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CANDIDATE SUBSTANCES LIST  
FOR BANS OR PHASE-OUTS

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and  
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## Executive Summary

In June 1991 the Ontario Ministry of the Environment's Hazardous Contaminants Branch and Water Resources Branch were directed to establish a list of candidate substances to be considered for banning, phasing out or use/release reductions. The results were: (i) a process for selecting the substances, (ii) primary and secondary lists of substances for consideration, (iii) a review of the data on loadings of the primary list substances to receiving waters from industrial and municipal direct point source dischargers, (iv) a hazard evaluation of industrial and municipal effluents monitored under MISA\* and (v) a review of the receiving water impacts, including sediment and biota impacts, attributable to point and non-point source inputs of substances on the Primary List.

The Primary List of Candidate Substances for Bans or Phase-Outs is a list of substances present in or discharged to Ontario surface waters which, out of the approximately 800 substances assessed, *are most inherently hazardous due to their persistence in water or sediment, potential to bioaccumulate and toxicity*. It is recommended that these substances be given first priority in considering candidate substances for banning, phasing out, or use/release reduction.

The Primary List is composed of the following 21 substances or substance groups:

- anthracene
- arsenic
- benzo[*a*]pyrene
- benzo[*ghi*]perylene
- benz[*a*]anthracene
- DDT (+ DDD & DDE)
- 1,4-dichlorobenzene
- 3,3'-dichlorobenzidine
- dieldrin
- hexachlorobenzene
- alpha-hexachlorocyclohexane ( $\alpha$ -HCH)
- gamma-hexachlorocyclohexane ( $\gamma$ -HCH)
- mercury
- mirex
- pentachlorophenol
- perylene
- phenanthrene
- polychlorinated biphenyls (PCBs)
- polychlorinated dibenzo-p-dioxins and -furans (PCDD/Fs)
- toxaphene
- tributyl tin

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\* Municipal-Industrial Strategy for Abatement, a program under which effluent from industrial and municipal sources directly discharged to surface water are monitored and regulated.

Although all Primary List substances except 3,3'-dichlorobenzidine have been detected at elevated concentrations in the Great Lakes basin, it has been demonstrated that 17 of the substances have caused impairments of water, sediment or biota in Ontario based on exceedences of available criteria. Of the remaining four substances, 1,4-dichlorobenzene and toxaphene have not been detected at levels which exceed established criteria, and 3,3'-dichlorobenzidine and tributyl tin could not be evaluated from a water/sediment/biota impairment perspective because no appropriate criteria have been established for these substances.

Nineteen of the Primary List substances have been monitored for under Ontario's MISA program or in the Municipal Water Pollution Control Plants Study\*. It has been demonstrated that of these 19 substances, 15 are being directly discharged to surface waters by Ontario-based industrial point sources or municipal water pollution control plants. Several substances are being discharged at high concentrations considered to be acutely toxic to aquatic biota, including arsenic, mercury, PCBs, PCDDs and benzo[a]pyrene.

A Secondary List composed of 46 substances is recommended as a "second tier" set of substances, to be considered after those on the Primary List have been addressed. The Secondary List of candidate substances are toxic and either persistent or bioaccumulative, or are both persistent and bioaccumulative but somewhat less toxic than those on the Primary List. These substances have not been evaluated in terms of loadings or environmental impacts.

The pesticides evaluated are those identified on the IJC Water Quality Board's list of critical water pollutants or are produced as byproducts of industrial processes. Other pesticides which may be present in effluent from municipal water pollution control plants will be considered in a later stage of this initiative.

This effort represents a major step towards creating a comprehensive multimedia bans or phase-outs list, a list of substances of concern from the perspectives of air, water, sediment, soil, waste and biota. These substances will be targeted for phase-outs, bans or use/release reduction. Work is currently underway to address substances released primarily to air and land that were not identified in this stage.

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\* A 1987 survey of 37 Ontario municipal water pollution control plants.

## Part I

# Development of a Candidate Substances List for Bans or Phase-Outs

## 1 Objective

The Environmental Program Principles Review Project (EPPRP) was initiated in March 1991 for the purpose of establishing an integrated approach for the development and delivery of the Ontario Ministry of the Environment's programs. One subsidiary project under the EPPRP was the establishment of a list of persistent, bioaccumulative, toxic substances for multimedia release reduction, banning and/or phase-out ("sunsetting").

As a way of developing a method for selecting candidate substances, and as the first step towards creating a comprehensive multimedia bans or phase-outs list, an initial list was to be established composed of highly hazardous substances present in or discharged to Ontario's surface waters.

The objective of creating a list of candidate substances for bans or phase-outs was to identify those substances released into or present in Ontario's surface waters which pose the greatest hazard, based on their potential to cause adverse impact on the environment. Three general characteristics of substances influence the severity and duration of such adverse impacts - persistence, bioaccumulation potential and toxicity, therefore the first step in the process is to identify those toxic contaminants that are persistent in water or sediment and are bioaccumulative. Such substances are considered to be candidates for banning or phasing out.

The list of candidate substances, therefore, is a list of substances which due to their physicochemical and toxicological properties are most inherently hazardous and should ideally not be permitted to enter the environment. However, of all the substances in the environment, those selected as first priority for consideration for bans or phase-outs are not necessarily those that present the greatest environmental health risk. "Risk" is a function of both exposure level and degree of adverse effect. The limited amount of exposure information available precluded the development of a systematic approach for identifying substances that pose the greatest risk. Risk assessment may be considered at a later stage after detailed exposure-related information has been obtained, e.g. environmental concentrations, contaminant loadings from point, diffuse and transboundary discharge sources and further evidence of demonstrable effects on biota at contaminated sites.

If a substance is regulated to a degree such that none of it enters the environment, the goal of *zero discharge* of that substance has been achieved. In its July 1991 Virtual Elimination Task Force interim report, the International Joint Commission defined zero discharge as the elimination of all inputs to the Great Lakes basin ecosystem of persistent toxic substances produced, used, distributed or disposed of in or around the basin, whether from direct release into waterways or the atmosphere, indirect releases such as agricultural and urban runoff, or inadvertent releases such as from spills. To obtain zero discharge, all sources of the target substances must be eliminated, rendering those substances unavailable and thus preventing any

opportunity for their entry to the environment. Regulatory instruments employed to attain zero discharge of a substance may be in the form of a ban on the use and generation of the substance or a phasing out of the use and generation of the substance (*i.e.* incremental reductions leading ultimately to a complete ban). Where a ban or phase-out is not technically or socioeconomically feasible, reduction in use of the substance or reduction in the release of the substance to the environment are alternate regulatory options.

The overall process by which substances are selected for as candidates for bans or phase-outs, further assessed and then regulated using various options is illustrated in Figure 1.1. Future efforts will involve assessment of exposure potential, the technical and economic feasibility of bans or phase-outs and the determination of which regulatory options are appropriate.

## 6 Summary of Ontario-Specific Data Evaluation

The Primary List was screened against a variety of Ontario-specific supporting information concerning:

- presence and loadings from industrial and municipal point sources discharging directly into Ontario surface waters;
- toxicity and potential hazards of MISA industrial and municipal effluents; and
- Ontario receiving water impacts.

In general, these evaluations support the position that the Primary List substances should be retained on a short list of candidate substances for bans or phase-outs from industrial and municipal point sources. The basis for this position is summarized below.

### 6.1 Point Source Loadings

The available loadings information indicate there are significant industrial or municipal point source inputs of fifteen highly hazardous substances to the aquatic environment, particularly arsenic, 1,4-dichlorobenzene, hexachlorobenzene, lindane, mercury, pentachlorophenol, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons. Direct industrial discharges of polychlorinated dibenzo-p-dioxins or dibenzofurans and municipal discharges of alpha-BHC were not greater than 1 kg per year.

### 6.2 Environmental Hazards of Point Source Discharges

Several highly hazardous substances are being discharged at high concentrations considered to be acutely toxic to aquatic organisms. These include arsenic, mercury, PCBs, polychlorinated dibenzo-p-dioxins and benzo[*a*]pyrene. Furthermore, some industrial sectors are discharging pentachlorophenol and polychlorinated dibenzofurans at low concentrations considered to be toxic to aquatic organisms when exposed to contaminated water for a major part of their lifespan.

Discharges of hexachlorobenzene, mercury, PCBs and polychlorinated dibenzo-p-dioxins or -furans at times exceeded concentrations corresponding to 1000 times the Provincial Water Quality Objectives or GLWQA specific objectives. These findings indicate an increased risk of serious environmental impacts including sediment accumulation and bioconcentration of persistent toxic substances, impaired fish habitat, loss of beneficial uses of aquatic resources, and increased costs for remediation in the vicinity of point source discharges.

### 6.3 Receiving Water Impacts

Receiving water impacts in Ontario were found for all Primary List substances except 3,3'-dichlorobenzidine (for which no data were available). These included elevated concentrations (i.e. above background levels) found in water, sediment, or biota in areas receiving anthropogenic inputs. Furthermore, widespread use impairments based on exceedances of available criteria were identified for all Primary List substances except 1,4-dichlorobenzene, 3,3'-dichlorobenzidine, toxaphene, and tributyltin. 1,4-dichlorobenzene was not detected at levels exceeding established criteria, and use impairments could not be ascertained for 3,3'-dichlorobenzidine and tributyltin as there are no water, sediment or biota criteria for these substances.

Impairments of water quality for supporting aquatic life were found for DDT and metabolites, dieldrin, HCB, alpha-BHC, gamma-BHC, mercury, PCP, and PCBs. Impairments of sediment quality for supporting aquatic life were found for arsenic, DDT and metabolites, dieldrin, HCB, alpha-BHC, gamma-BHC, mercury, mirex, anthracene, benz[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, perylene, and phenanthrene. Restrictions on dredging activities were found for arsenic, mercury, and PCBs. Restrictions or limitations on the safe consumption of fish by humans and wildlife were found for mercury, mirex, PCBs, and 2,3,7,8-TCDD. However, no restrictions on drinking water supplies for human consumption were found or attributable to the Primary List substances.

## Conclusions

- Of approximately 800 substances and groups of substances assessed, 21 have been designated as being most inherently hazardous due to their persistence, bioaccumulation potential and toxicity. These substances appear on the Primary List of Candidate Substances for Bans or Phase-Outs.
- It has been demonstrated that seventeen of the Primary List substances have caused impairments of beneficial uses of water, sediment or biota in Ontario. Of the remaining four substances, 1,4-dichlorobenzene and toxaphene have not been detected at levels which exceed established criteria, and 3,3'-dichlorobenzidine and tributyl tin could not be evaluated from a receiving water/sediment/biota impaired use perspective because no appropriate criteria have been established for these substances.
- Nineteen of the 21 Primary List substances were monitored under MISA or in the 1987 Municipal Water Pollution Control Plants Study. Analysis of the monitoring data has demonstrated that 13 substances are being directly discharged to surface water by Ontario-based industrial point sources and that 4 substances are being directly discharged by Ontario municipal water pollution control plants. Overall, 15 Primary List substances are being discharged by Ontario-based point sources; the substances not found to be discharged are DDT/DDD/DDE, dieldrin, mirex and toxaphene. Monitoring data were not available for tributyl tin and 3,3'-dichlorobenzidine.
- Several Primary List substances were found to be discharged at levels considered to be acutely toxic to aquatic biota. These were arsenic, mercury, PCBs, 2,3,7,8-TCDD and benzo[a]pyrene.
- An additional 46 substances were designated as being toxic and either persistent or bioaccumulative, or as being both persistent and bioaccumulative but somewhat less toxic than those on the Primary List. These substances appear on the Secondary List of Candidate Substances for Bans or Phase-Outs. This list is recommended as a "second tier" of substances, to be considered after those on the Primary List have been addressed.