

**Environment and Natural Resources Trust Fund  
2015 Request for Proposals (RFP)**

---

**Project Title:**

**ENRTF ID: 045-B**

Using Hydroacoustics to Monitor Sediment in Minnesotas Rivers

---

**Category:** B. Water Resources

---

**Total Project Budget:** \$ 455,663

**Proposed Project Time Period for the Funding Requested:** 3 years, July 2015 - December 2018

**Summary:**

Hydroacoustic equipment will be installed on the lower Minnesota and Mississippi Rivers to accurately measure suspended-sediment, replacing antiquated methods and directly supporting the MPCAs Sediment Reduction Strategy

---

**Name:** Christopher Ellison

**Sponsoring Organization:** U.S. Geological Survey

**Address:** 2280 Woodale Dr  
Mounds View MN 55112

**Telephone Number:** (763) 783-3121

**Email** cellison@usgs.gov

**Web Address** http://mn-internal.cr.usgs.gov/mnlocal/index.html

---

**Location**

**Region:** Central, Metro, SE

**County Name:** Blue Earth, Carver, Dakota, Goodhue, Hennepin, Le Sueur, Nicollet, Ramsey, Scott, Sibley, Wabasha, Washington

**City / Township:** Minneapolis-St Paul Metropolitan Area

---

**Alternate Text for Visual:**

Visual depicting hydroacoustic equipment monitoring riverine suspended-sediments

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	



**PROJECT TITLE: Using Hydroacoustics to monitor sediment in Minnesota's Rivers**

**I. PROJECT STATEMENT**

**Sediment-laden rivers and streams cost the State of Minnesota millions of dollars each year.** Excessive sediment in rivers degrades water quality and aquatic habitat, requires removal of dredge material, reduces recreational opportunities, and transports harmful contaminants. **Representative, consistent, and accurate measurements of sediment are needed because sediment is listed as the top impairment of Minnesota Rivers and because significant resources are being dedicated to understand the causes, effects, and sources of sediment in rivers.** A recent U.S. Geological Survey (USGS) sediment study in Minnesota indicated that the state's method of sampling for sediment (collecting a grab sample using an open container) does not adequately represent the amount of sediment in Minnesota's Rivers. Decisions based on inadequate data can cause the loss of millions of dollars if water-quality improvement programs and stream restoration and fish enhancement projects fail. The problems associated with using grab samples to measure sediment include:

- Grab samples only represent 50% of the total sediment being transported in Minnesota's Rivers
- Grab samples are typically collected every 4 – 6 weeks so there are large gaps in the data
- The under-representation of sediment associated with grab sampling transmits directly into inaccuracies in sediment load computations and subsequent interpretations

**Using hydroacoustic technology to measure sediment can eliminate the problems currently associated with grab sampling.** The method uses Acoustic Doppler Velocity Meters (ADVMs) mounted permanently on bridge piers below the water surface (fig 1.). Sound waves emitted from the ADVMs are correlated to suspended-sediment concentrations (SSC) from samples collected using USGS procedures. Benefits to this approach include:

- Hydroacoustics directly measure sediment in suspension. Historically, streamflow has been used to predict sediment between sample collection intervals but results using streamflow are inconsistent
- Gaps in the data are eliminated because SSC values are transmitted continuously from a datalogger in real time and the data can be made available to the public on the web
- The need to collect and ship large numbers of samples to the lab is eliminated, saving thousands of dollars in field data collection and laboratory analyses

**Monitoring sites would be located on the Minnesota and Mississippi Rivers at existing USGS streamgages.**

These rivers were selected because numerous state agencies and academia are actively engaged in efforts to reduce sediment in these rivers. Benefits of locating sites on these rivers at USGS streamgages include:

- Accurate quantification of sediment loads in the Minnesota River can be assigned to streambanks, ravines, and bluffs, which have been identified as major contributors (60-80%) of sediment
- Monitoring the South-Metro Mississippi River provides accurate sediment loads into Lake Pepin
- Direct monitoring support for the MPCA's Sediment Reduction Strategy to reduce sediment loads in the Minnesota River by 80 – 90 percent and in the South-Metro Mississippi River by 50-60 percent
- Providing accurate sediment load data for maintaining the navigation channel on the Minnesota and Mississippi Rivers by the U.S. Army Corps of Engineers

**II. PROJECT ACTIVITIES AND OUTCOMES**

This project would establish a network of advanced sediment monitoring sites. Each site will provide viewable online real-time continuous sediment loads for the Minnesota and Mississippi Rivers. It will synthesize results for incorporation with other sediment studies associated with the Minnesota and Mississippi Rivers.

**Activity 1:** Install ADVMs at four streamgaging sites on the Minnesota and Mississippi Rivers and collect water-sediment samples for SSC following USGS procedures.

**Budget: \$376,489**



**Environment and Natural Resources Trust Fund (ENRTF)**

**2015 Main Proposal**

**Project Title:** Using Hydroacoustics to monitor sediment in Minnesota’s Rivers

Outcome	Completion Date
1. ADVMs installed, programmed, and data logged and telemetered	October, 2015
2. ADVM acoustic signals recorded, SSC samples collected over a wide range of streamflow	November, 2017
3. SSC samples analyzed, quality control checks, entered into database	February, 2018

**Activity 2:** Develop relations between streamflow, acoustic signals, and sediment. A report will provide a forum to document improvements in sediment monitoring

**Budget: \$79,174**

Outcome	Completion Date
1. Process streamflow and acoustic data records, compile and quality check sediment data	April, 2018
2. Develop relations between ADVM acoustic signals and SSC using statistical methods	June, 2018
3. Analyze and interpret results, write, review, publish final report	December, 2018

**III. PROJECT STRATEGY**

**A. Project Team/Partners**

Name	Affiliation	Role
Christopher Ellison	U.S. Geological Survey	Principal investigator, manage and complete all activities; receive all ENRTF funds; contribute USGS funds
Greg Johnson	Minnesota Pollution Control Agency (MPCA)	MPCA has provided Clean Water Fund money for work leading up to this project and will likely continue to support sediment-monitoring work related to this project; technical liaison
Jon Hendrickson	U.S. Army Corps of Engineers (COE)	COE has provided money for work leading up to this project and will serve as technical liaison
Linda Loomis	Lower Minnesota River Watershed District (LMRWD)	LMRWD has provided money for work leading up to this project; interested party relative to dredge material storage responsibilities
Greg Kruse	Minnesota Department of Natural Resources	Regional streamflow analysis

**B. Project Impact and Long-Term Strategy**

This project provides important data to help State, Federal, and local governments make informed decisions to reduce sediment in the Minnesota and Mississippi Rivers. The long-term strategy would be to maintain the monitoring network over a 10-year period or longer to assess MPCA’s sediment reduction strategy. Once the acoustic signals are calibrated to SSC values (developed during this study), costs would be significantly reduced and the monitoring network would be maintained through collaborative contracts among the above agencies.

**C. Timeline Requirements**

This project would run from July 2015 through December 2018. The ADVM installations would be completed by October 2015 and the field work would be completed by November 2017. Two field seasons are needed to collect the SSC samples. The samples will be analyzed by the USGS sediment lab in Iowa. Due to the complexity of the data and subsequent analysis, an extensive peer review will be requested. Because of this, an additional 5 months will be needed to finalize the report. The total time requested will be 42 months.

## 2015 Detailed Project Budget

**Project Title: Using Hydroacoustics to monitor sediment in Minnesota's Rivers**

### IV. TOTAL ENRTF REQUEST BUDGET 3 years 5 months

<b>BUDGET ITEM</b>	<b>AMOUNT</b>
<b>Personnel:</b> 1 hydrologist, USGS project management and sediment specialist, 31% time for 3 years, 75% salary, 25% benefits.	\$ 117,415
1 hydrologic technician, USGS surface-water specialist, 17% time for 3 years, 75% salary, 25% benefits.	\$ 36,061
1 hydrologic technician, USGS surface-water specialist, 21% time for 3 years, 75% salary, 25% benefits.	\$ 27,963
1 student technician, recent grad program 6% time for 2 years, 75% salary, 25% benefits.	\$ 5,361
Overtime:	\$ 25,483
<b>Contracts:</b> Installation of Acoustic Doppler Velocity Meter, radio bridges, solar panel, deployment sled and I-beam - 4 sites	\$ 17,155
USGS headquarters technical services (QA/QC and database support)	\$ 59,272
Utilities: Comm. (cell)	\$ 573
<b>Printing:</b> USGS Science Investigation Report production	\$ 32,484
<b>Laboratory analyses:</b> USGS Sediment Lab in Iowa: 360 sediment samples	\$ 30,492
<b>Equipment:</b> Acoustic Doppler Velocity Meters (4 ADVMs, \$9,779 each) cables, radio bridges (8 at \$1,392 each), Solar panel 30 watt (4 at \$252 each), voltage regulator (4 at \$38 each), datalogger (1 at \$3,042), Satellite telemetry for one site below Lake Pepin: Sutron Satlink 2 (1 at \$2838), Antenna, yagi (1 at \$292 each), Cable (1 at \$24), GOES transmitter (1 at \$2,923 each), GOES radio (1 at \$2,753 each), Shelter for radio bridges, solar panel, battery (4 at \$700 each), liquitite conduit (40 feet at \$3.58/ft), Aluminum I-beam and sled assembly (4 at \$380 each), ADVM batteries (4 at \$56.45 each)	\$ 91,348
<b>Shipping:</b> Equipment shipping costs	\$ 510
<b>Supplies:</b> hardware (nuts, bolts, washers, flanges, pvc, etc) needed to install ADVMs, field paper (write-in-the-rain), 1 pressure sprayer, sampling bags, sampling nozzles for sampling at 9 sites to collect 180 samples	\$ 3,566
<b>Travel:</b> Sites are located within 50 miles of USGS Water Science Center, no lodging or MI&E costs	\$ -
<b>Other:</b> Datalogger rental for 2 years	\$ 1,427
<b>Vehicle fuel:</b> based on travel estimate, 650 miles per trip, 25 trips	\$ 6,553
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	<b>\$ 455,663</b>

### V. OTHER FUNDS

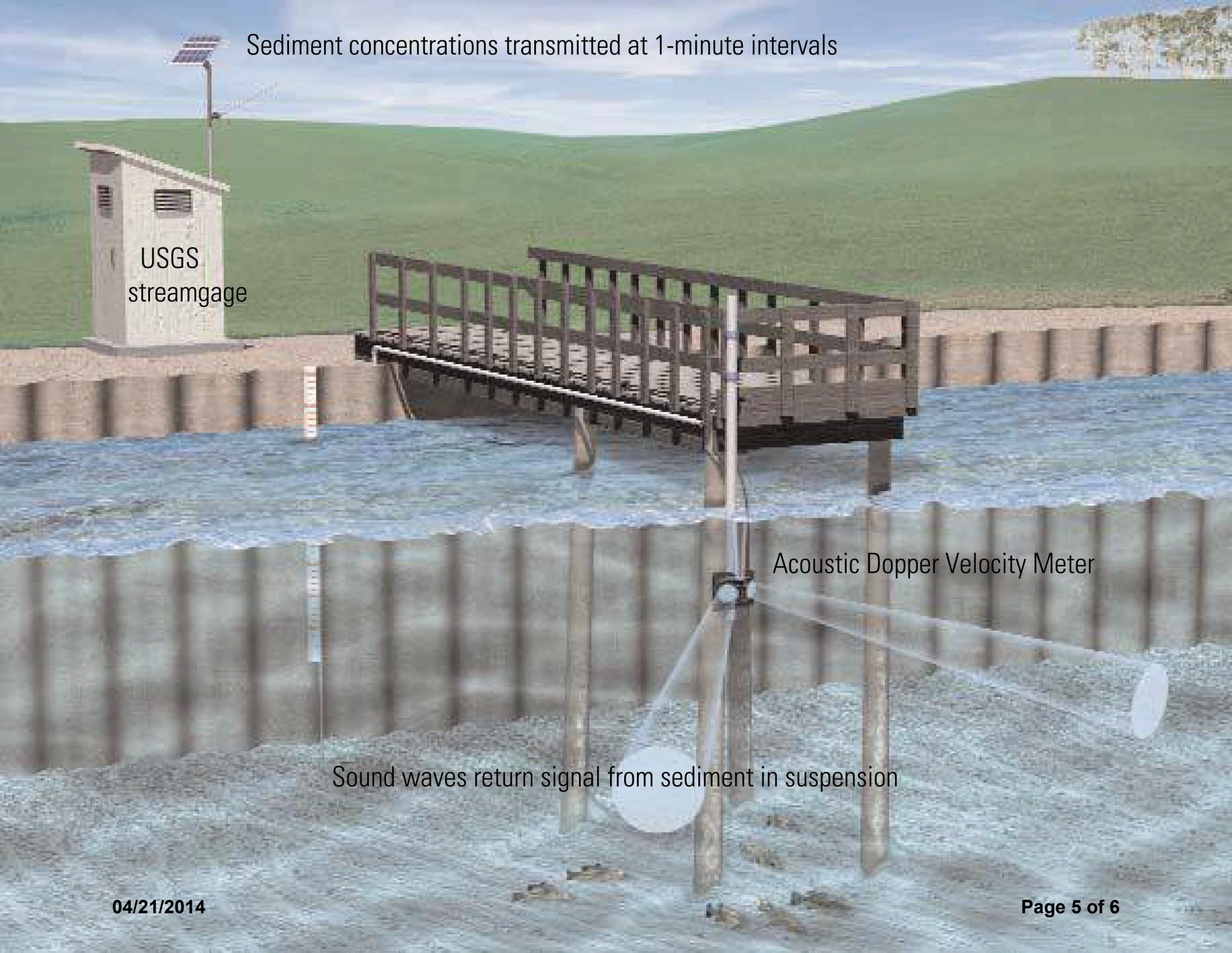
<b>SOURCE OF FUNDS</b>	<b>AMOUNT</b>	<b>Status</b>
<b>Other Non-State \$ To Be Applied To Project During Project Period:</b> USGS cooperative program matching funds. Portion of budget items not funded by this request	\$ 189,216	Secured
<b>Other State \$ To Be Applied To Project During Project Period:</b> N/A	\$ -	N/A
<b>In-kind Services To Be Applied To Project During Project Period:</b> N/A	\$ -	N/A
<b>Funding History: Suspended-sediment sampling at 3 sites on Minnesota River: 2010 - 2014</b> Minnesota Pollution Control Agency: \$127,000, U.S. Army Corps of Engineers: \$124,000, U.S. Geological Survey: \$78,800.	\$ 329,800	
<b>Remaining \$ From Current ENRTF Appropriation:</b> N/A	\$ -	N/A

Sediment concentrations transmitted at 1-minute intervals

USGS  
streamgauge

Acoustic Doppler Velocity Meter

Sound waves return signal from sediment in suspension



## **PROJECT MANAGER QUALIFICATIONS AND ORGANIZATION DESCRIPTION**

**Christopher Ellison** is Hydrologist with the Minnesota U.S. Geological Survey (USGS) Water Science Center. He has a Ph. D. in Rangeland Ecology and Watershed Management from the University of Wyoming. He serves as USGS' project chief related to sediment studies. In this capacity, he provides project oversight, technical assistance, and data analysis and reporting in support of sediment projects for the MPCA, DNR, Corps of Engineers, Lower Minnesota Watershed District, Rice Creek WD, and the Wild Rice WD. These projects vary in scope and relate fluvial sediment to aquatic habitat, TMDL studies, stream restoration, geomorphology, sediment budgets, and flood retention and diversion. He also is responsible for research and implementation of new technologies to improve understanding of sediment sources, fate, and transport mechanisms.

The **USGS** works as a partner with state agencies towards collecting and analyzing a myriad of water quality data. The USGS is uniquely positioned to carry out the work for this project effectively and efficiently through its operation of the statewide stream gaging network, specialized sediment sampling equipment, and experienced hydrologists and hydro-technicians. The USGS in Minnesota has state-of-the-art GIS expertise in the office and has access to the most current science and technology related to sediment research from USGS scientists nationwide.