October 2018

WORKPLAN

For

METALS COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT

Between

The United States Environmental Protection Agency

And

Aluminum Association, Aluminum REACH Consortium (ARC), Cobalt Institute, International Copper Association, Copper Development Association, International Lead Zinc Research Organization, International Zinc Association, NiPERA Inc.

Title of Project: Development of an overarching bioavailability modeling approach to support updating US EPA Aquatic Life Water Quality Criteria for metals

Objective

This five-year CRADA is expected to support *EPA's Draft FY 2018-2022 Strategic Plan Goal 1: Provide for Clean and Safe Water: Protect and Restore Water Quality* by working with external technical experts to identify an overarching, simplified modeling approach to predict the bioavailability of a variety of metals under the range of water chemistry conditions found in aquatic environments. This overarching modeling approach is intended to facilitate expedient and efficient development and implementation of Aquatic Life Ambient Water Quality Criteria for a number of metals. The resulting peer-reviewed modeling approach is expected to provide a framework for EPA to then work with individual metals associations to develop specific bioavailability models in support of EPA updating Aquatic Life Ambient Water Quality Criteria for metals. This activity is intended to better support states, territories and tribes with criteria that reflect the best available science and are easier to implement than current approaches.

Background

EPA has developed recommended aquatic life criteria for 10 metals (aluminum, arsenic, cadmium, chromium (III and IV), copper, iron, lead, nickel, silver, and zinc); several of these criteria were developed in the 1980's and have not been updated to reflect the latest scientific knowledge. Current science demonstrates that water chemistry parameters (*e.g.*, pH, dissolved organic carbon, and hardness) can affect the toxicity of metals by affecting the bioavailability of metals in the water to aquatic species. Several recent criteria efforts (Freshwater Copper, Draft Saltwater Copper, and Draft Aluminum) have already been updated to reflect these relationships using different modeling approaches.

Approach

Phase I – Development of an overarching modeling approach to predict the bioavailability metals

Through this collaboration, EPA and technical experts from metals associations intend to work together to identify a simplified, user-friendly, transparent, and easily implemented modeling approach to predicting bioavailability and toxicity of metals to aquatic organisms.

This effort will include:

- Reviewing and comparing the complexity, accuracy and usability of a variety of existing models.
    - This includes considering model types (e.g., Biotic Ligand Model (BLM) and Multiple Linear Regressions (MLR)) and the number of water chemistry parameters necessary to sufficiently capture ambient water chemistry impacts on bioavailability.
- Reviewing data quality of ecotoxicity datasets used for model development for individual metals and datasets potentially used for criteria derivation.
    - This effort will begin with two case studies (copper and aluminum) and expand to other metals as data and resources allow.
- Creating awareness of the CRADA effort outside of the partnership and engaging potential end-users (e.g., states) to assist with identifying priorities and criteria needs.

Once an overarching approach is identified by work with the collaborators, EPA plans to request that the recommended overarching modeling approach undergo external scientific peer review by EPA's Science Advisory Board (SAB).

This effort is supported by a SETAC North America sponsored Technical Workshop, "*Bioavailability-Based Aquatic Toxicity Models for Metals*", which occurred on December 3-7, 2017, and provided a mechanism for collaboration with a diversity of technical experts from

academia, consulting, federal government and industry. The Workshop will result in five publications summarizing the history, state of the science, and recommendations regarding the use of bioavailability-based models to predict toxicity to aquatic organisms, and be submitted to SETAC's journal, *Environmental Toxicology and Chemistry*, in 2018. The topics are:

1. State of the science of metals bioavailability in natural waters
2. Metal bioavailability models: current status, lessons learned, considerations for regulatory use, and the path forward
3. Guidance on the development of empirical bioavailability models for deriving water quality criteria for metals
4. Validation of bioavailability-based toxicity models for metals
5. Application of bioavailability-based metals freshwater toxicity models for criteria derivation using acute and chronic species sensitivity distributions.

Expected Deliverables (2018-2019):

1. SETAC Annual Meeting (November 2018) - EPA and collaborators will meet, describe the 2017 SETAC Technical Workshop, and engage with scientists and others on the CRADA effort.
2. Phase I report to inform SAB review - Detailed justification for model selection and key parameters required (*e.g.*, pH, hardness, DOC, and temperature), model comparisons/case studies, and recommendations for potential SAB review.
3. Response to SAB peer-review comments.

Phase II – Development of models to predict the bioavailability and toxicity of specific metals

Once an overarching modeling approach has been identified and reviewed by the SAB, EPA intends to work with the individual metals CRADA collaborators to develop and optimize the underlying bioavailability models applicable to specific metals to support Aquatic Life Ambient Water Quality Criteria development, expected to be based upon Phase I outcomes. EPA and collaborators may select to develop a single bioavailability model platform with modules for each specific metal that reflect the data and impact of water chemistry on specific metals, as appropriate. The goal of Phase II is to complete the models for specific metals represented by collaborators within the 5 years of the CRADA. EPA is expected to subsequently develop draft 304(a) criteria considering these models.

Expected Deliverables (2019-2022):

1. Determine order and timeline of metals model/criteria development – Based on balancing scientific readiness and priorities depending on environmental protection and end-user (e.g., states) needs, determined in part based on information collected in Phase I.
2. Gather/generate and review data on specific metals necessary for model development and EPA's subsequent criteria derivation.
3. Specific metal model development.
4. These steps and deliverables would be followed by peer-review of models.

Conclusions

As a result of the collaboration supported by the CRADA, EPA and experts in the field intend to work together to identify a simplified, overarching approach, reflecting the current state of the science, for predicting bioavailability and toxicity of metals to aquatic organisms. This overarching approach is expected to support expedient and efficient development of bioavailability models for each metal, beginning with the six metals represented in this collaboration.

EPA intends to subsequently develop draft Aquatic Life Ambient Water Quality Criteria, submit the drafts for independent, external peer review, publish the drafts for public comment, revise the drafts, and finalize the updated Aquatic Life Ambient Water Quality Criteria. These models and criteria are intended to better support states, territories and tribes with criteria that reflect the latest scientific knowledge and are easier to implement than existing approaches.