EXECUTIVE SUMMARY

WERF

WATER ENVIRONMENT RESEARCH FOUNDATION

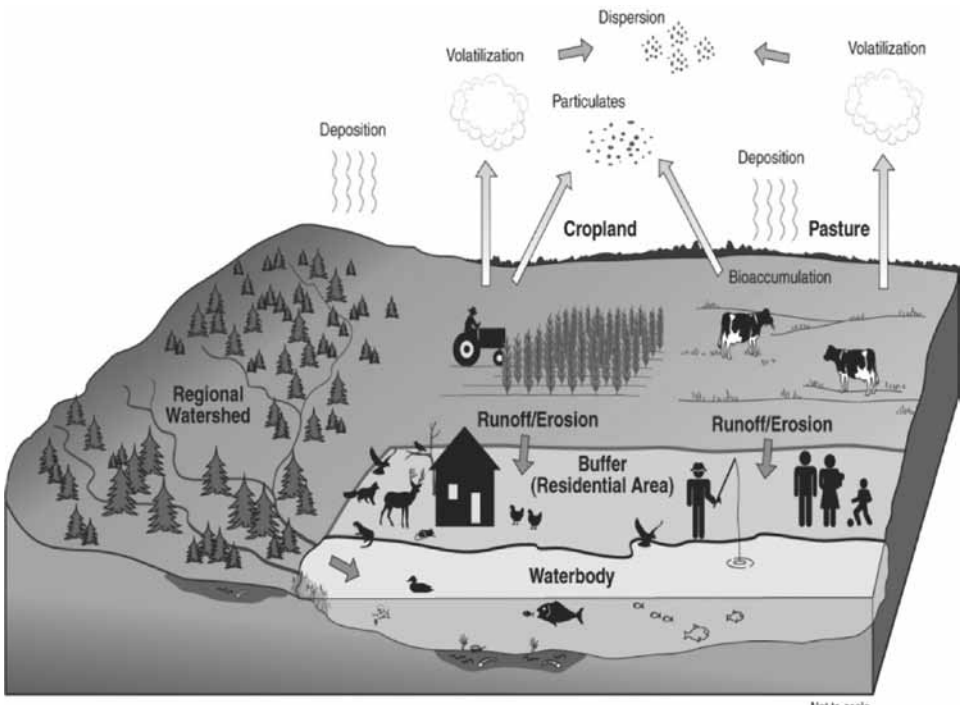
BIOSOLIDS

Trace Organic Chemicals in Biosolids-Amended Soils: State-of-the-Science Review

The presence of trace organic chemicals in municipal biosolids destined for land application was documented in the 2009 EPA Targeted National Sewage Sludge Survey. Risk assessments are needed to definitively determine whether there is any significance in the levels of trace organic chemicals found in biosolids-amended soils. This report identifies the data gaps that limit our ability to assess potential environmental and human health impacts of biosolids-borne trace organics in soils. The state-of-the science review is comprehensive in terms of the number of trace organic chemicals considered. The study provides the initial grouping of chemicals based on their importance in ultimately assessing any risk associated with trace organics in biosolids-amended soils.

Available Data Sources Were Thoroughly Evaluated

An evaluation was made to determine the trace organic chemicals of greatest interest in the terrestrial environment by categorizing them as *high priority* and *low priority*. The assessment was based on occurrence data and readily available information on basic properties such as bioaccumulation and toxicity. An evaluation of quantitative risk assessments was also conducted to identify the most important parameters for conducting ecological risk assessments and the techniques for obtaining the input parameter values. A minimum data set for risk modeling was identified. A comprehensive review identified the chemicals of greatest interest using data on their fate, transport, biotransfer from soil to plants and animals, and toxicity in the terrestrial environment. Based on the review, data gaps were identified for the parameters most important for conducting terrestrial risk assessments.



A Conceptual Diagram of the Exposure Pathways Considered in the U.S. EPA Risk Assessment.

BENEFITS

- Prioritizes the TOrCs of greatest interest based on occurrence and bioaccumulation data, environmental fate and transport characteristics, and toxicity.
- Provides a compilation of biosolids occurrence data for the targeted TOrCs.
- Provides an examination of risk assessment methodology used in the U.S. and Europe.
- Provides an overview of the physical, chemical, and biological processes affecting TOrC fate, transport, bioavailability, and toxicity in biosolids-amended soils for targeted TOrCs.

RELATED PRODUCTS

Fate of Estrogenic Compounds During Municipal Sludge Stabilization and Dewatering (04HHE6)

Evaluation of QSPR Techniques for Wastewater Treatment Processes (U2R07)

RELATED ONGOING RESEARCH

Categorizing Wastewater Treatment Processes by Their Efficacy in Reduction of a Suite of Indicator TOrC (CEC4R08)

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Priority was assigned to trace organic chemicals present at relatively higher concentrations in biosolids, as determined in the 2009 EPA Targeted National Sewage Sludge Survey or the 2006 USGS Biosolids Survey. Chemicals known to be toxic or bioaccumulative in aquatic systems were also considered high priority, regardless of concentration. In addition to the initial prioritization of chemicals and data gaps, the study provides:

- A comprehensive compilation of TOrC occurrence in biosolids.
- An examination of risk assessment methodologies used in the United States and Europe, identifying the minimum data set needed for ecological and human risk assessment modeling.
- A detailed overview of what is currently known about the physical, chemical, and biological processes affecting TOrC fate, transport, bioavailability, and toxicity in biosolids-amended soils for the targeted TOrCs.

Table 1. Generic Interpretation of Data Availability.

Tier 0	Essentially no data were available of this type for this class or subclass of TOrCs, including data that could be used for modeling.
Tier 1	For the majority of TOrCs in this class or subclass, some data were available, but available data are likely of limited utility or are limited to modeled systems only (i.e., not directly derived from experimental studies).
Tier 2	Useful data from experimental systems are available for a majority of TOrCs in this class or subclass, but most of the data are not directly applicable to biosolids-amended soils.
Tier 3	Substantial data of this type directly relevant for biosolids-amended soils are available, though some gaps in data may exist for specific TOrCs. For this class or subclass of TOrCs, data are available that have been measured in real world systems with biosolids-borne TOrCs and reasonable biosolids application rates, and/or in long-term field-based studies with appropriate attention to study design and QA/QC.

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Table 2. Summary of Data Availability for the High Priority Trace Organic Chemicals.

					Toxicity		
Chemical Class	**Occurrence**	**Mobility**	**Persistence**	**Bio-Availability**	**Human**	**Ecological**	**Microbial Impacts**
Brominated Flame Retardants (BFRs)	Tier 3	Tier 1	Tier 1	Tier 2	Tier 0	Tier 0	Tier 0
Perfluorochemicals (PFCs) and PFC Precursors	Tier 1	Tier 2	Tier 1	Tier 0	Tier 0	Tier 0	Tier 0
PPCPs: Antimicrobials	Tier 3	Tier 2	Tier 3	Tier 1	Tier 0	Tier 0	Tier 1
PPCPs: Antibiotics	Tier 3	Tier 2	Tier 1	Tier 0	Tier 2	Tier 0	Tier 1
PPCPs: Musks	Tier 3	Tier 2	Tier 3	Tier 2	Tier 1	Tier 0	Tier 0
PPCPs: Other	Tier 3	Tier 0	Tier 0	Tier 0	Tier 2	Tier 0	Tier 0
Plasticizers	Tier 3	Tier 2	Tier 1	Tier 1	Tier 1	Tier 0	Tier 0
Steroidal Chemicals	Tier 3	Tier 2	Tier 2	Tier 1	Tier 2	Tier 0	Tier 0
Surfactants	Tier 3	Tier 2	Tier 0	Tier 1	Tier 1	Tier 0	Tier 0