

Grand River Simulation Model



Client:
**Grand River Conservation
Authority**

The Grand River Simulation Model (GRSM) was originally developed by the Ontario Ministry of Environment in the late 1970s, as part of the Grand River Basin Water Management Study. The objective in developing GRSM was to provide a tool for assessing the cumulative impacts on river water quality of municipal sewage treatment plants and runoff from both rural and urban catchments.

During the 1970s, dissolved oxygen (DO) levels in the river were identified as a primary concern and indicator of water quality along the lower reaches of the Grand and Speed Rivers. Excessive growth of rooted aquatic vegetation (especially species such as *Cladophora glomerata* and *Potamogeton pectinatus*) were having a substantial and governing influence on daily DO fluctuations. Biomass proliferation was attributed to high phosphorus levels from various sources including agricultural runoff and municipal sewage plant discharges.

GRSM was therefore designed to provide explicit modeling of the interactions between phosphorus inputs to the river, aquatic plant growth, and resulting DO fluctuations. This required that the model represent photosynthetic growth of the dominant species of rooted aquatic vegetation, recognizing the influence of a range of factors including substrate conditions, nutrient availability, solar radiation, and water temperature. A specialized sub-model (ECOL) was developed to provide continuous simulation of aquatic biomass growth and DO fluxes caused by photosynthesis and respiration. ECOL was integrated into GRSM to provide continuous simulation of conditions within a series of model reaches that represent the Grand and Speed Rivers.

In 1995, the Grand River Conservation Authority proceeded to update and upgrade GRSM. As a first phase, XCG Consultants worked with another firm to design and conduct a river monitoring program. Data on DO, water temperature, and biomass conditions at strategic locations were gathered over the summer of 1995. The 1995 data set was then used to calibrate GRSM.

During the course of this project, the usability of GRSM was substantially improved. XCG staff developed a graphical Windows-based interface to allow the model user to view time series of model outputs, compare with recorded data, and develop statistics to summarize model results. The original GRSM had been a mainframe FORTRAN model that did not provide an easy way to view the substantial output generated by the model. The new graphical interface allows the user to see relationships between model inputs and outputs, as well as the interconnections between the simulated variables. This assisted with better examining and explaining model sensitivities and calibration.

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