Rural Stormwater Management Model
New tool to reduce stormwater runoff impacts

Heavy rains and melting snow can cause water to run off land in rural areas. If not properly managed, this runoff can lead to topsoil loss, erosion, and the potential for sediment and pollutants to reach creeks, rivers, and the lake.

A new tool was needed for rural areas to better manage stormwater, to slow runoff down, store it, and filter it to improve water quality. The Rural Stormwater Management Model (RSWMM) is a new modeling software tool to help conservation and stewardship professionals, drainage engineers, landowners, and communities. The software can help to identify the projects that work best to reduce stormwater impacts and assess the project scale and locations that may work best.

"The model is a new tool that can give people more detailed information about how their projects can reduce the impact of water running off of land during storm events. When someone sees the benefits created by a wetland, or berm, or natural barrier, or a planting project, or a change in cropping practices, they may be more likely to consider doing that project, or adopting that practice, on their property."

Alec Scott
Water and Planning Manager,
Ausable Bayfield Conservation

When working to preserve topsoil, reduce erosion, and keep sediment out of Lake Huron it's useful to know what projects work best and the recommended size and scale for those projects. New software modeling technology can provide better information to ministries, agencies, landowners, and community groups.

High-level Results

A new rural stormwater software modeling tool was created that:

- Prioritizes stormwater management areas

- Incorporates field-scale treatment and best management practices in stormwater and erosion and sediment control

- Compares the impacts of potential projects on water quantity and quality

- Allows rural watershed managers to better evaluate, prioritize, design and implement soil and water conservation projects to protect Lake Huron

- Informs and improves local long-term monitoring of weather, stormwater, and water quality and quantity

Project Context

Public concerns about water quality issues such as algal growth, excessive nutrients (e.g. phosphorus and nitrogen), and bacteria (e.g. *Escherichia coli,* E. coli) along the southeast shoreline of Lake Huron prompted the creation of the Lake Huron Southeast Shores Executive Steering Committee (LHSSESC) in 2010. This water-quality initiative is now known as Healthy Lake Huron: Clean Water, Clean Beaches. Partners include federal and provincial ministries, other levels of government, public health, and local conservation agencies, among other partners. Healthy Lake Huron partners work directly with stewardship professionals, landowners, and community groups to protect and improve water quality along Lake Huron's southeast shoreline, a largely rural area stretching from Sarnia to Tobermory in Ontario, Canada. Healthy Lake Huron identified five sentinel watersheds as priority areas for long-term monitoring and water quality improvement projects. Those five watershed areas are: Pine River; North Shore (Garvey Creek - Glenn Drain); Bayfield North (Gullies); Main Bayfield; and Lambton Shores.
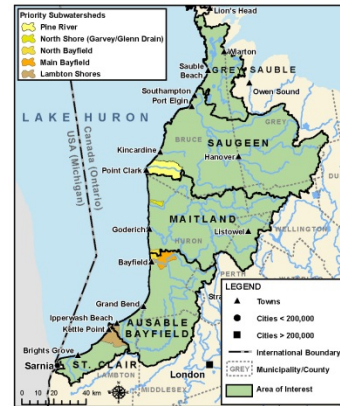
The Healthy Lake Huron area is a largely rural stretch of shoreline from Sarnia to Tobermory. Five priority watersheds have been identified for the purposes of long-term monitoring and stewardship projects.

Challenge

Computer models are useful tools for evaluating best practices and approaches to address specific rural water quality and quantity issues. When Healthy Lake Huron identified five priority watershed areas, existing stormwater models had limitations representing detailed hydrology, hydraulics, and hydrogeology in rural areas.

Project Goals

The RSWMM project set out to address the challenge by developing a physically-based computer model that will help practitioners (working with rural landowners, community groups, and funding partners) to choose optimal locations for agricultural best management practices (BMPs) or other stewardship projects. The model also needed to identify priority watersheds in which the incorporation of BMPs would have the most water quantity and quality benefits at the watershed outlet.

Improved monitoring of weather, water quality, and water quantity in the five priority areas was also needed, so a secondary goal was also to create or expand five water quality monitoring stations in these sentinel watersheds.

Solution

Healthy Lake Huron, with support of the Ontario Ministry of the Environment and Climate Change's Showcasing Water Innovation (SWI) program and other partners, developed the Rural Stormwater Management Model (RSWMM) to address current model limitations. The RSWMM builds upon PCSWMM, which is a spatial decision support system for US EPA SWMM5, one of the most widely used models for stormwater management, wastewater and watershed modeling. SWMM5 is developed and maintained by the United States Environmental Protection Agency (EPA). PCSWMM has been used on more than 10,000 projects. Benefits of building on PCSWMM include the software's ability to better model rural areas while continuing to model urban areas.

Better information for rural landowners and community groups, combined with financial incentive programs, can help inform stewardship projects and best management practices that preserve topsoil, reduce erosion, and keep sediment and pollutants out of creeks, rivers, and the lake.

The RSWMM project invited proposals for the model creation and after review of proposals, and meetings with proponents, the Technical Committee for the project decided to work collaboratively with two firms: Emmons & Olivier Resources, Inc. (EOR) as the primary contractor and Computational Hydraulics International (CHI). EOR's knowledge of modeling rural watersheds and urban and agricultural best management practices, as well as CHI's ongoing technical support and ability to update the PCSWMM software, was agreed to provide the best prospects for a model that will be used in the future and will grow.

Potential users of the model include soil and water conservation professionals and drainage engineers.

Results

PCSWMM software has the ability to simulate storm runoff flow rates and volumes

The results of the project are that:

- Five monitoring locations were added or upgraded to improve monitoring of water quality and quantity and weather in the five priority areas used as sentinel watersheds.
- Using data from the five sentinel watersheds for model development, PCSWMM has been upgraded to include:
  1. The impacts of a suite of agricultural best management practices (BMPs) on both water quantity and quality
  2. Landscape loading of nitrogen, phosphorus, and sediment coming from farm fields
  3. Nitrogen and phosphorus depletion along streams and creeks
  4. The impact on runoff by the different crop stages and seasonal changes throughout the farming season
  5. Groundwater hydrology and drain-tile hydraulics

Five new or upgraded stations were created in the five sentinel watersheds to improve long-term monitoring of water quality, water quantity, and weather.

Many of the needed features of a Rural Stormwater Management Model are now incorporated into the PCSWMM platform.

We learned through this project that no single model can provide all the knowledge needed to address water quality issues, but the RSWMM enhancements to PCSWMM provide a powerful new tool in the stewardship tool box. Another lesson learned is that more long-term monitoring is needed to make the model as robust as possible as it is further enhanced and updated in the future.

Stewardship projects designed with the help of the new software modeling tool can help to protect and improve the quality of water in Lake Huron.

Individual models have been created for each of the five sentinel watersheds based on detailed information collected as part of the project. These models will be used for evaluation new best management practices in these watersheds.

Next Steps

Now that detailed enhancements for rural areas have been added to existing modeling software, partners of the Healthy Lake Huron: Clean Water, Clean Beaches initiative will

work on using and improving this powerful new model as an important decision-making tool.

Additional features have been recommended for next steps. Continued monitoring of water quality and quantity and weather in the sentinel watersheds will allow for model refinement and improved calibration in the future. There also will be a need to train appropriate staff on the use of the new RSWMM features of PCSWMM.

The Healthy Lake Huron partnership plans to work with all levels of government, funding organizations, community groups, landowners, and professionals in the field to use this new tool, seek funding to continue monitoring improvements, continue to field-test and calibrate the model to improve the quality of the results, and implement stewardship projects strategically with information from the model.

Application for Ontario communities

The new Rural Stormwater Management Model (RSWMM) can benefit communities in Ontario and other parts of Canada and the world. The modeling software has urban and rural features and is of particular application in rural areas. The new features of RSWMM are incorporated into the existing PCSWMM software. The software, including RSWMM enhancements, is available through a purchased licence from Computational Hydraulics International (CHI), 147 Wyndham St. N., Suite 202, Guelph, Ontario, Canada N1H 4E9. Their website is www.chiwater.com. A one-month trial version of the software is also available. Contact CHI for information. Their email is info@chiwater.com. Telephone is: 519-767-0197.

New modeling software to better manage stormwater runoff in rural areas will be used along Lake Huron's southeast shore. This new technology can also provide benefits in other parts of Ontario, Canada, and North America.

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