Environment and Natural Resources Trust Fund
2010 Request for Proposals (RFP)

LCCMR ID: 042-A3

Project Title:

Floating Island Phosphorus Removal

LCCMR 2010 Funding Priority:

A. Water Resources

Total Project Budget: $ $283,817

Proposed Project Time Period for the Funding Requested: 3 years, 2010 - 2013

Other Non-State Funds: $ $0

Summary:

The goal of this project is to remove phosphorus from surface water by using a floating treatment plant residuals as the adsorbent

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Sponsoring Organization: University of Florida

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Location:

Region: Metro

County Name: Statewide

City / Township:

_____ Knowledge Base _____ Broad App. _____ Innovation

_____ Leverage _____ Outcomes

_____ Partnerships _____ Urgency _____ TOTAL

PROJECT TITLE: FLOATING ISLAND PHOSPHORUS REMOVAL

I. PROJECT STATEMENT

Eutrophication is defined as the increased growth of algae and aquatic plants, and is caused by excess nutrients, namely, phosphorus and nitrogen. Eutrophication has an adverse impact on waters by decreasing water clarity and dissolved oxygen. These changes in water quality, in turn, have an adverse impact on fish and other aquatic plants and animals. ***In Minnesota, nutrients and eutrophication account for the greatest percentage of listings in the final 2008 TMDL listings by parameter.*** Both point and non-point sources of nutrients contribute to the eutrophication potential of surface waters in Minnesota. Point sources of nutrients can be monitored and controlled at discharge locations, such as wastewater treatment plants. Nutrients from non-point sources, such as agricultural and residential run-off, are particularly difficult to control. Accordingly, an innovative treatment approach is required to decrease nutrient loadings to Minnesota's waters and prevent eutrophication.

The overall goal of this research project is to remove phosphorus from Minnesota's waters, and thereby decrease eutrophication and improve water quality. The specific objectives of this research project are (1) to conduct a bench-scale evaluation of a wide range of waste byproduct materials for adsorption of phosphorus (2) to design and test a floating island pilot plant that uses the most effective waste byproduct material to adsorb phosphorus. Waste byproduct materials, such as water treatment residuals, have been shown to adsorb phosphorus. These materials have the potential to be sustainable alternatives to commercial adsorbents and ion exchange resins. ***This project will focus on the Upper Mississippi River Basin, Twin Cities Metropolitan Area, which has a large number of eutrophic lakes.***

The Principal Investigator is currently conducting a study funded by the St. Johns River Water Management District (SJRWMD; State of Florida) investigating phosphorus removal by physical-chemical treatment. The goal of the SJRWMD project is to implement an engineered process that will remove phosphorus from tributaries draining into a lake. Preliminary results show that alum sludge, a waste byproduct material from water treatment, is an effective adsorbent for phosphorus. Design of an in-lake treatment process is currently underway. The results from the SJRWMD study will be used as a foundation for the proposed project of removing phosphorus from Minnesota's waters.

II. DESCRIPTION OF PROJECT RESULTS

Result 1: *Testing sustainable materials for phosphorus removal.* **Budget: $96,330.**
The bench-scale study will evaluate phosphorus removal by water treatment residuals. The water treatment residuals will include alum and ferric sludge, which are characterized as amorphous aluminum and iron hydroxides. ***All tests will be conducted using surface water from the Upper Mississippi River Basin, Twin Cities Metropolitan Area.*** Test waters will be chosen to investigate the impact of dissolved organic matter, turbidity, total nitrogen, and total phosphorus on phosphorus removal. ***The objective is to find a water treatment residual that removes phosphorus and results in minimal changes to water chemistry.*** Jar tests and rapid small-scale column tests will be used to assess the capacity and kinetics of phosphorus removal by alum and ferric sludge.

Deliverable	Completion Date
1. Comparison of phosphorus removal by alum and ferric sludge	**4/30/2011**
2. Track water quality changes by alum and ferric sludge treatment	**4/30/2011**

Result 2: *Design and construction of floating island pilot plant.* **Budget: $66,260.**
The floating island pilot plant will be designed to be a self-contained treatment unit. Design of the floating island will take place in parallel to work on Result 1. The floating island will be designed to treat up to one gallon per minute. The floating island will use two pontoons to float. The dimensions of the floating island will be approximately 6 ft wide by 16 ft long, and will be transported by boat trailer. The center of the floating island will house the power supply, pumps, treatment reactors, and water samplers. Power supply sources will include solar power and wind power. Power supply requirements for 12 and 24 hours per day treatment will be considered. The adsorbent materials will be tested in both a fixed-bed reactor and a fluidized bed reactor. Influent and effluent water samples will be collected by an automatic water sampler. ***The floating island pilot plant will be transported to and tested in Minnesota.***

Deliverable	Completion Date
1. Designs and permits for floating island pilot plant	**5/31/11**
2. Prototype floating island pilot plant	**6/30/11**

Result 3: *In-lake treatment for phosphorus removal.* **Budget: $121,227.**
The most effective water treatment residual from Result 1 will be used in the floating island pilot plant. Important considerations in choosing the adsorbent material will be its capacity for phosphorus and its changes to water chemistry. Accordingly, the adsorbent replacement rate will be an important testing parameter. ***The pilot plant testing will be conducted in eutrophic lakes in the Upper Mississippi River Basin, Twin Cities Metropolitan Area.*** The pilot plant testing will take place during the late summer and early fall when the lakes are ice free. Influent and effluent samples will be collected daily and analyzed in the field for orthophosphate, pH, turbidity, and ultraviolet absorbance. Additional samples will be analyzed at a local laboratory in Minnesota to ensure that water quality changes are kept to a minimum.

Deliverable	Completion Date
1. Preliminary report on the effectiveness of phosphorus removal by floating island pilot plant from Summer 2011	**12/31/11**
2. Final report on the effectiveness of phosphorus removal by floating island pilot plant from Summer 2011 and Summer 2012	**12/31/12**

III. PROJECT STRATEGY

A. Project Team/Partners
The project team includes Dr. Boyer, Dr. Mazyck, and Ms. Riley. Dr. Boyer has a current project evaluating phosphorus removal technologies. Dr. Mazyck has experience transferring bench-scale experiments to pilot-scale applications. Ms. Riley will assist with project management activities.

B. Timeline Requirements
The proposed project will be completed in two and one-half years. Bench-scale testing and pilot plant design will be conducted in 2010–2011. In-lake testing will be conducted in two phases: summer 2011 and 2012. Fall 2011 through spring 2012 will be used to make improvements to the pilot plant for the second phase of field testing in summer 2012.

C. Long-Term Strategy
N/A

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET (*2.5* years)

BUDGET ITEM	AMOUNT
Personnel:	$ -
PI: Dr. Boyer, FTE: 0.16, %sal: 77, %benefits: 23, duration: 2.5 years	$ 56,221
Co-PI: Dr. Mazyck, FTE: 0.08, %sal: 77, %benefits: 23, duration: 2.5 years	$ $31,254
Project Manager: Riley, FTE: 0.08, %sal: 77, %benefits: 23, duration: 2.5 years	$ 27,326
(2) Graduate Students: FTE: 1.5, %sal: 93, %benefits: 7, duration: 2.5 years	$ 103,250
Contracts: *NA*	$ -
Equipment/Tools/Supplies:	
Consumable laboratory supplies: chemicals, vials, gloves, aluminum foil, parafilm,… - Bench-scale experiments: glassware, peristaltic pump, magnetic stir plate - Pilot-scale experiments: floating structure, pumps, sample fraction collector	$ 15,000
Travel:	
Out-of-State Travel - Trips between Gainesville, Florida and project site in Minnesota.	$ 12,500
Additional Budget Items:	
Tuition - Calculated on established monthly rates by the university as follows: Jul-Aug 2010: $675.72/month, Sep 2010 - Aug 2011: $777.07/month, Sep 2011 - Aug 2012: 893.64/month, Sep-Dec 2012: 1027.68	$ 38,266
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 283,817

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period: *NA*	$ -	*Indicate: Secured or Pending*
Other State $ Being Applied to Project During Project Period: *NA*	$ -	*Indicate: Secured or Pending*
In-kind Services During Project Period: *NA*	$ -	
Remaining $ from Current Trust Fund Appropriation (if applicable): *NA*		*Indicate: Unspent? Not Legally Obligated ? Other?*
Funding History: *Indicate funding secured prior to July 1, 2010 for activities directly relevant to this specific funding request. State specific*	$ -	

PROJECT MANAGER QUALIFICATIONS AND ORGANIZATION DESCRIPTION

Treavor H. Boyer
Assistant Professor, Department of Environmental Engineering Sciences, University of Florida

B.S., Chemical Engineering, 2002, University of Florida, Gainesville, FL.
M.S., Environmental Engineering, 2004, University of North Carolina at Chapel Hill, Chapel Hill, NC.
Ph.D., Environmental Engineering, 2008, University of North Carolina at Chapel Hill, Chapel Hill, NC.

Dr. Treavor Boyer will be responsible for the overall project. Dr. Boyer's research expertise includes physical-chemical processes in natural and engineered aquatic systems, with a focus on studying the impact of natural organic matter. Dr. Boyer is Co-Principal Investigator on a project funded by the St. Johns River Water Management District (Florida), which is investigating innovative treatment processes and engineering approaches to remove phosphorus by in-lake treatment. One manuscript is in preparation from the first phase of this project.

Dr. David Mazyck is an Associate Professor in the Environmental Engineering Sciences Department at the University of Florida. Dr. Mazyck's expertise is adsorption process for aqueous and air phases. Dr. Mazyck also has extensive experience scaling up processes from laboratory scale to pilot- and full-scale, as well as commercializing innovative process technologies. Ms. Kristen Riley will assist with project management activities including schedules, budgets, and deliverables.

Organization Description
The University of Florida is a major public, land-grant, research university. The laboratories of Drs. Boyer and Mazyck are equipped to conduct bench-scale physical-chemical treatment experiments and measure a wide range of water quality parameters.