Workshop: **Preparing for Climate Change in the Great Lakes Region**

Presentation: **Scanning state-level adaptation challenges and opportunities**

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I. Introduction

Consideration of climate change frequently begins with the need for mitigation, i.e. the reduction of global level of CO_2 in the atmosphere to prevent further impacts. Adaptation has generally attracted less attention. However, as the negative impacts of climate change become visible across the world, the need to adapt to these changes becomes more obvious. Look no further than the floods in Iowa (June 2008), floods in Southern Wisconsin (2007 and June 2008), and to Louisiana following the four monster hurricanes of 2005, one of which destroyed more than 1800 lives in New Orleans in 2005, and it is obvious why state interest in adaptation is growing.

Adaptation here refers to any activity that reduces the negative impacts of climate change on natural and human systems. Successful adaptation does not mean that negative impacts will not occur; only that their adverse repercussions will be reduced compared to no adaptation. More and more entities are now reflecting

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on the adaptation needs and adaptive capacity of their stakeholders in the face of important climate uncertainty and researching the best ways to induce and promote adaptation.

This paper attempts the following:

- Reflect on the status of adaptation planning in the Great Lakes region;
- Offer perspectives on potential roles of government;
- Offer perspectives on strategies to support adaptation policy reform.

II. What is adaptation and why is it necessary?

Recent studies by credible scientists indicate that even if the CO_2 concentration in the atmosphere was fixed, surface air temperatures would continue to warm by up to 1.6ºF or 0.9 ºC by 2100.[2] Furthermore, progress in mitigation has proven difficult due to lack of available or cost-effective alternative energy technologies, as well as political difficulties at national and international levels. Therefore, some degree of future climate change – and ecosystem and economic impacts – is certain.[3]

There is growing evidence that the impacts of climate change are already beginning to be observed and felt throughout the world including here in the Great Lakes region. These impacts are summarized in the recent Healing Our Waters (HOW) report.

For the purposes of this paper, we consider climate change impacts on water quality and quantity.

Adaptation refers to those actions which might be taken to prevent or reduce damage from climate change by managing the risks to make human economic and social activities, as well as the natural environment, more climate resilient.[4] Adaptation measures that focus on reducing vulnerability to both current and future climate variability and extreme events represent a logical first step that delivers social and economic benefits regardless of the rate of future climate change.[5]

The variety of climate change repercussions call for highly diverse adaptation measures. For instance, lower water levels in the Great Lakes – St. Lawrence River will have environmental as well as economic impacts in numerous sectors (as shown by the following graph[6]), each of which will require a specific coping strategy. Adaptation actions may involve, for example, behavioral changes; operational modifications; technological interventions; revised planning and investment practices, regulations and legislation.[7]

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[2] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)], 2007.

[3] National Round Table on the Environment and the Economy (NRTEE), *The Role of Government in Adaptation to Climate Change: a Preliminary Exploration*, Government of Canada, 2007. Available online at: http://www.nrtee-trnee.ca/eng/publications/case-studies/adaptation/Adaptation-Working-Paper/Index-adaptation-eng.html

[4] *Ibid.,* section 2.1

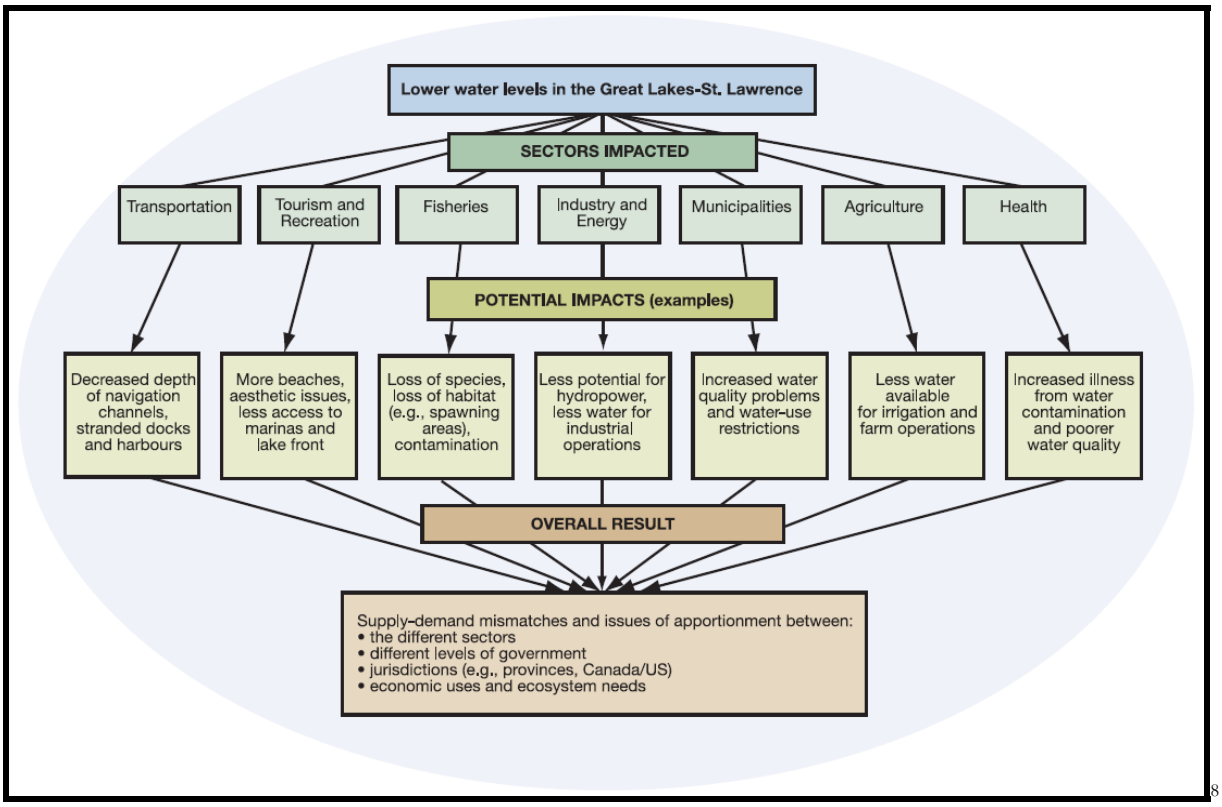
[5] Natural Resources Canada (NRCAN), Climate Change Impacts and Adaptation Program – From Impacts to Adaptation: Canada in a Changing Climate 2007, Government of Canada, 2007. Available online at: http://www.adaptation.nrcan.gc.ca/assess/2007/pdf/full-complet_e.pdf

[6] Lemmen, D.S. and Warren, F.J. (2004): Climate Change Impacts and Adaptation: a Canadian Perspective; Government of Canada in NRCAN 2007, p.19.

[7] *NRCAN supra* note 5, p. 29.

With 30 minutes of brainstorming, the audience for the June 27 workshop could generate lists of several specific policies that could be ripe for adaptation. Relevant to such a discussion are the following questions:

- Will more frequent severe storms cause more combined sewer overflows? How should policies be adapted on the following levels:
    - Federal (support for the Clean Water Act state revolving loan fund)
    - State (water quality standards and assumptions about dilution, mixing zones)
    - County and local (building codes for storm water retention).
- Will more frequent and severe droughts need to be addressed by policy changes?
    - Federal (multi-jurisdictional water management)
    - State (water quality standards, less flow to assimilate pollutants (dilution)).
    - County and local (restrictions on water use)
- What policy changes are triggered by lower Great Lakes water levels?
    - Federal (provide funding to acquire habitat to build resiliency)
    - State (protect public interest in newly-exposed bottom lands)
    - County/community (find a way to fund restoration and maintenance of infrastructure essential to coastal community economies, such as piers, breakwalls, docks, marinas that decay more rapidly when exposed to air)



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[8] *Lemmen and Warren supra* note 6 p. 37.

III. Does adaptation make sense environmentally and economically?

There are different types of adaptation measures. Adaptation includes activities that are taken before impacts are observed (anticipatory) and after impacts have been felt (reactive). Both can be planned (i.e. the result of deliberate policy decisions), while reactive adaptation can also occur spontaneously (i.e. autonomous, without planning).[9] Given uncertainty, proactive policies can result in needless costs while reactive policies can be much more expensive than avoiding the problem in the first place.[10] **In most circumstances anticipatory planned adaptation will incur lower long-term costs and be more effective than reactive and autonomous adaptation.[11]**

Furthermore, numerous adaptation measures are **'no-regrets' options**. 'No-regrets' refers to a policy or measure that would generate net social and/or economic benefits irrespective of whether or not climate change occurs. They generally have the double benefit of reducing short-term exposure to climate variability as well as long-term vulnerability to climate change. Examples of water 'no-regrets' adaptation measures are: improved management of water resources, increased efficiency in the use of water, designation of flood hazard zones, etc. Behavioral adaptations, such as enhanced water use efficiency, are assumed to have a very little cost leading to significant benefits in terms of offsetting damages[12] and are generally perceived as 'no-regrets' strategies.

Some of these 'no-regrets' options may result in large **environmental benefits**. Low water levels in the Great Lakes could compromise the wetlands that presently maintain shoreline integrity, reduce erosion, filter contaminants, absorb excess storm water, and provide important habitat for fish and wildlife.[13] Adaptation measures to reduce water demand could allow for increased water flows to the lakes and thus would help reduced negatives effects of low water levels.

There is a significant nexus between water resource management and climate change. Water programs can play a role in North America's efforts **to reduce greenhouse gases**. Water supply, treatment, conveyance and delivery consume 30% of the electricity on California's grid. Water conservation is a win-win-win situation: in many cases a single investment will have water supply (lower demand), water quality (adequate flow for maximum dilution) and greenhouse gas benefits (energy savings from water treatment facilities), and will lead to economic savings and greater sustainability of water infrastructure.[14] Water conservation thus offers environmental benefits, climate change mitigation opportunities and serves adaptive needs that arise as a result of changes in water availability and/or overall demand. Adaptation is supported particularly when water conservation is carried out in a broader context of water resources management.[15] If possible, synergies between mitigation and adaptation are worth examining. However, for the most part the two approaches to

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[9] *NRCAN supra* note 5 p. 5.

[10] *National Water Program Strategy: Response to Climate Change* (Public Review Draft), Office of Water, U.S. Environmental Protection Agency, March 2008., p. 23-24. Available online at: http://www.epa.gov/ow/climatechange/docs/3-27-08_ccdraftstrategy_final.pdf.

[11] *NRCAN supra* note 5 p. 5

[12] OECD, *Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments*, Executive summary, 2008. [Shardul Agrawala & Samuel Fankhauser (eds.)] Available online at: http://www.oecd.org/document/2/0,3343,fr_2649_34359_40691458_1_1_1_1,00.html

[13] Mortsch, L. Ingram, J. Hebb, A. and Doka, S. *Great Lakes Coastal Wetland Communities: Vulnerabilities to Climate Change and Response to Adaptation Strategies*; Environment Canada, 2006. Available online at: www.manu.uwaterloo.ca/research/aird/wetlands/index_files/page0012.htm

[14] *National Water Program Strategy supra* note 10 p. 24. For more info: See all section III-1. Greenhouse Gas Mitigation Related to Water

[15] *Ibid.*, p. 29.

addressing climate change are separate policy domains involving different actors and different policy questions and choices.[16]

In general, there remain knowledge gaps (regarding the vulnerability of some systems and future variability of the climate) that makes the adoption of "hard" adaptation measures (involving large infrastructure investments for instance) difficult to impose at this point in time. Opportunity costs (the use of resources that could otherwise be used for competing priorities) and the potential for maladaptation[17] are risks involved with the implementation of adaptation options. If environmental science has taught us anything, it is the lesson of understanding potentially unintended consequences before taking action.

Nonetheless, there already exists a relatively large amount of information about **adaptation costs** at the sectoral level (although it is unevenly distributed across sectors) that illustrate the positive cost-benefit relationship of anticipatory planned actions.

In the water sector, coastal zones and water infrastructures (such as water storage reservoirs, desalinization facilities and waste water treatment facilities) have been broadly studied. These studies reveal that the cost estimates for optimal levels of protection in coastal zones are typically relatively modest in normalized terms (although in absolute terms these still represent a significant investment).[18] Generally, the potential for adaptation measures to benefit the economy by increasing resource efficiency, creating new 'green' jobs and spurring technological development is also recognized. Hence, sufficient knowledge exists to support development of preliminary steps, adaptation priorities and to implement no-regrets adaptation actions.[19] More research is essential to identify adaptation options that are best catered to the Great Lakes region and systems.

Climate Change, Low Water Levels, Great Lakes Shipping and Recreation: A case in point for adaptation even as outstanding questions remain

As a transportation resource, the Great Lakes/St. Lawrence Seaway system plays a role in the North American economy. Tonnage in the U.S. and Canadian domestic trades is averaging about 164 million metric tons a year and import/export traffic via the Seaway adds another 30 million tons. This maritime transportation system supports industries vital to the region and the two respective countries. One study estimates that some $3.4 billion in economic impact and 60,000 jobs rely on the movement of goods within the Great Lakes-St. Lawrence shipping route annually (Easterling and Karl 2001). A significant, long term decline in Great Lakes/St. Lawrence water levels could thus have many potential consequences, both economic and environmental. A scenario described in the Canadian Climate Centre Model estimates that an additional 7.5 to 12.5 million cubic yards would need to be dredged annually at a cost of $85-142 million (Great Lakes Regional Assessment Group 2000). System connectivity is predicted to become 25% impaired, causing a loss of $850 million annually (Easterling and Karl 2001). Increased incidences of drought have historically caused modal shifts with resultant impacts. A 1988 Midwest drought cost the region over $49 billion, in part because riverine commercial shipping had to be replaced by more expensive and less energy-efficient railroad transport due to the Mississippi River's reduced water levels (Easterling and Karl 2001). But while the climate change models of increasing temperature ranges and lower water

[16] *NRTEE supra* note 3, section 2.

[17] Maladaptation refers to any deliberate adjustments in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead.

[18] *OECD supra* note 12.

[19] *National Water Program Strategy supra* note 10, p. 37.

levels bode for decreased conveyance per ship, that same climate pattern could lessen ice cover and extend the Great Lakes/St. Lawrence navigation season for a positive effect on conveyance. [20]

For each of the economic costs to the shipping industry supported by the Easterling and Karl studies, there are costs to the ecosystem to be considered. The cost of invasive species transported by ballast water is the most obvious. Dredging deeper channels to maintain current navigation depths will create a dredge spoil disposal problem, potentially threatening wetlands/habitat destruction and stirring up buried contaminants. Other unknowns include the net effect of climate change on aquatic invasive species; will warmer Great Lakes become hospitable to invaders from warm water ports? Would a longer navigation season increase the risk of AIS introduction and spread, and at what economic and environmental cost? Recreational boating is another favorite pastime that could be impaired – 4 million registered boats are owned in the region.[21] Reduced water levels may require dredging to ensure access to the 1,883 marinas, at a total annual cost of $68 million (Great Lakes Regional Assessment Group 2000). Reduced access to harbors of refuge caused by low water levels could also take a toll on human health and safety, particularly as many climate models predict increased weather volatility and fiercer storms.

The farther upstream we travel on this journey the more obvious it is that asking questions is the easy part. Global trade, commercial transportation, invasive species and recreational boating are all part of an equation that becomes infinitely more complex when one factors in the uncertainty that will always pervade the ability of humans to understand their impact on an ecosystem as valuable and vulnerable as the Great Lakes. The make definitive conclusions today smacks of hubris. To do nothing or to postpone taking the beginning steps necessary to find answers to these questions and challenging the policy status quo is also irresponsible.

IV. Current State and Province Adaptation Policy & Initiatives

At present, most Great Lakes states and provinces have adopted climate actions plans. [Readers should note that this landscape is changing rapidly.] These plans typically explain the impacts to the state as a result of climate change, provide state GHG emission inventory data, and make GHG emission reduction recommendations to avoid or reduce these impacts by sector. Of the Great Lakes states and provinces, only Indiana and Ohio do not have a climate action plan, while Michigan is in the process of creating one. However, general emphasis in most plans is on the economic and environmental value of reducing GHG emissions (i.e. mitigation) and very little attention has been given to adaptation.[22]

Minnesota, Quebec and Ontario's climate action plans reference adaptation. Quebec details specific adaptation measures. The Wisconsin Initiative on Climate Change Impacts and the New York Office of Climate Change intend to research and recommend adaptation measures. Alaska, California, Florida, Maryland, Oregon, and Washington have adaptation plans in progress. These plans are more detailed as they seek to define federal and state roles in climate impact response and identify where decisive and coordinated planning, funding and action are needed to reduce economic and human impacts.[23]

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[20] Center for Integrative Environmental Research (CIER), *The US Economic Impacts of Climate Change and the Costs of Inaction*, University of Maryland, October 2007, p. 22 and following. Available online at: http://www.cier.umd.edu/documents/US%20Economic%20Impacts%20of%20Climate%20Change%20and%20the%20Costs%20of%20Inaction.pdf

[21] Great Lakes Commission, *Great Lakes Recreational Boating's Economic Punch*, 2007.

[22] *Ibid.*

[23] Pew Center on Global Climate Change, *Adaptation Planning - What U.S. States and Localities are Doing.* Available online at: http://www.pewclimate.org/docUploads/State-Adapation-Planning-02-11-08_0.pdf

One explanation for the current status of state adaptation policy development is that the impacts of climate change may not yet seem as imminent or as threatening as in Alaska, the Gulf or states where melting ice, sea level rise and hurricane create compelling argument. . Moreover, costs-benefits studies on adaptation measures are still scarce or incomplete or do not cover the Great Lakes region specifically. Information on win-win and 'no-regrets' options is lacking.

However, as impacts are felt in the region, more frequent severe storms captivate the Midwest's attention and grim projections multiply the conditions for reforming adaption policies ripen.

In December 2005, the governments of Quebec, Ontario and the eight Great Lakes states signed the Great Lakes - St. Lawrence River Basin Sustainable Water Resource Agreement, which will manage water use and withdrawal in the basin and virtually prohibit out-of-basin diversions. The agreement makes explicit reference to climate change and the precautionary principle.[24]

Still, it cannot be assumed that sufficient and effective adaptation will take place in a spontaneous or unassisted manner. Most analyses suggest otherwise. Adaptation is likely to occur only when there is a perceived advantage to those who are adapting, resulting in the use of more costly reactive measures to prevent further damage after the climate change impacts have already been felt.[25] In this context, the role of governments in adaptation will involve finding a balance between protecting the safety of the public and facilitating and promoting adaptation without discouraging innovation, initiative and enterprise.[26]

V. Example: The Great Lakes Compact

The objective of the *Great Lakes-St. Lawrence River Basin Water Resources Compact* and the *Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement* is to regulate the water uses, withdrawals and to virtually prohibit diversions from the Great Lakes-St. Lawrence River Basin in order to prevent significant long-term adverse impacts on basin's ecosystems and watersheds and to protect the economic and environmental values of the waters and water dependent natural resources of the basin for future generations. Adoption and implementation of the Agreement/Compact is in progress.

The Great Lakes Compact/Agreement is an excellent example of the need for policy to adapt to climate change. The Compact/Agreement itself prepares the region for climate change. As climate continues to change over the next decades, the rules, codes, standards and legislations being enacted now will need to be adapted to the changing basin conditions. Research needed today will (hopefully, if it begins soon) provide the sound scientific basis upon which to base future policy amendments.

The parties, conscious of the changing environment of the basin, included some flexibility in the agreement. For instance, the agreement invites the parties to take into consideration the uncertainties of scientific knowledge and to "give *substantive consideration to climate change* or other significant threats to the basin"[27] (emphasis added) when they perform their periodic Cumulative Impacts Assessment of water withdrawals and consumptive uses. This assessment is then used as "a basis for the review of the Standard and the

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[24] *NRCAN supra* note 5 p. 196. The treaty can be found online at: http://www.cglg.org/projects/water/docs/12-13-05/Great_Lakes-St_Lawrence_River_Basin_Sustainable_Water_Resources_Agreement.pdf

[25] *CIER supra* note 20.

[26] *NRCAN supra* note 5 p. 431.

[27] The Great Lakes-St. Lawrence River Basin Water Resources Compact, article 4, section 4.15.b.

Exception Standard"[28] which determines new and increased water uses and withdrawals that can be approved by each state and province.

Also, the agreement recommends the use of adaptive management during the Cumulative Impacts Assessment. Adaptive management is defined as a "Water resources management system that provides a systematic process for evaluation, monitoring and learning from the outcomes of operational programs and adjustment of policies, plans and programs based on experience *and the evolution of scientific knowledge* concerning water resources and water dependent natural resources"[29] (emphasis added).

However, it can and will be argued that these flexibilities are not sufficient. Some will argue for a precautionary approach and others will demand sound science first. It will be essential to consider climate change during implementation of the Compact/Agreement.

For instance, parties' water management practices, conservation and efficiency programs are evolving to comply with the Compact. The changing ability of ecosystems to absorb more or less water withdrawals and still sustain or improve ecosystem values is under consideration. Cost effective and economically achievable practices and options will be considered. In this regard, the Water Resources Regional Body established by the Great Lakes Compact could provide broad regional oversight, promote best practices but especially, contribute to the scientific basis upon which economic and environmental policies could be amended.

VII. Next Steps

While recent research contributes to a better understanding of the impacts of climate change on the Great Lakes, there is still a tremendous lack of precision in scaling global climate models to the regional level. As this paper has argued, there is a definite lack of knowledge of the best solutions to address these problems. Research on both the science to understand the impacts and to evaluate adaptation options is the best way forward. Even in the face of this uncertainty, there is a need to develop and implement adaptation policies and practices today that will help manage the unavoidable. This begs yet more questions and provokes the following reflections, which could stimulate discussion at the June 27 workshop:

- What should be government priorities, roles and responsibilities in promoting greater climate resiliency and adaptation in the Great Lakes region? What should be the role of each level of government and what policy would be best implemented at the regional level?
    - Federal (U.S. and Canada)
    - State/Provincial
    - Municipal
- What are the roles and responsibilities of NGOs?
    - Education and outreach

[28] The Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement, article 209.4.
[29] The Great Lakes Compact, article 1.

        - Basic knowledge and understanding of climate change impacts is lacking in some quarters. Start here.
    - Advocacy
        - Ask challenging questions, such as:
            - When is it important to demand that policies be reformed now based on the precautionary principle?
            - When is it appropriate to let sound science proceed first?
        - Begin now forging alliances with like-minded or non-traditional allies
        - Listen to, understand and where possible, forge alliances with those who might mistakenly be presumed to be opponents.
- What is the role of Foundations?
    - What should be priorities for research efforts?
        - Understanding the adaptive capacity of Great Lakes ecosystems and infrastructure is a key to increasing their climate resiliency
        - The exploration and development of 'no-regrets' policy options as win-win strategies that could contribute to improving current and future resiliency is key
        - Understanding regional impacts (scaling from global models) is important. This may require resources that are beyond the capacity of some foundations.
    - As grantees begin the hard work ahead, (and in addition to providing support for adaptation policy reform) provide support so that grantees can educate government (all levels) on the importance of increasing funding for research.

"Adaptation actions that make both the present and the future more sustainable, sometimes referred to as 'no-regrets' measures, are often cited as the key to moving forward despite uncertainty. Adaptations in building and infrastructure design, water and energy conservation, renewable energy generation, and diversification of economies are win-win strategies that provide useful starting points for communities to increase their adaptive capacity."[30]

[30] *NRCAN supra* note 5 p. 430.