1987 Report on Great Lakes Water Quality

Appendix A

Progress in Developing Remedial Action Plans for Areas of Concern in the Great Lakes Basin

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Presented at Toledo, Ohio
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Cette publication peut aussi être obtenue en français.

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Acknowledgements

Remedial action plans (RAPs) for the 42 Areas of Concern in the Great Lakes basin are being prepared by the jurisdictions (i.e. the eight Great Lakes states and the Province of Ontario), with assistance from federal and local governments and concerned citizenry. The Water Quality Board wishes to acknowledge the RAP Coordinators and other members of the RAP writing teams who provided information for this report. In addition, the Board wishes to acknowledge the important contributions of all people working in many different capacities on development of RAPs. It will only be through a cooperative effort that we will be able to achieve our common goals.

Introduction

Since 1973, the Great Lakes Water Quality Board has identified Areas of Concern (originally called 'problem areas') where Great Lakes Water Quality Agreement objectives or jurisdictional standards, criteria or guidelines established to protect uses have been exceeded and remedial measures are necessary to restore beneficial uses. Areas of Concern include the major municipal and industrial centers on Great Lakes rivers, harbours and connecting channels.

The major problems identified in Areas of Concern have changed in parallel to the evolution of scientific knowledge of water quality problems (i.e. from bacterial pollution to eutrophication to toxic substances contamination) and progress in implementing pollution controls. Despite considerable progress, particularly in abating bacterial pollution and cultural eutrophication, the Board reports that there are still 42 Areas of Concern in the Great Lakes basin (Figure 1) where beneficial uses are impaired. Although some Areas of Concern still exhibit bacterial pollution and eutrophication problems, the major problem in 41 of the 42 Areas of Concern today is toxic substances contamination. In addition, there are differences between Areas of Concern in the severity of problems.

In 1985, the Board reported that it was not always clear on how to track and measure progress in Areas of Concern or how to remove one from the Areas of Concern list. In addition, there was at best, limited progress in remediating toxic substances problems in Areas of Concern. To alleviate these problems, the Board adopted a new system of categories for Areas of Concern which represents a logical sequence for problem solving and resolution. The categories identify the status of the information base, programs which are underway to fill in information gaps, and the status of remedial efforts. Remedial action plans are developed in order to address specific use impairments. Resolution takes place when evidence can be presented that the full complement of uses has been restored and the site can be removed from the Areas of Concern list.

As a result of adopting the six category system for classifying Areas of Concern in the 1985 Board Report, the eight Great Lakes states and the Province of Ontario committed themselves to developing a remedial action plan (RAP) to restore all beneficial uses in each Area of Concern within their political boundaries (see Table 1). RAPs will not only identify specific measures necessary to control existing sources of pollution, abate environmental contamination already present and restore beneficial uses, but also present timetables for remedial action implementation to be able to measure progress. Chapter 4 (i.e. Restoration of Areas of Concern) in the 1987 Water Quality Board Report presents an overview of the RAP development program. This appendix to the 1987 Water Quality Board Report has been prepared to present specific information on progress in developing remedial action plans for each of the 42 Areas of Concern. The data and information presented in this appendix is based on RAP status reports received in May 1987. Information is presented on each Area of Concern in the order presented in Table 1. For further details about a particular Area of Concern, the reader is encouraged to contact the RAP Coordinators identified in Annex 1.

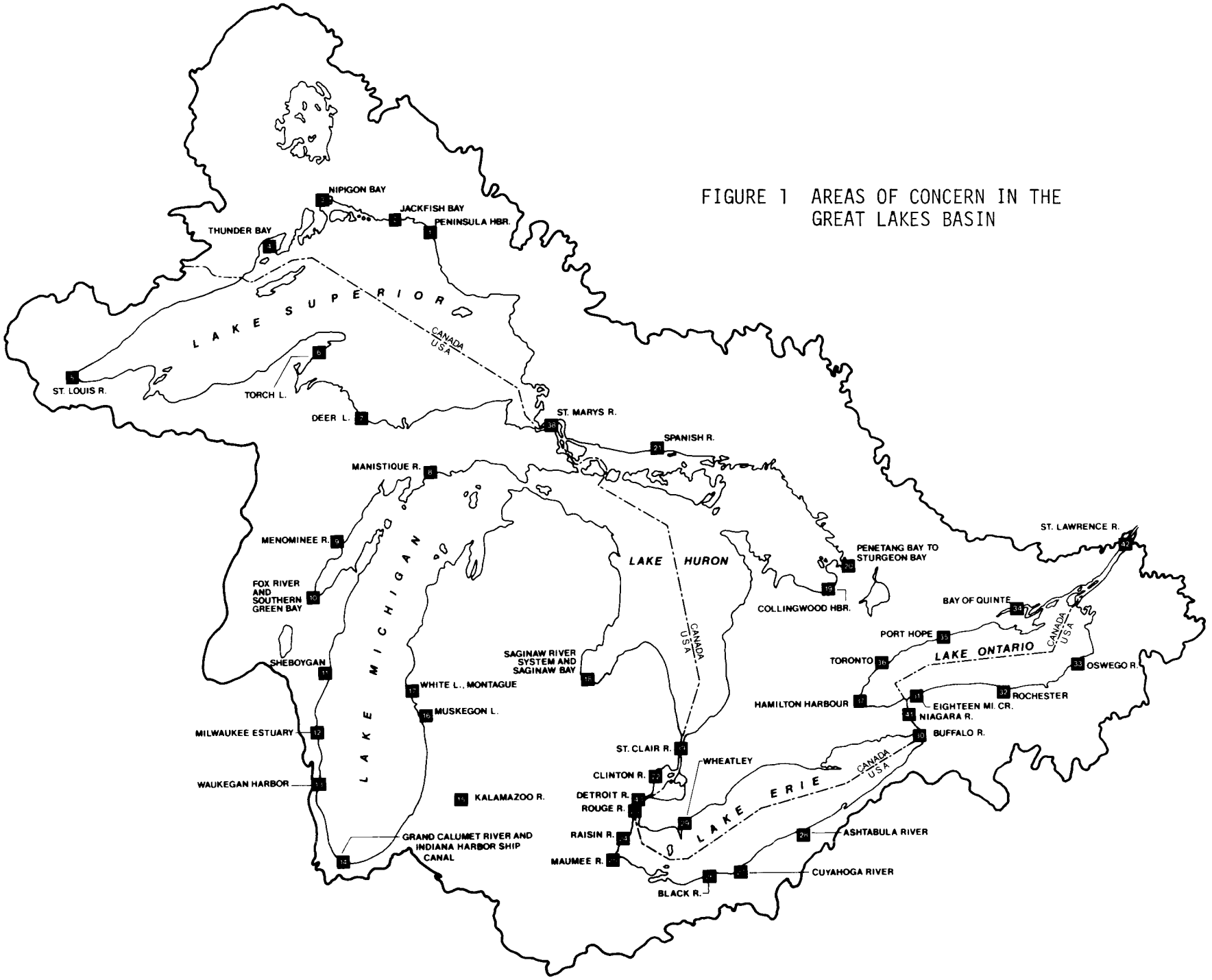

FIGURE 1 AREAS OF CONCERN IN THE GREAT LAKES BASIN

TABLE 1

JURISDICTIONS RESPONSIBLE FOR DEVELOPING REMEDIAL ACTION PLANS
FOR THE 42 AREAS OF CONCERN IN THE GREAT LAKES BASIN

RESPONSIBLE JURISDICTION	AREAS OF CONCERN BY LAKE BASIN	MAP REF. NO.[a]
	Lake Superior	
Ontario	Peninsula Harbour	1
Ontario	Jackfish Bay	2
Ontario	Nipigon Bay	3
Ontario	Thunder Bay	4
Minnesota/Wisconsin	St. Louis River	5
Michigan	Torch Lake	6
Michigan	Deer Lake-Carp Creek-Carp River	7
	Lake Michigan	
Michigan	Manistique River	8
Wisconsin/Michigan	Menominee River	9
Wisconsin	Fox River/Southern Green Bay	10
Wisconsin	Sheboygan	11
Wisconsin	Milwaukee Harbor	12
Illinois	Waukegan Harbor	13
Indiana	Grand Calumet River/Indiana Harbor Canal	14
Michigan	Kalamazoo River	15
Michigan	Muskegon Lake	16
Michigan	White Lake	17
	Lake Huron	
Michigan	Saginaw River/Saginaw Bay	18
Ontario	Collingwood Harbour	19
Ontario	Penetang Bay to Sturgeon Bay	20
Ontario	Spanish River Mouth	21
	Lake Erie	
Michigan	Clinton River	22
Michigan	Rouge River	23
Michigan	River Raisin	24
Ohio	Maumee River	25
Ohio	Black River	26
Ohio	Cuyahoga River	27
Ohio	Ashtabula River	28
Ontario	Wheatley Harbour	29
	Lake Ontario	
New York	Buffalo River	30
New York	Eighteen Mile Creek	31
New York	Rochester Embayment	32
New York	Oswego River	33
Ontario	Bay of Quinte	34
Ontario	Port Hope	35
Ontario	Toronto Waterfront	36
Ontario	Hamilton Harbour	37
	Connecting Channels	
Ontario/Michigan	St. Marys River	38
Ontario/Michigan	St. Clair River	39
Michigan/Ontario	Detroit River	40
Ontario/New York	Niagara River	41
Ontario/New York	St. Lawrence River	42

[a]See Figure 1.

1. PENINSULA HARBOUR

Environmental Assessment

Peninsula Harbour is located on the northeastern shore of Lake Superior, 300 km (186 miles) east of the city of Thunder Bay. The town of Marathon (population: 2,250) is situated on the southeastern shore of the harbour. The principal industry in the town of Marathon is a bleached-kraft pulp mill complex owned by James River-Marathon, Limited. Both the mill and the municipal sewage treatment plant discharge their effluents to Lake Superior, adjacent to Peninsula Harbour.

Prior to 1984, surveys of the Peninsula Harbour area indicated that the main impacts resulting from industrial discharges were bacteriological contamination, aesthetic impairment, mercury accumulation in fish and sediments, and organic enrichment of the lake bottom. The effects of the effluent plume on surface water chemistry were increased dissolved and suspended solids, nutrients, biochemical oxygen demand (BOD), chemical oxygen demand and phenols. The most significant changes in concentrations of these materials were restricted to the vicinity of the outfall.

An intensive study of the effluent plume characteristics in relation to the diffuser outfall was carried out in 1986. Near-field dilutions in the immediate vicinity of the diffuser were approximately 50:1 with dilutions of 1,000:1 being achieved within 4,000 m. Conductivity values in the vicinity of the diffuser ranged from 100 to 125 µmhos/cm, compared to background levels of 65 µmhos/cm. Prior to the installation of the diffuser outfall, conductivities near the point of discharge were as high as 400 µmhos/cm. Drastic reductions in concentrations of other pollutants such as BOD and phenols were also noted in the discharge area.

Bacteria levels were also much reduced in the 1986 survey where fecal coliform and fecal streptococcus levels were 10 and 4 per 100 mL, respectively. Previous levels were as high as 15,000 and 900 organisms per 100 mL, respectively.

Although the in-plant modernization program and the use of the diffuser to dilute the effluent have been successful in eliminating large areas of concentrated contamination, laboratory bioassays of the effluent prior to discharge remain very toxic at 96-hour LC_{50} values of approximately 15%. Results of plume tracking, fish caging and fish netting studies indicate, however, that there are no zones of acute lethality in Lake Superior in the vicinity of the discharge; nor does the effluent appear to represent a chemical barrier to shoreline passage of migrating fish. The benthic populations likewise were largely unaffected.

Prior to 1976, American Can Company of Canada Limited, the previous owner of the kraft mill, also operated a chlor-alkali plant on the mill property adjacent to Peninsula Harbour. Losses of mercury from this system were substantial and resulted in severe contamination of lake sediments and consequently the local fishery. Although recent surveys have indicated some improvements to sediment quality, levels as high as 27 mg/kg (1983 data) of mercury are still occasionally encountered (range in concentation: 0.06 - 27 mg/kg). Localized contamination by PCBs (23 - 690 µg/kg) is also evident. Iron, chromium and nickel concentrations in some of the sediment samples were found to be above open water dredge disposal guidelines. Other contaminants detected in some sediment samples include: dieldrin, HCB and oxychlordane.

In 1976, the year in which the chlor-alkali plant ceased operation, a common size class lake trout from Peninsula Harbour contained an average mercury concentration

of approximately 1.41 mg/kg, well above the Health and Welfare Canada consumption guideline of 0.5 mg/kg. Consequently, the Province of Ontario issued limited consumption advisories for smaller lake trout taken from Peninsula Harbour. Furthermore, the advisory indicated that consumption of large lake trout should be avoided entirely, as their mercury levels would exceed 1.5 mg/kg.

More recent surveys indicate that by 1985 the average mercury concentration in lake trout from Peninsula Harbour had fallen to 0.28 mg/kg. Consequently, current advisories indicate that lake trout under 65 cm in length may be consumed without limitation while those in excess of 65 cm are placed in the limited consumption category.

Concentrations of PCBs in the flesh of lake trout from Peninsula Harbour have decreased in a manner similar to that of mercury body burdens. In 1976, lake trout from Peninsula Harbour contained an average PCB level of 2.04 mg/kg. Larger fish were found to contain PCBs at concentrations as high as 10.0 mg/kg. By 1985 the average lake trout level for PCBs had declined to 0.42 mg/kg. Occasionally large lake trout tested have PCB levels which are somewhat higher than the 2.0 mg/kg consumption objective set by Health and Welfare Canada.

James River–Marathon Limited produces approximately 450 tonnes/day of bleached kraft pulp. The mill currently discharges approximately 65,000 m^3/day of effluent. The BOD load associated with the effluent is approximately 11.5 tonnes/day and the suspended solids loading is approximately 3.0 tonnes/day. In 1985, total phosphorus loadings from the mill were approximately 31.0 kg/day. The company is under a Control Order which governs the BOD, suspended solids and toxicity limits of the discharge until 1989.

The toxicity of the mill effluent has been tested on a routine basis since 1978. Early results indicated that the effluent exhibited a mean 96–hour LC_{50} value of between 30% and 35%. More recent results indicate increasing rather than decreasing toxicity (mean 13.5% $\pm$ 6.5% in seven tests conducted in 1985). The increased toxicity results observed in recent years may be due to the implementation of water conservation programs in the mill.

Historically, the mill discharged their effluent directly to the surface waters of Lake Superior. This resulted in the frequent creation of a stable, buoyant plume. The effluent plume often covered a very large area, was malodorous and unsightly as a result of discoloration and foaming. Under a number of Program Approvals, and recent Control Orders, the company significantly reduced their BOD and suspended solids loading in Lake Superior. In 1984 the company installed a diffuser outfall in order to curtail foaming and to provide rapid dilution of the effluent. The limits obtained in the current Control Order are derived from the Federal Pulp and Paper Regulations.

Improvements to the bleachery (in 1984) have resulted in lower suspended solids, better fiber recovery and a reduction in water use. Improvements to the recaustic areas (in 1986) have resulted in lower suspended solids, and a better spill collection system. General modernization has resulted in a decrease in BOD from 45 kg/t of production to less than 35 kg/t (1987) and less liquid and suspended solid losses to Lake Superior.

The township of Marathon, prior to 1980, discharged approximately 1,360 m^3/day of effluent from its primary treatment plant. The discharge was directly to Lake Superior at Pebbly Beach. In 1981, a new extended–aeration sewage treatment plant with a design capacity of approximately 2,000 m^3/day was commissioned.

The plant was expanded in 1986 to accommodate 4,400 m^3/day of treated effluent. The present discharge from the plant is approximately 1,000 m^3/day. Based on this flow and the 1986 effluent data, loadings to Lake Superior are estimated as 1.19 tonnes/a of BOD, 1.8 tonnes/a of suspended solids, and 1.34 tonnes/a of total phosphorus. A preliminary investigation in the vicinity of the outfall indicates that no water quality impairment is evident as a result of the plant operation. The plant is well designed and consistently meets all Ministry of the Environment requirements.

RAP Development Progress

To date, a considerable amount of available information has been gathered and is being incorporated into the draft RAP. Contact has been made with most of the major industries making them aware of the proposed plan preparations and informing them of their opportunity to provide input. The Ministry of Natural Resources member of the RAP team has delivered a presentation to the Lake Superior Fisheries Management Committee informing them of the RAP process and the need to evaluate existing fisheries information. A two-day workshop for all RAP team members for northern Lake Superior was held to prepare draft plans. Subsequently, a RAP summary was completed. Public meetings were held to obtain input for incorporation into the next draft scheduled for completion in June 1987.

Field survey requirements include:

A. An evaluation of the sewage treatment plant discharge at Marathon was conducted during the summer of 1986. A report is in preparation.

B. James River-Marathon Limited completed a study of receiving water quality in relation to the new diffuser outfall during the summer of 1986. The report was completed in December 1986.

C. The Ministry of the Environment recently conducted pre- and post- diffuser water quality studies and consequently there is no need for additional conventional water quality investigation at this time.

D. The outstanding issue of the mill effluent toxicity with respect to the Municipal-Industrial Strategy for Abatement (MISA) and other existing regulations is to be resolved.

E. Evaluation of mercury and PCB contamination of sediments and fish will be conducted in 1987.

F. Evaluation of the potential impact from solid waste handling at James River Corporation on the waters of Peninsula Harbour will be conducted in 1987.

Two other major issues need to be evaluated:

1. The long-standing issue of sublethal effects resulting from the discharge of trace organic contaminants to Lake Superior waters needs to be resolved.

2. Since the fishery in northern Lake Superior may be one of the most important resources in the Areas of Concern, from a recreational standpoint, considerable study of the fisheries communities is required. Ministry of Natural Resources is preparing an inventory of data pertaining to the fisheries communities and will be preparing a proposal to conduct

additional studies to fill in information gaps. It is anticipated that any major work will not proceed until 1988.

RAP Timetable

ACTIVITY	DATE
Remedial Actions and Investigations:	
Workshop – RAP writing team members – Thunder Bay.	February 1987
Completed description of Area of Concern (Environmental Conditions).	February 1987
Environmental Summary Report submitted to RAP Steering Committee.	March 1987
Initiate field investigations. a) Evaluate sediment contamination in Peninsula Harbour. Analyze for mercury and PCBs. b) Investigate the waste management practices at the wood waste site. Sample for leachate migration. c) Study contaminants in fish found in the area.	September 1987
Complete identification of major pollution sources.	September 1987
Complete evaluation of 1987 field data.	February 1988
Complete draft RAP.	January 1989
Submit draft RAP to Canada–Ontario Agreement Review Board.	March 1989
Finalization of RAP.	September 1989
Canada–Ontario Agreement review of final RAP	December 1989
Transmittal of final RAP to IJC's Water Quality Board.	January 1990
Public Involvement:	
Identification of public consultation framework and stakeholders.	July 1987
Provide stakeholders with information packages on Area of Concern.	September 1987
Public consultation of use goals.	January 1988
Provide description of remedial options for review.	March 1988
Public consultation on remedial options.	May 1988
Public review of draft RAP.	May 1989

2. JACKFISH BAY

Environmental Assessment

Jackfish Bay is located on the north shore of Lake Superior, approximately 250 km (155 miles) east of the city of Thunder Bay. The bay covers approximately 10 km^2 (3.9 square miles) and is divided into two arms: Moberly Bay on the west and Tunnel Bay on the east. Moberly Bay receives the drainage from the Blackbird Creek system, which has carried wastewater discharges from the Kimberly-Clark Canada Limited pulp and paper operations since the mill's inception in 1948. The Blackbird Creek drainage area encompasses 62 km^2 (24 sq. mi.) of rough wooded terrain.

A report issued by Ontario Ministry of the Environment (MOE) in 1969 made two significant conclusions about Jackfish Bay. The first was that the observed physical, chemical and biological conditions indicated the presence of toxic and organic pollution throughout Moberly Bay and the second was that the Blackbird Creek system was incapable of assimilating or reducing waste components to the extent necessary for the adequate protection of Jackfish Bay waters. The waters were characterized during that time as turbid, laden with suspended materials, malodorous and supporting high bacterial populations. The stream bottom sediments, furthermore, were blanketed with wood wastes throughout the 15 km (9 miles) reach of the system.

The Kimberly-Clark mill at Terrace Bay was almost completely destroyed by a fire in 1981 and has subsequently been rebuilt. Improvements in their operations have reduced the loads of biochemical oxygen demand (BOD), suspended solids and dissolved solids being discharged; however, water quality investigations in 1981 and 1984 revealed that under normal operating conditions, the ability of the Blackbird Creek system to assimilate oxygen demanding waste continues to be taxed far beyond its natural limit. Furthermore, no aquatic life has been detected in the creek or small lakes which form part of the Blackbird Creek system with the exception of microorganisms and occasionally, the rattailled maggot.

An area of Moberly Bay and Jackfish Bay of approximately 5 km^2 (1.9 square miles) has been altered to an extent where normal clean water bottom dwelling organisms are not able to survive and have been replaced by pollution-tolerant forms as a result of direct toxic influence of the effluent or deposition of organic wastes.

An Ontario MOE investigation of trace contaminants in pulp and paper effluents was conducted in 1982. The results indicated that the Kimberly-Clark effluent contained varying levels of toxic organic substances. Of the many pollutants tested, chlorinated phenolics and resin and fatty acids have been identified as being of particular concern.

The toxicity of the Kimberly-Clark effluent (discharged at Highway 17) as well as the toxicity of Blackbird Creek entering Lake Superior has been tested frequently during the last decade. Based on the most recent bioassay data (1984-1986), 96-hour LC_{50} values ranged from <10 - 45.6%.

Toxicity testing was conducted in 1983 by placing caged rainbow trout into Moberly Bay waters. These studies indicated toxic conditions in surface waters along the western shore of Jackfish Bay to Cody Island. Depressed dissolved oxygen levels were thought to affect the results and likely acted in combination with toxic constituents (such as resin acids) to produce the fish lethality observed in the field. The maximum distance from the Blackbird Creek discharge into Lake Superior at which 100% fish mortality was observed was 1.5 km. In addition, test fish which

survived showed accumulations of chlorophenols. Improvements in Kimberly-Clark effluent toxicity since 1983 should result in improved conditions in Jackfish Bay.

Concentrations of fecal coliform bacteria above the Provincial Water Quality Objective of 100 counts/100 mL (for total body contact recreation) were found to extend into Lake Superior, approximately 5 km (3 miles) from the mouth of Blackbird Creek.

A survey conducted in 1981 indicated that Jackfish Bay sediments contain significant levels of contaminants. Levels of chromium, iron, copper, oil and grease, chemical oxygen demand and total phosphorus exceeded accepted guidelines used to evaluate the suitability of dredged material for open water disposal. A survey of total Kjeldahl nitrogen (TKN), zinc, cadmium and mercury also found levels exceeded guidelines in a localized area near the mouth of Blackbird Creek.

A limited consumption advisory for lake trout greater than 45 cm is in effect for Jackfish Bay due to mercury exceeding 0.5 mg/kg (based on 1976 data). Lake whitefish and cisco, however, are suitable for unlimited consumption. In a 1983 study, PCBs were detected in young-of-the-year spottail shiners at 80 µg/kg (the Great Lakes Water Quality Agreement aquatic life objective is 100 µg/kg).

Effluent discharges have caused destruction of fish habitat in the Moberly Bay area and created a toxic environment to clean water organisms. Some improvement was noted between the 1973 and 1981 sediment information, however, sediment type was not considered and may account for the changes. The conditions will be further evaluated in summer 1987.

In addition to fisheries interest, the adjoining bay area is also utilized by diving clubs. These groups would like the turbidity in the area improved.

RAP Development Progress

To date, a considerable amount of available information has been gathered and is being incorporated into the draft RAP. Contact has been made with most of the major industries in the area, making them aware of the proposed plan preparations and informing them of their opportunity to provide input. The Ministry of Natural Resources (MNR) member of the RAP team delivered a presentation to the Lake Superior Fisheries Management Committee informing them of the RAP process and the need to evaluate existing fisheries information. A two-day workshop for all RAP team members for northern Lake Superior was held to prepare draft plans. Subsequently, a RAP summary was completed. Public meetings were held to obtain input for incorporation into the next draft scheduled for completion in June 1987.

Field survey requirements include:

A. Ontario MOE planned a major survey of Jackfish Bay during the summer of 1987. The survey was intended to update the status of water quality as well as detailing the contamination of sediments and effects on biota in this area.

B. Kimberly-Clark Limited is commited to providing an update of water quality of Jackfish Bay through a survey to be conducted in the summer of 1989. The company is obligated to report on this work as part of their 1987 Control Order.

C. Toxicity evaluations of the Kimberly-Clark effluent are ongoing. The end-of-pipe results will be used to determine compliance with the federal regulations and to predict effects in the field.

Two other major issues need to be examined include:

1. The long-standing issue of sublethal effects resulting from the discharge of trace organic contaminants to Lake Superior water needs to be resolved.

2. Since the fishery in northern Lake Superior may be one of the most important resources in the Areas of Concern, from a recreational standpoint, considerable study of the fisheries communities is required. The MNR is preparing an inventory of data pertaining to the fisheries communities and will, in addition, be preparing a proposal to conduct additional studies to fill information gaps. The costs of these studies are as yet unknown; however, it is anticipated that any major work will not proceed until 1988.

Kimberly-Clark of Canada Limited operates a kraft pulp mill at Terrace Bay which discharges its effluent into the Blackbird Creek system approximately 15 km (9 miles) upstream of the Blackbird Creek inlet to Jackfish Bay. The Kimberly-Clark mill is designed to produce approximately 1,135 tonnes per day of bleached kraft pulp. Average discharges of mill effluent contain an approximate load of 30 tonnes of BOD and 5.8 tonnes of suspended solids per day. In addition, loadings of considerable amounts of organic contaminants are discharged. This operation represents the sole discharge of point source pollutants to Jackfish Bay.

A Control Order was first issued to Kimberly-Clark in 1979, limiting the discharge of suspended solids and BOD. A subsequent Order in 1982 required further reductions in BOD and suspended solids and toxicity requirements, bringing the company into compliance with the Federal Pulp and Paper Regulations.

Steps taken by Kimberly-Clark include: completion of a spill control system for number 2 mill; improved spill recovery; improved bleachery operations with high chloride dioxide ($C10_2$) substitution; improvements to number 1 and number 2 brown stock washers; and installation of a knot recycle system. Collectively, these improvements have allowed the company to meet the BOD requirements. In 1984, the addition of a polymer feed system further improved the operating efficiency of the clarification system and a spill collection system was installed. This system includes the area where black liquor and turpentine can enter the mill sewer system. In 1986, a brown stock washer closure was installed to control effluent from the pulp mill. After the installation of the washer closure, the loading of BOD to a total mill effluent did not exceed an average of 30 kg/air dried tonne of pulp produced per day.

A new Control Order has just been issued to Kimberly-Clark directing them to continue compliance with the Federal Pulp and Paper Regulation. Kimberly-Clark must continue to meet the BOD loading requirement of 30 kg/air dried tonne throughout the Order and must reduce their suspended total solids load to 7.0 t/day. Continued reductions in effluent toxicity will also be required.

RAP Timetable

ACTIVITY	DATE
Remedial Actions and Investigations:	
Workshop – RAP writing team members – Thunder Bay.	February 1987
Completed description of Area of Concern (environmental conditions).	February 1987
Environmental Summary Report submitted to RAP Steering Committee.	March 1987
Initiate field investigations exposure to clams for trace organic uptake.	May 1987
a) Evaluation of contaminants in fish. b) Preliminary water quality evaluation.	August 1987 August 1987
Complete identification of major pollution sources.	September 1987
Complete evaluation of 1987 field data.	February 1988
Detailed water quality investigation.	June 1988
Complete Draft RAP.	January 1989
Submit Draft RAP to Canada–Ontario Agreement Review Board.	March 1989
Finalization of RAP.	September 1989
New Control Order will be issued to Kimberly–Clark Ltd.	December 1989
Canada–Ontario Agreement review of final RAP.	December 1989
Transmittal of final RAP to IJC's Water Quality Board.	January 1990
Public Involvement:	
Identification of public consultation framework and stakeholders.	August 1987
Provide stakeholders with information packages on Area of Concern.	September 1987
Public consultation of use goals.	January 1988
Provide public with description of remedial options.	May 1988
Public consultation on remedial options.	June 1988
Public review of Draft RAP.	April 1989

3. NIPIGON BAY

Environmental Assessment

Nipigon Bay lies on the north shore of Lake Superior in the District of Thunder Bay. Two towns are located in the vicinity of Nipigon Bay: Nipigon, with a population of approximately 2,500, is situated adjacent to Highway 11/17 near the Nipigon River, while the town of Red Rock is located near the river mouth. A pulp and paper mill is owned and operated by Domtar Packaging Limited in Red Rock adjacent to Nipigon Bay. The discharge from the Domtar plant as well as discharges from two municipally operated sewage treatment plants are the only point sources of pollution to Nipigon Bay. Asthetics, odour problems and the fishery are the major environmental concerns in Nipigon Bay.

The Domtar Red Rock mill is a dual-product mill with a capacity to produce 600 tonnes of kraft liner board and 175 tonnes of newsprint per day. Domtar discharges an effluent volume of up to 85,000 m^3/day into a shallow area of Nipigon Bay. A Control Order was first issued to Domtar in 1976, with subsequent Orders prepared in 1980 and 1986. These Orders required staged reduction in biochemical oxygen demand (BOD), suspended solids and toxicity. The Control Order issued on the Domtar mill in 1986 limits the BOD, suspended solids and toxicity of the effluent discharged to 23.0 tonnes/day, 5.5 tonnes/day and a 96 hour LC_{50} of 100%, respectively. The limits defined in the new Control Order are based on a combination of federal and provincial requirements.

The town of Red Rock discharges approximately 400 m^3/day of effluent, following primary treatment, to Nipigon Bay via a ditch which also services the Domtar mill. The concentrations of both BOD and suspended solids are 35 mg/L. The town of Nipigon discharges the effluent from its sewage treatment plant to the Nipigon River. Loadings of BOD and suspended solids are 30.0 and 32 kg/day, respectively. Effluent from the plant meets the requirements for a primary treatment facility.

Nipigon Bay has been the subject of several water quality studies over the last two decades. The Ontario Water Resources Commission, which preceded the Ontario Ministry of the Environment (Ontario MOE), conducted a biological survey in 1966 and 1967. The survey indicated severe impairment of water quality as evidenced by tainted fish flesh, extensive deposition of wood fibre on the lake bottom and high concentrations of oxygen-consuming and odour-causing materials in surface waters. At that time the effluent from the mill entered the bay without any significant treatment of wastewater.

The most recent detailed survey of Nipigon Bay water quality was conducted by Ontario MOE in 1983. Critical findings in this study relate to chemical quality of waters in the vicinity of the mill, toxicity to fish and effluent plume configuration.

The 1983 survey indicated that the water quality (as assessed by conventional parameters) in those areas of Nipigon Bay impacted by the Red Rock mill had improved substantially, in relation to the quality found during earlier surveys. Despite changes and improvements in water quality, violations of the Provincial Water Quality Objectives for phenols, total coliform bacteria and several metals were observed in a number of locations in the bay. Concentrations of reactive phenolics exceeded Provincial Water Quality Objectives up to 3.9 km (2.5 miles) from the mill outfall and were found up to 6 µg/L in the vicinity of the water treatment plant intake for the Town of Red Rock.

Resin and fatty acids are other pollutants of concern, since they are the principal substances responsible for toxicity in pulp and paper mill effluents. Several resin and

fatty acids were found in receiving waters at concentrations which are known to be toxic to fish. In addition, organoleptic chlorophenols were found in concentrations near the outfall at concentrations which have been shown to taint fish flesh. Poor dispersion of the effluent plume in Nipigon Bay appears to be a significant problem. Improved dispersion would reduce the area of noncompliance with Provincial Water Quality Objectives. The mill continues to work towards reducing the loadings of contaminants.

The toxicity of Domtar mill effluent has been regularly monitored since 1974. Static testing with the use of rainbow trout and laboratory bioassays has shown that the effluent quality frequently meets the provincial objective for toxicity.

Studies of Nipigon Bay sediments have identified organic fibers in all bottom samples collected within 1.5 km (0.9 miles) of the Domtar mill outfall. Bark and/or wood chips were found in the top 10 cm of most samples within 6 km (3.7 miles) of the outfall. Decreased concentrations of major elements were noted near the outfall due to the dilution of the inorganic fraction by the increasing amount of organic material. Sulphur levels showed direct correlations with proximity to the mill outfall. The organic carbon levels were higher towards the outfall, with levels as high as 31%. Concentrations of copper, nickel and lead were uniform across the study area ranging from 29 to 41, 6 to 69, and 11 to 42 mg/g, respectively. Concentration of mercury averaged 50 µg/kg in the river mouth samples and approximately 120 µg/kg in Nipigon Bay below the Domtar mill outfall.

Elevated levels of resin acids in sediments in the vicinity of the mill were also identified. An examination of sediments adjacent to the Domtar mill with respect to resin acid concentration indicated that the mill was the primary source of contaminants.

Collections in 1978 indicated there was no need for consumption limitations of lake whitefish, round whitefish, cisco, or lake trout. There was a need, however, for a limited consumption advisory for yellow perch over 30 cm, whose mercury levels were over 0.5 mg/kg. Since 1978, limited fish contamination data have been collected, however, yellow perch and white suckers were gathered in 1986 in the vicinity of the Domtar mill's outfall. Results for Hg, PCBs, mirex, other chlorinated hydrocarbon pesticides and dioxins should be available by mid-1987. Low levels of PCBs were found in young-of-the-year spottail shiners collected from Nipigon Bay in 1979 and 1983.

Nipigon Bay once supported a wide variety of fish species including lake trout, walleye, lake whitefish and lake herring. These species became extinct in Nipigon Bay many years ago. Through the electrofishing operations conducted during the summer of 1986, 158 fish representing 20 species were found including several species indicative of good water quality, thus suggesting some improvement in water quality conditions.

RAP Development Progress

To date, a considerable amount of available information has been gathered for inclusion in a draft RAP. Contact has been made with most of the major industries in the area, making them aware of the proposed plan preparations and informing them of their opportunity to provide input. The Ontario Ministry of Natural Resources member of the RAP team delivered a presentation to the Lake Superior Fisheries Management Committee informing the fisheries managers of the RAP process and the need to evaluate existing fisheries information. A two-day workshop for all the RAP team members for northern Lake Superior was held to assist in RAP preparation. A

summary report has been completed. Meetings with appropriate groups to obtain public input for incorporation into the draft of the RAP were held in June 1987.

Field survey requirements for completion of the RAP include:

1. A water quality survey of Nipigon Bay dealing with: a) effluent plume chemistry; and b) condition of the benthic community (conducted under contract to Ontario MOE in 1986; a report is in preparation and will be incorporated into the RAP).

2. An evaluation of the Trout Creek system with respect to contaminant input from woodwaste leachate at Red Rock will be conducted in 1987. It has been postulated that contaminants from the woodwaste storage have contributed to taste problems in the Red Rock municipal water supply.

3. An evaluation of the contribution of the Nipigon Sewage Treatment Plant to contamination of the Nipigon River and Nipigon Bay will be conducted in 1987.

4. Synoptic examination of sediment contamination in the vicinity of the Domtar mill at Red Rock will be conducted in 1987.

Two other major issues which need to be examined include:

1. The long-standing issue of sublethal effects resulting from the discharge of trace organic contaminants to Lake Superior waters needs to be resolved.

2. Since the fishery in northern Lake Superior may be one of the most important resources in the Areas of Concern (from a recreational standpoint), it has become clear that considerable study of the fisheries communities is required. The Ministry of Natural Resources is preparing an inventory of data pertaining to the fisheries communities and will be preparing a proposal to conduct additional studies to fill in information gaps. It is anticipated that any major work will not proceed until 1988.

RAP Timetable

ACTIVITY	DATE
Remedial Actions and Investigations:	
Workshop - RAP writing team members - Thunder Bay.	February 1987
Completed description of Area of Concern (Environmental Conditions).	February 1987
Environmental Summary Report submitted to RAP Steering Committee.	March 1987
Evaluate sediment quality in area of municipal water supply intake.	September 1987
Evaluate potential effects of leachate from woodwaste handling.	September 1987

Determine effects of sewage treatment plant discharge to Nipigon River.	September 1987
Complete identification of major pollution sources.	September 1987
Complete evaluation of 1987 field data.	February 1988
Complete draft RAP.	January 1989
Submit draft RAP to Canada–Ontario Agreement Review Board.	March 1989
Finalization of RAP.	September 1989
Canada–Ontario Agreement review of final RAP.	December 1989
New Control Order will be issued to Domtar Ltd.	December 1989
Transmittal of final RAP to IJC's Water Quality Board.	January 1990

Public Involvement:

Identification of public consultation framework and stakeholders.	September 1987
Provide stakeholders with information packages on Area of Concern.	October 1987
Public consultation of use goals.	February 1988
Provide public with description of remedial options.	April 1988
Public consultation on remedial options.	May 1988
Public review of draft RAP.	February 1989

4. THUNDER BAY (KAMINISTIKWIA RIVER)

Environmental Assessment

Degraded water quality in Thunder Bay is impacting an area close to the shore of Lake Superior and radiating out from the Kaministikwia River delta. The zone of influence extends as far east as the Welcome Islands. Conditions which approach background levels are found east of the Welcome Islands and to the south, near Pie Island and open Lake Superior.

This area of degradation is characterized by waters where the Provincial Water Quality Objectives are frequently exceeded with respect to bacteria and trace organic and inorganic contaminants.

Trace organic compounds and chlorophenols are found in waters extending northeast from Grand Point and including the Welcome Islands. The source of these materials is likely associated with discharges of pulp and paper mill wastes.

The largest single source of impaired water quality entering Thunder Bay harbour is via the Kaministikwia River system. The Kaministikwia River receives a number of discharges, the largest of which is from the Great Lakes Forest Products pulp and paper mill complex. Discharges into Kaministikwia River continue to result in dissolved oxygen depletion during summer low flows. The rivers of the Kaministikwia delta are further characterized by high concentrations of nonconventional contaminants associated with the pulp and paper industry in general.

Although bacteria levels have substantially decreased during the past decade as a result of improved treatment of municipal wastes, bacteria levels in the lower Kaministikwia River, in the vicinity of the pulp and paper mill discharges, continue to be high. The bacterial assessments, however, are complicated by the fact that Klebsiella bacteria, which are present in pulp and paper mill effluents, are included in the counts of total or fecal coliforms.

Recent assessments of nutrient concentrations in Thunder Bay indicate that although total phosphorus concentrations remain high in the lower Kaministikwia River, eutrophication is not a problem. Trend analyses based on weekly sampling of intake waters from the Bare Point pumping station in the northern part of Thunder Bay harbour showed no significant increases in total phosphorus or total Kjeldahl nitrogen from 1980–1984 and, as expected, no apparent increases in phytoplankton biomass. In general, phytoplankton production in Thunder Bay waters is low and does not represent a nuisance condition.

Sediment quality in Thunder Bay harbour and inflowing rivers has been extensively investigated over the last 15 years in response to concerns over dredge–spoil disposal. Early surveys indicated that Thunder Bay sediments, particularly in the vicinity of the Kaministikwia, McKellar and Mission Rivers were severely contaminated with mercury as a result of discharges from a Dow Chemical plant which operated upstream. Survey results indicated that sediments from many of these areas were unacceptable for open water disposal of dredge spoils. The creation of a confined dredge disposal facility in 1978 served as a repository for much of the contaminated sediment. Levels of mercury measured in 1979 had dropped considerably as a result of physical removal and natural dispersion mechanisms. Based on a 1979 Ontario Ministry of the Environment survey, elevated PCB and organochlorine concentrations are found in sediments in the Kaministikwia River and the northern inner harbour. Where mercury

concentrations did not restrict open water disposal, PCBs in these areas resulted in the decision to confine dredged spoils.

Surveys of the benthic communities in the Kaministikwia, Mission and McKellar Rivers and Thunder Bay were conducted by government agencies and consultants from 1965 to 1986. The dominant benthic organisms in these three rivers were ones typically found in organically-enriched sediments and waters with reduced oxygen levels. The densities of these animals generally decreased with distance downstream from the outfall of Great Lakes Forest Products, whereas the numbers of less tolerant species such as clams, snails and amphipods increased. The benthic communities in the inner harbour and nearshore areas of the City of Thunder Bay were comprised of both pollution tolerant and semi-tolerant organisms. Overall, the composition of the benthos indicated that moderate levels of organic enrichment occur in the sediments of this area.

Based on 1985 collections, walleye up to 45 cm in length from the Kaministikwia and Mission River mouths are suitable for unlimited consumption, larger walleye exceed 0.5 mg/kg mercury and limited consumption is advised. A similar situation is seen for white sucker. Northern pike up to 55 cm are suitable for unlimited consumption, but those over 55 cm are suitable for limited consumption due to elevated mercury levels. No PCB or organochlorine pesticide problems were noted and 2,3,7,8-TCDD was not detected.

The fisheries have been reduced in the lower Kaministikwia River. There is a great potential for the fishery to expand if water quality improves. The 1986 electrofishing study identified the area to the east of the Kaministikwia River as the most productive in terms of total numbers of fish caught and species diversity. From the 18 electrofishing runs, 1,635 fish of 25 species were identified; however, the study failed to find several species previously found by the Lakehead Region Conservation Authority.

Water temperatures are not suitable for most contact water sports, thus recreational use has only been minimally affected.

The degradation of environmental quality in Thunder Bay is largely from sources relating to the discharges from the forest products industries and to a lesser extent from the municipal wastewater handling facilities. There are eight major industrial point sources of pollutants to Thunder Bay, including four pulp and paper mills, a thermal generating station, a wood preserving operation, a chemical manufacturer and a flour processing plant.

Pulp mill effluents from Great Lakes Forest Products Limited, Abitibi-Price Thunder Bay Division, Abitibi-Price Provincial Paper, and Abitibi-Price Fort William Division contain conventional pollutants (BOD, suspended solids, phenols, and bacteria) as well as trace contaminants. While the effects of the conventional pollutants are generally well known, further study is required to assess the impact of the trace contaminants present in the effluents from these pulp mills on Thunder Bay water quality. Ontario Hydro's Thunder Bay thermal generating station is primarily a source of thermal pollution, although a more rigorous assessment of the effluent from this source may identify conventional pollutants.

The three Abitibi mills are under Control Orders for BOD and suspended solids discharges. Ogilvie Mills Limited is presently in compliance with their Control Order which limits BOD discharges to 900 kg/day. Reichhold should soon be connected with

the municipal sewer and is presently working towards reducing suspended solids. Great Lakes Forest Products Limited will come under a new Control Order in December 1987 to limit discharges to the Kaministikwia River.

The Northern Wood Preservers Inc. operation was identified in a 1984 Environment Canada survey as a source of dioxins, furans, pentachlorophenol, creosote and other toxic substances to Thunder Bay. The Ontario Ministry of the Environment is currently engaged in a study to identify sources and mechanisms of pollutant deposition, to delineate the extent of the contamination, and to develop an abatement and rehabilitation strategy. A field survey took place in 1986, and additional sediment sampling was planned for summer 1987.

Northern Wood Preservers Inc. will come under a new Control Order following evaluation of the 1986–87 survey data. Discharges of phenols and pentachlorophenols will be limited and direction will be given regarding sludge handling.

Most of the domestic sewage collected from the city of Thunder Bay receives primary and tertiary treatment before being discharged into the Kaministikwia River. Treated sewage flows being discharged from the expanded sewage treatment plant average 100,000 m^3/day. There is one direct discharge of untreated sewage to Thunder Bay. Three residences are on the system; flows from this source are estimated at approximately 1,375 L/day. There are three untreated sewers discharging to the Kaministikwia River. These sewers will be integrated into the municipal system in the near future and the wastes treated prior to discharge. Work commenced summer 1987 to connect two of the dischargers.

RAP Development Progress

A considerable amount of available information has been gathered and will be included in the draft RAP. Most of the major industries have been made aware of the proposed plan preparations and their opportunity to provide input. Highlights of activities related to RAP development include:

1. The Ontario Ministry of Natural Resources member of the RAP team delivered a presentation to the Lake Superior Fisheries Management Committee informing them of the RAP process and the need to evaluate existing fisheries information.

2. A two–day workshop for all the RAP team members for northern Lake Superior was held to prepare a draft plan.

3. A RAP summary was completed.

4. Meetings with appropriate groups to obtain public input for incorporation into the next draft of the plan were scheduled for June 1987.

Field survey requirements include:

A. Ministry of the Environment staff will continue to evaluate the significance of trace contaminants at Northern Wood Preservers. A study of the property and contaminated sediments was initiated in 1986 in response to a status report prepared by Environment Canada. Field activities will be complete in 1987.

B. Field studies of water quality in the Kaministikwia River and associated inner Thunder Bay harbour commenced in 1985 and were completed in 1986. The data evaluation is ongoing. The results will establish the need for additional work.

C. A study of the Kaministikwia River with respect to water usage is expected to be contracted out by the Ministry of the Environment in 1987. This study should result in a water management proposal which will balance the needs of cottagers in upstream areas, Ontario Hydro at Kakabeka Falls and Great Lakes Paper in the lower Kaministikwia River.

D. Following an evaluation of all existing data, the need for additional survey work will be assessed. It is anticipated that the bulk of new survey work will be conducted in 1988.

Two other major issues which need to be addressed include:

1. The long-standing issue of sublethal effects resulting from the discharge of trace organic contaminants to Lake Superior waters needs to be resolved.

2. Since the fishery in northern Lake Superior may be one of the most important resources in the Areas of Concern, from a recreational standpoint, it has become clear that considerable study of the fisheries communities is required. The Ministry of Natural Resources is preparing an inventory of data pertaining to the fisheries communities and will be preparing a proposal to conduct additional studies to fill in information gaps. It is anticipated that any major work will not proceed until 1988.

RAP Timetable

ACTIVITY	DATE
Remedial Actions and Investigations:	
Workshop – RAP Writing Team Members – Thunder Bay.	February 1987
Completed description of Area of Concern (Environmental Conditions).	February 1987
Environmental Summary Report submitted to RAP Steering Committee.	March 1987
Initiate field investigations: a) Evaluate sediment contamination at Northern Wood Preservers. b) Initiate data collection from Kaministikwia River respecting assimilative capacity, flow augmentation, loading of toxic materials and available fisheries habitat. c) Conduct detailed assessment of effluent toxicity at four pulp and paper mills.	June 1987
Complete identification of major pollution sources.	September 1987

Issue new Control Order to Great Lakes Forest Products.	December 1987
Issue new Control Order to Northern Wood Preservers.	December 1987
Complete evaluation of 1987 field data.	February 1988
Complete draft RAP.	January 1989
Submit draft RAP to Canada–Ontario Agreement Review Board.	March 1989
Finalization of RAP.	September 1989
Canada–Ontario Agreement review of final RAP.	December 1989
Issue new Control Order to the three Abitibi mills.	December 1989
Transmittal of final RAP to IJC's Water Quality Board.	January 1990
Public Involvement:	
Identification of public consultation framework and stakeholders.	November 1987
Provide stakeholders with information packages on Area of Concern.	December 1987
Public consultation of use goals.	March 1988
Provide public with description of remedial options.	August 1988
Public consultation on remedial options.	September 1988
Public review of draft RAP.	March 1989

5. ST. LOUIS RIVER/BAY

Environmental Assessment

St. Louis River and Bay is located at the western end of Lake Superior. Beneficial uses impaired in St. Louis River and Bay include human consumption of fish and dredging for navigational purposes (due to contaminated sediments).

The fishery of St. Louis Bay is impacted by toxic substances contamination. Minnesota has issued the following health advisories on fishes from the St. Louis River and St. Louis Bay:

Body of Water	Species	Contaminants
St. Louis River – upstream of Brookston	15–20" shorthead redhorse sucker	PCBs, Hg
St. Louis Bay	15–20" walleye	PCBs
	15–20" white sucker	PCBs
	15–30" northern pike	PCBs, Hg

These species of fish from Lake Superior proper do not have high levels of toxic substances and, therefore, Minnesota has not issued a public health advisory for them.

Recent data collected as part of the U.S. Environmental Protection Agency (EPA) National Dioxin Study have shown the presence of low concentrations of 2,3,7,8–tetrachlorodibenzo–p–dioxin in flesh of fish taken from the bay. Dioxin has been found in whole carp tissue samples up to 15.0 ng/kg. The beneficial use most impaired in St. Louis Bay is the consumption of fish.

Young–of–the–year spottail shiners sampled in 1983 were found to have PCB levels of 0.275 mg/kg, which are above the Great Lakes Water Quality Agreement Objective of 0.1 mg/kg and were the highest found in any of the 11 nearshore areas sampled on Lake Superior.

St. Louis Bay water quality has been affected primarily by historical discharges from local industrial and municipal sources. St. Louis River water clarity above the zone of dischargers is fairly good, yet the water is stained slightly brown due to high content of humic acids and related naturally occurring compounds. Water quality data generally show no significant problems, although past data have indicated elevated levels of mercury were found at some stations.

Sediment data collected by the Minnesota Pollution Control Agency (MPCA) were compared to concentrations listed in "Guidelines for Pollutional Classification of Great Lakes Harbour Sediments." The criteria showed St. Louis Bay to be moderately to heavily polluted with arsenic, chromium, and copper at most sites sampled. The sediment near the Western Lake Superior Sanitary District (WLSSD) outfall is heavily polluted with PCBs, arsenic, cadmium, chromium, copper, mercury and lead. Some sediment in St. Louis Bay is contaminated with PAH compounds due to former activities of an iron coking facility. Contaminated sediment is the major concern for St. Louis Bay and, therefore, should be the focus of remedial actions.

RAP Development Progress

Originally, St. Louis Bay was designated an Area of Concern due to elevated loadings of suspended solids, nutrients and biochemical oxygen demand directly into the bay by various industries and communities. This pollution had significant adverse impacts on the beneficial use of the fisheries of the bay. The polluted conditions placed severe stress on the fish populations inhabiting the area and caused fish kills during low flow conditions. In the early 1970s, the adverse impacts of the pollution and objectional taste of fish caught in the bay caused little or no sportfishing to occur.

In the mid-to-late 1970s, several actions caused remarkable improvement in the water quality and fisheries of St. Louis Bay:

1. Formation of the Western Lake Superior Sanitary District (WLSSD).

2. Consolidation of the treatment of a majority of the municipal and industrial discharges at a single facility with a single discharge.

3. Construction and operation of an advanced wastewater treatment system to treat the consolidated discharges.

These actions greatly improved the quality of St. Louis Bay water and fisheries. For example, from little or no sportfishing in the early 1970s angling pressure rose to 37,000 hours with a harvest of 46,000 fish in 1978. Creel surveys in 1980 and 1981 have showed stabilized levels of approximately 29,000 angling hours and 23,000 fish caught annually.

Two sites of improper hazardous waste disposal are being addressed by the MPCA. The U.S. Steel site and the Interlake site have been consolidated by the U.S. EPA into one hazardous waste site which has been named the St. Louis River site on the National Priorities List of Superfund. The U.S. Steel site and the Interlake site are also on the MPCA Permanent List of Priorities for remedial action and cleanup. At the Interlake site, the owner has cleaned up surficial deposits of coal tar material and the Remedial Investigation and Feasibility Study work order has been issued (see RAP timetable for schedule). At the U.S. Steel site, the Remedial Investigation and Feasibility Study has been initiated (see RAP timetable for schedule). In addition, 2,830,000 L (747,000 gallons) of coking byproducts and contaminated water have been removed from 23 on-site tanks.

An initial draft RAP was completed in June 1985 and was submitted to the U.S. EPA by the MPCA. U.S. EPA indicated a need for a more comprehensive document to address the toxic substances problems and the necessary solutions or remedial actions. U.S. EPA contracted with a consultant to put the available information and data into the appropriate RAP format.

Since the Area of Concern lies between Minnesota and Wisconsin, it is imperative that both jurisdictions work together to prepare the RAP and solve the problems. At a meeting in January 1987, Wisconsin informed Minnesota and U.S. EPA that it would not be in a position to begin significant activity on the RAP until October 1, 1987. It was agreed that Minnesota and Wisconsin would meet during the spring and summer of 1987 to begin development of the RAP by identifying interested local and state parties to provide necessary data and build local support; to determine areas of responsibility; and establish an interstate RAP coordinating committee. In May 1987, both states agreed to supply the U.S. EPA consultant with the data necessary to prepare an initial draft RAP.

RAP Timetable

ACTIVITY	DATE
Data and information gathering.	1985–1987
EPA contractor assistance in RAP development	Jan.–Dec. 1987
Final RAP completed.	Dec. 31, 1988*
Minnesota/Wisconsin RAP Coordinating Committee.	1987–1990
Investigation of sources to and extent of PCB and mercury contamination in St. Louis River/Bay.	1988–1989**
Investigation of sources to and extent of dioxin contamination in St. Louis River/Bay.	1987–1988
Remedial investigation of U.S. Steel Superfund Site.	1986–1987
Remedial Feasibility Study of U.S. Steel Superfund Site.	1987
Cleanup of U.S. Steel Superfund Site.	1988–1989
Remedial investigation of Interlake Superfund Site.	1987–1988
Remedial Feasibility Study of Interlake Superfund Site	1988–1989
Cleanup of Interlake Superfund Site	1989–1990

* It is hoped that a RAP can be completed by 1988; but this is conditional upon understanding of the toxic substances problems.

** Currently not funded (study proposals have been submitted by University of Minnesota–Duluth to Minnesota Sea Grant and U.S. Geological Survey).

6. TORCH LAKE

Environmental Assessment

Torch Lake is located at the base of the Keweenaw Peninsula in the Upper Peninsula of Michigan and is a tributary to Lake Superior. The lake is actually an embayment of the Portage Ship Canal, built to allow vessels to pass through the Keweenaw Peninsula. For more than 100 years, this 1,100 ha lake (mean depth 17 m) received stamp sand, mine tailings and miscellaneous industrial and municipal wastes resulting in the filling of more than 20 percent of its original volume. Since milling ceased in 1968, lake turbidity has decreased and shoreline mine tailings have become stabilized to a large degree. This trend is continuing.

External tumors in fish from Torch Lake and the Portage Ship Canal were first reported in the early 1970s. Although epidermal neoplasms (skin tumors) were reported during this time, liver tumors were not noticed. More recent examination of walleye and sauger from Torch Lake has revealed high frequencies of liver tumors in older and larger specimens. Although Torch Lake has a diverse fish community, only these two species have been found to have abnormal incidences of liver tumors. This high incidence of tumors led the Michigan Department of Public Health to issue a public health advisory against eating either fish from Torch Lake.

Several studies have been completed on the lake since the early 1970s. The only component of this ecosystem seriously impacted by the copper ore tailings is the benthic macroinvertebrates. Sediments are somewhat toxic, but the phytoplankton, zooplankton and fish communities are indicative of good water quality and meso/oligotrophic conditions.

Recently, several studies were completed to determine the extent of fish tumor problems and to identify the causative factor or factors. Xanthates and creosote were used in the copper concentrating process from 1926 to 1969. Both substances are biologically active in the liver where the tumors of concern were found. Xanthate–creosote fish exposure tests suggest liver tumor induction. Previous studies show that continuous exposure to xanthates causes serious liver problems in rainbow trout within 30 days. These substances have not been found in either sediments, tailings or water in Torch Lake. Ames tests on water and sediments have also been negative, as have hamster ovary cell exposures. Rainbow trout eggs and fry exposed to sediments or sediment–water extracts were negative one year after exposure. Environmental fate studies indicate that after six months xanthates would be degraded. There is no scientific evidence to indicate that tumor–inducing agents are present in Torch Lake above normal background levels.

Copper tailings are, in part, responsible for maintaining an average copper concentration of 30–45 µg/L in Torch Lake, 10 times higher than the ambient levels recorded for Lake Superior and six to nine times higher than the IJC's water quality objective for copper (5 µg/L). Based on Michigan Department of Natural Resources' Rule 57 to protect aquatic life, the criteria for copper in Torch Lake (depending on the hardness) is between 8.7 and 12.8 µg/L. The Trap Rock River (the major tributary to the lake) has an average copper concentration of about 34 µg/L. Surface runoff contributes about 68% of the 3,480 kg/a of copper discharged from Torch Lake. Sediment copper concentrations in Torch Lake range from a few hundred to over 2,000 mg/kg dry weight. The benthic macroinvertebrate community is sparce and negatively impacted by copper in the sediments. Copper–contaminated sediments from Torch Lake have been found to be highly toxic to Daphnia and Hexagenia.

Two lagoon systems have been built to treat the municipal wastes from the communities near the lake. Additional waste treatment will be provided by small communities on the Trap Rock River, the major tributary to the lake, when funds are available. No water quality degradation has been found in the lake due to discharges from the river.

RAP Development Progress

A draft RAP was received from a U.S. EPA consultant in August 1986. This draft was reviewed by Michigan DNR staff familiar with the problem. Comments were forwarded to the contractor in October 1986, with additional information and results of several recently completed studies. Discussions with the contractor on the new data and comments followed, and a second draft was received in February 1987. The second draft has been forwarded for review to various Michigan DNR personnel, U.S. EPA and staff members at Michigan Technological University that carried out several studies on the Torch Lake problem. All comments will be evaluated and important differences resolved before another draft is written by Michigan DNR staff. This third draft was available for public review and comment in August 1987 and a second public meeting was held in late August to solicit public comments for inclusion in the final RAP. The final RAP was completed in late summer for submission to the IJC's Water Quality Board in October 1987.

Further studies of Torch Lake have not been planned at this time. Fisheries Division of Michigan DNR is scheduled to plant saugers in Torch Lake in the near future. Torch Lake water quality will be monitored by Michigan DNR. Fish populations will be elevated, as need be, for management purposes and fish flesh will be monitored for contaminants by Michigan DNR. The only other recommendation is that debris, including barrels, on the lakeshore be removed.

Michigan DNR will be recommending that the health advisory be withdrawn and that Torch Lake be removed from the Areas of Concern list. The specific documentation will be provided in the RAP.

RAP Timetable

ACTIVITY	DATE
First public meeting held on Torch Lake Area of Concern.	July 1986
First draft RAP received from consultant.	August 1986
Second draft RAP received from consultant.	February 1987
Third draft RAP available for public comment.	August 1987.
Second public meeting held.	August 1987
RAP submitted to IJC's Water Quality Board.	October 1987

7. DEER LAKE-CARP CREEK/RIVER

Environmental Assessment

The Deer Lake–Carp Creek/River Area of Concern includes Deer Lake, Carp Creek and 32 km (20 miles) of the Carp River downstream to Marquette on Lake Superior. Deer Lake is a 367 ha (907 acres) hypereutrophic impoundment located near Ishpeming in Michigan's Upper Peninsula.

In 1981, mercury was found at high concentrations in fish (5.0 mg/kg), sediments (2–16 mg/kg) and fish–eating birds (40 mg/kg). A fish consumption advisory has been in effect since 1981 on all fish in Deer Lake and resident fish in Carp Creek and the Carp River downstream to Lake Superior. In addition, no bald eagle offspring have been produced from the nesting territory surrounding Deer Lake since records were first kept in 1963. In contrast, nesting success for bald eagles in other parts of Michigan's Upper Peninsula is excellent (0.99 probability of successful reproduction).

RAP Development Progress

Sludge at the Ishpeming wastewater treatment plant (WWTP) was found to have high concentrations of mercury in 1981. Primary sources were two industrial laboratories. Their discharges to the sewerage system were eliminated shortly thereafter. In 1985, a new $8 million regional WWTP came on line to replace the three inadequate primary WWTPs that discharged to Deer Lake via Carp Creek. This facility now provides secondary treatment (with phosphorus removal) to meet all downstream designated uses.

The Deer Lake impoundment was drawn down during the fall and winter of 1985 to eliminate as much of the fish population as possible and further reduce human and wildlife exposure to mercury. Fish in the natural 40 ha lake that remained after draw down were eradicated using rotenone in the fall of 1986. The impoundment was refilled in the spring of 1987 and yellow perch and walleyes planted. Mercury concentrations in these fish and their offspring will be monitored to determine when fish are safe to eat. These monitoring studies will be carried out with the Cleveland–Cliffs Iron (CCI) Company and the Michigan Department of Natural Resources (DNR), as outlined in the consent decree, for a period of ten years. CCI is committed to spend $18,000 per year for the ten–year period to monitor this ecosystem.

Additional studies of this lake may be undertaken, as the situation dictates, once conditions have stabilized in the lake following refilling. Observing this mercury contaminated impoundment and its aquatic resources during recovery gives the Michigan DNR a unique opportunity to contribute to our understanding of ecosystem recovery and resource management following remedial action.

The first draft of the remedial action plan (RAP) was received in September 1986 from a U.S. EPA consultant and reviewed by Michigan DNR staff familiar with the problem. Comments were sent to the consultant in October 1986, and another draft was expected in August 1987.

The second draft RAP will be reviewed by Michigan DNR staff, CCI's consultant from the Institute of Water Resources at Michigan State University and the public. Michigan DNR will incorporate the review comments into the final RAP which will be submitted to the IJC's Water Quality Board in October 1987.

On the basis of remedial actions taken to date and the fact that there is no significant adverse impact on Lake Superior, Michigan DNR will be recommending the Deer Lake–Carp Creek/River be removed from the Areas of Concern list. The specific documentation will be provided in the RAP.

RAP Timetable

ACTIVITY	DATE
Michigan commits to developing a RAP for Deer Lake–Carp Creek River.	1985
Public meeting held in Ishpeming, MI.	May 1986
First draft of RAP completed with assistance of U.S. EPA consultant.	September 1986
Second draft of RAP completed with assistance of U.S. EPA consultant.	August 1987
Public meeting for review and comment on RAP.	August 1987
Final RAP submitted to IJC's Water Quality Board.	October 1987
New regional WWTP came online to replace three inadequate primary WWTPs (discharge to Deer Lake via Carp Creek).	1985
Deer Lake drawn down to eliminate fish and reduce human and wildlife exposure to mercury.	Fall 1985 to Spring 1987
Fish in Deer Lake eradicated using rotenone.	Fall 1986 to Winter 1987
Monitoring mercury contamination of fish, particulate matter in water, sediments and the influent, effluent and sludge from the regional WWTP.	Annually, 1987–1997

8. MANISTIQUE RIVER

Environmental Assessment

The Manistique River is located in Schoolcraft County in Michigan's central upper peninsula. The river flows from the northeast and discharges into Lake Michigan at the City of Manistique. The upstream boundary of the Area of Concern begins at the dam in Manistique and extends downstream to the Manistique Harbor, a total length of approximately 2.4 km (1.5 miles).

The problems within the Area of Concern as identified in the 1985 Report on Great Lakes Water Quality are contaminated sediments (PCBs and heavy metals), a fish consumption advisory and impacted biota.

Impacts to the biota in the lower Manistique River and Harbor were first noted in the mid-1950s. These impacts were attributed primarily to deposits of wood fibers and organic waste from sawmill and papermill operations, and sanitary waste. Later studies also identified chemical wastes as contributing to the degradation.

PCB and heavy metal contamination of the harbor and lower Manistique River sediments were first identified in the mid-1970s. Mean concentration of PCBs in carp collected from the Area of Concern was 2.6 mg/kg, which exceeds the Food and Drug Administration (FDA) action level of 2 mg/kg. Therefore, a consumption advisory is in effect for carp caught below the dam in Manistique. River sediments immediately below Ministique Paper Company and harbour sediments are heavily polluted with PCBs (up to 66 mg/kg PCBs).

RAP Development Progress

Although numerous industries have discharged to the Manistique River Area of Concern in the past (e.g. saw mills, a chemical company), currently there are only two - the Manistique Papers Inc. and the Manistique Wastewater Treatment Plant (WWTP). Both facilities possess National Pollutant Discharge Elimination System (NPDES) permits.

Over the past 15 to 20 years a number of actions have taken place that resulted in improvements within the Area of Concern. In 1977, the Manistique WWTP upgraded to secondary treatment. Manistique Papers Inc. has also upgraded its wastewater treatment facilities to provide secondary treatment of process wastewater from its paper making operations. These improvements have greatly reduced oxygen demanding loads to the river and also reduced or eliminated the discharge of toxicants (metal and organic) and materials such as wood fibers and paper. A source of PCBs is contaminated soils eroding from the banks of an old deinking waste settling lagoon on the property of Manistique Paper. In 1986, at the request of the Michigan Department of Natural Resources (DNR), Manistique Papers Inc. placed a temporary erosion barrier over contaminated soils on company property.

Additional studies are necessary in order to determine what remedial measures are necessary within the Area of Concern. Additional analyses of the sediments and soils within and around the Manistique River and Manistique Harbor are needed in order to better define the areas of PCB and heavy metal contamination.

Public participation has been valuable in gathering information for the remedial action plan. On September 2, 1986, and July 30, 1987 public meetings were held in Manistique to inform the public of the concerns in the lower Manistique River and to

solicit their comments and suggestions. The attendees of those meetings and any other interested parties were given the opportunity to comment on the draft remedial action plan.

The second draft of the RAP is currently under review by Michigan DNR staff, attendees of the public meetings and other interested parties. The Manistique River RAP will be submitted to the IJC's Water Quality Board on October 1, 1987.

RAP Timetable

ACTIVITY	DATE
Manistique River RAP Public Meeting.	September 1986
First draft of RAP completed.	March 1987
Second draft of RAP completed.	July 1987
Public meeting to receive comments on second draft RAP.	July 1987
Finalize RAP.	Aug.–Sept. 1987
Submit RAP to IJC's Water Quality Board.	October 1987
Manistique Paper Company placed a temporary erosion barrier over soils suspected to be a source of PCBs to the Manistique River.	1986

9. MENOMINEE RIVER

Environmental Assessment

The fishery in the Menominee River is generally good. Lake sturgeon use the area for spawning. There is a good walleye fishery, although some taste and odor problems have been reported. The area receives heavy recreational use.

The primary concern in the Menominee River is the presence of arsenic in the sediments of the Marinette Harbor. In 1983 sediment arsenic concentrations of 135 to 3,310 mg/kg (dry weight) were reported in the top 60 cm of harbor sediment immediately adjacent to Ansul Fire Protection Company land (however, contamination is not limited to the top 60 cm). Fish have been monitored for arsenic since the late 1970s. Arsenic was not detected in fish fillets at levels of detection of 0.05 mg/kg. However, recent studies by the U.S. Fish and Wildlife Service, using lower detection limits, did detect arsenic in walleye fillets.

PCBs have been detected in fish in the area. However, these fish could be migrants from Green Bay and even the Fox River. In 1982, PCB loading from the Menominee River to Green Bay was 20–82 kg/a. Local beaches have been closed occasionally due to high counts of fecal coliform bacteria. Local wetlands are threatened by high water levels, development pressures and all–terrain vehicles.

Several dischargers are located in the Area of Concern; including Menominee Paper, Waupaca Foundry, Marinette wastewater treatment plant (WWTP), Menominee WWTP and Scott Paper. Landfills, salvage yards, a ship building facility and coal piles are located adjacent to the river. Proposed changes in land use include filling in of wetlands and marina developments. Dredging for navigation has also been proposed.

Most of the upstream watershed is forested, so there are many high quality tributaries draining into the Menominee River. Two paper mills, Niagara of Wisconsin and Champion International Corporation, and the WWTPs of Niagara, Aurora, Iron Mountain and Kingsford discharge into Menominee River approximately 141 km (88 miles) upstream.

RAP Development Progress

A Resource Conservation and Recovery Act (RCRA) Facility Assessment has been prepared for the Ansul Fire Protection facility which contains groundwater contaminated with arsenic. Ansul has conducted monitoring of the area. Based on the findings, a consent order will be drafted by Wisconsin Department of Natural Resources (DNR) for U.S. EPA's signature to require further monitoring and propose remedial actions to address the contaminated groundwater and sediment.

Discharge permits are being reissued for Wisconsin paper mill dischargers. Bioassay monitoring for toxicity will be included in reissued permits. The Menominee WWTP will be upgraded by 1988 to handle paper mill discharges.

The Menominee River RAP will be prepared from July 1987 to July 1989. The initial year will include development of a detailed scope of study, preliminary compilation of information and a public meeting to solicit public input on use concerns and problems the plan should address. The primary effort in developing the plan will begin the second year. Public input will be solicited through a Citizens Advisory Committee (second year) and public meetings. This will be a cooperative effort with the State of Michigan to the maximum degree possible.

RAP Timetable

The schedule for completing the RAP, future studies and remedial action is presented below. The schedule contains only actions currently underway or contained in current budgets. This schedule may be revised based on budget considerations and development of the RAP. The RAP will identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

ACTIVITY	DATE
Remedial Action Plan:	
Complete scope of study and compilation of information sources.	July 1987–July 1988
RAP development.	July 1988–July 1989
Submit RAP to IJC's Water Quality Board.	October 1989
Monitoring and Research:	
Ambient Monitoring of the Menominee River at U.S. 141.	1970–2000
Annual fish tissue monitoring of toxic substances to track trends and develop the fish consumption advisory.	1976–2000
Synoptic survey for wasteload allocation modeling between km 115 (mile 72) and 144 (mile 90) above river mouth.	1987–1990
Industrial and Municipal Discharges:	
Reissuance of Wisconsin's Pulp and Paper Mill Discharge Permits.	1987
Upgrading of Menominee WWTP to handle mill wastes.	1987–1988
Solid and Hazardous Waste:	
Ansul Consent Order issued.	To be determined
Ansul remedial actions to be completed.	To be determined
Habitat Management:	
West Shore Master Plan adopted to guide protection of west shore wetlands.	1979–2000
Counties and municipalities adopt and implement shoreland/wetland zoning.	1982–2000

Note: The schedule contains only actions currently underway or anticipated based on proposed work plans and agency budgets. The schedule will be reviewed and revised based on budget considerations and the development of the remedial action plan. The remedial action plan will also identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

10. FOX RIVER/SOUTHERN GREEN BAY

Environmental Assessment

There have been marked improvements in the water quality and the fishery of the Lower Fox River since 1972 when the Clean Water Act was signed and initial amendments to the Clean Water Act passed. However, major problems remain in the river and lower Green Bay. These problems are primarily associated with toxic contaminants, excess nutrients and turbidity, and habitat loss. Fish consumption advisories on some sport fish, a closed commercial carp fishery, reproductive impairments of some wildlife and closed public swimming beaches are examples of ongoing use impairments found in this Area of Concern.

Reductions in biochemical oxygen demand (BOD) and suspended solid loads in the late 1970s improved dissolved oxygen levels and the walleye sport fishery. Industries and municipal treatment plants reduced their discharge of BOD to the Lower Fox River by approximately 90% between 1972 and 1979. Summer dissolved oxygen levels which frequently were at 0–3 mg/L in 1972 rarely went below 5 mg/L in 1985 and 1986. A regionally renowned walleye fishery has been established below the De Pere Dam. A good sport and commercial perch fishery exists in the lower bay. However, some fish that were historically present, such as northern pike, sturgeon and muskellunge, are not found or are found only in limited numbers.

Toxic substances are a major concern. Over 100 toxic substances, including 37 priority pollutants and 11 different resin and fatty acids, were identified in the discharges to the Lower Fox River from 14 pulp and paper mills and five major municipal wastewater treatment plants.

Elevated levels of known toxic substances (specifically PCBs) in fish have resulted in the issuance of fish consumption advisories since 1976. A consumption advisory issued April 1, 1987 recommends that no one eat walleyes caught between the De Pere Dam and the mouth of the Fox River. High levels of PCBs have been found in fillets of all fish species monitored in this portion of the river. Low (parts per trillion) concentrations of furans and dioxins have also been found in the fish.

The buildup of certain halogenated hydrocarbons also affects fish and wildlife. Reproductive impairments in the Forster's tern, a state endangered species, have been linked to toxic substances. While studies show some natural reproduction of walleye below the De Pere dam, other studies indicate there may be reduction in reproductive success associated with high body burdens of toxic substances. A relatively low incidence of tumors has also been reported in bullhead from the Fox River. Preliminary bioassay tests of pulp and paper mills discharges to the entire Lower Fox River indicated discharges from four of 13 mills may be acutely toxic to fish and aquatic life. Acutely toxic ammonia concentrations are found near the mouth of the Fox River and chronically toxic levels of ammonia are found extending several kilometers into the bay.

Toxic contaminants are found in river and bay sediments. These contaminants make dredging for commercial navigation costly and controversial. Contaminated Fox River sediments are also believed to be the major source of PCBs delivered from the river to the bay.

Excess loads of nutrients, primarily phosphorus, are responsible for hypereutrophic conditions in the lower bay. Blue-green algae are abundant in the summer and cause nuisance conditions. Turbidity caused by algae and suspended solids is also a concern.

Water clarity does not meet the State's guideline of 1.3 m Secchi disc depth required for a swimming beach, and bottom rooted vegetation does not receive sufficient light for growth.

Habitat loss, especially filling of wetlands, has occurred over the years. The few wetlands that remain are currently threatened by high water levels as well as development pressures. The result is the loss of nesting areas and food sources for ducks, shore birds and other wildlife as well as fish spawning areas.

RAP Development Progress

The RAP is presently being developed by the Wisconsin Department of Natural Resources (DNR) in cooperation with other agencies and citizens of northeast Wisconsin. Over 70 people are directly involved, participating on a Citizens Advisory Committee and four technical advisory committees (Biota and Habitat Management, Toxic Substances Management, Nutrients and Eutrophication Management, and Institutional). The goal is to restore the beneficial uses of the Lower Fox River and Lower Green Bay by the year 2000. The plan will be prototype for the three other Wisconsin RAPs.

Initially Wisconsin DNR prepared a scope of study for the plan that identified problems the plan should address and the process for preparing the plan. Preparation of the plan has included two steps: a) preparation of technical advisory committee (TAC) reports and b) preparation of the integrated final plan. The TAC reports were finalized and a draft of the integrated plan available in summer 1987. All steps include input and review by the Citizens Advisory Committee, TACs and Wisconsin DNR. In January 1987 an informational hearing was held on the TAC reports, and similar meetings were held on the integrated plan in the summer of 1987.

The plan builds on major achievements in the past 15 years, principally major reductions of BOD and suspended solids. A dissolved oxygen water quality standard variance was removed for the Lower Fox River in 1986. Wisconsin's rule for wasteload allocations (NR 212) was revised in December 1986 to include new allocations for the Lower Fox River, providing a legal basis to insure that current water quality gains are maintained. A water quality standards review study has been initiated for the lower bay to determine if a winter 2 mg/L dissolved oxygen standard variance can be removed.

A major research study, The Green Bay Mass Balance Study, has been initiated to evaluate and model the fate and impact of toxic substances. The study is a cooperative effort between U.S. EPA's Great Lakes National Program Office, Wisconsin DNR, University of Wisconsin Sea Grant Program, and several other agencies. The study is one of the most ambitious of its type in the nation and is intended to provide guidance for management of toxic substances in the Great Lakes. The study should develop a model capable of: predicting the fate of toxic substances, particularly PCBs, in Green Bay and their delivery to Lake Michigan; describing the relative contribution of different sources; and predicting the ecosystem's response to proposed regulatory actions. The study will require a comprehensive quantification of loads from all significant sources (e.g. atmosphere, tributaries, groundwater, point and nonpoint). The study should determine the net rate of exchange of contaminants between compartments (e.g. sediment, water, biota and air) and the net rate of exchange with Lake Michigan. The transfer of toxic compounds from sources to sport and commercial fish species will also be modeled. As part of the mass balance, a national air monitoring station for toxic substances will be located in the bay. The mass balance study is scheduled to be completed in 1991.

Other toxic substances studies are underway. These include a two-year study evaluating the extent of PCB contamination in Little Lake Butte des Morts and its contribution to the Fox River. An epidemiological study of local residents is being conducted by Wisconsin's Department of Health and Social Services and University of Wisconsin Sea Grant to evaluate possible impacts of contaminants on Green Bay residents.

As part of their application for Wisconsin Pollutant Discharge Elimination System permit reissuance, pulp and paper mill dischargers were required to conduct Ceriodaphnia and fathead minnow bioassays. Similar requirements are anticipated to be contained in discharge permits for the mills that will be reissued this year. The major paper recycling mill (Ft. Howard Paper Co.) has been investigating ways to reduce PCB contamination in its effluent. Annual PCB loadings from this mill have decreased from 28 kg (61.7 pounds) in 1979, to 19.6 kg (43.1 pounds) in 1985, to 7.1 kg (15.7 pounds) in 1986.

Green Bay Metropolitan Sewerage District initiated facility planning in 1987 to determine the best way to reduce ammonia toxicity in its effluent. As part of the facility planning, other toxic substances and their impact, as well as possible ways to further reduce phosphorus loads, are also being investigated. The facility plan should be completed in early 1988.

Seven communities in the Fox River Valley have developed and are implementing approved pretreatment programs: Appleton, De Pere, Fond du Lac, Green Bay, Kaukauna, Neenah-Menasha and Oshkosh. These communities currently regulate approximately 60 categorical industrial facilities.

Lake Winnebago is the major lake lying between the Upper Fox and Wolf River basins and the Lower Fox River basin. In 1987, Wisconsin DNR initiated development of an ecosystem plan for the lake to improve its water quality, fishery and wildlife. The plan will also investigate ways of reducing phosphorus loads from the lake to the Lower Fox River and bay.

Wisconsin DNR has conducted fish tissue monitoring for toxic substances in the area since 1976. Monitoring will continue and is being expanded to include more fish species as well as some ducks and other wildlife. Results of these studies form the basis for the issuance of a fish consumption advisory which is updated twice a year. Associated with the Green Bay Mass Balance Study are several research projects to quantify fish populations and contaminant levels in the bay. Fish populations in the river were also intensely monitored by Wisconsin DNR fish managers in 1987. A planning program to protect the Fox and Wolf River basins from sea lamprey invasions was initiated by Wisconsin DNR in 1987.

Several programs are directed to habitat protection. Fox River Valley counties have adopted, and local municipalities are in the process of adopting, shoreland/wetland protection zoning. This zoning will protect wetlands over 2 ha (5 acres) immediately adjacent to the bay and its tributary streams as long as these areas are not contained within current bulkhead line boundaries. In 1979, Wisconsin DNR approved the West Shore Master Plan to guide purchase of important wetlands and wildlife habitat along the bay's west shore when the land becomes available.

Local awareness is critical to the implementation of the RAP and the long-range protection of the river and bay. Local initiatives have included in-service training for teachers on the bay and river, a poster contest for children asking them what the bay means to them, a photo contest and inclusion of a program on the RAP and bay in the meetings of many community groups.

RAP Timetable

The schedule for plan completion, studies, investigations and remedial actions is presented below. This timetable identifies only studies and actions underway or included in current program budgets. The schedule will be reviewed and revised based on budget considerations and development of the RAP. The RAP will specifically identify other actions needed to restore and enhance the bay and river.

ACTIVITY	DATE
Remedial Action Plan:	
First meetings Citizen's Advisory Committee, and technical advisory committees (TACs); research symposium held.	Feb.–March 1986
TAC reports (Biota and Habitat Management, Nutrients and Eutrophication Management, Toxic Substances Management and Institutional) prepared.	Mar. 1986–Aug. 1987
Draft of integrated RAP available. A public meeting and a public hearing held on the RAP.	September 1987
Approval of RAP by Wisconsin DNR and submittal to IJC.	December 1987
Initiate RAP implementation.	December 1987
Biennial review of RAP progress and five–year update of RAP (more frequent revisions if necessary).	1989–2000
Research and Monitoring Activities:	
Green Bay Mass Balance Study of Toxic Contaminants:	1987–1991
Planning and presurvey.	1987
Major field season.	1988
Follow–up field work.	1989
Modeling.	1990
Final reports due.	1991
Epidemiological study of Green Bay residents to determine potential human health effects from toxic substances.	1986–1987
Little Lake Butte des Morts study of contaminated sediments in the Fox River.	1985–1988
Annual fish contaminant monitoring to track field trends and develop fish consumption advisory.	1977–2000
Annual wildlife contaminant monitoring.	1985–2000
Ambient water quality monitoring of the Fox River and continuous monitoring of dissolved oxygen, temperature, pH and conductivity at five stations.	1971–2000

Synoptic water quality surveys of the river to provide data for waste load allocation review and modeling.	1989,1994,1999
Comprehensive fish study of Lower Fox River below De Pere Dam to guide future management of the fishery.	1986–1988
Annual fish management trawl of Green Bay fish reference stations to determine year strength of perch and other species.	1981–2000
Industrial and Municipal Sources:	
Wasteload allocation rule revised and adopted for Cluster III of the Fox River (includes Area of Concern).	1986
Reissuance of discharge permits for pulp and paper mills in the Fox River basin.	1987
Green Bay Metropolitan Sewerage District facility planning (to control ammonia and evaluate other toxic substances control needs).	1987–1988
Implementation of approved pretreatment plans for seven large communities in the Fox River basin.	1984–2000
Fish, Wildlife and Habitat Management:	
County and municipality adoption and implementation of wetland and shoreland zoning to protect wetlands.	1982–2000
Wisconsin DNR adoption and implementation of West Shore Master Plan to guide protection of wetlands on the west shore of Green Bay.	1979–2000
Initiate establishment of a Great Lakes strain muskellunge population in the Area of Concern.	1986–2000
Sea lamprey control program planning for Fox River.	1987–1988
Initiate Lake Winnebago Plan to improve water quality and fish and wildlife.	1986–1988

Note: The schedule contains only actions currently underway or anticipated based on proposed work plans and agency budgets. The schedule will be reviewed and revised based on budget considerations and the development of the remedial action plan. The remedial action plan will also identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

11. SHEBOYGAN

Environmental Assessment

The Lower Sheboygan River and Harbor Area of Concern includes the entire Sheboygan Harbor and approximately 19 km (12 miles) of the river from its mouth to Sheboygan Falls. Problems include fish and sediments contaminated with PCBs, a fish consumption advisory, high bacteria levels, excess sediment and turbidity and a poor quality community of aquatic organisms as indicated by an overabundance of pollution tolerant insects and algae.

PCBs contaminate the fish and the bottom sediments of the lower Sheboygan River. PCB concentrations in fish tissue are well above the U.S. Food and Drug Administration's recommended level for safe consumption. A fish consumption advisory was issued by Wisconsin and remains in effect for the Sheboygan River downstream of the Sheboygan Falls Dam. The bottom sediments of the lower Sheboygan River and harbor area are polluted with PCBs. A major source of PCB contamination was identified as a landfilled dike on the property of Tecumseh Products, Inc. This company, under State orders, removed the contaminated soil from this dike. They are also identified as a potentially responsible party by U.S. EPA and have accepted the lead role for conducting a Remedial Investigation and Feasibility Study for the lower Sheboygan River and Harbor under the Superfund Program.

The lower Sheboygan River is not achieving its full beneficial use potential according to a 1978 assessment. River water quality is influenced by its two major tributaries, the Mullet and Onion Rivers, and by point sources of pollution. Downstream of the mouth of the Mullet River pollutant loadings increased dramatically (2.3 to 8.5 times). The Mullet River contained higher concentrations of all pollutant parameters except total phosphorus and total nitrogen. The pollutant load further increased in response to discharges received from the Onion River and the Sheboygan Falls wastewater treatment plant (WWTP). The Onion River accounted for 43% of the total suspended solid loading and approximately 20% of the total phosphorus and total nitrogen loading. The Sheboygan Falls WWTP's total phosphorus and total nitrogen loading comprised approximately 10% of the total loading increase. The Kohler WWTP and an industrial point source in Kohler discharged to the Sheboygan River. These discharges, along with leachate from the Kohler landfill, caused an increase in pollutant loads downstream.

Although the extent of nonpoint source pollution has not been quantitatively assessed, it appears nonpoint sources of pollution seriously threaten water quality at high river flow and during wet weather runoff events. Stream banks were broken down and prone to erosion at numerous livestock watering access points and stream crossings. Manure spreading on frozen ground was widespread and minimum tillage practices were generally not observed. Urban and construction activities were typically carried out without regard for controlling stormwater runoff related pollution and many older septic systems exist in the watershed.

In the Lower Sheboygan River, from the Mullet River to the lower Kohler Dam, habitat plays a key role in determining aquatic community structure. The four dams in this segment inhibit natural aquatic community diversity and productivity. The macroinvertebrate and periphyton populations are not representative of healthy, productive communities. Macroinvertebrate diversity is low and although periphyton diversity is good, productivity is very poor. Tolerant individuals dominate both communities, as the water quality condition is indicated to be fair. Fish diversity

is low with tolerant species dominant. The dams limit upstream and downstream fish from establishing large populations in this segment. The Mullet and Onion Rivers discharge to this segment, but the resident fish populations in these major tributaries are not significant contributors to the population in the Sheboygan River. High PCB content in the tissue of fish downstream of the Sheboygan Falls Dam limits the potential for an unrestricted recreational fishery.

The water quality of this segment could be upgraded to meet its water quality potential by curbing agricultural nonpoint source problems in the Mullet and Onion River subbasins, and removal of unnecessary dams. Urban nonpoint pollution control and good operation and maintenance of WWTPs in the immediate drainage area would also be beneficial. The PCB levels in fish, however, will not be acceptable for consumption for a relatively longer period of time because of contaminated sediments.

Downstream from the lower Kohler Dam to Lake Michigan, water quality is fair to poor. Fish populations show good diversity, but are primarily representative of Lake Michigan migrants. The fishery potential of this reach is not met as indicated by the lack of a diverse resident fish population. The macroinvertebrate and periphyton communities are both highly productive, but are dominated by tolerant individuals. High turbidity and suspended solids levels limit the water quality in the segment. Urban and nonpoint source pollution abatement is necessary.

The Sheboygan River, below Sheboygan Falls, does not meet State water recreation standards. Both point and nonpoint sources contribute fecal bacteria to the lower reach of the river. Typically under normal operation the Sheboygan Falls and Kohler WWTPs discharge low concentrations of fecal bacteria, however, during periods of high precipitation both of these plants have bypassed untreated sewage to prevent surcharging of local sewers. The major source of fecal coliform bacteria to this section of the river is the discharge from the Mullet and Onion Rivers as indicated by the high bacterial counts found at the mouth of these two rivers.

RAP Development Progress

The Wisconsin Department of Natural Resources (DNR) has agreed to prepare a RAP for this Area of Concern by October 1, 1988. The plan, when complete, will provide Wisconsin's strategy for restoring the beneficial uses of the lower Sheboygan River ecosystem through the year 2000.

The Lower Sheboygan River and Harbor RAP will provide a clear statement of the environmental impairments, pollutants causing them, sources of pollutants, remedial steps needed and further work required. The RAP will build on the major ongoing water resources management efforts of the lower Sheboygan River and Harbor. These efforts include the Superfund investigation of the PCB and other in-place toxic substance contamination problems, the nonpoint source pollution abatement project (Priority Watershed Plan), and the Water Quality Management Plan Update (208 plan). The RAP will be incorporated into the Water Quality Management Plan Update for the lower Sheboygan River and Harbor.

Leaders in the Sheboygan area have organized the Sheboygan County Water Quality Task Force to address the problems of this area. Wisconsin DNR will work with this task force in the preparation of the plan. They will be asked to help identify the area's problems and the plan's objectives. They will also be asked to evaluate and comment on alternative strategies for remediation. Wisconsin DNR will work with the

task force on providing appropriate information and education to the public through member affiliations with other organizations.

An Interagency Technical Advisory and Coordination Committee has also been established to guide ongoing water resources management activities of the lower Sheboygan River and Harbor. This committee is composed of representatives of concerned state and federal agencies. Wisconsin DNR will consult this committee routinely on the technical issues in plan development. The committee will also insure interagency coordination and cooperation.

Two of the three watersheds that drain into the Sheboygan River have been designated priority watersheds for intensive nonpoint source management. The Sheboygan River watershed was selected in October 1985 as a priority watershed under the Wisconsin Nonpoint Source Water Pollution Abatement Program. The Onion River Watershed was selected in 1979. The goal of this program is to improve the water resources in these watersheds through the control of nonpoint sources of pollution. Approximately $750,000 and over $1,000,000 of cost sharing is anticipated to be provided for the Onion and Sheboygan priority watershed projects, respectively. The Onion River is in the implementation phase and pollution control practices are being installed.

In 1985, the lower Sheboygan River and Harbor was designated as a U.S. EPA Superfund site. Tecumseh Products, as a potentially responsible party, will conduct the Remedial Investigation and Feasibility Study under the guidance of U.S. EPA and the Wisconsin DNR. Implementation is scheduled to begin in 1989 after completion of the feasibility study.

The Wisconsin DNR is updating the Area-wide Water Quality Management Plan (208) for the Sheboygan River Basin in 1987. This plan will identify water quality problems and their probable sources in the basin. The plan will also identify water quality objectives for waters in the basin thereby indicating the level of control that will be needed for nonpoint sources, the Superfund project and point source discharge permits.

RAP Timetable

The schedule for completing the RAP, future studies and known remedial actions is listed below. The schedule contains only actions currently underway or anticipated based on proposed work plans and agency budgets. The schedule will be reviewed and may be revised based on budget considerations and the development of the RAP. The RAP will also identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

ACTIVITY	DATE
Remedial Action Plan:	
Draft RAP and public participation.	June 1987 – June 1988
Hold public hearing.	July 1988
Finalize and adopt plan.	October 1988

Water Quality Management Plan:	
Draft plan and public participation.	Jan. – Oct. 1987
Public hearing.	November 1987
Finalize and adopt plan.	December 1987
Update plan and RAP.	Mid – 1990s
Monitoring and Research Activities:	
Annual fish and sediment contamination monitoring.	Ongoing
Fixed station monthly monitoring for toxic and conventional pollutants.	Ongoing
Superfund Project:	
Designated as Superfund site.	1985
Remedial investigation/feasibility study (RI/FS).	1986
Work plan approved.	1987
Monitoring and analysis (RI/FS).	1987–1988
Alternative specific remedial investigation.	1988–1989
Implementation begins.	1989
Nonpoint Source Management:	
Sheboygan River Priority Watershed Project:	
Designated as priority watershed.	October 1986
Inventory nonpoint sources of pollution.*	1987–1988
Complete nonpoint source pollution abatement plan.*	1988
Implement best management practices.*	1989–1995
Onion River Priority Watershed Project:	
Plan approved.	1981
Implementation of nonpoint source best management practices.	1981–1989

Municipal and Industrial Discharges:

Point Source pollutant discharge elimination program – issuance of Wisconsin Pollutant Discharge Elimination System Permits and compliance monitoring.	Ongoing

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* Contingent on deliberations in State budget.

Note: The schedule contains only actions currently underway or anticipated based on proposed work plans and agency budgets. The schedule will be reviewed and revised based on budget considerations and the development of the remedial action plan. The remedial action plan will also identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

12. MILWAUKEE HARBOR

Environmental Assessment

This Area of Concern encompasses Milwaukee Harbor and nearshore areas bounded by a line extending from Sheridan Park northeast to the City of Milwaukee's Linwood water intake and southwest to North Point; Lower Milwaukee River downstream of North Avenue Dam; Menominee River downstream of 35th Street; and the Kinnickinnic River downstream of Chase Avenue.

Major water quality problems include contaminated sediments, low dissolved oxygen levels, a fish consumption advisory, excess nutrients and sediments, high bacteria levels, lack of spawning habitat, and conditions that detract from recreational use of the area.

The Milwaukee Outer Harbor and South Shore Harbor are formed by human-made breakwaters in an indentation of Lake Michigan known as Milwaukee Bay. The Milwaukee Outer Harbor has a surface area of 15 ha (1,300 acres) and depths ranging from 0.6 to 9.8 m (2 to 32 feet). Commercial shipping and port facilities, recreational boating, swimming, fishing, aesthetic, and waste assimilation are the major uses for the Outer Harbor. The 130 ha (320 acre) South Shore Harbor is located due south of the Outer Harbor. Depths are 0.6 to 4.9 m (2 to 16 feet). Recreational boating, fishing, swimming, aesthetics and park facilities are dominant uses.

The water in the Outer Harbor is turbid and supports high densities of algae. Over the years, a thick layer of sediments has accumulated which contain toxic inorganic and organic substances and nutrients.

The results of numerous studies indicate that the lowest dissolved oxygen levels occur during the late summer when the water body temperatures are high at all stations. The lowest dissolved oxygen levels measured in the Outer Harbor are not at a critical level for fish propagation. The only station which has experienced occasional dissolved oxygen levels below the fish and aquatic life criterion of 5.0 mg/L is near the Hoen Avenue Bridge at the Inner Harbor outlet to the Outer Harbor. The un-ionized ammonia monthly levels are acceptable, all less than the fish and aquatic life criterion (0.04 mg/L), except at the station near the Jones Island wastewater treatment plant (WWTP) outfall. On occasion ammonia concentrations at this location have been very high.

In 1982-83, 36 species of fish were collected from the Outer Harbor. Alewife and rainbow smelt were the dominant species in the Outer Harbor. Sport fish were represented by 16 species of which six were cold water salmonids. Yellow perch, brown trout, rainbow trout, lake trout, chinook salmon, brook trout, coho salmon and northern pike, respectively, were the most frequently collected sport species. Similar species were collected in the South Shore Harbor.

Pollutant loadings to the Outer Harbor are contributed from point and nonpoint sources originating in the Milwaukee, Menomonee and Kinnickinnic River watersheds and discharged through the Inner Harbor, the Jones Island WWTP (West Plant), combined sewer overflows during rainfall or snowmelt events, and an 18.2 ha (45 acre) confined disposal facility (CDF) for harbor dredge spoils. These inflows carry solids, organic matter, phosphorous, ammonia-nitrogen, heavy metals, chlorine and other materials into the Outer Harbor. Pollutant loadings to the South Shore Harbor originate from nonpoint sources and combined sewer overflows.

The Lower Milwaukee River includes all of the river that flows through Milwaukee County. Approximately 5.1 km (3.2 miles) stretch of the river is included in the Area of Concern, below the North Avenue Dam. Land uses in the lower river basin include medium to high density residential, industrial and commercial development. A total of 61 combined sewer overflows serving 2,300 ha (5,800 acres) discharge to the river in the Milwaukee area. There are an additional 127 known sanitary sewer flow relief devices located in the lower watershed. Over 60 known industries discharge primarily noncontact cooling water to the lower river directly or via tributaries and storm sewers.

Habitat in the lower river is limited by nonpoint source pollution, channelization, deposition of fine sediments and lack of suitable spawning substrate and cover. Problems attributable to nonpoint sources include organics, solids and turbidity, heavy metals, nutrients, bacteria and low dissolved oxygen.

Fish surveys performed in 1983 below the North Avenue Dam found 35 species, of which 23 were sport fish (six cold water species). Fish have direct access from Lake Michigan and tend to congregate below the dam. The most abundant fish caught were carp and white suckers followed by redhorse suckers, alewife, bluegills, rainbow trout, black crappie, black bullhead, rock bass, and goldfish. Several different year classes of walleye, northern pike, and black crappie indicate good survival below the dam.

The Milwaukee County Rivers Basin Study conducted during 1975–76 documented generally satisfactory water quality. However limited periods of poor water quality occurred at every station. Dissolved oxygen concentrations below the North Avenue Dam dropped below the 2.0 mg/L variance on several occasions. Un–ionized ammonia levels considered potentially toxic to aquatic life also occurred at most stations. All stations experienced potentially toxic concentrations of either mercury, copper, zinc, PCB, and the pesticide heptachlor in the water column. Maximum concentrations of pollutants occurred under wet weather, high flow conditions and in the downstream more urbanized areas. Sources of pollutants were primarily urban runoff, industrial spills, combined and sanitary sewer overflows, and resuspension of polluted bottom sediments.

Various toxic substance monitoring programs conducted by the Wisconsin Department of Natural Resources (DNR) from 1981–83 indicate the PCBs in the fish continue to limit uses in the Lower Milwaukee River. The mean PCB concentration of all fillet and whole fish samples collected was 10.8 mg/kg. Based on previous fish collections, levels of PCB appear to be steadily decreasing. Elevated levels of dieldrin, DDT, chlordane and mercury have also been found in some fish in the lower river. A snapping turtle collected in 1983 contained 0.2 μg/kg and 0.1 μg/kg of dioxin (2,3,7,8–TCDD) and furan (2,3,7,8–TCDF), respectively.

Bottom sediments in the Lower Milwaukee River remain contaminated with PCBs. Grab samples collected in 1980 indicated an average PCB level of 9.60 mg/kg. An abandoned City of Milwaukee landfill was identified as a significant source of PCBs in the lower river.

The Milwaukee River presently is not being utilized to its maximum recreational use potential. Full body contact recreational uses do not exist downstream of the North Avenue Dam.

The Menomonee River is approximately 44 km (27.5 miles) long and flows through Washington, Waukesha and Milwaukee counties. Approximately 4 km (2.5 miles) of the lower river are included in the Area of Concern. With a watershed area of 350 km^2

(137 square miles), it is a major tributary to the Milwaukee River, joining that river about 1 km upstream from its entry to Lake Michigan. The Burnham (southern channel) and the South Menomonee (northern channel) canals are both human-made tributaries to the Menomonee River. Land use in the drainage area is industrial, transportation, warehouse and materials storage.

In 1976, 175 known point sources of pollution discharged to the Menomonee River. These consisted of four municipal WWTPs, 25 combined sewer overflows (CSOs) and sanitary sewer overflow discharges from the cities of Milwaukee, West Allis, Greenfield, Wauwatosa and the Village of Menomonee Falls. There are six CSOs and a power plant discharge to the South Menomonee Canal.

The impact of CSOs on the South Menomonee Canal is considered to be significant. Pollutants also enter the canals as direct runoff from coal and salt storage areas, and scrap metal storage yards.

Bottom sediments in the Menomonee River show PCB and DDT contamination. Grab samples collected in 1980 indicate high contamination at the 27th Street viaduct with a PCB concentration of 290 μg/kg. A 1973 U.S. EPA survey of the South Menomonee Canal found concentrations over 10 mg/kg total PCBs and 0.32 to 0.84 mg/kg of DDT and its isomers. High concentrations of metals were also reported.

At present a water quality standard variance exists for the Menomonee River from the confluence with Honey Creek to the mouth at the Milwaukee River for fecal coliform bacteria. In this stretch of river, the bacterial criterion is to be no greater than 1,000 bacteria/100 mL (monthly geometric mean). Frequent violations of this standard occurred throughout the last 10 years.

In 1983, 20 species of fish were collected in the Menomonee river. Species included cold water salmonids, other sport fish, and forage species. Carp were the most abundant species present. Young-of-the-year perch were collected indicating the importance of this area of the Menomonee River to perch and, potentially, to other sport fish species. Past fish kills in the canals give an indication of the variety of species resident, at least at some times of the year. A February 1979 fish kill yielded carp, goldfish, white sucker, rainbow trout, channel catfish, black crappie, black bullhead and northern pike. The kill was a result of low dissolved oxygen levels.

PCBs in fish continue to limit uses in the Menomonee River. Of the 27 fish analyzed, only one species had PCB levels below the U.S. Food and Drug Administration (U.S. FDA) consumption advisory of 2 mg/kg. The mean PCB concentration of all whole fish samples collected was 22.5 mg/kg. Low, but detectable levels of dieldrin, DDT and chlordane have also been found.

The Kinnickinnic River drains 63.5 km^2 (24.8 square miles). The Area of Concern includes the portion of the river included in the Milwaukee Inner Harbor and 4 km (2.5 miles) of the Kinnickinnic River lying below Chase Street. The river drains predominantly high density residential and industrial areas, and to a lesser extent commercial areas and county parks.

About 18% of the watershed is included in the CSO area (23 CSO outfalls). There are an additional 29 known sanitary flow relief devices in the watershed. A total of 47 known industries discharge primarily noncontact cooling water to the stream directly or via tributaries and storm sewers. The entire watershed is drained by an extensive storm sewer system with approximately 92 outfalls.

The harbor has unique characteristics including flow reversals, stage fluctuations, thermal stratification and currents due to the hydraulic connection with Lake Michigan. In 1907 a flushing tunnel was constructed on the Kinnickinnic River at Chase Street which diverts water from the outer harbor to flush pollutants from the harbor. The lower portion of the river is maintained at 7.6 m (25 feet) depths for commercial navigation and includes the Kinnickinnic Turning Basin.

A comprehensive fishery survey of the estuary in 1983 found 23 species of fish. The most abundant were white suckers, followed by black bullheads, rainbow trout and carp. Fourteen of the species were sport fish, including five cold water species. Northern pike may be utilizing the lower river for spawning.

Established standards and criteria for dissolved oxygen, nutrients and metals appear to be met during dry weather flows; however, the fecal coliform bacteria standard is routinely violated. The operation of the flushing tunnel was also used to maintain standards.

The Kinnickinnic River upper estuary is currently being utilized by fishermen during the spring and fall trout and salmon runs. The lower estuary is used as a marina and boating area. Floating debris, septic odors, oil and grease, and industrial yards detract from the aesthetic value of this area.

RAP Development Progress

The Wisconsin DNR has committed to developing a RAP for the Milwaukee Harbor Area of Concern by October 1, 1989. The plan will provide Wisconsin's strategy for restoring beneficial uses of the Lower Milwaukee River Basin ecosystem by the year 2000. It will draw largely on past and ongoing planning efforts for the necessary data base. These efforts include the Milwaukee River Priority Watershed Program, Milwaukee Estuary Study and the Milwaukee River Basin Plan Update.

The largest and most expensive WWTP rehabilitation project in Wisconsin is the Milwaukee Metropolitan Sewerage District (MMSD) project. Approximately $309 million in federal funds and $200 million in State funds have been spent on the project since 1972. A facility plan for the project was completed in 1981. Funds needed to complete the project by 1992 have been estimated at an additional $262 million in federal funds and $240 million in State monies. The project includes renovation of the Jones Island and South Shore WWTPs and rehabilitation of sewer lines to reduce excess clear water. Relief sewers are being constructed to abate CSOs and bypassing of wastewater to surface waters. The relief sewer construction project includes approximately 27 km (17 miles) of deep tunnels, up to 8.5 m (28 feet) in diameter, to store untreated wastewater during wet weather conditions.

The MMSD water pollution abatement program is necessary to alleviate existing pollutant discharges from separate sewer system overflows and provide for the reduction in discharges from the combined sewer system. Overflows from the separate sewer system will ultimately be eliminated while the discharge from the CSOs would be limited to one or two times per year. The surface waters impacted by these pollutant sources are located primarily in the Milwaukee River basin. Upon completion of this water pollution abatement program, significant improvements in water quality should occur.

A 18 ha (45 acre) CDF for harbor dredge spoils is located in the southwestern part of the Outer Harbor. Tests indicate that the sediments placed within the CDF areas are heavily polluted by heavy metals, nutrients, oil and grease and by a number of organic compounds including PCBs. Recent assessments of the CDF indicate that return water from disposal operations is flowing around sand filters through the steel retaining walls. The U.S. Army Corp of Engineers operates the CDF facility, and is now in the process of obtaining a Wisconsin Pollutant Discharge Elimination System (WPDES) permit. The permit will include discharge effluent limitations for pollutants.

An important planning effort is the Milwaukee Harbor Estuary Study. This ongoing investigation is being conducted by the Southeast Wisconsin Regional Planning Commission in cooperation with MMSD, U.S. Geological Survey and the Wisconsin DNR. The primary objective of the study is to develop recommendations for the abatement of water pollution within Milwaukee Harbor to meet water use objectives in a cost effective manner and to further the protection and wise use of the resource. Secondary objectives include the abatement of damage caused by flooding, storm, and wave action; provision of navigation by deep draft vessels through implementation of an environmentally sound maintenance dredging program; prevention of shoreline deterioration in the harbor; and maximization of the harbor as prime urban recreation area.

On May 8, 1984, then Governor Anthony S. Earl signed into law the 1983 Wisconsin Act 416 designating the Milwaukee River Priority Watersheds Program. The legislature has appropriated 3.1 million dollars for clean up to landowners and local governments. The funding provided by the legislature will allow the Milwaukee River Priority Watersheds Program to follow the same schedule the Milwaukee Metropolitan Sewerage District (MMSD) is following for the remaining point source cleanup of the river. Therefore, installation of nonpoint source pollution control practice should be completed by the early 1990s.

The five priority watersheds designated by the legislature for cleanup are the Milwaukee River East-West Branches, Milwaukee River North Branch, Cedar Creek, Menomonee River, and the Milwaukee River South. This area encompasses 2,090 km^2 (815 square miles).

In addition to the priority watershed project, Wisconsin DNR is developing an integrated resource management plan for the basin. This plan will integrate the responsibilities of the Wisconsin DNR nonpoint source and land management program, with the work efforts of the Department's other pollution control (solid waste, wastewater, water regulation, water supply) and resource management programs (fisheries, forestry, parks, water resources and wildlife).

RAP Timetable

The schedule for completing the RAP, future studies and identified remedial actions is listed below. The schedule contains only actions currently underway or anticipated based on proposed work plans and agency budgets. The schedule will be reviewed and may be revised based on budget considerations and the development of the RAP. The RAP will also identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

ACTIVITY	DATE
Remedial Action Plan:	
Compile available data and information. Begin public participation and education.	July 1987–July 1988
Problem analysis and remedial alternatives development. RAP draft plan.	July 1988–July 1989
Public hearing. Finalize and adopt RAP.	July–October 1989
RAP submitted to IJC's Water Quality Board.	October 1989
Regular RAP updates through the basin planning process.	1990 (Ongoing)
Monitoring and Research Studies:	
Annual fish and sediment contaminant monitoring program.	Ongoing
Water quality standards review.	1985–1987
Monthly fixed station monitoring for conventional pollutants and toxic substances.	Ongoing
Biological and fisheries surveys.	1985–Ongoing
Develop toxic substances monitoring strategy.	1988
Milwaukee estuary study set control levels for MMSD pollution abatement.	1985–1987
Industrial and Municipal Dischargers:	
MMSD pretreatment program.	Ongoing
MMSD pollution abatement program for relief of CSO and urban nonpoint source impacts.	Ongoing–1996
MMSD treatment facility upgrade.	Ongoing–1992
Toxic substance criteria incorporated into MMSD's discharge permit.	1988
Solid and Hazardous Wastes:	
Environmental repair fund analysis of abandoned City of Milwaukee landfill.	1987–1988
Control and prevention of toxic substance spills.	Ongoing
U.S. Army Corps of Engineers rehabilitates the Milwaukee CDF for dredge spoil disposal.	1987–1988

Nonpoint Source Management:

Complete nonpoint source pollution abatement and integrated resource management plans for entire Milwaukee River basin.	1985–1990
Implement Milwaukee River Priority Watersheds Program plan recommendations for relief of urban and rural nonpoint sources and restoring beneficial uses throughout the basin.	1987–1998

Note: The schedule contains only actions currently underway or anticipated based on proposed work plans and agency budgets. The schedule will be reviewed and revised based on budget considerations and the development of the remedial action plan. The remedial action plan will also identify any additional actions that are needed to restore and protect the ecosystem and its beneficial uses.

13. WAUKEGAN HARBOR

Environmental Assessment

Waukegan Harbor is located on the west shore of Lake Michigan approximately 64 km (40 miles) north of Chicago in Waukegan, Illinois. In 1976 high concentrations of PCBs were discovered in harbor sediments and soil in the vicinity of the Outboard Marine Corporation (OMC). The PCBs were found to have been discharged from OMC outfalls. Consequently, the U.S. Environmental Protection Agency (EPA) and the State of Illinois took steps to halt the discharges and to force OMC to clean up contaminated areas. The discharges have ceased. Past cleanup efforts have been stymied by a series of lawsuits between OMC and U.S. EPA. The large volume of PCB–contaminated soils and sediments is the major unresolved problem.

The contaminated areas include about 15 ha (37 acres), including the Upper Harbor, Slip 3 and about 4 ha (10 acres) of land on the northern edge of OMC's property. The contaminated sections of OMC's property are the North Ditch, the Parking Lot, the Oval Lagoon, and the Crescent Ditch. All but the Parking Lot are part of a local surface drainage area that empties into Lake Michigan.

Numerous investigations at the site have indicated that approximately 500,000 kg (1.1 million pounds) of PCBs contaminate the site, approximately 136,000 kg (300,000 pounds) of which are in the harbor itself. PCB concentrations in harbor sediments are as high as 500,000 mg/kg in the most highly contaminated areas of the harbor (Slip 3). It has been estimated that as many as 20.4 kg (45 pounds) of PCBs are released into Lake Michigan each year, while an additional 20.4 kg per year are released into the air.

Waukegan Harbor is a center for much recreational boating and fishing. Available recreational facilities include public boat launching ramps, charter boat operations and the largest lakefront yacht dealer in the Chicago metropolitan area. Fishing, both in the harbor itself or offshore, is another popular activity. The City of Waukegan maintains an emergency drinking water intake in Waukegan Harbor, though it has rarely been used.

Because of the potential for human exposure to PCBs from this site, it was included on the National Priorities List (under the Comprehensive Environmental Response, Compensation and Liability Act or 'Superfund') in December 1982.

RAP Development Progress

Since March 1978, the U.S. EPA has been involved in numerous legal battles with OMC, including a suit under the Clean Water and Refuse Acts seeking a site cleanup, and one in the U.S. District regarding U.S. EPA's use of an administrative warrant to gain access to OMC's property for design of a remedy. In September 1985, the Seventh Circuit Court ruled that the U.S. EPA's use of this administrative warrant was not justified.

Under Superfund, U.S. EPA authorized a Source Control Feasibility Study in 1983. This document was reviewed during public meetings and public comment periods during 1983 and 1984, and the U.S. EPA–recommended alternative was revised based on public concern over the negative impacts of the proposed alternative on the socio–economic well being of the community.

On May 15, 1984, a Record of Decision was signed authorizing $21 million for the design and cleanup of the entire site. The recommended alternative consists of:

1. Dredging of all harbor sediments contaminated with 50 mg/kg or more PCBs.

2. Dredging and deep excavation of Slip 3.

3. Construction of a bypass sewer line through the North Ditch.

4. Construction of a slurry wall around, and a clay cap over, both the Oval Lagoon and Crescent Ditch, after hot spot (over 10,000 mg/kg) removal.

5. Containment of parking lot contamination by slurry wall.

6. Construction of an above ground containment cell on the parking lot area to hold contaminated materials removed from the Upper Harbor and Slip 3.

7. Fixation and offsite disposal of materials excavated from Slip 3, the Crescent Ditch, and the Oval Lagoon (hotspots).

Design work began in December 1984 but was put on hold in mid-March 1985 indefinitely due to the lack of site access. In October 1986, Congress passed the Superfund Amendments and Reauthorization Act, an amendment to the original Superfund Law (CERCLA), which contains specific site access provisions; thus resolving the problem of site access.

In December 1986, OMC submitted a cleanup proposal, which is currently being evaluated by the U.S. EPA and the Illinois Environmental Protection Agency.

Until a cleanup plan acceptable to U.S. EPA and Illinois EPA is negotiated, it is not possible to develop an implementable RAP for Waukegan Harbor. A 'Preliminary Draft Area of Concern remedial action plan' summarizing existing environmental data and actions to date was prepared by U.S. EPA's contractor in August 1985. This remains an internal document. It is expected that Illinois EPA will use it as a starting point for preparing a RAP once a cleanup is approved.

RAP Timetable

No specific timetable can be presented at this time due to uncertainty in the outcome of negotiations among OMC, U.S. EPA and Illinois EPA concerning a cleanup plan. Upon final resolution of these negotiations, a specific RAP timetable will be developed.

14. GRAND CALUMET RIVER/INDIANA HARBOR CANAL

Environmental Assessment

Many years of heavy industrial and municipal activity along the Grand Calumet River and the Indiana Harbor Ship Canal (GCR/IHC) have created severe water quality problems which have only recently begun to diminish. Combined sewer overflow contributes significantly to this problem, especially in the west branch of the Grand Calumet River. Toxic substances are of particular concern in this area because most of the flow in this system ultimately enters Lake Michigan; the remainder enters Illinois. The primary problem is sediment contamination, which limits the development of fish and other aquatic life and impairs other potential public uses.

The quality of aquatic habitat reflects the industrial and urban character of this region. Channelization and dredging have decreased the diversity of the river habitat and correspondingly reduced the diversity of aquatic organisms.

Although substantial reduction has been achieved for many pollutants, total pollutant loadings exceed the natural assimilative capacity of the Grand Calumet River. This, in conjunction with the existing contaminated sediments, precludes the colonization of benthic organisms, thus denying higher organisms an important food base. Even without contamination of sediments, spawning areas are scarce because of the homogeneous nature of the bottom. However, adjacent natural wetland areas exist which provide some habitat diversity.

Although the implementation of the National Pollutant Discharge Elimination System (NPDES) point sources control program during the past decade has resulted in significant improvements in water quality, surveys conducted in 1972 (U.S. EPA), 1979 (U.S. Army Corps of Engineers), and 1984 (Hydroqual) indicate that significant levels of toxic metals and organic contaminants persist in the sediments. These chemical constituents reflect the history of direct or indirect industrial discharges to the system. PCBs, heavy metals, and many other priority pollutants occur in concentrations that led to classification of the sediments as "heavily polluted." Recent priority pollutant analyses by Hydroqual have shown constituents to be present in both higher and lower concentrations than measured in previous years. Assimilative capacity of the river may have to be re-evaluated due to suspected toxicity evident from recent monitoring.

Heavy metal concentrations in the East Branch sediments decreased somewhat between 1972 and 1983. A particular reduction was noted by the Indiana State Board of Health (ISBH) in lead and zinc concentrations. In spite of these reductions, the sediments are still considered to be heavily polluted with all metals except mercury.

The effect of contaminated sediments on fish and benthic organisms was evaluated by U.S. EPA, Region V. These tests showed that sediments of the GCR system were highly toxic to aquatic life. Sediment quality data collected since these tests were run have not shown the improvement necessary to suggest that these waters should be given the classification appropriate for self-sustaining fish populations.

A survey was conducted by the Indiana Department of Environmental Management in 1986 to determine whether significant pollutant loadings to bottom sediments were still occurring. Calculated sedimentation rates were much lower than expected. However, gross pollution of these sediments with petroleum by-products was documented.

Transient aquatic life can be found in both the Grand Calumet River and Indiana Harbor Canal. A few resident fish have been observed, and even some salmonids stray into the east branch in autumn. The ISBH conducted investigations on fish and benthic macroinvertebrate populations between 1979 and 1986. Total numbers of fish as well as number of species detected were low. Carp was the only species that was collected during each fish collection period. For many species, only a few individuals were collected, indicating that these fish may have strayed into the river from Lake Michigan.

Chemical analyses of fish tissue collected in the east branch of the Grand Calumet River between Cline Avenue and the Indiana Harbor Canal in 1980 and 1982 indicate that the potential for bioaccumulation of toxicants exists in these waterways. Two of three samples of carp collected contained levels of PCBs and chlordane which exceeded the Federal Food and Drug Administration action levels. Several carp showed deformities such as missing fins and mouth aberrations.

Depressed conditions were also noted in the samples of benthic organisms collected from the IHC. The greatest number of species were oligochaete worms, followed by chironomid larvae. The inability of these waterways to support diverse, healthy populations of macroinvertebrate organisms drastically reduces the food base for the fish. This adds additional constraints to the development and maintenance of a substantial diverse community of fish in these waters.

In 1986, fish and benthic organisms were collected at five sites in the GCR/IHC system. Fish collections included samples from early summer and fall to determine whether seasonal population changes were occurring. The number of species observed in early summer was smaller than in fall at most sites. Some successful reproduction of golden shiner and goldfish populations does occur in the GCR. Fish populations in the west branch were seriously depressed during summer and fall (very low numbers of only two fish species observed).

There is evidence that biological communities have improved during the last five years. Fish and macroinvertebrate communities are becoming more diverse and, extremely pollution-tolerant forms, such as carp and oligochaetes, are losing dominance to more sensitive species like the golden shiners and bryozoans. Nevertheless, despite the recent improvements, conditions still will not permit development nor maintenance of a well-balanced, healthy aquatic community in the areas waterways.

RAP Development Progress

The Grand Calumet River/Indiana Harbor Canal RAP is being developed by the Indiana Department of Environmental Management (IDEM). A rough draft of the plan was completed on February 13, 1987. The rough draft was reviewed by IDEM, U.S. EPA, and the Northwest Indiana Citizens Advisory Committee. A number of changes are needed to reflect a more comprehensive discussion of air, solid and hazardous waste, and sediment management issues.

The RAP is part of a comprehensive plan which encompasses all programmatic efforts into a full range of ongoing regulatory and investigative activities. The plan, the Northwest Indiana Environmental Action Plan, delineates resources and establishes agency priorities necessary to achieve realistic areawide environmental results. The Environmental Action Plan establishes basic goals for cleaning up known environmental problems and provides a comprehensive framework for identifying new problems and implementing solutions. One component of the Environmental Action

Plan is the Grand Calumet Master Plan, which was the initial effort that identified the need to establish a systematic approach to solving the water related problems in and along the Grand Calumet River and Indiana Harbor Canal. The Environmental Action Plan brings together the activities of both the Grand Calumet Master Plan and the RAP to solve the environmental problems of Northwest Indiana.

To facilitate public involvement in carrying out the Environmental Action Plan, a Citizens Advisory Committee for Northwest Indiana was established by the Indiana Department of Environmental Management (IDEM). The Committee is composed of representatives from business, government, environmental groups, academia, and local government agencies. The committee's principal task is to monitor the implementation of the Environmental Action Plan and advise IDEM on the environmental needs of Northwest Indiana.

The principal agencies that are involved in the development of the RAP are U.S. EPA and IDEM. In implementing the RAP, the U.S. Geological Survey and the U.S. Army Corps of Engineers will also play significant roles. The U.S. Geological Survey, under agreements with IDEM, will provide technical assistance in defining surface and groundwater flow systems of the Area of Concern. The U.S. Army Corps of Engineers will have the responsibility for dredging the Indiana Harbor Canal and facilitating the appropriate disposal of the dredged material.

There are a number of activities underway related to RAP development. These include:

- The U.S. Geological Survey has half completed a study of the groundwater flow system in the Area of Concern.

- The U.S. Army Corps of Engineers has completed several sediment studies for the Indiana Harbor Canal.

- The U.S. Army Corps of Engineers has initiated the development of an Environmental Impact Statement to address the disposal of sediment in the Indiana Harbor Canal. Early coordination meetings with the Department of Environmental Management, U.S. EPA–Region V, and the Northwest Indiana Citizens Advisory Committee were held in March 1987.

- The Indiana Department of Environmental Management has identified a number of toxics of concern in the Grand Calumet River/Indiana Harbor Canal Area and began acquiring data on these toxicants in April 1986. When the study is complete in December 1987, the data will be used to augment the existing wasteload allocations for Area of Concern facilities.

- To deal with the 14 combined sewer overflows in the Area of Concern, each was evaluated during 1984–85, and a plan to eliminate dry weather discharges was completed in March 1987. The plan is expected to be completely implemented by February 1988.

RAP Timetable

ACTIVITY	DATE
Remedial Action Plan:	
Indiana commits to development of a RAP for the Grand Calumet River/Indiana Harbor Canal.	1985

Contract for the drafting of a RAP let by U.S. EPA to consultant.	1986
Rough draft of RAP delivered to Indiana.	February 1987
Public and other governmental agencies provide review and comments on draft RAP.	Feb–June 1987
IDEM rewrites draft RAP based on review comments and additional concerns.	November 1987
Final draft RAP becomes part of the Northwest Indiana Environmental Action Plan.	December 1987
Submission of RAP to IJC's Water Quality Board.	January 1988
Water Quality Standards:	
Water Quality Standards for the Grand Calumet River/ Indiana Harbor Canal and Lake Michigan nearshore revised to comply with the requirements of the Clean Water Act and Lake Michigan Toxic Pollutant Control/ Reduction Strategy.	September 1988
Sediment Management:	
Corps of Engineers develops the Environmental Impact Statement on Sediment Management for the Indiana Harbor Canal.	1988
Determination made by the Corps of Engineers on whether or not to remove sediment for the Indiana Harbor Canal and what technology will be employed for removal and disposal.	1988
NPDES Permits:	
Complete Toxicant Wasteload Allocation Study.	December 1987
Industrial and municipal permits revised to reflect waste allocation study results.	1992
Combined Sewer Overflows (CSOs):	
Complete the CSO Implementation Strategy.	April 1987
Dry weather discharges for CSO outfalls eliminated.	February 1988
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Actions:	
Complete site inspections for all potential 92 CERCLA sites.	January 1989

Complete the cleanup/remedial actions at sites on National Priorities List (as of 4/87).	September 1990
Complete the cleanup/remedial actions at all identified sites in Area of Concern.	After the year 2000
Hazardous Waste Facilities:	
Complete closures of all environmentally significant land disposal facilities in Area of Concern.	December 1988
Make final permit determination for all treatment/ storage facilities in Area of Concern.	November 1992
Monitoring and Surveillance:	
Determine extent of toxics in outfalls through biological studies which utilize chronic embryo–larval toxicity testing.	March 1988
Determine the extent and impact of sediment contamination in the Grand Calumet River/Indiana Harbor Canal and Lake Michigan Nearshore.	December 1988
Determine the extent and impact of groundwater contamination in the Area of Concern and delineate the groundwater flow system.	1988
Assess the impact of toxic substances from tributary surface waters, groundwater and atmospheric deposition on Lake Michigan utilizing fish tissue analysis.	1988
Assess status of submergent vegetation and benthos for the Area of Concern streams.	1988
Develop a series of environmental indicators to address health advisories, wastewater effluents, ambient air concentrations/source emissions and land use.	June 1988

15. KALAMAZOO RIVER

Environmental Assessment

The Kalamazoo River is located in the southwest portion of Michigan's lower peninsula. The river flows in a westerly direction and discharges into Lake Michigan. Approximately 128 km (80 miles) of the Kalamazoo River, between the City of Kalamazoo and the City of Saugatuck (Lake Michigan), are contaminated with PCBs. The upstream boundary of the Area of Concern is Calkins Dam, which forms Lake Allegan. The Area of Concern extends downstream to Lake Michigan, a distance of approximately 45 km (28 miles). The source area has been identified as the Kalamazoo River from Calkins Dam to the City of Kalamazoo, and Portage Creek, a tributary to the Kalamazoo River in Kalamazoo.

The major problem in the Kalamazoo River is contamination of biota, water and sediment with PCBs. PCBs have been found in the Area of Concern in relatively high concentrations, primarily in the water and fish. The major historical sources of PCBs in the Kalamazoo River appear to be the wastewater discharges from paper industries. The present problem is principally due to uncontained PCB-contaminated sediments, where an estimated 104,000 kg (230,000 pounds) of PCBs reside. Evidence suggests that contaminated sediments in natural depositional areas and behind both drawn down and operating hydroelectric dams are all potential sources of PCBs to the water column and fish. A fish consumption advisory has been issued for this area by the Michigan Department of Public Health. It is estimated that approximately 98 kg (217 pounds) PCBs per year are being transported from the Kalamazoo River to Lake Michigan.

RAP Development Progress

Since PCBs were identified as a problem in 1971, several actions have been taken to improve conditions. The discharge of PCBs has been substantially reduced due to the PCB ban, originally under Michigan law and now nationwide under the Toxic Substances Control Act. Further reductions have been required in some NPDES permits (such as for the City of Kalamazoo). However, these actions have not corrected the PCB contamination in the Kalamazoo River and Portage Creek.

The State of Michigan has identified two potentially responsible parties to date – Allied Paper Incorporated and Georgia Pacific Corporation. Both parties own property containing high concentrations of PCBs in the sediments which are believed to be contributing to the continuing contamination of the Kalamazoo River.

The State of Michigan gave notice on August 29, 1986, of its intent to file a civil action against SCM Corporation (owner of Allied Paper), Allied Paper Incorporated, and other property owners along Bryant Mill Pond. Notice was given pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, the Resource Conservation and Recovery Act, the Federal Water Pollution Control Act, and the Toxic Substances Control Act. The State will seek injunctive relief to abate and remedy the release of hazardous substances into the environment, declaratory relief, damages, civil penalties, cost of litigation, reimbursement of State response costs and all other appropriate relief.

The State of Michigan has contacted Georgia Pacific Corporation and requested that they complete a study of PCB contamination of their waste disposal ponds by August 31, 1987. If the study confirms the presence of PCBs, a remediation plan will be required.

A Remedial Investigation/Feasibility Study of the Kalamazoo River PCB problem was completed in July 1986, under State Act 307. This study recommended that remedial actions be taken at Bryant Mill Pond (Portage Creek) and the three State owned dams. Further investigation was recommended at Lake Allegan prior to remedial action. Remedial action funds ($1.5 million) were secured in 1987 under State Act 307 to deal with one of the State-owned dams (Trowbridge). Additional Act 307 funds have been allocated for fiscal year 1988 for actions at the remaining State-owned dams. Followup studies are underway on fish, water and sediment PCB concentrations, sediment burial rates, partition coefficients and erosion rates. These studies will provide the data necessary for recommendations on Lake Allegan. These studies will be completed by 1988.

Public meetings were held prior to and upon completion of the Remedial Investigation/Feasibility Study. A public meeting was also held in December 1986, to initiate the RAP. The State of Michigan has also provided the City of Kalamazoo with a $10,000 grant to establish a Basin Strategy Committee. This committee's purpose is to provide input into the planning process for the Kalamazoo River.

RAP Timetable

The timetable for the specific actions on the PCB problem is presented below:

ACTIVITY	DATE
Public meeting on Kalamazoo River RAP.	December 1986
Kalamazoo River Steering Committee established.	July 1987
First draft of RAP completed.	September 1987
Second draft of RAP completed.	December 1987
Public meeting and review of RAP.	December 1987
Submit RAP to IJC's Water Quality Board.	April 1988
Investigations:	
Remedial investigation and feasibility study.	March 1986
Addendum to remedial investigation and feasibility study.	July 1986
Georgia Pacific Waste Disposal Ponds Study.	August 1987
Follow-up studies.	December 1987

16. MUSKEGON LAKE

Environmental Assessment

The Muskegon Lake is a 1,679 ha (4,150 acre) inland coastal lake located in Muskegon County along the east shoreline of Lake Michigan, just north of the City of Muskegon.

Prior to 1973, Muskegon Lake received direct discharges of industrial process wastewater, municipal wastewater treatment plant effluent, combined sewer overflows and urban runoff. These discharges degraded water and habitat quality of Muskegon Lake and tributaries. The resulting excess nutrient enrichment and solids and toxic substance loadings resulted in nuisance algal blooms, reduced oxygen concentrations in the water column, tainted fish and contaminated sediments. Development of petroleum, chemical and heavy industries in the area resulted in contaminated groundwater in some areas. These conditions raised concerns about possible impacts on Lake Michigan and resultd in designating Muskegon Lake as an Area of Concern.

RAP Development Progress

Since 1973 local, state and federal sponsored remedial actions have improved water quality in Muskegon Lake and tributaries. A major action was the diversion of the industrial and municipal discharges away from the lake and tributaries to the Muskegon County Land Application Wastewater Treatment System (Muskegon Metro). This facility, located east of the City of Muskegon, is comprised of a 4,856 ha (12,000 acre) site with two 340 ha (850 acre) reservoirs used to store and treat the wastewater prior to land application. Underdrainage from the land application sites accumulates in surrounding drainage ditches and discharges to Mosquito Creek (Muskegon Lake watershed) and Black Creek (Mona Lake watershed). An approved industrial pretreatment program has further reduced the amount of waste treated at this facility.

Mosquito Creek, a designated coldwater stream tributary to the Muskegon River, receives 0.9–3.1 m^3/sec (20 to 70 MGD) of treated wastewater from the Muskegon Metro system. The excess hydraulic loadings has increased Mosquito Creek water levels and has altered water quality and floodplain characteristics by transforming the area from a wooded swamp to a shallow marsh immediately downstream of the outfall. Contaminant loadings are presently acceptable because of the absence of any adverse impacts on community health of biota of the receiving stream. Michigan water quality standard violations for dissolved oxygen have been documented downstream of the discharge. Plans to divert the discharge directly to the Muskegon River have been proposed.

The diversion of process wastewater away from Muskegon Lake and tributaries has, however, greatly improved water and habitat quality in Muskegon Lake by reducing the loadings of nutrients, oils and toxicants. Nuisance algal blooms have been eliminated, indicating an effective reduction in nutrient loadings to the lake. The lake supports an excellent walleye, largemouth bass, perch and northern pike fishery. Existing water quality also supports other popular recreational uses including swimming and boating.

Although the overall water quality of Muskegon Lake is good and there are no documented impacts on Lake Michigan resulting from Muskegon Lake, there are some localized problems. Sediment and fish contaminant monitoring surveys in 1986 were

made to determine trends in contaminant levels. Observations during the sediment contaminant survey indicated that littoral zone sediments are comprised primarily of sand. Normally, such sediments contain low contaminant levels and were, therefore, not sampled and analyzed. Elevated levels of heavy metals (copper, chromium, nickel, lead and zinc) continue to be associated with the fine particulate deposits found in the deeper basins of the lake. However, a comparison with 1980 data indicates a definite decline in concentrations. The 1986 sediment survey results indicated mercury concentrations averaged less than 0.5 mg/kg with a maximum concentration of 1.3 mg/kg, the latter in the vicinity of the Division Street (11th Street) storm sewer outfall and the defunct Michigan Foundry Supply site.

The National Dioxin Study and U.S. Food and Drug Administration (FDA) identified 2,3,7,8-TCDD levels up to 14 ng/kg in a single composite sample of Muskegon Lake carp. However, U.S. FDA analyses of 12 composite samples of walleye, largemouth bass, northern pike and carp collected from Muskegon Lake and Bear Lake in 1986 indicated dioxin levels less than detection (10 ng/kg). Carp and walleye collected in August 1986 have been sent to the U.S. EPA for dioxin analysis as part of a study concerning dioxin levels in the vicinity of bleached kraft pulp paper mills such as the S.D. Warren Company on Muskegon Lake. Analytical results are expected in late 1988.

Fish contaminant monitoring results from the 1986 survey indicated that average contaminant concentrations in carp from Bear Lake (a tributary to Muskegon Lake) and walleye from Muskegon Lake exceeded the Michigan Department of Public Health action levels of 2 mg/kg PCBs and 0.5 mg/kg mercury, respectively. Generally, those carp greater than 69 cm in length contained more than 2 mg/kg PCBs and walleye greater than 55 cm in length contained more than 0.5 mg/kg mercury. Although largemouth bass from Muskegon Lake and Bear Lake contained an average mercury concentration of 0.32 mg/kg, mercury concentrations in largemouth bass greater than 40 cm and 1,100 gm exceeded the 0.5 mg/kg mercury action level.

PCB concentrations in the two carp collected from Muskegon Lake during the 1986 survey were equal to or less than 2 mg/kg. However, it is assumed, based on the Bear Lake carp results, that most large carp in Muskegon Lake also contain PCB concentrations that exceed the U.S. FDA action level.

The observed elevated mercury and PCB levels are associated with large fish and are most likely attributable to the age of the fish, trophic preference, movement ranges and a long-term exposure to low level water concentrations resulting from atmospheric inputs to Lake Michigan and Muskegon Lake watershed. Sediment concentrations of PCBs and mercury do not appear to be a significant source in Muskegon Lake, except in localized areas near tributary mouths. Additional analyses of Muskegon Lake sediment samples are being done for PCBs at a detection level less than 1 mg/kg dry weight to further evaluate them as a potential source.

Two Superfund sites (Cordova (Ott/Story) Chemical Company and Duell and Gardner Landfill) are located in the Bear Creek watershed. Serious degradation of 2.6 km of Little Bear Creek has been noted due to seepage of contaminated groundwater from the Cordova (Ott/Story) site. Seepage is presently continuing unabated. Contaminant loadings consist primarily of volatile organic compounds. Federal and State programs are being developed to define alternative ways to stop contaminated groundwater entering Little Bear Creek. Duell and Gardner landfill accepted hazardous waste from 1930 to 1979. A remedial investigation was begun in 1987.

A public meeting was held August 1986 to provide the general public, local units of environmental groups an overview of the RAP development process, findings to date and an opportunity for citizens to provide comments and recommendations concerning the Musekgon Lake Area of Concern. Such input is essential to the development and implementation of the RAP. A second public meeting was held July 1987, following the completion of a second draft RAP, to afford an opportunity for comments and suggestions. The final RAP is scheduled for completion in August and submittal to the IJC's Water Quality Board in October 1987.

Based on available site specific data and public concerns the following conclusions and recommendations are made:

1. Muskegon Lake water quality has no apparent adverse impact on Lake Michigan.

2. Impaired uses in Muskegon Lake and Bear Lake are restricted to elevated PCB concentrations in large carp and mercury in large walleye and largemouth bass. This may be a result of atmospheric inputs versus inplace contaminant levels.

3. Ryerson Creek, Ruddiman Creek and Four Mile Creek, tributaries of Muskegon Lake, need to be assessed to determine localized sediment contaminant levels and habitat quality conditions. Ryerson Creek and Ruddiman Creek receive urban stormwater runoff and heat loads from industrial noncontact cooling water discharges. Four Mile Creek may be influenced by organic contaminated groundwater from an industrial site. A purgewell system is proposed to capture and treat the contaminated plume.

4. Bear Lake sediments, collected in March 1987, are being analyzed for PCBs since concentrations in four of seven carp collected from Bear Lake exceeded the U.S. FDA action level of 2 mg/kg wet weight. There is no known or suspected source of PCBs upstream of Bear Lake and previous sediment PCB results indicated less than 0.02 mg/kg. Mercury concentrations are also being analyzed.

5. Lake Michigan carp and walleye should be collected for fish contaminant analysis to determine if concentrations of PCB and mercury are similar to those in Muskegon Lake and Bear Lake fish. This may assist in determining if PCB and mercury in older fish is a site-specific or regional phenomenon.

Remedial actions will be developed and prioritized based on the outcome of these investigations.

RAP Timetable

ACTIVITY	DATE
First public meeting on Muskegon Lake.	August 1986
Second public meeting on Muskegon Lake RAP.	July 1987
Submit RAP to IJC's Water Quality Board.	October 1987

17. WHITE LAKE

Environmental Assessment

White Lake is a 1,040 ha (2,571 acre) lake located in Muskegon County along the east shoreline of Lake Michigan in the vicinity of Montague and Whitehall, Michigan. The White Lake Area of Concern includes White Lake proper and a 0.4 km zone around the lake. White Lake is an excellent walleye, perch, largemouth bass and northern pike fishery and sustains other popular recreational activities such as boating and swimming.

The major environmental problem is contaminated groundwater entering White Lake from the Occidental (Hooker) Chemical Company property. Groundwater contaminants of concern that enter White Lake include chloroform (0.2 – 3.4 mg/L), trichloroethylene (<0.01 – 3.0 mg/L), carbon tetrachloride (0.8 – 33.9 mg/L) and perchloroethylene (0.2 – 48.7 mg/L). Soil contaminants at the site, located about 1.2 km north of White Lake, are hexachlorocyclopentadiene (C–56), hexachlorobutadiene (C–46), hexachlorobenzene (C–66) and octachlorocyclopentene (C–58). These latter contaminants are not components of the groundwater entering White Lake from the contaminated plume. The macrobenthic invertebrate community is negatively impacted in the vicinity of the contaminated groundwater plume entering White Lake.

A 1979 Consent Judgement between the Hooker Chemical Company and the State of Michigan required the company to completely halt the flow of contaminated groundwater to White Lake. The Consent Judgement required the installation of purge wells to purge groundwater from the contaminated aquifer and provide treatment of the groundwater to remove contaminants of concern. The company has installed a series of purge wells and a carbon adsorption treatment system. The treated purge well water is discharged to White Lake pursuant to a National Pollutant Discharge Elimination System (NPDES) permit.

Prior to 1985 and after installation of the purge well system, Michigan Department of Natural Resources (DNR) evaluated the effectiveness of the purge well system as part of an ongoing compliance program and determined that the system was only intercepting 60% of the contaminated groundwater plume entering White Lake. In May 1985, the State filed a Motion to Compel with the Ingham County Circuit Court to enforce the provisions of the 1979 Consent Judgement and to compel the chemical company to improve its groundwater purge well and treatment system so that the flow of contaminated groundwater to White Lake would be completely halted. In December 1985, the Circuit Court affirmed the State's position that the Consent Judgement requires Hooker to completely halt the flow. Since that time, Hooker Chemical Company has made incremental increases in the groundwater purge rates and is capturing about 85–90% of the contaminated plume. The company still is not purging at a rate sufficient to halt the flow of contaminated groundwater to White Lake. Further improvements must be made before the company will be in compliance with the Consent Judgement on this issue. The State is continuing its efforts to obtain compliance.

In order to evaluate any impacts the company's treated effluent may have on fish in White Lake, Hooker Chemical was required by their NPDES permit to conduct a contaminant uptake study which involved exposing fish to the treated effluent. Study results showed the absence of detectable levels (detection level of 10 µg/kg) of hexachlorobutadiene, octachlorocyclopentene, hexachlorobenzene and mirex in whole rainbow trout after 28 days exposure to 100% treated effluent from Outfall 001. There is also concern for the ultimate disposition of contaminated soils on Hooker Chemical Company property.

Fish contaminant monitoring in White Lake in 1984 continued to show that carp populations contained an average concentration of 3.7 mg/kg PCBs, which exceeds the Michigan Department of Public Health's 2 mg/kg wet weight action level. Other contaminant concentrations were found to be less than levels of concern in other fish species analyzed. PCBs in the carp population are suspected to be acquired from atmospheric deposition to Lake Michigan and the White Lake watershed. Analysis of White Lake sediment samples collected in December 1986 by Michigan DNR indicated PCBs were undetectable at detection levels of 100 to 140 µg/kg, except one sample that contained 130 µg/kg. Sediments do not appear to be a major source of PCBs to carp.

White Lake sediment data from the December 1986 survey also indicated the littoral zones on the north, west and south sides of the lake are primarily sand. Sand typically contains low contaminant levels and during the survey were, therefore, not sampled except in the vicinity of Occidental Chemical Company's contaminated groundwater plume. Sediments northeast of the lake near the inlet were found to be primarily organic, influenced by runoff from upstream agriculturally used muck land.

A major sediment contaminant commonly found throughout the lake in the sublittoral areas during the 1986 survey was chromium. A maximum chromium concentration of 4,300 mg/kg was collected in the vicinity of the now defunct outfall of Whitehall Leather Company. Prior to 1976, the company's process water was discharged to White Lake. Lake sediment chromium concentrations, in the vicinity of the discharge, reportedly contained more than 23,000 mg/kg in 1980. Although elevated, the observed sediment chromium concentrations do not appear to be causing any impaired use of White Lake or Lake Michigan, nor was there any indication of excessive uptake of chromium by fish.

Since the mid–1970s, industrial and municipal wastewater from Whitehall and Montague have been treated at the Whitehall–Montague wastewater land application facility located about 3.2 km upstream of White Lake. Implementation of an approved industrial pretreatment plan has reduced the discharge of process wastes to the treatment facility. Underdrainage from several application sites is presently discharged to Silver Creek, a designated cold water stream, and thence to the White River and White Lake. Proposed plans are to divert the discharge directly to the White River.

Runoff from agricultural areas in the watershed is suspected of contributing nutrient loadings to the lake. Sediment analytical results from the 1986 survey indicate low levels of pesticides. The 1986 fall lake sampling also indicated acceptable average phosphorus concentrations during fall turnover of 0.015 mg/L. Additional survey data characterizing seasonal lake conditions is recommended to determine if remedial actions are needed to reduce nonpoint source nutrient loadings to the lake.

RAP Development Progress

A public meeting was held June 17, 1986 to provide the general public, local units of government, industrial representatives and environmental groups an overview of the RAP development process, findings to date and an opportunity to provide comments and recommendations concerning White Lake.

A second public meeting was held in August 1987, following the completion of a second draft of the RAP in order to afford an opportunity for comments and suggestions. The final RAP is scheduled for completion in September and submittal to the Water Quality Board in October 1987. Based on available data, the following conclusions are made.

1. White Lake Area of Concern has no known adverse effects on Lake Michigan.

2. The only documented impaired use in White Lake is a fish consumption advisory for carp because of elevated PCB levels.

3. The reduction of the discharge of contaminated groundwater from Occidental Chemical Company to White Lake should continue in order to completely halt the flow of contaminated groundwater to White Lake.

4. A nutrient budget of the lake should be done to determine seasonal lake conditions of White Lake to better determine the need for reducing nonpoint source loadings.

RAP Timetable

ACTIVITY	DATE
Michigan commits to developing a RAP for White Lake.	1985
Michigan files Motion to Compel to enforce 1979 Consent Judgement against Occidental (Hooker) Chemical Company.	May 1985
Circuit Court affirms Michigan's position to completely halt contaminated groundwater entering White Lake from Hooker property.	December 1985
White Lake sediment survey.	1986
First public meeting held for White Lake.	June 1986
Second public meeting held for White Lake.	August 1987
Michigan submits White Lake RAP to IJC's Water Quality Board.	October 1987

18. SAGINAW RIVER/BAY

Environmental Assessment

Saginaw Bay is a western extension of Lake Huron located in the east central portion of Michigan's lower peninsula. The bay is 82 km (51 miles) long, varies in width between 21–42 km (13 and 26 miles), and has a surface area of 2,960 km^2 (1,143 square miles). Anthropogenic inputs to Saginaw Bay are dominated by agriculture in the rural areas of the basin, and industrial and municipal wastewater discharges from four major urban areas – Flint, Saginaw, Bay City and Midland.

The physical boundaries of the Saginaw River/Bay Area of Concern have been defined as extending from the head of the Saginaw River, at the confluence of the Shiawassee and Tittabawassee Rivers upstream of Saginaw, to its mouth, and all of Saginaw Bay out to its interface with open Lake Huron at a line drawn between Au Sable Point and Point Aux Barques. Areas outside these physical boundaries, but within the Saginaw Bay basin, are considered in the RAP if they are sources of contaminants delivered to the Saginaw River and/or Saginaw Bay. For example, two point sources (Flint and Ragnone wastewater treatment plants) that discharge to the Flint River were identified as major contributors of heavy metals in 1981. If these facilities are still found to be significant contributors, they will be considered as part of the RAP.

Two major water quality issues have been identified as causing degraded environmental conditions in the Saginaw River/Bay system – eutrophication and toxic materials. These two problems have produced several environmental effects including contaminated sediments, fish consumption advisories, and impacted biota populations.

Sediments in the Saginaw River are most contaminated in, and immediately downstream of the two major urban centers of Saginaw and Bay City. Saginaw Bay sediments show the most elevated levels of contaminants in a sediment depositional zone north of the Saginaw River mouth. The principal materials of concern are PCBs and heavy metals, whose presence has primarily resulted from past discharges of industrial and municipal facilities into the Saginaw River. Present discharges of toxic materials from point sources are regulated through the National Pollutant Discharge Elimination System (NPDES) permit system, Rule 57 guidelines in Michigan's Water Quality Standards, and the State's industrial pretreatment program. A potential source of PCBs to the Saginaw River is the General Motors Plant in Bay City, where between 27 and 54 tonnes of PCBs have been released from the plant and now reside in and on the land adjacent to the Saginaw River.

Sediments of the St. Louis Reservoir are contaminated with polybrominated biphenyls (PBB), DDT and Tris (triisopropyl phosphate ester). Contamination of the fishery with PBB and DDT and its metabolites has been documented in the Pine, Tittabawassee and Saginaw Rivers. Contaminated sediments in the St. Louis Reservoir continue to be a potential source of contamination to the Area of Concern. For example, during the once–in–500–year flood which occurred in 1986, DDT was detected in the water column of the Tittabawassee River. Other pollutants of concern have been detected in Saginaw River/Bay fish, including hexachlorobenzene, polychlorinated dibenzofurans, dibenzo–p–dioxins, diphenyl ethers, styrenes and terphenyls. While these substances may be produced in the incomplete combustion of wastes containing chlorinated organic substances, they are also byproducts of chemical manufacture, particularly chlorinated benzenes, phenols and derivative herbicides. The higher concentrations of these substances in the fish in the Tittabawassee River than anywhere else in the Saginaw Bay basin suggest Dow Chemical Company's

Midland complex as a major source. The accumulation of chlorinated benzenes, phenols and derivative herbicides in the sediments downstream of this complex provides further support for this hypothesis.

No recent data are available on levels of contaminants in Saginaw Bay sediments. However, heavy metals concentrations in the bay are strongly influenced by sediment resuspension. Very limited data from 1985 suggest that water column values for lead, cadmium, copper and zinc are at or below levels measured in 1976–1978.

Sediments in the south branch of the Shiawassee River just north of Howell, Michigan are contaminated with high concentrations of PCBs originating primarily from the Cast Forge facility in Howell. A partial cleanup of the most contaminated reach was achieved in 1983 in settlement of a lawsuit filed by the Michigan Department of Natural Resources against Cast Forge in 1977. Subsequently, PCB levels in fish have declined in the contaminated reaches, although fish consumption advisories remain in effect and significant quantities of PCBs remain in the sediment that could be mobilized under high flow conditions.

Fish consumption advisories have been issued for the Area of Concern due to elevated levels of PCBs in fish. However, these advisories are restricted to bottom feeding fish and fish with relatively high levels of body fat. People are advised not to eat any carp or catfish from either the Saginaw River or Saginaw Bay. Additionally, for Saginaw Bay, it is suggested that people restrict their consumption of lake trout, rainbow trout and brown trout to no more than one meal per week. There are no advisories for yellow perch or walleye, the principal sport fish in Saginaw Bay.

Biota populations in the Saginaw River/Bay system have been impacted by both toxic materials and eutrophication. Toxic contaminants have necessitated the issuance of the fish consumption advisories just discussed, and it is suggested that they may be impacting the reproductive success of some picivorous (fish–eating) avian populations. The incidence of cross–beak syndrome in these colonies is believed to be higher than background and second only to Green Bay in the entire Great Lakes basin. Both herring gulls and common terns from Saginaw Bay have elevated levels of organochlorine contaminants. It is not presently known whether contaminant body burdens in Saginaw River/Bay aquatic populations are detrimental at any stage of their life cycles.

Over 100 Act 307 sites (hazardous waste sites) are located in the Saginaw River basin. No information is currently available on whether or not toxic substances are leaching into tributaries and the bay. In addition, combined sewer overflows in Saginaw and Bay City are potential sources of toxic substances, yet loadings data are currently not available.

It should also be recognized that the once–in–500 year flood (which occurred in 1986) may have caused considerable movement of contaminated sediment throughout the watershed. There is a need to perform investigations to determine how this major flood affected contaminant distribution with Saginaw River/Bay and potential effects on biota.

Excessive phosphorus inputs to Saginaw Bay have impacted biota by creating eutrophic conditions that favor nuisance species and inhibit more desirable species. Extensive blue–green algae blooms created taste and odor problems in drinking water supplies drawn from the bay as recently as the late 1970s. However, since then, bay water quality has improved due to the 1977 state ban on the use of phosphate detergents and reductions in phosphorus discharges from industrial and municipal

wastewater treatment plants due to facility upgrades and better operation. Blue-green algae populations have been substantially reduced and there are no reports of any recent taste and odor problems at drinking water plants drawing water from the bay. Additional reductions in phosphorus loads to the bay are needed, however, to further reduce eutrophic conditions. Early 1980 studies indicated that roughly 55% of bay phosphorus loads came from fertilizer runoff from cropland while 17% originated from other nonpoint sources, suggesting that further phosphorus input reduction efforts will require major nonpoint source controls. Historical data have shown a general decrease in total phosphorus loading from the Saginaw River to Saginaw Bay between 1974 and 1978. However, more recent data suggest a possible increase in total phosphorus loading between 1979 and 1985, although current sampling is inadequate.

Two points need to be considered when attempting to interpret this potential increase:

1. The annual average flow in the Saginaw River has been substantially higher than the historical average of 114 m^3/sec, ranging from 123% to 188% of this value during 1983–1985. Therefore, if the total phosphorus loading increase is real, it is likely due to nonpoint sources which are responsive to high river flow rates. This is consistent with the emphasis on nonpoint source control for further reductions in Saginaw Bay total phosphorus loadings.

2. Phosphorus from nonpoint sources is generally less bioavailable than that from point sources. Therefore, an immediate biological response due to increased loading is not expected. Limited data from Saginaw Bay in 1984–1985 suggest slight increases in chlorophyll a levels but no change in dissolved nutrient levels from 1980 conditions.

To quantify the amounts of phosphorus delivered by runoff from rich agricultural lands to Saginaw Bay and to calibrate a mathematical model of this process, a multi-year study was conducted for the East Central Michigan Planning and Development Region (ECMPDR) by a contractor under a grant from U.S. EPA's Great Lakes National Program Office. In addition, two separate, but coordinated, three-year benthic macroinvertebrate surveys are presently being conducted in Saginaw Bay to assess the present benthic community structure. Michigan's Fisheries Division began a survey in 1986 and a National Oceanic and Atmospheric Administration study began field collections in 1987.

In 1978–79, U.S. EPA's Large Lakes Research Station conducted an intensive study of Saginaw Bay leading to a mass balance budget for PCBs and a mathematical model of the PCB load-concentration relationship for the bay. At the same time, under contract to ECMPDR, a consulting firm performed similar studies on the Saginaw River. The results of these studies indicate that about 350 kg/a of PCBs was being delivered by the Saginaw River to Saginaw Bay. Once in the bay, the primary rate of loss of PCBs from the water column is through volatilization back into the air and association with settling particles. The primary rate of loss from the sediments is burial below the biologically active layer.

In addition, both the University of Michigan and U.S. EPA's Large Lakes Research Station in Grosse Ile, Michigan (LLRS) have modeled the load concentration relationship for phosphorus in Saginaw Bay to assist in the development of a target load reduction for the basin.

RAP Development Progress

Work began on the Saginaw River/Bay RAP in July 1986 with the assignment of a Michigan Department of Natural Resources (DNR) RAP coordinator from the Surface Water Quality Division. On September 16, 1986, Michigan DNR held a public meeting in Bay City that was attended by approximately 100 people. At this meeting, Michigan DNR staff described the Saginaw River/Bay RAP process, the major issues that would be addressed in the RAP, and invited the public to express their opinions about what water quality issues were of most concern to them in the Saginaw River/Bay system. All comments will be responded to in the RAP.

On September 25, 1986, Great Lakes United held a public hearing in Auburn, attended by roughly 80 people, including Michigan DNR staff responsible for the Saginaw River/Bay RAP. This meeting was held to solicit public comment with respect to the U.S.–Canada Great Lakes Water Quality Agreement and again the public responded with their concerns about water quality in the Saginaw River/Bay system. The public concerns expressed at this meeting will also be considered in the preparation of the RAP.

During August and September 1986, a contract was developed between Michigan DNR and ECMPDR to retain ECMPDR to produce the initial draft RAP document. ECMPDR is a regional planning agency, with offices in Saginaw, that serves 14 of the counties that surround Saginaw Bay. ECMPDR then subcontracted with the Great Lakes Natural Resource Center of the National Wildlife Federation (NWF), located in Ann Arbor, to have NWF prepare several sections of the draft RAP. NWF, in turn, secured the services of seven graduate students from the University of Michigan's School of Natural Resources to work on various aspects of the report.

ECMPDR and NWF began working on the Saginaw River/Bay RAP on October 1, 1986. On November 6, 1986, a meeting was held in Saginaw of the Saginaw River/Bay RAP Technical Work Group, which had been formed to (1) initially describe previous studies that had been done on the area and where this information could be obtained , and (2) to review drafts of the RAP for completeness and correctness of technical content. This group includes approximately 30 representatives, with expertise in various subject areas, from local, state and federal agencies including ECMPDR, NWF, Michigan DNR, IJC, U.S. EPA, U.S. Geological Survey, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, U.S. Soil Conservation Service, Michigan Department of Public Health, University of Michigan and several environmental consulting firms.

In January and February 1987, ECMPDR and NWF conducted a series of five public meetings throughout the Saginaw Bay basin (Bay City, Au Gres, Caseville, Caro and Midland) to inform the public about the RAP process and solicit public comment on what they perceive to be the water quality problems of the Saginaw River/Bay system.

On March 5, 1987, approximately 200 people attended a Saginaw Bay workshop held near Bay City, including those responsible for preparing the Saginaw River/Bay RAP. Though this workshop dealt with many issues beyond the scope of the RAP, such as commerce and tourism, Saginaw Bay water quality was a major focus of this activity and pertinent comments will be considered in preparing the RAP.

In April and May 1987, ECMPDR conducted a series of 'Key Group' meetings with local officials and the public to again solicit input to the RAP process. A separate meeting was held with each of the following groups: industry, agriculture, commerce, conservation/recreation, and municipal/local government.

In May, June and July 1987, ECMPDR organized a public group called the Saginaw Basin Natural Resource Steering Committee. This body will be open to any person wishing to participate. One of the activities of this committee, or a subgroup of the committee, will be to provide coordinated public input to the RAP process and provide public review and comment during the RAP's developmental stages and subsequent updates.

Additional efforts have been made to inform the general public in the Saginaw Bay basin about the RAP process and invite public comment and participation through a variety of methods including newspaper articles, radio broadcasts, the ECMPDR newsletter (which is sent to all units of local governments within the 14-county ECMPDR planning area), and several ECMPDR standing committees.

ECMPDR provided an initial draft of the RAP chapters describing the environmental setting, problems and sources to Michigan DNR in April 1987. These chapters have been distributed to the Technical Work Group for review. Based on the review comments ECMPDR revised these chapters and provided a complete first draft of the RAP to Michigan DNR in September 1987. Copies of the draft RAP will be provided to the Technical Work Group and the Natural Resource Steering Committee for review. On September 18, 1987, Michigan DNR staff presented the draft RAP to the Michigan Water Resources Commission (WRC) and the general public at the monthly meeting of the WRC held in Bay City. Additional meetings with the public are planned through November 1987 to discuss the draft RAP and receive general public comment. Following public comment and the review of both work groups, revisions will be made to the RAP, as necessary, and Michigan DNR will submit the Saginaw River/Bay RAP to the IJC's Water Quality Board for review in the spring of 1988.

RAP Timetable

ACTIVITY	DATE
Michigan commits to developing a RAP for Saginaw River/Bay.	1985
RAP development.	July 1986-Apr. 1988
Saginaw River/Bay RAP public meeting in Bay City, MI.	September 1986
Great Lakes United public meeting in Auburn, MI.	September 1986
Michigan DNR retains ECMPDR to prepare a draft RAP.	September 1986
ECMPDR subcontracts with the Great Lakes Natural Resource Center of National Wildlife Federation (NWF) to prepare several sections of the draft RAP.	October 1986
NWF secures the services of seven graduate students from University of Michigan's School of Natural Resources to assist in RAP preparation.	October 1986
Meeting of Saginaw River/Bay RAP Technical Work Group.	November 1986
ECMPDR and NWF hold five public meetings throughout the Saginaw BAy Basin.	Jan.-Feb. 1987

Saginaw Bay Workshop held.	March 1987
ECMPDR conducts 'key group' meetings with industry, agriculture, commerce, conservation/recreation, and municipal/local governments.	April–May 1987
Saginaw Bay Basin Natural Resource Steering Committee established.	May–July 1987
Initial draft of Environmental Setting, Problem Definition and Sources Chapters completed.	April 1987
First draft RAP completed.	September 1987
Public meetings to receive input on draft RAP.	Oct.–Nov. 1987
Saginaw River/Bay RAP submitted to IJC's Water Quality Board.	April 1988

19. COLLINGWOOD HARBOUR

Environmental Assessment

Collingwood Harbour was originally identified by Ontario Ministry of the Environment (MOE) as an Area of Concern in 1977 due to nuisance algal growth and elevated nutrient and bacterial levels. Surficial sediment studies (1974, 1983) have also indicated that harbour sediments exceed provincial guidelines for open-water disposal of dredged sediment for PCBs, lead and zinc. The Collingwood Shipyards and the local sewage treatment plant (STP) were suspected sources. A remedial program involving the expansion of the existing Collingwood sewage treatment plant to 24.5 x $10^3 m^3/d$ (5.4 MGD) was completed in 1982, and currently provides secondary treatment by activated sludge process with phosphorus removal. Contaminant loading figures since 1982 have indicated that the plant effluent is not meeting the Provincial phosphorus requirement. Operational inspection studies have determined that the problem has been associated with sludge handling inadequacies. Changes within the plant are presently underway. The 1986 field work included investigating the STP, the shipyards and all tributaries contributing to the harbour. Results were expected during the summer of 1987.

Although phosphorus and bacterial levels have decreased since 1974, results of surveys in 1980 and 1983 showed levels above the Provincial Water Quality Guidelines and Objectives.

Investigations of contaminants in sport fish in 1984 indicated low concentrations of mercury and essentially no PCBs or mirex accumulations, even in large perch of 35 cm. Additional collections of sport fish and juvenile fish for contaminant analyses were done in 1986.

Nuisance algal growth has been identified as an aesthetic problem in Collingwood Harbour due to nutrient loading. Past Cladophora studies in the harbour (1979-80) found that growth was restricted to the mouth of the harbour and near the STP outfall as a result of high turbidity and restricted harbour water movement. Biomonitoring investigations using filamentous algae were also performed to determine nutrient and metal concentrations indicative of recent water quality. This study was repeated in 1986 and results will be available by next winter. Inconclusive past survey work prompted benthic surveys to be carried out in 1986. Results were to be completed by the summer of 1987.

The first draft RAP for Collingwood Harbour (March 1986) identified the need for more current data, including the STP and the Collingwood Shipyards. The majority of the 1986 field data was not available until the summer of 1987; however, some preliminary findings are reported below.

1. Phosphorus fractionation data for sediments collected during 1986 indicated that a large portion of sediment-associated phosphorus is in an available form to the water column, and consequently would support algal growth. However, phosphorus in sediment with a higher content of sand appears to be in apatite form and not available to algae. Coring and intensive surficial sediment collection were also carried out recently to update information on past concerns. Those concerns are elevated levels of PCBs, lead and zinc, which had shown improvement from studies done in 1974 and 1983.

2. An evaluation of the Collingwood Harbour wetland was completed in the summer of 1986 by the Ontario Ministry of Natural Resources (MNR). The wetland was found to be a Provincially significant Class II wetland utilized by five significant bird species. Any future development at specific sites such as the mouth of Black Ash Creek or on either side of the harbour's western spit, may pose a potential threat to wildlife and fish resources.

3. Fish habitat was also identified and mapped during the summer of 1986 by Ontario MNR. The two major habitat types found were rocky rubble areas and submergent or emergent weedbeds. A total of ten macrophyte species were identified at sampling sites within these major habitats.

   Despite the harbour's limited size, it was found to exhibit a good sport fishery during both the summer and winter seasons. Because the harbour is sheltered from the Georgian Bay winds, it affords excellent angling for migrant fish. Such fish are attracted by the harbour's warm temperature, forage fish and other preferred conditions.

   An inventory of the harbour fish community was conducted by the Ministry of Natural Resources. The nearshore areas in the harbour were dominated by forage fish such as bluntnose minnow and alewife. Most of the fish collected were young-of-the-year, indicating good reproduction. The most abundant species caught were white and shorthead redhorse suckers, smelt, alewife, yellow perch and other sport fish including smallmouth bass, walleye, northern pike, and lake trout backcross.

RAP Development Progress

As part of the Water Quality Board's initiative on Areas of Concern, Collingwood Harbour was one of two Areas of Concern singled out to receive special effort in 1985 to develop a RAP as part of a learning process. This RAP would then serve as a model for other ones. A draft RAP was completed in March 1986 by Ontario MOE and Environment Canada. This draft RAP identified the need for more current data.

Extensive field work was carried out by Ontario MOE, Ontario MNR and Environment Canada during 1986-1987. The majority of these field data will not be incorporated into the RAP until sometime during the summer, or early fall of 1987. Additional field studies may be recommended at that time, as deemed necessary by the RAP Team.

The public participation plan for Collingwood Harbour is divided into four major stages. The first stage was expected to begin in July of 1987, with completion scheduled for sometime in 1989. This stage involves educating the public regarding the RAP process and current environmental status of the harbour. To accomplish this, a tabloid outlining the current status of the harbour and the RAP will be published and distributed prior to a winter public forum. The second stage is to obtain the views and priorities of the public with respect to desired use goals. This component is scheduled to start in January of 1988. Remedial options for the identified use goals will be developed by the RAP Team. Stage three of the public consultation program includes obtaining input and feedback from the public on these remedial options. To do this, the options and their implications will be presented to the public. The initiation of this stage is scheduled for January 1988. The agreed-upon use goals and remedial actions will be incorporated into the RAP. The final stage of the public participation plan is a public review of the RAP, to ensure that the plan accurately reflects their views. This stage may be repeated several times beginning in January 1989. The final Collingwood Harbour RAP is therefore scheduled sometime during 1989.

RAP Timetable

Presented below is a timetable of specific activities and actions undertaken since Ontario committed to developing a RAP in 1985.

ACTIVITY	DATE
RAP Development:	
Ontario commits to developing a RAP for Collingwood Harbour.	1985
Draft RAP prepared as part of a learning process.	March 1986
Public consultation framework, key stakeholders identified.	July 1987
Goals for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	April 1988
Preferred remedial actions, implementation schedule, based on cost/benefit and public consultation.	November 1988
Draft RAP with use goals, remedial actions, for agency and public review.	January 1989
Final RAP with implementation schedule, resource commitments, monitoring and evaluation program.	April 1989
Final RAP to IJC's Water Quality Board.	June 1989
Investigations:	
Environment Canada – Sediment (Public Works – dredging for approach channel only).	1985
Ontario MOE – Contaminants in juvenile fish.	1985–1986
Ontario MOE – Intensive investigations to fill data gaps for preparation of RAP environmental base: Update water quality, sediment, physical studies, direct and indirect source monitoring, shipyards investigations, Cladophora, algal bioassay, juvenile fish, and in–place pollutants program.	1986–1987
Ontario MOE/MNR – Contaminants in sport fish.	1986
Ontario MNR – Fish habitat and speciation, wetland evaluation.	1986
Environment Canada – Phosphorus fractionation, sediment cores.	1986

Ontario MOE – Update sediment chemistry (post–dredging – 1986/87).	1987
Remedial Actions:	
New process installed at Blue Mountain Pottery due to high lead levels in discharge to STP.	1985
Goodall Rubber Canada Ltd. – reprocess tank overflowed to storm sewer – level indicator and controls installed.	1985
Assessments of current STP design and operations to overcome problems relating primarily to in–plant sludge handling.	1985–1986
Blue Mountain Pottery operations shut down.	1986
As a result of recent dredging within the harbour, dredged sediments placed in a confined disposal facility constructed in 1986 at the Grain Elevators.	1986–1987
Shipyards closed – decommissioning of yards.	1986–1987
Certificates of Approval from Ontario OME to local industries in Collingwood (air emissions, handling transportation of waste) issued upon start–up for lifetime of industry unless process change.	Dependent on start–up of industry
Public Involvement:	
Public education on the RAP process and current environmental status of the harbour.	July 1987
Tabloid release.	Oct.–Nov. 1987
Open House.	December 1987
Use Goals (initiation)	January 1988
Remedial options feedback (initiation)	October 1988
Public review of RAP	January 1989
Final Collingwood RAP	June 1989

20. PENETANG BAY TO STURGEON BAY (SEVERN SOUND)

Environmental Assessment

Excessive algal growth in the Severn Sound, particularly in Penetang Bay, has been of public concern since the mid–1960s. Water quality surveys of Severn Sound by the Ontario Ministry of the Environment have identified municipal point source inputs as a cause of the eutrophication problem.

Recreation (aesthetics) is the main use impairment identified to date. Other uses such as swimming, boating and communal water taking, do not appear to be affected. Restriction of human consumption of sport fish populations (restricted consumption of walleye and smallmouth bass due to mercury contamination) in Severn Sound appears similar to other areas in Southern Georgian Bay and are not related to any localized source of contamination.

The Severn Sound is a complex of shallow bays supporting a warmwater and a migratory coldwater fishery. The bays are nutrient enriched and exhibit varying degrees of aquatic plant growth depending on factors such as light penetration, phytoplankton biomass, and exposure to wind and wave action.

The water quality response of Severn Sound to reduced phosphorus loadings from municipal point sources has been positive. Total phosphorus levels have declined approximately 50% between 1969 and 1986 in Midland and Penetang Bays, which receive the largest discharges from sewage treatment facilities. However, phosphorus levels are still high enough to produce nuisance algal growths, particularly in the southern portion of Penetang Bay. The average phytoplankton biomass in Severn Sound remains 10–20 times higher than in adjacent Nottawasaga Bay.

Factors which may account for the limited response to reduced municipal effluent phosphorus loadings in comparison to other similarly affected areas include: nonpoint sources (e.g. additional nutrient supply from agricultural runoff in the immediate watershed to the Sound); continued upgrading and expansion of sewage facilities throughout the monitoring period rather than at one point in time; extensive water circulation and exchange of Severn Sound with the open waters of Georgian Bay, leading to a greater dispersion and dilution of nutrient gradients (Penetang Bay is a notable exception to this generalization as the Bay has limited circulation and exchange); and seasonal changes in the availability of nutrients for algal growth in the Sound.

The annual total nutrient supply to Severn Sound has been determined. However, additional information on water exchange is required to calculate a nutrient budget. Further clarification of the relationship between nutrient supply and nutrient availability to the phytoplankton of the Sound is also required before further remedial measures can be planned.

Available information indicates only minor localized contamination of sediments has occurred. Confirmation of the influence of point source discharges on contaminant levels in biota must be obtained.

RAP Development Progress

The Severn Sound RAP Work Team consists of representatives from the Ontario Ministries of the Environment and Natural Resources, and Environmental Protection, Environment Canada. The team has completed a draft RAP (February 27, 1987),

which includes a description of the environmental conditions and potential sources in Severn Sound. The draft RAP will be supplemented with the results of field work and analyses still to be completed, as well as information obtained from the first stages of the public consultation program.

Those activities scheduled for 1987 include:

- o Updating the calculated total annual nutrient supply to the Sound through the inclusion of additional data collected over the last two years, as well as estimates of the agricultural component of supply from land drainage.

- o Completing the interpretation of current meter data and the development of a water budget for the Sound.

- o Continuation of the yearly water quality monitoring program initiated in 1973.

- o Collections of sport fish and young fish for contaminant analyses.

- o Undertaking the first two phases of the public consultation program. The first phase involves informing and educating the public regarding the RAP process and the current environmental status of Severn Sound. This will be initiated in the spring of 1988 and completed by late summer. The second phase involves obtaining the views and priorities of the public with respect to desired use options. This phase will be initiated in the fall of 1988 and is expected to be completed early in 1989.

Additional field studies to assist in the development of nutrient budgets, and to assess the bioavailability of nutrients may be initiated as deemed necessary by the RAP Team.

RAP Timetable

ACTIVITY	DATE
RAP Development:	
Public consultation framework.	September 1987
Identification of use options.	September 1988
Preferred remedial action and implementation schedule.	March 1989
Draft RAP for review.	September 1989
Final RAP.	January 1990
Submit RAP to IJC's Water Quality Board.	July 1990
Remedial Actions and Investigations:	
New Victoria Harbour wastewater treatment plant commenced operation with tertiary treatment for phosphorus removal.	1985

Interim phosphorus control strategy adopted by Central Region for Penetang Bay.	1985
Certificate of Approval for new Penetang wastewater treatment plant prepared incorporating intent of no further phosphorus load increase to Penetang Bay.	1985
Water quality monitoring – open waters (continuing since 1973).	1987
– Severn River enhanced monitoring (since 1984).	1987
Nutrient supply update to 1986.	April 1987
Exchange/water budget study.	June 1987
Small fish biomonitoring.	April 1988
Updated sport fish advisories – additional collections.	May 1988
Public Involvement Program:	
Outline of Public Involvement Program.	September 1987
Consultant selection.	November 1987
Approved documentation to inform public.	March 1988
Inform public.	May 1988
Public Forum	September 1988

21. SPANISH RIVER

Environmental Assessment

The Lower Spanish River and its delta were designated an Area of Concern in 1980. Problems included: tainting of fish flesh, depressed benthic fauna and indications of nutrient enrichment in the harbour. Concentrations of PCBs and some metals in the harbour sediments were found to exceed guidelines for the open water disposal of dredge spoils. Other past impaired uses included domestic water supplies, livestock watering and fish habitat.

Ongoing abatement at the E.B. Eddy pulp and paper mill in Espanola has resulted in significant improvements in water quality. Recovery of river benthic communities has been documented by E.B. Eddy consultants. Secondary treatment of the Eddy mill effluent has eliminated the fish flavour tainting problem. This has been confirmed by angler satisfaction surveys and laboratory taste tests completed in January 1987. Water quality has been improved and a resurgence of the sport fishery has occurred.

Monitoring of water chemistry in the lower reaches of the river has not confirmed the presence of excessive concentrations of nutrients.

Fish consumption advisories have been issued on larger yellow perch and walleye due to mercury concentrations exceeding 0.5 mg/kg. However, recent contaminant analyses have shown that mercury concentrations in fish are similar to those of headwater lakes in the Spanish River system.

Sediment analyses for the harbour area were completed in early 1987. Results continue to show concentrations of metals which exceed dredge disposal guidelines at some locations. Depositional zones are found to trap the highest metal concentrations. Nickel and copper, which originate from the metal mining/smelting operations in Sudbury, are elevated to the greatest degree. Additional studies are planned to evaluate the potential bioavailability of metals in sediments.

RAP Development Progress

Remedial actions at the river's primary point source discharge, the E.B. Eddy pulp and paper mill, have culminated with the implementation of secondary effluent treatment in 1983. This has resulted in a reduction of biochemical oxygen demand loads, suspended solids, effluent toxicity and taste and odour producing substances. Indications are that historical use impairments (resulting from the E.B. Eddy discharge) have been restored. However, the ramifications of elevated sediment contaminant levels remain to be addressed.

Major stakeholders (in RAP development) have been identified and a schedule has been drafted for proposed public information sessions. This public consultation process is intended to confirm the state of river use restoration and to identify use impairments that may have been overlooked.

RAP Timetable

ACTIVITY	DATE
Ontario commits to developing a RAP for the Spanish River.	1985

Public consultation framework, key stakeholders identified.	February 1987
Goals for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	October 1987
Draft RAP with use goals and remedial actions, for agency and public review.	February 1988
Final RAP with implementation schedule, resource commitments, monitoring and evaluation program.	May 1988
Final RAP to IJC's Water Quality Board.	June 1988
Remedial Actions and Investigations:	
E.B. Eddy industrial spill caused major fish kill in lower Spanish River. Company and individuals charged under Fisheries Act.	July 1983
Installation of secondary treatment, E.B. Eddy Forest Products Limited.	August 1983
E.B. Eddy judicial motion for abuse of process.	September 1984
Fish collections, Spanish River for contaminant (mercury and PCB) analyses.	1985
Abuse of process motion denied, Appeal to Supreme Court.	January 1986
Appeal rejected.	June 1986
Sediment survey of lower river/harbour area.	September 1986
Sediment survey laboratory results completed.	1987
Fish collection for taste evaluation.	Sept.–Oct. 1986
Fish flavour evaluation.	January 1987
E.B. Eddy trial commenced and adjourned.	January 1987
Sediment metal speciation.	March 1987
E.B. Eddy trial to reconvene.	June 1987
Continued monitoring of water quality with enhanced parameter list.	May–Oct. 1987

22. CLINTON RIVER

Environmental Assessment

In the past, nutrients, oxygen consuming substances and heavy metals have been discharged to the Clinton River by industries and municipal wastewater treatment plants (WWTPs) resulting in low dissolved oxygen and degradation of biological communities downstream of the discharges. A 1983 biological survey indicated tremendous improvement in aquatic communities downstream of these facilities. The survey did not include Mt. Clemens (at the mouth of the river).

Michigan Department of Natural Resources (DNR) has tentatively identified two impaired uses. Total body contact recreation in the lower Clinton River is impaired during wet weather due to fecal coliform bacteria exceeding 200/100 mL as a result of improperly or untreated human wastes from combined storm and sanitary sewer overflows in the Red Run watershed. No impairment of total body contact recreation occurs at Metropolitan Beach on Lake St. Clair. Impairment of aquatic life is based on a shift in the species diversity and densities in the benthic macroinvertebrate community. These shifts may be due to the pressure of heavy metals and organic contaminants in the sediments or to low dissolved oxygen. Sediments downstream of Mt. Clemens contain heavy metals and PCBs which exceed U.S. EPA criteria for open lake disposal. Low dissolved oxygen results mainly from municipal discharges and decaying organic materials. Low dissolved oxygen problems may be exacerbated during low flow conditions or when high lake levels cause flow reversals in the river. A 1980 Michigan DNR study indicated that Michigan's water quality standards were not likely to be met even if the Mt. Clemens WWTP discharge was eliminated. The percentage of the problem directly attributable to each source or type of source remains undefined largely because few studies have been done to document existing conditions. Neither of these factors result in impacts or impairments on Lake St. Clair.

RAP Development Progress

Conventional pollutant problems have been resolved primarily through the NPDES permit program and construction grants process. The National Pollutant Discharge Elimination System (NPDES) permit program is the major factor in the substantial reduction of pollutants to the Clinton River. All major NPDES permits in the Clinton River basin were reviewed and new effluent limits were developed during 1985. These new effluent limits were water quality or technology based (whichever was more restrictive). Water quality based limits were developed to meet the objectives of no impact on aquatic life outside the mixing zone and no acute toxicity within the mixing zone based on Michigan's water quality standards. Metals, organics and conventional pollutants were included in the effluent limit setting process. Presently, nearly all industrial facilities discharge only cooling, treated boiler blow down and/or storm water directly to the Clinton River. The process wastewater must undergo pretreatment before discharge to municipal treatment facilities. The pretreatment program has been implemented throughout the Clinton River basin as of 1987.

Only Rochester, Pontiac, Almont, Armada, Romeo, Warren and Mt. Clemens have direct municipal wastewater discharges to the Clinton River. All other towns in the Clinton River basin discharge via interceptors to the Detroit WWTP. Recent upgradings to the above facilities have occurred: Rochester (1986), Pontiac (1982), Almont (1987), Armada (1987), Romeo (1984), Warren (1980), and Mt. Clemens (1987).

Point sources of materials which have historically polluted the Clinton River are believed to no longer be discharged in quantities which would adversely impact human or aquatic life. As a result, there has been improvement in the biota in reaches where the NPDES permits have been issued and WWTP upgrades have occurred.

Nonpoint sources include runoff, landfills, atmospheric deposition and combined sewer overflows (CSOs). Some money was spent on pilot projects to reduce rural runoff in the Paint Creek watershed in 1986 and 1987. However, in general, urban runoff remains a pollution source. CSOs in the Clinton River basin outside the Twelve Towns, Red Run drainage area, have been or are being corrected except for occasional overflows at Mt. Clemens. Little improvement is expected from the Twelve Towns/Red Run watershed without a massive infusion of money to separate storm and sanitary sewers. During normal conditions, Twelve Towns wastewater flows to the Detroit WWTP. Heavy rains cause overflows of the Twelve Towns system to Red Run. During the 1983 biological survey, the aquatic life in Red Run was very limited in diversity and density.

A total of 69 'confirmed or possible groundwater contamination sites' have been identified in Macomb County by the U.S. Geological Survey (as of March 1987) in their Interim Report on Groundwater Movement Near the Upper Great Lakes Connecting Channels, Michigan. Many of these sites, including two Superfund sites (G & H Landfill and Liquid Disposal Incorporated), which are on the Clinton River flood plain, are adjacent to the Clinton River. Preliminary remedial investigations have noted PCB–contaminated soils from oil seeps at the G & H site. These investigations also revealed that levels of heavy metals and other organic chemicals were not elevated in this vicinity of the Clinton River. Another Superfund site, South Macomb Disposal Authority Facilities 9 and 9A, is located 1.6 – 2.4 km from the Clinton River. Contaminants from this site have been found to impact the water table and the upper artesian aquifer both on and off site. Contaminant loadings to the Clinton River from this site were judged to be minimal. Contaminant loadings from other area landfills are not known. A 1987 feasibility study was developed for leachate from 5–7 Red Run landfills. Both organic and heavy metal contaminants have been found in leachate entering Red Run.

On June 18, 1986 a Technical Advisory Committee meeting was held consisting of 15 representatives of state, local, federal and private interests with knowledge or data about the Clinton River. Reports from all Michigan DNR divisions and outside agencies were gathered by the RAP coordinator and sent to a U.S. EPA consultant assisting in RAP preparation.

Michigan DNR held a public meeting to give and gather information concerning the Clinton River on July 17, 1986, in Mt. Clemens. A second public meeting was held on February 26, 1987, concerning the proposed Clinton River dredging and confined disposal project. A final draft RAP will be distributed to all Technical Advisory Committee members and interested public. Another public meeting will be held after the final draft RAP has been reviewed by the public and the Technical Advisory Committee. Comments received from the public and the full Technical Advisory Committee will be consolidated by Michigan DNR for the final RAP. This RAP will be submitted to the Water Quality Board of the IJC on October 1, 1987.

RAP Timetable

ACTIVITY	DATE
Remedial Action Plan:	
Technical Advisory Committee established.	June 1986
Clinton River RAP Public Hearing.	July 1986
Michigan DNR received the first draft RAP from U.S. EPA consultant.	December 1986
Public meeting on Clinton River dredging and confined disposal project.	February 1987
Review of draft RAP.	Dec.1986 – Mar.1987
Michigan DNR receives second draft of RAP from consultant.	July 1987
Third public meeting held.	September 1987
Public review of RAP.	Aug.–Sept. 1987
Comments incorporated into RAP.	September 1987
RAP submitted to IJC's Water Quality Board.	October 1987
Remedial Actions and Investigations:	
All major NPDES permits in basin reviewed and new effluent limits developed.	1985
All pretreatment programs in basin implemented.	1985–1987
Rochester WWTP upgraded.	1986
Almont WWTP upgraded.	1987
Armada WWTP upgraded.	1987
Mt. Clemens WWTP upgraded.	1987
Pilot projects to reduce rural runoff in Paint Creek.	1986–1987
Feasibility study to investigate Red Run landfills and recommend remedial alternatives.	1987–1988
Sediment survey of lower Clinton River.	1987

23. ROUGE RIVER

Environmental Assessment

The Rouge River flows through Metropolitan Detroit and empties into the Detroit River. It is plagued by natural and human-made factors which limit water quality to the extent that approximately 64 km (39.8 miles) of river do not meet Michigan water quality standards or Great Lakes Water Quality Agreement objectives. Low dissolved oxygen concentrations and high fecal coliform bacteria levels occur in the river during wet and dry weather conditions. Sediments in the lower river are heavily contaminated with toxic substances and organic sludges, precluding the presence of normal aquatic life. Based on the most recent data available, sediments of the lower Rouge River are heavily polluted with cadmium, chromium, copper, lead, mercury, nickel, and zinc and moderately polluted with PCBs. PCBs biomagnify in carp and catfish. The Michigan Department of Public Health advises that no one consume either species from the Rouge River. Tumors have also been found in Rouge River fish. In addition, the Rouge River negatively impacts the Detroit River. Immediately downstream from the Rouge River, pollution tolerant aquatic worms number over one million per square meter of Detroit River bottom, demonstrating long-term, severe organic enrichment.

RAP Development Progress

On October 1, 1985 the Michigan Water Resources Commission (WRC) passed a resolution implementing the Rouge River Basin Strategy, an action plan and public participation process to abate water pollution in the Rouge River. The resolution confirmed that the Rouge River was designated an Area of Concern in the Great Lakes basin by the IJC because of its extremely poor level of water quality. It declared that because of its size and location, the Rouge River is a valuable resource that can be restored to provide substantial economic, recreational and aesthetic benefits to residents of the region. Finally, it approved the Rouge River Basin Strategy and called for implementation of remedial actions to correct water pollution problems in the Rouge River basin.

The strategy represents the systematic and comprehensive approach necessary to address the major problems of 185 combined sewer overflows within the drainage basin and contaminated bottom sediments. The process of public participation acknowledges that local units of government and concerned citizenry must be involved from the beginning of this process to clean up the Rouge River.

The Michigan Department of Natural Resources (DNR) and Southeast Michigan Council of Governments (SEMCOG) jointly convened the first Rouge River Basin Committee meeting February 14, 1986 to promote local participation in the development of the RAP.

The Rouge River Basin Committee includes over 100 representatives from counties, cities, villages, townships, the Governor's Office, Michigan WRC, Michigan Natural Resources Commission, Michigan DNR, Rouge River Watershed Council, SEMCOG, U.S. Army Corps of Engineers, U.S. EPA, industries, consulting firms, universities, and the IJC.

The development of a RAP to restore beneficial uses in the Rouge River is expected to take approximately two years. The Michigan WRC Resolution has set a goal for completely restoring beneficial uses in the Rouge River by the year 2005.

The development of the Rouge River RAP is making steady progress. The initial RAP was submitted to the Michigan WRC in January 1987 and the final RAP will be submitted to the WRC in January 1988. The following projects are part of RAP development and are in various stages of completion:

1. Fixed Station Ambient Water Quality Monitoring: The Wayne County Health Department was awarded a contract for the weekly collection of water quality samples at 22 monitoring stations in the Rouge basin. This project is accomplishing a major element of the Rouge Monitoring Strategy. These data will be used to evaluate existing conditions and define remedial project needs. The City of Detroit has volunteered to provide the laboratory analysis on the samples at no cost to the project.

2. Water Quality Data Compilation, Evaluation, and Report Archive: A large volume of water quality data has been collected through Michigan DNR studies, facilities planning and other studies. This information has not yet been fully evaluated to identify its adequacy for problem definition and remedial action identification. This study will systematically review and evaluate currently available water quality data on the Rouge River. The project will also make accessible selected data sets in computerized format.

3. CSO Plan Engineering Evaluation: Most of the facilities planning areas in the Rouge River basin have had plans prepared to control CSOs. This study will examine these plans to determine their inconsistencies and deficiencies and identify CSO control needs in the basin. This project will also result in the development of guidance for CSO plan updates that will be adequate and consistent across the Rouge River basin.

4. Screening Survey of Rouge River Sediments: The existing data on contamination of sediments in the Rouge River are limited. This study will establish a baseline for further work by performing a phase I assessment of sediment problems in the basin. The study will locate depositional areas, screen for toxicity and biological integrity, perform preliminary chemical analysis, and recommend further study based on probable impacts of pollutants.

5. Removal of Zinc Contaminated Sediments in the Lower Rouge River: In 1986, a settlement was reached with Double Eagle Steel Company (Dearborn, MI) involving cleanup costs, damages and penalties for excessive discharges of zinc into the Rouge River. Rouge Steel Company and USX Corporation, who jointly own Double Eagle, have agreed to pay $775,000 in penalties for past violations and $100,000 in damages. In addition, the companies have agreed to complete a comprehensive dredging program no later than September 1987 to remove zinc contaminated sediments from the Lower Rouge River.

6. Fish Tissue Analysis: In 1986, the Michigan Department of Public Health issued a fish consumption advisory for the lower portion of the Main Rouge. Fish will be collected from five additional sites in the Rouge and analyzed to determine if the advisory should be extended to other portions of the river.

7. Infrastructure Financing Committee: The Infrastructure Financing Committee is a consortium consisting of the City of Detroit, Oakland and Wayne Counties, SEMCOG and Michigan DNR. Funding for Committee activities is provided by the members, plus a grant award from the Metropolitan Affairs Corporation. The committee and its consultants are developing a mechanism for financing anticipated infrastructure improvements.

8. Rouge Rescue '87: This year the Rouge Rescue clean up, held on June 6th, was expanded to include 22 sites in all three counties. Two sites in Middle Rouge Parkway, Nankin Mills (Westland) and Levan Knolls Picnic Area (Livonia), featured displays and other activities, along with the cleanup. On June 5th, the day before Rouge Rescue '87, a luncheon was held at Henry Ford Estate for elected officials and special guests.

RAP Timetable

ACTIVITY	DATE
Strategy and Planning:	
Adoption of strategy setting 20–year restoration goal and two–year process to develop RAP.	1985
Initiation of RAP planning activities.	1985–1986
Completion of initial RAP.	1987
Completion of final RAP.	1988
Annual update of RAP	1989–2005
Monitoring Activities:	
Compile and evaluate data and establish permanent archive.	1987
Fixed station monitoring at 22 locations.	1986–2005
Single–event fixed station monitoring.	1987,1992,1997,2002
Intensive surveys of subbasins.	1987–1991
Biological and fisheries surveys.	1985,1991,1996,2001
Fish consumption advisory surveys.	1985,1987,1992, 1997,2002
Initial sediment surveys.	1986,1987
Followup sediment surveys in subbasins where sources have been controlled.	1992,1997,2002
Municipal/industrial discharge compliance monitoring by Michigan DNR.	1988

Self–monitoring by dischargers.	1985–2005
CSO monitoring.	1988–2005
Industrial/Municipal Sources:	
Reissuance of all NPDES Permits.	1987,1992,1997,2002
Review, revise and approve sewer project for North Huron Valley–Rouge Valley area.	1985–1987
Fund North Huron Valley–Rouge Valley project.	1988
Construct North Huron Valley–Rouge Valley project.	1989–1992
Review, revise and approve sewer project for Evergreen–Farmington area.	1987
Fund Evergreen–Farmington project.	1988
Construct Evergreen–Farmington project.	1989–1992
Review, revise and approve Detroit Pump Station 2.	1989
Fund and construct Pump Station 2.	1990–1992
Study Detroit collection and treatment system controls.	1986–1987
Construct Detroit system controls.	1988–1990
Combined Sewer Overflow Controls:	
Implement maintenance and system optimization programs.	1987–1988
Identify all CSO discharges.	1986
Review existing CSO facilities plans.	1986–1987
Issue or reissue all CSO NPDES permits.	1987,1992,1997,2002
Select a CSO control standard.	1987
Implement low capital intensive CSO control projects.	1987–1990
Update all local CSO plans.	1988–1989
Review, finalize, rank CSO projects.	1990
Implement larger scale CSO projects.	1990–2005
Audit all industrial pretreatment programs.	1986–1988
Implement controls on toxics from CSOs.	1988–1992

Nonpoint Sources:

Locate all stormwater discharge outfalls.	1986
Implement controls on significant identified nonpoint sources.	1987–1988
Prepare nonpoint watershed plan for Lower–2 subbasin.	1987
Implement nonpoint source controls in Lower–2 subbasin.	1988–1992
Determine subbasins with nonpoint source problems and establish priorities.	1987
Develop and implement nonpoint source controls in problem subbasins.	1987–1996
Issue stormwater permits as required by federal law.	1988

Sediments:

Rouge Steel and USX have committed to dredging zinc contaminated sediments from the Lower Rouge River adjacent to Double Eagle Steel Coating Company.	1987

Log and Debris Jams:

Survey of log jams.	1986
Develop and implement stream restoration master plan for a high priority subbasin.	1987
Involve public municipalities and Youth Corps in log jam and debris cleanup such as 'Rouge Rescue.'	1986–2005
Develop stream restoration master plan for all public ownership areas.	1988
Implement stream restoration master plan.	1989–1993

Financing Methods:

Identify public costs of needed pollution controls.	1987
Develop financing methods strategy.	1987–1988
Apply financing methods.	1989–2005

24. RIVER RAISIN

Environmental Assessment

The River Raisin is located in the southeastern portion of Michigan's lower peninsula in Monroe County. The Area of Concern has been defined as the lower 4.2 km (2.6 miles) portion of the River Raisin (including Plum Creek), downstream from the low head dam at Winchester Bridge in the City of Monroe, extending 0.8 km out into Lake Erie following the federal navigation channel and along the nearshore zone of Lake Erie, both north and south, for 1.6 km (1 mile).

Problems that exist today include heavy metal (copper, zinc, chromium) and PCB contamination of sediments and water column, sedimentation and siltation input from nonpoint sources, and a fish consumption advisory on carp. These problems have, in many cases, manifested themselves into current use impairments of the Area of Concern. The impaired uses include navigation and the fishery. The RAP is designed to address these impaired uses in the Area of Concern.

In 1983–1984, the U.S. EPA's Large Lakes Research Station, in Grosse Ile, Michigan performed a major research study of the transport, exposure and effects of toxic substances in the River Raisin. Water quality problems identified in this study included:

1. Surficial sediment contamination by PCBs, copper, zinc and chromium exists in and below the turning basin.

2. Carp, young–of–the–year emerald shiner and larval gizzard shad had elevated levels of PCBs.

3. Caged clams placed downstream of the turning basin bioaccumulated elevated levels of PCBs.

4. Effluent from the Monroe WWTP was toxic, based on Ceriodaphnia and fathead minnow bioassays.

5. There is an order–of–magnitude decline in invertebrate biomass from a point just upstream of Monroe to Monroe Harbor.

6. Histopathologic examination of larval gizzard shad revealed consistent presence of lesions in several organs (lesions consisted primarily of acute epithelial necrosis in contact with the environment and in the kidney). However, these study results were inconclusive because larval gizzard shad from the control station in western Lake Erie revealed the same type and incidence of lesions.

7. PCBs could be originating from the landfills (e.g. Port of Monroe landfill) and industrial dump sites bordering Monroe Harbor (PCBs may be transported to the river via groundwater).

RAP Development Progress

Michigan Department of Natural Resources (DNR) Groundwater Quality Division is continuing to investigate the landfills, lagoons and industrial sites along the banks of the River Raisin. The following sites are included on Michigan's Act 307 Proposed Priority List for Fiscal Year 1988: the Port of Monroe Landfill, Ford Motor Company,

Detroit Edison, Consolidated Packaging-South Plant, the City of Monroe Landfill, and the lower portion of the River Raisin itself. All of these sites have documented overland pathways for movement of toxic organics (PCBs) and heavy metals off site and into the waters of the Area of Concern. Cleanup of all these sites is pending, with the exception of the Port of Monroe Landfill which only has completed a feasibility study. The Port of Monroe landfill is suspected to be a significant source of contaminants to the Area of Concern. After a remedial investigation is completed, this site will be ranked for cleanup funding.

The first public meeting was held on June 26, 1986. During this meeting, pertinent information was presented by Michigan DNR staff and input, including concerns, was provided by the public. Since that time, Michigan has maintained an open channel of communication with the River Raisin Watershed Council. The second public meeting was scheduled for September 1987 at which time comments on the final draft RAP were to have been taken.

RAP Timetable

A list of major activities is presented below in the RAP timetable.

ACTIVITY	DATE
Technical Work Group formed.	April 1985
First public meeting held.	June 1986
First draft RAP received from consultant.	September 1986
Second draft RAP from consultant received.	June 1987
Third draft RAP completed by Michigan DNR.	August 1987
Second public meeting held.	September 1987
Final Draft RAP completed.	September 1987
Submit RAP to IJC's Water Quality Board.	October 1987

25. MAUMEE RIVER

Environmental Assessment

The Maumee River Area of Concern has been tentatively identified as the area from river kilometer 33 (RM 20.8) to the mouth, Maumee Bay, the nearshore area southeast of the mouth and the lower segments of several streams tributary to the mainstem and the Bay. The most impacted areas are the ship channel (river kilometer 11 to the mouth), lower Swan Creek, Otter Creek and the waters of the Bay immediately adjacent to the river mouth.

The Maumee River contributes the largest tributary load of suspended sediments and phosphorus to Lake Erie. The major source is agricultural runoff from upstream. Discharges from municipal sewage treatment plants and combined sewer overflows (CSOs) are also major sources of pollutants which are found at levels exceeding Ohio water quality standards for warmwater habitat. There are 25 point sources discharging to the Area of Concern: seven municipal and 18 industrial.

An intensive survey (including water quality, biological, sediment and fish tissue analyses) of the area was conducted by Ohio EPA in 1986. Fish composite indices, calculated from numbers and species diversity, indicated good water quality upstream of the shipping channel, but only fair conditions in the channel itself. The most impacted areas were at the mouth and the immediately adjacent Maumee Bay nearshore. Fish communities were composed primarily of emerald shiners, gizzard shad, white perch, common carp, yellow perch, white bass, freshwater drum, spottail shiners and others, all species tolerant of high turbidities.

Water quality sampling by Ohio Environmental Protection Agency (EPA) and the City of Toledo have documented violations of the following water quality standards: dissolved oxygen, ammonia, arsenic, lead, copper, zinc, cadmium, iron, mercury and fecal coliform bacteria. Violations were most frequent and extreme for ammonia, iron, copper and fecal coliform bacteria. Dissolved oxygen levels near the mouth fall below the 4 mg/L standard in July, August and September.

Fish tissue samples analyzed in 1976, 1978, 1979 and 1981 indicated elevated PCB levels in whole body composites. Concentrations ranged from 2.1 to 11.5 mg/kg. Several pesticides and phthalates were also detected, but at low levels. Data analysis of the 1986 samples (fillet and whole body composites) were scheduled for completion in 1987.

Based on 1982 and 1984 surveys, sediments in the ship channel are polluted with oxygen-consuming materials, cyanide, arsenic, copper, nickel, zinc, iron, ammonia, total phosphorus and oil and grease. Some PAHs and phthalates have been detected. PCBs have been detected at low levels, but cannot account for the elevated concentrations found in fish tissue.

The Dura landfill on the Ottawa River has been found to be leaking PCBs, volatile organics, phthalates and PAHs (leachate volume: 227,100 liters per day). The Stickney, Commercial Oil, Libbey Owens Ford and several closed Toledo landfills are known to be leaching various conventionals, metals and organic contaminants.

RAP Development Progress

Ohio is compiling a background report on the environmental quality of the Maumee River. This report is being written by a consultant contracted by U.S. EPA,

with major input from Ohio EPA and other state, federal and local agencies. The initial draft has been completed and reviewed by selected agencies for technical input. The completed report will be the basis for determining the need for future remedial actions and developing the RAP.

Ohio EPA will be working with the local planning agency to coordinate public input, develop local involvement and finalize the RAP. One meeting has been held to explain the RAP process to local organizations and to address their questions and concerns.

A number of studies and investigations have been initiated and/or completed. Results from the 1986 intensive field survey, performed to evaluate existing environmental impacts and determine potential stream uses, were expected in 1987 and will be incorporated into the background report. Several hazardous waste disposal sites are under investigation to measure and characterize the nature of leachate. The City of Toledo has contracted with a consultant to measure the impact of the Dura and Stickney landfills on the Ottawa River. Booms are in place to restrict the movement of runoff. Monitors, triggered by high flow, have been installed downstream of the Evergreen and Fondessey landfills to document possible contaminated runoff during storm events.

Several investigations have been done by the City of Toledo and Ohio EPA to determine the impact of CSOs on the area. Toledo is currently working on improvements to their wastewater treatment plant (WWTP), installation of tide gates on CSOs to eliminate intrusion of lake/river water, elimination of some CSOs and designing an underground tunnel to control the amount of discharge from CSOs. All wastewater treatment plants have approved pretreatment programs included in their National Pollutant Discharge Elimination System (NPDES) permits.

Nonpoint pollution has been addressed in several programs. Completed actions include ditch maintenance, stream bank stabilization and animal waste facility improvements. Considerable effort has been expended on implementing accelerated conservation tillage in the basin. Use of conservation tillage appears to be increasing slowly, but steadily.

RAP Timetable

Ohio has not established a target date for full restoration of beneficial uses in the Maumee River. This will be done after all remedial actions have been identified. In 1986, the Governor committed to a January 1989 completion date for the final RAP. Due to several changes in the original schedule and anticipated action from local organizations, a final RAP is now expected by 1988. A RAP timetable is presented below:

ACTIVITY	DATE
Remedial Action Plan:	
Acceptance of U.S. EPA's offer of a consultant to assist in RAP preparation.	August 1985
Initiated preparation of background report by consultant.	August 1986
Preliminary planning initiated for incorporation of public participation.	February 1987

Completion of first draft of background report.	February 1987
Initiation of Toledo Metropolitan Area Council of Governments involvement.	September 1987
Completion of RAP and submission to IJC's Water Quality Board.	June 1988
Review and update of RAP.	Annually until full restoration of beneficial uses
Remedial Investigations and Actions:	
Intensive biological and water quality survey.	1986
Sediment and fish tissue sampling.	1986, 1988, 1991
Evaluate fish contaminant data, issue advisories if appropriate.	1987
Pretreatment programs included in all WWTP NPDES permits.	1985–1986
Modifications to Toledo WWTP NPDES permit to include limits for metals.	1986
Completion of upgrades at Toledo WWTP and compliance with final NPDES permit.	1988
Construction of tide gates on Toledo CSOs to prevent inflow.	1986–1987
Investigation of Dura and Stickney landfills and initiation of cleanup.	1986
Installation of high flow monitors downstream of Evergreen and Fondessey waste disposal sites.	1986
Cleanup of an oil spill from the Commercial Oil disposal facility.	1986
Initiation of a 58.3 million dollar CSO abatement program for downtown Toledo.	1985
Initiation of engineering work for CSO tunnel project (Toledo).	1987
Elimination of dry weather overflows (Toledo).	1988
Elimination of the critical wet weather CSOs.	schedule presently being revised
Identification of priority watersheds for nonpoint pollution control of phosphorus in the Maumee basin.	1986

Use of conservation tillage practices.	Ongoing
A number of nonpoint source–related programs are underway by TMACOG (a local regional planning agency).	Ongoing
Completion of upgrades to the Perrysburg WWTP and compliance with final NPDES permit limits.	1988
Monitoring at one fixed station at the mouth by Ohio EPA.	Ongoing
Monitoring at several stations in the lower river by the city of Toledo.	Ongoing

26. BLACK RIVER

Environmental Assessment

An intensive biological and water quality survey conducted in 1982 revealed good water quality upstream from Elyria, Ohio. Water quality within the city of Elyria worsened due to industrial and municipal dischargers, combined sewer overflows (CSOs), sanitary sewer bypasses and overflows and nonpoint runoff. The major source is the Elyria wastewater treatment plant (WWTP) and the associated bypasses and overflows. Water quality improves somewhat further downstream, but then again falls in the harbor area and vicinity of the Lorain WWTP. Violations of Ohio water quality standards for protection of warmwater habitat are noted for dissolved oxygen, ammonia, fecal coliform bacteria, iron, lead, phenol, cyanide, cadmium and copper. Elevated concentrations of biochemical oxygen demand (BOD), total phosphorus and zinc are common.

Sediments in the harbor are heavily polluted with metals, oil and grease and oxygen consuming materials. The harbor is dredged annually for commercial navigation and all of the dredged sediment must be placed in a confined disposal facility. Further upstream, in the vicinity of the USX (formerly U.S. Steel) outfalls, the sediment has been found to be heavily polluted with metals and polynuclear aromatic hydrocarbons (PAHs). Sediment concentrations of PAH ranged from 4.8 to 390 mg/kg.

The degraded water quality and the contaminated sediments have impacted the biological community. Both fish and benthic populations were indicative of communities associated with poor water quality. Fish composite indices calculated in 1982, based on species diversity and numbers of fish, revealed only fair rankings for most of the Area of Concern. The PAH contaminated sediments are believed to be the cause of a high incidence of tumors in the bottom dwelling brown bullhead population in the river. Carp and brown bullhead had high body burdens of PAH and PCB (PAHs were greater than 1 mg/kg and PCBs were close to or exceeding the U.S. Food and Drug Administration (FDA) action level of 2 mg/kg); and small amounts of DDT and several other pesticides. The discovery of contamination of fish tissue and fish tumors resulted in the issuance of a health advisory in 1983 for the lower 8 km (5 miles) of the river, warning people not to consume the fish. This advisory will remain in effect until the total recovery of the health of the fish population has been demonstrated.

The major sources of problems in the Black River have been identified as polluted sediments contaminated by historical industrial discharges and the current inputs from the Elyria WWTP and CSOs. The Lorain WWTP contributes to a lesser degree. Remedial actions to correct all of these problems are currently underway.

RAP Development Progress

Ohio is compiling a background report on the environmental quality of the Black River. This report is being written by a consultant contracted by U.S. EPA, with major input from Ohio EPA. Other state, local and federal resource agencies have contributed technical information, and have reviewed the initial drafts of this report. The draft is undergoing final revision and will contain the conclusions and recommendations of the consultant, but will not have sufficient input by all parties involved to be considered an adequate RAP.

When the consultant's report has been completed, Ohio EPA will coordinate additional activities needed to incorporate public input and suggested plans for implementation. An initial basin planning meeting for public participation in development of the Black River RAP was held in the fall of 1987. The current plan is to send the consultant's report (when completed) to all identified "stakeholders" for review and comment. Each report will be accompanied by appropriate attachments and surveys designed to determine issues considered to be most important by the reviewers. Based on the response from the surveys, Ohio EPA will conduct informational and discussion meetings, if necessary, to focus on specific issues, discuss possible remedial solutions and identify responsible parties. This process will be repeated until an acceptable RAP has been developed. The RAP will then be submitted to IJC's Water Quality Board for its review process.

Several studies and investigations have been initiated or completed. An intensive biological and water quality survey was completed in 1982 by Ohio EPA for the lower Black River, including the harbor. The impacted areas of the river and the associated sources of pollutants were identified. Until remedial actions have been implemented, no further surveys are planned. Sediment and fish tissue analyses are scheduled for 1987 and 1990 as part of the Ohio EPA Five-Year Monitoring Strategy.

The major issues are being addressed. USX, formerly U.S. Steel, has closed down their coke plant and significantly decreased the pollutant loadings from the other outfalls. They have completed a survey delineating the sediment deposition zones and the extent of PAH contamination. They are required to dredge and dispose of these sediments as a condition of a Consent Decree issued by the U.S. District Court. A suitable disposal site for these sediments has not yet been approved by all authoritative parties, but a solution is being sought by U.S. EPA, Region V, Waste Management Division and USX.

The city of Elyria has received construction grants funding to upgrade their WWTP. A schedule for completion of construction at the plant and elimination of all bypasses and overflows has been set forth in a Consent Judgement issued by the U.S. District Court in March 1986. These improvements are underway.

The city of Lorain is currently working on sewer rehabilitation, CSO elimination and construction of a new west side WWTP to relieve the load on the east side plant. Both WWTPs have approved pretreatment programs.

RAP Timetable

Remedial actions to eliminate the major sources of contamination in the Black River were initiated prior to the 1985 request to develop a RAP. The RAP will serve to further define the pollutant problems and provide a means of tracking the progress of remedial actions. A target date for restoring beneficial uses to the lower Black River cannot be set until all remedial actions have been identified. In 1986, the Governor committed to a RAP completion date of January, 1989. This date was based on the completion of a background report which was to be prepared by the consultant in 1986. This report has not yet been finished and will require the incorporation of the public participation aspect before it is complete. This change will delay the completion of a final RAP until January 1990. A list of activities and the expected or realized completion dates is presented below:

ACTIVITY	DATE
Remedial Action Plan:	
Acceptance of U.S. EPA's offer of a consultant to assist in RAP preparation.	August 1985
Initiated preparation of background report by consultant.	September 1985
Completion of draft background report by consultant.	1986
Completion of final background report from the consultant.	August 1987
Initiation of review and public participation process.	1987
Completion of RAP and submittal to IJC's Water Quality Board for review.	January 1990
Review and Update of RAP.	Annually until full restoration has been achieved
Remedial Investigations and Actions:	
Issuance of more stringent NPDES permit for U.S. Steel.	Apr. 1985; Mar. 1986
Initiation of pretreatment programs at the Lorain and Elyria WWTPs.	December 1985
Sediment and fish tissue sampling.	1987 and 1990
Completion of upgrading Elyria WWTP and compliance with final NPDES permit limits.	December 1988
Elimination of all pump station overflows and rehabilitation of sanitary sewers for the Elyria system.	December 1988
Lorain WWTP in compliance with final NPDES permit limits.	December 1988
Dredging of PAH contaminated sediments by U.S. Steel.	1989
Completion of new Lorain Westside WWTP and compliance with NPDES permit limits.	January 1989
Intensive monitoring to determine effectiveness of completed remedial actions.	1991 and 1994
All Elyria separate sanitary sewer overflows eliminated.	December 1993
All overflows and bypasses associated with the Lorain system eliminated.	2004

27. CUYAHOGA RIVER

Environmental Assessment

The most impacted area of the Cuyahoga River is the shipping channel (RM 5.7 to the mouth). The natural hydrology and morphometry of this segment has been extremely altered through navigation channel dredging and shoreline development. Virtually no natural riverine habitat remains. The lower river is affected by industrial dischargers, including steel mills and chemical companies, urban runoff, combined sewer overflows (CSOs) and municipal dischargers. Presently, the ship channel has no aquatic habitat use designation in the Ohio water quality standards, but must meet nuisance prevention criteria. During an intensive survey by Ohio Environmental Protection Agency (EPA) in 1984, violations of the following criteria occurred: dissolved oxygen, cyanide, iron and copper. During periods of low flow, some segments of the ship channel were totally devoid of oxygen. Cyanide concentrations averaged 280 µg/L (the Ohio water quality standard is 38 µg/L). Elevated concentrations of ammonia, fecal coliform bacteria, phenol, lead, cadmium and zinc were common. The composition of the fish community reflected poor water quality.

Sediments in the ship channel are heavily polluted with ammonia, total Kjeldahl nitrogen, phosphorus, cyanide, oil and grease, cadmium, chromium, copper, lead, manganese, nickel, zinc, iron and volatile solids. All sediment dredged must be placed in a confined disposal facility. A number of organics, including PCBs, PAHs, phthalates and DDT, were found at elevated levels. Fish tissue analyses from 1980 to 1982 revealed PCB levels ranging from 1.6 to 23.0 mg/kg in whole fish.

The river upstream of the ship channel has been designated as warmwater habitat. Between river kilometer 9 and 22 (RM 5.7 and 13.5), water quality standards were exceeded for cyanide, cadmium, copper, iron, fecal coliform bacteria and phenol. Dischargers to this stream segment include LTV Steel, Harshaw Chemical, the Cleveland Southerly wastewater treatment plant (WWTP), several metal refining industries, CSOs, and the confluences of Big Creek and Mill Creek, which both contribute poor quality water. Upstream of this segment, occasional violations were measured for ammonia, iron, fecal coliform bacteria, cadmium, cyanide and copper. Biological indices for fish and invertebrates indicated fair water quality.

A severe toxicity problem was discovered during a 1984 Ohio EPA survey as far upstream as the Akron WWTP. Minor violations of conventional parameters in the river could not account for the degraded state of the biological community, and the release of a toxic substance from the Akron WWTP was suspected to be responsible. Although intensive sampling and analysis of the Akron WWTP effluent and further monitoring downstream failed to identify the causative factor, a reduction in toxicity of the Akron WWTP effluent was noted in subsequent sampling in 1985 and 1986. Possible reasons for the reduction of toxicity include: (a) one major industrial discharger stopped discharging; (b) the treatment system at the Akron WWTP was upgraded; (c) the Akron pretreatment program better policed industrial users discharging to the plant; and (d) the widely publicized documentation of the toxicity problem may have led some company or companies to change their discharge practices to the sanitary sewers. There appears to be some improvement in the biological community in this upper segment. However, toxic substance impacts are still evident, including deformities and eroded fins in fish and the lack of improvement in the index of biotic integrity.

Bioassays conducted from 1984 to 1986 on the effluent of 18 dischargers to the Cuyahoga River basin revealed that six were acutely toxic to Pimephales promelas and 13 were acutely toxic to Ceriodaphnia sp. Recent investigations by U.S. Fish and Wildlife Service in the ship channel have revealed the presence of tumors similar to those found in the brown bullheads in the Black River. Further monitoring is required to determine the extent and severity of this problem. The suspected cause of the tumors is benzo-a-pyrene.

RAP Development Progress

Ohio EPA has been working with a consultant contracted by U.S. EPA to prepare a preliminary background report which will be used as the basis for the RAP. An initial basin planning meeting for public participation in development of the Cuyahoga River RAP was held in the fall of 1987. It is anticipated that the preliminary background report will be distributed to all identified stakeholders for review. Based on the response to this report, informational and discussion meetings will be held to focus on selected issues, discuss possible remedial solutions and identify responsible parties. This process will be repeated until a final RAP is prepared and presented to the IJC Water Quality Board for review.

Since 1984, the Ohio EPA has conducted considerable monitoring in the lower Cuyahoga River basin. The intensive survey done in 1984 evaluated water quality and biological communities and identified impacted areas. Overall, significant improvements in the chemical/physical water quality were noted since the 1960s and 1970s. The oil and debris problems which caused the infamous fire of 1969 have been eliminated. Water quality violations for metals and conventional pollutants immediately downstream of the Akron and Cleveland Southerly WWTPs are few. This is mainly due to improvements and upgrades at the WWTPs. The discovery of a severe toxic response by biological communities downstream of the Akron WWTP led to a more extensive survey to determine the source and cause of the toxicity. Ohio EPA, U.S. EPA and the City of Akron cooperated in this study. Additional instream monitoring was conducted in 1985 and 1986 and was planned for 1987 and possibly subsequent years. Further toxicity tests and bioassays were planned for industrial and municipal dischargers in 1987.

Both the Akron and Southerly WWTPs have approved pretreatment programs. The Cleveland Southerly WWTP is in compliance with the 1 mg/L phosphorus standard and the rest of the interim limits of its National Pollutant Discharge Elimination System (NPDES) permit. Construction at the plant is currently underway to expand capacity to 7.6×10^5 m^3/day (200 MGD) and to improve the nitrification and sludge handling facilities. These upgrades will be completed in 1987 at which time the Southerly plant must be in compliance with the final limits of its NPDES permit. The increased capacity will be needed to handle input from the Cuyahoga Valley (CVI) and Southwest interceptor projects. Phase I of the CVI project is almost complete and has eliminated discharge from 12 small WWTPs and package plants. It also eliminated nearly 6,000 septic tanks. Phase II will involve areas upstream. The Southwest interceptor project will mainly involve elimination of surface water discharge to the Rocky River, but will also relieve some of the load on the Big Creek interceptor. The Northeast Ohio Regional Sewer District has initiated a number of projects and is in the planning stages to construct relief sewers and eliminate CSOs.

The Akron WWTP has completed construction of phosphorus removal facilities, but does not always comply with the 1 mg/L standard. The City of Akron has a phosphorus ban in effect within its service area. The number of primary settling tanks at the Akron plant has doubled and a new sludge composting facility is being phased in.

Many remedial actions, including issuance of updated NPDES permits for all dischargers, improvements in discharging practices by steel mills and chemical companies, elimination of some CSOs and cleanup of several hazardous waste disposal sites, were initiated prior to the 1985 decision to develop a RAP. Additional monitoring and toxics evaluations will be scheduled on a case by case basis as important municipal and industrial water quality based permits come up for reissuance.

RAP Timetable

No target date has been established for full restoration of beneficial uses in the Cuyahoga River. A use designation analysis needs to be done for the ship channel before objectives can be established. In 1986, the Governor committed to a 1989 completion date for Ohio RAPs. Originally, the RAPs were intended to be technical agency documents prepared with the assistance of a consultant. However, as the development process progressed, the scope of the RAPs expanded considerably and became more complex than anticipated. It was agreed that the success of the plans would depend on their acceptance by the local jurisdictions and the public, thus it was recommended that stakeholders have some role in the development of the plans. Therefore, the report from the consultant will now be used as the basis for development of the final RAP. Due to the complexity of the area, both environmentally and politically, a final RAP is not anticipated until 1991. A RAP timetable is presented below.

RAP Timetable

ACTIVITY	DATE
Remedial Action Plan:	
Acceptance of the services of a U.S. EPA consultant to assist in RAP preparation.	August 1985
Initiated background report preparation by consultant.	November 1985
Completion of first draft of background report.	April 1986
Completion of second draft of background report.	July 1986
Completion of final background report from consultant.	July 1987
Initiation of the public participation process.	1987
Completion of final RAP and submittal to the IJC's Water Quality Board for review.	January 1991
Review and update to RAP.	Annually after completion of final draft until full restoration has been achieved

Remedial Actions and Investigations:

Surveys to monitor toxic substance effects discovered during the 1984 Ohio EPA intensive survey.	1985, 1986, 1987
Sediment and fish tissue sampling	1985, 1986, 1988, 1991
Evaluate fish contaminant data and issue advisories if appropriate.	1987
Fixed station monitoring at two sites.	Annually
Use designation upgraded to warmwater habitat for the lower Cuyahoga River from the Cleveland Southerly WWTP to the upstream limit of the ship channel.	July 1986
Use attainability analysis for the ship channel and adoption of water quality standards.	1988
Approval of pretreatment programs for the Akron and Southerly WWTPs.	1985
Completion of construction and upgrades at Cleveland Southerly.	1987
Completion of the majority of projects in Phase I of the Cuyahoga Valley Interceptor.	1986
Completion of sludge composting facility at Akron WWTP.	1986
Completion of upgrades to Akron WWTP, including doubling the number of primary settling tanks.	1986
Elimination of 40 wet weather bypasses and overflows in the Akron service area.	1988
Re-evaluation of recommendations presented in the 1978 facilities plans for CSO improvement (by the Northeast Ohio Regional Sewer District).	1987

28. ASHTABULA RIVER

Environmental Assessment

The Ashtabula River Area of Concern has been designated as the segment from the 24th St. bridge (river kilometer 3.2) to the mouth, including the harbor and adjacent nearshore. The major concern is sediments that have been contaminated with oxygen consuming materials, metals, industrial chlorinated organics and PCBs. The primary source of these pollutants was past industrial discharge to Fields Brook, a tributary to the lower river. Dischargers to Fields Brook have significantly improved the quality of their effluents, but sediments had become so contaminated that the brook was classified as hazardous and its cleanup is being addressed under Superfund. Land adjacent to Fields Brook is heavily contaminated with chlorinated alkane and alkene solvents, particularly trichloroethylene. Eighteen industries and one municipal wastewater treatment plant (WWTP) discharge to the Area of Concern.

The contaminated sediments contributed to elevated toxic substances levels in fish tissue and subsequently the issuance of a fish consumption advisory for the lower 3.2 km (2 miles) of the river and the harbor in 1983. Total PCBs in fish tissue range from 0.68 to 10.66 mg/kg. Other chemicals of concern in fish include octachlorostyrene, hexachlorobenzene, hexachloroethane and hexachlorobutadiene.

Sediments in the upper section of the Area of Concern from the 24th Street bridge to the 5th St. bridge (river kilometer 3.2 to 1.6) are classified as contaminated and cannot be disposed in the open lake. Some of the harbor sediments exceed 50 mg/kg PCBs and thus must be disposed of by means consistent with the regulations promulgated under the Toxic Substances Control Act (TSCA). The U.S. Army Corps of Engineers (ACOE) has chosen to treat all the sediments to be dredged in the navigation channel that cannot be open lake disposed as TSCA waste. No dredging has occurred since 1981, due to concern that if these contaminated sediments were removed, the area would be recontaminated from Fields Brook sources. In 1985, the U.S. ACOE reconsidered its earlier position, acknowledging that the quantities of contaminated sediments being transported from Fields Brook to the Ashtabula River harbor were not significant. As a result, the U.S. ACOE plans to remove contaminated sediments in the Ashtabula River within the next couple of years independent of Superfund's cleanup schedule for Fields Brook.

Violations of Ohio water quality standards for protection of warmwater habitat were documented downstream of the Fields Brook confluence for zinc, cadmium and mercury. Several organic chemicals were also detected. No violations were noted upstream of Fields Brook.

In summary, the major problem in the Ashtabula River is contaminated sediments. Conventional pollutants are not a problem and agricultural nonpoint runoff has not been identified as a significant source of pollution. The groundwater in the vicinity of Fields Brook has been contaminated as a result of past disposal practices and may be contaminated as a result of the operation of landfills in the vicinity of the Ashtabula River.

RAP Development Progress

Ohio EPA is developing a RAP for the lower Ashtabula River. Cleanup of Fields Brook is being addressed under Superfund. The Fields Brook Record of Decision proposes to incinerate the most contaminated sediments and landfill the rest. No

additional remedial actions (beyond Superfund) are expected, unless new information documents problems not addressed by Superfund. As part of the Superfund process, a survey upstream of the Fields Brook confluence is tentatively being scheduled to determine if there are additional sources of contamination not associated with Fields Brook. Ohio EPA is working with a consultant contracted by U.S. EPA to write the environmental background report and formulate preliminary recommendations for development of a RAP. A second draft has been completed. The Ohio Department of Health has recently completed a cancer surveillance survey of the population living in the vicinity of Fields Brook. Great Lakes United has targeted the Astabula River Area of Concern for active involvement.

Due to the extent of contamination and the Superfund activity in the area, public involvement has been extensive over the past 20 years. The current intention is to hold a briefing meeting to inform the public of the Area of Concern/remedial action plan concept. Further public participation will be developed jointly with Superfund, Ohio Department of Health, U.S. ACOE and Great Lakes United projects.

A number of remedial actions are already underway. The quality of effluent from industrial dischargers has improved significantly through the NPDES permit process and changes in manufacturing processes. Bioassays to screen toxicity were performed on all dischargers to Fields Brook in 1981. All dischargers are operating under recently revised permits except for RMI, Vygen (Gen Corp) and Occidental Chemical (SCM). The new permits for these industries are in draft form. The Ashtabula WWTP had its pretreatment program approved in 1986 and subsequently incorporated in their NPDES permit. Ohio is also contemplating enforcement action against one Fields Brook facility that is discharging in violation of its permit.

The U.S. ACOE has committed to dredging the contaminated sediments of the inner harbor and has begun advising potential contractors, who will be doing the dredging, to obtain the necessary permits for disposal of the dredged material. Dredging is anticipated in 1989. Sediments in the outer harbor, considered suitable for open lake disposal, will be dredged in 1987 and open lake disposed. U.S. EPA Region V's Superfund program has agreed to consider a second phase cleanup of areas missed by the ACOE during navigation channel dredging if the contamination of the sediments can be traced back to Fields Brook sources. Otherwise, a separate Superfund action may be warranted.

RAP Timetable

A target date for complete restoration of the Ashtabula River cannot be projected until all remedial programs have been identified, including the cleanup of Fields Brook. The anticipated dredging of the inner harbor in 1989 is expected to remove the bulk of the pollution problems. The cleanup of Fields Brook will take much longer and no definite schedule has been established. Based on an expected completion date of 1987 for the consultant's report, the Governor set a date of January 1989 for completion of the final RAP. Changes in the original schedule will delay the finalization of the RAP to the latter part of 1989. The anticipated RAP timetable is presented below.

ACTIVITY	DATE
Remedial Action Plan Activities:	
Initiation of preparation of background report by consultant.	October 1986

Review of first draft of background report.	March 1987
Completion of final background report.	September 1987
Initiation of public participation process.	1987
RAP submitted to IJC's Water Quality Board for review.	August 1989
Review and update of RAP.	Annually until full restoration has been achieved
Remedial Actions:	
Implementation of pretreatment program at the Ashtabula WWTP.	1986
Dredging of outer harbor.	1987
Dredging of contaminated sediments from inner harbor.	1989
Surveillance Activities:	
Cancer surveillance survey by the Ohio Department of Health	1987
Sediment and fish tissue sampling.	1987 and 1990
Monthly ambient water quality sampling at the mouth of Fields Brook.	Ongoing
Monthly ambient water quality sampling at the Ashtabula public water supply intake.	Ongoing

29. WHEATLEY HARBOUR

Environmental Assessment

Wheatley Harbour was first designated an Area of Concern because of dissolved oxygen depletion, elevated bacterial levels, nutrient enrichment and organic (derived from living organisms) contamination of the harbour sediments. Subsequent studies have shown elevated levels of PCBs in the harbour sediments, which are considered unacceptable for open water disposal during dredging operations. However, the dredged material is acceptable for unconfined land disposal. The source of contamination is primarily historic discharges from local food processing operations. Sediment samples collected in 1986 from within the Wheatley Harbour Area of Concern had PCB concentrations ranging from undetectable to 630 µg/kg.

The water quality monitoring data collected over the last 20 years indicates improving trends in water quality, particularly dissolved oxygen, biochemical oxygen demand (BOD) and total phosphorus. These improvements are a result of major wastewater treatment improvements by local industries discharging to the harbour. Also, the construction of an extended aeration activated sludge wastewater treatment plant to service part of the residential and industrial sectors has reduced impacts from leaky septic tanks and some industrial sources. Several water quality objectives are still exceeded in Wheatley Harbour. However, water quality conditions are now approaching those found in adjacent watersheds in Essex County.

Even though the harbour is only five hectares (12.4 acres) in size, it presently supports a recreational and bait fish fishery. A creel survey conducted to characterize the Wheatley Harbour pier fishery estimated approximately 10,000 rod-hours of angling effort in 1985. It was calculated that the harvest would have been in excess of 9,000 fish. There is also a large harvest of bait fish (in the order of 100,000 dozen annually) taken from Wheatley Harbour.

The limited amount of field work done on PCB uptake by fish in Wheatley Harbour shows that concentrations in whole fish are below the Great Lakes Water Quality Agreement Objective of 100 µg/kg. A 1986 sediment bioassay using fathead minnows exposed over 10 days, however, showed PCB levels in the minnows ranging from below detection to 460 µg/kg. The impact of PCBs in sediments on aquatic life will be addressed with additional biomonitoring studies in 1987.

RAP Development Progress

The development of the Wheatley Harbour RAP was initiated in 1986 with the formation of a work team composed of representatives from the Ontario Ministry of the Environment (MOE) and Environment Canada. The Ontario Ministry of Natural Resources (MNR) and Ontario Ministry of Agriculture and Food have been recent additions in support of the RAP. Work has progressed on the description of environmental conditions within the harbour and a historical account of remedial actions undertaken. A draft report of this material has been prepared and will form the basis for public consultation.

Other considerations relating to the development of the RAP include the following:

Public Involvement:

A pilot questionnaire has been developed and will be forwarded to six to eight stakeholders for testing.

A questionnaire will be evaluated and modified and then forwarded to citizens who reside in the area. At the same time, press releases and newspaper ads will announce the availability of the questionnaire and the public involvement process in the RAP.

An open house will be held to present results of the questionnaire and the environmental status of the harbour.

Public consultation will take place to develop water use goals.

Public consultation will follow to discuss and determine options to meet the established water use goals.

Status of Existing Remedial Actions:

Municipal:

With the construction of the Wheatley-Romney Township Sewage Treatment Plant in late 1985, residential areas on the east side of the harbour are or will be connected. The treatment plant discharges through a diffuser 1.5 km (0.9 miles) east of the harbour and 460 m (1,510 feet) out into the lake. This will eliminate any potential impacts from leaking septic tank systems. Under the Utility Monitoring Information System, the effluent from the plant is analyzed every two weeks.

Industrial

All industries with process wastewater in the Wheatley Harbour area other than Omstead Foods Ltd. now discharge to the Wheatley-Romney Township Sewage Treatment Plant. This has eliminated any point source impact from these industries on the harbour.

Omstead Foods Ltd. is obligated through regular abatement programs of the Ontario MOE to meet effluent guidelines. These guidelines are presently under review and new effluent criteria will be established.

Prior to 1973, Omstead's wastewater effluent quality was typically: BOD 700 mg/L, suspended solids 1,800 mg/L, and total phosphorus 32 mg/L. From January 1984 to March 1986, their average wastewater effluent quality was BOD 45 mg/L, suspended solids 27 mg/L and total phosphorus 1.3 mg/L. However, the concentrations are typically less than the above averages because they include some very high values.

The remedial actions taken by Omstead Foods Ltd. since 1973 were as follows:

prior to 1973 – screened waste for solids removal

1973 – added aeration basin and clarifier

1976	–	improved pretreatment screens and added centrifuges and floatation equipment
1977	–	quadrupling of aeration basin, more aerators and additional clarifier
1983	–	new return and waste activated sludge pumping system. Addition of phosphorus removal equipment and nutrient addition system
1987	–	President of Omstead Foods Ltd. announces that they will be adding tertiary treatment.

Agricultural

As part of the Canada–Ontario commitment to reduce phosphorus loadings to Lake Erie, the Soil and Water Environmental Enhancement Program (SWEEP) has been introduced. SWEEP is a multi–year, multi–million dollar program funded by the federal and provincial governments and directed to the reduction of loadings through soil conservation practices.

The Ontario Soil Conservation Environmental Protection Assistance Program II (OSCEPAP II) is a provincial program which has been introduced to deal with soil conservation and manure management.

It is possible that Wheatley Harbour will benefit from SWEEP and OSCEPAP II, primarily through reductions in phosphorus and suspended sediments loads.

Dredge Spoils

At present, dredge spoils from maintenance dredging in the inner harbour are restricted to land disposal.

Dredging removes contaminants from the aquatic ecosystem and reduces the amount available for bioaccumulation or release to the water column.

Investigations

The Ontario MOE has operated a routine water quality sampling station at the mouth of Muddy Creek for the last 20 years. Water quality samples are taken on a monthly basis.

An additional 15 special studies have been conducted in Wheatley Harbour over the last 20 years. Both Environment Canada and the Ontario MOE have conducted water quality and sediment surveys.

Proposed additional studies for the 1987 field season:

a) evaluation of bioavailability of PCBs through benthic organisms and fish studies.

b) increased sampling of Omstead Foods Ltd. sludge and final effluent for PCBs.

c) the addition of PCB analysis to the established routine water quality station on Muddy Creek.

d) dissolved oxygen profiling in the harbour at least twice during the summer.

e) additional studies will be considered by RAP team upon completion of the 1986 sample analysis.

RAP Timetable

Presented below is a timetable of activities undertaken since Ontario committed to developing a RAP for Wheatley Harbour in 1985 (including planned activities in the future).

ACTIVITY	DATE
Public consultation framework, key stakeholders identified.	September 1987
Pilot questionnaire.	October 1987
Full questionnaire.	December 1987
First public meeting open house.	Spring 1988
Goals for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	Spring 1988
Preferred remedial actions and implementation schedule, based on cost/benefit and public consultation.	Summer 1988
Draft RAP with use goals and remedial actions, for agency and public review.	Fall 1988
Final RAP with implementation schedule, resource commitments, monitoring and evaluation program.	Spring 1989
Final RAP to IJC's Water Quality Board.	Summer 1989
Investigations:	
Water Quality and Sediment Survey (Ontario MOE).	1985
Water Quality and Sediment Survey (Environment Canada).	1986
Benthic Studies (Ontario MOE/Environment Canada).	1987
Carp studies, contaminants in sportfish, young-of-the-year shiners (Ontario MOE/MNR).	1987
Sludge and final effluent contaminant analysis for Omstead; dissolved oxygen profiling (Ontario MOE).	1987

Remedial Actions:

New activated sludge treatment plant to treat all industrial discharge (other than Omsteads) in Wheatley Harbour plus residential areas east side of harbour. Outfall located 1.5 km (0.9 miles) east of harbour and 460 m (1,510 feet) into Lake Erie.	1985

Soil and Water Environmental Enhancement Program (SWEEP)

Reduce phosphorus loadings to Lake Erie through soil conservation.	1986

Ontario Soil Conservation Environment Protection Assistance Program II (OSCEPAP II)

Deals with soil conservation and manure management.	1986

Omsteads

President states publically that tertiary system to be constructed in 1987.	1987

30. BUFFALO RIVER

Environmental Assessment

The Buffalo River has been subject to pollution problems such as bacteria, oil, excessive levels of phosphorus, chlorine, phenol and mercury and general discoloration since the 1940s. New and updated municipal wastewater treatment facilities and controls on industrial point source discharges have significantly reduced most of the conventional pollutants. The major problem in the Buffalo River is toxic substances and their effects on human health and the ecosystem.

Water quality standards in the Buffalo River are exceeded for heavy metals and various organic compounds. Contaminated sediments are the result of many years of discharges. It has been reported that the sediments are contaminated with conventional pollutants, heavy metals, industrial organic chemicals, PCBs and pesticides. These sediments may be contributing to problems in benthos and are a probable source of contamination to the water column, aquatic organisms and wildlife (through the food chain). Analyses of Niagara River Toxics Committee (NRTC) samples show an overall pattern of high bottom sediment pollutant concentrations in the Buffalo River (2.3 mg/kg DDT; 58.7 mg/kg HCB; 66.6 mg/kg Hg; 228 mg/kg PAHs). The presence of PAHs, found in the Buffalo River sediments, is a significant problem due to the potential carcinogens dibenzanthrene and benzo(a)pyrene. Fish with tumors and lesions have been found in the Buffalo River.

Contamination of the aquatic system with persistent toxic substances is considered a serious obstacle to public use of the river and fishery resources. Concentrations of persistent compounds can be found in fish which are many times background levels. These excessive concentrations pose a significant potential health risk for the organisms and consumers such as humans. Known contaminants include heavy metals; pesticides such as mirex, dieldrin/aldrin and DDT; dioxin; and industrial organic compounds such as PCBs, chlorobenzenes and PAHs.

Studies have shown that the benthic macroinvertebrate populations in the area are severely impaired. Benthic studies in the Buffalo River showed that the riverbed supports some organisms, but only species highly tolerant of organic and toxic wastes.

RAP Development Progress

An environmental consultant, under contract to U.S. EPA, is assisting New York in the preparation of a RAP for the Buffalo River.

Presented below are completed and ongoing remedial actions in the Buffalo and Niagara Rivers, resulting from the NRTC Study:

1. Surface Water Quality

The NRTC conducted regular waste source monitoring, and periodic monitoring of ambient conditions. This included testing of contaminants in fish and wildlife. Point sources and inplace pollutants were characterized. In addition, the contribution of some landfills was documented and the investigation of others was initiated. The NRTC report recommended remedial and preventive activities to control pollution and established procedures to monitor the effectiveness of these programs. U.S. EPA and New York State Department of Environmental Conservation (NYSDEC) both drafted plans to address these recommendations.

A number of actions have been completed to improve surface water quality. Major wastewater treatment plants provide secondary treatment. All the facilities have approved pretreatment programs in place. NYSDEC and U.S. EPA have reviewed all permits for the major toxic dischargers in the area. Permits were modified where necessary to make them consistent with the New York State Strategy for improved control of toxic discharges. In addition, New York State revised their water quality standards for toxics to include numerical standards for 96 different chemicals.

2. Hazardous Waste Control

High priority has been given to the investigation and cleanup of inactive hazardous waste sites by U.S. EPA and NYSDEC. All of the 61 sites identified by NRTC as having potential for contaminant migration are being investigated. Currently, NYSDEC has completed their hazard ranking scheme and Phase I investigations are underway.

3. Sediment Contamination

A sediment survey under a grant to Erie County by NYSDEC is being carried out on Buffalo River sediments. Sediment cores are being collected and the study is mapping the sediment contamination. NYSDEC is looking at sediment water column interactions and conducting elutriate bioassays.

4. Biota Contamination

NYSDEC expanded on a program developed by the Ontario Ministry of the Environment to monitor young-of-the-year spottail shiners to assess local sources of contaminant entry as an indicator of potential problems in game fish.

Beginning with the recommendations of the NRTC, U.S. EPA (in conjunction with NYSDEC) has put together an Action Plan to address the remediation of the area. This Action Plan is a dynamic document which will be reviewed and updated annually. The major components of the Action Plan include in addition to the activities outlined above:

- Monitoring Programs - long-term ambient monitoring is being conducted as part of a binational effort between the United States and Canada to estimate net contributions of chemicals with time.

- Integrated Enforcement - U.S. EPA and NYSDEC are developing data management tools and integrated enforcement strategies to deal with the unique set of problems in the Niagara River resulting from its high volume of flow, industrial diversity and its low levels of toxic chemical contamination.

In February 1987, NYDEC named an 18 member citizen's advisory group to work with New York State officials to develop the Buffalo River RAP. The group is comprised of individuals with a range of viewpoints, including environmental and sportsmen's leaders, city and county officials, and union representatives. The group's first meeting was held in March 1987.

Development of a detailed work plan for preparation of the Buffalo River RAP was not complete as of publication of this report. A draft of the background material for the Buffalo River RAP has been completed. Remedial actions, which are the heart of the RAP, are under discussion.

RAP Timetable

ACTIVITY	DATE
New York commits to developing a RAP for the Buffalo River.	1985
Citizen's Advisory Group established by NYSDEC.	February 1987
Citizen's Advisory Group holds first meeting.	March 1987

31. EIGHTEEN MILE CREEK

Environmental Assessment

This Area of Concern is defined as Eighteen Mile Creek, Olcott Harbor, and the nearshore waters of Lake Ontario to Olcott, New York. Use impairments include: the fishery, ecosystem productivity and aesthetics. Contamination of benthos and fish have been documented within Eighteen Mile Creek Area of Concern. Dredging for navigational purposes is a potential problem due to toxic substances contamination of sediments.

A 1981 study performed by Environment Canada identified volatile organic contaminants in the waters of Lake Ontario and included a station at the mouth of Eighteen Mile Creek. Data from that station indicated that the pollutant detected at the highest concentration was trichlorofluoromethane (Freon-11), a commonly used refrigerant and aerosol propellant. (Use of chlorofluorocarbons as aerosol propellants in personal and household products was banned in 1978). Other pollutants detected in the water were the solvents chloroform, 1,1,1-trichloroethane, bromodichloromethane, carbon tetrachloride, tetrachloroethylene and trichloroethylene.

Based on STORET ambient monitoring data from stations located within the Area of Concern, mean ambient water concentrations for the following pollutants exceed the Great Lakes Water Quality Agreement Objectives: cadmium (4.6 µg/L), copper (23.2 µg/L), lead (51.4 µg/L), nickel (28.4 µg/L), DDT (0.038 µg/L), and dieldrin (0.003 µg/L).

In June 1981, the U.S. Army Corps of Engineers (ACOE) collected and analyzed sediment samples from five sites within Olcott Harbor. This effort was conducted in support of harbor dredging activities proposed by the ACOE. Comparison of the samples with Great Lakes sediment quality guidelines suggested that Olcott Harbor sediments are moderately to heavily polluted with arsenic, chromium, copper, iron, lead, manganese, nickel and zinc. Dredging of Olcott Harbor for navigational purposes is restricted due to contaminated sediments. The ACOE also noted that sediment samples collected near the mouth of Eighteen Mile Creek were generally more contaminated than those collected near Lake Ontario.

Organic pollutant sediment concentration data from a 1981 survey of Olcott Harbor conducted by U.S. EPA show that organic pollutants were present in the Olcott Harbor sediment samples only at low levels. Only one pollutant, di-n-butyl phthalate (a plasticizer), was detected at a concentration in excess of 1 mg/kg.

A 1979 New York State Department of Health sediment survey found 12 mg/kg PCB below Burt Dam. Heavy metal, PCB and pesticide data from the analysis of largemouth bass caught in Eighteen Mile Creek in 1979 (reported by New York State Department of Environmental Conservation for 1979-1982 as part of its fish and wildlife program), show that only PCBs and DDT were actually detected in the fish flesh samples. PCB contamination was found to exceed the Agreement objective of 0.1 mg/kg by about one order of magnitude. The average DDT level of 0.68 mg/kg was within the 1 mg/kg Agreement objective for this pollutant. Whether other compounds are present in fish tissues at problem concentrations is not known.

RAP Development Progress

New York State Department of Environmental Conservation (NYSDEC) is preparing a remedial action plan (RAP) for Eighteen Mile Creek with assistance from an environmental consultant under contract to U.S. EPA.

An initial evaluation of Eighteen Mile Creek was started late in 1985 and completed in April 1986 (by the consultant) through the performance of three tasks aimed at determining what information was available and what information gaps existed. These three tasks were: 1) data needs report; 2) remedial action status summary; and 3) assessment of existing remedial actions and the need for RAP development. Assessment of the situation resulted in the opinion that a comprehensive RAP document was needed.

In March 1987, the consultant was authorized to continue its assistance to New York in the development of a RAP. A first draft has been prepared.

In 1976, NYSDEC issued its Water Quality Management Plan for the western section of the Lake Ontario basin. This plan addressed the compliance status of point sources located within the Area of Concern and remedial actions that had been taken to reduce point source pollutant loadings. At the time of issuance of this report, the following municipal point sources were located within the Area of Concern: Olcott Wastewater Treatment Plant (WWTP), Lockport WWTP, Newfane WWTP, and Gasport WWTP.

The report indicated that the Olcott WWTP, which discharged directly to Lake Ontario, was to be abandoned and its influent wastewaters were to be directed to a newly-constructed 6,100 m^3/day (1.6 MGD) advanced secondary treatment plant located in the Town of Newfane. This Newfane WWTP, which consists of an activated sludge unit, rapid sand filters, and phosphorus removal equipment, is designed to provide BOD removal of 95% and effluent phosphorus concentrations below 1 mg/L. The plant was being installed to replace the town's overloaded primary plant. At the time of NYSDEC's report, the City of Lockport had recently completed construction of a 83,000 m^3/day (22 MGD) activated sludge plant. This plant was expected to provide 85% BOD removal; however, effluent phosphorus concentrations below 1 mg/L were not expected, even subsequent to installation of phosphorus control technologies.

At the time of the report (1976), the Village of Gasport was under Commissioner's orders to abate pollution of Eighteen Mile Creek. The report indicated that NYSDEC expected Gasport to abandon its primary treatment plant and direct its wastewaters to the Lockport WWTP.

The problems at Olcott and Gasport have been corrected, with Olcott connecting to Newfane and Gasport upgrading its own treatment plant, which proved to be more cost-effective than connection to Lockport.

The 1976 Water Quality Management Plan also indicated that the following industrial point sources were located within the Area of Concern: Carborundum Corporation, Lockport Felt Plants #1 and #2, Cocker Saw Company, Van DeMark Chemical Company, Harrison Radiator Company, and Noury Chemical Company.

At the time of the report, Carborundum Corporation discharged directly to Lake Ontario. NYSDEC indicated, however, that this firm was in the process of diverting all of its wastewater discharges to the Newfane WWTP. The Lockport Felt Plants and

Cocker Saw Company, which were direct dischargers to Eighteen Mile Creek at the time of the report, were considered unabated polluters and were placed under an NYSDEC compliance schedule to divert their wastewaters to the Newfane WWTP as well.

The Van DeMark Chemical Company was placed under a compliance schedule to abate its discharges to Eighteen Mile Creek. At the time of the 1976 Water Quality Management Plan, wastewater treatment technologies were being installed in accordance with this schedule.

Harrison Radiator Company, a manufacturer of automotive radiators and air conditioners, was placed under a compliance schedule to meet a BOD discharge limitation of 113 kg/day (250 lb/day). According to this schedule, compliance was expected by the end of 1977.

The Noury Chemical Company is a manufacturer of benzoyl peroxide and oxylite. At the time of the report, the firm was under a NYSDEC compliance schedule to cease its discharges of raw waste to Eighteen Mile Creek, install pretreatment technologies, and redirect its wastewaters to the Newfane WWTP. This effort was to be completed prior to 1977.

The Lockport Felt plants have ceased operation. The other five industries have corrected their pollution problems, although Harrison Radiator must still reduce a fluoride exceedance.

RAP Timetable

As indicated above, initial tasks in the RAP formulation process were undertaken late in 1985. In the spring of 1987 NYSDEC radically revised its approach to RAP preparation so as to include a much broader participation by the many concerned publics than was originally planned. Development of a detailed work plan for preparation of the Eighteen Mile Creek RAP was not complete as of publication of this report.

ACTIVITY	DATE
New York commits to developing a RAP for Eighteen Mile Creek.	1985
Draft RAP prepared by consultant.	June 1987

32. ROCHESTER EMBAYMENT

Environmental Assessment

The Rochester Embayment Area of Concern is defined as Lake Ontario nearshore to Rochester, New York; Rochester Harbor; and water bodies located within Monroe County, including the Genesee River and Irondequoit Creek. Use impairments include: fish consumption, the fishery, ecosystem productivity and aesthetics. Major problems include toxic substances contamination of water and sediments and ammonia toxicity.

In 1981, the U.S. Environmental Protection Agency's Great Lakes National Program Office (GLNPO) conducted a limnological survey of Lake Ontario nearshore areas, including Rochester Embayment. Samples were collected at the mouth of the Genesee River, near the Rochester shoreline, and at a short distance out into the lake. Results indicate that conventional pollutant levels tend to decrease with distance from the mouth of the Genesee River. For example, Genesee River ammonia levels generally exceeded the specific ammonia objective of 20 µg/L. However, nearshore ammonia levels were close to or below the 20 µg/L criterion.

A New York State Department of Environmental Conservation (NYSDEC) 1984 conventional pollutant survey of the Genesee River also indicated that ammonia levels exceeded the ammonia objective. Dissolved oxygen, phenols and pH levels, on the other hand, satisfy the specific objectives for these pollutants.

The NYSDEC 1983 toxic pollutant survey of the Genesee River and Irondequoit Creek revealed that cadmium, chromium and zinc in Irondequoit Creek exceeded NYSDEC ambient aquatic criteria. A variety of organics (mostly volatiles) were identified in Genesee River samples. Most of these organics were found to be at levels close to their detection limits; however, 1,2-dichloropropane was quantified at 45 µg/L, well above its 1 µg/L detection limit. The compound 1,2-dichloropropane is used by industry as a degreasing agent as well as a solvent for fats, oils, resins and waxes. The metals cadmium, lead, silver and zinc were also found in Genesee River samples at levels exceeding NYSDEC ambient aquatic criteria.

A 1981 study conducted by Environment Canada identified volatile organic contaminants in nearshore stations off Rochester. The two volatile organics detected at the highest concentrations were trichlorofluoromethane (Freon-11) and 1,1,1-trichloroethane. Freon-11 is a widely used refrigerant and aerosol propellant and 1,1,1-trichloroethane is a common industrial degreasing agent and solvent. (Use of chlorofluorocarbons such as Freon-11 as aerosol propellants in personal and household products was banned in 1978).

A sediment study of the lower Genesee River was conducted by the Monroe County Health Department in 1986. A comparison of the sediment levels with GLNPO and Ontario Ministry of the Environment (MOE) dredging guidelines reveals that Rochester Harbor sediments (two stations) are moderately to heavily polluted with arsenic, copper, nickel, zinc and cyanide. Genesee River sediment data collected above and below two industrial outfalls (Kodak and GCO Corporation) and in the vicinity of the Riverside Cemetery, reveal that Genesee River sediments are moderately to heavily polluted with arsenic, nickel, zinc and cyanide.

Organic pollutant data from sediments collected at five locations within the Genesee River identify relatively high levels of toluene (a common industrial solvent for coatings and adhesives) and m-cresol (a constituent of pitch used as a sealant and

in wood preservation). Dredging guidelines have not been established for organic pollutants.

A 1981 GLNPO study on the levels of organic pollutants in sediments from 13 Genesee River locations found minimal organic contamination of Genesee River sediments; the highest concentration found was only 3.07 mg/kg (dimethyl phthalate at one sample site).

PCB and pesticide data from fish collected in Lake Ontario nearshore to Rochester, presented in NYSDEC's 1979–1982 reports on toxic substances in fish and wildlife, do not indicate excessive pesticide contamination, although quantifiable amounts of mirex were found in all fish species. PCB contamination was found to exceed the Great Lakes Water Quality Agreement Objective (0.1 μg/g) by about one order of magnitude. NYSDEC data on PCBs and pesticides in fish obtained from the Genesee River indicate only minimal pesticide contamination. PCB concentration was close to the Agreement Objective.

RAP Development Progress

An environmental consulting firm (hired by U.S. EPA) has been retained to assist New York in preparing a RAP. Early in 1986 the consultant, through a survey of existing data, evaluated the conditions at Rochester. Tasks conducted in this survey were: 1) data needs report; 2) remedial action status summary; and 3) assessment of existing remedial actions and the need for RAP development. It was decided that a comprehensive RAP for the Rochester Embayment should be prepared.

Past and ongoing program activities to control pollution in the Rochester Embayment include municipal collection system improvements, best management practices to control combined sewer overflows (CSOs), upgrading and expansion of municipal wastewater treatment plants (WWTPs), and regulation of industrial dischargers.

The City of Rochester is served by an old combined sewer collection system, and a major focus of remedial activity by the City and Monroe County has been on reducing the frequencies and volumes of overflows from this combined sewer system during rainfall events. In the early 1970s, Monroe County began its Combined Sewer Overflow Abatement Program (CSOAP). As part of the CSOAP, many major improvements have been made to the Rochester collection system, allowing the abandonment of many small WWTPs. Under the CSOAP, new interceptor tunnels are being constructed to expand the capacity of the collection system. Tunnel construction is currently over 60% complete and is projected to finish in the mid–1990s.

In addition to major collection system improvements, the Monroe County Department of Wastewater Management has instituted best management practices (BMPs) to control CSOs, implementation of which included modifications to overflow weirs and regulators. Monroe County CSO abatement efforts are continuing, with projects in the Northwest Quadrant, the Irondequoit Bay, the South Central, and the Gates–Chili–Ogden Districts.

Upgrading and expansion are planned for the VanLare (Rochester City), Northwest Quadrant, and Spencerport WWTPs, and the plant at the State School at Industry. The Southeast Irondequoit WWTP is to be abandoned upon completion of an interceptor tunnel.

In regard to control of industrial discharges, the Monroe County Water Quality Management Agency has indicated in its 1984 annual report that 232 indirect discharge permits were issued in Monroe County in 1983, and that 60 industries in Monroe County possess State Pollutant Discharge Elimination System (SPDES) permits which regulate direct discharges to county waterbodies. Indirect dischargers are required to monitor their wastewaters on a quarterly or monthly basis. The Water Quality Management Agency rates 1983 compliance by indirect dischargers as 'good.'

Urban stormwater runoff is a major nonpoint source of pollution in Monroe County. Stormwater runoff from urban areas and its effect on water quality were examined by Monroe County from 1980–1983, under the Federal Nationwide Urban Runoff Program (NURP). The NURP study concluded that approximately 40 kg/day of phosphorus enter Irondequoit Bay from stormwater runoff to Irondequoit Creek. Monroe County plans to reduce this loading to 14 kg/day utilizing Irondequoit Creek wetlands as a sedimentation basin. Flow regulating structures will be constructed in the wetlands to increase retention time and effect sedimentation. The NURP report called for preparation of a work plan to implement these wetlands flow control structures and also made the following recommendations:

- Prepare a model erosion control ordinance.
- Continue stream/bay monitoring.
- Develop plans to utilize soil infiltration to treat stormwater.
- Develop a comprehensive water quality management plan for the Irondequoit basin. (A draft of the plan was completed by Monroe County in July 1985.)

Another nonpoint source of pollution in Monroe County is leachate from inactive hazardous waste sites. Inactive hazardous waste sites in Monroe County have been inventoried by NYSDEC. The inventory lists name and location, site description, list of wastes stored, quantities (if known), description of remedial actions and assessment of environmental problems associated with the site.

RAP Timetable

In the spring of 1987 NYSDEC radically revised its approach to RAP preparation so as to include a much broader participation by the many concerned publics than was originally planned. Development of a detailed work plan for preparation of the Rochester Embayment RAP was not complete as of publication of this report. Presented below is the available timetable for RAP development and implementation.

ACTIVITY	DATE
New York commits to developing a RAP for Rochester Embayment.	1985
Consultant, assisted by NYSDEC, initiates compilation of available data and information for RAP development.	March 1987

33. OSWEGO RIVER

Environmental Assessment

The Oswego River Area of Concern includes the Oswego River in Oswego County, New York, Wine Creek located in Oswego, and the adjacent nearshore waters of Lake Ontario. Use impairments include: fish consumption, the fishery, ecosystem productivity and aesthetics. Major problems include toxic substances contamination of water and sediments and probable ammonia toxicity.

A limnological survey of Lake Ontario nearshore waters, conducted by U.S. EPA in 1981, revealed that conventional pollutant levels decrease with distance from the mouth of the Oswego River. For example, the Great Lakes Water Quality Agreement objective of 20 µg/L for ammonia was exceeded in all samples collected at the mouth of the river and at inner harbor areas, whereas one of the four samples collected at the outer harbor area and three of the four samples collected at the lake area did not exceed this objective.

New York State Department of Environmental Conservation's (NYSDEC) 1984 fixed station conventional pollutant survey of the river at Oswego showed that all river samples analyzed exceeded the Great Lakes Water Quality Agreement Objective of 20 µg/L ammonia. The Agreement dissolved oxygen objective (at least 6.0 µg/L), however, was not violated by any sample collected in the study.

In 1983, NYSDEC conducted a toxic pollutant survey of both Wine Creek and the Oswego River. Stream water samples were analyzed for priority pollutant metals and organics. In Wine Creek water samples, the metals chromium and zinc were identified and quantified and the organic solvent chloroform was found at 1 µg/L. Levels of chromium and zinc found in the Wine Creek samples did not exceed New York's ambient aquatic criteria, although the zinc levels did exceed the Agreement objective of 30 µg/L.

In Oswego River water samples, the metals of chromium, copper, mercury, nickel, and zinc were identified and quantified and again the organic solvent chloroform was found at 1 µg/L. Copper, mercury and zinc levels were found to exceed ambient aquatic criteria. Nickel levels did not exceed ambient aquatic criteria.

A 1981 study conducted by Environment Canada quantified levels of volatile contaminants in Lake Ontario water samples and determined that most were not detected or found only at trace levels in nearshore Oswego water samples. The pollutant with the highest level (120 ng/L) was trichlorofluoromethane (Freon–11), a chemical used as a refrigerant and an aerosol propellant. (Use of chlorofluorocarbons as aerosol propellants in personal and household products was banned in 1978). Also found at quantifiable levels were the solvents 1,1,1–trichloroethane, tetrachloroethylene, carbon tetrachloride and bromodichloromethane.

In 1976, U.S. EPA (Great Lakes National Program Office) reported on the degree of contamination of bottom sediments at nine Oswego Harbor stations analyzed for inorganic pollutants. A comparison of the sediment contaminant levels with the Great Lakes dredging guidelines indicates that Oswego Harbor sediments are moderately polluted with the metals manganese, arsenic and copper.

A sediment survey of Wine Creek, conducted by U.S. EPA in 1981, showed that in general, organic pollutant levels were near or below 1 mg/kg and would seem to indicate minimal organic contamination. The pollutants found at highest levels are

polynuclear aromatic hydrocarbons; these compounds are generally produced by the pyrolysis of coal, such as might occur in power plant and blast furnace operations.

The Oswego River is also one of the two major sources of mirex to Lake Ontario. Mirex contamination of the river is the result of a historical and instantaneous release from the Armstrong Cork Company located 14 km upstream from the river mouth. Mirex has accumulated in the fine-grained sediment of both the river and harbor.

Armstrong Cork Company has been discharging zinc Bis (diethyldithiocarbamate) in violation of its permit, and is under a compliance decree to stop such discharge. New York is considering extending the deadline for compliance. The substance is used as a curative-preservative in making gaskets.

A mixture of halogenated hydrocarbon solvents has been found to be migrating from source detention ponds on the Fulton Miller Brewing Company site toward the river. The site is relatively close (within 450 m) to the river, and the Fulton municipal well #2 was found to be contaminated by the materials. The well is within 150 m of the Oswego River.

Onondaga County has a variety of nutrient and toxic substances sources to the Oswego River, including publicly owned treatment works (POTWs) serving such relatively large communities as Liverpool and Baldwinsville.

The Oswego River receives discharges from Onondaga Lake, the Seneca River, and Oneida Lake. Onondaga Lake itself has been severely impacted, both historically and at present, by industrial discharges directly from Allied Chemical Company and Crucible Steel Corporation, as well as indirect industrial discharges from combined sewer overflows (CSOs), Ley Creek, and the Onondaga County Metropolitan Treatment Plant. Ley Creek treatment plant, which receives the wastes from over 100 industries, including Carrier Corporation and Terstedt Division of General Motors, has diverted its effluent to the Metropolitan Treatment Plant since the late 1960s. Allied Chemical Company has diverted part of its effluent to the Metropolitan Treatment Plant since the late 1970s, but still operates waste beds south of Onondaga Lake that leach mercury and various chlorinated compounds into the lake. Ley Creek has recently been identified as a source of PCB-contaminated sediments. Onondaga Lake is the only New York lake officially closed to fishing, because of mercury-contaminated fish. Approximately a dozen other, smaller POTWs are operated in Onondaga County, on tributaries to the Oswego River. Oneida Lake is a eutrophic lake receiving farmland and municipal waste loading from adjacent communities and from tributaries.

The Seneca River drains portions of the Finger Lakes and adjacent farmland; preliminary reports from a study now underway indicate that considerable pesticide loading may be due to the Seneca River contribution. Numerous communities discharge directly to the river or its tributaries.

PCBs, mercury and pesticide data from analyses of fish collected in Oswego Harbor in 1979 by NYSDEC revealed that PCBs exceeded the Agreement objective of 0.1 mg/kg. Also, mercury levels in some fish samples slightly exceeded the Agreement objective of 0.5 mg/kg. Mirex was identified and quantified in some of the fish samples, exceeding the Agreement objective. All other pesticides were consistently found at levels well below Agreement objectives.

PCBs, mercury, arsenic and pesticide data from analysis of fish collected in the Oswego River in 1978 by New York found that the average PCB levels exceeded the 0.1 mg/kg Agreement objective by up to an order of magnitude. Average mercury levels were found near or only slightly higher than 0.5 mg/kg Agreement objective. All remaining pollutants were consistently at levels well below the corresponding Agreement objectives.

RAP Development

A consultant, under contract to U.S. EPA, is assisting New York in developing a RAP for the Oswego River. In April 1986 the consultant concluded an initial assessment through the completion of three tasks: 1) data needs report; 2) remedial action status summary; and 3) assessment of existing remedial actions and the need for RAP development. Development of a comprehensive RAP for the Oswego River is proceeding.

Remedial actions needed to control point sources within the Oswego River were described in an Oswego County Subplan, in 1979. Currently, all municipal plants are in compliance and the Oswego River has an excess of assimilative capacity. Status of the municipal discharges is herein presented:

- Fulton Publically Owned Treatment Works (POTW) – The city has been granted a waiver of full secondary treatment requirements to permit continued use of its trickling filter facilities. The plant is being improved using local funds. The city is proceeding in accord with a schedule contained in a municipal compliance plan.

- Minetto POTW – NYSDEC approved the the Town's Wastewater Facilities Report in 1977, and POTW construction was completed prior to April 1979.

- Oswego East POTW – CSOs have been brought under control through the use of detention basins to intercept flow.

- Oswego West POTW – Raw sewage discharges have been abated. CSOs have been brought under control through construction of an interceptor and treatment facilities.

- Phoenix POTW – Construction of this second contact stabilization plant was completed in 1979. Contact drawings and specifications were prepared in 1979 to accomplish the elimination of stormwater inflow to the Phoenix sewer system. This project has been completed.

In regard to industrial discharges, the Oswego County Subplan pointed out that, of 26 major industrial direct dischargers, only four firms were found to be out of compliance. These have been placed on compliance schedules: Niagara Mohawk Nuclear Station, Lycoming; Niagara Mohawk Oswego Steam Station, Oswego; North End Paper Company, Fulton; and New York State Power Authority Nuclear Power Plant, Lycoming.

A major nonpoint source of pollution in Oswego County has been designated a Federal Superfund site. The citation for Pollution Abatement Services indicates that PCBs, phenols and solvents were stored/disposed at this site. The citation further indicates that leachate from this site may have resulted in groundwater contamination. All barrels, tanks and containers have been removed from the site, and further remedial actions are currently under consideration or are underway.

A Citizens' Advisory Committee was organized to assist in development of the Oswego River RAP. Several meetings were held in 1987.

RAP Timetable

In the spring of 1987 NYSDEC radically revised its approach to RAP preparation so as to include a much broader participation by the many concerned publics than was originally planned. Development of a detailed work plan for preparation of the Oswego River RAP was not complete as of publication of this report. Further study of the location and extent of contaminated sediments in the Oswego River/Harbor is warranted.

ACTIVITY	DATE
New York commits to developing a RAP for Oswego River.	1985
Initial compilation of relevant data and information by consultant completed.	April 1986
Public participation initiated (organizational meeting held in Fulton, NY).	April 1987

34. BAY OF QUINTE

Environmental Assessment

The Bay of Quinte was first identified as a 'problem area' because of its highly eutrophic condition. During the late 1950s, the Bay experienced a collapse of the walleye population, disappearance of its rooted plants and a massive increase in algal densities. With the provision of phosphorus removal at municipal point sources, loadings declined substantially by 1978 and improvements in water quality and changes in the fauna of the bay were documented. However, continuing reductions of municipal phosphorus inputs have not been followed by further recovery of the ecosystem (Table 1). Phosphorus concentrations initially declined but have recently increased, algal densities have increased, rooted plants have not returned to the bay and the fish community, while improved, has not stabilized.

The scientific data suggest that nutrient feedback and food chain relationships are now the predominant factors influencing water quality and the stability of the ecosystem.

Table 2. Mean concentrations of key trophic parameters in the Upper Bay of Quinte, 1972–1977, 1978–1983 and 1984–1985.

Parameter	1972–77	1978–83	1984–85
Total phosphorus (μg/L)	78	49.2	52.5
Phytoplankton density (mm^3/L)	13.1	7.03	11.9
Chlorophyll a (μg/L)	27.4	14.4	20.9
Secchi disc (m) 1.2	1.37	1.15	

Rooted plants, including Eurasian milfoil, were prevalent in the bay until the late 1960s when shading by algae largely wiped them out. A low biomass (26 g/m^3) exists with no indication of recovery.

The overall species composition of zooplankton in the bay has remained unchanged over the past 20 years. However, recent samplings have shown significant increases in abundance of Daphnia galeata mendotae, perhaps as a result of reduced fish predation.

The fish community includes 65 species. A major walleye fishery existed until the late 1950s. White perch numbers increased from the 1950s until 1978 when a decline of white perch and reappearance of walleye occurred. Some components of the fish community continue to fluctuate erratically.

Following reductions in phosphorus loadings, the bay's macroinvertebrate community showed shifts in species and reductions in standing stocks indicative of improved water quality. The amphipod Pontoporeia hoyi, an important component of fish diet, declined in the early 1970s but has recovered again, perhaps as a direct result of shifts in composition of the fish community.

Other environmental problems in the bay include: localized areas of bacterial contamination in the vicinity of Belleville, Trenton, Deseronto and Picton; loss of fish and wildlife habitat related to water quality and the disappearance of rooted plants; heavy metals and organic contaminants in sediments and the presence of mercury, PCBs and mirex in some size classes of some fish species. Acceptable levels of contaminants exist in most species and size classes, however the larger sizes of some important species including walleye and eel are affected.

There are no industries which discharge wastes directly into the Bay of Quinte. Treated municipal and institutional wastes are discharged to the bay from Trenton, Belleville, Deseronto, Napanee, Picton and the Canadian Forces Base at Trenton. The Deseronto facility uses an extended aeration process. All other facilities provide treatment by means of activated sludge processes. With the exception of Napanee, all of the sewage treatment plants (STPs) are currently in compliance with the 1 mg/L discharge limit for phosphorus. It is expected that additional abatement measures planned at Napanee will put the sewage treatment plant in compliance with the phosphorus discharge limits by the end of 1987.

The sources of bacteriological contamination at Belleville, which include storm sewers and storm event bypassing at the sewage treatment plant, are currently being studied through a municipal Pollution Control Planning Study and the re-examination of the sewage treatment plant. The sewage treatment plant has recently been upgraded to a design hydraulic capacity of 54.5 thousand cubic metres/day and received a 1985 average daily inflow of 40.02 thousand cubic metres/day, however bypassing continues to occur. The sources and significance of bacteriological contamination at Picton and Trenton are being re-examined as part of the RAP work program for 1987.

The scientific assessment of the data strongly suggests that futher restoration of the ecosystem is possible, but that it will require actions in addition to pollution abatement measures to bring about further significant improvements. These could include measures to re-establish the rooted plants, inactivate the sediment nutrient source and control the food chain by fisheries management practices.

RAP Development Progress

The Bay of Quinte RAP is being developed by a federal/provincial Coordinating Committee. The committee has representation from the Ontario Ministries of Environment, Natural Resources and Agricultural and Food, and the Federal Departments of Environment and Fisheries and Oceans.

One of the first actions taken by the committee was to convene a September 1986 workshop of key resource managers and members of the scientific community to scope out the concerns, establish realistic scientific goals and objectives for restoration of the ecosystem and formulate an approach for involving the Bay of Quinte stakeholders in the process of developing the RAP.

The resource inventory for the bay has been compiled by a writing team consisting of members of the scientific community, with collation being performed by a writing consultant.

The committee has identified about 250 community stakeholders which include all levels of government, industry, organized public and corporate interest groups and the general public. The public consultation process commenced in September 1986, with media advertisements followed by the mailing of a preliminary information package to

explain the purpose and process. A questionnaire concerning proposed uses to be restored to the bay and the goals and objectives of the action plan was then sent to the stakeholders. Their responses were incorporated with the committee's resource inventory and in January 1987, a progress report was sent to the stakeholders to serve as an information and discussion document for a public meeting which occurred on January 28, 1987.

The committee's preliminary conclusion, based on the assessment of available scientific data, was that the Bay of Quinte could not be fully restored by isolated and independent actions. Full restoration will require some conventional abatement type actions in combination with ecosystem management measures to re-establish the rooted plants, reduce the feedback of nutrients from the sediments and manage the ecosystem's food chain.

RAP Timetable

ACTIVITY	DATE
Remedial Action Plan:	
Public consultation framework, key stakeholders identified.	June 1987
Goals for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	December 1987
Preferred remedial actions, implementation schedule, based on cost/benefit and public consultation.	July 1988
Draft RAP with use goals, remedial actions, for agency and public review.	September 1988
Final RAP with implementation schedule, resource commitments, monitoring and evaluation program.	November 1988
Final RAP submitted to IJC's Water Quality Board.	December 1988
Investigations/Remedial Actions:	
Long-term monitoring of nutrient parameters and nuisance algal growth to detect response to reduced phosphorus loading at municipal sources.	Ongoing
Initial post-phosphorus control monitoring showed significant reductions in receiving water phosphorus concentrations indicative of positive response to abatement measures.	1978-1981
Bacteriological survey in municipalities of Trenton, Belleville, Deseronto, Picton. Extensive zone of impact related to wet weather raw sewage bypassing from Belleville STP found.	1981

Continued assessment revealed phytoplankton densities increasing to levels approaching pre-phosphorus control years.	1982-1984
Expansion of plant capacity at Belleville STP.	1984
Belleville area resampled after expansion of plant capacity; no improvement in bacteriological quality under runoff conditions; bacterial pollution of unknown origin believed to originate upstream of study area.	1984
Re-sampling of 1984 Belleville survey, including additional sampling at storm sewer outfalls, upstream Moira River. Major wet weather bacterial loading found to originate from Moira River (city storm sewers, runoff at Corby Distillers Ltd. outfall north of city).	1985
Reduced monitoring program established to assess long-term effects of municipal phosphorus loading reductions relative to other sources (sediments).	1985-1990

Public Involvement Program:

Identification of possible stakeholders.	September 1986
Initial contact with possible stakeholders.	September 1986
Press coverage of RAP in Belleville newspaper.	September 1986
A workshop convened in Belleville to discuss goals and objectives of the RAP and public participation.	September 1986
Press coverage of the RAP in Kingston newspaper.	September 1986
Public announcement of Bay of Quinte RAP in local newspapers (Belleville, Napanee, Picton and Trenton).	October 1986
Initial stakeholder list compiled.	October 1986
A letter explaining the RAP team's intent was mailed to stakeholders. A questionnaire was included to gather initial public response to these ideas and to expand the RAP goals to reflect accurately public concerns.	November 1986
RAP Team meeting to complete program for stakeholder participation component.	December 1986
Initial information gathering phase completed, and stakeholders informed of forthcoming Progress Report and January 28, 1987 public meeting by letter.	December 1986

Analysis of questionnaire responses completed for inclusion in Progress Report.	December 1986
Bay of Quinte RAP Progress Report, December 1986, mailed to public.	January 1987
Information on public meeting forwarded to stakeholders. Stakeholders wishing to present oral briefs summarizing their concern(s) to the RAP team at the meeting were asked to register this intent by January 26, 1987 and submit a written brief of their position.	January 1987
Press release of Progress Report and upcoming public meeting mailed by courier to local newspapers, radio and television stations.	January 1987
Public meeting in Belleville.	January 1987

35. PORT HOPE

Environmental Assessment

Port Hope Harbour is located on the north shore of Lake Ontario, approximately 100 km (62 miles) east of Toronto. Approximately 90,000 m^3 of sediments located in the turning basin and west slip areas of Port Hope Harbour are contaminated by uranium, radium, thorium, radioactive lead, heavy metals (Fe, Pb, Zn, Cu), and PCBs. Contamination is believed to be primarily the result of waste management practices associated with local radium and uranium refining operations prior to 1948.

Concentrations of radionuclides and heavy metals closely resemble residues generated by the radium and uranium refining operations conducted at this site during the 1930s and 1940s. Between 1933 and 1948 refinery wastes were stockpiled at a number of locations within the town of Port Hope, including adjacent to the turning basin. Migration of contaminants from these stockpiles is thought to be the principal source of contaminants found in the turning basin sediments. Sediment dating techniques have shown that maximum contamination levels are present in sediments deposited prior to 1948. Contaminants in more recently deposited sediments may be the result of sediment mixing processes.

Recent studies have shown that sediment in the west slip and turning basin is contaminated throughout its entire depth. The total volume of sediment in the turning basin and west slip is estimated at approximately 90,000 m^3. The turning basin is the area most contaminated. Based on a survey of 10 stations in the turning basin, mean surficial sediment concentrations of uranium and radium were 248.6 mg/kg (maximum: 1280.0 mg/kg) and 31.5 Bq/g (maximum: 297.0 Bq/g), respectively.

In 1985 Environment Canada, in conjunction with the Ontario Ministry of Natural Resources (MNR), performed a study to investigate the uptake of contaminants by resident fish species in the turning basin. Uranium and thorium series radionuclides were found in fish tissues, however, levels detected indicate that human consumption of fish taken from the harbour is unlikely to result in an exceedance of the stochastic dose limit recommended for protection of the general public. Radionuclide levels of fish tissue are also considerably below those values reported in the literature as causing adverse impact on the fish themselves.

Contaminants in sediments are believed to adversely impact the benthic population. Copper concentrations at a location in the turning basin are above those reported as causing acute toxicity to benthic organisms, however, toxic response conditions reported in 1968 were not detected during the 1984 survey. No data are available on bioavailability of contaminants in Port Hope Harbour.

Port Hope Harbour is not a suitable fish habitat. High summer water temperatures in the shallow basin, low dissolved oxygen content and murky waters discourage many fish species from entering the turning basin area. Port Hope Harbour does serve as a receiving water body for discharge from the adjacent uranium refinery operated by Eldorado Resources Ltd. The only use impairment associated with the in situ contaminant problem is use of the turning basin as a boat mooring facility by the Port Hope Yacht Club. Contamination of turning basin sediments has caused a cessation of maintenance dredging in this area. As a consequence, the Port Hope Yacht Club has reported a loss of navigational depth in some portions of the turning basin. Continued sedimentation will in time render the turning basin inoperative as a

boat mooring facility if dredging is not resumed. While proper dredging protocol and confined disposal of dredged materials would address concerns arising from the nonradiological contamination, the radionuclides present in turning basin and west slip sediment require that the storage and disposal of these dredged materials be in a low level radioactive waste management facility licenced by the Atomic Energy Control Board. As no such facility is presently available, dredging in this area may not proceed.

RAP Development Progress

Due to the radionuclide content, sediments of the turning basin and west slip have been classified as a low level radioactive waste. The decision has been made to remove the contaminated sediments from Port Hope Harbour for placement in a federally licensed low level radioactive waste disposal facility. Scheduling of sediment removal is dependent upon the establishment of a suitable disposal facility.

In December 1986, the Minister of State for Mines and Forests announced the formation of a special task force which will identify the process by which candidate sites will be selected for establishment of a low level radioactive disposal facility. Contaminated sediments from Port Hope Harbour are among the wastes identified for placement in this proposed facility.

The task force is expected to present its report within one year. Following this, there will be need for an evaluation and assessment period, and a facility construction period. An operational waste disposal facility, capable of receiving sediments from Port Hope Harbour, cannot be realistically anticipated prior to 1990. Removal of harbour sediments to a temporary storage area is another option, however, no suitable storage area exists, and experience of the Low Level Radioactive Waste Management Office suggests that designation of a storage facility can be as lengthy a process as is establishment of a disposal facility.

A draft RAP has been developed by Environment Canada and the Ontario Ministry of the Environment, in accordance with guidelines provided by IJC's Water Quality Board. The RAP addresses removal of contaminated sediments for disposal on land in an approved low level radioactive waste disposal facility. Detailed plans for sediment removal are being developed by the Low Level Radioactive Waste Management Office (AECL).

Public consultation and stakeholder discussions will be held during 1987 and 1988 with the objective of submitting a final RAP to the IJC's Water Quality Board in December 1989. This schedule is dependent on the recommendations of a recently formed task force on low level radioactive waste disposal and Environmental Assessment and Review Process panel hearings.

Public consultation in Port Hope will likely make use of:

1. Regular meetings with the Port Hope Environmental Advisory Committee (a citizen's group reporting to town council which conducts monthly public meetings).

2. Public meetings held under the auspices of the Port Hope Environmental Advisory Committee.

3. Evaluation of detailed sediment removal plans as part of public hearings held in conjunction with the Environmental Assessment and Review Process (EARP).

RAP Timetable

ACTIVITY	DATE
Environmental Data Base:	
Description of Area of Concern in terms of geographic location, watershed characteristics, existing uses and adjacent land uses.	completed December 1986
Description of existing environmental conditions.	completed December 1986
Identification and delineation of impaired uses and specific concerns with reference to applicable environmental quality standards, guidelines and objectives.	completed December 1986
Undertake field work to update/complete environmental data base:	
Data to be included from 1986 fish sampling studies to: a) provide an indication of background uranium and thorium in Great Lakes fish, and b) provide additional data pertaining to the radionuclide levels present in sport fish collected from the Ganaraska River.	December 1987
A fish sampling program will be initiated to determine levels of nonradionuclides in fish collected from the turning basin of Port Hope Harbour.	December 1987
A toxicity study in the nearshore zone of Lake Ontario in the vicinity of Port Hope Harbour will be completed.	December 1987
Pertinent information from a completed study of the impact of the Ganaraska River on the drinking water intake will be incorporated into the database.	December 1987
Pollution Sources:	
Identification of pollution sources and the extent to which they contribute to the identified problems.	completed December 1986
Description of existing and planned regulatory and administrative programs affecting pollution sources.	completed December 1986
A study of contaminant loadings to sediments from present day sources will be completed to determine the long-term impact after sediment removal.	December 1987

Restoration Goals and Objectives:	
Identification of goals for environmental quality and uses to be restored.	September 1987
Remedial Action Requirements:	
The Low Level Radioactive Waste Management Office (AECL) is conducting studies aimed at investigation of sediment removal options as well as evaluation of various cleanup criteria.	March 1988
Identification of estimated costs for remedial actions and the derived environmental benefits.	June 1988
Identification of preferred remedial actions, implementing entities and implementation schedule. (Timing depends on recommendations from recently formed task force on low level radioactive waste and EARP Panel.)	November 1988
Identification of further research studies required to clarify source/impact relationships and establish predictable environmental response to remedial alternatives.	November 1988
Public Consultation:	
Identification of public consultation framework, key stakeholders and timetable.	August 1987
Preparation and dissemination of public information and education material.	September 1987
Public consultation on remedial options (dependent on EARP Panel hearings).	November 1988
Public consultation on draft RAP.	February 1989
Remedial Action Plan Development:	
Preparation of draft RAP.	December 1988
Agency review and approval of draft RAP.	January 1989
Draft RAP is tabled at the Canada–Ontario Agreement (COA) Board of Review.	January 1989
Release of draft RAP for public consultation.	February 1989
Completion of RAP with implementation schedule, resource commitments and monitoring and evaluation schedule.*	September 1989

Agency review and approval of final RAP.	October 1989
Final RAP is tabled at the COA Board of Review.	October 1989
Transmittal of the final RAP to IJC's Water Quality Board.	December 1989

* Following sediment removal it will be necessary to conduct sediment sampling in order to: a) ensure compliance with cleanup criteria; and b) provide baseline data against which future changes in harbour sediment quality can be assessed.

36. TORONTO HARBOUR

Environmental Assessment

Toronto Harbour continues to be affected by bacteria and trace contaminant inputs which impact on adjacent water uses. Benthic invertebrate communities are disrupted in the vicinity of all major inputs to the Toronto Waterfront (rivermouths and sewage treatment plant discharges). The benthic communities in these areas are dominated by pollution tolerant tubificids. PCB levels in spottail shiners from Humber Bay have declined in recent years, but still exceed the Great Lakes Water Quality Agreement Objecive (GLWQA) of 100 µg/kg. Mean PCB concentrations in spottail shiners collected in the Toronto Harbour and in the vicinity of the Main sewage treatment plant (STP) were several times higher than the GLWQA objective. Chlordane and hexachlorobenzene concentrations in these fish were also elevated relative to other Great Lakes locations.

The Ontario Ministry of the Environment (MOE) has recommended restrictions on the consumption of some species of sport fish in the waterfront area due to the presence of mercury, PCB and mirex in their flesh. Organic contaminants (i.e. PCB and mirex), where they are a factor limiting consumption, appear to arise chiefly from sources outside the Toronto Harbour area. In some cases, elevated mercury levels cause restrictions on consumption, and these levels appear to result from natural background mercury sources.

High levels of contamination were found in sediments of Humber Bay, the Inner Toronto Harbour and Ashbridges Bay. Distinct zones of degradation have been associated with inputs of the Humber River and Humber STP to Humber Bay, flow of the Don River and storm and combined sewers to Inner Toronto Harbour, and discharges from storm and combined sewers into Ashbridges Bay. Most commonly found substances in sediments include PCBs, iron, cadmium, copper, chromium, lead, zinc, mercury, as well as oil and grease, phosphorus and solvent extractable compounds.

Preliminary results indicate that biota associated with Toronto sediments bioaccumulate mercury, zinc, copper and a variety of organic contaminants including PCBs, DDD, DDE, HCB, BHC, chlordane, heptachlor and aldrin. Most of these compounds were found in water and sediments, especially near the known sources.

The existing Humber STP outfall terminates 250 m from the tip of the Humber Bay Waterfront Area lakefill. Its proximity to shore appears to limit effluent dispersion. Both sediment quality and the benthic community within the immediate zone of impact demonstrate an adverse effect due to this effluent discharge.

Water quality offshore from the Main STP outfall, and the coastal waters adjacent to the STP's seawall discharge, are adversely affected by these discharges. Improvements are predicted in water quality for both these areas with the elimination of the seawall discharge and the possible redesign and relocation of the outfalls currently under assessment by the municipality.

Major pollutant source inputs to the Toronto Waterfront have been identified as the Humber, Main and Highland Creek sewage treatment plants (STPs), as well as the Humber and Don Rivers. Minor sources include the Highland Creek, Etobicoke Creek, Mimico Creek and the Rouge River. Loading estimates for all the above sources are available for total suspended solids, total phosphorus, nitrogen, copper and lead.

Quantification of loadings from the Humber, Main and Highland Creek STPs has been attempted for arsenic, cadmium, chromium, mercury, nickel, selenium, zinc, organochlorine pesticides, PAHs, phenols and cresols, and haloganated aliphatics.

The lakefilling operation at the East Headland has been identified as a diffuse source of trace metals and organics to the waterfront. Although it is difficult to quantify loadings for comparison with point source discharges, sediment trap survey results suggest that the loss of fill material with its associated contaminants, can create near-bed concentrations of suspended sediments similar to those encountered near the Main STP discharge.

Loss of material from the headland has been shown to have only a localized effect on water quality with no impact on drinking water supplies. However, despite the absence of short-term direct impacts on water quality, the lakefilling operation remains of concern due to the potential for long-term indirect impacts on the aquatic environment (e.g. as the result of sediment contamination and food web transmission of trace contaminants).

The major bathing beaches on the Toronto Waterfront have all been intermittently posted during recent years due to fecal coliform bacteria contamination. Between July 4 and September 5, 1986 there were a total of 925 beachdays posted (63% of the total beachdays). Bacterial contamination occurs primarily in response to runoff events.

The Toronto Waterfront is used extensively for pleasure boating and windsurfing. Though local evidence of a deleterious impact of water quality on windsurfers is not available, recent research had identified an increased health risk from windsurfing in bacteria contaminated waters. Concern over pleasure boating relates to the potential adverse effect of algae and turbidity on the water's aesthetic quality. Algal growth along the Toronto Waterfront is a function of elevated phosphorus levels in the nearshore. Filamentous algal growths (Cladophora) are also of concern to users of the Western Waterfront beaches and shoreline, where accumulations of detached Cladophora have interfered with beach and lakefront use.

RAP Development Progress

A Toronto RAP Team was established by Ontario Ministry of the Environment (MOE) and Environment Canada in June of 1986 to coordinate the development of a Toronto RAP. At the same time, local environmental groups supported by the City of Toronto initiated the development of a Waterfront remedial action plan (WRAP). The result of these two exercises to date has been the production of five comprehensive data base summary documents on the Toronto Waterfront:

1. A Remedial Action Plan for the Toronto Waterfront - prepared by the WRAP Committee, City of Toronto, March 1987. Sixty-five recommendations are presented to the IJC and the municipal, provincial and federal governments.

   The following reports summarize the status of water quality, sediments and biota with emphasis on trace contaminants and bacteria; identify water quality related issues and outline remedial actions to date.

2. (Draft) Toronto Waterfront Summary Report - Humber Bay - Ontario Ministry of the Environment - Water Resources Branch, 1986.

3. Toronto Eastern Waterfront Summary – A Report for the Toronto Remedial Action Plan Team, January 1987 – prepared by Beak Consultants Ltd., Canviro Consultants, Ecologistics Limited and Gore and Storrie Ltd.

4. Toronto Central Waterfront Summary – A Report for the Toronto Remedial Action Plan Team, January 1987 – prepared by Beak Consultants Ltd., Canviro Consultants, Ecologistics Limited and Gore and Storrie Ltd.

5. Toronto Western Waterfront Summary – Sources and Loadings – A Report for the Toronto Remedial Action Plan Team, January 1987 – prepared by Beak Consultants Ltd., Canviro Consultants, Ecologistics Limited and Gore and Storrie Ltd.

In the fall of 1986, a Toronto Waterfront RAP Public Consultation Steering Committee was formed by Ontario MOE and the Federal Department of the Environment. This committee identified two phases of the Toronto public consultation process: Phase I – Public Education and Information; and Phase II – Goal Setting and Remediation Planning. The Toronto RAP process is currently moving toward completion of Phase I. The communication objectives of the public information and education program are as follows: increase awareness and understanding of the problems; inform target audiences of the RAP process and opportunities for involvement; and build broad public support for remedial actions. As part of the public involvement program, Phase I, initial contacts have been made with the voluntary sector, the government sector, business sector and the general public, on issues related to water quality and water use as well as the RAP process proposed for the Toronto Waterfront. A detailed public information brochure is under preparation to support the public education process.

RAP Timetable

ACTIVITY	DATE
Ontario commits to developing a RAP for Toronto Harbour.	1985
Toronto RAP Team established by Ontario MOE and Environment Canada.	June 1986
Waterfront RAP completed by City of Toronto.	March 1987
Public consultation framework development.	June 1987
Public information meetings (Phase I).	Fall 1987
Goal setting through public consultation.	December 1987
Remedial options selection with public input.	June 1988
Public review of draft RAP.	July 1988
Submit Toronto Harbour RAP to IJC's Water Quality Board.	December 1988
Investigations:	
Water quality monitoring and development of fecal coliform predictive model for eastern beaches.	1984–1986

Water quality monitoring and development of fecal coliform predictive model for western beaches.	1984–1987
Water quality monitoring and development of fecal coliform predictive model for Centre Island beaches.	1985–1987
Investigations of nearshore current patterns at western beaches.	1985
Shoreline monitoring at eastern and western beaches.	1986
Eastern beaches water/sediment survey and data analysis.	1986
Extended water quality monitoring at western beaches.	1987
Joint pilot study on chlorination and ultraviolet treatment of combined sewer overflows and stormwater.	1985–1986
Monitoring of impact of 1984 Humber River diversion.	1986
Storm and combined sewer outfall monitoring and investigations.	1985–1987
Optimization of sanitary sewer system by Real–Time Control.	1985
Toronto sewer network interceptor analysis.	1985–1986
Metro–City trunk sewer system review and water quality management plan.	1985–1986
City of Scarborough – pollution control strategy.	1985–1986
Review of sewer separation impact and evaluation of alternative strategies in East York.	1985–1986
Inlet control study in York.	1985–1986
Highland Creek pollution survey – dry weather outfalls.	1986
Feasibility and impact of sewer outfall extensions in Etobicoke.	1986
Eastern beaches pollution abatement tanks design studies.	1986–1987
Design of staged diffuser at Centre Island beach.	1987
Humber treatment plant and sanitary trunk sewer system study.	1987
Main treatment plant and sanitary trunk sewer system study.	1987

Municipal–Industrial Strategy for Abatement (MISA) pilot site study at Main Toronto STP.	1986–1987
RAP related investigations (tributary loadings, development of fate and transport model for trace contaminants, bioavailability of metals, bacteriological contamination assessment).	1987
Remedial Actions:	
Physical shoreline cleanup on eastern and western beaches.	1984–1985
Physical shoreline improvements at Lee–Leuty beach.	1985–1986
Cross–connection removal.	1985–1987
Accelerated sewer separation projects.	1984–1987
Algae removal on Etobicoke lakefront areas.	1985–1986
Inlet control works.	1986–1987
Installation of beach sand at Amos Waites Park.	1986
Modifications to chambers to reduce sewage overflows.	1986
Diversion of parking lot drains at Sunnyside Beach.	1986
Improvements to Ashbridges Bay Beach.	1984–1987
Installation of roof restrictors or disconnection of roof downspouts.	1987
Elimination of pollutional point source at western beaches.	1987
Connection of Ellis Avenue storm outlet to road storm sewer on Lakeshore Blvd.	1987
Physical improvements to Rotary and Amos Waites Parks.	1985
Final restoration of Humber River diversion.	1985
Accelerated sewer separation.	1984–1987
Future Proposals:	
Construction of new outfall for Humber STP.	Under assessment
Improved treatment for Humber STP proposed.	Under assessment
Feasibility of maintaining North Toronto STP – Phaseout or upgrade and expand.	Under assessment

Upgrade of overflow chlorination facilities.	Under assessment
Main STP	
– Construction of new outfall.	Under assessment
– Improvement in solids handling.	1991
– Addition of aeration capacity.	1992
– Expansion of diffuser outfall.	1993
Highland Creek STP	
– Increase in plant capacity.	2000
– Upgrading plant aeration and solids handling and implementation of new decant liquor treatment.	1988–1989

37. HAMILTON HARBOUR

Environmental Assessment

Hamilton Harbour receives runoff and waste effluent from a 494 km^2 (192 mi^2) watershed. The watershed is rural in the upper reaches and urbanized in the eastern part around the harbour. The Niagara Escarpment bisects the drainage area. The harbour is 2,185 ha in size and is a deep water port which supports the largest iron and steel industrial complex in Canada. The total population in the watershed is estimated to be 365,900.

No municipal or industrial waste or runoff from the watershed is discharged directly to Lake Ontario. It is all discharged to streams that drain into the harbour or is discharged to the harbour directly. The harbour also receives the treated waste from a population outside the natural watershed (Burlington and Stoney Creek) and some additional stormwater as the result of a runoff diversion system. In essence, the harbour 'processes' all of this discharge (natural and human-made) before it exits the harbour through a ship canal across the long flat, natural sandbar that forms the east shore of the harbour. Consequently, the impact on Lake Ontario is much less than if these wastes were discharged directly to the lake. This could benefit the lake beaches and water supply intakes in this area of Lake Ontario, but places a large stress on the water quality and aquatic ecosystem of the harbour.

The problems in the harbour resulting from the more conventional contaminants such as bacteria, nutrients, suspended solids and oxygen-demanding materials have been apparent for some time. Water quality criteria are, at present, not met for oxygen, ammonia and phosphorus. There are occasional incidents when the criteria for iron and phenol are exceeded. While remedial programs have gone a considerable distance to improve the situation, the oxygen demand arising from ammonia and nutrient loadings, combined with the oxygen demand that has built up in bottom sediments, regularly depress the hypolimnetic dissolved oxygen levels in summer to levels below water quality standards established to accommodate an adequate fish habitat.

Suspended solids, phytoplankton and dissolved organics affect the clarity and colour of harbour water. This diminished aesthetic quality deters broader recreational use of the harbour, and may be an important factor limiting aquatic vegetation.

Fecal coliform bacteria levels have declined steadily since 1975. The open waters of the harbour now occasionally meet the criteria for swimming (100 organisms/mL), but the situation near the shore where swimming is desired is not yet suitable.

Significant levels of nutrients, several heavy metals and PCBs in surface sediments have been found in several parts of the harbour. The problem is most severe in Windermere Basin, a 40 ha (99 acre) catchment basin in the southeast corner of the harbour. Confined areas are used for disposal of dredged material.

Over 50 species of fish have been found in the harbour and its tributaries. The provincial "Guide to Eating Ontario Sport Fish" indicates that smelt, white perch up to 30 cm in length, brown bullhead up to 35 cm, carp up to 75 cm, and northern pike up to 75 cm are suitable for unlimited consumption. However, PCB concentrations exceed the federal guideline of 2.0 mg/kg in the larger white perch, brown bullheads and carp. A large number of fish, representing 11 species, were collected in 1985 and are currently being analyzed by Ontario Ministry of the Environment (MOE) for inorganic and organic contaminants.

Contaminant levels in migratory species such as coho, chinook, rainbow trout, brown trout, smelt, yellow perch and white suckers are similar to body burdens in fish from western Lake Ontario and may not be caused by contaminants in the harbour.

The biological significance of contaminant levels, particularly lead in tissue of waterfowl from the Windermere Basin, is also under investigation.

Fish tumour surveys in Hamilton Harbour indicate that brown bullheads and white suckers are affected with lip and body papillomas, and a number of liver lesions. Lip papilloma frequency in white suckers and brown bullheads is 39% and 23%, respectively. The prevalence of body lesions in brown bullheads and white suckers was 7% and 1.4%, respectively. Four percent of the white suckers and less than 3% of the brown bullheads were affected with liver tumours.

The relevance of these findings is still being investigated. The 39% prevalence reported in white suckers from Hamilton Harbour has not changed appreciably since 1973. Surveys from approximately 30 sites on the Great Lakes suggest that background prevalence ranges from 0 - 12% and that papilloma frequency is elevated in five sites along the northwest shore of Lake Ontario. Surprisingly, a 40% prevalence was also found at one site on Lake Huron that receives no industrial and only a small amount of municipal effluent. The occurrence of liver neoplasia is of more concern, but prevalence rates are higher at Sixteen Mile Creek than in Hamilton Harbour. These data are confounded by the absence of cause/effect relationships and uncertainty over exposure patterns. There is almost no information describing white sucker movements in Lake Ontario.

RAP Development Progress

The first step in developing the RAP was to prepare a technical summary of a number of recent investigations of the harbour. This was published in August 1985 with general management options. Other technical reports were developed on the impact of the harbour on western Lake Ontario and on trace contaminants in the harbour.

Two principal public consultation processes have been employed. One is directed at the general population of the Hamilton–Burlington area. The other involves the principal 'stakeholder' groups, including agencies, organizations, institutions, government bodies, industries and private citizen groups who make use of, wish to make use of, or in some manner have jurisdiction over the use of the harbour water. Both sets of activities started in July 1986.

A RAP Team, made up of representatives of the Ontario Ministry of the Environment (Water Resources Branch and West Central Region Office), Environment Canada (Environmental Protection Regional Office and the National Water Research Institute), Royal Botanical Gardens, Department of Fisheries and Oceans and the Ontario Ministry of Natural Resources, was formed in May 1986. This team has worked closely with the stakeholders throughout this process.

In June 1986, 60 potential stakeholders were interviewed individually to assess their views on the future for the harbour's water quality. Many of these individuals took part in a workshop July 10 and 11, 1986, where they were presented with the information on the harbour situation. They met on July 25th to finalize their views on the use goals for the harbour with accompanying principles and some specific recommendations on the direction of the action plan. The Interim Report of the stakeholders was released in September 1986.

The stakeholder group met in December 1986 to audit the first details of the work of the writing team. Subsequent meetings in January and February of 1987 dealt with specific issues and agency responses to the Interim Report. In March 1987, the first progress report of the RAP Team was discussed and recommendations were made to the team.

Parallel with this activity was a program to involve a wider public through general meetings in July 1986 and February and March 1987. These were information sessions with opportunities for questions to be addressed to the RAP Team. Several formal briefs were also presented. Throughout these consultations, full records have been kept of comments, advice and critiques.

Concurrent with the consultative process, the RAP Team drafted about 85% of those sections of the report dealing with the environmental data base. Specific objectives were prepared for the goals recommended by the stakeholders and several remedial action options were explored to achieve those objectives. This exploration of options is nearly complete for the more conventional contaminants, but has not been finalized yet for toxic contaminants or for habitat restoration.

Additional studies are scheduled for 1987 to assist in the development of the RAP. Their objectives are: a) detailed surveillance to set the baseline for future improvements and for design of future surveillance; b) further assessment of the contaminated sediments; c) feasibility of new mitigation measures (e.g. ammonia control at the Hamilton sewage treatment plant (STP) and phosphorus treatment for 0.1 mg/L total phosphorus in effluent, etc.); d) identification of fishery rehabilitation requirements; e) detailing the likely impact of various remedial options; and f) development of a cost-benefit analysis of remedial options. Agencies involved include Ontario Ministry of the Environment, Environment Canada, Department of Fisheries and Oceans, Royal Botanical Gardens and Hamilton-Wentworth Region.

No new remedial actions have been initiated as a result of the RAP, although several measures have just recently been completed by Stelco Canada and Hamilton-Wentworth Region. There are no outstanding control orders regarding effluents to the harbour. All STPs are within Ontario MOE guidelines, further reductions will have to be based on receiving water (harbour) requirements rather than on best available technology requirements or Lake Ontario loading reduction requirements. Significant reductions in industrial waste loadings to Hamilton Harbour have occurred since 1967. Percent reductions by parameter between 1967 and 1983 were: BOD (86%), suspended solids (83%), phosphorus (93%), ammonia (94%), cyanide (72%), phenolics (92%), and solvent extractables (94%).

RAP Timetable

ACTIVITY	DATE
Wastewater Treatment Works Completed:	
Stelco #2 byproducts final coke oven gas cooling – converted to indirect cooling.	1985
Stelco #1 byproducts interceptor sump effluent – diverted to treatment system.	1986
Dofasco coke oven byproducts cyanide tower – wet oxidation treatment.	1984

Dofasco #1 acid regeneration plant upgrading.	1984
Dofasco upgrading of oil recovery in the Ottawa Street sewer.	1984
Dofasco upgrading of cold mill wastewater treatment.	1986
Hamilton STP upgrading of phosphorus removal to meet the Great Lakes Water Quality Agreement Objective (1 mg/L).	1985

Wastewater Works Underway:

Stelco #1 byproducts final coke oven gas cooling – indirect cooler.	1987
Stelco #2 byproducts interceptor sump effluent – diversion to treatment.	1987
Stelco diversion of oil treatment plant effluent to further treatment.	1987
Dofasco hot mill filtration plant upgrading.	1987
Dofasco diversion of biological treatment plant effluent to municipal STP.	1987
Dofasco blast furance gas cleaning wastewater recirculation.	1988
Hamilton STP Greenhill combined sewer overflow (CSO) retention basin installed.	1987

Strategy and Planning:

Public consultation framework, key stakeholders identified.	June 1986
Goals for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	September 1987
Optional remedial actions, potential implementation schedule, based on cost/benefit analyses and public consultation.	December 1987
Draft RAP with use goals, remedial actions, for agency and public review.	February 1988
Final RAP with implementation schedule, resource commitments, monitoring and evaluation program.	March 1988
Final RAP to IJC's Water Quality Board.	May 1988

Monitoring Activities:

Analysis of STP effluent for toxic contaminants (185 priority pollutants).	1987
Initiation of first phase of monitoring of effluent for Iron and Steel Industry Sector under the Municipal/ Industrial Strategy for Abatement (MISA) Program.	1987
Intensive monitoring of harbour and tributaries to harbour to establish new baseline for future monitoring and to assess impact of previous remedial actions.	1986–1988
Redesign of monitoring program for ambient water quality STP effluents, fish, wildlife, sediment, and tributaries.	1987–1988
Specification of effluent and process monitoring for iron and steel industry (self monitoring), under the MISA program.	1988
Execution of the annual and intensive monitoring schedules designated in the plans noted above.	1988 – ongoing

Industrial and Municipal Sources:

Established best available technology (MISA) to be applied to STPs or to industrial components of STP inputs for toxic chemical remediation, and set schedule for implementation.	1989
Establish best available technology (MISA) to be applied to the iron and steel industry for toxic chemical remediation, and set schedule for implementation.	1989
Establish technology for ammonia treatment and further nutrient removal in STPs that is compatible with toxic chemical remediation strategy/technology and with loading targets for harbour.	1987–1988
Implementation of first stage of CSO remediation for Hamilton.	1987
Pilot plan for computer–assisted storm event control system to optimize sanitary and storm sewer operation (no sanitary sewer overflow and allowing treatment of worst component of storm runoff).	1988
Plan for completion of CSO remediation program.	1988

Nonpoint Sources:

Plan for control of suspended solids loading from major tributaries to the west end of harbour.	1987

Implementation of plan.	1988
Refinement of estimates of tributary contributions of contaminants to Hamilton Harbour.	1987
Check on atmospheric contributions of contaminants to Hamilton Harbour.	1988
Evaluation of alternatives for cleanup of Windermere Basin.	1985
Funding established for remediation of contaminated sediment problem in Windermere Basin, initiation of final engineering design and environmental assessment.	1987
Cleanup of Windermere Basin completed (dredging).	1989
Completion of assessment of contaminants in main harbour sediments.	1987

Recent Major Reports:

Hamilton Harbour Technical Summary and General Management Options (Ontario MOE).	1985
Final Report – Windermere Basin Study (Envirosearch Ltd., for Windermere Basin Advisory Committee).	1985
Impact of Hamilton Harbour on Western Lake Ontario (Ontario MOE).	1986
The Impact of Dredging and Spoils Disposal on Hamilton Harbour Fisheries: Implications for Rehabilitation. J.A. Holmes (for Department of Fisheries and Oceans)).	1986

Current Study Program Objectives:

Set new baseline for past and future remediation; assessment of contaminated sediments; identification of fishery and wildlife rehabilitation requirements; detailing the likely impact of the several possible remedial option scenarios, taking into account the possible interactions of control technologies and aquatic ecosystem response.	1987–1988

Public Consultation:

Survey of views of potential stakeholders.	June 1986
Information workshop and follow up.	July 1986
Interim report of stakeholders to Environment Canada and Ontario MOE on goals, principles and general strategy.	September 1986
Public information meeting.	October 1986

Stakeholders discussion of issues of Windermere Basin, recreation, access, infilling of harbour, agency programs.	Dec. 1986 – Feb. 1987
Public meeting on progress report.	March 1987
Review of progress report by stakeholders.	March 1987
Stakeholder meeting – progress report.	June 1987
Final report from stakeholders on goals and principles.	July 1987
Stakeholder meeting – progress report.	October 1987
Stakeholder meeting – review of draft RAP.	December 1987
Public meeting on draft RAP.	January 1988
Report of stakeholders to governments on RAP review.	February 1988
Periodic public review of progress on RAP.	1988–2005

38. ST. MARYS RIVER

Environmental Assessment

The St. Marys River, which flows approximately 110 km from Lake Superior to Lake Huron, is controlled at Sault Ste. Marie by locks, power plants and compensating works to regulate flow. The river supports navigation, provides fisheries and hydroelectric generating potentials (average flow 2,000 m^3/s), drinking water for a population approaching 100,000 and process waters for major heavy industries, including steel making and paper making. A significant sport fisheries industry exists in the St. Marys River, primarily on the American side of the river.

Power generation, shipping traffic and discharges of nutrients and toxic substances from industrial and municipal point sources, as well as urban nonpoint source discharges and combined sewer overflows, have contributed to degradation of river water, fish habitat, sediment and benthos quality. The river is classified as an Area of Concern due to degraded water quality which restricts water uses at many locations, mainly along the Ontario shoreline. These problems include conventional as well as heavy metals and organic pollutants.

Surveys of sediment quality, benthic community structure and water quality conducted from 1967–1974 by the Ontario Water Resources Commission and the Ontario Ministry of the Environment (MOE) generally revealed that biota, sediments and water quality along the U.S. shore of the river and in Lake Nicolet were good and that these areas could sustain a variety of water uses. However, these studies also indicated an impacted zone along the Canadian shore, downstream of industrial and municipal discharges. This zone was characterized by an impaired benthic community, contaminated sediments (iron, zinc, cyanide, oils and greases, phenols, wood particles) and elevated concentrations of phenols, iron, zinc, cyanide and ammonia in surface waters. Bacterial counts were in compliance with the Great Lakes Water Quality Agreement and provincial objectives for body contact recreation in most sections of the river, with the exception of localized areas along the Sault Ste. Marie, Ontario waterfront (storm sewers) and downstream of the easterly sewage treatment plant.

River water quality surveys have continued, extending from above the St. Marys Rapids to as far downstream as Little Lake George. Concentrations of contaminants associated with industrial (i.e. Algoma Steel) discharges, such as phenols, ammonia and cyanide, showed a steady decline along the Ontario shoreline between 1969 and 1980. Indeed, in 1983 their concentrations approached the 1978 Great Lakes Water Quality Agreement (GLWQA) and provincial objectives for the protection of aquatic life. This decrease is likely attributable to reduced point source loadings and the doubling of river flow along the Ontario shoreline from increased diversion to Great Lakes Power in 1982.

A 1983 surficial sediment and benthic macroinvertebrate community survey indicated a spatial distribution of contaminants similar to that observed in 1973. However, it also showed that levels of iron had decreased from 1973 maxima of 22–45% to 5–9% during 1983. Concurrently, zinc maxima decreased from 200–1,100 mg/kg in 1973 to a range of 200–654 mg/kg in 1983. Cyanide, found at levels up to 14 mg/kg in 1973, was not detected above 0.015 mg/kg in 1983 sediment samples. However, maximum oil and grease levels exhibited little change over this period and analysis of the 1983 benthic community revealed no significant improvements in diversity or abundance since 1973. Nevertheless, the areal extent of high oil and grease levels had decreased somewhat by 1983.

Data on organic contaminants in earlier sediment samples are limited. PCB distribution in 1983 was similar to that of the metals and oils and greases, although elevated levels were also observed along the Sault Ste. Marie, Michigan shoreline. Chlorinated phenols were not detected in 1983 sediment samples.

In general, these studies indicated that the areas of greatest sediment contamination and most impaired benthos were located along the Ontario shoreline of Sault Ste. Marie, at the Algoma slip and below the rapids.

Young-of-the-year yellow perch collected from Sault Ste. Marie, Ontario contained PCBs, but these concentrations (average 25 µg/kg) were well below the GLWQA objective (100 µg/kg) for the protection of birds and animals which consume fish. No detectable levels of chlorophenols or chlorinated aromatics were found in these fish.

Edible portions of sport fish collected in Canadian waters do not currently contain levels of organochlorines (PCBs, organochlorine pesticides, 2,3,7,8-TCDD) which exceed Health and Welfare Canada guidelines for consumption by humans. However, larger sizes of some species (e.g. lake trout, northern pike and walleye) do contain mercury at levels requiring advisories on consumption. This may be due to residual upstream (possibly natural) sources.

Fish eating advisories have not been issued in Michigan. In 1986, the Michigan Department of Natural Resources (DNR) collected sports fish from the lower St. Marys River for the analysis of the edible portions. The Michigan DNR is awaiting these analytical results. Additional samples were collected in the upper river in 1987 by Michigan DNR.

Recently, increasing emphasis has been placed on the determination of the concentrations, distribution and availability of PAHs in the river. In this regard, a preliminary investigation was initiated in 1984 using uncontaminated clams (in cages) exposed to river water for three weeks. Clam tissue content of phenanthrene indicates significant accumulation in the vicinity of Algoma Steel discharges and downstream. Similar spatial distribution patterns were observed for some other PAHs. Analyses have shown that some fish from the river (e.g. white sucker, brown bullhead) also contain detectable levels (µg/kg range) of some PAHs. Recently, the U.S. Fish and Wildlife Service (P.C. Baumann, Columbus, Ohio) has completed a fish tumor survey in Munuscong Bay of the St. Marys River which found 4% of the walleye and 6% of the bullhead with grossly observable liver tumors (3% of the latter were cancerous). Further studies are warranted.

A preliminary investigation of the conductivity of the St. Marys River sediments adjacent to the Algoma slag site has shown six areas where contaminated shallow groundwater at the shoreline of the site may be discharging into the St. Marys River. Four of these six sites correspond with areas where elevated heavy metals, oil and grease, PCBs and PAHs have been detected in sediments or biota. Further studies have been initiated to provide information on the environmental significance of these areas.

RAP Development Progress

The St. Marys River RAP is in its initial stages of development. Completion of the St. Marys River RAP is dependent upon the completion of the Upper Great Lakes Connecting Channels Study (UGLCCS) and the Municipal/ Industrial Strategy for Abatement (MISA) pilot studies to provide the detailed discharge and receiving water assessments.

Preliminary planning has been initiated with the appropriate jurisdictions. A St. Marys River RAP committee has been established, with representation from United States and Canadian federal, provincial and state agencies. The tentative framework for development of the RAP has been prepared, which includes a public participation process. The public will be involved in the RAP process as early as possible and throughout the development of the RAP.

It is not intended that the federal, provincial and state agencies suspend their jurisdictional responsibilities to implement remedial or abatement efforts by dischargers and/or agencies while the UGLCCS is completed and the St. Marys RAP is developed. Agencies will be initiating these requirements as information becomes available so as to complement and augment the RAP. For example, the recently amended Control Order for Algoma Steel Corporation Ltd. in Sault Ste. Marie, Ontario will require Algoma to further reduce contaminants in atmospheric and wastewater discharges. The U.S. EPA is considering the tannery waste disposal site in Sault Ste. Marie, Michigan for inclusion in the Superfund process.

A large number of studies recently have been initiated or are being planned by Canadian and U.S. agencies in the St. Marys River. These are designed to: update the existing data base on water quality; fill data gaps; follow up on new and emerging issues; or provide information necessary for additional remedial action. In large measure, these efforts fall under the binational UGLCCS and Ontario's MISA pilot study programs.

The objectives of the UGLCCS as required and agreed to in 1984 by all participating agencies are:

1. To determine the existing environmental condition of the St. Marys River to identify information gaps.

2. To undertake additional needed studies to: a) identify and quantify the impacts of conventional and toxic substances from point sources, nonpoint sources (both runoff and contaminated groundwater) and tributaries on beneficial human uses and on plant and animal populations in, along and below these waters; b) determine the adequacy of existing or proposed control programs to ensure or restore beneficial uses; and c) recommend appropriate control and surveillance programs to protect and monitor these waterways and the downstream lakes. Contaminants listed for study in the St. Marys River include: PCBs, heavy metals (cadmium, copper, cobalt, chromium, iron, zinc), PAHs, phenols, chlorides, oils and greases, chloramines, cyanide and nutrients (phosphorus, ammonia). The final report, with recommendations for appropriate control and surveillance programs, is scheduled for availability by early 1988.

MISA's ultimate goal is the virtual elimination of toxic contaminants in municipal and industrial discharges to Ontario's waterways. This will be achieved by establishing monitoring and best available technology (BAT) regulations for each industrial sector as well as the municipal sector. This program will cover all major toxic polluters of waterways within three years, beginning in mid-1986. A preliminary assessment of receiving water impacts will be required to confirm whether BAT effluent limits are sufficient for the protection of water quality or whether fullscale, detailed receiving water studies are required to establish more stringent water quality impact effluent limits. In this regard, the Ontario MOE is conducting field studies at a number of pilot sites across Ontario to assess and evaluate the impact of various discharges on receiving water environments. One of these pilot sites is the St. Marys River, focusing on the iron and steel sector (Algoma Steel).

RAP Timetable

ACTIVITY	DATE
Ontario/Michigan commit to develop a St. Marys River RAP.	1985
Upper Great Lakes Connecting Channels Study:	
Ambient Water Quality:	
Tributaries.	1984–1986
River.	1985–1986
Biota:	
Caged clams.	1984–1985
Contaminants in benthic fish and macroinvertebrates.	1984–1985
Ecological profiles.	1984–1986
Benthic community structure.	1985
Sediment toxicity.	1985
Sport fish.	1985–1986
Toxicokinetics of PAHs and PCBs.	1985–1986
Young–of–the–year fish.	1985–1986
Bottom Sediments:	
Surficial, river.	1985
Tributary mouth.	1985
Subbottom profiling and coring.	1986
Chemical transport modelling.	1985–1987
Nonpoint Sources:	
Agricultural sources.	1985–1987
Atmospheric deposition.	1985
Waste disposal sites/groundwater.	1985–1986
Point Source Dischargers (municipal, industrial, combined sewer overflows and urban stormwater).	1985–1986
Municipal/Industrial Strategy for Abatement:	
Ambient Water Quality:	
Analysis (water/suspended sediments).	1986–1987
Mutagenicity (water/suspended sediments).	1986–1987
Toxicity and bioaccumulation.	1987
Biota:	
Sport fish.	1986–1987
Young–of–the–year fish.	1986–1987
Caged clams.	1987
Contaminants in benthic fish and macroinvertebrates.	1987
Fish tumor survey.	1987
Mutagenicity (clam and fish tissue extracts).	1987

Bottom Sediments:	
Cores.	1986
Mutagenicity.	1986–1987
Toxicity and bioaccumulation.	1986–1987
Sediment traps.	1987
Surficial.	1987
Chemical transport modeling.	1986–1988
Nonpoint Source:	
Waste disposal site (Algoma Steel).	1986–1987
Point Source Dischargers (municipal/industrial):	
Analysis and loadings (water/suspended solids).	1986–1987
Effluent mutagenicity.	1986–1987
Effluent toxicity.	1986–1987
St. Marys RAP Process:	
Preparation of status reports.	Jan.–Feb. 1987
Status report presentations to:	
Ontario MOE RAP Steering Committee.	February 1987
Ontario MOE Management	March 1987
Develop public participation.	1987
Complete status report and submit to IJC's Water Quality Board.	March 1987
Ontario MOE prepares request for proposals to retain public participation consultant.	1987
Immediate Abatement Efforts:	
Algoma Steel Control Order	1987
St. Marys MISA pilot study.	1987
RAP team begins to identify information requirements and gaps.	October 1987
Public meeting: Process of public participation. Status report update.	November 1987
Identify stakeholders.	December 1987
UGLCCS Report completed.	March–April 1988
Define problems, identify further research needs to study cause and effect relationships. Suggest remediation public meeting.	June–July 1988
Define goals and objectives for remedial programs and public meeting.	October 1988

Socio–economic impacts (industry, municipalities, Ontario MOE, Environment Canada, Michigan DNR, U.S. EPA).	December 1988
MISA pilot study report.	December 1988
Present findings/consensus on priority of objectives and programs.	January 1989
Draft RAP.	March 1989
Public technical review.	May 1989
Submit St. Marys RAP to IJC's Water Quality Board.	September 1989

39. ST. CLAIR RIVER

Environmental Assessment

The St. Clair River serves as an outlet of Lake Huron and flows south to Lake St. Clair, a total distance of 64 km (39 miles). The river is an important international waterway with heavy demands put on it as a shipping channel and as a source of water for commercial, industrial and domestic uses. Approximately 75,000 United States and 89,000 Canadian citizens are supplied with drinking water from this water course.

The United States has 32 permitted discharges within 8 km (5 miles) of the river, of which six are municipal sewage treatment plants. On the Canadian side, there are 12 industrial and six municipal dischargers. The 12 industrial dischargers account for approximately 2 x 10^6 m^3/d (about 500 MGD) of industrial effluent comprised of process (10% of the total flow) and cooling waters (90% of total flow), primarily from the large petrochemical complex along the Canadian shoreline.

The river water, fish habitat, sediment and benthos quality have been impaired due to the discharge of nutrients and toxic substances from industrial and municipal point and nonpoint sources and inplace pollutants.

Contaminants found in elevated levels in sediments include chlorinated organics and volatile hydrocarbons such as hexachlorobenzene, hexachlorobutadiene, octachlorostyrene, carbon tetrachloride, perchloroethylene, hexachloroethane and PCBs, as well as heavy metals (primarily mercury and lead). Oil and grease (tars) were also found in the sediment. These contaminants were principally confined to a band approximately 100 m wide along the Ontario shoreline adjacent to the industrial area (Sarnia).

During the investigation of the Dow Chemical perchloroethylene spill a survey of the Cole Drain was conducted to assess contaminant input to the river. This ditch was of interest because the geographic limits of its watershed includes the landfill sites of Dow, Polysar, Imperial Oil, Fiberglas and the Sarnia sludge lagoons. The Cole Drain upstream of Polysar contained low concentrations of organics, 1,2–dichloroethane, 1,4–dichlorobenzene, 1,2,4–trichlorophenol and hexachlorobutadiene.

A recent study conducted by Ontario Ministry of the Environment (MOE) using caged clams indicated the presence of active sources of a number of chlorinated organics in the nearshore environment of the St. Clair River between Sarnia and Corunna. PCBs were detected in clams exposed along the Sarnia section of the St. Clair River. Low tissue concentrations in clams indicated relatively small inputs of limited bioavailability from historically contaminated sediments in the area. Currently, there are no regulatory guidelines available to assess the significance of the level of contamination of these organic compounds in the St. Clair River.

Sediments along the Canadian shore of Sarnia are polluted with oil and grease (tars) and the benthic fauna are disrupted. Core samples taken during the investigation of the Dow perchloroethylene spill described tar–saturated sediments in the deeper core layers.

Ontario MOE initiated monitoring activities in the St. Clair River in the late 1960s. At this time emphasis was focused on total phenols, a parameter associated with the refineries in the petrochemical industry. Between 1969 to 1978 phenol levels exceeded 1 µg/L (Great Lakes Water Quality Agreement Objective). The introduction of advanced treatment facilities at many of the industrial plants resulted in significant reduction of phenol concentrations in effluents between 1979 and 1982. Currently, phenol levels are well within the Agreement objectives.

Mercury contamination of river sediments is well documented. Several agencies have conducted monitoring programs. In 1969 a concentration of 1,470 mg/kg was found at a station just offshore of the Dow Chemical discharge. In 1977 concentrations offshore of the discharge had dropped to 58 mg/kg. The source of the mercury contamination has been terminated and significant reductions have been attained in the river ecosystem.

Lead levels are high in the St. Clair River. The most recent 1983 University of Windsor survey of lead in the St. Clair River found values of 2 to 42 mg/kg. The highest levels were reported near Ethyl Corporation's alkyllead plant.

The health of the macrozoobenthic communities in the St. Clair River was assessed in 1968, 1977 and 1985. The results of the 1985 survey show that the benthic community is impaired in the immediate area of the petrochemical industry. A comparison of benthic fauna between 1968 and 1977 revealed that water quality conditions have improved.

Current monitoring of the young-of-the-year fish revealed that accumulation of hexachlorobenzene (HCB) and octachlorostyrene (OCS) have occurred to levels of 230 and 560 µg/kg, respectively.

The most recent data (1983) for HCB in Lake St. Clair sport fish (edible portion) show that levels have declined since 1981. Levels in carp are 10 µg/kg, and channel catfish have residues of approximately 40 µg/kg. The 1983 data for OCS are 40 µg/kg and 90 µg/kg for carp and channel catfish, respectively. Residues of HCB and OCS in channel catfish are higher in Lake St. Clair than those in Lake Huron. For carp, the reverse applies. No consumption guidelines have been established for fish containing these compounds. Mercury levels in the edible portion (skinless, boneless fillet) exhibited a significant decline during the period 1970 to 1985. The current average level is about 25% of the 1970 value. Similarly, PCB levels have also declined compared with values in the mid-1970s. An Ontario fish consumption advisory has been recommended for large gizzard shad (25-45 cm, 10-18 inches) caught in the St. Clair River due to mercury, PCB, mirex and pesticides. Michigan health advisory recommends limited consumption of gizzard shad greater than 25 cm.

Bacterial contamination of local recreational areas has been identified as a problem and may be attributed to combined sewer overflows in Sarnia and malfunctioning septic tank systems and municipal sewage treatment plant effluents. Swimming advisories have been placed on beaches in Sarnia Bay and just downstream of Ontario Hydro's Lambton Generating Station.

Periodic contamination with conventional pollutants may occur in localized areas along the United States shoreline of the St. Clair River. Combined sewer overflows and occasional septic systems failure on Harsen's Island are the sources.

Several sites that may be contaminant sources to the St. Clair River have been identified by the Michigan Department of Natural Resources (DNR). However, available data do not conclusively link any of these storage and disposal areas and landfills to contamination of the river. These sites have been ranked under Michigan Public Act 307 and are included on the "Michigan Sites of Environmental Contamination Proposed Priority List." All of the identified 307 sites have received relatively low priority rankings, indicating that funding for remedial actions at these sites will not be immediately available under Act 307.

Between 1958 and 1974, industries in the Sarnia area disposed of industrial waste under pressure into the geologic Detroit River Formation. In the late 1960s and early 1970s several cases of upwelling of brackish waters and phenolic wastes were documented. The possibility that contaminants may be migrating to the St. Clair River via groundwater recharge is presently under investigation.

The most significant contribution of contaminants to the St. Clair River originates from Ontario industrial and municipal point sources. It is anticipated that regulatory measures such as the Municipal/Industrial Strategy for Abatement (MISA) will address these inputs on the Canadian side.

RAP Development Progress

The 'Letter of Intent', which was signed by Governor Blanchard of Michigan and Premier Peterson of Ontario in December 1985, identifies Ontario as the lead agency in the development of the St. Clair River RAP. The St. Clair River RAP is in its infancy. Much of the data used to formulate this plan will be obtained from the Upper Great Lakes Connecting Channels Study (UGLCCS) to be completed in 1988, and from the MISA Pilot site study initiated in 1986. To date one meeting has been held with representatives from federal, state and provincial agencies. This meeting focused on a framework for development of the plan. While a complete public participation plan has not yet been formulated, it will be a major and important component of the RAP.

The RAP team intends to implement a public participation program which will be acceptable to citizens of both countries and ensures that a forum is provided to involve all interested people in the RAP process. Eventually a consultant will be hired to implement a public participation program.

Canadian and United States agencies have initiated or are planning a large number of studies on the river. These are designed to update the existing database on water quality, to fill data gaps and to address new emerging issues. These efforts fall under the binational Upper Great Lakes Connecting Channels Study (UGLCCS) with field work having been completed by 1986. The objectives of the study are as follows:

1. To determine the existing environmental condition of the St. Clair River and information gaps.

2. To undertake additional needed studies to: identify and quantify the impacts of conventional and toxic substances from point sources, nonpoint sources (both runoff and contaminated groundwater) and tributaries on beneficial human uses and on plant and animal populations in, along and below these waters; determine the adequacy of existing or proposed control programs to ensure or restore beneficial uses; and recommend appropriate control and surveillance programs to protect and monitor these waterways and the downstream lakes.

MISA's goal is the virtual elimination of toxic contaminants in municipal and industrial discharges to Ontario's waterways. This will be achieved by establishing monitoring and best available technology (BAT) effluent regulations for each industrial sector, as well as the municipal sector. This program will cover all major toxic polluters of waterways within three years, beginning in mid-1986. The seven industrial sectors are: electrical power generation, inorganic chemicals, iron and steel, metal mining and refining, organic chemicals, petroleum refining, and pulp and paper. In addition, a preliminary assessment of receiving water impacts will be required to confirm whether BAT effluent limits are sufficient for the protection of water quality or whether fullscale, detailed receiving water studies are required to establish more

stringent water quality impact effluent limits. In this regard, the Ontario MOE is conducting field studies at a number of pilot sites across Ontario to assess and evaluate the impact of various discharges on receiving water environments. Special modelling and other assessment techniques, including the use of aquatic organisms as indicators of impacts on water quality, are being developed. One of these pilot sites is the St. Clair River, focusing on the organic chemicals sector (Dow Chemical).

The following is a list of remedial measures which have or are being undertaken along the St. Clair River.

Dow Chemical

Reduce volatile loadings in wastewater discharging to the St. Clair River from an estimated loading (November 1985) of 242 kg/d to 45 kg/d. Dow implemented a three-year, $12 million environmental initiative program. Projects completed:

1. $600,000 on a system to separate process wastewater from uncontaminated cooling water. The First Street acid tile sewer, identified as the source of the 'perc bubbles', was shut down and permanently sealed.

2. Upgrading of spill prevention facilities at an expenditure of $2.1 million. The bulk ($1.6 million) went to building or upgrading water contaminant reservoirs to improve the collection of contaminated water (primarily from the First Street chemical plants) and permit treatment prior to discharge. The upgrading of diking around processing equipment accounted for a further $500,000.

3. An expenditure of $1.6 million to install and upgrade treatment systems at various process units (e.g. the styrene, solvents and latex plants) to enhance their capability in removing contaminants from wastewaters and atmospheric vent gases (steam strippers).

4. The construction of a 365 m riverfront barrier wall and an extraction well system to eliminate the potential for subsurface migration of chemicals from the plant site to the river. Construction of the wall, which extends vertically 6–9 m below grade, began in May 1986 and was completed five months later at a cost of $1.3 million.

5. Additional money has been spent on employee environmental awareness programs. Over 800 Dow production employees received training to increase their knowledge of environmental legislation in Ontario. The company held 'Environmental Awareness Days' in each production unit to review environmental performance and identify areas for improvements.

6. Appointment of three fulltime environmental directors to assess and implement improvements in environmental systems.

7. Initiated a study in consultation with the Water Technology Centre, Burlington, and Ontario MOE staff, for improving the operations of Scott Road landfill leachate treatment facility.

8. Dow responded to the August 1985 perchloroethylene spill by cleaning up the perchloroethylene puddles, and historically contaminated sediments adjacent to the First Street sewer complex in the St. Clair River. Total cost was in excess of $1 million.

9. Dow has taken an active roll in the preparation of spill contingency plans to identify deficiencies and to ensure that emergency response is adequate.

10. Dow, in cooperation with Imperial Oil, participated in the cleanup of the Township Ditch by dredging contaminated sediment consisting primarily of chlorinated materials. This project commenced in 1982 and was completed in 1983.

Suncor

1. Suncor implemented a wastewater treatment plant upgrading program in 1986 at a cost of approximately $5 million.

2. In addition to treatment plant upgrading, wastewater holdup capacity was increased to provide storage for storm water overflow. This allows for reprocessing of storm water through the treatment facilities.

3. Both the new and existing impounding basins have had polyethylene liners installed to prevent the erosion of the basin walls and the leaching of material into the surrounding soil.

Polysar

1. Polysar constructed a biological oxidation plant to treat process streams at a cost of $25 million. This plant came on line in 1982.

2. Polysar has constructed a pipeline to transfer leachate from its Scott Road landfill to the company's treatment unit prior to discharge to the St. Clair River.

Esso Chemical

1. Although no physical changes have occurred at the plant since November 1985, Esso Chemical has placed greater emphasis on minimizing the loss of material to the sewers, as well as optimizing the operation of the wastewater treatment system.

Esso Petroleum

1. Esso has invested over $20 million on environmental improvements at the Sarnia Refinery over the last five years, including $5.7 million during 1986. Projects included:

   a) Improved storm water handling and diversion capabilities to avoid hydraulic overload of the treatment system.

   b) Upgraded existing wastewater treatment facilities, including increased oxygen supply to the biological treatment plant for improved aeration of the wastewater.

   c) Prior to 1980 drainage from the Esso Petroleum tank was treated through a gravity separator before being discharged to the Cole Drain. The company has installed a pipeline directly to their biological treatment plant where the leachate is treated prior to discharge.

Cabot Carbon

1. In 1984 the company constructed a storm water collection and treatment system.

Polysar (Corunna)

1. In 1984–85 the company initiated a program for the optimization of their existing Biox plant. This resulted in a significant decrease in phenol loadings.

Fiberglas

1. In 1983 the company completed remedial work on its landfill situated on Scott Road, and closed the facility. This effectively addressed the problem of phenolic leachate gaining access to local storm drains.

Shell

1. The upgrading of a storm collection and treatment system will be completed by December 1987.

Ethyl

1. The company has undertaken a program for the recycling of process waters, resulting in significant reductions in total loadings of contaminants to the St. Clair River.

Chinook

1. A closed–loop spray irrigation system to treat potentially contaminated water was completed in 1983.

All companies have undertaken a program to improve source separation of process wastewater streams resulting in lower loadings to the treatment system, thus helping to prevent hydraulic overload.

The Ontario MOE has retained a consultant to assess the input of contaminants originating from the Scott Road landfill site areas (Dow, Polysar, Imperial Oil, Fiberglas landfills and City of Sarnia sludge lagoons), both during dry and wet weather flows. This study will assist the Ontario MOE in determining the source and fate of contaminants originating from this area.

The Ontario MOE will also be expanding their investigation into the potential contamination of the freshwater aquifer by the past injection of industrial wastes into deep wells in the Sarnia area. The objectives are to determine groundwater quality and to assess groundwater velocities and gradients. This will enable Ontario MOE to determine the flux of contaminants to the river.

The City of Sarnia is in the process of trying to solve the problem of combined sewer overflows (CSOs) to the St. Clair River by undertaking a sewer separation program. However, the scheme is expensive and takes decades to complete. Ontario MOE has granted the City $60,000 for a water pollution control study. The grant will help the City develop a plan to solve the problems using new techniques that will be more cost effective and provide solutions faster than sewer separation. The study is expected to be completed within a year.

RAP Timetable

ACTIVITY	DATE
Immediate Abatement Efforts: Scott Road Landfill Area Study. Dow Slurry Wall. MISA.	November 1985
Ontario–Michigan sign Letter of Intent.	December 1985
Upper Great Lakes Connecting Channels Study.	
Ambient Water Quality.	
– Rivers.	1985
– Tributaries.	1985–1986
Biota.	
– caged clams.	1984–1985
– contaminants in fish and benthic macroinvertebrates.	1984–1985
– ecological profiles.	1984–1986
– benthic community structure.	1985–1986
– sediment toxicity.	1985
– sport fish.	1985–1986
– young–of–the–year fish.	1985–1986
– bioassay: agricultural biocides.	1986–1987
sediments to Hexagenia.	1986–1987
Nonpoint Sources.	
– agricultural sources.	1985–1986
– atmospheric deposition.	1985
– deep well project.	1985–1987
– waste disposal sites/groundwater.	1985–1987
Point Sources Dischargers.	
– municipal, industrial, urban stormwater and CSOs.	1985–1987
Sediments.	
– subbottom profiling and coring.	1984–1986
– transport and flux.	1985–1986
– tributary mouth.	1985–1986
Unsteady flow models.	1985–1986
St. Clair River Pollution Investigation.	1986
Municipal/Industrial Strategy for Abatement (MISA).	
Sequential sampling component.	
– water.	1986–1987
– effluent.	1986–1987

Ecosystem component.	
Supplementary Chemical Characterization.	
– centrifuging the water column.	1986–1987
– whole effluent.	1986–1987
– centrifuged effluent.	1986–1987
– effluent toxicity.	1986–1987
– mutagenicity testing.	1986–1987
Body Burden Analyses.	
– benthos and sculpins.	1986–1987
– spottail shiners.	1986–1987
– Cladophora.	1986–1987
– caged fish.	1986–1987
– clams.	1986–1987
– bacterial slime.	1986–1987
– phyto– and zooplankton.	1986–1987
– macrophytes.	1986–1987
Investigative Sampling.	
– water.	1986–1987
– bottom sediments.	1986–1987
– sediment cores (National Water Research Institute).	1986–1987
Status reports writing assignments.	January 1987
RAP team process discussion.	January 1987
Write status report.	Jan.–Feb. 1987
Status report presentations to:	
Ontario MOE RAP Steering Committee.	February 1987
Ontario MOE management.	March 1987
Finalize status report and submit to IJC's Water Quality Board.	March 1987
Ontario MOE writes request for proposals to retain public participation consultant.	July 1987
RAP team develops public participation process.	October 1987
RAP team prepares for first public meeting. Discuss information requirements and gaps.	1987
Public meeting: process of public participation; status report update.	1987
Identify stakeholders.	1987
UGLCCS Report.	March 1988
MISA.	1988
Define problems; identify further research needs to study cause and effect relationships; suggest remediation at public meeting.	June 1988

Define goals and objectives for remedial programs at public meeting.	October 1988
Socio-economic impacts; industry, municipalities, Ontario MOE, Environment Canada, Ontario MNR, Michigan DNR, U.S. EPA.	February 1989
Present findings; consensus on priority of objectives and programs.	March 1989
Draft RAP.	May 1989
Public technical review.	August 1989
Submit RAP to IJC's Water Quality Board.	December 1989

40. DETROIT RIVER

Environmental Assessment

The Detroit River connects Lake St. Clair and Lake Erie. It is 51 km (32 miles) long and serves as an international boundary between Michigan and Ontario. Although the Detroit River technically drains the entire Upper Great Lakes watershed, there are only five tributaries discharging directly to it, of which the largest is the Rouge River.

The Detroit River is used extensively for shipping, recreation, and public (3.75 million people in Canada and U.S.) and industrial water supply. It also receives treated wastewater from numerous municipal and industrial facilities, direct storm runoff and combined sewer overflows. Historically, the river was bordered by extensive wetlands, but now much of its shoreline has been filled and bulkheaded to accommodate industrial, municipal and residential development.

The Detroit River Area of Concern extends from Windmill Point to the Detroit Light. Areas outside these bounds are considered as the Source Area of Concern as far inland as the tributaries and service areas of the wastewater treatment plants reach.

Impaired uses include total body contact recreation, fish, and other aquatic life (including waterfowl). Impairment of total body contact recreation stems from the presence of fecal coliform bacteria in excess of Michigan's water quality standard and Ontario's water quality objective. Most fecal coliform bacteria violations occur in the vicinity of combined sewer overflows (CSOs) in Detroit and Windsor and downstream of Connor's Creek, the Rouge River, Little River and Turkey Creek. Impairment of fish is a result of elevated PCB body burdens in carp exceeding the U.S. Food and Drug Administration (FDA) guideline and elevated levels of mercury, PCBs and other organics in rock bass, white bass, walleye and freshwater drum (exceeding Ontario guidelines). Impairment of other aquatic life is based on shifts in density and diversity of the benthic macroinvertebrate community along the U.S. shore, primarily downstream of the Rouge River through the Trenton Channel. Waterfowl impairment is based upon PCB body burdens in ducks (average: 10 mg/kg) taken near Mud Island and up to eight km downstream.

Research on organic contaminants has found relatively high levels of PCBs, hexachlorobenzene (HCB) and octachlorostyrene (OCS) collected in sediments from certain areas of the river. Highest PCB concentrations (20–40 mg/kg) in sediments are found between Belle Isle and the Ambassador Bridge on the United States side. The most recent biological monitoring of organochlorine contaminants in the Detroit River found PCB levels significantly higher along the Michigan shore, with highest concentrations found in the Rouge River area. HCB and OCS were found at near–detection levels in clams from most monitoring stations. The most likely sources of these compounds are the Canadian petrochemical industries situated along the St. Clair River. Although there are no water quality or health related criteria for these compounds, their presence, although at low levels, calls for more research since they are known to be carcinogenic.

The most significant area contaminated with oil and grease is along the Michigan shoreline near the industrial complexes. Concentrations in these areas range from 100 to 29,000 mg/kg.

Heavy metal contamination of Detroit River sediments remains a problem, especially along the Michigan shore. Mercury levels in sediment are elevated downstream of the Detroit Wastewater Treatment Plant, Great Lakes Steel and the Rouge River. Elevated levels of cadmium, chromium, copper and zinc in sediments at the mouth of the Rouge River have been attributed to industrial sources and CSOs.

Approximately 30% of the bullheads in the lower Trenton Channel have skin or liver tumors. Many of these bullheads have barbels missing (linked to contact with contaminated sediments). These contaminated sediments have a strong potential to cause mutations in bacteria and are toxic to invertebrates.

RAP Development Progress

A 'Letter of Intent' signed by Governor Blanchard of Michigan and Premier Peterson of Ontario identifies Michigan as the lead agency in development of the Detroit River RAP.

The Detroit River RAP is in the early stages of development. The Michigan legislature appropriated $80,000 for fiscal year 1987 for Southeastern Michigan Council of Governments (SEMCOG) to aid the Michigan Department of Natural Resources (DNR) in developing the RAP. SEMCOG, with Michigan DNR support, contracted technical and public participation consultants. The Ontario Ministry of the Environment (MOE) has also hired a public participation consultant and coordination is underway. Michigan held an initial public hearing for the Detroit River RAP in October 1986. Stakeholder meetings were held in May–June 1987 as well as general public meetings in June and September 1987. A binational public advisory council will be established.

A Detroit River technical work group has been established under the direction of SEMCOG and Michigan DNR. This committee will draw together previous studies and relevant data, and review the draft RAP for technical content and completeness. The group will have representatives from state, local and federal governments, including the U.S. EPA, Ontario MOE, Environment Canada, International Joint Commission, United States Geological Survey, United States Fish and Wildlife Service, United States Army Corps of Engineers, Michigan Department of Public Health, local health departments, Fisheries, Parks, Hazardous Waste, Groundwater, Wildlife, Coastal Zone Management, Water Management, Nonpoint Source Management, Surface Water Quality, Community Assistance, local parks, Southeastern Michigan Council of Governments, various universities and others who have data to share.

Remedial actions already initiated on the United States side include the National Pollutant Discharge Elimination System (NPDES) permit program, updated Water Quality Standards, construction grants program, pollution incident prevention plans (PIPP), the pollution emergency alerting system (PEAS) and the industrial pretreatment program (IPP). A large number of specific activities have occurred at municipal and industrial facilities to reduce contaminants to the Detroit River. Two studies have been completed by the Michigan DNR in concert with the City of Detroit since the RAP process began. These studies examined PCBs in the sediments of Detroit sewers having overflows to the river and PCBs in Detroit River and Lake St. Clair sediments. Known sources of PCBs to the Detroit River include: the Detroit Wastewater Treatment Plant (approximately 1 kg/day), combined sewer overflows and PCB contaminated sediments entering from the storm sewers in Detroit (near the Carter Industrial Site).

Canada has upgraded a number of municipal wastewater treatment facilities by adding phosphorus removal. Several industrial treatment facilities were upgraded and a few direct industrial discharges to the Detroit River were eliminated. Other industrial dischargers are now studying their problems. Plans have also been made to construct sanitary sewers in the unsewered portion of Windsor.

Canadian and United States agencies have initiated a number of Detroit River studies designed to update existing water quality data, fill data gaps and address emerging issues. These efforts fall under the binational Upper Great Lakes Connecting Channels Study (field work completed in 1985 and 1986). The data and information generated by the Upper Great Lakes Connecting Channels Study will be used to complete the Detroit River RAP. Completion of this study is expected in early 1988.

RAP Timetable

ACTIVITY	DATE
Michigan/Ontario commit to developing a Detroit River RAP.	1985
Upper Great Lakes Connecting Channels Study (UGLCCS).	
Chemical Transport Modeling.	1985–1987
Point Source Assessment (industries, municipalities, CSOs, urban stormwater).	1985–1987
Nonpoint Source Assessment (waste disposal sites, groundwater, atmosphere, agriculture).	1985–1987
Ambient Water Quality Investigations.	1984–1986
Contaminated Sediment Studies.	1984–1986
Biological Effects Studies (benthos community structure, bioaccumulation of contaminants in fish, caged clams, sediment bioassays, bioaccumulation of contaminants in waterfowl, fish tumors, habitat).	1984–1987
State of Michigan legislature committed $80,000 to develop Detroit River RAP.	1986
U.S. and Canada initiated joint RAP development process.	September 1986
Michigan held its first Detroit River RAP public meeting.	October 1986
RAP team meeting, Windsor, Ontario.	October 1986
Stakeholders meetings held in Detroit.	May–June 1987
Three chapters of technical background information document obtained from consultant.	May 1987
Second general public meeting held in Windsor.	June 1987
Four additional chapters of technical background information document obtained from consultant.	June 1987
One additional chapter of technical background information document obtained from consultant.	August 1987
News letters to public and newspaper advertisements.	Sept.–Oct. 1987

Michigan/Ontario receive some preliminary UGLCCS data.	September 1987
Final technical background informational document due from consultant.	September 1987
Third general public meeting on Detroit River RAP held in Detroit.	October 1987
Complete review of technical background informational document.	December 1987
Public educational conference on Detroit River.	February 1988
Completion of UGLCCS.	March 1988
Prepare RAP.	April 1988–July 1989
Submit Detroit River RAP to IJC's Water Quality Board.	December 1989
Sewer construction project to eliminate raw sewage entering Turkey Creek from septic tanks ($20 million from Province of Ontario; $20 million local funding).	1987–1993

41. NIAGARA RIVER

Environmental Assessment

The Niagara River connects Lake Erie and Lake Ontario and forms the international boundary between Canada and the United States. It is a source of drinking water and industrial process and cooling water; it is harnessed as a source of energy, is a major tourist attraction, and is used as a receiver of the discharges and wastes from industries and municipalities along its shores. The river is about 59 km (37 miles) long and has an average flow of 5,700 m^3/s (approximately 200,000 cubic feet per second). It also carries a load of contaminants which includes wastes discharged to the four upper Great Lakes as well as wastes discharged from along its shores.

The major problem in the Niagara River is toxic substances and their potential effects on human health and the ecosystem. Water quality criteria are exceeded in the Niagara River for heavy metals and various organic compounds. The Niagara River Toxics Committee (NRTC) reported water quality criteria were exceeded for aluminum, cadmium, chromium, copper, lead and silver in at least one sample in most river segments. In addition, some stream segments occasionally exceeded water quality criteria for mercury, arsenic, cyanide and selenium. Four pesticides, dieldrin, alpha-BHC, gamma-BHC and chlordane, occasionally exceeded criteria in some river segments, particularly in the Wheatfield-Upper Niagara River segment.

The Niagara River also has sediments which are contaminated by many years of discharges. It has been reported that the sediments are contaminated with conventional pollutants, heavy metals, industrial organic chemicals, PCBs and pesticides.

Biological resources have been severely impaired by municipal and industrial discharges as well as inplace sediment pollutants. The local fishery is affected by PCBs, mercury and various organic chemicals of agricultural and industrial origin. Chemical contamination has caused the issuance of health advisories in the United States and Canada which restricts the consumption of sport fish and closed the commercial fishery for American eel. Fish consumption advisories have been issued for American eel, channel catfish, lake trout, chinook salmon, coho salmon, rainbow trout, brown trout and white perch. Field studies of fish pathology have indicated elevated frequencies of tumors among several species of Niagara River fish.

Contamination of the aquatic system with persistent toxic substances is a serious obstacle to public use of the river and fishery resources. Concentrations of certain persistent compounds can be found in fish which are many times higher than background levels. These excessive concentrations pose a significant potential health risk for the organisms and consumers, such as humans. The list of known contaminants includes heavy metals; pesticides such as mirex, dieldrin/aldrin, and DDT; dioxin; and industrial organic compounds such as PCBs, chlorobenzenes, and PAHs.

Ontario's RAP Development Progress

The NRTC's Report provided a comprehensive database for identifying problems. Subsequently, agreement was reached in October 1986 by U.S. Environmental Protection Agency, Environment Canada, New York State Department of Environmental Conservation (NYSDEC), and Ontario Ministry of the Environment (MOE) on a toxic substances management plan for the Niagara River. That plan provides for the reduction of loadings of toxic chemicals to the Niagara River in

accordance with a timetable and a set of specific objectives. The plan commits the four jurisdictions to apply the full extent of their domestic rules and regulations; and for point sources, specifies that "control measures will be based upon the application of best available technology, and the results of scientific evidence of environmental degradation."

In February 1987 the heads of these four environmental agencies involved with the Niagara River met in Toronto, Ontario and signed a 'Declaration of Intent for the Niagara River.' In that document, the Parties committed their agencies to a cleanup program for the Niagara River which included, along with other activities, a 50% reduction in loadings of certain persistent toxic substances to be achieved by the year 1996, using the 1986–87 point source discharge monitoring data as baseline. These reductions would be based on the activities outlined in the previously negotiated Niagara River Toxic Management Plan. The Declaration further states that "This (purpose) is consistent with the goal of virtual elimination of toxic discharges, as agreed upon in 1978 by the Governments of the United States and Canada under the Great Lakes Water Quality Agreement."

The 1984 report of the NRTC provided the first comprehensive cataloguing of sources of contamination to the Niagara River. The report also provided a preliminary assessment of the severity of the environmental impact and degradation along the river before it discharged into Lake Ontario. Based on 1981–1982 sampling, as identified in the NRTC report, the Ontario point sources contributed approximately 11% (152.2 kg/d) of the total loading of toxic contaminants to the river.

Point source discharge monitoring programs undertaken by Ontario since the NRTC Report, coupled with remedial measures undertaken in the interim period (1982–1985), show a greater than 60% reduction of gross loading of toxic contaminants from Ontario–based point sources (average load 57.6 kg/d). Some of the more important remedial measures have included expanded treatment processes at Atlas Steels, upgrading of the Niagara Falls sewage treatment plant and the elimination of the Stanley Avenue combined sewer in Niagara Falls. As recorded by the NRTC data and subsequent years' monitoring data, heavy metals contribute greater than 70% of these loading values. Therefore, organic constituents are less than 30% of the total Ontario load. The 1985 loadings from Ontario–based point sources represent less than 5% of the total point source loadings estimated by the NRTC based on 1982 sampling data.

Loadings from nonpoint sources could not be quantified and a specific investigative and interpretive program has been set up for 1987–1988 to address this problem. The NRTC identified five landfills in Ontario that had a potential to leach contaminants to the river. Environment Canada and Ontario MOE launched detailed preliminary investigations into each of these sites and reports of the findings have been made available to the public. Landfills that still need attention are being addressed further by the owners, with the environmental agencies closely monitoring activities and the progress at these sites.

Sport fish over the years have been showing a gradual decrease in the concentration of contaminants, suggesting a reduction in source loadings of these contaminants. However, indications are that there are still active sources of chemicals along the Niagara River which need to be addressed. The input of toxics have been confirmed through intensive biomonitoring using clams, spottail shiners and Cladophora along the river. The biomonitoring program is proposed for expansion during the 1987–1988 summer field periods.

The Province of Ontario has established a program called Municipal–Industrial Strategy for Abatement (MISA) to achieve many of the objectives of the Niagara River RAP and the Niagara River Toxic Management Plan for Ontario point sources. It is possible that MISA will achieve, totally or in part, the remedial objectives of these plans as well as a goal of 50% reduction as required by the Declaration of Intent.

As a result of the commitment to develop a RAP for the Niagara River and the recommendations of the NRTC Report, Environment Canada and Ontario MOE have undertaken the following studies:

1. Annual monitoring of toxic contaminants from all point source discharges.

2. Detailed investigations at all landfills identified in the NRTC report.

3. Yearly biomonitoring of clams, Cladophora and spottail shiners.

4. Intensive monitoring of ambient river chemical concentrations at Fort Erie and Niagara–on–the–Lake.

5. Intensive monitoring of chemical concentrations in raw and treated drinking water at filtration plants in the Niagara Peninsula.

The public in the Niagara area have been kept informed of environmental activities along the Niagara River by Ontario MOE staff and an energetic and enthusiastic press in the area. Public awareness of activities along the Niagara River has not formally been a part of the RAP process but has been in response to a dedicated public who are interested in the environment. Media coverage has been generated from the development of the Niagara River Toxic Management Plan and Declaration of Intent as well as from studies that have been undertaken.

The Niagara River Toxic Management Plan can be considered as an integral part of the RAP, since the objectives of the Toxic Management Plan lead to the reduction of discharges of toxics into the river. As part of the Niagara River Toxics Management Plan, there is also a public participation/ consultation component which meets many of the objectives of the RAP process.

Public meetings occurred in early January and a report responding to the issues raised at these meetings was released on July 28, 1987. Additional public participation programs and meetings are proposed and these will occur in accordance with the RAP requirements and objectives. Most stakeholders have been recognized by the RAP development team but there have been no formal meetings held.

The Ontario Ministry of Natural Resources District Office in Fonthill has been approached to assist in developing the fishery–related component of the Niagara RAP.

Further activities are planned in the public participation process as well as undertaking further studies over the next two–year period to refine the identification of the contribution of contaminants from the Welland River and from smaller tributaries on the Ontario side of the Niagara.

Ontario's RAP Timetable

ACTIVITY	DATE
Remedial Action Plan Development:	
Toxics Management Plan initiated.	1985
Province of Ontario initiatives relating to the Niagara River Toxics Committee report released.	September 1985 (updated March 1987)
Toxics Management Plan approved and released to public.	October 1986
Public meeting held in Niagara Falls, Ontario to discuss Toxics Management Plan.	January 1987
International Symposium on Toxics in the Niagara River held in Toronto. 'Declaration of Intent' signed by four agencies committing U.S. and Canada to a 50% reduction in toxic discharges by 1996 (Niagara River Toxics Management Plan).	February 1987
Report of the issues raised at the January 13, 1987 public meeting released.	June 1987
Public consultation plan and key stakeholders identified.	June 1987
Niagara River Toxics Management Plan update.	July 1987
Report on responses to issues raised at the January 1987 public meeting released (Responsiveness Report).	July 1987
Toxics Management Plan update and status report issued, stakeholders contacted.	July 1987
Toxics Management Plan status report.	January 1988
Goals established for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	December 1988
Preferred remedial actions, implementation schedule based on cost/benefit and public consultation.	January 1990
Draft RAP with use goals and remedial actions for agency and public review.	May 1990
Final RAP with implementation schedule, resource commitments, monitoring and evaluation program.	October 1990
Final RAP to IJC's Water Quality Board.	January 1991

Remedial Actions/Investigations:

Welland STP upgrading completed.	1984
Hydrogeological assessment begun at Cyanamid Welland landfill site.	1985
Fort Erie municipal landfill site sewage sludge drying lagoons phased out.	1985
Atlas Steel landfill waste acid pond closed and waste acid solidification plant constructed under a Ministry Control Order. Residual acid and sediment removed from the pond to the plant for treatment.	1985
Niagara Falls sewage treatment plant (STP) secondary treatment facility upgrading completed.	September 1985
Stabilization of remaining sludges at Atlas Steels landfill site completed.	October 1985
Hydrogeological study report of Atlas Steels landfill site released by Ontario MOE.	December 1985
Cyanamid, Niagara Falls/Ontario Hydro waste site hydrogeological study report made public by Ontario MOE.	February 1986
Consultants report on 1983 benthic study submitted to Ontario MOE.	April 1986
Sampling and analysis of fish and sediments in Sir Adam Beck Ontario Hydro reservoir.	Spring 1986
Capital works completed at Fleet Manufacturing including process modifications and cessation of plating operations.	1986
Cyanamid Welland landfill site Phase I final report issued.	Summer 1986
Welland River intensive investigation of two major point sources by Brock University.	Summer 1986
Cyanamid Niagara Falls/Ontario Hydro waste site Phase I report issued.	Summer 1986
Upstream/downstream Niagara River monitoring data report 1984–1986 released representing four agency agreement on data interpretation for mass balance approach to monitoring.	October 1986
Preregulation MISA monitoring initiated.	November 1986
Draft Control Order provided to Regional Operations, abatement staff for Atlas Steels.	January 1987

Hydrogeological study report of Fort Erie landfill completed for Ontario MOE.	March 1987
Point source monitoring effort doubled.	March 1987
Nonpoint source investigations to be undertaken.	1987–1988
Review current and proposed point source monitoring program, compare them to NRTC recommendations and identify other areas that should be addressed for the purpose of defining an appropriate point source monitoring program.	April 1987
Biomonitoring survey at major sources and tributaries.	June/July 1987
Cyanamid Niagara Falls/Ontario Hydro waste site Phase II interim report due.	July 1987
Cyanamid Welland landfill site Phase II final report due.	August 1987
Chippawa Creek coal tar deposit cleanup operations to be completed.	Fall 1987
Regional hydrogeology/water resources report due.	October 1987
Inplace pollutant study report completed.	1987
MISA – organic chemical regulations in effect.	Early 1988
MISA – STP regulations in effect.	1989
Implementation of industrial pretreatment program for City of Niagara Falls, Ontario Water Pollution Control Plant.	1990
50% reduction from 1986 loadings of chemicals of concern from point sources.	1996

New York's RAP Development Progress

A number of actions have been taken by New York to improve surface water quality. Major wastewater treatment plants provide secondary treatment, with Amherst, North Tonawanda and Niagara Falls providing tertiary level treatment. All the major facilities have approved pretreatment programs in place. New York State Department of Environmental Conservation (NYSDEC) and U.S. EPA have reviewed all permits for the major toxic dischargers in the area. Permits were modified where necessary to make them consistent with the New York State Strategy for improved control of toxic discharges. In addition, New York State revised their water quality standards for toxics to include numerical standards for 95 different chemicals.

High priority has been given to the investigation and cleanup of inactive hazardous waste sites by U.S. EPA and NYSDEC. Under the Resource Conservation and Recovery Act, 20 existing active hazardous waste sites in the Niagara River have been brought under interim regulation. They are all in various stages of the final permit or closure

process. All of the 61 sites identified by NRTC as having potential for contaminant migration are being investigated. Phase I investigations are underway.

In 1986, the voters of New York State passed the Environmental Quality Bond Act which provides $1.2 billion for remediation of hazardous waste sites. Particular attention has and will continue to be focused on the Niagara River.

To supplement work described in the NRTC report, New York is carrying out preliminary investigations on an additional 46 sites within the Niagara River basin and Phase II remedial investigations on 11 sites where remedial action had not been started at the time of the Niagara River Toxics Committee report.

Remedial actions are underway at a number of major sites along the Niagara River. DuPont has submitted a remedial plan for its Buffalo Avenue site which is currently under review by NYSDEC. Occidental Chemical Company has proposed a remedial plan for its Durez site which is also under review. The investigation of the 102nd Street site will be completed in 1987 with a feasibility study of remedial options to follow in 1988. At Hyde Park, construction of leachate storage and handling facilities will be completed by 1987. Remedial investigations are underway at the Occidental Chemical Company 'S-area' site and will be completed in 1987. Remedial investigations at the Occidental Buffalo Avenue plant site will likely begin in 1987. At Love Canal, the storm and sanitary sewers have been cleaned and the sediments have been collected and stored on site. Sediment excavation for creeks draining from the site are planned for 1988.

NYSDEC expanded the program developed by the Ontario MOE to monitor young-of-the-year spottail shiners to assess local sources of contaminant entry as an indicator of potential problems in game fish.

Beginning with the recommendations of the NRTC, U.S. EPA and NYSDEC have put together an action plan to address the remediation of the Niagara River area. The Niagara River action plan is a dynamic document which will be reviewed and updated annually. The major components of the action plan include, in addition to the activities outlined above:

- o Monitoring Programs - long-term ambient monitoring is being conducted by Environment Canada as part of a binational effort between the United States and Canada to estimate net contributions of chemicals to the Niagara River over time.

- o Integrated Enforcement - U.S. EPA and NYSDEC are developing data management tools and integrated enforcement strategies to deal with the unique set of problems in the Niagara River resulting from its high volume of flow, industrial diversity and its toxic chemical contamination.

In the spring of 1987, NYSDEC radically revised its approach to RAP preparation so as to include a much broader participation by the many concerned publics than was originally planned. Development of a detailed work plan for preparation of New York's Niagara River RAP was not complete at the time of this report's publication.

New York's RAP Timetable

ACTIVITY	DATE
Remedial Action Plan:	
New York commits to developing a RAP for the Niagara River.	1985

NYSDEC issues its Niagara River Implementation Plan that responds to the recommendations of the NRTC Report.	January 1985
NYSDEC revised water quality standards to include approximately 100 toxic substances.	July 1985
U.S. Army Corps of Engineers conducted contaminant mobility investigations at Times Beach confined disposal facility, including groundwater, surface water, sediment and animal and plant tissue studies.	1985–1987
Spottail shiner monitoring program performed to assess entry of toxic chemicals.	1985–1987
Develop bioaccumulation factors for toxic substances in Niagara River biota.	1986–1987
Research on contaminated sediments (radio–dating, chemistry, bioaccumulation studies, etc.).	1986–1987
Investigation of stormwater runoff from selected industrial sites.	1986–1987
Develop areawide groundwater hydrology model.	1986
Ensure that all State Pollutant Discharge Elimination System (SPDES) permits are consistent with New York State Strategy for improved control of toxic discharges.	1986
Assemble point source and ambient databases.	1986
Develop computer software packages to assist in identifying potential hot spots and to establish enforcement targets.	1986
Industrial Pretreatment: technical assistance to municipalities for enforcement.	1986
SPDES permit compliance: enhanced inspections for detected major dischargers.	1986
Binational monitoring program.	Ongoing
New York passes $1.2 billion Environmental Quality Bond Act for remediation of hazardous waste sites.	1986
'Declaration of Intent' signed by four agencies (including NYSDEC) commiting the United States and Canada to a 50% reduction in toxic substance loadings by 1996 (Niagara River Toxics Management Plan).	February 1987

Hazardous Waste Actions:

Love Canal:

Record of Decision signed which approved remediation of dioxin–contaminated sewers and creeks in the Emergency Declaration Area.	May 1985
Contractor engaged to remove contaminated sediments from storm and sanitary sewers in the Emergency Declaration Area.	Summer 1986
Sediment excavation initiated on creeks draining the Love Canal dump site.	1988

S–Area Site:

Settlement Agreement approved to allow federal and state governments to establish criteria and oversee cleanup at S–Area Site.	June 1985
Remedial investigation.	1987–1988
Containment program.	1989–1991
Monitoring program.	1989–1991

102nd St. Dump Site:

Remedial investigation of soils, groundwater and Niagara River sediments.	1985–1987
Feasibility study performed of remedial options at 102nd St. Dump Site.	1988

Hyde Park Dump Site:

Construction of leachate storage and handling facilities.	1987

Buffalo Ave. Plant Site:

Remedial investigation initiated.	1987

42. ST. LAWRENCE RIVER

Environmental Assessment

The St. Lawrence River has been identified as an Area of Concern due to degraded environmental conditions in the Cornwall/Lake St. Francis and Maitland areas in Canada and the Massena, New York area in the United States.

In Cornwall, Ontario, problems resulting from inputs of conventional contaminants such as nutrients and bacteria have been apparent for many years, however the presence of persistent contaminants has recently become a concern. Studies carried out by Ontario Ministry of the Environment (MOE) found: elevated levels of total phenols (4AAP reactive) in water (attributed to Domtar Fine Papers); elevated fecal coliform bacteria levels in the summer months; high mercury concentrations in sediments near the CIL discharge (Cornwall, Ontario); and high levels of PCBs in the north and south shore sediments. In 1983, Domtar completed modifications to its diffuser which improved the aesthetics and almost eliminated the fish tainting potential of the effluent plume.

The major concern is toxic contaminants in fish. In the Cornwall–Lake St. Francis area, Ontario MOE has advised that consumption of the larger sized recreational fish (walleye, perch, northern pike) be restricted. The commercial fishery (carp, white sucker, eel) is impaired due to present and historical discharges of mercury from CIL and Courtaulds, and PCBs from Massena, New York. CIL is presently in compliance with federal regulations for chlor–alkali plants and both sediment and sportfish mercury levels have declined significantly from 1970 to 1985.

In the Massena, New York area of the St. Lawrence River, heavy metals and toxic substances are present at sufficient levels to be of concern, and may be affecting the biota. Sampling results have indicated the presence of PCBs above acceptable limits in the water column and in sediments. Such samples have been taken periodically during the past three years in Massena area just downstream of the Reynolds Metals, General Motors and ALCOA industrial area. Lead, mercury and other hazardous wastes have also been present, but at lower levels. Various species of fish in the area are not safe for human consumption and consumption advisories have been issued. These advisories have been present for a number of years, and are continuing for the 1987 season. PAHs have also been found in relatively high concentrations downstream of Massena in river sediments.

PCB levels in sportfish from Lake St. Francis, Quebec are within Health and Welfare Canada's unrestricted consumption guideline, however, PCB levels in young–of–the–year spottail shiners exceed the Great Lakes Water Quality Agreement Objective for the protection of fish–eating birds. PCB levels exceeded the Canadian federal human consumption guideline of 2 mg/kg for sturgeon and channel catfish in 1978. These species have not been analyzed subsequently.

A study conducted by Ontario Ministry of Natural Resources (MNR) along the Cornwall waterfront in October of 1986 detected external abnormalities in the form of lip papillomas on several white suckers. The cause of these abnormalities may be natural (e.g. virus) or anthropogenic (i.e. discharge of chemical pollutants) in origin. Ontario MOE toxicity studies in 1984 found Courtauld's effluent acutely toxic to fish, however sampling near the outfalls could not confirm any instream zone of toxicity. In addition, elevated zinc levels in sediments and biota at Cornwall are attributed to discharges from Courtaulds. A control order proposed for Courtaulds will require the company to build a treatment plant to meet Ontario MOE standards for toxicity and the discharge of zinc.

Overfishing and habitat loss are responsible for the sturgeon population decline which has led to its naming as an endangered species in the United States and the closure of the commercial sturgeon fishery in Quebec in 1987.

With the exception of potential impacts on migrating fish, discharges or residual inputs from the Cornwall area do not have transboundary effects in New York waters due to the prevailing flow regime around Cornwall and the St. Regis Islands. As the St. Lawrence River flows wholely within Canada downstream of Cornwall, inputs from Massena, New York do impact Canadian waters in Lake St. Francis.

Other uses potentially impaired include swimming, boating and aesthetics. Some use impairment has been due to the excessive growth of aquatic weeds. In 1987, weed harvesting under the sponsorship of the Raisin River Conservation Authority has resumed and is expected to improve boating access.

Fecal coliform bacteria levels in the St. Lawrence River at Cornwall during 1980 and 1982 investigations exceeded the Provincial water quality objective of 100 organisms per 100 mL, however monitoring of swimming areas by the Ontario Ministry of Health has resulted in only one beach closing during recent years (August 1986). Fecal coliform bacteria densities in Domtar's pulp and paper mill effluent measured in 1980 and 1982 suggest that it is a major contributor (and speciation shows Klebsiella pneumoniae to be the dominant organism). Recent monitoring of the effluent has shown a decline in bacteria levels discharged due to operational changes. High fecal coliform bacteria densities in the vicinity of the Courtauld's BCL complex in 1982 indicate additional inputs from storm water or combined sewer overflows (CSOs). Private shoreline septic systems downstream of Cornwall are also potential sources of bacterial contamination. Upgrading of the Cornwall sewer system and sewage treatment plant (STP) expansion in 1987 will minimize the CSO problem.

In the Maitland, Ontario area (Blue Church Bay), high lead levels in some fish and sediment have been attributed to waste discharges from Dupont of Canada's tetraethyl lead (TEL) operation. Dupont produced TEL as a gasoline additive from 1965 to 1985 when the plant ceased operations. In 1985, Ontario MOE issued a fish consumption advisory in the Blue Church Bay/Maitland area based on lead levels in sportfish caught during 1983 and 1984. In 1987, this was removed due to a decline in lead levels after the plant closure. The distribution of lead in sediment in a 1984 Ontario MOE survey indicated that the TEL plant outfall had a localized impact. Comparison with Environment Canada data for the whole of the St. Lawrence River, however, shows a pattern consistent with a major input upstream of the Maitland area. The source of contaminated sediments not associated with local inputs was likely suspended particulates from Lake Ontario which were not retained by the depositional basins of that lake.

Elevated levels of HCBs, oil and grease and copper in Maitland area sediments may be associated with the continuing effluent from the Dupont monomer outfall. The need for further controls will be assessed during the RAP development process.

Ontario's RAP Development Progress

Since meeting for the first time in June 1986, a writing team made up of representatives from Environment Canada and the Ontario Ministries of Environment (MOE) and Natural Resources (MNR) has produced a status report on the Canadian environmental conditions and sources in the Cornwall–Lake St. Francis and Maitland areas of the St. Lawrence River. In addition, a public involvement program plan has

been developed. New York State and Environment Canada Quebec Region were also contacted at that time regarding their RAP development and involvement. Public involvement initiatives outside the scope of the RAP which occur in the Cornwall area are being monitored, and information collected in these forums will be utilized as input to the RAP.

In July 1986, the writing team again met to further detail writing assignments and assess progress. At the same time, the writing team felt that some initial contact with local groups to inform them about the RAP process and solicit their input would be beneficial. To that end, letters were sent out by the Ontario MOE Cornwall representative to the South Lancaster Fish and Game Club, the Mohawk Council of Akwesasne and Ducks Unlimited. In August of 1986, writing team members attended the Great Lakes United hearing in Cornwall.

In the fall of 1986 the team met on three occasions to review progress, and receive updates from Ontario MOE Kingston on activities and status of Kingston to Cornwall section of the river, and from Transport Canada and Environment Canada Quebec Region on their activities. Work was also started on a use matrix and identification of data gaps. A draft status report on environmental conditions and sources was prepared by December 1986.

Activities completed during January – March 1987 include Ontario MNR public meetings regarding fisheries management plans, and an update of the draft RAP document through several reviews and additions.

Ontario's RAP Timetable

ACTIVITY	DATE
Planning Activities:	
RAP writing team initiated RAP development.	June 1986
New York State and Environment Canada – Quebec Region contacted re RAP involvement.	June 1986
Letters sent to South Lancaster Fish and Game Club, the Mohawk Council of Akwesasne and Ducks Unlimited to solicit RAP involvement.	July 1986
Great Lakes United hearing in Cornwall attended by writing team.	August 1986
Draft background report on environmental conditions and sources prepared.	December 1986
RAP team member interviewed by local Cornwall radio station.	December 1986
Draft background report submitted to Steering Committee for review.	January 1987
Ontario MNR public meetings regarding fisheries management plan held in Cornwall.	Jan./Feb. 1987

Public involvement plan drafted and preliminary list of stakeholders identified.	June 1987
Final background report on environmental conditions and sources submitted to Steering Committee.	September 1987
Public consultation Phase I (public information).	Sept.–Dec. 1987
Goals established for environmental quality and uses to be restored based on jurisdictional objectives and public consultation.	January 1988
Preferred remedial actions identified based on cost–benefit and public consultation.	May 1988
Draft RAP prepared with use goals and remedial actions for agency and public review.	June 1988
Public review of draft RAP.	November 1988
Final RAP prepared with implementation schedule, resource commitments and a monitoring and evaluation program.	January 1989
Agency approval of final RAP and submission to IJC's Water Quality Board.	June 1989
Annual update of RAP incorporating long–term monitoring data (GLISP).	1989–1997
Remedial Action/Investigative Activities:	
Fish consumption advisory issued at Maitland on the basis of lead levels.	1985
Dupont of Canada at Maitland ceased TEL plant operations.	June 1985
Cornwall area sediment survey (Ontario MOE).	1985
Study of toxicity and impact of discharge from Courtaulds/BCL (Ontario MOE).	Summer 1985
Dupont TEL plant decommissioned.	August 1985
Dupont at Maitland sealed outfall pipes from TEL plant.	February 1986
Courtaulds/BCL instream effluent assessment report used as a support document for the Control Order for effluent discharge limits.	Early 1986
Inplace pollutants investigation at Cornwall (Ontario MOE).	Fall 1986

Electrofishing survey (Ontario MNR) along Cornwall waterfront and Maitland.	October 1986
Cornwall STP investigated as part of MISA 40 plant survey – effluent characterization.	1986/87
Control Order on effluent discharges (zinc removal and secondary treatment) from Courtaulds/BCL.	1987
Electrofishing report released by Ontario MNR.	January 1987
Hydrodynamic modelling of CIL/Domtar and Courtaulds/BCL discharges complete (Ontario MOE).	April 1987
Draft report on Cornwall sediment survey (1985) completed (Ontario MOE).	April 1987
Report finalized on 1984 sediment survey at Maitland (Ontario MOE).	April 1987
Fish consumption advisory based on lead levels lifted for Maitland/Blue Church Bay area.	May 1987
Cornwall STP expansion and sewer upgrading completed.	Summer 1987
Community of Glen Walter put on new municipal water treatment system.	Summer 1987
Sport fish collection at Maitland/Blue Church Bay.	Summer 1987
Resumption of weed harvesting program on Lake St. Francis.	Summer 1987
MISA organic chemical regulations in effect for Cornwall Chemicals, Courtaulds/BCL.	1988
MISA pulp and paper regulations in effect for Domtar Fine Papers in Cornwall (may require secondary treatment).	1989
Courtaulds to meet proposed controls for pH and zinc.	1989
MISA STP regulations in effect for Cornwall STP.	1989
Courtaulds to meet effluent toxicity requirement.	1992

New York's RAP Development Progress

In the spring of 1987, New York State Department of Environmental Conservation (NYSDEC) radically revised its approach to RAP preparation so as to provide for a much broader participation by the many concerned publics than was originally planned. Development of a detailed work plan for preparation of the St. Lawrence River RAP was not complete as of publication of this report. A consulting firm hired by U.S. EPA will assist NYSDEC in preparing its St. Lawrence River RAP.

In the State of New York, solid and hazardous waste sites have been identified in the Massena area in connection with three industries: Reynolds Metals, General Motors and ALCOA. Reynolds Metals has two sites on the inactive hazardous waste list. The two are the plant's main landfill and their existing black mud lagoon. NYSDEC is negotiating a Consent Order to do a remedial investigation and feasibility study but negotiations continue to drag on. In the meantime, Reynolds is undertaking some remedial work on its own.

A full-scale federal $1.2 million Superfund investigation at General Motors (GM) is nearing completion. Central Foundry signed an agreement with U.S. EPA to investigate essentially all their property with respect to hazardous waste, particularly PCBs. To date, all samples in the St. Lawrence River, all soil samples, and all waste sampling have been completed. Twenty-five groundwater monitoring wells have been installed. Samples have also been analyzed from residential wells including the Freedom School on the reservation. Initial samples showed the presence of PCB trace levels. A second round of testing did not substantiate initial findings. GM is presently supplying drinking water to households and the school. High levels of PCBs have been found in water column and sediment samples in the St. Lawrence River offshore from General Motors. It has been estimated that approximately 17,600 m^3 (23,000 cubic yards) of sediment in the St. Lawrence River downstream of the GM plant are in excess of 50 mg/kg PCBs. The draft feasibility investigation report confirms a contaminant plume of considerable proportion migrating from the industrial landfill to the St. Lawrence River. Therefore, GM has been requested to immediately stop using the site and cap it to minimize leaching. This is only an interim action. Additional remedial measures will be required following completion of the feasibility studies and remedial investigations (reports have been submitted in draft form). Remediation is expected to begin in 1987.

ALCOA has at least five separate sites listed on the inactive hazardous waste list. The number may be larger depending on how boundaries are drawn around the individual sites. ALCOA signed a Consent Order to perform a Remedial Investigation and Feasibility Study, which has been completed. Investigative sampling and submission of a plan were to be completed by October 1987. Site remediation is expected to begin in 1987.

<u>New York's RAP Activities on Hazardous Waste Sites</u>

Reynolds Metals: (proposed schedule)

Complete work plan and submit to NYSDEC.	July 1987
Approval of work plan.	August 1987
Field work for remedial investigation includes: - well installation. - surface water sampling. - sediment sampling.	August–October 1987
Draft remedial investigation submitted with work plan for Remedial Investigation and Feasibility Study.	March 1988
Feasibility study field work.	Spring/Summer 1988
Remedial Investigation and Feasibility Study.	July 1988

Implementation of Remedial Investigation and Feasibility Study.	Fall 1988

ALCOA

Remedial investigation submitted.	March 1987
Comments from NYSDEC re: Remedial investigation sent to ALCOA; further field work required.	June 1987
*Feasibility study complete.	February 1988
*Design phase.	Mar./88 – Mar./89
*Construction.	Spring 1989

* These activities are a proposed schedule and could change depending on amount of work needed to complete remedial investigation report.

General Motors Superfund

Preliminary remedial investigation report.	1986
**Final field work for remedial investigation report.	Summer 1987
Temporary cap installed.	mid–1987 – early 1988
**Feasibility study.	early 1988 – [early 1989]
Cleanup schedule.	mid–1988 [mid–1989]
Cleanup initiated.	late 1988 [late 1989]

** Could require up to two years for Remedial Investigation and Feasibility Study if a health risk assessment study is implemented into the remedial investigation; other dates would be delayed accordingly.

ANNEX 1

AREAS OF CONCERN IN THE GREAT LAKES BASIN

RAP COORDINATORS

1.	PENINSULA HARBOUR	Patricia Inch	OMOE, Thunder Bay	(807) 475–1315
2.	JACKFISH BAY	Jim Murphy	OMOE, Thunder Bay	(807) 475–1315
3.	NIPIGON BAY	Jake VanderWal	OMOE, Thunder Bay	(807) 475–1215
4.	THUNDER BAY	Jake VanderWal	OMOE, Thunder Bay	(807) 475–1215
5.	ST. LOUIS RIVER	Marvin Hora	MWPCA, Roseville	(612) 296–7215
6.	TORCH LAKE	Elwin Evans	MDNR, Lansing	(517) 335–4182
7.	DEER LAKE–CARP CREEK–CARP RIVER	Elwin Evans	MDNR, Lansing	(517) 335–4182
8.	MANISTIQUE RIVER	Brenda Sayles	MDNR, Lansing	(517) 335–4198
9.	MENOMINEE RIVER	Rick Lundgren Steve Skavroneck	MDNR, Lansing WDNR, Madison	(517) 335–3313 (608) 267–9352
10.	FOX RIVER/ GREEN BAY	Lynn Persson	WDNR, Madison	(608) 266–9267
11.	SHEBOYGAN HARBOR	Steve Skavroneck	WDNR, Madison	(608) 267–9352
12.	MILWAUKEE HARBOR	Steve Skavroneck	WDNR, Madison	(608) 267–9352
13.	WAUKEGAN HARBOR	Jim Park	IL EPA, Springfield	(217) 782–3362
14.	GRAND CALUMET/ INDIANA HARBOR	Robert Hilton	IN DEM, Indianapolis	(317) 232–8568
15.	KALAMAZOO RIVER	William Creal	MDNR, Lansing	(517) 335–4181
16.	MUSKEGON RIVER	John Wuycheck	MDNR, Lansing	(517) 335–4195
17.	WHITE LAKE	John Wuycheck	MDNR, Lansing	(517) 335–4195
18.	SAGINAW RIVER/ SAGINAW BAY	Greg Goudy	MDNR, Lansing	(517) 335–3310
19.	COLLINGWOOD HARBOUR	Katharine Simpson	OMOE, Toronto	(416) 323–4948
20.	PENETANG BAY TO STURGEON BAY	Keith Sherman	OMOE, Toronto	(416) 323–4956
21.	SPANISH RIVER	Art Roy	OMOE, Sudbury	(705) 675–4501
22.	CLINTON RIVER	Dave Kenaga	MDNR, Lansing	(517) 335–4314
23.	ROUGE RIVER	Jim Bredin	MDNR, Lansing	(517) 335–4140
24.	RIVER RAISIN	Scott Cornelius	MDNR, Lansing	(517) 335–4200
25.	MAUMEE RIVER	Julie Letterhos	OH EPA, Columbus	(614) 466–7029
26.	BLACK RIVER	Julie Letterhos	OH EPA, Columbus	(614) 466–7029
27.	CUYAHOGA RIVER	Julie Letterhos	OH EPA, Columbus	(614) 466–7029
28.	ASHTABULA RIVER	Julie Letterhos	OH EPA, Columbus	(614) 466–7029
29.	WHEATLEY HARBOUR	Doug Huber	OMOE, London	(519) 661–2200
30.	BUFFALO RIVER	Robert Collin	NYSDEC, Albany	(518) 457–0669
31.	EIGHTEEN MILE CREEK	Robert Collin	NYSDEC, Albany	(518) 457–0669
32.	ROCHESTER EMBAYMENT	Robert Collin	NYSDEC, Albany	(518) 457–0669
33.	OSWEGO RIVER	Robert Collin	NYSDEC, Albany	(518) 457–0669
34.	BAY OF QUINTE	Murray German	OMOE, Kingston	(613) 549–4000
35.	PORT HOPE	Robert Krauel	Env Canada	(416) 973–5858
36.	TORONTO WATERFRONT	Marta Griffiths	OMOE, Toronto	(416) 323–4955
37.	HAMILTON HARBOUR	Keith Rodgers	CCIW, Burlington	(416) 336–4888
38.	ST. MARYS RIVER	Wayne Wager Diana Klemans	OMOE, Sarnia MDNR, Lansing	(519) 336–4030 (517) 373–2758
39.	ST. CLAIR RIVER	Dean Edwardson Diana Klemans	OMOE, Sarnia MDNR, Lansing	(519) 336–4030 (517) 373–2758
40.	DETROIT RIVER	Dean Edwardson Dave Kenaga	OMOE, Sarnia MDNR, Lansing	(519) 336–4030 (517) 335–4314
41.	NIAGARA RIVER	Jaak Viirland Robert Collin	OMOE, Hamilton NYSDEC, Albany	(416) 521–7720 (518) 457–0669
42.	ST. LAWRENCE RIVER	John Marsden Robert Collin	Env Canada NYSDEC, Albany	(416) 973–1062 (518) 457–0669

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GLOSSARY

MEASUREMENTS UNITS

m	metre	1 m = 3.281 feet
ha	hectare	1 ha = 2.471 acres
km	kilometre	1 km = 0.621 mi
km^2	square kilometre	1 km^2 = 0.386 mi^2
mg/kg	milligram per kilogram	part per million
µg/kg	microgram per kilogram	part per billion
ng/kg	nanogram per kilogram	part per trillion
µg/L	microgram per liter	
L/d	liter per day	
m^3/d	cubic metres per day	
kg/a	kilograms per year	
t/a	tonnes per year	
µS/cm	microsiemens per centimetre	

CHEMICAL ACRONYMS

BOD	Biological Oxygen Demand: the amount of oxygen required for aerobic bacteria to oxidize completely the organic decomposable matter in water within a specified time and at a given temperature – an index to the degree of organic pollution in the water.
COD	Chemical Oxygen Demand: the amount of oxygen required to oxidize completely the inorganic oxidizable compounds present.
DDT	Dichlorodiphenyltrichloroethane
HCB	Hexachlorobenzene
PAH	Polynuclear aromatic hydrocarbons
TKN	Total Kjeldahl Nitrogen: the sum of the nitrogen contained in the free ammonia and other nitrogen compounds which are converted to ammonium sulfate under specified digestion conditions.
2,3,7,8–TCDD	2,3,7,8–tetrachlorodibenzo–p–dioxin
2,3,7,8–TCDF	2,3,7,8–tetrachlorodibenzofuran

OTHER TERMINOLOGY

CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Responses, Compensation and Liability Act
COA	Canada–Ontario Agreement
CSO	Combined Sewer Overflows
DFO	Department of Fisheries and Oceans
FDA	Food and Drug Administration
FWPCA	Federal Water Pollution Control Act
FWS	Fish and Wildlife Service
GLNPO	Great Lakes National Program Office
IDEM	Indiana Department of Environmental Management
ISBH	Indiana State Board of Health
LLRS	Large Lakes Research Station
MDNR	Michigan Department of Natural Resources
MDPH	Michigan Department of Public Health
MISA	Municipal Industrial Strategy for Abatement
MMSD	Milwaukee Metropolitan Sewerage District
MPCA	Minnesota Pollution Control Agency
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NYSDEC	New York State Department of Environmental Conservation
OMAF	Ontario Ministry of Agriculture and Food
OMNR	Ontario Ministry of Natural Resources
OMOE	Ontario Ministry of the Environment
RCRA	Resource Conservation and Recovery Act
SPDES	State Pollutant Dischage Elimination System
STORET	U.S. EPA computerized data base for the STOrage and RETrieval of data relating to the quality of waterways within and contiguous to the United States
TSCA	Toxic Substance Control Act
U.S. EPA	United States Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System
WWTP	Wastewater Treatment Plant

International Joint Commission
Commission mixte internationale

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