Upper Mississippi River Basin Association Project Summary

Upper Mississippi River Nutrient Monitoring, Occurrence, and Local Impacts: A Clean Water Act Perspective

Background

Phosphorus (P) and nitrogen (N) are necessary for aquatic life, but at elevated concentrations these nutrients can lead to adverse affects on both aquatic life and human uses of a water body.

Nutrients are often cited as a water quality concern on the Upper Mississippi River (UMR), particularly in terms of the UMR's contributions to Gulf of Mexico hypoxia. However, while Gulf hypoxia is a critical national issue, it may be less central to informing and motivating actions on a state and regional scale than local water quality impacts such as algal blooms, fish kills, and effects on drinking water supplies.

This project, undertaken by the Upper Mississippi River Basin Association (UMRBA) Water Quality Task Force, brought together data and research in order to examine the status of UMR nutrient monitoring and the occurrence of nutrients – both current and historic – on the UMR. The project also investigated nutrient impacts on the UMR's mainstem and how these affect attainment of Clean Water Act (CWA) designated uses.

The project was intended to inform the UMR states' ongoing water quality protection and nutrient reduction efforts.

The Upper Mississippi River basin, mainstem, and tributaries.

Project Process and Report

Project efforts included compilation and synthesis of existing information, a survey of water suppliers, and two work group sessions. The results of this work are detailed in the project report entitled: *Upper Mississippi River Nutrient Monitoring, Occurrence, and Local Impacts: A Clean Water Act Perspective*. The report presents a range of findings and recommendations for the states' consideration, with the understanding that it certainly will not be feasible to pursue all of the recommendations in the near term.

Project participants included CWA program staff, as well as representatives of other UMR programs and interests. Their contributions were essential to the project's success.

Findings and Recommendations

Major project findings and recommendations are as follows:

Monitoring and Data Collection

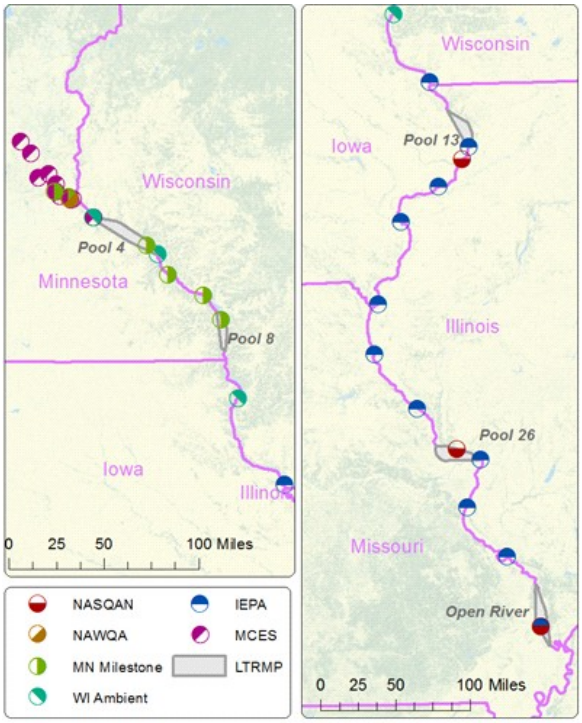
Findings:

- Extensive nutrient and nutrient-related monitoring occurs on the UMR mainstem and in the basin.
- However, important differences exist among monitoring programs, spatial gaps are present, and data system incompatibilities impede compilation and analysis, particularly on the basin scale.
- No common approaches for measuring algal blooms and fish kills are shared among states.

Recommendations:

- More consistent nutrient monitoring protocols are needed among programs, including a minimum parameter set and minimum sampling frequencies. Data reporting and sharing among programs should also be harmonized.
- The lateral and longitudinal extent of the UMR mainstem monitoring should be expanded, but not at the expense of existing basinwide nutrient monitoring.

- Continuous measurement of nutrient-related parameters and the establishment of a tributary load monitoring network should be considered.
- A UMR CWA monitoring strategy, including nutrient and nutrient-related parameters, is needed.
- Common methods of tracking and reporting algal blooms and fish kills should be identified.



Current UMR mainstem sampling locations for ongoing programs that include nutrient monitoring.

Sources, Concentrations, and Trends

Findings:

- UMR nutrient concentrations have increased significantly from pre-settlement levels, but levels have stabilized in many locations over the past twenty years, while rates of increase have slowed at other monitoring locations.
- Current concentrations of total nitrogen (TN) and total phosphorus (TP) are often above guidelines and criteria to limit eutrophication, though concentrations vary considerably by location and season.
- Research and modeling indicate that agricultural land use is the primary determinant of UMR nutrient loading, followed in importance by the presence of urban areas.
- Agricultural conservation practices have successfully reduced nutrient loading in many areas, but important challenges remain, including the loss of nitrogen to surface waters through subsurface flow.

Recommendations:

- Research on nutrient levels over time (e.g., core sampling) should be pursued on a broader scale to better discern trends. This is particularly true for phosphorus, as less historical data is available for phosphorus as compared to nitrogen.
- Successful UMR nutrient reduction efforts must address both agricultural nonpoint source pollution and point source contributions. Ideally, each source will be reduced in proportion to its relative contribution.
- Ongoing collaboration among local, state, federal, private, and other partners is essential in expanding agricultural conservation practices in the basin and improving their efficiency.

Impacts to UMR Designated Uses

Findings:

- Both nitrogen and phosphorus appear to contribute to local nutrient impacts on the UMR mainstem.
- Elevated nutrient concentrations alone do not necessarily cause eutrophication. They are a prerequisite for eutrophication, but other factors (e.g., water velocity and light penetration) also determine whether, when, and where eutrophic impacts occur.
- Among distinct strata within the UMR, backwaters are most adversely impacted by nutrients, with metaphyton (filamentous algae and duckweed) blooms a frequent occurrence in backwaters.
- Sestonic (floating) algal blooms also appear to be commonplace on the UMR. However, insufficient data exists to accurately estimate the

extent of cyanobacteria occurrence as part of these blooms.

- Fish and other UMR aquatic communities are likely affected by eutrophication, but the mechanism(s) and extent of impacts are not fully known.
- Based on current monitoring and water quality standards, direct toxicity to aquatic organisms from ammonia and to humans from nitrate does not presently appear to be an issue for the UMR.

Aerial photo of UMR Pool 8, with streaks of blue-green algae visible. (USDA National Agriculture Imagery Program photo)

Recommendations:

- Metaphyton sampling and quantification should be incorporated into monitoring programs.
- Definition(s) of nuisance sestonic algae should be developed for the entire UMR.

Filamentous algae growth in Spring Lake, Upper Mississippi River Pool 5. (Wisconsin DNR photo)

- N:P ratios, along with chlorophyll-a (chl-a) concentrations, should be measured in order to improve cyanobacteria bloom estimates.
- Further paired fish/nutrient monitoring and research should be conducted to clarify the extent and nature of nutrient-related impacts on fish communities.

CWA Implementation

Findings:

- While nutrients likely affect designated uses in a number of locations, there is currently only one nutrient-related CWA impairment listing on the UMR, at Lake Pepin.
- Wisconsin is currently the only UMR state to have a eutrophication-related numeric nutrient criterion applicable to flowing waters.
- Toxicity-related nitrate and ammonia criteria are largely consistent among states, though early life stage (ELS) schedules differ and new nitrate criteria for aquatic life are being considered.
- National Pollutant Discharge Elimination System (NPDES) permit requirements for nutrient monitoring vary among the UMR states.
- Survey responses indicate that the states' CWA approaches may not be fully congruent with water suppliers' needs and goals.
- States are taking differing approaches and are at different points in the process of addressing nutrients under the CWA.

Recommendations:

- The states and US EPA should consider the following in developing any numeric nutrient criteria applicable to the UMR:
  1) Target values may be needed for both phosphorus and nitrogen, potentially varying by river strata (e.g., flowing channel vs. off-channel areas).
  2) As eutrophication is dependent on several factors beyond nutrient concentrations alone, states may wish to account for response variables (e.g., biological parameters, dissolved oxygen, chl-a, biological oxygen demand) in conjunction with nutrient criteria in assessing the UMR. To be successful, such an approach requires significant dependency between nutrient levels and response variables, as well as protection of downstream uses.
  3) Numeric nutrient criteria are most likely to be effective as part of a comprehensive approach to nutrient reduction, including not only CWA tools but also other measures such as non-point source reduction strategies.
  4) Interstate considerations are critical. States will not necessarily employ identical approaches, but should work collaboratively and seek congruence in nutrient criteria for the UMR.
- NPDES nitrogen and phosphorus discharge monitoring requirements should be consistent among states.
- States should develop common ELS schedules for the UMR.
- Further dialog with UMR water suppliers should be pursued regarding CWA protection of drinking water uses.

Next Steps

The recommendations resulting from this project are both extensive and ambitious in their scope. As such, the expectation and intent is not that each and every recommendation will be implemented. Rather, the recommendations provide a set of options that the states, individually or collectively, may choose to pursue.

Further, while these recommendations are primarily addressed to the states, many of them will also require collaboration and participation from other agencies – most prominently from U.S. EPA.

The UMRBA Water Quality Executive Committee and Water Quality Task Force provide ongoing venues for the states and their partners to discuss, prioritize, and plan for action in response to these recommendations. These bodies are always interested in dialog and collaboration opportunities with others working on nutrients and other water quality issues.

For More Information

For more information, please see the full project report available on the UMRBA web site at: http://www.umrba.org/wq/umr-nutrients.pdf or contact Dave Hokanson, UMRBA Water Quality Program Director (651-224-2880 or dhokanson@umrba.org).

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