

# Developing Tools for Assessing the Impacts of Water Withdrawals in the Great Lakes-St. Lawrence Basin

## Summary

**Product:** Prototype linked-modeling framework for riverine watersheds

**Purpose:** Evaluate the ecological impacts of water withdrawals in river-based watershed

**Users:** State, provincial and local watershed managers, applicants for water withdrawals permits and regional water resources management decisionmakers

**Field-test Location:** Muskegon River watershed, Michigan

**Model Designers:** Limno-Tech, Inc., Ann Arbor, MI ([www.limno.com](http://www.limno.com))

**Future Applications:** Individual river-based watersheds in the Great Lakes basin

**Date of Completion:** June 1, 2004

## Background

Limno-Tech, Inc., an environmental engineering and science firm, has developed a prototype modeling tool to assess the ecological impacts of withdrawals and diversions for a Great Lakes watershed. As one of a series of projects supported by the Great Lakes Protection Fund, including the Great Lakes Commission's project on water conservation, it provides practical and scientific support to the governors' and premiers' commitments under Annex 2001 of the Great Lakes Charter ([www.cglg.org/1pdfs/Annex2001.pdf](http://www.cglg.org/1pdfs/Annex2001.pdf)).

The Annex outlines a framework for a set of guiding principles to review proposals for new and increased water withdrawals in the Great Lakes basin. The principles apply to withdrawals from all waters of the Great Lakes basin (groundwater, tributaries, inland lakes), not just the Great Lakes themselves. The implementation of the Annex calls for the development of a decision support system to ensure the best available information to make decisions on large-scale water withdrawals/diversions. Additionally, the Annex calls for further commitment to improve the sources and applications of scientific information regarding the water resources of the Great Lakes basin and the impacts of the withdrawals on the ecosystem. As guidance for the implementation of these provisions, the development of this prototype model provides insight on the challenges and opportunities in

developing models to assess water withdrawal impacts for other watersheds in the Great Lakes.

This modeling project builds upon the work that Limno-Tech completed for the Great Lakes Commission's Water Resources Management Decision Support System Project ([www.glc.org/wateruse/wrmdss/](http://www.glc.org/wateruse/wrmdss/)). Based on an inventory of models relevant to assessing ecological impacts of water withdrawals, Limno-Tech found that existing models generally address only part of the overall problem, such as watershed hydrologic response, channel hydraulics, sediment transport, water quality or ecological effects. No existing model by itself directly links a water withdrawal to ecological responses. Furthermore, no existing model addresses the broad range of potential ecological responses resulting from water withdrawal scenarios. This project addresses these gaps in modeling by constructing a prototype applicable to the riverine watersheds of the Great Lakes basin.

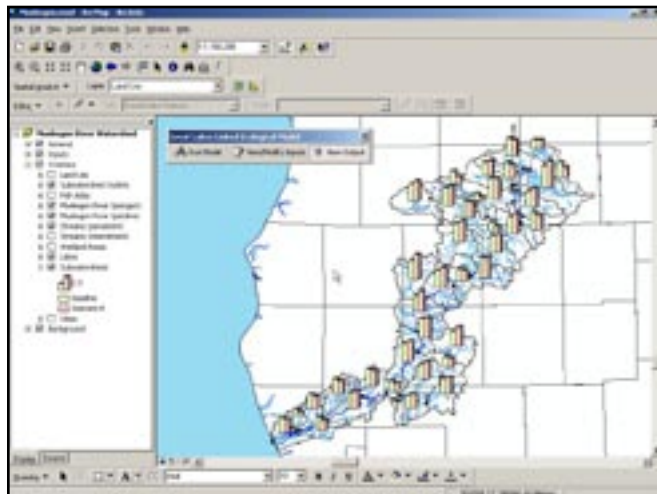
## What does this model do?

The model permits direct evaluation of how hydrologic changes associated with water withdrawals affect important ecological aspects of a river-based watershed. The modeling framework links a hydrologic/water



Todd Redder of Limno-Tech takes depth measurements needed for model development

quality model to a series of habitat-based ecosystem sub-models. Components of the modeling framework include watershed runoff and loading, channel hydraulics, water temperature (instream), water quality (instream), riparian wetland plant diversity, fish habitat supply and/or population, and wetland bird habitat supply. The model was field-tested on the Muskegon River watershed, located in northwest lower Michigan. Water withdrawals in this watershed can potentially impact flow regime and water temperature, thus affecting the habitat of brown trout and other important species in the system.



Example model output

## What are the project objectives?

1. Develop a prototype linked model for a Great Lakes tributary that can be used to assess the ecological effects of water withdrawals.
2. Explore issues and challenges to developing a model of this type, and its broader application to a wide range of Great Lakes basin systems.

## Vision

These modeling approaches as implemented in a specific watershed could be used as an adaptive management tool by incorporating results of ongoing monitoring, and thereby providing a synthesis tool and a methodology for assessing cumulative impacts of multiple flow modifications. They can also be used to simulate flow in areas of a watershed that are not gauged. In addition, models for individual watersheds could potentially be linked to form a larger Great Lakes basin assessment tool.

## How was the model developed?

**First Step** – Development of a broad conceptual model, illustrating all the cause-effect relationships that might exist between potential water withdrawal-induced physical (hydrologic and hydraulic) changes in the river-based watersheds in the Great Lakes basin, and the resulting ecological impacts.

**Second Step** – Development of a prototype linked-model framework specific to a Great Lakes river-based watershed system, through which issues, technical needs and obstacles were identified, and the model framework's general applicability was tested. Field testing was conducted in the Muskegon River watershed in parallel to model development to ensure the integrity of model linkages.



Muskegon River Watershed

## Where can I get more information?

Visit the project's web site at  
[www.glc.org/wateruse/tools/limno/](http://www.glc.org/wateruse/tools/limno/)  
 Web site launch date: June 1, 2004

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