EPA's Office of Research and Development

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

2015 BOSC Review

FY16-19 Nutrients Project Posters

Summary of Posters

1. Harmful Algal Blooms

This project represents the Agency's first effort to unify harmful algal blooms (HABs) research that had been previously carried out in isolation within various laboratories. A unified program is the most efficient way generate useful results for the Agency's decision makers as they seek to provide guidance regarding feasible analytical methods to quantify the presence of algal toxins, provide guidance regarding the frequency of monitoring necessary to determine if the algal toxins are present, recommend feasible treatment options, forecast, monitor and provide event response to HABs in lakes, rivers, estuaries, and reservoirs, and improve understanding of the ecology and health impacts of freshwater HABs.

2. Science to Improve Nutrient Management Practices, Metrics of Benefits, Accountability, and Communication

This project will demonstrate transferable modeling techniques and monitoring approaches to enable water resource professionals to make comparisons among nutrient reduction management scenarios across urban and agricultural areas. It will produce the applied science to allow better management of nutrient loadings to the Nation's water bodies. Improved management will contribute to the full restoration of designated uses, to adequate protection, and to meeting the future demands for clean water for all the needs of society and the environment.

3. Thresholds and Targeting Actions

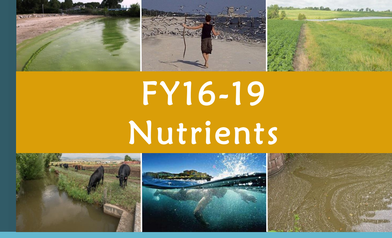
The project will implement novel field and laboratory-based studies, state-of-the-art modeling, and other research syntheses toward these goals and toward decreasing scientific uncertainty related to nutrient management. The key research areas involve improved nutrient indicator development, ecosystem response and recovery to excess nutrients, and nutrient sources and relative contributions to impairment.

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Harmful Algal Blooms

Nicholas Dugan, Project Lead | Tammy Jones-Lepp, Deputy Project Lead

EPA United States Environmental Protection Agency



Problem Summary and Decision Context

Harmful algal blooms (HABs) from algae, cyanobacteria and golden algae may occur naturally; however, human activities appear to be increasing the frequency of some HABs. HABs can have a variety of ecological, economic and human health impacts. Recent events in Toledo, Ohio demonstrated that the intensity and duration of freshwater HABs can negatively impact drinking water and recreational waters, potentially risking public health.

Recent legislation, such as the Harmful Algal Bloom and Hypoxia Research and Control Amendments Act of 2014 (HABHRCA) and proposed House Bill 212 Drinking Water Protection Act (DWPA), along with existing regulations, such as the Safe Drinking Water Act, provide a framework that authorizes the Agency to investigate all facets of the problem and propose a range of solutions.


Photo Credit: David Zapotosky

Utility to Agency

This project represents the Agency's first effort to unify HAB research that had been previously carried out in isolation within various laboratories. A unified program is the most efficient way generate useful results for the Agency's decision makers as they seek to do the following:

1. Provide guidance regarding feasible analytical methods to quantify the presence of algal toxins.
2. Provide guidance regarding the frequency of monitoring necessary to determine if the algal toxins are present.
3. Recommend feasible treatment options.
4. Forecast, monitor and provide event response to HABs in lakes, rivers, estuaries, and reservoirs.
5. Improve understanding of the ecology and health impacts of freshwater HABs.

Tasks and Projected Outputs

Task A – Management (Joel Allen, Task Lead)

(1) Reservoirs **(2)** recreation areas, and **(3)** drinking water treatment

Projected Outputs: Guidance on reservoir sampling strategies, reservoir hydraulic modifications and water treatment process design and operational modifications → with the ultimate goal of reducing the risk of toxin exposure through body contact and ingestion

Task B – Effects (Elizabeth Hilborn, Task Lead)

(1) Health, **(2)** ecosystem, and **(3)** economic

Projected Outputs: An improved understanding of adverse effects (on humans and cell lines), exposure biomarkers, toxicity mechanisms, food web disturbances and economic harm → with the ultimate goal of helping the Agency craft a response to HABs that is protective of human health and cost-effective.

Task C - Modeling (Betty Kreakie, Task Lead; Jeff Hollister, Deputy Task Lead)

(1) Database and data synthesis tools, **(2)** lake temperature modeling, **(3)** bloom indicator modeling, and **(4)** future scenarios

Projected Outputs: Progress towards predictive models of lake temperature and status of various bloom indicators across broad spatial extents. Ultimate goal is to use data intensive approaches to help the agency forecast HAB indicators across a range of possible future climate scenarios.

Task D – Analysis and Monitoring (James Lazorchak, Task Lead)

(1) Method development, **(2)** monitoring approaches, and **(3)** data integration

Projected Outputs: Improved ability to quantify HAB-related organisms and metabolic products in the environment → with the ultimate goal of improving the Agency's ability to monitor and characterize HAB-related threats.

Task E – Cyanobacteria Assessment Network and Satellite Remote Sensing (Blake Schaeffer, Task Lead)

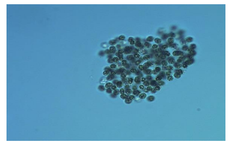
(1) Bloom identification using satellites, **(2)** Improved bloom identification algorithms, **(3)** data integration to identify landscape linkages to HABs, **(4)** connect satellite imagery and human health data, **(5)** connect satellite imagery and behavior/economic data, and **(6)** data dissemination through mobile applications

Projected Outputs: Progress toward the capability of detecting and quantifying blooms using satellite data records → with the ultimate goal of supporting environmental management and public use of lakes and estuaries.

Future Directions

- Continued development of Lake Harsha (Southwest Ohio) as a test platform for reservoir management and instrumentation.
- Assessment of human health impacts by analyzing satellite-generated bloom occurrence data with hospital records.
- Investigate the use of easy-to-collect hair and other samples as biomarkers of human exposure.
- Engineering studies to assess the impacts of water treatment chemicals on suspensions of intact cyanobacterial cells.
- Evaluate the efficacy of real-time biomonitoring systems such as daphnia and larval fish.
- Use the Agency's Geoplatform and EnviroAtlas to improve the movement of satellite-generated data to citizens and decision-makers at all levels.





Partner Engagement Opportunities

Current Partners:

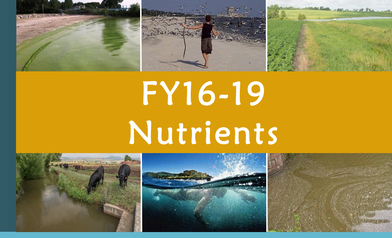
- Regions 5 & 8
- Office of Water – OST & OGWDW
- Safe & Healthy Communities Research Program
- US Army Corps of Engineers, NOAA, USGS, NASA
- Ohio EPA

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Thresholds & Targeting Actions

Heather Golden, Project Lead | Jim Hagy, Deputy Project Lead

EPA United States Environmental Protection Agency



Problem Summary and Decision Context

- Excess inputs of nutrients to watersheds have been linked to a host of ecosystem impacts. This project will **advance the science** needed to do the following:
  (1) Prioritize watersheds and nutrient* sources for management.
  (2) Define appropriate nutrient levels for management (e.g., TMDLs, quantitative goals for biological indicators of aquatic life uses, nutrient criteria) of the nation's waters.
- The project will implement novel field and laboratory-based studies, state-of-the-art modeling, and other research syntheses toward these goals and toward decreasing scientific uncertainty related to nutrient management.
- The three key task areas for this research involve: (1) Improved nutrient indicator development, (2) Ecosystem response and recovery to excess nutrients, (3) Nutrient sources and relative contributions to impairment.

Nutrient(s) refers to nitrogen and other co-pollutants, as outlined in the Nitrogen & Co-pollutant Research Roadmap

Utility to Agency

- Significant progress has been made addressing nutrient pollution; however, there remains an urgent need to accelerate this progress to meet ongoing environmental challenges.
- **Providing the right scientific information** that is readily-accessible to Program Offices (e.g., OST, OWOW, OAR) and Regions would help meet this need, while supporting better solutions and management of excess nutrients.

Tasks and Projected Outputs

Example Task-Level Research Foci

Task A: Improved Nutrient Indicator Development

- Research to identify and assess nutrient-sensitive endpoints and indicators for streams and coastal waters.
- Research to identify endpoints for aquatic life responses to coastal acidification and hypoxia.

Task B. Ecosystem Response and Recovery

- Multi-media (air, land, estuarine) model simulations of nutrient deposition, watershed nutrient cycling, and hypoxia (e.g., Mississippi River Basin, Gulf of Mexico)
- Simulations of nutrient loading/response and best management practice (BMP) effectiveness

Task C: Nutrient Sources and Contributions to Impairment

- Risk-based modeling approach for prioritizing watersheds
- Development and use of agricultural nutrient thresholds for prioritizing watersheds for management
- Improved methods to analyze anthropogenic nutrient sources in coastal acidification processes

Project Output: Research to inform (1) prioritization of watersheds for nutrient management and (2) setting nutrient-specific water quality and aquatic life thresholds for management.

Future Directions

Examples of FY16-19 Research Directions

Task A: Improved Indicators

- Assess how a key indicator of excess nutrients (i.e., periphyton) responds at various temporal and spatial scales to state-level nutrient targets in a freshwater, largely agricultural watershed.
- Examine the effects of nutrient-enhanced coastal acidification and hypoxia on marine species.

Task B: Ecosystem Response and Recovery

- Quantify the ecosystem responses to nutrient loads and exposures and recovery trajectories based on lab/field/multi-media modeling efforts.
- Assess how the additive stresses from climate change and acidification affect response and recovery to nutrient loadings in surface waters.

Task C: Nutrient Sources and Contributions

- Analyze approaches that inform the prioritization of watersheds for nutrient management.
- Assess and develop approaches to most accurately identify anthropogenic nutrient sources in coastal acidification processes.

Partner Engagement Opportunities

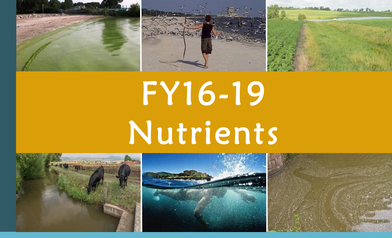
Representatives from OST, OWOW, and OAR have been engaged in the development of this project plan and project charter. Regional and other program office discussions are welcome.
Task Leads (Erik Pilgrim (Task A), John Lehrter (Task B), and Ann Keeley (Task C)) can also be contacted for more information.

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Science to Improve Nutrient Management Practices, Metrics of Benefits, Accountability, and Communication

Jana Compton, Project Lead | Chris Nietch, Deputy Project Lead

EPA United States Environmental Protection Agency

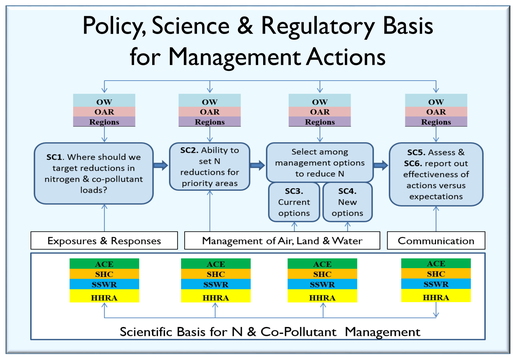


Problem Summary and Decision Context

Our Nation's current management strategies for point and non-point source nutrient reductions are inadequate to protect and meet the expected increased future demands of water for consumption, recreation, and ecological integrity.

This project is focused on the management of nutrient sources, loads, and concentrations within the context of changing demands and expected impacts on social, economic, and environmental systems.

Goal: Demonstrate transferable modeling techniques and monitoring approaches to enable water resource professionals to make comparisons among nutrient reduction management scenarios across urban and agricultural areas. This would consider management of nutrient source loads from WWTPs, septic systems, industrial point sources, air deposition and other non-point sources as well as native features of watersheds at multiple scales and across media (air, land, water).



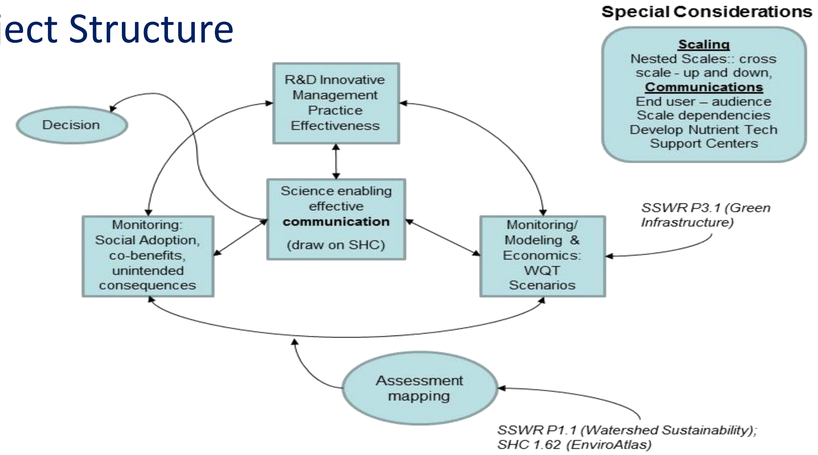
Utility to Agency

This project will produce the applied science to allow better management of nutrient loadings to the Nation's water bodies. Improved management will contribute to the full restoration of designated uses, to adequate protection, and to meeting the future demands for clean water for all the needs of society and the environment.

Tasks and Projected Outputs

Task		Task Lead
A	Tools for the assessment of innovative management practices	Paul Mayer NHEERL
B	Modeling approaches that allow for consideration of market-based policy options	Matt Heberling NRMRL
C	Monitoring & multimedia modeling approaches for verifying reduction	Yongping Yuan NERL
D	Science enabling effective communication	Michelle Latham NRMRL
E	Centers for water research on national priorities related to a systems view of nutrient management	Dale Manty NCER

Project Structure



Output 1

Documentation for considering sustainable management practices to reduce nutrient loading.

Intended User: Water resource planning and protection professionals at a variety of jurisdictional scales, for example OW, regional, and state staff, community organizations, watershed councils and groundwater management area staff.

Output 2

New metrics and monitoring designs to verify the expected benefits of nutrient reductions practices.

Intended User: Water resource planning and protection professionals at all jurisdictional scales, including regional, state and local entities.

Future Directions

This work will be conducted with up front involvement of relevant program offices, including OWOW, OW NARS program staff, OST, OGWDW, OAR programs, OAQPS, NCEE and OSP, EPA STAR grant-funded nutrient centers, and EPA Regional staff.

Connection to other relevant federal agencies is also critical. Potential collaborators include USGS national programs and regional science centers, USDA programs such as NRCS, FSA, ERS, and ARS as well as the new USDA regional climate hubs, and USACE divisions and basin-wide programs.

Projected demonstration projects:

- N-sink tool application, EPA Region 1
- Stream N removal evaluation, Region 3, Baltimore MD
- Viable water quality markets, Little Miami River, OH
- Southern Willamette Groundwater Management Area OR
- NCER nutrient centers CO, FL, PA/MD
- Analyses using National Aquatic Resources Survey data
- Communication lessons learned across projects

Partner Engagement Opportunities

In the local efforts, community-level stakeholders should include state, city and county governments, state agriculture and public health staff, groundwater management areas, soil and water conservation district staff, technology developers, technology innovation clusters, economic development organizations, utilities, fertilizer companies, watershed councils, and EPA regional staff. We also anticipate working with the Regional Technical Advisory Groups on nutrient issues that have formed in each EPA Regional office in conjunction with OW-OST.