Virtual elimination of toxic substances in the changing Great Lakes

by Alfred M. Beeton

The five St. Lawrence Great Lakes make up an international resource shared along a 1,000 mile boundary with Canada. These lakes and connecting waters contain 95% of the U.S. fresh surface water and 20% of the global surface fresh water. Over 30 million people rely on the lakes for drinking water. The Great Lakes, with a coastline of 4,500 miles in 8 states, truly are America's fourth coastline. The Atlantic coast, Pacific coast, and Gulf coast are 4,100, 4,000 and 3,200 miles respectively. The Great Lakes region is the heartland which with about 12% of the U.S. Population produces 33% of the national personal income and 37% of the total value of U.S. shipments related to manufactured exports.

People who are unfamiliar with the lakes frequently have a misconception about their size and importance. For example, five Chesapeake Bays would easily fit into Lake Michigan; the Bay has a surface area of 4,384 sq. mi. and Lake Michigan has a surface area of 22,400 sq. mi. The Great Lakes region is about equal in size to the Baltic Sea and Baltic countries.

Man's use or misuse of the Great Lakes ecosystem has resulted in major changes in the basin as well as in water quality and the biota. Early signs of major problems were the collapse of very productive fisheries such as those for cisco, bluepike, lake trout, and whitefish in Lake Erie. The Lake Erie cisco fishery production fluctuated from around 20 million to 48 million pounds per year into the 1920's. The first signs of trouble were apparent when the commercial catch dropped to only 147,000 pounds in 1936. The fishery recovered briefly and produced 16

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million pounds in 1946 followed by a precipitous decline to less than 1,000 pounds in the mid 1960's. Cisco still are to be found in Lake Erie but the population remains small. The change in the fish populations, large increases in phytoplankton abundances, replacement of so called clean water benthos with pollution tolerant species, and increases in chloride, sulfate, phosphorus and other chemicals were accepted as signs of accelerated eutrophication in Lake Erie and in other Great Lakes. Most of these changes were likely the consequences of nutrient enrichment, although these changes were not really documented until after World War II and the beginning of the wide spread use of DDT and similar compounds. Joint efforts and huge expenditures by Canada and the U.S. to upgrade sewage treatment and otherwise reduce nutrient loading to the Great Lakes have resulted in decreasing levels of phosphorus in the lakes, decreases in phytoplankton, and improvement in some stocks of native fishes. It should also be noted that various non-indigenous species gained access to and established viable populations in the Great Lakes over the past 100 years. The sea lamprey has been especially devastating because of its predation on large fish. It is believed to have almost eliminated the once abundant lake trout from the Great Lakes. More recently we have become increasingly alarmed over the rapid spread of the zebra mussel, an exotic from northern Europe, throughout the Great Lakes.

The major concern about the Great Lakes today is the accumulation of many kinds of toxic contaminants in the environment and biota. This concern is especially heightened by health advisories which inform pregnant women, nursing mothers and young children not to eat certain large fish. Furthermore, the advise is that <u>no one</u> should eat brown trout, lake trout or carp larger than 25" from Lake Michigan. It is encouraging that concentrations of PCB's and DDT in fish have declined in some of the Great Lakes. Nevertheless, the pattern is not consistent

throughout the system and concern is reenforced by continuing poor reproduction and birth deformaties among fish eating birds.

The Great Lakes Water Quality Agreements of 1972 and 1978 were signed by Canada and the U.S. to restore and enhance water quality in the Great Lakes Basin Ecosystem. A phosphorous load reduction supplement was signed in 1983. The most recent amendment was signed November 18, 1987. Article II (a) states, "The discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated." Annex 12(i) states, "The intent of programs specified in this Annex is to virtually eliminate the input of persistent toxic substances in order to protect human health and to ensure the continued health and productivity of living aquatic resources and human use thereof;" paragraph (ii) states, "The philosophy adopted for control of inputs of persistent toxic substances shall be zero discharge;".

The policy of virtual elimination and the philosophy of zero discharge have profound implications for regulatory strategies, technologies, monitoring, and those who will implement the policy. The International Joint Commission has decided to focus on the topic of virtual elimination. A joint Water Quality Board and Science Advisory Board Virtual Elimination Task Force has been established. In order to deal with virtual elimination of persistent toxic substances we need to improve identification of such substances and have a better understanding of the impact of these on the Great Lakes ecosystem including human health and reproduction. This means improving our knowledge of sources of toxic substances, e.g. airborne, non-point source, and route of exposure and pathways through the ecosystem. We will need to look at technological options for elimination of the compounds both those which are already in the ecosystem and those which could be eliminated at the source. A question which must be answered is, what is the

feasibility of a complete ban on manufacture, importation, transport, sale and use of persistent toxic substances? We need to determine the feasibility of removal of compounds already in the environment, e.g. in sediments. Legal provisions in Canada and the U.S. to implement virtual elimination will need to be determined, as will the socioeconomic problems which may occur. Obviously new objectives for monitoring and surveillance will be developed consistent with ecosystem objectives and consistent with the philosophy of zero discharge. We need to define zero discharge, e.g. biologically, technologically, or by analytical chemistry. In any case implementing a policy of virtual elimination will not be an easy task. The International Joint Commission should be commended for undertaking this task.