# Implications of Seasonal Anoxia and Sediment Resuspension on Lacustrine Sediment Nutrient Loading and Harmful Algal Bloom Initiation

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**USACE Harmful Algal Bloom Research & Development Initiative**

*Delivering scalable freshwater HAB prevention, detection and management technologies through collaboration, partnership and cutting-edge science*

**Problem** The work unit addresses two tasks. First, project partners at Texas A&M University Galveston (TAMUG) require water quality analysis for a large-scale limnology study examining nutrient cycling in multiple TX reservoirs in order to develop a comprehensive Harmful Algal Bloom (HAB) risk model. Second, sediment resuspension and vertical mixing of nutrient-rich bottom-waters release nutrients that play a key role in HAB outbreak initiation, but internal nutrient loadings associated with sediments in reservoirs of the southcentral US are poorly understood. As a result, ERDC will conduct sediment nutrient experiments to inform development of the TAMUG HAB risk model.

**Objective** The objective is to 1) complete water quality analysis for our TAMUG partners and 2) determine the magnitude and stoichiometry of nutrient loading from sediments during seasonal water column mixing and resuspension events. Both data sets will be incorporated into a model useful for lake and watershed scale HABs management.

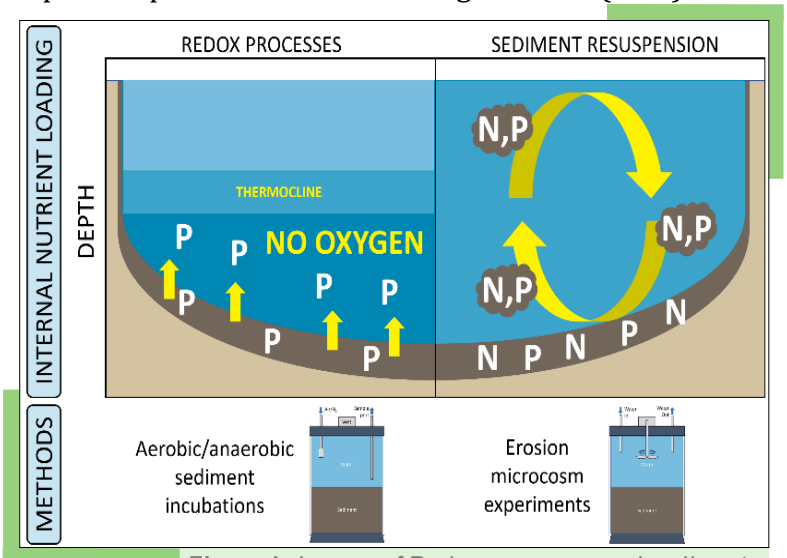


**Figure 1:** *Images of Redox processes and sediment resuspension.*

**Approach** 1) Characterize standard water quality parameters from several hundred seasonally stratified water quality samples collected by project partners at TAMUG; 2) Evaluate sediment morphology, available nutrients, and relevant solid phases in eight TX reservoirs; 3) Quantify nutrient concentrations in surface water, bottom water, and sediment pore water; 4) Determine magnitude of potential nutrient release from sediment to anoxic bottom waters using sediment incubations; and 5) Investigate nutrient release from sediment due to sediment resuspension using an erosion microcosm system.

**Results** Nutrient analysis has been completed on 450 water quality samples and data submitted to TAMUG partners for inclusion in the HAB risk model. Remaining tasks are dependent upon collection of in-tact sediment cores from eight Texas reservoirs. Two sediment collection field efforts conducted over the past year failed to collect in-tact sediment cores due to sediment characteristics (e.g., rock, hardpacked substrates) despite application of multiple sediment collection platforms (Figure 2). New tools and expertise are being investigated to collect sediments during FY23.

**Figure 2:** *From left to right: 1) Gravity corer fabricated to collect sediment cores in tubes compatible with our resuspension testing apparatus. 2) and 3) Box corer and several sediment core subsamples from Proctor Lake, TX. 4) Large EL research vessel mobilized to collect sediment during summer 2022.*

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## Major Milestones

| Date | Milestone |
|---|---|
| FY22, Q2 | Fabrication of sediment coring device and field testing (Complete) |
| FY22, Q2 | Quantify nutrients in surface water, bottom water, and porewater from 2021 and 2022 field seasons (450 samples) (In-Progress) |
| FY23, Q2 | Characterize sediment morphology, available nutrients, and relevant solid phases in each reservoir (Pending Funding) |
| FY23, Q2 | Field collection of sediment cores for incubations and erosion experiments (Pending Funding) |
| FY23, Q3 | Quantify nutrients in surface water, bottom water, and porewater from 2023 field season (Pending Funding) |
| FY23, Q3 | Determine magnitude of nutrient release to anoxic bottom waters (Pending Funding) |
| FY23, Q3 | Quantify nutrient release due to sediment resuspension (Pending Funding) |
| FY23, Q4 | Journal Article: Impact of sediment characteristics on importance of nutrient loading in warm monomictic reservoirs (Pending Funding) |
| FY23, Q4 | Conference Presentation: Impact of sediment characteristics on importance of nutrient loading in warm monomictic reservoirs (Pending Funding) |
| FY23, Q4 | Contribute to development of quantitative models and travel to TAMUG for in-person collaboration (Pending Funding) |
| FY23, Q4 | Journal Article: Quantitative model for HAB prediction (Pending Funding) |
| **Costs** | **FY22:**$121K **FY23:**$104K **TOTAL:**$225K |

## Partnership/Leveraging Opportunities

This work is leveraging a collaboration with research project partners from TAMUG. The collaboration will contribute to development of a comprehensive quantitative model to quantify harmful algal bloom outbreak risk.

## Value to USACE Mission

Characterization of sediments and quantification of sediment nutrient loading will improve lake-scale nutrient management strategies and contribute to watershed HAB risk model development.

***USACE Liaisons:*** Mandy Michalsen and Mike Greer of the USACE Engineering Research and Development Center (ERDC)