scribe database for import into Integral databases for reporting and data analysis.

Integral's use of Scribe minimized field data entry inconsistences and has saved field staff hundreds of hours of hand labeling and completing chain-of-custody forms. In 2021 alone, the generation of more than 7,000 sample labels and associated chain-of-custody forms was automated. It provided a sample management solution enabling field and office staff to easily plan, track, and coordinate sample collection.

Integral has continued to use Scribe successfully through 2022 and looks forward to realizing further efficiencies in the coming field seasons.

Hundreds of samples collected each day. Scribe outputs include the sample labels associated with each sample and then the generation of chain of custody forms.

Authors

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Mr. Patrick Gwinn has more than 25 years of environmental consulting experience, providing a broad base of expertise in the areas of human health and ecological risk assessment, water quality, fate and transport dispersion modeling, product stewardship, air toxics sampling, and hazardous waste management. He has been instrumental in developing and leading projects aimed at establishing site-specific ambient water quality criteria and pollutant discharge limits. He specializes in managing and conducting human health and ecological risk assessments, site assessments, air quality modeling projects, and remedial investigations for municipalities and the manufacturing and chemical industries. He has modeled the transport, exposure, and risks associated with PCBs, dioxins, chlorinated and aromatic hydrocarbons, aluminum, cadmium, chromium, lead, copper, and other heavy metals. Mr. Gwinn has served as an expert witness and as a non-testifying expert, providing technical guidance to legal counsel on matters related to organic and inorganic chemical forensics as well as chemical fate and transport. As an expert witness, he has prepared expert reports, undergone pretrial depositions, and provided courtroom testimony. As a non-testifying expert, he has provided technical support to legal counsel prior to, during, and subsequent to depositions as well as during courtroom proceedings.

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CAROLYN HUYNH

Ms. Carolyn Huynh is a scientist with 6 years of experience providing litigation and technical analysis support for environmental remediation and site investigations, data interpretation, and support for human health and ecological risk assessments for a variety of chemicals of concern. Ms. Huynh has extensive experience conducting environmental sampling, including collecting sediment, soil, groundwater, surface water, and biota samples, and conducting vegetation and nesting bird surveys. In addition, Ms. Huynh provides support for the review of state and federal laws, rules, and regulations to evaluate applicable environmental policies for NEPA- and California Environmental Quality Act (CEQA)-related projects. She is proficient in performing air modeling to support impact analyses under CEQA and managing cultural/tribal resource assessments.

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ADAM POMEROY

Mr. Adam Pomeroy is an assistant scientist who is experienced in soil, sediment, groundwater, and seepage sample collection. His experience in the field includes management of thousands of samples across various media using the Scribe program. He is also experienced in the use of Logplot8 software to digitize soil borings, subsurface sediment borings, and groundwater well logs. Mr. Pomeroy is able to synthesize field and analytical data into cohesive sections of summary and evaluation reports.

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CHARLES SHAW

Mr. Charles Shaw is a biologist focused on ecological risk assessment and spatial analysis of data. He is experienced in ecological sample collection, data processing and analysis in the statistical software R, and map creation and spatial data evaluation using ArcGIS. Mr. Shaw has worked on numerous field sample collections involving a wide range of media, including surface water, soil, sediment, aquatic and terrestrial macroinvertebrates, small mammals, and birds. He has also assisted in writing a variety of reports, including baseline ecological risk assessments, human health risk assessments, and field sampling plans.

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