

FINDINGS OF AN EXPERT CONSULTATION ON STRENGTHENING SCIENCE UNDER A RENEWED GREAT LAKES WATER QUALITY AGREEMENT

International Joint Commission Great Lakes Science Advisory Board

“Form follows function – that has been misunderstood. Form and function should be one, joined in a spiritual union”

-- Frank Lloyd Wright.

I. Introduction

On January 24-26, 2006, the Workgroup on Emerging Issues (Workgroup) of the International Joint Commission’s (Commission) Science Advisory Board (SAB) convened an Expert Consultation (for details see Appendix A) to explore means by which science might be strengthened within a renewed Great Lakes Water Quality Agreement (Agreement). Of particular interest were institutional arrangements that would best promote the use and integration of science in decision making. On the basis of workshop discussions, the Workgroup has crafted a series of recommendations intended to help guide the Commission as it discusses revisions of the Agreement with the Parties with respect to the issue of how best to enhance science-based decision making applied to transboundary water resource management and governance in the Great Lakes Basin.

Sustaining the ecological health of the Great Lakes Basin Ecosystem (hereafter referred to as “the Ecosystem”) relies on our ability to ascertain both current and future ecosystem stresses, predict the outcome of the stresses on ecosystem sustainability, and implement effective treatment. Accurate diagnosis, prognosis and treatment require an understanding of the ways in which human activities in the Basin (and beyond) influence the ecological health of the Ecosystem, and *vice versa*. Science - broadly construed - offers one primary mode of inquiry by which the causal structure of the Ecosystem can be inferred. Thus, a commitment to sustaining the integrity of the Ecosystem implies a commensurate commitment to Great Lakes science. This leads directly to the question of the extent to which current institutional arrangements under the Agreement are well-designed for the effective and efficient (a) conduct of Great Lakes science, and (b) delivery of scientific information to stakeholders. As a corollary, if existing institutional arrangements are not well-designed, what changes increase the likelihood of achieving these objectives?

The recommendations presented in Section III below are derived from what we consider to be several fundamental truths. First, a commitment to social justice (and intergenerational equity in particular) requires a commensurate commitment to ecologically sustainable development, not only by the Parties under the Agreement, but by all agencies in the Basin in whom some measure of decision-making authority is

vested. Second, because our understanding of the causal structure of the Ecosystem is - and will remain - incomplete, diagnoses, prognoses, and treatments are subject to uncertainty. Third, science is a necessary component of sustainable decision making with regards to Ecosystem health. Fourth, while ecosystem ailments may be manifested at a variety of spatial scales, all treatments are inevitably implemented at a local level.

Accountability - or rather, the lack thereof - was identified by Consultation participants as *the major hurdle to achieving the Objectives set out in the revised Agreement*. Limited accountability is due, in part, to the failure of the Agreement to adequately sustain many of the science functions enumerated in Section I below. While the current report focuses on issues of scientific accountability, we recognize that: (a) there are non-scientific accountability issues that should be addressed in any contemplated revision to the Agreement; and (b) there are additional accountability issues that lie outside the scope of the Agreement, but are nonetheless critical to sustaining the integrity of the Ecosystem and as such, must be resolved by the Parties.

Finally, we note that revisions to the Agreement may take several forms: (a) revisions to the Articles; (b) revisions to the existing Annexes by Protocol, which might include the addition of new Annexes, or the modification or deletion of current Annexes. Because of the formidable procedural issues involved in amending the Agreement, and in particular its Articles, the Workgroup strongly recommends that, as much as possible, the recommendations enumerated below be implemented by means of revisions to the current Annexes, rather than to the Articles proper.

II. The functions of science¹ under a revised Agreement

The Agreement defines the framework for sustainable Great Lakes science. As such, it must (minimally) sustain or (preferably) enhance:

- systematic and coordinated monitoring and surveillance with respect to both known and suspected stressors, and ecosystem responses thereto;
- elaboration of the causal relationships between stressors and ecological responses through hypothesis testing, refutation and refinement;
- effective and efficient decision-making with respect to Ecosystem protection, remediation or restoration;
- timely and accurate evaluation of the current ecological status of the Ecosystem, and trends therein;
- data management, integration, analysis, inference and interpretation (i.e., diagnosis, prognosis and prescription);
- identification of (scientific) data/information gaps and frontier/horizon issues;

¹ *Science is defined broadly to include the natural, health, and social sciences, mathematics, engineering, and technology (Report: Science Advice for Government Effectiveness. Issued by the Council of Science & Technology Advisors, May, 1999). We also embrace science as “a way of knowing”, including traditional knowledge.*

- dissemination of scientific data and information to stakeholders in a form that is both interpretable and usable;
- evaluation and assessment of performance in achieving Agreement Objectives or targets, and the efficient and coherent reporting thereof;
- public education on the current state of the Ecosystem, trends therein, and undertakings by the Parties to sustain the health of the Ecosystem;
- the development and support of local, community-based research and monitoring initiatives; and
- government-industry-academe-NGO collaborative research initiatives.

III. Findings and recommendations for strengthening science under a revised Agreement

The Great Lakes have witnessed many improvements since the inception of the Agreement, and continues to see improvements as a result of the amendments. The most dramatic example is the reversal of eutrophication in the lower lakes as a result of reductions in phosphorus loading and the well-documented reductions in the concentrations of some banned toxic chemicals in fish. Nonetheless, while science has advanced our understanding of the Ecosystem, political will has not kept pace and many goals of the Agreement have not been met.

This Consultation identified several areas where improvements to the Agreement could be made to improve the incorporation and utilization of science into decision making to better achieve the goals of the Agreement. These are reported below as “findings” and they are followed by specific recommendations from the SAB to the Commissioners, to be considered as part of any revision of the Agreement.

- **Finding: The current specification of core principles in the Agreement should be augmented to take into account new knowledge on decision-making under uncertainty**

The precautionary principle gained wide acceptance and public awareness following the 1992 Rio Declaration, and more recently, the 1998 Wingspread Consensus Statement. Since then it has, in various forms, been incorporated in many international and national agreements, policies and regulations. Principle 15 of the Rio Declaration states: "*Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*". The Wingspread Statement described the precautionary principle as "*when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically*" (Raffensperger and Tickner 1999). The various versions of this principle (Sandin 1999; Wiener and Rogers 2002), usually share two features: (a) where there exists evidence of a risk of serious or potentially irreversible negative outcomes,

rendered decisions may (“weak” precaution) or should (“strong” precaution) mitigate this risk even when strong scientific evidence of such risk is lacking; (b) reversal of burden of proof (“very strong” precaution) namely, that in rendering decisions, the decision-maker assumes that serious or irreversible outcomes will occur unless substantive evidence is adduced that they will not.

The principle of adaptive management (Holling 1978; Walters 1986) begins with the premise that, at least at present, most systems whose behaviour we are attempting to influence (i.e. “manage”) are complex and poorly understood. As such, management decisions should be regarded as scientific experiments designed to provide increased understanding of the causal structure of the system and, ideally, to test hypotheses about system behaviour. Consequently management decisions ought to be designed to elicit specific system responses; the knowledge acquired from these responses is then used to inform future decision-making. In the original formulation (Holling 1978; Walters 1986), learning by experimental decision-making was considered to transcend the more usual learning by trial and error decision-making or (the still more usual) anecdotal learning (Lee, 1999), although there is no reason in principle that the latter cannot be part of a (granted, somewhat less efficient) adaptive framework.

Decisions predicated on the assumption that expected effects will indeed occur run the risk of turning out to be very poor decisions if the unexpected does occur. By contrast, robust decisions are those that result in satisfactory outcomes even if there is large scientific uncertainty concerning the causes of observed effects, and limited ability to control (putative) causal factors, that is, under conditions where predicted outcomes are quite likely not to materialize. Ludwig et al. (1993), Walters (1997) and Lee (1999) have all pointed out that this is the usual case in many - if not most - environmental decision-making domains. As such, science-based environment decision-making should be robust (in the sense defined above) unless it can be demonstrated that the costs of such decisions are oppressively high.

Recommendation:

1. The Agreement should explicitly commit the Parties to decision-making including these overarching principles: the precautionary principle; the principle of adaptive management; and the principle of robustness. These Principles should be defined in Article I of the Agreement.

- **Finding: The Specific Objectives in the Agreement (Annex 1) are outdated, and the process to revise them has not been implemented**

Since the 1987 Protocol amending the 1978 Agreement, our understanding of the stresses on the Ecosystem, and their effects, has increased substantially. This accumulated knowledge requires that both the general objectives (Article III) and the specific

objectives (Article IV, Annex 1) be revisited. Moreover, a commitment to adaptive management necessarily implies that objectives be periodically reviewed to ensure their appropriateness in light of existing scientific (and other) information.

The current Agreement Supplement to Annex 1, 2(a) requires the Specific Objectives in Annex 1 to be reviewed at least every two years. Certainly this requirement has not been met.

Recommendations:

2. A revised Agreement should require the Parties (a) to satisfy this requirement; and (b) to report on the outcome of the review process. Moreover, this review should not be limited to general or specific objectives (Articles III and IV, Annex 1)

3. All revised objectives should be at least as stringent as existing federal or provincial/state water quality standards for the protection of aquatic life, and should make use of the best available current scientific knowledge on the impacts of pollutants on aquatic ecosystems and human health.

4. We recommend that the Objectives be constructed, where possible, using a process-oriented framework (rather than a specific value) to provide for maximum flexibility in incorporating new science as it becomes available. These objectives should be set to protect public health.

5. The Supplement to Annex 1, (3) should be revised to (a) include a formal listing of ecosystem health objectives and associated indicators for all Lakes, and (b) an explicit process by which these objectives and indicators will be revised.

- **Finding: There is inadequate scientific accountability under the current Agreement**

Participant discussion noted that the Great Lakes were not being managed effectively in part because the governance structure is incoherent, with too many organizations, little vertical or horizontal integration, and with no centralized decision-making body. This lack of structural coherence limits not only the conduct of science, but also the ability of decision-makers to make full use of existing science.

Recommendation:

6. A revised Agreement should include a new annex that clearly and explicitly addresses the issue of accountability to ensure that all Agreement-related recommendations are responded to in a timely, substantive and public manner. Specifically, a revised Agreement should require the Parties to establish a formal

process for defining: (1) performance indicators with respect to both the ecological health of the Ecosystem and program delivery, effectiveness, and outcomes; (2) standards (benchmarks) against which performance will be assessed; (3) the agencies or organizations responsible for the performance assessment; (4) the format and schedules for performance assessment reports; (5) provisions for communication of the results of performance assessment to the public; and (6) the format and content of responses to the assessment reports.

- **Finding: Surveillance and monitoring as well as basic and applied research is *ad hoc*, piecemeal, and inadequately supported**

Adaptive management requires the continuous infusion of new science into the decision-making process. Science must be provided to stakeholders in a form that is both interpretable and useful. Workshop participants identified a number of existing barriers to the pursuit of Ecosystem research and monitoring. Annex 17 notwithstanding, these include: (a) inadequate financial support; (b) insufficient attention to hypothesis-driven research (*versus* surveillance and monitoring); (c) inconsistent approaches to data gathering, processing and dissemination; (d) inadequacy to provide scientific capacity to local governments; (e) the absence of a formalized process for determining Ecosystem research priorities, and (f) failure to provide scientific information to stakeholders in an interpretable and usable form.

Recommendation:

7. The Parties should commit to a level of support for research and monitoring commensurate with the principles of adaptive management. Toward that end, the SAB (or similar body established under a revised Agreement) should be explicitly charged, in the Agreement, to undertake an ongoing assessment of research and monitoring needs, and a determination of costs required to ensure the full and timely implementation of Agreement provisions.

- **Finding: The lack of centralized data management, lack of data dissemination, inconsistent formats of data handling and storage, and lack of meta data all lead to incomplete use of existing scientific efforts**

Considerable scientific data and information currently exist for the Great Lakes and its ecosystem, and we have recommended further investments in science for the future. However, these data are only useful if they are properly managed and made accessible to users, including other scientists, resource managers, decision-makers, and the public. Data currently reside in a plethora of unrelated forms, from hard-copy

data sheets in filing cabinets to arcane databases developed and used by a single agency but not accessible by others. Data are collected using different procedures, preventing comparability of data. Meta data and quality assurance data are rarely reported and archived to provide context for future data users. For science to be used most effectively in decision-making and management of the Great Lakes, it is imperative that there be investments in data management that provide for accessibility, data quality, and comparability.

Recommendation:

8. The Agreement should be amended to require a coherent, consistent, and accessible binational data management system that includes meta data.

- **Finding: There is redundancy caused by the board structure constituted under the present Agreement, and the Boards do not adequately meet the advisory needs of the Commission**

The issues addressed and the activities of the SAB and the Water Quality Board (WQB) have increasingly overlapped. The Great Lakes Boards constituted under the original Agreement have, over time, become too inflexible and static to meet the challenging needs of Great Lakes' restoration - revision is necessary.

There was widespread feeling among conference participants that the current board structure, as specified under the 1978 Agreement, is outdated. While the optimal structure depends on the scientific functions (Section II above) one is attempting to maximize, many participants were of the view that the current board structure does not optimize *any* of the required functions.

Several models for a new board structure were discussed and are summarized below.

(a) Dissolve the WQB as its membership and mandate is redundant with the Parties' Binational Executive Committee. Expand the SAB to include a broader array of scientists to approximately 30-40 scientists.

(b) Combine the WQB and SAB into an Integrated Science and Policy Advisory Board, with an executive committee that reports to the Commissioners. Membership of this Board would include scientists and policy specialists.

(c) Create a Binational Academy of Scientists (on the order of hundreds) that can be called on to serve on *ad hoc* work groups addressing a specific issue of interest to the Commissioners (e.g., the NRC committees of the NAS in the U.S.). These *ad hoc* work groups would report to a standing executive committee (a smaller SAB) that would report to the Commissioners.

The board structure under a new Agreement should enable an adaptive management approach. Specifically, any new board structure should:

- be flexible to adapt to changing needs;
- provide current, timely, and integrated scientific advice to the Commissioners;
- address all relevant scientific issues;
- have broader representation of stakeholders; and
- access a larger pool of scientific expertise.

A public advisory panel which incorporates members from municipalities, NGOs, and the general public is regarded as an integral requirement of each of these possible board structures.

Recommendation:

9. It is recommended that a revised Agreement replace current Board arrangements with a single, Integrated Science and Policy Advisory Board, with an executive committee that would regularly report to the Commissioners. It is further recommended that this Board be supported by a larger Binational Academy of Scientists that can be consulted, as needed, to provide expert advice on current and emerging Commission priorities. The latter would be organized into issue-specific work groups, as needed, and prepare reports and recommendations for consideration by the Integrated Science and Policy Board and the Commissioners.

- **Finding: Local governments are primarily responsible for the activities requisite to achieving many of the objectives of the Agreement, yet they are not adequately represented and engaged**

Local governments have limited capacity to engage in the conduct and interpretation of science not-with-standing the fact that most of the implementation of science, e.g., restoration, is at the local level. While it is impractical to have representatives of local units of government be signatories to the Agreement, it is important to support the scientific objectives and activities at the local level and communicate these activities up to the Boards and Commission.

Recommendation:

10. Board structure under the revised Agreement should include enhanced interaction with representatives of local government and the public. The revised Agreement should consider the need for:

- *creation of a forum for local governments;*
- *ensuring data are shared freely and openly;*
- *facilitation of mechanisms to work with local coalitions;*
- *enhancement of local scientific capacity;*
- *facilitation of community volunteer initiatives and outreach to local planners; and*
- *facilitation of local public advisory councils.*

References

- Holling, C.S. 1978. Adaptive Environmental Assessment and Management. John Wiley and Sons, Chichester, England.
- Lee, K.N. 1999. Appraising adaptive management. *Cons. Ecol.* 3(2):3.
- Ludwig, D., R. Hilborn, and C. Walters. 1993. Uncertainty, resource exploitation, and conservation: lessons from history. *Science* 260 (2): 17.
- Raffensperger C. and J. Tickner (eds). 1999. Protecting Public Health and the Environment: Implementing the Precautionary Principle. Island Press, Washington DC.
- Sandin, P. 1999. Dimensions of the Precautionary Principle. *Human and Ecological Risk Assessment*, 5(5):889-907.
- Walters, C. 1986. Adaptive Management of Renewable Resources. Macmillan and Co., New York, New York.
- Walters, C. 1997. Challenges in adaptive management of riparian and coastal ecosystems. *Conservation Ecology* [online]1(2):1. URL: <http://www.consecol.org/vol1/iss2/art1/> Accessed on March 30, 2006.
- Wiener, J., and Rogers, M. 2002. Comparing Precaution in the United States and Europe. *Journal of Risk Research*, pp. 317-349.

Appendix A.

The Consultation was held at the Wingspread Conference Center (operated by The Johnson Foundation) in Racine, Wisconsin. Participants (listed below) remained within the self-contained private grounds for the entire meeting time, and the warm and inviting atmosphere of the accommodations and meeting areas encouraged extensive interactions and frank discussion free of institutional representation or affiliation that is found at most professional meetings. Approximately 30 people from the US and Canada attended or participated in the event, and came with backgrounds in academia, government (federal, state, and local), and industry. The Consultation program was structured in five sessions, each with a Convener and a Provocateur. The Convener, a member of the Workgroup, offered brief remarks to provide context for the session, introduced the Provocateur, and facilitated the discussion period. The Provocateur gave a 30-40 minute presentation, followed by lengthy discussion. The sessions were as follows:

- *The Ecosystem Approach to International Law*
Provocateur: Bradley Karkkainen
- *International Lessons in Transboundary Water Governance*
Provocateur: Rick Findlay
- *Mechanisms to Engage Local Government in Great Lakes Governance*
Provocateur: Mark Richardson
- *Horizontal Management in the Great Lakes Basin: Is There a Need for a Central Coordinating Body and Binational Surveillance and Monitoring?*
Provocateur: Mark Sproule-Jones
- Great Lakes Water Quality Agreement Institutional Arrangements: Historical Context
Presenter: James P. Bruce

The final session of the Consultation consisted of small breakout groups that addressed two questions: (1) What changes to the current institutional arrangements might be made to enhance science-based decision-making? I.e., What functions should science have, and what forms (of institutional arrangements) will support these functions?, and (2) to address accountability, what mechanisms might be recommended to assess the progress made by the Parties, and what consequences should there be if sufficient progress has not been made?

List of Participants

Kay Austin

Ecology Advisor
International Joint Commission
Suite 100
1250 - 23rd St., NW
Washington, DC 20440
Tel: 202-736-9011
Fax: 202-467-0746
E-Mail: austink@washington.ijc.org

Jack P. Blaney

Commissioner
Canadian Section
International Joint Commission
22nd Fl.
234 Laurier Ave., W
Ottawa, ON K1P 6K6
Canada
Tel: 613-995-2984
Fax: 613-993-5583
E-Mail: blaneyj@ottawa.ijc.org

Lisa Bourget

Secretary
United States Section
International Joint Commission
Suite 100
1250 - 23rd St., NW
Washington, DC 20440
Tel: 202-736-9008
Fax: 202-467-0746
E-Mail: bourgetl@washington.ijc.org

Irene Brooks

Commissioner
United States Section
International Joint Commission
Suite 100
1250 - 23rd St., NW
Washington, DC 20440
Tel: 202-736-9000
Fax: 202-476-0746
E-Mail: brooksi@washington.ijc.org

James P. Bruce

Soil and Water Conservation Society
1875 Juno Ave.
Ottawa, ON K1H 6S6
Canada
Tel: 613-731-5929
Fax: 613-731-3509
E-Mail: jpbuce@sympatico.ca

Leon Carl

Center Director
United States Geological Survey
1451 Green Rd.
Ann Arbor, MI 48105-2807
Tel: 734-214-7200
Fax: 734-214-7201
E-Mail: lcarl@usgs.gov

Murray Clamen

Secretary
Canadian Section
International Joint Commission
22nd Fl.
234 Laurier Ave., W
Ottawa, ON K1P 6K6
Canada
Tel: 613-995-0113
Fax: 613-993-5583
E-Mail: clamenm@ottawa.ijc.org

Steve Colman

Professor
Large Lakes Observatory
University of Minnesota-Duluth
2205 E. Fifth St.
Duluth, MN 55812
Tel: 218-726-6723
Fax: 218-726-6979
E-Mail: scolman@d.umn.edu

Michael J. Donahue

Vice President
Water Resources and Environmental
Services
URS Corporation
34555 W. Twelve Mile Rd.
Farmington Hills, MI 48331-5627
Tel: 248-553-9449
Fax: 248-553-9571
E-Mail: michael_donahue@
urscorp.com

Rick Findlay

Director
Water Programme
Pollution Probe
Suite 101
63 Sparks St.
Ottawa, ON K1P 5A6
Canada

Tel: 613-237-8666
Fax: 613-237-6111
E-Mail: rfindlay@pollutionprobe.org
Web: www.pollutionprobe.org

Scott Findlay

Director
Institute of the Environment
University of Ottawa
555 King Edward Ave.
Ottawa, ON K1N 6N5
Canada
Tel: 613-562-5874
Fax: 613-562-5873
E-Mail: sfindlay@science.uottawa.ca

Kim Fox

Acting Director
Water Infrastructure Protection Division
United States Environmental
Protection Agency
26 W. Martin Luther King Dr.
Cincinnati, OH 45268
Tel: 513-569-7820
Fax: 513-487-2555
E-Mail: fox.kim@epamail.epa.gov

Herb Gray

Chair and Commissioner
Canadian Section
International Joint Commission
22nd Fl.
234 Laurier Ave., W
Ottawa, ON K1P 6K6
Canada
Tel: 613-992-2417
Fax: 613-947-9386
E-Mail: giuntad@ottawa.ijc.org

Gary V. Gulezian

Director
Great Lakes National Program Office
United States Environmental
Protection Agency
77 W. Jackson Blvd., G-17J
Chicago, IL 60604
Tel: 312-886-5870
Fax: 312-886-2403
E-Mail: gulezian.gary@
epamail.epa.gov

Isobel Heathcote

Dean of Graduate Studies
University of Guelph
Third Fl., Rm. 324b
University Centre
Guelph, ON N1G 2W1
Canada
Tel: 519-824-4120, ext. 52441
Fax: 519-767-5743
E-Mail: iheathco@uoguelph.ca

Paul Horvatin

Program Manager
Great Lakes National Program Office
United States Environmental
Protection Agency
77 W. Jackson Blvd., G-17J
Chicago, IL 60604
Tel: 312-353-3612
Fax: 312-353-2018
E-Mail: horvatin.paul@epamail.epa.gov

Allan Jones

Environmental Consultant
Allan Jones & Associates, Inc.
2363 Sinclair Cir.
Burlington, ON L7P 3C1
Canada
Tel: 905-335-9669
Fax: 905-335-3716
E-Mail: allan.g.jones@sympatico.ca

Bradley Karkkainen

Professor of Law
University of Minnesota Law School
229 - 19th Ave., S
Minneapolis, MN 55455
Tel: 612-624-5294
E-Mail: bradk@umn.edu

Bruce Kirschner

Environmental Scientist
Great Lakes Regional Office
International Joint Commission
Suite 800
100 Ouellette Ave.
Windsor, ON N9A 6T3
Canada
Tel: 519-257-6710
Fax: 519-257-6740
E-Mail: kirschnerb@windsor.ijc.org

David Lean

Professor
Biology Department
University of Ottawa
30 Marie Currie
Ottawa, ON K1N 6N5
Canada
Tel: 613-562-5800, ext. 6349
Fax: 613-562-5486
E-Mail: dlean@science.uottawa.ca

Judith Perlinger

Associate Professor
Civil and Environmental
Engineering Department
Michigan Technological University
1400 Townsend Dr.
Houghton, MI 49931-1295
Tel: 906-487-3641
Fax: 906-487-2943
E-Mail: jperl@mtu.edu

Mark Richardson

Assistant Prosecuting Attorney
for Water Quality
Macomb County
Third Fl.
One S. Main St.
Mt. Clemens, MI 48043
Tel: 586-469-5593
Fax: 586-469-5609
E-Mail: mark.richardson@
macombcountymi.gov

Dennis L. Schornack

Chair
United States Section
International Joint Commission
Suite 100
1250 - 23rd St., NW
Washington, DC 20440
Tel: 202-736-9000
Fax: 202-467-0746
E-Mail: schornackd@
washington.ijc.org

Mark Servos

Scientific Director
Canadian Water Network
University of Waterloo
200 University Ave., W
Waterloo, ON N2L 3G1
Canada

FINAL - SAB, 3/30/06

Tel: 519-888-4567, ext. 6034

Fax: 519-883-7574

E-Mail: mservos@uwaterloo.ca

Mark Sproule-Jones

Victor K. Copps Professor

McMaster University

Kenneth Taylor Hall, Rm. 533

1280 Main St., W

Hamilton, ON L8S 4M4

Canada

Tel: 905-525-9140, ext. 23898

Fax: 905-527-3170

E-Mail: sproulem@mcmaster.ca

Deborah Swackhamer

Professor

Environmental Health Sciences

School of Public Health

University of Minnesota

Mayo Mail Code 807

420 Delaware St., SE

Minneapolis, MN 55455

Tel: 612-626-0435

Fax: 612-626-0650

E-Mail: dswack@tc.umn.edu

Karen Vigmostad

Director

Great Lakes Regional Office

International Joint Commission

Suite 800

100 Oulette Ave.

Windsor, ON N9A 6T3

Canada

Tel: 519-257-6715

Fax: 519-257-6740

E-Mail: vigmostadk@windsor.ijc.org

Joel Weiner

Senior Advisor

Canadian Section

International Joint Commission

22nd Fl.

234 Laurier Ave., W

Ottawa, ON K1P 6K6

Canada

Tel: 613-995-0930

Fax: 613-993-5583

E-Mail: weinerj@ottawa.ijc.org

The Johnson Foundation Staff

Steven T. Branca

Program Officer

Sustainable Development
and the Environment

Tel: 262-681-3347

Fax: 262-681-3325

E-mail: sbranca@johnsonfdn.org

Wendy S. Butler

Program Assistant

Tel: 262-681-3321

Fax: 262-681-3325

E-mail: wbutler@johnsonfdn.org