

Appendix B

State of the Lakes Ecosystem Conference (SOLEC) Indicators

Indicators: Background

The State of the Lakes Ecosystem Conference (SOLEC) was established by the US and Canada in 1992 to hold biannual conferences to meet the reporting requirements of the Great Lakes Water Quality Agreement (GLWQA). SOLEC has led the effort to collect, develop and refine a set of science-based, not programmatic, indicators and taken an adaptive management approach to continually improve the effort.

In LaMP 2000, Chapter Three presented a cross walk of the SOLEC indicators and the Lake Michigan Lakewide Management Plan goals. In preparation for LaMP 2006, the LaMP Technical Coordinating Committee conducted a review of current SOLEC indicators in association with the Lake Michigan LaMP Goals. An extremely strong alignment was found to still be in place.

The Lake Michigan LaMP has also adopted the SOLEC sustainability target gauge to help provide a quick, summary visual of a measurement of where we are in achievement of the goal. For LaMP 2006, the titles at each end of the gauge have changed from good and poor to sustainable and unsustainable. It is hoped this action will help underscore the need to take action. In addition, following the "Status of the Goal" at the beginning of each chapter a list of indicator titles are included to inform the reader as to the data used to inform the status conclusion.

SOLEC Great Lakes Revised Indicator Framework

SOLEC has also been reviewing the indicators and has undergone a peer review process. A strong message that emerged from both internal and external Peer Review sessions was the need to reduce the overall number of indicators by identifying and eliminating those indicators that may be unnecessary or redundant. An additional and related comment was that in order to accomplish this reduction, categorical groupings of indicators by topic, issue or theme could be developed. Based on these recommendations, SOLEC organizers grouped related indicators into the following categories and sub-categories (or "bundles" and "sub-bundles") for ease in and presentation of related information and understanding of the larger issue:

1. Contamination
 - a. Nutrients
 - b. Toxics in Biota
 - c. Toxics in Media
 - d. Sources and Loadings

2. Biotic Communities
 - a. Fish
 - b. Birds
 - c. Mammals
 - d. Amphibians
 - e. Invertebrates
 - f. Plants
 - g. General

3. Invasive Species
 - a. Aquatic
 - b. Terrestrial

4. Coastal Zones
 - a. Nearshore Aquatic
 - b. Coastal Wetlands
 - c. Terrestrial
5. Aquatic Habitats
 - a. Open Lake
 - b. Groundwater
6. Human Health
7. Land Use - Land Cover
 - a. General
 - b. Forest Lands
 - c. Agricultural Lands
 - d. Urban/Suburban Lands
 - e. Protected Areas
8. Resource Utilization
9. Climate Change

In this approach, many indicators are relevant to more than one category. For example, "Contaminants in Sport Fish" is included in both "Contamination: Toxics in Biota" and "Human Health." All of the indicators within a category, however, contribute to a more complete evaluation of environmental conditions pertaining to that category.

Other categories are possible, and they may of greater usefulness in the future. Likewise, the "old" categories previously used for reporting Great Lakes indicators may still be relevant for some users. As originally conceived, the Great Lakes suite of indicators was developed around the topics of open and nearshore waters, coastal wetlands, nearshore terrestrial, land use, human health, societal, and unbounded. Each indicator was associated with one primary category, but all the indicators were also evaluated for relevancy to other SOLEC categories and to other major environmental groupings (e.g., land, water, air, biota), issues (e.g., contaminants, invasive species, urban sprawl), or indicator systems (e.g., IJC Desired Outcomes, Great Lakes Water Quality Agreement Impaired Beneficial Uses).

The categories currently listed are incomplete, and others may be incorporated in the future. For example, under "Aquatic Habitats," indicators have yet to be identified and developed for inland surface waters, including tributaries, inland lakes, and inland wetlands. The category "Resource Utilization" is also very incomplete and will require quite extensive consideration of socio-economic indicators relevant to the assessment of Great Lakes ecosystem components. Likewise, "Human Health" could be expanded to "Human Health and Well Being" and include indicators to assess social values of residents in the Great Lakes basin.

Changes to the Indicator Assessment Process

In response to suggestions from the peer reviews that the SOLEC process for the assessment of indicators was not sufficiently transparent or standardized, some changes were made to make assessments more credible and internally consistent. Previously, the available assessment options were restricted to Good, Mixed Improving, Mixed, Mixed Deteriorating, and Poor. These were not always sufficient or helpful. For SOLEC 2004, a system is being used to better express the relative condition and trend for all indicators. Authors have

provided a qualitative assessment for their adopted as they have done in the past, but the assessment categories are now less ambiguous. Specifically, authors have provided a "condition" of the ecosystem related to their indicator by selecting a "good, fair, poor or mixed" status and then assigning a "direction" of "improving, unchanged, deteriorating or undetermined" to each indicator.

Five broad ranking categories were used to characterize the assessments:

- Good. The state of the ecosystem component(s) is/are presently meeting ecosystem objectives or otherwise is in acceptable condition.
- Fair. The ecosystem component(s) is/are currently exhibiting minimally acceptable conditions, but it is not meeting established ecosystem objectives, criteria, or other characteristics of fully acceptable conditions.
- Poor. The ecosystem component(s) is/are severely negatively impacted and it does not display even minimally acceptable conditions.
- Mixed. The ecosystem component(s) displays both good and degraded features.
- Not Assessed. There is insufficient information to make an assessment

In addition, four ecosystem trajectories (or trends over time) were recognized:

- Improving. Information provided by the report shows the ecosystem component(s) to be changing toward more acceptable conditions.
- Unchanging. Information provided by the report shows the ecosystem component(s) is/are neither getting better nor worse.
- Deteriorating. Information provided by the report shows the ecosystem component(s) to be changing away from acceptable conditions.
- Undetermined. Data are not available to assess the ecosystem component(s) over time, so no trend can be identified.

For Lake Michigan: Sustainability would be beyond meeting ecosystem objectives and would include a system to maintain that status which might include monitoring, a watershed plan and local or state programs or regulations to prevent regression and the ability to address new issues should they occur.

In the following pages, the status and trends are represented in the following manner..

Status					Trend			
					➔	◆	➔	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined
Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend								

CONTAMINATION

ID #	Indicator Name	2007 Assessment (Status, Trend)					
		Lake					
		SU	MI	HU	ER	ON	
Nutrients							
111	Phosphorus Concentrations and Loadings	open lake	?	→	?	?	→
		nearshore	?	?	?	?	?
7061	Nutrient Management Plans	2005 Report					
Toxics in Biota							
114	Contaminants in Young-of-the-Year Spottail Shiners	→	?	→	→	→	
115	Contaminants in Colonial Nesting Waterbirds	→	→	→	→	→	
121	Contaminants in Whole Fish	→	→	→	→	→	
124	External Anomaly Prevalence Index for Nearshore Fish	?	?	?	◆	◆	
4177	Biologic Markers of Human Exposure to Persistent Chemicals	?					
4201	Contaminants in Sport Fish	→	→	→	→	→	
4506	Contaminants in Snapping Turtle Eggs	?	?	?	?	?	
8135	Contaminants Affecting Productivity of Bald Eagles	→ 2005 Report					
8147	Population Monitoring and Contaminants Affecting the American Otter	? 2003 Report					
Toxics in Media							
117	Atmospheric Deposition of Toxic Chemicals	PCBs & others	→				
		PAHs & mercury	◆	&	→		
118	Toxic Chemical Concentrations in Offshore Waters	?	?	?	?	?	
119	Concentrations of Contaminants in Sediment Cores	→ & ?					
4175	Drinking Water Quality	◆					
4202	Air Quality	→					
9000	Acid Rain	→ 2005 Report					
Sources and Loadings							
117	Atmospheric Deposition of Toxic Chemicals	PCBs & others	→				
		PAHs & mercury	◆	&	→		
4202	Air Quality	→					
7065	Wastewater Treatment and Pollution	Progress Report					
9000	Acid Rain	→ 2005 Report					

BIOTIC COMMUNITIES

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
Fish						
8	Salmon and Trout	→	→	→	→	◆
9	Walleye	?	?	◆	◆	◆
17	Preyfish Populations	→	←	←	←	←
93	Lake Trout	→	←	→	◆	←
125	Status of Lake Sturgeon in the Great Lakes	?→	?→	?→	?	→
4502	Coastal Wetland Fish Community Health	Progress Report				
Birds						
115	Contaminants in Colonial Nesting Waterbirds	→	→	→	→	→
4507	Wetland-Dependent Bird Diversity and Abundance	?	←	←	←	←
8135	Contaminants Affecting Productivity of Bald Eagles	→ 2005 Report				
Mammals						
8147	Population Monitoring and Contaminants Affecting the American Otter	? 2003 Report				
Amphibians						
4504	Wetland-Dependent Amphibian Diversity and Abundance	?	◆	←	←	◆
7103	Groundwater Dependent Plant and Animal Communities	2005 Report				
Invertebrates						
68	Native Freshwater Mussels	2005 Report				
104	Benthos Diversity and Abundance - Aquatic Oligochaete Communities	◆	◆	◆	◆	◆
116	Zooplankton Populations	◆	?	?	?	?
122	<i>Hexagenia</i>	?	?	?	↔	?
123	Abundance of the Benth Amphipod <i>Diporeia</i> spp.	◆	←	←	←	←
4501	Coastal Wetland Invertebrate Community Health	2005 Progress Report				
Plants						
109	Phytoplankton Populations	? 2003 Report				
4862	Coastal Wetland Plant Community Health	◆	◆	←	◆	◆
8500	Forest Lands - Conservation of Biological Diversity	?				

INVASIVE SPECIES

ID #	Indicator Name	2007 Assessment (Status, Direction)				
		Lake				
		SU	MI	HU	ER	ON
Aquatic						
18	Sea Lamprey	→ 2005 Report				
9002	Non-Native Species (Aquatic)	◆	←	←	←	←
Terrestrial						
9002	Non-Native Species (Terrestrial)	?				

HUMAN HEALTH

ID #	Indicator Name	2007 Assessment (Status, Direction)				
		Lake				
		SU	MI	HU	ER	ON
4175	Drinking Water Quality	◆				
4177	Biological Markers of Human Exposure to Persistent Chemicals	?				
4200	Beach Advisories, Postings and Closures	?	?	◆?	?	?
4201	Contaminants in Sport Fish	→	→	→	→	→
4202	Air Quality	→				

RESOURCE UTILIZATION

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
3514	Commercial/Industrial Eco-Efficiency Measures	2003 Report				
7043	Economic Prosperity	? 2003 Report				
7056	Water Withdrawals	◆ 2005 Report				
7057	Energy Consumption	? 2005 Report				
7060	Solid Waste Disposal	?				
7064	Vehicle Use	←				
7065	Wastewater Treatment and Pollution	Progress Report				

COASTAL ZONES and AQUATIC HABITATS

ID #	Indicator Name	2007 Assessment (Status, Trend)					
		Lake					
		SU	MI	HU	ER	ON	
COASTAL ZONES							
Nearshore Aquatic							
4861	Effect of Water Level Fluctuations	?	2003 Report				
8131	Extent of Hardened Shoreline	←	2001 Report				
Coastal Wetlands							
4501	Coastal Wetland Invertebrate Community Health	2005 Progress Report					
4502	Coastal Wetland Fish Community Health	Progress Report					
4504	Wetland-Dependent Amphibian Diversity and Abundance	?	◆	←	←	◆	
4506	Contaminants in Snapping Turtle Eggs	?	?	?	?	?	
4507	Wetland-Dependent Bird Diversity and Abundance	?	←	←	←	←	
4510	Abundance of the Benthic Amphipod <i>Diporeia</i> spp.	◆	←	←	←	←	
4861	Effect of Water Level Fluctuations	?	2003 Report				
4862	Coastal Wetland Plant Community Health	◆	◆	←	◆	◆	
4863	Land Cover Adjacent to Coastal Wetlands	Progress Report					
Terrestrial							
4861	Effect of Water Level Fluctuations	?	2003 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Alvars	?	2001 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Cobble Beaches	←	2005 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Islands	?					
8129	Area, Quality and Protection of Special Lakeshore Communities - Sand Dunes	2005 Progress Report					
8131	Extent of Hardened Shoreline	←	2001 Report				
AQUATIC HABITATS							
Open Lake							
111	Phosphorus Concentrations and Loadings	open lake	?	←	?	?	←
		nearshore	?	?	?	?	?
118	Toxic Chemical Concentrations in Offshore Waters	?	?	?	?	?	
119	Concentrations of Contaminants in Sediment Cores	→ & ?					
8131	Extent of Hardened Shoreline	←	2001 Report				
Groundwater							
7100	Natural Groundwater Quality and Human-Induced Changes	2005 Report					
7101	Groundwater and Land: Use and Intensity	2005 Report					
7102	Base Flow Due to Groundwater Discharge	←					
7103	Groundwater Dependent Plant and Animal Communities	2005 Report					

LAND USE - LAND COVER

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
General						
4863	Land Cover Adjacent to Coastal Wetlands	Progress Report				
7002	Land Cover - Land Conversion	?	?	?	?	?
7054	Ground Surface Hardening	2005 Progress Report				
7101	Groundwater and Land: Use and Intensity	2005 Report				
Forest Lands						
8500	Forest Lands - Conservation of Biological Diversity	?				
8501	Forest Lands - Maintenance and Productive Capacity of Forest Ecosystems	?				
8503	Forest Lands - Conservation & Maintenance of Soil & Water Resources	?	?	?	?	?
Agricultural Lands						
7028	Sustainable Agriculture Practices	2005 Report				
7061	Nutrient Management Plans	2005 Report				
7062	Integrated Pest Management	2005 Report				
Urban/Suburban Lands						
7000	Urban Density	?				
7006	Brownfields Redevelopment	→				
7054	Ground Surface Hardening	2005 Progress Report				
Protected Areas						
8129	Area, Quality and Protection of Special Lakeshore Communities - Alvars	? 2001 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Cobble Beaches	← 2005 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Islands	?				
8129	Area, Quality and Protection of Special Lakeshore Communities - Sand Dunes	2005 Progress Report				
8164	Biodiversity Conservation Sites	Proposed Indicator				

CLIMATE CHANGE

ID #	Indicator Name	2007 Assessment (Status, Trend)
		Lake
		SU MI HU ER ON
4858	Climate Change: Ice Duration on the Great Lakes	←

