



## RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS,  
RESEARCH & INNOVATION

## TECHNICAL SUMMARY

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### PROJECT COST:

\$60,000



Debris can damage monitoring equipment, limiting or eliminating its effectiveness.

# Decision Support for Scour Monitoring on River Bridges

## What Was the Need?

Bridge scour occurs when rapidly moving water erodes the bed material from around bridge abutments or piers. This presents a major problem: Approximately 60 percent of bridge failures in the United States are due to bridge scour and stream instability.

Portable scour monitoring devices require inspectors to travel to bridge locations, which is often difficult due to the number of bridges and their locations across the state. Monitoring is particularly challenging during the annual snowmelt when most bridges are subject to high water flows. Fixed monitoring devices provide continuous monitoring, alerting personnel when the scour level becomes critical and requires attention.

A variety of fixed monitoring methods has been developed, ranging in complexity, cost, robustness and measurement resolution. Selecting the optimal device for a particular body of water and bridge can save money and time and can improve the accuracy of scour data. This in turn can lead to earlier detection of problems, which will allow for the timely closure and remediation of scour-critical bridges, potentially saving lives.

## What Was Our Goal?

The primary objective of this project was to develop a scour monitoring decision framework, or SMDF, to assist bridge operators in choosing the best fixed monitoring tool appropriate for each situation.

## What Did We Do?

Investigators first reviewed relevant research on scour monitoring methods, connecting existing technologies, experiences and techniques to challenges faced in Minnesota. They analyzed previous attempts in Minnesota and 37 other states that used fixed monitoring. Seven states were contacted and interviewed about their experiences with different monitoring methods.

Researchers then developed the SMDF, which employs an Excel workbook enabled with Visual Basic programming. The system accepts site-specific bridge and waterway information, compares it to critical scour monitoring technology characteristics, and then provides a ranking of the best tools for the site. To create this system, researchers first identified the critical bridge and waterway characteristics needed as inputs, including flow conditions, river flow habits, bridge geometry, bed material, and surface and subsurface material.

Eight fixed monitoring technologies were then characterized using categories and subcategories designed to identify strengths and weaknesses of each tool. The factors used for categorization are broad enough to evaluate any current and future monitoring options and to include sensor attributes, datalogger interface, personal interface, power, installation, cost, life span and serviceability.

Once the SMDF was complete, researchers tested it on five trunk highway bridges that

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*Bridge scour threatens bridge stability and the safety of the traveling public. Researchers developed a decision-making tool that uses the unique bridge and waterway characteristics of individual sites to help bridge operators successfully identify the best fixed scour monitoring methods.*

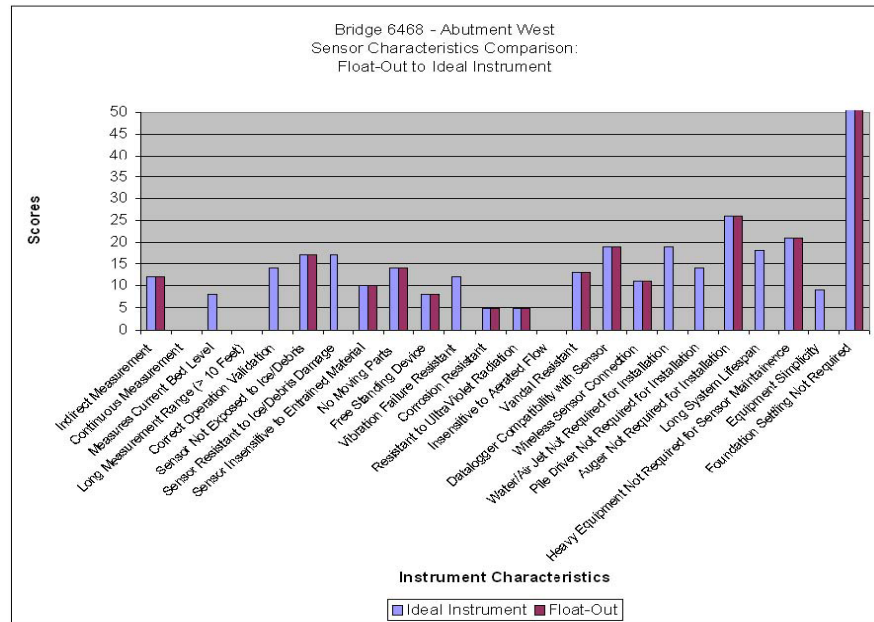
*“The framework developed from this project will help bridge owners evaluate and select bridge fixed scour monitoring alternatives.”*

–Andrea Hendrickson,  
Mn/DOT State Hydraulics  
Engineer

*“This decision-making tool addresses one of the major problems with regard to fixed scour monitoring instrumentation: No single methodology can be used to solve scour measuring problems for every situation.”*

–Jeff Marr,  
Associate Director of  
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The output of the SMDF can be viewed as a bar graph showing the importance of each characteristic and whether the selected tool satisfies the characteristic.

represented conditions found at most scour-critical bridge sites in Minnesota, inputting bridge and waterway data and generating monitoring tool recommendations.

Finally, researchers produced a user manual for the SMDF and detailed work plans for deployment of fixed monitoring equipment on two Minnesota bridges.

### What Did We Learn?

States' experiences with monitoring devices showed that no single scour monitoring method can be used for all the different situations encountered in the field. For example, manual magnetic collar devices are low cost and easy to install but are very susceptible to debris. Sonar devices—the most popular technology currently in use—are more expensive but provide continuous monitoring, allow easy data transmission and are only somewhat susceptible to debris.

Evaluation of previous fixed monitoring devices in Minnesota revealed several key lessons. Debris is a major concern as it can destroy the fixed monitoring equipment or cause inaccurate scour measurements. Monitoring equipment should be installed during low water events and a review of available subsoil information should be performed before installation. A regular maintenance schedule also needs to be set, appropriate for the device in question.

Application of the SMDF to bridges in Minnesota produced results that were intuitive to those already familiar with the range of fixed scour monitoring practices and the selected sites. The most common and highly rated tools for monitoring piers and abutments, according to the SMDF, were sonar and float-out devices, respectively. The SMDF assists engineers in deciding which type of fixed scour monitoring instrumentation is best suited for a specific bridge site and how to mitigate potential problems that may occur with the user-selected tool as well as warning users of atypical scour at the bridge site.

### What's Next?

Work plans developed as part of this research have been approved for funding. This implementation effort will involve the installation of several different types of fixed monitoring devices for further evaluation under real-world conditions.

*This Technical Summary pertains to Report 2010-14, “Bridge Scour Monitoring Technologies: Development of Evaluation and Selection Protocols for Application on River Bridges in Minnesota,” published March 2010. The full report can be accessed at <http://www.lrrb.org/PDF/201014.pdf>. For information about the scour monitoring implementation effort, please contact [Andrea.Hendrickson@state.mn.us](mailto:Andrea.Hendrickson@state.mn.us).*