Upper Mississippi River Basin Association

Water Quality Executive Committee and Water Quality Task Force Meeting

June 13-14, 2023

Agenda

with
Background
and
Supporting Materials

The Merrill
Muscatine, Iowa

UPPER MISSISSIPPI RIVER BASIN ASSOCIATION
WATER QUALITY EXECUTIVE COMMITTEE AND
WATER QUALITY TASK FORCE MEETING

June 13-14, 2023

Preliminary Agenda
Hybrid Meeting

Connection Information

- Web, video conferencing, click on the following link:
  - https://umrba.my.webex.com/umrba.my/j.php?MTID=m326b3e13c7da7f54bb4cbf33bdee54e7
- Dial-in number: (312) 535-8110
  - Access code: 2559 728 3010
  - Passcode: 1234

Tuesday, June 13

Time		Topic	Presenter
1:00 p.m.		Welcome and Introductions	***Glenn Skuta,*** *MN PCA*
1:05	A1-A8	Approval of the January 25, 2023 WQTF Draft Meeting Summary	***All***
1:10		UMRBA Updates • UMR Interstate Water Quality Monitoring in 2025-2026 • USEPA Exchange Network Grant • USEPA Regions 5 and 7 Science Liaison Meetings • UMRBA Multi-Benefit Conservation Practice Workshops • *How Clean is the River?* Report	***Lauren Salvato,*** *UMRBA*
	B1-B3	• Midwest CASC Proposal for Floodplain Reconnection	
1:50		Nutrients • Gulf Hypoxia Program Sub-Basin Committee Work Plan • Nutrient Reduction Strategy Updates	***Lauren Salvato,*** *UMRBA* ***All***
2:40		Break	
3:00		Nutrients (Continued)	***Becca Clay,*** *Practical Farmers of Iowa*
	C1-C5	• A Partnership to De-Risk Regenerative Agriculture Practices	
3:30		• What's Eating the Trempealeau Lakes: The Case for Controlling Nitrogen Loading	***Shawn Giblin,*** *WI DNR*

(Continued)

4:00	D1-D7	**Upper Mississippi River Restoration** • Long Term Resource Monitoring Information Needs	***Andrew Stephenson,*** *UMRBA*
4:30		**Adjourn**	

Wednesday, June 14

Time	Topic		Presenter
8:00 a.m.		**Welcome and Introductions**	***Glenn Skuta,*** *MN PCA*
8:05		**Recap of June 13 Discussions**	***All***
8:10	E	**UMRBA Water Quality Program** • FY 2023 Accomplishments Summary • FY 2024-2025 Work Plan Strategies	***Lauren Salvato****, UMRBA*
8:30	F	**WQEC Charter**	***Lauren Salvato****, UMRBA*
9:00	G	**Examining Biological Indicators of the Upper Mississippi River** • Review of 2009 Workshop Conclusions • Discussion	***Lauren Salvato,*** *UMRBA* ***All***
9:30		**Break**	
10:00		**Legacy Pesticides** • Analyzing Legacy Data from Illinois Rivers to Improve Pesticide Monitoring	***Ryan Sparks,*** *IL EPA*
10:30		**Clean Water Act** • 303(d) and 305(b) Lists • TMDLs in the Upper Mississippi River Basin	***All***
11:05		**Administrative Items** • WQEC and WQTF Chair Rotation • WQTF Fall 2023 Meeting	***All***
11:15 a.m.		**Adjourn**	

ATTACHMENT A

January 25, 2023 WQTF Draft Meeting Summary

(A-1 to A-8)

Upper Mississippi River Basin Association
Water Quality Task Force Virtual Meeting

January 25, 2023
Draft Highlights and Action Items Summary

Approval of the WQTF October 4, 2022 Meeting Summary

The UMRBA Water Quality Task Force (WQTF) approved the October 4, 2022 draft highlights and action items summary.

Fast Limnological Automated Measurements (FLAMe) on the Illinois River

Dr. Luke Loken described FLAMe as a mobile sampling platform designed to measure surface conditions across individual rivers and lakes. Traditional sensor technology is coupled with a global positioning system (GPS) to produce high resolution maps of surface water chemistry. The maps generated identify point source locations, infer processing rates, and produce distributions of surface water conditions. Examples of select parameters included in the sensors are temperature, conductivity, dissolved methane, dissolved carbon dioxide, nitrate, absorbance, tryptophan, algae fluorescence, and *E. coli* bacteria metabolic activity.

Loken shared the research questions for the FLAMe project on the Illinois River:

- How does water quality vary across the entire Illinois River?
- How do nutrients, turbidity, and hydrology relate to algal dynamics and productivity?
- How do these influence carbon and nitrogen cycling?

Transects for the Illinois River were collected in May, August, and November 2022. An upcoming transect is planned in March 2023. Discrete samples were also collected.

Loken displayed three transects of the following parameters: nitrate, turbidity, chlorophyll, dissolved oxygen, carbon dioxide, and methane. Note that the data are preliminary and not yet published. The three transects of nitrate data show the contributions of wastewater treatment plants in Chicago across seasons. In November, high concentrations of nitrate were observed in Chicago, likely due to reduced flow from Lake Michigan and colder temperatures.

Some initial conclusions include multiple parameters vary longitudinally in the Illinois River; nutrients, light availability, and hydrology likely control phytoplankton dynamics; and differences in respiration and production lead to variation in dissolved gases – e.g., oxygen, carbon dioxide, methane. In the future, Loken hopes to conduct similar transects on the Upper Mississippi River.

Kathi Jo Jankowski asked if there is spatial variation in carp populations longitudinally in the Illinois River (e.g., lower populations closer to Chicago)? Jankowski was curious if any top-down carp effects would impact spatial variation in chlorophyll. Loken replied that the carp observed while the transect was being

conducted varied longitudinally. Carp are actively managed in the upper part of the Illinois River. Loken is aware of research that has hypothesized there is a natural chemical defense acting as a fish barrier. The research has observed that carp in the upper reaches are less fit than in the lower reaches. Loken added that on the carp and chlorophyll relationship, there is a positive bottom-up influence of algae on carp i.e., carp consume chlorophyll. Loken postulated that there is a light limitation effect near Peoria as turbidity is high. Jankowski agreed and offered to send papers showing correlations between population size and chlorophyll concentrations over time in the Illinois River and some looking at filtration effects on algal communities.

Houser noticed the high methane, chlorophyll, and dissolved oxygen (DO) concentrations downstream of Starved Rock pool and asked Loken if he has any theories about why that is occurring. Loken responded that usually methane and carbon dioxide are paired together and used as an indicator of respiration. Methane can also be coupled with primary production if there is high algae or algal biomass and more productive lakes can also have high methane. Oxygen, carbon dioxide, and methane together can illustrate the dynamics of the metabolic regime transitioning from primary production to respiration to anaerobic. Loken plans to research those dynamics in the future.

In response to a question from Albert Ettinger, Loken said all measurements are taken between 8 a.m. and 4 p.m. Carbon dioxide concentrations are quite high but in a larger river system temporal and spatial noise is less of a concern. Ettinger understands that standard eutrophication means that DO is high during the day and carbon dioxide is low. Loken said the signal of high DO during the day and carbon dioxide levels depend on how much respiration is occurring at night. Using information from fixed stations, USGS scientists have observed that carbon dioxide variation in this region is not as large. Ettinger asked if the methane concentrations are of concern for climate change impacts. Loke replied that inland waters have always been a source of greenhouse gas emissions. By design, rivers receive all the things we put in them either naturally or artificially. Loken believes that methane in urban and human-influenced areas is a larger concern than methane emission from rivers. In response to a question from Ettinger about phosphorus data, Loken replied that 30 grab samples were collected. FLAMe does not currently include a phosphate sensor. Houser asked if the primary source of methane is from Chicago's greenhouse gas emissions. Loken said there is some human influence on methane cycling. In general, humans have elevated methane emission from inland waters. There is a positive link between eutrophication and methane – e.g., warmer temperatures create more methane and anoxia makes more methane. Loken offered to chat more as he and his collaborators are transitioning from data gathering to interpretation.

Kim Laing asked if Loken had to create data systems to support this rich dataset? Loken agreed there is a lot of data handling. Loken and his collaborators have developed workflows to quickly QA/QC, filter, and plot data to get to interpretation. There are not site IDs for every collection point so the best place for the data is in Science Base.

Fish Tissue Monitoring

National Fish Tissue Monitoring

John Healy works in the USEPA Office of Science and Technology (OST) and described USEPA's fish tissue monitoring studies. The first national fish tissue study conducted by USEPA was during 2000 to 2003. Since 2008, seven fish tissue studies have been conducted under the National Aquatic Resource Surveys (NARS). Across the seven studies, analysis of skin-off fillet composited samples was collected for mercury, PCBs, PFAS, and other target chemical groups that have been included periodically along the

way – e.g., PBDEs, dioxins and furans. Three of the seven studies were conducted through the National Rivers and Streams Assessment (NRSA) which includes the Upper Mississippi River and its tributaries. The sampling design of NRSA is probabilistic based assessments. Fish species are selected based off their abundance, those commonly consumed by people, and the volume of tissue to be analyzed.

Some conclusions from the NARS are that mercury and PCBs are widely distributed in fish from U.S. rivers and lakes, including the Great Lakes and PFOS is the dominant PFAS in freshwater fish. PFOS was detected in nearly every river and Great Lakes fillet composite sample.

Healy provided links to learn more:

- USEPA fish tissue studies: https://www.epa.gov/fish-tech/studies-fish-tissue-contamination
- USEPA national lake fish tissue survey design: https://link.springer.com/article/10.1007/s10661-008-0685-8
- Contaminants in fish from U.S. rivers: probability-based national assessments: https://www.sciencedirect.com/science/article/pii/S0048969722076604
- Study comparing biopsy plugs versus whole homogenized fillet for mercury and selenium analysis: https://link.springer.com/article/10.1007/s00244-021-00872-w

In response to a question from Robert Voss, Healy replied that the contaminates are reported in wet weight and not percent moisture. For selenium, percent moisture is reported. Voss asked the question because Missouri DNR has been trying to process archived fish tissue, which has become desiccated over time due to the freezing process. The approach has been to weigh the fish before freezing so the weight can be used once calculations are conducted. Healy said USEPA has been trying to promote the awareness of using archived fish tissue, but there is not much interest in reanalyzing older tissue. In response to a question from Ettinger about arsenic analyzed, Healy said that arsenic is not typically analyzed except for the National Lakes Fish Tissue study reported out in 2009. It has come up in the context of naturally occurring arsenic in USEPA Region 10. Otherwise. USEPA has not conducted arsenic in fish tissue studies at a national scale. Ettinger observed total arsenic fish tissue data on the Ohio River, and concentrations were higher than the former USEPA recommended arsenic criteria. Voss advised caution with arsenic in fish tissue, stating that speciation is required to determine which form of arsenic is toxic to the fish.

Salvato asked what changes are ahead for fish tissue sampling through NRSA. Healy said USEPA is having internal discussions now on whether to move fish tissue monitoring from every five to every 10 years. Contaminants would likely include PCBs, mercury, and PFAS. The advantage of moving to a 10-year cycle would be increasing the scope of contaminants.

Regional Ambient Fish Tissue Monitoring Program

Steve Schaff said that most of the knowledge and history of the Regional Ambient Fish Tissue (RAFT) program has retired. The RAFT program began in 1977 after USEPA Headquarters recommended regions analyze fish tissue. The original effort was focused on analyzing whole fish and lipids but in the 1980s that shifted to fillets, the portions of fish consumed by people. The two monitoring strategies included status and trends with sites spanning the four USEPA Region 7 states: Kansas, Nebraska, Iowa, and

Missouri. Initial data collected was for the following parameters: DDT, chlordane, mercury, and PCBs. The program eventually shifted to solely focus on mercury. Fish fillet plugs are taken in predatory sport fish and common carp may also be used for historical comparison. The RAFT program ended for Region 7 states but currently serves the tribes located in Region 7. Future RAFT initiatives include continued tribal sampling to promote cooperation in environmental sampling and sampling water bodies not sampled by state agencies. Schaff said he hopes to incorporate PFAS and microplastics into the sampling program.

Ryan Sparks asked if antibacterial or other atopic solutions are applied to the area of the plug to prevent future disease? Were plug samples composite samples or individual fish samples? Schaff replied that antibiotic spray is not used for RAFT samples, but it is used for the NRSA. The samples are composite samples for each sampling location, and average weight and length is recorded. Salvato asked how long fish tissue data has been collected for tribes. Schaff was unsure but recalled it was around 2008.

Missouri's Mississippi River Data

Voss recalled that in 2012 USEPA dropped trend site support for organics and other contaminants, but still supported mercury fish tissue analysis. Missouri DNR decided to absorb the cost of analysis but narrowed its sites to 13 statewide collected every other year. Two of those sites are on the Mississippi River at Caruthersville and Hannibal.

Voss presented results comparing average concentrations over time for bottom feeders at Caruthersville and Hannibal. One note of caution is that over the years, Missouri DNR has used multiple laboratories for fish tissue analysis. USEPA Region 7 was the first lab used through the RAFT program, then USGS Columbia Environmental Research Center was used, then Pace Analytical and as of 2021, Eurofins. Voss has observed noise in the data. For example, for DDT and metabolites, the trend was generally decreasing. There is a noticeable spike of DDT in 2021, which may be related to the change in laboratories but could have also been a spike in the contaminant. Voss added that 3-5 whole fish fillets are composited and blended together. This method aims to mitigate an individual fish spiking the concentration of the contaminant. Voss said that variables like the average body weight and average percent fat of the fish are important to take into account and can affect what the concentrations of contaminants are doing over time.

Salvato asked if the new laboratory used by Missouri DNR can analyze previously frozen samples to help determine the cause of the spike. Voss replied that Missouri DNR will not go back and analyze old fillets. There were years that Lindane, for example, would spike and the next year would be lower. In response to a question from Salvato about accessing fish tissue data, he said that the data are available to download but there is not a public interactive tool. Healy asked about the decision to look at whole fish rather than fillets. Voss replied that the RAFT long term trend sites used whole fish for bottom feeders and DNR wanted to maintain that for trend analysis. For fish advisories, Missouri DNR collects fillets and biopsy plugs for mercury and lead. There is a mercury dataset for bottom feeders, but the concentrations are low.

Micah Bennett asked Voss if Missouri has preliminary work on cyanotoxins in fish tissues in Missouri. Bennett recalled there is a session at the national fish workshop coming up. Voss replied that Missouri Department of Health, Missouri Conservation Department, and one of the state universities were involved. Voss recalled fillet data were low or non-detect for microcystin, while liver tissue had hits ranging from 300-400 ng/g.

Iowa's Mississippi River Data

Ken Krier described Iowa's effort to conduct fish tissue monitoring after analysis under Region 7 was significantly reduced in 2012. The Iowa Fish Tissue Monitoring Program (IFTMP) is a continuation of the RAFT program. Moving forward trend sites will be sampled every five years (the last sample was in 2016). Data are used to develop trends and not for fish advisories. Iowa's methodology is to analyze fish tissue plugs for mercury in predator species and to analyze composite skin-off fillet samples from bottom feeder species for mercury, chlordane, PCBs and dieldrin.

Krier displayed the contaminants analyzed in fish tissue since 1980s. He observed that the data are hard to show in a meaningful way because analytes were dropped out over time. In general, the contaminant average concentrations are as follows:

- PCBs: The last time Iowa issued a "do not eat" advisory level was in 1982. Since the late 1980s there have been few instances where there is a "one meal per week" advisory.

- Chlordane: Concentrations of the contaminant since 1982 have been far below the "one meal per week" advisory.

- Mercury: There has been no exceedances of the "one meal per week" advisory since 1982. For mercury results in predatory fish species, only once has the average concentration exceed the "one meal per week" advisory level of 0.3 mg/kg.

- Dieldren and DDE: Since 1982, results for both contaminants have decreased to near 0 mg/kg.

- Selenium and Pentachloroanisole (PCA): Both contaminants have had spikes in concentrations since 1988 and 1994 for PCA and selenium, respectively.

Next steps for the IFTMP are to finish statewide length Mercury advisories in 2023, restart bottom feeder status and trend sampling, conduct follow-up sampling on PCB advisory waterbodies, and to incorporate emerging contaminants in the program moving forward – e.g., PFAS.

Ettinger asked if the general takeaway is that fish tissue results are looking good except for mercury. Krier agreed but caveated that it is important to look at the results with age of fish and sampling techniques. Healy agreed that mercury data has been consistent over the years. Higher concentrations are observed in lentic water bodies.

In follow-up, Ettinger asked about the state of the knowledge of chloride liberating mercury in sediment. Voss said how mercury gets into fish tissue depends on the form mercury is in. If mercury has undergone methylation, then that form can magnify up the food chain. Different aspects of waterbodies affect the methylation rate. For example, a waterbody receiving fungicides or pesticides used on golf courses may have legacy mercury issues. Prevailing winds and coal burning will impact deposition rates. Missouri Department of Conservation is thinking about how to manage waterbodies if atmospheric deposition is constant. Are there other ways to manage fisheries or waterbodies to discourage the methylation rate and biomagnification rate? A possible strategy is monitoring the growth rates of fish populations. – i.e., to ensure that fish growth rates are stunted, which is a negative consequence of

mercury exposure. Voss concluded that it is good to keep an eye on mercury but teasing out if it is increasing or decreasing is complicated.

Zach Leibowitz asked if any of the presenters considered collecting fish egg/ovaries for selenium analysis as the current 304a are based on these values. Voss said that Missouri does analyze selenium in tissues but does not have contaminant concerns for selenium sources in state waters. Missouri DNR looks at selenium for its ability to mitigate the effects of mercury in fish tissue, so it pays attention to the mercury and selenium ration, less the 304a criteria. Healy said that selenium criteria include a fish tissue fillet component in addition to the egg/ovaries and recorded as a dry weight.

Discussion

- *Please describe how your state is involved in NARS and NRSA and how funding is leveraged. And what fish tissue methodology is used e.g., plugs, composite, skin on or off fillets.*

Minnesota – Laing said Minnesota PCA does not participate in NRSA. The funding is given back to USEPA to contract out field sampling. PCA does utilize the CWA Section 106 dollars to conduct a statewide intensification survey. Fish contaminant work is not included as part of that but in PCA's watershed monitoring program. PCA analyzes composite fillets for mercury, PCBs, and PFAS. In response to a question from Salvato, Laing said that Minnesota PCA participates in the National Lakes Assessments, National Coastal Assessments, sometimes with the wetlands assessment, and is considering participating in NRSA. In response to a question from Salvato about why Minnesota has not participated in the surveys, Laing replied that the methodologies vary too greatly. USEPA Region 5 is going to be in Minnesota this summer to conduct side by side monitoring.

Wisconsin – Mike Shupryt said that Wisconsin DNR participates in all the NARS surveys. The funding is used to enhance state scale surveys and typically samples approximately 50 sites within the state (except for wetlands and coastal surveys). Giblin said that Wisconsin uses skin-on fillets except for catfish and bullheads. Shupryt added the fish contaminant program is robust between the water qualities and fisheries department. In response to a question from Salvato, Giblin said that fish contaminant analysis on the UMR rotates by pool.

Shupryt agreed with Laing's statement that the methods do not always line up. Healy asked for more clarification about which methods do not line up and which indicators Laing and Shupryt are referring to. Laing replied many indicators do not line up, not just fish contaminant indicators. The side-by-side monitoring with Region 5 this summer will help Minnesota determine based on sampling methodologies which datasets it can utilize. Laing agreed with Shupryt's comment that if the methods are vastly different, then participation in NARS is closer to a contractor relationship than a participant relationship. Laing added the fish collection methodology in streams is fairly similar. Macroinvertebrate sampling in rivers and streams is very different. The USEPA fish collection method for large rivers is different than Wisconsin's method. Healy said he would follow up with specific questions. He is interested in increasing state and tribal participation in NARS.

Illinois – Sparks said Illinois EPA does not participate in NARS but is planning to participate in the upcoming 2028-2029 NRSA. Illinois EPA's fish tissue methodologies use skin-off fillets and composite samples of three to five species of similar length.

Iowa – Kendall said that Iowa State Hygienic Laboratory (SHL) does NRSA sampling in a contract with Iowa DNR. Krier emphasized the challenge of putting a team together to do additional sampling. Iowa DNR's ambient program is conducted with the help of SHL staff.

Missouri – Voss said fish tissue sampling for mercury is individual fish tissue analysis of nonlethal plug samples. When composite samples are analyzed, fish samples are compiled by combining samples of similar sized fish with less than 25% of variation in size. Whereas for mercury analysis, a variation in size is desired to understand length and age questions of fish associated with mercury contaminant levels. For NRSA, money is passed to USEPA to conduct the monitoring. For other national assessments, funding is passed to the University of Missouri.

Harmful Algal Blooms

The Ohio River HAB Prediction Tool

Greg Youngstrom discussed the catalyst for the development of the Ohio River HAB Prediction Tool. On August 19, 2015, a HAB was first reported just upstream of Wheeling, WV. In just a couple of weeks it extended over 650 miles, nearly to Evansville, IN and lasted over two months. Recreation advisories covered over 800 miles of the Ohio River. The final recreation advisory was lifted on November 4, 2015.The development of the risk characterization tool was a partnership between USEPA, National Weather Service (NWS) and ORSANCO.

After the 2015 HAB event, USEPA Office of Research Development (ORD) studied and observed two dynamics of the bloom: the bloom spread faster than the flow of water in the river, and rainfall patterns for the duration of the event transitioned from extremely wet to far drier than normal. The combination of events seemed to indicate that rainfall events flush existing nutrients in the river. There is already algae in the system, and long residence times between locks and dams (L&D) allows for the cyanobacteria to bloom.

The model supporting the Ohio River HAB Prediction Tool is based off flow data, the only parameter of sufficient density for statistical analysis, both temporally and spatially. Youngstrom displayed the tool, noting points at each of the L&Ds as well as a few select pool areas. The data capabilities include comparing current flow patterns to 2015 patterns and a display of the percentage of likelihood of a bloom. Water quality parameters from ORSANCO gages and two USGS supergages can also be incorporated. Youngstrom said if there is increased probability of a bloom occurring, he will make a more detailed investigation as to whether deploying ORSANCO staff into the field is necessary.

Considering limited ORSANCO staff capacity and the geographic magnitude of 981 miles of Ohio River, the tool is critical to focus in the areas most needed. Future developments include using the NWS extended forecasts to make future HAB predictions, including turbidity as a controlling factor, and creation of a mobile version.

Ettinger asked if ORSANCO plans to use the data to take action with regard to nutrient levels. Youngstrom said that ORSANCO is active in the Hypoxia Task Force and developing nutrient criteria for the Ohio River.

Administrative Items

Future Meetings

The next WQEC-WQTF hybrid meeting will be scheduled for June 13-14, 2023 in Muscatine, Iowa.

Participants

Ryan Sparks	Illinois Environmental Protection Agency
Dan Kendall	Iowa Department of Natural Resources
Ken Krier	Iowa Department of Natural Resources
Kim Laing	Minnesota Pollution Control Agency
Glenn Skuta	Minnesota Pollution Control Agency
Heather Peters	Missouri Department of Natural Resources
Robert Voss	Missouri Department of Natural Resources
Micah Bennett	U.S. Environmental Protection Agency, Region 5
Kathy Roeder	U.S. Environmental Protection Agency, Region 5
Chelsea Paxson	U.S. Environmental Protection Agency, Region 7
Steve Schaff	U.S. Environmental Protection Agency, Region 7
Zachary Leibowitz	U.S. Environmental Protection Agency, Region 7
John Healy	U.S. Environmental Protection Agency
Lisa Larimer	U.S. Environmental Protection Agency
John Wathen	U.S. Environmental Protection Agency
Megan Williams	U.S. Environmental Protection Agency
Erin Spry	Upper Mississippi River Basin Association
Lauren Salvato	Upper Mississippi River Basin Association
Shawn Giblin	Wisconsin Department of Natural Resources
Mike Shupryt	Wisconsin Department of Natural Resources
Sean Strom	Wisconsin Department of Natural Resources
Mike Halsted	Wisconsin Department of Transportation
Doug Daigle	Lower Mississippi River Basin Subcommittee
Greg Youngstrom	Ohio River Sanitation Commission
Luke Loken	U.S. Geological Survey, Upper Midwest Science Center
Jeff Houser	U.S. Geological Survey, Upper Midwest Environmental Science Center
Kathi Jo Jankowski	U.S. Geological Survey, Upper Midwest Environmental Science Center
Nicole Manasco	U.S. Army Corps of Engineers, Rock Island District
Davi Michl	U.S. Army Corps of Engineers, Rock Island District
Mike Skrabacz	U.S. Army Corps of Engineers, Rock Island District
Charles Brown	City of Moline Utilities
Albert Ettinger	Mississippi River Collaborative

ATTACHMENT B

UMRBA Updates

- **UMRBA Multi-Benefit Conservation Practice Workshops**
    - **November 9-10, 2022 UMRBA Multi-Benefit Conservation Practice Workshop Materials:** https://umrba.org/document/multi-benefit-workshops
    - **October 3-4, 2023 UMRBA Multi-Benefit Conservation Practice Workshop Information:** https://umrba.org/event/multi-benefit-workshop/10-2023
- **UMRBA Proposal: Floodplain Reconnection as a Nature-Based Solution to Improve Flood Conveyance and Storage (4/4/2023)** *(B-1 to B-3)*

Upper Mississippi River Basin Association

Floodplain Reconnection as a Nature-Based Solution to Improve Flood Conveyance and Storage

Proposal for a Collaborative Opportunity

Title: Floodplain Reconnection as a Nature-Based Solution to Improve Flood Conveyance and Storage

Project Summary:

Floodplain reconnection improves flood conveyance and storage, restores ecological processes and habitat, and improves water quality. In preparation for near-term opportunities to implement such projects throughout the UMRS (having authority and funding), the purpose for this project is to develop learning questions to inform a broader adaptive management framework and develop a suite of criteria to identify and prioritize the location of floodplain reconnection opportunities. In addition, this project will seek to illuminate the willingness of some landowners (e.g., private levee districts) to implement floodplain connectivity on their respective lands.

Background Information:

The Upper Mississippi River Basin Association (UMRBA) is an interstate organization formed by the Governors of Illinois, Iowa, Minnesota, Missouri, and Wisconsin to coordinate the states' river-related programs and policies and work with federal agencies that have river-related responsibilities. UMRBA works diligently with federal partners and stakeholders to advance multi-use management of the river, facilitating and fostering cooperative planning and coordinated management of the Upper Mississippi River basin's water and related land resources.

UMRBA is committed to working through the river's multi-jurisdictional framework to develop integrated, comprehensive, and systems-based approaches to minimizing the threat to health and safety resulting from flooding by using structural and nonstructural floodplain management measures.

Through various funding sources (Infrastructure Investment and Jobs Act, Inflation Reduction Act, annual appropriations, and private investments), there are near term opportunities to implement floodplain reconnection in various areas throughout the Upper Mississippi River System. While the primary purpose for floodplain reconnection through the near term funding sources is to improve fish and wildlife habitat, floodplain reconnection may also serve as an important nature-based solution to extreme precipitation.

Project Objective(s):

A) Develop a suite of learning objectives regarding the effectiveness of floodplain reconnection for improving flood conveyance and storage, ecological processes and habitat, water quality, and social equity under projected high water conditions (focused on flood intensity rather than timing and duration)

B) Develop a suite of generalized criteria for identifying and prioritizing locations for floodplain reconnection

C) Develop a suite of generalized metrics (ecological, social, economic) for evaluating the success of floodplain reconnection

D) Illuminate the acceptability and willingness of landowners in the Upper Mississippi and Illinois Rivers floodplains to implement floodplain reconnection as a nature-based solution

Project Description:

This project will integrate activities for improving resilience of people, fish, and wildlife populations and habitats and important ecological processes to major flood events in the Upper Mississippi River System through floodplain reconnection measures. Through a focused planning process, project collaborators and partners will develop foundational planning and learning objectives that will help facilitate future collaborations between and among efforts to improve i) flood conveyance and storage and ii) ecological processes and functions.

This project will benefit from decades of long-term monitoring and science, floodplain restoration planning and management, and well-functioning collaborations among governmental agencies, nongovernmental entities, and interest groups.

The first phase of the project will involve synthesizing existing information, tools, and planning efforts that can support floodplain reconnection activities in the Upper Mississippi River System – e.g., ecological conceptual models developed by UMESC through the Upper Mississippi River Restoration program.

The second phase of the project will include facilitated sessions among project collaborators and participants to review the synthesis and develop learning questions about floodplain reconnection (regarding flood conveyance and storage, ecological processes and habitat, water quality, and social equity), generalized criteria for prioritizing restoration opportunities, and metrics for evaluating the effectiveness of floodplain reconnection projects (tied to the learning questions).

The third phase of the project will include a targeted review among stakeholders and affected interests regarding the set of learning questions, project prioritization criteria, and evaluation metrics. In part, the purpose for this targeted review is to illuminate the willingness of some landowners (e.g., private levee districts) to implement floodplain connectivity on their respective lands.

Timeline:

Phase 1: *June – July 2023*

Phase 2: *August – September 2023*

Phase 3: *October – November 2023*

Project Update: *November 1, 2023*

Final Report: *December 1, 2023*

Product(s):

A) New collaborations and strengthened existing collaborations around floodplain reconnection

B) Report with high-level synthesis of existing floodplain reconnection knowledge and planning as well as learning questions, project prioritization criteria, and evaluation metrics as well as recommendations for future collaborations

Participants (Name, agency/organization, address, phone, email):

Principle Investigator(s):

Kirsten Wallace, Upper Mississippi River Basin Association (UMRBA)
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Collaborator(s):

UMRBA Member States (Illinois, Iowa, Minnesota, Missouri, and Wisconsin)
USFWS UMRS National Fish and Wildlife Refuge System
Migratory Bird Joint Ventures

USGS Collaborator(s):

Kristen Bouska and Molly Van Appledorn, UMESC

Project Participants:

- Agricultural interest groups, levee districts, Mississippi River Cities and Towns Initiative, Midwest Landscape Initiative, The Nature Conservancy, America's Watershed Initiative

Estimated Budget ($15,000 maximum with indirect costs):

USGS Personnel	Hours	Hourly Rate	Total Cost
Kristen Bouska	(In-kind)		$0.00
Molly Van Appledorn	(In-kind)		$0.00
Contractual			
UMRBA			$10,000
Migratory Bird Joint Ventures			$5,000
Supplies			$0.00
Sub-Total			$15,000
USGS Indirect Cost	0% (not needed)		$0.00
Gross Total			**$15,000**

ATTACHMENT C

Article: PepsiCo Announces $216 Million Investment in Long-Term Partnership with Three Major Farmer-facing Organizations to Support Regenerative Agriculture Transformation on More than Three Million Acres of U.S. Farmland (03/21/2023)

(C-1 to C-5)

PepsiCo Announces $216 Million Investment in Long-term Partnerships with Three Major Farmer-facing Organizations to Support Regenerative Agriculture Transformation on More than Three Million Acres of U.S. Farmland

NEWS PROVIDED BY
PepsiCo, Inc. →
Mar 21, 2023, 09:00 ET

Practical Farmers of Iowa, Soil and Water Outcomes Fund, and the Illinois Corn Growers Association partner with PepsiCo to drive adoption of regenerative agriculture practices and reduce carbon emissions

PURCHASE, N.Y., March 21, 2023 /PRNewswire/ -- PepsiCo today announces a $216 million multi-year investment in long-term, strategic partnership agreements with three of the most well-respected farmer-facing organizations – Practical Farmers of Iowa (PFI), Soil and Water Outcomes Fund (SWOF), and the IL Corn Growers Association (ICGA) – to drive adoption of regenerative agriculture practices across the United States. The combined impact of these three strategic partnerships is expected to support the accelerated uptake of regenerative practices on more than three million acres and deliver approximately three million metric tons of greenhouse gas (GHG) emission reductions and removals by 2030.

PepsiCo will work alongside these trusted organizations to establish and scale financial, agronomic, and social programs that enable the transition to regenerative agriculture practices through education, upfront investment in outcomes, peer coaching and networking, and cost-sharing.

Driven by PepsiCo Positive (pep+), the company's strategic, end-to-end business transformation, PepsiCo's strategic investment in PFI, SWOF and ICGA is essential to supporting the U.S. farming community as it makes changes that aim to secure production volumes and mitigate the impacts of climate change, while still cultivating quality, bountiful crops to feed the world's growing population.

"As the climate crisis continues to escalate, the threat to our food system increases as well," said Jim Andrew, Chief Sustainability Officer, PepsiCo. "It's critically important to partner, for the long term, with organizations that have earned the trust of farmers as they make the transition to adopt climate-smart agriculture practices. We intend to be shoulder-to-shoulder with farmers as they work to make soil healthier, sequester carbon, improve watershed health and biodiversity, and improve their livelihoods."

Through these partnerships, by 2030, PepsiCo will work with PFI to reach approximately 1.5 million acres; SWOF to reach nearly 1 million acres; and the ICGA to reach approximately 600,000 acres. Based on progress to date, these collaborative efforts are expected to deliver more than 500,000 regenerative acres by the end of 2023.

"We are excited to expand our partnership with PepsiCo and farmers in its supply chain to support the adoption of regenerative agriculture practices that have measurable impacts on soil health, the environment, and farm sustainability," said Adam Kiel, managing director of the Soil and Water Outcomes Fund. "By providing high-quality and customized agronomic assistance to farmers implementing new practices we help them reduce emissions and nutrient loss, unlock a new revenue stream, and increase the value of their farmland for current and future generations."

"PFI farmers have known for years that a supply chain that encourages farmers to grow only a couple of crops is not sustainable – it's not diverse or resilient enough for our changing world," said Sally Worley, Executive Director, Practical Farmers of Iowa. "The PFI model is proven – when

we plug farmers into our powerful network and connect them with a peer network, educational resources, funding and technical support, they're able to build more resilient farms. We're excited to continue partnering with PepsiCo and look forward to working together to create a more diversified and resilient agriculture."

"Farmers in Illinois want to make the best decisions for the resources in their care. They are invested in protecting and preserving their farms to pass something on to the next generation that is better than what they received. Sometimes, the heavy risk of new conservation practices gets in the way, but PepsiCo's partnership helps to lessen some of the risk involved for farmers to try a new practice and that will make a big difference," said Dirk Rice, Philo, IL farmer leader of ICGA.

As the largest food and beverage company in North America, and second largest globally, a resilient food system is essential to PepsiCo's business and its ability to meet its ambitious pep+ targets which include driving the adoption of regenerative agriculture practices across 7 million acres – approximately the size of PepsiCo's agricultural footprint – by 2030 and achieving net-zero emissions by 2040.

For more information about PepsiCo's commitment to positive agriculture, please click here.

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About PepsiCo

PepsiCo products are enjoyed by consumers more than one billion times a day in more than 200 countries and territories around the world. PepsiCo generated more than $86 billion in net revenue in 2022, driven by a complementary beverage and convenient foods portfolio that includes Lay's, Doritos, Cheetos, Gatorade, Pepsi-Cola, Mountain Dew, Quaker, and SodaStream. PepsiCo's product portfolio includes a wide range of enjoyable foods and beverages, including many iconic brands that generate more than $1 billion each in estimated annual retail sales.

Guiding PepsiCo is our vision to Be the Global Leader in Beverages and Convenient Foods by Winning with pep+ (PepsiCo Positive). pep+ is our strategic end-to-end transformation that puts sustainability and human capital at the center of how we will create value and growth by

operating within planetary boundaries and inspiring positive change for planet and people. For more information, visit www.pepsico.com, and follow on Twitter, Instagram, Facebook, and LinkedIn @PepsiCo.

PepsiCo Cautionary Statement

Statements in this release that are "forward-looking statements" are based on currently available information, operating plans and projections about future events and trends. Terminology such as "aim," "anticipate," "believe," "drive," "estimate," "expect," "expressed confidence," "forecast," "future," "goal," "guidance," "intend," "may," "objective," "outlook," "plan," "position," "potential," "project," "seek," "should," "strategy," "target," "will" or similar statements or variations of such words and other similar expressions are intended to identify forward looking statements, although not all forward-looking statements contain such terms. Forward-looking statements inherently involve risks and uncertainties that could cause PepsiCo's actual results to differ materially from those predicted in such forward-looking statements. Such risks and uncertainties include but are not limited to: damage to PepsiCo's reputation or brand image; water scarcity; disruption of PepsiCo's manufacturing operations or supply chain, including increased commodity, packaging, transportation, labor and other input costs; climate change or measures to address climate change; failure to comply with applicable laws and regulations; and potential liabilities and costs from litigation, claims, legal or regulatory proceedings, inquiries or investigations..

For additional information on these and other factors that could cause PepsiCo's actual results to materially differ from those set forth herein, please see PepsiCo's filings with the Securities and Exchange Commission, including its most recent annual report on Form 10-K and subsequent reports on Forms 10-Q and 8-K. Investors are cautioned not to place undue reliance on any such forward-looking statements, which speak only as of the date they are made. We undertake no obligation to update any forward-looking statement, whether as a result of new information, future events or otherwise.

About Practical Farmers

As a non-profit organization with more than 6,000 members, PFI equips farmers to build resilient farms and communities. We create learning opportunities via farmer-led events, on-farm research and educational content through our robust network of farmers. We also provide funding and technical assistance to help farmers adopt regenerative farming practices and

grow farm businesses. Our vision is an Iowa with healthy soil, healthy food, clean air, clean water, and resilient farms and vibrant communities. To learn more, visit http://practicalfarmers.org

About the Soil and Water Outcomes Fund

The Soil and Water Outcomes Fund provides cost effective solutions for soil and water stewardship, using the leading biophysical models and scientifically rigorous approaches to quantify carbon sequestration and water outcomes while providing technical assistance to aid growers on their journey to increase profitability through sustainability. During the past two years, the Soil and Water Outcomes Fund enrolled 240,000+ acres across 9 states and provided an average financial incentive of more than $31 per acre to farmers to implement new regenerative agriculture practices that reduce greenhouse gas emissions and improve water quality. The Soil and Water Outcomes Fund is a partnership of AgOutcomes, a subsidiary of the Iowa Soybean Association, and ReHarvest Partners, a subsidiary of Quantified Ventures. To learn more, visit https://www.theoutcomesfund.com.

About the IL Corn Growers Association

IL Corn Growers Association is a state-based organization that represents the interests of corn farmers in Illinois, maintaining a high profile on issues in Washington, DC, and Springfield, IL. Through grassroots advocacy, ICGA creates a future for Illinois farmers in which they can operate freely, responsibly, and successfully. In order to fulfill this mission, the organization conducts governmental affairs activities at all levels, market development projects, and educational and member service programs. For further information regarding their work and involvement, visit their website www.ilcorn.org.

SOURCE PepsiCo, Inc.

ATTACHMENT D

Upper Mississippi River Restoration Program Long Term Resource Monitoring Implementation Planning (5/8/2023)

(D-1 to D-7)

UMRR LTRM Information Needs

Selected for Further Development

Date of this version: 2023.05.08

Beginning in March 2022, a core team representing the UMRR LTRM Partnership has been meeting as part of an implementation planning process to prepare for a potential increase in funds made possible by the Water Resources Development Act of 2020. If additional funds are appropriated, this would present an opportunity to expand our understanding of the UMRS and better inform restoration and management.

The LTRM Implementation Planning Team (IPT) initially identified 29 information needs for evaluation using several optimization approaches. These 29 information needs were provided in the UMRR CC read ahead material for the October 2022 and March 2023 quarterly meetings. This document provides a brief description of each of the 11 information needs that have been tentatively selected for further development based on the optimization process developed by the IPT and described at the March 2023 UMRR CC quarterly meeting. At the May 2023 meeting, we will provide a description of how these 11 information needs were tentatively selected and the work currently underway to further develop these 11 information needs.

1.1 Floodplain Ecology: Vegetation Change Across the System

Information need: System-level vegetation change assessments. What is the spatial distribution of different plant species and communities? How have plant species distributions changed over time? What are the main drivers of plant species distribution and change over time? What are the drivers of forest loss across the system? What are the consequences of vegetation change for spatial patterns of forest fragmentation or other general landscape habitat features?

Geographic extent: Reach/UMRS scale. This may need to include some data from south of the UMRS floodplain as we could be seeing range expansion of southern species into the UMRS.

How the information will be used: Better assess and understand past and current plant species distributions and major drivers of vegetation change. Improve management and restoration by understanding mechanisms of vegetation change and preparing for emerging issues. Extend to specific HREPs by identifying hydrogeomorphic conditions for plant establishment and growth (e.g., elevation, soils, inundation).

Measurement or endpoint: 1) Collect (continue collecting) floodplain vegetation data, including forestry data, invasive species, (e.g., reed canary grass, Japanese hops), native herbaceous communities (sedge meadows), possibly explore the use of UAS for specific monitoring of areas. 2) Analyze vegetation data for change over space and time and associated drivers of change, 3) write reports/summaries and deliver maps of forest loss/vegetation change.

1.4 Floodplain ecology: terrestrial and aquatic herpetofauna

Information need: What is the abundance, distribution, and status of reptile and amphibian species within the Upper Mississippi River and Illinois Rivers? Better understand the spatial and temporal distribution of terrestrial and aquatic herpetofauna (i.e., reptiles and amphibians) that depend on the floodplain during different life cycle phases. What drives reptile and amphibian abundances and distribution throughout the UMRS and individual reaches? What, where, and how many non-native herpetofauna are present in the UMRS? Determine habitat use by focal communities through long-term monitoring. Develop habitat suitability models and map spatial prioritization of habitat throughout the UMRS.

Geographic extent: Reach/UMRS scale.

How the information will be used: Assessing ecosystem health by documenting herpetofauna abundance/use of the floodplain, improving management and restoration by identifying project futures that could improve habitat use, and preparing for emerging issues by identifying drivers of herpetofauna use and potential changes in them. Develop a management guide discussing results and management suggestions for reptiles and amphibians. Coupled with current forest inventory datasets and forest-flood interaction findings

Measurement or endpoint: Quantify the status of reptile and amphibian populations (abundance at LTRM study reach scale) and communities and identify relations with various other ecological attributes (e.g., habitat). Identify non-native species and potential/existing invasive status. Data on herpetofauna distribution and use of the floodplain and aquatic areas. A long-term component would establish a robust infrastructure for assessing trends and changes in reptile and amphibian abundances, distributions, and resilience (including species of concern) as well as infrastructure for targeted studies. Before-after-control-impact study design to determine community shifts across management strategies and habitats. Fine-scale reptile/amphibian suitability models. A comprehensive model of herpetofauna spatial prioritization as it pertains to the UMRS. Allow managers to relate habitat decisions to impacts on herpetofauna.

[Note that in selecting information need 1.4 for further development, the IPT considered that the information need regarding birds and bats on the floodplain could be combined with information need 1.4 as an "Upper trophic levels on the Floodplain" information need. The feasibility of doing so is currently being assessed. The original information need related to Birds and Bats on the floodplain is as follows:

1.3 Floodplain ecology: distribution of birds and bats

Information need: Better understand the spatial and temporal distribution of avian fauna (e.g., birds, bats) that depend on the floodplain during different life cycle phases. Determine habitat use by avian and bat communities through long-term monitoring. Develop habitat suitability models and map spatial prioritization of habitat throughout the UMRS.

Geographic extent: Reach/UMRS scale, and/or Reach between Pool 13 and Pool 26 is currently being sampled (Audubon), need for more data farther north.

How the information will be used: Assessing ecosystem health by documenting bird and bat abundance/use of the floodplain, improving management and restoration by identifying project futures that could improve habitat, and preparing for emerging issues by identifying drivers of bird and bat use and potential changes in them. Develop a management guide discussing results and management suggestions for birds and bats. Couple bird data with current forest inventory datasets and forest-flood interaction findings.

Measurement or endpoint: Data on bird and bat distribution and use of the floodplain. Before-after-control-impact study design to determine community shifts across management strategies and habitats. Fine-scale bird-habitat suitability models. Comprehensive model of faunal spatial prioritization as it pertains to the UMRS.]

2.1 Hydrogeomorphic change: Geomorphic trends

Information need: These information needs relate to predictive understanding of geomorphic trends within the rivers and their floodplains and include: 1. Where, how, and to what degree is the geomorphology of the river and floodplain changing and expected to change over planning horizons of decades to centuries? 2. How do these geomorphic changes relate to long-term changes in discharge and episodic weather events? 3. How are geomorphic changes affected by ongoing navigation channel operations, e.g., dredging and placement site operations, wing dikes, closing structures, revetments, etc.? 4. What are the implications for the future spatial and temporal distributions of habitat metrics such as water depth, inundation frequency/depth/duration, water residence time, and physical, biological, and chemical properties of the system? It will be addressed as empirical evaluations based on observed changes in bathymetric (elevation) data (as opposed to -processed-based evaluations in 2.2)

Geographic extent: Reach/UMRS scale. There is a system-wide need, but it may be approached operationally by nesting acquisition at a reach/pool level and scaling up to the system scale. Systemic assessment may be more easily justified for some kinds of data, for example, lidar data for which economies of scale can be achieved in a regular schedule of flights. Because of the time and cost investments required for bathymetric data collection at scales applicable to a range of project needs, bathymetric data may be amenable to targeted, sequential collections. An example might be the prioritization of backwater sedimentation rate monitoring in select areas.

How the information will be used: Understanding geomorphic change, and how it is integrated with future hydrology, is fundamental to assessing ecosystem health and resilience. Understanding the spatial and temporal distributions of geomorphic change will provide essential context for restoration planning and management decisions. Because the geomorphic template of the UMRS will provide fundamental insight into system trajectory, it is likely to be applicable when identifying emerging issues.

Measurement or endpoints: 1. Topo-bathymetric data collected to evaluate geomorphic change are also the foundation for hydrodynamic modeling; hence, a basic endpoint is multiple updates of gridded topo-bathymetric digital elevation models (DEMs) at appropriate resolutions; 2. Raster-based datasets of differences of topo-bathymetric DEMs collected over multiple periods to calculate rates, magnitudes, and locations of recent change; 3. Evaluations of expected rates, magnitudes, and locations of future change based on trends evident in repeated topo-bathymetric DEMs; 4. Statistical models relating geomorphic change and rates of change to covariates including emergent and submergent vegetation communities, factors in contributing watershed areas, channel geometry variables, channel-training structures, restoration projects, and distance to dams.

3.1 Aquatic ecology: Aquatic plant distribution

Information need: What are the factors which limit aquatic plant distribution and (re)establishment throughout the system, especially the unsampled portions of the lower impounded reach (P14-25). Is it individual factors e.g., lack of backwater or shallow areas or a combination of several physical/chemical (natural and/or anthropogenic) factors? What, if any, inputs from the tributaries in this reach contribute to the lack of aquatic plants? How does the hydrologic regime affect aquatic plant community dynamics? What are the implications of shifting seasonality and magnitude of hydrologic extremes? How do invasive species (of aquatic plants or other groups) impact native plant distribution?

Geographic extent: Reach/UMRS scale.

How the information will be used: Assessing status and trends, assessing ecosystem health and resilience. Improving management and restoration.

Measurement or endpoint: same endpoints as in LTRM aquatic vegetation sampling protocol (Yin et al. 2000; plant abundance, plant density, species composition, diversity metrics) and LTRM's water quality protocol (Soballe and Fischer 2004; at least 10 water quality parameters), aquatic plant presence/absence through time, and associated [bathymetry, water level fluctuation] herbivory, turbidity, flocculent sediment, flow, (flow refuge), water level fluctuations, other drivers (association with invasive species), herbicide concentrations, turbidity, flow, sediment composition) above and below tributary confluences.

3.3 Aquatic ecology: mussel distribution

Information need: What are the status and trends of mussel species within the Upper Mississippi River and Illinois Rivers? What, where, and how many non-native mussel species are present within the UMRS?

Geographic extent: Reach/UMRS scale

How the information will be used: Assessing ecosystem health and resilience. Improving management and restoration.

Measurement or endpoint: quantify the status and trends of mussel populations and communities and identify relations with various other ecological attributes (e.g., habitat, water level). Additional metrics (recruitment, survival, growth, diversity) may be needed.

3.7 Aquatic ecology: macroinvertebrate contribution.

Information need: What is the status (composition, abundance, and distribution) of native and non-native macroinvertebrates in the UMRS? What is the contribution and response of macroinvertebrates to ecosystem health and resilience? How will aquatic macroinvertebrates, and the ecosystem services they provide (biofiltration, nutrient cycling, fish forage) be affected by climate-induced changes and future river modifications?

Geographic extent: Reach/UMRS scale. Note: Species composition, structure, and tolerance levels will change across reaches

How the information will be used: Assessing ecosystem health and resilience.

Measurement or endpoint: community-level macroinvertebrate data on large (LTRM-inclusive and outpool reaches of UMRS) spatial and temporal scales capturing soft-substrate communities using benthic ponar and EPT communities using rock bag/plate samplers); trends and changes in macroinvertebrate abundances, distributions, and resilience. Shifts in community composition, abundance, and MBI tolerance values can reflect habitat and reach-wide resilience. Long-term component establishes robust infrastructure for targeted studies (e.g., contaminants, adult emergence, genetics, and microplastics).

3.9 Aquatic ecology: lower trophic contribution

Information need: What are the abundance, distribution, and status of lower trophic organisms (zooplankton and phytoplankton)? What is the lower trophic base contribution and response to ecosystem health and resilience? What, where, and how many non-native plankton are present in the UMRS?

Geographic extent: Reach/UMRS scale. Use existing phytoplankton samples from field stations. And consider specific outpool samples in the future that may have connections to other LT monitoring efforts (e.g., LTEF) or expansion of LTRM. Zooplankton and other lower trophic (e.g., microbes) investigations would require additional sample collection.

How the information will be used: Assessing ecosystem health and resilience.

Measurement or endpoint: Establish baseline abundance, community composition, and spatiotemporal change for lower trophic base and investigate relationships with environmental conditions. Identify non-native species and potential for or existing invasive status.

3.12 Aquatic ecology: river gradients

Information need: Understand status of fish, veg, (including invasive species present in monitoring) and water quality in the stretch of river between Pools 13 and 26.

Geographic extent: Reach/UMR scale

How the information will be used: Assessing ecosystem health and resilience.

Improving management and restoration by expanding understanding.

Measurement or endpoint: LTRM base monitoring data structure and/or other monitoring sources (e.g., FLAMe sensor or satellite data) across similar spatial scales and strata designations. The goal would be to expand LTRM data collection to the understudied reach though with likely less temporal intensity.

4.1 Restoration Applications: habitat conditions

Information need: What are the conditions needed to support species, guilds, and communities that are prioritized for conservation?

For example: What are the critical variables (e.g., substrate stability, velocity, host fish presence/absence, dissolved oxygen, temperature, food availability) driving the distribution and abundance of mussel species? What are the seasonal movement patterns, home ranges, and population bottlenecks of native and non-native fishes? Do fish in the river stay in the river consistently, or do they use tributary habitat during different seasons or life stages?

Geographic extent: Reach/UMRS scale (but products should be useable at project scale)

How the information will be used: Improving management and restoration

Measurement or endpoint: The endpoint of this information need is an improved understanding of the habitat conditions that support the life history needs of priority species (state and federal T&E; state species in greatest need of conservation; USFWS Trust species; national wildlife refuge priority resources of concern). This is a broad need and a working group would ideally be formed to determine which guild(s) and/or community(ies) to be the initial focus of targeted sampling and habitat assessments. Examples include lotic mussels, migratory fish such as blue sucker, paddlefish, and sturgeon, herps, etc. Methods will be taxa-dependent; for example, pit tags and pit tag readers could provide locational information on fish at different times of the year and different life stages.

4.3 Restoration Applications: floodplain vegetation change at HREP scales

Information need: Project-level monitoring to adaptively manage sites and improve forest simulation model parameters (see 1.2). What are the rates of mortality by age of different plant species in relation to built project features (e.g., soil types, elevations, inundation periods)? What are the establishment rates of unplanted species? How do invasives respond to built features?

Geographic extent: Local scale

How the information will be used: Adaptively manage HREP site conditions and plant assemblages as needed. Improve model parameters for future model applications.

Measurement or endpoint: Targeted floodplain vegetation measurements at HREP and other small-scale management sites pre- and post-project across a range of site conditions, HREP feature designs, and floodplain vegetation species and ages. Improved model parameters (reduce uncertainty), improved site conditions for HREPs and better project alternatives selected by improved modelling. Information, lessons learned transferred to other HREPs.

4.5 Restoration Applications: hypothesis testing

Information need: Capacity to use HREPs as opportunities to reduce uncertainties through research designed to test specific hypotheses. One approach is to ask which questions identified in the Research Frameworks can be addressed through intentional study of HREPs. Specific examples include understanding mussel velocity/substrate/shear stress requirements and validating wind fetch/wave models in Pool 13

Geographic extent: Reach/UMRS scale (project-level learning with systemic applications)

How the information will be used: Improving management and restoration

Measurement or endpoint: Improved understanding of assumptions regarding how HREP features/design influence physical and ecological processes. Ideally, a working group would be formed to identify the hypothesis to be tested and design research.

ATTACHMENT E

UMRBA 2022-2035 Water Quality Program Plan:

https://umrba.org/document/wq2022-2035

ATTACHMENT F

UMRBA WQEC Charter:

https://umrba.org/document/umrba-wqec-charter

ATTACHMENT G

Examining Biological Indicators for the Upper Mississippi River: Applications in Clean Water Act and Ecosystem Restoration Programs (05/2009):

https://umrba.org/document/umrba-2009-biological-indicators-workshop-summary