Department of Environmental Conservation

ST. LAWRENCE RIVER AT MASSENA REMEDIAL ACTION PLAN

—STAGE I—

November, 1990

ST. LAWRENCE RIVER REMEDIAL ACTION PLAN
MASSENA, NEW YORK

New York State Department of Environmental Conservation
MARIO M. CUOMO, *Governor* THOMAS C. JORLING, *Commissioner*

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I. Introduction

A. Background

In the Great Lakes basin, the International Joint Commission (IJC) has identified 42 Areas of Concern (AOC) where persistent toxic substances are impairing uses. The St. Lawrence River near Massena, NY is one of these AOCs.

The 1987 amendments to the United States-Canada Great Lakes Water Quality Agreement (GLWQA) called for Remedial Action Plans (RAPs) to be developed by the governments that make recommendations for cleanup of pollution problems in the AOCs.

Annex 2 of the GLWQA specifies requirements for developing Remedial Action Plans (RAPs) for Areas of Concern. As a guide for analyzing the problems in the AOC, the Annex provides a list of 14 indicators of use impairment. If any one of the indicators is found to exist or if other use impairments are identified in the AOC, causes and sources are listed and remedial actions are recommended to restore the impaired use.

A RAP embodies an aquatic ecosystem approach to restoring and protecting the biota and water quality in the AOC. Correction of these problems in the AOC will contribute to overall improvement of environmental conditions in the river and in the Great Lakes system.

The RAP defines problems and their causes, identifies sources of pollutants or disturbances, makes recommendations and commitments to remedial actions, and establishes a post remedial monitoring system.

Stage I contains the problem and source identification portions of the plan. Following the Introduction, Chapter 2 describes the setting of the AOC; Chapter 3 contains the RAP goal and the process by which the RAP was developed; Chapter 4 analyzes the existence of use impairments in the AOC; Chapter 5 identifies potential sources of pollutants, and Chapter 6 describes the public participation in the process thus far.

Stage II will contain a strategy for restoring impaired uses in the AOC. It will contain recommendations for remedial actions, commitments by agencies for short and long-term actions, and a plan for monitoring and evaluating the effects of the remedial actions.

The Massena area of the St. Lawrence River was originally listed as an AOC because of elevated levels of heavy metals in sediments near the mouth of the Grasse River, PCBs in spottail shiners in the same area, and heavy metals and PCBs in water samples collected in the lower Grasse, Raquette, and St. Regis Rivers.

B. RAP Development

The New York State Department of Environmental Conservation (NYSDEC) is the lead agency for developing and implementing the Massena RAP. Figure I-1 depicts the basic government/citizen management structure used to develop the RAP.

NYSDEC has established a Citizen Advisory Committee (CAC) as its primary means for the public to participate in the RAP process. The committee has participated in establishing goals for the RAP, assembling and evaluating data about the river, and in writing the chapters of the RAP.

Public participation in the RAP process does not end with the committee. Working with the CAC, NYSDEC has also developed materials and planned events such as public meetings and technical workshops to reach out to the community with information about the RAP, and to encourage others to get involved in the process. The objective is to build a support base for the implementation of the RAP.

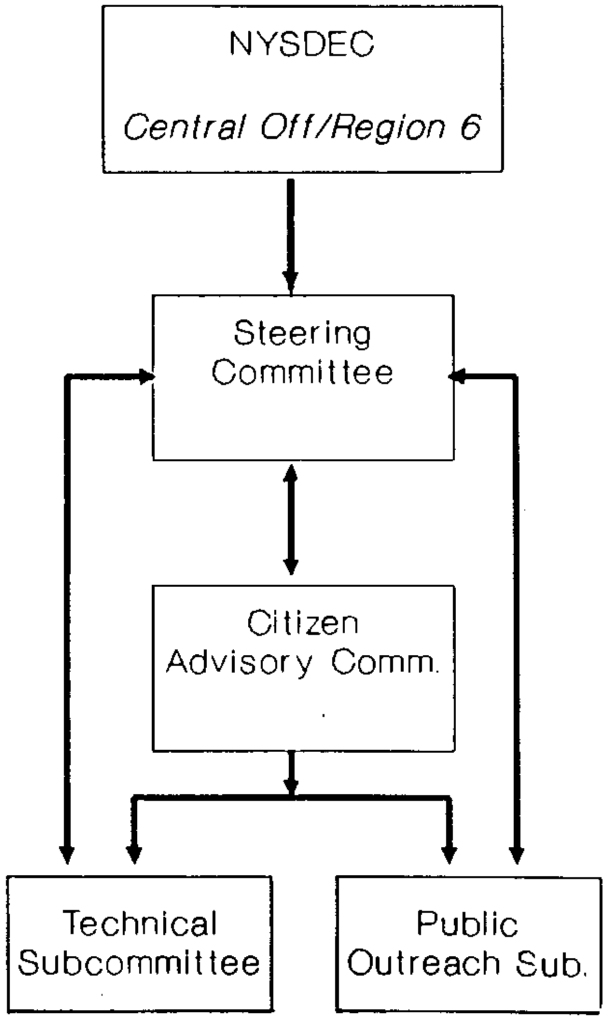

Figure I-1. RAP Management Structure

NYSDEC also worked with the Provinces of Ontario, Quebec and with the Mohawks at Akwesasne throughout the process. The governments and some citizens of these jurisdictions have contributed to joint statements of goals and problems, shared information needed to complete the RAP, and reviewed and commented on drafts of the document.

C. Intended Use of the RAP

The RAP will be a basis for determining priorities for the cleanup of the Massena AOC. It will outline a strategy for correcting the environmental problems and provide program managers with a basis for justifying resource commitments for implementing remedial actions.

The RAP is not intended to be a static document. Revisions are planned to effect changes in the information on which it is based. The update process will consist of review and revision by NYSDEC staff and members of the public. NYSDEC is developing a statewide policy describing the implementation and updating processes.

Other state agencies and local governments may also use the RAP as a guide for setting water quality and land use policies and for setting local cleanup priorities. Other agencies and private groups can make commitments in the Stage II portion of the RAP, assuming responsibility for particular remedial actions.

This document is the result of the cooperative efforts of many people, agencies, and governments. The recommendations contained within are tempered by NYSDEC's scope of responsibility as defined by the New York State Environmental Conservation Law and by the GLWQA intended scope of the RAPs. Dissenting opinions of those involved in the RAP development process have been included and identified as such.

II. Setting

A. Introduction

Background information on the AOC is important to the context of RAP development. The scope of the RAP, environmental, and institutional settings are considered in this chapter, including physical and socio-economic characteristics, past and present water quality, and current regulatory programs that address water quality problems in the St. Lawrence River and its sub-basins.

B. Scope

The scope of the RAP is bounded geographically, temporally, and jurisdictionally. These parameters play an important role in defining the problems and in proposing realistic remedial actions in the area. This report is therefore limited by the area defined as the Area of Concern, by the data available for that defined area, and by the time frame for which it is developed.

1. Geographic Scope

The Massena RAP addresses two areas that are of interest for New York State. The first is New York State's waters which includes the New York portion of the St. Lawrence River upstream of the Canadian boundary to the Massena public water supply intake, the Grasse River from the mouth upstream to the first dam, the Raquette River from the mouth upstream to the NYS route 420 bridge, and the St. Regis River from the mouth upstream to the dam at Hogansburg (Figure II-1). This is called the Massena Area of Concern (AOC) and has been used to test the fourteen GLWQA indicators to determine impairments to beneficial use of these waters.

The second area of special interest includes the non-U.S. waters from the Moses-Saunders Power Dam to the eastern outlet of Lake St. Francis (Figure II-2). This

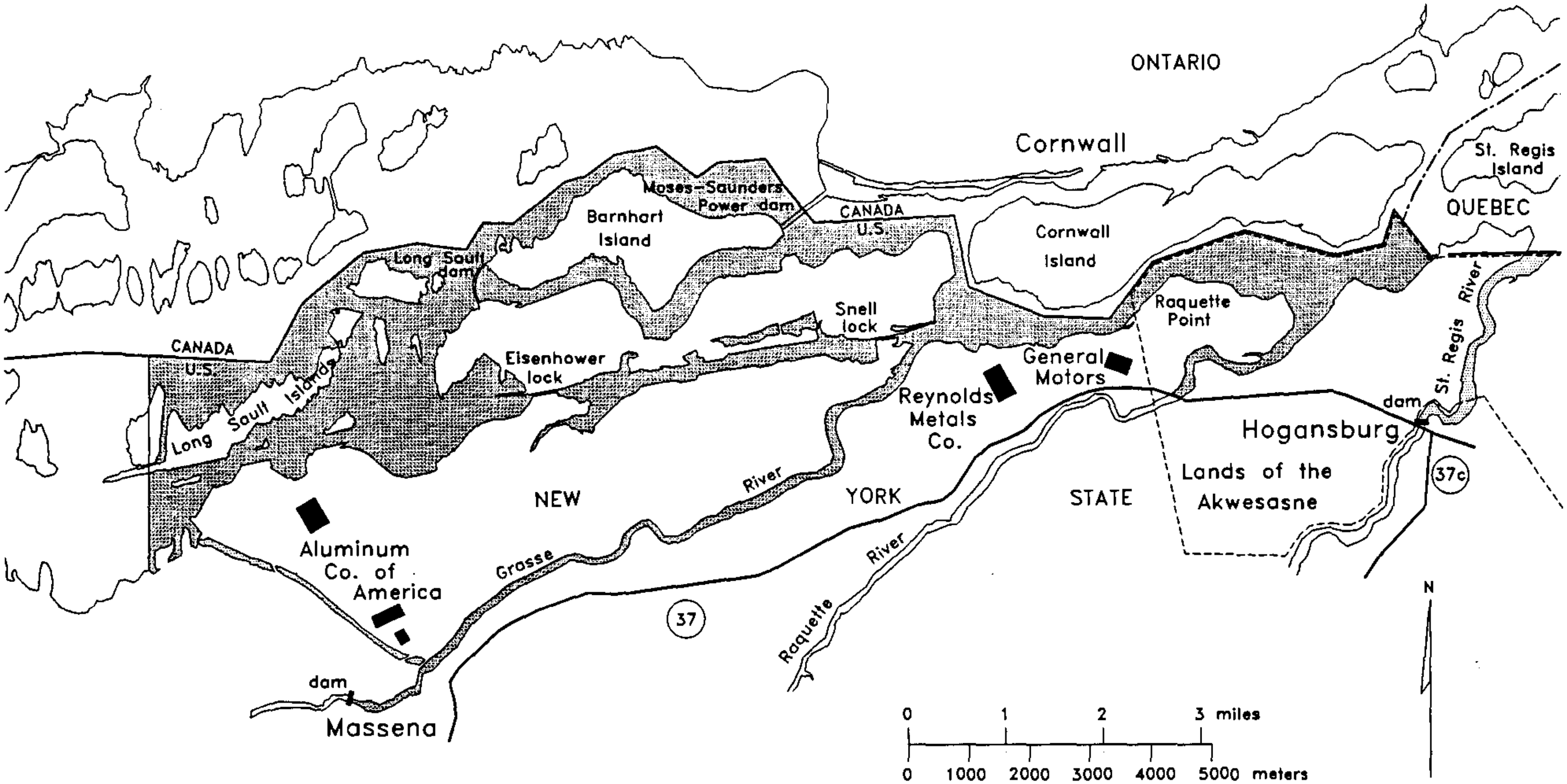

Figure II-1. The Massena Area of Concern

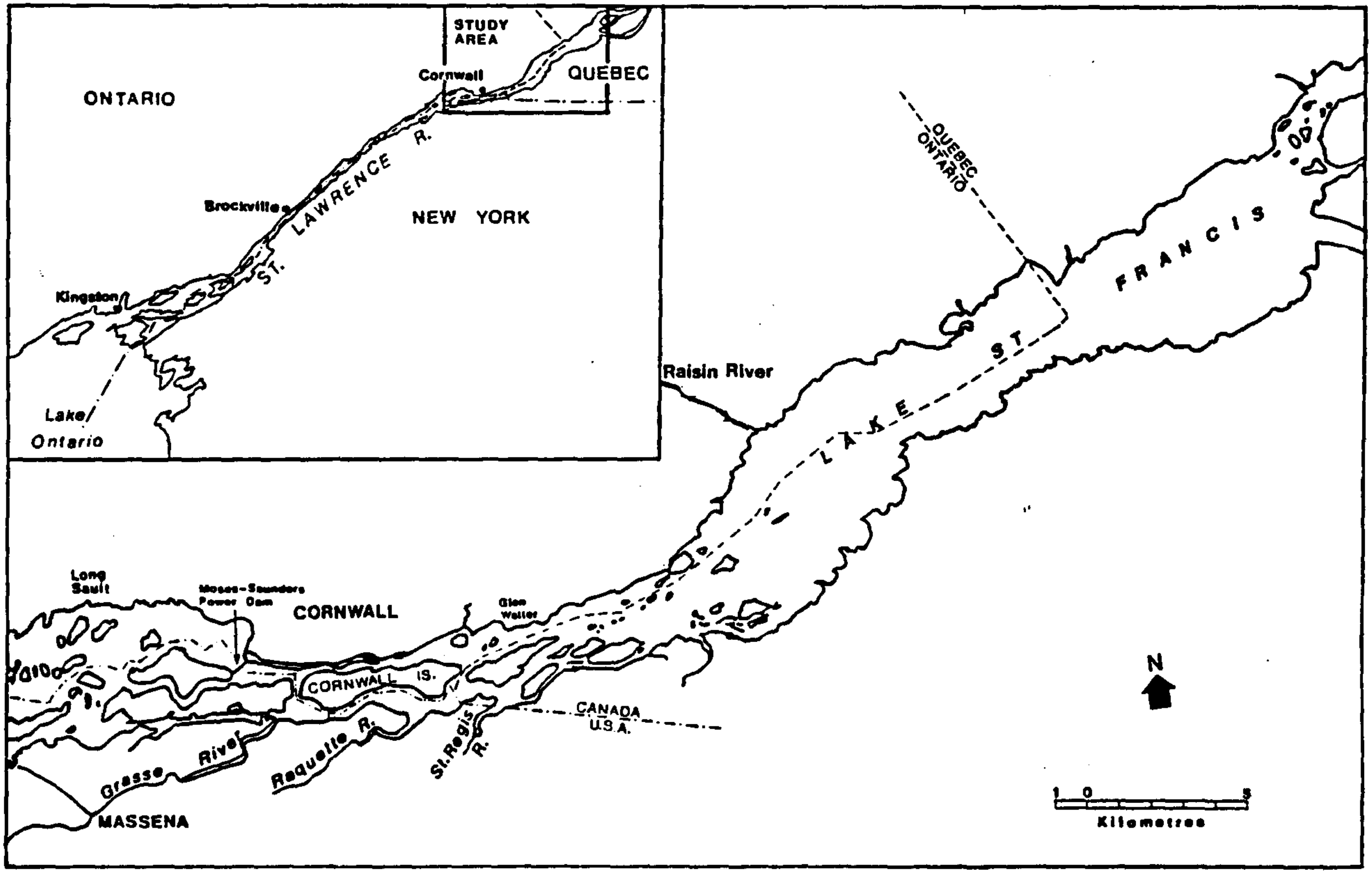

Figure II-2. The approximate geographic scope of the impacted area

area has been studied by Canadian jurisdictions to define impairments in downstream and cross-channel waters attributable to pollutants from the Cornwall area and those flowing out of the Massena AOC. The sources of the pollutants leaving the Massena AOC boundaries and potentially causing downstream or cross-channel impairments are identified. The sources of pollutants in the Massena AOC will be the subject of recommended remediation in the Stage II RAP.

The geographic scope of the plan does not include consideration of inputs from the St. Lawrence River upstream of Massena except in general terms. Some of these inputs may have an impact on the Massena AOC and will be identified as sources where possible. However, upstream conditions must be addressed in more broadly based lakewide and river management plans.

2. Time Frame

Data and information concerning the problem definition phase of the RAP were compiled and evaluated from all available sources. Priority was given to more recent data on sources and impacts in determining causes and problems in the Massena AOC. Data from 1987 to 1990 were generally used for describing current conditions. Occasionally, data from earlier years are cited for purposes of documenting contaminants of concern and their potential impacts if more recent data were not available.

Data that could be used in describing details of certain aspects of the problem definition phase of the RAP are still being collected. It should be recognized that whatever time frame is used, the RAP represents a snapshot of conditions in the Massena AOC using data available at that time. Updates of information will be necessary in order to keep the RAP current and to document changing conditions in the Massena AOC due to remedial efforts.

C. Environmental Setting

1. The St. Lawrence River Watershed

The St. Lawrence River is the connecting river system between the Great Lakes and the Atlantic Ocean. It is 870 miles long (1400 km), and in addition to draining the Great Lakes Basin, it drains major portions of the provinces of Quebec and Ontario and northern New York State. The St. Lawrence River's average flow in the Massena area is 245,000 cubic feet per second (cfs) (6030 cubic meters per second), with a recorded maximum flow of 352,000 cfs (9961 cms), and a recorded minimum of 139,000 cfs (3934 cms). By the time the river has passed through Quebec, its flow has nearly doubled. At that point it is one of the largest rivers in the world.

There are four dams on the St. Lawrence River in the Massena area. They include Long Sault Dam, Iroquois Dam, the Massena intake dam and the Moses-Saunders Power Dam. The Moses-Saunders Power Dam, owned and operated jointly by New York Power Authority and Ontario Hydro, generates electricity for New York, Vermont, New Hampshire, and Canada. It is located at the northeast end of Barnhart Island. On the southwest point of Barnhart Island, the Long Sault Dam diverts water from the main channel of the river to the power dam. Long Sault Dam also serves to pass excess flows during high water conditions. The Iroquois Dam is located 25 miles (40 km) upstream of Long Sault Dam near Rockway Point, New York and controls water flow into the lower St. Lawrence River. The Massena intake dam, due north of the village of Massena, prevents water from flowing down the old power canal and houses the water intake for the village. The power canal generated electricity in a powerhouse at the lower end of the canal which emptied into the Grasse River prior to the construction of the power dam. Presently, the power canal is a still waterbody with dams on either end.

Downstream of the Massena AOC, the river is regulated by the Beauharnois Dam near Montreal. The impounded water behind this dam is considered Lake St.

Francis. Water levels in the St. Lawrence River are regulated for navigation, hydroelectric power generation, and flood control (DOE, OMOE, OMNR, 1988).

2. The Massena AOC Sub-basins

Ninety-five percent of the flow of the St. Lawrence River comes from the Great Lakes. The rest is contributed by tributaries in the United States and Canada, downstream of the Lake Ontario outlet. Tributaries in the Massena AOC include the St. Regis, Raquette, and Grasse Rivers. Other major tributaries to the St. Lawrence River in New York State include the Oswegatchie, the Salmon, and the Chateugay Rivers (Figure II-3).

The Grasse River has a watershed which covers 608 square miles (1574 km2). It flows through the Village of Massena toward the St. Lawrence in a northeasterly direction. There is currently no flow gauging station on the Grasse River. However, the estimated average flow is 1100 cfs (31 cms). The Raquette River roughly parallels the Grasse River to the east. Its watershed is 1257 square miles (3257 km2). Flow records at the Town of Piercefield indicate an average flow of 1306 cfs (37 cms). Average flow at the mouth is estimated to be 1500 cfs (44 cms). The St. Regis River is similar in watershed area and flow. It covers 842 square miles (2180 km2) and has an estimated average flow of 1400 cfs (41 cms), at its mouth.

3. Current Water Quality Conditions

Water quality monitoring was conducted by Canadian agencies in 1988 at two St. Lawrence River stations approximately 100 meters below the Moses-Saunders Power Dam (OMOE, 1988). The average total PCB from 13 samples taken at the two stations was 1.27 ppt. One sample had a value of 3.55 ppt . The rest of the samples ranged in value from 0.56 to 1.55 ppt total PCB. All samples were above the New York State ambient water quality standard of 1.0 ppt for total PCB. Samples collected from the Grasse River in the AOC have also shown total PCB levels above 1 ppt (DOE, 1989).

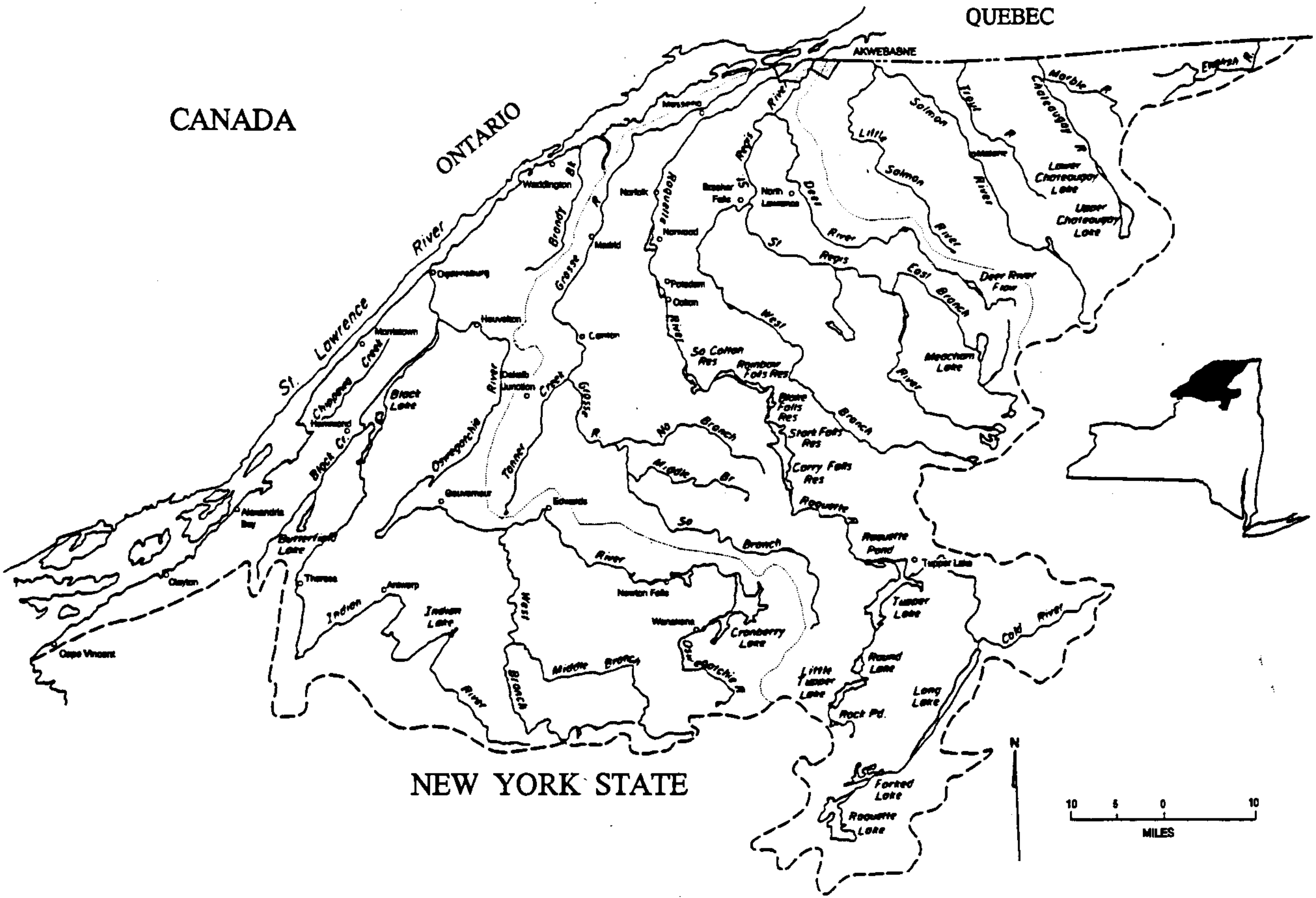

Figure II-3. The St. Lawrence River drainage basin (dashed line) and Massena AOC sub-basins (dotted line) in New York State

The Massena Village water supply meets all New York State standards for drinking water. The Massena water intake is located in Lake St. Lawrence above the Moses-Saunders Power Dam and, therefore, is at the upstream end of the Massena AOC. Analysis of raw intake water and treated tap water samples in 1988 indicate no detections of 20 organochlorine pesticides or PCB arochlors 1221, 1016, 1242, 1248, 1254, or 1260 (NYSDOH 1989). Detection limits for PCBs was 0.005 μg/l (ppb) and ranged from 0.01 to 0.5 μg/l (ppb) for the pesticides.

The St. Regis and Mohawk water supply system is at the downstream area of the Massena AOC. PCBs have been occasionally detected in the raw water intake, but not in the treated drinking water. PCBs have also been found in solids in the treatment facility backwash (Mohawks at Akwesasne, 1989).

There have been occasional exceedences of New York State water quality standards for heavy metals in both the St. Lawrence and Grasse Rivers. The 1986 New York State sampling showed exceedences for zinc in the St. Lawrence River and for cadmium in the Grasse River.

Barnhart Island State Park beach, located in the Massena AOC, is upstream of the power dam. The Massena Town Beach is located just upstream of the Massena AOC on the St. Lawrence River. There have been no reports of bacterial contamination at either site.

4. Aquatic Biota and Wildlife

The Massena AOC and parts of the river adjacent to it provide habitat and spawning grounds for many species of aquatic organisms. Game fish include northern pike, eel, yellow perch, walleye, muskellunge, grass pickerel, pumpkinseed, white bass, brown bullhead, smallmouth bass, carp, and rainbow smelt. Non-game species include alewife, troutperch, gizzard shad, brook stickleback, johnny darter, and spottail shiners. Lake sturgeon, lake trout, rainbow trout, and salmon are occasionally reported by anglers.

Riverine marsh areas provide habitat for other species including waterfowl, gulls, herons, cormorants, furbearers, and crustaceans. Plant species include cattails and bulrushes, and cladophora.

Recently an exotic species of mollusc, the zebra mussel (Dreissena polymorpha) was found during the 1990 winter maintenance of the Snell and Eisenhower locks in the Massena AOC (NYPA 1990). It was introduced into the Great Lakes from Europe, presumably by discharge of bilge water from ocean going vessels. Previously unknown to the St. Lawrence River, they have already spread rapidly in Lake Erie.

5. Habitat and Available Cover

Recent surveys of the international section of the St. Lawrence River indicate that the rocky shoreline sites in Lake St. Lawrence provide ideal warm water fish spawning areas, but that aquatic macrophyte growth and invertebrate populations are small or absent (Patch and Busch 1986). Sampling stations between the locks had the smallest invertebrate populations and virtually no aquatic macrophyte growth. Human intervention and natural processes in the St. Lawrence River section of the Massena AOC make it difficult for many aquatic plant species to survive. Dredging, water level changes, lock operations, bathymetry and hydrology make for unproductive conditions for macrophytes.

Several programs and projects have identified areas of significant habitat in the Massena AOC and sub-basins. The NYSDEC lists several areas around Massena in their Significant Habitat inventory (Table II-1). In general, the area around the St. Lawrence River provides for important wintering, nesting, and feeding areas for waterfowl and some raptors. The prime area for these species is the Wilson Hill Wildlife Management Area, just upstream of the Massena AOC. The AOC is also in a major flight path for raptors, waterfowl, and passerines during migrations. Long Sault Island is noted as a nesting area for terns. The only habitat for a fish species listed in the area is for the Lake Sturgeon. The waters below the Moses-

Table II-1 . AOC and sub-basin significant habitats, species of concern and status. 1.

Category	Species	Location	Comments
1. Signif. Habitat	Waterfowl	Cornwall to Wilson Hill Wildlife Mgt. Area	Wintering area
2. "	Raptors	Wilson Hill WMA	Nesting area
3. "	Osprey	Coles Creek	Feeding area
4. "	Lake Sturgeon	Moses-Saunders Dam (tailwaters)	Preferred habitat
5. "	Terns	Long Sault Island (northeast)	Nesting area
6. Endangered Species	Bald Eagle, Golden Eagle, Peregrine Falcon	AOC, Power Dam, and vicinity	Migration route spring and fall. Bald eagle reported at Power Dam in winter.
7. Threatened Species	Blandings Turtle	AOC and vicinity	Probable
8. "	Osprey, Red-shouldered hawk, Northern Harrier, Common Tern	"	Migration route
9. Species of Concern	Common Loon, Least Bittern, Eastern Bluebird, Henslow's Sparrow, Sedge Wren, Black Terns (?)	"	Breeders
10. "	Coopers Hawk, Vesper Sparrow	"	Migration route
11. Heritage Information	Lake Sturgeon	St. Lawr. River (USGS Massena Quad.)	2.
12. "	Fringed Gentian	Bank of St. Lawr. River (USGS Raq. River Quad.)	"
13. "	Lake Cress, Labrador Violet, Slender Bullrush	St. Lawr. River (USGS Louisville Quad.)	"

1. NYSDEC 1989. Pers. Comm., R.D. Faulknham, Reg. 6, Watertown, NY.
2. NYSDEC/Nature Conservancy inventory of known or probable occurrences of rare plants and animals.

Saunders Power Dam are known to harbor this species. Of note however, is that the islands near Massena are probably more important feeding, nesting, and breeding areas for other fish and shorebird species than the inventory data would suggest. The lake sturgeon and several species of rare plants which may exist in the Massena area are also listed in the NYSDEC and Nature Conservancy cooperative inventory program.

New York State lists several species of birds that use the Massena vicinity that are considered endangered. They include the bald eagle, the golden eagle, and the peregrine falcon. The area is primarily a stopping point in the migration route, but the bald eagle has been sited in winter at the power dam. The osprey, red-shouldered hawk, northern harrier, and common tern also inhabit the area and are considered threatened. The Blanding's turtle is the only threatened reptile species that may exist in the Massena AOC, but no individuals have yet been found. In total, 21 different species are listed as inhabiting or using the Massena area that are considered rare, or are thought to be endangered, threatened, or of concern relative to New York State criteria (NYSDEC, 1989).

D. Land and Water Use

Tourism and recreation are major uses of Massena and the surrounding areas. Attractions near Massena include Eisenhower Lock, the Moses-Saunders Power Dam, Robert Moses State Park, and the Akwesasne St. Regis Mohawk Reservation. The Seaway Trail, a nationally designated recreation trail, parallels the St. Lawrence River including that portion within the Massena AOC. Massena is also considered a gateway both to the Adirondack mountain region and Canada. Water related recreational uses include fishing, boating, sailing, and swimming. The river and associated impoundments provide an excellent cool water fishery. The lands adjacent to the Massena AOC are also used for picnicking, bike riding, and passive recreation. Trapping and waterfowl hunting are also popular uses of the shoreline and upland areas. Future plans for the area include an Aquarium/Ecological Center at Robinson Bay on the St. Lawrence River, and a major regional shopping mall. These projects will increase tourism. The Ecological Center will also be a major environmental education center for the surrounding area.

Table II-2 outlines land use and cover types in the three AOC sub-basins. Current estimates are not available, but land use patterns today are most likely similar to those outlined (USDA, 1975). Woodland makes up the largest proportion of the area of the Massena AOC sub-basins. Agriculture acreage is the next largest size area of the watersheds. Most agriculture is dairy related. Only one percent of the watersheds are attributed to developed "urban" areas. The largest urban area is located within the Massena AOC in the Grasse River sub-basin.

The New York Power Authority (NYPA) owns much of the land along the banks of the St. Lawrence River as required under the construction license. Historically, this has limited development along the river, which has indirectly resulted in areas that attract wildlife (St. Lawrence County Planning Board 1987).

In 1986, NYPA announced that approximately 5100 acres (2040 ha) of land underutilized for project operation, would be returned to private ownership. Development recommendations were made by the St. Lawrence County Planning Board for these parcels. An interagency task force consisting of representatives from the NY Power Authority, the Department of State, the New York State Department of Environmental Conservation, the New York State Office of Parks, Recreation, and Historic Preservation, the St. Lawrence-Eastern Ontario Commission, and the St. Lawrence County Planning Department was formed to review the proposals that were submitted for the use of these lands.

The Massena AOC has three industrial plants that provide a large economic base for the area. The Aluminum Company of America (ALCOA) employs approximately 1500 people. Reynolds Metals Company (760 employees) and General Motors Central Foundry (285 employees) also operate plants in the Massena AOC. The three large industrial plants use large quantities of water in their processes. Some water is recirculated for use. Waste water is treated by various processes before being discharged.

Table II-2. Land use summary for the St. Lawrence (Massena) River AOC sub-basins and percent total.

Use/Cover Type	Grasse River	Raquette River	St. Regis River
Cropland	55,053 acres 10%	26,175 acres 3%	31,345 acres 6%
Orchard, pasture, and former cropland	46,732 acres 8%	26,620 acres 3%	20,113 acres 4%
Woodland	369,160 acres 67%	656,892 acres 81%	429,731 acres 82%
Urban land	4,829 acres 1%	7,685 acres 1%	2,318 acres 1%
Non-sediment producing land	65,582 acres 12%	101,835 acres 12%	38,365 acres 7%
Other land	6,191 acres 1%	3,088 acres 1%	3,018 acres 1%
Total Area	547,547 acres (219,019 ha)	852,295 acres (340,918 ha)	524,890 acres (209,956 ha)

Source: USDA 1975.

In 1988, over 40 million cargo tonnes were shipped through the Montreal-Lake Ontario section of the Seaway in 3142 vessel transits. Though the number of transits were down 2.6%, tonnage had increased 1.5% from the previous year. Total revenues were over $37 million. Commodities shipped included: agricultural products 15,545,348 tonnes; mine products 16,200,120 tonnes; process products 8,688,490 tonnes; forest products 30,228 tonnes; animal products 73,483 tonnes (St. Lawrence Seaway Authority 1989).

Other commercial uses of the river include charter boat fishing and some commercial fishing in Canada.

Many communities use the river as a source of water for treatment to provide drinking water.

E. Demographics

The population of St. Lawrence County is 116,000. It is projected to reach 119,000 by 1992. Approximately 15,000 people live in the Town of Massena; 13,000 of them within the Village of Massena. The mean income for 38,000 households in the county is $22,000 (U.S.). Forty-six percent of the people aged 16 or over are employed, and 12% of the population lives in poverty, according to the U.S. Bureau of the Census statistics.

Almost 7,000 people in St. Lawrence County are employed in manufacturing. More than half of these are in primary metal manufacturing. Other types of employment include: service occupations 6692; retail 5605; transportation, communication, and public utilities 1033; wholesale trade 952; construction 876; finance, insurance, and real estate 830. Seventy-two percent of the housing in the county is owner occupied. The median home value is $28,694 (CACI 1988).

F. Other Jurisdictions

Akwesasne, the St. Regis-Mohawk reservation, is located just east of the Town of Massena and straddles the international border within the boundary of the Massena AOC. There are approximately 10,000 people at Akwesasne. Traditionally, the Mohawk people depended on subsistence fishing and farming. They currently draw and treat their drinking water from the river. The contaminated condition of the river and its biota prohibits continuance of this way of life. The people of Akwesasne feel the threat not only to their health, but also to their culture as the traditional way of life has been precluded in part due to the problems in the Massena AOC.

The Province of Quebec is directly downstream of Massena. Seventy-four municipalities with 2.5 million people in Quebec depend on the St. Lawrence River and Lake St. Francis for their drinking water. Other uses of the downstream section of the river include recreational boating, sport and commercial fishing, swimming and camping (Sylvestre 1989).

The Province of Ontario is directly across the river from the Massena AOC. A RAP is being prepared for the Canadian portion of the St. Lawrence River AOC at Cornwall by the Canadian federal and provincial agencies in cooperation with the Mohawks at Akwesasne.

Cornwall and other communities in Ontario use the St. Lawrence for drinking water, sport fishing, commercial fishing, waterfowl hunting, and agriculture (DOE, OMOE, OMNR 1988). There are several large industries located in Cornwall that discharge wastes to the Cornwall AOC (Table II-3).

G. Historic Background

The St. Lawrence River was a familiar thoroughfare for both Native Americans and European hunters and explorers for 200 years before a permanent settlement was

Table II-3. Industrial and municipal point source discharges to the Cornwall, Ontario AOC.

		Type
1.	BASF Canada Ltd.	Industrial
2.	BCL of Canada Ltd.	Industrial
3.	Canadian Industries Ltd.	Industrial
4.	Caravelle Carpets Ltd.	Industrial
5.	Celanese Canada Ltd.	Industrial
6.	Cornwall Chemicals Ltd.	Industrial
7.	Cornwall WWCP	Municipal
8.	Courtaulds (Canada) Ltd.	Industrial
9.	Domtar	Industrial
10.	Marimac	Industrial

established by either in the Massena area. The area was claimed as part of New York State after the American Revolution, but settlement of townships conflicted with Native American settlements established 30 years earlier (Dumas and Dumas 1988).

Through a series of treaties signed between New York State and the Mohawk Nation, certain lands were reserved for Native Americans and the rest became part of New York State's jurisdiction. The New York land was divided into ten townships and sold to entrepreneurs from Albany and New York City.

Logging was the first major non-native use of resources and land in the Massena area. Virgin forests were cut and the logs rafted down the river to Montreal. As the land was cleared, dairy farming became the predominant land use. Creameries to service the dairy farms, mills, brickyards, and tanneries grew up along the banks of the rivers. Water powered their operations and was an important component in their processes. Dairy farming is still an important activity in the north country.

The St. Lawrence Power Company was formed in 1897 to dig a canal from the St. Lawrence to the Grasse Rivers and used the drop in elevation between the two to generate electricity. This attracted larger industries to the area, such as the Pittsburgh Reduction Company, which was later renamed the Aluminum Company of America (ALCOA).

It had long been recognized that devising a way to circumvent the rapids on the St. Lawrence River would improve its usefulness as a transportation route. Early in the 1900s, the simultaneous development of the river's transportation and power potential became the focus of national and international deliberation. Finally, in 1954, Canada and the United States agreed on the development of the two projects. Both were accomplished simultaneously and by 1959, the St. Lawrence Seaway and the Moses-Saunders Power Project were completed.

These projects brought significant physical change to the river. Tons of earth were dredged and moved; 38,000 acres of land were flooded; thousands of residents relocated, and the river channel was deepened. Three impounding structures and seven locks were constructed in the international section of the river. The Long Sault rapids disappeared, and Lake St. Lawrence was formed.

The Seaway and power projects brought jobs and tourism to the Massena area. Because of the availability of inexpensive electricity and shipping, large industries such as Reynolds Metals and General Motors came to Massena. ALCOA was able to expand its operations. The dams and locks became tourist attractions. The Robert Moses State Park opened.

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III. Goals and Planning

A. Introduction

The Stage I RAP compiles and evaluates impaired uses and water quality problems identified in the Massena AOC It begins with a statement of the goal for water quality and proceeds in a logical fashion toward the development of a recommended remedial strategy and specific commitments in Stage II.

B. The RAP Goal and Its Legal Basis

1. The Joint Goal Statement

The ecosystem and the substances of concern in the St. Lawrence River do not respect political boundaries. However, New York believes implementation considerations make it necessary to develop a RAP for its own jurisdictional area. While this approach was not shared by all members of the CAC, the committee voted to support the NYSDEC in developing a separate RAP document for the Massena AOC. The RAP recognizes the importance of addressing the international nature of the problem.

Contaminants from the Massena AOC probably impact other jurisdictions. The Ontario Ministry of the Environment (MOE) is producing a RAP for the Canadian AOC at Cornwall that also recognizes downstream impacts. NYSDEC and MOE agreed to a process for producing a joint goal statement and a joint problem statement that encompass both jurisdictions and transboundary impacts. Figure III-1 depicts this process.

The joint goal statement is:

> The goal of the Cornwall and Massena Remedial Action Plans is to restore, protect, and maintain the chemical, physical, and biological integrity of the St. Lawrence River ecosystem, and in particular, the Akwesasne, Cornwall-Lake St. Francis and Massena Area of Concern in accordance with the Great Lakes Water Quality Agreement.

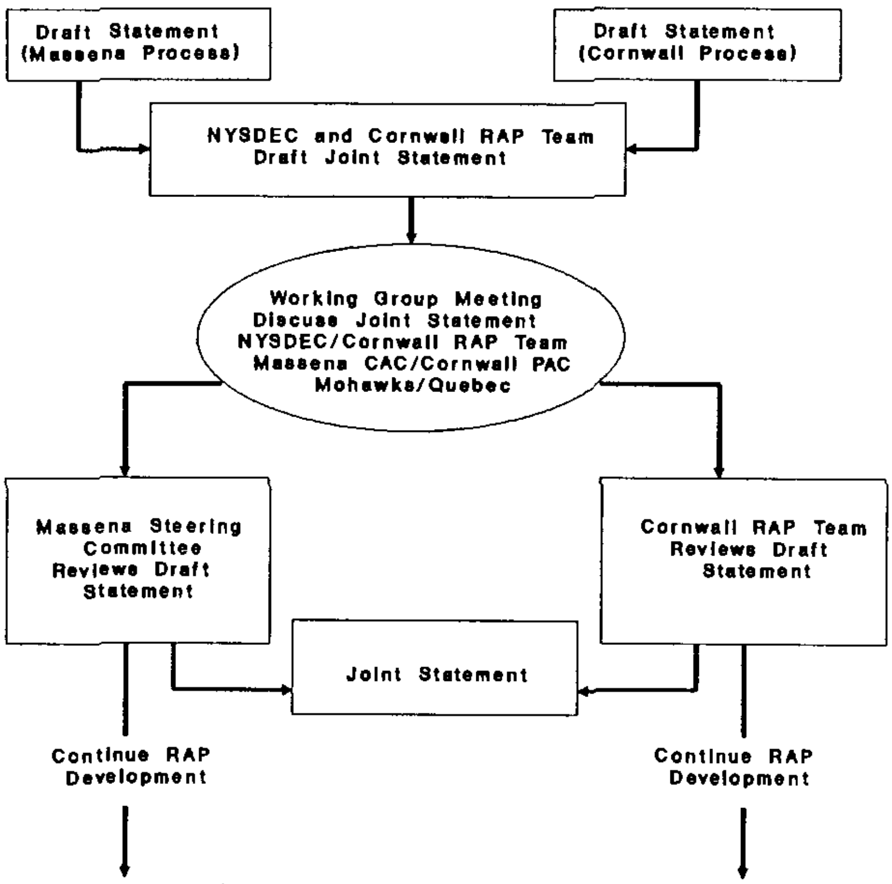

Figure III-1. Procedures for developing joint statements

The goal of the Cornwall and Massena Remedial Action Plans includes protecting the downstream aquatic ecosystem from adverse impacts originating in the Akwesasne, Cornwall-Lake St. Francis and Massena Area of Concern.

2. The Great Lakes Water Quality Agreement

The Great Lakes Water Quality Agreement (GLWQA) is an agreement between the United States and Canada that commits the two parties to certain actions and programs to improve the water quality of the Great Lakes and connecting channels.

In Article IV of the GLWQA, the parties recognize there are areas in the boundary waters of the Great Lakes system where one or more of the General or Specific Objectives of the GLWQA are not being met. These areas have been designated Areas of Concern by the IJC. Areas of Concern are places in the Great Lakes basin where beneficial uses of the water resource are impaired. The GLWQA defines impairment of beneficial uses as a change in the chemical, physical, or biological integrity of the Great Lakes system sufficient to cause any of the following indicators of use impairment:

(i) restriction on fish and wildlife consumption;
(ii) tainting of fish and wildlife flavor;
(iii) degradation of fish and wildlife populations;
(iv) fish tumors and other deformities;
(v) bird or animal deformities or reproduction problems;
(vi) degradation of benthos;
(vii) restriction on dredging activities;
(viii) eutrophication or undesirable algae;
(ix) restrictions on drinking water consumption or taste and odor problems;
(x) beach closings;
(xi) degradation of aesthetics;
(xii) added costs to agriculture or industry;
(xiii) degradation of phytoplankton and zooplankton populations;
(xiv) loss of fish and wildlife habitat.

The Massena CAC and NYSDEC have added a fifteenth impairment indicator:

(xv) transboundary impacts.

The RAP goal will have been reached when none of these impairment indicators exists in the Massena AOC. The GLWQA does not specify criteria for determining whether or not an impairment exists. However, the IJC has developed draft listing and delisting criteria for Areas of Concern. NYSDEC and the CAC used these as one of the tools for evaluating use impairments in the Massena AOC.

C. Federal and State Programs

1. The Clean Water Act

The federal Clean Water Act is the primary legal tool for controlling water pollution in the United States. The Act's goals are:

(i) to eliminate the discharge of pollutants into the navigable waters; and

(ii) wherever attainable, achieve a water quality that protects and allows for the propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water.

New York State's water pollution control programs implement the federal Clean Water Act in New York State and emphasizes achievement and maintenance of water quality that supports the best uses of each waterbody.

The St. Regis Mohawk Tribe is also implementing the Federal Clean Water Act on the St. Regis Mohawk Reservation and is in the process of developing a water quality management plan.

2. New York's Water Quality Classifications and Standards

The determination of best use is based on the physical character of the waterbody and its surroundings, the current use or potential use of the waterbody, and the existing and attainable water quality. Each waterbody's best use is determined in a public process. NYSDEC assigns the waterbody one of the following classifications that reflects its best use or condition related to best use:

A-special	drinking water with appropriate treatment, Great Lakes Boundary water
A	drinking water with appropriate treatment
B	primary contact recreation
C	fish propagation
D	fish survival

Each classification also includes the uses in the classifications listed below it.

New York State has adopted ambient water quality standards and guidance values for over 200 substances. The standard and guidance values are based on scientific evaluation of the toxicological characteristics of the substances and the ambient levels in water that ensure protection of human health and aquatic resources. These standards are one of the state's chief tools for evaluating whether use is protected.

Assignment of a particular classification does not prevent attainment of better water quality than necessary to maintain the best use. For instance, when technology based requirements (such as federal Best Available Technology guidelines) are used in writing wastewater discharge permits, the water may actually become cleaner than is required for the classification of that waterbody. Waters unaffected by discharge of treated wastewater commonly have a higher quality than the standards specify.

The 14 GLWQA indicators of impairment are generally consistent with the uses that New York State accommodates in its classification system. The exceptions are: (vii) restrictions on dredging activities, and (xii) added costs to agriculture and industry, which are not considered by New York as indicators of use impairments under the classification system. Those activities are considered in other specific program areas.

The St. Lawrence River is classified as A; the Grasse River is classified B; the Raquette River is classified B; and the St. Regis River is classified as C water.

3. The New York State Pollutant Discharge Elimination System (SPDES)

The SPDES program consists of permits issued to facilities wishing to discharge wastewater to the surface waters of New York. These permits list permissible quantities of substances that can be discharged in the wastewater effluent while maintaining the best use of that waterbody. SPDES permit limits are written on the basis of either water quality standards or best available treatment technology, whichever is stricter. These permits are periodically reviewed and made more stringent based on better available technology, better detection ability, or more stringent water quality standards.

4. Hazardous Waste Remediation Programs

The three industrial plants within the New York State portion of the Area of Concern have on-site inactive hazardous waste disposal sites. The major substance of concern for the three plants is PCBs, although other contaminants are present.

The remediation of the sites on the ALCOA plant property and on the Reynolds Metals plant property is being done under New York State Department of Environmental Conservation Commissioner Orders of Consent with the respective companies. The NYSDEC Commissioner order pertained to the terrestrial sites only and did not require remediation of the river sediments. In September 1989, the USEPA issued administrative orders which require ALCOA and Reynolds Metals to develop a cleanup program for river sediments.

General Motors will clean up the inactive sites on their property under a Federal Superfund order. This order includes the requirement to address both the terrestrial sites and off-site contamination in St. Lawrence River sediments.

All remediation work at the Massena industrial sites is in the investigation and evaluation stages. Final cleanup techniques and schedules have not yet been decided upon.

5. New York State Coastal Management Program

To address New York's coastal problems and opportunities, the Coastal Management Program contains policy statements which either promote the beneficial use of coastal resources, prevent their impairment, or deal with major activities that substantially affect resources. Federal and State agencies consider their actions in light of these policies. Local governments provide specificity to these policies as part of their responsibilities when preparing local waterfront revitalization programs. Participation in the local waterfront revitalization program is voluntary. The Town of Massena is not preparing a waterfront revitalization plan at this time. However, the policies of the State program are in effect.

These policies include promoting the use of coastal resources:

- revitalize underutilized waterfronts;
- facilitate water dependent uses;
- expand major ports;
- expand commercial fishing;
- expand public access and water related recreation;
- develop coastal energy resources;
- redevelop the existing built environment;
- expedite permitting procedures.

and protecting coastal resources:

- significant fish and wildlife habitats;
- traditional character of small harbors;
- historic and cultural resources;
- exceptional scenic areas;
- agricultural land;
- dunes, beaches, barrier islands, and other natural protective features;
- water and air resources;
- wetlands.

Some policies are derived from existing New York State statutes and regulations. Others are based on Article 42 of the Executive Law (Waterfront Revitialization and Coastal Resources), and Article 34 of the Environmental Conservation Law (Coastal Erosion Hazard Areas).

D. SARA Title III, Section 313 - Toxic Chemical Release Inventory (TRI)

Manufacturing facilities in designated standard industrial classifications are required to report to NYSDEC and USEPA their annual releases of toxic chemicals (NYSDEC 1989c). The facilities that are required to report are: 1.) from the manufacturing sector, 2.) have ten or more employees, and 3.) manufacture or process over 50,000 pounds (22,500 kg) per year or otherwise use over 10,000 pounds (4,500 kg) per year of a listed toxic chemical.

The TRI data have a number of limitations some of which are:

- Only manufacturing facilities are required to report;
- Only facilities with more than 10 employees are required to report;
- Only those chemicals listed in Section 313 (306 chemicals in 20 categories) were reported;

- Only those facilities that exceeded the minimum use or manufacturing quantities were required to report;
- Most release figures are estimates with no independent verification;
- The method of loss (accidental spills, etc.) are not specifically indicated although they are included in the amount reported;
- Transfer of substances offsite may/may not be out of the drainage basin.

These data can only be used as a screening tool for determining potential sources of substances to the watershed. Because of the limits on the information obtained in this program and the caveats listed above, these data can not be used to determine definitive sources of the substances listed, nor to assess impacts on the environment. Appendix C gives TRI data for the Massena AOC sub-basins.

E. NYSDEC Industrial Chemical Survey

Appendix C summarizes data reported to NYSDEC for the annual use and storage of chemicals of concern by major industries in the St. Lawrence River drainage basin. Only those substances cited as causing use impairment in the Massena AOC were evaluated.

In 1985, USEPA prepared the Chemical Emergency Preparedness Program which outlined how communities could help prevent and respond to local chemical accidents. In that plan, USEPA lists 402 toxic chemicals manufactured and used by industries nationwide that could endanger public health. NYSDEC, has as part of that initial plan, required industries to report on the use and storage of the chemicals that appear on the USEPA list. Companies are required to report which of the 402 chemicals are used and quantity stored at their facility. The company is also asked how the chemical is used.

These data do not indicate that these substances have escaped to the environment but they can be used as a screening tool to determine potential sources.

F. The RAP Development Process

The Stage I RAP began with development of the water quality goal statement and a determination of whether water quality impairments interfere with reaching the goal. The term "problem" refers to water quality impairments and the substances that cause the impairments. To identify problems the GLWQA use impairment indicators were examined relative to available environmental data, using proposed IJC criteria modified for the determination of impairment in the Massena AOC. The contaminants and other factors causing the impairment were also identified. NYSDEC staff collected data from work done by Department staff, other state agencies, Canadian agency research and Atwesasne research. Information was also collected at a technical workshop where scientists offered data from studies done in the Massena AOC and the St. Lawrence River and evaluated the credibility of the pieces of evidence.

Information from the public about how they want to use the river and the problems they see existing in the river was gathered at a public meeting held by the Massena CAC. These two sets of information were evaluated and used as evidence of impaired uses and of substances causing these impairments.

NYSDEC used discharge, ambient water quality and related program data to determine the sources of pollutants identified in the problem seciton.

Remedial objectives will be specified in the Stage II RAP for each known source of pollutants. An overall remedial strategy will be developed to meet the RAP goal. Commitments of agencies to specific remedial actions will be made to the extent that programs and funding are in place. The Stage II RAP will also include a monitoring plan to follow the progress of remedial actions and to determine whether the remedial actions are correcting the impairments.

Finally, the RAP will describe a long-term strategy for tracking remedial progress and reporting that progress to the public, for making further agency commitments, and for revising the overall remedial strategy as more information becomes available.

IV. Use Impairments and Their Causes

A. Introduction

Annex 2 of the GLWQA lists fourteen indicators of use impairment. Data from the Massena AOC were compiled relative to each of these indicators. Public concerns about the use impairments and the corresponding evidence were determined and are noted where appropriate. Where impairments are known, the data were examined to determine the probable cause or causes. The draft IJC listing and delisting criteria (Hartig 1988) were used as a basis for discussion and evaluation of the types and quality of data needed to determine individual impairments.

The riverine nature of the Massena AOC and evidence of probable impacts downstream have prompted the addition and evaluation of a fifteenth indicator of use impairment. Transboundary Impacts is not a GLWQA use impairment indicator, but export of contaminants from the Massena AOC needs to be evaluated in order to define problems in the aquatic ecosystem comprehensively.

Statements about use impairments and their causes for some indicators can be made with considerable certainty. For others, evidence of impairment or causes may lack rigorous scientific and statistical documentation. To convey the degree of confidence placed on conclusions about the indicators of use impairment, the following terms are used:

Yes — Direct evidence that the GLWQA or Massena RAP criterion is not satisfied (i.e., the use is impaired);

Likely — No direct evidence about the criterion exists or was found, but there may be indirect evidence that the criterion may not be satisfied;

Unlikely — No direct evidence concerning criterion, but indirect evidence exists indicating the criterion may be satisfied;

No	Direct evidence exists that the GLWQA or Massena RAP criterion is not satisfied (i.e., there is no use impairment).

The following terms are similarly used to describe the degree of confidence surrounding the evidence documenting specific causes of use impairment:

Known	Pollutant or disturbance is present and a direct link with the impairment has been established;
Probable	Pollutant or disturbance is present at a level expected to cause a known impairment, but the link with the impairment has not been definitively established;
Possible	Pollutant or disturbance is present at a level that may cause impairment, but direct evidence of impairment has not been documented.

Each indicator of use impairment is discussed on the following pages. Evidence of causes is summarized along with a discussion of the confidence associated with the evidence, data sources, and any conclusions drawn. Table IV-1 summarizes the impairments and their probable causes.

B. Indicators of Use Impairment and Causes

i.) Restrictions on Fish and Wildlife Consumption

a.) Criterion

When contaminant levels in fish or wildlife populations exceed current standards, objectives, or guidelines, or public health advisories are in effect for human consumption of fish or wildlife.

Table IV-1. Summary of impairment indicators, impairments and causes in the Massena AOC.

	Indicator(s)	Impairment	Likely Cause	Confidence of Cause
i.)	Restrictions on Fish and Wildlife Consumption	Yes	PCBs, Mercury, Mirex, Dioxin.	Known
xiv.)	Loss of Fish and Wildlife Habitat	Yes	Physical Disturbances. Contaminated Sediment.	Known Probable
xv.)	Transboundary Impacts	Yes	PCBs, Phosphorus, Metals (1.), Sediments.	Probable
iii.)	Degradation of Fish and Wildlife Populations	Likely	PCBs, DDE, Dioxin, Mercury. Physical Disturbances, Overharvest (fish).	Probable Possible
vi.)	Degradation of Benthos	Likely	PCBs, Lead, Copper, Physical Disturbances.	Probable
iv.)	Fish Tumors and Other Deformities	Likely	PAHs	Possible
v.)	Bird or Animal Deformities or Reproductive Problems	Likely	PCBs	Possible
ii.)	Tainting of Fish and Wildlife Flavor	No	-	Known
vii.)	Restrictions on Dredging Activities	No (2.)	-	Known
viii.)	Eutrophication or Undesirable Algae	No	-	Known
ix.)	Restrictions on Drinking Water Consumption, or Taste and Odor Problems	No	-	Known
x.)	Beach Closings	No	-	Known
xi.)	Degradation of Aesthetics	No	-	Known
xii.)	Added Costs to Agriculture or Industry	No	-	Known
xiii.)	Degradation of Phytoplankton and Zooplankton Populations	Unknown	-	-

(1.) Could include: aluminum, arsenic, cadmium, chromium, copper, cyanide, iron, lead, mercury, nickel, and zinc.
(2.) Maintenence dredging is unimpaired.

b.) Conclusion

Impairment - Yes

Causes (known) - PCBs, mirex, mercury, and dioxin.

c.) Evidence

The New York State Department of Health (NYSDOH) issued a fish consumption advisory in 1990 for the St. Lawrence River and the Massena AOC. They are based on recent data indicating levels of PCBs in exceedance of federal guidelines for marketing of fish. For the St. Lawrence River portion of the AOC and its tributaries up to the first impassable barrier, it is recommended that no American eel, carp, channel catfish, lake trout, chinook salmon, coho salmon over 21", rainbow trout over 25", and brown trout over 20" be consumed. This is the same advisory that applies to all New York waters of the St. Lawrence River and is caused by elevated levels of PCBs and mirex. It is also recommended that white perch, smaller coho salmon, rainbow trout and brown trout not be eaten more than once a month.

For the small embayment of the St. Lawrence River at the St. Lawrence and Franklin county line, it is recommended that no fish be consumed. For the Grasse River from its mouth to the dam in the village of Massena, consumption of smallmouth bass, brown bullhead and walleye should be limited to no more than one meal per month. In addition to these specific advisories, it is recommended that women of childbearing age and children under the age of 15 eat no fish of any species from these waterbodies.

The St. Regis Mohawks at Akwesasne Department of Health advises women of child bearing age, children under 15, and infants eat no fish caught from the waters in or around the St. Regis Mohawk Reservation (St. Regis Mohawk Env. Health Dept. 1985). They also advise all other residents eat only one meal (one-half pound) per week. This consumption advisory is specific to the Massena AOC. PCBs, mirex, dioxin, and mercury are cited as causes.

The Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources issued fish consumption advisories in 1990 for the Cornwall AOC and the St. Lawrence River. The advisories in Canadian waters are primarily the result of levels of mercury resulting from sources in the Cornwall AOC that exceed Health and Welfare Canada's consumption guidelines (0.5 ppm). Elevated levels of PCBs in fish tissue also exceed HWC guidelines (2.0 ppm). Sportfish consumption is restricted for walleye larger than 45 cm, northern pike larger than 35 cm, yellow perch larger than 25 cm, white suckers larger than 45 cm, smallmouth bass larger than 30 cm and black crappie larger than 15 cm due to the mercury contamination. Consumption of lake sturgeon larger than 45 cm, channel catfish larger than 30 cm, and brown bullhead larger than 30 cm is also restricted due to PCB levels.

A statewide waterfowl consumption advisory is in effect. It is recommended that mergansers not be consumed. It is also recommended that other species be consumed only twice per month. The NYSDOH recommends that women of childbearing age and children under 15 not consume snapping turtles. Waterfowl collected in the Massena AOC currently exceeding FDA consumption guidelines for PCBs and mirex include mallards, black ducks, American widgeon, and gadwalls (NYSDEC 1989c). No NYS AOC specific advisory exists for wildlife consumption.

In addition, the St. Regis Mohawk Health Department advises that women of child bearing age and children under 15 avoid eating snapping turtles. Painted turtles, muskrats, and frogs from the Massena AOC have also been shown to have tissue contaminant levels that exceed FDA guidelines for poultry consumption (Mohawk Nation at Akwesasne 1989).

d.) Summary

PCBs, mercury, and mirex exceed U.S. Food and Drug Administration, St. Regis Mohawk Department of Health guidelines, Health Welfare Canada guidelines, GLWQA specific objectives, and USEPA calculated bioaccumulation guidelines for fish consumption in several species of fish and wildlife in the St. Lawrence River and the Massena AOC (Table

IV-2). Dioxin (2,3,7,8-TCDD) levels in one fish exceeded the NYSDOH advisory level of 10 ppt, while 3 samples exceeded the 2.3 ppt NYSDEC guidelines for the protection of piscivorous wildlife.

ii.) Tainting of Fish and Wildlife Flavor

a.) Criterion

When effluent limits necessary to achieve ambient water quality standards for the anthropogenic substance(s) causing tainting are being exceeded or survey results have identified tainting of fish or wildlife flavor.

b.) Conclusion

Impairment - No

Causes - Not applicable.

c.) Evidence

New York State has eight water quality standards to protect against tainting of fish flesh or wildlife consumers of fish (NYSDEC 1985). They include the chlorobenzenes (chloro-, dichloro-, and trichloro-) at 50 ug/L, total unchlorinated phenols at 5.0 ug/L, total chlorinated phenols at 1.0 ug/L, aminocresols at 5.0 ug/L, dichlorophenol at 1.0 ug/L, and pentachlorophenol at 1.0 ug/L. Ambient water quality sampling in the Massena AOC and monitoring of industrial discharges has not shown exceedences for total phenol during 1985-1988 (NYSDEC 1989c,d). Surveys to document tainting of fish and wildlife have only been done by Canadian authorities downstream of the Massena AOC in Lake St. Francis. In 1987, creel surveys indicated no incidence of tainting in angler caught fish (OMNR 1988). No reports of tainting have been received by NYSDEC staff (NYSDEC 1988).

Table IV-2. Sportfish tissue contaminant levels in the Massena AOC.

SUBSTANCE	SPECIES	AVERAGE CONCEN.(Units)	LOCATION	DATE	CRITERIA (Agency)	REFERENCE
2,3,7,8 TCDD						
(Dioxin)	White Sucker	1.0 ppt	Grasse River	1989	65 ppt (USEPA);	1.
	Channel Catfish	12.8 ppt	Raquette River	1989	20 ppt (HWC)	1.
	"	10.5 ppt	Grasse River	1988	10 ppt (NYSDOH)	3.
	Smallmouth Bass	1.9 ppt	St. Lawr. River	"		"
	"	2.1 ppt	Raquette River	"		"
	"	1.3 ppt	N. Cornwall Is.	"		
	Walleye	1.3 ppt	St. Regis River	"		"
	"	2.8 ppt	Grasse River (mouth)	"		"
	Lake Sturgeon	4.2 ppt	Raquette River	"		"
	Northern Pike	1.4 ppt	Unnamed Trib.(mouth)	"		"
2,3,7,8 TCDF						
(Furan)	White Sucker	12.3 ppt	Grasse River	1989	NA	1.
	Smallmouth Bass	2.4 ppt	Raquette River	"		"
	"	5.6 ppt	St. Regis River	1988		3.
	"	4.3 ppt	N. Cornwall Is.	"		"
	Channel Catfish	3.0 ppt	Raquette River	1989		1.
	Brown Bullhead	2.6 ppt	St. Lawr. River	1988		3.
	"	70.2 ppt	Unnamed Trib.	"		"
	Northern Pike	18.3 ppt	"	"		"
	Yellow Perch	2.8 ppt	"	"		"
	Walleye	5.6 ppt	St. Regis River	"		"
	Lake Sturgeon	18.0 ppt	Raquette River	"		"
PCBs						
(Total)	Brown Bullhead	20.55 ppm	Unnamed Trib.	1988	2.0 ppm (FDA)	3.
	"	2.40 ppm	Grasse River	"		"
	White Sucker	6.39 ppm	Unnamed Trib.	"		"
	Yellow Perch	3.41 ppm	"	"		"
	Northern Pike	1.75 ppm	St. Lawr. River	"		"
	Smallmouth Bass	1.53 ppm	"	"		"
	American Eel	46.50 ppm	"	"		"
	"	3.82 ppm	Raquette River	"		"
	"	5.16 ppm	St. Regis River	"		"
	Channel Catfish	5.10 ppm	"	"		"
	"	3.27 ppm	Raquette River	"		"
	"	14.67 ppm	Grasse River	"		"
	"	1.54 ppm	N. Cornwall Is.	"		'
	Brook Trout	2.98 ppm	St. Regis River	"		"
	Carp	2.18 ppm	Raquette River	"		"
	"	28.97 ppm	"	"		"
		4.62 ppm	St. Lawr. River	"		"
	"	10.01 ppm	Snye Marsh	"		"
	"	8.74 ppm	N. Cornwall Is.	"		"
	Lake Sturgeon	2.62 ppm	Raquette River	"		"
	White Bass	2.06 ppm	"	"		"
	Walleye	2.95 ppm	Grasse River	"		"
	Chinook Salmon	1.48 ppm	"	"		"

Table IV-2. (Cont.) Sportfish tissue contaminant levels in the Massena AOC.

SUBSTANCE	SPECIES	AVERAGE CONCEN.(Units)	LOCATION	DATE	CRITERIA (Agency)	REFERENCE
PCBs (Total)	Golden Redhorse	2.82 ppm	N. Cornwall Is.	"		
(cont.)	Pumpkinseed	2.92 ppm	"	"		"
Mirex	American Eel	0.08 ppm	St. Lawr. River	1988	0.1 ppm (FDA,	3.
	"	0.02 ppm	Raquette River	"	HWC);	"
	Walleye	0.07 ppm	St. Lawr. River	"	< Detection	"
	"	0.03 ppm	Grasse River	"	(GLWQA)	"
	"	0.03 ppm	Snye Marsh	"		"
	Channel Catfish	0.09 ppm	St. Regis River	"		"
	"	0.04 ppm	Raquette River	"		"
	"	0.06 ppm	"	"		"
	"	0.20 ppm	Grasse River	"		"
	Brook Trout	0.09 ppm	St. Regis River	"		"
	Lake Sturgeon	0.02 ppm	Raquette River	"		"
	Muskellunge	0.02 ppm	"	"		"
	"	0.02 ppm	St. Lawr. River	"		"
	White Bass	0.06 ppm	Raquette River	"		"
	Carp	0.07 ppm	"	"		"
	"	0.03 ppm	Snye Marsh	"		"
	"	0.05 ppm	St. Lawr. River	"		"
	Smallmouth Bass	0.01 ppm	Grasse River	"		"
	Golden Redhorse	0.03 ppm	N. Cornwall Is.	"		"
Mercury	Smallmouth Bass	0.58 ppm	St. Lawr. River	1988	0.50 ppm (GLWQA)	3.
	"	0.56 ppm	St. Regis River	"	1.0 ppm (FDA)	"
	"	0.64 ppm	N. Cornwall Is.	"		"
	Northern Pike	0.60 ppm	Unnamed Trib.	"		"
	"	0.71 ppm	St. Lawr. River	"		"
	"	0.71 ppm	"	"		"
	"	0.55 ppm	St. Regis River	"		"
	"	0.75 ppm	Raquette River	"		"
	Rock Bass	0.51 ppm	Unnamed Trib.	"		"
	"	0.64 ppm	N. Cornwall Is.	"		"
	American Eel	0.87 ppm	St. Lawr. River	"		"
	Muskellunge	0.71 ppm	"	"		"
	Walleye	0.93 ppm	"	"		"
	Channel Catfish	0.50 ppm	St. Regis River	"		"
	Pumpkinseed	0.70 ppm	Raquette River	"		"
	Golden Redhorse	0.66 ppm	N. Cornwall Is.	"		"

NA = Not Available.
USEPA = U.S. Env. Prot. Agency
HWC = Health Welfare Canada
FDA = (U.S.) Food and Drug Administration
GLWQA = Great Lakes Water Quality Agreement
NYSDOH = New York State Dept. Health

References:
1. USEPA 1989.
2. NYSDEC 1987.
3. NYSDEC 1990a. (see Appendix A.)

d.) Summary

Sampling data indicate no recent exceedances of ambient or discharge standards or limits to protect against fish and wildlife tainting. Canadian creel survey data indicated no tainting of fish and wildlife tissue due to sources in the Massena AOC. NYSDEC has received no reports of tainting by anglers.

iii.) Degradation of Fish and Wildlife Populations

a.) Criterion

When fish and wildlife personnel have identified degraded fish or wildlife populations due to a cause within the watershed as part of fish and wildlife management programs.

b.) Conclusion

Impairment - Likely.

Causes (probable) - PCBs, DDE, dioxin and mercury.
(possible) - physical disturbances, and overharvest (fish).

c.) Evidence

Stable coolwater-warmwater fish populations have been documented by netting, electroshocking, and creel surveys in Lake St. Lawrence (NYSDEC 1987a) and Lake St. Francis (OMNR 1987, 1987a). Historic declines in the sturgeon population have been related to habitat changes and overfishing (Dumont et al. 1987).

There is no direct evidence that water quality has adversely affected fish and wildlife populations in the Massena AOC. Forage fish tissue PCB levels (Skinner and Jackling 1989) are similar to levels that caused reproductive impairment in mink in laboratory situations (Auerlich et al. 1973). Dioxin (2,3,7,8-TCDD) levels in fish also exceed

NYSDEC guidelines for the protection of piscivorous wildlife (Newell et al. 1987) and could be considered indirect evidence of impacts on wildlife populations. Elevated levels of PCB, DDE, and mercury have been found in mink captured within five miles of the St. Lawrence River, compared with mink taken further inland (Foley et al. 1988). This study implies that PCBs, DDE and mercury may be a cause of reproductive impairment and therefore populations decline in the AOC.

The Mohawks at Akwesasne report the lack of mink taken by trapping or sitings as indirect evidence of problems with the population (Mohawks at Akwesasne 1989).

Physical disturbances in the Massena AOC have indirectly impacted fish and wildlife populations. Dredging in the navigation channel and natural erosion of shoreline are possible causes.

d.) Summary

No specific fish or wildlife management goals have been developed for the Massena AOC. However, indirect evidence of impacts on localized fish, aquatic invertebrate, and furbearer populations and contaminant levels in snapping turtles, amphibians, and waterfowl suggests that water quality of the Massena AOC is impaired based on this indicator.

iv.) Fish Tumors or Other Deformities

a.) Criterion

One would expect a zero liver tumor incidence rate in fishes from clean locations. However, due to uncertainty in fish movement, other possible causes and experience with field data, a site will be listed as an Area of Concern when the incidence of neoplastic or pre-neoplastic liver tumors exceeds 2% in bullheads or 3.5% in suckers.

b.) Conclusion

Impairment - Likely.

Causes (possible) - PAHs in sediment.

c). Evidence

There has been no published documentation of fish tumors or deformities for the Massena AOC. There are angler reports of lesions in some fish species caught (Mohawks at Akwesasne 1989a). Fish tumors were reported in commercial harvests from the Quebec portion of Lake St. Francis, but incidence rate and tumor type were not determined (QMOE 1989). External abnormalities were reported as extremely rare in fish examined during 1988 surveys by Ontario MNR in Lake St. Francis (DOE, OMOE, OMNR 1988).

Polynuclear aromatic hydrocarbons have been identified as the cause of liver tumors in brown bullheads and several other species in the Great Lakes basin (USFWS 1989). One of these compounds, benzo(a)pyrene (B(a)P) has been detected in industrial discharges to the AOC and in ambient monitoring by NYSDEC since 1985. While data are limited, levels of B(a)P detected have been very low and slight permit exceedences have only been documented in two samples since 1986 (NYSDEC 1989).

Limited sediment data from one area within the AOC indicate relatively high levels of PAHs (Table IV-3). The levels documented are comparable to those in the Buffalo River where liver tumors in some fish species have been linked to sediment PAHs (Black 1988). While PAH levels are similar in the sites compared, other data such as total organic carbon, total volatile solids, grain size, etc. are not available for comparison and could effect toxicity or teratogenicity of the contaminants.

There have been no studies to determine fish liver tumor incidence in the Massena AOC.

Table IV-3. Massena AOC PAH analyses compared with levels found by NYSDEC and Erie County in Buffalo River sediments (mg/kg or ppm).

Substance	St. Lawrence-Massena[1] Values (Range) (7 Samples)	Buffalo River NYSDEC (10 Samples)	Values (Mean) Erie County (58 Samples)
acenaphthene	<MDL[2]	0.237	1.165
acenaphthylene	-----	-----	1.332
anthracene	<MDL-1.01	0.855	4.091
benz(a)anthracene	<MDL-4.0	1.336	2.184
benzo(a)pyrene	4.32-7.92	1.229	2.056
benzo(b)fluoranthene	-----	1.709	1.161
benzo(ghi)perylene	<MDL-2.02	1.355	1.730
benzo(k)fluoranthene	2.94-4.37	0.683	1.641
chrysene	<MDL-4.57	0.800	1.639
dibenzo(a,h)anthracene	<MDL	0.869	1.539
fluoranthene	<MDL-3.64	4.661	3.919
fluorene	<MDL	-----	2.097
indeno(1,2,3-cd)pyrene	<MDL-3.74	1.539	2.073
naphthalene	<MDL	-----	4.435
phenanthrene	<MDL-4.16	2.498	4.079
pyrene	<MDL-2.78	5.481	3.167

[1]RMT, Inc. 1986.

[2]<MDL - less than method detection limit

d.) Summary

No definitive statement about impairment can be made because the necessary studies have not been conducted. The levels of PAHs in the sediment in the Massena AOC would suggest that impairment is likely.

v.) Bird or Animal Deformities or Reproductive Problems

a.) Criterion

A site will be listed as an Area of Concern when incidence rates of cross-bill syndrome, reproductive failure, etc., are significantly (95% probability level) higher than incidence rates at control sites. Further, a site will be listed when bald eagle reproduction is less than one eaglet per active nest.

b.) Conclusion

Impairment - Likely.

Causes (possible) - PCBs.

c). Evidence

There have been no studies to compare bird or animal deformities or reproductive problems in the Massena AOC with control area populations. There are no known eagle nests in the area. However, the Massena AOC is a known migration route for eagles (NYSDEC 1990).

NYSDEC has developed fish flesh criteria to protect fish eating birds and animals (Newell, et al. 1987). Table IV-4 lists NYSDEC and GLWQA criteria and forage fish tissue levels found in the Massena AOC. Criteria are exceeded for PCBs. Also, PCB levels in spottail shiners from the AOC have been shown to cause reproductive problems in mink in laboratory studies (Auerlich, et al. 1973).

Table IV-4. Massena AOC young-of-the-year forage fish tissue contaminant levels (ppm) compared with criteria for the protection of fish consuming birds and animals.

	MEAN CONTAMINANT LEVELS (std. dev.)					CRITERIA (ppm)	
SUBSTANCE	1983 (1.)	1986 (2.)	1987 (2.)	1988 (3.)	1989 (3.)	NYSDEC (4.)	GLWQA
PCBs (total)	0.954 (0.343)	0.831 (0.240)	0.291 (0.29)	21.5 (4.3)	22.6 (14.0)	0.11	0.1
Aldrin/Dieldrin	-	0.0098 (0.0016)	0.0035 (0.002)	-	-	0.022	-
DDT and Metabolites	0.006 (0.004)	0.070 (0.015)	-	0.018 (0.008)	-	0.2	1.0
Mercury	-	0.032-0.053 (5.)	-	-	-	-	0.5
Mirex/Photomirex	0.006 (0.002)	< 0.005 (1.)	< 0.002 (1.)	-	-	0.33	-

1. Suns et al. 1985.
2. Skinner and Jackling 1989.
3. OMOE 1989, 1990.
4. Newell et al. 1987.
5. Range of values.

Species include spottail shiners, emerald shiners and bluntnose minnows.

Indirect evidence is also found in abnormal motor coordination noted in a green frog from the Massena AOC (NYSDEC 1989d) and reduced populations of mink at the Mohawk Nation at Akwesasne (Mohawk Nation at Akwesasne 1989).

d). Summary

Although no comprehensive studies have been completed, indirect evidence exists in the form of exceedences in fish tissue criteria designed to protect piscivorous wildlife. These data indicate the likelihood of impairment caused by these substances.

vi.) Degradation of Benthos

a.) Criterion

When the benthic macroinvertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. Benthic invertebrate community structure and composition are good indicators of ecosystem status. Further, benthic invertebrates are effective for bioassessment of sediment-associated contaminants. A site will be listed when toxicity or bioavailability of sediment-associated contaminants is significantly (95% probability level) higher than controls.

b.) Conclusion

Impairment - Likely.

Causes (probable) - PCBs, lead, copper, and physical disturbances

c.) Evidence

Data on benthic macroinvertebrates from the Massena AOC in 1977, 1983, and 1986 indicate that significant population level impacts had not occurred at the mouths of the Grasse, Raquette, and St. Regis Rivers (NYSDEC 1989e, Griffiths 1988). Some data indicate physical conditions have influenced populations (Patch and Busch 1986). Comparisons were made to main river channel populations in the Massena AOC in these studies. In fact, a 1979 study indicated somewhat declining populations in relation to numbers and diversity relative to upriver sites (USFWS 1979).

Significant localized impacts on benthic invertebrate populations have been reported (NYSDEC 1989 d,e). Contaminant levels in macroinvertebrates have been shown to be elevated (PCBs, copper, lead) compared to background levels (NYSDEC 1989e, Kauss et al. 1988). Toxicity tests on invertebrates have not been conducted in the Massena AOC.

d.) Summary

Although widespread adverse impacts have probably not occurred, localized impacts within the Massena AOC related to metals and PCBs are likely. This precludes delisting the Massena AOC based on this use impairment.

vii.) Restrictions on Dredging Activities

a.) Criterion

When contaminants in sediment exceed standards, guidelines, or objectives, and there are restrictions on the disposal of dredged materials. The Great Lakes states have individual policies based on a case-by-case consideration of contaminant levels and deep-water placements. USEPA criteria for sediment classification are used to help make a determination.

b.) Conclusion

Impairment - No

c.) Evidence

There are currently no restrictions on disposal of dredged sediment from the main navigation channel of the St. Lawrence River in the Massena AOC.

There are no New York State standards for contaminated sediments. USEPA Region V has developed dredge disposal guidelines that subjectively define moderate and heavily polluted sediments in the upper Great Lakes (IJC 1982). These guidelines are not based on scientific evidence of environmental impact. However, their strict application to bottom sediments in parts of the Massena AOC would lead these sediments to be classified as moderately or heavily polluted (Table IV-5). Substances that have been found at levels in AOC sediments that could cause restrictions on dredging and disposal activities include arsenic, chromium, copper, nickel, PCBs and zinc.

NYSDEC has developed guidance (NYSDEC 1989g) for the use of sediment data to protect aquatic organisms that would indirectly be exposed to contaminants in sediment. The guidance is based on the theory that toxics in sediment can become bioavailable in the interstitial (pore) water (NYSDEC 1990a). The best parameter to make predictions on bioavailability of non-polar organic substances is the fraction of total organic carbon in the sediment. The formula uses the applicable ambient water quality standard and the octanol/water partition coefficient as a surrogate to the sediment/organic carbon partition coefficient. The criterion can be made site-specific by relating the criterion to the sediment fraction of organic carbon.

For example:

$$\text{Sediment Criterion (ug/gOC)} = \text{(AWQS, ug/l)} \times K_{ow}\ \text{l/kg)} \times 1\ \text{KG/1000 gOC}$$

where; OC = organic carbon content

AWQS = ambient water quality std.

K_{ow} = octanol/water partition coefficient

1 kg/1000 gOC is a unit conversion factor

Table IV-5. Range of levels of contaminants in the Massena AOC[1], Lake Ontario bottom sediments and USEPA open water disposal guidelines (mg/kg dry weight or ppm).

Substance	AOC St. Law. R.	AOC Raquette R.	AOC Grasse R.	L. Ontario[2] Sediments "Background"	USEPA Disposal Guidelines[3] Moderate	Heavy
arsenic	1.51-8.0	1.06	----	12	3-8	> 8
cadmium	< 2.0	< 2.0	----	2.5	--	> 6
chromium	11.6-29.6	< 10.0	----	75	25-75	> 75
copper	13.6-43.1	171	----	65	25-50	> 50
iron	6,240-14,190	10,840	----	5.9%	17,000-25,000	> 25,000
lead	< 20-35	< 20.0	----	55	40-60	> 60
mercury	0.12-0.22	< 0.10	----	0.6	---	> 1
nickel	< 0.08-4630[5]	< 8.0	----	75	20-50	> 50
PCBs	ND-13.75	ND-2.31[4]	< 0.08-695	---	1-10	> 10
zinc	39.2-123	111	----	145	90-200	> 200

[1]Sources: RMT, Inc. 1986; Woodward-Clyde 1989; Young-Morgan Assoc. 1989.
[2]OMOE 1988. Upper 95% confidence interval.
[3]IJC 1982.
[4]Aroclor 1248
[5]Aroclor 1232
ND = Not detected.

PCB criterion = 0.001 ul/l X $10^{6.2}$ = 1.4 ug/gOC

For a site with 3 % organic carbon in the sediment, multiply the criterion by the fraction of OC:

Site specific PCB criterion = 1.4 ug/gOC X 30 gOC/kg
= 42 ug/kg

These procedures could be used to determine sediment contaminant levels above which impacts to associated biota would be expected.

d.) Summary

There are currently no restrictions on dredging activities in the navigation channel of the St. Lawrence River in the Massena AOC. However, impairment would be likely relative to contaminant levels in sediments of the Massena AOC if dredging operations were expanded.

viii.) Eutrophication or Undesirable Algae

a.) Criterion

When there are persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal accumulation on bathing beaches, nuisance algal blooms, decreased water clarity, etc.) attributed to accelerated or cultural eutrophication or the area is contributing to the lack of achievement of the Great Lakes phosphorus target loads identified in Annex 3 of the GLWQA.

b.) Conclusion

Impairment - No.

Causes - Not applicable.

c.) Evidence

Dissolved oxygen levels in 1986 determined in the Grasse River below Massena and in the Raquette River were all above NYS water quality standards (5 mg/L) and GLWQA objectives (6 mg/L) in 1986 (NYSDEC 1988).

Turbidity at the two sampling sites has been determined to be relatively high (Table IV-6) indicating sediment loading to the St. Lawrence River from these two tributaries. Measurements in the main channel of the river were not made. There are no numeric standards or criteria for turbidity. Tributary flows are small relative to the main river.

Phosphorus and nitrogen inputs from the Grasse and Raquette Rivers are elevated relative to upriver sites. Eutrophic conditions have not been reported in the Massena AOC. However, nuisance growth of aquatic vegetation has been noted downstream in Lake St. Francis (DOE, OMOE, ONMR 1988). Algal blooms have not been reported in the Massena AOC.

d.) Summary

Eutrophication or excess algal growth has not been a problem in the Massena AOC. This is probably due to high flow rates in the St. Lawrence River.

ix.) <u>Restrictions on Drinking Water Consumption or Taste and Odor Problems</u>

a.) Criterion

The primary concern is public health and potable water supply. Thus, any waters (intended for human consumption) that contained disease-causing organisms or hazardous concentrations of toxic chemicals or radioactive substances in exceedence of standards, objectives, or guidelines will be listed as an Area of Concern. Further, a site will be listed as an Area of Concern when taste and odor problems are present (e.g. taste and odor problems due to blue-green algae or phenolic compounds).

Table IV-6. Average (Std. Dev.) turbidity, total phosphorus, un-ionized ammonia, and dissolved oxygen for 1986 upstream and Massena AOC sampling sites[1].

	- Upstream - St. Law. River (Cape Vincent)	- AOC - Grasse River (Massena)	- AOC - Raquette River (Massena)	Criteria (Agency)
Turbidity (ntu's)	1.4 (0.9)	4.8 (2.5)	2.6 (1.2)	---
Total phosphorus (ug/L or ppb)	19.9 (11.7)	48.0 (16.5)	21.5 (8.2)	---
Un-ionized ammonia (ug/L or ppb)	2.2 (1.8)	1.0 (0.8)	0.9 (1.5)[2]	20 (IJC)
Dissolved oxygen (mg/L or ppm)	10.1 (2.0)	8.8 (1.6)	9.1 (1.3)	5.0 (NYS)
			6.0 (IJC)	

---

[1]NYSDEC 1988.

[2]Sample size = 5 with 3 non-detections;
Sample size = 8 for all others.

b.) Conclusion

Impairment - No.

Causes - Not applicable.

c.) Evidence

Currently, there are no restrictions on drinking water in the Massena AOC. Recent data on treated drinking water indicate no detectable levels of toxic contaminants (NYSDOH 1989, 1989a; Mohawk Nation at Akwesasne 1989a), nor have exceedences in New York State standards or guidance values been reported.

Recent raw water analyses of Grasse and Raquette River water (Kauss et al. 1988; NYSDEC 1988; Mohawk Nation at Akwesasne 1989a), as well as from the St. Lawrence River near the Massena Canal (ALCOA 1989) have occasionally indicated detectable levels of PCBs.

d.) Summary

Current data on treated water indicate no impairment of use relative to the drinking water criterion.

x.) Beach Closings

a.) Criterion

When there are persistent beach closings due to contamination from bacteria, fungi, or viruses that may produce enteric disorders or eye, ear, nose, throat, and skin infections or other human diseases and infections.

b.) Conclusion

Impairment - No.

Causes - Not applicable.

c.) Evidence

There is one public beach in the Massena AOC and several upstream on the St. Lawrence River. There is no history of beach closings in the Towns of Massena or the upstream towns of Louisville, or Waddington. The beach in the Massena AOC on New York Power Authority property has not experienced any closings due to problems relative to bacteria, etc. (NYPA 1989).

Undocumented eye, ear, and throat infections have been reported in non-beach areas of the Raquette, St. Regis, and St. Lawrence River by the St. Regis Mohawks (Mohawk Nation at Akwesasne 1989).

d.) Summary

There is no history of beach closings in the Massena AOC or surrounding area beaches.

xi.) Degradation of Aesthetics

a.) Criterion

When debris, oil, scum, or any substance produces a persistent, objectionable deposit, unnatural color or turbidity, or unnatural odor.

b.) Conclusion

Impairment - No.

Causes - Not applicable.

c.) Evidence

No oil spill, turbidity problems, etc., have been reported in the Massena AOC. The high flow rates in the main channel of the St. Lawrence River probably inhibit deposition of these substances within the Massena AOC.

Comprehensive surveys to determine public perception of the existence or extent of this impairment have not been done. However, some members of the CAC feel industrial air emissions in the Massena AOC have an impact on general aesthetics in the region and could therefore adversely effect recreational water uses (CAC 1989).

d.) Summary

No direct evidence of aesthetic impairment exists relative to water quality. Industrial air emissions have been cited as indirectly impairing recreational water uses in general.

xii.) <u>Added Costs to Agriculture or Industry</u>

a.) Criterion

When there are additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) or industrial purposes (i.e. intended for commercial or industrial applications and non-contact food processing).

b.) Conclusion

Impairment - No.

Causes - Not applicable.

c.) Evidence

There are no known costs to industry or agricultural concerns for treatment of water taken from the Massena AOC prior to use. Some members of the CAC have suggested that some indirect costs to industries and residents have been incurred that are not documentable or quantifiable. They include: loss of charter boat fishing activities; loss of commercial fishing; and loss of agriculture techniques previously used by the Mohawks at Akwesasne (CAC 1989).

d.) Summary

Major industries in the Massena AOC have indicated that no additional costs have been associated with treating water prior to use.

xiii.) Degradation of Phytoplankton and Zooplankton Populations

a.) Criterion

When phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physiochemical characteristics. Phytoplankton and zooplankton populations should also be used to assess the effects of contaminants. A site will be listed as an Area of Concern when phytoplankton or zooplankton bioassays (e.g. Ceriodaphnia: algal fractionation bioassays) confirm toxicity (significant at the 95% probability level).

b.) Conclusion

Impairment - Unknown.

c.) Evidence

There are no data on phytoplankton or zooplankton assemblages in the Massena AOC. Upstream St. Lawrence River and Lake Ontario data indicate the influence of the Lake Ontario phytoplankton populations on St. Lawrence River populations (Mills and Forney 1987). Studies downstream in the St. Lawrence River also indicate that shifts in communities were reflective of physical habitat changes (Mills et al. 1981).

d.) Summary

The appropriate information necessary to make a decision on this impairment has not been gathered.

xiv.) Loss of Fish and Wildlife Habitat

a.) Criterion

When fish and wildlife personnel have identified loss of fish and wildlife habitat due to water quality contamination as part of fish and wildlife management programs.

b.) Conclusion

Impairment - Yes.

Causes (known) - Physical disturbances, contaminated sediments.

c.) Evidence

Fish and wildlife habitat was dramatically altered in 1954-1958 during construction of the St. Lawrence Seaway project. Since then, there has been no known study of the long-term loss of habitat for fish and wildlife in the Massena AOC. Northern pike spawning marshes have been adversely impacted in Lake St. Lawrence by the lack of extreme water level fluctuations (NYSDEC 1989f). Shifts in some fish species abundance are likely attributable to gross physical changes and flow regimes since construction of the Seaway (Osterberg 1985). While habitat changes can be attributed to the development of the seaway project, those impacts are not the result of more recent water quality contamination and are therefore not within the scope of the RAP.

Loss of fish spawning and nursery habitat due to tributary sediment loading is also not evident in the Massena AOC. Elevated suspended sediment levels, or depleted dissolved oxygen have not been reported in ambient water quality surveys (NYSDEC 1988).

There are several wetland areas in the Massena AOC (Figure IV-1). One is associated with ALCOA and one large one with Reynolds Metals, Inc. and General Motors. Contamination of water and sediment of the wetlands will have an indirect impact on biota in those area. Contamination of wetlands can be viewed as a direct loss of significant fish and wildlife habitat in the AOC.

A small three acre (1.2 ha) marsh on the ALCOA property, referred to as the West Marsh, has been documented to have PCBs ranging from 1 ppm the greater than 29,000 ppm in sediment (Eng. Sci 1989). The marsh is located in a groundwater discharge zone with groundwater discharging to the area from the north, south, and west.

A 170 acre (68 ha) wetland is located in the vicinity of the Reynolds Metals and General Motors property. Sampling and analysis in 1988 in the area of the wetland just south of the Reynolds Solid Waste Landfill (see Appendix B), documented PCB levels ranging from less than 0.1 ppm to 9.4 ppm in sediment (NYSDEC 1989d). The highest levels in sediment were found at the sites closest to the landfill. Two water samples collected from the same area had total PCB levels of 1348.6 ppt and 9111.0 ppt.

A third wetland is located south of the Grasse River, east of the Village of Massena. There are currently no known data concerning the contamination or potential contamination of this wetland.

Figure IV-1. Wetlands in the Massena AOC. (Numbering designations refer to NYSDEC wetlands inventory mapping program)

Contaminated sediment in tributaries to the St. Lawrence River could indirectly effect fish by adversely impacting benthic macroinvertebrates. The gross loss of fisheries habitat is not evident, however. The lack of benthic invertebrates in localized areas of the Massena AOC has been reported (NYSDEC 1989d) and could indirectly affect forage fish populations in those areas.

d.) Summary

Elevated levels of heavy metals, PCBs, and PAHs are probably directly impacting benthos in localized areas of the Massena AOC. However, the loss of habitat is not widespread. Indirect impacts on fish and benthos due to contaminated sediments are likely. A small marsh on the ALCOA property is impacted by toxics. Gross changes in habitat due to historic physical manipulation are known but are not water quality related.

xv.) Transboundary Impacts

a.) Criterion

When evidence is available of adverse impacts on water quality occurring in Ontario or Quebec because of transport of pollutants from the Massena AOC.

b.) Conclusion

Impairment - Yes.

Causes - (probable) PCBs, phosphorus, nitrogen, heavy metals, sediments.

c.) Evidence

There is no direct information on the net export of contaminants from the Massena AOC. PCBs and mercury have been documented in forage fish species downstream in Lake St. Francis (DOE 1989). Concentrations of PCBs and mercury in sport fish tissue from Lake

St. Francis have also been found. PCBs were below Ontario consumption guidelines in 1984 and 1985 while mercury exceeded guidelines (DOE, OMOE, OMNR 1988). Mirex was not detected during that period in Lake St. Francis (Table IV-7).

It is difficult to determine the impact of the Massena AOC contaminants on downstream resources since Lake Ontario contributes a large percentage of the same organic and inorganic pollutants to the St. Lawrence River in both water and suspended sediment (Sylvestre 1987).

Hydrologic conditions (Figure IV-2) would indicate that cross-river impacts are not likely. Flows seem to stratify north to south in the river. Fish tissue levels of mercury and PCBs would support this premise since sources of mercury have been noted in Canada and PCBs in New York (QMOE 1989a).

Analyses of some raw water samples collected downstream of the Massena AOC in Lake St. Francis have shown PCB levels above 50 ug/L (QMOE 1989).

Total loading of nutrients from the Massena AOC are not known but estimates of total phosphorus loads are probably low in comparison with the St. Lawrence River. Export of nutrients and sediment may be causing eutrophication downstream and have been cited as an impairment with sources in the Cornwall AOC (DOE, OMOE, OMNR 1988).

d.) Summary

Indirect information exists that provides evidence of downstream impacts on aquatic resources from sources originating in the Massena AOC, the Cornwall AOC, and upstream. Impacts of sources directly across the river are unlikely due to hydrologic characteristics. Eutrophication has been indicated to have had some impact in localized areas downstream of the Massena AOC. Basinwide sources of contaminants upstream of the Massena AOC could have general impacts on the downstream aquatic ecosystem.

Table IV-7. Comparison of smallmouth bass tissue contaminant levels (mg/l) in the St. Lawrence River.

Substance	Alexandria Bay[1] (1983) Mean (Range)	Massena[1] (1983) Mean (Range)	Lake St. Francis[2] (1984) Mean (Range)
PCB (Total)	0.05 (0.13-0.89)	0.63 (0.15-1.79)	0.22 (0.04-0.47)
Mercury	-----	0.49 (0.19-1.37)	0.64 (0.32-1.00)
Mirex	0.03 (<0.01-0.06)	0.03 (<0.01-0.08)	-----
DDT	0.03 (0.01-0.08)	0.04 (0.01-0.10)	-----

[1] NYSDEC 1987.
[2] DOE, OMOE, OMNR 1988.

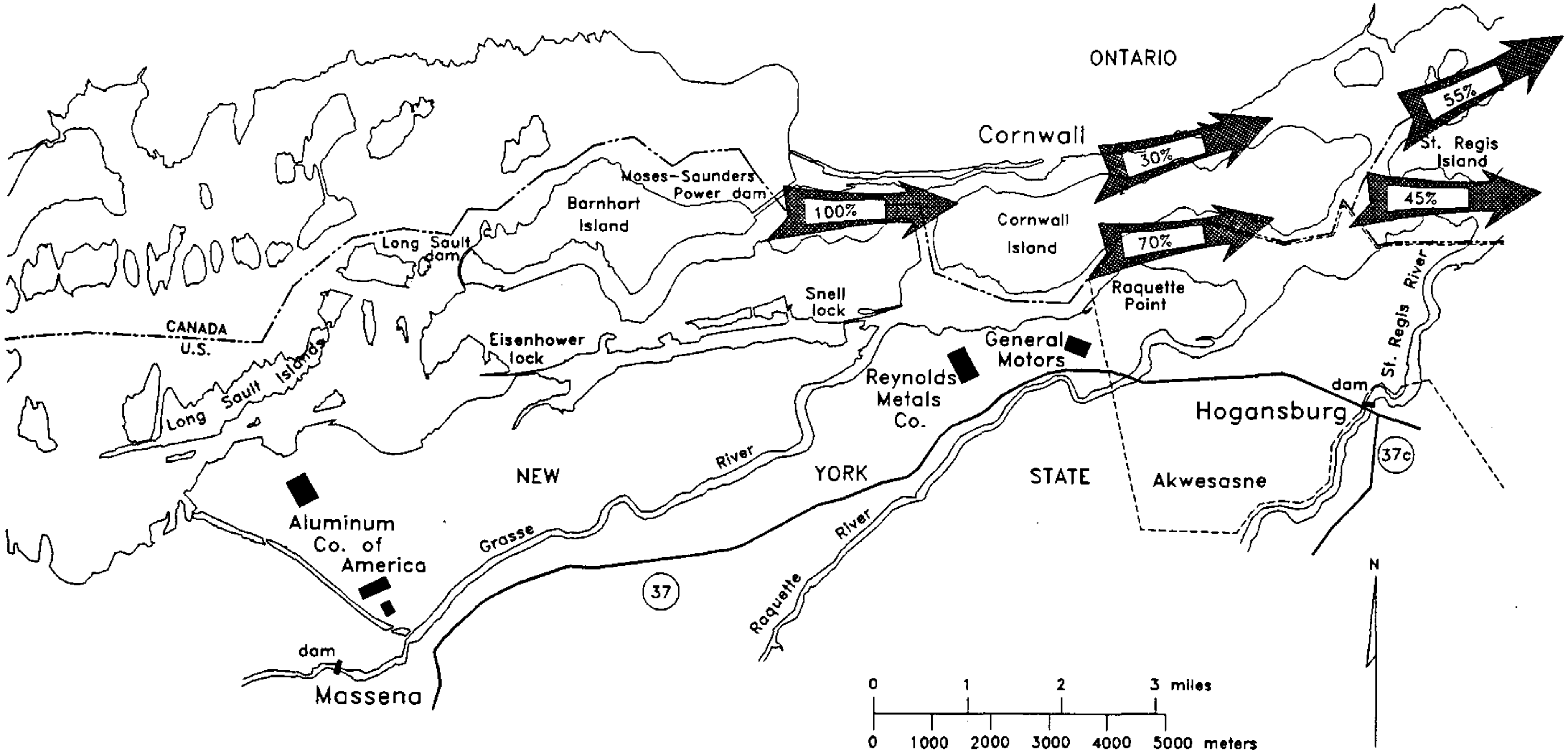

Figure IV-2. Estimated flow (% total) of the St. Lawrence River in the Massena AOC.

C. Lake Ontario

The Lake Ontario Toxics Management Plan (LOTC 1989) was developed by Canadian and U.S. agencies to deal with short and long-term planning to reduce toxic contamination of Lake Ontario. The St. Lawrence River is not within the geographic or programmatic scope of the LOTMP, but the Plan has some relevance to the Massena AOC and recommended remediation.

The LOTMP lists 11 priority contaminants of concern that are noted as currently exceeding one or more Canadian or U.S. water column or biota standards or criteria (Table IV-8). Of the 11 critical substances, seven are also GLWQA designated critical pollutants.

In the Massena AOC, 12 specific contaminants have been cited as contributing to the causes of use impairment. In addition, classes or groups of substances have been determined to be causing use impairment that may not be identified in either the LOTMP or IJC listings. They include contaminated sediments (impairment numbers xiv. and xv.), heavy metals (number xv.), and exotic species (number xv.). Five of the individual contaminants suspected of causing use impairment in the Massena AOC are on the list of 11 critical substances in the LOTMP. They include PCBs, dioxin, mirex, mercury, and DDE. Lake Ontario, then, is a source of these contaminants to the St. Lawrence River. The successful long-term control and reduction in loadings to Lake Ontario will in turn effect the remedial efforts in the St. Lawrence River near Massena.

Table IV-8. Lake Ontario Toxics Management Plan, GLWQA, and Massena AOC substances of concern.

Substance	LOTMP	GLWQA	Massena
PCBs (total)	x	x	x
dioxin (2,3,7,8-TCDD)	x	x	x
mirex (& photomirex)	x	x	x
DDT and metabolites	x	x	x (DDE)
mercury	x	x	x
hexachlorobenzene	x	x	
dieldrin	x	x	
chlordane	x		
iron	x		
aluminum	x		
octachlorostyrene	x		
arsenic			x
chromium			x
copper			x
lead			x
nickel			x
PAHs			x
zinc			x

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V. Sources of Pollutants Causing Impairments

A. Introduction

Pollutants causing impairment of beneficial uses are identified in Chapter IV. The purpose of Chapter V is to identify the likely sources of these pollutants to the Massena AOC so that remedial measures can be recommended in Stage II of the RAP.

Table V-1 outlines the causes identified in Chapter IV with the types of known and potential sources of pollutants and disturbances to the Massena AOC. An overview of the source types is given followed by background information on the individual or groups of pollutants and the potential environmental impact. The evidence available on the source of each pollutant type is discussed next. Where available information suggests that sources to the tributaries or upstream are significant, it is presented also.

Data on sources are typically indirect and generally do not allow identification with complete certainty. Data on loadings of pollutants to the Massena AOC and from the AOC to the downstream St. Lawrence River areas are inadequate to estimate mass balances. Gross estimates are made, however, of loadings from several sources in order to try to understand the magnitude of the potential impact from the various inputs. A glossary of units and conversion factors is included in Appendix D.

B. Overview of Source Types

Sources of pollutants to the Massena AOC can be categorized as either point or nonpoint sources. Point sources include both municipal and industrial facilities which discharge treated wastewater through regulated outfalls such as a pipe. Figure V-1 shows permitted facilities discharging to the St. Lawrence River drainage basin.

Municipal sewage collection and treatment systems can process both domestic and industrial wastes. Table V-2 lists the municipal discharges in the St. Lawrence River drainage basin. The facilities are generally small, ranging in size from 15,000 gallons

Table V-1. Summary of causes and sources of impaired uses in the Massena AOC.

Indicator(s)	Impairment	Identified Cause(s)	Known Source(s)	Potential Source(s)
i.) Restrictions on Fish and Wildlife Consumption	Yes	PCBs, Dioxin	AOC Ind. Discharges, Inactive Haz. Waste Sites	Cont. Sediments
		PCBs, Mirex, Dioxin	Lake Ontario	-
		Mercury	Inactive Haz. Waste Sites, Cornwall AOC	Cont. Sediments
xiv.) Loss of Fish and Wildlife Habitat	Yes	Physical Disturbances	Dredging	Natural Erosion
		Contaminated Sediment	Inactive Haz. Waste Sites	-
xv.) Transboundary Impacts	Yes	PCBs	Indust. Discharges, Lake Ontario	Inactive Haz. Waste Sites, Atmos. Deposition
		Metals (1.), Sediments	AOC Indust./Muni. Discharges	Inactive Haz. Waste Sites
		Phosphorus	Muni. Discharges, CSOs	Other Nonpoint Sources
iii.) Degradation of Fish and Wildlife Populations	Likely	PCBs	AOC Ind. Discharges	-
		PCBs, DDE, Mercury	Lake Ontario Cornwall AOC	-
		Physical Disturbances	Seaway Construction	Inactive Haz. Waste Sites, AOC Ind. Discharges
		Overharvest (fish)	-	Comm. Fish.(historic)
vi.) Degradation of Benthos	Likely	PCBs, Lead, Copper	AOC Ind. Discharges, Cont. Sediments	Inactive Haz. Waste Sites, Other Nonpoint Sources
		Physical Disturbances	-	Dredging
iv.) Fish Tumors and Other Deformities	Likely	PAHs	-	Cont. Sediments
v.) Bird or Animal Deformities or Reproductive Problems	Likely	PCBs	-	Cont. Sediments

(1.) Could include; Aluminum, Arsenic, Cadmium, Chromium, Copper, Cyanide, Iron, Lead, Mercury, Nickel, Zinc.

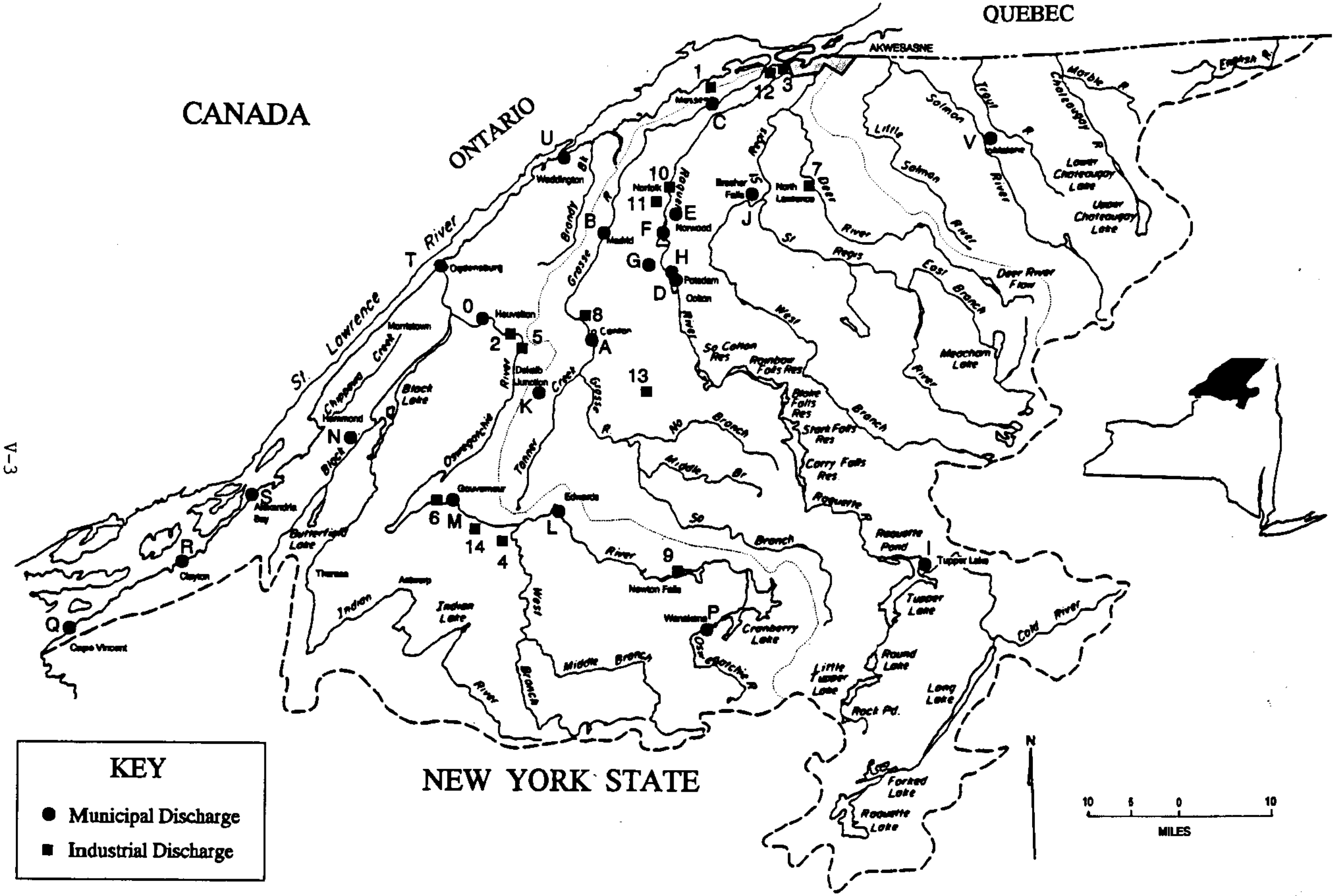


Figure V-1. NYS municipal and industrial discharges to the St. Lawrence River drainage basin (Letter sites refer to Table V-2; numbered sites refer to Table V-3)

Table V-2 . Municipal wastewater discharges and combined sewer overflows (CSOs) in the St. Lawrence River drainage basin.

Facility	Basin/Sub-basin	Design Flow (MGD)	CSOs
A. Canton (V)	Grasse River	2.00	-
B. Madrid (T)	Grasse River	0.12	-
C. Massena (V)	Grasse River	2.70	6
D. Colton (T)	Raquette River	0.07	-
E. Norfolk (T)	Raquette River	0.16	-
F. Norwood (V)	Raquette River	0.43	-
G. Potsdam (T)	Raquette River	0.04	-
H. Potsdam (V)	Raquette River	3.30	-
I. Tupper Lake (V)	Raquette River	1.10	-
J. Brasher Falls (T)	St. Regis River	0.12	-
K. DeKalb Junction (T)	Oswegatchie River	0.03	-
L. Edwards (V)	Oswegatchie River	0.08	-
M. Gouverneur (V)	Oswegatchie River	3.50	1
N. Hammond (V)	Oswegatchie River	0.04	-
O. Heuvelton (V)	Oswegatchie River	0.45	-
P. Wanakena	Oswegatchie River	0.015	-
Q. Cape Vincent (V)	St. Lawrence River	0.14	3
R. Clayton (V)	St. Lawrence River	0.31	2
S. Alexandria Bay (V)	St. Lawrence River	0.75	2
T. Ogdensburg (C)	St. Lawrence River	6.50	18
U. Waddington (V)	St. Lawrence River	0.16	-
V. Malone (V)	Salmon River	3.70 (groundwater dis.)	-

(V) - Village
(T) - Town
(C) - City
(MGD) - Million gallons per day

(57 m^3) per day to 6.5 million gallons (2.5 x 10^4 m^3) per day. Some municipal treatment systems also handle stormwater flows and are called combined systems. To prevent backup of sewers during heavy storm or snowmelt periods, these systems are equipped with overflow outlets that discharge flow directly to surface waters. These combined sewer overflows (CSOs) can be a significant source of pollution to surface waters. There are 27 known CSOs in the St. Lawrence River basin (Table V-2). Six CSOs are located in or immediately upstream of the Massena AOC.

Industrial discharges in the St. Lawrence River basin are listed in Table V-3. All discharges are regulated under the State Pollution Discharge Elimination System (SPDES) program administered by NYSDEC. Of the 14, four are major industrial dischargers, three are mining operations, four are paper mills, and three are food processing plants (dairy). Three industries discharge wastewater directly to waters within the Massena AOC. Those three include ALCOA, General Motors, and Reynolds Metals. Figure V-2 locates point sources directly to the Massena AOC.

Not all point source discharges contain substances causing use impairment in the Massena AOC. The ten permitted discharges in the St. Lawrence River drainage basin that are known to contain toxic substances are listed in Table V-4. Nine are industrial facilities, and one is a municipal wastewater treatment plant. These facilities discharge at least one of the substances listed as potential causes of use impairment in the Massena AOC.

Pollutant sources that are diffuse and not concentrated at a specific outfall or pipe are designated nonpoint sources. These include hazardous waste and landfill sites where leachate may run off the site or contaminated groundwater may drain away from the site underground. Runoff from agricultural and developed areas may carry pesticides and fertilizers to surface waters. Similarly, runoff from industrial land may carry spilled industrial chemicals into water courses. Pollutants are also deposited from the atmosphere onto land or directly into waterbodies. These pollutants may originate locally or from hundreds of miles away.

Table V-3. Industries discharging to the St. Lawrence River drainage basin (average 1989 flows, all outfalls).

Facility	Basin/Sub-basin	Flow (MGD)
1. Alcoa	Grasse River	13.30
2. Corning Glass Co.	Grasse River	0.31
3. General Motors	Raquette River, St. Lawrence River	0.22
4. Gouverneur Talc Co.	Oswegatchie River	0.35
5. Heuvelton Whey Co.	Oswegatchie River	1.00 (1.)
6. James River Paper Co.	Oswegatchie River	0.75
7. Kraft Inc. Dairy Group	St. Regis River	0.90
8. Kraft Food	Grasse River	0.50 (2.)
9. Newton Falls Paper Co.	Oswegatchie River	6.70
10. Norfolk Paper Co.	Raquette River	0.37
11. Potsdam Paper Co.	Raquette River	1.10
12. Reynolds Metals Co.	St. Lawrence River	3.70
13. Zinc Corp. of America	Grasse River	0.36
14. Zinc Corp. of America	Oswegatchie River	1.90

(1.) Permitted discharge, no measurements.
(2.) Non-contact cooling water only.

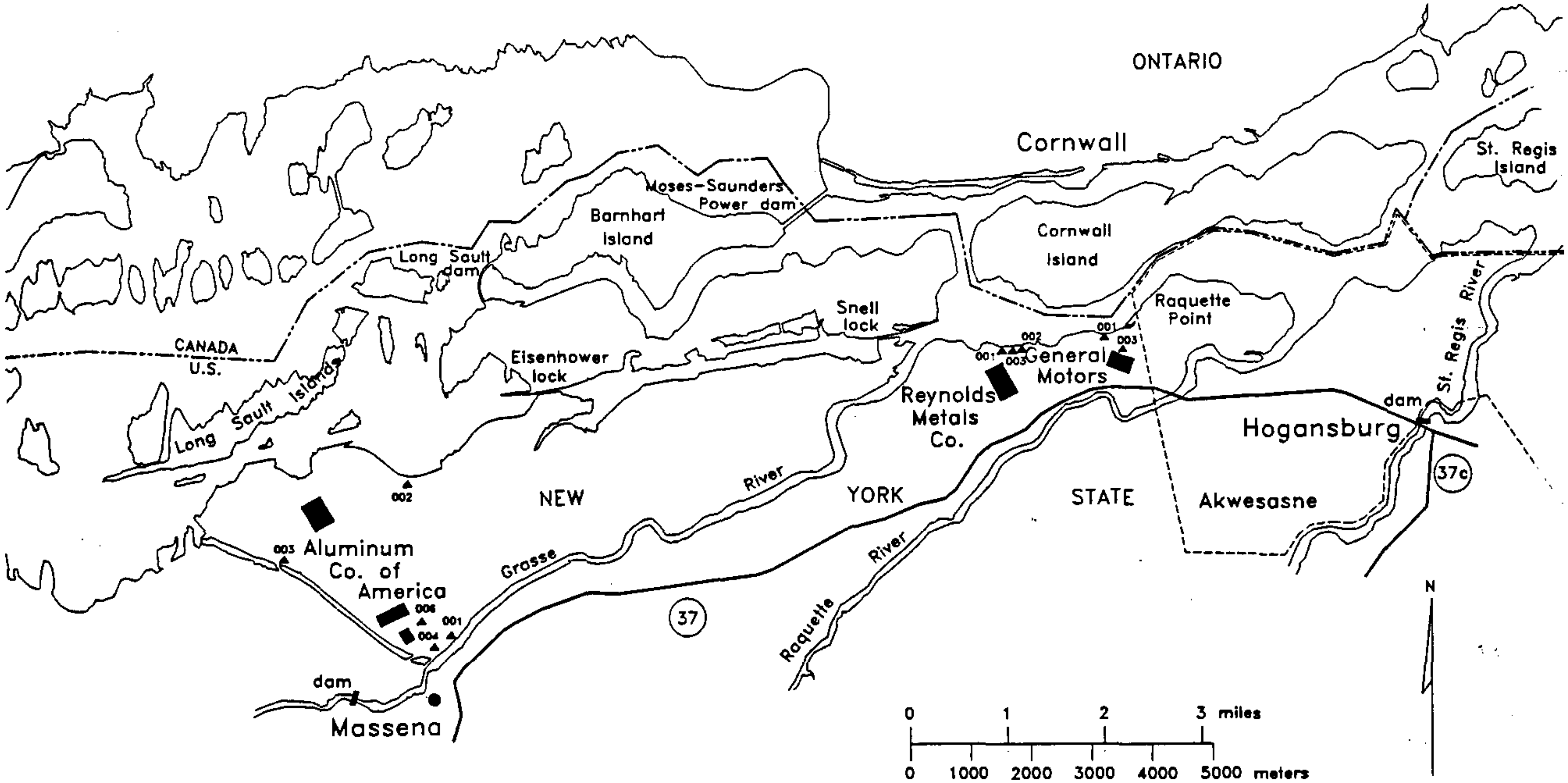


Figure V-2. Industrial (▲) and municipal (●) outfalls adjacent to the Massena AOC.

Table V-4. Toxic substances causing use impairment in the Massena AOC found in permitted discharges in the St. Lawrence River basin.

	Facility									
Substance	ALCOA	Corning Glass Co.	General Motors	Gouverneur Talc	James River Paper Co.	Newton Falls Paper Co.	Ogdensburg STP	Potsdam Paper Co.	Reynolds Metals	Zinc Corp. of America
DDT, metab.	-	-	-	-	-	-	-	-	-	-
Dioxin	-	-	-	-	-	-	-	-	-	-
Mirex	-	-	-	-	-	-	-	-	-	-
PAHs	X	-	-	-	-	-	-	-	X	-
PCBs	X	-	X	-	-	-	-	-	X	-
Aluminum	X	-	X	-	-	-	-	-	X	X
Arsenic	-	-	-	-	-	-	-	-	X	-
Cadmium	-	-	-	-	-	-	X	-	-	X
Chromium	-	-	X	-	X	-	-	-	-	-
Copper	X	X	X	-	X	X	X	-	-	X
Cyanide	X	-	-	-	-	X	X	-	X	X
Iron	-	X	X	X	-	-	-	-	-	X
Lead	-	-	-	-	-	-	X	-	-	X
Mercury	-	-	-	-	-	-	-	-	-	X
Nickel	-	-	-	-	-	-	X	-	-	-
Zinc	X	-	-	X	X	-	X	X	X	X

Fourteen inactive hazardous waste sites have been identified in the St. Lawrence River basin (Figure V-3). Table V-5 lists the sites and gives a brief background description and status of the site investigations. Nine of the thirteen sites are associated with industries in the Massena AOC. Descriptions of these sites and the ongoing investigations surrounding proposed remediation at the sites are found in Appendix B.

An additional source of pollutants to the St. Lawrence River and the Massena AOC is Lake Ontario and the sources to it. Measurements of pollutants at the head of the St. Lawrence River are provided in order that interpretation of inputs of pollutants to the Massena AOC from Lake Ontario can be made relative to impacts from other sources. The identification of sources in the Upper Great Lakes or in Canada is outside the scope of this RAP but these sources are being addressed under several other Remedial Action Plans as well as by two binational management plans, the Niagara River and Lake Ontario Toxics Management Plans. For the purposes of this plan, identification of potential sources to the St. Lawrence River upstream of Massena will be made, however, evaluation of sources to the Massena AOC will be confined to the Grasse, Raquette, and St. Regis Rivers sub-basins.

C. Evidence of Sources of Pollution

Conventional pollutant sources and sources of toxic substances are discussed separately. Physical disturbances are discussed under the section on conventional pollutants.

1. Toxic Substances

a. Polychlorinated Biphenyls

PCBs are mixtures of chlorinated biphenyls with different degrees of chlorination. They are relatively insoluble in water and adhere readily and strongly to sediments, soils, and are soluble in fatty tissue. Because they are nonflammable and have useful heat exchange and electrical insulation properties, they have been used extensively in the electrical industry in capacitors and transformers. They were also used in hydraulic, lubricating and

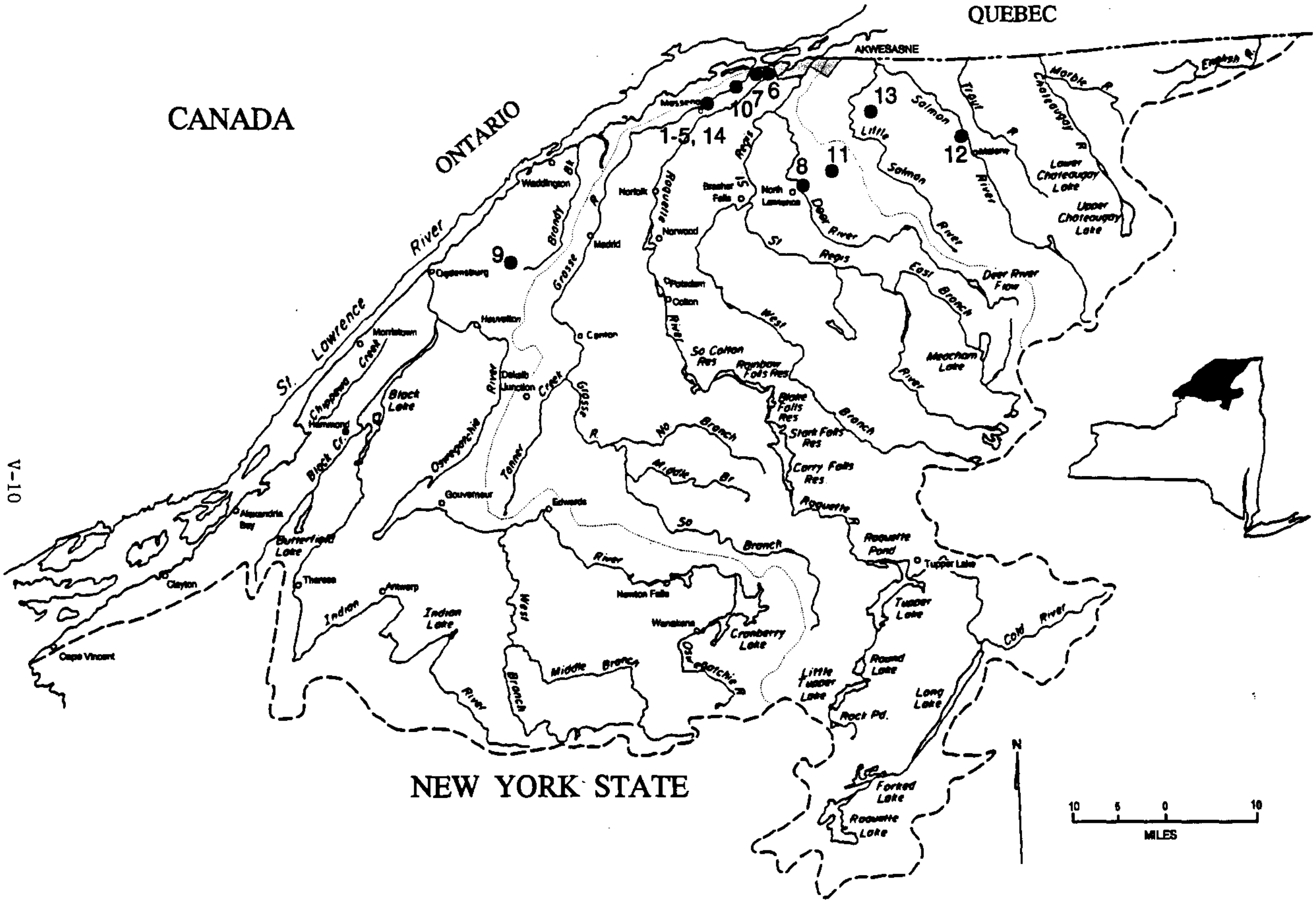


Figure V-3. NYS Hazardous Waste Sites in the St. Lawrence River Drainage Basin (numbered sites refer to Table V-5)

Table V-5. Inactive hazardous waste sites in the St. Lawrence River drainage basin.

Name	(I.D. Number)	Location	Size (Acres)	Description
1)	ALCOA-Inactive pot liner disposal site (645001)	Massena	3	Inactive, unlined disposal area used for pot liner waste.
2)	ALCOA-Industrial landfill and annex (645002)	Massena	22	17 acre active landfill established in 1955 and 5 acre inactive landfill established in 1903.
3)	ALCOA-Inactive pot liner disposal site (645003)	Massena	2	Inactive pot liner landfill near Robinson Creek.
4)	ALCOA-Dennison Road (645004)	Massena	0.75	Former disposal area for oily sludges, solvents, degreasers, etc.
5)	ALCOA-wastewater and waste oil lagoons (645005)	Massena	100	Five lagoons used for wastewater and waste oil treatment.
6)	General Motors Corp., Central Foundry Division (645007)	Massena	270	Industrial landfill, sludge disposal pits, wastewater pumphouse, five lagoons, misc. soil cont., & sediment contamination.
7)	Reynolds Metals (645009)	Massena	112	Industrial landfill, plant area, black mud lagoon, sediment cont., etc.
8)	North Lawrence Oil Dump (645013)	Lawrence	2	Waste oil and sludge disposal area located adjacent to a wetland.
9)	Sealand Restoration (645014)	Lisbon	1	Former industrial landfill and storage pit for oil spill debris, solvents, & illegally disposed degreasers. This site was remediated in 1990.

Table V-5 (continued)

Name	(I.D. Number)	Location	Size (Acres)	Description
10)	St. Lawrence-Grasse River (645015)	Massena	1,000	River segment from the St. Lawrence/Franklin County line to the Snell lock, and along the south shore of the St. Lawrence River out of the shipping canal; up the Grasse River to the Massena Power Canal discharge. Sediment contamination is concentrated near the ALCOA, Reynolds, and GMC-CFD discharge points.
11)	York Oil Company (517002)	Moira	17	Lagoons and storage tanks used as part of an oil recovery operation. PCB contamination is throughout the site.
12)	Malone Landfill (517003)	Malone	60	Leachate samples from this municipal landfill have shown contaminants present.
13)	Bombay Landfill (517004)	Bombay	63	Groundwater monitoring wells from this landfill have shown contaminants present.
14)	ALCOA Oily Waste Landfill (645016)	Massena	<1	Contains about 1400 yd^3 of residuals from heavy lube oil sludge.

cutting oil formulations as well as in pesticide formulations, adhesives, plastics, inks, paints, and sealants. The use of PCBs, except in certain closed systems, has been banned in the United States since the late 1970s. The New York State water quality standard is 0.001 ug/L (ppb) in all waters. The Food and Drug Administration (FDA) fish tissue consumption guideline is 2 ug/g (ppm). The GLWQA objective for PCBs is 0.1 ug/g (ppm) in fish tissue to protect fish consuming birds and animals, due to the fact that they bioaccumulate organochlorines. NYSDEC has a similar fish consuming wildlife criteria of 0.11 ug/g (Newell et al 1987).

PCBs have been identified as a known cause of fish and wildlife consumption advisories, in the St. Lawrence River and therefore, the Massena AOC. They are also probable causes of degraded fish and wildlife populations, degradation of benthos, and transboundary impacts. The levels noted in the AOC also have the potential to cause bird or animal reproductive problems.

There are several sources in the basin that are or may be contributing PCBs to the Massena AOC. These include:

- ALCOA, Reynolds Metals and General Motors facilities discharging wastewater directly to the AOC;

- Inactive hazardous waste sites associated with the three major industries and in the Grasse and Raquette River sub-basins where PCBs have been confirmed;

- Runoff from the three major industrial sites and developed areas;

- Contaminated bottom sediments in the Grasse, Raquette, and St. Lawrence Rivers within the boundary of the Massena AOC;

- Lake Ontario and the St. Lawrence River upstream of the Massena AOC;

- Atmospheric inputs to the St. Lawrence River drainage basin.

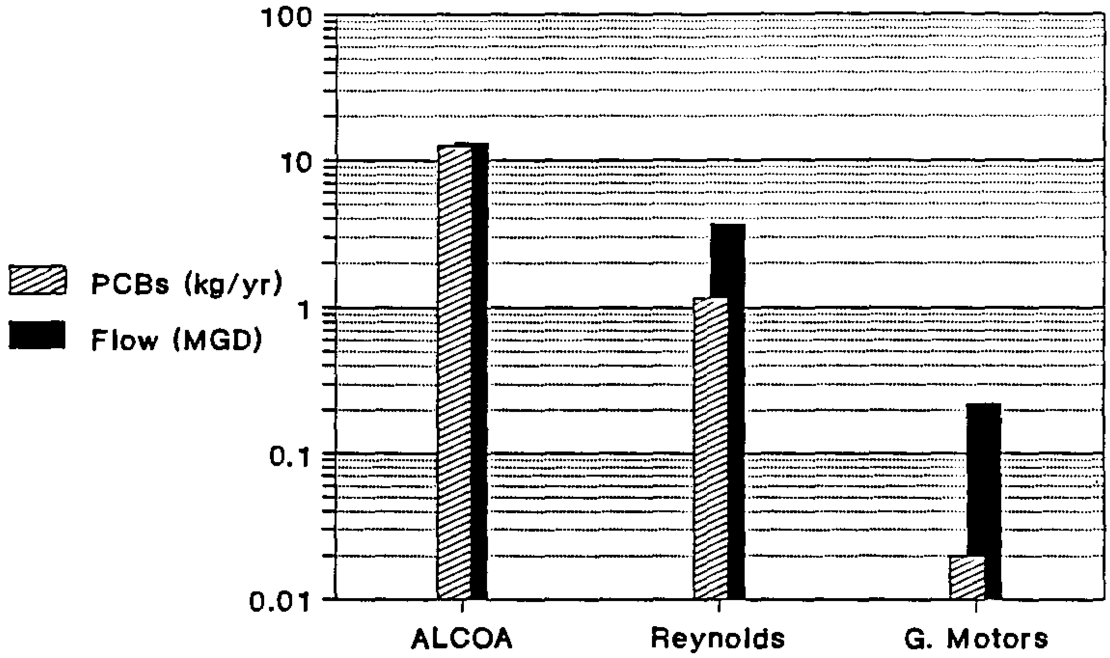
PCBs are ubiquitous in the Lake Ontario/St. Lawrence River drainage basin, probably due in part to atmospheric inputs. Sport fish from all parts of New York State contain measurable amounts of PCBs in their tissues (NYSDEC 1987). A baseline or "backgound" level of total PCBs in NY fish tissue has been estimated to be about 0.1 ppm on a wet weight basis (NYSDEC 1990c).

Lake trout from Hemlock Lake, a western New York water supply reservoir with no industrial or municipal discharge, had PCB tissue levels of 0.49 ug/g in 1984. The lake trout in Lake Ontario averaged 2.4 ug/g (ppm) in 1985 samples (IJC 1989). While lake trout are not regularly found in the St. Lawrence River, indigenous species had PCB tissue levels ranging from 2 ug/g (ppm) to greater than 46 ug/g (ppm) in 1988. Smallmouth bass from the Massena AOC averaged 1.53 ug/g (ppm) PCBs in 1988, while smallmouth bass from the St. Lawrence River near the Lake Ontario outlet averaged 0.51 ug/g in 1983 (NYSDEC 1987). In 1988, smallmouth bass and carp from several Lake Ontario locations averaged 54 ppm PCB on lipid basis (NYSDEC 1990c). This is similar to 1988 levels found in St. Lawrence River fish in the Massena AOC (58 ppm and 59 ppm) (NYSDEC 1990c). Spottail shiners sampled in 1986 above the Moses-Saunders Power Dam on the St. Lawrence River had average PCB concentrations of 0.05 ug/g (ppm), while spottail shiners collected the same year below Massena area industrial outfalls had average PCB tissue levels ranging from 0.83 to 6.35 ug/g (NYSDEC 1990). Lake Ontario and the St. Lawrence River have an impact on PCB levels in fish in the Massena AOC. However, recent analyses of fish collected near the mouth of the Grasse River and near the mouth of an unnamed tributary to the St. Lawrence River near General Motors has indicated those areas and an area on the north shore of Cornwall Island as sources of PCBs (NYSDEC 1990c and Appendix A).

PCBs have been detected in industrial point source discharges to the Massena AOC. A rough estimate of the total annual discharge of PCBs by the three major industries is shown in Figure V-4. These estimates are from permitted discharges only and do not include runoff from the industrial sites. The values were calculated using average 1989 discharge rates using limited sampling data. The actual annual loading from these permitted discharges could therefore, be somewhat lower or higher. These data are most useful in comparing the relative amounts of PCBs discharged to the Massena AOC from the point source components of the total load with the other probable sources. Recent data available on the individual discharges of the three industries were plotted relative to permit limits (Figures V-5 through V-9).

Inactive hazardous waste sites are a second known source of PCBs to the Massena AOC. Table V-6 lists the inactive hazardous waste sites in the St. Lawrence River drainage basin and the toxic substances confirmed to be at those sites by groundwater, leachate, and soils testing. The 14 sites in the St. Lawrence River drainage basin are at various stages of investigation and evaluation (NYSDEC 1990a). Therefore, the amount of data available varies from site to site. It appears that the eight inactive hazardous waste sites in the drainage of the Grasse and Raquette Rivers are sources of PCBs and other substances via groundwater and runoff. Other sites have been less intensively monitored at this time and are only considered potential sources of pollutants. Three of those sites (the North Lawrence Oil dump, Sealand Restoration and York Oil Company) have had PCBs confirmed during testing. The Sealand Restoration site was remediated in 1990 but could have contributed PCBs to the St. Lawrence River drainage basin prior to remediation.

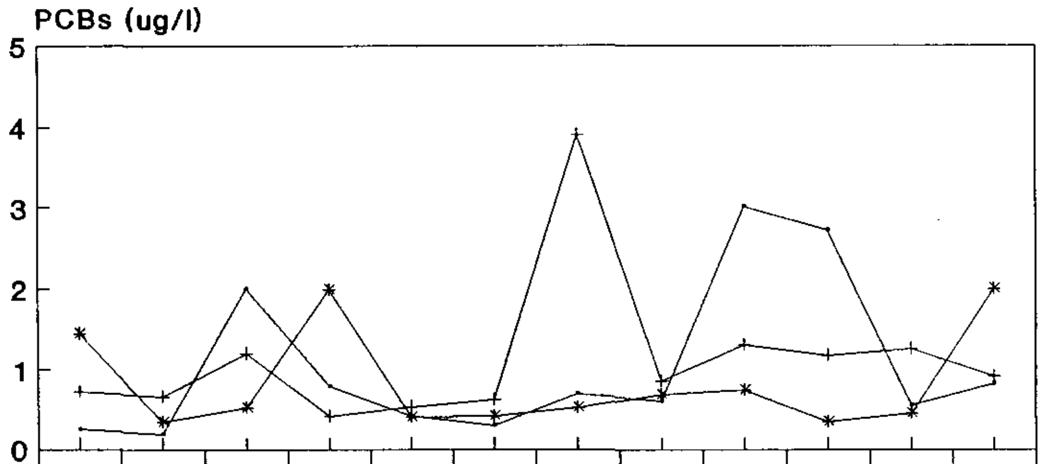
The inactive hazardous waste sites adjacent to the Massena AOC are those sites associated with the three major industries, ALCOA, General Motors, and Reynolds Metals. A detailed description of the sites and their



	ALCOA	Reynolds	G. Motors
PCBs (kg/yr)	12.45	1.16	0.02
Flow (MGD)	13.3	3.7	0.22

Figure V-4. Estimated annual discharge of PCBs and relative flows for Massena AOC industries (1989 data)

ALCOA



Month	1	2	3	4	5	6	7	8	9	10	11	12
1987	0.25	0.19	2	0.79	0.42	0.3	0.7	0.6	3.02	2.73	0.56	0.82
1988	0.72	0.66	1.2	0.42	0.53	0.63	3.9	0.86	1.3	1.18	1.26	0.92
1989	1.44	0.35	0.52	1.99	0.4	0.42	0.52	0.68	0.74	0.35	0.45	2

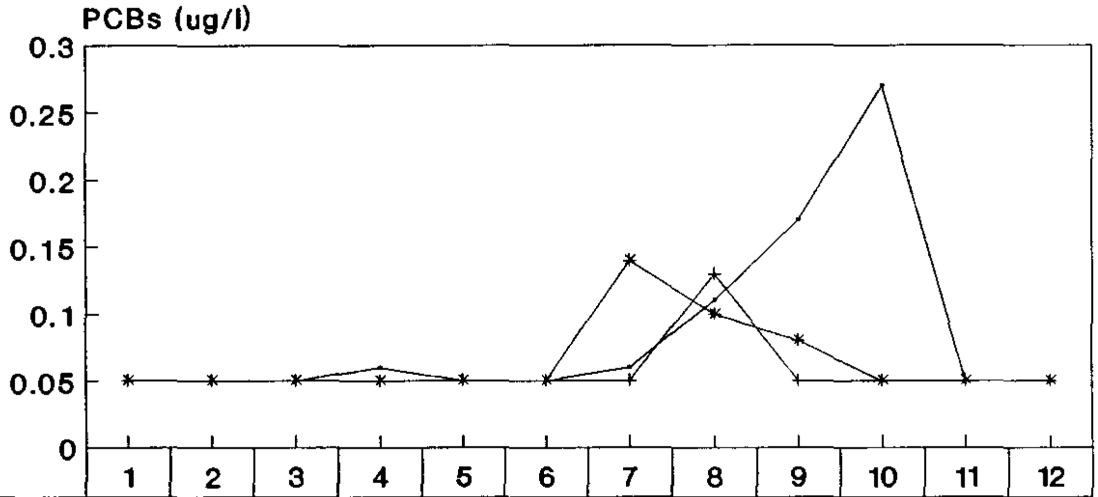
Month

—•— 1987 —+— 1988 —*— 1989

Outfall 001

Figure V-5. Monthly maximum discharge of PCBs at ALCOA outfall #001 (detection limit = 0.05 ug/l; permit limit = 2.0 ug/l)

General Motors



	1	2	3	4	5	6	7	8	9	10	11	12
1987	0.05	0.05	0.05	0.06	0.05	0.05	0.06	0.11	0.17	0.27	0.05	0.05
1988	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05	0.05
1989	0.05	0.05	0.05	0.05	0.05	0.05	0.14	0.1	0.08	0.05	0.05	0.05

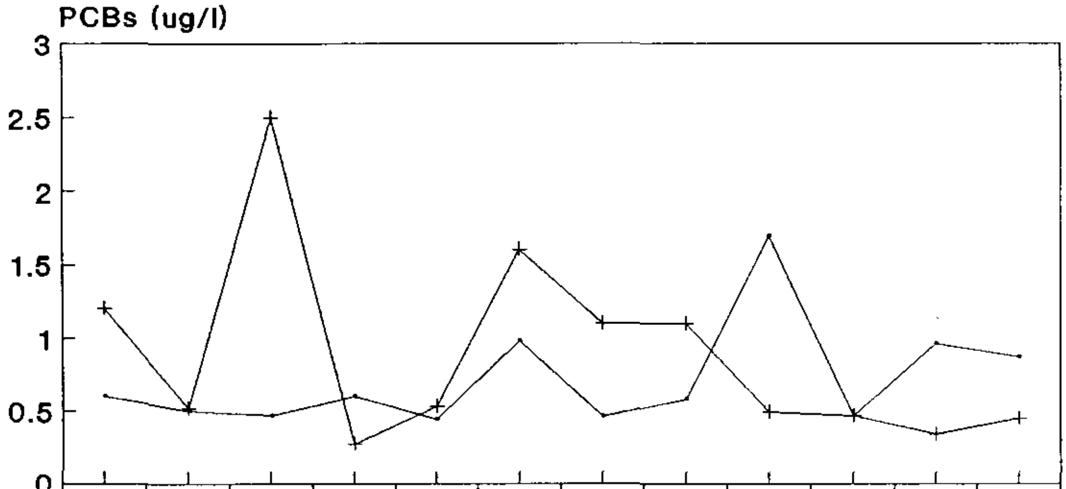
Month

— 1987 —+— 1988 —*— 1989

Outfall 001

Figure V-6. Monthly maximum discharge of PCBs at General Motors outfall #001 (detection limit = 0.05 ug/l; permit limit = 2.0 ug/l)

General Motors



	1	2	3	4	5	6	7	8	9	10	11	12
1987	0.6	0.5	0.47	0.6	0.44	0.98	0.46	0.58	1.7	0.47	0.96	0.87
1988	1.2	0.52	2.5	0.27	0.53	1.6	1.1	1.1	0.49	0.47	0.34	0.45

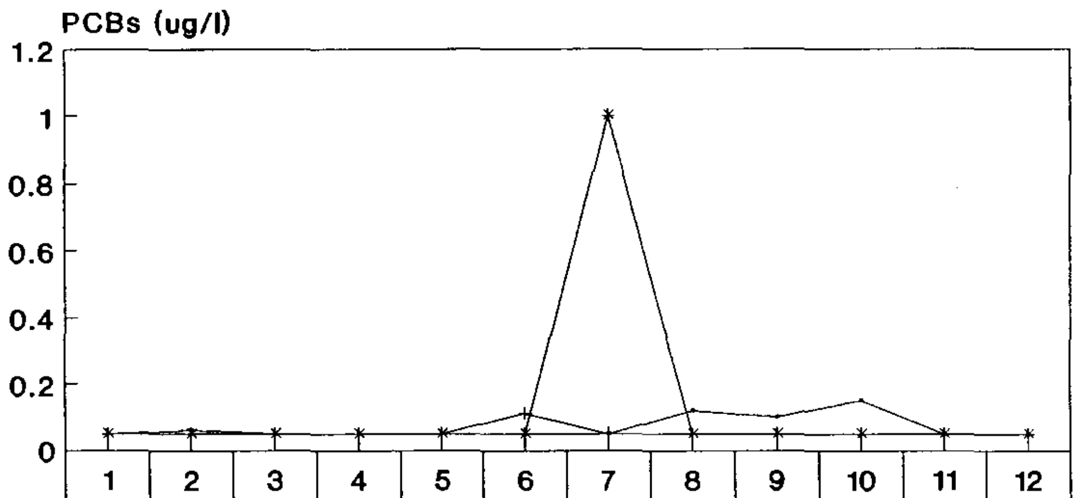
Month

1987 1988

Outfall 002

Figure V-7. Monthly maximum discharge of PCBs at General Motors outfall #002 (detection limit = 0.05 ug/l; permit limmit = 2.0 ug/l; outfall abandoned in 12/1988)

General Motors



	1	2	3	4	5	6	7	8	9	10	11	12
1987	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.12	0.1	0.15	0.05	0.05
1988	0.05	0.05	0.05	0.05	0.05	0.11	0.05	0.05	0.05	0.05	0.05	0.05
1989	0.05	0.05	0.05	0.05	0.05	0.05	1	0.05	0.05	0.05	0.05	0.05

Month

— 1987 —+— 1988 —*— 1989

Outfall 003

Figure V-8. Monthly maximum discharge of PCBs at General Motors outfall #003
(detection limit = 0.05 ug/l; permit limit = 2.0 ug/l)

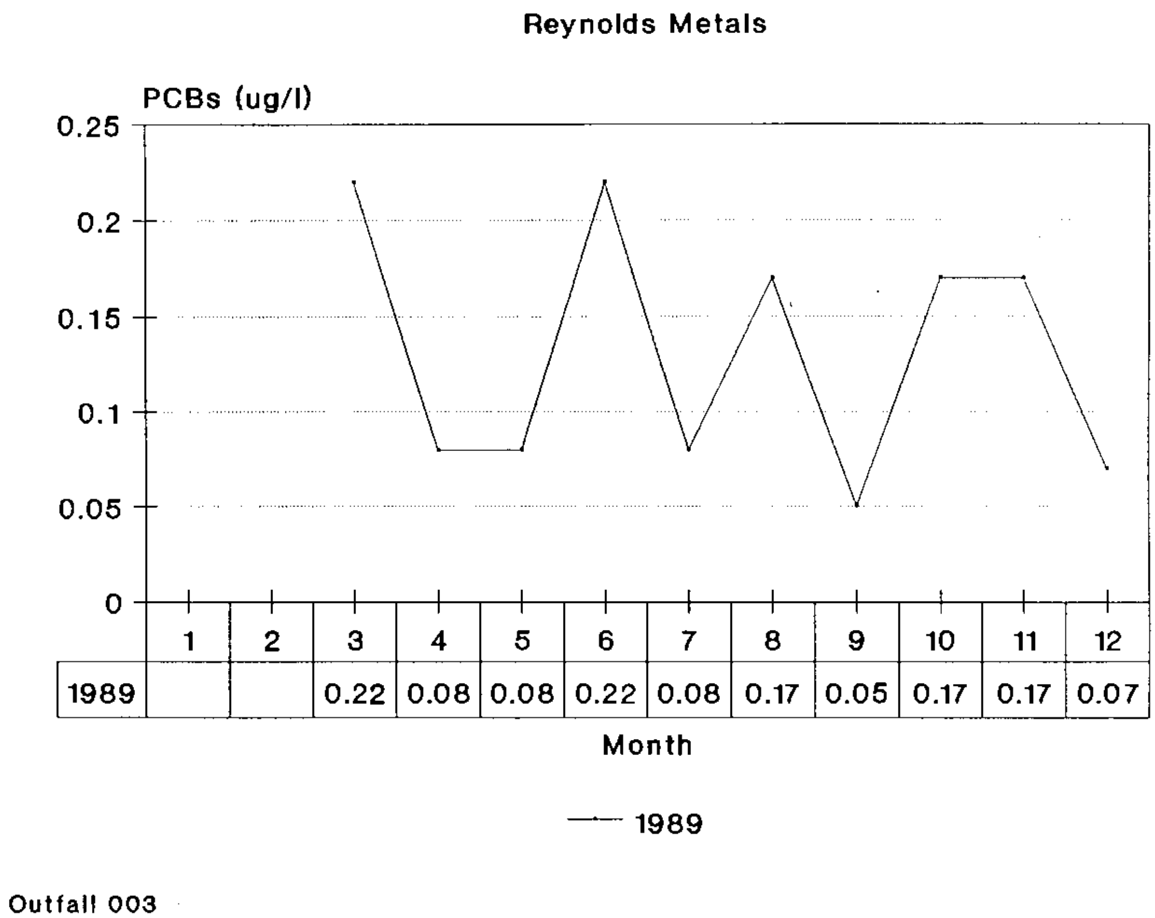


Figure V-9. Monthly maximum discharge of PCBs at Reynolds Metals outfall #003 (detection limit = 0.05 ug/l)

Table V-6. Substances of concern confirmed at inactive hazardous waste sites in the St. Lawrence River drainage basin.

	Waste Sites (1.)													
Substance	1 (2.)	2 (3.)	3 (2.)	4 (3.)	5 (4.)	6 (5.)	7 (6.)	8	9(7.)	10	11	12	13	14
DDT and metabolites	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Dioxin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	-	X	X	X	X	X	X	-	-	X	-	X	-	-
PCBs	X	X	-	X	X	X	X	X	X	X	X	-	-	X
Aluminum	X	X	X	-	X	X	-	-	-	-	-	-	-	-
[illegible]enic	-	-	-	-	X	X	X	-	-	-	-	-	-	-
Cadmium	-	X	-	X	X	X	-	-	X	-	-	-	-	-
Chromium	X	-	-	-	-	X	-	-	-	-	-	-	-	-
Copper	X	X	-	-	X	X	X	-	-	-	-	-	-	-
Cyanide	X	-	X	-	X	-	X	-	-	-	-	-	-	-
Iron	-	-	-	-	-	X	X	-	-	X	-	-	-	-
Lead	X	-	-	-	-	X	-	X	X	-	-	-	-	-
Mercury	-	X	-	-	-	X	-	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	X	-	-	-	X	-	-	-	-
Zinc	-	-	-	-	X	X	-	-	X	-	-	-	-	-

(1.) Site numbers refer to Figure V-3 and Table V-4 .
(2.) Includes groundwater and leachate data.
(3.) Includes groundwater, leachate and soil data.
(4.) Includes groundwater and sludge data.
(5.) Includes groundwater, surface soil and subsurface soil data.
(6.) Includes groundwater data only.
(7.) Site remediated in 1990.

current status is given in Appendix B. Sampling data from groundwater monitoring wells,surface soils, and bottom sediments in the rivers near these sites indicates some offsite movement of PCBs to the Massena AOC water courses.

Bottom sediments contaminated with PCBs are also probably a source of toxics to the water column. Contaminated sediments have been cited as causing use impairments in the Massena AOC. Insufficient data currently exists to determine the absolute contribution of PCBs from sediment to the water column and their concurrent impact on fish and wildlife resources. Documentation of the extent of PCB contamination of bottom sediments is being prepared under the federal and state hazardous waste remediation programs. Sediment sampling sites used to document the potential sources of contamination are shown in Figure V-10. Details of sites and data are given in Appendix D. Sources of PCBs upstream of the Massena AOC have been identified but direct documentation is lacking in many cases. The magnitude of their impact cannot be determined with confidence. However, the presentation of data and estimates of PCB loadings to the Massena AOC from sources outside the AOC is important to the understanding of the problem. Figure V-11 shows the estimated loadings of PCBs from various sources. The total annual load estimate can only be considered approximate due to the potential sources of error inherent in calculating some of the loading components. Ambient monitoring at the head of the St. Lawrence River by Environment Canada provided the data representing loading of PCBs from Lake Ontario (DOE 1990). Lower detection limits and a change to high volume samplers resulted in higher loading estimates to the River in 1989. Point source estimates were derived from average discharge data provided to NYSDEC. (NYSDEC 1989).

The largest source of variability is probably in the atmospheric and surface runoff estimates. Dry deposition contributions were estimated from data

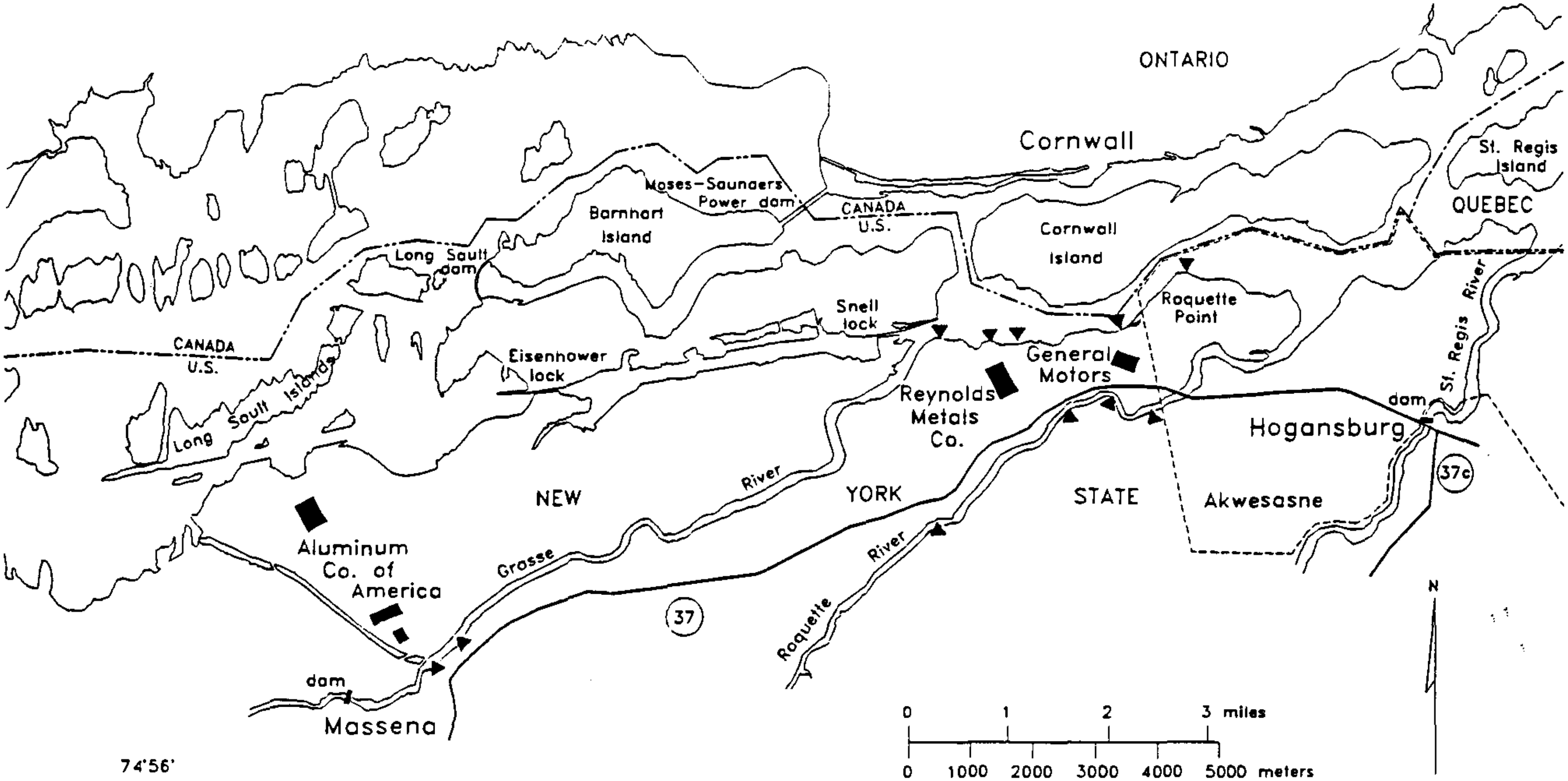


Figure V-10. Approximate locations (▲) in the Massena AOC where sediment samples have been collected for contaminant analyses (Sources: RMT 1986; Woodward-Clyde 1989; Young-Morgan Assoc. 1989)

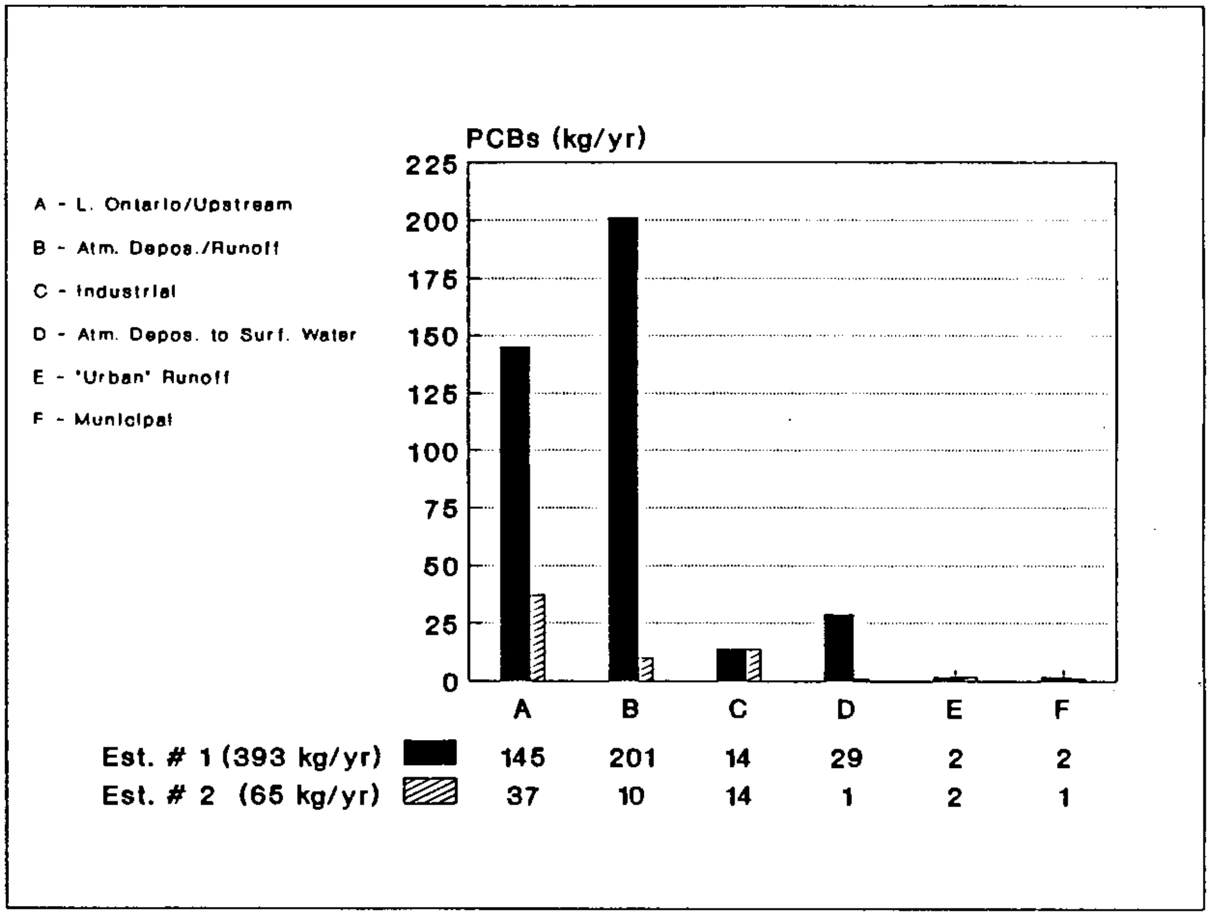


Figure V- 11. Estimated annual loading of PCBs to the Massena AOC in 1989 from various sources (#1 @ 40 ng/l PCB in atmospheric deposition; #2 @ 2.4 ng/l) developed for Lake Superior, a much less developed basin than Lake Ontario or the St. Lawrence River. Runoff from the watershed was calculated using an average of 31" (0.8m) precipitation on the basin with 7% reaching streams at average PCB concentrations of 40 ug/L (ppb) (Rice 1989). This figure was used in the #1 estimate for the atmospheric components in Figure V-11. Estimate #2 was made using 2.4 ug/L (ppb) in the atmospheric components (IJC 1988). Dry fallout onto surface waters was calculated using 100 $ug/m^2/yr$ over 1% of the watershed (Rice 1989). The St. Lawrence River was estimated to average two miles (3.2 km) in width for 110 miles (176 km) in length upstream of Massena. Residential runoff values were calculated using 0.04 ug/L (ppb) PCB at 31" (0.8m) precipitation annually with 50% runoff (Wong 1981). Runoff from industrial areas was estimated by using 0.08 ug/L (ppb) PCB at 31" (0.8m) precipitation annually at 50% runoff (Wong 1981). Discharges of PCBs from municipal point sources in the basin were assumed to be 0.02 ug/L (ppb).

Despite the assumptions and limitations of the data, this analysis implies that a portion of the current PCB loading to the Massena AOC is coming from Lake Ontario, the St. Lawrence River and from atmospheric inputs to the watershed. The values for PCBs in rainfall vary by an order of magnitude making the estimates somewhat questionable. Also, current loadings may not reflect the impact on aquatic biota as described in Chapter IV. Additional surveillance monitoring data must be gathered in New York State to better determine the loading components and predict their impacts on the aquatic resources.

b. Dioxin

Dioxins are chlorinated organic compounds with low water solubility that bind to sediment and soil particles and concentrate in fatty tissues. Dioxins bioaccumulate moderately in the aquatic environment. They are by-products of incomplete combustion in the presence of chlorine and are found in fly ash and other products of these processes. They are also by-products of the alkaline treatment of chlorinated phenols. One of the most toxic forms is 2,3,7,8-tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD). The New York State water quality standard for TCDD is 0.000001 ug/L (ppb) in A, A-Special, B, C, and D waters based on prevention of bioaccumulation in fish flesh. There is no FDA guideline for TCDD, but the New York State Department of Health has set 10 ng/kg (ppt) as a fish tissue level that would trigger a consumption advisory. The NYSDEC piscivorous wildlife guideline for dioxin is 2.3 ng/kg (ppt).

Dioxin has been identified as a contributing cause of the fish and wildlife consumption advisory. It has also been detected in fish from the Massena AOC. A channel catfish sampled from the mouth of the Grasse River in the Massena AOC in 1988 had tissue levels of 10 ng/kg (ppt) TCDD (USEPA 1989). A brown bullhead and northern pike collected the same year in the St. Lawrence River near the mouth of an unnamed tributary on the General Motors property had detectable levels of 2,3,7,8-TCDD in their tissue (NYSDEC 1990).

There are no known or permitted discharges of dioxin in the basin. There are no known inactive hazardous waste sites in the basin reported to contain dioxin. However, dioxin is not routinely analyzed for due to the analytical difficulty and expense. Polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofurans have been detected in soil samples taken from the Reynolds Metals property, however (Woodward-Clyde 1989). A potential source from a process facility has been suggested. These data indicate a potential source of dioxins and furans to the AOC as a result of their typical association with PCBs and subsequent distribution in the environment. Lake Ontario may also be a source of dioxin since fish sampled there have shown elevated levels in tissue (NYSDEC 1990d).

c. Mirex

Mirex is a persistent chlorinated compound that is resistant to biological and chemical degradation. It is converted to photomirex by sunlight with the loss of one chlorine atom per molecule. Both compounds are insoluble in water but concentrate in fatty tissue and adhere to sediment particles. Mirex was originally used as an insecticide and fire retardant and was produced in Niagara Falls, New York. It is no longer produced or used in New York. Mirex was used for experimental purposes by Armstrong Cork near Fulton, New York in the 1960s. Mirex bioaccumulates in the aquatic food chain and is an animal carcinogen. The New York State water quality standard is 0.001 ug/L (ppb) for all waters. The FDA fish flesh consumption guideline is 0.1 mg/kg (ppm). The GLWQA objective for mirex is less than detection in water and aquatic organisms. The method detection limit in water using USEPA standard methods is 0.1 mg/l (ppm). In fish tissue it is 0.01 mg/kg (ppm).

Mirex has been identified as a known cause of fish and wildlife consumption advisories in the St. Lawrence River, and therefore, the Massena AOC. Channel catfish from the Grasse River exceeded the FDA consumption guideline for mirex in 1988. Most samples collected and analyzed, however, were well below the FDA guideline (NYSDEC 1989). There is evidence that Lake Ontario is the source of mirex to the St. Lawrence River. Mirex is listed in the Lake Ontario Toxics Management Plan as having impacted Lake Ontario biota. Historic sources of mirex to Lake Ontario have been identified in the Niagara River and Oswego River drainage basins only (NYSDEC 1989b). No sources of mirex have been identified in the St. Lawrence River basin or in the Massena AOC. There are no known permitted discharges of mirex in the basin and no known uses. It has not been identified at any of the inactive hazardous waste sites in the basin, but is not regularly analyzed for.

d. Mercury

Mercury is found as a natural mineral, usually as the sulfide. In its refined form it is widely used in batteries, electrical contacts, and thermometers. Mercury is also found in coal and can be released to the environment during combustion. At one time, it was used extensively in the electrolytic production of chlorine from brine. It was also used as a pesticide and a slimacide, but was banned from use in New York effective July 1, 1971. In streams, ponds, and lakes, it is bound to sediments but can be transformed by certain bacteria to form methyl mercury which is rapidly taken up by aquatic life, particularly fish. New York State has a water quality standard of 2 ug/L (ppb) for mercury based on protection of public health in A and A-Special waters, and a guidance value of 0.2 ug/L (ppb) in A, A-Special, B, and C waters, based on prevention of bioaccumulation in fish flesh. The FDA fish flesh consumption guideline is 1 mg/kg (ppm). The GLWQA objective for mercury is 0.2 ug/L (ppb) in filtered water and 0.5 ug/g (ppm) in whole fish.

Mercury has been determined to be adversely impacting use in the Massena AOC. It has caused restrictions on fish and wildlife consumption, and is implicated in transboundary impacts. It is likely one of the components of the causes of degraded fish and wildlife populations also.

There are a few known sources in the St. Lawrence River drainage basin that are probably contributing mercury to the Massena AOC. They include:

- two inactive hazardous waste sites in the Massena AOC;
- two industrial discharges from mining operations;
- Lake Ontario.

Potential sources of mercury include:

- Cornwall, Ontario industrial point source;
- Natural processes;
- Atmospheric deposition.

There are no permitted discharges of mercury to the Massena AOC. One industrial discharge to a tributary of the Grasse River and one to the Oswegatchie River have mercury limits in their discharge permits. Both facilities are mining operations operated by Zinc Corporation of America. Mercury has not been detected during effluent monitoring. Two inactive hazardous waste sites adjacent to the Massena AOC are known to contain mercury. Testing of groundwater, soils, and leachate from these sites has confirmed mercury contamination. Tissue analyses of sport fish collected in 1988 indicate exceedences of GLWQA objectives for all eight species collected. The location of fish sampling sites included the St. Lawrence, Grasse, Raquette, and St. Regis Rivers, within the boundaries of the Massena AOC.

Upstream sources of mercury could also be impacting the Massena AOC resources. Smallmouth bass from Chaumont Bay near the outlet of Lake Ontario, had an average of 0.54 ppm, (0.28-0.77 ppm) in 1983 (NYSDEC 1987). Smallmouth bass analyzed in 1988 from the Massena AOC had mean levels of 0.56 and 0.58 ppm mercury. Other areas outside the Massena AOC have also been shown to have similar levels of mercury in smallmouth bass.

Significant point sources of mercury have been documented on the Canadian side of the St. Lawrence River in the vicinity of Cornwall (DOE, OMOE, OMNR 1988). Sediment levels exceeded Provincial guidelines for disposal at two major industrial discharges in 1985. Hydrologic conditions probably preclude direct impact of these mercury discharges across the river at Massena. However, movement of fish that bioaccumulate mercury or other contaminants is not restricted by these flow patterns.

e. DDT and metabolites

DDT, a chlorinated hydrocarbon insecticide, was at one time the most widely used chemical for the control of insect pests. It was used for more than 30 years. Its forms included powders, emulsions, and encapsulations. The use of DDT was discontinued in 1973 after being banned by USEPA.

DDT is a persistent, fat-soluble pesticide. Because of its persistent nature, hydrophobic properties and solubility in lipids, DDT and its metabolites are concentrated by aquatic organisms at all trophic levels. DDT has several metabolites. The two most frequently found in nature are TDE (DDD or Rhothane), and DDE.

In all New York State waters the standard for DDT and metabolites is 0.001 ug/L (ppb) in Class A, A-Special, B, C, and D waters based on protection of aquatic resources. The FDA fish tissue consumption guideline for DDT is 5.0 ppm. The GLWQA objective for DDT and metabolites is 1.0 ppm for the protection of fish consuming birds and animals. NYSDEC has a 0.2 ppm guideline for the protection of fish consuming wildlife.

DDE has been cited as one of the substances likely causing degradation of fish and wildlife populations in the Massena AOC. A few fish sampled in 1983 from sites within the boundaries of the Massena AOC had detectable levels of DDT and metabolites in their tissues. All levels were well below standards or guidelines for consumption, however. Forage fish collected in 1979-1981, 1983, 1986, and 1987 also had detectable levels of DDT, but well below guidelines for the protection of piscivorous wildlife (Appendix A). Despite the documented low levels in fish, mink sampled within five miles o: the St. Lawrence River had elevated levels of DDE in their tissues (Foley et al. 1988).

Lake Ontario is the only known source of DDT and its metabolites to the Massena AOC.

There are no known permitted discharges or use of DDT or its metabolites in the St. Lawrence River basin. A one acre (0.4 ha) inactive hazardous waste site is confirmed to have had DDT and DDD in surface soil samples analyzed during initial remedial investigations. This site, the Sealand Restoration site, is located in the town of Lisbon. The analyses indicated very low levels of the two substances and the levels were consistent with levels detected on nearby farm fields not used for disposal of contaminants. The site is not in the sub-basins to the Massena AOC, but could have contributed contaminants to the St. Lawrence River upstream of Massena before it was remediated in 1990.

Elevated levels of DDT noted in fish tissue samples taken in eastern Lake Ontario and the St. Lawrence River near Massena in the early 1980's (NYSDEC 1987) are thought to be declining, at least for young-of-the-year spottail shiners (Skinner and Jackling 1989). Spottail shiners collected at the head of the St. Lawrence River averaged 14 ng/g DDE in 1985, 13 ng/g in 1986 and 6 ng/g in 1987. Average concentratons of DDE in St. Lawrence River young-of-the-year spottail shiners from the Massena AOC ranged as high as 70 ng/g in 1986 for one sample, but all others collected in the St. Lawrence River or eastern Lake Ontario were below 30 ng/g. These levels are well below regulatory limits set by FDA (5000 ng/g), IJC (1000 ng/g) and NYSDEC for piscivorous wildlife criteria (200 ng/g).

Loadings of DDT and metabolites by water and suspended sediment are also thought to be declining in Lake Ontario and the St. Lawrence River (IJC 1989a). The highest levels of DDT and metabolites (33 and 34 ug/kg) were detected in suspended sediment samples collected in 1981 from Kingston and Cornwall, Ontario, upstream of Massena (IJC 1989a). Data from 1985 indicate a decline in suspended sediment loading of total DDT at Wolfe Island (11 lbs/yr; 5kg/yr) near the head of the St. Lawrence River, when compared to 1982 loadings for the same location (31 lbs/yr; 14 kg/yr). These data indicate that upstream sources may still be contributing to the levels of DDT and metabolites detected in the St. Lawrence River biota at Massena.

f. Polynuclear Aromatic Hydrocarbons (PAHs)

Polynuclear aromatic hydrocarbons (PAHs) are a diverse class of compounds consisting of substituted polycyclic and heterocyclic aromatic rings. PAHs are formed as a result of incomplete combustion of organic compounds. Among the PAHs are compounds such as benzo(a)pyrene, and benz(a)anthracene.

PAHs are present in the environment from both natural sources and human activities. As a group, they are widely distributed in the environment.

PAHs adsorb strongly onto suspended particulates and biota and their transport will be determined largely by the patterns of sediment deposition and resuspension in the aquatic system. PAHs dissolved in the water column are believed to degrade by direct photolysis at a rapid rate. The fate of those PAHs which accumulate in the sediment is thought to be biodegradation and biotransformation by benthic organisms.

Benzo(a)pyrene is one of the most toxic PAHs. It has been documented to cause liver tumors in freshwater fish. The New York State ambient water quality standard for benzo(a)pyrene is 0.0012 ug/L (ppb) for the protection against bioaccumulation in aquatic organisms in Class A, A-Special, B, C, and D waters. The New York State standard for Class A drinking water is 0.002 ug/L (ppb).

Ten different PAHs have been detected in sediment samples taken in the Massena AOC (RMT, Inc. 1986). This group of chemicals has been cited as a likely cause of fish tumors or other deformities although the necessary tumor surveys have not been conducted to confirm this. The levels detected in localized bottom sediments indirectly suggest the likelihood that tumors in fish exist.

There are several sources of PAHs to the Massena AOC. These include:

- ALCOA and Reynolds Metals point source discharges to Massena AOC;

- six of the eight inactive hazardous waste sites in the Massena AOC.

Two point source discharges within the Massena AOC are known to contain PAHs. Information is currently inadequate to determine loadings from these sources to the receiving waters. Benzo(a)pyrene is listed in two permitted discharges to the Massena AOC, that of ALCOA and Reynolds Metals. Reynolds Metals also has five other PAHs in its discharge permits. No exceedences of limits for any PAHs were recorded for either of these permitted discharges in 1989 or 1987. One exceedence of the benzo(a)pyrene limit out of 12 samples occurred in 1988 in a Reynolds outfall (NYSDEC 1989).

Six of the inactive hazardous waste sites in the Massena AOC sub-basins have been documented to have PAHs in groundwater, leachate, and soils associated with the sites (Table V-6). All six of the sites are associated with the three major industries in the Massena AOC.

Sediments contaminated with PAHs have also been documented at areas in the Massena AOC. Sediments from the Grasse River in the vicinity of

ALCOA and the St. Lawrence River near both the Reynolds Metals and General Motors facilities have been sampled and analyzed for contaminants. The most extensive sampling and analysis for PAHs was done adjacent to the GM property in the St. Lawrence River. PAH contamination there (Table IV-3) is associated with outfalls and land based activities adjacent to the River.

g. Metals

Arsenic, chromium, copper, lead, nickel, and zinc are metals found naturally in the earth's crust usually combined with one or more elements such as oxygen, chlorine, sulfur, etc. Arsenic is mainly used in this country in the production of pesticides. The others are typically used in manufacturing processes for household and industrial products. Most are also found in the atmosphere from combustion and industrial emissions. Low levels of metals are common in waters across New York State. Cadmium, copper, lead, mercury, nickel, and zinc were the most frequently identified pollutants during statewide sampling and analysis of surface waters in 1986 (NYSDEC 1988). Table V-7 shows applicable New York State standards and GLWQA objectives for the metals of concern. There are no fish tissue guidelines for any of the metals in this group.

Metals as a group have been identified as the cause of use impairment downstream of the Massena AOC. The 11 metals listed for the transboundary impacts are potential causes of impacts. In addition, arsenic, chromium, copper, lead, nikel and zinc in bottom sediments in the Massena AOC have the potential of causing additional impacts. These six metals, cited as impacting benthos and potentially, dredging, will be evaluated relative to potential sources. Inventory data for aluminum, cadmium, cyanide and iron are provided where available. Mercury was evaluated separately in a previous section.

Table V-7. New York State standards and GLWQA objectives for selected metals (ug/l or ppb).

	NYSDEC Human Health Class A,A-Special	NYSDEC Aquatic Res. Protection Classes A,A-Special,B,C	GLWQA
arsenic	50	190 [1]	50
chromium (total)	50	207 [2]	50
copper	200	12 [2]	5
lead	50	3 [2]	25
nickel	----	96 [2]	25
zinc	300	30	30

[1] Dissolved form.

[2] Formula based standards were calculated at 100 mg/L hardness ($CaCO_3$).

There are numerous known sources of metals in and to the Massena AOC. These include:

- All of the point source discharges in the St. Lawrence River drainage basin;

- Discharges from ALCOA, Reynolds Metals and General Motors industrial facilities to the Massena AOC;

- All of the inactive hazardous waste sites in the Massena AOC and in the entire St. Lawrence River drainage basin;

- Lake Ontario.

Potential sources of metals include:

- Natural leaching processes and other nonpoint sources.

Data on metals levels in biota are limited for the Massena AOC. Some data are available for metals levels in snails (Lymphaea catascopium) and giant water bug (Belostoma sp.) collected from the St. Lawrence River near the General Motors facility in 1986. All the 13 metals analyzed for in macroinvertebrates were below detection levels except for copper, lead, and zinc (NYSDEC 1990b). Tissue levels of lead did not reflect contaminated conditions in the areas sampled (NYSDEC 1990d).

Comprehensive data on metals levels in bottom sediments are not available. However, elevated levels of copper (Appendix B) have been detected in bottom sediments of the St. Lawrence River, the Massena power canal, and the Grasse River in the vicinity of the ALCOA facility outfalls (Eng. Sci. 1989).

There are point source discharges to the St. Lawrence River basin (Table V-4) that contain one or more of the metals of concern. The three major industries in the Massena AOC discharge arsenic, copper, chromium, and zinc. There were no known exceedences of ALCOA, General Motors, or Reynolds Metals permit limits for any of these metals in 1988 or 1989 (NYSDEC 1989). There are ten facilities in the St. Lawrence drainage basin that discharge at least one metal. Copper and zinc are found in seven discharges. Chromium is found in two, while arsenic and nickel are found in only one discharge each.

The inactive hazardous waste sites in the St. Lawrence River basin and in sub-basins to the Massena AOC are sources of metals (Table V-6). Sampling and analysis of groundwater, leachate, and soils associated with the sites indicates that six of the eight sites in the Massena AOC have at least one of the metals present. One of the sites contains all six metals considered. Two of the five inactive waste sites outside of the Massena AOC sub-basins also have metals in them.

2. Conventional Pollutants

a. <u>Phosphorus</u>

Phosphorus occurs naturally in soils, sediments, and surface waters. Excess phosphorus in waterbodies can lead to rapid growth of microscopic plant life (phytoplankton) during summer. Decaying phytoplankton may remove oxygen from the water that is needed by other biota life. It also may wash up on beaches as algal mats. Excess phosphorus can also accelerate growth of rooted aquatic plants. Since phosphorus is a natural component of animal and plant life, it is found in domestic sewage.

Treatment of sewage reduces the phosphorus load, but some will remain in the effluent. Inadequate treatment of sewage or combined overflows will accentuate problems connected with phosphorus. Phosphorus is a major component of fertilizers and is likely to be found in runoff from agricultural and developed land. There is no water quality standard for phosphate or polyphosphate, but there is a 1 mg/L (ppm) limit required by the GLWQA on all sewage treatment plants discharging more than 1 million gallons per day to Lake Ontario.

Phosphorus has been cited by Canadian agencies as a cause of use impairment in areas downstream of the Massena AOC. Nuisance plant and algal growths have been documented in Lake St. Francis, downstream of the Massena AOC (DOE, OMOE, OMNR 1988). Most of the phosphorus associated impacts are concentrated along the north Canadian shore of Lake St. Francis. High flow conditions in the Massena AOC probably preclude problems there.

Total wastewater discharges from municipal facilities are less than 0.1% the average daily flow of the St. Lawrence River at Cornwall (IJC 1989a). Data for the Grasse and St. Regis Rivers are not sufficient to calculate accurate flows however, estimated loadings of phosphorus are given on Table V-8. There are several known sources of phosphorus in the St. Lawrence River drainage basin. These include:

- Six New York State municipal treatment facilities that discharge more than one million gallons per day treated wastewater to the St. Lawrence River drainage basin. The Village of Massena sewage treatment plant discharges directly to the Massena AOC;

- Six combined sewer overflow systems in or near the Massena AOC and 16 more in the St. Lawrence River drainage basin;

- Nonpoint sources due to runoff from agricultural and developed areas in the New York State sub-basins;

- Lake Ontario.

Table V-8. Estimated total phosphorus loadings to the St. Lawrence River and Massena AOC sub-basins.

	Flow (cms)	Average Total Phosphorus (mg/l)	Phosphorus Load (tonnes/yr)
Lake Ontario (Wolfe Is.)	8039	0.011	2789
Oswegatchie River	81	0.036	92
Raquette River	60	0.022	42
Grasse River	32	0.048	48
St. Regis River	25	0.035[1]	28

Sources: IJC 1989a;
DOE, OMOE, OMNR 1988;
NYSDEC 1988a.

[1] Estimated value.

There are insufficient data to calculate mass balances of phosphorus for the sub-basins and the St. Lawrence River upstream of Massena. There are also insufficient data to determine accurate loadings of phosphorus from the point source discharges in the basin.

Nonpoint sources of pollution have been assessed for the St.Lawrence River basin (NYSDEC 1989d) as part of a statewide effort to evaluate and recommend abatement strategies. While the basin is noted as being largely agricultural, nutrients or pollutants associated with agricultural runoff are not cited as causing any use impairments in the basin. On-site wastewater treatment facilities are noted, however as having the potential to cause impairment.

b. Physical Disturbances

Major modifications of the natural habitat of the St. Lawrence River have occurred as a result of construction of dams, locks, and dikes to facilitate navigation and generate electric power. Some of disturbances occurred as early as 1897. The majority of the disturbances occurred in the period of 1954 to 1959 during the development of St. Lawrence Seaway and the Moses - Saunders Power Project by Canada and the United States. These projects changed the hydrologic conditions of the river upstream of Cornwall. Impoundments altered fish habitats like the Long Sault rapids while creating others like Lake St. Lawrence. Dredging of the navigation channel is also changing substrate suitable for certain bottom dwelling invertebrates.

Natural erosion of shoreline is expected. The development of the Seaway destabilized the shoreline and encouraged rapid erosion in some areas. Impoundments have concurrently created backwaters and depositional areas that are now more productive than before. The net effect is a change in the type of habitat available. The nearly static water levels now being maintained in the St. Lawrence River have allowed the dense growth of cattails (Typha sp.) in many marshes with a subsequent loss of desirable fish and wildlife habitat.

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VI. Public Participation

A. Introduction

In the Massena RAP process, public participation and the technical processes have been given equal emphasis. Before beginning work on the plan, NYSDEC invited members of the public to help define the process for developing the RAP. The public is any individual or group who may be or thinks they may be affected by a DEC action or policy, who would like to be involved in the development or implementation of policy, or who has information or expertise relevant to development or implementation of the policy. Publics include citizens, other government agencies, other DEC divisions, governments of other jurisdictions, and citizens of other jurisdictions.

Public participation occurs both formally and informally. Formal activities include a Citizen Advisory Committee, government-to-government communication, public meetings, technical workshops, and public outreach activities. Informal participation has occurred through communication among committee members and other members of the public, and through conversations between agency staff and members of the public.

The public has played an important role in shaping the process and products of the RAP. They have highlighted issues, contributed information, helped develop and review the plan, and added individual and collective energy to the project.

B. Citizen Involvement

The GLWQA requires that the RAP process include citizens working with the responsible lead agency: "The parties in cooperation with state and provincial governments shall ensure that the public is consulted in all actions undertaken pursuant to this Annex" (GLWQA 1987).

1. Citizen Advisory Committee (CAC)

The central focus of public participation on the Massena RAP is the Citizen Advisory Committee. It comprises thirty members from many different interest groups and advises NYSDEC on the development of the plan.

Adopting criteria established by the USEPA in implementing the Clean Water Act, NYSDEC drew members of the CAC from four broad groups: elected and appointed government officials; organizations that have an economic interest; organizations that have a non-economic interest; and private citizens.

Representatives of sportsmen, industry, environmental groups, local government officials, educators, Native Americans, civic groups, small business, labor organizations, and government agencies are members of the Massena CAC.

The individuals who were appointed to the committee were chosen after consultation with the involved interest groups and community members. The CAC is the chief advisor to NYSDEC on the RAP. Additionally, the committee has built a support network for the RAP in the community. The RAP will need the support of the community if it is to be implemented successfully.

2. Technical Subcommittee

The Technical Subcommittee reviews and interprets technical information for the CAC and is involved with the development of the technical aspects of the RAP. They helped assemble and evaluate data used in the problem identification portion of the RAP contained in Stage I and will continue to help develop Stage II in a similar manner.

Members of the Technical Subcommittee have participated in technical workshops, attended seminars and conferences on related topics, sponsored speakers on technical subjects to inform the CAC members, and worked with

NYSDEC staff in producing the chapters describing the problems and sources. They have reviewed the problem chapter at different stages of completion and made significant suggestions and comments. The subcommittee led discussion of technical issues at the CAC meetings when review and comment were required.

The Technical Subcommittee prepared comments for the IJC on the draft listing/delisting criteria and suggested changes in impairment descriptions. The Subcommittee also plans to comment on the hazardous waste site remediation activities going on at the three industrial plants.

3. Public Outreach Subcommittee

The Public Outreach Subcommittee was formed soon after the CAC itself. Its mission is to inform the community about the RAP and to enlist their involvement and support; first for the development of the plan, and then for its implementation. The subcommittee does this through a series of public outreach activities which involve developing information materials, planning events, and communicating with other groups.

The subcommittee and NYSDEC developed a public outreach plan which identified goals, audiences and messages, and techniques to be used to reach the audiences. Accomplishments during the first year included a slide/tape presentation used to introduce the RAP process to community groups, a public information workshop on desired uses for the St. Lawrence River, and a boat tour of the Massena AOC for CAC members.

During the second year the subcommittee and NYSDEC produced a logo, a traveling display, fact sheets, two issues of the newsletter, and a shortened version of the slide show for exhibit use. The committee also held a poster/song writing contest in local schools.

4. Steering Committee

The Steering Committee was formed to direct the Massena RAP project, develop a project schedule, coordinate the activities of the CAC and the NYSDEC, and to give the CAC members a strong voice in the management of the project. Members are comprised of NYSDEC program and communication staff, the executive members of the CAC, the chairman and vice chairs of the full committee, and the chairs of the Technical and Public Outreach Subcommittees. The Steering Committee is chaired by NYSDEC and reviews the progress and activities of the CAC and its subcommittees. It sets agendas for the CAC's approval and is the forum for discussion of policy matters.

C. Other Publics

1. Communication Between the Massena CAC and the Cornwall PAC

Two mechanisms for international communication have been established. The first involves development of joint goal and problem statements for the two RAPs by NYSDEC and Ontario MOE. The joint goal statement was prepared and agreed upon by all jurisdictions and the CAC in 1989. A joint problem statement is currently being developed.

The St. Lawrence River Restoration Council, an organization with members from the Massena CAC, the Cornwall PAC, and Mohawks Agree on Safe Health, was accepted by the Massena CAC as a mechanism for communication among the three groups.

2. Government-to-Government Communication

Because the problems in Massena affect the downstream river ecosystem in other jurisdictions, it was important for NYSDEC to establish communication with the governments of these jurisdictions.

The provinces of Ontario and Quebec, and the Mohawk Nation at Akwesasne all have an interest in what New York State proposes for the Massena AOC. In addition, Environment Canada and the U.S. EPA represent the federal governments that are involved directly or indirectly in various enforcement actions as well as in the RAP process itself. NYSDEC maintains contact with representatives of these jurisdictions and shares technical materials and information with them. The other jurisdictions routinely share their materials, reports, etc., with the NYSDEC.

D. Contributions of the Public to the Plan

1. The Writing Process

The Massena Stage I RAP was developed in four steps. The first step was the development of a purpose outline which told what each chapter in the document would accomplish. Next, a topic outline was prepared. This piece gave the topics to be covered in the chapter and the order in which they will be developed. The CAC suggested changes in structure or in content at this stage.

Following the topic outline, argument outlines were prepared. The writers added text and described each topic, making the arguments that were needed to support each point. There were several iterations at this step where the committee suggested changes in content. From an argument outline, the writers created a draft document.

2. Problem Identification

Initially, the public was requested at an informational workshop to establish their desired uses of the river. A summary of their comments on uses and problems was sent to people on the RAP mailing list and used to develop goals for the RAP. NYSDEC compiled existing data on water quality and contaminant levels in biota and sediment, and related those data to the 14 GLWQA indicators of impairment. The Technical Subcommittee and the NYSDEC then held a technical workshop to bring together persons who have expertise on the river to share and evaluate the available data and to develop a problem statement. At the technical workshop, each impairment indicator was considered in order to determine if existing evidence supported the conclusions about use impairment in the Massena AOC. The committee and the technical experts helped develop and review the problem identification portion of the RAP throughout the months following this workshop.

3. Source Identification

Data on contaminant sources were compiled by the NYSDEC and reviewed by the Cornwall RAP team, the St. Regis Mohawks, members of the Technical Subcommittee, and the CAC in general.

VII. Mohawk Community of Akwesasne[1]

Akwesasne lies within the provinces of Quebec, and Ontario and New York State. The Mohawk lands encompass several islands including Cornwall, Pilon, Coloquhoun, Yellow and Ile Saint-Regis as well as portions of the south shore of the St. Lawrence River. The people are governed by the Mohawk Council of Akwesasne.

A. The Mohawk Community

1. Population

The present population of Akwesasne is approximately 6,000 registered on the "Canadian" membership roles and 4,200 on the "American" membership roles. Another 400 are not registered on either role but consider themselves Mohawk Nation citizens. The total population is approximately 10,600.

The Mohawk people of Akwesasne are registered as Native peoples in both Canada and the United States. Approximately 34% of the population is absent from the community at any one time. They will be working and living in the surrounding area and all over the world. The growth rate of the population averages about 2% per year. The growth rate and the retiring elderly have a serious effect on the social services which must be extended to our people.

2. Language

Approximately 70% of the Akwesasne's residents speak Mohawk as a first language and English second. Many of the elders speak only Mohawk. The Mohawk language is taught throughout the school system from kindergarten to high school. Some Universities offer Mohawk language as a credit course.

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1 Text provided by H. Lickers, Mohawk Council of Akwesasne, Env. Div., 1990.

3. Housing

Houses at Akwesasne are mostly of wood frame construction, with the newer houses meeting construction standards. There are, however, many houses which do not have proper heating or plumbing. It is not uncommon for two families to inhabit one house.

St. Regis Village	280 homes
Snye	180 homes
Cornwall Island	310 homes
United States	430 homes
	1,200 homes

The average occupancy rate is 6.25 people per house.

4. Utilities

Community water systems take their water from the St. Lawrence River near the village of St. Regis. Only the village of St. Regis and the American portion of the community are on a treated water system. Most of the other people in the community depend on wells.

The village of St. Regis has the only sewage treatment facility. The rest of the community depends upon septic systems to dispose of human waste.

Electricity is supplied by the St. Lawrence Power Company for Cornwall Island, Quebec Hydro for the Snye, and St. Regis Village and Niagara Mohawk for the United States.

Solid waste from the Canadian portion of the community goes to the Massena landfill site, while the American portion dumps in the Town of Bombay landfill. A solid waste recycling plan is being prepared for implementation. Two abandoned landfill sites, one on Cornwall Island and one in the Snye are being capped and closed.

5. Communications and Education

The Mohawk Governments of Akwesasne maintain their own education systems. Three school systems provide a "Canadian", "American", and a traditional education experience. The Mohawk Community of Akwesasne has three newspapers, two local and one international, as well as an FM radio station.

6. Police, Fire, and Emergency Services

Police services are provided for the Canadian portion of the community. The Akwesasne Police Force works in cooperation with the Ontario Provincial Police, Quebec Provincial Police, New York State Police, and the Royal Canadian Mounted Police (RCMP).

Fire protection services are provided by a volunteer fire department. Stations are located on Cornwall Island, Snye and Hogansburg.

Emergency medical care is provided by the St. Regis Ambulance Unit located in St. Regis Village, and the St. Regis Rescue Squad located in Hogansburg. All of the technicians are certified by Emergency Medical Technical Technicians in Quebec and New York State.

B. The Mohawk Perspective

1. Introduction

A thousand years ago, the Great Lakes Basin and the St. Lawrence River System were home to many Native Nations. Each of these nations living within the context of their territories, each of these nations having a different perception of the whole, but all of them honouring the earth as their mother. This single over riding principle of family, was the power of these nations. All people, animals, plants and things had a place in the process of life. The spirits of the earth, sky and waters talk with all life and shared the beauty of the Creator's purpose. The native people formulated governments, religions and cultures which respect this whole and tried to preserve the dignity of all. Many centuries were needed to develop the complex cooperative world view, so that it was present in every aspect of human life.

Within the Great Lakes Basin and St. Lawrence River System, there are some 350,000 Canada/USA federally recognized native lands. These lands are found in the most crucial areas of the system. Most of the connecting channels have associated native territories, and much of the Canadian shoreline is dotted with native communities. These native communities have special legal, cultural and political powers recognized by the governments of Canada and the United States.

2. Historical Review

The St. Lawrence River was called "Kaniataraowaneneh" which means "the majestic and magnificent river", by the Mohawk people of Akwesasne. The river has been a provider of fish, wildlife and other resource stocks. It has been the road which our people have travelled for trade with other nations and acted as a defense moat in times of war. The bounty of the river has made possible the growth of Akwesasne as a community of Mohawk Indians.

Archaeological evidence has shown a thriving population of Iroquoian peoples occupied this area for some 5000 years. Conflicts with the Huron and Algonquin Nations, strengthened the resolve of the Mohawk people to remain in this resource rich area. The remains of cornfields, longhouses and other structures can be found on the islands and mainland of the territory.

The earliest record of Mohawk settlement in Akwesasne is 1746. The Jesuit priests of Montreal with a group of Mohawks from Kahnawake came down the river to establish a mission. At the present village of St. Regis, they were met by a group of Mohawk people who were occupying the current site. These two groups merged to form the present day Akwesasne community. A church was established and built in 1753.

In the 1800's after the war of 1812, the border between Canada and the United States was established. The border cut straight through the Mohawk Community of Akwesasne. This split the community into a "Canadian portion" and "American portion". By 1867 and the formation of the Dominion of Canada, border problems had begun to disrupt the Mohawk Nation Council of Chiefs. In the early 1900's, the St. Regis Band Council was established by the Canadian government, the St. Regis Mohawk Tribal Council was established by the United States government, but the Mohawk Nation Council of Chiefs was still the sovereign Council of the Mohawks. The complexity of the governments formed has made it almost impossible for the Mohawk people to mount a single coordination effort except on environmental issues.

In 1834, the Mohawk Nation Council of Chiefs and their allies within the Seven Nations Treaty, called on Great Britain to stop the destruction of the St. Lawrence River due to the construction of the Beauharnois Barge structure near Valleyfield, Quebec. The Mohawk Nation Chiefs explained that the construction of these structures would cause the water levels to be affected upstream in the territories of Akwesasne. Marsh meadows used for agriculture and livestock would be affected, fishing grounds and spawning beds would decrease the fish stocks in the river. The officials of the British Governments believed that the compensation in the form of money was the only goal of the Mohawk Chiefs. The Mohawk Chiefs in several meetings made it clear that they were worried about the river's destruction. The British Government paid compensation to the Mohawk Chiefs for their losses, doing nothing about the river's destruction.

In 1949, the greatest engineering feat was about to be started, the construction of the St. Lawrence Seaway was to open up the starving markets and ports on the Great Lakes and increase the wealth of the whole region. Everyone in Canada and the United States were happy, the Great War was over and the two countries could now build a better future for all. The St. Lawrence Seaway was seen as the centre piece for this start. Problems great and small were swept aside in the maddening drive to complete the project. The Mohawk Chiefs of Akwesasne, however, saw their small lands being destroyed by earth movers. Their fields polluted by river dredging and their wetlands destroyed. Treaties and agreements which protected their place in Canada and the United States were being set aside by these governments in their insane haste to finish the Seaway. By 1959, the St. Lawrence Seaway was finished, the Mohawk lands at Akwesasne looked like a battle zone. Raw earth scars blemished the shorelines of the islands and the mainland. Vast spoils areas grew no vegetation. Spawning beds and wetlands were destroyed, and governmental indifference ignored calls by the Mohawk Nation Chiefs. To add injury to insult, the Canada and the United States governments wanted to charge a toll to the Mohawk people to help the governments pay for construction of the St. Lawrence Seaway.

By the 1970's however, another problem began to manifest itself. The construction of the St. Lawrence Seaway and associated power dams greatly increased the potential for industrialization. Existing industries increased their size and production and new industries moved into the area. This industrial expansion increased the flow of contaminants into the air, water and lands of the surrounding area. The people of Akwesasne who depended upon the natural resources of the area now found these resources contaminated and dangerous to their health and livelihood.

The vast array of contaminants and governmental indifference led the leaders of the Mohawk Council to start the St. Regis Environmental Division in 1976. This division was to protect and enhance the natural environment of the community of Akwesasne and to act as an information, research and remedial facility to improve the environment as well as informing the Mohawk community concerning environmental issues. It was also to supply expertise and support to other native and non-native nations. These far reaching aims have been and are still the goals of the Environmental Division. The St. Regis Environmental Division was the first environmental division of its kind in both Canada and the United States. The St. Regis Mohawk Tribal Council established their Akwesasne Environmental Health Division in 1985 in response to the General Motors toxic waste site. The Mohawk people have also formed a public oversight and advisory group called Mohawks Agree on Safe Health (MASH).

3. Mohawk Governments of Akwesasne

Akwesasne, the traditional name meaning "Land Where the Partridge Drums" is a Mohawk territory which is situated on the shores of the St. Lawrence River and its territories are in Canada and the United States. The territory straddles the international border at the junction of Quebec, Ontario and New York State. The towns and cities in the immediate area are: Massena, New York to the west, Cornwall, Ontario to the north, and Huntington, Quebec to the east.

Presently, the territory of Akwesasne is governed by three Mohawk governments.

a. The Mohawk Nation Council of Chiefs

This Council is the historical and active government of all Mohawk citizens, comprised of nine life term chiefs and nine clan mothers. The Mohawk Nation Council is responsible to a larger alliance called the Six Nations Confederacy (Iroquois Confederacy) which meets regularly at the Grand Council Fire in Onondaga near Syracuse, N.Y. The Great Law of Peace is the ruling constitution of the confederacy and its member Nations.

b. The Mohawk Council of Akwesasne

This council is a community government within the territory of Akwesasne. It is an elective council voted in every three years by the resident voting population of the "Canadian portion of the Mohawk territory". It is comprised of twelve (12) Chiefs, four chiefs from each of three electoral districts: Snye, Cornwall Island and St. Regis Village. A Grand Chief of the Council is elected by a simple majority from all electoral districts and acts as a chairperson to the Council for a three year term. It provides, through Indian and Northern Affairs Canada, various public service functions to meet the civil needs of the community (i.e., Eduction, Health, Environment, Welfare, Land & Estates and Membership). The Mohawk

Council of Akwesasne is recognized by the Canadian government as having special aboriginal rights according the Canadian constitution, Indian Act and various other acts passed by the Canadian government.

c. The St. Regis Mohawk Tribal Council

This council is another community government within the territory of Akwesasne. There are three elected chiefs and three elected sub-chiefs each with a term of three years. The terms, however, are not served concurrently. The chiefs and sub-chiefs are elected from the electoral rolls kept for the "American portion of the Mohawk territory". It provides, through the United States Federal government and the Bureau of Indian Affairs, various public and civil services (i.e., Eduction, Health, Land & Estates, Membership). The St. Regis Mohawk Tribal Council is recognized by the American government as having special rights and privileges according to the Clean Water, Clean Air and various other acts and laws.

4. Akwesasne Environmental Taskforce

These three governments work in cooperation from time to time on various issues. The Mohawk Governments of Akwesasne believe that the environment is one such issue. Through the Akwesasne Environmental Taskforce, the Mohawk Governments of Akwesasne are able to monitor and participate in all environmental activities within our territory. The Akwesasne Environmental Taskforce is composed of the environmental chiefs of the Mohawk governments, all Mohawk government environmental directors and technicians, plus representatives of Mohawks Agree on Safe Health and various non-native advisory groups.

5. St. Lawrence River Remedial Action Plan

The Mohawk Governments of Akwesasne in late 1987 and early 1988 began discussions with the United States, Canada, Quebec, Ontario and New York State concerning the Mohawk governments involvement with the St. Lawrence River Remedial Action Plan for the Cornwall/Massena Area of Concern. On February 23, 1988, all the governments agreed that:

a. The Mohawk Governments of Akwesasne support the concept of an international remedial action plan for the Cornwall/Massena Area of Concern.

b. The Mohawk Governments of Akwesasne will participate directly in the preparation of the Remedial Action Plan. Personnel from the Councils will be mandated to fulfill this function to the State and Provincial governments.

c. The Mohawk Governments of Akwesasne will provide expertise and information to the St. Lawrence River Remedial Action Plan on a reciprocal basis with the governments involved in the plan.

d. The Mohawk Governments of Akwesasne propose that the governments of Canada and the United States fund the activities of the Mohawk governments in support of the Remedial Action Plan.

e. The Mohawk Governments of Akwesasne will prepare for submission and approval as part of the St. Lawrence River Remedial Action Plan a Mohawk philosophical perspective of the St. Lawrence River.

f. The Mohawk Governments of Akwesasne will participate in the evaluation and implementation phase of the Remedial Action Plan.

The Mohawk Governments of Akwesasne and the other governments have been working diligently to fulfill the agreement.

C. Words of Spiritual Communication

The Mohawk Nation is governed by the guiding principles, embodied in two words "Ohenton Kariwetakwen". Words of spiritual communication toward the natural environment, expressed before anything else. Whenever our people gather, a speaker is chosen to find the finest words of thanksgiving directed toward the earth mother and all of creation.

We encourage all people who may listen, to feel for the environment as we have felt since creation. We are living in turbulent times as ancient prophesies are being fulfilled. Indeed as has been foretold, the trees would start dying from their tops down. The waters would be dirtied and many fish and water life would die. Great destruction awaits our children and grandchildren if we fail to find answers needed to heal the environment. We encourage the best possible Remedial Action Plan for the clean-up of "Kaniatarowaneneh" St. Lawrence River be adopted.

The People

We who have gathered together see that our cycle continues. We have been given the duty to live in harmony with one another and with other living things. We are grateful and give thanks that this is true.

We also give greetings and thanks that our people still share the knowledge of our culture and ceremonies and still are able to pass it on.

We have our elders here and also the new faces are coming towards us, which is the cycle of our families, for all this we give thanks and greetings for mankind in mind, health and spirit.

Now our minds are one

Agreed

The Mother Earth

We give thanks and greetings to the earth, she is giving that which makes us strong and healthy. She supports our feet as we walk upon her. We are grateful that she continues to perform her duties as she was instructed. The women and Mother Earth are one; givers of life.

We are her colour, her flesh and her roots. Once we acknowledge and respect her role, then begins a true relationship, and all that is from her returns to her.

Now our minds are one
Agreed

The Three Sisters

Our people have been given three main foods from the plant world. They are known as the three sisters; corn, beans and squash. We acknowledge them for providing strength to mankind and also to many other forms of life.

For this we give thanks and greetings in hope that they will continue to replenish Mother Earth with the necessities of the life cycle.

Now our minds are one
Agreed

Plant Life

We give greetings and thanks to plant life. Within plants is the force of substance that sustains many life forms; among them are food, medicine and beauty.

From the time of creation we have seen the various forms of plant life work many wonders in areas deep below the many waters and the highest of mountains. We give greetings and thanks, and hope that we will continue to see plant life for generations to come.

Now our minds are one
Agreed

Medicinal Plants

We greet and give acknowledgment thanksgiving to the medicine plants of the world. They have been instructed by the Creator to cure disease and sickness.

Our people will always know their native names for this is the name we will use when we are weak and sick, for invested in the plants is the power to heal. They come in many forms and have many duties. It is said that because of this, our relationship is very close. Through the ones who have been vested with knowledge of the medicine plant, we give thanks.

Now our minds are one
Agreed

The Animals

We give thanks and greetings to all animals of which we know the names. They are still living in the forest and other hidden places, we see them sometimes. Also from time to time they are still able to provide us with food, clothing, shelter and beauty.

This gives us happiness and peace of mind because we know that they are still carrying out their instructions as given by the Creator.

Therefore, let us give thanks and greetings to our animal brothers.

Now our minds are one
Agreed

Bodies of Water

We give thanks to the spirit of waters for our strength of well being. The waters of the world have provided to many; they quench thirst, provide flood for plant life, and are the source of strength for many medicines we need. Once acknowledged, this too becomes a great power for those who seek its gift, for mankind himself is made from the waters.

Now our minds are one
Agreed

Trees

We acknowledge and give greetings to the trees of the forests. The continue to perform the instructions which they were given. The maple tree is symbolized as the head of the trees. It provides us with syrup, which is the first sign of rebirth of spring. All the trees provide us with shelter and fruits of many varieties. The beauty of the trees is ever changing. Some of the trees stay the same throughout the cycle of the year.

Long ago our people were given a way of peace and strength and this way is symbolized by the everlasting tree of peace. The trees are standing firm toward the sky for which we give a thanksgiving.

Now our minds are one
Agreed

Bird

we now turn our thoughts toward the winged creatures that spread their wings just above our heads to as far upward as they can go.

We know them as having certain names. We see them, and we are grateful.

They [illegible] songs which they sing to help us appreciate our own purpose in life. We are reminded to enjoy our life cycle. Some birds are available to us as food. We believe that they are carrying out their responsibilities.

To us the eagle is the symbol of strength. It is said that they fly the highest and can see the creation. It warns us if any great danger is coming. We show our gratitude for the fulfillment of his duties.

Now our minds are one

Agreed

The Four Winds

We listen, hear their voices as they blow above our heads. We are assured that they follow the instructions given them, sometimes bringing rain, and renewing the waters upon the earth. They always bring us strength. They come from the four directions.

The air and winds are still active in the changing of the seasons. Winter is the time when the earth is covered with snow and cold winds blow. Summer wind causes life to continue. In the fall season life matures and gets ready for the continuation of the cycle once more.

You refresh us and make us strong. For this we give greetings and thanksgiving.

Now our minds are one

Agreed

Our Grandfathers, The Thunderers

We call them our Grandfathers. They are the Thunder People. We are of one mind that we should give them greetings and thanks.

Our Grandfathers have been given certain responsibilities. We see them roaming the sky above, carrying with them water to renew life.

At certain times we hear our Grandfathers making loud noises. Our Elders tell us their voices are loud to suppress the powerful beings (not of his making) within the Mother Earth, from coming to the surface where the people dwell. Grandfathers, you are known to us as protective guardians and as medicine, so we now offer these words of thanksgiving.

Now our minds are one
Agreed

The Moon or Night Sun

In our world we have night time or darkness. During this time we see the moon reflects lights, so that there isn't complete darkness. We have been instructed to address her our Grandmother. In her cycle she makes her face in harmony with other female life.

She is still following these instructions and we see her stages. Within these are the natural cycle of women. She determines the arrival of children on earth, causes the tides of the ocean, and she also helps us measure time.

We know that there are to sides to the natural flow, for day time there is night. They are on equal balance yet. Our Grandmother continues to lead us. We remain grateful, and we express our thanksgiving.

Now our minds are one
Agreed

The Day Sun

Our thoughts turn toward the sky. We see the day sun, the source of all life. We are instructed to call him our eldest brother. He comes from the east, travels across the sky, and sets in the west. With the sunshine we can see the perfect gifts which we are grateful for.

Brother sun nourishes Mother Earth and is the source of light and warmth. The cycle of the sun changes; during the winter months there is just enough heat and sunshine to allow Mother Earth to rest; we say "She wears a blanket of snow". As the cycle continues the sunshine and heat becomes stronger to allow all life forms to be reborn.

Our brother is the source of all fires of life. With every new sunrise is a new miracle; for this we are grateful.

Now our minds are one
Agreed

Stars

The stars are helpers of our Grandmother moon. They have spread themselves all across the sky. Our people knew their names and their messages of future happenings, even to helping mold individual character of mankind.

When we travel at night we lift our faces to the stars and are guided to our homes.

They bring dew to the gardens and all growing plants on Mother Earth.

When we look in the sky to the vast beauty of the Stars, we know they are following the way the Creator intended. For this we offer our greetings and Thanksgiving.

Now our minds are one
Agreed

The Sky Dwellers

The four powerful spirit beings who have been assigned by the Creator to guide us both by day and by night are called the Sky Dwellers. Our Creator directed these helpers to assist him in dealing with us when we are happy and of many minds during our journey on Mother Earth. They know and so our every act and they guide us with the teachings that the Creator established.

For the power of direction, we give greetings and Thanksgiving to these four beings, his helpers.

Now our minds are one
Agreed

The Creator

Now, we turn our thoughts to the Creator. We will choose our finest words to give thanks and greeting to Him. He has prepared all these things on earth for our peace of mind. Then he thought, "I will now prepare a place for myself where no one will know my fact, but I will be listening and keeping watch on the people moving about on the earth."

And indeed, we see that all things are faithful to their duties as he has instructed them. We will therefore gather our minds into one and give thanks to the Creator.

Now our minds are one
Agreed

Closing Words

We have directed our voices toward our Creator in the best way that we will abide by his word so that we may yet be happy.

If we have left something out, or if there are more who have other needs and other words, let them send their voices to the Creator in their own ways. Let us be satisfied that we have gone as far as it was possible to fulfill our responsibility.

Now our minds are one

Agreed

Appendix A.

Massena AOC Fish Tissue Contaminant Levels

Table A-1. Chemical contaminants in fish from the St. Lawrence River, Grasse River, Raquette River, St. Regis River and Robinson Creek 1975 through 1987.

Location	Species	No. of: Year	Fish	Analyses	Length (mm) Mean	Length (mm) Maximum	Total PCB (ppm) Mean	Total PCB (ppm) Maximum	Total DDT (ppm) Mean	Total DDT (ppm) Maximum	Total Mirex (ppm) Mean	Total Mirex (ppm) Maximum
St. Lawrence River												
- Ogdensburg	Emerald shiner	1986	90	9	27		0.53	0.63	0.01	0.013	0.01	0.01
	(whole)	1987	90	9	28		0.05	0.067	0.01	0.012	0.005	-
	Muskellunge	1976	1	1	892	-	2.17	-	0.47	-	0.04	-
	Northern pike	1976	5	5	594	714	1.07	1.90	0.17	0.24	0.05	0.07
	Rock bass (whole)	1976	11	4	144	198	0.21	0.25	0.04	0.06	NA[a]	-
	Smallmouth bass	1976	11	11	330	384	1.58	3.64	0.23	0.49	0.06	0.23
		1977	21	2	288	404	3.03	5.46	0.83	1.69	0.07	0.20
		1983	13	13	318	425	0.42	0.74	0.03	0.05	0.02	0.04
		1986	10	10	329	389	0.28	0.52	0.037	0.058	0.010	0.01
	Spottail shiner (whole)	1985	90	9	25		0.10	0.10	0.005	0.009	0.005	-
	Yellow perch	1976	4	2	237	246	1.60	3.61	0.23	0.49	0.01	0.03
		1981	20	2	352	425	1.21	1.25	0.02	0.03	0.01	0.01
		1986	10	10	223	246	0.05	0.05	0.005	0.010	0.01	0.01
	White sucker	1977	15	2	472	532	0.66	0.75	0.08	0.09	0.01	0.01
Massena above power dam	Fallfish	1980	4	4	125	130	0.25	0.52	0.010	0.016	NA	-
	Rock bass	1980	4	4	118	160	0.18	0.24	0.01	0.017	NA	-
	Spottail shiner	1980					ND	-	ND	-		-
		1986	90	9	28		0.05	0.05	0.005	0.006	0.005	0.01
- Massena below power dam	American eel	1976	26	26	838	953	6.63	16.71	1.34	2.52	0.005	0.20
	Black crappie	1980	1	1	270	-	0.52	-	0.067	-	NA	-
	Brown bullhead	1976	1	1	335	-	2.09	-	0.46	-	0.03	-
	Channel catfish	1976	1	1	625	-	12.71	-	1.00	-	0.25	-
	Lake sturgeon	1976	1	1	1092	-	1.44	-	0.03	-	0.01	-
	Northern pike	1976	2	2	645	706	3.83	3.93	0.41	0.42	0.08	0.09
	Pumpkinseed	1976	1	1	157	-	0.56	-	0.07	-	0.01	-
		1980	2	2	95	110	0.21	0.26	0.013	0.013	NA	-
	Redhorse spp.	1979	2	1	438	460	1.83	-	0.12	-	0.01	-

Source: NYSDEC 1990. Unpublished report, Bur. Env. Prot., Division of Fish & Wildlife, Albany, NY

Table A-1 (continued)

Location	Species	No. of: Year	Fish	Analyses	Length (mm) Mean	Maximum	Total PCB (ppm) Mean	Maximum	Total DDT (ppm) Mean	Maximum	Total Mirex (ppm) Mean	Maximum
	Smallmouth bass	1976	16	16	304	371	2.63 (1.73	16.17 5.28)[b]	0.37 (0.25	2.05 0.63)[b]	0.059 (0.045	0.27 0.13)
		1977	33	33	294	381	3.10	8.78	0.23	0.78	0.09	0.31
		1979	14	2	284	325	4.07	9.20	0.14	0.18	0.03	0.03
		1980	2	2	195	200	0.08	0.10	0.008	0.01	NA	-
		1981	19	2	352	425	1.21	1.25	0.12	0.12	0.06	0.07
		1983	23	23	350	432	0.63	1.79	0.041	0.11	0.039	0.10
	Walleye	1976	8	8	501	635	3.46	8.57	0.41	1.11	0.044	0.10
	White bass	1976	4	4	350	419	14.17 (2.73	48.49 4.00)[b]	0.38	0.92	0.025	0.07
	White perch	1976	15	15	260	287	4.80	11.80	0.72	1.40	0.098	0.19
		1977	16	16	252	305	7.13	13.48	0.45	0.83	0.23	0.76
	White sucker	1979	18	2	308	461	0.53	0.75	0.03	0.05	0.01	0.01
	Yellow perch	1976	7	7	296	312	2.18	4.26	0.30	0.37	0.060	0.11
		1981	8	1	254	278	0.55	-	0.04	-	0.02	-
Mouth of Grass River	Bluntnose minnow	1987	90	9	32		0.45	0.67	0.002	0.007	0.01	0.01
	Brown bullhead	1980	4	4	188	240	1.21	2.74	0.038	0.069	NA	
	Rock bass	1980	4	4	173	200	0.65	0.99	0.99	0.018	NA	-
	Spottail shiner	1986	80	8	28		0.83	1.42	0.010	0.016	0.01	0.01
		1987	90	9	40		0.29	0.35	0.002	0.006	0.01	0.01
At Reynolds Metals outfall	Fallfish	1980	1	1	160	-	2.53	-	ND	-	NA	-
	Northern pike	1980	1	1	550	-	7.10	-	ND	-	NA	-
	Rock bass	1980	6	6	162	200	2.46	3.82	ND	ND[c]	NA	-
	Spottail shiner	1985	90	9	23		1.52	1.79	0.021	0.24	0.01	0.01
	(Whole)	1986	90	9	27		6.35	10.07	0.070	0.10	0.01	0.01
- bay just below General Motors	Spottail shiner (whole)	1986	90	9	28		1.22	1.91	0.017	0.023	0.01	0.01
Racquette Point	Lake sturgeon	1986	1	1	1700	-						
	- muscle						3.41				0.04	
	- roe						7.95				0.09	
	- liver						10.2				0.14	

Table A-1 (continued)

Location	Species	No. of: Year	Fish	Analyses	Length (mm) Mean	Maximum	Total PCB (ppm) Mean	Maximum	Total DDT (ppm) Mean	Maximum	Total Mirex (ppm) Mean	Maximum
Grass River												
- above Massena	Pumpkinseed	1980	6	6	137	160	0.097	0.14	0.003	0.005	NA	-
	Smallmouth bass	1980	2	2	215	250	1.25	1.30	0.10	0.10	NA	-
	White sucker	1980	1	1	320	-	0.089	-	0.006	-	NA	-
- Below Massena Sewage Treatment Plant	Brown bullhead	1980	1	1	280	-	1.48	-	ND	-	NA	-
	Fall fish	1980	2	2	245	290	3.45	3.52	ND	ND	NA	-
	Rock bass	1980	3	3	143	190	1.08	2.44	ND	ND	NA	-
	Smallmouth bass	1980	2	2	220	230	1.54	2.08	ND	ND	NA	-
- vicinity of Trout Brook	Chinook salmon	1985	6	6	863	910	1.48	3.17	0.22	0.50	0.22	0.43
- approximately 1 Km above mouth	Spottail shiner	1979	70	7	51	NG	2.07	NG	0.095	NG	TR[d]	NG[e]
		1981	70	7	53	NG	1.12	NG	0.039	NG	0.008	NG
		1983	60	6	52	NG	0.95	NG	0.006	NG	0.006	NG

Table A-1 (continued)

Location	Species	No. of: Year	Fish	Analyses	Length (mm) Mean	Maximum	Total PCB (ppm) Mean	Maximum	Total DDT (ppm) Mean	Maximum	Total Mirex (ppm) Mean	Maximum
Raquette River												
- Norfolk	Shorthead redhorse	1975	15	3	448	546	0.76	1.00	NA	-	NA	-
	Smallmouth bass	1975	15	3	305	373	1.20	2.10	NA	-	NA	-
- Unionville	Silver redhorse	1978	10	1	608	636	2.38	-	0.01	-	0.01	-
	Smallmouth bass	1978	7	1	291	345	0.50	-	0.01	-	0.01	-
		1982	28	4	286	400	0.37	1.04	0.02	0.06	0.01	0.01
- above mouth	Spottail shiner	1979	70	7	50	NG	0.38	NG	0.092	NG	0.006	NG

Table A-1 (continued)

Location	Species	No. of: Year	Fish	Analyses	Length (mm) Mean	Maximum	Total PCB (ppm) Mean	Maximum	Total DDT (ppm) Mean	Maximum	Total Mirex (ppm) Mean	Maximum
St.Regis River - Helena	Silver redhorse	1978	8	1	495	530	0.04	-	0.01	-	0.01	-
	Smallmouth bass	1978	24	2	335	483	0.07	0.08	0.01	0.01	0.01	0.01
Robinson Creek	Brown bullhead	1980	4	4	178	290	1.08	2.13	0.05	0.092	NA	-
	Golden shiner	1980	3	3	130	140	0.26	0.37	0.01	0.008	NA	-
	Northern pike	1980	1	1	540	-	0.14	-	0.004	-	NA	-

a NA = Not analyzed.
b One high value excluded to give adjusted mean and maximum concentrations.
c ND = Not detected.
d Tr = Trace.
e NG = Not given.

Table A-2. Summary of organochlorine and mercury concentrations in the standard fillets of fish collected in the spring of 1988 from the St. Lawrence River and several tributaries in the vicinity of the General Motors Central Foundry operation near Massena, New York.[a]

Part I-A

LOCATION	SPECIES	NO. OF FISH ANALYZED	NO. OF ANALYSES	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	AVERAGE LIPID (%)	LIPID RANGE (%)	AVERAGE TOTAL PCB (ppm)	TOTAL PCB RANGE (ppm)
Mouth-unnamed tributary at GM	American eel	1	1	818	-	1243	-	18.10	-	0.66	-
	Brown bullhead	4	4	257	242-285	245	182- 329	0.92	0.27-1.63	20.55	<0.15-81.49
	Northern pike	5	5	587	560-630	1269	1063-1478	0.10	0.05-0.16	2.73	0.48- 5.12
	Pumpkinseed*	4	4	186	175-190	160	135- 190	<0.01	<0.01-0.01	<0.15	<0.15-<0.15
	Rock bass*	5	5	221	205-240	286	210- 362	0.28	0.01-0.65	1.04	<0.15- 4.02
	White sucker	4	4	454	435-467	1060	860-1184	0.82	0.05-1.49	6.39	0.29-11.00
	Yellow perch	7	7	253	180-287	238	65- 350	0.54	0.05-1.58	3.41	0.20-12.26
St. Lawrence River -east of unnamed tributary; west of Raquette Point	Brown bullhead	5	5	266	260-276	296	272- 336	1.68	0.75-2.98	0.90	0.50- 1.60
	Carp	1	1	773	-	8314	-	20.20	-	4.62	-
	Northern pike	2	2	772	735-810	3342	2760-3924	0.74	0.48-0.99	1.75	0.46- 3.02
	Rainbow trout	2	2	522	496-548	2226	1781-2672	6.45	5.40-7.50	0.90	0.86- 0.94
	Smallmouth bass	5	5	285	132-350	521	445- 676	2.07	0.52-5.40	1.53	0.19- 4.42
	Walleye	6	6	533	345-589	2117	1879-2355	1.77	0.45-3.30	0.55	0.23- 1.04
	White sucker	4	4	508	430-550	1877	899-2483	1.58	0.94-2.60	0.43	0.30- 0.63
	Yellow perch*	4	4	274	253-291	281	230- 337	0.12	0.03-0.26	0.08	0.08- 0.11
St. Lawrence River -near St. Regis Village	American eel	1	1	731	-	754	-	24.40	-	46.50	-
	Golden redhorse	2	2	484	480-487	1630	1418-1843	2.47	0.94-4.00	0.31	0.13- 0.50
	Muskellunge*	2	2	909	830-988	5129	3529-6729	0.12	0.03-0.20	<0.15	<0.15- 0.18
	Northern pike	5	5	637	595-690	1579	1320-2030	0.19	0.08-0.37	<0.15	<0.15- 0.16
	Pumpkinseed*	5	5	162	152-172	105	89- 122	0.14	0.03-0.36	<0.15	<0.15-<0.15
	Smallmouth bass	5	5	300	273-343	433	312- 644	0.99	0.26-1.90	0.58	0.22- 0.84
	Walleye	1	1	608	-	2492	-	6.40	-	2.42	-
	White sucker	2	2	376	375-378	664	663- 664	0.22	0.17-0.26	<0.15	<0.15-<0.15
	Yellow perch	5	5	250	224-268	243	173- 288	0.86	0.15-3.00	0.37	0.14- 1.08

[a]In this table, use of the term "RANGE" refers to a depiction of minimum and maximum values and not a calculated range in the statistical sense.
*One or more fish contained less than 0.05 percent lipid.

Source: NYSDEC 1990. Chemical contaminants in fish from the St. Lawrence River drainage on lands of the Mohawk Nation at Akwesasne and near the General Motors Corporation/Central Foundry Division Massena, New York plant. Technical report #90=1, Bureau of Environmental Protection, Division of Fish and Wildlife, Albany, NY.

Table A-2 (continued)

Part 1-B

LOCATION	SPECIES	AVERAGE "AROCLOR 1221" (ppm)	"AROCLOR 1221" RANGE (ppm)	AVERAGE "AROCLOR 1016" (ppm)	"AROCLOR 1016" RANGE (ppm)	AVERAGE "AROCLOR 1254" (ppm)	"AROCLOR 1254" RANGE (ppm)	AVERAGE PCB (lipid-ppm)[b]	PCB RANGE (lipid-ppm)[b]
Mouth-unnamed tributary at GM	American eel	<0.05	-	0.15	-	0.48	-	3.6	-
	Brown bullhead	0.32	<0.05- 1.19	17.25	<0.05-68.70	2.99	<0.05-11.60	2020.8	15.6-7989.2
	Northern pike	<0.05	<0.05-<0.05	1.99	0.09- 4.27	0.71	0.37- 1.30	3140.2	404.2-4730.0
	Pumpkinseed	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	1437.5	750.0-2000.0
	Rock bass	<0.05	<0.05-<0.05	0.29	<0.05- 1.20	0.72	<0.05- 2.80	468.4	62.5- 750.0
	White sucker	<0.05	<0.05-<0.05	3.16	0.17- 6.15	3.20	0.09- 4.82	761.1	578.0-1067.9
	Yellow perch	<0.05	<0.05-<0.05	2.18	0.06- 8.46	1.21	<0.05- 3.77	900.8	42.7-1880.0
St. Lawrence River -east of unnamed tributary; west of Raquette Point	Brown bullhead	<0.05	<0.05-<0.05	0.35	0.16- 0.70	0.52	0.31- 0.88	54.7	45.8- 66.0
	Carp	<0.05	-	2.30	-	2.30	-	22.9	-
	Northern pike	<0.05	<0.05-<0.05	0.73	0.15- 1.30	1.00	0.29- 1.70	201.2	96.9- 305.6
	Rainbow trout	<0.05	<0.05-<0.05	0.12	0.10- 0.14	0.76	0.73- 0.78	14.2	12.6- 15.8
	Smallmouth bass	0.05	<0.05- 0.13	0.20	<0.05- 0.69	1.28	0.14- 3.70	73.3	35.3- 176.6
	Walleye	<0.05	<0.05-<0.05	0.11	0.05- 0.24	0.41	0.15- 0.77	34.1	26.8- 50.7
	White sucker	<0.05	<0.05-<0.05	0.08	0.06- 0.10	0.33	0.21- 0.51	31.9	16.7- 52.7
	Yellow perch	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.03	<0.05- 0.06	115.3	42.3- 250.0
St. Lawrence River -near St. Regis Village	American eel	<0.05	-	0.68	-	45.80	-	190.6	-
	Golden redhorse	<0.05	<0.05-<0.05	0.08	<0.05- 0.13	0.21	0.08- 0.34	13.1	12.4- 13.8
	Muskellunge	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.08	<0.05- 0.13	170.0	90.0- 250.0
	Northern pike	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.07	<0.05- 0.11	70.2	40.5- 93.8
	Pumpkinseed	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05- 0.09	111.8	38.9- 250.0
	Smallmouth bass	<0.05	<0.05-<0.05	0.06	<0.05- 0.12	0.49	0.17- 0.69	69.0	33.4- 90.8
	Walleye	<0.05	-	0.20	-	2.20	-	37.9	-
	White sucker	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.06	0.06- 0.06	53.5	42.3- 64.7
	Yellow perch	<0.05	<0.05-<0.05	0.07	<0.05- 0.21	0.28	0.09- 0.85	65.1	36.2- 100.0

[b] "lipid-ppm" refers to the expression of total PCB in parts per million (ppm) on the basis of concentration in the fat or lipid material. Hence, it is ug total PCB/g of lipid or total PCB in ppm on a lipid basis.

Table A-2 (continued)

Part I-C

LOCATION	SPECIES	AVERAGE MIREX (ppm)	MIREX RANGE (ppm)	AVERAGE DDE (ppm)	DDE RANGE (ppm)	AVERAGE DIELDRIN (ppm)	DIELDRIN RANGE (ppm)	AVERAGE TRANSNONACHLOR (ppm)	TRANSNONACHLOR RANGE (ppm)	AVERAGE MERCURY (ppm)	MERCURY RANGE (ppm)
Mouth-unnamed tributary at GM	American eel	<0.01	-	0.09	-	0.01	-	<0.01	-	0.07	-
	Brown bullhead	<0.01	<0.01- 0.04	0.07	<0.01- 0.28	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.21	0.13-0.32
	Northern pike	<0.01	<0.01-<0.01	0.02	0.02- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.60	0.44-0.80
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.30	0.21-0.35
	Rock bass	<0.01	<0.01-<0.01	0.02	<0.01- 0.07	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.51	0.34-0.76
	White sucker	<0.01	<0.01-<0.01	0.06	<0.01- 0.10	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.39	0.32-0.48
	Yellow perch	<0.01	<0.01-<0.01	0.03	<0.01- 0.08	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.40	0.18-0.59
St. Lawrence River -east of unnamed tributary; west of Raquette Point	Brown bullhead	<0.01	<0.01-<0.01	0.02	0.01- 0.03	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.10	0.08-0.13
	Carp	-	-	0.19	-	0.02	-	<0.01	-	0.34	-
	Northern pike	<0.02(1)	-	0.06	0.03- 0.09	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.71	0.48-0.94
	Rainbow trout	-	-	0.13	0.13- 0.13	0.01	0.01- 0.02	<0.01	<0.01-<0.01	0.12	0.12-0.13
	Smallmouth bass	0.02(3)	<0.01- 0.03	0.09	0.02- 0.21	0.01	<0.01- 0.02	0.01	<0.01- 0.01	0.46	0.37-0.62
	Walleye	-	-	0.06	0.02- 0.11	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.40	0.24-0.50
	White sucker	-	-	0.03	0.02- 0.04	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.38	0.28-0.55
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.30	0.21-0.50
St. Lawrence River -near St. Regis Village	American eel	0.08	-	0.31	-	0.04	-	<0.01	-	0.87	-
	Golden redhorse	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.20	0.17-0.23
	Muskellunge	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.71	0.45-0.97
	Northern pike	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.71	0.52-0.92
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.15	0.10-0.22
	Smallmouth bass	<0.01	<0.01-<0.01	0.03	0.01- 0.05	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.58	0.49-0.71
	Walleye	0.07	-	0.30	-	0.02	-	0.02	-	0.93	-
	White sucker	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.13	0.12-0.15
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01- 0.04	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.34	0.20-0.55

Table A-2 (continued)

LOCATION	SPECIES	NO. OF FISH ANALYZED	NO. OF ANALYSES	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	AVERAGE LIPID (%)	LIPID RANGE (%)	AVERAGE TOTAL PCB (ppm)	TOTAL PCB RANGE (ppm)
St. Lawrence River -north channel of Cornwall Island	Brown bullhead	5	5	249	230-270	238	171- 332	0.51	0.16- 0.87	0.59	<0.15- 2.14
	Carp	4	4	651	575-720	5052	2709-7292	11.92	5.77-18.00	8.74	1.06-28.04
	Channel catfish	1	1	460	-	830	-	11.70	-	1.54	-
	Golden redhorse	1	1	740	-	6357	-	9.37	-	2.82	-
	Northern pike	1	1	520	-	841	-	0.10	-	0.20	-
	Pumpkinseed	3	3	190	170-210	168	121- 220	0.51	0.39- 0.62	2.92	0.15- 8.08
	Rock bass*	3	3	238	220-250	302	248- 350	<0.01	<0.01- 0.01	<0.15	<0.15-<0.15
	Smallmouth bass*	5	5	298	288-326	350	290- 446	0.17	0.04- 0.59	0.16	<0.15- 0.30
	Yellow perch	4	4	242	230-257	195	164- 248	0.12	0.06- 0.23	<0.15	<0.15- 0.28
St. Lawrence River -above Robert Moses Power Dam	Brown bullhead	5	5	251	235-285	227	170- 310	0.52	0.25- 0.86	0.15	<0.15- 0.1[illegible]
	Carp	2	2	708	682-734	6663	5127-8199	9.46	3.11-15.80	2.19	0.84- 3.5[illegible]
	Muskellunge	1	1	574	-	1358	-	0.25	-	<0.15	-
	Northern pike*	4	4	670	537-774	1893	895-2752	0.20	<0.01- 0.57	<0.15	<0.15- 0.32
	Smallmouth bass*	6	6	296	237-330	385	170- 492	0.30	0.02- 0.77	0.17	<0.15- 0.2[illegible]
	White sucker	5	5	450	420-542	978	510-1968	0.17	0.12- 0.34	<0.15	<0.15- 0.20
	Yellow perch	5	5	145	98-243	219	192- 266	0.21	0.08- 0.48	<0.15	<0.15-<0.15
St. Regis River -below Hogansburg Dam	American eel	4	4	738	644-790	962	775-1115	25.0	18.50-33.00	5.16	2.18- 7.87
	Brown bullhead	5	5	297	271-316	390	292- 466	0.74	0.44- 1.10	0.25	0.18- 0.36
	Channel catfish	5	5	593	580-613	2371	1486-2866	9.50	3.70-15.60	5.10	1.33-10.14
	Northern pike*	4	4	524	435-687	907	433-1709	0.14	0.03- 0.27	<0.15	<0.15- 0.18
	Pumpkinseed	2	2	220	215-226	296	294- 298	0.38	0.22- 0.53	<0.15	<0.15-<0.15
	Rock bass	3	3	196	169-217	187	110- 249	0.59	0.25- 0.83	0.18	0.15- 0.22
	Smallmouth bass	5	5	816	669-918	816	669- 918	1.32	0.35- 3.00	0.64	0.26- 1.22
	Brook trout	1	1	575	-	2864	-	7.91	-	2.98	-
	Walleye	5	5	458	340-630	1045	395-2369	0.83	0.18- 1.10	0.33	0.16- 0.62
	Yellow perch*	5	5	274	265-284	305	273- 336	0.37	0.01- 0.92	<0.15	<0.15- 0.20

Table A-2 (continued)

LOCATION	SPECIES	AVERAGE "AROCLOR 1221" (ppm)	"AROCLOR 1221" RANGE (ppm)	AVERAGE "AROCLOR 1016" (ppm)	"AROCLOR 1016" RANGE (ppm)	AVERAGE "AROCLOR 1254" (ppm)	"AROCLOR 1254" RANGE (ppm)	AVERAGE PCB (lipid-ppm)	PCB RANGE (lipid-ppm)
St. Lawrence River -north channel of Cornwall Island	Brown bullhead	<0.05	<0.05-<0.05	0.22	<0.05- 0.82	0.35	<0.05- 1.30	162.7	8.6- 466.3
	Carp	<0.05	<0.05-<0.05	1.92	0.10- 7.06	6.80	0.93-20.96	81.7	15.0- 272.3
	Channel catfish	<0.05	-	0.18	-	1.34	-	13.2	-
	Golden redhorse	<0.05	-	0.19	-	2.60	-	30.0	-
	Northern pike	<0.05	-	<0.05	-	0.05	-	200.0	-
	Pumpkinseed	<0.05	<0.05-<0.05	1.24	<0.05- 3.51	1.65	0.10- 4.55	489.0	28.3-1304.0
	Rock bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	1250.0	750.0-1500.0
	Smallmouth bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.11	<0.05- 0.25	158.8	50.8- 255.6
	Yellow perch	<0.05	<0.05-<0.05	0.08	<0.05- 0.23	<0.05	<0.05-<0.05	130.2	32.6- 280.0
St. Lawrence River -above Robert Moses Power Dam	Brown bullhead	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.09	<0.05- 0.13	29.9	19.8- 36.0
	Carp	<0.05	<0.05-<0.05	0.14	0.06- 0.21	2.03	0.76- 3.30	24.8	22.4- 27.2
	Muskellunge	<0.05	-	<0.05	-	<0.05	-	30.0	-
	Northern pike	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.09	<0.05- 0.27	495.3	50.0-1500.0
	Smallmouth bass	<0.05	<0.05-<0.05	<0.05	<0.05- 0.15	0.10	<0.05- 0.21	181.8	33.8- 500.0
	White sucker	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.05	<0.05- 0.05	66.8	22.1- 133.3
	Yellow perch	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05- 0.09	53.2	29.2- 93.8
St. Regis River -below Hogansburg Dam	American eel	<0.05	<0.05-<0.05	0.78	0.53- 1.13	4.36	1.63- 6.95	19.2	11.3- 26.8
	Brown bullhead	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.20	0.14- 0.31	34.4	26.1- 45.0
	Channel catfish	<0.05	<0.05-<0.05	0.34	0.12- 0.57	4.73	1.19- 9.55	55.0	22.4- 75.7
	Northern pike	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.08	<0.05- 0.14	141.6	41.1- 250.0
	Pumpkinseed	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	24.1	14.2- 34.1
	Rock bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.12	0.10- 0.17	36.0	23.3- 58.4
	Smallmouth bass	<0.05	<0.05-<0.05	0.13	<0.05- 0.32	0.49	0.18- 0.87	61.3	40.5- 91.4
	Brook trout	<0.05	-	0.31	-	2.65	-	37.7	-
	Walleye	<0.05	<0.05-<0.05	0.08	<0.05- 0.19	0.22	0.11- 0.40	51.0	19.0- 116.7
	Yellow perch	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.07	<0.05- 0.12	205.9	21.6- 750.0

Table A-2 (continued)

Part II-C

LOCATION	SPECIES	AVERAGE MIREX (ppm)	MIREX RANGE (ppm)	AVERAGE DDE (ppm)	DDE RANGE (ppm)	AVERAGE DIELDRIN (ppm)	DIELDRIN RANGE (ppm)	AVERAGE TRANSNONACHLOR (ppm)	TRANSNONACHLOR RANGE (ppm)	AVERAGE MERCURY (ppm)	MERCURY RANGE (ppm)
St. Lawrence River -north channel of Cornwall Island	Brown bullhead	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.17	0.13-0.24
	Carp	0.03	<0.01- 0.08	0.31	0.08- 0.55	0.01	<0.01- 0.03	<0.01	<0.01-<0.01	0.42	0.34-0.52
	Channel catfish	<0.04	-	0.17	-	0.02	-	0.02	-	0.48	-
	Golden redhorse	0.03	-	0.24	-	0.02	-	0.02	-	0.66	-
	Northern pike	<0.01	-	0.01	-	<0.01	-	<0.01	-	0.10	-
	Pumpkinseed	<0.01	<0.01-<0.01	0.03	<0.01- 0.07	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.18	0.13-0.26
	Rock bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.64	0.48-0.8[illegible]
	Smallmouth bass	<0.01	<0.01-<0.01	<0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.64	0.51-0.88
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.05	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.26	0.13-0.45
St. Lawrence River -above Robert Moses Power Dam	Brown bullhead	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.13	0.10-0.19
	Carp	0.10	0.02- 0.17	0.21	0.14- 0.27	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	0.48	0.42-0.54
	Muskellunge	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.31	-
	Northern pike	<0.01	<0.01-<0.01	0.01	<0.01- 0.04	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.87	0.35-2.06
	Smallmouth bass	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.49	0.32-0.64
	White sucker	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.42	0.20-0.59
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.27	0.14-0.48
St. Regis River -below Hogansburg Dam	American eel	0.01	<0.01- 0.02	0.12	0.06- 0.18	0.03	0.02- 0.04	<0.01	<0.01-<0.01	0.33	0.18-0.45
	Brown bullhead	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.25	0.16-0.33
	Channel catfish	0.09	0.03- 0.23	0.50	0.10- 1.10	0.02	<0.01- 0.03	0.03	<0.01- 0.05	0.50	0.26-0.91
	Northern pike	0.01	<0.01- 0.01	0.01	<0.01- 0.03	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.55	0.48-0.70
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.36	0.35-0.37
	Rock bass	<0.01	<0.01-<0.01	<0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.40	0.28-0.55
	Smallmouth bass	<0.01	<0.01- 0.02	0.05	0.02- 0.10	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.56	0.38-0.68
	Brook trout	0.09	-	0.44	-	0.02	-	0.03	-	0.39	-
	Walleye	<0.01	<0.01-<0.01	0.03	0.01- 0.05	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.36	0.15-0.64
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.05	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.34	0.16-0.49

LOCATION	SPECIES	NO. OF FISH ANALYZED	NO. OF ANALYSES	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	AVERAGE LIPID (%)	LIPID RANGE (%)	AVERAGE TOTAL PCB (ppm)	TOTAL PCB RANGE (ppm)
St. Regis River -above Hogansburg Dam	Brown bullhead*	1	1	245	-	190	-	<0.01	-	<0.15	-
	Carp	1	1	710	-	7198	-	16.30	-	2.90	-
	Fallfish	2	2	229	215-243	122	113- 132	1.36	0.22- 2.50	<0.15	<0.15-<0.15
	Pumpkinseed	2	2	211	200-222	260	209- 311	0.98	0.41- 1.56	<0.15	<0.15- 0.18
	Rock bass	3	3	156	150-168	82	70- 104	0.08	0.05- 0.11	<0.15	<0.15-<0.15
	Smallmouth bass*	6	6	340	304-361	589	396- 713	0.23	0.03- 0.41	0.15	<0.15- 0.26
	Walleye	4	4	492	455-568	1174	720-2018	0.22	0.11- 0.42	<0.15	<0.15-<0.15
	Yellow perch	5	5	213	203-232	136	110- 185	0.60	0.40- 0.76	0.21	<0.15- 0.44
Raquette River -at mouth	American eel	1	1	797	-	1153	-	25.40	-	3.82	-
	Brown bullhead	2	2	316	287-344	498	375- 622	1.24	0.79- 1.70	0.53	0.52- 0.54
	Bluegill	2	2	200	190-210	230	217- 242	0.78	0.16- 1.40	0.21	0.14- 0.28
	Carp	1	1	635	-	4015	-	9.40	-	2.18	-
	Channel catfish	5	5	560	460-698	2052	930-4079	9.22	1.70-21.40	3.27	1.76- 6.70
	Golden redhorse	3	3	414	405-427	889	835- 923	5.14	0.82-13.30	0.63	0.16- 1.46
	Grass pickerel	1	1	639	-	1540	-	0.10	-	0.12	-
	Lake sturgeon	2	2	790	620-959	4121	1016-7226	16.30	6.20-26.40	2.62	1.04- 4.20
	Muskellunge	1	1	932	-	7941	-	1.20	-	1.08	-
	Northern pike	5	5	598	519-655	1477	845-1787	0.33	0.09- 0.75	0.27	<0.15- 0.47
	Pumpkinseed	1	1	194	-	214	-	0.64	-	0.19	-
	Smallmouth bass	5	5	323	313-349	584	506- 777	0.97	0.38- 1.50	0.60	0.30- 0.92
	White bass	2	2	300	292-307	468	434- 503	5.05	2.90- 7.20	2.06	1.76- 2.36
	Walleye	3	3	478	469-492	983	959-1012	1.70	1.20- 2.30	0.57	0.24- 0.76
	Yellow perch	2	2	221	212-230	140	122- 158	0.84	0.75- 0.94	0.23	0.18- 0.27

Table A-2 (continued)

Part III-B

LOCATION	SPECIES	AVERAGE "AROCLOR 1221" (ppm)	"AROCLOR 1221" RANGE (ppm)	AVERAGE "AROCLOR 1016" (ppm)	"AROCLOR 1016" RANGE (ppm)	AVERAGE "AROCLOR 1254" (ppm)	"AROCLOR 1254" RANGE (ppm)	AVERAGE PCB (lipid-ppm)	PCB RANGE (lipid-ppm)
St. Regis River -above Hogansburg Dam	Brown bullhead	<0.05	-	<0.05	-	<0.05	-	30.0	-
	Carp	<0.05	-	0.85	-	2.02	-	17.8	-
	Fallfish	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	18.5	3.0- 34.1
	Pumpkinseed	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.08	<0.05- 0.13	14.9	11.5- 18.3
	Rock bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	104.0	68.2-150.0
	Smallmouth bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.10	<0.05- 0.21	106.9	18.3-250.0
	Walleye	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	41.9	17.9- 68.2
	Yellow perch	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.16	<0.05- 0.39	39.6	11.2-110.0
Raquette River -at mouth	American eel	<0.05	-	0.80	-	3.00	-	15.1	-
	Brown bullhead	<0.05	<0.05-<0.05	0.21	0.19- 0.23	0.30	0.27- 0.32	49.2	31.9- 66.5
	Bluegill	<0.05	<0.05-<0.05	0.06	<0.05- 0.10	0.12	0.09- 0.16	52.6	20.3- 85.0
	Carp	<0.05	-	0.65	-	1.50	-	23.1	-
	Channel catfish	<0.05	<0.05-<0.05	0.20	<0.05- 0.68	3.04	1.60- 6.00	66.9	19.9-226.5
	Golden redhorse	<0.05	<0.05-<0.05	0.22	<0.05- 0.55	0.38	0.11- 0.88	18.4	10.9- 32.0
	Grass pickerel	<0.05	-	<0.05	-	0.07	-	119.0	-
	Lake sturgeon	<0.05	<0.05-<0.05	1.00	0.27- 1.72	1.60	0.74- 2.46	16.3	15.9- 16.7
	Muskellunge	<0.05	-	0.22	-	0.83	-	89.6	-
	Northern pike	<0.05	<0.05-<0.05	0.06	<0.05- 0.15	0.19	0.09- 0.36	116.8	62.4-165.6
	Pumpkinseed	<0.05	-	0.05	-	0.11	-	29.1	-
	Smallmouth bass	<0.05	<0.05- 0.14	0.09	<0.05- 0.18	0.46	0.14- 0.72	72.6	43.3-130.8
	White bass	<0.05	<0.05-<0.05	0.32	0.30- 0.34	1.72	1.40- 2.03	46.8	32.7- 60.9
	Walleye	<0.05	<0.05-<0.05	0.11	0.07- 0.15	0.43	0.15- 0.62	32.9	20.1- 47.6
	Yellow perch	<0.05	<0.05-<0.05	0.05	<0.05- 0.06	0.16	0.14- 0.18	26.6	24.7- 28.5

Table A-2 (continued)

Part III-C

LOCATION	SPECIES	AVERAGE MIREX (ppm)	MIREX RANGE (ppm)	AVERAGE DDE (ppm)	DDE RANGE (ppm)	AVERAGE DIELDRIN (ppm)	DIELDRIN RANGE (ppm)	AVERAGE TRANSNONACHLOR (ppm)	TRANSNONACHLOR RANGE (ppm)	AVERAGE MERCURY (ppm)	MERCURY RANGE (ppm)
St. Regis River -above Hogansburg Dam	Brown bullhead	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.13	-
	Carp	<0.01	-	0.13	-	0.02	-	0.02	-	0.37	-
	Fallfish	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.56	0.15-0.96
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.26	0.15-0.37
	Rock bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.34	0.20-0.51
	Smallmouth bass	<0.01	<0.01-<0.01	<0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.58	0.06-0.95
	Walleye	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.83	0.36-1.04
	Yellow perch	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.17	0.10-0.41
Raquette River -at mouth	American eel	0.02	-	0.13	-	0.04	-	<0.01	-	0.42	-
	Brown bullhead	<0.01(1)	-	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.09	0.09-0.10
	Bluegill	-	-	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.21	0.13-0.29
	Carp	<0.01	-	0.04	-	<0.01	-	<0.01	-	0.21	-
	Channel catfish	0.04	<0.01- 0.05	0.39	0.14- 0.80	0.02	<0.01- 0.06	0.02	<0.01- 0.05	0.39	0.21-0.56
	Golden redhorse	<0.01(1)	-	0.03	<0.01-0.08	0.01	<0.01- 0.03	<0.01	<0.01-<0.01	0.14	0.10-0.18
	Grass pickerel	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.47	-
	Lake sturgeon	0.02	0.01- 0.02	0.14	0.09- 0.19	0.03	0.02- 0.05	0.01	<0.01- 0.01	0.27	0.20-0.34
	Muskellunge	0.02	-	0.08	-	<0.01	-	<0.01	-	1.04	-
	Northern pike	<0.01(4)	<0.01-<0.01	<0.01	<0.01-<0.05	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.49	0.26-0.66
	Pumpkinseed	<0.01	-	<0.01	-	<0.01	-	<0.01	-	0.13	-
	Smallmouth bass	<0.01	<0.01- 0.02	0.04	0.01- 0.06	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.41	0.27-0.53
	White bass	0.06	0.06- 0.06	0.22	0.20- 0.24	0.02	0.02- 0.02	<0.01	<0.01-<0.01	0.38	0.38-0.39
	Walleye	<0.01	<0.01-<0.01	0.06	0.02- 0.09	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.44	0.31-0.52
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.16	0.16-0.17

Table A-2 (continued)

LOCATION	SPECIES	NO. OF FISH ANALYZED	NO. OF ANALYSES	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	AVERAGE LIPID (%)	LIPID RANGE (%)	AVERAGE TOTAL PCB (ppm)	TOTAL PCB RANGE (ppm)
Raquette River -near Rt. 37 Bridge	Brown bullhead	1	1	134	-	711	-	0.88	-	0.58	-
	Carp	4	4	768	700- 800	7706	1795-10604	23.30	19.20-25.50	28.97	7.44-40.92
	Channel catfish	1	1	670	-	3365	-	7.26	-	6.84	-
	Golden redhorse	3	3	413	390- 430	920	876- 971	1.70	0.51- 3.10	0.38	<0.15- 0.64
	Northern pike	3	3	674	580- 761	2003	1201- 2455	0.12	0.08- 0.18	0.34	0.10- 0.64
	Pumpkinseed	2	2	200	200- 200	217	208- 226	0.42	0.25- 0.58	0.14	0.11- 0.17
	Smallmouth bass	5	5	313	272- 335	512	295- 590	0.70	0.41- 1.10	0.44	0.27- 0.64
	White perch	2	2	278	265- 290	425	325- 525	9.50	6.50-12.50	2.96	2.02- 3.90
	Yellow perch	5	5	200	175- 270	126	82- 277	0.58	0.28- 1.18	0.28	0.11- 0.42
Grass River -at mouth	Brown bullhead	4	4	250	220- 270	206	141- 245	1.35	0.92- 2.20	2.40	1.42- 3.58
	Channel catfish	5	5	525	370- 725	1875	1025- 3818	9.92	3.50-17.70	14.67	1.58-46.84
	Northern pike*	5	5	763	690- 855	2922	2028- 4427	0.36	0.03- 0.80	1.42	<0.15- 3.52
	Smallmouth bass	5	5	327	310- 346	542	477- 600	0.54	0.09- 1.40	1.01	0.26- 1.80
	Walleye	5	5	488	435- 535	1168	830- 1556	5.81	0.48-20.60	2.95	0.22- 9.14
	Yellow perch	5	5	247	220- 290	211	154- 313	0.62	0.19- 1.20	0.52	<0.15- 2.12
St. Lawrence River -vicinity Snye Marsh	Brown bullhead	5	5	320	270- 339	471	293- 568	0.73	0.51- 0.93	0.36	0.16- 0.70
	Carp	5	5	683	650- 735	5778	4242- 8409	13.08	7.80-24.00	10.01	4.06-19.82
	Largemouth bass	3	3	403	349- 434	1138	719- 1374	0.09	0.05- 0.17	<0.15	<0.15-<0.15
	Northern pike*	5	5	719	664- 870	2309	1650- 3794	0.09	<0.01- 0.19	<0.15	<0.15-<0.15
	Smallmouth bass	4	4	340	305- 387	669	511- 1018	1.46	0.66- 2.60	0.80	0.46- 1.32
	Walleye	3	3	557	490- 600	1866	1118- 2332	2.23	0.28- 3.90	0.88	0.15- 1.65
	Yellow perch	5	5	257	235- 273	240	172- 273	0.43	0.19- 0.83	<0.15	<0.15- 0.47
St. Lawrence River -upstream of Eisenhower Lock	Carp	3	3	657	527- 814	5480	2360- 9836	9.49	0.88-17.40	4.74	0.30- 9.80
	Muskellunge	1	1	952	-	6361	-	2.10	-	1.92	-
	Northern pike *	2	2	780	550-1010	4000	1162- 6838	0.14	0.04- 0.25	0.24	0.20- 0.27
	Pumpkinseed	5	5	194	165- 209	206	115- 252	0.60	0.26- 1.10	0.22	0.16- 0.34
	Smallmouth bass	5	5	367	340- 397	715	496- 901	0.21	0.08- 0.29	0.21	0.13- 0.31
	White sucker *	5	5	379	329- 425	667	537- 853	0.29	0.04- 0.47	<0.15	<0.15-<0.15
	Yellow perch	1	1	262	-	234	-	0.87	-	1.28	-

Table A-2 (continued)

LOCATION	SPECIES	AVERAGE "AROCLOR 1221" (ppm)	"AROCLOR 1221" RANGE (ppm)	AVERAGE "AROCLOR 1016" (ppm)	"AROCLOR 1016" RANGE (ppm)	AVERAGE "AROCLOR 1254" (ppm)	"AROCLOR 1254" RANGE (ppm)	AVERAGE PCB (lipid-ppm)	PCB RANGE (lipid-ppm)
Raquette River -near Rt. 37 Bridge	Brown bullhead	<0.05	-	0.32	-	0.23	-	65.3	-
	Carp	<0.05	<0.05-<0.05	8.19	0.81-17.6	20.75	6.60-32.90	128.2	30.0- 197.0
	Channel catfish	<0.05	-	0.33	-	6.48	-	94.2	-
	Golden redhorse	<0.05	<0.05-<0.05	0.14	<0.05- 0.28	0.22	<0.05- 0.34	23.9	14.0- 43.0
	Northern pike	<0.05	<0.05-<0.05	0.07	<0.05- 0.10	0.25	0.05- 0.53	271.1	94.5- 363.8
	Pumpkinseed	<0.05	<0.05-<0.05	0.06	0.06- 0.06	0.05	<0.05- 0.08	36.3	28.6- 44.0
	Smallmouth bass	<0.05	<0.05-<0.05	0.09	0.07- 0.10	0.33	0.17- 0.53	69.5	31.9- 96.5
	White perch	0.10	<0.05-0.18	0.41	0.30- 0.52	2.45	1.70- 3.20	31.2	31.2- 31.2
	Yellow perch	<0.05	<0.05-<0.05	0.09	<0.05- 0.18	0.16	0.06- 0.32	52.0	33.9- 79.3
Grass River -at mouth	Brown bullhead	<0.05	<0.05-<0.05	0.64	0.30- 0.90	1.74	1.09- 2.80	208.6	79.8- 389.7
	Channel catfish	<0.05	<0.05-<0.05	0.85	0.17- 2.03	13.79	1.20-44.79	336.9	9.0-1338.4
	Northern pike	<0.05	<0.05-<0.05	0.58	<0.05- 1.50	0.82	<0.05- 2.00	485.0	150.6- 773.1
	Smallmouth bass	<0.05	<0.05-<0.05	0.20	<0.05- 0.40	0.79	0.21- 1.41	385.5	41.9- 784.8
	Walleye	<0.05	<0.05-<0.05	1.24	<0.05- 4.33	1.69	0.17- 4.78	57.2	31.9- 105.9
	Yellow perch	<0.05	<0.05-<0.05	0.20	<0.05- 0.90	0.29	<0.05- 1.19	110.6	11.2- 459.8
St. Lawrence River -vicinity Snye Marsh	Brown bullhead	<0.05	<0.05-<0.05	0.05	<0.05- 0.12	0.28	0.09- 0.65	48.9	17.8- 90.9
	Carp	<0.05	<0.05-<0.05	1.59	0.10- 6.40	8.39	3.94-13.40	90.1	20.2- 198.2
	Largemouth bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.06	<0.05- 0.08	143.2	71.2- 208.3
	Northern pike	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05- 0.10	370.6	78.9-1500.0
	Smallmouth bass	<0.05	<0.05-<0.05	0.12	0.07- 0.20	0.65	0.36- 1.10	57.0	48.8- 69.5
	Walleye	<0.05	<0.05-<0.05	0.12	<0.05- 0.23	0.73	0.10- 1.40	43.0	33.0- [illegible].6
	Yellow perch	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05- 0.08	25.5	15.3- [illegible]
St. Lawrence River -upstream of Eisenhower Lock	Carp	<0.05	<0.05-<0.05	0.08	<0.05- 0.18	4.64	0.25- 9.59	51.3	23.7- 96.[illegible]
	Muskellunge	<0.05	<0.05-<0.05	0.29	-	1.61	-	91.7	-
	Northern pike	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.18	0.15- 0.22	377.5	80.0- 675.0
	Pumpkinseed	<0.05	<0.05-<0.05	<0.05	<0.05- 0.08	0.15	0.08- 0.23	50.3	14.5- 89.3
	Smallmouth bass	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	0.15	0.08- 0.21	108.9	72.4- 162.5
	White sucker	<0.05	<0.05-<0.05	<0.05	<0.05-<0.05	<0.05	<0.05- 0.07	63.5	16.0- 187.5
	Yellow perch	<0.05	-	1.03	-	0.22	-	146.6	-

Table A-2 (continued)

LOCATION	SPECIES	AVERAGE MIREX (ppm)	MIREX RANGE (ppm)	AVERAGE DDE (ppm)	DDE RANGE (ppm)	AVERAGE DIELDRIN (ppm)	DIELDRIN RANGE (ppm)	AVERAGE TRANSNONACHLOR (ppm)	TRANSNONACHLOR RANGE (ppm)	AVERAGE MERCURY (ppm)	MERCURY RANGE (ppm)
Raquette River -near Rt. 37 Bridge	Brown bullhead	<0.01	-	0.01	-	<0.01	-	<0.01	-	0.11	-
	Carp	0.07	<0.01- 0.17	0.71	0.61- 0.80	0.03	0.02- 0.04	0.06	<0.01- 0.15	0.40	0.30-0.46
	Channel catfish	0.06	-	0.50	-	0.01	-	0.02	-	0.85	-
	Golden redhorse	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.19	0.11-0.25
	Northern pike	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.75	0.45-1.11
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.70	0.25-1.14
	Smallmouth bass	<0.01	<0.01-<0.01	0.03	0.02- 0.05	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.42	0.22-0.56
	White perch	<0.01	<0.01-<0.01	0.24	0.21- 0.27	0.03	0.03- 0.04	0.01	<0.01- 0.02	0.38	0.26-0.50
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.16	0.09-0.29
Grass River -at mouth	Brown bullhead	<0.01	<0.01-<0.01	0.03	0.02- 0.04	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.18	0.15-0.20
	Channel catfish	0.20	0.02- 0.67	1.02	0.14- 3.20	0.02	<0.01- 0.02	0.02	<0.01- 0.04	0.70	0.15-1.96
	Northern pike	<0.01	<0.01-<0.01	0.04	<0.01- 0.08	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.83	0.52-1.24
	Smallmouth bass	0.01	<0.01- 0.03	0.04	0.01- 0.11	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.63	0.35-0.82
	Walleye	0.03	<0.01- 0.06	0.17	0.03- 0.49	0.02	<0.01- 0.04	0.01	<0.01- 0.04	0.42	0.24-0.52
	Yellow perch	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.37	0.19-0.60
St. Lawrence River -vicinity Snye Marsh	Brown bullhead	<0.01	<0.01-<0.01	0.01	<0.01- 0.03	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.21	0.13-0.32
	Carp	0.03	<0.01- 0.06	0.39	0.23- 0.72	0.02	<0.01- 0.03	<0.01	<0.01- 0.01	0.40	0.30-0.58
	Largemouth bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.61	0.45-0.80
	Northern pike	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.88	0.65-1.16
	Smallmouth bass	-	-	0.08	0.03- 0.14	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.46	0.42-0.52
	Walleye	0.03	<0.01- 0.05	0.10	0.01- 0.19	<0.01	<0.01- 0.01	0.01	<0.01- 0.02	0.56	0.42-0.74
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.32	0.12-0.47
St. Lawrence River -upstream of Eisenhower Lock	Carp	0.05	<0.01- 0.14	0.40	0.03- 0.85	0.03	<0.01- 0.07	0.01	<0.01- 0.02	0.37	0.23-0.48
	Muskellunge	0.02	-	0.10	-	<0.01	-	<0.01	-	0.95	-
	Northern pike	<0.01	<0.01-<0.01	0.03	0.02- 0.03	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.85	0.48-1.22
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.23	0.11-0.34
	Smallmouth bass	<0.01	<0.01-<0.01	0.02	<0.01- 0.02	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.71	0.56-0.88
	White sucker	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.17	0.10-0.26
	Yellow perch	<0.01	-	0.03	-	<0.01	-	<0.01	-	0.38	-

Table A-3. Summary of dioxin and dibenzofuran at parts per trillion (ppt) in composite samples of standard fillets of fish collected in the spring of 1988 from the St. Lawrence River and several tributaries in the vicinity of the General Motors Central Foundry operation near Massena, New York.

		DIOXINS (total-ppt)*					DIBENZOFURANS (total-ppt)*				
LOCATION	SPECIES	Tetra-	Penta-	Hexa-	Hepta-	Octa-	Tetra-	Penta-	Hexa-	Hepta-	Octa-
Mouth	B. bull.	0.8 (100)	<0.1 (ND)	<0.3 (ND)	<0.1 (ND)	<1.9	70.2 (11)	30.1 (21)	1.8 (68)	0.3 (87)	<0.2
-unnamed trib	N. pike	1.4 (75)	<0.1 (ND)	<0.1 (ND)	<0.1 (ND)	1.9	18.3 (48)	6.1 (77)	<1.5 (ND)	<0.6 (ND)	<0.2
at GM	Y. perch	<0.7 (ND)	<0.1 (ND)	<0.1 (ND)	<0.2 (ND)	2.1	2.8 (76)	1.8 (66)	0.2 (ND)	<0.1 (ND)	<0.3
St. Lawrence R.											
-e. of unnamed	B. bull.	1.2 (100)	<0.6 (ND)	0.6 (87)	0.6 (100)	6.0	2.6 (66)	3.6 (102)	2.3 (42)	<784.7 (ND)	<0.2
trib; west	Sm. bass	1.9 (100)	<0.3 (ND)	<0.1 (ND)	<0.1 (ND)	3.1	4.5 (84)	1.4 (102)	0.3 (ND)	<3.9 (ND)	0.8
of Raquette Pt.	Walleye	1.5 (100)	<0.1 (ND)	<0.1 (ND)	<0.1 (ND)	2.4	2.1 (100)	0.5 (102)	<3.2 (ND)	<1.4 (ND)	<0.1
-near St. Regis	N. pike	1.0 (100)	<0.3 (ND)	<0.1 (ND)	<0.1 (ND)	2.0	3.5 (87)	0.6 (102)	<1.8 (ND)	<0.5 (ND)	<0.2
Village	Sm. bass	1.3 (100)	<0.4 (ND)	<0.1 (ND)	<0.4 (ND)	2.9	3.1 (100)	0.7 (102)	<3.2 (ND)	<1.7 (ND)	<0.2
	Y. perch	<0.3 (ND)	<0.9 (ND)	<1.2 (ND)	<9.2 (ND)	67.2	2.2 (66)	<0.8 (ND)	0.6 (ND)	<8.2 (ND)	11.2
-n. channel	B. bull.	<0.7 (ND)	<0.1 (ND)	<0.1 (ND)	<0.3 (ND)	2.0	1.5 (36)	0.8 (102)	<1.3 (ND)	0.2 (87)	<0.1
Cornwall Is.	Sm. bass	1.3 (100)	<0.2 (ND)	<0.3 (ND)	<0.4 (ND)	<2.6	4.3 (53)	<0.5 (ND)	<4.3 (ND)	<3.1 (ND)	<0.6
	Y. perch	<0.3 (ND)	<0.1 (ND)	<0.1 (ND)	<0.2 (ND)	1.2	0.4 (ND)	0.7 (36)	<0.4 (ND)	<0.4 (ND)	<0.2
-above Moses	B. bull.	<0.6 (ND)	<0.2 (ND)	0.2 (87)	<0.2 (ND)	2.7	1.8 (53)	1.4 (39)	0.2 (ND)	0.4 (ND)	<0.3
Power Dam	Sm. bass	1.2 (100)	<0.1 (ND)	<0.1 (ND)	<0.1 (ND)	1.9	2.4 (62)	0.7 (102)	0.4 (ND)	0.2 (88)	<0.2
	Y. perch	0.3 (100)	<0.1 (ND)	<0.2 (ND)	1.0 (48)	3.6	1.5 (71)	<0.3 (ND)	<0.6 (ND)	0.5 (ND)	<0.1
St. Regis R.											
-below	Sm. bass	<1.8 (ND)	<0.4 (ND)	<0.1 (ND)	<0.2 (ND)	3.2	1.5 (ND)	0.3 (ND)	<5.5 (ND)	0.1 (87)	<0.2
Hogansburg	Walleye	1.3 (100)	<0.1 (ND)	<0.3 (ND)	<0.7 (ND)	4.0	3.4 (54)	0.4 (ND)	<3.5 (ND)	0.1 (88)	<0.1
dam	Y. perch	<0.4 (ND)	<0.4 (ND)	<0.3 (ND)	<0.3 (ND)	4.7	<1.3 (ND)	<0.3 (ND)	1.1 (ND)	<0.8 (ND)	<0.5
-above	Sm. bass	0.7 (100)	<0.3 (ND)	<0.4 (ND)	<0.5 (ND)	3.6	5.6 (22)	<4.3 (ND)	<2.0 (ND)	<1.3 (ND)	0.5
Hogansburg	Walleye	<0.2 (ND)	<0.3 (ND)	<0.3 (ND)	<0.4 (ND)	<1.5	<0.1 (ND)	<0.2 (ND)	<0.2 (ND)	<0.3 (ND)	<0.5
dam	Y. perch	<0.2 (ND)	<0.3 (ND)	<0.3 (ND)	<0.4 (ND)	5.4	<1.1 (64)	<0.2 (ND)	<0.6 (ND)	<0.3 (ND)	<0.5

Source: NYSDEC 1990. Chemical contaminants in fish from the St. Lawrence River drainage on lands of the Mohawk Nation at Akwesasne and near the General Motors Corporation/Central Foundry Division Massena, New York plant. Technical report #90=1, Bureau of Environmental Protection, Division of Fish and Wildlife, Albany, NY.

Table A-3 (continued)

		DIOXINS (total-ppt)*									DIBENZOFURANS (total-ppt)*								
LOCATION	SPECIES	Tetra-		Penta-		Hexa-		Hepta-		Octa-	Tetra-		Penta-		Hexa-		Hepta-		Octa-
Raquette R. -at mouth	N. pike	<0.7	(ND)	<0.3	(ND)	<0.3	(ND)	<0.4	(ND)	2.4	3.5	(93)	1.2	(102)	<0.9	(ND)	<0.4	(ND)	<0.5
	Sm. bass	1.6	(100)	<0.3	(ND)	<0.3	(ND)	<0.4	(ND)	2.6	3.6	(91)	0.6	(102)	<1.4	(ND)	<1.0	(ND)	<0.5
	L. sturgeon	4.2	(100)	<0.4	(ND)	<1.3	(ND)	<0.8	(ND)	5.3	18.0	(98)	4.5	(81)	0.3	(ND)	<3.6	(ND)	<0.6
	Walleye	1.7	(100)	<0.3	(ND)	<0.4	(ND)	<0.4	(ND)	4.6	4.0	(82)	<1.1	(ND)	<1.1	(ND)	<0.3	(ND)	<0.5
-near Rt. 37 Bridge	N. pike	0.6	(100)	<0.3	(ND)	<0.4	(ND)	<0.5	(ND)	3.7	0.8	(ND)	0.4	(ND)	<1.0	(ND)	0.5	(ND)	<0.6
	Sm. bass	2.1	(100)	<0.3	(ND)	<0.3	(ND)	0.4	(ND)	3.8	4.7	(100)	0.9	(102)	<3.9	(ND)	<2.6	(ND)	<0.5
	Y. perch	0.3	(100)	<0.3	(ND)	<0.3	(ND)	<0.4	(ND)	3.0	1.3	(72)	<0.2	(ND)	<0.3	(ND)	<0.3	(ND)	<0.4
Grass R. -at mouth	Ch. catfish	10.5	(100)	2.0	(100)	2.3	(87)	0.3	(ND)	5.7	2.0	(49)	8.8	(91)	<45.0	(ND)	<14.4	(ND)	<0.2
	Sm. bass	1.1	(100)	<0.1	(ND)	<0.1	(ND)	<0.5	(ND)	3.5	3.2	(59)	<2.0	(ND)	<2.2	(ND)	<1.2	(ND)	<0.1
	Walleye	2.8	(100)	<0.4	(ND)	<0.9	(ND)	<0.3	(ND)	2.8	4.7	(83)	2.0	(51)	0.2	(ND)	<1.1	(ND)	<0.1
St. Lawrence R. -vicinity of Snye Marsh	N. pike	0.7	(100)	<0.2	(ND)	<0.3	(ND)	<0.4	(ND)	2.7	3.3	(100)	<1.0	(ND)	<0.9	(ND)	0.7	(ND)	<0.6
	Sm. bass	1.9	(100)	<0.3	(ND)	<0.3	(ND)	<0.5	(ND)	<2.6	6.5	(90)	0.6	(ND)	<1.7	(ND)	<1.1	(ND)	0.5
	Y. perch	<0.2	(ND)	<0.2	(ND)	<0.3	(ND)	<0.5	(ND)	2.3	1.4	(84)	<0.2	(ND)	<0.2	(ND)	<0.3	(ND)	<0.5
-upstream of Eisenbower Lock	Muskellunge	2.1	(100)	<5.6	(ND)	<0.5	(ND)	<0.9	(ND)	2.6	8.9	(100)	0.8	(ND)	<2.6	(ND)	1.1	(ND)	<1.2
	N. pike	2.0	(100)	<0.3	(ND)	<0.7	(ND)	<0.6	(ND)	2.0	4.9	(92)	1.2	(ND)	<5.3	(ND)	<3.2	(ND)	<0.8
	Sm. bass	1.1	(100)	<0.1	(ND)	<0.2	(ND)	<0.2	(ND)	2.3	2.0	(69)	1.9	(18)	0.2	(ND)	<6.8	(ND)	<0.2

*Parenthetic values reflect percentage composition within a congeneric group of several specific quantifiable congeners (ND = not determined):

	Dioxins	Dibenzofurans
Tetra-	2,3,7,8-	2,3,7,8-
Penta-	1,2,3,7,8-	2,3,4,7,8-
Hexa-	1,2,3,4,7,8- 1,2,3,7,8,9 1,2,3,6,7,8-	1,2,3,4,7,8- 1,2,3,7,8,9- 1,2,3,6,7,8- 2,3,4,6,7,8-
Hepta-	1,2,3,4,6,7,8-	1,2,3,4,6,7,8- 1,2,3,4,7,8,9-

Table A-4. Summary of organochlorine concentrations in the standard fish, sediment, whole frog and composits of whole snails collected in the spring of 1989 and fall of 1988 from the Grasse River in the vicinity of the ALCOA plant near Massena, New York.

Part I-A

LOCATION	SPECIES	NO. OF FISH ANALYZED	NO. OF ANALYSES	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	AVERAGE LIPID (%)	LIPID RANGE (%)	AVERAGE TOTAL PCB (ppm)	TOTAL PCB RANGE (ppm)
above Dam in Massena	Rock bass	10	10	145	125-167	60	35- 95	0.27	0.11-0.51	0.03	<0.02- 0.11
	Smallmouth bass	10	10	303	203-437	370	100-1090	0.27	0.10-0.51	<0.02	<0.02-<0.02
	Brown bullhead	10	10	241	176-267	178	64- 240	0.38	0.11-0.76	0.03	<0.02- 0.15
	Pumpkinseed	10	10	154	140-171	74	50- 110	0.25	0.14-0.47	<0.02	<0.02-<0.02
at Alcoa discharge	Pumpkinseed	10	10	161	139-193	120	59- 186	0.17	0.08-0.33	0.26	0.05- 0.65
	Smallmouth bass	10	10	244	163-372	255	56- 718	0.58	0.23-1.71	2.63	0.20- 7.72
	Brown bullhead	10	10	254	154-312	204	42- 350	0.80	0.38-1.53	4.55	0.81- 9.21
	Rock bass	10	10	174	158-182	111	85- 140	0.23	0.12-0.65	0.28	0.05- 0.79
	Yellow perch	10	10	174	152-200	66	42- 108	0.38	0.10-0.78	0.91	0.15- 2.57
at Mouth	Yellow perch	10	10	190	158-228	87	44- 152	0.25	0.11-0.48	1.89	0.98- 2.99
	Brown bullhead	10	10	250	148-318	218	40- 425	1.04	0.45-2.02	4.52	0.84-10.73
	Pumpkinseed	7	7	125	104-143	38	10- 76	0.29	0.13-0.62	2.58	0.60- 7.06
	Rock Bass	2	2	180	164-196	81	78- 84	0.16	0.14-0.17	0.62	0.40- 0.86
at Alcoa discharge	Sediment	1	1	-	-	-	-	15.31	-	< 0.02	-
	Green frog	1	1	-	-	-	-	0.99	-	0.88	-
at Massena STP	Snail	-	1	-	-	-	-	0.40	-	1.64	
at Chase Mills	Snail	-	1	-	-	-	-	0.31	-	<0.02	-
St. Lawrence R. at head of Power Canal	Snail	-	1	-	-	-	-	0.38	-	<0.02	-

Source: NYSDEC 1990. Chemical contaminants in fish from the St. Lawrence River drainage on lands of the Mohawk Nation at Akwesasne and near the General Motors Corporation/Central Foundry Division Massena, New York plant. Technical report #90=1, Bureau of Environmental Protection, Division of Fish and Wildlife, Albany, NY.

Table A-4 (continued) Part I-B

LOCATION	SPECIES	AVERAGE TOTAL DDT (ppm)	TOTAL DDT RANGE (ppm)	AVERAGE "AROCLOR 1016" (ppm)	"AROCLOR 1016" RANGE (ppm)	AVERAGE "AROCLOR 1254" (ppm)	"AROCLOR 1254" RANGE (ppm)	AVERAGE PCB (lipid-ppm)	PCB RANGE (lipid-ppm)
above Dam in Massena	Rock bass	< 0.01	< 0.01-<0.01	< 0.01	<0.01-<0.01	0.02	<0.01- 0.10	14.4	3.9- 48.6
	Smallmouth bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	9.1	3.9- 20.0
	Brown bullhead	<0.01	<0.01- 0.01	0.02	<0.01- 0.13	0.01	<0.01- 0.02	10.7	2.6- 45.0
	Pumpkinseed	<0.01	<0.01-<0.01	0.01	<0.01-<0.01	<0.01	<0.01-<0.01	9.4	4.3- 14.3
at Alcoa Discharge	Pumpkinseed	0.01	<0.01- 0.06	0.10	0.01- 0.21	0.16	0.01- 0.48	152.3	19.2- 278.2
	Smallmouth bass	0.03	<0.01- 0.08	1.41	0.03- 4.11	1.23	0.10- 3.61	534.1	47.6-1238.3
	Brown bullhead	0.03	<0.01- 0.06	2.85	0.42- 6.20	1.70	0.39- 3.13	564.2	121.5-1029.1
	Rock bass	<0.01	<0.01- 0.01	0.14	<0.01- 0.36	0.14	0.03- 0.43	133.7	29.7- 493.3
	Yellow perch	<0.01	<0.01-<0.01	0.59	0.08- 1.68	0.32	0.07- 0.89	248.6	91.2- 645.0
at Mouth	Yellow perch	<0.01	<0.01-<0.01	1.11	0.63- 1.91	0.79	0.36- 2.00	816.5	494.1-1417.9
	Brown bullhead	0.02	<0.01- 0.12	2.22	0.40- 5.53	2.30	0.44- 5.20	484.9	170.1-1411.8
	Pumpkinseed	<0.01	<0.01-<0.01	1.27	0.31- 3.43	1.31	0.29- 3.63	878.6	368.8-2715.4
	Rock bass	<0.01	<0.01-<0.01	0.34	0.21- 0.48	0.28	0.17- 0.39	419.0	222.9- 615.0
at Alcoa discharge	Sediment	<0.01	-	<0.02	-	<0.02	-	-	-
	Green frog	<0.01	-	0.32	-	0.56	-	89.2	-
at Massena STP	Snail	<0.01	-	0.06	-	1.58	-	411.0	-
at Chase Mills	Snail	<0.01	-	<0.02	-	<0.02	-	<6.5	-
St. Lawrence R. at head of Power Canal	Snail	<0.01	-	<0.02	-	<0.02	-	<5	-

Table A-4 (continued)

LOCATION	SPECIES	AVERAGE MIREX (ppm)	MIREX RANGE (ppm)	CHLORDANE (ppm)	CHLORDANE RANGE (ppm)	AVERAGE MERCURY (ppm)	MERCURY RANGE (ppm)
Above Dam in Massena	Rock bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.24	0.19-0.34
	Smallmouth bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.52	0.37-0.68
	Brown Bullhead	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.22	0.08-0.38
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.19	0.13-0.31
at Alcoa discharge	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.20	0.08-0.45
	Smallmouth bass	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	0.42	0.21-0.90
	Brown bullhead	<0.01	<0.01-<0.01	0.01	<0.01- 0.02	0.21	0.15-0.30
	Rock bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.32	0.17-0.44
	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.16	0.10-0.30
at Mouth	Yellow perch	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.22	0.11-0.39
	Brown bullhead	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.16	0.07-0.28
	Pumpkinseed	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.11	0.06-0.22
	Rock bass	<0.01	<0.01-<0.01	<0.01	<0.01-<0.01	0.22	0.15-0.28
at Alcoa discharge	Sediment	<0.01	-	<0.01	-	-	-
	Green frog	<0.01	-	<0.01	-	-	-
at Massena STP	Snail	<0.01	-	<0.01	-	-	-
at Chase Mills	Snail	<0.01	-	<0.01	-	-	-
St. Lawrence R. at head of Power Canal	Snail	<0.01	-	<0.01	-	-	-

Appendix B.

Massena AOC Industrial Facilities and Inactive Hazardous Waste Site Descriptions

A. ALCOA

The Aluminum Company of America (ALCOA) aluminum and aluminum product production facility encompasses approximately 3500 acres (1,400 ha) in the Massena Area of Concern. The facility is surrounded by the St. Lawrence River (north), the Grasse River (southeast), the Massena Power Canal (southwest), and a residential area along Dennison Road (northeast), (Figure B-1).

Past disposal practices at this facility have caused its listing in the NYSDEC registry of inactive hazardous waste disposal sites. A remedial consent order for the plant site was signed by NYSDEC and ALCOA in January, 1985. An on-site remedial investigation has been ongoing. Also, the EPA has recently issued an administrative order (Section 106) to ALCOA for the investigation and remediation of the river system adjacent to their property.

The ALCOA facility was established in Massena in 1903. The facility produces primary aluminum, aluminum ingots, extrusions and fabricated wire, rod and bar products. A conductor accessories division is no longer in operation and a cable conductor mill is presently operated by another company. Processing includes aluminum smelting, ingot casting, and aluminum fabrication.

All water used by the ALCOA facility comes from the St. Lawrence River and is chlorinated before use. All discharges are regulated by State Pollutant Discharge Elimination System (SPDES) permit number NY0001732.

Process wastewater is treated by a lagoon system and eventually discharged to the Grasse River through outfall 001. Wastewater from the primary aluminum process is mainly from the potliner air emission scrubbing system. This wastewater is treated with lime and settled in the primary lagoon. The wastewater is further stabilized in the 60 acre (24 ha) secondary lagoon before discharge through outfall 001.

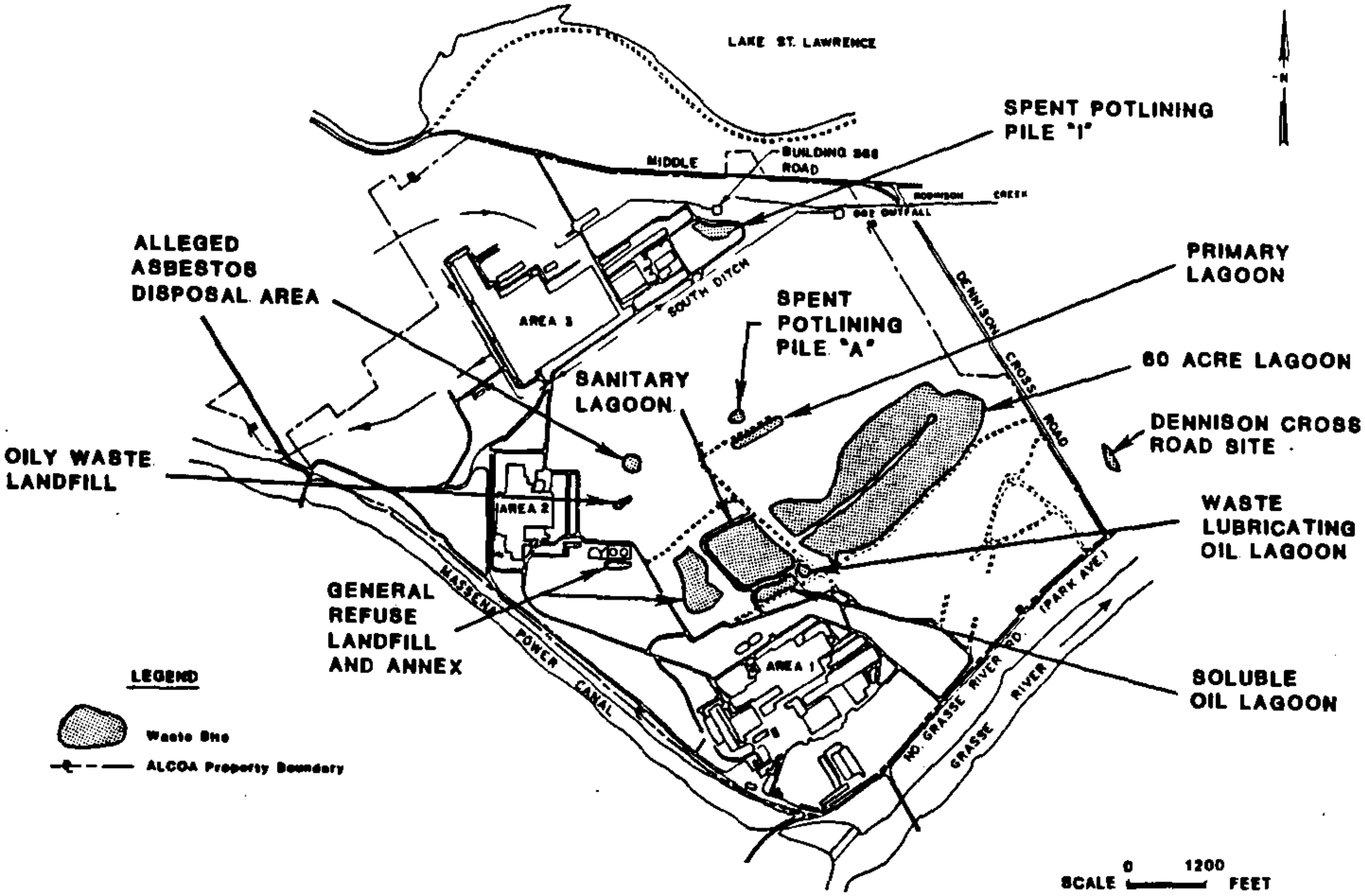

Figure B-1. Locations of inactive hazardous waste sites at the ALCOA facility.

Other wastewaters from ingot casting, extrusion and fabricating mill enter the lagoon directly without prior pretreatment. Sanitary wastewater is treated in the sanitary lagoon, seasonally chlorinated, and combined with the lagoon discharge for eventual combined discharge through outfall 001 to the Grasse River.

Outfall 002 is used primarily for stormwater discharge to the Grasse River. However, this outfall may also be used as an emergency bypass for primary aluminum process wastewater after lime treatment. An oil/water separator is available for use before discharge.

Outfall 003 discharges to the Massena Power Canal. It is used for stormwater runoff and noncontact cooling water. The water flows through two oil/water separators prior to discharge.

Outfall 004 also discharges stormwater runoff and noncontact cooling water. The water flows through an oil/water separator prior to discharge to the Grasse River.

Thirteen disposal areas have been identified throughout the ALCOA property. These areas are summarized in Table B-1 and are shown on Figure B-1. These areas are the subject of an ongoing inactive hazardous waste site remedial program. Groundwater sampling sites and data are shown on Figure B-2. Bottom sediment and surface water sampling sites and data are shown in Figures B-3 and B-4. The general direction of groundwater flow and water table elevations are shown in Figures B-2 and B-5.

1. Spent Potlining Pile "A"

Spent potlining pile "A" is listed in the NYS registry of inactive hazardous waste sites as site number 645001. This three acre inactive potliner disposal area is located near the center of the ALCOA property in an unlined gravel pit. Groundwater data from the area indicate contamination by cyanide, butylbenzylphthalate, trimethylisilanol, ammonia, total organic carbon, total organic halogens, chloride, fluoride, oil, grease, and sulfate. Fluoride, sulfate, and

TABLE B-1

SUMMARY OF ALCOA MASSENA DISPOSAL AREAS

Site Name	Site No.	Type and Size of Disposal Area	Period of Operation
Spent Potlining Pile "A"	645001	Inactive Pile 1-1/2 acres	1976 - September, 1983
General Refuse Landfill	645002	Active Landfill 17 acres	1955 - Present
Landfill Annex		Inactive 5 acres	
Spent Potlining Pile "I"	645003	Inactive Pile 4 acres	1951 - 1976
Dennison Cross Road Disposal Area	645004	Inactive Landfill 3/4 acre	1969 - 1979
Soluble Oil Lagoon	645005(A)	Inactive Unlined Lagoon 650'x200'x6'	1959 - December, 1986
Waste Lubricating Oil Lagoon	645005(B)	Inactive Unlined Lagoon 170'x210'x5'	1969 - 1980
Primary Lagoon	645005(C)	Active Unlined Lagoon 175'x800'x9'	1972 - Present
Dredge Spoils Area		8 Acres	
60 Acre Lagoon	645005(D)	Active Unlined Facultative Lagoon - 60 acres	1972 - Present
Alleged Asbestos Disposal Area	645006	Inactive Landfill 1.75 acres	1955 - 1965
Oily Waste Landfill	Area #7	Inactive Four Cell Landfill 1,800 cu.yds. (1 acre)	November, 1979 - December, 1984
Sanitary Lagoon	Area #8	Active Unlined Lagoon 800'x1,000' (18 acres)	1962 - Present

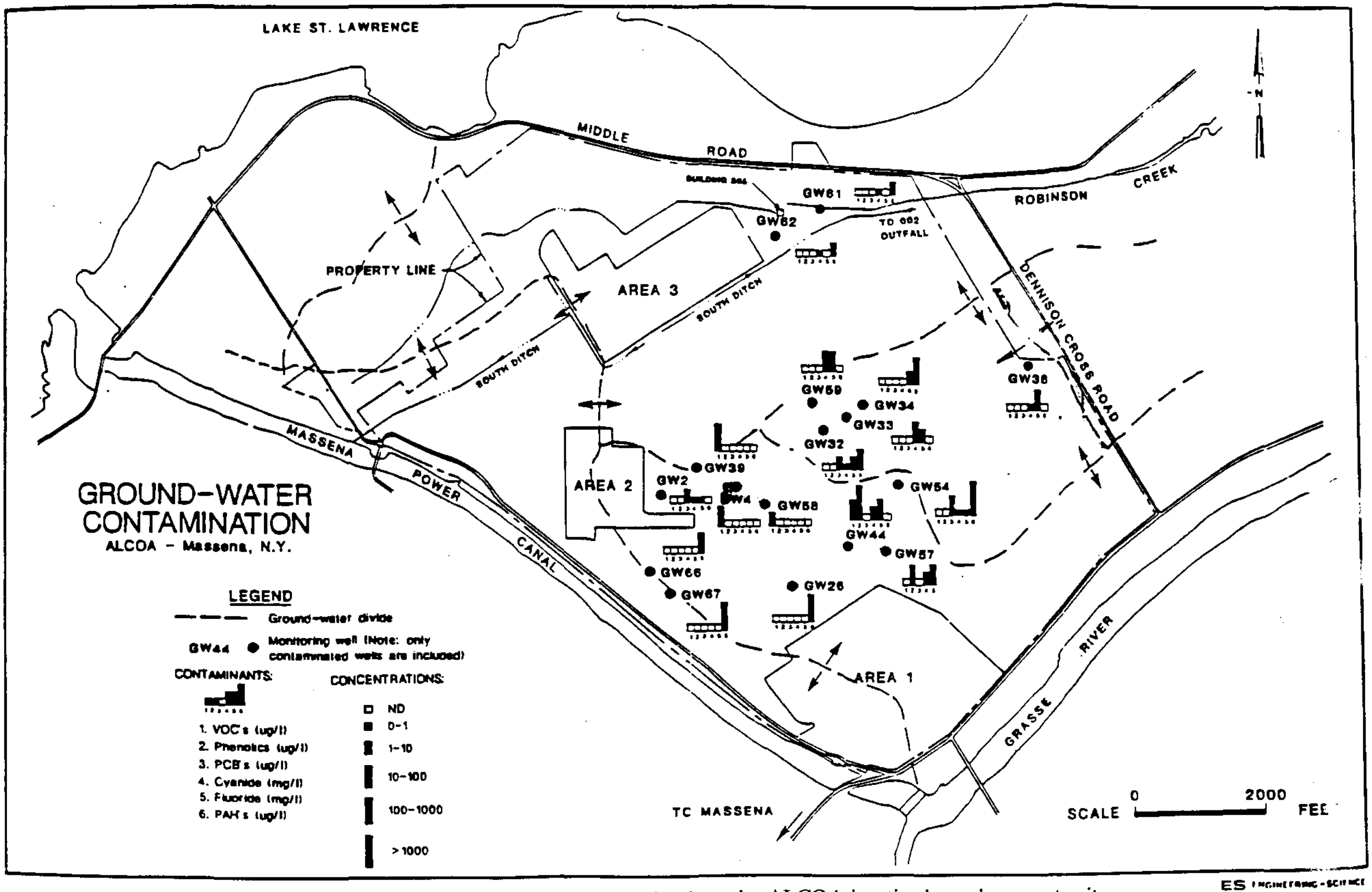

Figure B-2. Groundwater sampling locations and contaminant levels at the ALCOA inactive hazardous waste sites.

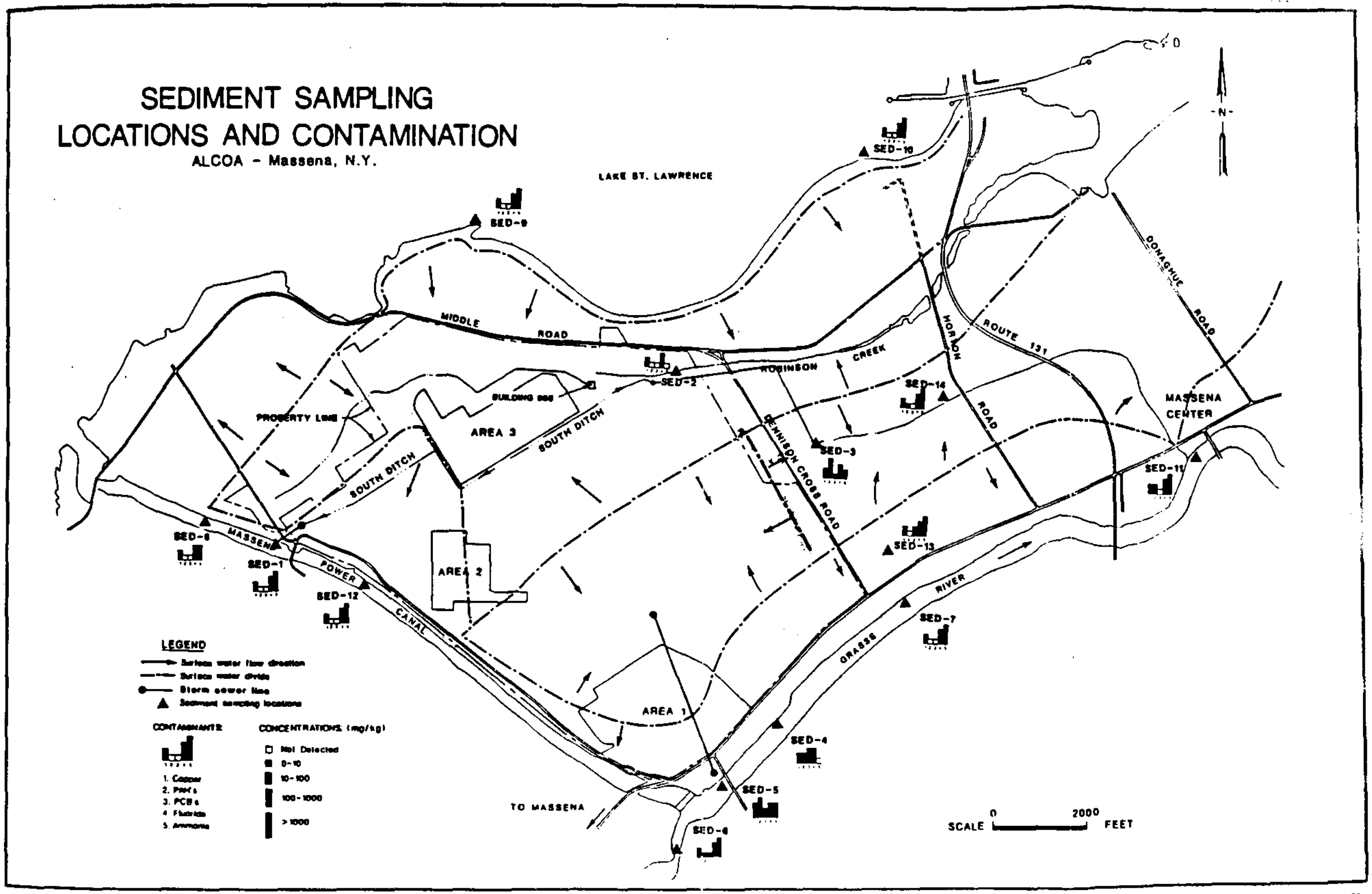

Figure B-3. Sediment sampling locations and contaminant levels near the ALCOA inactive hazardous waste sites.

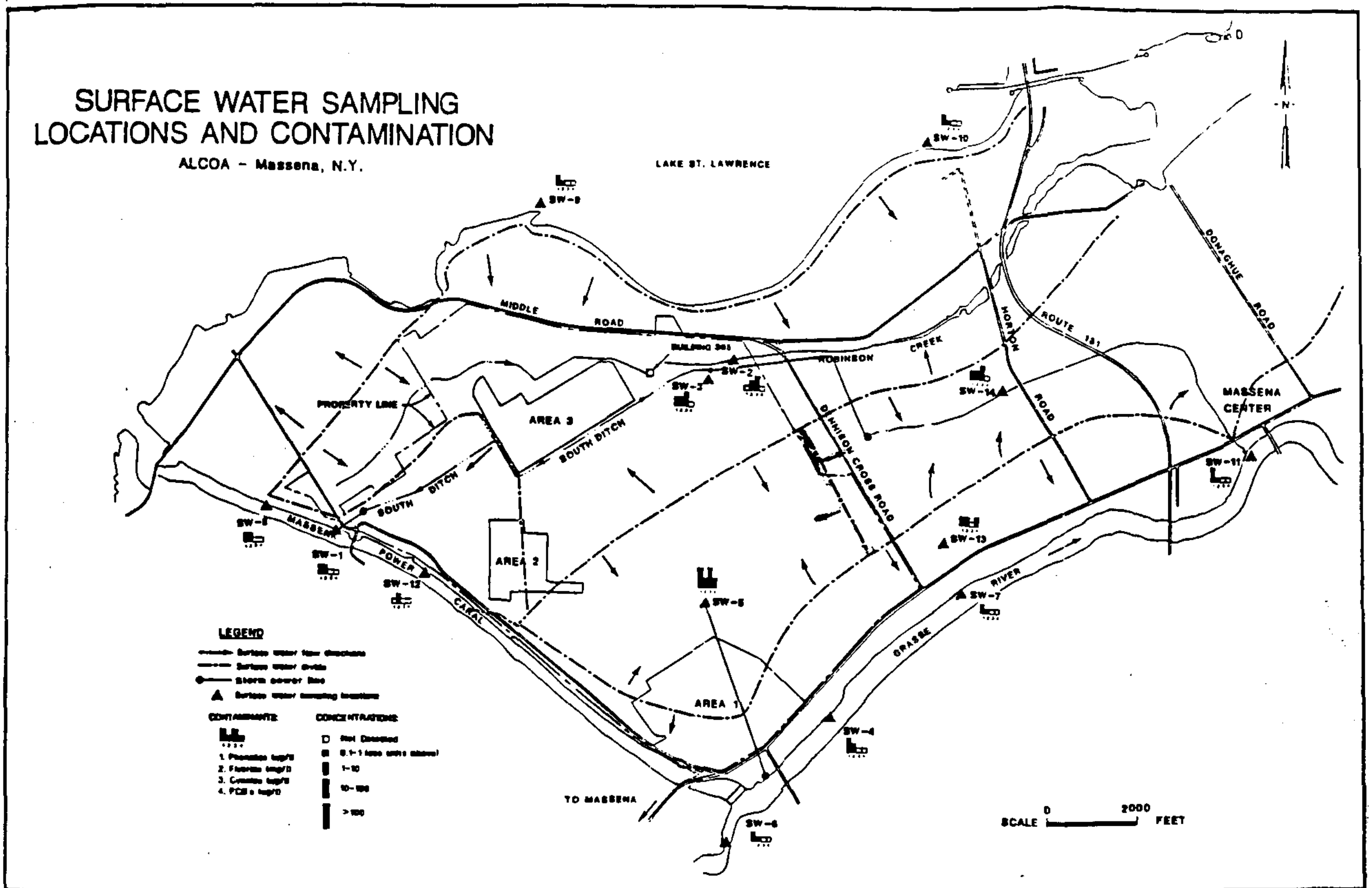

Figure B-4. Surface water sampling locations and contaminant levels near the ALCOA inactive hazardous waste sites.

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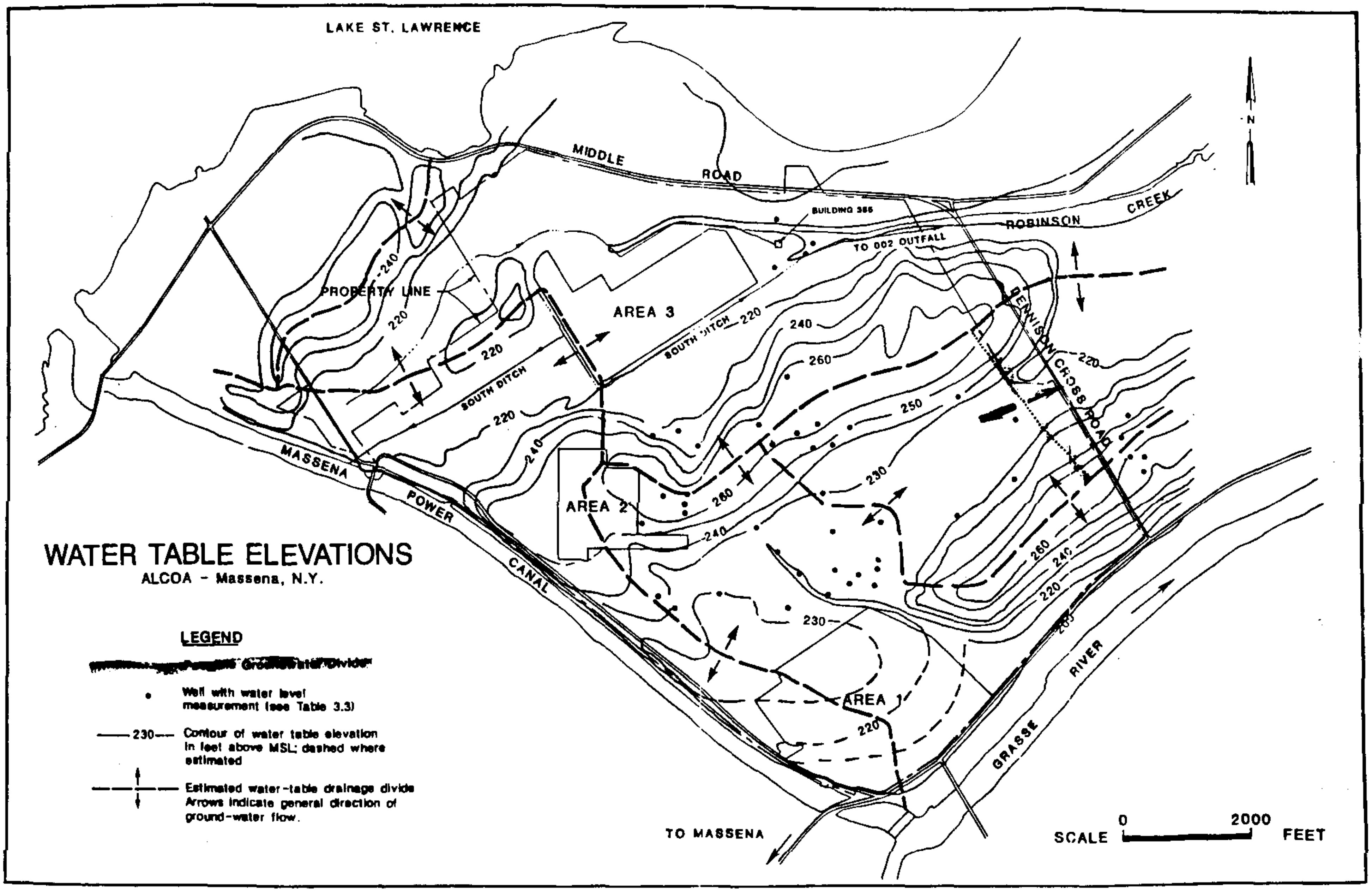

Figure B-5. Estimated groundwater elevations at the ALCOA inactive hazardous waste sites.

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cyanide levels exceed applicable groundwater standards in some of the wells in this area.

2. ALCOA Industrial Landfill and Annex

This area is listed in the NYS registry of inactive hazardous waste sites as site number 645002. It consists of a 17 acre (6.8 ha) active landfill that has been used since 1955 and a five acre inactive landfill annex that opened in 1903. The active portion has been used for industrial and cafeteria waste. The landfill has also allegedly received asbestos waste and dross. Area groundwater sampling has shown the following substances greater than standards or background concentrations: benzo(a)anthracene, benzo(b)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, napthalene, 2-methylnapthalene, ammonia, total organic halogens, oil, grease, and sulfates.

3. Spent Potlining Pile "I"

This four acre (1.6 ha) inactive potliner landfill is listed in the NYS registry of inactive hazardous waste sites as site number 645003. It is located approximately 100 feet (30 m) from Robinson Creek, which empties into the St. Lawrence River. The site was operational from 1951 to 1976, after which it was covered. In 1983, a final cover of 18-24 inches (0.46-0.61 m) of clay was applied. A caustic solution of ferric cyanide has been leaching from the site. A leachate collection system installed in 1984 collects some, but not all of this leachate. Groundwater monitoring has confirmed contamination by benzo(b)fluoranthene, total organic carbon, oil, grease, cyanide, and fluoride.

4. Dennison Road

This 3/4 acre (0.3 ha) inactive landfill was operated from 1969 to 1979 in a ravine formed from river sludge materials. It is listed as NYSDEC inactive hazardous waste site number 645004. Disposal included oil sludges, chlorinated solvents, degreasers, and solvent degreasing still bottoms. Monitoring has shown groundwater levels greater than background for ammonia, total organic carbon, oil, and grease.

5. Wastewater and Waste Oil Lagoons

This is site number 645005 in the NYSDEC inactive hazardous waste site registry. It consists of five lagoons: primary, 60 acre (24 ha), soluble oil, waste oil, and sanitary waste.

The primary lagoon is an initial settling basin for wastewater treatment. The unlined lagoon is approximately 800 feet x 175 feet x 9 feet deep, and with the adjoining dredge spoils area, encompasses eight acres of the ALCOA site. The primary contaminants of concern are PCBs and polynuclear aromatic hydrocarbons.

Primary lagoon effluent discharges to the unlined 60 acre lagoon for further treatment. The main contaminants of concern are PCBs, polynuclear aromatic hydrocarbons, cyanides, and fluorides. The 18 acre (7.2 ha) sanitary lagoon serves as a treatment lagoon for sanitary wastes and has similar contaminant concerns.

The three acre soluble oil lagoon received soluble oils (until 1986), spent caustic, acid solutions, and spent wax emulsions from 1959 until 1983. Contaminants include phenols, cyanides, fluoride, PCBs, and polynuclear aromatic hydrocarbons.

The 1.5 acre (0.6 ha) waste lubricating oil lagoon received halogenated organics, hydrocarbons, oils, and grease from 1969 to 1980. Waste was removed from the lagoon in 1980 and disposed in the soluble oil lagoon. The remaining oil was solidified with sand, cement dust, and soil and capped with clay. Phenols, cyanides, and fluorides have been detected around this lagoon.

6. Oily Waste Landfill

The oily waste landfill (# 645016) received wastes such as speed dry rags and sludges from 1979 to 1984. Wastes were disposed of in two solidification nets.

Subsurface stratigraphy at the site is characterized by a brown, moderate to dense sandy till overlying a gray, dense sandy till. Bedrock is thought to be approximately 135 to 140 feet (40-42 m) beneath the site.

The site is located on a groundwater divide with shallow groundwater flowing generally to the north and south. Local shallow groundwater flow in the immediate vicinity of the site appears to be radial in nature. Based on the groundwater level measurements, it is evident that a strong downward vertical gradient is present beneath the site.

PCBs and volatile organic compounds have consistently been detected in shallow groundwater downgradient of the site. PCBs, benzene, toluene and 2,4-dichlorophenol have also been detected in deep groundwater samples downgradient of the site.

7. Other Waste Disposal Areas

A three acre marsh on ALCOA property referred to as West Marsh, is contaminated with PCBs in the 1 to 29,000 ppm range. An estimated 2,100 yd^3 (1588 m^3) of soil and sediment are effected. Deposits are thought to be underlain with of marine silty sand and gravel and marine sandy, silty clay. An unknown thickness of glacial till is under this layer. Bedrock could be approximately 85 feet (26 m) below the site. The marsh is in a groundwater discharge zone with groundwater discharging to the area from the north, south and west.

The streambed of an unnamed tributary is also listed as a site requiring remediation. There is approximately 400 feet (120 m) of streambed with 700 yd^3 (529 m^3) of sediment contaminated with PCBs and PAHs. Sampling in the upstream portion of the Unnamed Tributary has documented PCBs at concentrations as high as 35 ppm and PAHs ranging from 6.5 to 16,420 ppm.

The alleged asbestos disposal area was used from 1955 to 1965. Dross and other industrial wastes (including the alleged asbestos) has been disposed. Subsequent testing has indicated no hazardous waste at this site and it was closed pursuant to solid waste regulations.

References

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2. Engineering Science (1989). Waste Site Investigation ALCOA Massena Operations. Volume IV - Supplemental Report. March 1989.

3. NYSDEC (1988). Inactive Hazardous Waste Disposal Sites in New York State, Volume 6. April 1989.

4. NYSDEC State Pollutant Discharge Elimination Permit #NY0001732.

5. NYSDEC, Aluminum Company of America of America SPDES profile.

6. NYSDEC 1990. Pers. Comm., D. Sweredoski.

B. General Motors Corporation - Central Foundry Division

The General Motors Corporation Central Foundry Division (GMC-CFD) Massena plant encompasses approximately 228 acres (91 ha) in the Area of Concern. The plant is surrounded by the St. Lawrence River (north), the Raquette River (south), the St. Regis Mohawk Reservation (east), the Reynolds Metal Company, and the St. Lawrence Seaway Development Corporation (west), (Figure B-6). With the exception of the manufacturing plants, the surrounding area is primarily forest and agricultural lands.

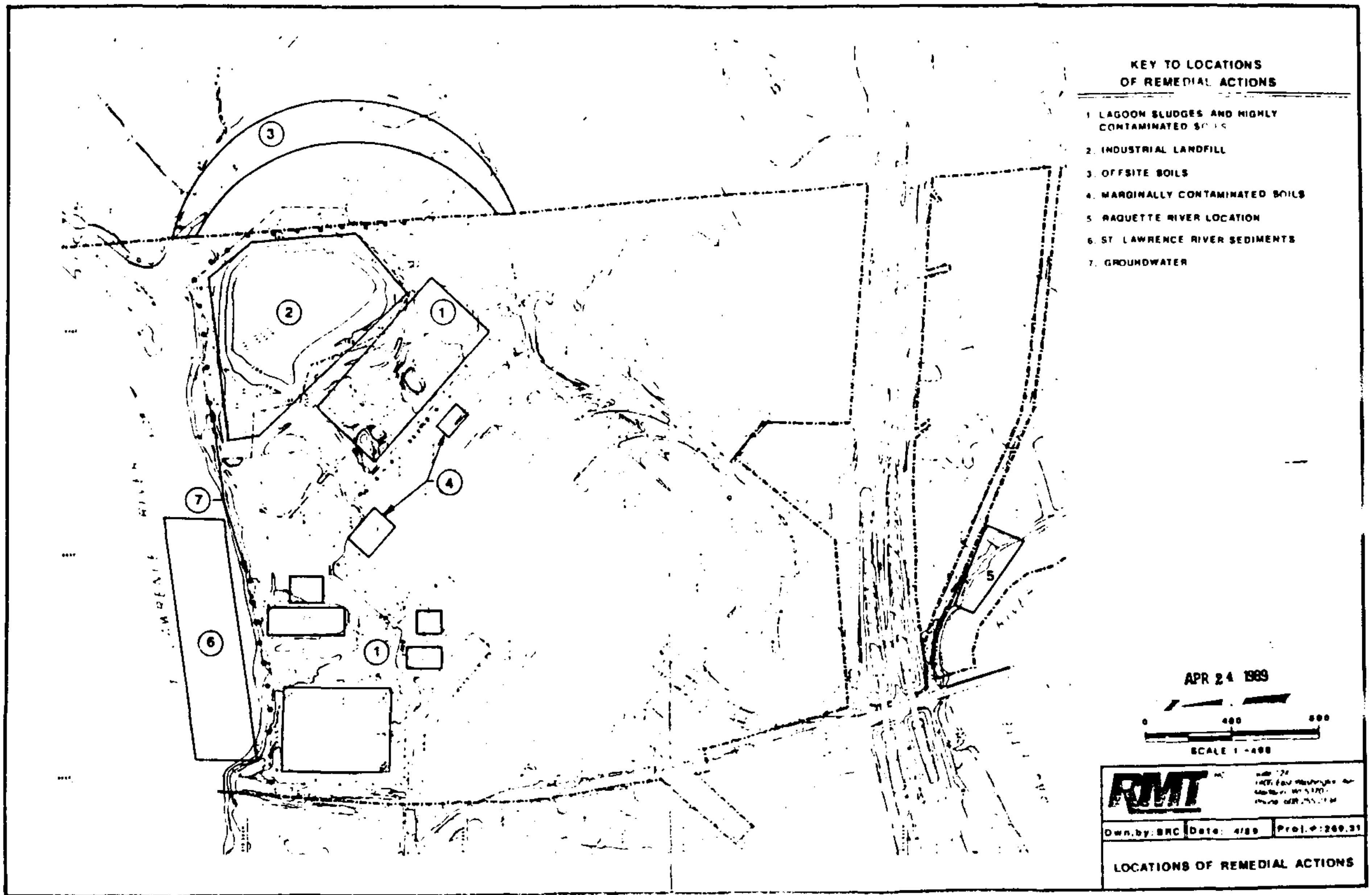

Figure B-6. Location of waste sites at General Motors facility.

Polychlorinated biphenyls (PCBs) were used in die casting machine hydraulic fluid from 1959 until 1973. Past disposal practices associated with PCBs caused this facility to be placed on the EPA's National Priority list (CERCLA). Therefore, this site was the subject of a two-phase remedial investigation and is currently the focus of a feasibility study for site remediation.

The GMC-CFD facility opened in the fall of 1958 using electrical power generated by the newly developed St. Lawrence Seaway. The plant initially produced Corvair cylinder heads from aluminum as its main product. However, in 1968, production of the Corvair was discontinued. Die casting and permanent molding were substituted in the plant's operations.

The facility has cast molten aluminum into automotive parts such as manifolds, transmission casings and pistons. The aluminum parts were typically cast using sand/resin molds, permanent molds, and die castings. However, the facility presently only casts molten aluminum into ingots and cylinder heads. Die casting has been phased out in favor of the lost foam process.

The die casting machines have been estimated to have leaked approximately 100,000 gallons of hydraulic fluid per year due to the high (up to 2500 psi) operational pressures. In the early 1960's a hydraulic fluid reclamation system was installed. The leaking hydraulic fluid was caught by drains that surround each machine and transported to the reclamation system. Wastewater from the reclamation system and stormwater was sent through a 1.5 million gallon lagoon and weir system before eventual discharge to the St. Lawrence River.

The lagoon was periodically drained and the sludge was landfilled on site. In 1968/69 a gunite lined interceptor lagoon (60' x 90' x 7' 13' deep) was added to this system to add retention time for the reclamation process. Hydraulic fluid was drained and flushed in the 1970s. However, residual PCBs remain throughout the treatment system above a 50 ppm level and require proper offsite disposal.

A physical/chemical treatment and hydraulic fluid recovery system was installed at GMC-CFD from 1972 to 1976. This included a corrugated plate interceptor, centrifuge and filtration system was used for hydraulic fluid recycle. The water from this system was processed further by a 350,000 gallon holding lagoon, lamella separator, chemical treatment (lime, soda ash, flocculants), and rapid sand filtration. After treatment, the water was recirculated. A 500,000 gallon lagoon, and finally a 10 million gallon non-contact cooling water lagoon were installed to retain and recirculate water.

This system was intended to be a closed loop system. However, infiltration, precipitation, and runoff added water to the system. Therefore it was necessary to overflow the 10 million gallon lagoon to the 1.5 million gallon lagoon. This water eventually was discharged to the St. Lawrence River through SPDES outfall 001. This system, at times, failed to meet SPDES permit discharge limits due to poor organic and total dissolved solids removals.

Therefore, in 1980, GMC-CFD installed an activated sludge treatment system (aeration basin, 2 clarifiers, and a pump house) and activated carbon columns to assist in meeting SPDES permit discharge limits. In 1985 additional carbon absorption and chemical coagulation was installed. Also, the 1.5 million gallon lagoon was hydraulically separated from the wastewater system.

Originally, the facility had three separate outfalls. Process wastewaters and non-contact cooling waters were diverted from outfall 002 to 001 before 1977. After this diversion, outfall 002 received only stormwater. Outfall 002 and outfall 003 are presently joined and discharge to the St. Lawrence River. This combined outfall consists of stormwater and river water pump leakage from the main pump house. Outfall 001 is the main discharge for process wastewater.

All sanitary wastewater (sewage) was pumped to the neighboring Reynolds Metals Company sewage treatment plant until 1988. Now, GMC-CFD treats its own sanitary wastewater in the wastewater treatment system.

There are a number of other waste disposal areas throughout the GMC-CFD property. These areas are described below.

1. North Disposal Area

In December 1971, approximately 800,000 gallons of PCB contaminated sludge was removed from the 1.5 million gallon lagoon and placed into pits adjacent to the lagoon in the north disposal area. These pits were backfilled in 1973 with tree stumps, construction debris, and soil. It is estimated that this area contains up to 12,000 cubic yards of contaminated materials with subsurface PCB levels reaching 31,000 ppm. The groundwater in the area has levels up to 4.1 ppb.

An adjacent pump house also contained approximately 13,000 gallons of PCB liquids in a wet well. This pumphouse was abandoned in 1976 and closed under consent order in 1985.

2. East Disposal Area

From 1973 to 1975 sludge removed from the 1.5 million gallon lagoon was taken to the bermed east disposal area. This constructed settling basin had berms eight to ten feet high and was approximately three acres in size.

In the summer of 1975, the berm was breached causing water and sludge to flow to the property line. This allowed water containing PCBs to flow to the reservation. Visibly contaminated material was redisposed in the east area by GCM-CFD personnel.

The east area was backfilled with construction debris, boulders, and soil in 1977. Portions of this area have since been graded and paved during plant expansions. The remedial investigations have found PCB concentrations in the soil of up to 41,000 ppm.

3. Industrial Landfill

The northeast portion of the facility contains an eight acre landfill that rises 30 feet above the natural ground level. The landfill was subject to interim remedial measures during the summers of 1987 and 1988 including closing, grading, and temporary capping. The landfill has received foundry sand, soil excavated during construction, bulk waste debris such as furnaces, and other industrial waste. In addition, the landfill has received unknown amounts of chemical wastes including PCB contaminated sludges, lubricants, caustic waste, degreasers, and aluminum dross.

The remedial investigation has shown the presence of PCBs, volatile organics, phenols, and polynuclear aromatics in both the subsurface of the landfill and site groundwater.

4. Lagoons

The interceptor lagoon used from 1968 to 1976 was covered in September 1976 with construction debris and soil. The eastern end of this lagoon was partially covered in 1980 by the newly constructed wastewater aeration basins.

The 350,000 gallon lagoon that was part of the wastewater system from 1976 to 1980 is currently inactive. It contains an estimated 300,000 gallons of PCB contaminated sludges. The 1.5 million gallon lagoon is also currently inactive.The remedial investigation has shown all lagoon sludges to be contaminated to some degree and the existence of a contaminant plume in this area. The 10 million gallon and the 500,000 gallon lagoons are currently active in the plant's recirculatory water system. Water from any of the four lagoons undergoes treatment and carbon filtration prior to discharge to the St. Lawrence River.

Since 1980, all wastewater treatment sludges have been shipped to permitted hazardous waste disposal facilities out of the drainage basin (CECOS in Buffalo, New York or Chemical Waste Management in Emil, Al). These sludges are generated as part of the plants wastewater treatment system.

5. River Sediments

Outfalls to the St. Lawrence and Raquette rivers have caused sediment contamination. The remedial investigation has documented sediment concentrations of PCBs up to 5,693 ppm in the St. Lawrence River adjacent to the GMC-CFD plant. In addition, sediment contamination has been found in an unnamed tributary to the St. Lawrence and the Raquette River. In 1970, PCB contaminated soil was placed on the north bank of the Raquette River, immediately east of the Tavern Road Bridge.

References

1. RMT (1986). Draft Remedial Investigation report for Remedial Investigation/Feasibility study at GMC-CFD Massena Facility.

2. RMT (1988). Phase II Remedial Investigation Addendum report for Remedial Investigation/Feasibility study at GMC-CFD Massena Facility.

3. RMT (1989). Draft Feasibility study for the Remedial Investigation/Feasibility study. GMC-CFD Massena Facility.

C. Reynolds Metals, Inc.

The Reynolds Metals, Inc., St. Lawrence reduction Massena plant encompasses approximately 112 acres (4.5 ha) of a total 1600 acres (648 ha) of Reynolds Metals property in the Area of Concern. The Reynolds property is surrounded by the St. Lawrence and Grasse Rivers (north), Raquette River (south), Conrail and General Motors (east), and Haverstock Road (west) (Figure B-7).

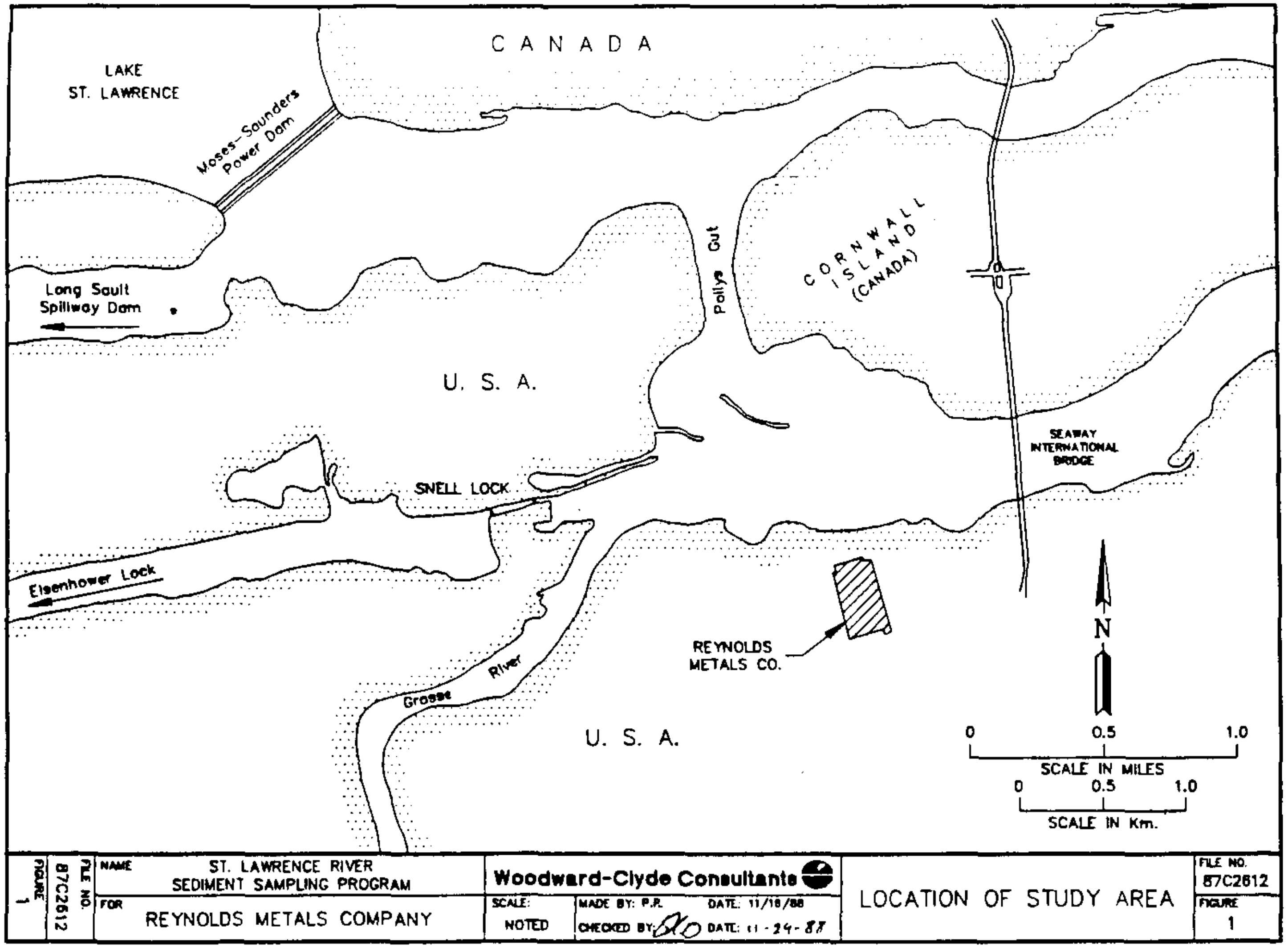

Figure B-7. Location of Reynolds Metals, Inc., facility within the Massena AOC.

Past disposal practices at this facility have caused its listing in the NYSDEC registry of inactive hazardous waste disposal sites. A remedial consent order for the plant site was signed by NYSDEC and Reynolds in September, 1987. An on-site remedial investigation has been ongoing. Also, the EPA has recently issued an administrative order (Section 106) to Reynolds for the investigation and remediation of the river system adjacent to their property.

Built in 1958, the Reynolds plant uses electrical power generated by the St. Lawrence Seaway. The facility produces aluminum from aluminum (aluminum oxide) in a series of individual pots. Each pot has a pot liner consisting of a mixture of coal tar pitch, coke, and other materials.

A heat transfer medium (HTM) system is used to allow the pitch to flow and be pumped. This HTM system previously used a PCB based oil. Despite numerous purgings, the PCB concentrations remain 10-20 ppm in this system. Past leaks and spills of this system, as well as electrical transformers and hydraulic equipment, are the suspected sources of PCBs at this facility.

After approximately five years of service, a spent pot liner is removed from the pots and crushed for cryolite recovery. Wastes from cryolite recovery are combined with air pollution control scrubber liquor and treated by chemical precipitation. More cryolite is recovered and the remaining liquor is returned to the fume control system.

Wastewater bleed from the cryolite recovery and fume control systems are combined with casting and electrical cooling waters for discharge from outfall 001. Storm runoff from areas immediately adjacent to the main manufacturing buildings are also discharged through outfall 001. All discharges are regulated by State Pollutant Discharge Elimination System (SPDES), permit number NY 0000132.

Sanitary sewage from both the Reynolds and GMC-CFD plants were previously treated separately and discharged through outfall 003. However, as of July, 1988, GMC-CFD treats its sanitary wastes at its own facility. Reynolds treatment consists of activated sludge and chlorination. In addition, a granular activated carbon treatment system was added in July, 1988 to remove PCBs from the wastestream. Sludges from this system were previously disposed of at the Reynolds landfill. They are now being held on site in sludge drying beds due to their hazardous nature.

Outfall 002 discharges cooling water from the casting process, induction furnace, and compressor. Outfall 004 discharges runoff from the east and west number 6 oil tank dikes, and the coal tar tank dike area. The bermed area water is treated by the activated sludge system and carbon filtration to remove PCBs prior to discharge.

1. Landfill

The 11.5 acre (4.7 ha) landfill is located on the southwest corner of the site adjacent to a wetland, (Figure B-8). In 1984 a leachate collection and control system was installed. It included bank improvements with a containment berm, surface and subsurface leachate collection, a 350,000 gallon storage tank, with eventual discharge to the existing wastewater treatment plant. This system catches some, but not all of the contaminant flow to the wetlands south of the landfill.

The primary contaminants of concern include (the maximum concentrations detected in groundwater monitoring wells are shown in parenthesis): PCB (8.4 ppb), fluorides (290 ppm), cyanides (18.5 ppm), sulfates (1800 ppm), sodium (3120 ppm), and aluminum (18.4 ppm). Other contaminants detected above New York standards are nitrate, phenols, iron, selenium, manganese, magnesium, antimony, arsenic, berylium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-CD)pyrene, pyrene.

2. Former Pot Liner Storage Area

The former pot liner storage area is located in the eastern portion of the landfill. Although the pot liner has been removed, this area continues to be a source of

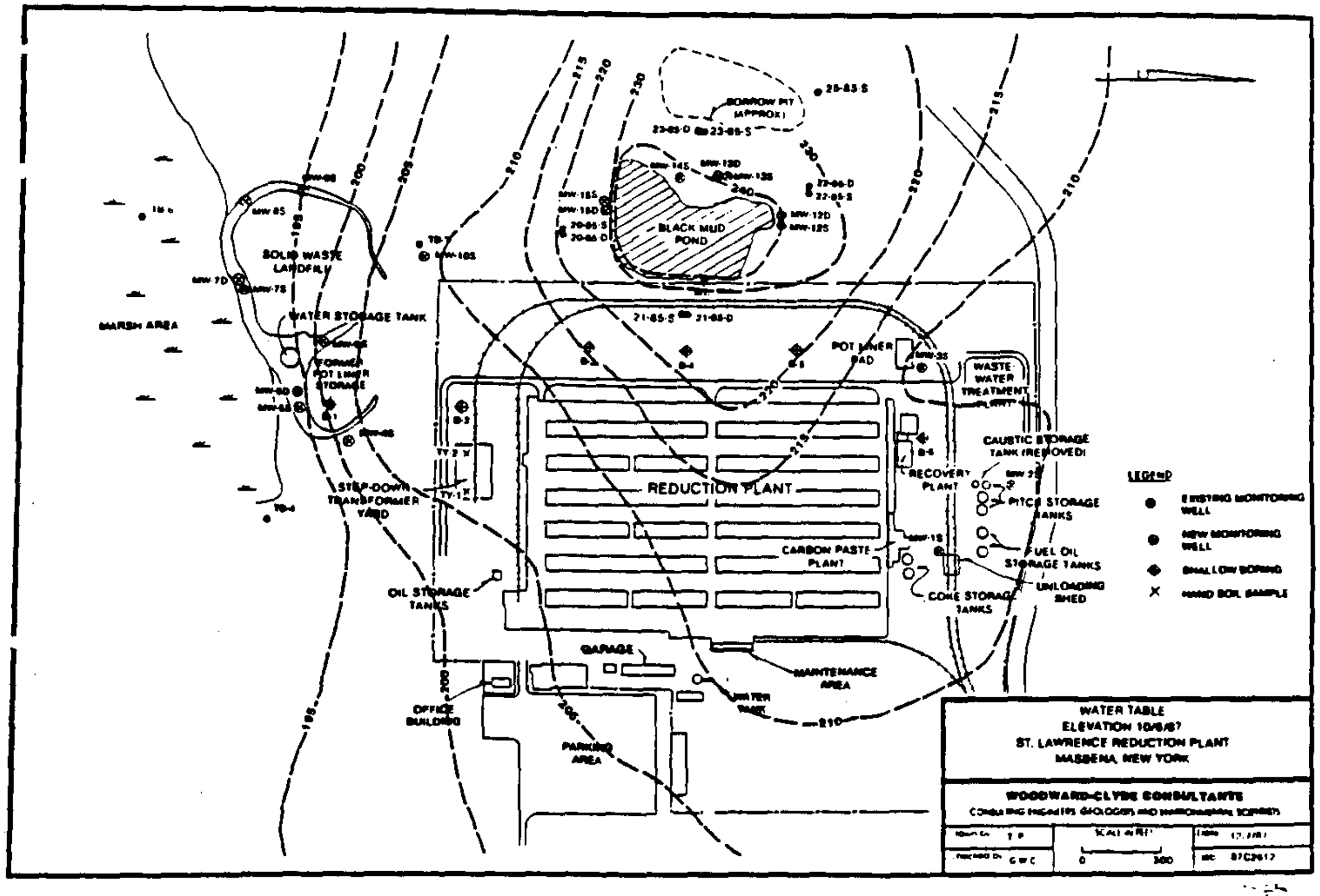

Figure B-8. Location of waste disposal sites, monitoring wells, and water table elevations at the Reynolds Metals facility.

contamination to the adjacent wetland. Groundwater in this area has shown elevated levels of fluorides, cyanides, sulfates, sodium, aluminum, iron, and pH.

3. Black Mud Pond

Black Mud Pond is a six acre (2.4 ha) lagoon constructed in an unlined borrow pit in 1973. It was designed to hold settling carbon solids from the emission control and cryolite recovery systems. By increasing the ponds dike height in 1980, it reached its current capacity of 20 million gallons.

In 1982, liquor was observed leaking approximately 100 feet northwest of the pond. This leak was remedied in 1985 by constructing a cutoff wall with compacted till from a borrow pit west of the pond.

Groundwater in the area contains sulfates (up to 880 ppm) and magnesium (up to 337 ppm), which are components of black mud. Other contaminants detected include aluminum, iron, sodium, cyanides, fluorides, phenols, and antimony. Polynuclear aromatics and PCBs have been detected in the black mud, and in goundwater (PCBs, 0.19 ppb).

4. Plant Area

The caustic storage area, pitch unloading area, pot liner storage pad, and HTM system are being investigated to determine the extent of PCB contamination in the soils. Groundwater contamination is still under investigation.

5. River Sediments

Outfalls to the St. Lawrence River have caused PCB sediment contamination. The sediment sampling program conducted by Reynolds has shown levels of PCBs to be up to 1300 ppm in the near shore sediments, see Figure B-9. The sediment contamination pattern is analogous to water flow patterns in the nearshore area of the outfalls.

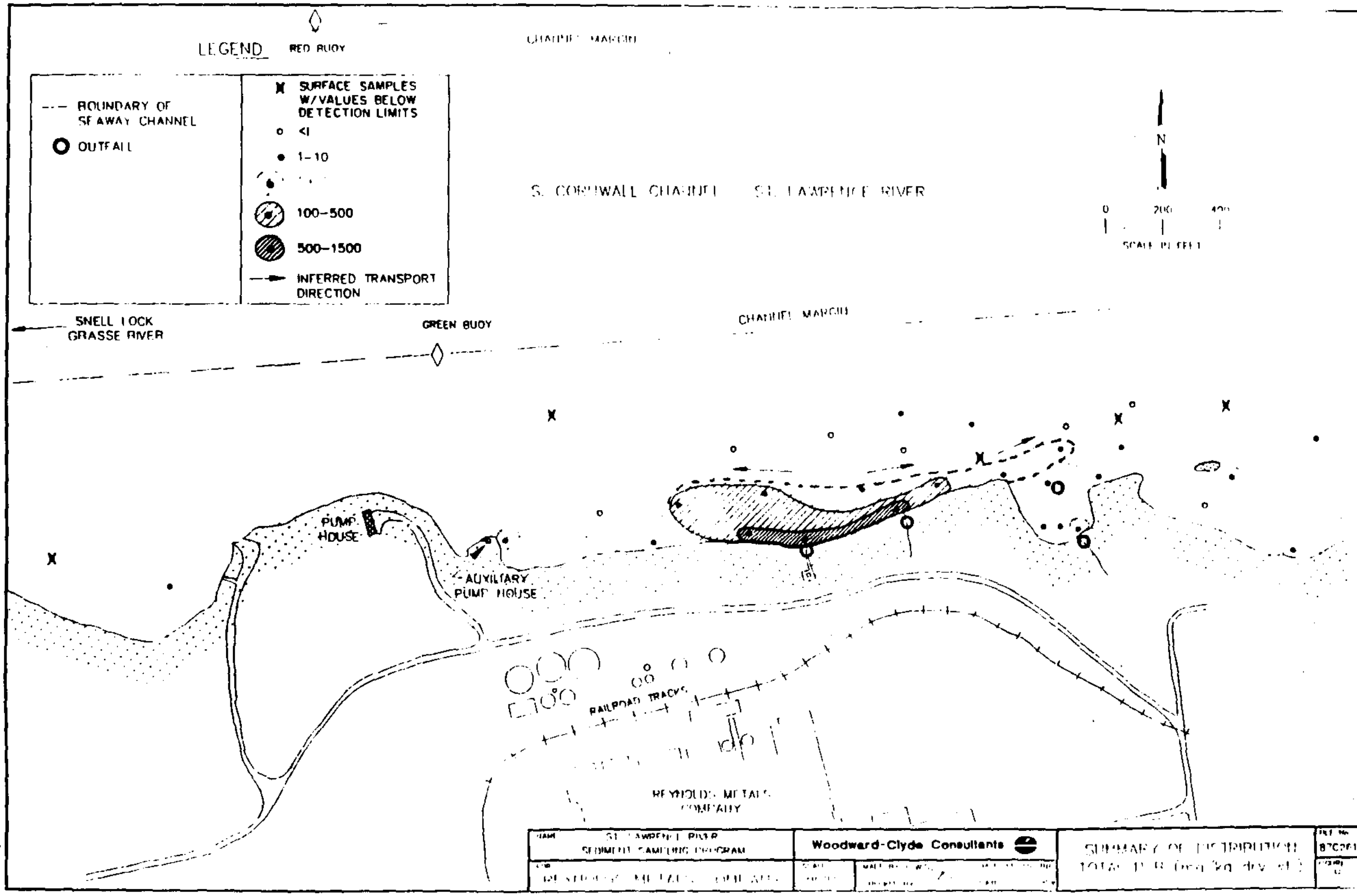

Figure B-9. Bottom sediment sample of PCB levels from the St. Lawrence River near the Reynolds Metals, Inc. facility.

References

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2. Woodward-Clyde Consultants (1989). St. Lawrence River sediment sampling program. Final Report, 1988 studies. January, 1989.

3. Woodward-Clyde Consultants (1989). Report on PCB source identification assessment. Prepared for Reynolds Metals Company St. Lawrence Reduction Plant, Massena, NY, 20 February, 1989.

4. Woodward-Clyde Consultants (1989). Quarterly groundwater sampling. Prepared for Reynolds Metals Company, Massena, Nov. 2, 1989.

5. NYSDEC, State Pollutant Discharge Elimination Permit #NY0000132.

Appendix C.

Toxic Chemical Release Inventory Data and Industrial Chemical Survey Data

Summary of 1988 toxic release inventory data for the Massena AOC and sub-basins.

Facility	Location	Chemical	Quantity (lb/yr)	Type Emission/Status
St. Lawrence River Drainage Basin				
General Motors	Massena	ethylene glycol	1-499	Discharge to water
		" "	500-999	Transfer to offsite location
		" "	1-499	" " " "
		sodium hydroxide	4050	" " " "
		aluminum oxide	1-499	Stack or point air emissions
		" "	1-499	Transfer to offsite location
		copper	1-499	Discharged to water
		"	1-499	Transfer to offsite location
		"	1-499	" " " "
		chlorine	1-499	Fugitive air emissions
Hoosier Magnetics, Inc.	Ogdensburg	barium compounds	500-999	Stack or point air Inc.emissions
		" "	1-499	Transfer to offsite to POTW
		" "	1-499	Transfer to offsite location
Mitel, Inc.	Ogdensburg	methanol	1-499	Transfer to offsite location
		isopropanol	1-499	" " " "
		n-butyl alcohol	1-499	" " " "
		1,1,2-trichloro-1,2	1-499	" " " "
		methyl ethyl ketone	1-499	" " " "
		methyl isobutyl ketone	1-499	" " " "
Reynolds Metal Co.	Massena	alumimum oxide	12,000	Fugitive air emissions
		" "	250,000	Stack or point air emissions
		" "	1,200,000	Releases to surface impoundment
		" "	1,021,857	Transfer to offsite locations
		copper	1-499	Stack or point air emissions
		phosphoric acid (PO_4)	20,000	Discharge to water
		hydrofluoric acid	133,500	Stack or point air emissions
		chlorine	3,300	" " " "

Facility	Location	Chemical	Quantity (lb/yr)	Type Emission/Status
		"	3,100	Discharge to water
		zinc compounds	4,400	Discharge to water
		manganese compounds	1-499	Stack or point air emissions
Universal Foods Corp.	Ogdensburg	sodium hydroxide	1,194	Transfer offsite to POTW
		phosphoric acid (PO_4)	85,384	" " "
		nitric acid	14,660	" " "
<u>St. Regis River Sub-Basin</u>				
McCadam Cheese Co., Inc.	Chateaugay	sodium hydroxide	1-499	Transfer offsite to POTW
		sulfuric acid	1-499	" " "
<u>Grasse River Sub-Basin</u>				
Aluminum Company of America	Massena	1,1,1-trichloroethane	120,000	Fugitive air emissions
		"	9,600	Stack or point air emissions
		sodium hydroxide	1,600	" " "
		" "	260,000	Transfer to offsite locations
		aluminum oxide	1,000,000	Fugitive air emissions
		" "	59,000	Stack or point emissions
		" "	1-499	Discharge to water
		" "	970,000	Released to onsite landfill
		lead	1,200	Stack or point air emissions
		total manganese	500-999	" " "
		chromium	500-999	" " "
		copper	9,600	" " "
		"	1,500	Discharge to water
		"	1-499	Release to onsite landfill
		zinc	3,300	Stack or point air emissions
		zinc	2,000	Discharge to water
		hydrofluoric acid	140,000	Fugitive air emissions

Facility	Location	Chemical	Quantity (lb/yr)	Type Emission/Status
		" "	9,000	Stack or point air emissions
		sulfuric acid	1-499	" " "
		" "	18,000	Transfer to offsite locations
		nitric acid	1-499	Stack or point air emissions
		" "	25,000	Transfer to offsite locations
		chlorine	1,400	Stack or point air emissions
Kraft, Inc (Canton Cheese)	Canton	sodium hydroxide	9,192	Transfer offsite to POTW
		phosphoric acid (PO_4)	15,669	" " "
<u>Oswegatchie River Sub-Basin</u>				
Corning, Inc.	Canton	trichloroethylene	249	Fugitive air emissions
		" "	80	Stack or point source emissions
		hydrochloric acid	1,900	Fugitive air emissions
		" "	1,100,000	Stack or point source emissions
Papyrus Newton Falls	Newton Falls	PCBs		36,400Transfer to offsite locations
		ammonia	1-499	Fugitive air emissions
		"	1-499	Stack or point source emissions
		"	525	Discharge to water
		chlorine	1-499	Fugitive air emissions
		"	2,400	Discharge to water

POTW = Publicly Operated Treatment Works

Industrial chemical survey listing of chemicals of concern in the Massena AOC (March 1990).

Company Name	City	Chemical Name	Annual Use	Amount on Hand	Units	Use Code[1.]
Grasse River Sub-Basin						
Aluminum Company of America	Massena	lead (compounds)	80,331	6,694	L	BAS
		chromium (compounds)	172,091	14,340	L	BAS
		copper (compounds)	3,215,922	267,994	L	BAS
		zinc (compounds)	1,108,792	92,399	L	BAS
		PCB	0	138	G	CLO
Oswegatchie River Sub-Basin						
Cives Steel Company (Northern)	Gouverneur	lead-print component	unknown	0	U	NLU
		zinc-print component	20,000	1,000	L	BAS
Corning, Inc.	Canton	PCB	1	1	L	CLO
ZCA Mines, Inc. (Balmat No. 4)	Balmat	copper sulfate	unknown	24,500	L	BAS
		PCB	0	100	G	CLO
		lead mineral concentrates	4,286,000	2,020,000	L	PRO
		zinc mineral concentrates	228,888,000	14,168,000	L	PRO
St. Lawrence River Basin						
American Computer Assembly Co.	Ogdensburg	lead (compounds)	unknown	unknown	U	COT
		copper (compounds)	unknown	unknown	U	COT
Bulldog Jorden Co. (Div. Newell)	Ogdensburg	zinc anodes	7,000	2,200	L	REA

Company Name	City	Chemical Name	Annual Use	Amount on Hand	Units	Use Code[1]
General Motors Corp. (Central Foundry)	Massena	lead (compounds)	28	28	L	CLO
		copper (compounds)	43,976	14,213	L	PRO
		PCB	unknown	unknown	U	NLU
Reynolds Metal Co.	Massena	mercury (compounds)	0	110	L	CLO
		nickel (compounds)	20,600	unknown	L	BAS
		chromium (compounds)	22,353	unknown	L	BAS
		copper (compounds)	1,450,221	unknown	L	BAS
		zinc (compounds)	212,752	unknown	L	BAS
		PCB	0	93,271	L	CLO
Raquette River Sub-Basin						
ZCA Mines, Inc. (Pierrepont)	Pierrepont	lead sulfide	300,000	900	L	PRO
		zinc sulfide	54,000,000	163,000	L	PRO
St. Regis River Sub-Basin						
Kraft Industries Dairy Group	N. Lawrence	PCB capacitor (removed)	0	0	U	NLU

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[1] Use Code - See use code index, page C-7.

L = Pounds
G = Gallons
U = Unknown

Industrial chemical survey use code index

Use Code	Purpose of Use of SubstanceofConcern
BAS	Blended and used as solvents packaged and distributed.
PES	Pesticides, herbicides, slimicides, insecticides, rodenticides.
CLN	Cleaning, degreasing, etc.
CLO	Anything used in closed system, also chemicals that are treated and disposed of in landfills.
CON	Confidential
COT	Coatings
NLU	No longer used.
PKG	Packaged and/or distributed.
PRO	Produced, manufactured, reclaimed chemicals, by-products.
RAD	Used in research and development and also in laboratories.
REA	Reacted; used up or changed (as in chemical reaction).
UNK	Unknown use of reported substance.

Appendix D.

Sediment Sampling Sites and Data

Table D-1. Summary of River Sediment Samples and PCB Concentrations

SOURCE	SAMPLING STATION	SAMPLING DATE	DEPTH OF SAMPLE (ft)	DESCRIPTION	PCB CONCENTRATION (mg/kg, dry weight) 1232	1248
Raquette River	SR-1	8/27/85	Surface	Sandy sediment between cobbles	< 0.08	< 0.08
	SR-2	8/27/85	Surface	Sand	< 0.08	< 0.08
	SR-3	8/27/85	Surface	Sandy sediment between cobbles	< 1.2	2.31
	SR-4	8/27/85	Surface	Sandy sediment between cobbles	0.50	< 0.08
St. Lawrence River	SL-1	8/29/85	--	No sample retrieved	--	--
	SL-2	8/27/85	Surface	Dark grey fine-grained silty sand, some clay, very hard	16.7	< 1.2
	SL-3	8/27/85	Surface	Dark grey clay with black streaks, shell fragments and vegetation	6.07	< 0.08
	SL-4	8/27/85	Surface	Dark grey to black clay	8.37	< 0.08
	SL-5	8/27/85	Surface	Grey silty sand with black mottles	1.22	< 0.08
	SL-6a	8/29/85	0.0 - 0.3	Grey silt, some f. to m. sand, tr. f. gravel, black oily appearance on surface of sample	< 0.08	1.3
	SL-6b	8/29/85	0.3 - 0.8	Grey silt, some f. to c. sand, with c. gravel (TILL)	< 0.08	0.46
	SL-6c	8/29/85	0.8 - 1.3	As above (TILL)	< 0.08	< 0.08
	SL-6d	8/29/85	1.3 - 1.8	Grey silt, some f. to c. sand, little f. to c. gravel (TILL)	--	--
	SL-6e	8/29/85	1.8 - 2.3	As above (TILL)	--	--
	SL-6f	8/29/85	2.3 - 2.9	As above (TILL)	--	--
	SL-7	8/27/85	Surface	Black-grey silty sand	8.20	< 0.08
	SL-8	8/27/85	Surface	Black-grey clayey silt	15.8	< 0.08
	SL-9	8/27/85	Surface	Sandy silt, many large pebbles	30.4	< 0.08
	SL-10	8/28/85	Surface	Hard packed sand, shell fragments	3.1	< 0.08

SOURCE: RMT, Inc. 1989 Draft Remedial Investigation Report Remedial Investigation/Feasibility Study at GMC-CFD Massena Facility, Massena, New York.

Summary (Cont.) of River Sediment Samples and PCB Concentrations

SOURCE	SAMPLING STATION	SAMPLING DATE	DEPTH OF SAMPLE (ft)	DESCRIPTION	PCB CONCENTRATION (mg/kg, dry weight) 1232	1248
	SL-11a	8/29/85	0.0 - 0.3	Grey to black silt and clay, tr. f. sand, oily appearance	4630	271
	SL-11b	8/29/85	0.3 - 0.8	Dark grey silt and clay, gradual increase in f. to m. sand content	1269	516
	SL-11c	8/29/85	0.8 - 1.3	Dark grey silt, some clay, tr. f. to c. sand, tr. f. to c. gravel (TILL)	1.31	< 0.08
	SL-11d	8/29/85	1.3 - 1.8	Dark grey silt, little clay, little f. to c. sand, tr. c. gravel (TILL)	--	--
	SL-12a	8/30/85	0.0 - 0.3	Dark green-grey to black clay, oily appearance	4342	1351
	SL-12b	8/30/85	0.3 - 0.8	Dark grey to black silt clay, tr. f. sand. Oily sheen to depth of 0.5 ft	3867 177	706 22.1
	SL-12c	8/30/85	0.8 - 1.3	Sand, tr. c. sand to f. gravel. Change of 1.25 ft to grey silt, little clay, little c. gravel (TILL)	--	--
	SL-12d	8/30/85	1.3 - 1.8	Grey silt, some clay, tr. f. to c. sand, tr. c. gravel (TILL)	--	--
	SL-12e	8/30/85	1.8 - 2.3	As above (TILL)	--	--
	SL-12f	8/30/85	2.3 - 2.8	As above (TILL)	--	--
	SL-12g	8/30/85	2.8 - 3.3	As above (TILL)	--	--
	SL-12h	8/30/85	3.3 - 3.8	As above (TILL)	--	--
	SL-12i	8/30/85	3.8 - 4.2	Grey silt, little clay, some f. to c. sand, tr. m. to c. sand, tr. f. to c. gravel. Denser than previous samples (TILL)	--	--
	SL-12j	8/30/85	4.2 - 4.8	As above	--	--

Summary (Cont.) of River Sediment Samples and PCB Concentrations

SOURCE	SAMPLING STATION	SAMPLING DATE	DEPTH OF SAMPLE (ft)	DESCRIPTION	PCB CONCENTRATION (mg/kg, dry weight) 1232	1248
	SL-13a	8/30/85	0.0 - 0.3	Dark grey to black very soft clay and silt, tr. f. sand, slight oily sheen	11.3	4.14
	SL-13b	8/30/85	0.3 - 0.8	Dark grey to black silt and clay, oily appearance to depth of 0.5 ft	36.9	< 1.2
	SL-13c	8/30/85	0.8 - 1.3	Dark grey silt and clay, black stains	69.0	7.9
	SL-13d	8/30/85	1.3 - 2.0	Grey silt to 1.5 ft grey silt, tr. f. to c. sand, little c. gravel (TILL)	--	--
	SL-13e	8/30/85	2.0 - 2.6	As above to 2.4 ft change to grey silt, little clay, very soft, oily appearance	--	--
	SL-14a	8/30/85	0.0 - 0.3	Dark grey to black silt and clay, very oily appearance	338	69.3
	SL-14b	8/30/85	0.3 - 0.8	As above	323	165
	SL-14c	8/30/85	0.8 - 1.3	Grey to olive grey silt and clay, tr. f. sand	124	36.6
	SL-14d	8/30/85	1.3 - 2.3	Grey silt and f. sand to 1.7 ft. grey f. sand, some m. sand, tr. c. gravel, tr. shell fragments	--	--
	SL-15	8/28/85	Surface	Sandy silt, many large pebbles	2.94	1.54
	SL-16	8/28/85	Surface	Hard packed sand and shell fragments	28.5	9.39
	SL-17	8/28/85	Surface	Grey fine sand and silty sand, oily	189	230
	SL-18	8/28/85	Surface	Fine grey sandy silt	57.9	65.1
	SL-19	8/28/85	Surface	Fine grey silty sand. Very oily, strong odor	1434	861
	SL-20	8/28/85	Surface	Fine black sandy silty, oily	72.7	39.5

Summary (Cont.) of River Sediment Samples and PCB Concentrations

SOURCE	SAMPLING STATION	SAMPLING DATE	DEPTH OF SAMPLE (ft)	DESCRIPTION	PCB CONCENTRATION (mg/kg, dry weight) 1232	1248
	SL-21	8/28/85	Surface	Fine black sandy silty, oily	37.9	31.3
	SL-22	8/28/85	Surface	Grey sandy clay	0.38	< 0.08
	SL-23	8/28/85	Surface	Black-blue silty clay with shells. Appears oily	2.6	< 0.08
	SL-24	8/28/85	Surface	Black-blue silty clay. Appears oily	2.9	< 0.08
	SL-25	8/28/85	Surface	Black-blue silty clay. Appears oily	489	56.3
	SL-26	8/28/85	Surface	Black silty sand with grey mottling	< 0.08	6.2
	SL-27	8/28/85	Surface	Silty, clay, black	410	60
	SL-28a	8/30/85	0.0 - 0.3	Dark grey to black silt and clay, tr. f. sand	< 0.08	1.90
	SL-28b	8/30/85	0.2 - 0.8	Dark grey to black clay	< 0.08	1.77
	SL-28c	8/30/85	0.8 - 1.3	As above	< 0.08	0.8
	SL-28d	9/10/85	1.33 - 2.33	Dark grey clay, black streaks and flecks (organic/vegetative matter)	--	--
	SL-28e	9/10/85	2.33 - 2.83	As above	--	--
	SL-28f	9/10/85	2.83 - 3.52	As above	--	--
	SL-28g	9/10/85	3.52 - 3.33	As above	--	--
	SL-28h	9/10/85	3.33 - 3.83	As above	--	--
	SL-28i	9/10/85	3.83 - 4.25	As above	--	--

Summary (Cont.) of River Sediment Samples and PCB Concentrations

SOURCE	SAMPLING STATION	SAMPLING DATE	DEPTH OF SAMPLE (ft)	DESCRIPTION	PCB CONCENTRATION (mg/kg, dry weight) 1232	1248
Tributary on St. Regis Mohawk Res.	SM-1	9/9/85	Surface	Black silt and decomposing vegetation	< 1.2	47.8
	SM-2	9/9/85	Surface	Black silt and clay, decomposed vegetation	< 0.08	3.49
	SM-3	9/8/85	Surface	Silt and clay, matted vegetation	< 0.08	5.12
	SM-4	9/8/85	Surface	V. dark brown to black silt, matted vegetation	< 1.2	22.4
	SM-5	9/9/85	Surface	Dark brown to black silt	< 0.08	0.39
	SM-6	9/8/85	Surface	Black silt, decomposed vegetation	< 0.08	1.34

Table D-2. Organic Compounds Observed in the St. Lawrence River Sediment Samples (SL-15 to 21, and D2)

	Concentration (mg/kg, dry wt.)	Number of Samples In Which Compound Detected
Volatile Organic Compounds		
Methyl Ethyl Ketone	0.0179 to 0.0321	7
2-Hexanone	0.0958	1
Methyl-iso-butyl Ketone	0.0397	1
Phenols		
4-Methylphenol	BMDL	1
Poly-Nuclear Aromatic Hydrocarbons		
Acenaphthene	BMDL	2
Anthracene	BMDL to 1.01	2
Benzo (a) anthracene	BMDL to 4.00	5
Benzo (a) pyrene	4.32 to 6.55	2
Benzo (b) fluoranthene	1.72 to 7.92	5
Benzo (g,h,i) perylene	BMDL to 2.02	3
Benzo (k) fluoranthene	2.94 to 4.37	2
Chrysene	BMDL to 4.57	5
Dibenzo (a, h) anthracene	BMDL	2
Fluoranthene	BMDL to 3.64	7
Fluorene	BMDL	5
Indeno (1,2,3-cd) pyrene	BMDL to 3.74	3
Naphthalene	BMDL	1
Phenanthrene	BMDL to 4.16	6
Pyrene	BMDL to 2.78	6
2-Methylnaphthalene	BMDL	1
Phthalate Esters		
bis (2-ethylhexyl) phthalate	BMDL to 2.57	8
Di-n-butylphthalate	BMDL to 1.38	2
Di-n-octyl Phthalate	BMDL to 3.22	3
Other Compounds		
Dibenzofuran	BMDL	2

SOURCE: RMT, Inc. 1986. Draft Remedial Investigation Report Remedial Investigation/Feasibility Study at GMC-CFD Massena Facility, Massena, New York.

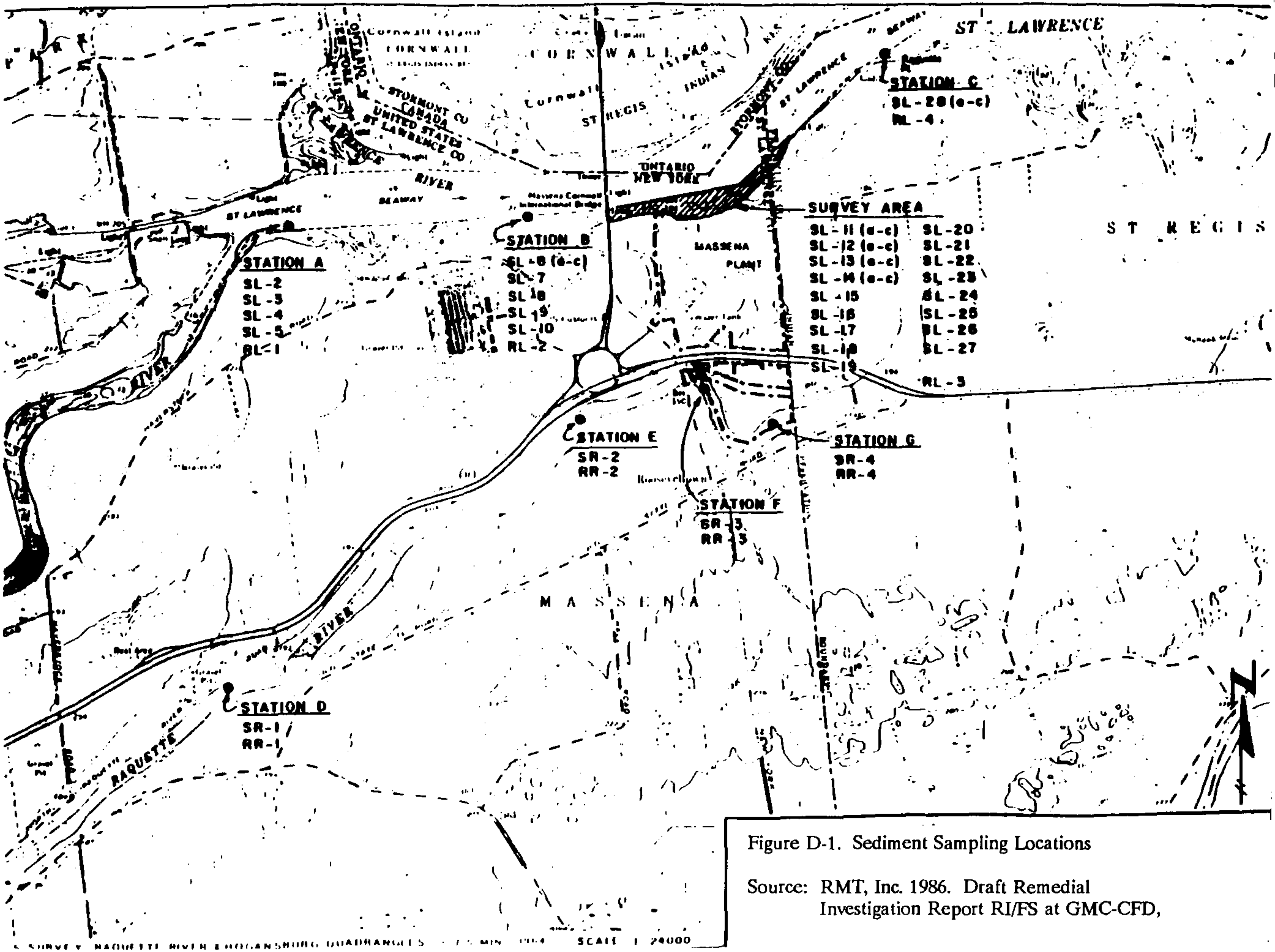
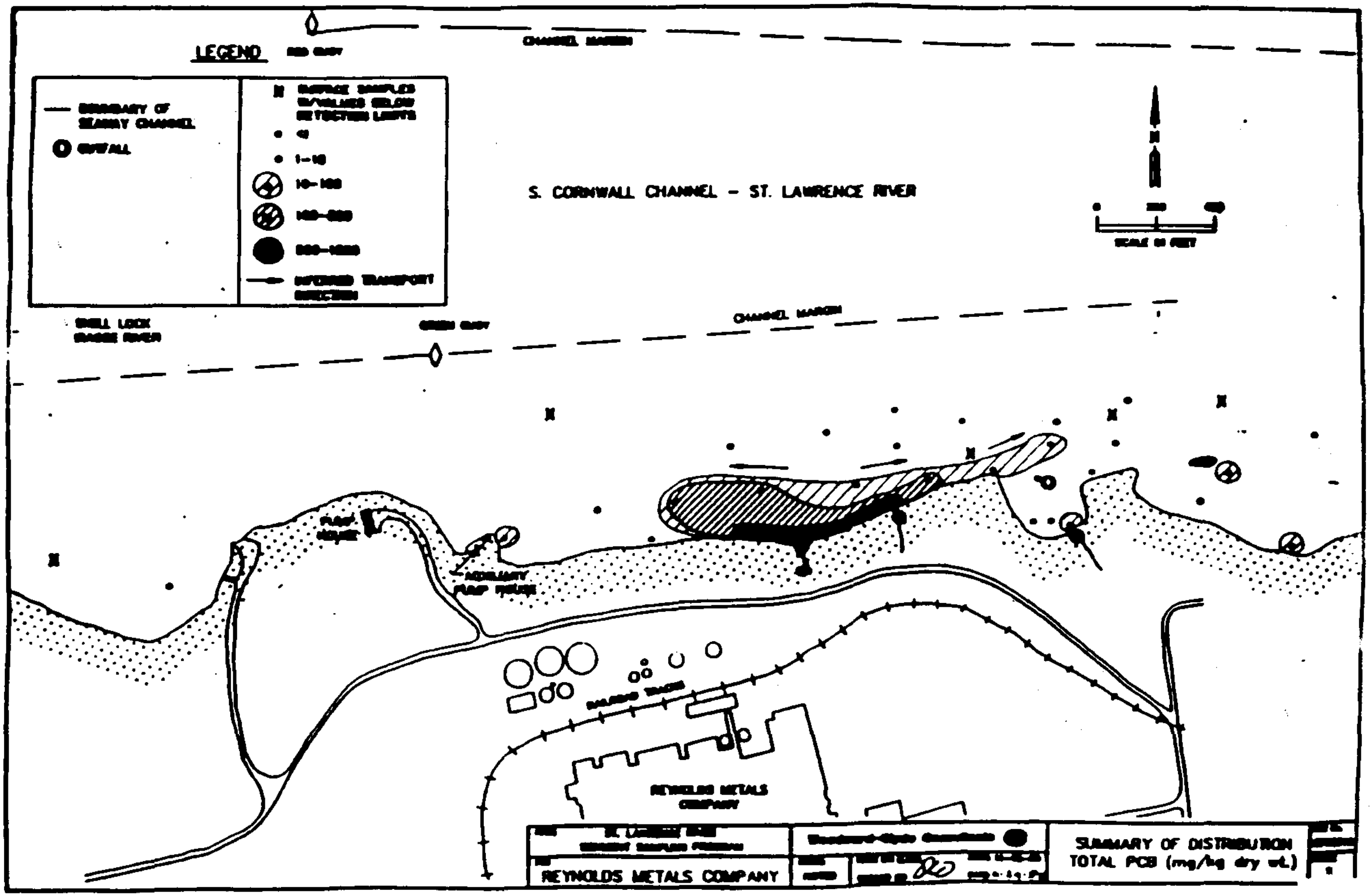


Figure D-1. Sediment Sampling Locations

Source: RMT, Inc. 1986. Draft Remedial Investigation Report RI/FS at GMC-CFD,

Figure D-2. Bottom sediment sample levels of PCBs from the St. Lawrence River
near the Reynolds Metals, Inc. facility



Source: Woodward-Clyde Consultants 1988. Revised Phase I St. Lawrence Reduction Plant, Reynolds Metals, Inc., Massena, New York.

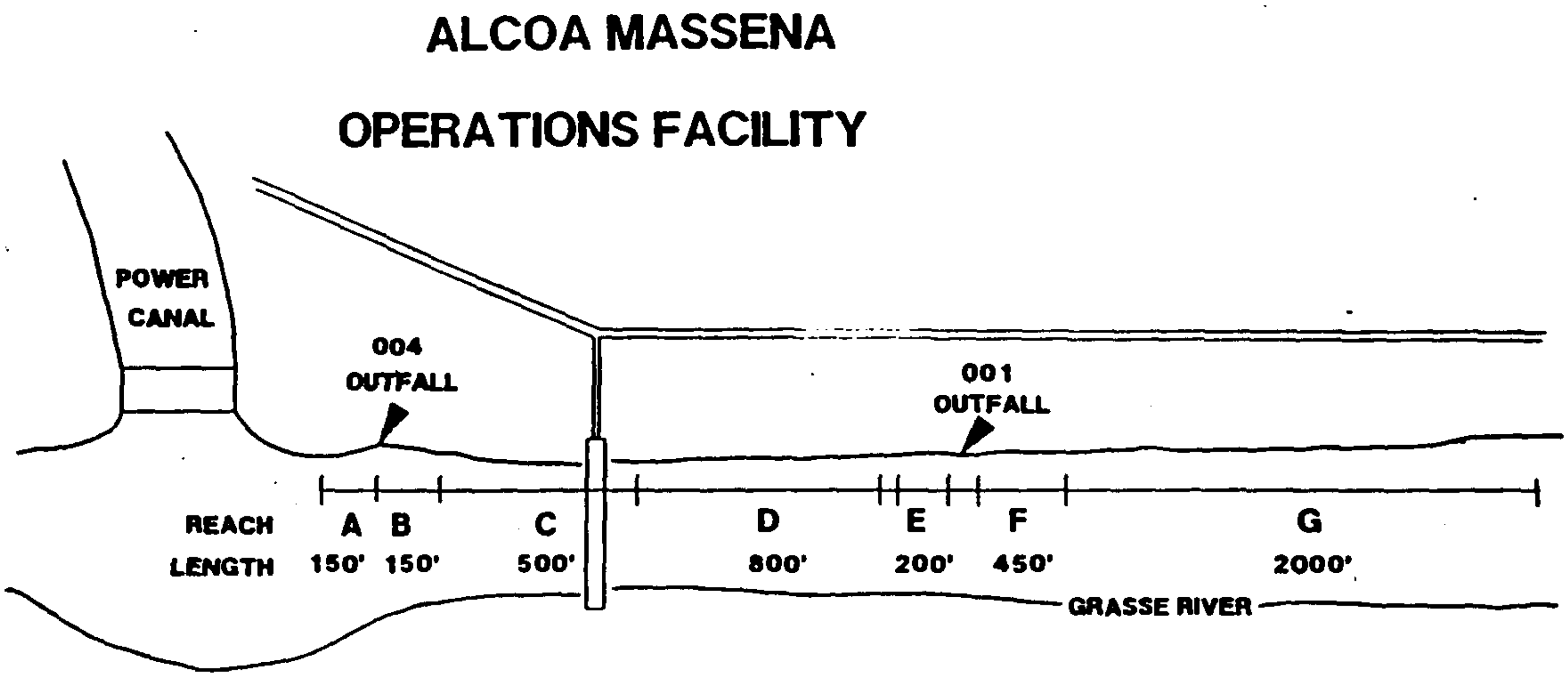


Figure D-3. Locations of 1986 & 1987 Sediment Reaches
in the Grasse River, Massena, New York

SOURCE: YOUNG-MORGAN & ASSOC. INC. [illegible] DATA REVIEW. PCB DISTRIBUTION IN THE GRASSE RIVER, MASSENA, NEW YORK.
PREPARED FOR: ALUMINUM COMPANY OF AMERICA. p. 7.

Sediment PCB Concentrations: Grasse River - 1986

TOTAL PCB (mg/kg)						
REACH						
A	B	C	D	E	F	G
0.16	0.16	0.88	0.38	9.27	27.9	22.1
<0.06	<0.06	<0.07	<0.09	1.17	486	5.44
0.16	<0.08	0.35	<0.08	15.1	25.5	5.03
<0.06	0.46	2.99	<0.09	3.96	0.66	14.1
0.37	9.53	59.7	0.69	.546	9.1	
0.16	0.74	<0.09	2.45	1.63	26.3	
<0.06	<0.49	0.26	0.32	99.8	3.27	
<0.06	<0.08	1.07	0.73	1.12	1.66	
<0.06	0.52	1.17	0.69	4.46	0.33	
0.70	2.02	0.19	0.27		<0.21	
	<0.50	<0.08	0.34		20.6	
	0.18	<0.08	0.4		20.7	
	0.28	0.13	1.44		5.71	
	1.31	3.8	0.92		3.34	
	1.57		1.46		15.4	
			0.14		7.39	
			0.67		18.1	
			0.77		21.9	
			1.92		1105	
			0.58			

SOURCE: Young-Morgan & Assoc., Inc. 1989. Historical Data Review PCB Distribution in the Grasse River, Massena, NY. Prepared for ALCOA.

Table D-3 (continued)

Sediment PCB Concentrations: Grasse River - 1987

TOTAL PCB (mg/kg)						
REACH						
A	B	C	D	E	F	G
		1.46		1.49	41.4	31.7
		0.06		0.89	21.8	23.3
		0.53			19.7	9.43
		0.23			6.4	4.39
		<0.01			0.09	[illegible]
					61.4	22.8
					13.4	9.09
					17.5	36.7
					53.7	2.01
					3.8	13.5
					3.99	0.41
						4.52
						2.51
						1.47
						4.54
						34.3
						3.73
						9.1
						3.89
						0.05
						0.15
						12.6
						41.5
						2.86
						4.94

SOURCE: Young-Morgan & Assoc., Inc. 1989. Historical Data Review, PCB Distribution in the Grasse River, Massena, New York. Prepared for ALCOA.

Appendix E.

Glossary of Units of Measurement and Conversion Factors

meter - m	1m = 3.28 feet
gram - g	1000g = 1kg = 2.205 pounds
tonne - t	lt = 2,205 pounds
liter - 1	1l = 0.2642 gallons (US)

killogram - kg	1 kg = 10^3 g
miligram - mg	1 mg = 10^{-3} g
microgram - ug	1 ug = 10^{-6} g
nanogram - ng	1 ng = 10^{-9} g
mililiter - ml	1 ml = 10^{-3} l

cubic meters per day	- m^3/d
tonnes per year	- t/yr
kilograms per day	- kg/d
cubic meters per second	- cms or m^3/s
cubic feet per second	- cfs
pounds per day	- lb/d

parts per million	- ppm
parts per billion	- ppb
parts per trillion	- ppt

miligrams per liter	- mg/l = ppm
micrograms per liter	- ug/l = ppb
nanograms per liter	- ng/l = ppt
micrograms per gram	- ug/g = ppm
miligrams per kilogram	- mg/kg = ppm
micrograms per kilogram	- ug/kg = ppb
nanograms per kilogram	- ng/kg = ppt

Appendix F.

Responsiveness Summary

In addition to working with the Citizen Advisory Committee while developing the Massena Stage I RAP, DEC distributed a final draft of the plan to local government officials, the Mohawks at Akwesasne, the Cornwall RAP Team and Public Advisory Committee and the general public.

A public meeting was held in Massena on June 28, 1990. At this meeting DEC received comments on the draft plan and discussed issues with the participants. DEC also received verbal and written comments from about 20 individuals.

Three types of comments were received:

1. Editorial comments;

2. Specific informational comments (additional data sources, clarification of meaning and correction of incorrect information);

3. Issue comments (issues of policy or basic premise of the document).

DEC staff addressed editorial and informational comments. Most comments contributed to improvement of the thoroughness and accuracy of the document.

General issues and informational comments that require a response are addressed in this summary. They are listed by chapter for the convenience of the reader.

Chapter II. Setting

Comment:

Land use and water use should be discussed separately and each in more depth.

Response:

The GLWQA charges the parties to develop RAPs based on water quality related problems. While land use can affect water quality, the focus of the Stage I RAP is use impairment identification due to water quality problems. Where land use has had significant impact on water quality in the AOC, the issues have been addressed (e.g. inactive hazardous waste sites).

Chapter III. Goals and Planning

Comment:

One international RAP for the St. Lawrence River should be developed.

Response:

The NYSDEC decided that the development of a RAP for the U.S. side of the AOC was necessary to address the practicalities of planning and remediation of problems under our regulatory control.

Chapter IV. Use Impairments and Their Causes

Comment:

Lake St. Francis should be included in the AOC because of the recognition of transboundary impacts as a problem and because of its inclusion in the RAP joint goal statement.

Response:

Lake St. Francis is included in the AOC and is being addressed by Canadian agencies in the Cornwall RAP. Impacts from Massena sources on Lake St. Francis forage fish, sport fish tissue levels and raw water levels were referenced in Stage I. Those sources of contaminants will be addressed in Stage II. No changes were made relative to this comment.

Comment:

It is important that the impaired uses described by Quebec agencies for Lake St. Francis be identified in Chapter 4 of the Massena Stage I report.

Response:

A section has been added to impairment indicator number xiv.) Transboundary Impacts on the reported use impairments in Lake St. Francis as described in the report, "Quebec's Concerns about the Quality of Lake St. Francis (draft)", by Sylvestre (1989).

Comment:

Some impairments are listed as "no" or "unknown" due to lack of data. Recommendations should be made in the RAP for studies to provide the data needed to make a definitive judgement on the existence of the impairment.

Response:

No impairments are listed as "no" due to lack of data. Recommendations for follow-up studies are part of the Stage II report and will be recommended where appropriate. No changes were made relative to this comment.

Comment:

The plan does not actually accomplish an ecosystem approach.

Response:

The plan addresses all ecosystem compartments using the GLWQA indicators of use impairment in defining water quality related problems in the AOC. To this extent the plan does take an ecosystem approach in documenting and defining water quality related use impairments. No changes were made relative to this comment.

i.) <u>Restrictions on Fish and Wildlife Consumption</u>

Comment:

The Lake Ontario basinwide fish consumption advisory is not appropriate for describing the fish consumption advisory use impairment indicator for the Massena AOC.

Response:

At the time the RAP was drafted, an AOC-specific fish consumption advisory was not in effect. The Lake Ontario/St. Lawrence River advisory was described in an attempt to indicate a problem with certain levels of consumption of fish relative to PCBs, a cause of use impairment in the AOC. The same statewide advisory for some waterfowl was described in a similar manner. In both cases, levels of certain contaminants in fish and wildlife tissue from the AOC are noted as exceeding certain criteria for consumption. Therefore, the link between the basinwide advisories and the levels in the AOC was made relative to this use impairment.

Recently, a fish consumption advisory specific to the Massena area was issued by the NYSDOH based on several toxics found in the AOC. The Stage I report was revised relative to this new advisory. Also, a statement has been added that an AOC-specific wildlife consumption advisory does not exist.

Comment:

No current (1988/89) data were incorporated into the conclusions about fish consumption advisories.

Response:

Table IV-2 lists sportfish tissue contaminant data from 1986 through 1989, the most recent available at the time of writing the report. Recent data on dioxin and furan levels in fish tissue were recently made available and were incorporated into the report. The "possible" designation for dioxin was changed to "known" for this impairment indicator.

Comment:

Based on your own data and ours (Canadian), there should be mercury restrictions on consumption of some species of fish.

Response:

Mercury is listed on Table IV-1 and on page IV-4 as one of the causes of the fish consumption advisories. Mercury is one of the substances noted as being a reason for the Mohawk advisory on fish consumption for the AOC. A section on the Canadian advisories was added to clarify the issue of causes of this use impairment indicator in the St. Lawrence River.

iii.) Degradation of Fish and Wildlife Populations

Comment:

An insufficient description was given of how conclusions were reached regarding mercury as a cause of this use impairment indicator.

Response:

A statement has been added to this section relating the indirect evidence provided by Foley, et al. to the implied conclusion of population declines of mink in the AOC.

Comment:

Erosion of the shoreline due to shipping, water level changes and flow and due to the localized impact of shoreline development should be noted as direct/indirect impacts on fish and wildlife populations.

Response:

Physical disturbances are noted in several places as having an indirect impact on fish and wildlife populations in the AOC (Table IV-1, page IV-3). No data to document the exact physical disturbance causing the impact on populations in the AOC was found, however. Dredging, which is an ongoing practice in the navigation channel and natural shoreline erosion are noted as possible causes. No changes were made relative to this comment.

iv.) <u>Fish Tumors and Other Deformities</u>

Comment:

Preliminary results from (Canadian) surveys in 1990 indicate existence of tumors on walleye. Other contaminants may act synergistically to cause tumors, etc.

Response:

A statement was added to address the recent data collected by Canadian agencies on fish tumors. The data are not for liver neoplasia, however, and therefore do not add to the information base on liver tumors in the AOC. The most comprehensive studies linking cause and effect of toxics and liver tumors in fish are for PAHs. Data on PAHs are presented in Table IV-3 and the likelihood of their causing tumors is noted on page IV-11.

Synergistic effects could be a consideration, but documentation of their impact can still only be speculated upon at this time. No changes were made relative to this part of the comment.

xiv.) <u>Loss of Fish and Wildlife Habitat</u>

Comment:

Wetlands impacted by sources of contamination in the Massena AOC have not been discussed in sufficient detail relative to the potential loss of fish and wildlife habitat.

Response:

Agreed. Sediment data collected at two of the three largest wetlands in the Massena AOC were added to the discussion of this use impairment indicator. A map was also added showing the general location of the wetlands discussed.

xv.) <u>Transboundary Impacts</u>

Comment:

The report implies that zebra mussels are causing impacts outside the Massena AOC while originating in the Massena AOC. The exotic species discussion should be deleted from this use impairment indicator.

Response:

Agreed. The zebra mussel is having significant impacts in the Great Lakes system, however, it currently is not impairing any uses in the Massena AOC, nor is it likely that the Massena AOC is the source of the problem. The discussion of zebra mussels as a cause of transboundary impacts was deleted.

<u>Chapter V. Sources of Pollutants Causing Impairments</u>

Comment:

Air emissions should be considered as part of an ecosystem approach.

Response:

An attempt was made to indicate the significance of the relative contribution of air deposition of toxics to the Great Lakes basin upstream of the Massena AOC.

There are no data to document the direct impact of air emissions of toxics determined to be causing water quality related use impairments in the AOC.

Table V-1 notes in general terms the potential for atmospheric deposition to be causing impacts on water quality outside the Massena AOC. No changes were made relative to this comment.

Comment:

Dioxin data are available to indicate potential sources of contamination to the AOC. They should be used to discuss sources of dioxin and the subsequent contamination of fish tissue.

Response:

Agreed. The data were added to the Chapter V discussion about dioxin and the potential sources to the fish tissue contamination.

Comment:

The report states that there are currently no standards for sediment quality that can be used to address the dredging impairment indicator other than the USEPA disposal guidelines. Methodologies for the development of sediment quality guidelines have been developed by the Division of Fish and Wildlife and could be used to make decisions about potential impacts on biota and remediation targets.

Response:

Agreed. The methodology for developing sediment quality guidelines was added to the discussion in Chapter V about contaminated sediment as a potential source to the AOC. An example for PCBs is also noted. A map indicating the sites of sediment sample collections by the three consultants to the major industries was also added to show the attempt to determine sources of the contaminants to the stream and river.

Comment:

Information on NYSDEC's statewide nonpoint source assessment for the watershed and sub-basins should be included in the potential sources section of the Stage I report.

Reponse:

Agreed. The NYSDEC 1989 report was cited and the appropriate information about nonpoint sources in the St. Lawrence River drainage basin was added.

Chapter VI. Public Participation

Comment:

The Massena Citizen Advisory Committee is too heavily influenced by industry interests.

Response:

Details of the development of the RAP and the formation of the CAC and subcomittees are described in Chapter 6. A concerted effort was made to form a CAC that was balanced and had representatives from major constituencies and interest groups in the Massena community and surrounding area. No changes were made relative to this comment.

General Comments

Comment:

Consideration of choices for remediation should not be limited in the design phase by lack of fiscal or staffing resources.

Response:

The Stage II report will provide details on the status of current remediation projects and recommend additional work. Where appropriate, cost estimates will be provided.