# Prioritization of Exposure Pathways at Sediment Sites Impacted by Per- and Polyfluoroalkyl Substances

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**Background/Objectives.** Many scientific and regulatory data gaps are currently associated with the assessment and management of per- and polyfluoroalkyl substances (PFAS) in sediments. PFAS associated with aqueous film-forming foam (AFFF), used in the fighting of Class B hydrocarbon fires, can include hundreds to thousands of compounds with varying mobilities and toxicities, and have the potential to impact downgradient sediments and aquatic habitats near AFFF releases. Understanding the key ecological and human health exposure pathways and receptors at risk from exposure to PFAS will help prioritize site-specific assessments and potential mitigation of risks.

**Approach/Activities.** For ecological receptors, the potential risks to aquatic life and aquatic-dependent birds and mammals were evaluated at five PFAS impacted sediment sites to understand relative exposures from multiple PFAS. A recently published (Larson et al. 2018) empirical based bioaccumulation model for seven PFAS was used to evaluate the key exposure pathways of concern for wildlife. Aquatic species sensitivity distributions were used to characterize the potential for direct aquatic toxicity from exposure to PFOS, and relative risks to aquatic life and wildlife were evaluated. For human health exposure pathways, comparisons of direct contact exposures and consumption of fish and shellfish were evaluated for relative risks from PFOS and PFOA at each of the five sites included in the bioaccumulation model. Risk-based threshold concentrations in sediment and water were developed as where toxicity values were available. The influence of selecting appropriate relative source contributions of fish consumption to risk-based thresholds were evaluated, data gaps identified, and on-going research needs discussed.

**Results/Lessons Learned.** The evaluation of relative risks indicated that bioaccumulation of PFAS in the food web may result in adverse effects to aquatic-life dependent birds and mammals at lower concentrations than those that indicate a potential risk to aquatic invertebrates and fish. Avian and mammalian species with higher benthic invertebrate and incidental sediment ingestion components to their diets indicated the highest exposures. PFOS, followed by PFHxS and PFDS were the predominant PFAS for avian exposure. Risk-based threshold concentrations (RBTC) of PFOS in sediments for protection of avian species ranged from 8 ng/g to 190 ng/g. Comparisons of RTBCs to direct toxicity values for aquatic life indicate adverse effects to birds and mammals are likely at lower concentrations of PFOS in sediment and water than those causing direct effects to aquatic or benthic community health. RTBCs of PFOS in sediments and surface water for consumption of fish are lower than concentrations of PFOS associated with acceptable risk via drinking water or recreational use. Based on this evaluation, AFFF-impacted sites with aquatic habitats where exposure pathways for avian, mammalian and human receptors are complete, human health fish consumption exposures are likely to drive risk management decisions, followed by aquatic dependent wildlife and then aquatic life.