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Upper Lakes Reference Group: Reference Questions, Summary and Recommendations

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UPPER LAKES REFERENCE GROUP

REFERENCE QUESTIONS

SUMMARY AND RECOMMENDATIONS
1. Are the waters of Lake Superior and Lake Huron being polluted on either side of the boundary to an extent (a) which is causing or is likely to cause injury to health or property on the other side of the boundary; or (b) which is causing, or likely to cause, a degradation of existing levels of water quality in these two lakes or in downstream portions of the Great Lakes System?

2. If the foregoing questions are answered in the affirmative, to what extent, by what causes, and in what localities is such pollution taking place?

3. If the Commission should find that pollution of the character just referred to is taking place, what remedial measures would, in its judgement, be most practicable to restore and protect the quality of the waters, and what would be the probable cost?

4. In the event that the Commission should find that little or no pollution of the character referred to is taking place at the present time, what preventive measures would in its judgement be most practicable to ensure that such pollution does not occur in the future and what would be the probable cost?
SUMMARY

The Upper Lakes Reference Group concludes that the water quality of Lake Superior and Lake Huron is still excellent but that man's impact is clearly evident. Overall, the water quality is much better than both the objectives given in the Water Quality Agreement and the jurisdictional standards, with only isolated instances of pollution. The Reference Group considers it imperative that the waters of the Upper Lakes be maintained at their present high quality to preserve and protect all existing and future uses. The following discussion emphasizes the major concerns of the Reference Group and provides recommendations for protection of the lakes. Volumes I, II, and III may be consulted for the supporting details.

The Reference Group finds that the only transboundary water pollution (violation of existing criteria, objectives, or standards) occurs in the St. Marys River where the discharges of phenolic substances by Algoma Steel and by the City of Sault Ste. Marie, Ontario violate the Agreement objectives. Also, some species of fish in both lakes contain high concentrations of heavy metals or toxic organics, which constitutes a whole lake problem. Point sources are only a minor source of metals and organics and are generally under control. The major sources are atmospheric inputs and land runoff which require better understanding before specific control measures can be developed.

The Reference Group finds that there is some degradation of water quality of both Lake Superior and Lake Huron caused by the inputs of nutrients, organics, and bacteria. The degradation related to nutrients and organics affects both the open waters and nearshore areas of the Upper Lakes but contributes only slightly to the problems in the Lower Lakes. Phosphorus is the nutrient which usually limits growth in both the open lake and the nearshore areas and is therefore considered in detail by the Reference Group. Bacteriological degradation is only found in nearshore areas with violations occurring at some locations. There are also violations of the Ontario radiological criteria for radium in drinking water supplies at Serpent Harbour on the North Channel. Water quality in the western arm of Lake Superior has been seriously degraded by the asbestos inputs by Reserve Mining Company at Silver Bay, Minnesota.

The Reference Group finds atmospheric inputs are a significant source of nutrients, metals, and organics, contributing about 15% of the phosphorus and 30-40% of the lead and the copper input to the Upper Lakes. However, the state of the art in modelling atmospheric transport and deposition is such
that specific sources and possible reductions of atmospheric inputs cannot be reliably forecast at present. Point source control programs on wastewater discharges are still the most effective means of protecting the water quality, but these alone are not sufficient to avoid degradation.

The Reference Group also finds that vessel wastes, erosion, thermal inputs, dredging, and spills are causing or likely to cause some degradation of the Upper Lakes but to a much lesser degree than the aforementioned sources. Vessel wastes are of concern due to the localized impacts on harbours and the import of chloride and foreign biota to the lakes. Spills always have an adverse environmental impact, but the long-term effects are not documented. Further, it is equally important to have an effective program for spill prevention as for spill response.

The objectives of the following recommendations are to abate all existing pollution (Reference Question 3) and to preserve and to maintain the overall high quality of the Upper Lakes (Reference Question 4). In the judgment of the Reference Group, these recommendations are the best answers to these questions. The Reference Group also recognizes the need to further improve our understanding of the dynamics of the system. Key among these is man's understanding of nearshore-offshore exchange processes, which is essential if the Great Lakes are to be properly managed as a resource. To provide this additional knowledge about the areas of concern to the Reference Group, additional recommendations for surveillance have been developed; these are presented in Volume I.

ENRICHMENT

CORRECTION OF EXISTING PROBLEMS (REFERENCE QUESTIONS 1, 2, AND 3)

Saginaw Bay has the most serious enrichment problem in Lake Huron; remedial programs presently underway by Michigan will reduce the phosphorus entering the bay from 1300 to 700 tonnes per year (t/a).

Duluth-Superior Harbor has the most serious enrichment problem in Lake Superior; remedial programs presently underway by Wisconsin and Minnesota will alleviate the problems by reducing the phosphorus load from 230 to 70 t/a. This will also alleviate the problem of elevated phytoplankton biomass concentrations in the western arm of Lake Superior.

The following seven areas also show signs of enrichment in Lake Huron:

**ONTARIO**
- Goderich-Maitland River Basin
- Penetang Bay
- Midland Bay
- Collingwood Harbour

**MICHIGAN**
- Cheboygan
- Alpena
- Harbor Beach
Municipal treatment facilities incorporating phosphorus removal have been completed at Penetang Bay, Midland Bay, and Collingwood Harbour. Phosphorus removal is presently planned for Cheboygan, Alpena, and Harbor Beach.

The Reference Group recommends:

1. Michigan ensure that the point source remedial programs in the Saginaw Bay Basin are completed by December 1978, to reduce the annual phosphorus load by 600 t/a.

2. Wisconsin and Minnesota ensure that the point source remedial programs in the Duluth-Superior Harbor area are completed by December 1978, to reduce the annual phosphorus load by 160 t/a.

3. The condition of Saginaw Bay and of Duluth-Superior Harbor be re-examined upon implementation of the phosphorus removal programs to determine if additional load reductions are needed.

4. The identification and control of the sources of phosphorus contributing to the problems in the Goderich area.

5. Surveillance be maintained at Penetang Bay, Midland Bay, and Collingwood Harbour to determine whether improvements are occurring as expected or whether additional remedial programs are warranted.

NONDEGRADATION (REFERENCE QUESTION 4)

The Reference Group concludes that it is desirable to maintain and protect the present oligotrophic condition of Lake Huron and of Lake Superior for present and future use and to ensure the delivery of high quality water to the Lower Lakes. To maintain the present water quality in the Upper Lakes, the following allowable phosphorus loading limits must not be exceeded:

<table>
<thead>
<tr>
<th>Location</th>
<th>1974</th>
<th>After Scheduled Reductions</th>
<th>Projection to 2020</th>
<th>Maximum Allowable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Superior</td>
<td>4140</td>
<td>3940</td>
<td>4770</td>
<td>3900</td>
</tr>
<tr>
<td>Lake Huron (Main Lake)</td>
<td>3720</td>
<td>3020</td>
<td>4230</td>
<td>3600</td>
</tr>
<tr>
<td>Georgian Bay</td>
<td>928</td>
<td>928</td>
<td>1180</td>
<td>928</td>
</tr>
<tr>
<td>North Channel</td>
<td>1220</td>
<td>1220</td>
<td>1700</td>
<td>1220</td>
</tr>
</tbody>
</table>

In-place and planned point source phosphorus control programs are presently adequate to protect the Upper Lakes, but Lake Superior, Georgian Bay, and the North Channel are at or near their maximum allowable load limits. Phosphorus inputs are projected to increase. Because of these projected increases, reductions of future phosphorus loadings from municipal and industrial sources alone will not be adequate. Therefore, the Reference Group recommends:
6. The phosphorus concentration in all municipal and industrial discharges be reduced to 1.0 mg/l or less as soon as possible.

7. The allowable phosphorus content of all detergents be limited to not more than 0.5% phosphorus by weight.

8. All practicable measures be taken to reduce phosphorus loadings from land use and nonpoint sources.

PUBLIC HEALTH MICROBIOLOGY

The following areas exhibited bacteriological water quality degradation:

LAKE HURON

- Ontario - Sault Ste. Marie
- Town of Blind River
- Spanish River
- Penetang
- Owen Sound
- Goderich

LAKE SUPERIOR

- Ontario - Marathon
- Jackfish Bay
- Red Rock
- Thunder Bay
- Minnesota/Wisconsin - Duluth-Superior Harbor

- Michigan - Black River
- Ontonagon
- Marquette
- Munising

- Michigan - Harbor Beach
- Tawas City
- Alpena
- Cheboygan
- Saginaw River mouth

Presently available technology, if properly applied, is adequate to handle all existing bacteriological problems. The Reference Group recommends:

9. The jurisdictions undertake the necessary remedial programs to bring these areas into compliance with the Water Quality Agreement objectives.

The Reference Group concludes that the existing microbiology objectives in the Agreement are inadequate for the overall assessment and the protection of water quality in respect to public health. The Reference Group recommends:

10. New microbiological objectives be established and standard measurement methods be developed.

METALS

Sediments in the following areas exhibit elevated metals concentrations:

LAKE SUPERIOR

- Ontario - Marathon: mercury
- Jackfish Bay: mercury
- Thunder Bay: mercury, zinc
Michigan - Munising: zinc, lead, copper
Upper Portage Entry: copper
Isle Royale area: mercury

LAKE HURON

Ontario - Serpent River: nickel
Spanish River: nickel
Collingwood: zinc, cadmium, lead
Penetang: zinc
Midland: zinc, lead, mercury
Parry Sound Harbour: zinc
Goderich: lead
Tobermory: lead
Owen Sound: lead
Nottawasaga Bay: lead

Ontario/Michigan - St. Marys River: iron, zinc

Michigan - Saginaw Bay: zinc, lead
Lexington: zinc
Harbor Beach: zinc
Cheboygan: zinc
Saginaw Depositional Basin: mercury, lead, copper, nickel, cadmium

The elevated concentrations of mercury at Thunder Bay and Marathon and copper at Upper Portage Entry are considered residual and should decrease with time without additional remedial programs. The elevations at some of these areas may be natural.

Elevated concentrations of mercury are found in some fish from both Lake Huron and Lake Superior; food guidelines are occasionally exceeded. Some chubs from Lake Huron also exhibit elevated arsenic concentrations.

The concentration of copper in water is elevated in the open water of central Lake Huron, at Tawas City, Upper and Lower Portage Entries, Ontonagon, and Marquette. Zinc concentrations are elevated at DeTour Passage and Saginaw Bay. Iron and manganese concentrations are slightly elevated in the western arm of Lake Superior compared to the rest of the lake. The concentrations found occasionally approach or exceed the objectives proposed by the Water Quality Objectives Subcommittee.

To abate the existing high levels of metals in sediment and water, eliminate contamination of fish, and prevent future problems, the Reference Group recommends:

11. There be no increase allowed for inputs of any metals to the Upper Lakes.
12. Mercury discharges from the American Can of Canada, Ltd. chlor-alkali plant at Marathon be eliminated by December 1978 as scheduled, and any other sources identified in the future also be eliminated.

13. Remedial programs to reduce iron and zinc discharges from Algoma Steel Co. at Sault Ste. Marie, Ontario should be developed and implemented as soon as possible.

14. The metals input from atmospheric sources be quantified and the maximum possible reductions be made as soon as possible.

15. The Governments monitor the unexplained high arsenic content in Lake Huron chubs and take the necessary measures to prevent worsening conditions.

16. The Governments monitor the identified high metals content in sediments and in water, and take the necessary measures to prevent worsening conditions.

ORGANIC CONTAMINANTS

TOXIC ORGANICS

Toxic organic substances can accumulate in aquatic organisms, sediments, fish, and other animals and can be transferred up through the food chain to man. Because of the known toxicity, limited knowledge of chronic sublethal effects, violations of present objectives, the apparent ineffectiveness of existing partial bans of some toxic organics, and possible significant atmospheric transport, the Reference Group recommends:

17. A total ban on the manufacture, sale, transport, and use of PCB's, aldrin, dieldrin, and DDT and its derivatives.

18. That for lindane, chlorobenzene compounds, chlordane, octachlorostyrene, and other man-made organics such as halogenated hydrocarbons, an accelerated program be initiated to evaluate effects on human health and biota, to establish a better basis for criteria, and to develop remedial programs as needed. Until the effects are fully understood there should be no increased manufacture, use, or discharge of these compounds.

19. Environmental and health effects be fully evaluated before new organic compounds are produced, distributed, or used.

20. The Governments immediately implement programs to minimize pesticide use, as recommended in the Early Action Program Report of March 1974, prepared by the Pollution from Land Use Activities Reference Group.
TASTE AND ODOUR COMPOUNDS

The Reference Group recommends:

21. Appropriate remedial measures be taken to eliminate the remaining taste and odour problems at Thunder Bay, Marathon, Jackfish Bay, and the mouth of the Spanish River, caused by pulp and paper mills.

22. Governments ensure that the waste treatment facilities for Algoma Steel at Sault Ste. Marie, Ontario be completed as soon as possible to achieve the Agreement objective for phenolic substances.

23. Governments ensure that appropriate measures be taken at Sault Ste. Marie, Ontario to reduce the present phenolic discharges from the sewage collection and treatment facilities so as to achieve the Agreement objective for phenolic substances by December 1978.

ASBESTOS

To protect public health, the Reference Group recommends:

24. Reserve Mining Company immediately cease discharging tailings, which contain asbestiform fibres, to Lake Superior.

25. The erosion and further asbestos loading from the tailings delta at Silver Bay, Minnesota be minimized.


27. The IJC develop and recommend to Governments a water quality objective for asbestos.

28. The Governments intensify their support of research on the effects of fibre size, shape, and concentration on the health of all biological forms in the Upper Lakes especially man.

29. That the surveillance program for Lake Superior include monitoring the changes in asbestos concentration subsequent to the cessation of the Reserve Mining Company discharge.

RADIOACTIVITY

The concentrations of $^{226}$Ra in Serpent Harbour were found to exceed the Ontario public drinking water supply criteria. However these have declined substantially as a result of abatement programs which have been implemented since 1965. The adequacy of these programs to achieve compliance is not known. The Reference Group recommends:
30. The adequacy of present programs be assessed and, if needed, additional abatement measures be implemented in the Elliot Lake area to achieve compliance with the Ontario drinking water criteria.

31. The jurisdictions initiate without delay the surveillance plan prepared by the Radioactivity Subcommittee and incorporated into the Great Lakes surveillance plan developed by the Surveillance Subcommittee, in order to ascertain that changes in radioactivity occur as predicted and that no localized increase in concentration occurs.

DREDGING

The Reference Group recommends:

32. The Governments act upon the recommendations of the International Working Group on the Abatement and Control of Pollution from Dredging Activities, leading to the development and adoption of compatible regulations for dredging and dredge spoil disposal that fully consider the short- and long-term effects.

VESSEL WASTES

Chloride from the discharge of seawater ballast accounts for 4% of the total chloride load to Lake Superior. In addition, this discharge may result in the introduction of undesirable salt and brackish water biota; based on previous experience with lampreys and alewives, this could be a serious problem. The discharge of personal wastes can cause public health problems. The Reference Group recommends:

33. Existing and proposed vessel waste regulations be amended to prohibit discharges of personal wastes from all vessels into Lakes Huron and Superior or into any of its harbours or embayments. Major ports should be required to provide adequate pumpout facilities for personal wastes.

34. All ocean vessels inbound to the Great Lakes be required to exchange seawater ballast for acceptable freshwater ballast prior to entering the Saint Lawrence Seaway.

35. Compatible regulations be developed and appropriate remedial programs be instituted to abate operational and functional waste discharges. Particular attention should be given to ocean-going vessels, self-loading/unloading vessels, and tankers.

SPILLS

Information about spills in the Upper Lakes is generally inadequate. The Reference Group recommends:

36. The regulatory agencies conduct post-spill studies to determine the associated long-term environmental effects of spills and cleanup.
37. As a result of these studies, improvements should be made in response measures and recovery technology.

38. The information base regarding the nature and the character of the material spilled be upgraded and reported in a common format.

THERMAL

Present thermal discharges do not cause serious water quality degradation. However, thermal inputs will increase. Potential problems, particularly in the area of fish larvae and fish entrainment, are of concern. Therefore, the Reference Group recommends:

39. Comprehensive environmental assessment studies be conducted for each thermal discharger to be sited on the Upper Lakes with particular emphasis given to the design of intake and discharge structures to minimize fish and fish larvae entrainment.

ATMOSPHERIC INPUTS

Preliminary measurements indicate that the atmosphere is a significant source of materials loading to the Upper Lakes. The Reference Group recommends:

40. The Governments include phosphorus as an air pollution control parameter and determine its sources.

41. A surveillance program for atmospheric loading to the Upper Lakes, including synthetic organics, arsenic, and mercury, be instituted.

WATER QUALITY AGREEMENT OBJECTIVES

The present criteria, standards, or objectives developed by the jurisdictions to protect specified uses are often significantly divergent. The Reference Group recommends:

42. The IJC continue to review all the criteria, standards, and objectives presently used and, where necessary, refine the present objectives and develop new specific objectives for inclusion in the Water Quality Agreement; and where less stringent criteria are in force, recommend the adoption of criteria at least as stringent as the objectives in the Agreement.