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Report
to the
Governments
of the
United States
and
Canada

New and Revised Great Lakes Water Quality Objectives

Volume I



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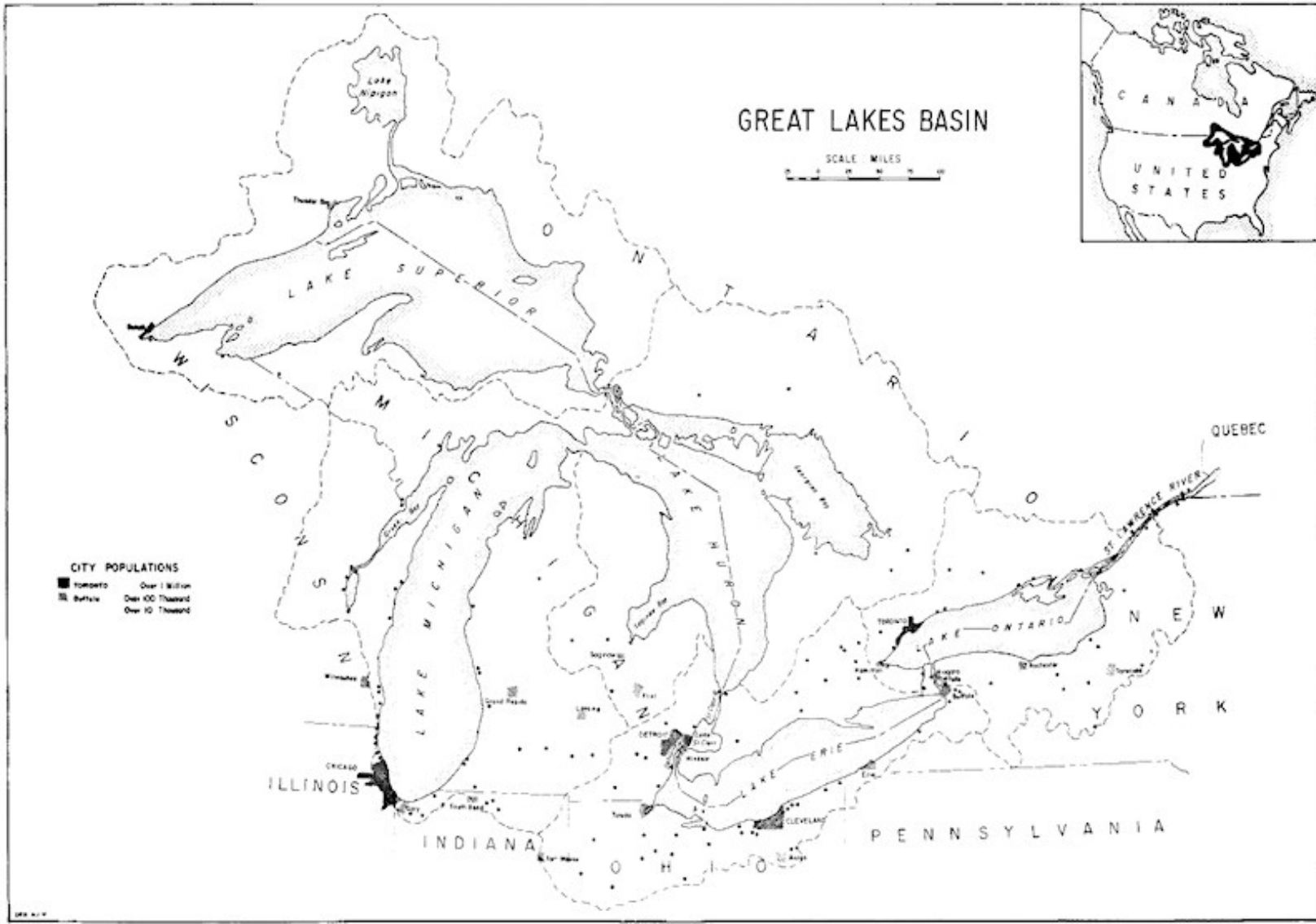
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Chapter I

INTRODUCTION

This report of the International Joint Commission is in response to various requirements of the Great Lakes Water Quality Agreement for the development of new and revised water quality objectives. It describes the background of the Agreement, the Water Quality Board, Research Advisory Board and their committee systems through which the objectives were developed and processed. The report reviews the public hearing and summarizes the testimony given at the hearing and submitted subsequently to the Commission. A brief summary is presented on the rationale for each objective. Detailed rationale is contained in Volume II of this report. Finally, the report presents the recommendations of the Commission.

Chapter II

BACKGROUND

On April 15, 1972 the Governments of the United States and Canada signed the Great Lakes Water Quality Agreement. The two countries, concerned about the grave deterioration of water quality of the Great Lakes, agreed that the best means to achieve improved water quality in the Great Lakes System is through the adoption of common objectives, the development and implementation of cooperative programs and other measures, and the assignment of special responsibilities to the International Joint Commission.

Under Article VI of the Agreement, the International Joint Commission was designated to assist in the implementation of the Agreement, pursuant to Article IX of the Boundary Waters Treaty of 1909. Among the responsibilities given to the Commission was the "Tendering of advice and recommendations to the Parties and to the State and Provincial Governments on problems of the quality of the boundary waters of the Great Lakes System, including specific recommendations concerning the water quality objectives..."

Under Article VII of the Agreement, the Commission was directed to establish a Great Lakes Water Quality Board to assist it in the exercise of the powers and responsibilities assigned to it under the Agreement. The Commission was also directed to establish a Research Advisory Board which would relate to research activities in Canada and the United States concerning the quality of the waters of the Great Lakes System. That

Board's functions and responsibilities are specified in the terms of reference contained in the Agreement. The Board was directed to "work at all times in close cooperation with the Great Lakes Water Quality Board."

Once the Water Quality Board was organized and functioning, it established an Implementation Committee and four subcommittees to assist it in carrying out its responsibilities to the Commission. One of the subcommittees was the Water Quality Objectives Subcommittee whose function was to assess the adequacy of the objectives in the Agreement and develop new or revised objectives.

Similarly, the Research Advisory Board established a series of committees to support it in carrying out its responsibilities. One of these was the Standing Committee on the Scientific Basis for Water Quality Criteria. The Research Advisory Board has recently reorganized its supporting groups and this former committee is now a Task Force on the Scientific Basis for Water Quality Criteria.

The membership of the Boards and supporting groups is listed in Appendix A.

Articles II and III and Annex 1 of the Agreement set out the general objectives and some specific objectives to be met to ensure that pollution of the boundary waters does not occur. Annex 1 includes a list of substances for which specific water quality objectives were to be considered.

The Water Quality Objectives Subcommittee and the Task Force on the Scientific Basis for Water Quality Criteria have worked together in developing specific water quality objectives for a range of parameters, which, if not exceeded, will protect the most sensitive beneficial use of the boundary waters. Thus, the objectives have been established to protect aquatic life or its consumers (i.e. fish, birds and mammals), public water supply and/or recreational use, depending upon which is the most sensitive.

The objectives are based on best available scientific information on cause/effect relationships between pollutants and water use. The objectives also provide a refinement of the restoration and enhancement and non-degradation principles set forth in the Agreement. This has been accomplished by reviewing best available information, direct contact with experts and the use of workshops to develop state-of-the-art information in areas where further data were desired. The output from this joint activity; i.e. specific water quality objectives for many substances and the scientific rationale for these objectives, are discussed in Chapter IV of this report.

The proposed new and revised water quality objectives were considered by the Water Quality Board and recommended to the International Joint Commission in the Board's Annual Reports for 1974 and 1975. The Commission decided to submit these proposed new and revised objectives to public review prior to recommending them to the Governments for adoption and inclusion as amendments to the Agreement.

The Commission proceeded to publicize and hold public hearings on these objectives on December 7 and 8, 1976 in Windsor, Ontario. The details of these hearings are covered

in Chapter V of this report. The hearing records were kept open until February 1, 1977 to receive additional briefs on the objectives. All briefs were reviewed and the recommendations they contained were taken into consideration.

Chapter III

MEANING OF WATER QUALITY OBJECTIVES

Under Article IV of the Boundary Waters Treaty of 1909, Canada and the United States assumed a mutual obligation that "boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other". In general terms, water quality objectives are common guidelines adopted by both countries to provide a mechanism for ensuring that Article IV of the Treaty and Articles II, III and IV of the Great Lakes Water Quality Agreement are respected. This chapter outlines in more specific terms the evolution of the concept of water quality objectives stemming from the investigation of the Lower Lakes by the International Joint Commission in 1970. The chapter also explains the difference between objectives and water quality standards.

In the 1970 IJC Report to Governments on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River, the purpose and nature of water quality objectives are outlined very succinctly and are summarized in the following paragraph.

Water quality objectives are desirable levels of water quality to be obtained in the boundary waters of the Great Lakes System and are not intended to preclude the establishment of more stringent requirements. They take into account the criteria for a whole spectrum of water uses; supplies for municipal, industrial and agricultural purposes,

recreation, aesthetic enjoyment and the propagation of aquatic life and wildlife. The objectives are intended to be the minimum basis for formulating provincial and state water quality standards and meaningful programs to achieve the desirable levels of water quality. In short, water quality objectives are goals to be maintained or achieved in the boundary waters through effective pollution control programs in both countries.

The 1970 Report states that compliance with the objectives would involve the monitoring of waste discharges by provincial and state water pollution control agencies and also might involve effluent controls or other measures in some cases. The Report proposed to the Governments several specific and general water quality objectives for the Lower Lakes and St. Lawrence River.

Recognizing the values of effective co-operative action as demonstrated during the Lower Lakes investigation, the Governments of the United States and Canada entered into the 1972 Great Lakes Water Quality Agreement. Many of the general and specific water quality objectives recommended in the 1970 Report formed part of the 1972 Agreement and became applicable for the boundary waters of the Great Lakes system.

The Agreement recognized, however, that as more information became available, the original water quality objectives should be revised and new ones added. In developing new and revised water quality objectives, the Great Lakes Water Quality Board and the Great Lakes Research Advisory Board and their committees adopted the concept of the protection of the most sensitive beneficial uses. This includes principally the protection of

aquatic life as well as fish-consuming birds and mammals. Protection of public water supply is also included where appropriate. For certain parameters, aesthetic and/or recreational uses are the most sensitive ones.

The concept of protecting the most sensitive beneficial uses is a refinement of the two countries' desire to protect and enhance Great Lakes water quality. The Water Quality Board and the Research Advisory Board feel that in order to restore, protect, and enhance the Great Lakes, all uses should be protected. The mechanism by which this can be achieved is the protection of the most sensitive beneficial use. This refinement is consistent with the stated intent of the Agreement and the Commission fully supports it.

Article IV of the Great Lakes Water Quality Agreement specifies that the Parties shall use the best efforts to ensure that water quality standards and other regulatory requirements of the state and provincial governments are consistent with the achievement of the water quality objectives. The difference between objectives and water quality standards should be carefully noted. While the two Governments have made mutual commitments to ensure the achievement of water quality objectives, the means by which the objectives are achieved are a jurisdictional prerogative. Water quality standards and other legally enforceable regulatory requirements are prescribed levels of water quality established by governmental authorities in each jurisdiction. These water quality objectives have been developed on the basis of scientifically defensible data to protect the most sensitive beneficial use. Standards and similar legal requirements should be established by each jurisdiction after careful consideration of the designated uses, social and economic factors, and technological capability, and should be consistent with the objectives.

Chapter IV

PROPOSED WATER QUALITY OBJECTIVES AND THEIR SCIENTIFIC RATIONALE

This chapter presents the new and revised water quality objectives which are being recommended by the Commission to the Governments for inclusion in the Great Lakes Water Quality Agreement.

The format of Annex 1 of the Agreement has been followed in the presentation in order to provide an uncomplicated reference method between the existing objectives and those now being recommended. Revisions to specific water quality objectives are presented under the heading of specific water quality objectives. Many new objectives for mercury and other toxic heavy metals, persistent organic contaminants and oil, petrochemicals and immiscible substances are recommended. The objectives for non-degradation and mixing zones are revised. The final section of the chapter contains recommendations for objectives on substances included under the heading "consultation" which did not come under the previously described sections.

Following the description of each new and revised objective, the basis for that objective is presented in nonscientific language. Also, the basis has been abbreviated very considerably. The reader is referred to the complete rationale for each objective which is published in a separate document entitled "New and Revised Great Lakes Water Quality Objectives", Volume II, May, 1977.

Basic approaches were adopted to derive water quality objectives for heavy metals, persistent organic compounds and mixing zones. The following paragraphs describe these approaches.

With respect to heavy metals, considerable efforts were made to establish objectives on relationships between metal forms and their toxicity. To this end, a workshop was sponsored by the Commission and attended by experts from North America and Europe. It was determined that currently such relationships have not been established, nor are there reliable methods for monitoring such forms. Thus, the objectives for metals refer to total concentrations of each metal in an unfiltered (whole water), digested sample.

There is an extensive discussion on this in Volume II. As most laboratory measurements of lethal and sublethal toxicity are based on total metal concentrations, the Commission recommends that until the chemistry of metals in natural waters and the effects of metal forms to aquatic biota is better understood, the objectives based on total metal concentrations be adopted for the Great Lakes.

Persistent organic contaminants are known to be present in the Great Lakes. Objectives are recommended for the known persistent organic contaminants for which scientific data exist. Where data are available to establish "safe" tissue levels, and not available to establish "safe" water levels due to inadequate information on bioconcentration factors, quantification levels are recommended. Quantification levels are not permanent substitutes for experimentally determined "safe" concentrations. They are designed to provide a mechanism for action by regulatory agencies and to assure appropriate analytical methodology. The results of a survey of ten Great Lakes region laboratories which are

currently doing routine analysis of persistent organic compounds determined that the recommended levels of quantification are applicable. The recommended levels are based on the mean of the three lowest quantification levels reported. "Substantial absence" is therefore considered in a practical sense as the concentration which is below that which can be quantified.

While the new objective for mixing zones is extensive and generally self-explanatory, additional information is available in Volume II on this objective.

The International Joint Commission recommends the establishment of the new and modified specific water quality objectives as outlined in this Chapter, in accordance with item 8(b) of Annex 1 of the Great Lakes Water Quality Agreement:

Whenever the International Joint Commission, acting pursuant to Article VI of the Agreement, shall recommend the establishment of new or modified specific water quality objectives, this Annex shall be amended in accordance with such recommendation on receipt by the Commission of a letter from each Party indicating its agreement with the recommendation.

The recommended revisions to Annex I of the Great Lakes Water Quality Agreement are as follows:

1. Specific Objectives.
 - (a) Microbiology. no change currently recommended.
 - (b) Dissolved Oxygen. no change currently recommended.
 - (c) Total Dissolved Solids. no change currently recommended.
 - (d) Taste and Odour.

EXISTING

Phenols and other objectionable taste and odour producing substances should be substantially absent.

REVISION

Taste, Odour, and Tainting Substances.

- 1) Raw public water supply sources should be essentially free from objectionable taste and odour for aesthetic reasons.*

- 2) Levels of phenolic compounds should not exceed 0.001 milligram per litre in raw public water supplies to protect against taste and odour in domestic water.*

- 3) Substances entering the water as the result of human activity that cause tainting of edible aquatic organisms should not be present in concentrations which will lower the acceptability of these organisms as determined by organoleptic tests .*

The rationale for the recommended revision is described in Volume II. There are adequate data to support the specified levels of phenolic compounds. The revisions provide more specificity with regard to Taste and Odour. Also, information is summarized on concentrations in wastewaters and specific chemical compounds in water that can produce identifiable taste in fish flesh.

- (e) pH.

EXISTING

Values should not be outside the range of 6.7 to 8.5.

REVISION

Values of pH should not be outside the range of 6.5 to 9.0, nor should discharges change the pH at the boundary of a designated mixing zone more than 0.5 units from the ambient level.

Present evidence indicates that the expanded pH range will provide adequate protection for the life processes of fresh water fish and bottom dwelling invertebrates. The recommended pH range is well within that recommended for public water supplies (5.0 to 9.0). Because pH changes may increase the toxicity of various components in waters, pH changes of more than 0.5 pH units should be avoided.

- (f) Iron. no change currently recommended.
- (g) Phosphorus (P). no change currently recommended.
- (h) Radioactivity. presently under review by Governments.

2. Interim Objectives.

- (a) Temperature. no change currently recommended.
- (b) Mercury and Other Toxic Heavy Metals. The following specific objectives are recommended under the heading of "metals" to replace the interim objective:
 - i) Arsenic.
Concentrations of total arsenic in an unfiltered water sample should not exceed 50 micrograms per litre to protect raw waters for public water supplies.

Concentrations of arsenic considered safe for public drinking water supplies are substantially lower than those required to protect aquatic life. The objective of 50 micrograms per litre is in keeping with the level proposed by the United States Environmental Protection Agency, in the Federal Register, March 14, 1975 and the 1968 Canadian Drinking Water Standards and Objectives.

ii) Cadmium.

Concentrations of total cadmium in an unfiltered water sample should not exceed 0.2 microgram per litre to protect aquatic life.

The objective of 0.2 microgram per litre is recommended because of the extreme sensitivity to cadmium of trout and zooplankton reproduction.

iii) Chromium.

Concentrations of total chromium in an unfiltered water sample should not exceed 50 micrograms per litre to protect raw waters for public water supplies.

Concentrations of chromium considered safe for public drinking water supplies, as established by United States and Canadian guidelines at 50 micrograms per litre, adequately protect aquatic life.

iv) Lead.

Concentrations of total lead in an unfiltered water sample should not exceed 10 microgram per litre in Lake Superior, 20 microgram per litre in Lake Huron and 25 micrograms per litre in all remaining Great Lakes to protect aquatic life.

The criteria for lead for aquatic biota require a more stringent objective than for drinking water. To account for the variation with water hardness of the response of an observed fish species to total lead in water, the objective of 10 micrograms per litre in Lake Superior, 20 micrograms per litre in Lake Huron and 25 micrograms per litre in all other lakes is recommended.

v) Mercury.

Concentrations of total mercury in a filtered water sample 'should not exceed 0.2 microgram per litre nor should the concentration of total mercury in whole fish exceed 0.5 microgram per gram (wet weight basis) to protect aquatic life as well as fish-consuming birds.

The biologically significant form of mercury is methyl mercury. The bulk of mercury found in fresh water fish occurs in this form. It is nearly impossible to correlate environmental concentrations of total mercury in unfiltered water with concentrations of methyl mercury which accumulate in fish. Mercury in filtered water samples is arbitrarily assumed to be methyl mercury. The effect of concentrations of methyl mercury in fish on fish-eating birds necessitates the limitation of total mercury in fish not to exceed 0.5 microgram per gram. This limitation also assures long term protection of fish.

The simultaneous application of the proposed objectives for water and for bioaccumulated mercury in fish should protect aquatic life as well as the consumers (e.g. fish, birds and mammals) of aquatic life.

vi) Selenium.

Concentrations of total selenium in an unfiltered water sample should not exceed 10 microgram per litre to protect raw water for public water supplies.

The recommended limitation of concentration for total selenium of 10 micrograms per litre in an unfiltered water sample conforms with that of the Water Quality Criteria 1972 (NAS/NAE 1973), Canada and the World Health Organization. This recommendation for the protection of raw drinking water supplies is more stringent than that required to protect aquatic biota.

vii) Zinc.

Concentrations of total zinc in an unfiltered water sample should not exceed 30 microgram per litre to protect aquatic life.

In view of the great sensitivity of fish to low concentrations of zinc, the objective of 30 micrograms per litre is recommended. This compares with the United States and Canadian drinking water permissible limit of 5,000 micrograms per litre and the Canadian drinking water objective of less than 1,000 micrograms per litre.

- (c) Persistent Organic Contaminants. Persistent pest control products and other persistent organic contaminants that are toxic or harmful to human, animal or aquatic life should be *substantially* absent in the waters. Recognizing that such substances are present in the Great Lakes, the following objectives are recommended for the known persistent organic contaminants for which scientific data exist.

Pesticides.

i) Aldrin/Dieldrin.

The sum of the concentrations of aldrin and dieldrin in water should not exceed the recommended quantification limit of 0.001 microgram per litre. The sum of concentration of aldrin and dieldrin in the edible portion of fish should not exceed 0.3 microgram per gram for the protection of human consumers of fish.

It has been shown that the toxicity to aquatic organisms of both aldrin and dieldrin is similar. Consequently, the recommendation has been expressed in terms of the total concentrations in water of dieldrin and aldrin. Aldrin and dieldrin have recently been shown to be carcinogenic. This factor has influenced the determination of the objective of 0.001 microgram per litre. The recommended edible fish tissue concentration of 0.3 microgram per gram is the concentration allowed under the United States Food and Drug Administration guidelines.

ii) Chlordane.

The concentration of chlordane in water should not exceed 0.06 microgram per litre for the protection of aquatic life

Long term flow-through studies on the effects of chlordane, including studies on the effect on reproduction of fathead minnows, bluegills and brook trout, have shown that a derived "safe" concentration would be 0.06 microgram per litre.

iii) DDT and Metabolites.

The sum of the concentrations of DDT and its metabolites in water

should not exceed the recommended quantification limit of 0.003 microgram per litre. The sum of the concentration of DDT and its metabolites in whole fish (wet weight basis) should not exceed 1.0 microgram per gram for the protection of fish consuming aquatic birds.

"Safe" concentrations of DDT in water for fish have not been established by long term experiments measuring subtle effects on fish. Therefore, no "safe" water concentration of DDT can be established. Consequently, the concentration of DDT in water should not exceed 0.003 microgram per litre. The permissible body burden in fish was set at 1.0 microgram per gram total DDT to protect aquatic birds on the basis of egg shell thinning studies.

iv) *Endrin.*

The concentration of endrin in water should not exceed the recommended quantification limit of 0.002 microgram per litre. The concentration of endrin in the edible portion of fish should not exceed 0.3 microgram per gram for the protection of human consumers of fish.

There are no experimental data available which would establish "safe" levels of endrin in water for aquatic organisms. Consequently, it is recommended that the concentration of endrin in water should not exceed 0.002 microgram per litre.

To protect fish consumers, the 0.3 microgram per gram value is the United States Food and Drug Administration guideline for residues of endrin in edible fish tissue.

v) Heptachlor.

The sum of the concentrations of heptachlor and heptachlor epoxide in water should not exceed the recommended quantification limit of 0.001 microgram per litre. The sum of the concentrations of heptachlor and heptachlor epoxide in edible portions of fish should not exceed 0.3 microgram per gram for the protection of human consumers of fish.

On the basis of available evidence, no experimentally determinable "safe" levels of heptachlor in water can be set. Therefore, the concentration of heptachlor in water should not exceed 0.001 microgram per litre.

The 0.3 microgram per gram value is the United States Food and Drug Administration guideline for residues of heptachlor in edible fish tissue.

vi) Lindane.

The concentration of lindane in water should not exceed 0.01 microgram per litre for the protection of aquatic life. The concentration of lindane in edible portions of fish should not exceed 0.3 microgram per gram for the protection of human consumers of fish.

Little information is available on the accumulation of lindane in fish tissues. The recommended criterion is based on the 0.3 microgram per gram administrative guidelines of the United States Food and Drug Administration for lindane in edible portions of fish.

vii) Methoxychlor.

The concentration of methoxychlor in water should not exceed 0.04 microgram per litre for the protection of aquatic life.

Studies of the chronic effects of methoxychlor under field conditions showed that methoxychlor produced subtle effects on some invertebrate populations. These studies were used to determine that the concentration of 0.04 microgram per litre should not be exceeded.

viii) Toxaphene

The concentration of toxaphene in water should not exceed 0.008 microgram per litre for the protection of aquatic life.

In bioassay studies it was found that toxaphene in water affected the growth and development of fish species. On this basis the concentration limit of toxaphene was calculated to be 0.008 microgram per litre.

Other Toxic Persistent Compounds.

i) *Phthalic Acid Esters.*

The concentrations of dibutyl phthalate and di(2-ethylhexyl) phthalate in water should not exceed 4.0 micrograms per litre and 0.6 microgram per litre, respectively, for the protection of aquatic life. Other phthalic acid esters should not exceed the recommended quantification limit of 0.2 microgram per litre in waters for the protection of aquatic life.

The chronic toxicities of dibutyl phthalate (DBP) and di-(2-ethylhexyl) phthalate (DEHP) have not been as well defined as desired. However, chronic studies so far completed suggest that both compounds are biologically active at concentrations well below acutely toxic concentrations. Based on these data, the maximum levels of 4.0 micrograms per litre for DBP and 0.6 microgram per litre for DEHP were obtained. Until

such time as chronic data on other phthalic acid esters (PAE's) become available, it is recommended that concentrations of these compounds in water be limited to 0.2 microgram per litre.

ii) Polychlorinated Biphenyls (PCBs).

The concentration of total polychlorinated biphenyls in fish tissues (whole fish, calculated on a wet weight basis), should not exceed 0.1 microgram per gram for the protection of fish-consuming birds and animals.

Using the lowest dietary concentration of polychlorinated biphenyls (PCBs) observed to produce a deleterious biological effect in test animals, the limit of 0.1 microgram per gram was developed. A conservative bioconcentration factor could be used to calculate a water concentration for total PCBs which should prevent tissue levels greater than 0.1 microgram per gram. However, this would result in a PCB concentration in water which is below present routine analytical sensitivities to detect it, making the recommended levels impossible to monitor or enforce. It is therefore recommended that the regulatory agencies undertake fish and bird monitoring programs to determine compliance with the recommendation on tissue levels.

iii) Other Organic Contaminants.

For other organic contaminants, the levels of which are not specified but which can be demonstrated to be persistent and are likely to be toxic, it is recommended that the concentrations of such compounds in water or aquatic organisms be substantially absent and less than the detection level as determined by the best scientific methodology available at the time.

- (d) Settleable and Suspended Materials. The following specific objective is recommended under the heading of "Settleable and Suspended Materials and Light Transmission" to replace the interim objective:

EXISTING

Waters should be free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life or waterfowl.

REVISION

For the protection of aquatic life, waters should be free from substances attributable to municipal, industrial or other discharges resulting from activity that will settle to form putrescent or otherwise objectionable sludge deposits or that will alter the value of the Secchi disk depth by more than 10 percent.

The 10 percent value has been chosen as a level that can be detected quite easily and at which appreciable changes in algal production may begin to occur.

- (e) Oil, Petrochemicals and Immiscible Substances. The following specific objective is recommended under the heading of Oil and Petrochemicals to replace the interim objective.

EXISTING

Waters should be free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges in amounts sufficient to be unsightly or deleterious.

REVISION

Oil and petrochemicals should not be present in concentrations that:

- 1) can be detected as visible film, sheen or discoloration on the surface;*
- 2) can be detected by odour;*
- 3) can cause tainting of fish or edible invertebrates;*
- 4) can form deposits on shorelines and bottom sediments that are detectable by sight or odour, or deleterious to resident aquatic organisms.*

To protect aesthetic values, water and shoreline recreation, all four components of the objective are required. "Safe" concentrations for aquatic life have not been included, since other uses are more restrictive. Any hazards to humans from drinking oil-polluted water will not arise because such substances become objectionable at concentrations far below their chronic toxicity levels.

3. Non-degradation.

EXISTING

Notwithstanding the adoption of specific water quality objectives, all reasonable and practicable measures shall be taken in accordance with paragraph 4 of Article III of the Agreement to maintain the levels of water quality existing at the date of entry into force of the Agreement in those areas of the boundary waters of the Great Lakes System where such levels exceed the specific water quality objectives.

REVISION

Notwithstanding the adoption of specific water quality objectives, all reasonable and practicable measures shall be taken in accordance with paragraph 4 of Article III of the Agreement to maintain the levels of water quality existing at the date of entry into force

of the Agreement in those areas of the boundary waters of the Great Lakes System where such *water quality is better than that prescribed by the specific water quality objectives.*

4. Sampling Data. no change currently recommended.

5. Mixing Zones.

EXISTING

The responsible regulatory agencies may designate restricted mixing zones in the vicinity of outfalls within which the specific water quality objectives shall not apply. Mixing zones shall not be considered a substitute for adequate treatment or control of discharges at their source.

REVISION

The responsible regulatory agencies may designate restricted mixing zones in the vicinity of outfalls within which the specific water quality objectives shall not apply. Mixing zones shall not be considered a substitute for adequate treatment or control of discharges at their source.

A mixing zone is an area, contiguous to a point source, where exceptions to water quality objectives and conditions otherwise applicable to the receiving waterbody may be granted. Thus, a mixing zone represents a loss in value.

The following guidelines should be used in the designation of mixing zones.

- 1. Specific water quality objectives and conditions applicable to the receiving waterbody should be met at the boundary of mixing zones.*

2. *The size, shape and exact location of a mixing zone should be specified so that both the discharger and the regulatory agency know the bounds. The size should be minimized to the greatest possible degree.*
3. *Limitations on mixing zones should be established by the responsible regulatory agency on a case-by-case basis, where "case" refers to both local considerations and the waterbody as a whole, or segment of the waterbody.*
4. *Existing biological, chemical, physical and hydrological conditions should be known when considering location of a new mixing zone or limitations on an existing one.*
5. *Areas of extraordinary value should be designated off-limits for mixing zones.*
6. *When designing conditions to protect specific organisms it is necessary to know that the organisms would normally inhabit the area within the mixing zone. Zones of passage should be assured either by location or design of conditions within mixing zones. Mixing zones should not form a barrier to migratory routes of aquatic species or interfere with biological communities or populations of important species to a degree which is damaging to the ecosystem, or diminish other beneficial uses disproportionately.*
7. *No conditions within the mixing zone should be permitted which are either (a) rapidly lethal to important aquatic life (conditions which result in sudden fish kills and mortality of organisms passing through the mixing zone); or (b) which cause irreversible responses which could result in detrimental post-exposure effects; or (c) which result in bioconcentration of toxic materials which are harmful to the organism or consumers.*

8. *Concentrations of toxic materials at any point in the mixing zone where important species are physically capable of residing should not exceed the 24-to 96-hour LC₅₀.*

9. *Many of the general water quality objectives should apply to discharge-related materials within mixing zones. The zones should be free of:*

(a) objectionable deposits;

(b) unsightly or deleterious amounts of flotsam, debris, oil, scum and other floating matter;

*(c) substances producing objectionable colour, odour, taste, or turbidity;
and*

(d) substances and conditions or combinations thereof at levels which produce aquatic life in nuisance quantities that interfere with other uses.

10. *Mixing zones may overlap unless the combined effects exceed the conditions set forth in other guidelines.*

11. *Municipal and other water supply intakes and recreational areas should not be in mixing zones as a general conclusion, but local knowledge of the effluent characteristics and the type of discharge associated with the zone could allow such a mixture of uses.*

6. Localized Areas. no changes are currently recommended.

7. Consultation.

(a) Of the substances listed for consideration, specific objectives for arsenic,

cadmium, chromium, lead, mercury, oil, some organic chemicals (persistent organic compounds), phenols, selenium and zinc, were already presented in the preceding sections of this chapter. Objectives for ammonia, copper, cyanide and nickel have been drafted.

Objectives for barium, chloride and sulfate have been carefully studied. However, none are being recommended at this time. These chemicals are part of the constituents in the Total Dissolved Solids group which is presently covered by an existing objective in the Agreement. It is recommended that this objective be retained without change.

For the remaining substances, the following specific objectives are recommended:

1) Fluoride.

Concentrations of total fluoride in an unfiltered water sample should not exceed 1.2 milligrams per litre to protect raw waters for public water supplies.

Since most of the fluoride toxicity studies on aquatic life have involved either the use of low calcium dilution waters or marine organisms, it is not practical to set an objective based on the protection of aquatic life. Therefore, it is recommended that an objective of 1.2 milligrams per litre total fluoride in an unfiltered water sample be used to protect raw water for public water supplies. This is consistent with or more stringent than the upper limits recommended by the World Health Organization, the United States Public Health Service, and the Canada Department of National Health and Welfare.

11) Organic Compounds.

General Objective.

Concentrations of unspecified, non-persistent pesticides should not exceed 0.05 of the median lethal concentration in a 96-hour test for any sensitive local species.

Where neither "no-effect" nor estimated "safe" levels have been determined for these compounds, it is recommended that protection be afforded aquatic life through the use of a 0.05 safety factor applied to the median lethal concentration in a 96-hour test for any sensitive local species.

Diazinon.

The concentration of Diazinon in an unfiltered water sample should not exceed 0.08 microgram per litre for the protection of aquatic life.

Available data on the long term acute toxicity and chronic effect of diazinon indicate that concentrations in an unfiltered water sample not exceeding 0.08 microgram per litre should protect sensitive species or fish and aquatic invertebrates.

Unspecified Non-Persistent Toxic Substances and Complex Effluents

Unspecified non-persistent toxic substances and complex effluents of municipal, industrial or other origin should not be present in concentrations which exceed 0.05 of the median lethal concentration (96-hour LC_{50}) for any sensitive local species to protect aquatic life.

This procedural objective is developed to limit the effects of: (1) unspecified non-persistent substances toxic to aquatic life but which are not presently identified by a

specific objective within Annex 1 of the Agreement, and (2) complex industrial and municipal effluents which are toxic to aquatic life and are discharged directly to the Great Lakes. In view of the unspecified nature and lack of an adequate toxicological data base for these substances, the objective recommends use of an application factor with acute toxicity data derived for approved test species.

Asbestos

Asbestos should be kept at the lowest practicable levels and in any event should be controlled to the extent necessary to prevent harmful effects on health.

At this time there is insufficient information to recommend a meaningful or defensible numerical asbestiform fibre objective for protection of aquatic organisms, raw public water supply or drinking water.

The Commission reiterates its recommendation (Third Annual Report, Great Lakes Water Quality) that the Federal Governments formalize current informal practices by setting up a joint task force for the purpose of coordinating the investigation of sampling and analytical problems, as well as health effects, from asbestiform fibres. This recommendation resulted from an extensive study performed by and published in the Research Advisory Board Report "Asbestos in the Great Lakes Basin", February 1975.

Chapter V

PUBLIC HEARINGS

On December 7th and 8th, 1976, the International Joint Commission held public hearings on the "Proposed New and Revised Water Quality Objectives for the Great Lakes". In accordance with the Commission's Rules of Procedure, Notice of the Public Hearings was published in the Canada Gazette and the U.S. Federal Register. Notices were also mailed to public interest groups, trade associations, private companies, municipal, provincial, state and federal governments, and to elected representatives in the Great Lakes Region.

Recognizing the varied interest levels and technical knowledge of the audience which the Commission wished to be advised of the hearings and participate in them, the staff prepared three different information packets. These were mailed to a selected list of interested parties. All of the jurisdictions participated in developing the mailing list. In addition, numerous directories were used and the hearings were mentioned in Focus, the Agreement newsletter which is sent to 14,000 Great Lakes Basin residents.

The first of the information packets contained a notice of the hearings and a fact sheet which outlined the responsibilities of the Commission, the purpose of the hearings, the hearing format, and hints to those preparing statements. Over 3,000 copies of this general packet were mailed.

The fact sheet and notice were supplemented with a letter, the Agreement, and a booklet in the second materials packet. In the booklet were an explanation of the purpose of the objectives and the approach used by those who prepared them, and lists of the original Agreement objectives, those being recommended for annexation to the Agreement, and those under development. Nearly 800 copies were mailed in the initial distribution and an additional 100 were copied to respond to requests.

In the third package were a letter, the fact sheet, a copy of the Agreement and the "Proposed New and Revised Specific Water Quality Objectives", September, 1976. In addition to the lists in the booklet, this document contained the detailed scientific rationales for each of the recommended objectives. All 600 of the copies printed were distributed by mid-December. Over 80 copies of parts of the document were mailed in response to requests following the hearing.

HEARING FORMAT

The two days of hearings were open to the general public. Each day the presiding Commissioner welcomed participants, explained the IJC's role, the requirements in the Agreement for objectives, and the purpose of the hearing. The Great Lakes Water Quality Board Chairmen followed by summarizing the proposed objectives and then statements were presented. After each person read his statement, Commissioners asked questions. Then members of the Water Quality Objectives Subcommittee of the Great Lakes Water Quality Board and the Task Force on Scientific Basis for Water Quality Criteria of the Great Lakes Research Advisory Board responded to points raised in the presentation. A dialogue among the person who read a statement, the committee members who had prepared the

objectives and the Commissioners followed. After all presenters were heard each day, questions were taken from the audience which included representatives of the media, industry and the general public.

The hearings were transcribed by a stenographer. Copies of the transcription are on file at the IJC Headquarters Offices in Ottawa and Washington as well as the Great Lakes Regional Office in Windsor, Ontario.

The hearing records were kept open until February 1, 1977, to receive additional briefs on the proposed objectives.

Seven presentations were made to the Commission during the two-day hearing. A total of 17 briefs were received prior to February 1, 1977.

HIGHLIGHTS OF PUBLIC COMMENTS

Testimony presented at the hearings and submitted briefs disclosed a wide range of concerns on the proposed water quality objectives and mechanisms by which they are to be applied. The following highlights indicate the sense of testimony received:

- Industry is very concerned that all those objectives being proposed as minimum objectives would eventually be turned into a kind of minimum baseline standards. Those objectives have a way of becoming standards or regulations when somebody has to go to get a permit to do something.
- In formulating water quality management programs, a balance is required between the social costs and environmental protection. The balance should

probably be on the side of caution and not on the side of allowing the entrepreneur to proceed until the evidence is all in.

- The economic or social consequences of proceeding on the basis of protecting the most sensitive use in the aquatic ecosystem have not been considered explicitly by the Board in the development of the objectives.
- Members of the Great Lakes Water Quality Board as administrators of their agencies are certainly aware of some economic or social impacts of the water quality objectives being proposed.
- How will the social, economic assessment of the proposed water quality objectives occur? Industry would like to have some input.
- Practice of protecting the most sensitive and beneficial uses of the boundary waters seems to be based on the principle of 'no risk'. Industry is challenging this principle as a basis for legislation.
- The concept of 'no risk' is, in effect, minimum risk on the basis of current available information.
- The Great Lakes cannot afford to wait until all the scientific evidence has been established.
- EPA Water Quality Criteria are designed for the entire country of the United States whereas the water quality objectives are designed for the specific area of the Great Lakes.

- Synergistic effects have not been taken into account. Therefore, a specific water quality objective is developed on the assumption that everything else is fine except this particular parameter. But, in reality, there is some risk involved.
- The non-degradation and enhancement policies outlined in the proposed objectives are in conflict with the principles of water management. These concepts lead to a zero risk policy with questionable benefit to society at high cost.
- The objectives have been developed without significant input from industrial or community sectors. Industries should have representation to the Great Lakes Water Quality Board to provide early input for the setting of objectives.
- Industry would like to take part in the development of water quality objectives. Concentration alone does not necessarily define the risk to society. Total loadings may also be significant as well as the background levels.
- The human health aspects of water quality objectives have been given due consideration and care in the development of the objectives.
- Industry expresses concern about the concept of "quantification limits" as stated in the objective.
- Industry questions the concept of setting metal objectives on the basis of total metal.

- The selection of mixing zone areas is in effect an assignment of risk. One has to accept some level of damage in that particular lake or water body and that will be the mixing zone area.
- When mixing zones are designated by an administrator, he is definitely assigning how much risk is acceptable to the Great Lakes.
- Mixing zone boundaries should be delineated on a case-by-case basis and should be the joint responsibility of the regulatory agency and the discharger.

Chapter VI

SOCIAL AND ECONOMIC CONSIDERATIONS

Water quality objectives establish limits on the impact of man's activity on water quality in order to protect the most sensitive beneficial uses of the water body in question and the long term interests of society. Except in circumstances where economic activity is at a level such that objectives are not exceeded, present and future uses of the water as a receiving medium for polluting residuals must be restricted if the water quality is to be maintained and/or enhanced.

The Commission has not attempted to estimate either the direct costs to industry and municipalities, or the indirect socio-economic costs of the proposed water quality objectives. This omission does not reflect a lack of recognition of the importance of this aspect of the objectives, but rather the lack of readily available data and the Commission's belief that a special study of costs did not fall within its responsibilities. In fact, the Commission had hoped that a review of the proposed objectives by industry, resulting from the wide circulation of the Board's report and through the public hearing process, would have provided substantial information and comment on the potential economic effect of implementation on individual industries and firms. This did not occur. Several comments were received from industrial sources which conveyed the concern of industry about possible severe economic and social disruption, and the necessity for detailed economic

analysis of the effects prior to the implementation of the objectives by Governments.

The Commission suggests that recognition be given of the importance of socio-economic effects when the jurisdictions utilize the objectives in setting legally enforceable regulatory requirements.

Despite the complexity of cost-benefit analysis, such analysis is considered by the Commission to be an important element in the reasoned and equitable consideration by Governments of the overall practicability of implementing objectives through their regulatory mechanisms. The proposed objectives have been established on the basis of scientific investigation. They define the technical-biological concerns and limits. The overall social costs and benefits of implementing, or failing to implement, the programs necessary to reach those objectives may be difficult to establish, but wisdom dictates the protection of the quality of waters for multiform beneficial uses for future generations by using the best information available.

Chapter VII

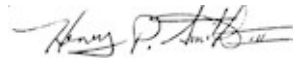
RECOMMENDATIONS

The Commission recommends that the Governments adopt the water quality objectives as recommended in this report for inclusion in the Great Lakes Water Quality Agreement.

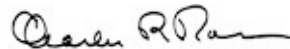
Signed this 12th day of May 1977 as the International Joint Commission's report to the Governments of Canada and the United States on Proposed New and Revised Water Quality Objectives for the Great Lakes.



Maxwell Cohen



Henry P. Smith III



Charles R. Ross



Bernard Beaupré



Keith A. Henry


Victor L. Smith

Victor L. Smith

APPENDIX A

MEMBERSHIP LISTS

MEMBERSHIP OF THE GREAT LAKES WATER QUALITY BOARD AND GREAT
LAKES RESEARCH ADVISORY BOARD AND THEIR COMMITTEES

MEMBERSHIP GREAT LAKES WATER QUALITY BOARD

These are the individuals who served on the Great Lakes Water Quality Board while the recommended objectives were being developed.

Canada

A.T. Prince, Atomic Energy Control Board, *Canadian Chairman*
J.P. Bruce, Department of Fisheries and Environment, *Appointed Canadian Chairman 1974*
R.W. Slater, Department of Fisheries and Environment, *Appointed Canadian Chairman, 1976*
D.P. Caplice, Ontario Ministry of the Environment
D.S. Caverly, Environmental Hearing Board, Province of Ontario
P.R. L'Heureux, Service de Protection de l'Environnement
Captain G. Leask, Ministry of Transport
W.A. Steggle, Ontario Ministry of the Environment
K.H. Loftus, Ontario Ministry of Natural Resources
R.H. Millest, Department of Fisheries and Environment
P.M. Higgins, Department of Fisheries and Environment

United States

F.T. Mayo, U.S. Environmental Protection Agency, *United States, Chairman*
G.R. Alexander, Jr., U.S. Environmental Protection Agency, *Appointed United States Chairman, 1976*
R.H. Briceland, Illinois Environmental Protection Agency
A.S. Earl, Wisconsin Department of Natural Resources
O.H. Hert, Indiana Stream Pollution Control Board
W.A. Lyon, Pennsylvania Department of Environmental Resources
P.L. Gove, Minnesota Pollution Control Agency
W.G. Turney, Michigan Department of Natural Resources
E.F. Seebald, New York Department of Environmental Conservation
N.E. Williams, Ohio Environmental Protection Agency
T.G. Frangos, Wisconsin Department of Natural Resources
G.J. Merritt, Minnesota Pollution Control Agency
R.W. Purdy, Michigan Department of Natural Resources
M.L. Leahy, Illinois Bureau of Budget
D.F. Metzler, New York Department of Environmental Conservation
I.L. Whitman, Ohio Environmental Protection Agency

MEMBERSHIP

GREAT LAKES RESEARCH ADVISORY BOARD

These are the individuals who served on the Great Lakes Research Advisory Board while the recommended objectives were being developed.

Canada

J.P. Bruce, Department of Fisheries and Environment, *Canadian Chairman*
A.R. LeFeuvre, Department of Fisheries and Environment, *Appointed Canadian Chairman, 1974*
A.J. Drapeau, Ecole Polytechnique, Montreal, Quebec
H.R. Holland, Sarnia, Ontario
P.D. Foley, Ontario Ministry of the Environment
J.C.N. Westwood, University of Ottawa, Ottawa, Ontario
J.D. Roseborough, Ontario Ministry of Natural Resources
M. Munro, Mayor, Burlington, Ontario
M.G. Johnson, Department of Fisheries and Environment
J.R. Vallentyne, Department of Fisheries and Environment
J.R. Kramer, McMaster University, Hamilton, Ontario
F.C. Elder, Department of Fisheries and Environment, *Ex-Officio*
R.K. Lane, Department of Fisheries and Environment, *Ex-Officio*

United States

S.M. Greenfield, formerly, U.S. Environmental Protection Agency, United States
Chairman
A.F. Bartsch, U.S. Environmental Protection Agency, Appointed United States
Chairman, 1974
D.I. Mount, U.S. Environmental Protection Agency, Appointed *United States*
Chairman, 1976
T.T. Davis, U.S. Environmental Protection Agency, *Alternate for A.F. Bartsch*
E.J. Aubert, National Oceanographic and Atmospheric Administration
L.B. Dworksy, Cornell University, Ithaca, New York
A.R. Balden, Hot Springs Village, Arkansas
E. Stebbins, Citizens for Clean Air and Water Inc., Cleveland, Ohio
H.E. Allen, Illinois Institute of Technology, Chicago, Illinois
L.J. Hetling, New York Department of Environmental Conservation
C.M. Fetterolf, Jr., Great Lakes Fishery Commission, *Ex-Officio*
G.E. Watkins, Edison Electric Institute, New York
A.J. McDonnell, Pennsylvania State University, University Park, Pennsylvania
J. Shapiro, University of Minnesota, Minneapolis, Minnesota

MEMBERSHIP

WATER QUALITY OBJECTIVES SUBCOMMITTEE OF THE GREAT LAKES WATER QUALITY BOARD

These are the individuals who served on the Water Quality Objectives Subcommittee while the recommended objectives were being developed.

C.M. Fetterolf, Great Lakes Fishery Commission, *Chairman*
S.W. Reeder, Department of Fisheries and Environment, Appointed *Chairman 1975*
W.H. Anderl, Minnesota Pollution Control Agency
G.C. Becking, Health and Welfare Canada
T. Brydges, Ontario Ministry of the Environment
P.S. Chamut, Department of Fisheries and Environment
G.B. Garrett, Ohio Environmental Protection Agency
P.V. Hodson, Department of Fisheries and Environment
J.R. Kelso, Department of Fisheries and Environment
D.B. Stevens, Department of Environmental Conservation
R.G. Boelens, Ontario Ministry of Environment
M.G. Johnson, Department of Fisheries and Environment, *Ex-Officio*
G.P. Brezner, N.Y. Department of Environmental Conservation
J.B. Park, Illinois Environmental Protection Agency
C.P. Potos, U.S. Environmental Protection Agency
J. Robinson, Michigan Department of Natural Resources
K.E. Schoener, Pennsylvania Department of Environmental Resources
D.H. Schuettpelz, Wisconsin Department of Natural Resources
J.A. Terrault, Services de Protection de L'Environnement
C.T. Blomgren, Illinois Environmental Protection Agency
R. Mt. Pleasant, Department of Environmental Conservation
R.E. Maylath, Department of Environmental Conservation, *Alternate for R. Mt. Pleasant*
J. Pegors, Minnesota Pollution Control Agency
R.K. Lane, Department of Fisheries and Environment
N.A. Berg, U.S. Department of Agriculture, *Ex-Officio*
J.G. Konrad, Wisconsin Department of Natural Resources, *Alternate for N.A. Berg*
C. Timm, U.S. Environmental Protection Agency, *Ex-Officio*
D.C. Kraus, U.S. Environmental Protection Agency, *Alternate for C. Timm*
G.K. Rodgers, Department of Fisheries and Environment, *Ex-Officio*
K.L. Kaiser, Department of Fisheries and Environment, *Alternate for G.K. Rodgers*
W.E. Fox, U.S. Environmental Protection Agency, *Official Observer*

MEMBERSHIP

STANDING COMMITTEE ON SCIENTIFIC BASIS FOR WATER QUALITY CRITERIA OF THE GREAT LAKES RESEARCH ADVISORY BOARD

These are the individuals who served on the Standing Committee on Scientific Basis for Water Quality Criteria while the recommended objectives were being developed.

W. Brungs, U.S. Environmental Protection Agency, *Chairman*

A. Robertson, National Oceanic and Atmospheric Administration, *Appointed
Chairman 1975*

C.M. Fetterolf, Great Lakes Fishery Commission

R. Hartung, University of Michigan

I. Hoffman, National Research Council of Canada

S.W. Reeder, Department of Fisheries and Environment

J. Sprague, University of Guelph

W.M. Strachan, Department of Fisheries and Environment

APPENDIX B

LIST OF PRESENTERS

LIST OF PRESENTERS

PUBLIC HEARINGS, CLEARY AUDITORIUM, WINDSOR, ONTARIO

December 7, 1976

Arthur M. Timms, Conservation Council of Ontario
John Robinson, Michigan Department of Natural Resources
William A. Steggles, Ontario Ministry of Environment
James Cowden, Kent State University for Lake Michigan Federation
Mimi Becker for Edith Chase, North East Ohio - League of Women Voters
Mimi Becker, Great Lakes Tomorrow

December 8, 1976

Donald Hoskins, Petroleum Association for the Conservation of the Canadian
Environment

APPENDIX C

**LIST OF BRIEFS SUBMITTED
FOLLOWING THE HEARINGS**

ON

WATER QUALITY OBJECTIVES, WINDSOR, ONTARIO
DECEMBER 7-8, 1976

**LIST OF BRIEFS SUBMITTED
FOLLOWING
WATER QUALITY OBJECTIVES HEARINGS, WINDSOR, ONTARIO
DECEMBER 7-8, 1976**

J.P. Ela, Sierra Club, Madison, Wisconsin
L.L. Falk, E.I. du Pont de Nemours and Company, Wilmington, Delaware
J.H. Hughes, Commonwealth Edison, Chicago, Illinois
M. Lewis, League of Women Voters, Tiffin, Ohio
T.O. Andrews, Hammermill Paper Company, Erie, Pennsylvania
J.J. Hubs/B. Karn, Northeast Ohio Areawide Coordinating Agency, Cleveland, Ohio
P.A. Vander Myde, Department of Agriculture, Washington, D.C.
H.D. Paavila, Canadian Pulp and Paper Association, Montreal, Quebec
A.J. Harris, STELCO, Hamilton, Ontario
W.R. Johnson, General Motors Corporation, Warren, Michigan
A.D. Hoskins, Petroleum Association for the Conservation of the Canadian Environment
W.L. Canniff, Canadian Chemical Producers' Association
Corporation of the City of Sault Ste. Marie, Ontario
M. Singleton, Federation of Ontario Naturalists, Don Mills, Ontario
W. Skewis, Ontario Natural Gas Association, Toronto, Ontario
K. Ashby, Private Citizen, Port Hope, Ontario