

**Technical Review Workgroup for Metals and Asbestos
Bioavailability Committee Annual Report:
Accomplishments and Activities for Calendar Year 2021**

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TRW Bioavailability Committee Accomplishments of 2021

Reports and Guidance on the Bioavailability of Metals in Soil

1. **Guidance for Sample Collection for In Vitro Bioaccessibility Assay for Arsenic and Lead in Soil and Applications of Relative Bioavailability Data in Human Health Risk Assessment (OSWER 9200.3-100a)**

Completed and posted updated sampling guidance to support soil arsenic and lead relative bioavailability (RBA) assessments at sites. The update provides guidance on data quality objectives for RBA sampling, sample planning, application of RBA data in human health risk assessment, frequently asked questions, and case studies. The guidance is available at: <https://semspub.epa.gov/work/HQ/100002712.pdf>

2. **Regional Training Sessions for the IVBA Sampling Guidance for Relative Bioavailability (RBA) for Lead and Arsenic**

Developed training videos and materials for EPA Regional training sessions on application of the updated RBA sampling guidance. Training sessions were presented to risk assessors and risk managers in Regions 1, 2, 4, 5, and 10.

3. **Virtual Tool for Planning and Evaluating Sampling Plans for Site Assessment of Soil Arsenic and Lead Bioavailability**

This tool supports the updated RBA sampling guidance which emphasizes the importance of Data Quality Objectives in designing and evaluating sampling plans. A prototype was developed that allows risk assessors and risk managers to estimate numbers of soil samples needed to achieve clean-up decision errors established in sampling Data Quality Objectives. The tool accounts for expected variance in soil concentration and RBA, analytical error in measurement of concentration and IVBA, and error in predicting RBA from IVBA. The tool can be used to evaluate discrete sampling and incremental composted sampling designs.

4. **Layperson Fact Sheets on Methods to Assess Lead and Arsenic Bioavailability**

Continued development of Fact Sheets intended for nontechnical users to provide an overview of measurement and application of lead and arsenic relative bioavailability.

5. **Flat Creek Reference Soil Material (FCRM) for Lead and Arsenic**

In collaboration with U.S. Geological Survey (USGS), the TRW Bioavailability Committee continued development of a new soil Reference Material for lead and arsenic, using material collected from a Superfund site in Region 8. The new Reference Material is intended to replace the depleted National Institute of Standards and Technology Soil Reference Materials (SRMs; NIST 2710 and NIST 2711), and to be used as Quality Control standards in analyses of arsenic and lead levels in soil IVBA assays (Method 1340). New studies provide information on RBA of lead and arsenic for the FCRM using the mouse model.

6. **Flat Creek Reference Soil Material (FCRM) Specification Sheet**

Completed development of the specification sheet for the FCRM. The FCRM was developed in collaboration with U.S. Geological Survey (USGS) and the TRW Bioavailability Committee to development of a new soil Reference Material for lead and arsenic, using material collected from a Superfund site in Region 8. The new Reference Material is intended to replace the depleted National Institute of Standards and Technology Soil Reference Materials (SRMs; NIST 2710 and NIST 2711), and to be used as Quality Control standards in analyses of arsenic and lead levels in soil IVBA assays (Method 1340).

Communication, Training, and Outreach

1. **Hotline:** The TRW Bioavailability Committee responds to questions from inquiries made either by telephone to the TRW Bioavailability Committee hotline (toll-free 1-866-282-8622) or via bahelp@epa.gov. The TRW Bioavailability Committee responded to two requests for assistance in 2021 from EPA Regions and one request from a consultant to the Texas Commission on Environmental Quality. Requests were for the following information:
 - a. Use of amendments to reduce bioavailability of lead in soil;
 - b. Site-specific bioavailability testing for lead;
 - c. Application of soil metal bioavailability sampling guidance tool for site-specific application of bioavailability data for arsenic in soil.
2. **Publications/Presentations/Training:**
 - a. Betts AR, Millard G, Plunkett S, Johnson M, Eckley C, Luxton T. (2021) Effect of biochar types and characteristics on fluxes of mercury from a mercury-contaminated soil. Poster Presentation. ASA-CSSA-SSSA International Annual Meeting. Salt Lake City, UT, 2021 (virtual).
 - b. Bradham KD, Lambert M. (2021) Bioavailability, bioaccessibility and innovative remediation methods. Sustainable and healthy communities. Board of Scientific Counselors Subcommittee (BOSC) Contaminated Sites Research, March 2021. ORD-041380.
 - c. Giggs JL, Thomas DJ, Fry R, Bradham KD. (2021) Improving the predictive value of bioaccessibility assays and their use to provide mechanistic insights into bioavailability for toxic metals/metalloids - A research prospectus. J Toxicol Environ Health, Part B Crit Rev 24:307-324.
 - d. Karna R, Noerpel M, Nelson C, Elek B, Herbin-Davis K, Diamond G, Bradham K, Thomas DJ, Scheckel, KG. (2021) Bioavailable soil Pb minimized by in-situ transformation to plumbojarosite. Proc Natl Acad Sci 118(3):e2020315117.
 - e. Sowers TD, Diamond G, Thomas DJ, Bradham KD. (2021) High lead bioavailability of indoor dust contaminated with paint lead species. NC State Postdoctoral Research Symposium, STICS ORD-041897.

- f. Sowers TD, Diamond G, Thomas DJ, Bradham KD. (2020) High lead bioavailability of indoor dust contaminated with paint lead species. Abstract for Soil Science Society of America, November 2020. STICS ORD-038071.
- g. Sowers TD, Diamond G, Thomas DJ, Bradham KD. (2020) High lead bioavailability of indoor dust contaminated with paint lead species. Oral presentation Soil Science Society of America, November 2020 (virtual).
- h. Sowers TD, Nelson CM, Blackmon MD, Jerden ML, Kirby AM, Scheckel KG, Diamond GL, Bradham KD. (2022) Interconnected soil iron and arsenic speciation effects on arsenic bioaccessibility and bioavailability: A current state of science. *J Toxicol Environ Health, Part B Crit Rev* 25(1): 2022.
- i. Sowers TD, Nelson CM, Diamond GL, Blackmon MD, Jerden ML, Kirby AM, Noerpel MR, Scheckel KG, Thomas DJ, Bradham KD. (2020) High lead bioavailability of indoor dust contaminated with paint lead species. *Environ Sci Technol* 55:402-411.

3. **Website:** The TRW continues to support the incorporation of materials as appropriate.

Coordination/Support with States, Regions, EPA Program Offices, and Other Federal Agencies

1. **EPA Region 3:** Provided review and consultation regarding a remedial investigation/feasibility study of the Jackson Ceramix Superfund site. This consultation provided comments on a study of effectiveness of amending agents (humic acid, phosphate) or decreasing soil lead bioavailability.
2. **USGS:** Continued collaboration for the development and analysis of a new lead and arsenic soil Reference Material. The BAC reviewed and finalized reports of round robin studies to derive a consensus value for arsenic and lead *in vitro* bioaccessibility for a new soil reference material (FCRM).
3. **EPA Region 2:** Provided review and consultation regarding a pilot scale study remediation of Lead (Pb) at the Burnt Fly Bog Superfund site by soil amendment application. Soil amendments included apatite for phosphate source and ‘reactive substrate’ containing compost and gypsum as a source of phosphorus and sulfur. This consultation involved field sampling and analysis of Pb solubility and speciation of amended plots. This consultation also involved installation of shallow groundwater monitoring wells. Treatment efficacy measured by change in porewater lead concentration and solid phase Pb speciation.

TRW Bioavailability Committee Plans for 2022

1. **Outreach - training on application of the arsenic and lead IVBA sampling guidance.** Continue training sessions and develop additional training materials for EPA regions on application of the Arsenic and Lead IVBA Sampling Guidance.

2. **RBA sampling tools and research**
 - a. **Software Tool.** Continue development of the software tool for estimating RBA sampling requirements to support DQOs
 - b. **Manuscript Development.** Develop a publication on quantitative analysis of error in estimation of RBA-adjusted exposure point concentrations
3. **Arsenic and lead RBA/IVBA layperson fact sheets.** Finalize general Fact Sheets describing RBA and IVBA methods to assess arsenic and lead. The target audience for these fact sheets is EPA Community Involvement Coordinators and Public Affairs Officers.
4. **Manuscript development for the Flat Creek Reference Material for lead and arsenic.** Develop publication on the new reference material development, including analyses by lead and arsenic IVBA, EPA Method 3051A, and *in vivo* RBA assays
5. **Refinement and evaluation of mouse assay for lead bioavailability.** Evaluate contaminated and amended soils in mouse model assay for continued development of mouse assay for use in assessing *in situ* lead amended soils.
6. **Update arsenic and lead IVBA SOP**
 - a. Revise the arsenic and lead IVBA SOP to include consensus values for the Flat Creek Reference Material.
 - b. Conduct a round robin analysis for NIST 2710a to assess potential drift in values.
7. **Development of soil lead and arsenic remediation technologies that utilize laboratory synthesized amendments.** Assess the long-term stability of lead/arsenic remediation technologies, including phosphate and jarosite, under field conditions for soils of heterogeneous chemical characteristics.
8. **Evaluate IVBA-RBA prediction model for lead and arsenic for soils sieved to <150 µm.** Conduct grain size analysis archived soils to measure grain size and determine if grain size distribution affects the IVBA-RBA relationship.
9. **Develop an IVBA assay to predict lead bioavailability in amended soils.** Initiate development of a lead IVBA assay to determine lead bioavailability in phosphate amended soils. Currently, this can only be assessed using *in vivo* assays.
10. **Evaluation of lead bioavailability in paired soil and indoor house dusts.** Analyses of samples collected in American Healthy Homes Study II (AHHS) to quantify lead concentrations in drinking water, soils, and indoor house dusts, and quantify lead bioavailability in a subset of paired soils and indoor house dusts.

11. **Evaluation of *in vitro* models of human intestinal cells for assessing soil lead bioavailability.** Evaluate a three-dimensional *in vitro* model of the human small intestine to estimate soil lead bioavailability.
12. **TRW Bioavailability Committee business**
 - a. **Biennial Meeting.** Plan for in-person biennial Meeting for October/November 2022.
 - b. **Annual Report.** Develop the Calendar Year 2022 Bioavailability Committee Annual Report.