Chapter V

CURRENT CONTROLS AND REMEDIAL PROGRAMS

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5.1 Introduction

Legislative mandates to control toxic chemical discharges and remedy the results of past disposal practices are in effect on both sides of the international border. Although these mandates are promulgated by national and state or provincial governments, they are also consistent with international agreements, such as the Great Lakes Water Quality Agreement of 1978. The control and remedial mandates for toxic substances are translated to a large extent into specific programs in each jurisdiction. As a result of the differences in political and judicial systems on each side of the border, the individual legislative and regulatory frameworks in Canada and the United States have led to different programs for toxic substances control.

This chapter describes the international, national, state, and provincial legislative and regulatory frameworks and the programs underway to implement the frameworks. Where specific control or remedial programs are in place, these are examined in the light of our present knowledge to determine how well they are expected to satisfy international concerns in the next few years. Where deficiencies are noted, recommendations are presented that are expected to improve these programs so that they will be acceptable to all jurisdictions.

5.2 International Framework

The United States and Canada have a history of cooperation with regard to the Great Lakes area that dates back at least as far as the Boundary Waters Treaty of 1909. Article IV of that Treaty provides:

> "It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."

The Treaty also created the International Joint Commission (IJC), which has the responsibility to monitor progress towards the goals

established by the Treaty and to resolve disputes between the United States and Canada where necessary with regard to the Great Lakes area.

In 1972, the United States and Canada entered into the first Great Lakes Water Quality Agreement, which established water quality objectives for the Great Lakes. Subsequent reports by the IJC and agency experience in implementing the 1972 Agreement led to the Great Lakes Water Quality Agreement of 1978, which supercedes the previous Agreement. The 1978 Agreement outlines with much greater specificity the two governments' commitment to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem.

With regard to toxic substances in toxic amounts the Agreement establishes the policy that:

> "The discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated."

In addition to General Objectives contained in the Agreement, there are Specific Objectives in Article IV and Annex I of the 1978 Agreement which "represent the minimum level of water quality desired in the boundary waters of the Great Lakes System". These include both conventional and toxic pollutants.

Further, Annex 12 of the 1978 Agreement states that regulatory strategies to deal with persistent toxic substances shall be based on the following general principles:

(i) "The intent of programs specified in this Annex is to virtually eliminate the input of persistent toxic substances in order to protect human health and to ensure the continued health and productivity of living aquatic resources and man's use thereof;

(ii) The philosophy adopted for control of input of persistent toxic substances shall be zero discharge."

In addition, the Agreement states that "all Parties shall take all reasonable and practical measures to rehabilitate those portions of the Great Lakes System adversely affected by persistent toxic substances."

It is agreed in Article V that the water quality standards and other regulatory requirements of the United States and Canada "shall be consistent with the achievement of the General and Specific Objectives." Recognizing the implementation of domestic water pollution laws is often delegated to state and provincial governments, Article V specifically provides:

> "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. Flow augmentation shall not be considered as a substitute for adequate treatment to meet water quality standards or other regulatory requirements."

Article XI 2(c) requires that: "The Parties commit themselves to seek the cooperation of the State and Provincial Governments in all matters relating to this Agreement."

5.3 Regulatory Framework-United States

The key legislative tools for the control of toxic substances in the United States are the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, also commonly referred to as Superfund), and the Toxic Substances Control Act (TSCA). With the exception of TSCA, all these statutes recognize the primary role of the states to reduce and eliminate pollution.

The primary legislative tools for the control of toxic substances in New York State are the Environmental Conservation Law: Article 17, Water Pollution Control; Article 27, Title 9, Industrial Hazardous Waste Management Act; and Article 27, Title 13, Inactive Hazardous Waste Disposal Sites.

The CWA and RCRA require the State to submit programs for the implementation of the federal statues under State Law to the Administrator of the U.S. Environmental Protection Agency.

The State of New York was delegated the authority to implement the Clean Water Act permit program in October 1975. It is anticipated that New York will receive final authorization to undertake primary responsibility for the implementation of the RCRA permit program by January 1985. The CERCLA program does not involve program delegation to the States. However, as described below, CERCLA recognizes State primacy in many areas and requires a federal-state partnership in remediation strategies.

One of the primary results of the federal environmental statutes promulgated since the 1970's has been the development of a consistent approach to pollution abatement programs in the various states, even though the details of program implementation may vary from state to state. The U.S. regulatory framework will be discussed below according to statutory programs with the respective roles of the federal and New York State governments discussed within the context of each program.

A characteristic common to the federal-state working relationship in all of these statutory programs has been an increasing degree of refinement in role definitions. The result has been a reduction in duplicative or inconsistent efforts and a more efficient utilization of limited resources.

5.3.1 U.S. Clean Water Act

The Clean Water Act declares it to be unlawful for anyone to discharge pollutants from a point source to waters of the United States

without a permit. The permit program is termed the National/State Pollutant Discharge Elimination System (NPDES in those jurisdiction where EPA has management lead; SPDES in states like New York which have been delegated program management by EPA).

Efforts at pollution abatement from point sources (i.e., discrete, easily identified sources of pollution such as pipes and ditches) under prior legislation were frustrated by the need to show water quality violations as a result of a particular discharge. The precise cause of water quality violations was difficult to prove, and severely impeded enforcement of the law.

In 1972, the regulatory basis was changed to technology standards which all dischargers in certain industrial categories were required to meet. The technology standards were established in two stages: the best practicable technology (BPT) required to be achieved July 1, 1977, and the best available technology economically achievable (BAT), which was scheduled to be achieved by July 1, 1984. The technology standards established minimum performance requirements for point sources. More stringent limitations can be established when necessary for the attainment of water quality standards or, where necessary, to satisfy more stringent requirements of state or federal law.

In 1977, the Clean Water Act was amended to place increased emphasis upon the control of toxic pollutants for the second-round BAT permits. It was the intent of Congress that uniform standards (effluent limitation guidelines) be established for categories of point sources within a specific industrial grouping, e.g. organic chemicals manufacture. Substantial delays are being experienced in the promulgation of these guidelines. Draft permits have been prepared for individual facilities in N.Y. State upon the basis of best engineering judgement (BEJ) in those instances where federal guidelines have not yet been promulgated.

New York State, in cooperation with EPA, has prepared several permits for discharge facilities on the Niagara Frontier. These permits not only applied technology-based determinations based on EPA treatability studies, but also encompassed more stringent standards based upon New York State water quality standards for the Niagara River and other international waters . These, in turn reflected the water quality objectives of the Great Lakes Water Quality Agreement of 1978. The limitations in BEJ permits are significantly more stringent in many respects than proposed effluent limitation guidelines published by EPA, particularly for the organic chemical industry.

In addition to regulating industrial facilities which discharge their wastes directly to receiving water bodies, the Clean Water Act also imposes requirements on indirect dischargers, i.e., industrial facilities which discharge their wastes for treatment into publicly owned treatment works (POTWs). Indirect discharges do not have their own SPDES permits, but are regulated through pretreatment standards. The primary objectives of the pretreatment regulations are to prevent the discharge of pollutants which, due to their toxicity, interfere with the operation of municipal wastewater treatment facilities and may pass through these facilities and enter the waterways of the state untreated, or will prevent or severely limit disposal options for large volumes of municipal sludge. POTW's are required by their SPDES permits to incorporate pretreatment standards into industrial waste allocations or municipal ordinances. These pretreatment standards are then enforceable against the industry, by the POTW, and the state and federal governments.

5.3.2 New York State Water Pollution Control Acts

At the state level Article 17, Water Pollution Control, of the Environmental Conservation Law contains the State's statutes whose purpose is to safeguard the waters of the state by preventing new pollution and abating existing pollution.

The Article defines the waters to be protected to include both surface and groundwaters. Similarly, the types of discharges to be regulated broadly include "sewage" (water-carried human or animal wastes) and industrial wastes.

The discharge of these wastes into the State waters is regulated by the establishment of water quality standards and classifications. Each body of water is protected on the basis of how it can be safely used, i.e., whether it is used for drinking, bathing, etc. It is unlawful to discharge wastes which may or will cause such standards to be violated. Finally, it is illegal to use a discharge outlet unless it is in compliance with all standards and an outlet cannot be constructed without a permit. In order to comply with the provisions of the Federal Clean Water Act, Article 17 also includes the State Pollutant Discharge Elimination System (SPDES). The SPDES laws prohibit waste discharges without a permit.

5.3.3 U.S. Resource Conservation and Recovery Act (RCRA)

RCRA, enacted in 1976, encompasses the basic federal program regulating the generation, transportation, treatment, storage, and disposal of hazardous wastes. Its regulatory focus is twofold: (1) a manifest system which requires those who transport, treat, store, or dispose of hazardous materials to provide an accounting mechanism for tracking and controlling hazardous materials from the time the material is generated through its ultimate disposal, or as frequently expressed, from "cradle to grave"; and (2) a permit system to implement performance standards for those who treat, store, or dispose of hazardous wastes.

Existing facilities which treat, store, or dispose of hazardous wastes and which comply with certain notice requirements are accorded "interim status" authorization to continue operations, pending the processing and issuance of final RCRA permits for these activities. The interim status requirements include groundwater monitoring for most existing land treatment, storage, or disposal facilities, and all facilities are subject to operation

and maintenance requirements. Regulations establishing stringent treatment requirements (incineration and land disposal), storage requirements, and transportation requirements have been promulgated over the last few years. These requirements will be incorporated in RCRA permits which will then supercede the "interim status" classification.

It is anticipated that New York State will have final authorization to administer RCRA programs by January 1985. RCRA allows states to establish their own regulatory programs for the control of hazardous wastes provided that these programs are at least as stringent as the federal regulatory programs. In March 1982, New York State substantially revised its solid waste regulations, commonly referred to as the Part 360 regulations, for consistency with the federal RCRA program.

New York State already exercises many of the investigative, regulatory, and enforcement alternatives available to the federal government. EPA and New York have entered into a cooperative agreement to apportion the substantial RCRA workload.

At the present time, New York is performing a predominant share of facilities inspections, manifest reviews, and other investigative functions. In addition, New York is exercising the primary role in enforcing the interim status and manifest system violations. Due to the high volume of the workload in processing RCRA permits, New York is assisting EPA by drafting permits for subsequent EPA approval.

Along with the regulatory structure described above, RCRA Section 7003 provides an important enforcement tool. This section provides EPA with the authority to bring a suit in United States district court to restrain any person who is handling, storing, treating, transporting, or disposing of hazardous waste in a manner that will cause or contribute to any "imminent and substantial endangerment to human health or the environment." This provision has served as the primary support for hazardous waste litigation to require defendant corporations to install remedial measures, to prevent

migration of hazardous wastes from landfills, and to clean up wastes which have migrated in the past.

Another provision of RCRA, Section 3013, provides authority to require facilities which may have created a substantial hazard due to the treatment, storage, or disposal of hazardous wastes to conduct such monitoring, testing, and analysis to define the nature and extent of a hazard.

5.3.4 New York State Industrial Hazardous Waste Management Act

The purpose of Article 27, Title 9 of the Environmental Conservation Law is to regulate the management of hazardous waste from its generation, storage, transportation, treatment, and disposal in a manner consistent with the Federal Resource, Conservation and Recovery Act of 1976. The intent of the Act is to protect the health, safety, and welfare of the people against harm from hazardous wastes and to provide safe and effective means for disposal of hazardous waste.

5.3.5 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA was enacted in 1980 to supplement existing federal hazardous waste laws by providing the government with greater flexibility in the nature and timing of its response to a release or threatened release of hazardous substances.

Section 104 authorizes the government to use the "Superfund" ($1.6 billion raised by taxes on the production and importation of petroleum and certain chemicals, supplemented by funds from general revenues) for removal (essentially immediate emergency measures such as security fences or removal of leaking drums from land surface) or remedial (permanent long-term remedies) activities to abate an imminent and substantial danger from a release or threatened release of hazardous substances.

Section 104 is qualified in many respects:

(i) a determination must first be made that parties responsible for the release or threatened release are unwilling to properly perform necessary removal or remedial action;

(ii) there must be a cost-effectiveness analysis which provides a balance between the need to protect public health and welfare at the facility and the need for use of the Superfund for responses at other sites across the United States; and

(iii) EPA and the state where the site is located must enter into an agreement in which the state agrees to pay 10 percent of the cost of the remedial action (50 percent for a state municipal site).

These requirements have resulted in continued delays in the implementation of CERCLA remedies, especially in states which, unlike New York, have made no provision for raising the 10% matching share. (New York State has enacted a Hazardous Waste Remedial Fund statute under Article 27 of the Environmental Conservation Law with a fund of $10 million to finance the State share of remedial actions.) However, since extensive remedial investigations (RI) and feasibility studies (FS) concerning alternative remedial measures must frequently be conducted before actual remedies can be effected, EPA has determined that such RI/FS activities can be started with the Superfund without prior consultation with responsible parties or execution of an agreement with the state.

The state role in CERCLA actions is delineated on a site-by-site basis. In addition, CERCLA requires that the National Contingency Plan (originally required to be developed for a hazardous material provision of the Clean Water Act) be revised to codify procedures for implementing CERCLA remedial actions. These procedures include the development of a list of at least 400 top priority sites for CERCLA response action. The federal government has developed a system to assign national priority rankings to

sites certified to it by the states based on the local impact or potential impact of the site on public or environmental health.

It is important to note that CERCLA does not alter the underlying responsibility of those who caused or contributed to the danger to bear the ultimate costs for remedial action. CERCLA provides additional authority for the government to seek injunctive relief in the courts to compel a responsible party to take action necessary to protect public health and welfare. If a responsible party violates such an order, he may be liable for punitive damages three times the amount of the expenditure the government made from the Superfund to take remedial action. The punitive damage provision is in addition to the government's ability to seek reimbursement from responsible parties for its actual expenditures to replenish the Superfund.

5.3.6 New York State Inactive Hazardous Waste Disposal Site Acts

Article 27, Title 13 of the Environmental Conservation Law establishes procedures for and provides powers to protect public health and the environment from the threats posed by inactive hazardous waste disposal sites. This Article requires the maintenance of a registry of sites, provides authority for remedial programs and establishes the State Superfund.

5.3.7 Toxic Substances Control Act (TSCA)

The federal TSCA was enacted to prevent environmental exposure to new products which may present an "unreasonable risk" to human health or the environment. Prior to the manufacture of new chemicals, a company must submit a premanufacture notice (PMN). EPA can require testing of the chemical, and, on the basis of this assessment, can prohibit or limit the use of substances which present an unreasonable risk.

In addition to the control of new chemicals, TSCA also regulates the control and disposal of specific existing chemicals that present an

unreasonable risk to human health or the environment. For example, stringent regulations governing the disposal of PCBs have been promulgated under TSCA authority.

Toxic material legislation under TSCA is the one area with no counterpart on the state level.

5.4 Regulatory Framework-Canada

5.4.1 Federal Legislation

The Environmental Contaminants Act (ECA) and the Fisheries Act (FA) are the two major pieces of Canadian federal legislation for the control of the release of toxic substances to the environment.

5.4.1.1 Environmental Contaminants Act (ECA)

The ECA provides the power to investigate substances or classes of substances to determine their hazard potential and to formulate regulations for their control. Under the ECA, regulations can be formulated to deal with the general release of a chemical to the environment and dangerous uses of that chemical or products which contain it. The Act requires industry to report all available information on new chemicals where import or manufacture on a first time basis exceeds 500 kg per year. Detailed health and environmental assessments must be performed by the government before control are considered for a toxic substance. These may be in the form of a ban or restriction in use and can also control actual amounts of a specific chemical being released to the environment. A potential shortcoming is that, in the interim period between reporting and imposition of controls, a new chemical could be in unlimited use. However, emergency provisions are contained in the Act whereby any chemical suspected of being a significant hazard can be restricted from use until further information is available. The ECA has been used to control or restrict the uses of PCB, mirex, polychlorinatedterphenyls (PCT), polybrominatedbiphenyls (PBB), and chlorofluorocarbons (CFC).

5.4.1.2 Fisheries Act (FA)

The Fisheries Act was designed primarily to protect the fisheries resources in Canada. Priorities for controls are based on gross loadings to receiving streams and are developed on an industrial sector basis. Although the Act contains provisions to control and prevent pollution by setting standards according to regulation, activities with respect to toxic substances have been limited (e.g., mercury from chloralkali plants, phenol from petroleum refineries).

Unless the development of regulations can be accelerated, the FA will only be useful in addressing very urgent situations for toxic substances requiring control in water discharges.

5.4.2 Provincial Legislation

5.4.2.1 Ontario Water Resources Act

At the provincial level, the workhorse statute dealing with water pollution in Ontario since 1957 has been the Ontario Water Resources Act, now administered by the Minister of the Environment. It confers on the Minister "the supervision of all surface waters and ground waters in Ontario." The Act contains provisions dealing with the protection of water quality and water quantity and provides the legislative base for the construction, financing, and operation of municipal sewage and water treatment facilities.

The main offense section of the Act provides that no one may discharge any material that may impair the quality of the water of any lake, river, or stream. Court interpretation of the term "impair" has not required prosecution to establish that the lake or river has been impaired, but rather that the material deposited has the capacity to impair the quality of the water. The provision does not apply, however, where the discharge issues from sewage works constructed and operated in accordance with approvals given under the Act or predecessor legislation. In this situation, the Act could be difficult to enforce.

The Act also confers powers on Directors of the Ministry of the Environment, subject to appeal, to order industrial or commercial enterprises to install, construct, or arrange proper facilities for the collection, transmission, treatment, or disposal of their sewage. The term "sewage" includes commercial and industrial wastes. A corresponding power enables orders to be given to municipalities to establish, maintain, operate, and improve its water works or sewage works.

Provisions of the Act also require Ministry approval of sewage or water works before they are established, extended, or changed.

5.4.2.2 Environmental Protection Act

Until now, the Ontario Water Resources Act has been the primary enforcement vehicle for water pollution offenses; however, the Environmental Protection Act of 1971 has also had important implications in water quality decisions. In the first place, the general prohibitions under the 1971 Act apply to impairment of water as well as of land and of the air. The 1971 Act empowers Ministry Directors to issue Control Orders limiting or controlling discharge of contaminants to water; it also enables the issuance of a comprehensive order to deal with the air, water, and land pollution problems of a company in an integrated way.

The 1971 Act also provides the legal framework for waste management, including the establishment and operation of waste disposal sites. Hearings are mandatory prior to the establishment of any sites dealing with hazardous waste, hauled liquid industrial waste, or any other waste that the Director ascertains is the equivalent of the domestic waste of not less than 1,500 persons. The operation of sites without the required Certificate of Approval is an offense under the 1971 Act, and powers are conferred on the Directors to order clean up of illegal deposits.

Conditions may be imposed on the Certificates of Approval for waste disposal sites in the same way as they are imposed on sewage and water

treatment facilities under the Ontario Water Resources Act.

The Environmental Protection Act contains a provision for cleanup of discharges that have already occurred. The section provides that where any person has caused the discharge of a contaminant that injures land, water, property, or plant life, the Minister may order such person to take all steps necessary to repair the injury or damage. Although the section has been used primarily to deal with oil spills, it is significant in that it addresses itself to the remedy of past discharges, including contaminants that have leached from a waste site.

Furthermore, it is Ministry policy to prevent the release of substances defined as having "zero tolerance limits" and to minimize the release of substances for which Provincial Water Quality Objectives have not yet been established. Tools in addressing the control of discharges include:

i) Program Approvals, which are cooperative programs developed jointly by the discharger and the Ministry to reduce discharges not in compliance with Ministry requirements;

ii) Certificates of Approval, which are issued by the Ministry for processes, treatment facilities, etc., whose discharges are in compliance with Ministry requirements;

iii) Control Orders, which are issued as the situation dictates where cooperative efforts and Program Approvals fail to result in acceptable discharges being attained in a reasonable time frame;

iv) Stop Orders, which can be issued by the Minister in cases of extreme threat to the environment.

5.4.2.3 Environmental Assessment Act

The cornerstone of the Ontario legislation in controlling new projects is the Environmental Assessment Act of 1975. The Act provides that the proponent of an undertaking to which the Act applies shall submit an environmental assessment to the Minister and may not proceed until the approval of the Minister is received. The Minister is required to review each environmental assessment received, and to make public both the assessment and the review. A public hearing can be initiated by anyone and will proceed unless the Minister determines that such a hearing is frivolous, vexatious, unnecessary, or may cause undue delay. The Minister may impose terms and conditions with respect to the undertaking. Hearings under the Act are held by the Environmental Assessment Board, and the decision of the Board is deemed to be the decision of the Minister and final unless it is, within twenty-eight days, changed by the Minister with the approval of the Cabinet.

The Act first applied to activities conducted by the Crown and its agencies. In the second phase, the Act included programs carried out by municipalities. The third phase will ultimately apply to projects carried out by the private sector.

In general, the Canadian legislation differs from the American approach in allowing a high degree of administrative discretion to regulatory agencies. For example, regulations on water quality standards have not been established by Ontario. Instead, the Ministry employs guidelines and criteria to meet local conditions. Such guidelines do not have legal status in the sense that a contravention of them could result in a prosecution. However, administrative tribunals dealing with appeals from decisions of Directors issuing orders or imposing conditions or refusals are likely to give effect to guidelines.

5.5 Programs and Their Effectiveness

A major objective of the Niagara River Toxics Committee was to examine the effectiveness of the control programs that are in place on both sides of the river and recommend, if necessary, ways in which these programs can be improved. Four sources of pollutants to the river have been considered: (i) point source discharge, (ii) landfill dump sites and contaminated groundwater, (iii) contaminated sediments, and (iv) upstream sources.

Because the structure of control programs for point sources is different on each side of the river, the analysis of the effectiveness of these programs was carried out independently. On the United States side, an overall strategy for control has been adopted based on state and federal mandates and is now underway. The likelihood that this program will achieve certain objectives can be examined.

On the Canadian side the control programs have requirements that provide for flexibility and are tailored to assessment and negotiations on a case-by-case basis, thus gearing the control requirements to the specific environmental conditions. For most facilities, past control programs have not been geared to toxic chemicals as a general classification except as provided for in the policies and water quality criteria[1]. Where appropriate, controls have been placed on specific toxic contaminants based on effluent guidelines or water quality considerations. It is difficult to predict for both sides of the river how the control programs will deal with the presence of toxic substances at very low levels.

An analysis of the effectiveness of waste site remedial programs on both sides of the river is difficult to make with the information currently available. Considerable remedial work has been done on the New York side of the river and further work must be done to ensure that contaminant migration

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[1] Water Management, Ontario Ministry of the Environment, 1978.

to the river is under control. On the Ontario side of the river, sufficient information is not yet available to assess whether any of the sites will require remedial action. The next step will be to secure this additional information.

Contaminated sediments occur on both sides of the river as a consequence of past and present discharges from point and non-point sources, resuspension of Niagara River tributary and Lake Erie sediments, and general redistribution of the sediment particles. Neither side has started a program to address this potential problem source, so it is appropriate that the discussion here be a unified one with recommendations for cooperative action.

Upstream sources include that portion of Lake Erie outside the study area and the entire Upper Great Lakes basin. Inputs of chemicals into the Niagara River from upstream sources have been documented in Chapter IV but the Committee has not carried out an assessment of control programs in areas outside the Niagara River.

5.5.1 Industrial and Municipal Point Sources (New York)

5.5.1.1 Program Description and Effectiveness

Discharges of toxic chemicals from industrial and municipal point sources are controlled through the SPDES permit program. The first round of permits under the Clean Water Act addressed conventional pollutants. During the last two years, a concentrated effort has been made in New York State to address toxic chemicals in these permits. The priority area for permit revision has been the Niagara Frontier.

The permits for all municipal and industrial facilities discharging other than sanitary sewage to the Niagara River or its tributaries have been reviewed and rewritten, where necessary, to insure that toxic substances are being controlled. At the time of preparation of this section, permits for 37 facilities had been reviewed. Six facilities have closed since the review

began, 19 permits had been issued or modified, eight were ready to be issued, and four were still being processed.

The permits address toxic chemicals which are known or are suspected to be in the discharge, based on information on chemicals used and plant processes. This includes the 129 EPA priority pollutants and other substances. The permit limits are established based on three considerations:

1) national technology standards where available (Best Available Technology economically feasible) or best engineering judgement where national standards do not exist,

2) the effect of the discharge on the best use of the receiving waters as reflected in ambient water quality criteria or standards and

3) a reasonably achievable detection limit for the chemical in the discharge.

Both the technology limit and the water quality protection limit are calculated for each chemical, and the lower of the two is used if it is above the detection limit. If it is below the detection limit, the detection limit is used to derive the permit limit.

July 1, 1984 was the Clean Water Act deadline for achievement of BAT. As a result of some major engineering problems, however, and the delay in promulgating national technology-based effluent standards, municipalities will not meet their permit requirements until the end of 1985. Industries will not meet theirs until the end of 1986.

Since many industries in the Niagara Frontier do not discharge directly to the river but discharge to a municipal system, the reissuing of permits is closely linked to the development of state-approved industrial

pretreatment programs that give the municipalities technical and legal means to force industries to treat their wastes before discharge to the sewer. The municipalities that own the six major wastewater treatment facilities are all at various stages of developing an industrial pretreatment program, and this will be completed by the end of 1985.

To assure that the permitted discharges in total will not contravene New York State water quality standards, a preliminary discharge allocation scheme has been devised to guide the permit writing. The allocation scheme is a working document to be revised as more information becomes available. The scheme, in its present form, has the following features and limitations:

(a) The river is divided into reaches, and a waste load accounting is performed for permitted discharges (average permit limits) on a reach basis. Permitted loadings to each reach are based on BAT and State water quality criteria. They incorporate the consideration of once in ten years, seven consecutive day low flow conditions in the river and a 30% allowance for future growth;

(b) It is assumed that the pollutants discharged to the river are not degraded or lost from the water column;

(c) For the international sections of the river, the full New York discharge is allocated to one-half of the river flow; the allocated flow is further reduced to accommodate lateral stratification in the river; and in the lower river between the falls and the power plant discharges, an appropriate minimum flow is used that takes into account the power plant diversion and assumes complete mixing;

(d) With few exceptions, a zero concentration is assumed to be the Lake Erie background for toxic substances, since data have not been available to establish a better estimate;

(e) Non-point sources are presently not accounted for in the waste load allocation (toxic waste dumpsites and urban storm sewers).

Assumptions (d) and (e) are necessary because of a lack of data on Lake Erie background water quality concentrations for many substances and a lack of estimates for waste load contributions from non-point sources in the Niagara area including landfills, stormwater, etc. These two major limiting assumptions could cause underestimation of waste loads to the river.

The following assesses how the cumulative discharges under the discharge permit system, for each chemical that has a criterion by any of the participating agencies, will meet or exceed the minimum agency criteria in the river. New York State Water Quality Standards used to develop the permitted allocations are not always equivalent to the GLWQA water quality objectives (and in some cases exceed other agency criteria). Minimum of all agency criteria and Great Lakes Water Quality Agreement objectives are shown in Table 5.1 for those chemicals found in the ambient environment. For other substances, the minimum number has been selected from among the New York State and Ontario criteria and Great Lakes Water Quality Agreement objectives. The permits limit many chemicals for which ambient criteria do not exist; for purposes of this analysis, the effectiveness of controls on such chemicals cannot be assessed.

Final limits from point source permits were combined with the flow in the river to calculate expected river concentrations of chemicals assuming complete mixing and no losses in the river. In most cases, the loadings were based on the monthly or daily average permit limit or action level . Where average limits were not specified the monthly maximum limit was used. Where the chemical was not limited in the permit, the estimated measured loading was used instead (Chapter II). Where plants or parts of plants have closed since the project sampling, the closed outfalls are assumed to make no contribution to the loading. Since a number of permits were being processed when these calculations were performed (March 1984), draft versions of permits have sometimes been used where these were judged likely to be close to the final version.

Three critical reaches of the river were examined: 1) the Tonawanda Channel to the power diversion above the falls, which is entirely U.S. waters, 2) the reach starting just above the falls at the power diversion and continuing over the falls to the Robert Moses Niagara Power Plant tail race, and 3) the lower river from the Robert Moses tail race to Lake Ontario. This division is necessary because the river flows available to receive the loadings vary in the different reaches.

TABLE 5.1

MINIMUM AGENCY CRITERIA AND PREDICTED AMBIENT CONCENTRATIONS (ug/L)
IN CRITICAL REACHES CALCULATED FROM PERMIT LIMITS

COMPOUND	MINIMUM CRITERION	TONAWANDA SPDES CONC	FALLS TO RMOSES SPDES CONC	LOWER RIVER SPDES CONC
Acenaphthene	1700	0.0021	0.0424	0.0110
Aldrin	0.001	0.0000	0.0001	0.0000
Aluminum	100	0.0000	0.0000	0.0855
Antimony	50	0.1887	0.5648	0.2051
Arsenic	10	0.3036	0.3823	0.1983
Benzene	1.500	0.0622	0.1152	0.0491
Benzidine	0.040	0.0000	0.0000	0.0000
Benzo(A)anthracene or Chrysene	0.200	0.0019	0.0000	0.0006
Benzo(A)pyrene	0.200	0.0037	0.0037	0.0022
Benzo(B)fluor. or Benzo(K)fluor.	0.200	0.0030	0.0000	0.0010
Beryllium	1.100	0.0368	0.0381	0.0431
Bis(2-ethylhexyl) phthalate	0.600	0.5203	0.1101	0.2046
Bromodichloromethane	50	0.2876	0.0536	0.1093
Bromoform	50	0.0000	0.0424	0.0102
Butylbenzyl phthalate	3.0000	0.0003	0.4243	0.1025
Cadmium	0.012	0.6477	0.1485	0.2617
Carbon tetrachloride	0.300	0.0000	0.3618	0.0873
p-Chloro-m-cresol	1.000	0.0000	0.0461	0.0111
Chlorobenzene	50	0.0012	0.2455	0.0597
Chloroform	0.200	0.2533	0.5263	0.2140
2-Chlorophenol	1.000	0.0010	0.0424	0.0106
Chromium	40	5.1465	0.6660	1.9428
Copper	2.000	2.3371	2.2105	1.3433
m/p-Cresol	1.000	0.0001	0.0000	0.0000
o-Cresol	1.000	0.0001	0.0000	0.0000
Cyanide	3.500	0.4550	0.3039	0.2290
Cyanide, Total	3.500	2.7443	0.5060	1.0803
4,4'-DDD	0.001	0.0015	0.0000	0.0005
4,4'-DDE	0.001	0.0000	0.0000	0.0000
Di-n-butyl phthalate	3.000	0.0443	0.4619	0.1266

NOTES: _____ indicates chemicals and predicted concentrations where criterion is exceeded.

------ indicates where predicted concentrations exceed one-half criterion.

TABLE 5.1 (Continued)

COMPOUND	MINIMUM CRITERION	TONAWANDA SPDES CONC	FALLS TO RMOSES SPDES CONC	LOWER RIVER SPDES CONC
Di-n-octyl phthalate	0.200	0.0210	0.1994	0.0553
Dibromochloromethane	50	0.0000	0.2562	0.0618
1,2-Dichlorobenzene	763	0.0146	0.0564	0.0186
1,3-Dichlorobenzene	763	0.0011	0.0403	0.0101
1,4-Dichlorobenzene	763	0.0380	0.0456	0.0240
1,1-Dichloroethane	50	0.0224	0.0005	0.0078
1,2-Dichloroethane	1.000	0.0224	0.0000	0.0077
TRNS-1,2-dichloroethylene	11600	0.1477	0.3463	0.1341
2,4-Dichlorophenol	1.000	0.0003	0.0424	0.0103
CIS-1,3-dichloropropene	244	0.0000	0.1061	0.0256
TRNS-1,3-dichloropropene	244	0.0002	0.1326	0.0321
Dieldrin	0.001	0.0000	0.0000	0.0000
Diethyl phthalate	0.200	0.0000	0.1994	0.0481
Dimethyl phthalate	0.200	0.0000	0.2328	0.0562
2,4-Dimethylphenol	1.000	0.0490	0.0000	0.0168
2,4-Dinitrophenol	1.000	0.0000	0.0404	0.0098
alpha-Endosulfan	0.003	0.0032	0.0041	0.0021
beta-Endosulfan	0.003	0.0030	0.0040	0.0020
Endrin	0.002	0.0000	0.0000	0.0000
Ethylbenzene	50	0.0479	0.1061	0.0420
Fluoranthene	0.200	0.0139	0.0080	0.0067
Heptachlor	0.001	0.0001	0.0043	0.0011
Heptachlor epoxide	0.001	0.0000	0.0000	0.0000
Hexachlorobenzene	0.040	0.0001	0.0042	0.0011
Hexachlorobutadiene	0.400	0.0007	0.0276	0.0069
alpha-Hexachlorocyclohexane	0.010	0.0040	0.0134	0.0046
beta-Hexachlorocyclohexane	0.010	0.0049	0.0134	0.0049
gamma-Hexachlorocyclohexane	0.010	0.0049	0.0140	0.0050
Iron	300	26.625	0.0000	9.1941
Isophorone	117000	0.0007	0.0000	0.0002
Lead	0.750	3.8713	2.0686	1.8414
Manganese	50	0.0000	0.0000	0.0427
Mercury	0.2	0.0365	0.0225	0.0183
Methyl chloride	50	0.0000	0.0530	0.0128
Methylene chloride	10	0.6434	1.2154	0.5134
Mirex	0.001	0.0000	0.0051	0.0012

TABLE 5.1 (Continued)

COMPOUND	MINIMUM CRITERION	TONAWANDA SPDES CONC	FALLS TO RMOSES SPDES CONC	LOWER RIVER SPDES CONC
N-Nitrosodiphenylamine	14	0.0159	0.0424	0.0157
Naphthalene	620	0.0493	0.0626	0.0320
Nickel	15	4.1002	2.8003	2.1213
Nitrobenzene	30	0.0003	0.0000	0.0001
PCB-1248	0.001	0.0017	0.0000	0.0006
PCB, Total	0.001	0.0011	0.0011	0.0007
Pentachlorophenol	0.400	0.0004	0.0424	0.0104
Phenol	1.000	0.1403	0.5978	0.2136
Phenols, Total	1.000	0.7628	1.0935	0.5249
Pyrene	0.200	0.0156	0.0462	0.0165
Selenium	1.000	0.1426	0.3626	0.1384
Silver	0.100	0.1565	0.1425	0.0907
1,2,3,4-Tetrachlorobenzene	50	0.0000	0.0573	0.0138
1,2,4,5-Tetrachlorobenzene	50	0.0000	0.0042	0.0010
1,1,2,2-Tetrachloroethane	0.300	0.0152	0.2283	0.0603
Tetrachloroethylene	2.000	0.3012	0.4535	0.2125
Thallium	20	0.0024	0.0117	0.0036
Toluene	10	0.3653	0.2281	0.1907
1,2,3-Trichlorobenzene	50	0.0000	0.0785	0.0189
1,2,4-Trichlorobenzene	50	0.0339	0.1002	0.0358
1,3,5-Trichlorobenzene	50	0.0000	0.0785	0.0189
1,1,1-Trichloroethane	50	0.0229	0.1213	0.0371
Trichloroethylene	5	0.0670	0.5605	0.1582
Trichlorofluoromethane	50	0.0007	0.0000	0.0003
2,4,6-Trichlorophenol	970	0.0001	0.0461	0.0112
Vinyl chloride	1.000	0.0004	0.3145	0.0760
m/p-Xylene	50	0.0004	0.0000	0.0002
o-Xylene	50	0.0003	0.0000	0.0001
Zinc	30	16.872	3.7166	6.6903

In the Tonawanda Channel, a flow of 62,000 cfs (1756 cms) is used but a lateral stratification of 40% is assumed to give a flow of 24,800 cfs (702 cms). The 62,000 cfs (1756 cms) flow is the MA7CD10 flow (the minimum average flow for seven consecutive days that is statistically expected to occur once every 10 years). This is considerably less than the long term average flow of the Tonawanda Channel, 87,720 cfs (2484 cms). The power diversions at times account for up to 75% of the mean river flow above the falls. After passing through the Robert Moses power plant, diverted water is discharged to the river below the falls. Between the falls and the power plant tail race the river flow is frequently reduced to 50,000 cfs (1416 cms) to adhere to the 1950 Niagara Treaty. Half of this reduced flow has been assumed available for New York State discharges. The other half is available to the Province of Ontario. Allowing a 30% safety factor, commonly used in New York for regulated streams, the effective flow available in the reach is 17,500 cfs (496 cms). It is assumed, because of lateral stratification, that all of the contaminant loads entering upstream of the power diversion, with the exception of those from Occidental Chemical, are carried through the diversions (Robert Moses and Sir Adam Beck Power Plant) and around the falls. Between the Robert Moses tail race and Lake Ontario, the lower river and all upstream flows combine to give an estimated MA7CD10 flow of 145,000 cfs (4106 cms). Half of this (72,500 cfs) (2053 cms) is assumed available for New York State discharges in this lower river reach.

All contaminants entering the river are assumed to continue downstream unaltered and are included in the loads entering the lower river reach. The assessment is made by examining the fully mixed receiving waters at the end of each critical reach.

The results of the loading calculations are shown for the three river reaches in Table 5.1 along with the minimum agency criteria for comparison. The chemicals for which the calculated ambient level exceeds the minimum agency ambient criterion are underlined in Table 5.1 and listed in Table 5.2. For these chemicals, the permit limit process will not achieve the minimum criteria established by the participating agencies, at least in

TABLE 5.2

SUBSTANCES FOR WHICH CALCULATED AMBIENT CONCENTRATIONS BASED ON PERMIT LOADS EXCEED MINIMUM AGENCY CRITERIA.

Cadmium
Carbon tetrachloride
Chloroform
Copper
4,4'-DDE
Dimethyl phthalate
Alpha-endosulfan
Beta-endosulfan
Heptachlor
Alpha-hexachlorocyclohexane
Beta-hexachlorocyclohexane
Gamma-hexachlorocyclohexane
Lead
Mirex
PCB-1248
PCB,total
Phenols, total
Silver

some reach of the river based on the river flows used.

Note that strictly cumulative loadings are calculated, and no attempt has been made to include losses caused by volatilization or other means. The criteria used for comparison are the minimum participating agency criteria (this includes Great Lakes Water Quality Agreement objectives) which, in some cases, are lower than those adopted by New York State.

Two other factors which could cause an underestimation of the loadings to the river are (i) the use of average permit limits, and (ii) the measured loads, used where permit limits do not exist, are probably on the low side of the long-term average loads for most facilities, due to the period of severe economic depression during which the DEC sampling was

performed (Employment in manufacturing in Erie and Niagara Counties fell 30% between 1979 and 1983).

5.5.1.2 Chemicals for Which Criteria are Apparently Exceeded by Calculated Loads

For each of the compounds in Table 5.2, the contributions from facilities that make up 90% of the loading to each river segment were examined to determine the apparent cause of the criterion being exceeded. The loading figures were converted to equivalent ambient river concentrations. These numbers are displayed in the following tables. For most substances, the New York State criterion is equal to the minimum agency criterion. Where it is not, the New York State criterion is mentioned in the discussion. Also shown are the calculated river concentrations, the interim limit loadings that currently apply to the facility (where limits exist), and the ambient concentrations calculated from the loadings measured in this project (Measured Load).

Cadmium (Criterion = 0.012 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.5612/34.05	-/-*
N. Tonawanda WWTP	Monitor only	0.0823/4.99	0.0083/0.504

*The symbol "-/-" indicates this chemical was undetected in the particular discharge. This applies to all tables in this section.

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Du Pont	0.1060/4.54	0.1060/4.54	-/-
Niagara Falls WWTP	0.2119/9.07	0.0424/1.81	-/-

Lower River

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.1920/34.05	-/-
Du Pont	0.0256/4.54	0.0256/4.54	-/-

The major cadmium contributions are derived from permit limit levels. The New York State criterion which the permit limits were designed to achieve is 300 ug/L. This number is considerably higher than the criteria proposed by all the other participating agencies, which range from 0.012 ug/L to 0.2 ug/L.

Carbon tetrachloride (Criterion = 0.300 ug/l)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	(1)	0.2121/9.08	-/-
Olin	(2)	0.1061/4.54	0.0053/0.227
Occidental (N.F.)	no limit	0.0382/1.64	-/-

(1) Interim limit for total volatiles is 454 Kg/day.
(2) Interim limit for total volatiles is 181 Kg/day.

The individual permit limit loads for Niagara Falls Wastewater Treatment Plant, Olin, and Occidental Chemical and Plastics would not cause the criterion to be exceeded. However, the combined permit limits exceed the criterion in the Falls to R. Moses reach. The high Olin number reflects the permit limit of 4.54 kg/day for total organics and the assumption that carbon tetrachloride could be discharged at this limit.

Chloroform (Criterion = 0.200 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	monitor only	0.1901/11.54	0.1006/6.104
Amherst WWTP	no limit	0.0374/2.26	-/-

Although neither of the two facilities above causes the criterion to be exceeded by itself, the combined permitted discharge load exceeds the criterion.

Chloroform (Criterion = 0.200 ug/L)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Du Pont	0.1962/8.40	0.1962/8.40	0.0013/0.056
Niagara Falls WWTP	(1)	0.1909/8.17	0.2462/10.54
Olin	(2)	0.1061/4.54	0.1664/7.12

(1) Interim limit for total volatiles is 454 kg/day.
(2) Interim limit for total volatiles is 181 kg/day.

The cumulative permitted load from the Niagara Falls Wastewater Treatment Plant, Du Pont, and Olin exceeds the criterion, although individually they do not.

Lower River

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.0650/11.53	0.0344/6.10
Du Pont	0.0474/8.41	0.0474/8.40	0.0003/0.056
Niagara Falls WWTP	(1)	0.0461/8.17	0.0595/10.54
Olin	(2)	0.0256/4.54	0.0402/7.12
Amherst WWTP	no limit	0.0128/2.27	-/-

(1) Interim limit for total volatiles is 454 kg/day.
(2) Interim limit for total volatiles is 181 kg/day.

Permitted loads from Buffalo Sewer Authority, Du Pont, and the Niagara Falls Wastewater Treatment Plant are, on the basis of these calculations, major contributors to the Lower River. These contributions, together with the smaller permitted load from Olin and the Amherst WWTP, caused the total permitted load to exceed the criterion.

Chloroform is formed, particularly in municipal systems, by chlorination of wastewater containing natural organic polymers such as humic acid. Chlorine may be discharged to the plant by tributary industries, but it is also used as a disinfectant by the sewage treatment plant to reduce the number of pathogenic organisms in its discharge. This may be an example of the benefits achieved by chlorination resulting in a potentially adverse effect on the environment.

Copper (Criterion = 2.00 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	1.9754/119.87	0.7532/45.7
Amherst WWTP	no limit	0.1646/9.99	-/-

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	2.1188/90.7	1.6971/72.65	0.7042/30.14
Occidental (N.F.)	no limit	0.3315/14.19	-/-

The New York State water quality standard for copper is 200 ug/L, which is considerably higher than the copper criteria adopted by the other participating agencies. The permitted loads exceed the criterion in two reaches of the river.

4,4'-DDE (Criterion = 0.001 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.0015/0.091	-/-

The permitted load of 4,4'-DDE from the Buffalo Sewer Authority exceed the criterion for this compound in the Tonawanda Channel.

Dimethyl phthalate (Criterion = 0.200 ug/L)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	1.9155/82.0	0.1994/8.54	-/-

The criterion for dimethyl phthalate is exceeded by the permitted loads in the Falls to R. Moses reach. The New York State criterion for dimethyl phthalate is 50 ug/L, considerably higher than criteria of the other participating agencies.

Alpha-endosulfan (Criterion = 0.003 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.0030/0.182	-/-

The Buffalo Sewer Authority permit limit uses up all the allocation for the Tonawanda Channel. The criterion is exceeded because of the apparent presence of alpha-endosulfan in very small amounts from a number of non-permit sources. Note that alpha-endosulfan, a pesticide, was not confirmed in New York samples; thus the apparent exceedance of the criterion may or may not be spurious.

Falls to F. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	0.0528/2.26	0.0030/0.128	-/-
Occidental (N.F.)	Monitor only	0.0011/0.047	0.0016/0.068

In the Falls to R. Moses reach, the permitted discharge from the Niagara Falls Wastewater Treatment Plant and from Occidental are both within the criterion limit but their combined permit limits cause the criterion to be exceeded.

Beta-endosulfan (Criterion = 0.003 g/L)

Falls to F. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	0.0528/2.26	0.0030/0.128	-/-
Occidental (N.F.)	Monitor only	0.0011/0.047	-/-

Although the permit limits for the Niagara Falls Wastewater Treatment Plant and Occidental would not individually cause the criterion to be exceeded, their combined loadings exceed the criterion in the Falls to R. Moses reach.

Heptachlor (Criterion = 0.001 ug/L)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	0.0528/2.26	0.0042/0.180	0.0005/0.021

The Niagara Falls Wastewater Treatment Plant permit limit allows sufficient heptachlor to be discharged to exceed the criterion in the Falls to R. Moses reach. The limit was derived from a working analytical detection limit of 1 ug/L in the discharge.

Alpha-hexachlorocyclohexane (Criterion = 0.010 ug/L)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Olin	Monitor only	0.0064/0.274	0.0005/0.021
Niagara Falls WWTP	0.0528/2.26	0.0042/0.180	0.0042/0.180
Occidental (N.F.)	no limit	0.0028/0.120	0.0032/0.137

Although the individual permit limits of Olin, Niagara Falls Wastewater Treatment Plant, and Occidental would not cause the ambient criterion to be exceeded, the combined loadings would do so in the Falls to R. Moses reach. The Niagara Falls Wastewater Treatment Plant limit was based on a working analytical detection limit of 1 ug/L in the discharge.

Beta -hexachlorocyclohexane (Criterion = 0.010 ug/L)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Olin	Monitor only	0.0064/0.27	0.0000/0*
Niagara Falls WWTP	0.0528/2.26	0.0042/0.18	0.0011/0.047
Occidental (N.F.)	no limit	0.0028/0.12	0.0003/0.013

Although the individual permit limits of Olin, Niagara Falls Wastewater Treatment Plant, and Occidental have been individually calculated not to exceed the criterion, the combined loadings would exceed the criterion by a small amount in the Falls to R. Moses reach. The Niagara Falls Wastewater Treatment Plant limit was based on a working analytical detection limit of 1 ug/L in the discharges.

*Calculated concentrations are less than 0.00005 ug/L.

Gamma-hexachlorocyclohexane (Criterion = 0.010 ug/L

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Olin	Monitor only	0.0064/0.27	0.0003/0.013
Niagara Falls WWTP	0.0528/2.26	0.0042/0.18	0.0011/0.047
Occidental (N.F.)	no limit	0.0028/0.12	0.0112/0.479

The major permitted contributors to the pesticide gamma-hexachlorocyclohexane are Olin, Niagara Falls Wastewater Treatment Plant, and Occidental. None cause the criterion to be exceeded by themselves, but the cumulative load does cause the criterion to be exceeded.

Lead (Criterion = 0.750 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	2.2448/136.21	0.7878/47.8
PVS Chemicals	0.5740/34.83	0.5740/34.83	-/-
Amherst WWTP	no limit	0.2472/14.99(1)	0.2472/14.99
N.Tonawanda WWTP	Monitor only	0.2058/12.49	-/-
Town of Tonawanda WWTP	no limit	0.1871/11.35	-/-
Niagara County SD #1	no limit	0.0875/5.31	0.0190/1.15

(1) measured load based on one 24-hour composite sample; no permit limit for lead.

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	1.6971/72.65	1.6971/72.65	0.0372/1.60
Occidental (N.F.)	none	0.0524/2.24	-/-

Lower River

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.7680/136.22	0.2695/47.8
Niagara Falls WWTP	0.4096/72.65	0.4096/72.65	0.0090/1.60
PVS Chemicals	0.1964/34.84	0.1964/34.84	-/-
Amherst WWTP	no limit	0.0845/14.99(1)	0.0845/14.99
N.Tonawanda WWTP	Monitor only	0.0704/12.49	-/-
Town of Tonawanda WWTP	no limit	0.0640/11.35	-/-
Niagara County S.D. #1	no limit	0.0300/5.32	0.0065/1.15

(1) measured load based on one 24-hour composite sample; no permit limit for lead.

The New York State criterion for lead in the Niagara River is 9.9 ug/L, which is greater than the minimum criterion of the other participating agencies. This explains why some of the major dischargers have permitted loads that would, by themselves, cause the minimum agency criterion to be exceeded in all three reaches.

Mirex (Criterion = 0.001 ug/L)
Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	no limit	0.0042/0.18	-/-
Occidental (N.F.)	0.008/0.03	0.008/0.03	(not measured)

The permitted limits for mirex from the Niagara Falls Wastewater Treatment Plant and Occidental are insufficient to meet the criterion in the Falls to R. Moses reach. At the time the Niagara Falls permit was drafted, the mirex limit was set at the estimated treatability limit of 0.4 lbs (0.18 Kg) per day because no ambient criterion was available for this substance. The Occidental permit limit was set at 1 ug/L based on a minimum detection limit of 1 ug/L in the discharge.

Lower River

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	no limit	0.0010/0.18	-/-
Occidental (N.F.)	0.0002/0.03	0.0002/0.03	(not measured)

Although both facilities with permitted mirex loads in this reach are within the criterion, the combination of the two dischargers exceeds the criterion.

PCB-1248 (Criterion = 0.001 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Bethlehem Steel	no limit	no limit	0.0017/0.103

PCB-1248 was measured at one outfall of Bethlehem Steel for which a permit has been issued. This permit, however, does not set a limit on PCB. PCB-1248 was not confirmed in the New York State analyses by GC/MS or a second GC column.

PCB, total (Criterion = 0.001 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.0011/0.07	-/-

The permitted load for PCBs from the Buffalo Sewer Authority is calculated to exceed the criterion in the Tonawanda Channel.

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	0.0528/2.26	0.0011/0.05	0.2505/10.72

The permitted load for PCBs from the Niagara Falls Wastewater Treatment Plant is calculated to exceed the criterion in the falls to R. Moses reach by 10%.

Phenols, total (Criterion = 1.000 ug/L)

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Niagara Falls WWTP	6.8912/295	0.8591/36.78	2.4858/106.41
Occidental (N.F.)	no limit	0.2100/8.99	-/-

Although the permitted loads from the Niagara Falls Wastewater Treatment Plant and Occidental would not individually cause the criterion in this reach to be exceeded, the combined permitted loads would exceed the ambient criterion by 9%.

Silver (Criterion = 0.100 ug/L)

Tonawanda Channel

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d)		
	Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Buffalo Sewer Authority	Monitor only	0.1003/6.09	0.1351/8.2
N.Tonawanda WWTP	Monitor only	0.0165/1.00	-/-
PVS Chemicals	0.0075/0.455	0.0075/0.455	0.0104/0.631

The permit load for silver from the Buffalo Sewer Authority is set to give an ambient concentration equal to the criterion. However, permitted loads from the North Tonawanda Wastewater Treatment Plant and PVS chemicals added to this would cause the criterion to be exceeded.

Falls to R. Moses

FACILITY	CALCULATED RIVER CONCENTRATIONS (ug/L)/LOAD (kg/d) Based on Permit Limit (Interim)	Based on Permit Limit (Final)	Based on Measured Load
Occidental (N.F.)	no limit	0.0753/3.37	0.0198/0.848
Du Pont	0.0557/2.38	0.0557/2.38	-/-

The permitted loads of silver from Occidental Chemical and Plastics and Du Pont are well below the criterion individually, but the combined loads exceed the criterion.

5.5.1.3 Chemicals for Which One Half the Criterion Level is Apparently Exceeded

The following six substances are of potential concern because their calculated permitted loads are greater than one-half the criterion in at least one river reach:

- Bis(2-ethylhexyl) phthalate
- Cyanide, total
- Di-n-octyl phthalate
- Diethyl phthalate
- Phenol
- 1,1,2,2-Tetrachloroethane
- Zinc

For each substance, additional measurements, usually made by the discharger, have been reviewed and compared with the New York State results to see whether the DEC sampling might have underestimated the loading, and if the use of higher loading figures would cause the criteria to be exceeded.

Bis(2-ethylhexyl) phthalate (Criterion = 0.600 ug/L)

Three facilities discharging to the Tonawanda Channel show higher discharge loads than were measured in the DEC sampling. However, using these loads in place of the DEC loads would cause a calculated ambient concentration increase of only 0.005 ug/L in the Tonawanda Channel. This increase is not sufficient to bring the calculated ambient concentration up to the criterion of 0.600 ug/L.

Cyanide, hydrolyzable (Criterion = 3.500 ug/L)

In the Tonawanda Channel reach, self-monitoring results were higher (6.2 kg/day) than DEC measurements (0.36 kg/day) for the Tonawanda Coke discharge. However, this increased load would not cause the criterion to be exceeded.

Di-n-octyl phthalate (Criterion = 0.200 ug/L)

Since the calculated di-n-octyl phthalate ambient concentration is close to the criterion it is not surprising that consideration of other analyses pushes the calculated concentration over the limit (from 0.1994 ug/l to 0.2438 ug/l). The permitted load for the Niagara Falls Wastewater Treatment Plant is the sole contributor in the Falls to R. Moses section. Self-monitoring by Olin shows the presence of di-n-octyl phthalate that was not found in DEC sampling. This substance is not included in the Olin permit.

Diethyl phthalate (Criterion = 0.200 ug/L)

The permit limit for diethyl phthalate at the Niagara Falls Wastewater Treatment Plant gives a calculated ambient concentration of 0.1994 ug/L in the Falls to R. Moses reach. Additional data do not indicate that the criterion would be exceeded.

Phenol (Criterion = 1.00 ug/L)

In the Falls to R. Moses section, the only known phenol contributors are Occidental and the Niagara Falls Wastewater Treatment Plant. Additional data do not indicate that the criterion would be exceeded.

1,1,2,2-tetrachloroethane (Criterion = 0.300 ug/L)

Increased loads of 1,1,2,2-tetrachloroethane over DEC estimates were reported from measurements made by the Niagara Falls Wastewater Treatment

Plant and Olin, which both contribute to the Falls to R. Moses reach. This substance is limited in the Niagara Falls Treatment Plant permit but not at Olin. If the higher estimate from Olin (an increase of 6.22 kg/day) is used together with the permitted loads from other facilities, the calculated ambient level increases from 0.2112 ug/l to 0.3236 ug/L, exceeding the criterion of 0.300 ug/L.

Zinc (Criterion = 30 ug/L)

The self-monitoring records from Niagara River dischargers show considerably higher loads of zinc reported (around 90 kg/day) than found in the DEC sampling. However, the criterion of 30 ug/L would not be exceeded even if these higher estimates were used in the load calculations.

5.5.1.4 Summary of New York Industrial and Municipal Point Sources

For all chemicals and facilities listed, the new round of permits represents a major tightening of toxic substances controls. In most cases, specific enforceable numerical limits have replaced either no limits or monitoring only requirements. In a few cases, the interim and final limits are the same. Nowhere do the new limits allow an increase over the current allowable discharge.

In all but a limited number of cases, the current discharge levels are below the final permit levels. To a great extent, the current levels are lowered by the depressed economy which has occurred during the project. The controls would allow increases over current levels in many of these discharges, but whether or not this will actually occur cannot be determined.

Most chemicals are controlled to levels that satisfy the Great Lakes Water Quality Agreement objectives and the ambient criteria of all participating agencies. Exceptions are cadmium, copper, and lead which were within the New York State standards, but greatly exceed the other agency criteria.

Other substances which are likely to exceed criteria if discharged at the permit limit are chloroform, heptachlor, mirex, and silver. Beta- and gamma-hexachlorocyclohexane, carbon tetrachloride, dimethyl phthalate, total phenols, total PCBs, and 4,4'-DDD, are calculated to exceed criteria. However, the amounts by which the criteria would be exceeded are calculated to be much smaller than for the other substances mentioned.

When data sets other than those of the DEC sampling are examined for chemicals whose calculated ambient concentrations lie between the criterion and one half the criterion, di-n-octyl phthalate and 1,1,2,2-tetrachloroethane may exceed the criteria.

5.5.2 Industrial and Municipal Discharges-Ontario

As previously discussed, control programs in Ontario have their legislative base in the Ontario Water Resources Act and the Environmental Protection Act. Provisions in these Acts prohibit the impairment of surface waters in the province as measured by established Provincial Water Quality Objectives and Drinking Water Quality Criteria. Effluent or discharge requirements are established on a case-by-case basis with the consideration of both the characteristics of the receiving water (ie. existing water quality, assimilative capacity, mixing zone analysis, etc.) and provincial and federal effluent regulations/guidelines. The resultant discharge requirements are incorporated into Certificates of Approval, provided for in the Ontario Water Resources Act, and specify both loadings and concentrations.

The following discussion summarizes the existing control status for all significant sources in Ontario by river sub-area and predicts, quantitatively where possible, the EPA priority pollutant loading reductions that would be realized under the control programs presently available to the Ministry of the Environment. It should be kept in mind that existing programs in Ontario have not been directed specifically at the control of trace organic pollutants as a general classification, but rather at hazardous pollutants for which policies have been established, and other specific

pollutants (metals, phenols) that, based on case-by-case knowledge, are recognized as requiring control. The additional control options proposed in this chapter for trace organics and heavy metals have been developed in accord with the Ministry's policy of progression towards the Great Lakes Water Quality Agreement (1978) objective of zero discharge of persistent toxic contaminants, and to minimize the release of all substances for which Provincial Water Quality Objectives have not yet been established.

5.5.2.1 Projected Loadings (by reach) Under Present Control Programs

(a) Fort Erie Sub-Area

The Fort Erie Anger Ave. WPCP treats municipal sewage and some industrial discharges using conventional sedimentation, phosphorus removal via chemical addition, and chlorination. Operating data indicate satisfactory removal of BOD, suspended sediments, and phosphorus. No additional priority pollutant control programs are planned at the present time for this primary treatment facility. Therefore, no loading reductions are anticipated for priority pollutants in the immediate future.

Fleet Industries has undergone a recent environmental survey under Section 126 of the Environmental Protection Act. The survey results indicated the need for further control of metals discharges. Abatement action (likely in 1984) would reduce chromium from 1.1 kg/d as measured in the MOE Niagara River surveys to a maximum of 0.91 kg/d based on the Provincial discharge objective for chromium of 1 mg/L and a flowrate of 910 m^3/d. The reduction of 0.2 kg/d in itself appears minor but is only an estimated minimum based on just meeting the MOE discharge objective. Even controlled to no greater than 1 mg/L of chromium, Fleet could still be a significant source (if chromium loading is greater than 0.454 kg/d), but would be in compliance with present MOE requirements.

(b) Chippawa Sub-Area

There are no significant sources of priority pollutants in this sub-area.

(c) Niagara Falls, Ontario Sub-Area

The Welland WPCP treats municipal sewage and some industrial discharges using conventional sedimentation, activated sludge treatment, phosphorus removal, and chlorination. Operating data indicate satisfactory removal of conventional pollutants (BOD, suspended solids, and phosphorus). No additional priority pollutant control programs are currently planned for this secondary treatment facility and no reductions in loadings are anticipated in the immediate future.

The McMaster Avenue Combined Sewer is a source of untreated municipal sewage, industrial process discharges storm water, and cooling water. Since the 1981/82 surveys, some segregation of flows has been carried out, but the sewer is still a source of sanitary sewage and process wastewater. Ongoing abatement efforts include proposals to separate these discharges from the sewer. This action should reduce loadings of all reported priority pollutants during dry weather flow conditions. Potential reductions are discussed in the next section dealing with strategies to improve controls.

Atlas Steels was under a Control Order (which expired in September 1983) to reduce metals and suspended solids. Chromium discharge should be reduced to at least 27 kg/d from 37 kg/d based on the 1981 average flowrate. The effect on other priority pollutants detected is not quanitifiable at present.

The Cyanamid Canada Inc. Welland Plant is under a Control Order (which expires in September 1984) which should reduce discharges of chromium and cyanide at least to the levels shown below:

Chromium: from 4.9 kg/d to 1.9 kg/d (Welland River discharge)

Cyanide: from 2.3 kg/d to 1.5 kg/d (Thompson Creek discharge)

(Both estimated reductions are based on the 1982 average flows).

The effect of the proposed treatment system on other priority pollutants is not quantifiable at present.

The Cyanamid Canada, Inc. Niagara Falls plant, although a significant source of zinc, cyanide, and one phthalate according to cutoffs defined in this report, is in compliance with applicable MOE discharge objectives, except for occasionally exceeding suspended solids requirements. There are no proposed control programs aimed at priority pollutant discharges, and therefore no major impact on loadings is anticipated at this time.

The Niagara Falls WPCP treats municipal sewage and some industrial discharges using conventional sedimentation, phosphorus removal, and chlorination. Operating data indicate satisfactory removal of conventional pollutants. No specific priority pollutant control programs are planned for this primary treatment facility, but secondary treatment is being proposed. This would likely result in reduced priority pollutant loadings. Quantitative estimates are presented in the following section.

5.5.2.2 Strategies to Improve Controls

As summarized in Chapter II, Canadian point sources were responsible for 1.1% to 29.5% of the loadings of various categories of priority pollutants. Much of the pollutant load for a given category originated from a limited number of sources. Four significant municipal sources (3 municipal WPCPs and 1 combined sewer overflow) were responsible for 69% of the priority pollutant organics and 83% of the 4AAP Phenols. Four significant industrial

sources accounted for 62% of the metals and 83% of the cyanide. This is summarized below:

POLLUTANT CATEGORY	% OF TOTAL CANADIAN POINT SOURCE LOADING		
	Significant Municipal	Significant Industrial	Total M&I
EPA Priority Pollutants			
1. Organics	69%	28%	97%
2. Metals	37%	62%	99%
3. Cyanide	15%	83%	98%
4AAP Phenols	83%	14%	97%

The most logical conclusion to be drawn from this summary is that a strategy for control directed at the significant Canadian point sources will be most effective in reducing the toxic substances contribution from all Canadian point sources to the Niagara River.

The eight significant sources are the Fort Erie (Anger Ave.), Welland, and Niagara Falls WPCPs, the McMaster Ave. combined sewer overflow, Atlas Steels, the two Cyanamid Plants (Welland and Niagara Falls), and Fleet Manufacturing. A control program for these sources which satisfies the needs of the Niagara River must address categorical pollutant loadings as well as individual compounds or pollutants of concern. The control strategies recommended are intended to tackle pollutant loadings with the objective of reducing the input of categorical organic priority pollutants and heavy metals. This is considered the first tier in addressing available control strategies.

The second tier is an evaluation of pollutant loading on a compound specific basis and identifies the significant sources of individual Group 1 contaminants. Table 5.3 lists six control strategies appropriate to the significant Ontario point sources to the Niagara River (Tier 1). Table 5.4 lists the significant Canadian sources of the Group I organics with highest loadings. The control strategies appropriate to each significant source in Table 5.4 are listed by a number which corresponds to Table 5.3.

TABLE 5.3

CONTROL STRATEGIES WHICH WILL REDUCE CATEGORICAL POLLUTANT LOADINGS TO THE NIAGARA RIVER FROM SIGNIFICANT ONTARIO POINT SOURCES (TIER 1)

	CONTROL STRATEGIES	MAJOR SOURCES AFFECTED	POLLUTANTS AFFECTED
1.	Conventional Secondary Treatment at Municpal WPCPs (Activated Sludge)	Fort Erie (Anger Ave.)WPCP Niagara Falls WPCP	Organics Heavy Metals Phenolics Cyanide
2.	Eliminate Sanitary O/Fs and Industrial Process Inputs to Combined Sewers	McMaster Ave. Sewer	Organics Heavy Metals Phenolics
3.	Treatment of Heavy Metals	Atlas Steels** Cyanamid Welland** Fleet Mfg.	Chromium Nickel Zinc Lead Copper
4.	Treatment of Cyanide	Cyanamid-Welland** and Niagara Plants	Cyanide
5.	Investigation of Upstream Sources to WPCPs (Industrial Pretreatment, Spill Contingency Plans)	Welland WPCP Fort Erie (Anger Ave.)WPCP* Niagara Falls WPCP*	Lead Copper Zinc EPA Volatiles Phenol
6.	Good Housekeeping and Maintenance***	Atlas Steels** Cyanamid Welland** Cyanamid Niagara	Specific Volatiles and Phthalates

* Need for Fort Erie (Anger Ave.) and Niagara Falls WPCP Industrial Pretreatment Programs would depend on WPCP performance following upgrading to secondary treatment. In addition, industrial pretreatment should be considered as a means of upgrading treatment plant effluent quality to meet receiving water quality requirements as necessary in the future.

** Control Orders and related control programs have already addressed some pollutants directly and may affect others indirectly due to concomitant removal during treatment.

*** Good Housekeeping intended to address Group I (Chapter VI, chemicals requiring immediate action) and heavy metals and other EPA Priority Pollutants.

TABLE 5.4

CONTROL STRATEGIES WHICH WILL REDUCE THE LOADINGS OF THE MOST SIGNIFICANT GROUP I ORGANICS FROM ONTARIO POINT SOURCES (TIER II)

GROUP I PARAMETERS*	SOURCES	CONTRIBUTION TO TOTAL LOADINGS %	kg/d	CONTROL STRATEGIES
1. Bis(2-ethylhexyl) phthalate (0.924 kg/d)	Niagara Falls WPCP	32%	0.30	1,5
	McMaster Ave. CSO	29%	0.27	2
	Atlas Steels	14%	0.13	6
	Fort Erie (Anger Ave.) WPCP	11%	0.10	1,5
	Cyanamid Welland	10%	0.09	6
2. Methylene chloride (0.902 kg/d)	Niagara Falls WPCP	44%	0.40	1,5
	Fort Erie (Anger Ave.) WPCP	18%	0.16	1,5
	Welland WPCP	6%	0.05	1,5
	**	32%	0.29	-
3. 1,2-Dichloroethane (0.399 kg/d)	Fort Erie (Anger Ave.) WPCP	80%	0.32	1,5
	Niagara Falls	15%	0.06	1,5
	Cyanamid Welland	3%	0.01	6
	McMaster Ave. Combined Sewer	2%	0.01	2
4. Chloroform (0.336 kg/d)	Niagara Falls WPCP	33%	0.11	1,5
	Fort Erie (Anger Ave.) WPCP	30%	0.10	1,5
	Cyanamid Welland	15%	0.05	6
	Welland WPCP	9%	0.03	5
	McMaster Ave. Combined Sewer	6%	0.02	2
5. Benzene (0.259 kg/d)	Niagara Falls WPCP	31%	0.08	1,5
	Fort Erie (Anger Ave.) WPCP	23%	0.06	1,5
	Welland WPCP	12%	0.03	5
	Cyanamid Welland	12%	0.03	6
	**	22%	0.06	-

TABLE 5.4 (continued)

GROUP I PARAMETERS*	SOURCES	CONTRIBUTION TO TOTAL LOADINGS %	kg/d	CONTROL STRATEGIES
6. Tetrachloroethylene (0.132 kg/d)	Niagara Falls WPCP	30%	0.04	1,5
	Fort Erie Anger Ave.) WPCP	30%	0.04	1,5
	Welland WPCP	30%	0.04	5
7. Phenol (0.110 kg/d)	Niagara Falls WPCP	46%	0.05	1,5
	Welland WPCP	37%	0.04	5
	Fort Erie (Anger Ave.) WPCP	10%	0.01	1,5

* These parameters account for ~97% of the loading of priority pollutant Group I organics from Canadian point sources.

** Remaining sources are numerous and of small individual magnitude.

Twenty organic compounds accounted for 99% of the organic priority pollutant loading from Canadian point sources. Seven of the twenty were compounds contained in the Group I List. A total of 27 Group I organic compounds were detected in Canadian point source effluents at least once. The seven Group I chemicals listed in Table 5.4 amounted to 3.09 kg/d, or 18% of the total organic priority pollutants. The remaining 20 Group I compounds had a total load of 0.08 kg/d or 0.4% of the total, and are not discussed further.

The total priority pollutant heavy metals loading was composed mainly of nickel, chromium, lead, zinc, and copper, which together made up 99% of the total point source metals loading. Heavy metals and organic pollutants can be controlled by the Tier 1 control strategies recommended in Table 5.3. Cyanide was discharged mainly from the Cyanamid plants and the control strategy may require the treatment of cyanide contaminated waste streams. The existing Control Order for Cyanamid Welland has already addressed cyanide. Atlas Steels was also under a Control Order (to September 1983) requiring the control of wastewater contaminated with heavy metals.

5.5.2.3 Control Strategies

The six control strategies identified were conceived in isolation from the analytical data with the objective of addressing all pollutants from the significant sources. As can be seen for the individual pollutants listed in Table 5.4 and the loadings and equivalent concentrations presented in Table 5.5, most of the individual organic priority pollutants are present at very low levels in individual point source effluents. Pollutant treatability is therefore a factor to be considered when evaluating the feasibility of each control strategy. However, priority pollutants are not the only contaminants present in complex effluents, and total pollutant loading represented by conventional parameters such as BOD, COD, and suspended solids has also been considered. The technical and theoretical feasbility of each control strategy is discussed in below.

TABLE 5.5

SIGNIFICANT CANADIAN POINT SOURCES OF EPA PRIORITY POLLUTANTS
RANKED BY TOTAL LOADING

MAJOR POINT SOURCE (m^3/d)	UNITS	EPA PRIORITY POLLUTANT CATEGORY				TOTAL PRIORITY POLLUTANTS
		Organics	Cyanide	Metals	Phenolics	
Atlas Steels	kg/d	3.7	ND	70	0.14	73.7
(27,200)	ug/L*	136	ND	2,574	5.1	2,710
Niagara Falls WPCP	kg/d	6.3	0.34	17	0.87	23.6
(40,700)	ug/L*	155	8	420	21	580
Welland WPCP	kg/d	0.58	0.16	17	0.16	17.8
(36,900)	ug/L*	16	4	460	4	480
McMaster Ave. Sewer	kg/d	0.73	ND	13.07	0.37	13.7
(12,350)	ug/L*	59	ND	1,060	30	1,110
Cyanamid Welland	kg/d	0.47	2.3	10.	0.17	12.6
(24,900)	ug/L*	19	92	400	7	510
Fort Erie WPCP	kg/d	5.0	0.10	2.0	0.27	7.1
(11,400)	ug/L*	440	9	175	24	620

TABLE (continued)

MAJOR POINT SOURCE (m^3/d)	UNITS	EPA PRIORITY POLLUTANT CATEGORY				TOTAL PRIORITY POLLUTANTS
		Organics	Cyanide	Metals	Phenolics	
Cyanamid Niagara	kg/d	0.35	0.96	0.73	ND	2.0
(39,300)	ug/L*	9	24	19	ND	50
Fleet Manufacturing	kg/d	0.12	ND	1.2	ND	1.3
(910)	ug/L*	132	ND	1,320	ND	1,430
Total Loadings**	kg/d	17.2	3.9	131	2.0	152

* The equivalent average total concentration for each pollutant group (loading/flow).

** The major sources account for 98%+ of the priority pollutant loadings from Canadian point sources.

ND Not Detected.

(a) Conventional Secondary Treatment At Primary WPCPs

The U.S. EPA published a report in 1982 on the "Fate of Priority Pollutants In Publicly Owned Treatment Works" (EPA 440/1-81/303). In this study of secondary sewage treatment plants, the primary portions of plants surveyed achieved, on average, 19% removal of BOD and 45% removal of suspended solids. Plants utilizing secondary activated sludge treatment accomplished 90% removal of both BOD and suspended solids. Similar operational data are provided below for the Fort Erie (Anger Ave.), Niagara Falls and Welland WPCPs (Welland is a conventional secondary plant).

REMOVAL OF CONVENTIONAL POLLUTANTS BY WPCPs*

PLANT	UNITS	BOD			Suspended Solids		
		In	Out	% Removal	In	Out	% Removal
Fort Erie	mg/L	110	36	66%	84	27	68%
	kg/d	1700	590	66%	1400	440	68%
Niagara Falls	mg/L	100	27	74%	160	26	84%
	kg/d	5900	1600	74%	9500	1500	84%
Welland	mg/L	81	8	90%	130	12	92%
	kg/d	4400	440	90%	7300	660	92%

* Annual averages for 1981.

The Fort Erie, Anger Ave. and Niagara Falls WPCPs are achieving well above the average removal rates reported by EPA; however, the EPA plants were secondary and may not have been optimizing primary treatment to the same extent. The Welland secondary plant was equivalent to the EPA average for secondary activated sludge treatment. Assuming that Fort Erie and Niagara Falls were upgraded to achieve 90% removal, the additional load of BOD and suspended solids that could be removed would be:

Fort Erie	410 kg/d BOD
Anger Ave. WPCP	310 kg/d suspended solids
Niagara Falls	980 kg/d BOD
WPCP	560 kg/d suspended solids

A similar comparison can be made for individual priority pollutants based on the EPA study. The Fort Erie (Anger Ave.) and Niagara Falls WPCPs discharged totals of 5.1 kg/d and 6.1 kg/d, respectively, of organic EPA priority pollutants, equivalent to total concentrations of 450 ug/L and 150 ug/L in the effluents. These two plants were often the first among the major sources of 20 most abundant priority organics, 8 of which are Group I compounds. Based on the POTW plant summary data, the removal of selected organics and metals that might be accomplished by upgrading the WPCPs to secondary treatment have been calculated and presented in Table 5.6. The individual reduction of pollutants listed was highly variable; however, applying the overall reduction of 87.3% to the loadings for the two WPCPs, the following estimated reduction of total priority pollutants would be expected:

WPCP	Present Load (kg/d)	Estimated After Upgrading (kg/d)
Niagara Falls	23.6	3.0
Fort Erie	7.1	0.91
TOTAL	30.7	3.91

Reduction: 27 kg/d or 18% of total Canadian Loading.

TABLE 5.6

AVERAGE ADDITIONAL REMOVALS OF SELECTED POLLUTANTS BASED ON RESULTS OF EPA POTW STUDY (kg/d)
(EPA 440/1-81/303, PAGE 61)

POLLUTANT	EPA POTW STUDY		Actual 1° Loading, Theoretical 2° Loading and Total Reduction				
	Primary Removal (1°)	Secondary* Removal (2°)	Fort Erie Anger Ave. 1°	Fort Erie Anger Ave. 2°	Niagara Falls 1°	Niagara Falls 2°	Reduction in Load due to 2° Treatment
BOD	19%	90%	590	170	1600	590	730
Total suspended solids	45%	90%	440	140	1500	950	1500
Chromium***	27%	84%	0.08	0.03	3.6	0.18	3.5
copper***	22%	84%	0.49	0.18	0.93	0.46	0.78
Lead***	57%	82%	0	0	0.57	0.24	0.33
Nickel***	14%	34%	0.04	0.03	0.33	0.11	0.23
Zinc***	27%	81%	1.3	0.21	11	0.89	11
Cyanide***	27%	62%	0.10	0.05	0.34	0.06	0.33
Benzene***	25%	77%	0.06	0.02	0.08	0.02	0.10
Bis(2-ethylhexyl) pthalate	0%	62%	0.10	0.04	0.30	0.005	0.35
Butylbenzyl phthalate	62%	94%	0.08	0.01	0	0	0.07
Chloroform***	14%	62%	0.10	0.03	0.11	0.01	0.17
Di-n-butyl pthalate	36%	68%	0.99	0.10	3.40	0.57	3.7
Diethyl phthalate	56%	91%	0.16	0.03	0.79	0.07	0.85
Methylene chloride***	0%	48%	0.16	0.08	0.40	0.05	0.43
Naphthalene	44%	92%	0.05	0.01	0.08	0.01	0.11
Phenol***	8%	89%	0.01	0.001	0.05	0.006	0.05
Tetrachloro-ethylene***	4%	82%	0.04	0.01	0.04	0.008	0.06
Toluene	0%	93%	0.05	0.02	0.18	0.01	0.20
Trichloroethylene	20%	90%	0.15	0.02	0.005	0.001	0.14
1,1,1-Trichlorethane	40%	88%	0.06	0.01	0.11	0.02	0.14
trans-1,2-Dichloroethylene	36%	80%	1.8	0.01	0.06	0.02	1.8
TOTAL (Percent)			5.8	0.89	22	2.7	24(87%) (16 kg/d metals + cyanide 8.2 kg/d organic)

* Secondary activated sludge
** Based on data from 1 or 2 plants
*** Group I chemical

(b) Elimination of Sanitary/Industrial Input to McMaster Ave. CSO

The McMaster Avenue sewer is a combined sewer which discharges directly to the Welland River at a rate of roughly 12,500-27,000 m^3/d (average annual flow 1981 and measured flow October 6-8, 1981 during wet weather). Table 5.5 lists the total priority pollutants for each pollutant category during the 1981-82 surveys. It is anticipated that if stormwater and industrial cooling water were segregated from sanitary and industrial process wastewater, a major portion of the 13.7 kg/d of total priority pollutants would be removed from the discharge. In order to estimate the reduction in pollutant loading that might be accomplished by sewer segregation, data for heavy metals and organics in urban industrial storm drainage and once through cooling water sources (Niagara River, City of Welland and Municipal Water Supply) were used[1]. It was estimated that total priority pollutant organics and 4AAP phenols would be reduced to 5 ug/L and 1 ug/L respectively, based on the above data. The estimate for total heavy metals was based on the average concentrations of priority pollutant metals in stormwater from industrial and residential areas of Sarnia, Hamilton, and Cornwall, Ontario, two Welland River intake samples, and one sample of the Welland municipal water supply. The average of 0.74 mg/L, may be an overestimation for Welland, which is less industrialized than the three urban centers considered.

The estimates based on these calculations appear below:

POLLUTANT CATEGORY	McMASTER AVENUE SEWER LOADINGS (kg/d)	
	Before Segregation	After Segregation at 12,500 m^3/d
Organics	0.73	0.06
Cyanide	0	0
Metals	13	9.2
4AAP Phenols	0.37	0.01
TOTALS	14.1	9.3

Reduction 4.8 kg/d or 3% of total Canadian Point Source Loading

[1] Wong, J., "Persistent Toxic Substances In Surface Runoff", NWRI, October 1981, EPS-OR 1981 Survey Data).

The reduction in pollutant loading estimated above does not include the decrease in other pollutants not on the EPA priority list, such as iron, aluminum, BOD, and specific organics.

(c) Treatment of Heavy Metals

The major sources of heavy metals were Atlas Steels, the Niagara Falls and Welland WPCPs, the McMaster Avenue Sewer, and Cyanamid Welland.

Atlas Steels alone accounted for 53% of the total Canadian point source loading of heavy metals. Atlas Steels has recently completed the last of its Control Order requirements, which called for the installation of a solidification process to treat the waste acid and alkaline rinse from the Cold Draw and Strip Mill. If the Ontario industrial discharge objective was achieved for nickel and chromium (the metals that exceeded the 1 mg/L objective in the Atlas effluent), their effluent loadings would be reduced from a total of 60 kg/d to a total of 54 kg/d at a flow of 27,200 m^3/d (1981 annual average).

The Control Order requirements issued to Cyanamid of Canada (Welland Plant) are to be met by September 30, 1984. The limitations for chromium (1 mg/L) and cyanide (0.1 mg/L) will reduce the loadings of these contaminants to a maximum of 1.9 kg/d and 1.5 kg/d respectively. This represents a minimum reduction for chromium of 3.0 kg/d and for cyanide of 0.39 kg/d for a total priority pollutants reduction of 3.4 kg/d.

Fleet Manufacturing had the smallest total priority pollutants loading for significant point sources (1.2 kg/d). However, due to a low effluent flow, the Ontario objective of 1 mg/L for chromium is often exceeded. Based on the 1981/82 survey results, the loading of chromium will be reduced at least 0.2 kg/d when this facility is brought into compliance.

(d) Treatment of Cyanide

The Cyanamid Welland plant is required to reduce its cyanide loading by September 1984. Compliance with the Ontario discharge objective of 0.1 mg/L will result in a minimum loading reduction of 0.39 kg/d. Cyanamid Niagara Falls was in compliance with this objective during the 1981 and 1982 surveys.

(e) Investigation of Upstream Sources to WPCPs

This control strategy incorporates Industrial Pretreatment and Spill Contingency Plans. Though not possible to quantify, reductions of significant pollutants may be achieved by requiring pretreatment of industrial process wastes prior to discharge to the sewer system. Spill contingency plans such as in-line holding tanks for highly contaminated process wastes would complement the pretreatment program and reduce periodic increases in the discharge of heavy metals and organics.

The significant pollutants, determined by the cutoff values in Chapter II, should form the inital parameter list for investigating upstream sources to municipal WPCPs. The significant pollutants are listed below:

WPCP	Significant Pollutants (In Excess of Cutoff Values)
1. Fort Erie(Anger Ave.)	Total phenols (4AAP) Copper Zinc 1,2-Dichloroethane 1,2-Dichloroethene Dimethyl phthalate Dibutyl phthalate

2. Niagara Falls	Total Cyanide Total Phenolics Chromium Copper Lead Zinc Methylene chloride 2,4-Dichlorophenol Dibutyl phthalate Diethyl phthalate Bis(2-ethylhexyl) phthalate
3. Welland	Copper Lead Zinc

A pretreatment program would not be implemented until the effluent quality of the secondary plants was investigated, since many of these pollutants would be eliminated or reduced. However, secondary plant design requires a given quality of plant influent, necessitating pretreatment of selected sources.

Since the Welland WPCP is an existing secondary plant, upstream investigations of the sources of copper, lead, and zinc should proceed, with lead taking priority. Welland WPCP was the largest Canadian point source of lead (13 kg/d) in the Niagara River study area. Zinc and copper were of lower magnitude at 1.7 and 0.70 kg/d respectively.

(f) Good Housekeeping and Maintenance

An operational facility has a schedule of periodic maintenance and inspection which could include searching for leaks in cooling water or process piping. Good housekeeping includes clean-up, mitigating spills, dykes around storage tanks or floor drainage areas, etc. By investigating the sources of certain pollutants in the facility effluent, it may be possible to avoid releasing the contaminant to the environment.

In assessing the point source survey data, it was determined that the following chemicals should be investigated by the facility concerned.

1. Atlas Steels
   Methylene chloride
   Trichlorethylene

2. Cyanamid, Niagara Falls
   Butylbenzyl phthalate
   Di-n-octyl phthalate
   Aluminum

3. Cyanamid, Welland
   Di-n-butyl phthalate
   Aluminum
   1,1-Dichloroethane

5.5.2.4 Summary of Ontario Industrial and Municipal Point Sources

Although the potential reduction of priority pollutants resulting from the implementation of the six control strategies can neither be estimated with certainty nor entirely quantified, it appears that major reductions may already have been achieved or are technically feasible. Table 5.7 presents a summary of the above discussion and indicates that a potential reduction of some 28% may be possible, with remedial efforts at Fort Erie (Anger Ave.) and Niagara Falls WPCPs resulting in the most significant results.

TABLE 5.7

ESTIMATED POTENTIAL REDUCTION OF PRIORITY POLLUTANT LOADINGS IF CONTROL STRATEGIES ARE ADOPTED AT CANADIAN FACILITIES
(kg/d)

	CONTROL STRATEGY	FACILITIES EFFECTED	LOADING REDUCTION (kg/d)
1.	Conventional Secondary Treatment	Niagara Falls WPCP	21
		Fort Erie (Anger Ave.) WPCP	6.2
2.	Segregation of Combined Sewer Overflows	McMaster Ave. Combined Sewer	4.8

TABLE (continued)

	CONTROL STRATEGY	FACILITIES EFFECTED	LOADING REDUCTION (kg/d)
3.	Treatment of Heavy Metals	Atlas Steels Cyanamid Welland Fleet	6.0 3.0 0.20
4.	Treatment of Cyanide	Cyanamid Welland Cyanamid Niagara Falls	0.39 -
5.	Industrial Pre-Treatment Spill Contingency Plants	Niagara Falls Fort Erie (Anger Ave.) and Welland WPCP	?
6.	Good Housekeeping	All industries where required to supplement that in place	?
	TOTAL REDUCTION		42 or more 27% or more

5.5.3 Hazardous Waste Sites - New York

Hazardous waste disposal sites are not addressed in terms of acceptable loads to the Niagara River. As a result, the impact of cleaning up the sites cannot be estimated in a quantitative sense. The remedial programs being undertaken are designed to isolate the sites or to remove or treat the wastes to prevent contaminant migration.

The programs currently being implemented are authorized under New York State Environmental Conservation Law Chapter 282 of the laws of 1979 and Chapter 857 of the laws of 1982 (State Superfund) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Federal Superfund). The federal Superfund law in New York State is administered through the Department of Environmental Conservation. It is intended that the responsible parties undertake remedial action whenever possible. Public

funding is used only when responsible parties cannot be located or lack resources, or when litigation against the parties is unsuccessful or prolonged.

Sixty-one sites have been identified on the New York side of the river as having a significant potential for contaminant migration to the Niagara River. Fifty sites require completion of site specific investigations and eleven sites require work to be initiated, in order to confirm the occurrence, extent, and magnitude of contaminant movement.

The current status of remedial activity for sites having a significant potential for contaminant migration along the Niagara River is summarized in Table 3.8 of Chapter III. The major categories of remedial activity include sites with remedial activities underway, sites under litigation, sites with investigations underway, sites with preliminary investigations underway or completed, and sites with no remedial actions to date.

One site, Occidental Chemical-Love Canal, has had remedial construction initiated, and is being remediated by DEC/EPA under state/federal superfund. Litigation action has also been initiated to recover governmental expenditures.

Litigation has been initiated involving the following 27 sites: Occidental Chemical-"S" Area, Occidental Chemical-102nd Street, Occidental Chemical-Buffalo Avenue Plant (9 sites), Occidental Chemical-Durez Division (14 sites), Olin-102nd Street, and Solvent Chemical.

Joint state/federal actions have been filed involving the Occidental Chemical-"S" Area, Occidental Chemical-102nd Street, and Olin-102nd Street site. For the Occidental Chemical-Buffalo Avenue Plant, Occidental Chemical-Durez Division and Solvent Chemical sites actions have been filed by the state Attorney General. A negotiated settlement has been submitted for Federal Court approval for the Occidental Chemical "S" Area site.

Preliminary investigations have been undertaken or completed at six sites, including Bethlehem Steel, Alltift, Allied Chemical-Site 107, and Olin-Buffalo Avenue Plant (3 sites).

Preliminary investigations are underway at Bethlehem Steel as a result of negotiations between the owner and EPA/DEC. The remaining preliminary investigations have been completed by the owners based on negotiations with DEC. Further investigation is required at these sites and will be initiated by the owners or the state/federal government during 1984-85.

Detailed site investigations are currently underway at the following 15 sites: Buffalo Color (3 sites), Columbus-McKinnon, Bell Aerospace Textron, Du Pont-Necco Park, Reichold-Varcum Chemical, Du Pont, Buffalo Avenue Plant (6 sites), Occidental Chemical Hyde Park, and Niagara County Refuse Disposal.

The Niagara County Refuse Disposal site is being investigated under state/federal superfund. The Occidental Chemical Hyde Park site remedial investigation program is being undertaken as a result of a federal Government approved settlement of state/federal actions. The Buffalo Color Corporation is under a Consent Order with DEC to conduct investigations at its three sites. The remaining site investigations are being undertaken by the site owners based on negotiatons with DEC. Remedial construction has been initiated at the Du Pont-Necco Park and Buffalo Avenue Plant sites along with the site investigations.

Twelve sites have had no remedial action initiated to date: Times Beach, Mobil Oil Corporation, McNaughton-Brooks, Inc., Squaw Island, Allied Chemical-Site 105, Tonawanda Coke, INS Equipment Corporation, Huntley Power Station, Gratwick-Riverside Park, Griffon Park, Buffalo Avenue, and Charles Gibson.

While an investigatory program has been developed for the Charles Gibson site, no activity has been initiated to date. All of the above sites will have investigations initiated during 1984-85, either by the owner or the state/federal government, to confirm or deny the existence of a significant environmental threat.

These investigations will be more detailed than those conducted as part of the Niagara River Toxics Project and will be designed to provide a final site assessment.

While activity is underway to achieve remediation at most of the sites, it is unlikely that complete isolation of the sites will be attained soon. It is, therefore, unlikely that there will be any significant decrease of chemical loading to the river from these sites in the immediate future.

5.5.4 Landfill Sites-Ontario

Based upon the findings of the monitoring programs carried out on the seventeen landfill sites in the Niagara Region of Ontario, five of these disposal sites have a significant potential for contaminant migration through surface and/or sub-surface leachate. The assessment of potential contaminant migration from these sites incorporated knowledge of the contents of the site as well as monitoring data on surface runoff, groundwater, and/or leachate seepage.

At the Atlas Landfill in Welland, it is recognized that surface runoff, containing a leachate fraction, overflows through a concrete weir structure to the Welland River and eventually to the Niagara River some 25 km (16 miles) downstream. If this overflow is determined to contravene Ontario water quality guidelines then appropriate action must be taken for alternate disposal.

It is proposed that control strategies for these sites consist of a detailed investigative program followed up by site-specific remedial

measures. The investigative program for each of the five sites would be designed on a site specific basis according to the existing information base (monitoring data, previous studies, etc.). Remedial programs cannot be developed at the present time on the sole basis of the screening study results presented in this report. Quantitative estimates of contaminant loadings from the sites and detailed migration patterns have not been established. However, the results of the screening study can be used to develop a framework for a detailed investigative program.

5.5.5 Control of Contaminated Bottom Sediments

There are no general programs in place on either side of the border to address contaminated bottom sediments. Although several sediment sites are identified in Chapter IV as having high levels of chemicals of concern, no remedial measures can be developed without better knowledge of the areal extent, depth, and contaminant concentrations of the sediments. Sites identified in Chapter IV with particularly high sediment contamination are: the Lake Erie open-lake disposal site, the mouth of Smoke Creek, the Lackawanna Canal, the lower Buffalo River, the Black Rock Canal, the mouth of Scajaquada Creek, the eastern U.S. shore near the northern Buffalo City line, the mouth of Two-Mile Creek, the west end of the Little River behind Cayuga Island, the 102nd Street embayment, and portions of the lower river below the Falls.

These contaminated sediments will gradually move downstream and enter Lake Ontario. Whether or not this will have a significant environmental effect depends on the total amount of contamination, its ability to be leached from the sediment and enter the food chain, and its rate of movement downstream. None of these variables is known nor can they be estimated at this time. Sediment removal operations are currently underway by the U.S. Army Corps of Engineers to maintain navigation channels and harbors. Before remedial work is undertaken, the responsible agency must make every effort to ensure that the sources of the contamination to the

sediments are stopped. It will be of little benefit to perform remedial action only to find that the contamination reappears.

5.6 Summary

The various control programs currently in place on both sides of the Niagara River have been examined.

For control of point source discharges, the scope of authority and powers of enforcement for both the New York State SPDES permit program and the Ontario Certificate of Approval system appear to be adequate. The necessary powers to require pre-treatment programs in association with the discharge permit programs in both jurisdictions also appear to be in place.

On the New York side, the SPDES permit and pre-treatment programs have the ability to achieve the goals set for them by the state and federal governments, and they should be pursued to full implementation. A number of apparent deficiencies in individual permits have been noted which require further investigation and possible correction; these deficiencies include certain substances for which the permitted discharge levels may result in ambient water concentrations that exceed minimum agency criteria. On the Ontario side, the Certificates of Approval required by all dischargers incorporate the effluent limits set by the provincial and federal governments. In addition, a strategy has been developed which addresses the upgrading of discharge permit requirements for major industrial and municipal sources, to include limits for toxic substances present in trace amounts.

The non-point source programs are at a less advanced stage. On the New York side, 61 sites have been identified as potential sources of contaminant migration to the river. A systematic program to assess and prevent these sites from contributing contaminants to the river should be undertaken. Since it is difficult to determine whether or not many of these sites are contributing contaminants, this program should concentrate on investigation and remedial activity until it can be clearly demonstrated that

the sites do not have an adverse effect on the river. On the Ontario side, five sites have been identified as having a potential for contaminating the river. Little is known about their impact on groundwater, since sub-surface investigations are incomplete or have not been done.

Contaminated sediments, which are in part the result of past inputs, need to be further investigated to gain a better knowledge of their extent and potential for adverse effect on the river and Lake Ontario. It would be premature to undertake remedial dredging before it is certain that upstream sources are eliminated.

All the general and specific objectives of the Great Lakes Water Quality Agreement of 1978 have not yet been attained and are not likely to be attained within the near future. Eventual attainment of these objectives will require strong commitments by the responsible agencies and the general public on both sides of the river.