
Sunset over Lake Champlain. Taken by Julie Moore, Stone Environmental, Inc.

**WATER RESOURCES**

**User**
Lake Champlain Basin Program, Bordered by the States of Vermont, New York and the Province of Quebec

**Partner**
Stone Environmental, Esri partner since 2009, based in Montpelier, Vermont

**Challenge**
Identify and target critical source areas of pollution

**Solution**
ArcGIS® for Desktop
ArcGIS Spatial Analyst (Extension)
ArcGIS℠ Online
ArcGIS for Server
USDA's SWAT

**Results**
Targeted implementation of BMPs showed a 1.8 to 2.9 times increase in overall watershed management effectiveness compared to random implementation.

# Targeting Pollution with GIS

Lake Champlain is one of the largest lakes in North America. It is 120 miles long, with a surface area of 435 square miles and a maximum depth of 400 feet. The 8,234-square-mile watershed drains nearly half the land area of Vermont and portions of northeastern New York and southern Quebec. It has been designated a phosphorus-impaired water body. As a result, the Environmental Protection Agency (EPA) has developed a total maximum daily load (TMDL) plan for the Vermont portion of the lake.

## The Challenge

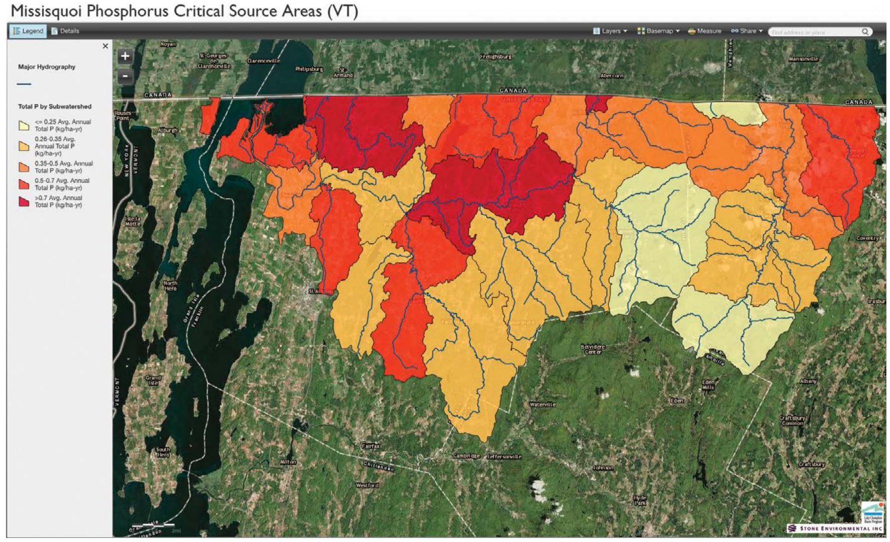
The Vermont portion of the lake, Missisquoi Bay, has one of the highest in-lake phosphorus concentrations in Lake Champlain, greatly exceeding designated levels. It has long been impaired by eutrophication caused by excessive phosphorus loads from its watershed.

The Lake Champlain Basin Program needed a way to identify the highest critical source areas (CSAs), which would result in more effective and cost-efficient watershed management strategies and maximum reduction of pollutants.

## The Partner

Stone Environmental provides scientific tools, apps, modeling, analyses, and visualizations to help clients with solutions related to water resources management, brownfield redevelopment, and agricultural stewardship.

Missisquoi Phosphorus Critical Source Areas (VT)




Screenshot provided by Stone Environmental.

"As a result of this critical source area mapping, NRCS was able to target outreach efforts and program funding to the farms and fields with the most critical water quality concerns in the Missisquoi Bay watershed."

**Kip Potter**
Water Quality Specialist
US Department of Agriculture,
Natural Resources Conservation Service, Vermont

## The Solution

Stone carried out a watershed modeling project that identified and ranked CSAs at multiple scales across the Missisquoi Bay Basin using the best available geospatial data and the Soil and Water Assessment Tool (SWAT). One output of running the SWAT was an estimate of phosphorus reduction potential from traditional versus targeted best management practices (BMPs). Stone also assessed the effects of predicted climate change on CSAs. The SWAT has proven to be an effective model for assessing water resources and nonpoint source pollution for a wide range of scales and environmental conditions.

For the Missisquoi Bay watershed, Stone developed a SWAT implementation that enabled simulation of phosphorus transport processes at a resolution never before used at the basin scale. The approach relied on rigorous development of GIS datasets and their careful integration with SWAT. The outputs were published in ArcGIS℠ Online for conservation planners to work with farmers in identifying and implementing BMPs that would result in maximum phosphorus reductions.

## The Results

The subwatershed level results are being used to target areas of the basin for more focused management, as well as more intensive future monitoring and modeling. The field and subfield level results are being used to prioritize locations for allocation of resources that support the implementation of practices—such as cover cropping and reduced tillage—aimed at reducing phosphorus loss and improving water quality.

In addition, Stone evaluated the relative effectiveness of two possible approaches for implementation of BMPs: random implementation to 20 percent of eligible land and targeted implementation to those CSAs ranking in the highest 20 percent. Targeted implementation of BMPs was shown to result in a 1.8 to 2.9 times increase in overall effectiveness compared to random implementation.

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