Upper Mississippi River Basin
Water Quality-Related Science Needs

Provided to U.S. EPA Region 7 from the
Upper Mississippi River Basin Association Water Quality Executive Committee

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At the November 17, 2010 meeting of the Upper Mississippi River Basin Association (UMRBA) Water Quality Executive Committee (WQEC), Region 7's Water, Wetlands, and Pesticides Division Director Art Spratlin requested the states' input regarding water quality-related science needs in the Upper Mississippi River (UMR) basin. Spratlin requested this input to share with U.S. EPA's Office and Research and Development (ORD), given Region 7's ORD liaison role.

The following is a summary of science needs identified by UMRBA's WQEC and Water Quality Task Force (WQTF) in response to this request. It is a comprehensive list of all the ideas put forth by the WQEC and WQTF. As such, it includes more possibilities than ORD can likely address in the near term and may also include items that fall outside of ORD's mission. Thus we recognize that this list is a starting point for discussion and would welcome further conversation as these ideas are explored, actionable items identified, and priorities established.

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1) Extrapolating Data for Clean Water Act Purposes

A large amount of water quality and related (e.g., biological) data is available for the UMR mainstem. However, much of this data has not been collected with Clean Water Act (CWA) purposes in mind. Therefore, data sets often do not provide for full spatial coverage (longitudinally and laterally) and/or do not align with existing state water quality criteria.

In particular, the Long Term Resource Monitoring Program (LTRMP), which is part of the U.S. Army Corps of Engineers' Environmental Management Program, has compiled extensive water quality, physical, and biological data for the UMR mainstem. LTRMP's monitoring is very intensive in terms of its spatial coverage within sampled pools, the number of parameters measured, and seasonal coverage (for some parameters). As such, LTRMP is the single most comprehensive ongoing UMR monitoring program. However, it is limited to five study pools on the UMR (Pool 4, Pool 8, Pool 13, Pool 26, and the Open River) and one on the Illinois River (La Grange).

A critical science need is to determine whether, and to what extent, LTRMP data can be extrapolated to portions of the UMR beyond the study pools, for purposes of:

a) determining compliance with current water quality standards,

b) developing new/revised water quality standards (such as biological or nutrient-related standards),

c) determining compliance with any new/revised water quality standards, and

d) aiding the development of a comprehensive UMR CWA monitoring strategy.

U.S. EPA's assistance in examining these issues and helping develop tools or guidance for the states to use in extrapolating data would be of great value as the states seek to improve their ability to assess the UMR under the CWA.

2) Supporting the States' Capacity to Implement Biological Assessment

As the states move toward integrating biological assessment into their UMR CWA programs, as is currently happening via the UMRBA's biological assessment guidance document project, there will be a continuing need to address science questions emerging along with expanding implementation. For example, the current UMRBA project is examining questions regarding condition classes and attainment thresholds in the river's main channel (based on a limited number of biological assemblages) and has benefited greatly from work done by U.S. EPA's Environmental Monitoring and Assessment Program. However, significant scientific work remains to examine similar questions in other river strata (e.g., backwaters) and to expand the number of assemblages incorporated in order to provide more robust, comprehensive and accurate CWA assessments. Providing assistance to the states in addressing questions such as these will be essential in supporting their ongoing UMR biological assessment efforts.

3) Addressing Nutrient-Related Research Needs

Watershed-Specific Factors Affecting Nutrient and Sediment Loading

Reducing nutrient and sediment inputs to the Mississippi River remains an ongoing challenge and the UMR states share an interest in better understanding the factors that affect loading to UMR tributaries and the mainstem. While a number of models and approaches (e.g., SPARROW and SWAT modeling, phosphorus indices, etc.) have been developed to provide insight into nutrient loading at various scales, a need remains a need to better understand watershed-specific factors including:

a) the influence of hydrologic modification (e.g., tiling systems), geology, and topography on nutrient and sediment loading

b) the role of bluff and bank erosion, in-stream erosion, and field sources in nutrient and sediment loading, and

c) nutrient budgets and mass balance in UMR tributaries and the mainstem.

Research in these areas can provide valuable information to the states as they proceed in their nutrient reduction efforts, particularly in targeting agricultural BMP implementation.

Estimating Pre-Settlement Nutrient Levels

While some work has been done on the UMR mainstem (i.e., Lake Pepin) to estimate pre-settlement nutrient levels, expanded work in this area is needed for other parts of the mainstem and the basin as a whole. This type of information is valuable for comparing current conditions to historic conditions, developing nutrient criteria, and calculating TMDL allocations.

Related Monitoring Needs

Enhanced monitoring is needed to both better characterize nutrient and sediment levels and assess the success of reduction efforts. This is particularly important in the context of targeted efforts such as the Mississippi River Bain Healthy Watersheds Initiative (MRBI). Monitoring data will also valuable in understanding links between nutrient levels and UMR aquatic community health (see # 4 below). While the need for enhanced monitoring is primarily an implementation and resource allocation challenge, rather than a science question, any scientific guidance in optimizing nutrient and sediment monitoring for the UMR and its basin would be of great value.

4) Examining Causal Linkages between Nutrient Levels, Related Parameters, and Aquatic Community Health

Improved Understanding of UMR-Specific Interactions

In order to better assess the impacts of nutrients on UMR CWA aquatic life designated uses, the states and U.S. EPA would be well served by further investigation into the causal linkages between nutrient levels, excessive primary production, and the health of aquatic communities in the UMR mainstem. While research exists that directly links phosphorus to destructive algal blooms in northern US states, and

nitrogen to the hypoxic zone in the Gulf of Mexico, the connection of phosphorus and nitrogen concentrations to the condition of various aquatic assemblages across the lateral strata of the UMR is not well established.

Standardizing and Expanding Metaphyton Monitoring, Examining Impacts on Aquatic Communities

While metaphyton (i.e., filamentous algae and duckweed) blooms in the UMR's off-channel areas are a visible expression of elevated nutrient levels, metaphyton monitoring to date on the River has been limited. LTRMP and Wisconsin DNR staff have recently developed a quantification protocol and collected data for three UMR pools. Support in standardizing and expanding such monitoring would help quantify the occurrence of algal blooms and related surface plant growth. Moreover, U.S. EPA's assistance in examining the data collected by such efforts, in order to elucidate relationships between metaphyton and UMR aquatic community health (and thereby determine whether metaphyton is a useful response variable for assessing CWA aquatic life use attainment), would be extremely valuable.

Relationships Between Nutrients, Dissolved Oxygen, and Aquatic Life

Current research is not definitive on the question of how fluctuations in dissolved oxygen (DO) concentrations, particularly moderate fluctuations near existing criteria levels, impact aquatic life. More investigation is needed into whether average daily concentrations, daily minima, daily ranges, or weekly or monthly values are most closely correlated with aquatic community health, while accounting for differences across the lateral strata of the UMR, and for off-channel areas in particular. These types of investigations are relevant to nutrient issues as nutrient-triggered algal blooms can result in reduced DO concentrations and/or increased daily DO fluctuation. In addition, the impact of zebra mussels and aquatic vegetation on DO levels warrants further investigation, particularly in terms of how these impacts are expressed in the UMR's main channel.