



Lake St. Croix



Otto Wiegand

Conclusions and recommendations:

Croplands are not the only source of phosphorus to Lake St. Croix, but they are a major contributor to the degraded water quality conditions in the St. Croix watershed. Even though reductions in phosphorus loss from any one agricultural Best Management Practice (BMP) may be modest, in combination the reductions can be substantial. BMPs that promote soil health and live green cover on crop fields in the fall to early spring can substantially reduce loss of phosphorus from cropland.

These practices help protect our lakes and streams while reducing runoff and keeping nutrients in the field. There is no quick fix. Recovery will take time and improvements may be difficult to see, but if we take steps now to reduce the amount of pollutants entering the river, over time water quality will begin to improve.

BMP MODELING ASSUMPTIONS AND OUTPUTS (practices from the previous page)

- ¹NO-TILL (NT)**
 - No-till scenarios were simulated by removing all tillage practices from the rotations and increasing both infiltration capacity and surface roughness of the fields.
- ²VEGETATED FILTER STRIPS (VFS)**
 - Vegetated filter strips are strips of grass along the bottom edge of a field that can filter out sediment and nutrients from runoff.
- ³GRASSED WATERWAYS (GWAT)**
 - A grassed waterway is a strip of grass planted in low parts of fields where runoff flows during snowmelt or storm events, thus protecting these temporary channels from erosion while trapping nutrients.
- ⁴SOIL-TEST PHOSPHORUS (STP)**
 - Soil-test phosphorus is the phosphorus concentration in the soil, determined when farmers send in soil samples to a laboratory for testing. Soils with high STP lose large amounts of phosphorus to runoff.
- ⁵FALL COVER CROPS (FCC)**
 - Fall cover crops were implemented in the model by planting a small grain on September 8 each year in corn-silage, corn-grain and soybean fields. Planting in early September allows the cover crop to become established before winter dormancy sets in.
 - Full implementation of fall cover crops in all rotations reduced phosphorus loss at the field edge by 49%.
- ⁶IMPROVED SOIL HEALTH (ISH)**
 - Improved soil health was modeled as a modification of the fall cover crop scenario, where in addition all tillage was removed, and infiltration, field roughness and soil available water-holding capacity were increased to simulate greater infiltration and organic-matter content of a healthy soil.
 - When reduced soil-phosphorus concentrations were added to the improved soil health scenario, a further reduction of phosphorus loads was achieved, for a total of 56% reduction.

“BMPs that promote soil health...can substantially reduce loss of phosphorus from cropland.”

For more information, technical assistance and possible cost share funding:

- **Contact your Wisconsin County Land and Water Conservation Department or Minnesota County Soil and Water Conservation Department, or call your Natural Resources Conservation Service District Conservationist.**
- **Consider attending a field event hosted by one of the Farmer-Led Councils in Polk, Pierce, Dunn or St. Croix Counties.**
- **Attend one of the Conservation Professional Training sessions on Soil Health. To learn more, visit: conservation-training.uwex.edu**

Authors:

John Haack, UW-Extension

**James Almendinger,
St. Croix Watershed Research Station,
Science Museum of Minnesota**



ST. CROIX WATERSHED CROPLAND PRACTICES FOR REDUCING PHOSPHORUS LOSS

A recovery plan based on maximum loads

Many lakes in the St. Croix watershed, including Lake St. Croix, have excess phosphorus, resulting in high levels of algae. Phosphorus originates at multiple sources including farm fields, construction sites, wastewater facilities, industrial discharges, storm drains and even back yards. Total Maximum Daily Loads (TMDLs) are plans that outline the **maximum nutrient levels that a water body can maintain** while still remaining healthy. TMDLs are becoming an increasingly common way to bring phosphorus levels in check. The St. Croix Recovery Plan aims to **reduce the amount of phosphorus entering Lake St. Croix by 27%**. Based on the TMDL, the plan aims to make the waters within the St. Croix watershed **healthy and sustainable** for use by industry, agriculture and other citizens of the state.

TOTAL MAXIMUM DAILY LOAD



THE WATERSHED

The St. Croix watershed includes all of the land drained by the rivers that flow into the St. Croix River and ultimately, Lake St. Croix near Hudson, Wisconsin. The waters of Lake St. Croix drain into the Mississippi River at Prescott, Wisconsin. Although the St. Croix remains one of the most scenic and high quality river systems in the Midwest, its water quality has been degraded by too much phosphorus.



A commonsense approach, the St. Croix River Recovery Plan accounts for allowable nutrient levels that are inevitably produced from urban, suburban and rural land areas. The approach relies on the **collective efforts of all watershed contributors to reach the goal**. Millions of dollars have already been spent to reduce phosphorus from community wastewater facilities and other “end-of-pipe” point sources by about 75% since the early 1990s.

This publication focuses on the Soil and Water Assessment Tool (SWAT) estimates of phosphorus reduction from agricultural best management practices applied to cropland areas.



Mark Edlund

EXAMPLES:

■ **FARMER-LED COUNCILS** are collaborations between groups of farmers in the St. Croix watershed, UW-Extension and county partners. These groups support research to find effective, efficient and adoptable solutions that improve water quality and farm productivity and profitability, resulting in reduced phosphorus and sediment loading. Improvements are accomplished by:

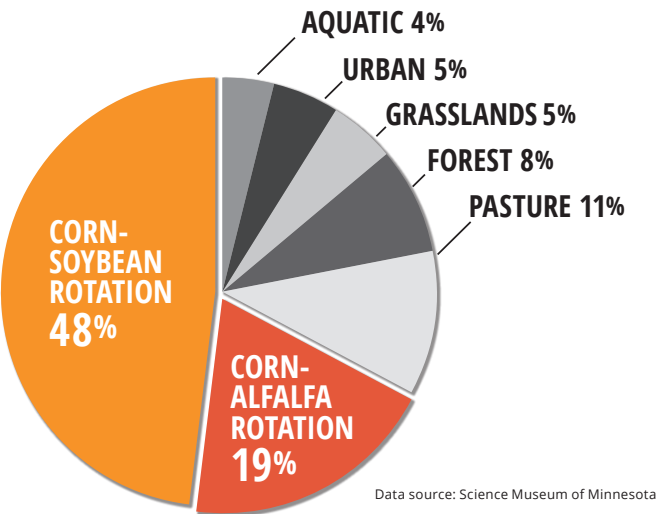
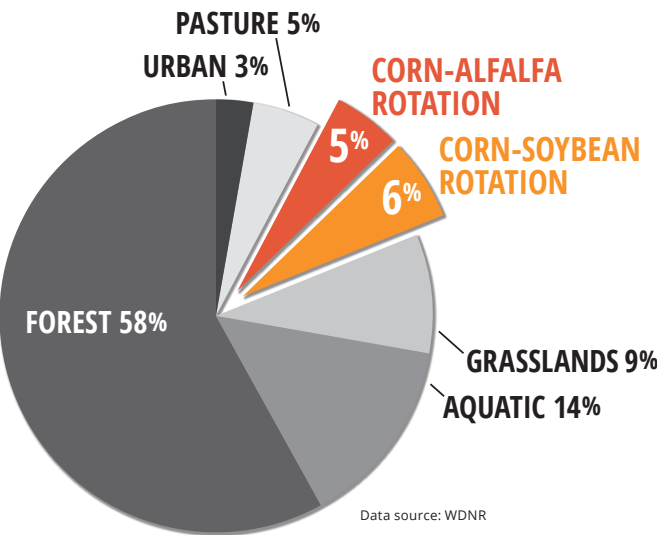
- (1) increasing farmer knowledge** about, and engagement with the positive relationship between soil productivity, farm profitability and water quality issues, including the adoption of conservation practices. As a result, these groups and several counties in Western Wisconsin went from 500 acres of cover crops to tens of thousands of acres of cover crops in just two years.
- (2) developing leadership** around water quality among farmers in the selected sub-watersheds.
- (3) developing a unique collaborative model** of water quality improvement through farmer engagement that can be replicated in watersheds throughout the Upper Mississippi River Basin and nationwide.

The farmers themselves determine the best paths to conservation success within their watersheds and recruit and encourage other farmers to participate.

■ **EDGE-OF-FIELD MONITORING** research by UW-Extension in cooperation with local farmers is providing important data to determine effectiveness of various agricultural conservation practices. Recent research in partnership with a Polk county farmer documented extremely low edge-of-field runoff during a major rain event on fields managed for soil health. Similar edge-of-field monitors are located on several farms in the St. Croix watershed.

TYPES OF LAND USE
within the St. Croix watershed

ESTIMATED RUNOFF SOURCES OF PHOSPHORUS
entering Lake St. Croix



Types of land use and phosphorus sources in the St. Croix watershed

Phosphorus loss from cropland is a major contributor to water quality concerns in the watershed. About 85% of phosphorus comes from nutrients transported by water from a variety of activities on the land that are often called nonpoint sources. **Corn-soybean and corn-alfalfa rotations account for 11% of the land use and contribute an estimated 67% of the phosphorus** that winds up in the St. Croix River. Agricultural Best Management Practices (BMPs), especially those that promote soil health and support living green cover on fields during the fall to early spring, **can substantially reduce losses of phosphorus** from cropland. These practices help keep nutrients in the fields while protecting our lakes and streams.

TMDL goal-setting

A TMDL is an analysis of the amount of a particular pollutant that a stream or lake can receive before exceeding water quality standards set to protect and maintain uses such as drinking water, fishing and swimming. The goal of a TMDL is to set limits on pollutants (phosphorus for the St. Croix) to correct water quality problems.

“The St. Croix Recovery plan aims to reduce the amount of phosphorus entering Lake St. Croix by 27%.”



St. Croix River near Danbury

Estimating impacts of agricultural Best Management Practices (BMPs) with a model

A COMPUTERIZED WATERSHED MODEL is a tool that simulates runoff and erosion from fields and other lands. In particular, it can estimate the loss of phosphorus from fields and its transport to rivers and lakes. Models can also help communities and farmers target effective conservation solutions to help control loss of phosphorus from fields.

A Soil and Water Assessment Tool (SWAT) model was run by the Science Museum of Minnesota to simulate sediment and phosphorus loss from two representative crop rotations. The first was a 6-year Corn-Alfalfa rotation (1 year corn-grain, 1 year corn-silage, and 4 years alfalfa), and the second was a 2-year Corn-Soybean rotation (1 year corn-grain, 1 year soybeans). The baseline model was built using a mix of conventional and conservation tillage in these rotations that typifies current practices. A critical use of the model was to simulate how agricultural Best Management Practices (BMPs) could reduce phosphorus loss from fields relative to baseline conditions. Each BMP changes some combination of tillage and cropping patterns in these rotations, which could be programmed into the model to see the effect on phosphorus loss and transport.

Estimating the amount of phosphorus leaving agricultural fields is complicated by many factors:

- the amount and timing of rainfall and snowmelt;
- soil type;
- topography;
- vegetative cover; and
- agricultural practices such as crop rotations, tillage, and applications of manure and inorganic fertilizer.

POUNDS OF PHOSPHORUS shown in the graph at right are edge-of-field estimates that represent the amount of phosphorus transported off uplands before reaching streams, lakes or wetlands. Depending on the local landscape some of this “edge-of-field” phosphorus may be trapped prior to reaching the St. Croix River.

BASELINE represents these rotations with none of the BMPs applied. Tillage in the baseline watershed model was assumed to include chisel plowing in the fall or spring, followed by disking in the spring just prior to planting.

SOIL AND WATER ASSESSMENT TOOL FACTORS

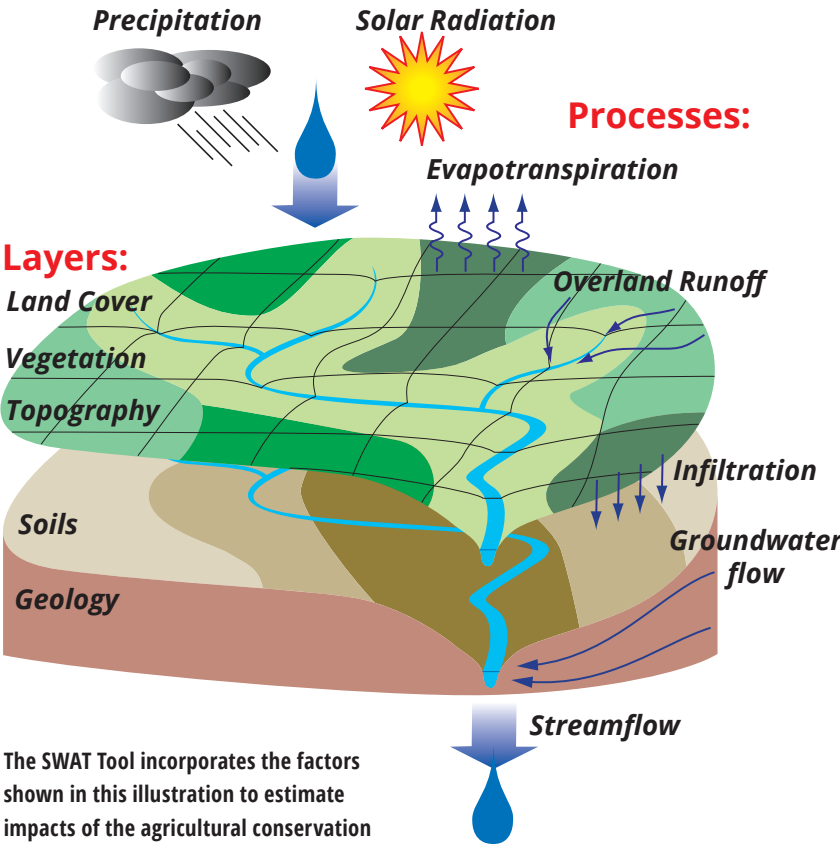
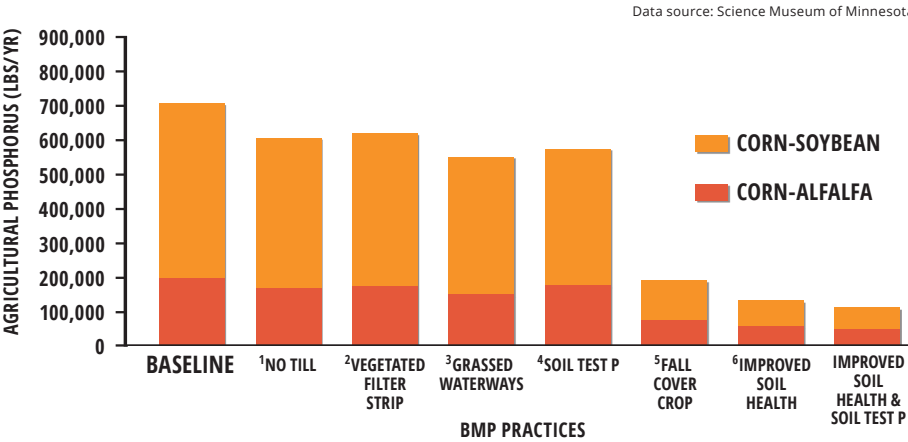


Illustration: Science Museum of Minnesota

CORN-ALFALFA AND CORN-SOYBEAN ROTATION
PHOSPHORUS LOSS REDUCTIONS
associated with BMP practices



¹⁻⁶See Modeling Assumptions on the following page.