1999-05-07

Study of Indicators Initiatives

Lynne M. Witty

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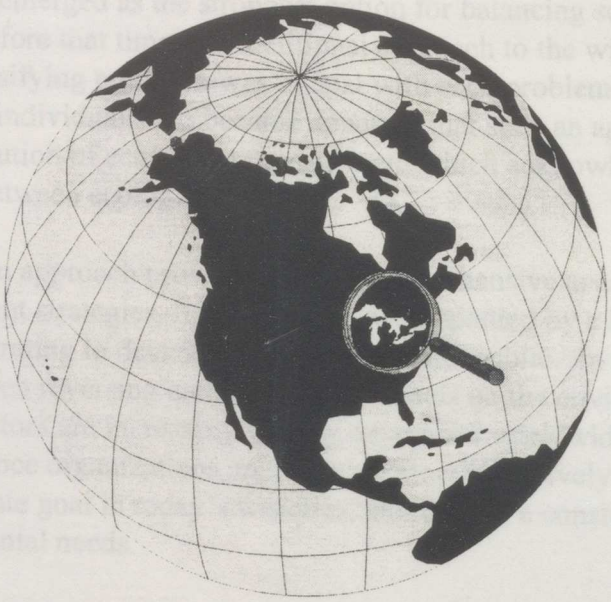

prepared for the

INDICATORS IMPLEMENTATION TASK FORCE

of the

INTERNATIONAL JOINT COMMISSION

by

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May 7, 1999

International Joint Commission
Commission mixte internationale

EXECUTIVE SUMMARY

Indicators initiatives have been gaining in popularity since the late 1980s when the topic of sustainable development emerged as the strongest option for balancing socioeconomic and environmental needs. Before that time, the traditional approach to the widespread degradation of natural habitats and intensifying pollution was to deal with each problem as it emerged by treating each component individually. It became apparent that such an approach was inadequate, particularly with the evolution of ecosystem management which acknowledges the multiple interactions within and between ecological systems.

Although an ecosystem approach provides a more comprehensive analysis in support of environmental management strategies, it is inevitably accompanied by a level of complexity which is particularly frustrating to decision-makers and to the public. In order to assess the progress in halting and even reversing anthropogenic impacts on the environment, frameworks based on the use of indicators are increasingly being developed worldwide. This is an evolving and very complex field since organizations are focusing more intensively on sustainable development as the ultimate goal in today's societies, based upon a consideration of social, economic, and environmental needs.

The International Joint Commission's (IJC) involvement in this field was initiated by the recognition of the "Great Lakes Basin Ecosystem" for the first time in the 1978 revision to the Great Lakes Water Quality Agreement (the "Agreement"). Although previous IJC Task Forces did investigate the use of indicators, the establishment of the Indicators for Evaluation Task Force (IETF) in 1993 truly launched this initiative, leading to the publication of a proposed IJC indicators framework in the 1996 report Indicators to Evaluate Progress under the Great Lakes Water Quality Agreement. With the inception of the Indicators Implementation Task Force (IITF) in 1997, research into this framework was initiated.

As with any endeavor into a field wrought with so many levels of complexity, a study of similar efforts by other organizations often serves as an invaluable source of guidance. By learning from the successes and failures of others, the IJC can best frame its own indicators work, geared toward assessing progress under the Agreement. This was the central purpose of this report.

The review of indicators initiatives has brought several issues to the foreground. Following is a list of suggestions that have recurred throughout this research as necessary to the successful implementation of indicators strategies:

- unprecedented collaboration must become the norm to allow for real improvement
- an internationally supported framework must be developed to provide a "common language" and to facilitate inter-agency communication

- indicators are needed which are "necessary and sufficient" for local needs
- indicators must be tied to specific goals and objectives. Targets add an easily interpreted element to this process which clearly demonstrate progress toward goals
- this work must be continually monitored and updated as new issues emerge
- managing databases in an efficient and standard manner is absolutely critical
- frameworks need to be geared to policymakers and the public at large
- indicators must be placed within a proper context or risk misinterpretation

The IETF (1996) proposed framework of Desired Outcomes and indicators/measurements comes as close as any of the initiatives reviewed to following the above suggestions. Striving to implement some of the lessons learned from other indicators initiatives, outlined in this report, would strengthen the goals of the IJC in assessing progress under the Great Lakes Water Quality Agreement.

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Table 1. Common Acronyms

Acronym	*Title*
AEOC	Aquatic Ecosystems Objectives Committee
ANZECC	Australian and New Zealand Environmental and Conservation Council
BC	British Columbia
BCSD	Business Council for Sustainable Development
BEC	Binational Executive Committee
C&I	Criteria and Indicators
CCFM	Canadian Council of Forest Ministers
CCIW	Canada Centre for Inland Waters
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation
CIFOR	Center for International Forestry Research
CSERA	Canadian System of Environmental and Resource Accounts
EC	Environment Canada
EMAP	Environmental Monitoring Assessment Program
EUROSTAT	Statistical Office of the European Communities
FRAP	Fraser River Action Plan
G7	Group of 7 Nations (Britain, Canada, France, Germany, Italy, Japan, and the United States)
GDP	Gross Domestic Product
GIS	Geographic Information System
GLFC	Great Lakes Fishery Commission
GLNPO	Great Lakes National Program Office
GLWQI	Great Lakes Water Quality Initiative
GMI	Green Mountain Institute
GPI	Genuine Progress Index
HC	Health Canada
IETF	Indicators for Evaluation Task Force
IISD	International Institute for Sustainable Development
IITF	Indicators Implementation Task Force

1.0 INTRODUCTION

The Great Lakes Region is an area of extremes, be it on a geographical scale or via political complexities. "As well as anywhere in the world, the Great Lakes Basin exemplifies the modern tendency to push the environment to the brink" (Government of Canada, 1991). When the level of degradation reached the point where it could no longer be ignored or attributed to the "price of progress", both Canada and the U.S. were quick to respond. The result was the Great Lakes Water Quality Agreement, signed in 1972 then revised in 1978 and amended in a 1987 Protocol. Its ultimate goal is "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem" (Governments of Canada and the United States, 1987).

In response to the increased emphasis in the 1987 Protocol on "ecosystem management" and the need for measurement tools to evaluate its implementation, the IJC established the IETF in 1993 to design an indicators framework. This was meant to assess the progress of the two nations in implementing their commitments under the Agreement. In 1997, the IITF was established to research this issue. As part of their initial investigation, the task force reviewed the indicators work by other nations. This was one of the critical first steps since the lessons learned by more established programs can serve to guide the development of new frameworks.

This report represents an effort to continue in this vein and to update the IITF on some of the initiatives being carried out worldwide. It begins by setting a historical context through a chronology of indicators work within the Great Lakes Basin. The topic of sustainable development upon which many of the indicators initiatives reviewed are based, is briefly discussed in Section 3. This is followed by an outline of the IETF framework then a review of Multinational, Canadian, and American initiatives in Sections 5-7, respectively. The report ends with concluding remarks tying together the overall themes presented throughout.

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2.0 CHRONOLOGY OF INDICATORS WORK IN THE GREAT LAKES BASIN

As understanding of nature's processes increases, new approaches are continually evolving worldwide to monitor and mitigate the impact of human societies on ecosystems. These developments are often reflected in legislation and have a major impact on how business is carried out in both Canada and the U.S.. Current indicators initiatives, within the Great Lakes Basin and beyond, need to be considered in the context of this evolving understanding of the need for a multidimensional (i.e. ecosystem) approach to environmental problems. A chronology of indicators initiatives was therefore compiled, focusing not only on the primary events which occurred within the Great Lakes Basin proper, but also including the major international initiatives which have had a significant influence on policymakers in this region. Though by no means exhaustive, this study was meant to give the reader an appreciation for how recently indicators have entered into the language of decision-makers and how work in this domain is shaped by the legislative influences of both nations.

1909 - U.S. and Great Britain (for Canada) enter into the "Boundary Water Treaty"
(the first binational environmental agreement)
- IJC is created under article VII of this Treaty and serves as an open forum for resolving/ preventing disputes between Canada and the U.S. in regard to pollution issues affecting the common border

1911 - 1st meeting of the IJC, consisting of 3 U.S. and 3 Canadian impartial Commissioners

1955 - binational "Great Lakes Fishery Commission" is established
- first set out to find a means of controlling the decimation of the Great Lakes fish populations by parasitic sea lamprey. Their work has been expanded to include coordination of government efforts to restore fish populations

1962 - "Silent Spring" by Rachel Carson is released
- this book is one of the first strong public warnings of the dangers of toxic chemicals in the environment

1964 - request from Canada and U.S. to the IJC for a study
- due to public demands and increasing concerns over the impact of toxic chemicals on the Great Lakes Basin, the IJC begins a study of pollution problems in the Great Lakes

1965 - U.S. "Water Quality Act" passes into law

1968 - **U.S. National Technical Advisory Committee on Water Quality Criteria issues a report**
- this report recommends that physical and chemical measures be used to monitor improvement in water quality

1969 - **U.S. "National Environmental Policy Act" (NEPA) passes into law**
- it is the U.S.'s basic national charter for environmental protection. It establishes policy, sets goals, and provides means (such as environmental impact analyses and records of decision) for carrying out the policy

1970 - **IJC issues its report which sprang from the Parties' 1964 request**
- the report, entitled "Lower Great Lakes Pollution Reference" sets the stage for the Great Lakes Water Quality Agreement and supports mounting claims of serious pollution impacts in the region
- **Canadian "Water Act" passes into law**
- **U.S. EPA is created**

1971 - **U.S. EPA establishes the "Large Lakes Research Station" at Grosse Île, Michigan**
- this is the first official program aimed at researching the Great Lakes
- **first draft of the "Canada-Ontario Agreement" is signed**

1972 - **U.S. and Canada sign the "Great Lakes Water Quality Agreement"**
- **U.S. passes its "Clean Water Act"**

1976 - **U.S. "National Forest Management Act" passes into law**
- supports the development of management indicator species

1977 - **U.S. EPA establishes the "Great Lakes National Program Office" (GLNPO)**
- this office is charged with coordinating U.S. activities pursuant to the Agreement
- it is the main focal point for coordinating U.S. EPA efforts with all other agencies working on Great Lakes issues

1978 - **the Agreement is revised to better reflect current issues in the Great Lakes Basin**
- shift of focus from nutrients to toxic substances
- calls for "virtual elimination" of Persistent Toxic Substance discharge into the Great Lakes
- the "Great Lakes Basin Ecosystem" is defined for the first time and becomes the focus for future binational management strategies
- **the IJC's Science Advisory Board establishes the AEOC (Aquatic Ecosystems Objectives Committee)**
- their mandate is to develop ecosystem objectives for the Great Lakes, pursuant to the revised Agreement

- **U.S. EPA officially recognizes the unique status of the Great Lakes in the "Clean Water Act" and begins the process of developing the Great Lakes Water Quality Initiative (GLWQI)**

1990 - **OECD (Organization for Economic Cooperation and Development) initiates a specific program on environmental indicators and produces a conceptual framework using the "Pressure-State-Response" (PSR) model**
- this work was initiated in response to the request by G7 nations made in 1989
- the PSR model is subsequently used by several organizations worldwide to frame their own indicators initiatives
- **U.S. passes the "Great Lakes Critical Programs Act"**
- this serves to codify ongoing U.S. EPA efforts in developing the GLWQI
- **amendment to the U.S. "Clean Water Act"**
- requires U.S. EPA to publish water quality guidance for the Great Lakes System which conform to the Agreement. This work is known as the "Great Lakes Initiative"
- **Canada releases its "Green Plan"**
- this was initiated in preparation for the 1992 UNCED (United Nations Conference on Economic Development)
- makes government-wide commitments to developing a national set of environmental indicators
- **behavioral differences found in New York infants whose mothers ate Great Lakes fish**

1991 - **first progress report on the Canadian National Environmental Indicators**
- **U.S. - Canada Air Quality Agreement is enacted**
- calls for reductions in acid rain
- **the national governments of Canada and the U.S., in collaboration with Ontario, Michigan, Minnesota, and Wisconsin, agree to establish a "Binational Program to Restore and Protect the Lake Superior Basin"**
- **the U.S. Geological Survey, in conjunction with the U.S. EPA and other Federal/ State agencies, creates the ITFM (Intergovernmental Task Force on Monitoring Water Quality)**
- purpose is to develop an integrated, nationwide strategy for monitoring water quality which includes work on establishing indicators

1992 - **UNCED takes place in Rio de Janeiro - Agenda 21 is the final product of this conference**
- strongly advocates the principles of sustainable development
- endorses "eco-efficiency" as a major initiative for business to contribute to sustainable development
- member countries of OECD issue environmental performance reports in which "core indicators" emerge

- this conference initiates a wave of new initiatives to develop indicators of sustainable development
- **as a follow-up to UNCED, CCME (Canadian Council of Ministers of the Environment), Environment Canada, IISD (International Institute for Sustainable Development), NRTEE (National Round Table on the Environment and Economy), and the International Development Research Centre meet and devise "Le Project de Société"**
- meant to track Canada's progress in implementing Agenda 21 and to propose a national sustainable development strategy

1993 - **IJC establishes the IETF (Indicators for Evaluation Task Force)**
- mandate is to develop a framework for evaluating progress under the Agreement (including indicators)
- **U.S. "Government Performance and Results Act" is enacted**
- intended to improve public confidence by holding federal agencies accountable for program results and to improve federal program effectiveness and decision-making

1994 - **"Ecosystem Charter for the Great Lakes-St. Lawrence Basin" is issued**
- though not legally binding, this document builds upon the Boundary Waters Treaty and the Great Lakes Water Quality Agreement
- meant to further efforts to implement an ecosystem approach to this region
- **Canada's "Environmental Assessment Act" passes into law**
- meant to integrate sustainable development principles into all federal planning and decision-making
- **latest revision of the "Canada-Ontario Agreement" is signed (other revisions in 1976, 1982, and 1986)**
- revised to better reflect the revised Agreement of 1978 and its 1987 Protocol
- this is Canada's primary vehicle for fulfilling its responsibilities under the Agreement

1995 - **"State of the Great Lakes Report" is issued**
- first binational attempt by governments to relate the state of ecological variables to a set of indicators developed for that purpose
- **U.S. EPA issues the "Great Lakes Water Quality Initiative"**
- holds water quality guidance for the Great Lakes
- **States and the U.S. EPA enter into a joint commitment on May 17 to implement NEPPS (National Environmental Performance Partnership System)**
- meant to protect the environment and more effectively operate U.S. environmental protection programs
- one of the major components to this is an increased use of environmental goals and indicators

1996 - **IETF publishes its indicators framework in the report "Indicators to Evaluate Progress under the Great Lakes Water Quality Agreement"**

1997 - IJC establishes the IITF (Indicators Implementation Task Force)
- mandate is primarily to investigate the feasibility of implementing the IETF's proposed framework
- **revised "Joint Strategic Plan for Management of Great Lakes Fishery"**
- reaffirms the ecosystem approach to Great Lakes management
- recognizes the need for coordination with the Agreement and for better integration of fisheries with ecosystem management initiatives

Although the stage was set by several earlier pieces of legislation and research endeavors, the decade of the 1990s was the real launching point for several indicators initiatives, worldwide. The concept of sustainable development emerged as the strongest option for balancing socioeconomic and environmental needs, thus initiating more comprehensive analysis into the ecosystem approach and a refocus of policy needs. In preparation for the 1992 UNCED (United Nations Conference on Economic Development) in Rio, several international agencies began work on new ways to integrate these concepts into their operations. A brief discussion of the topic of sustainable development is presented in the next Section of this report, followed by an outline of the IETF framework in Section 4 then a review of major indicators initiatives in Sections 5-7.

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3.0 SUSTAINABLE DEVELOPMENT ISSUES

Life has been molded into many different forms, thereby creating intricate interrelationships, known as "ecosystems." Complexity lends itself to stability in such systems so that threats to ecosystems also threaten "biodiversity" (i.e. the diversity of life on Earth). These threats have become a major focus of concern for scientists worldwide as the human species continues to have serious impacts on the environment. Despite seemingly endless variations of life forms, landscapes, and the depth of human cultures, widespread environmental degradation has brought common concerns (e.g. air and water pollution levels) to the public consciousness.

In an attempt to deal with this mounting public tension, certain concepts are being increasingly discussed in an international setting, including those on which the IJC's work is based: sustainable development, an ecosystem approach to environmental management, and biodiversity. In order to achieve and maintain a biodiverse planet, balance between human needs and the needs of the environment must be attained. This is a simple definition for "sustainable development", a concept which can partly be achieved through an "ecosystem approach." Many of the inadequacies of the past in dealing with serious environmental damage can be traced to a de-constructed approach. As Shear (1996) stated, the early response to negative impacts was to deal with each case as it arose, an approach which did not work well due to the complexities inherent to natural systems.

The growing realization that the problems of environmental degradation cannot simply be labeled and dealt with in an *ad-hoc* manner has left both the public and decision-makers in a very frustrated state. The global need for structure and guidance in setting policies has increasingly led to research into setting specific goals, to be measured through the use of indicators. As Harris and Scheberle stated in 1995:

> *"...the move toward ecosystem management and integrated programs in the natural resources and pollution control agencies, combined with the need to better measure progress in environmental protection and the development of a risk assessment framework, were the forces that converged in the political arenas to influence the development of measurable ecological indicators."*

Each region has unique environmental difficulties to deal with, based upon the specific combination of biogeographic, climatic, cultural, political, and socioeconomic conditions within its boundaries. However, nations are being drawn together by common sets of issues which they are increasingly faced with and the realization that "cooperation is essential because [environmental] problems do not respect political boundaries" (Government of Canada and the U.S. EPA, 1995).

Bi-national agreements, notably the Great Lakes Water Quality Agreement, attempt to bring a common language to the political arena so that a framework for dealing with pollution issues can

be set in motion. By studying the attempts of other nations to develop their own indicators programs, improvements can be made based upon the lessons they have learned.

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4.0 IETF PROPOSED INDICATORS FRAMEWORK

As was outlined in the introductory Section of this report, the IJC's mandate to assess progress under the Agreement and to develop advice to the Parties led to the establishment of the IETF in 1993. Its research into developing an appropriate framework was published in the 1996 report Indicators to Evaluate Progress under the Great Lakes Water Quality Agreement. This model is based upon five key components, shown in Figure 1 and summarized as:

1. Agreement Purpose
2. Desired Outcomes
3. Relevant Data and Information
4. Stresses
5. Programs and Policy

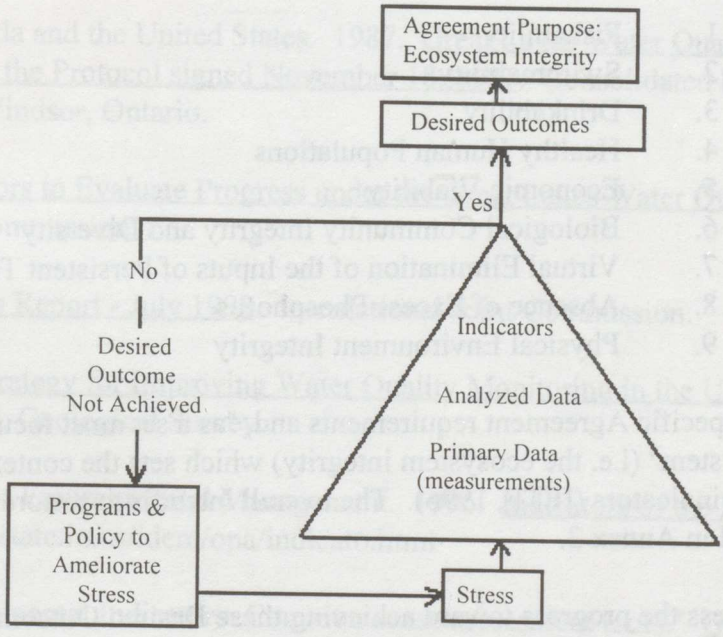

Figure 1. IETF Proposed Framework to Evaluate Agreement Progress (IETF, 1996)

The emphasis is on policy-related indicators since the goal is to achieve the purpose of the Agreement, namely **ecosystem integrity**. This encompasses the following three major factors: the ability of an ecosystem to operate normally under normal conditions, to cope with stress, and to continue to evolve and develop (IETF, 1996). More specifically, the Agreement's ultimate goal is to "restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem" (Governments of Canada and the United States, 1987).

Although the term "sustainable development" does not appear in the text of the Agreement, the IJC does believe that "socioeconomic considerations are implicitly embedded in, and a logical interpretation of the principles underlying the Agreement" (IETF, 1996). The focus on policy assessments provides feedback on which programs/policies are effective and which need to be revised. Therefore, this approach increases the efficiency of programs and also the accountability for results (RRI, 1994).

The IETF framework is based upon nine **Desired Outcomes**, "in part derived from Annex 2 [of the Agreement], "Impairment of Beneficial Uses", against which to gauge progress" (IITF, 1998). They are:

1. Fishability
2. Swimmability
3. Drinkability
4. Healthy Human Populations
5. Economic Viability
6. Biological Community Integrity and Diversity
7. Virtual Elimination of the Inputs of Persistent Toxic Substances
8. Absence of Excess Phosphorus
9. Physical Environment Integrity

These are tied to specific Agreement requirements and, "as a set must focus on the sustainability of the entire ecosystem" (i.e. the ecosystem integrity) which sets the contextual framework for the IJC's work on indicators (IETF, 1996). The overall intent is to restore the beneficial use impairments listed in Annex 2.

In order to assess the progress toward achieving these Desired Outcomes, sets of **indicators** have been developed. The ITFM (1994) defined an environmental indicator as:

> *"a measurable feature which singly or in combination provides managerially and scientifically useful evidence of environmental and ecosystem quality, or reliable evidence of trends in quality"*

"Indicators are bridges between technical data and definitive conclusions about achievement of a Desired Outcome" (IETF, 1996). Raw data must be set within an appropriate context in order to be transformed into indicators (Indiana Department of Environmental Management, 1996). The IETF's main criteria for choosing their indicators were: reflect the goals of the Agreement,

scientifically complete, and understandable to the public.

An appropriate framework was needed to structure a coherent indicator set. Among the many proponents of the OECD PSR framework is the IJC and its various task forces whose set of indicators/measurements is meant to assess *pressures* (or stress) on the environment by human influences, the actual *state* (or condition) of the Basin, and *responses* to this condition by society and decision-makers (SEGIP, 199?).

Responses can be manifested as programs and policy to ameliorate the stress on the condition of the Great Lakes Basin ecosystem, measures which may need to be altered if Desired Outcomes are not achieved. This is shown in Figure 1 as a continually evolving, feedback system. A detailed analysis of the Framework is presented in the IETF's 1996 report Indicators to Evaluate Progress under the Great Lakes Water Quality Agreement.

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5.0 MULTINATIONAL INDICATORS INITIATIVES

5.1 Core Set of Indicators for Environmental Performance Reviews:

The OECD (Organization for Economic Cooperation and Development) has been carrying out work on environmental indicators for quite some time, especially since the 1989 G7 meeting called for studies into the integration of economic and environmental monitoring systems. A further impetus for continuing work in this area was the launch of "Environmental Performance Reviews", which are primarily aimed at helping member countries of the OECD to improve their individual and collective performance in environmental management. In 1993, the agency released a Core Set of Indicators for Environmental Performance Reviews.

This work is set within a PSR (pressure-state-response) framework which serves to structure and classify types of indicators. In such a model, *pressure* refers to stresses from human activities on the environment, *state* reflects the present conditions in an ecosystem, and *response* deals with society's efforts to tackle environmental problems (caused by pressures so that a feedback mechanism is enacted). Although classification of indicators is useful, it provides insufficient guidance for setting policies and management plans. Therefore, the OECD selected the following **14 key issues** to focus their efforts upon:

1. Climate change
2. Stratospheric ozone depletion
3. Eutrophication
4. Acidification
5. Toxic contamination
6. Urban environmental quality

7 & 8. Biological diversity and landscape

9. Waste

Represent "Environmental Quality"

10. Water resources
11. Forest resources
12. Fish resources
13. Soil degradation

Represent "Environmental Quantity"

14 - General indicators (e.g. population growth and density)

Within each issue, indicators are chosen based upon their policy relevance, analytical soundness, and measurability to represent *pressures, conditions,* and *responses*. The following is an example for Issue #10 - Water Resources:

Indicator of environmental pressure - intensity of use of water resources (S)

Indicator of environmental condition - frequency, duration and extent of water shortages (M)

Indicator of societal response - water prices and user charges for waste water treatment as a percentage of the cost (M)

Not only are indicators classified according to type (PSR) and issue, but they are also designated according to their degree of measurability. In the above example, "S" refers to a measurable, short-term indicator, while "M" refers to a need for more data collection efforts (only measurable in the medium term), and the final classification of "L" requires long term monitoring and significant data development.

The OECD report focuses on each individual issue with sections providing: a description of environmental concerns and policy relevance with respect to major international agreements (e.g. Agenda 21), a discussion of indicators of environmental *pressures, conditions*, and *responses,* and an outline of the data availability for each category of indicator.

This core set of indicators is meant to form a common link to all OECD member nations and allows for cross-country comparisons. These are generally supplemented by more detailed, country-specific indicators which reflect the unique conditions each region is faced with and the needs of decision-makers. The adoption of the PSR model leaves a great deal of lee-way in choosing a final set of indicators, as will be shown throughout the following Sections. The OECD framework is simply that....a means of framing an indicators initiative which is then tailored to suit the needs of the users. The same key issues emerged in most of the initiatives reviewed in this report, including the IETF proposed framework with a few notable exceptions.

Although the importance of forests and soils may be incorporated into some of the Desired Outcomes (i.e. *Biological Community Integrity and Diversity* and *Physical Environment Integrity*), this is not evident and none of the proposed indicators include a consideration of forests or soils. The IETF framework focuses upon aquatic resources when it comes to the issue of the health and integrity of habitats. If a Basin-wide approach is to be adopted, a consideration of terrestrial zones must also be incorporated and highlighted.

It is useful to clearly outline the pieces of environmental legislation which may be of significance to each indicator since this will have a major influence on how implementation strategies will proceed. There is an amazing level of complexity to the legislative influences present in the Great Lakes Basin, as would be expected in a region covering two powerful industrial nations. Research into the potential impacts of the Canadian and American environmental legal systems on the implementation of an IJC indicators framework is highly recommended.

Also, having an assessment of data availability clearly indicated would help future potential users to determine the usefulness of that indicator for their purposes. This topic was explored in

detail in the 1999 IITF Researchers' Report, but could be summarized in future IJC indicators reports, an endeavor that would be especially critical if these are geared to potential users of the framework. The OECD's use of "degrees of measurability" clearly summarizes the level of data development for each indicator. This type of designation could be incorporated into an IJC model and is highly recommended, especially if this initiative is to be viewed and used by the non-scientific community (i.e. decision-makers and the public).

5.2 Eco-efficiency:

The WBCSD (World Business Council for Sustainable Development) is a coalition of 120 international companies united by a shared commitment to the environment and to principles of economic growth and sustainable development. It was formed in 1995 by the merger of the BCSD (Business Council for Sustainable Development) and WICE (World Industry Council for the Environment), following the 1992 UNCED. During this conference, the term "*eco-efficiency*" was first coined by BCSD and was endorsed by member nations as a tangible way for businesses to contribute to sustainable development.

Eco-efficiency embraces the concepts of pollution prevention, source reduction, waste reduction, and clean(er) production, thereby bringing about reduced pollution through process change. It is also based upon the following **seven elements**:

- Reduce material intensity of goods and services
- Reduce energy intensity of goods and services
- Reduce toxic dispersion
- Enhance material recyclability
- Maximize sustainable use of renewable resources
- Extend product durability
- Increase service intensity of goods and services

Process change and product innovation will achieve significant performance gains at lower cost. Therefore, companies which manage their resources more efficiently will gain a competitive advantage. As the report states *"companies cannot afford not to adopt eco-efficiency."* Eco-efficiency makes the link between the environmental and economic strands of sustainability and is strongly supported by the OECD.

Metrics will play a major role in developing a uniform framework for companies to measure their eco-efficiency and for financial markets to evaluate a company's performance. The classification scheme is based upon **three elements**:

- *Category* - broad areas of influence on the environment, human health, quality of life, and business
- *Aspect* - type of information related to specific categories

- *Indicator* - measurement of an aspect that can be used to track and demonstrate performance

Indicators need to be developed at a macroeconomic level and at a microeconomic level. Important environmental indicators in macro terms are: energy, materials, water, transportation, waste, and emissions leading to global warming and ozone depletion. Although there are a growing number of companies doing work in this field, there is an urgent need for coordination and standardization of indicator sets.

The report analyzed 17 corporate environmental reports to assess the current state of work on eco-efficiency metrics. Overall, in terms of data, the output side of production still receives the most focus with often only rudimentary information on inputs. Companies make limited use of environmental metrics and there is a general lack of precision, standards, and reporting of environmental performance and achievements against specific targets. The correlation of environmental performance to a company's economic figures is not a widely-used practice. However, there is a growing consensus that reaching the ultimate goal of sustainable development must be done in economic terms and that eco-efficiency is one possible means of framing future initiatives.

Eco-efficiency is geared to businesses seeking to adopt a more sustainable means of production. Therefore, such a sector specific model would be of limited use to the IJC's need for tools to assess progress toward the Agreement (i.e. policy specificity). As this model is increasingly being discussed in economic circles, the IJC should be aware of its existence.

5.3 Environmental Pressure Indices:

EUROSTAT (Statistical Office of the European Communities) is collaborating with several agencies to develop *environmental pressure indices* for the 15 member states of the European Union. The European Commission initiated creation of an environmental-economic information system, a proposal which was strongly supported by the European Parliament on October 11, 1995 and endorsed by the European Council of Ministers of the Environment on December 16, 1997.

This project aims to describe human activities that are harmful to the environment (i.e. "Pressures" under the OECD framework) in a comprehensive, systematic, and comparable way by using 60-100 pressure indicators. Based upon the analysis of 10 Scientific Advisory Groups from all Member States of the European Union, consisting of over 2000 experts, six indicators, deemed to be the most important and relevant, are presented under each of the following **ten environmental policy fields**:

- Air Pollution
- Climate Change
- Loss of Biodiversity

- Marine Environment and Coastal Zones
- Ozone Layer Depletion
- Dispersion of Toxic Substances
- Urban Environmental Problems
- Waste
- Water Pollution and Water Resources
- Resource Depletion

For example, the following indicators are grouped under the policy field "Water Pollution and Water Resources":

- Nutrient use (nitrogen and phosphorus)
- Groundwater abstraction
- Pesticides used per hectare of utilized agriculture area
- Nitrogen used per hectare of utilized agriculture area
- Water treated/water collected
- Emissions of organic matter as BOD (biochemical oxygen demand)

The web site for this project (http://www.telcom.es/tau/enviroindicators.htm) is easily accessible to interested parties and holds a set of clear methodology sheets for each indicator, presenting the following information:

1. Brief description of the indicator with units of measurements
2. Context within the European community and international conventions and agreements (e.g. Agenda 21)
   - ranks the indicator by policy relevance, analytical soundness, responsiveness, and a core ranking
   - presents the most appropriate related "State Indicator" (under the PSR model)
3. Significance - shows linkages to other pressure indicators
   - sets specific targets
4. Methodology - description and definitions
   - limitations
   - gives alternative definitions for the indicator

The next phase of the project will involve aggregating indicators into a set of 10 Pressure Indices which will show trends for the ten policy fields in a condensed format. This will help to facilitate communication in the European Union although it is recognized that data problems are a significant impediment to further development. Data availability, comparability, gaps, and a lack of reliable time series data showing trends will have to be dealt with before the next stage can proceed.

Although the IETF and the IITF do not currently have a need for indices, this could be of

significance in the future as the IJC's indicators program evolves. Certainly they are very easy for the public to understand and are useful for showing overall trends; however, indices must be used with caution, with the appropriate context very clearly established.

This project sets the indicators within a legislative context, an endeavor which should be researched by the IJC, at the least to provide a more comprehensive analysis of the potential for future implementation. Specific targets also serve to focus the attention of the public and decision-makers and should be considered for the IJC's own framework.

Having each indicator clearly described on methodology sheets, made accessible to interested parties through the Internet, enhances the potential for acceptance and support as implementation strategies proceed. In particular, having the data limitations clearly outlined would enhance the acceptability by potential users of the framework. Research into the topic of data availability has been an ongoing priority for the IITF and was summarized in the 1999 IITF Researchers' Final Report. The task of the IITF Researchers was complicated by the overlaps between indicators and Desired Outcomes and by the imprecise wording of these indicators. This difficulty was dealt with in the abovementioned EUROSTAT framework and should become a necessary component of future IJC indicators methodology sheets.

5.4 Bathing Water Quality Directive:

In 1976, one of the first pieces of European environmental legislation was passed as the result of concerns over bathing water quality. Directive 76/160/EEE represents a collective effort by Member States of the European Commission to identify, monitor and report on bathing areas (European Commission, 1997).

The system is based on a monitoring protocol involving the assessment of 2 microbiological parameters (total and faecal coliforms) and three physico-chemical parameters (mineral oils, surface active substances due to detergents, and phenols). The following summary of the protocol is directly derived from the web site for this program, found at: http://europa.int/water/water-bathing/index_en.html.

Water samples are taken during the bathing season (at the minimum every 15 days) and are tested in laboratories. On the basis of the presence or absence in the water samples of the indicators above certain levels - **I or mandatory values** define the minimum quality level and the **G or guide values** define the stricter level - **bathing water gets a quality status** as is indicated in Table 2.

Table 2. Bathing Water Indicator System (European Commission, 1997)

Color Designation	*Water Quality Status*
Blue	Bathing water in compliance with the more stringent G values
Green	Bathing water in compliance with the minimum quality (I values)
Red	Bathing water not respecting the minimum quality level or not sampled
Orange	Bathing water which is insufficiently monitored and therefore no information about the quality can be given
Black	Area where bathing is temporarily prohibited because of a danger for the health of bathers, but where water is monitored and necessary action is taken to remedy the problem

Information is posted on each bathing area, preferably within 24-48 hours of water analysis. This data has been compiled annually since 1991 and is released to the public, via a paper report and a website, before the beginning of the next bathing season. Citizens are therefore able to make judgements as to the quality of the bathing areas. Significant economic impacts could potentially result from this program's influence over the choice of holiday destinations, leading to impacts on the tourism industry as a whole.

This is an initiative that has a very clear potential application to the IETF's framework. Specifically, the *Swimmability* Desired Outcome could benefit from this type of easily understood and visual program. The Internet application enhances the public acceptance and knowledge of this system and could be considered for future IJC indicators initiatives, regardless of the indicators that are finally chosen.

5.5 NAFTA and the CEC:

The tri-lateral "North American Free Trade Agreement" (NAFTA), signed by Canada, the United States and Mexico in 1994, was supplemented by the North American Agreement on Environmental Cooperation (NAAEC), entered into that same year. The Commission for Environmental Cooperation (CEC) was subsequently created to administer this side accord. It primarily achieves its mandate through information exchange, consulting services, and by fostering the development of new strategies for dealing with issues affecting the continent.

Two primary components of multinational environmental cooperation were identified (CEC, 1997):

1. Respect for each nation's sovereignty in establishing priorities, policies and legal frameworks that suit the needs of each country.

monitoring of key indicators, on a reliable, cross-national, overtime basis, together with timely publication of the results will represent an important contribution" (CEC, 1999). Each is in the relatively early process of developing methods to assess the progress toward implementing their respective Agreements and have learned from the lessons of other agencies who have engaged in this type of work for a much longer period of time. International collaborative efforts are gaining increasing importance as the realization that environmental problems do not respect political boundaries becomes more apparent.

Table 3. Preliminary CEC Framework (CEC, 1999)

Component	*Category or Issue*	*Indicators*
1. Air	1.1 Outdoor Urban Air Quality	1) Ambient concentrations and emissions of common air pollutants: TSP (PM_{10}), CO, SO_2, O_3 (ambient only), NO_x
		2) Ambient concentrations and emissions of toxic air pollutants: inorganic toxics (Pb, Mn, etc.), organic toxics (VOCs, PAHs, dioxins, furans)
	1.2 Acid Rain	3) Emissions of SO_2, NO_x
	1.3 Climate Change and Ozone Depletion	4) Emissions of CO_2, CFCs, N_2O, CH_4
2. Water	2.1 Water Quality	5) BOD, TSS, nitrates, phosphates, ammonium, faecal coliform, organic toxics (PCBs, dioxins, etc.), heavy metals
	2.2 Water Supply	6) Withdrawal rates, use (groundwater and surface water, treated and untreated, by sector), replenishment rates
3. Land	3.1 Soil Quantity	7) Consumption of land for hazardous and non-hazardous waste disposal, land conversion, erosion, conservation and set-aside programs, tillage methods
	3.2 Soil Quality	8) Impact of chemicals applications, soil organic matter levels, changes in soil structure, overuse of marginal land, irrigation, salinization, desertification, erosion, soil contamination (by hazardous and non-hazardous wastes)
4. Biota	4.1 General	9) Species depletion (including flora and animals)
		10) Endemic species
		11) Number of species at risk (threatened and endangered)
		12) Loss and fragmentation of habitat (forests, wetlands, other wildlands)
		13) Rural to urban conversion of land
		14) Natural protected areas (area, quality, % by ecoregion type)
	4.2 Forests	15) For each major forest type: amount of forest cover, rate of deforestation, rate of afforestation, successful regeneration, standing volume, mean annual increment vs. harvesting rates

5.6 U.S.-Mexico Border Indicators:

"In 1996, the U.S.-Mexico Border XXI Program was initiated as an innovative binational effort to bring together the diverse U.S. and Mexican federal entities responsible for the shared environment" (U.S. EPA, 1997). The goal is to achieve sustainable development in both nations through a balance of socioeconomic and environmental considerations.

Developing indicators to evaluate the effectiveness of border environmental policy is a key objective of this program. Although a limited set has thus far been presented, it is anticipated that this number will grow as the initiative evolves. The OECD "Pressure-State-Response" model was adopted, with indicators being developed for each category, to be integrated in future reports.

The U.S.-Mexico Program also adopts 2 types of indicators to more comprehensively represent the border area. The following definitions are derived from the report United States-Mexico Border Environmental Indicators - 1997 (U.S. EPA, 1997):

1. *Environmental Indicators:*
   Direct or indirect measures of environmental quality that can be used to assess status and trends in the environment's ability to support human and ecological health. (Example: Number of species at risk for extinction)

2. *Performance Indicators:*
   Direct or indirect measures of the achievement of the intended purpose of a program, expressed as either an environmental result or program activity. (Example: Number of children tested for blood lead levels)

Nine workgroups incorporated both of these types into their proposed indicator sets. Overall, 6 "State" indicators and 7 "Response" indicators have been developed for a total of 13, and 8 "Pressure", 5 "State", and 22 "Response" indicators are in progress, for a total of 35. A summary of this initiative is shown in Table 4. A more complete presentation of all 48 indicators can be viewed in the abovementioned report.

The clearly outlined designation of each indicator enhances the understandability of the overall framework. For those unfamiliar with the PSR model, having sets of indicators for each category is beneficial and should also aid in the future efforts to produce a more integrated system. This program began by setting the foundation which will be solidified in the future, as the initiative evolves. If one of the objectives of an indicators project is to engage the public, the overall goals and components of the adopted framework must be very clearly presented. The report for the U.S.-Mexico Program is detailed yet quite understandable to the lay-person. It should be kept in mind for future indicators communication endeavors by the IJC.

Table 4. Framework for the U.S.-Mexico Border XXI Program (U.S. EPA, 1997)

Workgroup	*Pressure Indicators*	*State Indicators*	*Response Indicators*
1. Air	*1 in progress*	1) Ambient air concentrations for the criteria pollutants in each sister city	
		2) Areas that have exceedances of ambient air standards	
		3) Number of exceedances of each ambient air standard	
2. Contingency Planning and Emergency Response		*1 in progress*	*3 in progress*
3. Cooperative Enforcement and Compliance Assurance			1) Number of inspections conducted in the border area
			2) Number of enforcement actions and penalties in the border area
			3) Amount of money spent on injunctive relief and supplemental environmental projects in the U.S. border area
			4) Amount of pollution reduced as a result of enforcement
4. Environmental Health		*2 in progress*	*4 in progress*
5. Environmental Information Resources		4) Number of hits on the Border XXI Internet homepage	
		5) Amount of updated GIS data	
6. Hazardous and Solid Waste	*2 in progress*		*5 in progress*
7. Natural Resources			*7 in progress*
8. Pollution Prevention	*5 in progress*		*3 in progress*
9. Water		6) Percentage of population being served potable water	5) Percentage of population provided wastewater sewer service
		2 in progress	6) Percentage of wastewater collected receiving wastewater treatment
			7) Percentage of total volume of drinking water being disinfected prior to delivery

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6.0 CANADIAN INDICATORS INITIATIVES

6.1 International Institute for Sustainable Development (IISD):

This agency is based in Winnipeg and promotes sustainable development ideals, mainly by serving as an excellent resource base and by providing guidance to other agencies engaging in this type of work. As part of a 2-year project on measuring sustainable development performance, the IISD compiled a list of Canadian indicators initiatives which was added to a database of other international, national, and more locally-based projects. This Internet accessible list can be found at: http://iisd.ca/measure/compendium.asp.

The IISD compendium currently includes a total of 186 indicator initiatives, 77 of which are based in North America. Each listing can be selected to reveal a summary of the project, geographical scope, reporting framework, and contact information.

Overall, this is a valuable launching-point for researching other indicator initiatives taking place worldwide and provides much needed guidance for those striving to implement sustainable development ideals. It should be considered as one of the primary resources enabling the IJC to remain up-to-date on the evolving themes in these implementation strategies.

6.2 Canada's National Environmental Indicator Series:

Work on this national indicator set was initiated by the 1989 G7 request that environmental indicators be developed within the context of integrated environmental and economic decision-making. Canada acknowledged the importance of this work by issuing Canada's Green Plan in 1990, thereby making a government-wide commitment to develop a national set of environmental indicators.

A Progress Report, released by Environment Canada in April of 1991, presented 43 preliminary indicators in 17 issue areas, using the PSR framework developed by the OECD. In this case, it is referred to as the "Stress-Condition-Response" (SCR) model although the principles remain the same. The **four themes** providing the context for this work are:

1. Assuring ecosystem integrity
2. Assuring human health and well-being
3. Assuring natural resource flexibility

3 primary environmental goals for sustainable development

4. Pervasive influencing factors → influence attainment of the above three goals

The 17 issue areas are grouped under each of these four themes, based upon the SCR model. These issues are long-standing national priorities and are shown in Table 5. For a full listing of the indicators in this Series, the reader is referred to Environment Canada's 1991 report.

Table 5. Framework for the Canadian National Environmental Indicator Series (EC, 1991)

Theme	*Issues*
1. Ecological Life Support	1) Stratospheric ozone depletion*
	2) Climate change*
	3) Toxic contaminants in the environment*
	4) Acid rain*
	5) Biodiversity change
	6) Marine ecosystems
2. Human Health and Well-being	7) Urban air quality*
	8) Urban water*
	9) Freshwater quality
	10) Urban green space
3. Natural Resource Sustainability	11) Sustaining Canada's forests*
	12) Sustaining Canada's marine resources*
	13) Sustaining Canada's agricultural resources
4. Pervasive Influencing Factors	14) Canadian passenger transportation*
	15) Energy consumption*
	16) Population growth and lifestyle patterns
	17) Solid and hazardous waste generation

[*Issues for which indicators have been developed as of April 30, 1999]

For each issue, potential indicators of stress, condition, and societal response are identified and developed, based upon the OECD model. For example, an indicator under the issue of toxic contaminants in the environment (#3 under theme 1) is *"contaminant levels in double-breasted cormorants eggs: DDE and PCBs, 1970-1996."* Criteria for selection include: sensitivity to change, supported by reliable and readily available data, and must be understood and accepted by the intended users.

This information is presented in periodic "SOE Bulletins" and technical supplements which are regularly released to the public by Environment Canada. These present each indicator within its issue context, show a clear linkage within the SCR model, and provide supporting data. They are available on the Internet via Environment Canada's Green Lane at: http://www1.ec.gc.ca/~ind (EC, 1998b). More attempts are currently being made to link environmental indicators to economic and social changes, both in terms of causes and effects.

This would give a better representation of the state of ecosystems as a whole, not just individual components.

Although this is a very comprehensive system, its multiple layers add a level of complexity which could decrease public understandability. The attempt to develop linkages should provide more clear indications of progress. The IETF proposed framework of Desired Outcomes gives a more straight-forward analysis of environmental trends while incorporating many of the same issues into the model. Notable exceptions are forests, transportation, waste generation, and population analyses. For this last issue, the IETF *Healthy Human Populations* Desired Outcome only includes assessments of the physical health of humans. A consideration of other factors affecting the quality of life should be a topic of discussion.

6.3 Environmental Trends in British Columbia:

BC's Ministry of the Environment, Lands, and Parks released a report on Environmental Trends in British Columbia in 1998. They focused their study on the outcomes of government efforts, rather than on the efforts themselves, by measuring progress toward attaining the following **environmental goals**:

1. Natural diversity
2. Healthy and safe land, water and air
3. Sustainable social, economic, and recreational benefits
4. Responsive and adaptive organization

The framework was developed around the following four basic questions: What is happening to the environment? Why is it happening? Why is it significant? What are we doing about it? A Stress-Condition-Response model was applied although the main focus remained on the **state** of the ecosystem. The provincial set of 12 key indicators of environmental health were grouped under four general categories, shown in Table 6.

As an example, the indicator of water quality (#6 under category #3, "Water") is measured as the number of water bodies in excellent, good, fair, borderline, or poor condition as rated by the water quality index used in BC. In some cases, specific and quantifiable targets (established by provincial, national, or international agreements) have been set to guide progress on achieving the four broad environmental goals.

Table 6. Framework for the BC Indicators (BC, 1998)

Category	*Indicators*
1. Land	1) Protected areas
	2) Solid Waste
2. Air	3) Fine particulates
	4) Stratospheric ozone depletion
	5) Greenhouse gases
3. Water	6) Water quality
	7) Groundwater
4. Natural Diversity	8) Species at risk
	9) Forest species
	10) Wildlife
	11) Fish
	12) Toxic contaminants in biota

Annual updates of the indicators are presented in the document series Environmental Trends for British Columbia. This information is also available on the Internet at: http://www.env.gov.bc.ca/sppl/soerpt. Each of the 12 indicators is presented on 2 pages, accompanied by the following information:

- Information on status and trends
- Importance of the indicator
- Actions being taken
- Specific goals
- Sub-regional picture of the issue
- Summary of sources of problems or threats
- Comparison with other jurisdictions
- Specific targets (if applicable)

A specific target under the indicator "species at risk in BC" is that, by 2001, BC will develop status assessments and recovery plans for all threatened or endangered species within its borders. As was mentioned previously, targets are especially useful since they provide a clear indication to the public of the environmental trends in their environment. They also serve to focus and redirect measures to mitigate negative impacts. Targets should be considered and discussed for possible incorporation into future IJC indicators initiatives.

BC recognizes that it will need the full participation of the public, industry, and other involved parties and that this will probably necessitate the development of a personal "stewardship ethic." By living their lives in a more sustainable manner (e.g. generating less waste), citizens will have a major impact on the status of the entire province.

BC also recognizes that these indicators will require constant updates and monitoring, an endeavor which is both time-consuming and extremely expensive. Therefore, strategic partnerships will be an absolute necessity if this project is to succeed.

Lastly, it is acknowledged that the most effective indicators are often those which defy categorizing because they cross media or issue boundaries. All of the above 3 generalizations are certainly applicable to any indicator initiative and have been seen in the IITF's own research into indicators.

6.4 Great Lakes Health Indicators:

The Great Lakes Health Effects Program represents Health Canada's participation in the Great Lakes Action Plan, launched in 1989 and the subsequent replacement plan, termed Great Lakes 2000, which was initiated in 1994. These programs demonstrate the Government's commitment to implementing sustainable development within the Great Lakes Basin Ecosystem.

In 1998, Health Canada (HC) released the report Health-Related Indicators for the Great Lakes Basin Population: Numbers 1 to 20 "as part of a federal commitment to the Canada-Ontario Agreement and to the Great Lakes Water Quality Agreement" (IITF, 1998). The agency recognizes that indicators are needed to monitor progress and changes in human health within the Great Lakes environment. "Indicators are also needed to assess the effectiveness of health and environmental policies and actions in protecting or improving the health of the Great Lakes Basin population" (HC, 1998).

This report presents a set of 20 indicators under 3 general categories, shown in Table 7. The first category, "Indicators of Health Effects," links human exposure to environmental contaminants through measurable effects on health or health risk. The second category, "Indicators of Exposure," examines the contaminant levels measured in human tissues or estimates the daily intake of persistent contaminants by Great Lakes populations. The final category, "Patterns and Trends in Disease Incidence," looks at the geographic and time variations in rates of diseases.

Within the report, each of these 20 indicators is summarized on 2-3 sheets explaining the issue context and current findings. The overall goal is to support the attainment of sustainable development within the Great Lakes Basin by assessing the level of negative environmental impacts on human health. This project should be considered by the IJC for its potential support of the Desired Outcome *Healthy Human Populations*.

Table 7. Framework for the Great Lakes Health Indicators (HC, 1998)

Category	*Indicators*
1. Indicators of Health Effects	1) Effects of air pollutants on rates of hospital admission for cardiorespiratory disease
	2) Cancer risk and chlorination disinfection by-products in Ontario drinking water
2. Indicators of Exposure	3) Persistent organochlorine contaminants in human breast milk
	4) Blood lead in children
	5) Exposure of the Great Lakes Basin population to aldrin and dieldrin
	6) Exposure of the Great Lakes Basin population to benzo(a)pyrene
	7) Exposure of the Great Lakes Basin population to chlordane
	8) Exposure of the Great Lakes Basin population to DDT
	9) Exposure of the Great Lakes Basin population to dioxins and furans
	10) Exposure of the Great Lakes Basin population to hexachlorobenzene
	11) Exposure of the Great Lakes Basin population to mercury
	12) Exposure of the Great Lakes Basin population to mirex
	13) Exposure of the Great Lakes Basin population to PCBs
	14) Chemical contaminants in Great Lakes Basin drinking water
	15) Recreational water quality in the Great Lakes Basin
	16) Radionuclides in the Great Lakes Basin
	17) Geographic Distribution of levels of persistent contaminants in human
3. Patterns and Trends in Disease Incidence	18) Geographic distribution of cancer incidence in Ontario, 1984-1988
	19) Geographic distribution of birth defects in Ontario, 1978-1988
	20) Patterns and trends in cancer incidence

6.5 State of Calgary:

This is a municipal initiative which was launched in 1996 with the general mission to "promote, encourage and support community-level discussion, actions and initiatives that move Calgary toward a sustainable future" (Sustainable Calgary, 1998b).

The framework, shown in Table 8, is based on five themes and 24 related indicators, representing the overall state of the city and pressures upon it.

Table 8. Framework for the State of Calgary Indicators (Sustainable Calgary, 1998a)

Theme	*Indicators*
1. Economy	1) Number of hours at minimum wage needed to meet basic needs
	2) Housing affordability
	3) Poverty in Calgary: - income gap between high and low income households - number of people living below the poverty line - number of children dependent on social assistance - number of people using food banks
	4) Unemployment/employment
	5) Business diversification/concentration: - diversification of businesses in Calgary - percentage of Calgary businesses dependent on the oil and gas industry
2. Health and Education	6) Percentage of healthy birth weight babies
	7) Annual asthma hospitalization rate
	8) Residents who rate their health as good
	9) Literacy rate (at grade three level)
	10) Level of education of population
3. Community	11) Volunteerism
	12) Sense of community: - neighbourliness or connectedness - proportion of residents with a lack of social support
	13) Leisure time: - recreation participation in Calgary - number of free performances/art exhibits in public spaces
	14) Valuing cultural diversity
	15) Safety: - percentage of people victimized yearly
4. Natural Environment	16) Air quality
	17) Water use per capita
	18) Surface water quality
	19) May bird species count
	20) Quantity of pesticides used on public areas
	21) Food: - veggie mile (i.e. the distance food travels to the supermarket) - availability of local produce
5. Resource Use	22) Domestic waste per capita
	23) Energy use per capita (includes carbon and non carbon uses)
	24) Mobility: - average commuting distance to work - transit ridership - ratio of carpool trips to total trips - walking distance to basic services

Each section of the report focuses on one of these five themes, clearly outlines the related indicators, presents basic statistics highlighting the overall trends, and suggests to the readers what they can do to support implementation of that aspect of sustainable development in their city. The layout and use of terminology strives to ensure the comprehension of these concepts by the lay-person. Indeed, one of the indicator selection criteria was public interest and understandability.

Calgary's State of our City Report (Sustainable Calgary, 1998b) summarizes the main sustainability trends, as indicated by the abovementioned framework. It further proceeds to outline three actions needed to sustain a high quality of natural environment, namely:

- improve downstream water quality
- control urban sprawl
- limit or eliminate the use of pesticides in the city

The report highlights that the two primary concerns of Calgarians are: a high rate of resource consumption and growing economic and social difficulties with people of lower incomes. The ultimate goal of a sustainable Calgary will require that all citizens become involved. This indicators initiative clearly demonstrates the city's commitment to this ideal.

Although the IJC framework is based upon gaining an overall assessment of the health and integrity of the entire Great Lakes Basin, the actions of the numerous municipalities which comprise it have a critical impact on these issues. Adopting a system of sustainability at a local level will allow for more adequate implementation of the goals of the Great Lakes Water Quality Agreement. Such community-based projects should be endorsed by interested parties.

6.6 Genuine Progress Index (GPI):

The GPI was originally developed by Americans Cobb, Halstead and Rowe in 1995 as a holistic measure of progress integrating social, economic and environmental variables (GPI Atlantic, 1998a). In 1997, Nova Scotia was assigned by Statistics Canada as a pilot project for Canada and they adapted the original set to best reflect local conditions and to emphasize policy applications and relevance. This work demonstrates an acknowledgment that the traditional measure of progress, based upon the Gross Domestic Product (GDP), is inadequate for addressing the importance of sustainable development. It has widely been accepted that "new indicators of progress are urgently needed to guide our society: ones that include the presently unpriced value of natural and societal capital in addition to the value of conventionally measured economic production . . . the GPI is an important step in this direction" (GPI Atlantic, 1998a).

The Nova Scotia GPI is based upon social, economic and environmental indicators selected to reflect community well being and prosperity and to determine progress toward sustainability. The trends over the last 25 years for these will be integrated with existing market statistics to construct an overall index of sustainable development for the province, the GPI, expected to be

released in 2000 (GPI Atlantic, 1998b).

The first three sets of values form the basic parameters of the Nova Scotia GPI and establish the fundamental goals against which progress can be measured, while the fourth set represents other human and social values to be considered (GPI Atlantic, 1998b). These are further subdivided into specific aspects for which indicators have been/are being developed, as is shown in Table 9.

The local community will be kept up-to-date on the results of this pilot project through a supplement to Halifax's "Daily News." This information will also be made available on the Internet website, located at: http://www.gpiatlantic.org. Although the current application is provincial, this project is potentially of national and international significance. It also shows Canada's dedication to its commitments under Agenda 21, the concluding document to the 1992 United Nations Conference on Economic Development (UNCED) in Rio.

This work is of particular relevance to the IETF Desired Outcome *Economic Viability*. Since this is the only Desired Outcome which has not been researched to date, the endeavors by statistical agencies to implement indicators into their work should be closely analysed.

Table 9. Framework for the Nova Scotia GPI (GPI Atlantic, 1998a)

Value Set	*Aspects*	*Indicators*
1. Security	1.1 Physical Safety	1) Crime rates
		2) Costs of transportation
	1.2 Health	3) Cost of health care
	1.3 Livelihood Security	4) A specific index has been developed which includes a consideration of underemployment
2. Equity	2.1 Inter-generational Equity	5) Net foreign lending or borrowing, differentiated as being for investment purposes or for finance consumption
	2.2 Intra-generational Equity	6) Income distribution
	2.3 Geographical Equity	7) Financial and human capital movements
3. Environmental Quality	3.1 Natural Resource Accounts	8) Forests
		9) Fisheries
		10) Soils and Agriculture
		11) Wetlands
		12) Non-renewable resources
	3.2 Environmental Conservation and Degradation	13) Air quality
		14) Water quality
		15) Terrestrial impacts (e.g. solid waste)
	3.3 Ecological Footprint Analysis	16) Ecological footprint analysis
4. Other Human and Social Values	4.1 Freedom	17) Human freedom index which includes human rights, community participation, etc.
	4.2 Knowledge	18) Quality and access to education
	4.3 Caring Society	19) Care for the vulnerable and less productive members of society

6.7 Sustainability Indicators for Transportation:

The Ontario Round Table on the Environment and Economy (ORTEE) was established in 1989 as a spin off of the Brundtland Commission's visit to Canada in 1986, the Canadian Environmental Protection Act's passage into law in 1988, and the release of Agenda 21 in 1992. The ORTEE's primary mandate was to work toward the ultimate goal of sustainable development, including establishing a framework for this initiative. When the ORTEE's second mandate reached its end in 1995, the York Centre for Applied Sustainability (YCAS) was established to continue this work.

The ORTEE brought together the "Ontario Transportation Collaborative" to investigate the feasibility of introducing sustainability indicators into Ontario's transportation system. They recognized that "the conventional approach to many transportation indicators, which focus on specific actions, is likely to be less powerful and useful than a broader set of sustainability criteria that can be applied to numerous policy options, not just to transportation related ones" (IndEco, 1995).

Their framework is therefore based on supporting the implementation of sustainable development through a consideration of the four categories of criteria and related indicators shown in Table 10. The model also includes a consideration of the following three central aspects to sustainability:

- local actions have more than local effects
- all parts are not interchangeable
- distributions (not just averages) are important

The report goes on to suggest a transportation option in support of sustainability. By converting energy use from gasoline vehicles to natural gas, the impact of greenhouse gas emissions could be alleviated. The authors recognize that their model has inherent limitations, including: it is based on averaged data and not distributions and it is weak in addressing social issues. Despite these weaknesses, this initiative is a positive step toward gaining support for sustainable development implementation from a major player in the equation, the transportation sector.

Updates of this information are provided through the ORTEE's website, located at: http://www.web.net/ortee/main.html. The reader is referred to this source for a more complete analysis of this framework.

Transportation is a sector that is not highlighted in the IETF framework. Considering the serious impacts that vehicle emissions have on the physical integrity of the environment, contributions to the levels of persistent toxic substances leading to potential impacts on the health of human populations, and the destruction of natural habitats to make way for roadways and railroads, it should be focused upon more intensively by the IJC in future indicators initiatives.

Table 10. Framework for the ORTEE Sustainable Transportation Indicators (IndEco, 1995)

Category	*Criteria*	*Indicators*
1. Environmental	1.1 Emissions	1) CO_2 loading
	1.2 Non Renewable Resource Use	2) Ecological footprint analysis
	1.3 Habitat Disruption	3) Land use
2. Economic	2.1 Meaningful Employment	4) Employment
	2.2 Contribution to Quality of Life	5) Green GDP
	2.3 Support Societal Initiatives	6) Tax revenues
	2.4 Minimize Time and Cost	7) Commute cost
3. Social	3.1 Promotion of Interaction	8) Population density
		9) Commute time
		10) Population near natural areas
	3.2 Protect/enhance life, health, community	11) Deaths and injuries
		12) Crime
		13) Community disruption
		14) Family violence and divorce
	3.3 Equity	15) Distribution inequality index
		16) Demotechnic index
		17) E-index
	3.4 Accessibility	18) Vehicle access
		19) Public transit access
4. System	4.1 Redundancy	20) Non fossil fuel use
	4.2 Diversity	21) Energy efficiency
	4.3 Integrity	22) Mixed land use
		23) Trips with 2 or more modes

6.8 Econnections:

Statistics Canada launched this initiative in 1991 at the request of the Government of Canada, under the auspices of Canada's Green Plan, driven by increasing public environmental awareness. It represents the statistical basis for this agency's national attempt to link the environment and economy through the Canadian System of Environmental and Resource Accounts (CSERA). "The new system is a major step forward in detailing these [economic-environmental] linkages and will undoubtedly become a model for international and national statistical agencies worldwide" (GPI Atlantic, 1998).

The Brundtland Commission's 1987 call for research into this area set the stage for a more intensive focus on developing frameworks which incorporate these linkages. "Today many industrialized countries, and a growing number of developing nations, can claim a well-established set of environmental and resource accounts" (Statistics Canada, 1997). As a leading international statistical agency, research by Statistics Canada into this field will undoubtedly draw the interest of other national organizations as they attempt to incorporate a consideration of environmental values into their own economic schemes.

The Econnections framework is based upon the following five environmental-economic themes, meant to provide a launching-point for attaining sustainable development:

1. Natural resource stocks
2. Use of land resources
3. Consumption of materials and energy
4. Waste production
5. Environmental protection expenditures

Updates are made through annual report cards and data made available on CD-ROM. Each indicator is presented on 2 pages which include the following fields:

- Theme
- Geographic scope
- Time series
- Frequency of update
- Description
- Significance
- Method of calculation
- Data limitations
- Reliability
- Analysis
- Related indicators (from Econnections and from Canada's National Indicator Series - see Section 6.2 of this report)

As with the ORTEE initiative reviewed previously, Statistics Canada recognizes that their

model will continually evolve as societies gain a better understanding of economic-environmental interactions. For a complete analysis of their framework, the reader is referred to the report Econnections: Linking the Environment and the Economy - Concepts, Sources and Methods of the Canadian System of Environmental and Resource Accounts (Statistics Canada, 1997). This paper provides an international context by comparing the CSERA system to that of other agencies worldwide. In doing so, lessons can be drawn from the experiences of these organizations. Again, this is an area that should be researched by the IJC as it seeks to expand its knowledge of other indicators initiatives and, more specifically, to support the Desired Outcome *Economic Viability.*

6.9 Quality of Life Index for Ontario:

This is a provincial initiative launched by the Ontario Social Development Council, based on the UNDP (United Nations Development Program) model of sustainable human development. "The Quality of Life Index (QLI) is a composite index made up of twelve indicators covering the social, health, economic, and environmental conditions which affect the quality of life in communities throughout Ontario" (Shookner, 1998). The QLI serves as a provincial benchmark, allowing for provincial-local and community-community comparisons and should become a regular component of community planning processes.

The framework, based on four dimensions of the quality of life, has 12 core indicators, as is shown in Table 11.

Table 11. Framework for the Ontario Quality of Life Index (Shookner, 1997)

Dimension of the quality of life	*Indicators*
1. Social Trends	1) People receiving social assistance
	2) Children in care of children's care societies
	3) People on waiting lists for social housing
2. Economic Trends	4) Local unemployment rate
	5) Proportion of local labour force working
	6) Number of bankruptcies reported
3. Health Trends	7) Number of suicide deaths
	8) Number of elderly on waiting lists for long-term care
	9) Low birth rates
4. Environmental Trends	10) Hours of moderate/poor air quality
	11) Number of toxic spills
	12) Number of tonnes of waste diverted from landfills by blue boxes

The QLI is based upon the base year of 1990 which has been assigned a value of 100. A detailed explanation of how it is calculated is included in the report Quality of Life in Ontario - 1997, available on the Internet at: http://www.qli-ont.org/report.html. The resulting value reflects the percentage increase or decrease from the base year. The QLI was calculated to be **87.2** in September 1998, **90.1** for May 1998, and **96.9** for November 1998, showing a positive improvement at each reporting cycle.

In order to gain a more adequate understanding of progress, one must examine the trends for the individual indicators. For example, although the latest figure (i.e. 96.9 - a 3.1% reduction in quality of life in Ontario since 1990) represents a significant improvement in the quality of life for Ontarians, the waiting lists for long-term health care continue to grow and the number of bankruptcies being reported is still increasing. Therefore, the final Index number must be set within an appropriate context.

The strength of such indexes comes from their ability to become pivotal points for discussion. "The indexes are tools for action because they can focus response. They will be an early warning system that identifies the impact of major changes that are under way . . . " (Smith, 1998).

The Ontario QLI is expected to be updated twice a year to show overall trends and to initiate remedial actions quickly, if required. It is readily accessible to the public on the Internet. More communities are adopting the QLI "to raise public awareness about issues which affect our quality of life and to mobilize community resources to address them" (Shookner, 1998). These include: Toronto, Cambridge, Sudbury, Ottawa, and Hamilton, among others.

Although the IETF (1996) states that the use of indices is not called for in their proposed indicators framework, it is a subject that should be considered in the future. The QLI provides a method to tie together all of the ideals represented by the IETF Desired Outcomes. In other words, the public may want to know "Can I drink the water, eat the fish, swim in the water?", all of which relate to the overall quality of life. This is an area that should be explored as public communications strategies are developed by the IJC for its indicators initiatives.

6.10 Fraser River Action Plan (FRAP):

This program began in 1991 and was completed in 1998 as a joint initiative of Environment Canada (EC) and the Department of Fisheries and Oceans. The FRAP was established as part of the Government of Canada's Green Plan and was focused on the scale of the entire watershed and its governance. It was launched in recognition of the importance of the Fraser River Basin to the economic and social health of the local communities and also due to the extent of degradation of the ecosystem's various components.

In 1992, the Fraser Basin Management Board was created to take the lead in guiding the initiative. This was replaced by the Fraser Basin Council in 1997 with a primary mandate to promote and monitor the implementation of a "Charter for Sustainability." "The Charter, designed to protect and enhance the sustainability of the Fraser River and its vast basin, will guide social, economic, environmental and institutional actions toward sustainability" (EC, 1997).

One of the primary goals of these bodies was to develop a cooperative management plan based on the principles of sustainability, achieved through strategic partnerships. The initiative "is guided by two core principles at the heart of sustainability: everything is connected and we are all responsible and accountable" (EC, 1998a). In recognition of this, the framework was based on four themes: partnerships, public education and action, a whole watershed scope, and ecosystem science. Projects and initiatives were then divided into **four categories or "areas of concern"**: aquatic science, urban issues, agriculture, and forest industries.

A 5-year action plan for assessing progress under the Charter for Sustainability in these areas is currently being developed. Information is widely distributed through various media such as fact sheets, videos, brochures, CD-ROM, etc. and on the Internet at: http://www.pyr.ec.gc.ca/ec/frap/index.html. Two educational campaigns for youth were also launched to support the FRAP.

This project has several parallels to the IITF's work. The themes listed above all apply to the IJC's attempt to implement an indicators strategy. Partnerships are absolutely critical since two nations are involved and due to the shear size and magnitude of legislative complexity inherent to the Great Lakes Basin. The set of IETF Desired Outcomes collectively presents a picture of the health/integrity of the whole watershed. Since an ecosystem approach is advocated in the Great Lakes Water Quality Agreement, it must be incorporated into the IJC's indicators work. Lastly, public participation will be a necessary component to successfully implementing the IJC's framework. Future activity within the Fraser River Basin should be monitored for potential application to the IJC's own work.

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7.0 AMERICAN INDICATORS INITIATIVES

7.1 Sustainable Forestry C&I:

A project team, including members from Canada, the U.S., and Mexico, engaged in this 7th worldwide CIFOR (Center for International Forestry Research) test, the study area being the Boise National Forest. The overall aim of this global project is to develop sets of locally appropriate criteria and indicators (C&I) at the forest management level in support of sustainable forestry principles.

This compilation report is an independent review of the progress of North American agencies doing work on sustainable forestry C&I. Notably, the CCFM (Canadian Council of Forest Ministers) engaged in this work in preparation for the 1992 UNCED in Rio. Their framework is based upon a set of 6 criteria, 22 elements, and 83 indicators.

After the 1992 UNCED, the "Montreal Process" evolved to develop guidelines or criteria to ensure sustainable development implementation. This endeavor now includes 12 countries, covering over 90% of the world's temperate and boreal forests, and is based upon 7 criteria and 67 indicators.

Overall, this project found that C&I are still in the development phase and that integration of indicators across disciplines (sectoral lines) is very difficult due to a lack of basic theory on sustainability. Team members found that C&I are generally divided into **four broad categories**:

1. *Ecological* - most attention has been devoted to this category
   - progress is hindered by a lack of understanding of ecosystem function and how to measure complex variables in the long-term
   - often agencies rely too heavily on available data which may be "stretched to fit"
2. *Economic* - may be easier to assess the negation of an indicator rather than the affirmation (i.e. inequality vs. equality)
   - it is difficult to incorporate sustainability of economic/social systems into the realm of forest sustainability
3. *Management* - concepts of forest management are applied only to harvestable areas. This is a major problem since indicators should assess an entire area
   - must loosen the definition of management to include "no management," "restoration," etc.
4. *Social* - must be geared to specific cultures in order to be applicable
   - for example, the CCFM initiative is written from a North American context but is poorly detailed and is geared to the national level only (data not specific enough)

The CIFOR project recognizes that sustainability will only be attained if nations strive for the best arrangements of ecological, economic, and social values through time. In their reviews, they have found that:

- most sustainable forestry C&I initiatives are at too broad a scale to be relevant
- such work will only be successful if specific targets are set
- terminology is often vague and confusing
- operational issues are not addressed (data management and quality control)
- there is no accepted theoretical basis for integration of ecological, social, and economic indicators

CIFOR strongly recommends that further debate over developing C&I from a national to a forest management unit scale needs to take place and that a conceptual framework must be established. Despite the criticisms, they recognize that C&I could fill a critical role in assessing forestry sustainability and could provide a basis for international cooperation in support of these principles.

Although the IETF proposed framework does not include a consideration of forestry aspects, the findings of the CIFOR project are certainly relevant. Many of the indicators initiatives reviewed for this report are based upon existing data which indeed may be "stretched to fit" due to current economic restrictions. The use of targets is again brought up as an area which should be considered for future IJC work in this field. The data which are used to support indicators are mostly based upon economic valuation of environmental components. A consideration of other, "intangible" values (e.g. educational values, cultural values, a stewardship ethic) should be kept in mind when designing indicators framework based upon the ultimate goal of sustainable development.

Other issues which are raised were also emphasized by the IITF Researchers in their 1999 Researchers' Final Report, namely vague terminology and operational matters. In order to facilitate the data collection process, the framework must be clearly defined and understood by all involved parties. The primary reason for the failure of some indicators initiatives can be attributed to issues of data management (i.e. quality assurance and quality control measures). These aspects should be dealt with by the IJC in future initiatives.

7.2 Lake Erie Quality Index:

This project was undertaken by the Ohio Lake Erie Commission to evaluate 28 aspects of Lake Erie's status through the use of 10 indicators and 28 metrics. This framework was designed to mostly use existing databases and to discern short and long term trends. The **3 main objectives** were to:

1. Determine what is essential to know about Lake Erie
2. Design and implement effective measuring systems for these essential factors
3. Establish goals and scoring systems that will allow for critical evaluation of progress

Also, unlike most of the other initiatives being reviewed, this report is intended for the public and, therefore, was designed using straightforward terms and easily understood references. Three "themes" or areas of focus were used to set the context for the report, shown in Table 12.

These 10 indicators were evaluated through the use of 28 metrics, each of which measured a specific parameter that was compared to an established goal and scored. The report uses 2 different scoring systems:

(1) If using a set of numerical goals, the % attained was compared to a straight sliding scale
(2) Otherwise, a 4-point scoring system was used (i.e. poor=1, fair=2, good=3, excellent=4)

Table 12. Framework for the Lake Erie Quality Index (OLEC, 1998)

Theme	*Indicators*
1. Environment	1) Water quality
	2) Pollution sources
	3) Habitat
	4) Biological
2. Recreational Resources	5) Coastal recreation
	6) Fishing
	7) Boating
	8) Beaches
3. Derived Economy	9) Tourism
	10) Shipping

Scores for individual metrics were weighted according to importance, then tallied to produce a descriptive rating for the overall indicators. Using this system, the following are the final conclusions on the state of Lake Erie's health:

Indicator	*Rating*
Water quality	Good
Pollution sources	Fair
Habitat	Fair
Biological	Good
Coastal recreation	Good
Boating	Good
Fishing	Excellent
Beaches	Good
Tourism	Excellent
Shipping	Fair

For example, to assess the rating for "Water quality," the following 5 metrics were used:

Metric	*Rating*
Toxic contamination	Good
Contaminated sediments	Poor
Bacterial pollution	Fair
Drinking water	Excellent
Water clarity	Excellent

These metrics were averaged to get the overall rating of "Good" for the indicator "Water quality." Although the area has seen drastic improvements over the past 25 years, the Ohio Lake Erie Commission views this endeavor as just a starting point to continual monitoring and restoration efforts. Metrics and indicators must be constantly reviewed and updated if the information is to be kept relevant for the Ohio public.

The focus of this report was on producing a framework which could be easily understood by the non-scientific community (i.e. the public and decision-makers). As the IJC explores the public relations aspect of their indicators work, the Lake Erie Water Quality Index should be kept in mind as a potential model.

7.3 Environmental Indicators of Water Quality:

This report, representing the first national set of water environmental indicators, was issued by the U.S. EPA's Office of Water and various partners. Although these were developed on a national scale, they were designed to also work at smaller geographic scales.

The **2 national environmental goals** for water quality on which this report is based are:

1. *Clean Waters* - to support uses such as fishing, swimming, and drinking water
   - protection and rehabilitation of wetlands
   - cleaner ground waters

- support healthy communities of aquatic life

2. *Safe Drinking Water* - consistently safe to drink

In order to check progress toward these 2 goals, a series of milestones for each was established, based upon a 10-year target (by 2005). Milestones for each goal use a water quality indicator to measure progress toward the 2005 target. For example, the milestone for wetland acreage (indicator #9) is set as an annual increase of at least 100 000 acres of wetlands area by 2005. Also, the framework was set up around five water quality objectives and a total of 18 indicators, as is indicated in Table 13

Table 13 Framework for the Environmental Indicators of Water Quality in the U.S. (U.S. EPA, 1996)

Water Quality Objective	*Indicators*
1. Conserve and enhance public health	1) Population served by community drinking water systems violating health-based requirements
	2) Population served by unfiltered surface water systems at risk from microbiological pollution
	3) Population served by drinking water systems exceeding lead action levels
	4) Source water protection
	5) Fish consumption advisories
	6) Shellfish growing water classification
2. Conserve and enhance aquatic ecosystems	7) Biological integrity
	8) Species at risk
	9) Wetland acreage
3. Support uses designated by the States and Tribes in their water quality standards	10) Designated uses in state and tribal water quality standards
4. Conserve and improve ambient conditions	11) Ground water pollutants
	12) Surface water pollution
	13) Selected coastal surface water pollutants in shellfish
	14) Estuarine eutrophication conditions
	15) Contaminated sediments
5. Reduce or prevent pollutant loadings and other stressors	16) Selected point source loadings to (a) surface water and (b) ground water
	17) Nonpoint source loadings to surface water
	18) Marine debris

This report concentrates on the state (or condition) of water resources although it does acknowledge the value of the entire OECD "PSR" model.

Many of the indicators in this framework are also reflected in the IETF model. However, two notable exceptions should be mentioned. Contaminated sediments are a major source of pollution to the Great Lakes Basin Ecosystem and impact several of the Desired Outcomes (e.g. *Fishability, Drinkability, Biological Community Integrity and Diversity, Virtual Elimination of Inputs of Persistent Toxic Substances,* and *Physical Environment Integrity*). They should therefore be highlighted by having a separate indicator designated to monitor trends in their levels.

Secondly, the U.S. EPA model has as one of its objectives to "Support uses designated by the States and Tribes in their water quality standards." Again, the multiple legislative and policy-related influences over the implementation of any indicators initiative should at a minimum be a major point of consideration. IJC research into this aspect of the Great Lakes Basin would be a necessity to facilitate potential implementation strategies.

7.4 Index of Watershed Indicators:

This work is based upon the above initiative on "Indicators of Water Quality" in the U.S., developed by the U.S. EPA and several partners. As is outlined in the previous section, 18 national indicators are used to assess the health of water resources. The Index was created by the same division (U.S. EPA - Office of Water) and evaluates a similar set of indicators for each of the 2111 watersheds in the 48 states (Alaska, Hawaii, and Puerto Rico are currently being added) (U.S. EPA, 1997).

The **3 goals** for undertaking this work are:

1. Develop a more complete descriptive technique for characterizing the condition and vulnerability of water resources nationally than has been previously available
2. Make this information available to the public through a companion application, "Surf your Watershed"
3. Establish a national baseline on the condition of aquatic resources to be used over time to help measure progress toward the goal that all watersheds be healthy and productive places

The Index uses 15 indicators ("data layers"), 7 of which assess the condition and 8 the vulnerability (i.e. conditions or activities that may stress the resource):

- Forest riparian habitat
- Ground water vulnerability
- Watershed nitrogen export

Another feature was also added, namely the "Enviromapper for watersheds." This provides the users with interactive GIS functionality using EPA spatial data. Users can view this data at a National, State, or County level. Overall, this project encompasses the ultimate in current technological advances and strives to engage the public in finding out as much as they can about the watersheds of interest to them. It could serve as a model for future IJC indicators communications strategies.

One of the primary goals of the Index of Watershed Indicators project is to establish a national baseline. Although this is outside of the IJC's mandate, such an endeavor could serve as a means of assessing the progress of involved parties in attaining a sustainable Great Lakes Basin Ecosystem through community-based, provincial/state, national and binational comparisons. An international component could also be developed, considering the scale of the watershed involved and the various indicators strategies being developed worldwide. Maintaining a certain level of understanding of the efforts by other agencies would facilitate strategic partnerships and could help to refocus goals and supporting programs.

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8.0 CONCLUSIONS

One of the most striking aspects of current IITF research on indicators initiatives is how similar are the issues facing the parties engaging in this type of effort. Work by other agencies, including the OECD (Organization for Economic Cooperation and Development), the European Union, Environment Canada and the U.S. EPA supported the findings of the IITF researchers regarding the complexity of this work, as was outlined in the 1999 IITF Researchers' Final Report. Many monitoring programs fail because operational issues (e.g. data management, use of accepted standards, proper quality control) are not adequately addressed. As well, several of the concepts upon which this work is based (e.g. sustainable development and the ecosystem approach) are constantly evolving and being redefined. Regular monitoring and updating of indicators and measurements are essential as new issues emerge.

Various nations, agencies and multinational organizations are faced with similar environmental issues (e.g. toxic contaminants), most of which cross political boundaries. Therefore, it is imperative that collaboration through strategic partnerships becomes the norm. As the IJC has stated, multi-jurisdictional agencies play an increasingly critical role in coordinating efforts within the Great Lakes Basin (*Focus,* Nov./Dec. 1998).

To advance inter-agency communication and cooperation, there is a growing need for a widely supported international indicator framework to help guide local decision-makers and to provide a "common language," based upon clear terminology and concepts. Although an international framework can allow for cross-country comparisons, it is meant to be supplemented by more detailed, location-specific indicators which reflect the unique conditions each region is faced with and the needs of decision-makers.

The public and decision-makers are increasingly frustrated by the problems of dealing with widespread environmental degradation. Therefore, indicators work must be responsive to the needs of these parties and must be easily understood and accepted. The global need for structure and guidance in setting and implementing policies has led to research into setting specific goals, to be measured through the use of indicators. Specific targets add an easily interpreted element to this process and clearly demonstrate progress toward goals (e.g. the IJC's Desired Outcomes geared toward the Agreement).

The public is also demanding more accountability from agencies vis-à-vis the efficiency of their programs and the use of tax dollars. Goals and targets are clear methods for assessing organization/program performance and may help to outline the need for redirection or consolidation of efforts. Also, increasing the efficiency of sampling and reporting protocols translates into significant monetary savings. Making data collection, reporting, and indicators framework more standardized will inevitably bring about positive impacts as they will help to reduce unnecessary and expensive duplication of efforts.

Another factor that has a major impact on the structuring of indicators work is their intended use. For example, a set of indicators meant to measure environmental performance may differ significantly from a set designed to report on the state of the environment or a set used in environmental accounting. A focus on sustainable development vs. sector specificity (e.g. transportation, mining, etc.) will also have a pronounced influence on this work.

A balance between the database compilers' concerns about the quality of the data and the policymakers' need for guidance must be established. Also, a proper context must be defined within a legislative framework. Major national and international agreements and conventions should be tied to more local initiatives in order to "nest" various efforts, thereby increasing program efficiency. Indicators must be placed within a proper context or risk misinterpretation.

The IETF (1996) proposed framework of Desired Outcomes and indicators/measurements comes as close as any of the initiatives reviewed to following the above suggestions. Striving to implement some of the lessons learned from other indicators initiatives, outlined in the previous Sections of this report, would strengthen the goals of the IJC in assessing progress under the Great Lakes Water Quality Agreement.