Total ENRTF Project Budget:	**ENRTF Appropriation**	**$ 264,000**
	Minus Amount Spent:	**$ 0**
	Equal Balance:	**$ 264,000**

Legal Citation: ML 2010, Chap.[____], Sec.[____], Subd._____.

Appropriation Language:

II. PROJECT SUMMARY AND RESULTS:

The antibacterial compound triclosan is present in many consumer products, including soaps, toothpastes, lotions, and deodorants. Recent work has shown that triclosan and its chlorinated derivatives are present in treated wastewater effluents which are discharged into surface waters. Once present in surface waters, sunlight converts triclosan and its chlorinated derivatives into dioxins. Dioxins are a class of chemicals that are known to be toxic and carcinogenic. They are also persistent and accumulate in sediments and fish. The goal of this project is to determine the concentrations of dioxins present in lake sediments that are attributable to triclosan. This will be accomplished by collecting sediment cores from five wastewater-impacted lakes and one un-impacted (control) lake located in different areas of the State. The sediment cores will be dated at high resolution, and the concentrations of triclosan and dioxins will be determined for different time periods over the historic period of triclosan use. This will allow both historical and recent loads of triclosan, triclosan-derived dioxins, and total dioxins to Minnesota lakes to be determined. The knowledge gained through this project will help determine if additional steps should be taken to limit triclosan discharges into the environment through wastewater treatment, community education, product regulation, or a combination thereof. Because dioxins are toxic and bioaccumulative, this work will have immediate bearing on food webs and fish consumers (including humans) statewide.

III. PROGRESS SUMMARY AS OF *[ ]*:

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT 1: *Core collection and dating*

Description: Duplicate sediment cores will be taken from five lakes impacted by wastewater effluents (and thus triclosan) and one control site. The impacted sites to be sampled are Lake Pepin, Lake St. Croix, Lake Superior near the entrance to the Duluth Harbor, Lake Winona near Alexandria, and Shagawa Lake near Ely. The control site will be either Lake Itasca or a lake in the Boundary Waters Canoe Area that is not impacted by wastewater or triclosan. The control site will allow determination of background dioxin levels. Fresh sediment cores are needed to minimize any losses of the dioxins during storage/handling. The cores will be collected by a piston or box-type corer from a small boat. Cores will be dated as a function of depth using lead-210 and cesium-137 methods, and the organic matter content will be determined as a function of depth. Sediment deposition rates as a function of time will be calculated based on the dating results. By knowing the year in which sediments were deposited and the rates of

sediment deposition, it will be possible to calculate the mass of triclosan and dioxins delivered to the sediment over time after conducting the analyses outlined in Result 2.

Summary Budget Information for Result 1:	**ENRTF Budget:**	**$ 94,000**
	Amount Spent:	**$ 0**
	Balance:	**$ 94,000**

Deliverable/Outcome	**Completion Date**	**Budget**
1. Core collection	February 2011	$ 18,000
2. Core dating and determination of sediment deposition rates	August 2011	$ 76,000

Result Completion Date: September 2011

Result Status as of (January 2011):

Result Status as of (July 2011)**:**

Result Status as of (January 2012)**:**

Result Status as of (July 2012)**:**

Final Report Summary:

RESULT 2: *Measurement of triclosan and dioxins in sediment cores*

Description: The collected sediment cores will be sliced into sections (each with a mass of 5-30 grams) as a function of depth. Each sample will be split with one being extracted for triclosan (and, if possible, triclosan derivatives) and the other for dioxins. Samples to be analyzed for triclosan will be extracted using the requested accelerated solvent extraction system. The extracts will be cleaned using solid-phase extraction and silica gel and then triclosan concentrations will be determined using liquid chromatography-tandem mass spectrometry. Samples for dioxin analysis will be extracted using the Soxhlet method, cleaned up, and analyzed using high resolution gas chromatography-high resolution mass spectrometry. Appropriate surrogate and internal standards will be used to ensure data accuracy and reproducibility. The triclosan and dioxin concentrations and loads (mass and mass per area) will be determined as a function of time. We will also analyze for all di- to octa-chlorinated dioxins in the sediment cores. Analyzing for all dioxins (not just those that are triclosan derived) will provide additional valuable information about the relative sources (e.g., atmospheric deposition versus wastewater) of dioxins to Minnesota waters.

Summary Budget Information for Result 2:	**ENRTF Budget:**	**$ 170,000**
	Amount Spent:	**$ 0**
	Balance:	**$ 170,000**

Deliverable/Outcome	Completion Date	Budget
1. Determine triclosan concentrations	January 2012	$ 75,000
2. Measure triclosan derived and total dioxins in the sediment core	March 2012	$ 75,000
3. Calculate current and historical contribution of triclosan to dioxin loads using calculated dates of samples and deposition rates	June 2012	$ 10,000
4. Data synthesis, reporting, and recommendations	June 2012	$ 10,000

Result Completion Date: July 2012

Result Status as of (January 2011):

Result Status as of (July 2011)**:**

Result Status as of (January 2012)**:**

Result Status as of (July 2012)**:**

Final Report Summary:

V. TOTAL ENRTF PROJECT BUDGET:

See instructions for each one—explanations needed

Personnel: $150,000. Project manager Dr. William Arnold will be paid for 10% of his annual effort to the project (during summer months). He will be responsible for project coordination, assisting with core sampling and extractions, and project reporting. Two graduate students will be employed by the project. Each will devote 43.75% of their time during their academic year and 50% during one summer to the project. For graduate students, 50% time is full employment. The students will date and extract the sediment cores and conduct the analyses for triclosan.

Contracts: $ 37,000. Dr. Daniel Engstrom (Science Museum of Minnesota & Adjunct Professor of Geology, University of Minnesota) will have responsibility for collecting and dating the sediment cores. He will devote 4% of his time to the project ($12,000). The remaining $25,000 is analytical costs associated with sediment dating.

Equipment/Tools/Supplies: $ 35,000 Accelerated Solvent Extractor

Acquisition (Fee Title or Permanent Easements): $ 0

Travel: $ 3,000 for in-state travel. Mileage, hotel, meal charges for trips to collect sediment samples

Additional Budget Items: $ 39,000. The funds will be used to purchase necessary chemicals, solvents, standards, extraction cartridges, and other laboratory supplies necessary to extract and quantify triclosan and the dioxins in the core samples ($14,000). The remaining $25,000 is to pay for extraction of dioxins and time on the instruments used for the analysis of triclosan and dioxins.

TOTAL ENRTF PROJECT BUDGET: $ 264,000

Explanation of Capital Expenditures Greater Than $3,500:
A sum of $35,000 is budgeted for the purchase of a accelerated solvent extraction system. This essential piece of equipment is needed to extract triclsoan and its derivatives from sediment core samples. It allows extractions to be done in 2 hours per sample (versus 2-4 days with traditional methods). Given the number of samples to processed for triclosan, this efficiency is needed. In the future the equipment would be used for extraction of a variety of endocrine disrupting compounds and pharmaceuticals from sediments, soils, and sludges for analysis. This equipment is currently not available at the University of Minnesota.

VI. PROJECT STRATEGY:

A. Project Partners: Dr. Daniel Engstrom (Science Museum of Minnesota & Adjunct Professor of Geology, University of Minnesota) will have responsibility for collecting and dating the sediment cores (contract of $37,000). Charles Sueper (Pace Analytical Laboratories) will assist with dioxin extractions and analyses.

B. Project Impact and Long-term Strategy: Triclosan is of questionable effectiveness as an antibacterial compound and the formation of dioxins is an undesirable outcome of its use. We will provide the data necessary for a voluntary or a regulatory solution.

C. Other Funds Proposed to be Spent during the Project Period: Dr. Arnold will contribute 2% unpaid effort to the project.

D. Spending HIstory: None.

VII. DISSEMINATION: Information will be disseminated and archived via reports to LCCMR, peer-reviewed publications, and presentations at conferences. Sediment samples will be stored and/or freeze-dried for potential future analyses. Extracts will also be labeled and archived (frozen) for potential future analyses.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than January 2011, July 2011, and January 2012. A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: DIOXINS DERIVED FROM ANTIBACTERIALS IN MINNESOTA LAKES

Project Manager Name: William Arnold

Trust Fund Appropriation: $ 264,000

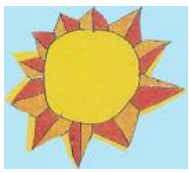
2010 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Core collection and dating			*Measurement of triclosan and dioxins in sediment cores*				
BUDGET ITEM								
PERSONNEL: wages and benefits								
William Arnold (10%, summer salary per year, fringe benefit rate 32.3%)	10,272			27,860			38,132	
Graduate Student 1 (43.75% time, tuition $14.25 per hour salaried, health insurance 17.56%, summer FICA 7.44%)	28,982			26,952			55,934	
Graduate Student 2(43.75% time, tuition $14.25 per hour salaried, health insurance 17.56%, summer FICA 7.44%)	16,246			39,688			55,934	
Contracts								
Professional/technical Science Museum of Minnesota, Dr. Daniel Engstrom, Sediment Coring and Dating	37,000						37,000	
Capital equipment over $3,500 (Accelerated Solvent Extraction System)				35,000			35,000	
Supplies (Laboratory supplies)				14,000			14,000	
Travel expenses in Minnesota	1,500			1,500			3,000	
Other (Instrument time/analytical fees)				25,000			25,000	
COLUMN TOTAL	**$94,000**	**$0**	**$94,000**	**$170,000**	**$0**	**$170,000**	**$264,000**	**$0**

Path from triclosan to dioxins in MN waters and fish

Antibacterial soap with triclosan

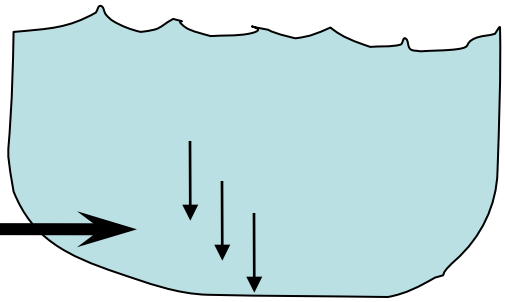
Incomplete triclosan removal in wastewater treatment

Discharge to surface water



sunlight

Photolysis in Rivers/Lakes
Triclosan → Dioxin



Dioxin deposition in lake sediments

Bioaccumulation in fish

- Toxic (poisonous)
- Carcinogenic (cancer causing)
- Endocrine disrupting (hormone mimic)
- Developmental effects (birth defects)

Human exposure

- Toxic (poisonous)
- Carcinogenic (cancer causing)
- Endocrine disrupting (hormone mimic)
- Developmental effects (birth defects)
- Diabetes