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DEPARTMENT OF TRANSPORTATION

OFFICE OF RESEARCH & INNOVATION

TECHNICAL SUMMARY

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PROJECT COST:
$101,814

This SCL was correctly installed on a wood fiber blanket. A wooden stake on the downslope side of the log prevents it from rolling.

Sediment Control Log Guidance for Field Applications

What Was the Need?

Whenever MnDOT or its contractors engage in construction, maintenance or other projects that substantially disturb the soil at a project site, they are required to use practices that reduce sediment discharge from the site when it rains. Sediment control methods are used as perimeter barriers around stockpiles, for inlet protection, as check dams in small drainage ditches and also along natural waterways such as streams, ponds or wetlands.

A commonly used method is the sediment control log (SCL)—a linear roll constructed with an outer sleeve of varying permeability that is filled with natural biodegradable infiltration materials such as straw, coconut fiber (also known as coir), compost or rocks. MnDOT's SCLs range from 6 to 9 inches in diameter and up to 30 feet in length.

Researchers tested sediment control logs in the lab and in the field to determine the relative filtration capabilities of these devices. They also developed design guidelines for correct selection and contributed to ongoing educational efforts.

While MnDOT has used SCLs extensively for many years, these devices often fail because their performance is not well-defined or understood. SCLs are also frequently installed incorrectly or in inappropriate locations. Because SCL use represents a substantial cost to the agency, MnDOT sought to learn actual performance parameters as well as optimum locations and installation methods.

What Was Our Goal?

The goal of this project was to improve practitioners' ability to select the appropriate SCL for a specific purpose and location. To achieve this goal, researchers sought to:

- Determine the hydraulic characteristics of SCLs—how SCLs constructed from different encasement fabrics and internal media allow the passage of water.
- Evaluate the sediment removal efficiency of these SCLs and the effect of trapped sediment on their hydraulic characteristics.
- Develop design guidelines for selecting SCLs based on log materials and the characteristics of the watershed where they will be installed.
- Organize the selection guidelines into a format that can be used by field practitioners for amending or upgrading the device.

What Did We Do?

First, researchers conducted a literature review of studies published from 1995 to 2013 that examined a variety of sediment control methods.

Next, they determined the physical characteristics of 12 SCLs filled with diverse biodegradable media, ranging from straw; coconut fiber; wood fiber; wood chips; light, medium and heavy compost; and rock. Then they investigated the hydraulic characteristics of the SCLs, most importantly the volumetric flow rate through logs of various media, using the flume at the University of Minnesota's Biosystems and Agricultural Engineering Laboratory.

A sediment flume was constructed at this laboratory that researchers used to evaluate the sediment removal efficiencies and failure rates of a subset of five logs. The subset

continued

"This study compared the sediment filtration capabilities and effective life cycles of a range of sediment control logs. This new knowledge will allow us to reduce costs in all areas of sediment control log use and more effectively protect the environment."

—Dwayne Stenlund,
Erosion Control Specialist, MnDOT Office of Erosion Control and Stormwater Management

"Sediment control log failure is a worldwide problem. This research takes a substantial step toward a better understanding of the parameters within which SCLs can be effective, clarifying with data their capabilities as well as their limitations."

—Bruce Wilson,
Professor, University of Minnesota College of Science and Engineering

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Overtopping occurred at this failed SCL installation, indicated by the dried sediment on the log.

was selected to capture the range of hydraulic response representing a variety of log materials.

Researchers also examined field installations of SCLs in locations across the state to learn how SCLs were installed and, if failing, how they had failed.

Finally, they produced two SCL selection tools and developed training materials about SCL use.

What Did We Learn?

From the literature review, researchers reviewed seven laboratory studies and nine field studies examining a wide range of sediment control methods. They found no studies similar to this project that compared different kinds of SCLs for their sediment removal efficiency, life cycles and appropriate siting.

Researchers investigated the physical characteristics of 12 SCLs, including diameter, density and percent volumetric pore space. They conducted material size analysis and other tests to determine saturated moisture content, capillary moisture content, saturated conductivity and other relevant hydraulic measures. Using results from the laboratory flume, they documented the flow rates of water through the SCLs.

The physical characteristics of the 12 SCLs varied substantially. For example, densities ranged from 2.18 pounds to 18.5 pounds per cubic foot. Hydraulic characteristics, such as the amount of water retained and the rate of fluid flow through the medium, also varied widely.

The subset of five logs tested for sediment removal efficiency showed how much sediment each log could filter at three flow rates and how much sediment buildup would cause log failure. These results combined with earlier hydraulic data allowed researchers to extrapolate the relative comparative longevity of different SCL media and to develop two SCL selection tools: one for ditch checks and one for perimeter control. The tools will guide practitioners to select the correct SCLs using watershed area, basin and ditch slope. Researchers also adapted the results of the investigations into a set of training materials for erosion control and stormwater management.

What's Next?

The two decision tools will guide the selection of correct SCLs for particular locations. SCL training materials have already been implemented in the erosion control and stormwater management certification workshops.

These results represent a substantial step forward in addressing the widespread problem of SCL failure by providing a better understanding of SCL capabilities and installation requirements. Further field studies could advance SCL effectiveness.

This Technical Summary pertains to Report 2019-23, "Sediment Control Log Performance, Design and Decision Matrix for Field Applications," published May 2019. The full report can be accessed at mndot.gov/research/reports/2019/201923.pdf.