Environment and Natural Resources Trust Fund (ENRTF)
2010 Work Program

Date of Report: Sept. 24, 2009
Date of Next Progress Report: Dec. 31, 2010
Date of Work Program Approval:
Project Completion Date: June 30, 2012

I. PROJECT TITLE: Sulfate Release From Mining in the St. Louis River Watershed

Project Manager: Michael Berndt
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Location: *St. Louis County, Minnesota – St. Louis River watershed*

Total ENRTF Project Budget:	**ENRTF Appropriation**	**$270,000**
	Minus Amount Spent:	**$ 0**
	Equal Balance:	**$270,000**

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

Appropriation Language:

II. PROJECT SUMMARY AND RESULTS:

Over a century of iron mining in Northeastern Minnesota has left numerous waste rock piles, open pits, and tailings basins that appear to be the dominant sources of sulfate to the St. Louis River. This sulfate has become a recent environmental concern owing to the possibility that it may be reduced by bacteria to sulfide in locations downstream. Methylmercury, the type of mercury that accumulates in fish, is a well-known byproduct of this reaction. This project will evaluate sources and fate of sulfate in the St. Louis River Basin to help quantify environmental effects of increased sulfate loading to the St. Louis River and to determine the best means to reduce or avoid sulfate loading from mining, especially to reducing environments where methylmercury production is occurring.

This study will advance along three fronts: (1) identification and mapping of current sulfate sources (waste rock piles, tailings basins, water-filled pits), (2) providing an objective assessment of treatment options, including heretofore untried (in Minnesota) in-pit sulfate reduction, and (3) evaluation of the impacts of seasonally controlled sulfate releases on chemical processes occurring between Cloquet and the St. Louis River Estuary. Ongoing DNR research has focused on the St. Louis River north of Cloquet. The result of this research will be a consistent and comprehensive series of recommendations and supporting documents that state agencies, industry, and other stake holders can use to help manage sulfate releases to the St. Louis River.

III. PROGRESS SUMMARY AS OF *[insert date of Work Program progress report]*:

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT 1: Interim Report on Source and Fate of Sulfate in the St. Louis River Watershed

Description: This report will summarize work completed in the first year on three primary sub-projects described in Results 2 through 4, below. These three studies overlap with each other and this document will serve as a reference document when evaluating where more specific emphasis is needed during the second year of the overall study. It will be distributed to stakeholders for comment and will help make the final report for the whole project a more inclusive, complete document.

Summary Budget Information for Result 1:	**ENRTF Budget:**	**$5,000**
	Amount Spent:	**$0**
	Balance:	**$5,000**

Deliverable/Outcome	Completion Date	Budget
1. *Interim Report*	June 30, 2011	$5,000

Result Completion Date: *(June 30, 2011)*

Result Status as of *(December 31, 2010)*:

Final Report Summary:

RESULT 2: Environmental Effect of Sulfate in the Lower Saint Louis River and Estuary

Description: This portion of the study evaluates the total amount of sulfate from the mineland regions that reach the lower St. Louis River and enters the estuary on Lake Superior. It also determines how this sulfate behaves once it reaches the estuary and the degree to which it promotes methylation of mercury. Sulfur isotope and sulfate concentrations are measured weekly at Scanlon Dam to quantify the sulfate source specifically from the mining regions and examination of multiple cores collected from the estuary to determine the degree to which the sulfate is being reduced and affecting chemical processes within the sediments.

Summary Budget Information for Result 2:	**ENRTF Budget:**	**$90,000**
	Amount Spent:	**$ 0**
	Balance:	**$ 90,000**

Deliverable/Outcome	Completion Date	Budget
1.Water Chemistry and Sediment Results Year 1	June 30,2011	$45,000
2. Final Report and Results for Years 1 and 2	June 30,2012	$45,000

Result Completion Date: *(June 30, 2012)*

Result Status as of *(December 31, 2010)*:
Result Status as of *(June 30, 2011)*:
Result Status as of *(December 31, 2011)*:
Final Report Summary:

RESULT 3: Source and Fate of SO4 in the Upper St. Louis River Watershed

Description: This report will evaluate primary sources of sulfate and identify local areas of sulfate reduction in the Iron Mining Region using isotope geochemistry and measurements of dissolved organic carbon, major dissolved cations and anions, and water flow measurements in the mining region. These surveys will be conducted during four seasons throughout the year representing dry and wet summer periods, spring runoff, and winter base flow conditions. The observed variability in each of these parameters will be used as an input for Result 2 (above) to specifically help quantify the sources of sulfate to the lower St. Louis River region.

Summary Budget Information for Result 3: **ENRTF Budget:** **$100,000**
Amount Spent: **$0**
Balance: **$100,000**

Deliverable/Outcome	Completion Date	Budget
1. Water Chemistry and Source Rock data from upper St. Louis River in Year 1.	June 30, 2011	$50,000
2. Final Report and Results for Years 1 and 2	June 30, 2012	$50,000

Result Completion Date: *(June 30, 2012)*

Result Status as of *(December 31, 2010)*:
Result Status as of *(June 30, 2011)*:
Result Status as of *(December 31, 2011)*:
Final Report Summary:

RESULT 4: Treatment and Reclamation Options for reducing SO_4 release from the Iron Range Mining Region

Description: This portion of the study will evaluate mitigation and control options for SO_4 from mineland areas. Small scale experiments will be conducted on naturally occurring high sulfate waters in mine-pits, which is where sulfate derived from waste rock piles is most often pooled. The primary method that will be evaluated involves reducing the sulfate in the deepest waters of pits that are in the process of filling and/or that do not turn over yearly (meromictic). Results from this study will be compared to other known methods of sulfate mitigation and control in an effort to determine how best to control sulfate release from mineland areas.

Summary Budget Information for Result 4: **ENRTF Budget:** **$70,000**
Amount Spent: **$ 0**
Balance: **$ 70,000**

Deliverable/Outcome	Completion Date	Budget
1. Experimental Results from Year 1 Study	June 30, 2011	$35,000
2. Final Report and Results for Years 1 and 2	June 30, 2012	$35,000

Result Completion Date: *(June 30, 2012)*

Result Status as of *(December 31, 2010)*:
Result Status as of *(June 30, 2011)*:
Result Status as of *(December 31, 2011)*:
Final Report Summary:

RESULT 5: Summary Report and Recommendations Management of Sulfate Release from Mineland Areas

Description: This report will provide a less technical summary of the work completed and results for the three largely independent studies listed above (Results 2 through 4). The purpose of this report is to provide an overview and summary of recommendations that can be understood by less technically inclined individuals. The more technical documents on which this report will be based will be available for those interested in the full details of the studies that were conducted during the project period. No update will be provided during the first year of the study because results from the full study will need be nearly completed before work on this report can begin.

Summary Budget Information for Result 5:	**ENRTF Budget:**	**$5,000**
	Amount Spent:	**$ 0**
	Balance:	**$5,000**

Deliverable/Outcome	Completion Date	Budget
5. Final Report	June 30, 2012	$5,000

Result Completion Date: *(June 30, 2012)*

Result Status as of *(December 31, 2011)*:
Final Report Summary:

V. TOTAL ENRTF PROJECT BUDGET:

Personnel: $ 130,000
Research Scientist II: $105,000.00
Chemist 1: $20,000.00
Student summer assistant: $5000.00
Funds will not be used for classified state employees unless the funded portions of their salaries are backfilled with unclassified staff.

Contracts: $ 125,000
University of Minnesota-Duluth Research Support ($65,000)

Dr. James Miller, University of Minnesota, Duluth: $35,000.00. Doctor Miller is an associate professor at the University of Minnesota-Duluth and he will contribute his time at no cost to the project. These funds will be used to fund the salary of a graduate student assistant and to provide supplies and expenses needed for the research, particularly during the first year of the study (Results 1 and 2 above). See peer review addendum for more complete explanation of Dr. Miller's role.

Dr. Nathan Johnson, University of Minnesota, Duluth: $30,000.00. Dr. Nathan Johnson is an assistant professor at the University of Minnesota- Duluth. Doctor Johnson is a professor at the University of Minnesota-Duluth and he will contribute his time at no cost to the project. These funds will be used to fund the salary of a graduate student assistant and to provide supplies and expenses needed for the research, particularly during the second year of the study (Results 1 and 2 above). See peer review addendum for more complete explanation of Dr. Johnson's role.

Chemical Analyses and Stream Gaging ($50,000)

- Sulfate Isotope measurements: Waterloo Isotope Laboratory ($22,500): The Minnesota Department of health has established a long relationship and has an existing contract with this Canadian laboratory. Few laboratories and no Minnesota state facilities provide sulfate isotopic measurement.
- DOC, Hg and MeHg: Minnesota Department of Health: $8,500.
- Dissolved Cations and Anions, including SO4: Contract Laboratories $19,000.00
- Stream gaging: DNR Division of Waters or, if necessary, contracted using the RFP process ($10,000)

Equipment/Tools/Supplies: $ 10,000

- 100s of sample bottles and specialized sampling equipment (disposable filters, rubber gloves, clean pipettes, and tubing) are required for the large number of samples that will be collected during the course of stream sampling in the mineland region (Result 2) and at the Scanlon Dam (Result 3) as well as sampling of waters produced in laboratory experiments (Result 4). Numerous vacutainers and several specially constructed tube-reactors are required for the construction of equipment needed for conducting the larger scale experiments later in the study.

Travel: $ 5000

Sampling trips in Minnesota. It is estimated that there will be 50 overnight stays in Northeastern Minnesota required for sampling trips. Per diem, transportation, and lodging were estimated at $100.00 per night.

Additional Budget Items: none

TOTAL ENRTF PROJECT BUDGET: $270,000

Explanation of Capital Expenditures Greater Than $3,500: none

VI. PROJECT STRATEGY:

A. Project Partners:

Funds from this appropriation:

Dr. James Miller, University of Minnesota, Duluth: $35,000.00

Dr. Nathan Johnson, University of Minnesota, Duluth: $30,000.00

B. Project Impact and Long-term Strategy:

The MPCA in 2006 provided new guidance that discourages SO_4 loading into streams and lakes where it may promote formation Hg of MeHg, the kind of Hg that accumulates in fish tissues. The result of this research will be a consistent and comprehensive series of recommendations and supporting documents that state agencies, industry, and other stake holders can use to help manage mining-related sulfate releases to the St. Louis River and its estuary in Lake Superior.

C. Other Funds Proposed to be Spent during the Project Period:

An estimated $22,000 in DNR shared services.

DNR Lands and Minerals will also contribute up to 40% of Dr. Berndt's time to this project. Funds from the ENRTF will not be used for this salary.

Dr. Nathan Johnson has applied for funding through a non-state entity (US Geological Survey) which would permit the DNR to provide a $35,000.00 matching grant through its Environmental Cooperative Research fund. His research proposal is pending and so is not listed specifically elsewhere.

D. Spending HIstory:
The Minnesota Department of Natural Resources conducted a previous preliminary study on sulfate and methyl mercury reactions in the upper St. Louis River region north of Cloquet. The project was directed by Dr. Berndt and funded through the Minerals Coordinating Committee and the draft report was completed in June 2009 and updated to address comments on Dec. 30, 2009 (Berndt and Bavin, 2009). The cost of this project, not including Dr. Berndt's time, which was donated to the project, was $150,000.00. This previous research was also supplemented by a grant from the MPCA for $20,077.00 and a separate report generated from that contract (Bavin and Berndt, 2009) was produced in June 2009.

VII. DISSEMINATION:
All reports from the Minnesota Department of Natural Resources are public documents. The documents prepared in connection with this study will all be published as official DNR reports, available free to citizens in electronic format via a searchable public Web site.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than Dec. 31, 2010, June 30, 2011, Dec. 31 2012, and June 30, 2012**. A final work program report and associated products will be submitted between June 30 and August 1, 2011 as requested by the LCCMR.**

IX. RESEARCH PROJECTS: A research addendum has been completed and is going through the peer review process. The final research addendum is expected to be completed on Feb. 3 2010.

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

Project Title: *Sulfate Release from Mining in the St. Louis River Watershed*

Project Manager Name: *Michael E. Berndt*

Trust Fund Appropriation: $

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2010 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 4 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 5 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Interim Report			*Upper St. Louis River*			*Lower St. Louis River and Estuary*			*Treatment and Reclamation*			*Final Report*				
BUDGET ITEM																	
PERSONNEL: wages and benefits Research Scientist II	5,000	0	5,000	25,000	0	25,000	25,000	0	25,000	45,000	0	45,000	5,000	0	5,000	105,000	105,000
Student Worker							5,000	0	5,000							5,000	5,000
Chemist 1				5,000	0	5,000	5,000	0	5,000	10,000	0	10,000				20,000	20,000
Contracts																0	0
University of Minnesota Duluth - Contracts to Dr. James Miller and Dr. Nathan Johnson who are collaborating in this effort. (See work program and peer review adendum for more detail)				25,000	0	25,000	40,000	0	40,000							65,000	65,000
																0	0
																0	0
Other contracts																0	0
Waterloo Isotope Laboratory, Canada (Sulfate isotopes)				15,000	0	15,000	7,500	0	7,500							22,500	22,500
Stream Gaging Contract or DNR Division of Waters or other contract laboratory				10,000	0	10,000										10,000	10,000
Minnesota Department of Health (DOC and Hg analysis)				5,500	0	5,500	3,000	0	3,000							8,500	8,500
Cation and Anion Analysis Contracts (Either U of M specialty lab or other contract laboratory selected through competitive contract)				6,500	0	6,500	2,500	0	2,500	10,000	0	10,000				19,000	19,000
																	0
Non-capital Equipment / Tools *(what equipment? Give a general description and cost)*																0	0
Supplies																0	0
laboratory supplies (see work program for more detail)				4,000	0	4,000	1,000	0	1,000	5,000	0	5,000				10,000	10,000
Travel expenses in Minnesota				4,000	0	4,000	1,000	0	1,000							5,000	5,000
COLUMN TOTAL	**$5,000**	**$0**	**$5,000**	**$100,000**	**$0**	**$100,000**	**$90,000**	**$0**	**$90,000**	**$70,000**	**$0**	**$70,000**	**$5,000**	**$0**	**$5,000**	**$270,000**	**$270,000**