Toward a Water Resources Management Decision Support System for the Great Lakes-St. Lawrence River Basin




Project recommendations

In many areas of North America (and beyond), water sources and associated ecosystems are being stressed by withdrawals and diversions from aquifers, lakes, rivers and reservoirs to meet the needs of cities, farms, homes and industries. In August 2000, the Great Lakes Commission and its collaborators initiated a project to respond to the increasing need for data and information to inform state and provincial decisionmaking on issues involving the withdrawal, use and consumption of Great Lakes-St. Lawrence River water resources.

Titled *Toward a Water Resources Management Decision Support System for the Great Lakes-St. Lawrence River Basin*, this multi-year initiative has involved the compilation and synthesis of information on the status of Great Lakes water resources, current water withdrawals and uses, and the ecological impacts of individual and cumulative water withdrawals. The impetus for this project can be traced to a statement issued by the Council of Great Lakes Governors in late 1999 providing a set of principles for a stronger water resources management framework for the region. Through this statement, which built upon the Great Lakes Charter of 1985 and led to the development of the Great Lakes Charter Annex in 2001, the governors and premiers agreed that a durable, simple, and efficient water management regime is needed to protect the resource and retain decisionmaking authority within the basin. The project was subsequently modified to maximize its relevance to Annex implementation.

The project was guided by a management team of state, provincial and federal water resource experts, with the assistance of an advisory committee of stakeholders and several technical subcommittees with specialized expertise. This project has produced several major products which, singly and collectively, will strengthen water quantity decisionmaking processes at the federal, state, provincial and municipal levels.

Presented below is a chapter-by-chapter overview of the of the project's key findings and recommendations. Once implemented, these recommendations can provide the basis for a Water Resources Management Decision Support System (WRMDSS), and for accessing the data and information needed to maximize its value in promoting the informed use, management and protection of the region's valuable water resources.

The full report, including an executive summary and appendices, is available online at:
www.glc.org/wateruse/wrmdss.html

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WRMDSS




Chapter 2: Status Assessment of Great Lakes-St. Lawrence River Water Resources

Following a project overview in Chapter One, Chapter Two summarizes the work of the Status Assessment of Water Resources Technical Subcommittee. It describes the hydrology of the Great Lakes system, the process for measuring levels and flows, and the uncertainty associated with such measurements. The chapter also recommends improvements to current monitoring activities that will enhance decisionmaking processes. In so doing, it helps lay the groundwork for a decision support system that is applicable to a broad range of variables and geographic areas ranging from small sub-basins (e.g., a single tributary) to the entire Great Lakes-St. Lawrence River system.

Chapter 3: Inventory of Water Withdrawl and Use Data Information

Chapter Three describes the outcomes of the work of the Water Withdrawal and Use Technical Subcommittee, including an assessment of state and provincial water use data collection programs, the functionality of the Great Lakes Regional Water Use Database, and consumptive use accounting. The role of demand forecasting in regional water resources management is also examined. Commitments under the Great Lakes Charter are used as a yardstick to measure the progress made in water use data collection and the contribution of that data to water resources management activities.

Chapter 4: Water Conservation in the Great Lakes-St. Lawrence River Region

Chapter Four presents water conservation information gathered under the direction of the Water Withdrawal and Use Technical Subcommittee, through a survey of state and provincial programs and associated information on best management practices. A growing emphasis on water conservation signals a significant shift from past water management practices that viewed Great Lakes water as a virtually limitless resource that could accommodate all current and anticipated in-basin demands. A commitment to "environmentally sound and economically feasible water conservation measures," as stated in the Great Lakes Charter Annex, is critically important if the region is to

Chapter 2 Recommendations

Monitoring/Modeling

1) Evaluate the adequacy of hydrologic/hydraulic monitoring systems, within the context of the Annex, after a decisionmaking standard is agreed upon.
2) Secure agency commitments to core, long-term, geographically distributed hydrologic/hydraulic monitoring that will be needed to implement the decisionmaking standard.
3) Support the continued maintenance and enhancement of the Great Lakes water level gauging network, and quantify and report uncertainties.
4) Develop coordinated binational methods for evaluating groundwater flow directly and indirectly to the Great Lakes and their tributary watersheds, using common data standards and models.
5) Systematically evaluate the adequacy of existing tributary stream gauging to meet Annex implementation needs and develop coordinated binational methods for calculating streamflow for all ungauged areas.
6) Develop coordinated binational methods, with measures of uncertainty, for calculating over-lake precipitation and evaporation processes using existing remote sensing techniques.
7) Develop coordinated binational methods, with measures of uncertainty, for calculating and/or measuring flows, customized for each connecting channel, St. Lawrence River and diversion into/out of the Great Lakes.
8) Continue development and refinement of systemwide hydraulic routing models so that effects of proposed withdrawals and the uncertainty of the effects can be predicted.

Information Availability

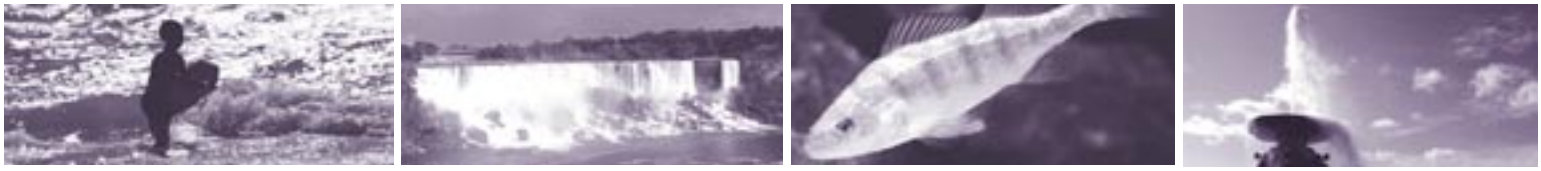
9) Develop common data standards and reporting practices for hydraulic/hydrologic data and other information relevant to the Annex, with emphasis on determining watershed impacts.
10) Ensure easy access to hydraulic/hydrologic data for decisionmakers and other interested parties via clearinghouse services, and conventional and electronic communications technology.

Information Use

11) Incorporate an understanding of hydrologic variability and uncertainty at the appropriate temporal and spatial scales in the decisionmaking process.

Chapter 3 Recommendations

1) Develop state/provincial legislative and programmatic authority with adequate funding and technical support to carry out the water withdrawal and use data collection and reporting commitments in the Great Lakes Charter and Charter Annex.
2) Evaluate the effectiveness of the Great Lakes Regional Water Use Database in supporting the decisionmaking process and revise and upgrade as needed to make it a more useful planning tool.
3) Provide a more uniform and consistent base of data and information through the state/provincial water use data collection and reporting programs to facilitate comparison and evaluation.
4) Develop reporting requirements for incorporation into state/provincial water use data collection and reporting programs.
5) Improve state/provincial consumptive use reporting processes to ensure reliable and accurate data.
6) Develop and apply uniform consumptive use coefficients for each water use category until such time that a better method of measuring consumptive water use is available.
7) Develop and regularly pursue a uniform regional approach to demand forecasting in the interest of strengthening jurisdictional and regional planning processes.



demonstrate a capability to responsibly manage its own resources. The chapter details 15 types of water conservation practices ranging from financial incentives to technological improvements, singly and in combination.

Chapter 5: Ecological Impacts Associated with Great Lakes Water Withdrawls

Chapter Five examines the prospective individual and cumulative ecological impacts of water withdrawals based on the work of the Inventory of Information on Ecological Impacts Technical Subcommittee. This chapter presents a list of "essential questions" regarding potential ecological impacts that should be addressed in reviewing water withdrawal proposals, a literature search and analysis, and an inventory and assessment of existing computer models with some relevance to assessing ecological impacts from water withdrawals. The subcommittee also examined, through a case study approach, various prospective definitions and applications of the resource-based decisionmaking standard as presented in the Great Lakes Charter Annex. Research and data collection priorities to help inform the decisionmaking process associated with new or increased Great Lakes basin water withdrawals were then developed.

Based on the research of the subcommittee, the ecological impacts of a given water withdrawal were found to be most clearly discernible at the nearshore and sub-watershed levels, where relatively small changes in water levels and flows could affect the supported ecosystems.

Chapter 6: Resource Improvement Standard for Water Resource Projects

Chapter Six presents an analysis of the issues and potential application associated with the "resource improvement" concept embodied in the Great Lakes Charter Annex. This work, accomplished under the direction of the Inventory of Information on Ecological Impacts Technical Subcommittee, supports development of a new regional water resources management decisionmaking standard, as outlined in Directive #3 of the Annex. The resource improvement standard should be specific enough to provide scientifically sound guidance, yet flexible enough to accommodate the inherent uniqueness of individual proposals.

Chapter 4 Recommendations

1) Develop and apply water conservation models that foster a coordinated regional approach and address the Charter Annex standard of "environmentally sound and economically feasible."
2) Establish an information clearinghouse to publicize best management practices pertaining to individual sectors of water use.
3) Develop and update state/provincial drought contingency plans to ensure adequate attention to water conservation.
4) Develop specific water conservation provisions as part of state/provincial water management programs.
5) Undertake an economic analysis to identify the financial benefits of water conservation, and use results to promote adoption of such practices at the local level.
6) Develop a regional information/education program to promote the adoption of water conservation practices.

Chapter 5 Recommendations

1) Review and refine the list of "essential questions" to ensure comprehensiveness and feasibility in a decision support framework.
2) Funding for research and development should be directed at a) mining data from existing sources, and b) studies of both qualitative and quantitative stress-response relationships. Data and information gaps should be identified and studies conducted to fill those gaps, with a particular focus on sub-watersheds.
3) Developing indicators and thresholds to inform the discussion of "no significant adverse individual or cumulative impacts" relating to ecological impacts from water withdrawals.
4) Synthesize and model the quantitative relationships between water withdrawals/diversions in various types of Great Lakes-St. Lawrence River ecosystems (large lakes, inland lakes, streams and rivers, groundwater) and potential ecological impacts of those water withdrawals.
5) Develop linked model frameworks for selected water withdrawal scenarios by building on the existing model inventory.
6) Intensify and enhance research that supports more accurate predictions of regional climate change, population growth, demand forecasting and land use changes, and use this information to help evaluate ecological sensitivities.
7) Improve data to assess and model ecological impacts of water withdrawals at different temporal and spatial scales, particularly on a nearshore and sub-watershed basis, where impacts are most discernible.
8) Improve understanding of variability and uncertainty in levels and flows to strengthen the decision support system.
9) Monitor ecological and hydrological responses to water withdrawal activities, with a special emphasis on sub-watersheds and nearshore zones.

Chapter 6 Recommendations

1) Develop precise definitions for terms in Directive #3 of the Annex; guidance on the application of spatial and temporal dimensions of "resource improvement"; and a science-based evaluation methodology that presents acceptable procedures for assessing withdrawal proposals.
2) Continue and improve case study analysis and "scenario testing" to explore applications of a resource improvement standard.
3) Conduct a more thorough study of the resource improvement concept.




Chapter 7: Information and Communications

Chapter Seven presents examples of a decision support system and communication tools that can assist in the decisionmaking process. Key points to consider when integrating data and information into a decision support system are presented, along with an overview of evolving technologies, such as Internet, real time data, metadata and GIS that may contribute significantly to water resources management decisionmaking.

Chapter 8: Pulling it all together: Project Synthesis

The conclusion of this project activity signals the beginning of the next critical step: implementing recommendations in the interest of designing and operating a decision support system. Principal among these needs are: 1) the challenges of meeting present and future data and information needs; 2) issues of scale in assessing ecosystem impacts of water withdrawals; 3) cumulative impacts occurring over space and time; 4) groundwater hydrology in the basin; and 5) the full range of ecological impacts associated with water withdrawal.

Project research has identified a significant amount of relevant water resources data and information pertaining to water withdrawal and use proposals and their impacts. However, there are equally significant inadequacies in data and information that, until addressed, will compromise the region's ability to make scientifically sound water resources management decisions. The numerous recommendations of this report address the need to improve the quality and quantity of this data and information.

The WRMDSS report was prepared by the Great Lakes Commission for the Great Lakes states and provinces, with support from the Great Lakes Protection Fund. The full report, including all appendixes, is available online at www.glc.org/wateruse/wrmdss or in print copy and CD-ROM from the Great Lakes Commission.

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Chapter 7 Recommendations

1) Develop integrated Internet web pages to facilitate data and information exchange, distribution and access.
2) Develop metadata to accompany all geospatial and temporal data used in a Water Resources Management Decision Support System.
3) Incorporate a robust communications strategy into the Water Resources Management Decision Support System, involving a range of interrelated tools such as Internet technologies; email and online discussion groups; and conventional communications including printed materials, meetings, conferences and symposia.

Chapter 8 Concluding Observations (selected)

- Understanding the uncertainties associated with the data and information available on water resources can, in many cases, be as critical as the information itself;
- A pressing need exists to improve the collection and reporting of accurate, consistent and uniform water withdrawal and use data;
- Much is still unknown about the region's groundwater resources. Expansion of tributary stream gauging and groundwater monitoring networks will be critical in accessing the data and information needed to support a WRMDSS;
- Climate change effects could become the primary stressor to levels and flows and would influence demand forecasts, cumulative impacts assessments, and even future individual water withdrawal decisions. As such, understanding the magnitude and nature of potential climate change effects should be a research priority;
- Improving the base of data related to water withdrawal and use, surface water and groundwater resources, and ecological/biological effects will require substantial commitment on the part of all units of government;
- An implementation plan for this report's recommendations needs to be developed and implemented in consultation with relevant state and provincial officials. This should include prioritization and costing-out of recommendations and a strategy to conduct needed research and policy analysis to address and apply them as a WRMDSS is developed.

Ordering a Report

The full WRMDSS report, including all appendixes, is available online at **www.glc.org/wateruse/wrmdss**
The report is also available on CD-ROM, or in print with CD-ROM appendixes, from:

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