SON Number: ERSON-23-C1 **28 October 2021**

Strategic Environmental Research and Development Program (SERDP)

FY 2023 STATEMENT OF NEED

Environmental Restoration (ER) Program Area

TRANSFORMATION OF POLYFLUOROALKYL SUBSTANCES FOUND IN SOIL AND GROUNDWATER AT AFFF-IMPACTED SITES

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop an improved understanding of transformation processes for polyfluoroalkyl substances (aka "precursors") in the subsurface at aqueous film-forming foam (AFFF)-impacted sites. Specific research areas of interest include:

- Identification of microbiological and/or abiotic processes and pathways capable of either transforming or degrading AFFF-relevant precursors.
- Evaluation of relevant environmental factors that affect transformation rates such as subsurface geochemistry, soil chemical/physical properties, nutrient availability, etc.
- Development of methodologies and/or molecular biological tools (MBTs) to assess or predict the extent and rate of in situ transformation under ambient field conditions.

Proposals may address one or more of the objectives listed above. Research and development activities at laboratory-, bench-, and field-scale will be considered. Work does not necessarily have to culminate in a field-scale effort.

2. Expected Benefits of Proposed Work

Quantifying the extent and rate of in situ precursor transformation is critical to the long-term management of AFFF-impacted sites. Knowledge of the ubiquity with which transformation processes occur, rates of transformation, how those rates potentially change over time, and the relevant terminal perfluoroalkyl acid (PFAA) transformation products will dramatically improve risk assessment and site management decisions.

3. Background

Per- and polyfluoroalkyl substances (PFAS) are present in AFFF used by the DoD and other organizations to extinguish hydrocarbon fires. Different AFFF formulations have been used, but all contain a complex mixture of PFAS, including those of greatest regulatory concern - the PFAAs and potential PFAA precursors. EPA has recommended a Health Advisory Level for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), and several states have promulgated standards for PFOA, PFOS, and some of the related PFAAs.

SERDP has been funding research on AFFF in the environment for several years to improve PFAS analysis, to develop tools for assessing the fate of PFAS in the subsurface, and to evaluate the potential for in situ remediation. A recent SERDP & ESTCP-sponsored workshop identified a number of research needs, and proposers should view the Workshop Report to obtain additional

detail concerning these discussions. PFOS is of particular concern to DoD, as it is the predominant PFAS at AFFF-impacted sites (Anderson et al., 2021). PFOS (and to a lesser extent PFHxS) was the primary PFAS in legacy electrochemical fluorination (ECF)-based AFFF formulations and may accumulate over time as a result of precursor transformation (Anderson et al., 2016; Zhang et al. 2017). Thus, both ECF- and telomer-based AFFF formulations are relevant to this SON.

Field studies have confirmed the occurrence and predominance of precursors within soil and groundwater at AFFF-impacted sites. Previous work has shown that several precursors can be partially biodegraded to ultimately form PFAAs under aerobic conditions. Partial biodegradation of precursors has also been observed under anaerobic conditions albeit at much slower rates. Thus, PFAA precursors can potentially sustain source zones at AFFF-impacted sites, but all inference to date is limited to very empirical field studies or highly controlled laboratory studies under ideal microbiological conditions. While methods have been developed to quantify the total concentration of otherwise unmeasurable precursors (Houtz and Sedlak 2012), there are currently no equivalent methods for assessing the current extent and rate of transformation under in situ field conditions. Knowledge of the in situ transformation rates and extent and the relevant processes involved are critical to site management.

4. Cost and Duration of Proposed Work

The cost and time to meet the requirements of this SON are at the discretion of the proposer. Two options are available:

Standard Proposals: These proposals describe a complete research effort. The proposer should incorporate the appropriate time, schedule, and cost requirements to accomplish the scope of work proposed. SERDP projects normally run from two to five years in length and vary considerably in cost consistent with the scope of the effort. It is expected that most proposals will fall into this category.

Limited Scope Proposals: Proposers with innovative approaches to the SON that entail high technical risk or have minimal supporting data may submit a Limited Scope Proposal for funding up to $250,000 and approximately one year in duration. Such proposals may be eligible for follow-on funding if they result in a successful initial project. The objective of these proposals should be to acquire the data necessary to demonstrate proof-of-concept or reduction of risk that will lead to development of a future Standard Proposal. Proposers should submit Limited Scope Proposals in accordance with the SERDP Core Solicitation instructions and deadlines.

5. Point of Contact

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For Core proposal submission due dates, instructions, and additional solicitation information, visit the SERDP website.

References

Anderson RH, GC Long, RC Porter, and JK Anderson. 2016. Occurrence of select perfluoroalkyl substances at U.S. Air Force aqueous film-forming foam release sites other than fire-training areas: Field-validation of critical fate and transport properties. *Chemosphere* 150:678-685.

Anderson RH, TT Thompson, HF Stroo, and A Leeson. 2021. US Department of Defense–Funded Fate and Transport Research on Per-and Polyfluoroalkyl Substances at Aqueous Film–Forming Foam–Impacted Sites. *Environmental toxicology and chemistry*, *40*(1), 37.

Houtz EF, and DL Sedlak. 2012. Oxidative conversion as a means of detecting precursors to perfluoroalkyl acids in urban runoff. *Environmental science & technology*, *46*(17), 9342-9349.