REQUEST FOR PROPOSALS

Development of a Roadmap for DBP Toxicity Tools, Surrogates and Indicators to Help Utility Decision Making (RFP 4944)

Objective

The objective of the workshop and report is to develop a 10-year vision for the drinking water research community with a suggested research roadmap that will answer outstanding questions related to the assessment of relative risks from disinfection byproducts (DBPs) in drinking water. Specifically, the roadmap should outline the questions and research projects that will be needed to provide municipal water utilities with chemical and bioanalytical tools to assess relative risk from DBPs in drinking water after different treatment trains or water qualities, and include strategies to identify indicators or surrogates for potential human biological responses to inorganic and organic DBPs in drinking water. Moving beyond TOC, TOX, THMs, and HAAs, a workshop will identify the path forward that will eventually determine what assays, tools, surrogates or indicators (chemical or biological) are best suited to provide an overall risk reduction strategy.

Budget

Proposals requesting The Water Research Foundation (WRF) funding in the range of **$ 75,000** will be considered for this effort. Total funds requested from WRF will be taken into consideration in the final proposal selection process.

Background

In the last decade, nearly 700 DBPs have been identified in treated water. Chemical analysis of so many individual species presents a significant technical, financial, and risk management challenge for water utilities. The current body of DBP exposure and toxicology research suggests that further reduction of risks posed by DBPs in drinking water will require a new approach rather than measuring every possible DBP specie and determining the relative toxicity of each specie. This may be useful to federal agencies during the development of an individual

or class of DBPs regulation. However, such approaches are costly, cumbersome, and typically out of reach for most utilities to make decisions regarding changes in treatment technologies (e.g., adoption of granular activated carbon versus advanced oxidation) or changes in disinfection strategies (e.g., ozone, chlorine, chloramines, chlorine dioxide, UV).

Risk is a function of both DBP occurrence concentrations and toxicity. Water utilities face the challenge of dealing with mixtures of DBPs, often having concentrations that differ by orders of magnitude, as well as having different toxicities. While water utilities typically adopt treatment technologies to meet current regulations for individual or classes of DBPs, there is growing interest in understanding potential unintended consequences of treatment changes on the potential formation of unknown or currently nonregulated DBPs that may or may not be regulated in the future.

Research supported by WRF over the past decade has applied many bio-assay related toxicity testing platforms to understand relative toxicity of individual DBPs. Mammalian cell lines, bacterial cells, zebra fish and their embryos, and various gene assays have been applied to understand relative cyto- and/or geno-toxicity of emerging DBPs. Some of these assays are performed in a very small number of laboratories, with limited intra-laboratory comparisons, while others can be high throughput and may be more widely accessible to the water community. Various "organ-on-a-chip" platforms have been applied to study disease or assess toxicity of industrial chemicals. Animal (rat, mouse) testing is significantly costlier than bio-assays. Generally, similar patterns have emerged where iodinated DBPs are more toxic than brominated and chlorinated analogs. However, application of these testing platforms on drinking waters containing mixtures of DBPs often requires pre-concentration and interpretations of results that are difficult translate into actionable information utilities can use to make decisions on selection or operation of treatment technologies at specific locations.

Currently, the typical tools to assess DBP exposure risk are measurements of occurrence of the individual DBPs, typically the nine regulated DBPs, and modeled predictions based on the chemistry of DBP formation. Successful surrogates would be useful for both planning purposes and as real-time *actionable information* for utility operations (e.g., modify coagulant dosing, modify filter run time, increase disinfectant residual, etc.). Once developed and fully evaluated, indicators/surrogates would allow utilities to assess changes in toxicity to guide risk management decisions, including (1) selection of water treatment plant processes, (2) evaluation of source waters for treatment, and (3) performance of ongoing water treatment operations.

Research Approach

The project would include a workshop convening experts from the water industry, environmental toxicology, and other fields, to develop a research roadmap for development of rapid indictors/surrogates for DBPs produced during drinking water treatment. The workshop should include a group consensus of current strengths and weaknesses of existing toxicity assay platforms. The workshop would look beyond the assays currently available today and develop

a list of objectives that toxicity assays should be able to address by the year 2028. To identify clear objectives for toxicity assay development, workshop participants would answer key questions that define the use of scenarios and resulting performance criteria for new toxicity assays:

1. What operational or technology selection decisions will a water utility in 2028 make based on DBP toxicity assay results?
2. What sampling and analysis frequency must be maintained to support targeted operational/technology selection decisions, and what cost level is acceptable for these use scenarios to be sustainable?
3. What is the appropriate proficiency level for sampling, analysis, and interpretation of assay results (e.g., Should the assays be automated, processed by water treatment plant operators, processed by approved laboratories, or intra-laboratory validated research facilities)?
4. Can DBP toxicity be separated for general toxicity from other chemicals in finished drinking water?
5. Should assay results be quantitative or qualitative (e.g., A is lower than B)?
6. What is the value of different end-points (e.g., cytotoxicity, genotoxicity, gene expression/suppression, biomarkers) to the water industry?
7. Are bioassays best used in research rather than water treatment operations?
8. Are there surrogates or indicators that correlate well with bioassay responses?

Upon identification of criteria for bioassays, the workshop would attempt to develop a timeline for the types of projects or discoveries that would need to be achieved every 2 years from the present to the year 2028 to realize a suitable suite of chemical and biological assays for the water industry. The roadmap would be published and serve as a guide for future research on nonregulated DBPs.

Due to logistical constraints, it is likely that the total number of workshop participants will be limited to 25 to 30 researchers. The identified researchers will have to represent various key topics around nonregulated DBPs. There is a much larger community of researchers with relevant expertise. WRF is open to gathering, and would appreciate project approaches that garner, informed, well-organized input to inform the workshop discussion from the broader expert community.

The selected facilitator for this workshop is expected to prepare a high-level summary of research conducted by WRF, EPA, and other entities on nonregulated DBPs. The primary focus will be on the research conducted in the last 7 to 10 years in this topic area. This high-level summary will address the findings on various groups of DBPs (e.g., nitrogenous DBPs) that have been researched, along with the analytical methods and toxicity assessment methods utilized in those research projects. Proposed future research ideas suggested in the recently completed projects will also be compiled in this summary and presented in reasonable categories.

To develop the list of participants, the workshop facilitator is expected to consult with the principal investigators of the recently completed bioassay research projects conducted with the water sector in mind; engage manufacturers that have moved similar tools from concept to implementation in other sectors; and involve experts with an understanding of how water treatment plant design and process control manages variability in influent water quality and ongoing process performance. A preliminary list will be developed and will be reviewed by the WRF representative and PAC members. After developing the final list, the facilitator is expected to convene and conduct the workshop. Workshop participants will be provided with the summary described in the previous paragraph along with a list of key questions to prepare for active participation at the workshop. After the completion of the workshop, a report will be generated summarizing the findings. The following key topics will be addressed in the workshop report:

- High level summary of completed research on nonregulated DBP occurrence and toxicity;
- Consensus of current strengths and weaknesses of existing toxicity assay and surrogate platforms;
- Criteria for the use of toxicity assays and surrogates in the future;
- Key research questions identified by previous researchers in distinct categories;
- Identification of the nonregulated DBP landscape in coming decades;
- Data gaps from current status to the future status;
- Identification of key research topics as milestones in the roadmap to 2028.

Proposal Submittal Instructions

Proposals should be submitted to EmOpp@waterrf.org by 3PM MT on August 7, 2018. For proposal submittal questions please contact Caroline Bruck, Senior Administrative Assistant, at cbruck@WaterRF.org (303-347-6118). For technical questions about the RFP, please contact Djanette Khiari, Research Manager, at dkhiari@waterrf.org (303-734-3478). Proposals must be submitted in one Adobe Acrobat (.pdf) file. The Emerging Opportunities Program has unique proposal requirements. Please follow the submission instructions below and do not reference requirements of other research programs. Proposals not adhering to the restrictions below will not be accepted.

The entire proposal, excluding the proposal cover worksheet, resumes, budget form, budget narrative, co-funding support form (when applicable), schedule, and references, should **not exceed six pages in length**. Proposals must include the following components.

- **Proposal Cover Worksheet** - See the Emerging Opportunity Program Worksheets section at: http://www.waterrf.org/funding/Pages/proposal-guidelines.aspx
- **Background and Statement of Need**– Provide a brief summary of the current state of knowledge for the issue that the proposed research will help address, and the drivers for the proposed research. This section should clearly articulate:
  1) How this work compares to past or ongoing related research.

2) If the proposed work is duplicative of past research efforts, why this additional work is needed.

- **Objectives** – The proposed research objectives should be clearly identified in one or two sentences.
- **Technical Approach** – Describe how the proposed research will be conducted and the tasks necessary to accomplish the objectives.
- **Benefit to WRF Subscribers** – Identify the practical benefits of the proposed research to water utilities and the water community.
- **Research Team and Other Participants** – Identify the key members of the research team and provide brief statements of their qualifications to conduct the proposed research. Identify any other organizations that have committed to collaborate on the proposed research. Curriculum vitae or resumes for research team members are required.
- **Budget**– A detailed budget is required. The researcher should identify the amount of WRF funds requested and any other cost-share, in-kind, or cash support for the proposed research. The following items will need to be included with the budget. They can be found in the Emerging Opportunities Research Program Worksheets section at http://www.waterrf.org/funding/Pages/proposal-guidelines.aspx
    - Budget Form for Proposals
    - Budget Narrative
    - Emerging Opportunities Co-Funding Support Form (when applicable): Each co-funding organization providing cash to the project payable directly to WRF must complete a separate Emerging Opportunities Co-Funding Support Form and include it with the proposal package.
- **Schedule** - A detailed schedule is required.
- **References** (optional) – detailed citations are not required in the proposal, but may be provided at the discretion of the researcher.

Proposal Review and Funding Decision

WRF will form a Project Advisory Committee (PAC) composed of volunteer professionals with expertise in the research subject area to oversee the project(s) funded through this solicitation. Proposals will be reviewed by WRF staff and the PAC against established evaluation criteria. WRF may request additional information from the researcher based on this review, and interviews may be conducted for the top three proposals. Proposals are treated confidentially and will not be shared outside of WRF.

The proposal review and selection process, from initial submittal through final decision, generally will not exceed 3-4 weeks.