Addressing Future Water Levels on the Upper Great Lakes:

Toward a New Regulation Plan

Summer 2011

Progress Report: International Upper Great Lakes Study

contents

for more information

If you would like more information on the Study or want to provide comments on the Study's preliminary findings, please visit the Study web site at **www.iugls.org**, at **www.facebook.com/iugls** or **twitter.com/IUGLS**.

Highlights

In 2007, the International Joint Commission launched a five-year study to look at future water levels in the upper Great Lakes and the options for regulating those levels to support the region's economic and environmental interests. In the entire upper lakes basin, water levels are currently influenced through a regulation plan at the St. Marys River control structures at Sault Ste. Marie, where Lake Superior outflows have been regulated since 1914.

Over long periods of time, a regulation plan can generally affect the balance between Lake Superior and Lake Michigan-Huron (considered as one lake, since they are at the same water level). However, the ability to influence high and low water levels through regulation is severely limited by the natural variation in climate conditions, the risks that climate change could introduce more extreme conditions in the future, and the physical geography of the lakes and connecting channels. Moreover, the natural shifting of the earth's crust has serious implications for both water regulation and coastal interests.

There is a high degree of uncertainty about how climate change will affect future water levels over the next several decades. In response, the Study has undertaken the most comprehensive and balanced analysis ever made of climate change in the Great Lakes basin. The Study concludes that future water levels are likely to remain within a relatively small range around their long-term averages. While lower water levels in the future are likely, water users around the lakes have to be prepared for episodes of higher levels, too. Any new regulation plan, therefore, must be *robust* – effective and flexible enough to perform well in an uncertain future.

A new regulation plan also must recognize and balance the needs of the *key economic and environmental interests* in the upper Great Lakes. Some of these interests, such as recreational boating and ecosystems, were not specifically listed in the original 1909 treaty between Canada and the United States that established a co-management approach to boundary waters. The Study's *shared vision planning* exercise has allowed representatives of these key interests to provide information regarding their needs and preferences related to Great Lakes water management.

Given the limited ability to regulate the lakes, the Study also has looked at:

- the feasibility of building new control structures either to restore water levels on Lake Michigan-Huron to conditions that existed prior to channel modifications or regulate the entire Great Lakes-St. Lawrence River system; and,
- adaptive management measures, such as strengthened monitoring and information sharing, that can help water managers and property owners know what to expect in terms of changing water levels so that they can take action to reduce risks.

From the start, public involvement has been an important part of the Study. This summer, Study experts and members of a Public Interest Advisory Group will be holding a series of informational meetings to provide background information, present preliminary findings and invite public comments *(see schedule on page 4)*.

In the fall, the Study's management board will complete its evaluation of the regulation plan options, taking into account public input. The Study's final report will be submitted to the International Joint Commission by March 2012.

The International Joint Commission will conduct public hearings after the Study is completed and put forward a new regulation plan to the governments of Canada and the United States.

Pictured right: The St. Marys River, where outflows from Lake Superior have been regulated since 1914 under an International Joint Commission Order of Approval. Today, the control structures consist of three hydropower plants and a gated dam at the head of the rapids known as the Compensating Works.

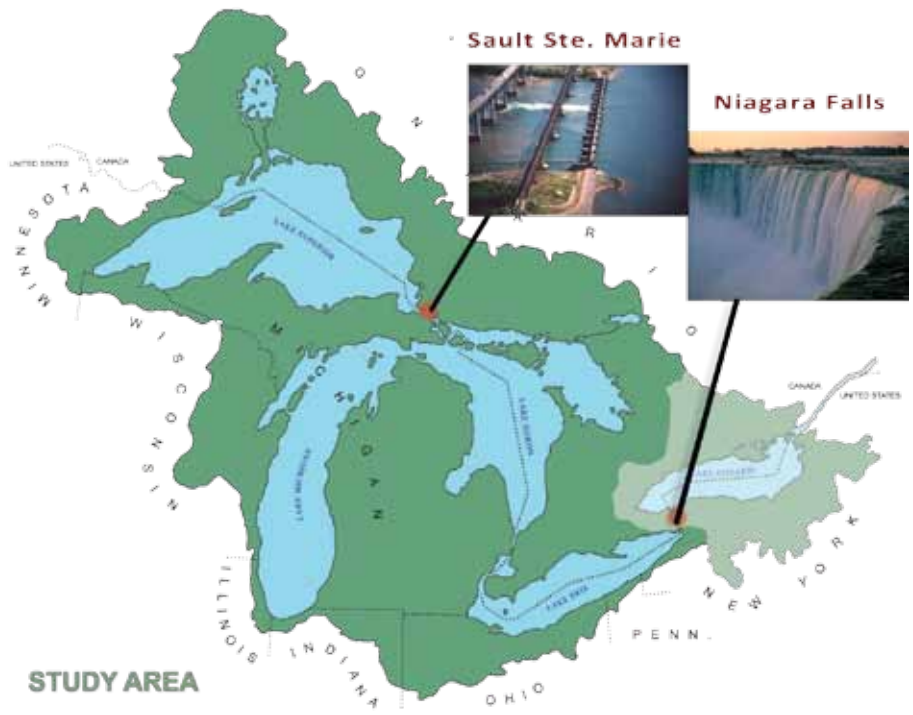
Why are we reviewing the regulation of Lake Superior?

A five-year international study is looking at future water levels in the upper Great Lakes and the options for regulating those levels to support the region's economic and environmental interests.

Water levels in the upper Great Lakes basin *(see map)* of Canada and the United States have a profound effect on the lives of the more than 25 million people who live in the region. Many depend on the lakes or connecting channels for drinking water and electricity, enjoy boating and fishing, or work for industries that rely on the Great Lakes fleet to transport raw materials and finished products. Water levels also are important for maintaining healthy wetlands, fisheries and ecosystems.

In the vast territory of the upper Great Lakes basin, water levels can be affected by regulation at only one location upstream from Niagara Falls: the control structures in the St. Marys River at the twin cities of Sault Ste. Marie in Ontario and Michigan. The release of water from Lake Superior has been regulated by the International Joint Commission, the bi-national agency established by Canada and the United States under the *Boundary Waters Treaty of 1909*.

There are limits to the ability to influence high or low water levels in the Great Lakes through a regulation plan. The major factors affecting the water supply to the lakes — precipitation, evaporation and runoff — vary naturally over time and cannot be controlled. Now climate change raises the risk of even more extreme conditions in the decades ahead. In addition, the St. Marys River is small compared to the huge surface area and great depth of Lake Superior and has a limited capacity to move the water downstream. At the same time, apparent water levels are affected by *glacial isostatic adjustment*, the gradual and uneven tilting of the land as the earth's crust adjusts from the last period of continental glaciation more than 10,000 years ago. *(See page 3 for details.)*



Upper Great Lakes Basin: For the purposes of the Study, the upper Great Lakes basin stretches from the headwaters of Lake Superior downstream to Niagara Falls, an area of about 686,000 square km (265,000 square miles).

In 2007, the International Joint Commission launched the *International Upper Great Lakes Study* to:

- review the regulation of Lake Superior outflows; and,
- assess the need for improvements to address the changing conditions of the upper Great Lakes and the evolving needs of the many interests served by the system.

After comprehensive research, analysis and public input, the Study now is testing more than 20 options for a new regulation plan against two key questions:

1. *Can the plan be effective and flexible enough to handle the range of changing — though difficult to predict — future water level conditions?*
2. *Can the plan find a reasonable balance among the many water-using interests in the Great Lakes basin?*

How will a new regulation plan balance many interests in the upper Great Lakes?

The Study is applying a "shared vision" approach to balancing the many interests of water users in the basin.

The *Boundary Waters Treaty* establishes an order of precedence for water uses. Under the Treaty, the interests of *domestic and sanitary water uses*, *navigation* and *hydroelectric generation and irrigation* are given preference in the development of regulation plans. No mention was made in 1909 of interests that are now recognized as playing an important role in supporting a healthy and vibrant Great Lakes, such as recreational uses and ecosystems. However, the Treaty does require that the Commission consider impacts on all interests. *(Article VIII)*

With this in mind, the Study is looking at the evolving needs of six key interest groups affected by any new regulation plan:

1. *Domestic, Municipal and Industrial Water Uses:* public and private sector organizations using water for domestic, municipal and industrial purposes, including owners/operators of water and water treatment facilities, power plants, farms relying on irrigation, and large industrial plants, such as mines, paper manufacturers and chemical plants.
2. *Commercial Navigation:* owners/operators of the U.S. and Canadian fleets of bulk carriers, tankers, barges and other commercial ships transporting goods in the Great Lakes-St. Lawrence Seaway system, as well as ocean-going cargo vessels.
3. *Hydroelectric Generation:* the owners/operators of the three hydroelectric generating stations on the St. Marys River, the stations in the Niagara River and those that use the Welland Canal.
4. *Ecosystems:* the biological components, and the ecological benefits they provide, of the natural environment of the Great Lakes basin.
5. *Coastal Zone:* individuals and organizations with a direct interest in property along the shorelines and connecting channels of the upper Great Lakes.
6. *Recreational Boating and Tourism:* individuals, companies and associations with a direct involvement in coastal tourism, recreational boating and fishing, marinas and boat retailers, and the commercial cruise ship industry.

To recognize and balance the needs of these different interests, the Study has applied *shared vision planning*, a proven water management planning technique in which representatives of each interest are directly involved in the development of candidate plans. Through user-friendly computer modelling, participants have been able to learn about potential outcomes under various plans and help the Study identify needs and preferences related to Great Lakes water management.

The Current Lake Superior Regulation Plan:

Plan 1977-A

The International Joint Commission's original *Order of Approval* in 1914 established the basic objectives for regulating Lake Superior's outflow and focused on the needs of navigation, hydropower and domestic and sanitary water users. More recent plans such as the current plan, 1977-A (in effect since 1990), have begun to recognize the importance of other factors, such as water levels in Lake Michigan-Huron and the need to maintain fish habitat in the St. Marys River rapids.

The main objective of 1977-A is to establish a flow that will bring the levels of Lakes Superior, Michigan and Huron to nearly the same relative position within their respective ranges of actual historical levels. The plan also tries to prevent the level of Lake Superior from rising above or falling below certain levels *(see table below)*. The plan also safeguards against high levels in the harbour below the Soo Locks, provides a fixed minimum release, and limits winter flows.

Summary of Monthly Mean Water Levels and Outflows

	metres	feet
Lake Superior		
Average	*183.41*	*601.74*
Minimum	182.72	599.48
Maximum	183.91	603.38
Range	***1.19***	***3.90***
Lake Michigan-Huron		
Average	*176.44*	*578.87*
Minimum	175.58	576.05
Maximum	177.50	582.35
Range	***1.92***	***6.30***

How will a new regulation plan deal with climate change and glacial isostatic adjustment (GIA)?

In working toward a new regulation plan for Lake Superior outflows, the Study is undertaking a rigorous analysis of two powerful forces affecting water levels in the Great Lakes basin: climate change and glacial isostatic adjustment (GIA).

In particular, climate change introduces a high level of uncertainty to predicting likely future water levels across the basin, making it difficult to design one regulation plan that will be optimal for all plausible future conditions. Therefore, candidate regulation plans will be evaluated for *robustness* — their ability to handle a range of conditions in an uncertain future. However, the regulation plan for controlling outflows from Lake Superior cannot be the sole mechanism for dealing with climate change *(see page 4)*.

Climate Change

Given the high degree of uncertainty about climate change and climate variability at the regional level of the Great Lakes basin, the Study has approached the issue carefully to ensure a rigorous and balanced analysis. The Study has used a range of models and data sources, including:

- global- and regional-scale climate models;
- statistical models;
- historical water levels; and
- geological records going back nearly 5,000 years.

Preliminary findings from the Study's climate research indicate that, compared to current climate conditions, the climate in the upper Great Lakes basin during the next 30 years is likely to be characterized by:

- an increase in precipitation and possibly more frequent intense storms;
- an increase in evaporation coupled with increased wind speeds that offsets the precipitation increase;
- increased lake temperatures; and,
- slight increases in water supply to the basin during winter/spring accompanied by larger decreases in supply during late summer/early fall, resulting in slight overall annual declines.

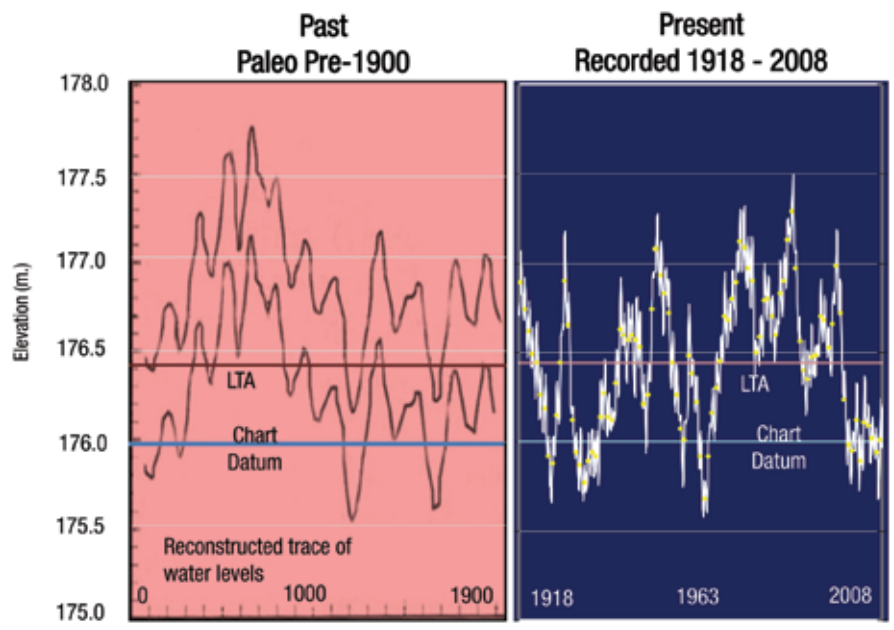
The Study's work indicates that, on an annual basis, water levels are likely to remain within a range fairly close to their long-term averages. The 2,000-year paleo record of lake levels *(pink chart)* shows somewhat higher lake levels than the recorded 100-year water levels *(blue chart)*, but with no difference in low water levels. The data are referenced to the long-term average (LTA) and chart datum. Chart datum is the reference level for navigation charts. While lower water levels in the future are likely, we have to be prepared for episodes of higher levels, too. This finding is in contrast to past studies of climate change impacts in which upper Great Lakes water levels, at the extreme, could decline by a metre (3.28 feet) or more by the end of this century. Modelling results from the Study's two recently developed regional climate models *(green chart)* predict that net basin supply will remain at near historic levels, whereas global climate models show much greater variability.

Glacial Isostatic Adjustment

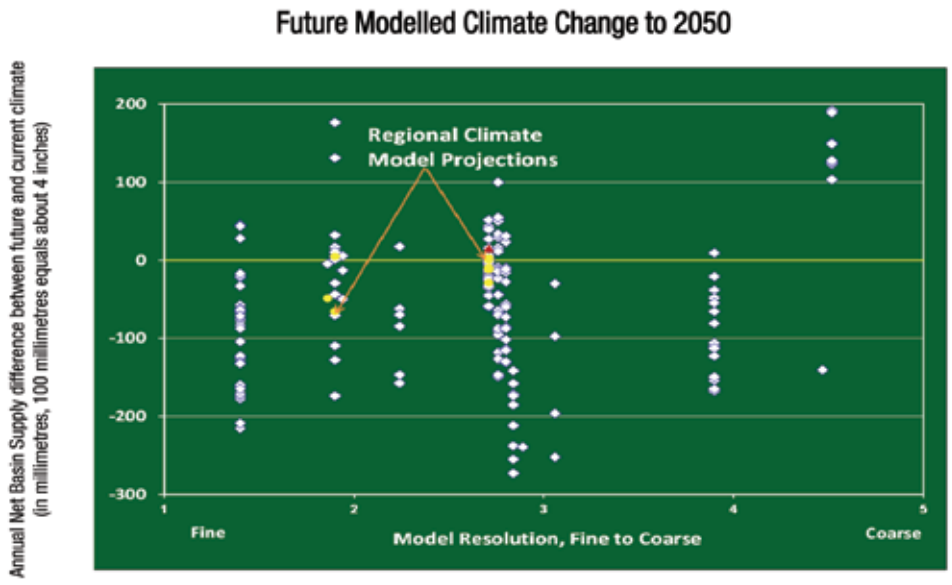
During the last period of continental glaciation, which ended about 10,000 years ago, the tremendous weight of ice that covered most of the Great Lakes region depressed the earth's crust. At the same time, land beyond the edge of the glacier bulged upward. When the glacier retreated, the land that had been covered with ice began to rise while the land that had bulged up began to sink.

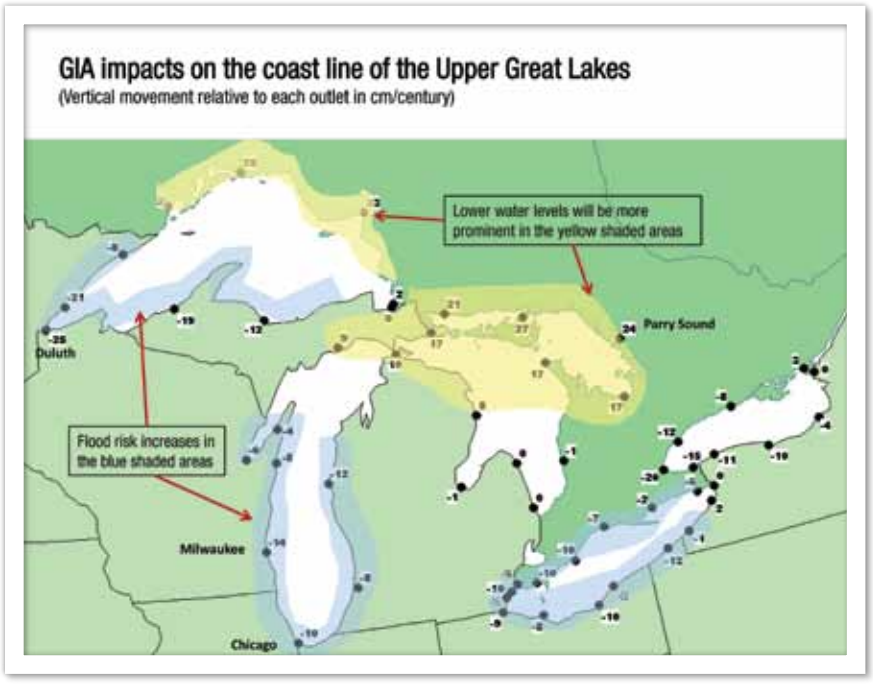
This rising and sinking process continues today and has the effect of gradually "tilting" the Great Lakes basin over time.

The impact of this "tilting" is particularly noticeable along the shorelines, where features on the rising or sinking land can be compared directly to water levels and near-shore depths. For example, the shoreline of Parry Sound, Ontario, in Georgian Bay is rising at a rate of about 24 cm (9.4 in) per century relative to the lake outlet. At the same time, the shoreline around Milwaukee, Wisconsin, is sinking at a rate of about 14 cm (5.5 in) per century relative to the lake outlet. *(See map at right.)*



LTA: Long-Term Lake-wide Average, 1918 to 2008, 176.44 m (578.87 ft)
Chart datum for Lake Michigan-Huron is 176.0 m (577.5 ft)





The different impacts of this adjustment serve to heighten the impacts of climate change, presenting a complicated challenge to developing a long-term regulation plan.

definitions

Climate variability: naturally occurring climate phenomenon reflecting the interaction between large bodies of water and the atmosphere for a specified period of time.

Climate change: a change of climate which is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods.

What else can be done beyond a regulation plan?

The Study is examining two approaches to deal with future water levels that lie beyond what can be influenced through Lake Superior regulation.

Regulation of Lake Superior outflows can help reduce some impacts from changing water levels on Lake Superior and Lake Michigan-Huron. But regulation alone can do little to avoid or cope with future impacts on the shorelines of downstream lakes and rivers, especially at extremes. That's why the Study is exploring *new control structures for restoration or multi-lake regulation* and *adaptive management*.

Restoration and Multi-Lake Regulation

The Study is examining the feasibility of:

- building new control structures in the St. Clair River to restore historical water levels in Lake Michigan-Huron; and,
- using existing and new control structures to help regulate the Great Lakes-St. Lawrence River system on a system-wide basis.

A technical assessment commissioned by the Study concluded that *restoration structures*, such as submerged sills or weirs, are technically feasible. Submerged sills act as 'speed bumps' at the bottom of the river, restricting water flows and raising upstream levels.

However, new control structures would generate a mix of benefits and adverse impacts for various sectors and locations. For example, higher water levels from these structures would likely benefit commercial navigation in the lakes, as well as shoreline property and wetlands in Georgian Bay. But structures to raise Lake Michigan-Huron likely raise the risk of flooding upstream and would adversely affect hydroelectric generation and shoreline property and wetlands along Lake St. Clair and Lake Erie — as well as damage sensitive habitat for five threatened or endangered species in the St. Clair River system, including the Lake Sturgeon. In addition, such structures can be expensive — a series of up to 13 underwater sills in the upper St. Clair River, for example, could cost from $70 to more than $200 million — and require decades to seek agreements, approvals and funding for construction.

Multi-lake regulation would involve using existing control structures on the St. Marys and St. Lawrence Rivers and building new structures on the St. Clair and Niagara Rivers. The general objective would be to keep the entire Great Lakes-St. Lawrence River system within observed historical extremes on all lakes, even under the more extreme projected climate conditions in the future. Preliminary estimates put the cost of multi-lake regulation at more than $8 billion.

Adaptive Management

There are risks to property owners, companies, local governments, ecosystems and other interests whether water levels rise or decline. High water levels can cause significant damage through flooding, erosion, and loss of beaches, recreational lands, and wetlands. Low levels can threaten water supplies, restrict power generation, expose mudflats, limit tourism, isolate wetlands, and severely restrict navigation.

Improved information and modelling of potential changes can help water managers, state, provincial and municipal planners and property owners adapt and improve their ability to cope with high and low levels.

Adaptive management is a process of continuous learning — improving planning decisions as new information becomes available or as conditions in the basin change. Building the capacity in this area will require:

- enhanced *monitoring and modelling of precipitation and evaporation* over the lakes and *runoff* to the lakes;
- improved *tracking of physical changes* underway in the lakes and connecting channels, including those caused by human activity; and,
- distributing timely *information* to individuals, governments and companies in the Great Lakes so that they can plan to reduce possible risks from changing water levels.

What are the next steps?

Public involvement has been an important part of the Study.

Recognizing the many interests concerned with future water levels in the upper Great Lakes, the International Joint Commission appointed a bi-national Public Interest Advisory Group. With 20 members bringing expertise from a wide range of interests, the group has provided guidance to the Study and helped develop and implement a comprehensive public information and engagement program, using public meetings, workshops, conferences, newsletters, email and the internet.

This summer, Study experts and Public Interest Advisory Group members will be holding 12 town hall meetings where members of the public can learn about the Study and its preliminary findings and provide their comments.

The Study's management board will then complete its evaluation of the candidate regulation plans, taking into account public input.

The Study's final report and recommendations will be submitted to the International Joint Commission by March 2012. Subsequently, the Commission will conduct public hearings and put forward a new regulation plan to the governments of Canada and the United States.

For more information on the *International Upper Great Lakes Study*, visit the Study website at **www.iugls.org**, at **www.facebook.com/iugls** or **twitter.com/IUGLS**.

Schedule of Public Meetings

(Please visit www.iugls.org for more information.)

Sturgeon Bay, Wisconsin	**July 18, 2011**	**7:00 – 9:00 pm, CDT**
3rd Avenue Playhouse	239 North 3rd Avenue	
Milwaukee, Wisconsin	**July 19, 2011**	**7:00 – 9:00 pm, CDT**
University of Wisconsin-Milwaukee WATER Institute	600 East Greenfield Avenue	
Toledo, Ohio	**July 27, 2011**	**7:00 – 9:00 pm, EDT**
Lake Erie Center	6200 Bayshore Road, Oregon	
Grosse Pointe Farms, Michigan	**July 28, 2011**	**7:00 – 9:00 pm, EDT**
Grosse Pointe War Memorial	32 Lakeshore Drive	
Muskegon, Michigan	**July 30, 2011**	**10:00 am – noon, EDT**
Annis Water Resources Institute	740 W. Shoreline Drive	
Sarnia, Ontario	**August 2, 2011**	**7:00 – 9:00 pm, EDT**
Lambton College, Room A223	1457 London Road	
Collingwood, Ontario	**August 3, 2011**	**7:00 – 9:00 pm, EDT**
Royal Canadian Legion	490 Ontario Street	
Midland, Ontario	**August 4, 2011**	**7:00 – 9:00 pm, EDT**
Royal Canadian Legion	196 Queen Street	
Manitoulin Island, Ontario	**August 6, 2011**	**10:00 am – noon, EDT**
Kagawong Park Center — Main Hall	39 Henry Drive (downtown Kagawong – bottom of hill)	
Superior, Wisconsin	**August 9, 2011**	**7:00 – 9:00 pm, CDT**
Yellowjacket Union	1605 Catlin Avenue	
Thunder Bay, Ontario	**August 10, 2011**	**7:00 – 9:00 pm, EDT**
Lakehead University, ATAC Room	955 Oliver Road	
Sault Ste. Marie, Ontario	**August 11, 2011**	**7:00 – 9:00 pm, EDT**
Algoma University, Great West Life Theatre	1520 Queen Street East	