A REVIEW OF THE IMPACT OF WATER QUALITY AGREEMENT OBJECTIVES ON WATER QUALITY STANDARDS

Prepared For:
The Great Lakes Water Quality Board

By K. H. Walker
Great Lakes Regional Office
International Joint Commission
June 1980

A REVIEW OF THE IMPACT OF WATER QUALITY AGREEMENT OBJECTIVES ON WATER QUALITY STANDARDS

Water quality objectives were considered the foundation for achieving improved water quality in the Great Lakes System in both the 1972 and the 1978 Great Lakes Water Quality Agreements. Since the procedures for developing and including water quality objectives into the Agreement involve relatively long periods of time and considerable input of manpower, candidates for future water quality objectives must be carefully selected. There are hundreds of compounds and concepts that might be considered for development as an objective. It has been suggested that some objectives have been developed simply because suitable data were available, rather than because there was a useful need for the objective.

The question could be asked as to what should be the future program in the development of water quality objectives. This report is designed to provide a basis for discussion on this subject by exploring the questions: Have the Agreement Water Quality Objectives been used by the jurisdictions in developing their water quality standards? If not, why not?

HISTORY/RATIONALE

The concept of using water quality objectives as guidelines for preserving or restoring the water quality of the Great Lakes is one of long standing for the International Joint Commission. The Commission's 1950 report on the pollution problems of the Connecting Channels of the Great Lakes set forth specific water quality objectives "designed to restore and maintain the waters of the Connecting Channels in a condition which would not impair the many uses desired of them".

Note: Portions of this report have been excerpted from previous reports of the International Joint Commission and the Great Lakes Water Quality Board.

In its 1970 report on "Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River", the Commission recommended water quality objectives for adoption by the Governments and for recognition by jurisdictions as the minimal basis for the establishment of standards for these waters. In the report, the Commission stated: "The Objectives are intended to be the minimum basis for formulating provincial and state water quality standards and meaningful programmes to achieve the desirable levels of water quality." The Commission further stated that "It is intended that the Objectives be reviewed periodically in the light of quality requirements, technological changes in both industry and waste treatment processes, and policy".

In the report, the terms water quality criteria, objectives, and standards were defined as follows:

"In this Report water quality criteria are the scientific requirements for the preservation of the aquatic environment and designated water uses. They imply adequate water quality conditions. Water quality objectives are desirable levels of quality to be attained in the receiving waters. They take into account the criteria for the whole spectrum of water uses: supplies for municipal, industrial and agricultural purposes, recreation, aesthetic enjoyment and the propagation of aquatic and wildlife. Water quality standards are the prescribed levels of water quality established by governmental authorities in programmes designed to achieve water quality objectives."

law

Recognizing the recommendations in this IJC report, the Parties based the 1972 Great Lakes Water Quality Agreement on a concept of adopting water quality objectives to achieve improved water quality in the Great Lakes System. These objectives were goals to be maintained and achieved in the boundary waters through effective pollution control programmes in both countries. The Agreement listed General and Specific Water Quality Objectives, and made provision for modifying existing objectives and adopting new ones. These provisions were continued in the 1978 Great Lakes Water Quality Agreement.

In the 1978 Agreement General Objectives are defined as: Broad descriptions of water quality conditions consistent with the protection of the beneficial uses and the level of environmental quality which the Parties desire to secure and which will provide overall water management guidance. Specific Objectives are defined as: The concentration or quantity of a substance or level of effect that the Parties agree, after investigation, to recognize as a maximum or minimum desired limit for a defined body of water or portion thereof, taking into account the beneficial uses or level of environmental quality which the Parties desire to secure and protect.

ESTABLISHMENT OF WATER QUALITY OBJECTIVES

While the 1972 Agreement was in effect, the following procedures were used to revise the existing objectives and to develop new ones:

The Water Quality Board established a Water Quality Objectives Subcommittee whose function was to assess the adequacy of the objectives in the Agreement and develop new or revised objectives. The Research Advisory Board established a Committee, which later became a Task Force, on the Scientific Basis for Water Quality Criteria. Its charge was to supply scientific expertise to the Water Quality Objectives Subcommittee to enable the development of scientifically defensible water quality objectives.

These committees worked together in developing specific water quality objectives for a range of parameters, which, if not exceeded, would protect the most sensitive beneficial use of the boundary waters. Thus, the objectives proposed were designed to protect aquatic life or its consumers (i.e. fish, birds and mammals), public water supply and/or recreational use, depending upon which was the most sensitive.

The objectives were based on best available scientific information on cause/effect relationships between pollutants and water use. The objectives also provided a refinement of the restoration and enhancement and non-degradation principles set forth in the Agreement. This was accomplished by reviewing best available information, making direct contact with experts and

by using workshops to develop state-of-the-art information in areas where further data were desired. The outputs from this joint activity were specific water quality objectives for many substances and the scientific rationale for these objectives.

The Water Quality Board reviewed the proposed objectives and recommended them to the International Joint Commission, giving primary consideration to the protection and enhancement of Great Lakes water quality. The Board considered many aspects of the proposed objectives, including the practicality of using them as a basis for regulatory action. No consideration was given to the socio-economic implications of achieving the objectives.

The International Joint Commission then held public hearings on the objectives prior to recommending them to Governments for adoption and inclusion as amendments to the Agreement.

During 1978, the committees of the two Boards were revised. The Research Advisory Board, which was renamed the Science Advisory Board in the 1978 Agreement, replaced its Task Force on the Scientific Basis for Water Quality Criteria with an Aquatic Ecosystem Objectives Committee. The committee's assignment was to develop the scientific basis for aquatic ecosystem objectives, always considering protection of the most sensitive use.

The Water Quality Board disbanded its Water Quality Objectives Subcommittee. In its place, an Objectives Assessment Subcommittee was proposed to assess each scientifically proposed objective in terms of the technological difficulty or practicability of implementing the objective. The committee was to consider such factors as effluent limitations, mixing zones and drainage patterns for use in implementing the objective. In addition, it was to consider the socio-economic impact of implementing the objective.

This committee was not to be activated until a Task Force on the Chlorine Objective made its report on the socio-economic implications of the chlorine objective. The Task Force recommended that future socio-economic assessments of proposed objectives should be carried out by the jurisdictions. As a

result, the committee was not established. The current thinking of the Board is that a Task Force could be established, on a case-by-case basis, to consider proposed objectives as they are referred to the Water Quality Board.

NEW AND REVISED OBJECTIVES

Eight specific and five interim water quality objectives were established by the 1972 Water Quality Agreement as shown in Table 1. Some of these have been revised and new ones have been developed by the procedures previously described.

TABLE 1

SPECIFIC AND INTERIM WATER QUALITY OBJECTIVES
CONTAINED IN ANNEX 1 OF THE 1972 GREAT LAKES WATER QUALITY AGREEMENT

SPECIFIC OBJECTIVES	INTERIM OBJECTIVES
Microbiology Dissolved Oxygen Total Dissolved Solids Taste and Odour pH Iron Phosphorus Radioactivity	Temperature Mercury and Other Toxic Heavy Metals Persistent Organic Contaminants Settleable and Suspended Materials Oil, Petrochemicals and Immersible Substances

Proposed new and revised water quality objectives were recommended to the International Joint Commission by the Great Lakes Water Quality Board in the Board's Annual Reports for 1974, 1975 and 1976.

These objectives were transmitted to the International Joint Commission in two separate reports called "Proposed New and Revised Water Quality Objectives". These reports included the objectives as well as the scientific rationale for each objective. The first report (September 1976) included objectives known as Group 1 which are shown in Table 2. The second report (January 1978) covered Group 2 objectives which are shown in Table 3.

TABLE 2

GROUP 1 - NEW AND REVISED WATER QUALITY OBJECTIVES AND BASIC CONCEPTS RECOMMENDED BY THE BOARD TO THE COMMISSION FOR ADOPTION BY THE GOVERNMENTS

NEW AND REVISED WATER QUALITY OBJECTIVES	
Aldrin	Lead
Chlordane	Mercury
DDT and Metabolites	Selenium
Endrin	Zinc
Heptachlor	Fluoride
Lindane	Pesticides General Objective
Methoxychlor	Diazinon
Toxaphene	Oil and Petrochemicals
Phthalic Acid Esters	Unspecific Non-Persistent Substances and Complex Effluents
Polychlorinated Biphenyls (PCBs)	pH
Other Organic Contaminants	Tainting Substances
Arsenic	Settleable and Suspended Solids and Light Transmission
Cadmium	
Chromium	
Asbestos	

BASIC CONCEPTS
Non-degradation
Enhancement
Mixing Zones Guidelines

TABLE 3

GROUP 2 - NEW AND REVISED WATER QUALITY OBJECTIVES RECOMMENDED BY THE BOARD TO THE COMMISSION FOR ADOPTION BY THE GOVERNMENTS

Copper	Guthion	Ammonia
Iron	Parathion	Hydrogen Sulfide
Nickel	Cyanide	Temperature
Silver	Dodecachloropenta-cyclodecane (mirex)	Chlorine

The Group 2 report defined the terms "water quality objective", "criteria" and "standard" as used in the report. These definitions were slightly modified from those cited previously which were used in the 1970 International Joint Commission report on "Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River". The terms were defined as follows:

Water Quality Objectives - The criteria for a concentration of a substance or a description of a condition that is considered to be safe for the most sensitive use and which has been chosen as a goal by the Governments of Canada and the United States as a part of the Great Lakes Water Quality Agreement.

Water Quality Criteria - The concentration of a substance in the water or in aquatic organisms which has been established by scientific investiga- tion as being a safe level (a level which would not cause damage to a specific water use).

Water Quality Standard - Criteria or objectives which have been included as part of the enforceable environmental control laws of a unit of government. Standards usually contain criteria for a specific use and a schedule for compliance.

STATUS OF OBJECTIVES

The status of water quality objectives is shown in Table 4. The 1978 Water Quality Agreement contains 41 Specific Water Quality Objectives. Four others (chlorine, cyanide, silver, temperature) that were previously recommended to the International Joint Commission by the Water Quality Board are being reconsidered by the Board at the request of the Governments and the IJC. A revised objective for Dissolved Oxygen is being reviewed by the Board.

The Aquatic Ecosystem Objectives Committee is developing an Ecosystem Objective which will be a comprehensive approach to considering the Great Lakes Basin Ecosystem. The Committee is working on objectives for microbiology (indicator organisms and pathogens), pentachlorophenol, polychlorinated dibenzodioxins, and polynuclear aromatic hydrocarbons. It is also reviewing the acceptability of the nutrient objective previously proposed by the Research Advisory Board and is reviewing the information base for the existing objectives and the objectives under reconsideration.

TABLE 4

STATUS OF AGREEMENT WATER QUALITY OBJECTIVES

CONTAINED IN 1978 AGREEMENT

Persistent Toxic Substances

Organic	Inorganic
Aldrin/Dieldrin	Arsenic
Chlordane	Cadmium
DDT and Metabolites	Chromium
Endrin	Copper
Heptachlor/ Heptachlor Epoxide	Iron
Lindane	Lead
Methoxychlor	Mercury
Mirex	Nickel
Toxaphene	Selenium
Phthalic Acid Esters	Zinc
PCBs	Fluoride
Other Organic Contaminants	Total Dissolved Solids

Non-Persistent Toxic Substances

Organic	Inorganic
Diazinon	Ammonia
Guthion	Hydrogen Sulfide
Parathion	
Other Pesticides	
Unspecified Non-Persistent Toxic Substances and Complex Effluents	
Oil and Petrochemicals	

Other Substances

Dissolved Oxygen	Nutrients
pH	Tainting Substances

Physical Characteristics

Asbestos	Temperature
Settleable and Suspended Solids, & Light Transmission	

Microbiological

Radiological

UNDER RECONSIDERATION

Persistent Toxic Substances

Inorganic

Silver

Non-Persistent Compounds

Organic	Inorganic
Cyanide	Chlorine

Physical Characteristics

Temperature

UNDER REVIEW

Dissolved Oxygen

UNDER DEVELOPMENT

Ecosystem Objective

Indicator Organisms and Pathogens

Pentachlorophenol

Polychlorinated dibenzo-dioxins

Polynuclear Aromatic Hydrocarbons

OBJECTIVES/STANDARDS

Water quality objectives are minimum 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. Once the United States and Canada accept water quality objectives, they are obligated by the Agreement to develop programs and measures (including water quality standards) consistent with achievement of these objectives in boundary waters of the Great Lakes. In general, water quality objectives are goals to be maintained or achieved in the boundary waters through effective pollution control programs in both countries. Compliance with the objectives is intended to ensure protection of the most sensitive uses of the international waters.

On the other hand, water quality standards and other legally enforceable regulatory requirements are prescribed levels of water quality established by governmental authorities in each jurisdiction. They are generically different from objectives. While water quality objectives are developed on the sole basis of scientifically defensible data to protect the most sensitive uses, standards and similar legal requirements are generally established by each jurisdiction after considering the designated uses and the factors of social and economic consequences as well as technological ability. For this reason, standards are not necessarily identical to water quality objectives.

RELATION OF OBJECTIVES TO STANDARDS

Table 5 (Appendix I) contains values and statements for many parameters as expressed by the Red Book (Quality Criteria for Water 1976), the Great Lakes Water Quality Agreement Water Quality Objectives, the Great Lakes States Water Quality Standards, and Ontario's Water Quality Objectives. This table was developed by the Great Lakes National Program Office, Region V, U.S. EPA.

Once arranged in a form such as in Table 5, there is a tendency to compare the various values. However, objectives and standards are not the same, as previously discussed, and any direct comparison of the numbers is not valid. Even the same numbers in the standards of two states may not represent the same degree of stringency in applying the standard since different conditions may be used, e.g. amount of dilution water considered, concept of mixing zones, etc. Also the water use being protected may not always be the same.

Nevertheless, the information contained in Table 5 can be used to make some preliminary evaluations on whether or not the Agreement Water Quality Objectives have impacted the standards and objectives of the jurisdictions. The standards of Ohio and Pennsylvania and the objectives of Ontario reflect a strong influence from the Agreement Objectives. Other states reflect the objectives to a lesser degree. However, it must be recognized that several states made the last revisions to their standards prior to the signing of the 1978 Water Quality Agreement. Obviously, these standards cannot reflect the Objectives in the 1978 Agreement.

In a report prepared by the Great Lakes Basin Commission Staff on "Post-PLUARG Evaluation of Great Lakes Water Quality Management Studies and Programs", a comparison was made of Great Lakes Water Quality Agreement Objectives, state water quality standards and existing water quality. The evaluation indicated consistency between the objectives and the standards for many of the pesticides, metals, and other contaminants.

IMPACT OF AGREEMENT OBJECTIVES

Article V (1) in the Agreement states: "Water quality standards and other regulatory requirements of the Parties shall be consistent with the achievement of the General and Specific Objectives. The Parties shall use their best efforts to ensure that water quality standards and other regulatory requirements of the State and Provincial Governments shall similarly be consistent with the achievement of these objectives". The following sections outline the policies and procedures used in the federal, provincial and state levels to meet this requirement.

Canada and Ontario

In the Canada-Ontario Agreement on Great Lakes Water Quality, Canada and Ontario agreed to adopt the water quality objectives as the minimal basis to be used by them in establishing water quality standards or other regulatory requirements respecting the boundary waters. They also agreed that the objectives shall be the basis for designing and assessing pollution abatement programs and other measures taken to improve or maintain water quality in the Great Lakes.

Ontario

only objectives

The Province of Ontario employs guidelines and criteria for water quality management in approving the adequacy of facilities for waste discharge and disposal. The booklet, "Water Management - Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment", published in November 1978 contains a statement that "the Province has agreed that the revised Specific Water Quality Objectives contained in the Great Lakes Water Quality Agreement shall be used in environmental programs to achieve and maintain Great Lakes water quality". The revision takes into account the requirements of Article VI, Section 1(b) of the 1978 Agreement, specifying the establishment of effluent limitations for industrial facilities. Such requirements are incorporated in Certificates of Approval for new or expanded work, and in formal programs and control orders for existing waste dischargers.

The values of the objectives adopted by the Province in the booklet are shown in Table 5. For the most part, these are identical with the Agreement Objectives. A comparison of the Provincial Objectives with the Agreement Objectives for 32 parameters shows that Ontario's Objectives are the same for 25, are less stringent for three, more stringent for two, and no value was established for two others. Thus, 84 percent of the Provincial Objectives are equal to or more stringent than the Agreement Objectives for these 32 parameters.

United States and Great Lakes States

In accordance with the Agreement, the U.S. Federal Government has assumed the responsibility of ensuring that the water quality objectives are considered in the State Water Quality Standards review process which is required at least once each three-year period as stipulated in Section 303 of the Clean Water Act.

It is U.S. EPA's policy that water quality objectives under the Agreement and water quality criteria outlined in the U.S. EPA publication Quality Criteria for Water 1976 should be considered. In instances where water quality objectives in the Agreement are more stringent than criteria listed in the EPA publication, the more stringent values should be considered for the Great Lakes waters. Although this policy is practiced, it does not appear to be stated per se in any EPA guidelines, State/EPA Agreements, "208" plans, etc.

U.S. EPA reviews the proposed standards revisions concurrently with the state. Once the standards are adopted by the state, they are submitted to EPA for final approval. In the event that a state adopts standards that are not acceptable to EPA, the agency can promulgate standards either wholly or in part for that state.

The states conduct a technical evaluation of their water quality standards. This includes the following steps, although each state does not necessarily consider all of these factors:

- Review the proposed water quality objectives in the Agreement to verify their technical adequacy and achievability.

- Compare the proposed objectives with the water quality standards which are currently in effect.

- Evaluate the impact of the proposed objective on present or future wastewater dischargers to determine if the objective would result in a change in the required level of treatment.

- Determine if implementation of existing water quality standards and abatement programs would result in the achievement of water quality consistent with the proposed objectives.

- Evaluate the social and economic consequences of the proposed objective.

- Determine if the goals of the proposed objective are consistent with the maintenance of the designated use of the waters for the public interest.

Each state distributes the proposed revisions to its standards for public review, usually upon issuance of a notice for public hearing. Single or multiple hearings are held, depending on the area affected by the standard revisions. They are chaired by an impartial hearing officer. On the basis of comments received, further revisions may be made. Before adoption as final standards, legal, legislative or administrative review and approval are required. The exact procedure for the final review will vary from state to state dependent on administrative requirements. In most states, water quality standards become state law upon promulgation.

Illinois

The water quality standards program in Illinois is under the direction of the Illinois Environmental Protection Agency. The standards for Lake Michigan were established in 1972. The values were set at levels that were being recorded at that time in the open waters of the lake and were designed to provide for nondegradation of the waters.

Since the standards were set prior to the 1972 Agreement, the values are consistent with the Agreement Objectives only by coincidence. The state plans to reassess the water quality standards applicable to Lake Michigan within the next year. The evaluation process will include consideration of the Agreement Objectives.

Indiana

The Indiana Stream Pollution Control Board made the last revision to its water quality standards in 1978. The Agreement Water Quality Objectives were considered in developing the standards, but they do not contain any specific reference to the Agreement or the Objectives.

Michigan

The Michigan Department of Natural Resources last revised its Water Quality Standards in 1973. These standards reflected the 1972 Agreement as stated in Rule 1080: "To be consistent with the Agreement between the United States of America and Canada on Great Lakes water quality effective April 15, 1972, the following conditions shall apply to the Michigan waters of the Great Lakes and their connecting waterways . . . ." The rule established values for pH, total dissolved solids, and iron which were consistent with the Agreement Objectives.

The Michigan standards are now being revised. An earlier revision went to public hearings in 1976 but was not accepted by the Legislature. A new revision has been developed using input from a public participation committee. This revision is expected to go to public hearings later this year. The values in these revised standards will be consistent with the Agreement Objectives.

Minnesota

The Minnesota Pollution Control Agency last made revisions to its Water Quality Standards in 1973. At that time, the involvement of the state's Water Quality Standards staff in the IJC Agreement committees helped to maintain an awareness of the Agreement Objectives. The standards are being revised and have been in the hearing process for the past year. The values generally relate to those in the Red Book. There is no specific reference to the Water Quality Agreement or the Water Quality Objectives in the standards since standards are developed and applied statewide. The state administrative

procedures generally require an independent showing of need and reasonableness in an adversary hearing setting and while Minnesota standards are considered adequate and compatible with IJC objectives, the objectives have not been adopted per se.

New York

The New York State Department of Environmental Conservation last revised its Water Quality Standards in 1974. These standards do not, of course, reflect the Objectives adopted in the 1978 Agreement. The standards do follow quite closely the values for the Objectives in the 1972 Agreement. Also, the state established a classification of Class A-Special - International Boundary Waters. [A statement in this classification indicates that the waters will also meet the New York State Department of Health drinking water standards after conventional treatment.]

The Department of Environmental Conservation held a series of five hearings on revised water quality standards in the latter part of 1978. These standards were based on a concept of zero effect level, i.e. no effect on the most sensitive species. Because of severe adverse comments on the revisions, they were withdrawn. The DEC has now developed new revisions and plans to hold a series of public participation meetings during the fall of 1980. These revisions will probably reflect a position of using best efforts to achieve the Agreement Water Quality Objectives.

Ohio

The Ohio Environmental Protection Agency amended its Water Quality Standards in 1977. These standards were developed using data from the Agreement Objectives and ORSANCO where applicable. These were supplemented using Red Book and local data as appropriate.

The use of the Agreement Objectives is not specifically acknowledged in the standards. Reference is made to the IJC and the Agreement under the listing for Phosphorus as follows: ". . . or such stricter requirements as may be imposed by the Ohio EPA in accordance with the International Joint Commission (U.S.-Canada agreement)".

A comparison of the values in the water quality standards with 33 of the Agreement Objectives shows that 18 are the same, five are less stringent, five are more stringent, and no value was established for the five others. Thus, 70 percent of the state values are equal to or more stringent than the Agreement Objectives for these 33 parameters.

The U.S. EPA is in litigation with the Ohio EPA on the state's standards. The major differences between the two agencies involve minimum DO levels for inland streams as well as the assignment of a limited aquatic use designation to essentially headwater streams which originate in highly industrialized urban areas. The U.S. EPA is expected to promulgate standards for Ohio in June under the process mentioned previously.

Pennsylvania

The Pennsylvania Department of Environmental Resources adopted the current water quality standards in August 1979 with an effective date of October 1979. Approval by the U.S. EPA is pending.

In setting the standards, the state considered the Water Quality Objectives as they existed in March 1978, the time the proposed standards document was developed. Additional objectives included in the 1978 Agreement were anticipated by using recommendations made by the Water Quality Board. Some values were revised or an LC_{50} with an appropriate application factor was used where the state felt it would be more realistic.

The March 1978 document recognized the Great Lakes Water Quality Agreement and the state's obligation to meet its provisions. The standards contain a specific section which designates water uses protected and specific water quality criteria for Lake Erie. This section contains the following statement: "Determination of compliance with specific criteria shall be based on statistically valid sampling data. For lake-wide dissolved solids limit, the Great Lakes Regional Office of the IJC will determine compliance."

These standards reflect a high degree of consistency with the Agreement Objectives. A comparison of the values in the standards with 30 of the

Agreement Objectives shows that 18 are the same, three are less stringent, one is more stringent, and no value was established for the eight others. Thus, 63 percent of the state values are equal to or more stringent than the Agreement Objectives for these 30 parameters.

Wisconsin

The Wisconsin Department of Natural Resources last made a revision in its water quality standards of significance to the Great Lakes waters in January 1978. The values from the Red Book were used almost exclusively in setting the standards so that any consistency of these values with the Agreement Objectives is coincidental.

There is no direct reference to the Agreement or the Agreement Objectives in the water quality standards although such a reference would probably be included in future revisions to the standards. The Agreement Objectives are considered when reviewing a permit for a discharge into Great Lakes waters.

DISCUSSION

The Agreement Objectives have had a decided impact on the water quality standards and objectives adopted by the jurisdictions. Some jurisdictions have related their programs to the Agreement more than others. In some states, the last revision made to their standards preceeded the 1978 Agreement and therefore do not reflect those objectives. The revisions now under consideration will recognize the Agreement and objectives to a greater extent.

In a letter to the Secretary of the Water Quality Board dated May 13, 1980, the IJC stated its desire to continue with a program of developing specific water quality objectives. The letter indicated that the Commission intended to advise the Science Advisory Board to continue with the development of objectives.

The Science Advisory Board discussed the need for further development of specific water quality objectives at the 35th Meeting held May 6-7, 1980. The minutes of the Board's meeting summarize this discussion as follows: "The Board agreed that water quality objectives are the foundation of the Great

Lakes Water Quality Agreement and they do not necessarily have to be incorporated in water quality standards but are benchmarks or goals which provide useful direction for the development of pollution control programs. The Board further agreed that scientifically defensible objectives for many parameters as possible should be developed, and its Aquatic Ecosystems Objectives Standing Committee should be advised of the Board's support for continued work on developing new objectives".

CONCLUSIONS

It appears that the specific water quality objectives continue to be considered as the foundation for the Great Lakes Water Quality Agreement by the Parties, the IJC, the Science Advisory Board, and the jurisdictions. There seems to be no justification or reason for altering the basic concept and use of objectives. However, to ensure that the development of objectives continues to proceed on a logical and effective basis, it would be appropriate for the Water Quality Board, the Science Advisory Board, with its Aquatic Ecosystem Objectives Committee, and others interested in these activities to discuss the future development of objectives and their respective roles in the program.

REFERENCES

Great Lakes Water Quality Board. Great Lakes Water Quality, Fifth Annual Report to the International Joint Commission. Windsor, Ontario, July 1977.

Great Lakes Water Quality Board. Great Lakes Water Quality, Fourth Annual Report to the International Joint Commission. Windsor, Ontario, July 1976.

Great Lakes Water Quality Board. Great Lakes Water Quality, Seventh Annual Report to the International Joint Commission. Windsor, Ontario, July 1979.

Great Lakes Water Quality Board. Great Lakes Water Quality, Third Annual Report to the International Joint Commission. Windsor, Ontario, July 1975.

Great Lakes Water Quality Board. Group 2 - New and Revised Specific Water Quality Objectives Proposed for the 1972 Agreement Between the United States and Canada on Great Lakes Water Quality by the Great Lakes Water Quality Board. Windsor, Ontario, January 1978.

Great Lakes Water Quality Board. New and Revised Specific Water Quality Objectives Proposed for the 1972 Agreement Between the United States and Canada on Great Lakes Water Quality by the Great Lakes Water Quality Board. Windsor, Ontario, September 1976.

International Joint Commission. New and Revised Great Lakes Water Quality Objectives, International Joint Commission Report to the Governments of the United States and Canada. 2 vols. Washington, D.C. and Ottawa, Ontario, International Joint Commission, 1977.

International Joint Commission. Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. Ottawa, 1970.

Ontario Ministry of the Environment. Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment. Toronto, Ministry of the Environment, 1978.

Sullivan, Rose Ann C., Paul A. Sanders and William C. Sonzogni. Post-PLUARG Evaluation of Great Lakes Water Quality Management Studies and Programs. Ann Arbor, Michigan, Great Lakes Basin Commission, 1980.

United States Department of State and Canada Department of External Affairs. Great Lakes Water Quality Agreement of 1978: Agreement with Annexes and Terms of Reference, Between the United States of America and Canada. Windsor, Ontario, International Joint Commission, 1978.

United States Department of State and Canada Department of External Affairs. Great Lakes Water Quality Agreement, With Annexes and Texts and Terms of Reference, Signed at Ottawa April 15, 1972. Windsor, Ontario, International Joint Commission, 1972, reprinted 1974.

United States Environmental Protection Agency. Review and Comparison of the Great Lakes Water Quality Agreement Specific Water Quality Objectives and Current State Standards, Preliminary Draft. Chicago, Great Lakes National Program Office, 1980.

Water Quality Objectives, Water Quality Standards and Other Regulatory Requirements, Implementation Committee Report to Water Quality Board. Unpublished. March 9-10, 1977.

APPENDIX I

TABLE 5

STATE WATER QUALITY STANDARDS AND ONTARIO WATER QUALITY OBJECTIVES APPLICABLE TO THE GREAT LAKES*

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Alkalinity	20 mg/L as $CaCO_3$ (a)	-	-	-	20 mg/L as $CaCO_3$	-	-	20 mg/L as $CaCO_3$	20 mg/L as $CaCO_3$	-	Not decreased by more than 25% background
Aluminum	-	-	-	-	-	-	-	-	0.1x96hrLC$_{50}$(H)	-	-
Ammonia	20 µg/L (a) (un-ionized)	20 µg/L (a) (un-ionized) 500 µg/L (b)	20 µg/L	20 µg/L monthly average 50 µg/L daily maximum	-	200 µg/L	25 µg/L un-ionized ammonia & at no time shall ammonia-N concentrations exceed 6.5 mg/L	20 µg/L un-ionized	500 µg/L	2000 µg/L at pH 8	20 µg/L (a) un-ionized
Arsenic	50 µg/L (b) 100 µg/L (c)	50 µg/L (b)	10 µg/L	50 µg/L	-	10 µg/L	50 µg/L	50 µg/L 100 µg/L (c)	50 µg/L	-	10 µg/L (b) 100 µg/L (a)
Asbestos	-	Lowest practical level	-	-	-	-	-	-	-	-	-
Barium	1 mg/L (b)	-	1 mg/L	1 mg/L	-	1 mg/L	1 mg/L	1 mg/L	-	-	-
Beryllium	11 µg/L soft water (a) 1100 µg/L hard water (a) 100 µg/L (c)	-	-	-	-	-	1100 µg/L hard	11 µg/L soft water (a) 1100 µg/L hard water (a) 100 µg/L (c)	-		11 µg/L soft water (a) 1100 µg/L hard water (a)
Boron	750 µg/L (c)	-	1000 µg/L	-	-	-	-	750 µg/L (c)	-	-	-
Cadmium	10 µg/L (b) (a) soft water 0.4 µg/L hard water 1.2 µg/L for cladocerans & salmonid fishes soft water 4.0 µg/L hard water 12 µg/L other less sensitive aquatic life	0.2 µg/L (a)	10 µg/L	10 µg/L	0.03x96 hr TL_m	10 µg/L	1.2 µg/L	10 µg/L (b) (a) soft water 0.4 µg/L hard water 1.2 µg/L for cladocerans & salmonid fishes soft water 4.0 µg/L hard water 12 µg/L other less sensitive aquatic life	0.01x96hr LC$_{50}$ (H)	300 µg/L	0.2 µg/L (a)

NOTE:

(a) Protection for aquatic life

(b) Protection for health, welfare

(c) Protection for irrigation

(D) Every reasonable effort should be made to minimize human exposure.

(E) The persistence, bioaccumulation potential and carcinogenicity caution human exposure to a minimum.

(F) Concentration in edible portion of fish (wet weight basis).

(G) Concentration in whole fish tissues (wet weight basis).

(H) Representative important species.

*This table was developed by the Great Lakes National Program Office, Region V, U.S. EPA. The attachments noted under Mixing Zones, Dissolved Oxygen, and Temperature are not included as part of this report.

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Carbon Dioxide	-	-	-	-	25 mg/L as free CO_2	-	-	-	-	-	-
Chloride	-	-	12 mg/L	15 mg/L monthly average 20 mg/L daily maximum	50 mg/L monthly average	50 mg/L	-	-	-	-	250 mg/L (b)
Total Residual Chlorine	2 µg/L salmonid fish 10 µg/L (a)	-	-	-	-		2 µg/L	2 µg/L salmonid fish 10 µg/L (a)	-	-	2 µg/L
Chromium	50 µg/L (b) 100 µg/L (a)	50 µg/L	50 µg/L	50 µg/L	20 µg/L	20 µg/L	50 µg/L	50 µg/L 100 µg/L	50 µg/L	-	100 µg/L (a)
Carbon Chloroform Extract	-	-	700 µg/L	-	-	200 µg/L	-	-	-	-	200 µg/L (b)
Fecal Coliform Bacteria	Bathing Waters Based on a minimum of 5 samples taken over a 30-day period, the fecal coliform bacterial level should not exceed a log mean of 200 per 100mL, nor should more than 10% of total samples taken during any 30-day period exceed 400 per 100 mL. Shellfish Harvesting Waters The median fecal coliform bacterial concentration should not exceed 14 MPN per 100 mL with not more than 10% of samples exceeding 43 MPN per 100 mL for the taking of shellfish.	Waters used for body contact recreation activities should be substantially free from bacteria, fungi, or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections or other human diseases & infections.	Based on a minimum of 5 samples taken over not more than a 30-day period, fecal coliforms shall not exceed a geometric mean of 200 per 100 mL.	The fecal coliform content for whole body contact recreation shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor exceed 400/100 mL in more than 10% of all samples taken during a month. (MPN or MF count/100 mL). The fecal coliform content in the open water of Lake Michigan shall not exceed a geometric mean of 20 per 100mL.	Waters of the state protected for total body contact recreation shall contain not more than 200 fecal coliforms per 100 mL.	Disinfection of wastewater effluent to reduce the coliform organisms levels is required year round. The geometric mean for the fecal coliform organisms shall not exceed 200 MPN per 100 mL in a period of 30 consecutive days & 400 most probable number per 100 mL in a period of 7 consecutive days.	Geometric mean fecal coliform content (either MPN or MF), based on not less than 5 samples within a 30-day period shall not exceed 200 per 100 mL & shall not exceed 400 per 100 mL in more than 10% of the samples taken during any 30-day period.	The membrane filter fecal coliform count shall not exceed 200 per 100 mL as geometric mean based on not less than 5 samples per month, nor exceed 400 per 100 mL in more than 10% of all samples during any month.	Bacteria - the geometric mean of not less than 5 samples taken over not more than a 30-day period should not exceed 1000/100 mL total coliforms, nor should be substantially free from bacteria, fungi, or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections or other human diseases and infections. 200/100 mL fecal coliform	The geometric mean of not less than 5 samples taken over not more than a 30-day period should not exceed 1000 per 100 mL total coliform nor 200 per 100 mL of fecal coliform.	A potential health hazard exists if the fecal coliform geometric mean density for a series of water samples exceeds 100 per 100 mL. Water quality is considered impaired when the total coliform geometric mean density for a series of water samples exceeds 1000 per 100 mL.
Total Organic Carbon	-	-	-	-	-	-	-	-	-	-	5 mg/L

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Color	Waters shall be virtually free from substances producing objectionable color for aesthetic purposes. The source of supply should not exceed 75 color units on the platinum-cobalt scale for domestic water supplies; and increased color (in combination with turbidity) should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life.	-	-	5 color units monthly average 15 daily maximum	10% of the incident light should reach the bottom of any desired photosynthetic zone in which adequate Dissolved Oxygen levels are maintained.	15 color units	-	75 color units	-	-	5 colour units
Copper	1.0 mg/L (b) 0.1x96 hr LC_{50} Sensitive aquatic resident species	5 µg/L	20 µg/L	-	0.1x96 hr TL_m	10 µg/L 0.1x96 hr TL_m Sensitive aquatic resident species	5 µg/L	1.0 mg/L 0.1x96 hr LC_{50} Sensitive aquatic resident species	0.1x96 hr LC_{50} (H)	200 µg/L	1000 µg/L (b) 5 µg/L (a)
Cyanide	5 µg/L (a)	-	25 µg/L	10 µg/L	-	10 µg/L	25 µg/L 5 µg/L Amenable to chlorination	5 µg/L	5 µg/L HCN + CN^-	100 µg/L	5 µg/L 10 µg/L (b)
Ferro- or Ferric Cyanide	-	-	-	-	-	-	-	-	-	400 µg/L as Fe $(CN)_6$	-
Foaming Agents	-	-	500 µg/L	-	-	-	-	-	-	-	-
Fluoride	-	1200 µg/L (b)	1400 µg/L	1000 µg/L	-	1500 µg/L	1800 µg/L	-	2000 µg/L	-	1200 µg/L (b)
Gases, Total Dissolved	To protect freshwater and marine aquatic life, the total dissolved gas concentrations in water should not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.	-	-	-	-	-	-	-	-	-	To protect aquatic organisms, the total dissolved gas concentrations in water should not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.
Hardness	Conc. mg/L $CaCO_3$ 0-75 -Soft 75-150-Moderately Hard 150-300-Hard 300 & up-Very Hard	-	-	-	-	50 mg/L	-	-	-	-	-

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Color	Waters shall be virtually free from substances producing objectionable color for aesthetic purposes. The source of supply should not exceed 75 color units on the platinum-cobalt scale for domestic water supplies; and increased color (in combination with turbidity) should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life.	-	-	5 color units monthly average 15 daily maximum	10% of the incident light should reach the bottom of any desired photosynthetic zone in which adequate Dissolved Oxygen levels are maintained.	15 color units	-	75 color units	-	-	5 colour units
Copper	1.0 mg/L (b) 0.1x96 hr LC_{50} Sensitive aquatic resident species	5 µg/L	20 µg/L	-	0.1x96 hr TL_m	10 µg/L 0.1x96 hr TL_m Sensitive aquatic resident species	5 µg/L	1.0 mg/L 0.1x96 hr LC_{50} Sensitive aquatic resident species	0.1x96 hr LC_{50} (H)	200 µg/L	1000 µg/L (b) 5 µg/L (a)
Cyanide	5 µg/L (a)	-	25 µg/L	10 µg/L	-	10 µg/L	25 µg/L 5 µg/L Amenable to chlorination	5 µg/L	5 µg/L $HCN + CN^-$	100 µg/L	5 µg/L 10 µg/L (b)
Ferro- or Ferric Cyanide	-	-	-	-	-	-	-	-	-	400 µg/L as Fe $(CN)_6$	-
Foaming Agents	-	-	500 µg/L	-	-	-	-	-	-	-	-
Fluoride	-	1200 µg/L (b)	1400 µg/L	1000 µg/L	-	1500 µg/L	1800 µg/L	-	2000 µg/L	-	1200 µg/L (b)
Gases, Total Dissolved	To protect freshwater and marine aquatic life, the total dissolved gas concentrations in water should not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.	-	-	-	-	-	-	-	-	-	To protect aquatic organisms, the total dissolved gas concentrations in water should not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.
Hardness	Conc. mg/L $CaCO_3$ 0-75 -Soft 75-150-Moderately Hard 150-300-Hard 300 & up-Very Hard	-	-	-	-	50 mg/L	-	-	-	-	-

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Color	Waters shall be virtually free from substances producing objectionable color for aesthetic purposes. The source of supply should not exceed 75 color units on the platinum-cobalt scale for domestic water supplies; and increased color (in combination with turbidity) should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life.	-	-	5 color units monthly average 15 daily maximum	10% of the incident light should reach the bottom of any desired photosynthetic zone in which adequate Dissolved Oxygen levels are maintained.	15 color units	-	75 color units	-	-	5 colour units
Copper	1.0 mg/L (b) 0.1x96 hr LC_{50} Sensitive aquatic resident species	5 µg/L	20 µg/L	-	0.1x96 hr TL_m	10 µg/L 0.1x96 hr TL_m Sensitive aquatic resident species	5 µg/L	1.0 mg/L 0.1x96 hr LC_{50} Sensitive aquatic resident species	0.1x96 hr LC_{50} (H)	200 µg/L	1000 µg/L (b) 5 µg/L (a)
Cyanide	5 µg/L (a)	-	25 µg/L	10 µg/L	-	10 µg/L	25 µg/L 5 µg/L Amenable to chlorination	5 µg/L	5 µg/L HCN + CN^-	100 µg/L	5 µg/L 10 µg/L (b)
Ferro- or Ferric Cyanide	-	-	-	-	-	-	-	-	-	400 µg/L as Fe $(CN)_6$	-
Foaming Agents	-	-	500 µg/L	-	-	-	-	-	-	-	-
Fluoride	-	1200 µg/L (b)	1400 µg/L	1000 µg/L	-	1500 µg/L	1800 µg/L	-	2000 µg/L	-	1200 µg/L (b)
Gases, Total Dissolved	To protect freshwater and marine aquatic life, the total dissolved gas concentrations in water should not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.	-	-	-	-	-	-	-	-	-	To protect aquatic organisms, the total dissolved gas concentrations in water should not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.
Hardness	Conc. mg/L $CaCO_3$ 0-75 -Soft 75-150-Moderately Hard 150-300-Hard 300 & up-Very Hard	-	-	-	-	50 mg/L	-	-	-	-	-

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Iron	300 µg/L (b) 1000 µg/L (a)	300 µg/L (a)	300 µg/L	150 µg/L monthly average 300 µg/L daily maximum	300 µg/L	300 µg/L (b)	1000 µg/L 300 µg/L soluble	300 µg/L (b) 1000 µg/L (a)	300 µg/L or natural levels	300 µg/L Lake Erie and Niagara River	300 µg/L (a)(b)
Lead	50 µg/L for domestic water supply (health). 0.01 times the 96-hr LC_{50} value, using the receiving or comparable water as the diluent & soluble lead measurements (using 0.45 micron filter) for sensitive freshwater resident species.	10 µg/L (a) Lake Superior 20 µg/L Lake Huron 25 µg/L all others	50 µg/L	50 µg/L	-	50 µg/L	30 µg/L	50 µg/L	50 µg/L or 0.01x96 hr LC_{50} (H)	-	The total lead concentration should not exceed the values given below: Alkalinity mg/L as $CaCO_3$ / Max. lead concentration µg/L <20 / 5 20-40 / 10 40-80 / 20 >80 / 25
Manganese	50 µg/L (b)	-	50 µg/L	-	-	50 µg/L	50 µg/L	50 µg/L	1000 µg/L	-	50 µg/L (b)
Mercury	2.0 µg/L (b) 0.05 µg/L (a)	0.2 µg/L 0.5 µg/g (G)	0.5 µg/L	0.05 µg/L	-	-	0.5 µg/g Whole fish 0.05 µg/L monthly average 0.2 µg/L any time	2.0 µg/L (b) 0.05 µg/L (a)	0.2 µg/L Unfiltered Water Sample	-	0.2 µg/L Filtered 0.5 µg/g (G)
Mixing Zones	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached
MBAS/LAS	-	-	-	-	0.14x48 hr TL_m MBAS/LAS	0.5 mg/L MBAS	0.5 mg/L MBAS	-	-	-	0.5 mg/L MBAS (b)
Nickel	0.01x96 hr LC_{50} (a)	25 µg/L	1000 µg/L	-	-	-	25 µg/L	0.01x96 hr LC_{50}	.01x96 hr LC_{50}	-	25 µg/L (a)
Nitrates	-	-	10 mg/L	-	-	45 mg/L as NO_3	10.0 mg/L	10 mg/L	-	-	10 mg/L (b)
Nitrites	-	-	1 mg/L	-	-	-	-	-	-	-	-
Nitrate & Nitrite	10 mg/L (b) Nitrate Nitrogen	-	-	-	-	-	100 mg/L	-	10 mg/L	-	-
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	0.15 mg/L No ammonia

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Oil and Grease	For domestic water supply: Virtually free from oil and grease, particularly from the tastes and odors that emanate from petroleum products. For aquatic life: (1) Levels of individual petrochemicals in the water column should not exceed 0.01 of the lowest continuous flow 96-hr LC_{50} to several important freshwater or marine species, each having a demonstrated high susceptibility to oils and petrochemicals; (2) Levels of oil or petrochemicals in the sediment which cause deleterious effects to the biota should not be allowed; (3) Surface waters shall be virtually free from floating nonpetroleum oils of vegetable or animal origin, as well as petroleum derived oils.	Oil and petrochemicals should not be present in concentrations that: (i) can be detected as visible film, sheen or discoloration on the surface; (ii) can be detected by odor; (iii) can cause tainting of edible aquatic organisms; and (iv) can form deposits on shorelines and bottom sediments that are detectable by sight or odor, or are deleterious to resident aquatic organisms.	0.1 mg/L Hexane-Soluble	Oil or similar materials shall not be present in such quantities that they will produce a visible film on the water surface, coat the banks and bottom of the lake or harbors or any way be toxic or harmful to fish and aquatic life.	Absent	Absent	Surface waters shall be free from floating oils and shall at no time produce a visible sheen or color film. Levels of oils or petrochemicals in the sediment or on the banks of a watercourse which cause deleterious effects to the biota will not be permitted. At no time will chlorofluorocarbon extractable materials in water exceed 5 mg/L.	Absent	Absent	No visible film	Oil or petrochemicals should not be present in concentrations that: can be detected as a visible film, sheen, or discolouration on the surface; can be detected by odour; can cause tainting of edible aquatic organisms; can form deposits on shorelines and bottom sediments that are detectable by sight or odour or are deleterious to residual aquatic organisms.
Dissolved Oxygen	Aesthetics: Water should contain sufficient dissolved oxygen to maintain aerobic conditions in the water column and, except as affected by natural phenomena, at the sediment-water interface. Freshwater aquatic life: A minimum concentration of dissolved oxygen to maintain good fish populations is 5.0 mg/L. The criterion for salmonid spawning beds is a minimum of 5.0 mg/L in the interstitial water of the gravel.	In the connecting channels and in the upper waters of the lakes, the dissolved oxygen level should not be less than 6.0 mg/L at any time; in hypolimmetic waters, it should be not less than necessary for the support of fish-life, particularly cold water species.	90% of saturation	7.0 mg/L	6.0 mg/L	7.0 mg/L October 1 to May 31 6 mg/L - All other times	6.0 mg/L	5.0 mg/L	6.0 mg/L	6.0 mg/L in Lake Erie and Niagara River 4.0 mg/L in Lake Ontario and excepted areas in Lake Erie	see attached

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Aldrin/ Dieldrin	0.003 µg/L (a) (D)	0.001 µg/L (a) 0.3 µg/g (F)	1 µg/L	-	-	-	0.01 µg/L Aldrin 0.001 µg/L Diel.	0.003 µg/L	.001 µg/L 0.3 µg/g (F)	-	0.001 µg/L 0.3 µg/g (F)
Benzene Hexachloride	-	-	-	-	-	-	0.1 µg/L	-	-	-	-
Chlordane	0.01 µg/L (a) (D)	0.06 µg/L (a)	3 µg/L	-	-	-	0.01 µg/L 3.0 µg/L (b)	0.01 µg/L	0.06 µg/L	-	0.06 µg/L
Chlorophenoxy Herbicides	2,4-D 100 µg/L(b) 2,4,5-TP 10 µg/L (b)	-	2,4-D 20 µg/L 2,4,5-TP 10 µg/L	-	-	-	2,4-D 100 µg/L(b) 2,4,5-TP 10 µg/L (b)	2,4-D 100 µg/L 2,4,5-TP 10 µg/L	-	-	2,4-D 4 µg/L
Coumaphos	-	-	-	-	-	-	0.001 µg/L	-	-	-	-
Dalapon	-	-	-	-	-	-	110 µg/L	-	-	-	110 µg/L
DDT	0.001 µg/L (a) (D)	0.003 µg/L (a) 1.0 µg/g (F)	50 µg/L	-	-	-	0.001 µg/L 50 µg/L (b)	0.001 µg/L	0.003 µg/L 1.0 µg/g (F)	-	0.003 µg/L 1.0 µg/g (F)
Demeton	0.1 µg/L (a)	-	-	-	-	-	0.1 µg/L	0.1 µg/L	-	-	
Diazinon	-	0.08 µg/L (a)	-	-	-	-	0.009 µg/L	-	-	-	0.08 µg/L
Dicamba	-	-	-	-	-	-	200 µg/L	-	-	-	200 µg/L
Dichlorvos	-	-	-	-	-	-	0.001 µg/L	-	-	-	-
Diquat	-	-	-	-	-	-	0.5 µg/L	-	-	-	0.5 µg/L
Diuron	-	-	-	-	-	-	-	-	-	-	1.6 µg/L
Dursban	-	-	-	-	-	-	0.001 µg/L	-	-	-	0.001 µg/L
Endosulfan	0.003 µg/L (a)	-	-	-	-	-	0.003 µg/L	0.003 µg/L	-	-	0.003 µg/L
Endrin	0.2 µg/L (b) 0.004 µg/L (a)	0.002 µg/L (a) 0.3 µg/g (F)	0.5 µg/L	-	-	-	.002 µg/L 0.2 µg/L (b)	0.2 µg/L (b) 0.004 µg/L (a)	0.002 µg/L 0.3 µg/g (F)	-	0.002 µg/L 0.3 µg/g (F)
Fenthion	-	-	-	-	-	-	-	-	-	-	0.006 µg/L
Guthion	0.01 µg/L (a)	0.005 µg/L (a)	-	-	-	-	0.005 µg/L	0.01 µg/L	-	-	0.005 µg/L
Heptachlor Epoxide	0.001 µg/L (a) (D)	0.001 µg/L (a) 0.3 µg/g (F)	0.1 µg/L	-	-	-	0.001 µg/L 0.1 µg/L (b)	0.001 µg/L	0.001 µg/L 0.3 µg/g (F)	-	0.001 µg/L 0.3 µg/g (F)
Lindane	4.0 µg/L (b) 0.01 µg/L (a)	0.01 µg/L (a) 0.3 µg/g (F)	5.0 µg/L	-	-	-	4.0 µg/L (b) 0.01 µg/L	4.0 µg/L (b) 0.01 µg/L	0.01 µg/L 0.3 µg/g (F)	-	0.01 µg/L 0.3 µg/g (F)
Malathion	0.1 µg/L (a)	-	-	-	-	-	0.1 µg/L	0.1 µg/L	-	-	0.1 µg/L
Methoxychlor	100 µg/L (b) 0.03 µg/L (a)	0.04 µg/L (a)	100 µg/L	-	-	-	100 µg/L (b) 0.005 µg/L	100 µg/L (b) 0.03 µg/L	0.04 µg/L	-	0.04 µg/L
Mirex	0.001 µg/L (a)	Less than detection levels		-	-	-	0.001 µg/L	0.001 µg/L	-	-	0.001 µg/L
Naled	-	-	-	-	-	-	0.004 µg/L	-	-	-	-
Parathion	0.04 µg/L(a)	0.008 µg/L (a)	100 µg/L	-	-	-	0.008 µg/L	0.04 µg/L	-	-	0.008 µg/L
Phosphamidon	-	-	-	-	-	-	0.03 µg/L	-	-	-	
Pyrethrum	-	-	-	-	-	-	-	-	-	-	0.01 µg/L
Simazine	-	-	-	-	-	-	10 µg/L	-	-	-	10 µg/L
TEPP	-	-	-	-	-	-	0.4 µg/L	-	-	-	-
Toxaphene	5 µg/L (b) 0.005 µg/L (a)	0.008 µg/L (a)	5.0 µg/L	-	-	-	5 µg/L (b) 0.005 µg/L	5 µg/L (b) 0.005 µg/L	0.008 µg/L	-	0.008 µg/L

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
pH	5 - 9 (b) 6.5 - 9.0 (a)	Values of pH should not be outside the range of 6.5 to 9.0, nor should discharge change the pH at the boundary of a limited use zone more than 0.5 units from that of the ambient waters.	7.0 - 9.0	7.5 - 8.5	6.7 - 8.5	6.5 - 8.5	6.5 - 9.0	6.0 - 9.0	6.5 - 9.0	6.7 - 8.5 in Lake Erie and Niagara River. 6.5 - 8.5 in Lake Ontario and excepted areas of Lake Erie	6.5 - 8.5
Phenol	1.0 µg/L (b) To protect against fish flesh tainting	1.0 µg/L (b)	1 µg/L	1 µg/L monthly average 3 µg/L daily maximum	-	1 µg/L	1 µg/L	1 µg/L	5 µg/L	5.0 µg/L in non-excepted portion of Lake Ontario only	1 µg/L tainting
Phosphorus	0.1 µg/L yellow	see attached Water Quality Agreement Annex 3	.007 mg/L	0.03 mg/L monthly average 0.04 mg/L daily maximum	-	1 mg/L Discharge Effluent	1 mg/L Discharge Effluent	0.1 µg/L Yellow	Prevent nuisance growth	Prevent nuisance growth	20 µg/L Prevent nuisance growth
Plant Nutrients	-	-	-	-	Prevent nuisance growth	-	-	-	-	-	-
Phthalate Esters	3 µg/L (a)	-	-	-	-	-	3 µg/L	3 µg/L	-	-	-
Dibutyl Phthalate	-	4.0 µg/L (a)	-	-	-	-	-	-	4 µg/L	-	4 µg/L
Di (2-Ethylhexyl) Phthalate	-	0.6 µg/L (a)	-	-	-	-	-	-	0.6 µg/L	-	0.6 µg/L
Other Phthalic Acid Esters	-	0.2 µg/L (a)	-	-	-	-	-	-	0.2 µg/L	-	0.2 µg/L
Polychlorinated Biphenyls	0.001 µg/L (a) (E)	0.1 µg/g (G)	-	0.001 µg/L	-	-	Absent (b) 0.001 µg/L other waters 10.0 µg/g (G)	0.001 µg/L	0.001 µg/L 0.1 µg/g (G)	-	0.001 µg/L
Selenium	10 µg/L (b) 0.01x96 hr LC_{50} (a) Sensitive resident species	10 µg/L (b)	10 µg/L	10 µg/L	-	10 µg/L	10 µg/L	10 µg/L 0.1x96 hr LC_{50}	10 µg/L	-	100 µg/L (a)
Silver	50 µg/L (b) 0.01x96 hr LC_{50} (a) Sensitive resident species	-	5.0 µg/L	50 µg/L	-	50 µg/L	50 µg/L	-	-	-	0.1 µg/L (a)

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Solids (Dissolved)	250 mg/L (b) Chlorides Sulfates	Total Dissolved Solids In Lake Erie, Lake Ontario and the International Section of the St. Lawrence River, the level of total dissolved solids should not exceed 200 mg/L. In the St. Clair River, Lake St. Clair, the Detroit River & the Niagara River, the level should be consistent with maintaining the levels of total dissolved solids in Lakes Erie and Ontario at not to exceed 200 mg/L. In the remaining boundary waters, pending further study, the level of total dissolved solids should not exceed present levels.	180 mg/L	172 mg/L monthly average 200 mg/L daily maximum	Controlled point source 500 mg/L monthly average 750 mg/L any time Lake Erie 200 mg/L	500 mg/L	200 mg/L	500 mg/L monthly average 750 mg/L any time	200 mg/L	200 mg/L in Lake Erie and Niagara River 500 mg/L in Lake Ontario and excepted areas of Lake Erie	500 mg/L (b) Dissolved solids must not be added to increase the ambient concentrations by more than 1/3 of the natural concentrations to protect aquatic life. The added solids should not significantly alter the overall ionic balance of the receiving waters.
Solids (Suspended Settleable) Turbidity	Freshwater fish and other aquatic life: Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life.	Settleable and Suspended Solids and Light Transmission For the protection of aquatic life, waters should be free from substances attributable to municipal, industrial or other discharges resulting from human activity that will settle to form putrescent or otherwise objectionable sludge deposits or that will alter the value of Secchi disc depth by more than 10%.	-	-	No unnatural turbidity, color, oil films, floating solids, foams, settleable solids or deposits injurious to any designated use.	30 mg/L	-	-	-	None from sewage industral wastes or other wastes which will cause deposition or be deleterious for any best usage determined for the specific waters which are assigned to this class.	-
Sulfide-Hydrogen Sulfide	2 µg/L (a) Undissociated	2.0 µg/L (a) Undissociated	-	-	-	-	-	2 µg/L	-	-	2 µg/L (a)
Sulfates	-	-	24 mg/L	26 mg/L monthly average 50 mg/L daily maximum	-	250 mg/L	-	-	-	-	250 mg/L (b)

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Tainting Substances	Materials should not be present in concentrations that individually or in combination produce undesirable flavors which are detectable by organoleptic tests performed on the edible portions of aquatic organisms.	(a) Raw public water supply sources should be essentially free from objectionable taste and odor for aesthetic reasons. (b) Levels of phenolic compounds should not exceed 1.0 µg/L in public water supplies to protect against taste and odor in domestic water. (c) Substances entering 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.	-	-	Materials that impart odor or taste to fish flesh or other freshwater edible products are not allowed to enter receiving waters at levels that produce tainting.	-	-	-	-	-	-
Temperature	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached
Toxic Substances	-	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached	see attached
Turbidity Value	-	-	-	-	10 JTU	5	-	-	-	-	<10% change of Secchi disc reading.
Zinc	5 mg/L (b) 0.01x96 hr LC_{50} (a) Sensitive resident species	0.03 mg/L (a)	1.0 mg/L	-	0.01x96 hr TL_m	5 mg/L	0.03 mg/L	5 mg/L	0.01x96 hr LC_{50} (H)	0.3 mg/L	0.03 mg/L (a) 5 mg/L (b)

Table 5 cont'd.

PARAMETER	RED BOOK	WATER QUALITY OBJECTIVES	ILLINOIS	INDIANA	MICHIGAN	MINNESOTA	OHIO	WISCONSIN	PENNSYLVANIA	NEW YORK	ONTARIO WATER QUALITY OBJECTIVES
Radiological	None	The level of radioactivity in waters outside of any defined source control area should not result in a TED_{50} (total equivalent dose integrated over 50 years as calculated in accordance with the methodology established by the International Commission on Radiological Protection) greater than 1 millirem to the whole body from a daily ingestion of 2.2 liters of lake water for 1 year. For dose commitments between 1 and 5 millirem at the periphery of the source control area, source investigation and corrective action are recommended if releases are not as low as reasonably achievable. For dose commitments greater than 5 millirem, the responsible regulatory authorities shall determine appropriate corrective action.	Gross beta concentration shall not exceed 100 pico curies per liter (pCi/L). Concentrations of radium 226 and strontium 90 shall not exceed 1 and 2 pico curies per liter respectively.	Gross beta concentration shall not exceed 100 pico curies per liter (pCi/L). Concentrations of radium 226 and strontium 90 shall not exceed 1 and 2 pico curies per liter respectively.	Criteria of U.S. Atomic Energy Commission (Nuclear Regulatory Commission)	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having use.	-	-	Radioactivity should be kept at the lowest practicable level & in any event should be controlled to the extent necessary to prevent harmful effects on health.	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.	Gross beta emitters - 1000 pCi/L Radium-226 3 pCi/L Strontium-90 10 pCi/L