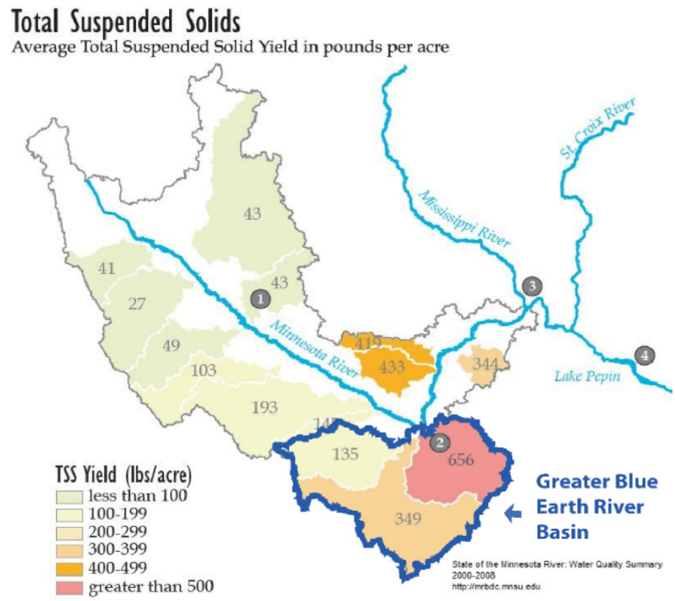
Collaborative for Sediment Source Reduction – Greater Blue Earth River Basin
Summary of Findings

The Collaborative for Sediment Source Reduction (CSSR) was a five-year effort to evaluate strategies for sediment source reduction in the Greater Blue Earth River Basin. With support from local, state, agribusiness, and environmental organizations, a diverse stakeholder group met nine times to evaluate watershed strategies for reducing sediment loading to the Minnesota River and beyond.

CSSR Goal: *To identify a strategy for reducing sediment loading in the Greater Blue Earth watershed using a decision framework that incorporates the best available scientific information, accounts for uncertainty, and provides a model for decision making throughout the Minnesota River Basin. We hope that the strategy developed will be effective, cost-efficient, fair, and supported by all stakeholders.*



There are numerous reasons to be concerned about sediment loading from the Blue Earth River Basin. The Minnesota River and many of its tributaries, including the Blue Earth, are known to be impaired for suspended solids. This causes problems downstream. Sediment causes deposition problems on the lower Minnesota River, degrades water quality in the Mississippi River, and increases the rate at which Lake Pepin is filling. Although the Minnesota River delivers only about one-third of the water to the Mississippi River and Lake Pepin, it delivers more than two-thirds of the sediment. The largest source of sediment to the Minnesota River is the Blue Earth River Basin, which includes the Watonwan and Le Sueur Rivers.

The citizens of Minnesota are committing considerable public funding to improve water quality in the Minnesota River, particularly with the passage of the 2008 Clean Water Land and Legacy Amendment. It is important that these funds are spent effectively, such that the benefit of cleaner water is realized for all. In terms of sediment and turbidity, that means we need to identify the most cost-effective conservation practices and locations for reducing excess soil and sediment erosion, along with associated phosphorus. We also need to think more broadly in order to set priorities for conservation investment throughout the watershed.

The Collaborative for Sediment Source Reduction (CSSR) was launched with the goal of developing an agreed-upon strategy for reducing sediment delivery from the Blue Earth River Basin. At the heart of CSSR was a group of local, state, and industry stakeholders with whom we developed a model to forecast changes in sediment loading in response to different combinations of conservation practices. Combined with information on the cost and effectiveness of different management options, the group used the model to evaluate watershed strategies for reducing sediment loading.

In addition to identifying the best methods and locations for reducing excess erosion and sediment delivery, solving the loading problem depends on a shared understanding of the issues among stakeholders, including farmers, conservation groups, and regulatory agencies. CSSR provided a forum for different interests to work together to evaluate different conservation strategies. We focused on understanding how the landscape works, rather than assigning responsibility for its current condition or tackling the social challenges of implementation and funding. We hoped that a common understanding would lead to an agreed-upon strategy that would drive action to address this important problem. The watershed is large and there were many options to consider. A key question concerned the best balance between directly reducing erosion of local sources (via grassed waterways, rip-rap, etc.) and indirectly reducing erosion by controlling runoff and reducing high river flows.

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The setting and the challenge

The Minnesota River has always been a large source of sediment. At the end of the last Ice Age, about 13,400 years ago, the ancestral Minnesota River experienced enormous floods from a temporary glacial lake impounded by the remains of the continental ice sheet to the north. These floods caused the river bed to scour by as much as 200 ft. When the Minnesota River dropped in elevation, its tributaries steepened and began carving the valleys that we see today along the Minnesota River around the city of Mankato. These tributaries are among the most rapidly downcutting rivers in the world. Their rates of erosion and sediment loading are considerably larger than other rivers in the state.

As large as this natural background sediment supply has been, the rates of soil erosion and sediment supply increased five-fold as the region was developed for row-crop agriculture in the late 19th Century and into the 20th Century. Despite extensive improvements in soil conservation over the past 80 years, this high rate of sediment supply continues today. As the amount of sediment from upland soil erosion diminished, the amount of sediment derived from the steep bluffs along the river channels increased over the last half of the 20th century. The largest source of sediment shifted from fields to the banks and bluffs along the incised river valleys. The cause of this increase in near-channel sediment supply is an increase in river flow. Higher flows produce deeper water and swifter currents, as well as more channel shifting that can direct erosive flows against the channel banks and bluffs. As we evaluated solutions to reduce sediment loading, we considered not only actions to reduce upland soil erosion and stabilize bluffs, but also actions to reduce the peak river flows.

Google Earth image of an incised portion of the Blue Earth Watershed south of Mankato, MN

The CSSR Model

In order to evaluate the cost and effectiveness of different combinations of practices to reduce sediment loading, we needed a model that could link sediment delivery to conservation practice. The scope of the model is large – the Blue Earth Watershed (including the Le Sueur and the Watonwan) drains 2,265,500 acres. We aimed for a model that would be simple and fast, while still reliably capturing sediment delivery from the Basin. By building the model with input from CSSR stakeholders, we hoped to include conservation practices that were both effective and acceptable.

Not all eroded sediment makes its way downstream to the mouth of the watershed and into the Minnesota River. In fact, often only a small fraction of it is transported all the way downstream because there are many locations along the way that trap sediment. We addressed this well-known "sediment delivery problem" using modern high-resolution topography to estimate sediment delivery throughout the watershed. Another key part of the model is a relation between river flow and the rate of sediment loss from near-channel sources, particularly bluffs. We used the extensive monitoring conducted by the Minnesota Pollution Control Agency and its partners to determine how the rate of near-channel sediment supply increases with flow. We found that the flows currently producing most of the near-channel sediment are more common today than in the past. For example, the high flows estimated to produce more than two-thirds of the near channel sediment supply occur today about 5 days per year on average. Flows of that size occurred less than one day per year, on average, in the middle of the last century. We used the relationship between flow and near-channel sediment loss to estimate how future runoff reductions might reduce sediment loading from those sources.

The CSSR model is designed to estimate annual cost and sediment load reductions associated with different combinations of conservation practices. It does not explicitly consider other factors, such as the challenges of implementing different conservation practices at the watershed scale, or additional benefits to wildlife, water quality, or recreation. The CSSR model provides a starting point for these broader considerations.

CSSR Findings

The final CSSR meeting was held on March 7, 2017 at Minnesota State University in Mankato, Minn. The meeting included stakeholders who had participated throughout the five year project, as well as invited attendees who broadened the perspective and experience of the group. After a recap of the primary findings of the supporting research, the group worked with the simulation model and discussed the outcomes. The meeting concluded with a discussion of findings, reported here.

Some ravines produce very large amounts of sediment from a small area. Conservation practices that reduce flow and erosion from ravines are among the most cost-effective. A range of practices can be considered, including water storage and stabilization at ravine tips and stabilization and revegetation within ravines with a large amount of stored sediment. Although ravines are locally prolific sources of sediment, their number is not large enough to account for more than about 10% of the sediment loading to the Blue Earth River and its tributaries.

Ravines that are large local sources of sediment can be targeted. Investment in stabilizing these ravines is supported. Ravine stabilization is not sufficient to reduce sediment loading to meet water quality standards.

A solution to the sediment loading problem must address the largest source of sediment: the steep bluffs along the incised lower portions of the Blue Earth River Watershed. Bluffs contribute about 60% of the sediment delivered from the watershed to the Minnesota River. Sediment loss from bluffs can be reduced by mechanically stabilizing the bluff toe or by reducing the frequency and magnitude of flood flows that erode the bluff. Either of these approaches may be cost effective, although other factors must also be considered. For example, toe stabilization, like any engineered solution, will have a limited lifespan. Also, the river channel may shift away from a protected bluff and initiate erosion elsewhere. Some bluffs are relatively inaccessible, making construction work difficult. Bluff protection may be worthwhile in specific locations, particularly where homes or roads and bridges are threatened by rapid bluff retreat, but it is neither desirable nor feasible to address sediment supply from bluff erosion through mechanical protection alone.

Eroding bluffs that threaten infrastructure and produce exceptionally large amounts of sediment can be targeted. Investment in stabilizing these bluffs is worthwhile, but bluff stabilization is not the most effective solution for long-term reduction in sediment loading across the watershed.

Although targeted treatment of particularly erosive ravines and bluffs is worthwhile, water conservation actions that reduce river floods offer a potentially long-term solution that targets the cause of the problem. Sediment erosion from persistently large flood flows produces the majority of the elevated sediment supply. Water storage for reducing flood flows is most likely to be effective when placed in upland areas above the lower, incised parts of the watershed. Cover crops, winter annual crops, and perennials can also contribute to flow reductions. Water storage, whether in permanent wetlands or short-term storage structures such as water and sediment control basins, can also offer other benefits, such as wildlife conservation and nutrient load reduction.

Achieving water quality standards will require priority investment in more temporary water storage to reduce flood flows and bluff erosion. This is a critical component of a strategy to reduce sediment in the Minnesota River.

Optimism was expressed at the workshop that many within the agricultural community are open to water storage practices, especially when activities that increase water holding capacity of productive farmlands are combined with targeted practices such as sediment basins and wetlands. It is now possible to target conservation practices with precision and it was stressed that implementation plans should support precision targeting and streamlined agency coordination in order to direct conservation investment to the most promising and effective locations..

CSSR Participants

The people listed below attended the final meeting of the CSSR workgroup or reviewed the meeting materials and outcomes and indicate that this report is an accurate account of the findings of the workgroup.

David Ward	Farmer, Mapleton, MN
Steve Sodeman	Farmer, Consultant, St James, MN
Dave Bucklin	GBERBA, Cottonwood SWCD
Eric Gulbransen	Waseca SWCD
Wayne Cords	Waseca SWCD
Leann Buck	MN Association of SWCD
Julie Conrad	Blue Earth County
Warren Formo	MN Ag Water Resources Center
Adam Birr	MN Corn Growers Assoc.
Paul Meints	MN Corn Growers Assoc.
Heidi Peterson	MDA
Jon Lore	MN DNR
Linda Loomis	Lwr MN R Watershed District
Ed Lenz	BWSR
Shaina Keseley	BWSR
Al Kean	BWSR
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Chris Lenhart	UM
Brad Gordon	UM
Les Everett	UM Water Resources Center
Ann Lewandowski	UM Water Resources Center
Scott Sparlin	Coalition for a Clean MN River
Duane Ninneman	Clean Up the River Environment
Carrie Jennings	Freshwater Society
Rebecca Seal Soileau	USACE
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For further information

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