Environment and Natural Resources Trust Fund (ENRTF) M.L. 2016 Work Plan

Date of Report: January 20, 2016

Date of Next Status Update Report: July 1, 2016

Date of Work Plan Approval:

Project Completion Date: June 30, 2019

Does this submission include an amendment request? __No__

PROJECT TITLE: **Tracking and Preventing Harmful Algal Blooms**

Project Manager: Daniel R. Engstrom

Organization: St. Croix Watershed Research Station
Science Museum of Minnesota

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Location: Statewide

		M.L. 2015, Chp. 76, Sec. 2, Subd. 10 Emerging Issues Account $	M.L. 2016, Chp. xx, Sec. xx, Subd. Work Plan $
Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$93,000**	**$500,000**
	Amount Spent:	**$0**	**$0**
	Balance	**$93,000**	**$500,000**

Legal Citation: M.L. 2016, Chp. xx, Sec. xx, Subd. xx
M.L. 2015, Chp. 76, Sec. 2, Subd. 10

Appropriation Language:
M.L. 2016, Chp. xx, Sec. xx, Subd. xx
Insert text here

M.L. 2015, Chp. 76, Sec. 2, Subd. 10
$1,000,000 the first year is from the trust fund to an emerging issues account authorized in Minnesota Statutes, section 116P.08, subdivision 4, paragraph (d).

I. PROJECT TITLE: Tracking and Preventing Harmful Algal Blooms

II. PROJECT STATEMENT:

Harmful algal blooms (HABs), especially those caused by toxin-producing blue-green algae (Cyanobacteria), significantly reduce the recreational and ecological value of Minnesota lakes. They negatively impact water quality, degrade fisheries, and are a health concern for humans and domesticated animals. The duration, frequency, and extent of harmful algal blooms are increasing worldwide. New evidence points to similar changes in some Minnesota lakes, yet little information is available on historical trends in blooms or the present-day composition of algae associated with bloom formation and toxin production. Harmful algal blooms occur as discrete events and are known to relate to phosphorus concentration. However, the seasonality, water-quality conditions, and sediment-water interactions that drive these events are not well understood. A better understanding of the lake characteristics and nutrient-climate interactions that stimulate harmful algal blooms would facilitate new corrective measures and better allocation of management resources.

This project will address three key questions regarding the occurrence, composition, and causes of HABs: (1) when do they occur, in which type of lakes, and which species and toxins are present; (2) are they increasing in Minnesota, and if so, in which lakes; and (3) what are the main environmental factors causing bloom formation and toxin production? To answer the first question, we will intensively monitor a set of five lakes on a bimonthly (twice per month) basis for composition and abundance of algae, their associated toxins, and key water-quality variables including nutrients (N and P), temperature, dissolved oxygen levels, chlorophyll a, and phycocyanin. We will also deploy temperature and oxygen recorders to continuously monitor key variables that affect in-lake nutrient cycling, along with sediment traps to track seasonal changes in algal composition and abundance. This sampling will be done in collaboration with the DNR and PCA as part of their long-term Sentinel Lakes monitoring program. The second question will be addressed by analysis of dated sediment cores from 10 lakes for fossil algal pigments to assess historical changes in the abundance of cyanobacteria and other algae. This will allow us to determine where and when HABs have increased and link them to possible drivers such as land-use change and temperature increases. These lakes will also be selected from among those in the Minnesota Sentinel Lakes program and will cover a range of lake types (trophic status, lake depth, and size) and ecoregions of the state. The third question will focus on a single Sentinel Lake with known bloom problems. Here we will pair results from the monitoring and sediment cores with watershed and in-lake models of phosphorus loading to determine the critical factors leading to bloom development including watershed inputs, recycling from sediments, and changing lake temperatures.

This work will be done in collaboration with the University of Minnesota in their complementary project (038-B), "Increasing Harmful Algal Blooms in Minnesota Lakes". The two research teams will coordinate monitoring effort on an overlapping set of lakes to extend the reach of this work from intensive laboratory studies to a broad range of observable field conditions in Minnesota lakes. Both research teams will regularly share data and results and coordinate the collection of samples when practical, and both groups will work jointly with the Minnesota Interagency Workgroup on Blue-Green Algae (MPCA, MDNR, MDH, MVMA) to update the agencies on our latest findings, coordinate research, response, and outreach efforts, and evaluate any emerging issues.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of July 1, 2016:

Project Status as of January 1, 2017:

Project Status as of July 1 2017:

Project Status as of January 1 2018:

Project Status as of July 1 2018:

Project Status as of January 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Jump-start lake monitoring program
Description: We will begin monitoring of algal blooms and associated limnological conditions at the onset of open water conditions in the first year of the project (April 2016). HABs typically appear in mid- to late-summer, but the conditions leading up to bloom formation cannot be understood without spring and early summer monitoring. Monitoring will be conducted at five Sentinel Lakes on a twice-monthly basis as described under Activity 2. In addition, we will instrument the five lakes with recording temperature and oxygen probes to continuously monitor chemical and physical lake conditions and sediment traps to track seasonal changes in algal composition and abundance.

Summary Budget Information for Activity 1: **ENRTF Budget: $ 93,000**
Amount Spent: $ 0
Balance: $ 93,000

Outcome	Completion Date
1. *Accelerate the lake monitoring program by beginning in year-1 of the project (April, 2016) and extend the monitoring period to 7 months (April-October) for each of two years*	December 2016
2. *Instrument five lake with recording oxygen and temperature probes and sediment traps to continuously track changes in water column condition and algal composition and abundance*	December 2016

Activity Status as of July 1, 2016:

Activity Status as of January 1, 2017:

Activity Status as of July 1 2017:

Activity Status as of January 1 2018:

Activity Status as of July 1 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 2: Identify species composition and timing of harmful algal blooms
Description: We will assess the relationship between algal communities and water quality in a representative group of Minnesota lakes to determine the distribution, abundance, and seasonality of bloom-forming species. Current water quality monitoring of five Sentinel Lakes (carried out by the MN DNR and MPCA) will be amended to include a twice-monthly algae sampling during the ice-free period over two years that will be analyzed by the St. Croix Watershed Research Station's CHARM Laboratory (Center for Harmful Algal Research in Minnesota), established with prior ENRTF support. Cyanobacteria that are detected will be quantified in terms of biomass (bloom vs. non-bloom), danger to public health (toxin producing vs. non-toxin producing), and provenance (invasive vs. historically occurring).

Sampling will be done on an alternating 2-week basis for those lakes scheduled for routine monthly monitoring by DNR/MPCA field staff. Each site visit will include the collection of algal samples from near-surface and thermocline depths along with samples (epilimnion and hypolimnion) for water chemistry – total-N, total-P, nitrate/ammonia, soluble reactive P, dissolved organic and inorganic carbon – and algal toxins. Depth profiles of temperature, conductivity, pH, dissolved oxygen, chlorophyll *a*, and phycocyanin (a photosynthetic pigment specific to cyanobacteria) will be made with a YSI water-quality sonde specifically acquired for the project.

Soft algae (including cyanobacteria) will be identified and enumerated on a specialized "inverted" microscope recently acquired through ENRTF funding of our ongoing project, "Watershed-Scale Monitoring of Long-Term Best-Management Practice Effectiveness". Algal toxins, including microcystin, anatoxin-a, and cylindrospermopsin, will be analyzed by ELISA microplate reader.

Summary Budget Information for Activity 2: **ENRTF Budget: $ 164,300**
Amount Spent: $ 0
Balance: $ 164,300

Outcome	Completion Date
1. *A quantification of the seasonality of harmful algal blooms across a representative sampling of Minnesota lakes*	June 2018
2. *The identification of bloom-forming species, the associated risk for toxin production, and the occurrence of invasive blue-green algae*	June 2018

Activity Status as of January 1, 2017:

Activity Status as of July 1 2017:

Activity Status as of January 1 2018:

Activity Status as of July 1 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 3: Reconstruct frequency of algal blooms relative to natural conditions
Description: We will determine where and when bloom-forming algae have increased in Minnesota lakes over the last century to better understand the causes and susceptibility of individual lakes to bloom development. We will use sediment paleolimnological methods to reconstruct the frequency and severity of cyanobacterial blooms in 10 lakes selected from the Sentinel Lakes monitoring program. Sediment cores will be collected from each lake and dated using radioisotopes at the St. Croix Watershed Research Station to establish a continuous history of lake condition over the last 150 years. Dated sections will be analyzed for fossil algal pigments, including those unique to blue-green algae, to determine presence, abundance, and frequency of harmful algal blooms in a historical context.

To obtain the sediment chronology, cores will be radiometrically dated by ^{210}Pb methods, supplemented as needed by identifying the 1963 ^{137}Cs peak that is remnant from the atmospheric testing of nuclear bombs. Based on typical sediment accumulation rates in Minnesota lakes, it should be possible to obtain reliable dates back to the mid to early 1800s in all lakes. Dating resolution will be roughly decadal overall, but more detailed (approximately 5-year) for the most recent 2-3 decades.

The sediment cores will be analyzed for a suite of components to assess changes in algal abundance and composition as well as nutrient levels that contribute to the development of HABs. Fossil pigments specific to cyanobacteria along with those produced by other algal groups will be the primary tool for reconstructing changes in HABs and overall lake productivity. In concert with pigment analyses, lake-water phosphorus content over time will be estimated by analysis of the remains of diatoms, a group of algae with certain species that are diagnostic of phosphorus content in the water in which they live. General algal productivity will be assessed by the accumulation of biogenic silica, which is largely composed of the glass cell walls of these diatoms. The phosphorus content (both total and extractable fractions) of the sediment will determine apparent loads of this essential nutrient.

Ultimately, core reconstructions will be compared with local land-use history, nitrogen deposition trends, and meteorological records (temperature, wind speed, precipitation) to determine whether any of these potential drivers of limnological change are correlated with shifts in lake productivity and, in particular, the abundance of HAB-forming algae.

Summary Budget Information for Activity 3: **ENRTF Budget: $ 173,400**
Amount Spent: $ 0
Balance: $ 173,400

Outcome	**Completion Date**
1. *A comparison of historical changes in harmful algae among a large suite of Sentinel lakes to determine the geographic extent and timing of the problem*	January 2018
2. *An assessment of the likely drivers of increasing harmful algae by comparison of trends in lake sediment cores with changes in landscape, land-use, and climate over the period of record*	December 2018

Activity Status as of January 1, 2017:

Activity Status as of July 1 2017:

Activity Status as of January 1 2018:

Activity Status as of July 1 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 4: Determine how nutrients and climate interact to favor harmful algae
Description: We will quantify phosphorus inputs and cycling in an intensively monitored sentinel lake to determine the critical factors leading to bloom development including watershed inputs, recycling from sediments, and changing lake temperatures. The study lake will be among those sampled in Activities 1 and 2, thus allowing us to pair monitoring of harmful algae blooms with mechanistic models that describe watershed inputs and internal recycling of nutrients. We will measure potential for in-lake recycling of legacy nutrients (phosphorus) by determining the fraction of labile phosphorus in the lake sediment. We will monitor bloom formation by quantifying harmful algae in sediment traps and water column samples, along with potential environmental controls, including water chemistry, lake temperatures, and oxygen depletion of bottom waters.

These results will be paired with watershed and in-lake models to better understand the factors contributing to bloom formation. Specifically, we will use the Soil and Water Assessment Tool (SWAT), a watershed modeling program developed by the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA) to estimate watershed nutrient loads, present-day and in the past. Model construction requires inputs of hydrography, topography, soils, land cover, and agricultural management practices. For the study watershed, a SWAT model will be calibrated to current (2000-2010 average) land-use and climate conditions. In particular, the model will be constrained to match the sediment and phosphorus loads inferred from the sediment core data for this recent time period. Then, the model will be run to simulate sediment and phosphorus loads for selected periods in the past and tested against the sediment core data for these past periods. These model runs will build the mechanistic relationship between the erosional and fertilization history of the terrestrial watershed and how this history is recorded in the lake sediments.

To complete the analysis and infer the impact of watershed land use on lake-water quality, a coupled hydrodynamic – nutrient cycling model, CE-QUAL-W2, will be used to simulate algal and nutrient dynamics within the lake as well as the water-column physical parameters (temperature, dissolved oxygen) that govern them. A primary goal of in-lake modeling will be to partition the loading of phosphorus between external (watershed) and internal (sediment) sources. A secondary goal will be to use SWAT-model inferred nutrient loading for a selected past time period and see if a calibrated CE-QUAL-W2 model can predict the algal community as determined in the sediment core.

Summary Budget Information for Activity 4: **ENRTF Budget: $ 162,300**
Amount Spent: $ 0
Balance: $ 162,300

Outcome	Completion Date
1. *A mechanistic understanding of drivers of harmful algal blooms based on intensive monitoring of algae phenology and in-lake processes*	June 2019
2. *A determination of the relative importance of external loading vs. the internal recycling of phosphorus in terms of driving harmful algal blooms across lakes*	June 2019
3. *A predictive framework linking internal and external nutrient loads to the occurrence of harmful algal blooms in Minnesota lakes*	June 2019

Activity Status as of January 1, 2017:

Activity Status as of July 1 2017:

Activity Status as of January 1 2018:

Activity Status as of July 1 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

V. DISSEMINATION:

Description: We will collaborate with the Minnesota Interagency Workgroup on Blue-Green Algae (MPCA, MDNR, MDH, MVMA) to update the agencies on our latest findings, coordinate research, response, and outreach efforts, and evaluate any emerging issues. The Workgroup currently meets twice each year.

In addition, we will distill results from this study into compelling, accessible, and readable stories that will be widely distributed through electronic communications channels. This will include feature articles focusing on specific research results; regular short blog posts about the methods, activities, and people behind the study, and a quarterly email newsletter, "*Field Notes*", with links to the articles and blog posts.

A final project report will document all findings for reference by state personnel, presentations at regional meetings will apprise stakeholders of our methods and results, and publications in peer-reviewed journals will inform the wider academic research community.

Status as of July 1, 2016:

Status as of January 1, 2017:

Status as of July 1 2017:

Status as of January 1 2018:

Status as of July 1 2018:

Status as of January 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 384,100	1 sediment geochemist at 8% FTE for 2 years ($21,600); 1 algal and diatom analyst at 50% FTE for 2.5 years ($122,400); 1 algal toxin specialist and data analyst at 50% FTE for 3.5 years ($128,400); 1 hydrologist/watershed modeler at 35% FTE for 2 years ($70,100); 1 field technician at 75% FTE for 2 years ($41,600)
Professional/Technical/Service Contracts:	$ 68,800	USGS CE-QUAL modeling of in-lake process and field monitoring of discharge over 3 years ($50,000); Fossil pigment analysis by specialized external lab ($18,800)
Equipment/Tools/Supplies:	$ 30,000	Dissolved oxygen and temperature recording probes ($24,000); Field supplies including sediment traps, sample bottles, vials & reagents ($6,000)
Capital Expenditures over $5,000:	$ 30,000	YSI Water-quality sonde ($20,000); ELISA microplate reader ($10,000);
Travel Expenses in MN:	$ 19,600	Field work: sediment core collection and twice-monthly lake sampling
Other: Analytical Services	$ 60,500	Lab analysis of water samples (N, P, DOC, DIC) and sediment cores: radiometric dating (Lead-210, Cesium-137); biogenic silica; loss-on-ignition, sediment phosphorus and metals
TOTAL ENRTF BUDGET:	**$593,000**	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: A dedicated water-quality sonde with sensors for chlorophyll a and phycocyanin is required for the intensive (twice-monthly) lake monitoring as outlined under Activity 1. An ELISA microplate reader for analysis of cyanobacterial toxins as described under Activity 2.

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 5.36

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
Science Museum of Minnesota	$ 215,000	$	Unrecovered support services (lab & equipment maintenance, infrastructure, project administration), 43% of direct costs
State			
DNR & MPCA (in-kind)	$ 105,000		Support in collecting water and phytoplankton samples from Sentinel Lakes
TOTAL OTHER FUNDS:	**$ 320,000**	**$**	

VII. PROJECT STRATEGY:

A. Project Partners: DNR/MPCA (Sentinel lakes monitoring)
U.S. Geological Survey (CE-QUAL-W2 modeling)

B. Project Impact and Long-term Strategy:

This project will provide a statewide assessment of whether the threat of HABs is increasing in Minnesota and, if so, it will help identify the factors most likely contributing to that change. There has been only limited, short-term monitoring of HABs in Minnesota lakes, and evidence for changes in bloom frequency and severity is largely anecdotal. The reconstruction of past algal abundance from sediment cores, as outlined in this study, will provide a solid historical context for the present-day condition of Minnesota lakes. While excess nutrients, particularly phosphorus have long been known to stimulate algal growth, there are other factors that may play an equally important role; these include changes in the thermal structure of lakes (duration and stability of stratification), surface water temperatures and length of the growing season, atmospheric deposition of reactive nitrogen, invasive species such as the common carp, and internal feedback from the growth and senescence of the algal blooms themselves.

This study will improve our ability to predict when HABs occur, when they produce toxins, and how long those toxins persist. Again, monitoring of algal blooms and their toxins has been largely discontinuous and non-systematic so that we have only limited information about the seasonality, abundance, and composition of HABs or their associated toxins in our lakes. Because algal blooms and toxin production are relatively short-term events, high-frequency, systematic monitoring and modeling of both algae and associated physico-chemical conditions is needed to understand the risk posed by HABs and the factors contributing to their development.

This project integrates an extensive package of watershed monitoring data, sediment analytical results, watershed modeling, and in-lake modeling in a way that will engender mechanistic understanding of how and why harmful algal blooms occur. A key benefit of the project is the transferability of the results. Models are inherently flexible in their application, and the lessons learned in calibrating the models to our study site can be passed along in fitting the models to other sites. Furthermore, the calibrated models can be run with possible future land use or climate data, thus giving tremendous predictive power to infer potential impacts on our lakes.

Finally, as a long-term strategy, this study will establish infrastructure and capacity to identify harmful algae and toxins within the state of Minnesota; our state agencies currently outsource much of this work. The research staff who will carry out this project already possess expertise in algal identification and ecology. The work carried out here will help hone those skills, particularly with cyanobacteria and other soft algae, which are taxonomically difficult and environmentally complex. We anticipate that this study will raise additional questions about HABS and that solutions to the problem will involve long-term research investment beyond that outlined here.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
MPCA (Lake of the Woods nutrient mass-balance study)	January 2012 -- July 2016	$ 300,000
ENRTF (M.L. 2014, Chp. 226, Sec. 2, Subd. 03g; “Watershed-Scale Monitoring of Long-Term Best-Management Practice Effectiveness”) to establish Center for Harmful Algae Research in Minnesota (CHARM lab)	July 2014 -- June 2017	$ 900,000
ENRTF (M.L. 2009, Chap 143, Sect 2, Subd 05c "Cooperative Habitat Research in Deep Lakes") MN DNR subcontract to SMM	July 2010 -- June 2013	$ 90,000

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: N/A

IX. VISUAL COMPONENT or MAP(S): See attached figure

X. RESEARCH ADDENDUM: See attached Research Addendum

XI. REPORTING REQUIREMENTS:

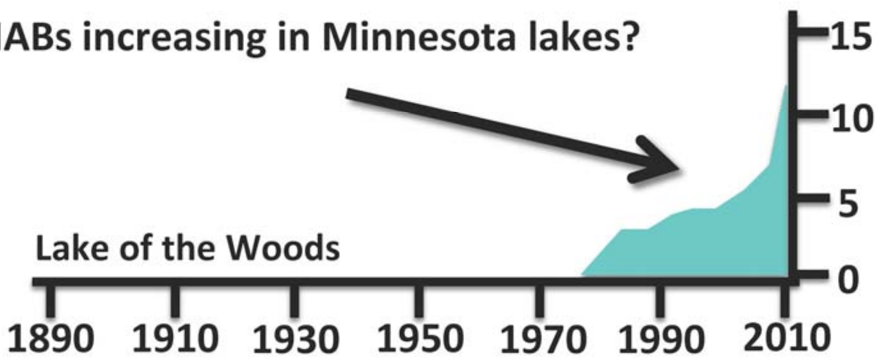
Periodic work plan status update reports will be submitted no later than the end of the months of July 2016, January 2017, July 2017, January 2018, July 2018, and January 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

What's going on with Harmful Algal Blooms (HABs) in Minnesota lakes?

- **What algae are present, when do they bloom, and are they harmful?**

HABs to the public: a soupy green mess

- **HABs increasing in Minnesota lakes?**



Harmful algae preserved in lake sediment

- **Excess phosphorus causes HABs, but which is the bigger problem?**
  - ? **Watershed inputs**
  - ? **In-lake recycling**

The Ghost of Phosphorus Past

Environment and Natural Resources Trust Fund
M.L. 2016 Project Budget

Project Title: Tracking and Preventing Harmful Algal Blooms
Legal Citation:
Project Manager: Daniel R. Engstrom
Organization: St. Croix Watershed Research Station, Science Museum of Minnesota
M.L. 2016 ENRTF Appropriation: **$** 593,000
Project Length and Completion Date: 3.5 Years, June 30, 2019
Date of Report: January 25, 2016

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	Activity 4 Budget	Amount Spent	Activity 4 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	*M.L. 2015, Chp. 76, Sec. 2, Subd. 10Emerging Issues Account - Jump-start lake monitoring program*			*Identify species composition and timing of harmful algal blooms*			*Reconstruct frequency of algal blooms relative to natural conditions*			*Determine how nutrients and climate interact to favor harmful algae*				
Personnel (Wages and Benefits)	$42,900	$0	$42,900	$127,200	$0	$127,200	$107,200	$0	$107,200	$106,800	$0	$106,800	$384,100	$384,100
Engstrom, Research Director: Sediment dating; 8% FTE for 2 yr; Salary=77%, Benefits=23% ($21,600)														
Edlund, Senior Scientist (1 of 2); Diatom & BG algae analyses; 50% FTE for 2.5 yr; Salary=77%, Benefits=23% ($122,400)														
Almendinger, Senior Scientist (1 of 2); SWAT modeling; 35% FTE for 2 yr; Salary=77%, Benefits=23% ($70,100)														
Heathcote, Asst. Scientist; BG algae and toxins; data synthesis; 50% FTE for 3.5 yr; Salary=77%, Benefits=23% ($128,400)														
Field Technician; Lakea monitoring and sampling; 75% FTE for 2 yr; Salalry=77%, Benefits=23% ($41,600)														
Professional/Technical/Service Contracts														
U.S. Geological Survey (for CE-QUAL-W2 modeling of lake hydrodynamics and phosphorus cycling)										$50,000	$0	$50,000	$50,000	$50,000
University of Regina (for analysis of fossil plant pigments in sediment cores)							$18,800	$0	$18,800				$18,800	$18,800
Equipment/Tools/Supplies														
Field supplies (sediment traps, sample bottles & vials, reagents)	$1,000	$0	$1,000	$5,000	$0	$5,000							$6,000	$6,000
Dissolved oxygen and temperature recording probes	$18,500	$0	$18,500							$5,500	$0	$5,500	$24,000	$24,000
Capital Expenditures Over $5,000														
YSI multi-parameter sonde for water-column measurements	$20,000	$0	$20,000										$20,000	$20,000
ELISA micoplate reader and supplies for analysis of algal toxins				$10,000	$0	$10,000							$10,000	$10,000
Travel expenses in Minnesota	$6,500	$0	$6,500	$10,500	$0	$10,500	$2,600	$0	$2,600				$19,600	$19,600
Lake monitoring & coring (mileage and gas, ~70 trips) $11,500														
Lake monitoring & coring (meals) $6,200														
Lake monitoring & coring (lodging) $1,900														
Other														
Lab analysis of water samples (N, P, DOC, DIC) and sediment cores: radiometric dating (Lead-210, Cesium-137); biogenic silica; loss-on-ignition, sediment phosphorus and metals	$4,100	$0	$4,100	$11,600	$0	$11,600	$44,800	$0	$44,800				$60,500	$60,500
COLUMN TOTAL	**$93,000**	**$0**	**$93,000**	**$164,300**	**$0**	**$164,300**	**$173,400**	**$0**	**$173,400**	**$162,300**	**$0**	**$162,300**	**$593,000**	**$593,000**