

# Project Update



## Unregulated Organic Chemicals in Biosolids: Prioritization, Fate, and Risk Evaluation for Land Application (5125)

**Reporting Period:** June 30 – October 1, 2023

**Principal Investigator:** Lola Olabode, The Water Research Foundation

### Objectives

This research seeks a better understanding of the occurrence, fate, and transport of chemical pollutants in land-applied biosolids, particularly those that may persist and/or accumulate in soils and biota. There are five main objectives, each supported by a series of tasks with task leads:

- Objective 1: Conduct data mining and modeling to prioritize unregulated organic chemicals (UOCs) by identifying chemicals with a higher propensity to be mobile and bioavailable following biosolids land applications
- Objective 2: Develop rapid standard methods for measuring mobile and bioavailable fractions of UOCs in biosolids
- Objective 3: Conduct field studies under different application scenarios to determine plant uptake, earthworm accumulation, leaching, and runoff of the high-priority UOCs at sites in California, Virginia, Illinois, and Indiana to support a national approach
- Objective 4: Evaluate risk assessment fate and transport models for their prediction accuracy using literature, laboratory, and field derived data
- Objective 5: Work closely with industry partners and community stakeholders to solicit input and develop risk-based optimal management practices to ensure safe land applications of biosolids nationwide.

### Activities and Progress

During this research period, the previous list of prioritized UOCs was refined. A database of 910 biosolids-borne chemicals was developed after compiling the United States Environmental Protection Agency's (USEPA's) lists of biosolids-borne chemicals. A screening approach reduced the number of priority UOCs to 125. Five scoring scenarios were evaluated: mobility and bioaccumulation; mobility and persistence; mobility, persistence, and toxicity; persistence, bioaccumulation, and toxicity; and mobility, persistence, bioaccumulation, and toxicity. The 125 priority UOCs were categorized into high and low priority. A total of 45 UOCs were classified as high priority, and the remaining 80 UOCs were classified as low priority. While the database and analysis of the highest priority UOCs has been completed, the overall results will be continually assessed throughout the project period. The University of California Riverside (UCR) team prioritized 44 UOCs. The finalized extraction methods for water/porewater and soil had acceptable recoveries, and the finalized biosolids extraction method provided acceptable recoveries for 42 of 44 targeted UOCs. The two UOCs having unacceptable recoveries were 3,3',5,5'-Tetrabromobisphenol A (TBBPA) and Triclocarban. Details of the methods will be presented for publication along with the UOC residue values from recycled irrigation water, field soil, and Class A biosolids used in field plot studies in selected California sites.



Development of a passive sampling assay using simple materials to estimate bioavailable and labile chemical concentrations represents a novel scientific undertaking for biosolids-borne contaminants that may contribute to better management and expansion of biosolids-use in agriculture. Preliminary validation of biosolids and soil extraction methods for UOCs were completed during this period in targeted sites in California, Indiana, Illinois, and Virginia. Field studies of the high-priority UOCs at these sites are ongoing. A few technical problems were encountered with the instrumentation from the previous reporting period. This still impacts the sample injection, and thus the validation of methods. The delay in the method validation also delayed the rapid assay methods. Procedural sampling mistakes resulted in re-sampling of a site area, delaying processing. The number and variety of compounds targeted poses a challenge for the non-PFAS UOC method validation; hence, the data analysis requires more time than anticipated. Added sampling areas have increased workload. The team continues to work with other grantees, industry, and biosolids community stakeholders, and they expanded outreach by participating at the Water Environment Federation's (WEF's) Circular Economy Water Summit in 2023.

## Communications and Outreach

- Warke, M., and D. McAvoy. Prioritization of Biosolids-Borne UOCs. Oral Presentation. Chicago, IL: USDA W4170 Annual Meeting, June 27, 2023.
- Warke, M. and D. McAvoy. Prioritization of Biosolids-Borne Unregulated Organic Compounds. Poster Presentation.

### For more information, contact:

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Cincinnati, OH: Postdoctoral Association at Cincinnati Children's Hospital Medical Center, September 19, 2023.

- Alvarez-Ruiz R., and L. S. Lee. Assessment of the PFAS accumulation and leaching to groundwater from biosolids land-applied as a waste management strategy. Indianapolis, IN: American Chemical Society (ACS) Spring 2023, Crossroads of Chemistry, March 26-30.
- Dennis, N. M., A. Braun, and J. Gan. LC-MS/MS and Extraction Methods for Targeted Analysis of a Complex Mixture of Environmental Concern in US Biosolids. Louisville, KY: The Society of Toxicology and Chemistry (SETAC) 44th Annual Meeting, November 13, 2023.
- Braun, A., N. M. Dennis, and J. Gan. Sorption of Biosolids-borne Unregulated Organic Chemicals (UOCs) in Soil. Louisville, KY: The Society of Toxicology and Chemistry (SETAC) 44th Annual Meeting, November 13, 2023.

## Future Activities

- Prepare publication on the prioritization of biosolids-borne UOCs in amended soils
- Finalize all analysis, extraction methods, and procedures for non-PFAS UOCs in biosolids and the UOC analysis for three sites on biosolids
- Complete the data processing for validation of the extraction and analysis procedures for non-PFAS UOCs in biosolids and soil
- Conduct field surveys, sample collection, analysis, and a Virginia site visit
- Conduct stakeholder meeting(s) at Purdue University in Lafayette, Indiana, March 2024

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