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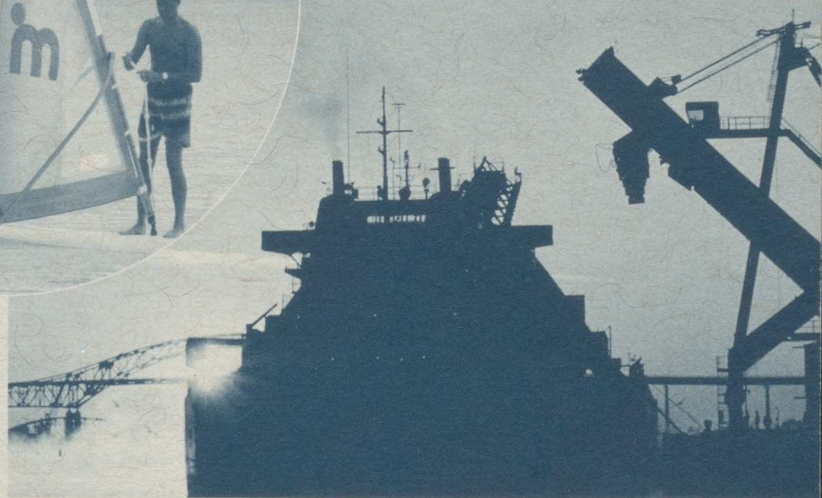
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GREAT LAKES 2000:

BUILDING A VISION

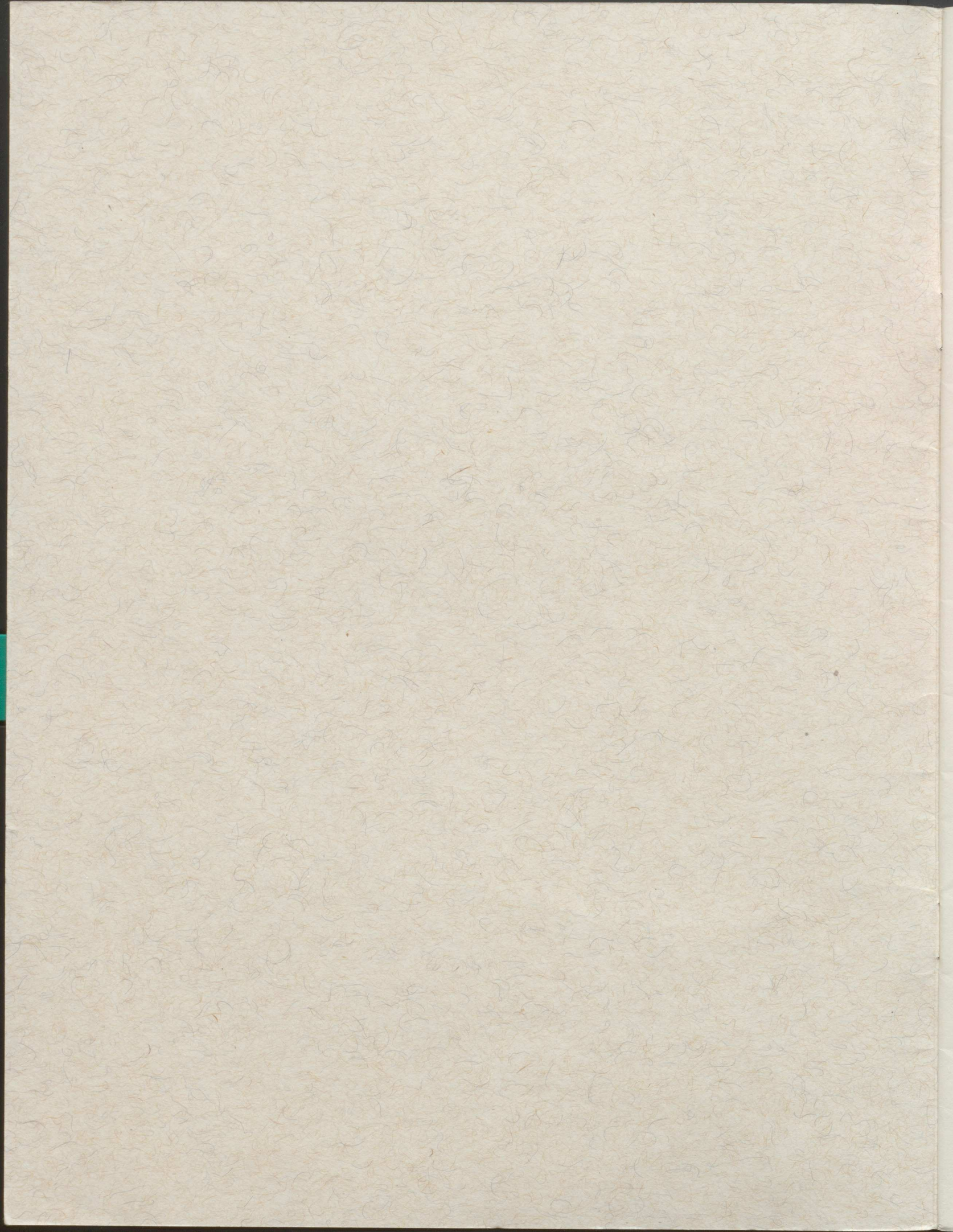
Summary Report of the Workshop of the Council
of Great Lakes Research Managers on **Futures**



1990



International Joint Commission
United States and Canada



GREAT LAKES 2000:

BUILDING A VISION

Summary Report of the Workshop of the Council
of Great Lakes Research Managers on **Futures**



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ISBN 1-895085-19-5



International Joint Commission
United States and Canada

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**Commissioner Robert S.K. Welch
International Joint Commission,
Canadian Section**

The Commission and the Great Lakes research community have had a long history of working together on environmental quality issues. In its third Biennial Report to the governments of Canada and the United States, the Commission specifically acknowledged the importance of this role. In that report, the Commission set a course of action for research as follows:

Viewed from a historical perspective, the Great Lakes research community has played a central role in altering governments and the public to the need to become aware of the impacts on the Great Lakes system. In the 1950s and 1960s scientists, working individually and collectively through learned and professional societies, were able to focus public and political attention on the Great Lakes. This attention led in turn to a Reference to the International Joint Commission in 1964 to examine and report on the pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. The Commission relied on members of the Great Lakes research community and others to serve on its study teams and to address the questions posed as a result of what was later called the Lower Lakes Reference. These experts, mainly engineers and scientists who had worked on water quality issues, worked under the Commission umbrella to build interaction consensus and commitment to address lower lakes eutrophication.

The Great Lakes research community continued to play major role following the signing of the 1972 Great Lakes Water Quality Agreement. Direct Agreement-related research as well as other study efforts were undertaken to support two other major Commission References, the Upper Lakes reference Group and the Pollution from Land Use Activities Reference Group (PLUARG). Both studies highlighted the issue of toxic substances in the Great Lakes system and focused attention on the dangers posed by toxic substances. These studies, along with reports of the Commission's Great Lakes Research Advisory Board (now the Great Lakes Science Advisory Board), drew attention to the need for a Great Lakes ecosystem approach.

This involvement has continued and expanded with the 1978 Agreement and its emphasis on an ecosystem approach. The Research community, with an expanding range of disciplines in the natural and social sciences, has continued to help solve a wide range of issues encompassed within the Agreement and has operated essentially as part of an ongoing decision-support system. This active and intense involvement of the Great Lakes research community in Commission work is an excellent example of the mutually supportive relationship between the Commission and expert advisors who serve on its boards, and how a binational effort can lead to important initiatives.

Many scientific aspects of Agreement issues are only vaguely understood and actual implementation is limited by incomplete understanding of the specific and cumulative causes and impacts of human activities on the Great Lakes system. Detailed understanding of how the Great Lakes system functions, including its institutional framework, is an ongoing and expanding requirement.

The Commission looks to the Great Lakes community to *anticipate* the specific implications of human activities and help define the major emerging issues demanding research attention. Researchers also help to assess the predicted and actual consequences of human activities in the Great Lakes ecosystem and to adapt and adopt policies, programs and other measures that are consistent with emerging ecosystem realities. The Parties will continue to benefit from sustaining a level of Great Lakes-related scientific expertise consistent with the historical role described above.

The third Biennial Report, released in December 1986, remains as relevant today as when signed. It was the Commission's primary contribution to the governmental review which led to the signing of the 1987 Protocol amending or updating the 1978 Agreement. The new Protocol offers many challenges and opportunities for the research community.

The Agreements, collectively, are a reflection of how Great Lakes science has evolved to support this unprecedented international effort to "restore and maintain" the integrity of the Great Lakes Basin Ecosystem. Each Agreement has in its own way also been a blueprint or at least a framework that defines the major perceived research needs for the foreseeable future.

The 1987 Protocol is no exception. Indeed the explicit research obligations summarized in Annex 17 on Research and Development are daunting and, while they can be addressed, they are not likely to be resolved without new approaches.

**Excerpts from 1978 Great Lakes
Water Quality Agreement
Annex 17, Research and Development**

1. **Purpose.** This Annex delineates research needs to support the achievement of the goals of the Agreement.
2. **Implementation.** The Parties, in cooperation with State and Provincial Governments, shall conduct research in order to:
 - (a) determine the mass transfer of pollutants between the Great Lakes Basin Ecosystem components of water, sediments, air, land and biota, and the processes controlling the transfer of pollutants across the interfaces between these components;
 - (b) develop load reduction models for pollutants in the Great Lakes System;
 - (c) determine the physical and transformational processes affecting the delivery of pollutants by tributaries to the Great Lakes;

- (d) determine cause-effect inter-relationships of productivity and ecotoxicity, and identify future research needs;
- (e) determine the relationship of contaminated sediments on ecosystem health;
- (f) determine pollutant exchanges between the Areas of Concern and the open lakes, including cause-effect inter-relationships among nutrients, productivity, sediments, pollutants, biota and ecosystem health, and to develop in-situ chemical, physical and biological remedial options;
- (g) determine the aquatic effects of varying lake levels in relation to pollution sources, particularly respecting the conservation of wetlands and the fate and effects of pollutants in the Great Lakes Basin Ecosystem;
- (h) determine the ecotoxicity and toxicity effects of pollutants in the development of water quality objectives;
- (i) determine the impact of water quality and the introduction of non-native species on fish and wildlife populations and habitats in order to develop feasible options for their recovery, restoration or enhancement;
- (j) encourage the development of control technologies for treatment of municipal and industrial effluents, atmospheric emissions and the disposal of wastes, including deposited in landfills;
- (k) develop action levels for contamination that incorporate multi-media exposures and the interactive effects of chemicals; and
- (l) develop approaches to population-based studies to determine the long-term, low-level effects of toxic substances on human health.

In a way, the history of the Agreement is a history of defining and redefining the nature of the problem. The more we come to appreciate the complexity and system nature of Great Lakes issues, the more it is forcing us to question the

adequacy of our understanding of how these issues are to be managed over time. Indeed the success of this international experiment in ecosystem management is likely to be very dependent on the ability of the scientific community to develop that understanding to the point where these issues can be satisfactorily resolved or at least managed over time. Scientists also have a responsibility to communicate this understanding to people who are not familiar with the technical jargon, but who have a very good capacity to ask legitimate "so what" questions. In other words, what you say may even sound profound - what does it really mean?

We live in interesting and turbulent times. The World Commission on Environment and Development in its recent report on "Our Common Future" explored some of the challenges of working towards sustainable development. The Governments of the United States and Canada in drafting the Great Lakes Agreement have defined the purpose as being to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem. The scientific community clearly has an opportunity to help design a future that is consistent with these lofty objectives.

Many of the environmental problems that we face today are a result of our failure to anticipate the negative impacts of human actions. There is a clear need to improve our ability to anticipate and prevent negative impacts. We also need to be able to monitor and assess what is happening and be

able to adapt in appropriate ways to unforeseen circumstances. Another need that is currently focused on the Areas of Concern and Remedial Action Plans is the need to develop appropriate ways of accelerating the recovery of degraded ecosystems. In each of these areas we look to the scientific community to provide much of the leadership.

In its 1987 report to the Commission the Science Advisory Board reiterated its conclusion that, "It is unrealistic to assume that we can effectively manage systems as complex as the Great Lakes or the Great Lakes Basin Ecosystem; what we can do is influence human uses and abuses of the natural systems on which we depend." Such a conclusion which seems to me to be entirely consistent with the ecosystem approach called for in the Agreement of human activities in the Great Lakes Basin Ecosystem.

All in all, it seems clear to me that the Great Lakes scientific community has a very important and exciting agenda in front of it. This workshop on Great Lakes Research Futures is one important step in refining that agenda. On behalf of myself and my fellow Commissioners, I would like to express our hopes and good wishes for a most successful workshop.

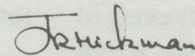
The general objective of the Council of Great Lakes Research Managers, as defined in the Councils' terms of reference, is to enhance the ability of the Great Lakes Science Advisory Board and the International Joint Commission to provide effective leadership, guidance, support and evaluation of Great Lakes research programs with particular reference to programs required or funded pursuant to the provisions of the Great Lakes Water Quality Agreement. More specifically, the Commission has instructed that the Council, in pursuing this general objective, may: a) promote inter-jurisdictional and multidisciplinary planning and co-ordination of research related to the implementation of the Great Lakes Water Quality Agreement; and b) identify research needs and establish priorities. In reviewing this mandate, the Council concluded that an effective means of beginning to address these important responsibilities would be to convene and host

a major "Futures" workshop on the future of Great Lakes research.

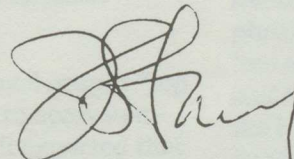
The Great Lakes Water Quality Agreement of 1978, especially as amended by the 1987 Protocol, contains many challenges for the research community. The Agreement emphasizes the need for an ecosystems approach to restoring and maintaining the integrity of the waters of the Great Lakes Basin Ecosystem. And, in order to achieve this purpose the Governments of the United States and Canada agreed "to make a maximum effort to develop the programs, practices and technology necessary for a better understanding of the Great Lakes Basin Ecosystem." The research community has an important role to play in developing practical, timely advice to help meet these obligations.

The Futures Workshop held in Niagara-on-the-Lake during September 1989 was an opportunity for experts on water quality issues

to meet with Great Lakes Research Managers to jointly seek creative and innovative solutions to intractable old problems and to identify new problems that require new approaches and new talent. That workshop resulted in this report. The report reflects a general consensus as to some of the things that the research community might do to help anticipate and promote constructive change. More importantly, those present came away from the conference with renewed enthusiasm and confidence that the research community would be able to respond adequately to the challenges reflected in the Great Lakes Water Quality Agreement. The many concrete ideas for inter-agency, multidisciplinary research helped to foster a spirit of cooperation that will help ensure that the research community is more able to respond effectively to the urgent needs of today while, at the same time, preparing for the important environmental issues of the 1990s and beyond.



J. Roy Hickman
Canadian
CoChair



Jon G. Stanley
United States
CoChair

Council of Great Lakes Research Managers

The Futures Workshop was sponsored by the Council of Great Lakes Research Managers, cochaired by David Egar (Canada) and Jon Stanley (United States). Funding was provided through the Council by the International Joint Commission. The Rawson Academy of Aquatic Science, under contract, developed the background materials, organized the workshop and produced a draft proceedings with assistance from the U.S. Sea Grant directors.

The study team formed to guide the work, included Don Gamble (project leader), John Gannon, Andrew Hamilton, Russell Moll, Henry Regier, Peter Seidl, Michael Gilbertson, Peter Sly and Richard Thomas. Ray Rouse and Bob Hays were the workshop facilitators. The workshop participants are listed with their affiliations in Appendix A.

The initial drafts of this report were prepared by Don Gamble and Peter Sly from the Rawson Academy with guidance from Bob Ragotzkie of the Great Lakes Sea Grant Program. Jon Stanley, David Egar and Peter Seidl of the Council of Great Lakes Research Managers reviewed the draft manuscripts. The Council reviewed and edited the content of the second to last draft report.

Part I of this report is a summary of the workshop. The Introduction (Chapter 1) was prepared by Don Gamble and Peter Sly. The workshop summary (Chapters 2 to 6) was prepared by Don Gamble. The summary of the highlights of the discussion between the panel and workshop participants (Chapter 7) was prepared by Peter Seidl. The manuscript was nurtured from the earliest drafts through to final draft presented to IJC by Jan

Wetter. The final report was re-edited and prepared at the International Joint Commission by Sally Cole-Misch and Douglas Alley, with graphics by Bruce Jamieson.

If any proof of the intellectual buoyancy or intrinsic worth of the history, philosophy and application of science were ever needed, nothing better could be provided than what has emerged in the Great Lakes over the last several decades. This report builds on that legacy and looks to the future — something that could never have happened without the personal commitments of scientists and the ongoing support offered by their governments. Acknowledging this contribution is a necessary part of the process of looking ahead to the next decade in the Great Lakes basin.

1.1 The Approach



The purpose of the work leading to production of this report was to establish a framework for future natural and social science research in the Great Lakes basin. Overall, the work highlighted the knowledge required to manage the human use of the aquatic ecosystem in the Great Lakes basin and to provide for sustainable development into the 21st Century. The Canada-U.S. Council of Great Lakes Research Managers sponsored the work, and The Rawson Academy of Aquatic Science prepared the background material and final report. Along with the U.S. Great Lakes Sea Grant directors, the Academy also organized and hosted the workshop at the Niagara Institute on September 20-22, 1989.

In order to establish a framework, the history of Great Lakes research to date, and regional and global economic, social and environmental trends, and future options were considered. The report, "Our Common Future" of the United Nations Commission on the Environment and Development, and the review of Sustainable Development in the Great Lakes being conducted by the Conservation Foundation (Washington) and the Institute for Research on Public Policy (Ottawa) were particularly relevant to this process. As the project progressed, the meaning of sustainable development and the ecosystem approach merged, since the ecosystem is taken to encompass both the "natural" and human components of the environment

and, within the human component, it includes both social and economic dimensions.

In sponsoring this project the Council of Great Lakes Research Managers had three objectives:

- a. to understand the future challenges to the research community in the Great Lakes as they relate to research and research management;
- b. to develop a consensus on the directions and priorities of research to meet those challenges; and
- c. to produce a report for research managers and government decision-makers that summarizes the merits and value of the work of the Great Lakes research community to date; sets out the scope of the demands that must be met into the 21st Century; and describes the level of effort and the types of research that will be needed to meet such demands.

In general, the Council sought "top down" approaches to ecosystem-oriented research. It expected that one of the products would be a number of governing ideas for projects embodying the ecosystem concept — projects that might involve two or more United States and/or Canadian organizations, that would be multidisciplinary (including social and health sciences), and that would explore the relationships and synthesize traditional ecosystem compartments.

This project included three distinct parts. First, the Rawson Academy,

with assistance from the Sea Grant Directors, prepared a background briefing book highlighting some of the more important considerations for ecosystem-oriented Great Lakes research. The briefing book contained eight papers, five of which are reproduced in the separate *Proceedings* under Part II: Understanding the Research Challenge (Chapters 7 - 11, inclusive).

Second, the workshop was held with participation by Great Lakes research managers and experts from Canada and the United States (see Appendix A). A four-part "Search" process was used to elicit the views of participants on the kinds of issues facing managers in the Great Lakes in the 1990s and beyond. A distillation of ideas of possible ecosystem research programs is presented in Appendix B of the *Proceedings*, while summary of the workshop is provided as Part I of the *Proceedings*, and as the *Summary Report*. In addition, the workshop included an after-dinner welcoming address by IJC Commissioner Robert Welch that emphasized the need for an ecosystem approach in the Great Lakes and a panel discussion chaired by the Honourable John Fraser, Speaker of the House of Commons. Mr. Fraser invited four senior Canadian and American officials to join him in a discussion of the future needs for research in the basin. The Council for Great Lakes Research Managers met on the last day of the workshop to discuss the results and to begin implementing the recommendations.

Finally, the Academy, Sea Grant Directors and the Council worked together to produce this report.

1.2 Research and Research Management: A Background Summary

The workshop's focus included:

- understanding future challenges to the research community in the Great Lakes, related to research and to research management; and
- developing a consensus on the directions and priorities of research needed to address these challenges.

In examining these issues, it is important to recognize that the priorities which define program and project research may not be the same. For example, national programs may emphasize concerns that are not shared equally in different regions. Data that are now required to support detailed project studies may not conform to previously defined program requirements. Management strategies may emphasize actions based on available information rather than seeking new knowledge.

These observations indicate that the issues extend beyond the bounds of environmental research and into the sphere of research management. Scientific research and research management are complementary; they are not mutually exclusive. The emphasis shifts according to the relative roles of research and management, as shown in Figure 1.

Although Figure 1 does not implicitly establish the priorities which

focus management at each of its many levels, it is useful to draw attention to research and management roles and responsibilities in:

- defining programs, and program and component priorities;
- passing information up and down within agency structures to build, maintain and evaluate programs;
- passing information to the public domain and assessing feedback; and
- evaluating the effectiveness of programs and the projects which form their component parts.

In general, many scientists working in the Great Lakes basin have expressed the opinion that management and research have been successful in their respective roles in the lower part of Figure 1 but both management and research have been less successful in fulfilling the roles in the upper half. For

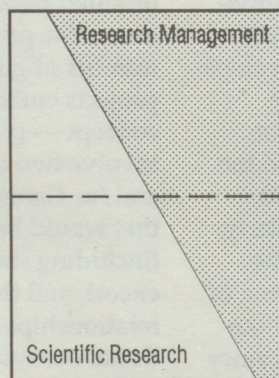
example, a year or so after signing of the 1972 Great Lakes Water Quality Agreement (GLWQA), management seemed perplexed when researchers appeared uncertain about the development of water quality criteria that could be built into an improved water quality agreement. The researchers acknowledged that specific concentration values could be developed; however, these would have meaning only if management was able to define the intended water use requirements. Only in that way could the researchers target their analyses. Obviously, neither group could deal with the task on its own.

It has taken time to understand this interdependence of research management and scientific research. Research can erect probable scenarios that are useful to test management options. However, management needs to define the framework or goals and then transfer useful information (such as scenarios) throughout their respective departments or agencies and into

EMPHASIS AND SUMMARY OF PRINCIPAL ROLES

Scientific Research

- Prepares science information for transfer within an agency or to public domain
- Defines research objectives and analytical research
- Does research
- Does review and publication



Research Management

- Defines programs and component priority based on agency and public needs
- Directs and manages the use of human and material resources
- Follows administrative procedures
- Channels information up and down and within the agency structure
- Evaluates programs and projects
- Manages research projects

FIGURE 1. Shared Roles of Management and Research In Science: A Matter of Emphasis

the public domain. This transfer function is often acknowledged as a key to political and socio-economic support for decisionmaking arising from research, thereby transferring what we know into what we do. In addition, there is an important and often quite independent scientific agenda defined by the international cutting edge of activities in the research community itself.

The essential roles of information transfer, constituency, confidence and support building are illustrated in the background documents to be found in Part II of the *Proceedings*. The documents provide information considerably beyond these roles and it is hoped that they will trigger additional discussions that are needed to define future directions in Great Lakes research. These documents reflect the independent views of their authors and should not be construed as an indication of the opinions of the Council of Great Lakes Research Managers. They are, nevertheless, valuable tools which help to focus information and discussion in key areas of consideration.

Some key points have been selected from each chapter in Part II of the *Proceedings* and are summarized below.

1.2.1 A Retrospective: Research Recommendations in the Great Lakes Basin

Chapter 7 lists recommendations derived from major Great Lakes documents since the mid-1970s and categorizes them into four levels. Based on the analysis of

recommendations, many research studies in various fields of natural science and socio-economic science have been proposed. However, few if any specific recommendations call for programs linking the two fields while a number of general recommendations certainly link natural and socio-economic sciences, their lack of clarity almost certainly detracts from any priority that might be placed to support such work at the project level.

Environmental research (physics, chemistry, biology and related fields) recommendations are heavily weighted towards applied products, and this imbalance is likely to be detrimental to long-term understanding of key processes (such as contaminant mass transfer at the sediment/water interface, as called for in Annex 14 of the Protocol to the 1978 Great Lakes Water Quality Agreement. A related comment referring to the use of directed research, is noted in Chapter 8: "By confining research it did not yield more useful results and it had to borrow from outside concepts to re-establish its utility."

In addition to presenting an analysis of research recommendations, Chapter 7 provides a ready source of information about the recommendations themselves and may be used to help structure program priorities in the 1990s.

1.2.2 Why Bother? Contributions of Research to Policies and Regulations

Chapter 8 provides a brief historical sketch of the settlement

patterns in the Great Lakes region and their associated cultural impacts on the environment. A summary of jurisdictional and management roles in the basin follows, including the roles of the Great Lakes Fishery Commission (GLFC) and International Joint Commission (IJC). A summary of the science base and the location and development of major environmental research facilities is also provided. Four examples of the ways in which science has been used to deal with issues in the Great Lakes basin are presented along with a short summary of some of the more important scientific contributions. The last part of this chapter outlines the conceptual base of science and the scientific approach that will be most appropriate to address the ecosystem approach/sustainable development. In particular, it addresses the roles of analysis and synthesis.

1.2.3 Charting Our Common Future: Science, the Ecosystem Approach and Sustainable Development (a Canadian Perspective)

Chapter 9 notes that the long-term viability of goals and objectives is a prerequisite for sustainable development. It calls for models which interrelate socio-economic and environmental sciences and are simple enough to understand, yet robust enough to withstand challenge. As an example, analogy is drawn with the development and use of the Vol-lenweider nutrient loading model.

One of the major difficulties confronting decisionmaking related to sustainable development is that

benefits and disbenefits of selected decisions may not be clearly resolved or, more specifically, may not be of immediate concern. Not all concerns may be addressed by scientific research within available time frames. A merging of the concepts of the ecosystem approach and sustainable development lies ahead.

Two examples to apply the concept of sustainable development are provided. A further discussion of the scientific approach (previously noted in Chapter 8) is presented and an example of one technique that could be used to link natural and socio-economic studies through modeling is given.

The chapter notes that science needs to provide not only the best possible information for decision-making but, also, that it should be used to evaluate the impacts of decisionmaking; further, behavioral science might be used to accelerate attitudinal change in a beneficial way.

1.2.4 The Challenge: Ecosystem Science in the Great Lakes

Chapter 10 focuses on the need to address ecosystem integrity, ecosystem health and sustainability. It recognizes that because the Great Lakes have been so thoroughly perturbed by human activities, it may be impossible to use these waters in the construct of undisturbed or balanced systems. Rather, comparisons may need to be drawn from other large aquatic systems that are more remote from cultural impact.

Remedial measures, enhancement and other management activities may need to make greater use of experimental management and ecosystem experiment, as a means to support and clarify model predictions in large aquatic systems. Such experiments are powerful tools and recognized for their application to analysis and synthesis of global research issues, particularly because of the size and complexities of the Great Lakes Basin Ecosystem.

Caution is expressed about the lack of maturity in many parts of ecosystem science, particularly in the fallibility of many existing constructs.

1.2.5 Getting There from Here: Future Directions in Great Lakes Research

Chapter 11 includes three themes: the changing context of research needs; the role of science in addressing issues; and relationships between the GLWQA and science. It views the linkage between environmental and socio-economic science as an integral part of all research needs.

This chapter summarizes the trends occurring in science and its host community as our conceptual understanding of the ecosystem approach and sustainable development evolves. The document focuses much of its attention on the significance of the new annexes in the 1987 Protocol to the 1978 GLWQA, in particular the Remedial Action Plans (RAPs), rehabilitation, of contaminated sediments, and mass transfer. It also raises

concerns about whether we are tackling the right questions and whether or not the science is defensible. Further, the point is implicitly made that we need to clear our thinking and come to common agreements on the approach to and applications of what we know. For example, is the prime directive for contaminants that they are "guilty" until proven "innocent"? It is this kind of question that demands more explicit direction or definition from management. Finally, a number of action opportunities are noted, covering not only research but also how it is done.

2.1 Four Conclusions

With the briefing material provided before the workshop, the workshop participants arrived at four major conclusions, summarized as follows:

• A Guiding Vision for the 21st Century: (Chapter 3)

A well defined and efficient research effort in the Great Lakes basin for the 1990s and beyond requires that management and scientists share a common focus and that this largely reflects the vision, concerns and wishes of the population of the basin.

• Addressing New Research: (Chapter 4)

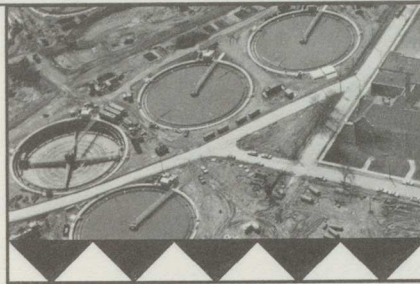
Strategic Planning

A new strategy for Great Lakes research is needed that is forward looking, that influences and coordinates the research agenda of the principal management agencies in the basin, and that encourages more transdisciplinary and interdisciplinary work.

Emphasis

Research in the 1990s should:

- continue and build on the solid base of natural science that has been established in the basin over the last several decades;



- place greater emphasis on the needs of social, socio-economic and human health related science;

- take a more holistic view, particularly in support of the ecosystem/sustainable development approach, with better integration of natural, socio-economic and social science work;

- place greater emphasis on synthesis of research;

- open new opportunities for better use of the existing scientific resources and expertise in the basin, both structurally (through coordination at all three levels of government and with universities, nongovernment organizations and industry) and conceptually (through better appreciation of the roles of basic and applied research, engineering and other applied technologies);

- foster closer working relationships between research staff in government, industry, academia and other specialist groups; and

- accelerate the transfer of knowledge with other regional and global science establishments that are working on ecosystems research and sustainable development.

Evaluation

Because of the complexities of ecosystem science and, frequently,

the difficulty of maintaining a long-term focus, research management will require a means to monitor the implementation of strategic plans for research, particularly to avoid the depletion of research capacity under growing pressures to provide "quick response" capabilities that are oriented toward technology transfer rather than research.

• Mobilizing Intellectual Capital (Chapter 5)

If the pressing social, economic and environmental challenges facing the Great Lakes in the 1990s are to be addressed with any degree of success, the research community will require additional financial resources. Immediate measures also must be developed to strengthen human resources within the Great Lakes science community and to expand the intellectual reach of this community to encompass and integrate social as well as natural sciences.

• Theory into Practice: Communicating and Educating (Chapter 6)

The Great Lakes research community has a special responsibility to provide easily understood and accurate information to the people who live in the basin and to decisionmakers in the public and private sectors. Given the seriousness of the issues, there is a need to develop a proactive education and communication strategy that would:

- establish an open dialogue between the scientific community and the public to ensure that research is responsive to needs and priorities;
- bring science and the results of research into the public educational system at all levels;
- facilitate the translation of research findings into policy and legislation by improving lines of communication between the research community and senior decisionmakers in all sectors; and
- improve the flow of relevant information between researchers working in different fields and institutions, and between researchers, research managers and others.

Each of these conclusions led to the development of more specific recommendations for action as described in the following four chapters. Together, this begins the process of establishing a 1990s framework for the Great Lakes natural and social science community. Implementation and success depends upon followup work by those who made commitments at the workshop and the subsequent meeting of the Council, and particularly on the ability of the Council secretariat to track, prompt and otherwise monitor and report on activities.



3.1 Workshop Conclusion

A well defined and efficient research effort in the Great Lakes basin for the 1990s and beyond requires that management and scientists share a common focus and that this focus reflects the vision, concerns and wishes of the population of the basin.

The ability of the human species to destabilize, change and often to degrade the ecosystem of which it is a part has been well established. There can be no doubt that the management of human activities is a critical element in the ability of the Great Lakes and global ecosystem to continue to support life. Indeed, at the workshop, there was widespread agreement with the conclusions of the World Commission on Environment and Development (the Brundtland Commission) that social order and the survival of the human species is now at risk because of human induced phenomena within the ecosystem. That global context is changing popular notions of what actions are necessary, how soon and where. It is prompting a re-examination of regional and local issues like those that have influenced the Great Lakes research community.

How human activities are directed and governed over the next two decades will be a major factor in global survival. The conscious exercise of choice is critical. Exercising that choice is increasingly dependent on the provision of sound information, much of it coming from the research

community. But just as important is the definition of desired outcomes, of visions that society wants to realize. Research can provide a means to desired ends, but it also goes beyond that; the research community plays an active role in the design of a desired future. Without a more deliberate and comprehensive attempt to address the question of what it is that we really want to achieve throughout the basin, decisions run the risk of being made on the basis of short-term trade-offs and expediency. Under these terms one can only assume that the Great Lakes Basin Ecosystem will be more deteriorated in the 21st Century than it is today.

Clearly, the research community helps to shape a vision, whether explicit or implicit, by anticipating problems, analyzing possible solutions, and assessing both short and long-term consequences. However, the future of Great Lakes Basin Ecosystem depends to a large degree on the shared values and choices of a much larger society in this and adjacent regions, and the influence of a growing number of powerful global environmental, economic, social and cultural forces.

3.2 A Basinwide Vision: "Great Lakes 2000"

It is perhaps telling that despite the billions of dollars spent on "cleaning up" past mistakes in the Great Lakes over the last several decades, there has yet to be a clear articulation of a widely held vision for the basin; not of what we are trying to get away from (pollution) but of what it is that we are all working toward.

Granted, in various parts of a number of binational and regional agreements elements of desired outcomes have been offered and, in some instances, even required. The Remedial Action Plans (RAPs) and Lakewide Management Plans (LMPs) arising from the 1987 Protocol to the 1978 Great Lakes Water Quality Agreement are good examples. However, the elements remain fragmented, both conceptually and jurisdictionally. They remain dictated more by a reaction to past pollution problems than by the anticipation of future challenges opportunities. And even where explicit requirements have been made, responsibilities are diffuse and accountability remains vague within the eight states, two provinces, two federal governments and the host of agencies, corporations and other groups in the basin. This must change.

3.2.1 Action Recommended

The Council of Great Lakes Governors and Premiers, with support from the International Joint Commission (IJC) and the Great Lakes Fishery Commission (GLFC), and

federal agencies on both sides of the border, should begin to build a broadly based public consensus for a decade "Great Lakes 2000." This will define a 21st Century social, economic, environmental and political vision for the region. The development of an Ecosystem Charter for the Great Lakes will provide an essential underpinning for human activities in all jurisdictions and sectors.

3.2.2 Action Initiation

To initiate this action, subject to consultation with the IJC, GLFC and federal agencies, the workshop recommended that the co-chairs of the Council of Great Lakes Research Managers develop an official request to the Council of Great Lakes Governors and Premiers, proposing that such a charter be developed.

3.3 A Vision of and for the Research Community

Achieving a goal depends to a large degree on agreement on what should be accomplished. In looking ahead to the 1990s, the Great Lakes research community is no exception.

Workshop participants were asked to describe their vision for the natural and social science research community in the decade ahead using the simple and rather obvious premise that the research framework is built most sensibly within parameters envisioned by

the researchers themselves and within the context of the larger vision of Great Lakes society. Like many other matters in the region, Great Lakes science is, itself, tied to the efforts of global science and these must not be ignored. Reaching agreement on what should characterize a viable ecosystem-oriented research effort in the Great Lakes basin therefore becomes a specific challenge for the science community.

3.3.1 Action Recommended

The research community in the Great Lakes basin needs to interact more with the community at large if it is to deal effectively with the anticipated environmental, economic, social, technical and political challenges in the 1990s and beyond. Research managers could assist by developing mechanisms for public commentary and discussion of major scientific issues in the basin. Research scientists should be encouraged to participate in these discussions and should help to formulate long-term research objectives compatible with the community needs and at the same time seek to use opportunities arising to advance the cutting edge of science.

3.3.2 Action Initiation

No action was initiated. Further discussion is needed to develop a response to these recommenda-

4.1 Workshop Conclusion



• Strategic Approach

A new strategy for Great Lakes research is needed that is forward looking, that influences and co-ordinates the research agenda of the principal management agencies in the basin, and that encourages more transdisciplinary and interdisciplinary work.

• Emphasis

Research in the 1990s should:

- build on the solid natural science base that has been established in the basin over the last several decades;
- place greater emphasis on the needs of social, socio-economic, and human health related science;
- take a more holistic view, particularly in support of the ecosystem/sustainable development approach, with better integration of natural, socio-economic and social science work;
- place greater emphasis on synthesis of research;
- open new opportunities to better use existing scientific resources and expertise in the basin, structurally (through coordination at all three levels of government and with universities, nongovernment organizations and industry) and conceptually (through better appreciation of the roles of basic and applied research, engineering and other applied technologies);
- foster closer working relationships between research staff in

government, industry, academia and other specialist groups; and

- accelerate the transfer of knowledge with other regional and global science establishments that are working on ecosystems research and sustainable development.

• Evaluation

Because of the complexities of ecosystem science and, frequently, the difficulty of maintaining a long-term focus, research management will require a means to monitor implementation of strategic plans for research, particularly to avoid the depletion of research capacity under growing pressures to provide "quick response" capabilities that are oriented toward technology transfer rather than research.

The future research challenge in the Great Lakes is regional and global. From an international perspective, the accomplishments in the Great Lakes over the last several decades offers great promise for the rehabilitation of degraded regional ecosystems, worldwide. The ability of the basin's binational research community to address important ecosystem problems involving two federal governments, eight states, two provinces and numerous local jurisdictions, provides a strong base from which to build in the 1990s and a much needed example internationally.

While many specific and pressing research matters still must be addressed, it is clear that if a comprehensive approach to regional

ecosystem issues cannot be developed in the Great Lakes, it probably cannot be accomplished in most other regions that are also suffering serious ecological damage. This places a special imperative on the research community in the basin to move quickly and seize the initiative, not only because of the urgency of the growing problems throughout the basin, but also because of the need to build on past successes and provide much needed international scientific leadership.

4.2 Accepting Global Leadership: An Ecosystem Center/Network

The Great Lakes offer a wonderful international opportunity to demonstrate in a systematic fashion how various governments, scientific disciplines, research tools, and management and communication techniques can be applied to meet the challenge of sustainable development and global ecological security. Unlike most other regions, the issue is not how or where to start but rather how to best build from what has already been learned and accomplished. However, to realize this opportunity, an institutional catalyst in the form of a new center/network is needed. Using a holistic approach, this body should be assigned a research mandate that covers the basin as a whole and its contiguous regions. The emphasis should be on synthesis, seeking to involve experienced and broadly based

ecosystem scientists and specialists in information systems and systems analysis. Because the requirement for ecosystem work already exists in binational agreements, there is an obvious need for a coherent means to support the diverse expertise necessary to actually undertake this work. Further, must provide clear direction, reporting and evaluation.

A wide range of options could bring such a center or network into existence. Whatever mechanism is used, a new, focused commitment on ecosystem/sustainable development oriented synthesis research is required.

4.2.1 Action Recommended

A Great Lakes-St. Lawrence Ecosystem Studies International Center/Network should be established as a clearly identified research entity that would:

- a. provide direct support for holistic research and synthesis in the natural, social, health and applied sciences throughout the basin and contiguous regions;
- b. take a futures approach, seeking to anticipate and prevent problems, and demonstrate Great Lakes Basin Ecosystem solutions regionally, nationally and internationally;
- c. provide ecosystem policy advice to all levels of governments, government agencies, corporations and the public on both sides of the border;
- d. convene workshops, conferences and otherwise provide an outreach function to stimulate

professional and social learning and change;

- e. draw on outside experts with widely respected experience in science and culture to evaluate programs and projects and to anticipate the interests of future generations in the region; and
- f. strengthen international links in transdisciplinary ecosystem research.

4.2.2 Action Initiated

To initiate and encourage this action, the Council of Great Lakes Research Managers agreed to allocate seed money to study the general role, structure and feasibility of a Great Lakes St. Lawrence Ecosystem Studies International Center/Network. The Great Lakes Fishery Commission and the International Council of Scientific Unions will be invited to participate, and a committee will establish the terms of reference and study budget that ensures multi-stakeholder participation, obtains funding and awards and supervises the work. A progress report will be circulated to all members of the Council at its meeting in 1990, and it is hoped that the study will be completed before the end of the 1990 fiscal year.

4.3 Developing an Ecosystem Model

Although a whole-basin approach is required in ecosystem modeling, the overall construct will be made up from a number of components,

and not all parts of the basin will need to be addressed in each model component. It is clear that neither the complete fabric nor the architecture exists for such a model, yet a number of partly related substructures do exist and can be built upon. A bold approach is needed to expand the base of available models, to assess their strengths and weaknesses, and to define what types of models may best meet management needs.

Definition of ecosystem model needs is a difficult task, as is the construction of such models. There is no clear end use or development path. Rather, the evolution of such models will be interactive, with research advancing more refined and effective models periodically. After using and applying the models, scientists and resource managers will become more adept at understanding them and defining the scale, scope and required resolution of this ecosystem model. While components may deal specifically with biological, chemical and physical variables, the final construct will aim to link socio-economic variables to these variables.

4.3.1 Action Recommended

A Great Lakes Basin Ecosystem framework model, with submodels, should be developed in the 1990s and completed by the year 2000 as a Canada-United States contribution to understanding the key factors in maintaining global ecosystem integrity. The model would:

- build from a conceptual base, be integrative, issue driven, verifiable, and capable of tying

together submodels that could be revised and adapted to emerging issues or scenarios;

- provide a much needed structure for organizing data bases and make them more accessible to the research and decisionmaking community;
- provide a tool to support scenario analysis (anticipation of issues) and to help identify research needs and data gaps; and
- support state of the environment reporting.

To begin, it is recommended that a steering committee be established with responsibility for at least four actions:

- i. to develop and implement a practical plan for an ecosystem model building project;
- ii. to establish a technical committee of experts to identify and assign specific ecosystem model building needs;
- iii. to organize the first conceptual model workshop in 1990 that would include experts such as modelers, natural, health and social scientists, engineers, economists and others; and
- iv. to monitor progress and to report annually to the Council and other participating agencies.

4.3.2 Action Initiated

To initiate this action, the Council of Great Lakes Research Managers has identified a Steering Committee headed by Dr. John A. Cooley

and has agreed to fund a workshop in fiscal 1990/91 to begin development of the conceptual model.

4.4 Developing Ecosystem Integrity Indicators

The workshop participants identified the need to develop a scientifically sound and socially relevant set of indices or proxy indicators, perhaps analogous to the gross national product (GNP) or the consumer price index, that would provide a general sense of the state of the Great Lakes Basin Ecosystem as a whole and its changes over time. Useful models exist in such areas as the air quality index and the ten ecosystem indicators now being used in Green Bay.

4.4.1 Action Recommended

A workshop should be held before the end of fiscal year 1990 to develop an approach to meaningful lakewide/basinwide indicators of ecosystem integrity. In the meantime, the Green Bay (RAP) indices/indicators should be developed further as the basis of an example of what can be done on a limited scale. The objective is to have indicators used in lakewide management plans by 1995.

4.4.2 Action Initiated

The Council of Great Lakes Research Managers will immediately establish a binational committee on Ecosystem Indices and will provide the seed funding for a workshop to be held in 1991 - 1992.

4.5 Establishing Environment-Economy Linkages

Several areas of transdisciplinary research in need of immediate effort are tied directly to the concept of sustainable development articulated by the United Nations World Commission on Environment and Development. Understanding the environment-economy link of this concept is vital for the 1990s in the Great Lakes basin.

4.5.1 Recommended Action

A research project to establish the quantitative relationship between economic development, ecosystem stress and environmental costs should be undertaken as a priority so that decisionmaking in the Great Lakes basin in the 1990s can incorporate environmental values in economic development. The work should involve the Institute for Research on Public Policy, The Center for the Great Lakes, Sea Grant, the World Bank and other institutions dealing with economic development in the basin and worldwide.

4.5.2 Action Initiated

The Council co-chairs will approach senior managers in Canada and the United States to obtain support for environment-economy research projects in the basin.

5.1 Workshop Conclusion



If the pressing social, economic and environmental challenges facing the Great Lakes in the 1990s are to be addressed with any degree of success, the research community will require additional financial resources. Immediate measures also must be developed to strengthen human resources within the Great Lakes science community and to expand the intellectual reach of this community to encompass and integrate social as well as natural sciences.

Outside the science community, there is a widespread but seriously flawed assumption that a solid base of expertise will continue to be available to provide technological "quick fixes" to what are becoming increasingly difficult, often life threatening, long-term problems in the Great Lakes basin. Given the demonstrated ability of the research community to identify and respond to previous environmental crises over the last decade, this assumption is understandable but highly inaccurate.

The seriousness of the challenges ahead cannot be overstated. Within the science community it is acknowledged that the past successes were, by and large, the easy ones. What lies ahead is formidable. The abundance of world class expertise that has been enjoyed in the past in the Great lakes region has lulled us into a false sense of security — one that now threatens our ability to address those very things that will threaten orderly social and economic development in the basin. An entire generation of Great Lakes scien-

tists is now gone, lost through migration to the coasts, shifts to program administration, and retirement. Neither universities nor government laboratories have maintained an adequate replacement rate for these scientists and not enough new environmental scientists are being trained. Young scientists and graduate students are not being attracted to Great Lakes research, and if they are interested many have correctly perceived that funding cuts and uncertainties for Great Lakes research do not bode well for careers on Great Lakes issues. Thus many are turning to other scientific endeavors or moving out of the basin altogether.

The challenge facing the Great Lakes society in the 1990s has regional and global eco-security implications. The challenge cannot be deferred. It will demand imposing heavy economic and social costs. If this is to be addressed in a constructive fashion, there must be a renewed effort to marshal, hold, attract and foster the very best scientific expertise, in a world that will become desperate for the same kinds of skills that are already in diminishing supply in many jurisdictions. Of particular concern are intellectual resources in the social sciences, because very few expert social scientists have been engaged in Great Lakes research in the past and graduate students in this field generally are pursuing careers elsewhere. This problem cannot be solved by allocating only money. Rather, it requires a major change

in attitude by universities and their social science departments, which presently give little or no priority or credibility to natural resource matters in general and Great Lakes resources in particular.

Research cannot be turned on and off like a tap. As has been more than evident in the Great Lakes past, intellectual investments pay off handsomely but usually in the longterm. The return on investment from a socio-political perspective can vary from 10 to 25 years or more.

It was suggested at the workshop that the Great Lakes community may have less than a decade to turn things around. That kind of sentiment is widely supported not only from a regional perspective but also from a global perspective. Indeed, the United Nations World Commission on Environment and Development has put the case in stark, unmistakable terms: the role of the natural and social science research community is becoming increasingly important, and must be strengthened immediately to meet the challenge ahead.

A climate of fiscal restraint, on both sides of the border and at all levels of government over the last decade, has led to a steady erosion and dissipation of research efforts. This policy of divestment has had damaging consequences on the management and conservation of Great Lakes resources. Long-term research programs, by their very nature, are easy targets for officials faced with immediate demands to reduce expenditures. The research community has generally been unsuccessful in articulating the

consequences of doing so, and the Sea Grant Program was only able to maintain near level funding by soliciting monies from alternate sources. But there is a lesson there: Sea Grant's limited success was derived largely from widespread and vocal public support for the program.

It is time to re-establish steady funding for systematic, long-term research. This is the only way to break with the inefficiencies of the past and to more properly anticipate and prevent future problems.

5.2 Mustering Financial Resources

It is unfortunately true that little research can be done without dedication of both human and financial resources, and that long-term research requires long-term support. While it is also true that knowledge is continually accumulating, it is essential that each generation of researchers gain experience under the guidance of their more senior scientists and their peers. Continuity and consistency are vital ingredients in productive scientific endeavours.

Increased funding is demanded by a host of organizations for many reasons throughout the basin. Some are obviously compelling because they appear to be immediately and directly tied to particular human welfare and vested interests. The value of others, like ecosystem research, are not so apparent; yet, they are equally

urgent, particularly because they are often concealed from day-to-day public scrutiny and constitute steadily increasing, irreversible, long-term threats to the region. As the chair of the panel discussion pointed out (see Part III of this report), this situation can only be compared to the situation that exists just prior to the declaration of war. Ready or not, the need for mustering all possible resources is immediately thrust upon us. It is foolhardy to think that many research questions can be deferred without serious ecological security risks. Human and financial resources must be committed to the long-term task of meeting the challenge.

5.2.1 Recommended Action

Research managers in the Great Lakes should develop innovative means to raise and allocate additional financial resources for the development of scientific capacity and to strengthen research support mechanisms for long-term synthesis studies, both within and outside government laboratories.

5.2.2 Action Initiation

The Council of Great Lakes Research Managers, in conjunction with the Great Lakes Science Advisory Board, the Great Lakes Fishery Commission and others, will establish a multi-stakeholder public and private sector Great Lakes 2000 Committee to:

- define new actions that can be initiated or coordinated to lever more funds for ecosystem research within all sectors and groups active in the Great Lakes basin;
- examine inter-agency, cooperative mechanisms and other statutory and private funding options, including such things as endowments, as a means of freeing more resources for research; and
- recommend ways to increase the effective allocation of financial and human resources and other wise remove constraints imposed on the research community.

5.3 Staying Relevant and On Track

Scientific resources must be used in the most effective way and, in particular, research staff must be used to address concerns where research is most needed. Many current concerns relate as much or more to technology and engineering than to research and they should be addressed by appropriately skilled staff. For example, many questions concerning technologies for application to contaminated sediments require input from both research and engineering as a blending of new knowledge and existing technology. The use of combined research and engineering skills in many different fields will be essential to respond effectively to the International Joint Commission (IJC) Remedial Action Plans (RAPs). Since most government research institutes employ few engineers, it may be appropriate to consider closer cooperation with the private sector to jointly staff projects.

Research and management staff should discuss the extent to which programs and projects will deploy research resources and the extent to which environmental engineering should become incorporated into planned and ongoing activities. It is important, therefore, that problems to be studied are clearly articulated and that study objectives are well understood. It is not sufficient that research plans and activities are well developed; it is equally important that the results of such work, experimental resource management actions and the implementation of a range of management strategies be regularly assessed or monitored through a technical audit to ensure that there is continual learning from success and failure.

5.3.1 Action Recommended

The research community should join in developing and implementing an overall strategic plan for Great Lakes Basin Ecosystem research. This should include a general audit and assessment plan with specific objectives such as:

- an assessment of whether the objectives have been clearly articulated and understood by all affected parties;
- a means to judge accountability for implementation;
- tracking actions to determine whether they have achieved the plan's objectives;
- a means to modify approaches in light of new issues, new information or the insufficiency of existing information;

- a way to assess whether shortcomings have been addressed; and
- a public reporting to the community and the funding agencies on the continued relevance of the plan and necessary revisions to it.

5.3.2 Action Initiation

A "Great Lakes 2000" Committee will be assigned responsibility for auditing the strategic research plan. This committee should develop a general outline of its proposed work by the end of 1990 and submit the outline for approval to the Council.

5.4 The 3 R's: Recruitment, Replacement and Retention

The strengthening of the research community in the Great Lakes basin begins with the creation of a healthy research climate that attracts and holds expertise. That climate is established by the opportunities offered. In that sense, senior managers and political leaders must accept science first as a highly personal, almost artistic avocation with a worldwide clientele, than as a production process amenable to hierarchical management. It is not something that can be addressed only by the infusion of money, although that is a vital ingredient for the kind of stability essential for science. It cannot be reasonably expected from the provision of physical facilities alone, although that can be useful

to concentrate effort efficiently. And it is not something that can be kick-started from a vision or mission statement, although that is often the basis for a commitment that sustains the effort both personally and professionally for the scientist.

The strengthening of research includes all these things but goes much further. It leads to the establishment of something that may seem elusive to the outsider but is well understood at the leading edge of the science community: a vigorous intellectual environment that by its own power attracts and develops skill, encourages initiative and provides incentive for innovation. And increasingly, in the field of ecosystem sciences, it insists on transdisciplinary expertise and synthesis. This is what must be reestablished in the Great Lakes.

Although it is a significant challenge, a vigorous intellectual environment must be re-established in the Great Lakes region. The consequences of not doing so will ultimately be born most heavily by the people who make their home in the Great Lakes basin, not the research community. How can Great Lakes scientists be recruited from other friends or from the coasts? How can graduate students be attracted? How can universities and government laboratories be properly persuaded that the basin requires their attention? And how can retraining be introduced to assist those who have decades of experience in addressing the changing needs of research?

Perhaps it would be easier if the public and private sector decision-makers of today understood that they are already in a bidding war for the expertise that will be a vital part of the foundation for future social and economic survival. It is time to wake up. The community of scientists in the Great Lakes that has served us so well in the past is aging, and is working under outmoded institutional and intellectual frameworks.

5.4.1 Action Recommended

Within the next two years, the managers of research institutes in the Great Lakes, in conjunction with their colleagues in surrounding universities, should develop a comprehensive, basinwide plan to increase the number of appropriately trained scientists so by the year 2000 the number of researchers in the region will have doubled. The plan should explore how to establish better links between universities, industries and government laboratories, and should include better access to field facilities and equipment, and improved maintenance of and access to collections and databases.

5.4.2 Action Initiation

The Council of Great Lakes Research Managers, through its secretariat and with the assistance of its newly formed "Great Lakes 2000" Committee, will develop an outline and justification for a two-year plan to provide mechanisms and support systems to attract and retain high calibre, ecosystem-oriented natural and social scientists, science support staff and research managers. The plan will

be forwarded to the International Joint Commission and the parties thereto so it can be implemented with full implementation proposed by 1993.

5.5 Transdisciplinary and Interjurisdictional Research

An ecosystem is a human descriptive concept of the seamless web of natural elements, actions, interactions and dependencies. The system itself is not conducive to understanding by intellectually carving the whole into disciplinary units or political jurisdictions. This human reductionist imperative from the past, however useful, now raises many obstacles for the development of process knowledge and workable management solutions.

The limits that inadvertently have been imposed on the way that scientific research has been done in the past must be removed. Ecosystem-oriented science is evolving. Since there is no clear precedent, research management systems must be flexible, with emphasis less on responsibility and more on accountability.

5.5.1 Action Recommended

- a. To a greater degree, science programs should include exploratory and anticipatory research initiatives.
- b. Research that bridges the traditional scientific disciplines and institutional mandates and cuts

across political jurisdictions in the Great Lakes should be encouraged over the next five years by a variety of incentives, including measures arising from formal references to the IJC, dedicated funds, career enhancement, and fellowship programs and interchanges.

- c. Science programs should be expanded in scope and more deliberately linked, in part, to the development of social policies and governing statutes in the basin. Transdisciplinary teams should become involved in programs and projects as well as planning and developments such as the Remedial Action Plans (RAPs) and the Great Lakes Protection Fund.
- d. The Council of Great Lakes Research Managers should be expanded to include expertise in economics, sociology and communications as the first step in the promotion of program activities that stress transdisciplinary research.

5.5.2 Action Initiation

- a. The Council of Great Lakes Research Managers, through the newly created "Great Lakes 2000" Committee (5.3.2), will develop a proposal for the encouragement of transdisciplinary/transjurisdictional research for consideration by the IJC and the Great Lakes Fishery Commission.
- b. The secretary to the Council will prepare transmittal documents for funding agencies with Great Lakes missions or mandates

(e.g. Sea Grant, National Science Foundation, Protection Fund, National Scientific Environmental Research Committee (NSERC)/National Research Council (NRC), Health Research Council, U.S. Fish and Wildlife Services (U.S. FWS), National Oceanic and Atmospheric Administration (NOAA), U.S. Environmental Protection Agency (U.S. EPA), Environment Canada, Canadian Universities and other institutions that press the need for targeted research and training funds which integrate social/ political/economic and engineering disciplines with natural sciences in the Great Lakes basin.

- c. The Council, through its secretariat, will develop a transdisciplinary membership action plan.

5.6 Valuing Science

Despite many past and continuing contributions, science appears to be losing stature in society. Yet the demands on the research community to solve many of the world's problems continues to increase. The result is that frustration among researchers is increasingly common. This frustration needs to be dealt with deliberately. Science directors must play a leadership role, not only in supervising research, but also in fostering pride in the scientific profession and the contributions research makes to society.

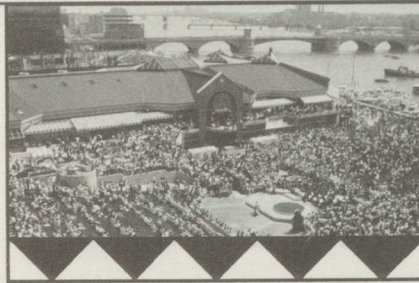
5.6.1 Action Recommended

Governments should directly acknowledge the value of the research effort in future Great Lakes policy and planning and promote scientific leadership for 1990s problem solving by:

- creating meaningful and open interactive mechanisms for dialogue between the science community and senior government decisionmakers at all levels;
- establishing science leadership as a prerequisite for science management;
- fostering and encouraging excellence in science through administrative stability and the creation of nonmonetary incentives such as science exchange, fellowships and awards.

5.6.2 Action Initiation

A number of ongoing actions are addressing many of the above points. Re-assessment of these activities should be undertaken following future audits. Additionally, ongoing programs should be evaluated to see if further improvements can be made under existing management authority and within existing budgets.



6.1 Workshop Conclusion

The Great Lakes research community has a special responsibility to provide easily understood and accurate information to the people who live in the basin and to decisionmakers in the public and private sectors. Given the seriousness of the issues, there is a need to develop a proactive education and communication strategy that would:

- establish an open dialogue between the scientific community and the public to ensure that research is responsive to needs and priorities;
- bring science and the results of research into the public education system at all levels;
- facilitate the translation of research findings into policy and legislation by opening new lines of communication between scientists and senior decisionmakers in all sectors; and
- improve the flow of relevant information between researchers working in different fields and institutions, and between researchers, research managers and others.

6.2 Using An Ecosystem Vision and Charter

A basinwide, forward-looking, consensus-building exercise for the Great Lakes (see Chapter 4)

would offer an ideal means to bridge the communication and information gaps that now exist between various groups, institutions and jurisdictions. It would provide, among other things, a forward looking and constructive basis for the kinds of comprehensive education and communication programs that will be required in the region over the next decade if public choices are to be made in support of ecosystem integrity.

6.2.1 Action Recommended

The decade "Great Lakes 2000" (see Chapter 3) should be a major component of a basinwide education and communication strategy. The initial focus should be on the development of a Great Lakes Ecosystem Charter through the involvement of schools, citizen interest groups, private corporations, universities and governments at all levels.

6.2.2 Action Initiation

The Council of Great Lakes Research Managers will recommend to the IJC, GLFC and other federal agencies, The Center for the Great Lakes and the Council of Great Lakes Governors and Premiers (See 3.2.2) that a Great Lakes Ecosystem Charter be used as the starting point for public discussion and that schools throughout the basin be asked to provide the illustrations and text for the preamble of a charter or other decade "Great Lakes 2000" exercise.

6.3 Extension Services

Translation of scientific activities and the results of research, into terms that are relevant and understandable to the public, is often neglected. It is an important activity of the research community, particularly in a heavily populated and industrialized area like the Great Lakes basin. The U.S. Sea Grant Program advisory service provides a good example of what can be done to inform and educate the public, but much more needs to be done (especially on the Canadian side) to bridge the gulf between scientific literature and public understanding. Education for all age groups, especially graduate and other forms of adult education, is a risk-free investment that yields large and growing dividends. It is an investment that cannot be neglected, and must become a primary goal in the Great Lakes basin.

6.3.1 Action Recommended

Research programs in the Great Lakes basin should place particular emphasis on extension services that communicate, and interpret research to the public. To facilitate this, it is recommended that:

- a. a Great Lakes section of the National Marine Educators Association (NMEA) and other similar programs be established; and
- b. a workshop be organized by Canadians in the spring of 1991 to review how outreach services could be improved similar to

those offered by the U.S. Sea Grant Program and other similar organizations. The results of the workshop should be brought to the fall 1991 Sea Grant meeting in order to combine forces to create an efficient basinwide program.

6.3.2 Action Initiation

The Council of Great Lakes Research Managers will ask that Dr. J. Reutter and Dr. J. Vallentyne to approach the National Marine Educators Association about establishing a Great Lakes section and bring that section into the mainstream of environmental education in the basin.

The Council Secretariat will request that the Science Liaison Officer at the National Water Research Institute (Burlington), together with a colleague from the Ontario Ministry of Natural Resources, take the lead in organizing a meeting for people interested in developing an extension service in Canada. The meeting would draw on the ongoing activities of Canadian universities in the basin, government agencies and public interest groups such as Great Lakes United.

6.4 Answering to the Public

Almost without exception, funds that support Canadian and American research in the Great Lakes are provided by taxpayers. Workshop participants recognized that there is an obvious — but often overlooked — need to provide direct public program accountability to

the people who not only support but also benefit from the work.

6.4.1 Action Recommended

The research community in the Great Lakes should improve communication links to and from the public that it serves. Specific measures to accomplish this should include:

- a. a clear indication in all research programs of how the results will be transmitted to the public;
- b. a "Council of Great Lakes Research Managers Award for Excellence in Research Communication" presented annually at the meeting of the International Association of Great Lakes Research to a research scientist working in the basin who, by example, has best linked research activity to a wider public interest;
- c. a formal policy statement by the Council declaring that it supports scientists' participation in educational programs and that such activity is recognized as an important part of research;
- d. participation of outside interest groups, corporate leaders and public officials in the activities of the Council;
- e. the development of a basinwide communications and education strategy through the International Joint Commission, the Council of Great Lakes Research Managers, the Great Lakes Fishery Commission, International Association for Great Lakes Research or others; and

f. development of training programs for scientists on communication/education strategies — how many have a background in communications and know how to interact with the public?

6.4.2 Action Initiation

The Council of Great Lakes Research Managers will:

- recommend to the International Joint Commission that research funding proposals should be encouraged to include an appropriate public communication component and means be developed throughout the basin to have research funding and management agencies adopt such an approach;
- make executive summaries of Council meetings and workshops available to interested senior officials in the public and private sectors in the basin and to active environmental and other nongovernment organizations in the region;
- consider an annual award for science communication; and
- as a matter of practice for all future meetings, invite policy makers and other interested parties to participate in summary sessions and social functions of this Council.

6.5 Marketing Research and the Research Community

Some in the research community assume that because scientific work is important, the merits are obvious and others will seek out research information. This assumption has isolated the research effort to the margins of the larger community of decisionmakers and the interested public. Although there are several notable examples of how individual research scientists and institutes have actively sought involvement from the broader public, a compelling need remains to shift traditional roles and to establish a more proactive attitude within the research community.

6.5.1 Action Recommended

The Great Lakes research community, and the Council of Great Lakes Research Managers in particular, should develop a proactive stance to public communication.

6.5.2 Action Initiation

The Council of Great Lakes Research Managers, through its secretariat and the public information section of the International Joint Commission, will establish a "Great Lakes 2000" Communications Network with assistance from the Great Lakes Commission's Communication Task Force, and charge it with reviewing current communication/education/marketing efforts for Great Lakes research and develop and present a new program to the Council for consideration.

6.6 Streamlining Information Access

Easy access to the scientific work completed in the basin is important to the scientists and managers using the information, and the interested public. The ecosystem approach necessitates communication between and among teams of specialists and transdisciplinary workers. The research community and nonspecialists need improved communications frameworks to identify proposed and implemented research.

6.6.1 Action Recommended

An easily accessible electronic "bulletin board" and other frequently updated descriptions of research projects for the Great Lakes basin should be developed and made available to all those who work with social and natural science issues in the region.

6.6.2 Action Initiated

The Council of Great Lakes Research Managers will dedicate a specific agenda item at their next meeting to developing a streamlined method to access information on research and research activities, to establish a comprehensive, basinwide system from a number of existing systems such as the one used by U.S. Sea Grant.

6.7 Greater Community Involvement

The research task in the 1990s is simply too large to be assumed by any one group. It is inherent in an ecosystem approach that there be widespread involvement by the people who make the region their home; they are key parts of the ecosystem and must accept greater responsibility for it.

6.7.1 Action Recommended

As part of the Great Lakes research strategic plan for the 1990s, a citizen-oriented effort should be encouraged to enhance environmental reporting, to marshal public involvement and to increase opportunities for exchanging information with the research community in the basin.

6.7.2 Action Initiation

The Council of Great Lakes Research Managers acknowledges the need for broadly based public involvement and will write to all active organizations in the basin to encourage the establishment of a public participation network. The Council, through its secretariat, will assemble a package that includes information on possible funding sources (e.g. the Environmental Partners Fund in Canada) and possible organizational models based on the Atmospheric Environment Service citizens observers and Trout Unlimited's programs, among others.

There was extensive dialogue and discussion after the panel presentation. What follows is a summary of the general themes and some individual points of view arising from this discussion. This effort was undertaken on a binational basis but it is tantamount to recognizing that there are two different political systems that the science seems to support.

The panel and workshop participants identified many barriers that need to be overcome when communicating science to the decision-maker, and that the mechanism, if not found soon, will hinder progress to solve the major problems. This does not only exist in the Great Lakes - Saint Lawrence River Basin but globally as well.

It is the existing institutional framework that is responsible for the information transfer process. There are examples of institutions setting clear policies, in order to work in cooperation with others, so as not to confuse the issues. But many of the research and management institutions now in place do not have the balance needed to react fast enough and radically enough to cope with rapid, massive scale changes. The future horizon is expanding and we are woefully unprepared to take on the global change, but the effort must continue.

The development of new organizations are the least attractive answer to a lot of the problems. There would be major disagreements within public universities and government agencies in both countries if the creation of yet another institute or super-agency were proposed, especially when the funds for this effort are levered away from them. What is needed are new agendas for a lot of the

existing environmental institutions and corporate ones, including finance ministries. The problems we are concerned with today are global in nature and it will involve many more countries, besides the United States of America and Canada, to address the issues.

There is knowledge relevant to politics in science, and it is in most ways up to the science to address issues globally and this translates into "Planetary Politics." As we are working in a much more sophisticated international mode and sovereignty in many respects is going to be of much less importance, transnational scientific experiences will be how scientists communicate across borders and solve problems.

The timeframe to solve the problems is exponentially decreasing and we are already into decades to centuries when addressing issues, such as global climate change, ozone depletion, toxic chemicals and acid rain. A strategy is needed. At present, the research institutions do not seem to have the right timeframe in mind when strategies to deal with the problems are developed. There are two time frames to consider: 1. solve the problem and 2. react to what cannot be solved in the meantime and hopefully the problem will be solved. This approach should also consider that the correct measurements are taken in order to be aware of a problem and that the validation of models is paramount in this exercise.

Scientific information should be public and should not have to be filtered directly through the political process, as it presently is. The decisionmakers who set the envi-

ronmental agendas and create government policy need synthesized, understandable information. Scientists have shown that they are capable of laying out a political agenda (i.e. phosphorus issue). There are examples where we do know the answers, but we have not been able to implement them. For land holdings, for instance, to effectively reduce loads of sediment and nutrients to the environment, the land owners may have to change their behavior and practices and lifestyles.

The conveyance of scientific information as advice to governments for action and policy decisions is much needed. This mechanism needs to be collaborative and transboundary. There are presently mechanisms being established and opportunities to transform institutions, but the setting of priorities and the avenues for transferring that scientific information to the recently-created institutions is missing. One mechanism is the provincial and national roundtables which act as forums for information and idea exchanges between the public, government and industries. To bypass bureaucracy, the roundtable initiatives can be incredibly effective. There is a need by decision and policy makers to acquire good translatable, transferable communication with a simple clear message that is backed by sound scientific advice. A communication network also must be in place to be effective in this process. The fact that extraordinary actions are needed to bypass the government bureaucracy, to get the message across, is an indication that the system, as it is presently set up, is flawed.

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