



DEC

Division of Water

**St. Lawrence River At Massena, New York
Remedial Action Plan
STATUS REPORT**

May 2000



New York State Department of Environmental Conservation

George E. Pataki, Governor

John P. Cahill, Commissioner

Introductory Notes

The St. Lawrence River at Massena Remedial Action Plan (RAP) Status Report was prepared by the New York State Department of Environmental Conservation in cooperation with the St. Lawrence River at Massena Remedial Advisory Committee. The document provides the status of the use impairment indicators, a progress report on remedial activities, strategies to restore and protect beneficial uses, delisting criteria, and a listing of priority remedial activities.

The Status Report was first prepared in draft for review. All substantive comments have been incorporated into this final publication compiled by Bob Townsend, the RAP Coordinator. Copies of the Status Report, as well as other Remedial Action Plan documents, are available from NYSDEC, Division of Water, Bureau of Watershed Management, 50 Wolf Road, Albany, New York, 12233-3508, phone (518) 457-9603. A summary of the RAP is on the website: <http://www.epa.gov/glnpo/aoc/stlawrence.html>

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I. EXECUTIVE SUMMARY:

As the lead agency for developing and implementing the St. Lawrence River at Massena Remedial Action Plan (RAP), New York State Department of Environmental Conservation began RAP development in 1988. This process was assisted by the formation of the Massena Citizen Advisory Committee which consisted of members from industry, local government, environmental groups, sporting interests, academia, and business. The Stage 1 report, which identifies use impairments, their causes and sources, was completed in 1990. The Stage 2 RAP, completed in 1991, includes the development of remedial strategies to restore water quality and beneficial uses of the tributary rivers and the St. Lawrence River and to eliminate adverse impacts to the Area of Concern (AOC) from sources of pollutants at major hazardous waste sites as well as from other sources within the drainage basin and AOC.

Following completion of the Stage 2 RAP, a Remedial Advisory Committee (RAC) was appointed to represent all stakeholders and assist NYSDEC in RAP implementation. The first RAP Update was completed in August 1992. A second comprehensive Update was completed in April 1995 that describes Stages 1 and 2, documents remedial progress, and develops remedial strategy tracking. A Summary Update was published in June 1996, that established a format to focus on RAP implementation. The Summary Update identified priority remedial strategies which included over thirty remedial activities involving investigative recommendations, assessments, plans, and improvement actions needed to restore beneficial uses.

This April 2000 Status Report continues the summary update format. High priority has been given to the cleanup of land-based hazardous waste sites and contaminated river sediments. Considerable progress has made towards the completion of land-based remediation at the ALCOA and Reynolds Metals sites as well as with the contaminated river sediment removal in the St. Lawrence River at General Motors. Further dredging is planned in the St. Lawrence River at Reynolds Metals during the summer construction season of 2001. Before, during and post-remediation monitoring is needed and is essential to the reassessment of the use impairment indicators in the Area of Concern. The goal is to assure that the watershed and AOC itself are not contributing to impairments in the Area of Concern and that beneficial uses are restored and protected.

Because of the international aspect of this Remedial Action Plan, an evaluation of the possible transboundary effects associated with the downstream interests and jurisdictions (Canadian, Provincial, and Mohawk Nation at Akwesasne) is a complicating factor for this connecting channel Area of Concern. As New York State has taken the lead to address the Massena area impairments, Canadian jurisdictions have also taken responsibility for the development and implementation of the RAP concerning the Ontario and Quebec side of the river (St. Law. River RAP at Cornwall).

The Massena Remedial Advisory Committee and NYSDEC have further developed use impairment restoration and protection (delisting) criteria and remedial strategies. These criteria and strategies are being applied to focus attention on priority remedial activities and to document progress as beneficial uses are restored and protected. The Remedial Action Plan process, including quarterly meetings of the Remedial Advisory Committee and the publication of Status Reports, is planned to continue. This process will facilitate RAP implementation and document the accomplishment of the incremental steps involving Stage 3 that leads to the restoration and protection of beneficial uses in the St. Lawrence River at Massena Area of Concern.

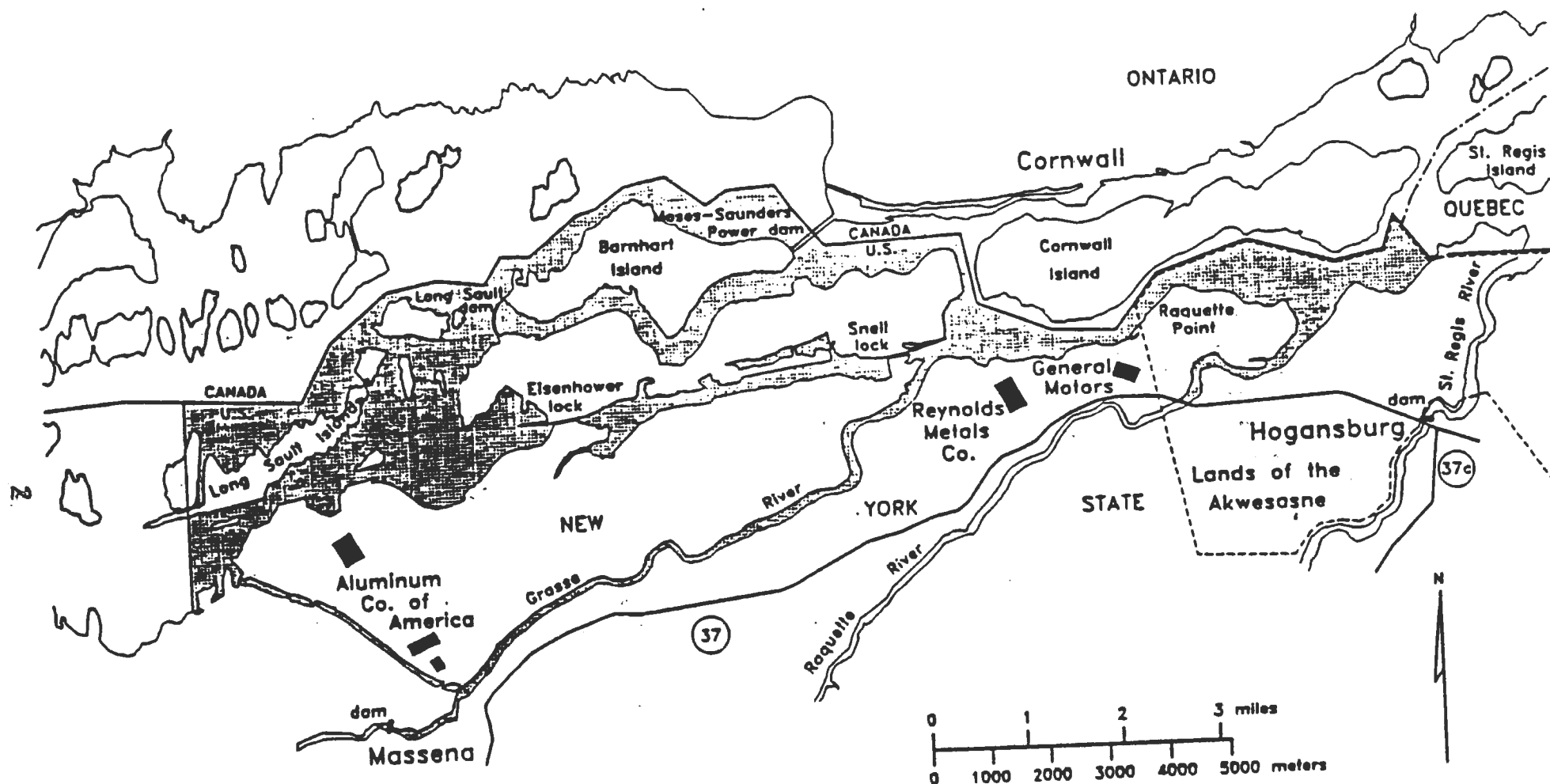


Figure 1: LOCATION MAP for the ST. LAWRENCE RIVER
AREA OF CONCERN at MASSENA, NEW YORK

II. INTRODUCTION:

The purpose of this Remedial Action Plan (RAP) Status Report of Use Impairments, Progress, Strategies, Criteria, and Priorities is to provide assistance to those persons involved in the identification, development, implementation, and tracking of remedial strategies and priorities. As we progress beyond 2000, the task remains to restore and protect the beneficial uses in the St. Lawrence River at Massena AOC. This Status Report is designed to fulfill the need of having a "working document" for the Remedial Advisory Committee (RAC) on which to base discussions and document progress to achieve the RAP goal. RAC members are listed in Appendix A.

This 2000 Massena RAP Status Report provides the current status of use impairment indicators and remedial activity progress, updates use impairment restoration strategies and priority remedial activities, and presents use impairment restoration and protection criteria. This Status Report builds on the problem definition and remedial strategies identified in previous Massena RAP publications and is intended to not only update progress but to track and to guide the implementation of remedial activities of the St. Lawrence River at Massena RAP. The format of this Status Report follows that established in the previous 1996 Summary Update document.

The Massena, New York portion of this connecting channel Area of Concern (Figure 1), being developed and implemented for the St. Lawrence River at Massena/Cornwall Remedial Action Plan, has the goal to restore, protect and maintain the chemical, physical and biological integrity of the river's ecosystem in accordance with the Great Lakes Water Quality Agreement. The RAP is a dynamic process (Figure 2) that is being implemented to address AOC water quality, watershed and ecosystem pollution problems and to assure that beneficial uses are restored and protected.

Specifics concerning the basis for use impairment definitions, sources, and potential sources of contamination are described in detail in the Stage 1 Remedial Action Plan dated November 1990. The Stage 2 RAP document dated August 1991 and the RAP Update of August 1992, describes environmental programs, recommended remedial activities, and commitments that are ongoing, planned or needed to restore and to protect the beneficial uses. The 1995 Remedial Action Plan Update provided a comprehensive summary of Stage 1 and Stage 2, updated the specifics of current remedial program activities, and established a reporting process that details the development, implementation, and tracking of remedial strategies to address each use impairment. Descriptions of various environmental control program initiatives that support RAP strategies are also included in the comprehensive 1995 RAP Update.

The foundation established by Stage 1, Stage 2, and the recent Update documents provides the necessary background to continue to move forward with RAP implementation and progress reporting. In order to achieve the goals of the Massena RAP, the remedial strategies are designed to focus on the restoration and protection of beneficial uses (e.g. addressing the habitat impairment), and the cleanup of the contamination sources (e.g. land-based and contaminated river sediment toxic chemicals) that involve the Area of Concern. This 2000 RAP Status Report describes the progress achieved and the corrective strategies necessary to continue to address both contamination sources and use impairments.

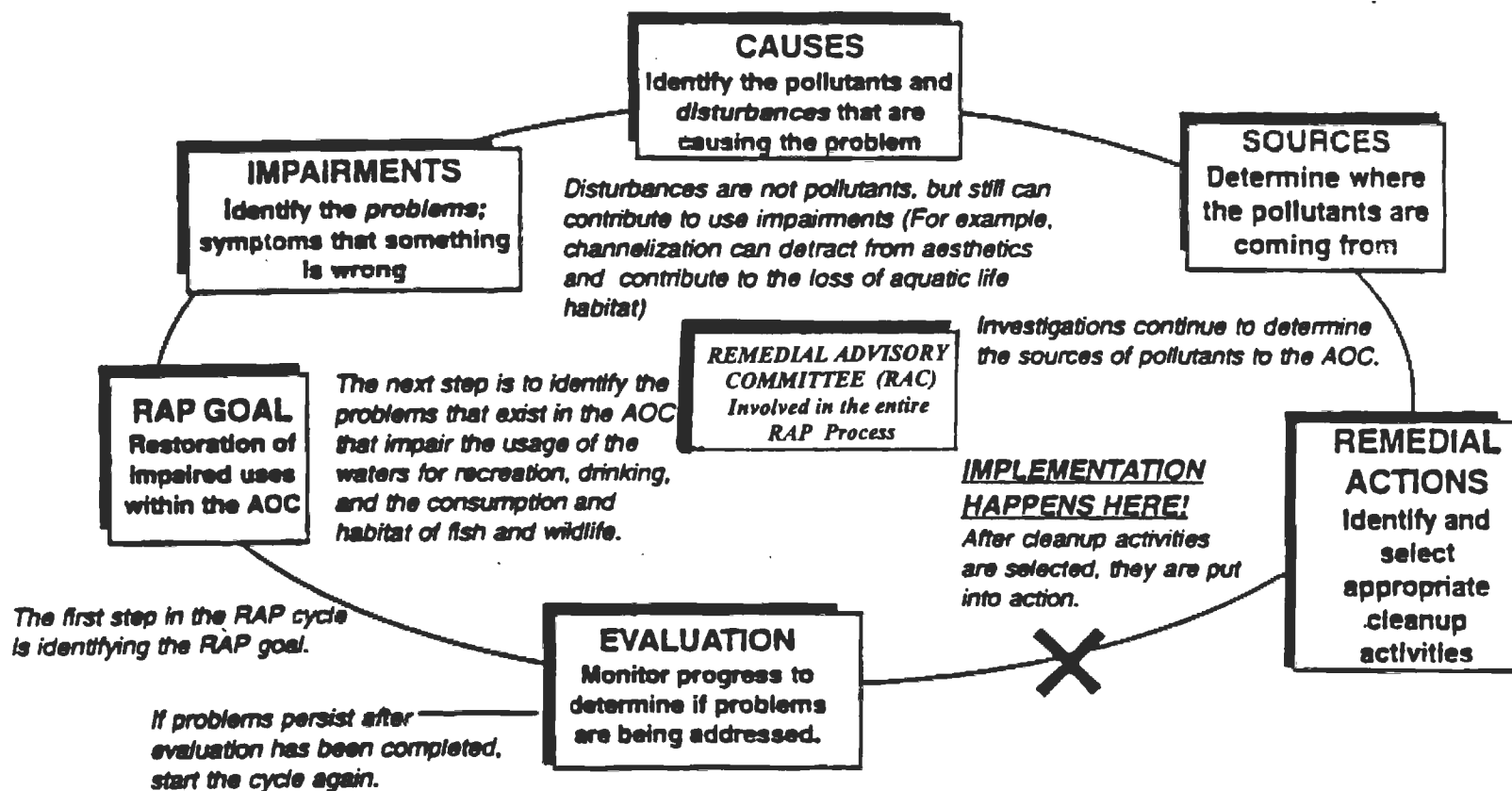


Figure 2 : THE RAP PROCESS MODEL

III. USE IMPAIRMENTS:

The waters, river bottoms, and fish and wildlife of the Area of Concern have been affected by hazardous waste sites, contaminated river sediments, local and upstream wastewater discharges, physical disturbances (the dam and seaway construction), natural erosion, atmospheric deposition, Lake Ontario waters, and commercial fishing to some degree. The Stage 1 RAP identified hazardous waste sites, contaminated river sediments, and industrial discharges as the major sources of contaminants to the AOC. Fourteen use impairment indicators as listed in Annex 2 of the Great Lakes Water Quality Agreement of 1978 have been assessed. An additional indicator to address the "transboundary impacts" associated with the international boundary with Canada has also been evaluated. The St. Lawrence River at Massena RAP currently identifies three of these fifteen use impairment indicators as impaired and six other use impairment indicators as subject to further review, investigation, and assessment.

A. Use Impairment Indicator Status

Table 1 lists the use impairment indicators and then summarizes their Stage 1 status along with their current status of impairment. This status comparison has been added to the listing of use impairments so that, as the RAP process continues, we can document progress and obtain a "quick look" of any changes and identify the remaining impairment priorities.

Table 1 also contains a comment for each use impairment relative to establishing restoration and protection of the beneficial use. Key elements and needs to address the use impairment are summarized in this comment column. Summarizing the impairment status from the total list of fifteen use impairment indicators on Table 1 we see that three indicators for the Stage 1 Massena RAP are determined to be "impaired"; five others are rated as "likely or unknown"; one has been "reopened"; and, the remaining six are rated as "not impaired".

The four use impairment indicators rated as "likely impaired", along with the indicators rated as "unknown" and "reopened" will need further assessment / study to make status determinations. Also, among those possibly requiring further investigation to update status assessments, are two indicators previously rated not impaired that are to receive expanded review. These two involve the dredging restrictions and beach closings use impairments. Under these indicators, we will evaluate dredging restrictions outside the seaway channel and partial body contact in open waters of the Area of Concern. The one "reopened" indicator involving drinking water taste and odor problems has become a real problem for the Village of Massena. Additional data and remedial action on this taste and odor problem has been identified as a need.

The primary use impairments in the St. Lawrence River at Massena Area of Concern involve fish and wildlife consumption restrictions, loss of fish and wildlife habitat, and transboundary impacts. Consumption restrictions are associated with contaminated river sediments, hazardous waste sites and industrial discharges, and also involve the larger lakewide advisories associated with Lake Ontario. The primary cause contributing to these restrictions is the evidence involving PCBs. The loss of fish and wildlife habitat are attributed to the dredging from the dam and seaway projects and natural erosion. Transboundary impacts involve primarily downstream considerations, cross river effects to a lesser degree, upstream impacts from Lake Ontario, and atmospheric deposition.

TABLE 1 - USE IMPAIRMENT STATUS
St. Lawrence River at Massena Remedial Action Plan

USE IMPAIRMENT	STAGE 1 STATUS	CURRENT STATUS	AREA OF CONCERN COMMENT
Fish and Wildlife Consumption Restrictions	Impaired	Impaired	Primary cause is PCBs; Need post remediation study and non-AOC determination
Loss of Fish and Wildlife Habitat	Impaired	Impaired	Seaway and Dam changed features; need reassessment based on current conditions
Transboundary Impacts	Impaired	Impaired	Post remediation studies will be key; consider AOC and watershed effects downstream
Degradation of Fish and Wildlife Populations	Likely	Likely	Need AOC assessment / study to verify (and define desired population levels)
Fish Tumors or Other Deformities	Likely	Likely	Need AOC assessment / study to verify
Bird or Animal Deformities or Reproductive Problems	Likely	Likely	Need AOC assessment / study to verify
Degradation of Benthos	Likely	Likely	Need AOC assessment / study to verify (with community structure focus)
Restrictions on Dredging Activities	Not Impaired	Not Impaired	Not impaired for maintenance dredging; (to review potential expanded dredging)
Beach Closings	Not Impaired	Not Impaired	No beach impairment; (to expand review for partial body contact considerations)
Degradation of Plankton Populations	Unknown	Unknown	Need AOC assessment / study to determine
Tainting of Fish and Wildlife Flavor	Not Impaired	Not Impaired	Tumor assessment / study will further support
Eutrophication or Undesirable Algae	Not Impaired	Not Impaired	Added partial body contact review under "Beach Closings" will aid determination
Drinking Water Restrictions, Taste and Odor Problems	Not Impaired	Reopened for determination	The Village of Massena water supply has reported repeated occurrence of taste and odor problems; additional treatment may be needed.
Degradation of Aesthetics	Not Impaired	Not Impaired	Survey would be useful
Added Costs to Agriculture or Industry	Not Impaired	Not Impaired	Need to verify no transboundary impact

TABLE 2 - USE IMPAIRMENT CAUSES AND SOURCES

St. Lawrence River at Massena Remedial Action Plan

USE IMPAIRMENT	CAUSES	SOURCES
Fish and Wildlife Consumption Restrictions	PCBs, Mirex, Dioxin	Inactive hazardous waste sites, Contaminated sediments, Industrial discharges
Loss of Fish and Wildlife Habitat	Physical disturbances, Natural erosion Contaminated sediments, Foreign species	Dredging, natural erosion
Transboundary Impacts	PCBs, DDE, Phosphorus, Metals, Mercury, Sediments, (Cornwall Phos.)	Waste sites, Atmospheric deposition, Pt. source discharges, Lake Ontario
Degradation of Fish and Wildlife Populations	PCBs, DDE, Mercury, Physical disturbances, Fish overharvest	Point source discharges, Hazardous waste sites, seaway construction, Cornwall AOC Commercial fishing (historic), L. Ontario
Fish Tumors or Other Deformities	PAHs	Contaminated sediments
Bird or Animal Deformities or Reprod. Problems	PCBs	Contaminated sediments
Degradation of Benthos	PCBs, PAHs, Lead, Copper, Physical disturbances	Pt. source discharges, Contaminated sediments, waste sites, nonpoint sources
Restrictions on Dredging Activities	To consider larger area for PCBs, Arsenic, Chromium, Copper, Nickel, Zinc	If any: Contaminated sediments, Inactive haz. waste sites, Industrial discharges
Beach Closings	To consider partial body contact downstream from combined sewer overflows	If any: Municipal discharges, CSOs
Degradation of Plankton Populations	Not believed impaired	If any: Contributing sources above
Tainting of Fish and Wildlife Flavor	Not impaired	None known
Eutrophication or Undesirable Algae	Not impaired	None known
Drinking Water Restrictions, Taste and Odor Problems	Geosmin and 2-methylisoborneol (MIB)	Two compounds (geosmin and MIB) commonly occur in water supplies.
Degradation of Aesthetics	Not impaired	None known
Added Costs to Agriculture or Industry	Not impaired	None known

In the 1996 St. Lawrence River at Massena RAP Update Summary document, strategy management forms were developed for each use impairment indicator. These strategies used the best available information to identify the needed follow-up actions, responsible parties, target dates, and status for each indicator. These "Use Impairment Strategy Management Forms" have been updated further in this 2000 Status Report in Appendix B. Eleven use impairment strategy forms (3 impaired, 5 further study, 2 expanded review, and 1 reopened) are included. Each form establishes a strategy on which the Remedial Advisory Committee can proceed.

B. USE IMPAIRMENT CAUSES AND SOURCES

Table 2 has been developed to identify the specific causes and sources of each use impairment in the St. Lawrence River at Massena AOC. This information was developed in the Massena RAP Stage 1 and Stage 2 documents. In this Massena RAP 2000 Status Report, **Table 2** lists the use impairment indicators (consistent with **Table 1**) and then summarizes the causes of the impairment and the sources of contamination. The data used to identify sources does not always provide direct evidence with complete certainty. The link between an impairment and a source must therefore be logically inferred in some instances. Documented environmental and source evidence data were examined in Chapters 4 and 5 of the Stage I RAP published in November 1990.

Tables 1 and 2 are used to summarize the status, causes, and sources of the use impairments as established in the Stage 1 and Stage 2 documents. Clearly, PCBs are a main cause of use impairments in the St. Lawrence River at Massena AOC. Other contaminants of concern include DDE, PAHs, mercury, metals, arsenic, and phosphorus. Other causes include physical disturbances created by the construction of the power dam and the St. Lawrence River Seaway, natural erosion, foreign species (zebra mussels), fish over-harvest, and contaminated sediments.

The sources of the causes of the use impairments shown in **Table 2** include: inactive hazardous waste sites, contaminated sediments, industrial and municipal point source discharges, dredging, atmospheric deposition, nonpoint sources, and Lake Ontario. Land-based hazardous waste site cleanup activities as well as contaminated river sediment dredging projects are being implemented by the three major industries in the Area of Concern to address PCBs and the other contaminants of concern. This remediation is addressing the major sources of use impairments identified in the RAP and is expected to contribute significantly to the restoration and protection of beneficial uses in the Area of Concern.

IV. REMEDIAL ACTIVITY PROGRESS:

The RAP process strives to identify all remedial activity contributing to the goal to eliminate use impairments in the Area of Concern. This effort includes identifying a sequence of events needed to restore and to protect beneficial uses and then working to achieve and to expedite these activities. Concurrent with this RAP planning and implementation effort, various New York State Department of Environmental Conservation (NYSDEC) and other agency environmental program activities are in place and progressing as part of ongoing environmental programs, protection laws, and policies. The RAP seeks to influence and encourage these program activities to address local area, watershed, and ecosystem concerns involved with the RAP. In turn, these activities do contribute and support progress towards achieving the RAP goals. The progress, accomplishments, and specific needs of the Remedial Action Plan need to be communicated to all involved parties and stakeholders.

The RAP strategies developed in the following section, therefore, make use of all resource commitments and related remedial actions and provide an ecosystem approach for the remedial activities to restore and to protect beneficial uses. By communicating the RAP process, it is desired that remedial activities incorporate this ecosystem approach. One purpose of the Remedial Advisory Committee is to assure that all stakeholders' interests and concerns have been satisfactorily investigated and resolved as much as possible. A key to this is securing implementation commitments to achieve RAP objectives.

To facilitate reporting of remedial activity progress, the RAP subject matter is broken down into the nine major program area/remedial activity topics that follow. Brief summary descriptions of progress in these nine environmental program activity areas are provided below. Additional details of the projects and past progress of implementation in each of these nine areas are also presented in the comprehensive St. Lawrence River at Massena RAP 1995 Update document.

A. Hazardous Waste Site Remediation (land-based)

USEPA and NYSDEC have issued Administrative Orders that require land-based as well as contaminated river sediment remediation. Implementation of these orders is fundamental to Area of Concern rehabilitation and forms a basis for most initial remedial strategies. Completion and settlement of these remediation activities includes Natural Resource Damage Claims which are to address recovery for any damage and injury to the natural resources. Land-based remedial actions are required at each of the three large Massena area industrial sites. Significant progress has been accomplished at both the ALCOA and Reynolds Metals sites, and General Motors is also moving forward with its land-based remediation.

- **ALCOA** - There were two Records of Decision covering a total of fourteen sites; The first ROD was issued in March 1991 and addresses eight sites: Spent Potlining Piles "I" and "A"; Dennison Cross Road; Soluble Oil Lagoon; Primary Lagoon and Dredge Spoils Areas; Oily Waste Landfill; West March; and the Unnamed Tributary. All sites in this ROD have been remediated except the "Soluble Oil Lagoon".

The second ROD was issued in January 1992 and addresses six sites: Waste Lubricating Oil Lagoon; General Refuse Landfill; Landfill Annex; 60 Acre Lagoon; Sanitary Lagoon; and the East Marsh. All sites in second ROD have been remediated except the "60 Acre Lagoon". In addition, during the course of remedial work, four non-ROD sites were identified that require remediation: the HPM press and ST-51 sites, both of which have been completed; and, the West Fill and Plant Roads sites which are planned.

In summary, 12 of the 14 sites addressed by enforcement orders are complete and 2 of 4 additional sites are complete. Therefore 14 of the 18 sites have been completed. Those remaining to be completed include the Soluble Oil Lagoon, the 60 Acre Lagoon, the West Fill area, and unpaved Plant Roads. Projected costs for land-based and river sediments is in excess of \$250M. An estimated 190,000 cubic meters of PCB contaminated waste and soil and 24,000 cubic meters of pot liner waste containing cyanide and fluoride contamination will be removed and placed in the secure landfill.

- **Reynolds Metals** - The plant site consists of the entire Reynolds Metal Company facility and adjacent land areas which have been impacted by the handling and disposal of hazardous wastes. The major areas of remediation are the black mud pond, landfill and former potliner storage area, wetlands, north yard, potliner pad, miscellaneous areas including the rectifier yard and adjacent rectifier yard drainage ditch, and an area north of Haverstock Road. The major land areas with the most serious contamination have essentially been remediated with the waste sent to a secure off-site landfill for disposal.

NYSDEC issued a consent order in 1987 requiring the investigation and evaluation of remedial alternatives to determine the nature and extent of contamination and to address the clean-up of the site. Interim measures were commenced in 1988. A Record of Decision was issued in 1992 to implement remedial activities and soon thereafter a Remedial Design/ Remedial Action consent order was issued in 1993. Remedial construction commenced that year and most of the construction has been completed; except for the final landfill cap.

The black mud pond was used for the disposal of spent potliner after it had been digested to extract cryolite. Potlining waste is no longer disposed of at this site. The Landfill received both solid and hazardous waste including general mill waste, C&D debris, sludges contaminated with PCBs, and potliner waste. The landfill no longer receives these wastes and there is a moat around the landfill to catch all stormwater and eroded sediments that runs off. A new leachate collection system was installed in June of 1995. Runoff and sediments contaminated with cyanide, fluoride, sulfate, and PCBs from the potliner storage area and the rectifier yard which historically were allowed to flow into the adjacent wetlands have been corrected.

Site clean up has addressed the leaks, spills, waste handling, and waste disposal practices that resulted in site wide PCB, cyanide, fluoride, and sulfate contamination threatening health and the environment. A long-term operation and maintenance program has been initiated which will assess the effectiveness of the remediation at each area of the site. The total estimated cost for land and river remediation at Reynolds Metals is in excess of \$100 million.

There are no residences in the vicinity of the Reynolds Metals facility site. PCB contamination on the north end of the site, which affected the St. Lawrence River, has been remediated. The nearest public water supply downstream of this site is the Akwesasne Mohawk Reservation Site which is approximately 3 miles away. This water supply is closely monitored due to the proximity of contaminated areas. Test results indicate no detectable PCBs present in the treated drinking water. There is a fish consumption advisory for the St. Lawrence and Grasse Rivers. The contamination has affected Fish and wildlife.

- **General Motors** - The hazardous waste site at the GM facility consists of an industrial landfill, north and east sludge disposal areas, an out-of-service oily waste lagoon, three active wastewater/stormwater lagoons, various areas with soil contamination, and associated sediment contamination in the St. Lawrence and Raquette Rivers and in an unnamed tributary to the St. Lawrence River.

USEPA issued a consent order in 1985 requiring site investigation and remediation evaluation for the entire site, including river sediments. A two phased Remedial Investigation was completed, and conditionally accepted by the USEPA in November 1988. In 1988, an interim remedial measure was performed which involved closing, grading, and construction of a temporary cap on the industrial landfill located near the eastern border of the site adjacent to the Mohawks (Akwesasne) lands.

The USEPA issued a ROD for Operable Unit 1 in 1990, which addressed all site areas except for the east area and industrial landfill. The remedy included removal and treatment of contaminated river sediment, excavation and treatment of land-based soil and sludge, and groundwater recovery and treatment. In 1992, USEPA issued a ROD for Operable Unit 2 (addressing the landfill and east area) which identified remedies as: containment with an improved cap for the industrial landfill and partial excavation/treatment followed by similar containment for the east area.

In 1995 GM constructed a series of stormwater controls at the site including a 2 million-gallon lagoon and a dedicated water treatment system. GM also consolidated contaminated soils from miscellaneous areas of the site into the east area. PCB contamination has been well characterized throughout the site. The most recent sampling during 1999 further characterized the extent of PCB contamination in the Industrial Landfill and at the Raquette River. As part of a plant wastewater treatment system maintenance activity, GM remediated two lagoons at the site during 1999. The dewatered sludges from those operations were also sent to an off-site landfill.

In early 1999, USEPA issued an amendment to the 1990 Operable Unit 1 ROD for a limited portion of the site, which requires either off-site disposal or consolidation into the east area depending on PCB concentration. The site areas addressed in the ROD were the Raquette River, stockpiled St. Lawrence River Sediment, and soils excavated during construction of a groundwater collection system at the site. In addition EPA included a contingency, should access to the cove and Mohawk land be approved, that these materials would be addressed in the same manner.

Future remediation activities include removal of soils and sediment from the Raquette River, installation of a groundwater collection and treatment system, excavation and management of materials from the two remaining lagoons and the north and east areas, construction of permanent caps over the industrial landfill and east areas, and remediation of the cove and upland soils on Mohawk land.

- **Other Watershed Sites** - Remedial activities at other land-based hazardous waste sites within the watershed are associated with localized problems that are believed to have less impact on the Area of Concern use impairments. It is expected that the PCB cleanup activities in the St. Lawrence River watershed (underway, committed to, or completed) will eliminate all significant PCB contributions to the St. Lawrence River and that the use impairments caused by chemical discharges will cease to exist in the foreseeable future. The Remedial Advisory Committee is in the process of developing restoration targets (see Section VI and Appendix C) and a surveillance plan for the AOC to determine when the impairments cease to exist.

B. Contaminated River Sediments (river-based)

Contaminated river sediment dredging projects are required by USEPA enforcement orders and are in various phases of implementation adjacent to the three major industries. The Administrative Orders that require sediment removal work are designed so that there is no lapse of responsibility for the remediation of PCB contaminated areas along the Grasse River and into and including downstream portions of the St. Lawrence River. In other words, all major contaminated sediment areas are addressed under one of the three federal orders such that where one facility's investigative and remedial dredging responsibility ends another facility's responsibility takes over. USEPA has published a contaminated sediment management strategy (summarized in the Appendix L newsletter).

- **General Motors** - Sediments in the St. Lawrence River were dredged by General Motors and its contractors in 1995. An elaborate sheet piling and silt curtain containment system was installed and monitored. Extensive filtrate treatment was provided for dewatered dredge materials. Over 80% of the dredged area had final PCB concentrations below 10 ppm with an average of 3 ppm. The remaining area, with concentrations of PCBs in excess of 10 ppm, was secured by constructing an "armoring layer" composed of sand blended with carbon, then gravel, and then heavy stone. The dredged sediments were dewatered and stockpiled on site until 1999.

GM shipped the sediments to an off-site landfill in accordance with an amendment to the 1990 Operable Unit 1 ROD signed by USEPA in early 1999.

Since the completion of dredging in the St. Lawrence in 1995, GM has been annually collecting young-of-the year spottail shiners to assess the localized impact of dredging and partial armoring/capping. PCB concentrations have shown no significant change from pre-dredging data collect by NYSDEC and Environment Canada.

Excavation of sediments from the cove and soils on Mohawk land adjacent to the site has not yet been addressed. Neither GM or USEPA have received approval for access to the area from the Mohawks. An advisory for consuming fish from the St. Lawrence River and cove area remains in effect.

GM performed additional pre-design characterization of soils and sediment at the Raquette River in 1999. Remediation of this area is expected to be performed during 2000, once final design plans have been reviewed and approved.

- **Reynolds Metals** - The Reynolds Metals Company contaminated sediment removal from the St. Lawrence River involves dredging approximately 77,600 cubic yards of sediments with PCB concentrations less than one ppm. Reynolds intends to dredge the river using the Cable Arm Environmental Bucket technology to avoid resuspension and mixing of contaminated sediments and, like GM, to use sheet piling to secure the dredge area.

All sediments with PCB concentrations greater than 50 ppm but less than 500 ppm will be shipped offsite to an approved landfill for disposal. All sediments with PCB concentrations greater than 500 ppm will be shipped offsite for treatment and then disposal in an approved landfill. All sediments with PCB concentrations less than 50 ppm will be disposed of in the onsite landfill.

The sediment removal is currently projected to occur during the 2001 construction season. Reynolds is revising the design documents to incorporate the changes made by the EPA to the Record of Decision document and the items discussed during several conferences between EPA and Reynolds Metals in 1999.

- **ALCOA** - EPA issued an administrative order in 1989 requiring the investigation and remediation of contaminated river sediments. Where the company is required to remove contaminated sediments in the Grasse River, a pilot dredging project was completed in 1995 with the primary dredging plans still under development. A final report on the success of dredging approx. 3000 cu yds of contaminated sediments "the pilot project" will provide insight and plans for any additional dredging.

Since that time, Alcoa has collected further data in a series of supplemental remedial studies to evaluate the PCB sources and their fate in the river. An initial analysis of

alternative remedial measures report was submitted in 1996. Based on the final version of this report, EPA will begin review in 2000 and then prepare a proposed remedial action plan, that will ultimately lead to the development of a Record of Decision (ROD) that will state the remediation requirements to address the contamination.

C. Point Source Discharges

A significant reduction in the mass of PCBs and other contaminants discharged from the Massena area industries (primarily stormwater/site related) has been achieved by the installation of improved wastewater treatment systems, implementation of best management practices, and interim/completed remediation activities. The permit renewal process involving the three major industrial companies has the goal of achieving non-detectable discharge levels of PCBs, as well as reduced discharges of other contaminants for each water discharge. Although PCBs are no longer used, past waste disposal practices have so contaminated the facility sites that stormwater runoff outfall monitoring is still a concern. The overall site remediation work required to cleanup PCB contamination combined with the treatment of discharges is expected to address contamination issues.

Reynolds Metals has installed new state-of-the-art air cleaning equipment and has rebuilt their aluminum reduction facility to increase efficiency and reduce the production of contaminants. The levels of PCBs in the wastewater discharges has improved and is expected to decrease to non-detectable levels. The cost of upgrading of the plant and air cleaning equipment is projected to exceed \$250M in addition to the cleanup costs.

At General Motors, the PCB levels in the wastewater (non-process/stormwater) have been reduced to where most samples are non-detectable. ALCOA is in general compliance with water and air discharge standards. ALCOA has reduced their water use dramatically and has accomplished the reduction of their PCB discharges to non-detectable levels, except for an occasional excursion. Corrective action continues to identify any sources of the PCBs and eliminate the discharge. New HDPE lined stormwater impoundments have been installed at ALCOA as part of the current SPDES discharge permit.

D. Nonpoint Source Pollution Control

Excessive nutrients (phosphorus) and sedimentation (erosion) from agriculture are believed to be the main nonpoint source pollution problems in the St. Lawrence River Basin. County Water Quality Management Strategies have been developed to address nonpoint source pollution. Implementation of these County Water Quality Management Strategies and related Best Management Practices (BMPs), including improvements to stormwater management, is recommended and is progressing. Various funding programs (grants) continue to support and be available to assist in the implementation of these nonpoint source pollution control efforts. Refer to the 1995 update for additional details. The St. Regis Mohawk Tribe has received a Clean Water/Clean Air Bond Act grant to prevent erosion and contain dredged materials along the St. Lawrence River (described in Appendix J).

E. Air Pollution Control

The remedial strategy calls for the reduction of hydrogen fluoride and other contaminant emissions from the major industrial facilities in the AOC. The National Emission Standard for Hazardous Air Pollutants (NESHAP) for Primary Aluminum Production requires air discharges to comply with emission limits which address hydrogen fluoride and polycyclic organic matter (POM) emissions.

At ALCOA, the plant is in general compliance with the NESHAP air discharge standards. Alcoa submitted a formal initial compliance notification in December, 1999. Reynolds Metals has recently completed the installation and startup of a new fume control system that will meet the NESHAP requirements. Reynolds expects to complete replacement of pot hoods with the new design that provides better capture of pollutants by December, 2000. The new fume control system and new pot hooding will allow Reynolds to make their formal demonstration of compliance with all NESHAP requirements by October, 2001. General Motors has installed rooftop thermal incinerators to destroy styrene and benzene VOC's.

EPA plans to issue a rule to cover emissions of Hazardous Air Pollutants (HAP) from Secondary Aluminum Production Processes in 2000. This NESHAP will require Alcoa, Reynolds, and GM Powertrain to comply with emission limits for particulate, hydrogen chloride, total hydrocarbons, and dioxin/furans within 3 years of promulgation.

F. Fish and Wildlife Assessments/Actions

Many of the use impairments are based on fish and wildlife conditions and considerations. DEC has issued many scientific collectors licenses for use in the AOC. As a result, some fish and wildlife investigative information has been reported and yet many investigations remain unfunded. The data and findings of these studies need to be shared with DEC and others. Consumption restrictions and habitat impairments are known. Environmental monitoring, as well as further habitat study and assessment, is needed to establish required remediation which may include enhanced management plans and actual construction projects. The relicensing of the power dam by the Federal Energy Regulatory Commission should have some bearing towards resolving related use impairments. As part of the relicensing, money is planned to create a Future Habitat Improvement Fund and a Future Fisheries Management Fund as well as the rehabilitation of a boat launch at Hawkins Point.

G. Health and Environmental Assessments/Actions

Three studies and the resulting report documents that evaluate human health risks and focus on the Akwesasne Mohawk population have been completed as well as the summary document dated January 1995. The reports conclude that the health risks to the Mohawk Nation at Akwesasne from the consumption of fish contaminated with PCBs are greater than those of anglers on major New York State waterbodies. Mohawk risks are larger primarily because the average PCB levels in the St. Lawrence River fish are higher than those in fish from some of the other waterbodies. Higher consumption rates of locally caught fish also contribute to higher risks. The results of the studies confirm the value of the health advisories for fish and wildlife consumption and call for the continuation of educational and outreach efforts until contaminant levels, particularly PCBs, decrease. Follow-up studies and

continued public outreach activities are needed to monitor and to reduce the exposure to local persons. For example, maintaining current and useful contaminated fish consumption advisory information serves to reduce exposure of user groups, particularly young women having or intending to have children. Funding is needed for follow-up investigations. Addition ongoing studies conducted by the "Superfund Basic Research Program" in conjunction with The School of Public Health at the University at Albany, are described in Appendix H.

H. Investigations and Monitoring Activities

As part of remediation activities, monitoring plans have been established for contaminated river sediment removal and land-based hazardous waste site projects. The development and implementation of these plans are subject to regulatory review and approval. These activities need to be closely monitored for RAP coordination. The focus of these projects and environmental monitoring is to minimize the local and downstream impacts resulting from the remedial activities and to assure that compliance with cleanup criteria is achieved.

In addition to the remedial activity monitoring required of the industries, pre- and post-cleanup assessments directed at evaluating the extent of the restoration of beneficial uses will be needed. These further health, fish, wildlife, plankton, and macroinvertebrate studies and investigations will be used to better define a change in status of use impairment indicators under the RAP process and therefore need to be coordinated with delisting criteria. Funding for these additional investigations and assessments is limited and in most cases is subject to specific priorities. Priority investigation and monitoring activities are identified and listed in Section VII herein. Excerpts of tables from a comprehensive listing of monitoring activities in and around the Area of Concern (Joint Monitoring Statement, 1992) are presented in Appendix D. These tables were updated with research activities in 1994 and are presented in Appendix E. A current comprehensive update would be appropriate.

I. Public Participation and Outreach

Regular meetings of the Remedial Advisory Committee (RAC) throughout the implementation of the Stage 2, and documentation of the Stage 3, Remedial Action Plan implementation process will continue to keep stakeholders informed of remedial activities and progress and continue to provide a means for local concerns to be heard, responded to, and addressed. Field trips are used to learn more about the specifics of remedial activities and are coordinated with current implementation activities and committee interests. An informational video describing the Massena Area of Concern has been prepared to increase public awareness about the restoration and protection activities and the needs of this important geographic area. A newsletter, promotional brochure, and RAP display are other examples of outreach activities that have been incorporated into the public participation activities involving the Massena AOC. The Remedial Advisory Committee will continue to provide advice and consultation to the St. Lawrence at Massena RAP. The RAP will benefit from two ongoing initiatives:

- St. Lawrence Aquarium and Ecological Center (SLAEC) - see Appendix F.
- St. Lawrence-Lake Ontario Research Initiative (SLRLO) - see Appendix G.

V. RESTORATION AND PROTECTION STRATEGIES:

Eleven of the fifteen use impairment indicators for the St. Lawrence River at Massena Remedial Action Plan require the development and implementation of remedial strategies. Due to the well known recent chronic occurrence of taste and odor problems in the Village of Massena's drinking water supply, the use impairment indicator addressing "Drinking Water Restrictions, Taste and Odor Problems" was recently added to this list. The restoration and protection strategies, as applied to each use impairment indicator and to the sources of contamination, are further described below in narrative summaries. For additional details addressing the use impairment indicators, refer to the eleven "Use Impairment Strategy Management Forms" contained in Appendix B and to Tables 1, 2, 3, and 4 contained in this Massena RAP Update document.

A. Summaries of Remedial Strategies for each Use Impairment Indicator

The narrative summaries for each Use Impairment Restoration and Protection Strategy management form for the Massena Area of Concern are described below. The eleven use impairment strategy management forms are in Appendix B. The restoration and protection criteria are summarized in Table 3 and described in more detail in Appendix C. The goal of the Remedial Action Plan then becomes to achieve the development and implementation of the remedial strategies and the delisting criteria. The remedial strategies are designed to restore and to protect the beneficial uses for each of the use impairment indicators:

1. Fish and Wildlife Consumption Restrictions

The consumption restriction use impairment is caused by PCBs, Mirex, and dioxin. The sources of the historic cause of this use impairment include industrial discharges, inactive hazardous waste sites, contaminated river sediments, air deposition, and Lake Ontario. Following the removal of sediments from the St. Lawrence and Grasse Rivers by the three major Massena industries, and the completion of land-based hazardous waste site remediation, investigations and long term monitoring will be needed to evaluate the extent of any remaining impairment. The ongoing land-based and river-based waste site remediation work, along with improved treatment of point source discharges, will contribute to the restoration and protection of the beneficial use. The establishment and implementation of Best Management Practices (BMPs) involving fish, aquatic and wildlife as well as human health, will also benefit the restoration and protection of this and other problems identified by the use impairment indicators.

Following reports on the completion of remediation in the AOC, it is expected that the three major industries will continue to document the accomplishments. The industries will need to verify that hazardous waste site cleanup standards have been achieved. When fish and wildlife studies indicate that contaminant levels are acceptable and when there are no health advisories due to causes from the AOC and its watershed, modification to the use impairment status can be reconsidered. Additional fish and wildlife or human health management strategies may be required.

[Note: Table 1 from Stage 2 of the RAP had previously identified mercury, dioxin, and Mirex as additional likely causes of this use impairment. Some changes have occurred, and mercury is not identified as contributing to advisories in the St. Lawrence River. Mirex and dioxin are once again identified as contributing to consumption advisories of fish in the St. Lawrence River.]

2. Loss of Fish and Wildlife Habitat

This use impairment is due to contaminated river sediments and physical disturbances caused by the construction of the power dam and St. Lawrence Seaway. Loss of fish and wildlife habitat involves the presence of elevated levels of PCBs, metals and PAHs that are most likely impacting the benthos. Dredging, natural erosion, and other sediment disturbances (e.g. prop wash) are other sources that contribute to the cause of this use impairment.

There are three key actions that will contribute to the restoration and protection of habitat: 1) the completion of hazardous waste site remediation and the implementation of Best Management Practices including wetland restoration projects by the three major industries, 2) the implementation of Federal Energy Regulatory Commission (FERC) relicensing requirements affecting habitat by the New York Power Authority concerning the power dam, and 3) the assessment and verification by NYSDEC that the type, quantity, and quality of habitat in the AOC is adequate and that management plans (including seaway dredging) are in-place to protect this beneficial use. Also, the documentation of the improvements to the abundant existing and new habitat outside the AOC will contribute to resolving this use impairment.

3. Transboundary Impacts

This additional use impairment indicator (used to address binational considerations) is rated as impaired and is believed to be caused by the pollution transport of PCBs, phosphorus, nitrogen, metals and contaminated sediments to downstream Canadian St. Lawrence River areas. Sources of pollutant transport include land-based hazardous waste sites, contaminated river sediments, point source discharges including combined sewer overflows (CSOs), suspended solids, Lake Ontario, and potentially atmospheric deposition and nonpoint sources.

Once the contaminated river sediment and land-based remediation has been completed (estimate 2002), the accomplishment of cleanup levels and the existence of any contributions to downstream impacts will need to be assessed. Ambient water quality standards, air discharge standards, sediment criteria, and flora/fauna criteria need to be achieved. The Lake Ontario Lakewide Management Plan (LaMP) must address any upstream Lake Ontario effect on downstream St. Lawrence River areas. Also, as noted under the beach closings use impairment indicator (#9), further assessment is needed concerning the existence and extent of any partial-body contact use impairment in non-bathing beach areas.

4. Degradation of Fish and Wildlife Populations

This likely use impairment is caused by PCBs, mercury, DDE, physical disturbances and fish over-harvesting. The sources include industrial discharges, inactive hazardous waste sites, contaminated sediments, Lake Ontario, the Cornwall AOC and the international seaway. Further studies are needed to define the extent of any impairment and to assess the results of implementing the required remedial activities that address the consumption restrictions and habitat impairments above. The construction of the seaway and power dam changed the ecology significantly such that a post-1959 fish and wildlife baseline, to define the desired fish and wildlife community structure (number and balance), is needed.

The following items need to be addressed in order to resolve this use impairment: demonstrate that environmental threats are addressed, document that fish and wildlife management goals are achieved, document no toxicity from sediments, and verify that a healthy, reproducing population of bentivores and piscivores exists. Also the fish and wildlife habitat, that is near the AOC but outside the defined boundary and was created as a result of the St. Lawrence Seaway construction, needs to be assessed as to its contribution towards restoration of this beneficial use.

5. Fish Tumors or Other Deformities

This likely use impairment is probably partially due to PAHs (off the Reynolds site) from contaminated river sediments. A current fish pathology study before and most importantly after the sediment removal is needed for comparison and a determination of the existence of tumors. The use impairment is considered resolved when the incidence rates of fish tumors and other deformities do not exceed unimpacted areas, survey data confirm the absence of liver tumors in bullheads or suckers, fish tissue standards are achieved, and there are no deformities observed in resident species.

6. Bird and Animal Deformities or Reproductive Problems

This likely use impairment is probably caused by PCBs from contaminated river sediments. After completing the land-based hazardous waste site and contaminated river sediment remediation work, investigations and longer term monitoring will be needed to define the existence and extent of any use impairment. Enhancements to fish/aquatic/wildlife management plans may also be needed.

The delisting criteria are satisfied when studies demonstrate compliance with tissue standards or objectives as a protection level and when wetland assessment indicates healthy communities of significant species. Incidence rates should not exceed control sites. Without sufficient evidence to suggest that deformities or reproductive impairment is probable, an extensive biomonitoring program is not warranted.

7. Degradation of Benthos

This likely use impairment is probably due to PCBs, PAHs, lead, copper and physical disturbances that come from industrial discharges, contaminated river sediments, inactive hazardous waste sites, nonpoint sources and river activity. After completing the land-based hazardous waste site and contaminated river sediment remediation work, investigations and longer term monitoring will be needed to define the existence and extent of any use impairment. Enhancements to fish/aquatic/wildlife management plans may also be needed. PAHs have been added as a cause of the degradation of benthos use impairment because studies have shown PAHs to have substantially altered benthic populations at Reynolds Metals. These studies were required by NYSDEC as preliminary monitoring for the dredging project.

The delisting criteria are satisfied when benthic surveys demonstrate a healthy community. In the absence of community data, sediment quality criteria must be achieved such that no threat is evident. The emphasis is placed on demonstrating the absence of toxic effects of sediment associated contaminants and on demonstrating bioassay results comparable to controls.

8. Restrictions on Dredging Activities

Although this use impairment indicator has been determined unimpaired for the ongoing St. Lawrence Seaway navigational channel maintenance dredging, it is believed an impairment is likely to exist when considering expanded dredging proposals outside the seaway maintenance channel. Here, there is concern about chemicals such as PCBs, arsenic, chromium, copper, nickel and zinc that are known to be present in contaminated river sediments. After implementing the required contaminated river sediment removal projects, and defining further the contaminated sediment guidelines, investigations will be needed: sediment analyses, toxicity tests, benthic studies, bioaccumulation studies, fish surveys and deformity assessment. Based on these, determinations on the extent of any dredging restrictions and/or any further required remedial actions and dredging decisions can then be made.

Under the enforcement orders, the required remedial dredging activities will have substantial restrictions on conducting the dredging and on the disposal of the dredged materials and associated water effluent. For example, dredged contaminated river sediments are to be placed in approved landfills, return water will undergo treatment by flocculants and activated carbon, and certain monitoring activities and studies must be conducted.

Delisting criteria are satisfied when sediment criteria are achieved. Further, restricted dredging activities must be approved and must not be the result of active AOC or watershed sources. Study results should confirm this. Dredging approvals need to verify that dredged material disposal does not contribute to use impairments and that beneficial uses are protected.

9. Beach Closings

Although this use impairment indicator has been determined unimpaired for the New York State portion of the AOC, further assessment is needed concerning the existence and extent of any partial-body contact use impairment in non-bathing beach areas downstream of combined sewer overflows (CSOs). Following the development and evaluation of additional data, which should include bacteria, an assessment of any impairment will be made.

Delisting criteria are satisfied when bathing beach and partial body contact water standards and guidelines are achieved. Concentrations of fecal coliform and *E. coli* should be consistently below 100 colonies per 100 ml sampled.

10. Degradation of Plankton Populations

The existence and extent of any use impairment is unknown. Current studies are needed and more importantly, following the completion of ongoing and planned land-based hazardous waste site and contaminated river sediment remediation, investigations and long term monitoring are required to assess the status of this use impairment indicator.

Delisting criteria are satisfied when a healthy fish community can be demonstrated. Bioassay data should confirm no significant toxicity in ambient waters. When compared to unimpacted areas, the plankton community structure should be favorable (population, size, and variability). In the absence of community structure data, an evaluation requires plankton bioassays to confirm no toxic impact in ambient waters. A healthy fish community should be observed in the Area of Concern.

11. Drinking Water Restrictions, Taste and Odor Problems

Taste and odor problems were not considered impaired in the Stage 1 document developed in 1990. With the occurrence of the exotic species zebra mussels in the Great Lakes and the St. Lawrence River, increased water clarity has contributed to the presence of the compounds geosmin and MIB. This in turn has created a taste and odor in the drinking water supply that is currently a nuisance. Because of this, the status of this use impairment indicator needs to be reassessed. The problem has now started to occur more frequently than seasonally such that the Village of Massena, as well as other localities along the St. Lawrence River, may have to or have had to provide additional treatment to the drinking water supply. A research paper brief on the cause of taste and odor problems in the St. Lawrence River is presented in Appendix I.

B. Use Impairment Restoration and Protection Strategy Management Forms

With the actions that have been taken or are in progress or planned, we have developed an integrated strategy for managing each use impairment indicator to assure the restoration and protection of beneficial uses as described below.

The development of the remedial strategies for each use impairment was initiated by identifying the specific actions and needs that should restore and protect the beneficial uses. Further, the current status of these remedial strategies is defined as well as a projected completion date and an identification of a responsible party (as much as possible). This information for each use impairment indicator is then consolidated on a single page form entitled the "Use Impairment Restoration and Protection Strategy" management form. These strategy management forms are contained in Appendix B and are to be updated periodically to document the status of remedial activity progress and any strategy modifications.

Each Use Impairment Restoration and Protection Strategy management form therefore targets a specific use impairment and provides impairment descriptive data, a remedial strategy plan with status, and narrative comments. Summary descriptions of the remedial strategies for the eleven use impairments identified as impaired or as requiring further investigation for the St. Lawrence River at Massena Area of Concern are presented next. Each use impairment strategy management form in Appendix B describes its use impairment indicator status as either impaired, likely impaired, unknown impairment, or reopened for further assessment. The eleven use impairments and their status are:

1. Fish and wildlife consumption restrictions	-impaired
2. Loss of fish and wildlife habitat	-impaired
3. Transboundary impacts	-impaired
4. Degradation of fish and wildlife populations	-likely
5. Fish tumors or other deformities	-likely
6. Bird and animal deformities/reproductive prob.	-likely
7. Degradation of benthos	-likely
8. Restrictions on dredging activities	-expanded review
9. Beach closings	-expanded review
10. Degradation of plankton populations	-unknown
11. Drinking Water Restrictions: Taste and Odor	-reassessment

["Delisting" Criteria are further developed in Section VI herein. Appendix C contains additional details for these criteria for each of the fifteen use impairment indicators.]

VI. RESTORATION AND PROTECTION (DELISTING) CRITERIA:

In addition to providing a summary of specific delisting criteria definitions for each use impairment indicator, this section will expand on defining the goal(s) and beneficial uses for the Massena Area of Concern.

A. Goals and Beneficial Uses for the Massena AOC

For the St. Lawrence River (Cornwall/Massena) AOC, the development of the RAP is proceeding as two separate documents: the Cornwall (Ontario, Canada) RAP and the Massena (New York, United States) RAP. NYSDEC, the Massena RAC, the Cornwall RAP team and the Cornwall Public Advisory Committee (PAC), in consultation with Quebec and the Mohawk Nation at Akwesasne, developed a single goal for the two RAPs. The goal recognizes that pollution affects more than the immediate area of a particular jurisdiction and that attention should also be turned to downstream and cross-stream areas that are impacted by pollution from the Area of Concern.

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. The Remedial Action Plans include protecting the downstream aquatic ecosystem from adverse impacts originating in the AOC and its watershed. This goal was agreed upon by NYSDEC, the Massena Citizen Advisory Committee (CAC), the Canadian governments, the Cornwall Public Advisory Committee (PAC) and the Mohawks at Akwesasne. The 1994 Binational Statement, which summarizes the Stage 1 Massena and Cornwall RAP documents, endorses this goal.

In order to implement this broad goal statement for the Massena RAP, the Remedial Advisory Committee has further defined specific RAP goals and beneficial uses that describe the desired water quality, AOC conditions, and stakeholders' uses. This expanded breakdown of the RAP goal(s) and the beneficial uses are listed below:

*** RAP Goals:**

1. Water quality in the St. Lawrence River that achieves best use standards and is not adversely affected by tributary rivers and streams.
2. All river waters aesthetically pleasing so as to encourage active and passive recreation.
3. Fish and wildlife levels in the AOC that are sustained and free of consumption restrictions.
4. Remedial activities that provide for the restoration of use impairments and the long term protection of beneficial uses.

*** Beneficial Uses:**

1. Commercial uses include shipping, normal marine traffic, and business activities such as tourism and trade including related recreational uses.
2. Recreational uses include boating, sport and ice fishing, nature observation, public marinas, charters, sightseeing, and stewardship activities.
3. Municipal and public uses include drinking water, recreational activities, educational opportunities, and treated wastewater disposal.
4. Industrial uses include transportation and treated wastewater disposal.
5. Non-human uses: fish and wildlife habitat for resident and migratory species, food production for fish and wildlife, the preservation of natural resources, and the protection of watershed ecology uses.

To evaluate the extent to which the Area of Concern will support these goals and uses, the Remedial Advisory Committee has developed restoration and protection criteria for each use impairment indicator. These criteria will provide the definition of the goal or restoration target that is desired to satisfy each use impairment and ultimately lead to the delisting of the Area of Concern. The following section describes these criteria:

B. Table 3 - Beneficial Use Restoration and Protection (Delisting) Criteria

For each of the fifteen use impairment indicators, restoration and protection (delisting) criteria have been developed. Together, these criteria provide the necessary mechanism to evaluate the extent to which a beneficial use has been restored and protected against future impairment. By evaluating the status of each of these criteria (restoration targets) and by providing a discussion of the rationale and supporting data, the specific needs have been determined for all use impairments in order to accomplish the RAP goals.

Appendix C provides a detailed description of the restoration and protection criteria for each use impairment indicator. In Appendix C, the use impairment indicators are separated into three groups based on the current status evaluated for each use impairment: Group 1) indicators have a status of impaired; Group 2) indicators need further study; and, Group 3) use impairment indicators are rated as not impaired. A description of the rationale and supporting data needed to address the individual criteria for each use impairment indicator is included.

Table 3 has been developed as a summary of the listing of the restoration and protection criteria for use each use impairment and the status of each criteria. Table 3 follows this section. The further definition of the criteria, their updated status, and reporting their supporting data needs are all subject to progress updates and modifications based on recommendations by the Remedial Advisory Committee as coordinated by NYSDEC.

TABLE 3 - RESTORATION AND PROTECTION (Delisting) CRITERIA

St. Lawrence River at Massena Remedial Action Plan

USE IMPAIRMENT	RESTORATION CRITERIA	STATUS
Fish and Wildlife Consumption Restrictions	<ul style="list-style-type: none"> * No AOC restrictions due to in-place or watershed sources. * Compliance with fish and wildlife tissue standards. * Other upstream sources addressed by LaMP. * Attain sediment criteria and waste site standards. 	<ul style="list-style-type: none"> * Impaired * Need data * Need to verify * Need data
Loss of Fish and Wildlife Habitat	<ul style="list-style-type: none"> * Amount and quality of habitat exists and protected to meet goals * Amount and type of wetlands and riparian vegetation adequate with beneficial use protected. * Management plans in place to restore and protect habitat. * FERC relicensing requirements met. 	<ul style="list-style-type: none"> * Impaired * Need data * Need to verify * License Pending
Transboundary Impacts	<ul style="list-style-type: none"> * River and land-based remediation complete; no contribution from AOC/watershed to Cornwall RAP/downstream use impairments. * Attain ambient water quality stds. and sediment criteria. * Attain flora and fauna environmental and health criteria. * Other upstream St. Lawrence River sources addressed by LaMP. * Downstream contamination concerns addressed. 	<ul style="list-style-type: none"> * Impaired * Need data * Need study * Need to verify * Need to assess
Degradation of Fish and Wildlife Populations	<ul style="list-style-type: none"> * Attain desired level of healthy and self-sustaining communities. * AOC consistent with Great Lakes ecosystem objectives and Great Lakes Fishery Commission fish community goals. * In the absence of community structure data, bioassays confirm no significant toxicity from the water column or sediments. * Attain quantitative fishery targets (biomass, percent, richness) 	<ul style="list-style-type: none"> * Need data * Need to verify * Need data * Need data
Fish Tumors or Other Deformities	<ul style="list-style-type: none"> * Incidence rates do not exceed rates in unimpacted control sites. * No neoplastic or preneoplastic liver tumors in bullheads/suckers. * Attain IJC, state, and federal tissue standards/objectives. 	<ul style="list-style-type: none"> * Need data * Need survey * Need to verify
Bird or Animal Deformities or Reproductive Problems	<ul style="list-style-type: none"> * Attain IJC, state, and federal tissue standards/objectives. * Attain appropriate sediment quality criteria. * Deformity or reproductive incident rates less than inland controls * Wetlands support healthy communities of significant species. * Biomonitoring results better than unimpacted control sites. 	<ul style="list-style-type: none"> * Need data * Need to verify * Need data * Need survey * Need data
Degradation of Benthos	<ul style="list-style-type: none"> * Macroinvertebrate structure similar to unimpacted control sites. * Mesotrophic species present where suitable substrates are located * Absent community data, toxicity of sediments parallels controls. * Resident fauna do not have elevated contaminants. 	<ul style="list-style-type: none"> * Need data * Need survey * Need data * Need data
Restrictions on Dredging Activities	<ul style="list-style-type: none"> * AOC sediments (metals, organics, nutrients) meet stds./criteria. * Restrictions not due to AOC watershed; beneficial use protected. * Dredge spoil disposal does not contribute to use impairments, activities registered and approved, beneficial uses protected. 	<ul style="list-style-type: none"> * Not Impaired + * Not Impaired * Not Impaired

TABLE 3 - RESTORATION AND PROTECTION (Delisting) CRITERIA - continued

Beach Closings	<ul style="list-style-type: none"> * Waters do not exceed standards, guidelines, or objectives of use. * For beaches: no toxic irritants, numerical and clarity standards attained, and free from public health advisories. * For beaches: daily geometric mean for fecal coli < 100 colonies. * Attain ambient water quality standards for total and fecal coli. * Demonstrate stormwater CSO areas present no threat. 	<ul style="list-style-type: none"> * Not Impaired + * Not Impaired * Not Impaired * Not Impaired * Not Impaired +
Degradation of Plankton Populations	<ul style="list-style-type: none"> * Plankton community structure similar to unimpacted control sites * Absent community data, no plankton bioassay toxicity impact. * Healthy fish communities present in the AOC. 	<ul style="list-style-type: none"> * Not Impaired + * Not Impaired * Not Impaired
Tainting of Fish and Wildlife Flavor	<ul style="list-style-type: none"> * No complaints about fish tainting. * Survey results confirm no tainting. * Ambient water quality standards and criteria not exceeded 	<ul style="list-style-type: none"> * Not Impaired * Not Impaired * Not Impaired
Eutrophication or Undesirable Algae	<ul style="list-style-type: none"> * No persistent water quality problems from cultural eutrophication * Ambient water quality standards, criteria, guidelines attained. * Beneficial goals are achieved and maintained (boating, fishing) 	<ul style="list-style-type: none"> * Not Impaired * Not Impaired * Not Impaired
Drinking Water Restrictions, Taste and Odor Problems	<ul style="list-style-type: none"> * No taste and odor problems for treated drinking water supplies. * Attain treated drinking water health standards and criteria. * Drinking water treatment requirements not excessive. 	<ul style="list-style-type: none"> * Seasonal Impact * Not Impaired * Not Impaired
Degradation of Aesthetics	<ul style="list-style-type: none"> * AOC waters devoid of substances producing aesthetic problems. * No increase in turbidity causing a visible contrast to natural. * No visible residue of oil or floating substances. * Acceptable response to spills with preventive measures. 	<ul style="list-style-type: none"> * Not Impaired * Not Impaired * Not Impaired * Not Impaired
Added Costs to Agriculture or Industry	<ul style="list-style-type: none"> * No added costs to treat water due to AOC or spill conditions. * No transboundary impact due to watershed/AOC contamination. 	<ul style="list-style-type: none"> * Not Impaired * Not Impaired

NOTE: Achieving all delisting criteria would indicate the preparation of a Stage 3 document is appropriate.

+ = Additional survey data may be appropriate to verify and assure protection.

VII. PRIORITY REMEDIAL ACTIVITIES:

Based on the use impairment restoration and protection strategies and the criteria developed in the preceding two sections, necessary priority remedial activities can be identified and listed. In order to accomplish the RAP goals and to restore beneficial uses, these priority remedial activities are fundamental to continuing progress with remedial strategies that involve each use impairment. Priority remedial activities will be most important to keep in mind as "next step items" for the year 2000 and beyond. These activities are essential to addressing the restoration and protection criteria and will be most useful towards affecting use impairment status considerations and reassessments.

Remedial activities consist of the following three activity groups: physical construction and actual remedial work; investigation, monitoring, and assessment; and management plans, controls, and documentation. The June 1996 Massena RAP Update document first presented this information in table and listings by activity. Below, Table 4 has been further updated and listings in each of three remedial activity groups are provided. By updating the status of remedial activities and by including current study results with current strategy components, the priorities or next step items can be identified. Listings of the remedial activities in the three activity groups follow to assist in this strategy development and implementation.

■ Physical Construction / Actual Remedial Work

The 1996 RAP Update document identified the completion of construction work at the three major industries as key remedial measures to the RAP. The work includes land-based and river based remediation as well as wetland restoration projects.

1. Complete land-based remediation
2. Complete contaminated river sediment remediation
3. Restore wetland areas
4. Complete landfill protection at GM
5. Upgrade point source discharge treatment (air and water)

■ Investigation, Monitoring, and Assessment Activities:

Numerous investigative and assessment information has been identified as needed. Experts need to determine what is essential for the completion of remediation and for the assessment of the restoration of beneficial uses. The delisting criteria are linked to these determinations.

1. Assessment of the contaminant release associated with the required remedial work (ongoing and post remediation).
2. Conduct sediment analyses and compare to sediment criteria (as developed).
3. Verification of achieving site cleanup standards.
4. Develop/implement fish pathology study (tumors/deformities).
5. Document fish tissue standards/objectives achieved.
6. Conduct fish survey (to address quantitative analysis).
7. Establishment of a habitat and community structure baseline (post 1959).
8. Assessment of the quantity, quality, and balance of habitat areas.
9. Define desired fish and wildlife populations and balance goals.

10. Verify/document acceptable fish and wildlife population levels present.
11. Verify/document fish and wildlife management goals achieved.
12. Confirm wetlands support a healthy community.
13. Obtain/assess plankton community structure data.
14. Verification of achieving ambient water quality standards.
15. Confirm no significant toxicity in AOC water and/or sediment.
16. Assess non-bathing beach water quality for use impairment.
17. Document any deformities, assure occurrence less than inland controls.
18. Establish and monitor status of transboundary effect(s).
19. Monitoring and assessment of additional fish/wildlife consumption data.
20. Conduct benthic community structure studies.
21. Verify populations of mesotrophic species acceptable.
22. Document biomonitoring study results better than control results.
23. Verify flora/fauna health criteria achieved.
24. Assessment of the upstream contaminant release associated with the required remedial work (ongoing and post inactive hazardous waste site remediation).
25. Establishment of fish and wildlife habitat and community structure baselines; may need to conduct quantitative analyses of selected species.
26. Conduct aesthetics survey to assure beneficial uses intact.
27. Nonpoint source study and impact assessment.
28. Dioxin (and fluoride) source evaluation and impact assessment.
29. Determine weed harvesting or other equipment needs to address any eutrophication and/or aesthetics impairment (focus on AOC).
30. Assess human health studies (Superfund Research) to determine the any needed next steps to address human, aquatic, and/or wildlife health in the Area of Concern.

■ **Management Plans, Controls, and Documentation**

As noted above, each Use Impairment Restoration and Protection Strategy management form lists the remedial strategies identified to address a use impairment, its contamination sources, and the causes. Below are excerpts of the action items that call for the development of certain management plans, controls, or needed documentation to accomplish the restoration and protection of beneficial uses:

1. Obtain/implement FERC relicensing (Re: New York Power Authority) and determine applicability of specific projects plans towards resolving use impairments and protecting beneficial uses.
2. Continue the SPDES permit renewal/modification process; evaluate toxic control and reduced loadings to the AOC.
3. Monitor/pursue the development of contaminated sediment criteria or other guidelines to assist in making in-place toxics decisions.
4. Implement BMPs associated with specific remedial projects. Develop/implement any additional BMPs to address the restoration and protection of beneficial uses.
5. Verify LaMP addresses Lake Ontario effects on the AOC and interactions.
6. Assure AOC dredging is protective (Re: channel maintenance, other restrictions)
7. Document accomplishment (Re: public participation, delisting criteria)

VIII. OVERALL RAP STRATEGY AND NEXT STEPS:

■ RAP Strategy

Implementation of the St. Lawrence River at Massena Remedial Action Plan is a dynamic process that will incorporate improvements, identify use impairment changes and provide periodic update reports as knowledge on the status of the use impairments, location of sources, and effectiveness of remedial action implementation advances. Ultimately, the RAP must document the implementation of restoration and protection activities regarding the Area of Concern that indicate the delisting criteria have been achieved.

Implementation of the remedial measures of the three large local industries has already been identified as critical to the success of the RAP. The measures must, however, be encouraged to address the larger ecosystem approach of the RAP. Because of the international nature of this Area of Concern, a joint U.S./Canadian statement of progress and resolution of use impairments is also desired. Cleaning up the known sources of pollutants of this shared multi-use waterbody is fundamental to reclaiming and maintaining the valuable resource of the St. Lawrence River.

Once significant progress has been made in the improvement of use impairment status and/or significant details of remedial activity implementation have been accomplished that address contamination sources, an expanded RAP Update document (as done in 1995) can be produced to report on these activities. Ultimately, Stage 3 will require documentation of the resolution of all use impairments and satisfactory evidence that contamination sources are no longer impacting beneficial uses in the Area of Concern.

■ Table 4 - Summary of Sources, Impairments, Causes, and Remedial Strategies

Table 4 has been developed to summarize the remedial activity strategies needed to address the sources, causes, and use impairment concerns and to show their interrelationship. For example, a specific cause (e.g. PCBs) may contribute to more than one contamination source or impairment concern. Similarly, specific remedial strategies (e.g. investigation, management plan, or physical improvement) may contribute to addressing more than one contamination source, use impairment concern, or cause of an impairment.

In addition to describing the remedial strategies needed to address the sources and use impairment concerns, **Table 4** also identifies the needed documentation and provides an overall status of the remedial strategies for each source or impairment concern. These strategies and needs have been identified by the RAC committee and NYSDEC as necessary steps to restore and to protect beneficial uses and to work towards the delisting of the Area of Concern. **Table 4** is closely linked to the three lists of priority remedial activities.

TABLE 4 - SUMMARY OF SOURCES, USE IMPAIRMENTS, CAUSES, AND REMEDIAL STRATEGIES
St. Lawrence River at Massena Remedial Action Plan

Source or Use Impairment	Cause	Remedial Activity Strategies			Status
		Investigation/Assessment	Plans / Improvements	Documentation	
Land-based Hazardous Waste Sites	PCBs, Dioxin, Mercury	Determine contaminant releases and verify cleanup standards achieved.	Implement remedial actions*. Identify any add'l fish and wildlife health actions.	Long-term monitoring and remedial effects; evaluate aqua culture study.	I,R,U
Contaminated Sediments	PCBs, Dioxin, Mercury, Metals	Determine contaminant releases and verify cleanup standards achieved.	Implement remedial actions*. Identify any add'l fish and wildlife health actions.	Long-term monitoring and remedial effects; evaluate aqua culture study.	I,R,U
Other Non-point (AOC & Watershed)	Dredging, Construction, Physical Disturbances, Spills (Haz. sub.), Natural Erosion Sediments	Identify, measure and evaluate the effects of remedial actions.	Define investigations. Define needed practices (BMPs) & controls. Implement actions identified to control nonpoint pollution.	Conduct long-term monitoring; document remedial effect.	N
Point Source (Industrial & Municipal SPDES)	Phosphorus, PCBs, Organic Compounds, Metals, Contaminated Sediments	Identify, measure and evaluate the effects of remedial actions.	Complete SPDES renewals*. Define any new controls. Implement measures identified by permits and controls.	Conduct long-term monitoring; document remedial effect.	I,N
Combined Sewer Overflows	Metals, Phosphorus	Identify, measure and evaluate the effects of remedial actions.	Complete SPDES renewals* and CSO controls. Determine additional controls.	Conduct long-term monitoring; document remedial effect.	I,N
Other Point Sources	None known	Identify any sources. Perform loading assessment.	Develop based on new information and/or mass balance discrepancy.	Conduct long-term monitoring; document remedial effect.	N
Lake Ontario	PCBs, Dioxin, Mirex, DDE	Transport study. Conduct water column analyses and assess source load contributions.	Encourage added source control and pollution prevention practices.	Conduct long-term monitoring; document remedial effect.	N

Source or Use Impairment	Cause	Remedial Activity Strategies			Status
Air Deposition	PCBs, Fluoride, Organic Compounds	Transport study. Conduct air pollution analyses and assess source load contributions.	Encourage added source control and pollution prevention practices*.	Conduct long-term monitoring; document remedial effect.	I,N
Fish & Wildlife Consumption Restrictions	PCBs	Measure fish and wildlife levels on a continual basis to assess; apply criteria to evaluate; verify cleanup standards achieved.	Complete site remediation*. Implement BMPs/controls. Establish any add'l fish and wildlife or human health management plans.	Achieve < contam. levels. Define no health advisory (due to AOC). Conduct long term monitoring.	I,P,N
Fish & Wildlife Habitat Loss and Impairment	Physical Disturbances, Contaminated Sediments, Natural Erosion Sediments, Introduced Species, Water Level Controls.	Evaluate existing habitat. Develop non-indigenous and non-AOC habitat use plans. Assess cause impacts (Zebra Mussels, Purple Loosestrife, and others)	Assess type, quantity, and quality of habitat; verify adequate. Develop/implement habitat improvement plan. Define any controls for cause factors.	Conduct long-term monitoring; document remedial effect; track implementation of FERC relicensing requirements.	N
Transboundary Impacts	PCBs, DDE, Metals, Mercury, Phosphorus Cornwall AOC	Identify upstream causes. Measure water/air column and determine extent of any problem. Verify standards and cleanup levels achieved.	Complete land & river haz. waste site remediation*. Develop/implement BMPs. Verify protection.	Monitor; Document no contributory effect to Cornwall/downstream from the AOC; verify LaMP address upstream (L.Ont.) effects/impacts.	I,N
Other possible impairments: [Contaminated Benthos; Tumors or Deformities; Bathing/Dredging Restrictions; Fish/Wildlife/Bird problems of reproduction or population; Drinking Water Taste & Odor]	PCBs, DDE, PAHs, Metals, Mercury, Physical Disturbances, Overharvest of Fish, Contaminated Sediments, Geosmin and MIB.	Perform studies to find and eliminate any impairment. Verify attainment of restoration/protection criteria. Study to verify existence and define remedial measure(s).	Complete site remediation*. Perform projects to achieve criteria and verify. Develop/implement BMPs.	Link impairment to source and assess the results of remedial action. Conduct long-term monitoring; document remedial effect(s).	I,N

NOTES: Metals could include: Aluminum, Arsenic, Cadmium, Chromium, Copper, Cyanide, Iron, Lead, Mercury, Nickel, Zinc.

* Implementation progressing at ALCOA, General Motors, and Reynolds Metals.

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P = Planned
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The remedial strategies are established to address the sources of contamination to restore and to protect beneficial uses and are involved with the three areas of priority remedial activities: 1) conducting investigation and assessment activities, 2) the development and implementation of plans, controls, and physical construction improvement activities, and 3) the documentation of the progress and the ultimate success story that needs to be communicated as part of the Stage 3 RAP document.

■ **Next Steps**

1. Continue Remedial Advisory Committee meetings and involve the committee to address strategies, emerging issues, membership, and RAP goals.
2. Evaluate remedial measure success by the three large local industries.
3. Further refine the delisting criteria and needed remedial actions identification.
4. Continue monitoring, overview, and reporting for the RAP.
5. Enhance public participation activities involving the RAP.

■ **Selected References**

1. New York State Department of Environmental Conservation (NYSDEC). St. Lawrence River at Massena, New York Remedial Action Plan Summary Update, June 1996. 48 pp.
2. New York State Department of Environmental Conservation (NYSDEC). St. Lawrence River at Massena, New York Remedial Action Plan Update, April 1995. 144 pp.
3. Environment Canada, OMEE, OMNR, USEPA, and NYSDEC. A Binational Statement: Cornwall/Massena RAPs Stage 1 Summary, 1994. 17pp.
4. NYSDEC. St. Lawrence River at Massena RAP Update, August 1992.
5. NYSDEC. St. Lawrence River at Massena RAP Stage II, August 1991.
6. NYSDEC. St. Lawrence River at Massena RAP Stage I, November 1990.

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APPENDIX A

LIST OF REMEDIAL ADVISORY COMMITTEE MEMBERS

- | | | |
|----|---|---|
| 1. | Dave Arquette
St. Regis Mohawk Tribe
Community Building
Hagansburg, NY 13655 | St. Regis Mohawk Tribe
518-358-5937 |
| 2. | John Feeley
PO Box 6144
St. Lawrence Centre Mall
Massena, NY 13662 | St. Lawrence Aquarium and
Ecological Center
315-769-0787 |
| 3. | Steve Litwheler
NYSDEC, Region 6
State Office Building
Watertown, NY 13601 | N.Y. State Department of
Environmental Conservation
315-785-2238 |
| 4. | Ron McDougall,
RAC Chairperson
General Motors Powertrain
Route 37 East, PO Box 460
Massena, NY 13662 | UAW Local 465 Health & Safety Rep.
315-764-0271 (work)
315-764-2293 (plant) |
| 5. | Doug Premo
General Motors Powertrain
Route 37 East, PO Box 460
Massena, NY 13662 | General Motors Central Foundry
315-764-2233 (work) |
| 6. | Karen Vermillion
2 College Park Road
Potsdam, NY 13676 | Citizen
315-379-0857 (work)
315-268-9029 (home) |
| 7. | Tom Young
Clarkson University
PO Box 5715
Potsdam, NY 13699 | Clarkson University
315-268-4430 |

APPENDIX B

Strategy Management Forms

Presented below is the shell of the Use Impairment Restoration and Protection Strategy management form. This blank form is provided as a worksheet to update the completed strategy management forms that follow:

USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN:

FORM#:

USE IMPAIRMENT INDICATOR:

IJC#:

AOC LOCATION:

IMPAIRMENT RATING & CAUSES:

POLLUTION SOURCES:

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1.			
2.			
3.			
4.			
5.			
6.			

COMMENTS:

STATUS KEY:

C = Completed

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I = Implementation progressing

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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA, NY FORM#: 1

USE IMPAIRMENT INDICATOR: Fish & Wildlife Consumption Restrictions

IJC#: 1 AOC LOCATION: St. Lawrence, Grasse & Raquette Rivers

IMPAIRMENT RATING & CAUSES: IMPAIRED - PCBs

POLLUTION SOURCES: AOC industrial discharges, inactive hazardous waste sites, Lake Ontario, contaminated sediments

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. _Ongoing_	NYSDEC	Renew major industrial SPDES permits	_I_
2. _06/00_	GLRC	Evaluate Aquaculture Contam. Study (Grant)	_U_
3. _10/00_	Indust.	Complete haz. waste rem. & implement BMPs	_I_
4. _10/01_	Indust.	Verify site cleanup standards achieved	_I_
5. _6/02_	Indust.	Report on success of remediation in AOC	_N_
5. _Ongoing_	NYSDEC	Document F & W study contam. levels	_N_
6. _____	NYSDEC	Establish any add'l F & W management plans	_N_
7. _____	NYSDOH	Declare no health advisories (AOC caused)	_N_
9. _____	DEC/DOH	Establish any add'l health mgt. strategy	_N_
10. _____	RAC/DEC	Reassess use impairment status	_N_

=====

COMMENTS: Contaminant levels in fish & wildlife exceed current stds., guidelines or objectives; public health advisories are in effect. Contaminated sediment removal and haz. waste land based remediation projects are the first large steps towards restoration of impaired uses. Follow-up on mgt. plans, investigations and long term monitoring will provide needed documentation. As determined by the Division of Fish & Wildlife in 1994, Mirex is no longer considered a significant impairment cause. Hg and Dioxin have not contributed to health advisories on fish and are also deleted.

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C = Completed	I = Implementation progressing
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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE RIVER AT MASSENA FORM#: 2

USE IMPAIRMENT INDICATOR: Loss of Fish and Wildlife Habitat

IJC#: 14 AOC LOCATION: Within AOC

IMPAIRMENT RATING & CAUSES: IMPAIRED - contaminated sediments and physical disturbances from construction of dams and seaway.

POLLUTION SOURCES: Elevated levels of contaminants including PCBs, metals and PAHs most likely impact benthos; dredging and potentially natural erosion disturbances are sources.

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. _____	NYSDEC	Establish habitat baseline (post 1959) *	N
2. 10/00	Indust.	Complete haz. waste rem. & implement BMPs	I
3. 10/01	NYPA	Implement FERC relicensing requirements	R
4. 12/02	NYSDEC	Assess quantity & quality of habitat areas	N
5. _____	NYSDEC	Verify adequate habitat (amt./type/quality)	N
6. _____	NYSDEC	Verify mgt. plans inplace to protect habitat	N
7. _____	RAC/DEC	Reassess use impairment status	N

=====

COMMENTS: Localized habitat impairment within the AOC has been identified as part of fish and wildlife management programs. Contamination of water and sediment of wetlands is directly related to loss of habitat. * The construction of the power dam and the St. Lawrence Seaway dramatically altered habitat after its 1959 completion. Changed habitat areas within and outside the Area of Concern need to be assessed and a habitat baseline established. The creation of new habitat areas will also serve to restore this impairment. Overall habitat assessment should include the development of non-indigenous and non-AOC habitat use plans as well as an assessment of the cause impacts from zebra mussels and purple loosestrife.

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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE RIVER AT MASSENA FORM#: 3

USE IMPAIRMENT INDICATOR: **Transboundary Impacts**

IJC#: 15 AOC LOCATION: Binational issues; downstream St. Lawrence River impacts.

IMPAIRMENT RATING & CAUSES: IMPAIRED - Probable causes are downstream transport of PCBs, phosphorus, nitrogen, metals and sediments. Cross-river transport not likely.

POLLUTION SOURCES: Inactive hazardous waste sites, point source discharges, CSOs, Lake Ontario and potentially atmospheric deposition and nonpoint sources. No direct evidence documented.

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>

- | | | | | |
|----|---------|---------|---|---|
| 1. | 10/00 | Indust. | Complete haz. waste rem. & implement BMPs | I |
| 2. | 10/01 | Indust. | Verify cleanup levels achieved | N |
| 3. | Ongoing | EPA/DEC | Verify ambient water quality stds. achieved | N |
| 4. | Ongoing | EPA/DEC | Verify contam. river sediment criteria met | N |
| 5. | | EPA/DEC | Establish no transboundary effect * | N |
| 6. | | EPA/DEC | Verify flora/fauna health criteria met | N |
| 7. | | EPA/DEC | Verify LaMP addresses Lake Ontario effects | N |
| 8. | | NYSDEC | Dev./Impl. any add'l needed BMP's | N |
| 9. | | RAC/DEC | Reassess use impairment status | N |

=====

COMMENTS: Indirect evidence exists for downstream St. Lawrence River impacts from the Massena AOC, Cornwall AOC and upstream (Lake Ontario) sources. Cross-river impacts are not likely. * Need to establish no contributory effect from the Massena portion of the AOC and its watershed to the Cornwall portion of the AOC and downstream and document that the LaMP addresses any upstream (Lake Ontario) contributions.

STATUS KEY:

C = Completed	I = Implementation progressing
P = Planned	U = Under development/assessment/investigation
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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA

FORM#: 4

USE IMPAIRMENT INDICATOR: **Degradation of Fish and Wildlife Populations**

IJC#: 3 AOC LOCATION: St. Lawrence, Grasse & Raquette Rivers

IMPAIRMENT RATING & CAUSES: LIKELY - PCBs, Mercury, DDE, physical disturbances and fish overharvesting

POLLUTION SOURCES: AOC industrial discharges, Lake Ontario, Cornwall AOC, international seaway, inactive haz. waste sites and contaminated sediments

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. _____	NYSDEC	Develop baseline community data (post 1959)	N_
2. _____	NYSDEC	Assess F & W numbers and balance goals	N_
3. 10/00	Indust.	Complete haz. waste rem. & implement BMPs	I_
4. _____	NYSDEC	Verify acceptable F & W population levels	N_
5. _____	NYSDEC	Confirm no significant toxicity	N_
6. _____	NYSDEC	Document F & W targets/mgt. goals achieved	N_
7. _____	RAC/DEC	Reassess use impairment status	N_

=====

COMMENTS: This use impairment was identified by fish and wildlife management programs. YOY trend analyses and management goals are needed to provide for the assessment and protection of piscivorous wildlife. In the vicinity of the AOC, haz. waste site remediation and habitat mgt. plans (for fish/aquatic/wildlife) will be key elements. The RAP needs to document that environmental threats are addressed by the remediation. Fish and Wildlife community survey and structure data (number & balance) are needed to document that goals are achieved, that there is not toxicity from sediments present, and that a healthy reproducing population of bentivores and poscivores exists.

STATUS KEY:

C = Completed
P = Planned
D = Deferred

I = Implementation progressing
U = Under development/assessment/investigation
N = Needs development/assessment/investigation
R = Required by enforcement/permit/agreement

USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA

FORM#: 5

USE IMPAIRMENT INDICATOR: Fish Tumors or Other Deformities

IJC#: 4 AOC LOCATION: Within AOC

IMPAIRMENT RATING & CAUSES: LIKELY - PAHs

POLLUTION SOURCES: Potentially contaminated sediments

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. _____	NYSDEC	Dev./Imp. fish pathology study (tumors/def.)	__N__
2. 10/00	Indust.	Complete haz. waste rem. & implement BMPs	__I__
3. _____	NYSDEC	Conduct fish survey (liver tumors)	__N__
4. _____	NYSDEC	Verify compliance (fish tissue stds./objs.)	__N__
5. _____	NYSDEC	Verify no observed reproductive deformities*	__N__
6. _____	RAC/DEC	Reassess use impairment status	__N__
7. _____			

=====

COMMENTS: Limited data and reports have indicated tumor rates exceed those in unimpacted areas. A current fish pathology study and fish survey are needed to verify compliance with fish tissue standards and objectives and to verify no observed reproductive deformities. Studies should be conducted before and after sediment removal. The most significant concentration of PAHs is located in the river off of the Reynolds site. The use impairment is resolved when the incidence rates of fish tumors and other deformities do not exceed unimpacted areas; survey data confirm the absence of liver tumors in bullheads or suckers; fish tissue stds. are achieved; and, there are no deformities observed in resident fish.

STATUS KEY:

C = Completed
P = Planned
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I = Implementation progressing
U = Under development/assessment/investigation
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R = Required by enforcement/permit/agreement

USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA

FORM#: 6

USE IMPAIRMENT INDICATOR: Bird or Animal Deformities or
Reproductive Problems

IJC#: 5 AOC LOCATION: Within AOC

IMPAIRMENT RATING & CAUSES: LIKELY - PCBs

POLLUTION SOURCES: Potentially contaminated sediments

=====

<u>TARGET</u>	<u>RESP.</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
<u>DATE:</u>	<u>PARTY</u>		
1. _10/00_	Indust.	Complete haz. waste rem. & implement BMPs	_I_
2. _10/01_	Indust.	Verify cleanup levels attained	_N_
3. _Ongoing_	NYSDEC	Attain State, Fed, IJC tissue stds./objs.	_N_
4. _Ongoing_	NYSDEC	Confirm incident rates < inland controls	_N_
5. _Ongoing_	NYSDEC	Confirm wetlands support healthy community	_N_
6. _Ongoing_	NYSDEC	Biomonitoring results better than controls*	_N_
7. _____	RAC/DEC	Reassess use impairment status	_N_
8. _____			

=====

COMMENTS: Indirect evidence relative to fish tissue, frog coordination and reduced mink animal populations exists. No data on unusual incidents of cross-bill syndrome, egg-shell thinning or eagle populations exists. The delisting criteria are satisfied when studies demonstrate compliance with tissue standards and objectives and healthy communities of significant species are observed. Incidence rates should not exceed control sites. An extensive * biomonitoring program is not warranted unless sufficient evidence suggests that deformities or reproductive impairment is probable.

STATUS KEY:

C = Completed	I = Implementation progressing
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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA FORM#: 7

USE IMPAIRMENT INDICATOR: Degradation of Benthos

IJC#: 6 AOC LOCATION: St. Lawrence, Grasse & Raquette Rivers

IMPAIRMENT RATING & CAUSES: LIKELY - PCBs, lead, copper, PAHs and physical disturbances

POLLUTION SOURCES: Potentially industrial discharges, contaminated sediments, inactive hazardous waste sites, nonpoint sources and physical disturbances.

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. 10/00	Indust.	Complete haz. waste rem. & implement BMPs	I
2. 10/01	Indust.	Verify cleanup levels attained	N
3. _____	NYSDEC	Conduct benthic community structure studies	N
4. _____	NYSDEC	Confirm sediment quality criteria achieved	N
5. _____	NYSDEC	Verify populations of mesotrophic species	N
6. _____	NYSDEC	Bioassay results better than controls	N
7. _____	RAC/DEC	Reassess use impairment status	N
8. _____			

=====

COMMENTS: PAHs were added as a cause. A 1979 study indicated somewhat declining benthic populations. Data is needed to document that the macroinvertebrate community structure does not significantly diverge from unimpaired area. Also, data is needed to document no significant toxicity (bioavailability) of sediment-associated contaminants. The delisting criteria are satisfied when benthic surveys demonstrate a healthy community. In the absence of community data, sediment quality criteria are to be achieved such that no threat is evident. The emphasis is on demonstrating the absence of toxic effects of sediment associated contaminants and on demonstrating bioassay results comparable to controls.

STATUS KEY:

C = Completed	I = Implementation progressing
P = Planned	U = Under development/assessment/investigation
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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA

FORM#: 8

USE IMPAIRMENT INDICATOR: Restrictions on Dredging Activities

IJC#: 7

AOC LOCATION: AOC beyond navigation channel

IMPAIRMENT RATING(S) & CAUSES: UNIMPAIRED - (seaway channel
navigational maintenance dredging only)
LIKELY - concern for expanded dredging proposals outside the seaway
channel for: PCBs, Arsenic, Chromium, Copper, Nickel & Zinc.

POLLUTION SOURCES: Contaminated sediments from hazardous waste
sites and industrial discharges.

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. 10/00	Indust.	Complete haz. waste rem. & implement BMPs	I
2. 10/01	Indust.	Verify cleanup levels attained	N
3. _____	EPA/DEC	Define contaminated sediment criteria	N
4. _____	NYSDEC	Define span of AOC dredge area	N
5. _____	NYSDEC	Conduct sediment analyses and evaluate	N
6. _____	NYSDEC	Confirm sediment criteria achieved	N
7. _____	NYSDEC	Assure dredging restrict. safe/approved*	N
8. _____	RAC/DEC	Reassess use impairment status	N

=====

COMMENTS: Seaway dredging is not impaired. Need to review
expanded dredge area for restrictions on dredging and/or disposal
activities. Because disposal of dredged material in the St.
Lawrence River is prohibited, proper disposal plans for dredge
spoils must be approved. * Delisting criteria are satisfied when
the sediment criteria are achieved and any restricted dredging
activities are approved & registered. Studies should confirm that
the cause of any restrictions is not the result of currently active
AOC or watershed sources. Spoil disposal must not contribute to
use impairments and beneficial uses must be protected.

STATUS KEY:

C = Completed

P = Planned

D = Deferred

I = Implementation progressing

U = Under development/assessment/investigation

N = Needs development/assessment/investigation

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USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA

FORM#: 9

USE IMPAIRMENT INDICATOR: Beach Closings

IJC#: 10

AOC LOCATION: Downstream of Massena area CSOs, downstream in the St. Lawrence River, and in the Canadian AOC (beach closure impairment).

IMPAIRMENT RATING(S) & CAUSES: UNIMPAIRED - (defined by Stage 1 and Stage 2 documents for the New York State portion of the AOC)

FURTHER ASSESSMENT - (needed for partial body contact downstream of CSOs, for bacteria in Canadian AOC, and for downstream St. Lawrence River bathing and partial-body contact area impacts)

POLLUTION SOURCES: none documented

=====

<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. 10/00	DEC/RAC	Assess Canadian beach closing indicator	P
2. _____	NYSDEC	Obtain water quality data (partial contact)	N
3. _____	NYSDEC	Evaluate WQ data against stds./guidelines	N
4. _____	NYSDEC	Verify coliform standards achieved	N
5. _____	NYSDEC	Assess CSO impact (on part.body contact)	N
7. _____	RAC/DEC	reassess use impairment status	N

=====

COMMENTS: Further documentation of water quality data is needed to evaluate any exceedance of standards or guidelines in the St. Lawrence River near: 1) Canadian beaches; 2) Mohawk Nation at Akwesasne non-bathing beach areas; 3) partial-body contact areas downstream of CSOs. Delisting criteria are satisfied when bathing beach and partial body contact water standards and guidelines are achieved. The concentrations of fecal coliform and E. coli are to be consistently below 100 colonies per 100 ml samples.

STATUS KEY:

C = Completed
P = Planned
D = Deferred

I = Implementation progressing
U = Underdevelopment/assessment/investigation
N = Needs development/assessment/investigation
R = Required by enforcement/permit/agreement

USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA FORM#: 10

USE IMPAIRMENT INDICATOR: Degradation of Plankton Populations

IJC#: 13 AOC LOCATION: Investigation needed

IMPAIRMENT RATING & CAUSES: UNKNOWN

POLLUTION SOURCES: Past hazardous waste disposal areas; physical habitat changes.

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<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. 10/00	Indust.	Complete haz. waste rem. & implement BMPs	I
2. _____	NYSDEC	Obtain plankton community structure data	N
3. _____	NYSDEC	Confirm no sign. divergence from controls	N
4. _____	NYSDEC	Bioassays confirm no toxicity (No #2 *)	N
5. _____	RAC/DEC	Reassess use impairment status	N
6. _____			

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COMMENTS: Phytoplankton and Zooplankton population data are needed to evaluate if plankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. * In the absence of community structure data, an evaluation requires plankton bioassays to confirm no toxicity impact in ambient waters. A helpful indicator is to observe a healthy fish community in the AOC. Delisting criteria are satisfied when a healthy fish community can be demonstrated. Bioassay data should confirm no significant toxicity in ambient waters. A favorable comparison to unimpacted areas should be observed for the plankton community structure.

STATUS KEY:

C = Completed	I = Implementation progressing
P = Planned	U = Under development/assessment/investigation
D = Deferred	N = Needs development/assessment/investigation
	R = Required by enforcement/permit/agreement

USE IMPAIRMENT RESTORATION and PROTECTION STRATEGY

REMEDIAL ACTION PLAN: ST. LAWRENCE AT MASSENA FORM#: 11

USE IMPAIRMENT INDICATOR: Taste & Odor Problems - Drinking Water

IJC#: 9 AOC LOCATION: From Massena Water Intake

IMPAIRMENT RATING & CAUSES: Seasonal - Geosmin, MIB

POLLUTION SOURCES: bluegreen algae, zebra mussels, and bacteria

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<u>TARGET</u>	<u>RESP.</u>		
<u>DATE:</u>	<u>PARTY</u>	<u>REMEDIAL STRATEGY / ACTION ITEM:</u>	<u>STATUS:</u>
1. _____	Massena	Develop Corrective Strategy	I_
2. _____	Massena	Implement Corrective Action	P_
3. _____	NYSDEC	Inform RAC of Progress	
4. _____	NYSDEC	Verify resolution (i.e.Treatment effect)	
5. _____	RAC/DEC	Reassess use impairment status	
6. _____			
7. _____			

=====

COMMENTS: This taste and odor problem has been progressing worse over ten years. It is known that the chemical compounds geosmin and MIB are the cause. Contributing sources include bluegreen algae, zebra mussels, and a bacteria actinomycetes. Three treatments are thought to work best to combat this problem: 1)add activated carbon to the existing filtration process, 2) Construct separate carbon filtration, and 3) ozonation treatment. The water is currently pre-chlorinated in a mile long intake pipe which complicates carbon filtration effectiveness. The Village of Massena is working with Stearns & Wheeler Consultants to resolve this taste and odor problem.

STATUS KEY:

C = Completed	I = Implementation progressing
P = Planned	U = Under development/assessment/investigation
D = Deferred	N = Needs development/assessment/investigation
	R = Required by enforcement/permit/agreement

APPENDIX C

Use Impairment Restoration and Protection Criteria

Appendix C provides a detailed description of the restoration and protection criteria for each use impairment indicator. The use impairment indicators are presented below in three groups based on the current evaluation of the status of each use impairment as described in Table 1 herein: Group 1) use impairment indicators have a status of impaired; Group 2) indicators have a status of needing further study; and, Group 3) indicators have a status of not impaired. A description of the rationale and supporting data needed to address the use impairment is included for each indicator's restoration and protection criteria.

In this 1996 Summary Update, Table 4 has been developed as a summary that lists the criteria for use each use impairment and indicates the status of accomplishing each criteria. These criteria have been developed by listing specific standards and guidelines needed to declare a use impairment indicator as not impaired. As such, certain aspects of these criteria are dynamic and are subject to revision as progress is made in further defining the restoration targets for Great Lakes Areas of Concern. The three groups of use impairment indicators follow:

1. **Use Impairments rated as IMPAIRED:** These use impairment indicators have a status of impaired. Upon achieving all defined restoration and protection criteria, the use impairment indicator will be considered no longer impaired with its beneficial use protected. [Note: Each use impairment indicator that follows is underlined. Each restoration and protection criteria that follows starts with "*"]

Fish and Wildlife Consumption Restrictions -

- * Restrictions on fish and wildlife consumption in the Area of Concern due to watershed or in-place contaminants are absent. Contaminant levels created by anthropogenic chemicals do not exceed current standards, objectives or guidelines in all non-migratory fish and wildlife. No public health advisories are in effect for human consumption.
- * U.S. Food and Drug Administration Action Level of 2 mg/kg PCBs in the edible portion of the fish; and, 0.05 mg/kg in fish tissue accomplished to protect human health in New York State. (Determine chemicals of concern and allowable levels for all consumed species. FDA levels and AOC levels may differ; need to verify standards and specify acceptable levels)
- * Any remaining restrictions on fish and wildlife consumption are due to upstream sources that are addressed by other management plans such as Lakewide Management Plans (LaMPs).
- * Cleanup standards have been accomplished both in contaminated river sediments and land-based hazardous waste sites. (Specify standards)

Rationale: Delisting criteria are satisfied when the absence of consumption advisories due to sources from the AOC and its watershed are in accordance with IJC guidelines and address jurisdictional, state, and federal standards.

Supporting Data: Document fish and wildlife study reports that indicate satisfactory consumption result levels. Verify remediation results assure protection.

Loss of Fish and Wildlife Habitat -

- * Amounts and quality of physical, chemical, and biological habitat required to meet fish and wildlife management goals have been achieved and protected.
- * Amount and type of wetlands and riparian vegetation adequate with beneficial uses protected.
- * Local plans or other management plans in place to restore and protect habitat.
- * Federal Energy Regulatory Commission (FERC) relicensing process requirements accomplished to enhance and protect habitat.

Rationale: Delisting criteria are satisfied when fish and wildlife management goals have been achieved and protected. The location of habitat creation will be based on compatibility with other use goals, such that an acceptable balance among habitat, shipping and boating interests is achieved. A post-seaway/power dam construction habitat baseline needs development. Stakeholders, Remedial Advisory Committee members, and biological professionals all have roles in identifying acceptable habitat levels.

Supporting Data: Describe desired habitat and management goals. List specific habitat creation and/or rehabilitation projects and the status of each in the AOC. (For example, additional littoral shore may be provided by the creation of islands.) Describe fish and wildlife management programs. Demonstrate rehabilitation and protection of habitat. Document that current habitat surveys indicate an adequate amount of habitat is present with no additional loss attributable to water or sediment quality. Document FERC relicensing requirements and accomplishments.

Transboundary Impacts -

- * River and land-based remediation is accomplished such that the Massena AOC and its watershed do not contribute as a source to the use impairments in the Cornwall portion of this connecting channel AOC. Cleanup levels are achieved.
- * Specific ambient water quality standards, air discharge standards, and contaminated sediment criteria have been achieved to define no contributory effect to use impairments in the entire U.S./Canadian AOC.

- * Flora and fauna meet established environmental and health criteria to define no contributory effect to use impairments in the entire U.S./Canadian AOC.
- * Any remaining impacts to the entire AOC are attributable to upstream effects not associated with the AOC and its watershed and are being addressed by some other management plan such as a Lakewide Management Plan (LaMP). Includes water/air impacts.
- * Downstream contamination concerns are acknowledged and addressed to the maximum extent practicable under the RAP.

Rationale: Delisting criteria are satisfied when all potential transboundary impacts from the Massena AOC and its watershed are determined to have no significant effect on the use impairments in the Cornwall portion of the AOC or downstream.

Supporting Data: Studies providing ambient water quality, air discharge, and sediment data demonstrate no AOC or downstream effects. Flora and fauna surveys also indicate no AOC or downstream effects to the environment or health.

2. **Use Impairments rated as NEEDING FURTHER STUDY:** These use impairment indicators have a status of likely, unknown impairment, or expanded review and require further investigation or assessment. Upon achieving all defined restoration and protection criteria, the beneficial use will have been enhanced by the RAP process, the RAP goals satisfied, and the use impairment indicator considered no longer impaired with its beneficial use protected. [Note: Each use impairment indicator that follows is underlined. Each restoration and protection criteria that follows starts with "***"]

Degradation of Fish and Wildlife Populations -

- * Environmental conditions support healthy, self-sustaining communities of desired fish and wildlife at predetermined levels of abundance that would be expected from the amount and quality of suitable physical, chemical, and biological habitat present.
- * Fish and wildlife objectives for the AOC are consistent with Great Lakes ecosystem objectives and Great Lakes Fishery Commission fish community goals.
- * In the absence of community structure data, fish and wildlife bioassays confirm no significant toxicity from water column or sediment contaminants.
- * Quantitative fishery targets achieved indicating a self-sustaining mesotrophic community. Targets include: kg/ha units of biomass of fish in littoral habitats, percent of native species, and species richness per survey transect.

Rationale: Delisting criteria are satisfied for fish when populations are determined to be healthy and self-sustaining in a mesotrophic environment. Effort is needed to demonstrate that environmental threats to all species are addressed by fish and wildlife management programs consistent with the GLWQA, Great Lakes Fishery Commission goals, and Great Lakes ecosystem objectives. The construction of the seaway and power dam changed the ecology significantly such that a post 1959 fish and wildlife baseline needs to be developed.

Supporting Data: Fish and wildlife community structure data (number and balance) supports conclusions; abundance and composition is not impaired based on historical data. Desired levels within a statistical range achieved. Sediment bioassays with fish confirm no significant toxicity. Surveys indicate healthy, reproducing populations of benthivores and piscivores. Bird preservation guidelines, nature observation, aesthetics, and resident and transitory species guidelines are achieved.

Fish Tumors or Other Deformities -

- * Incidence rates of fish tumors or other deformities do not exceed rates at unimpacted control sites.
- * Survey data confirm the absence of neoplastic or preneoplastic liver tumors in bullheads or suckers.
- * Compliance with IJC, state and federal biological tissue standards or objectives.
- * No reproductive deformities in observed resident species.

Rationale: Delisting criteria are satisfied when survey results are consistent with expert opinion on tumors and there are no reports of tumors or other deformities based on acknowledged background incidence.

Supporting Data: Survey results confirm the absence of tumors and demonstrate no significant difference from control sites. Studies document that the AOC and watershed sources are not the cause of any reported incidence. Fishing and nature observation goals met.

Bird or Animal Deformities or Reproductive Problems -

- * Compliance with IJC, state and federal biological tissue standards or objectives.
- * Compliance with the establishment of appropriate sediment quality criteria.
- * Incidence rates of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species do not exceed background levels of inland control populations.

- * Wetlands support healthy communities of significant species.
- * When conducted, biomonitoring study results are better than standards or objectives when compared to unimpacted control sites.

Rationale: Delisting criteria are satisfied when studies demonstrate compliance with tissue standards or objectives which indicates healthy communities; this protection level serves to prevent the initiation of tumors and deformities in species and their consumers. Incidence rates should not exceed control sites. Without sufficient evidence to suggest that deformities or reproductive impairment is probable, an extensive biomonitoring program is not warranted.

Supporting Data: Survey results from bird, animal, and amphibian populations confirm the absence of deformities or reproductive problems and demonstrate no significant difference from control sites. AOC and watershed sources are not the cause of any incidence. Measurements verify a healthy community and population balance. Habitat and nature observation goals are achieved.

Degradation of Benthos -

- * Benthic macroinvertebrate community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics.
- * In the absence of community structure data, the toxicity of sediment-associated contaminants is not significantly higher than controls at unimpacted sites.
- * Populations of mesotrophic species are present in the benthos where suitable substrates are located.
- * Resident fauna do not have elevated contaminants.

Rationale: Delisting criteria are satisfied when benthic surveys demonstrate a healthy community. In the absence of community data, sediment quality criteria are to be achieved such that no threat is evident. Because of boating and shipping, the emphasis is placed on demonstrating the absence of acute and chronic toxic effects of sediment associated contaminants and on demonstrating bioassay results comparable to controls.

Supporting Data: Benthic macroinvertebrate community structure surveys, at representative locations in the AOC, are desired with results comparable to unimpacted control site composition. When performed, bioassay results comparable to control site values are desired. Demonstrate that appropriate sediment quality criteria requirements are achieved. Need to determine acceptable statistical deviation of benthic community structure and control site relationship.

Restrictions on Dredging Activities -

- * Concentrations of metals, trace organic compounds and nutrients in the sediment within the AOC (located within the actual or potential dredging areas and current shipping routes) do not exceed the sediment quality standards, criteria, or guidelines for acceptable dredge and disposal material (lowest effect levels), except where background concentrations exceed levels.
- * When sediment criteria are exceeded, any restrictions on dredging are specific to in-place conditions located within the actual or potential shipping routes and are not attributable to current AOC watershed contributions. Restricted dredging activities are registered with and have appropriate authority approval. Restrictions do not contribute to other use impairments and assure beneficial use protection.
- * When restricted dredging is approved, sediment disposal activities are also registered and approved by appropriate authority. These disposal activities do not contribute to other use impairments and assure beneficial use protection.

Rationale: Delisting criteria are satisfied when contaminants in sediments do not exceed standards, criteria, or guidelines such that they are not causing restrictions on the dredging. Where restrictions exist, dredging and disposal activities are approved, do not contribute to other use impairments, and provide use protection. Restricted dredging areas are due to in-place conditions and are not the result of currently active AOC or other watershed sources.

Supporting Data: Sediment core results are in compliance with IJC and state sediment quality standards, criteria and guidelines. Where data is available, provide graphic displays of trends. Restricted dredging and disposal activities must be monitored to assure beneficial use protection. Assure against sediment toxicity.

Beach Closings -

- * When waters, which are commonly used for total body contact or partial body contact recreation, do not exceed standards, objectives, or guidelines for such beneficial use.
- * For public swimming beaches, the waters must be free of chemical substances capable of creating toxic reactions or irritations to skin/membranes, must achieve numerical and clarity standards for safety, and must be free of public health advisories.
- * Beaches are considered safe for swimming when the daily geometric mean of a minimum of five fecal coliform samples collected from different sites within the beach area is less than 100 colonies per 100 ml. based on standardized sampling protocols.

* Ambient water quality standards are not exceeded: The monthly median value for total coliforms per 100 ml., and more than 20 percent of the samples, from a minimum of five samples, does not exceed 2,400 and 5,000 respectively. The monthly geometric mean of fecal coliforms per 100 ml. from a minimum of five samples, does not exceed 200.

* Exceptions apply to stormwater events in non-bathing beach areas located downstream below combined sewer overflows. Monitoring may indicate some standards and guideline exceedences; however, these non-bathing partial body contact areas must present no threat to downstream designated bathing areas.

Rationale: Delisting criteria are satisfied when bathing beach and partial body contact water standards and guidelines are met. Concentrations of fecal coliform and E. coli should be consistently below 100 colonies per 100 ml. sampled.

Supporting Data: Coliform data, bathing beach reports, and AOC open water quality surveys indicate the beneficial use of bathing in beach areas and partial body contact in non-bathing areas is in compliance with regulations and protected against health threats.

Degradation of Plankton Populations -

* Phytoplankton or zooplankton community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics.

* In the absence of community structure data, plankton bioassays confirm no toxicity impact in ambient waters (i.e. no growth inhibition).

* Healthy fish communities are present in the Area of Concern which indicates a viable plankton community.

Rationale: Delisting criteria are satisfied when a healthy fish community can be demonstrated. This incorporates the ecosystem approach. Bioassay data should confirm no significant toxicity in ambient waters in accordance with AOC beneficial use goals.

Supporting Data: Plankton community structure data and bioassay toxicity data support observations of the presence of healthy fish communities. Plankton community structure favorable when compared to unimpacted sites in population, composition, and statistical variability.

3. **Use Impairments rated as NOT IMPAIRED:** These use impairment indicators have a status of not impaired. Upon confirming that all defined restoration and protection criteria have been achieved, the use impairment indicator will be verified as not impaired with beneficial use protected. [Note: Each use impairment indicator that follows is underlined. Each restoration and protection criteria that follows starts with "**"]

Tainting of Fish and Wildlife Flavor -

- * There are no complaints about fish tainting.
- * Survey results confirm no tainting of fish and wildlife flavor.
- * The presence of tainting contaminants (such as phenols) in the water column do not exceed ambient water quality standards and criteria.

Rationale: Delisting criteria are satisfied when there is an absence of reports of fish tainting and surveys support this conclusion. Compliance with ambient water quality standards, objectives, and guidelines indicates no tainting problem.

Supporting Data: Documented reports and ambient water quality data support beneficial use goals.

Eutrophication or Undesirable Algae -

- * No persistent water quality problems attributed to cultural eutrophication (e.g. none of the following present: dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity).
- * Ambient water quality survey data consistently equal to or better than standards, criteria, or guidelines.
- * Beneficial goals are achieved and maintained including boating, fishing, sightseeing, nature observation, aesthetics, passive and active recreational activities.

Rationale: Delisting criteria are satisfied when survey results indicate phosphorus concentrations and loadings, chlorophyll, ammonia, water clarity, dissolved oxygen and other ambient water quality levels are consistently better than standards, criteria, and guidelines. The observation of algal blooms in the AOC or downstream needs to be evaluated as to the cause, the undesirable nature and any proposed remedial action.

Supporting Data: Suggested thresholds for ambient water quality in the AOC include: phosphorus concentration < 20 ug/l, Secchi disc transparency > 1.2 meters, dissolved oxygen > 6 mg/l, unionized NH₃ < 0.02 mg/l.

Drinking Water Restrictions, Taste and Odor Problems -

- * The absence of taste and odor problems for treated drinking water supplies.
- * No exceedence of human health standards, guidelines, or objectives for treated drinking water supplies for densities of disease causing organisms or concentrations of hazardous or toxic chemicals or radioactive substances.
- * For treated drinking water, the treatment needed to make raw water suitable for drinking does not exceed the standard treatment used in other comparable portions of the Great Lakes which are known not to be degraded (e.g. settling, coagulation, and disinfection treatment is standard).

Rationale: Delisting criteria are satisfied when standard drinking water treatment practices are employed and human health standards and guidelines are achieved. Contaminants from the Area of Concern watershed and the AOC should not be causing drinking water quality problems in the AOC or contributing to transboundary impacts:

Supporting Data: Ambient water quality and treated drinking water quality survey data confirm compliance with the New York State standards and guidelines. Document that there is no significant health impact from transboundary effects.

Degradation of Aesthetics -

- * Area of Concern waters are devoid of any substance which produces a persistent objectionable deposit, unnatural color, or turbidity, or unnatural odor (e.g. oil slick, surface scum).
- * No increase in turbidity that would cause a visible contrast from natural conditions.
- * No visible residue of oil or floating substances.
- * Any sightings of oil, scum, floating objects, or reports or objectionable odors are spill related and at a frequency of occurrence and cleanup response acceptable to the public (instances of repeated spills require improved response and prevention measures).

Rationale: Delisting criteria are satisfied when the narrative standards for ambient water quality parameters such as suspended solids, oil, and color are achieved. These require no presence that would adversely affect the waters best use or interfere with achieving the beneficial use goals.

Supporting Data: Document that the quantitative targets established for dischargers having the potential to cause such conditions are achieved: 3 mg/l for suspended solids, 15 mg/l for oil and no floating substances. Verify that water clarity data, bioassay, and bacteria survey data support aesthetic use goals. Document that the implementation of remedial measures involving physical construction provide protection of beneficial uses and improve AOC aesthetics.

Added Costs to Agriculture or Industry -

- * No additional costs are required to treat water prior to use due to contamination or spills within the Area of Concern.
- * No transboundary impact due to watershed or AOC contamination.

Rationale: Delisting criteria are satisfied when there are no additional costs required to treat the water prior to use for agricultural or industrial purposes (e.g. livestock watering, irrigation, crop-spraying, noncontact food processing, industrial application).

Supporting Data: No reports of increased costs to agriculture or industrial business due to spills or in-place contamination impairing water use.

3.1 Water and Sediment Monitoring

1992

Table 1 summarizes the results of discussions of the Water and Sediment Workgroup according to the framework matrix.

TABLE 1. Framework matrix summarizing monitoring status, recommended monitoring activities and research needs with respect to water and sediment monitoring in support of relevant issues.

ISSUE and IMPAIRMENT STATUS	IS IT BEING MONITORED?	IS IT ADEQUATE?	WHAT MORE IS REQUIRED?
1. Restrictions on fish and wildlife consumption <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	YES	NO	RESEARCH NEED: - need to determine specific pathways for contaminant uptake by biota. RECOMMENDED MONITORING: - undertake sampling program for dioxins (especially in sediment) as funding permits; PCB monitoring should be congener-specific (for trends, loads and modelling); site-specific trend monitoring data are required for the mouth of the Grasse River (especially PCBs), within the shipping channel, and near the locks; need to integrate monitoring activities with the upstream programs; and need to include selenium and hexachlorobenzene in monitoring programs with respect to biota uptake.
2. Tainting of fish and wildlife flavour <i>Further Study - Canada</i> <i>Not Impaired - U.S.</i>	NA	NA	NA
3. Degradation of fish and wildlife populations <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	YES	NOT SPECIFIED	RESEARCH NEED: - relationships between population degradation and chemicals needs to be determined which may identify chemicals in water and/or sediment which will require specific monitoring program.
4. Fish tumours or other deformities <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	YES	NOT SPECIFIED	RESEARCH NEED: - causes of tumours not determined; PAHs generally attributed as cause and may be monitoring requirements with respect to concentrations and spatial occurrence in sediment.
5. Bird or animal deformities or reproductive problems <i>Further Study - Canada</i> <i>Likely Impaired - U.S.</i>	NA	NA	RESEARCH NEED: - no deformities documented; if found, then relationships to chemicals needs to be determined before water and/or sediment monitoring can be developed.
6. Degradation of benthos <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	YES	NO	RESEARCH NEED: - must develop new methods to investigate and interpret relationships among all media. RECOMMENDED MONITORING: - should repeat 1985 coordinated water, sediment and biota survey every 5 years.
7. Restrictions on dredging <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	YES	NO	RECOMMENDED MONITORING: - all dredging projects must continue to be monitored prior to undertaking and ensure sediment guidelines are complied with.
8. Eutrophication or undesirable algae <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	YES	YES	No additional water or sediment monitoring required.
9. Restrictions on drinking water or taste and odour problems <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	YES	YES	No additional water or sediment monitoring required.

ISSUE and IMPAIRMENT STATUS	IS IT BEING MONITORED?	IS IT ADEQUATE?	WHAT MORE IS REQUIRED?
10. Beach closings <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	YES	NO	RECOMMENDED MONITORING: - although beaches are adequately monitored there is a need for periodic surveys of bacterial organisms in other areas.
11. Degradation of aesthetics <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	YES	YES	No additional water or sediment monitoring required.
12. Added costs to agriculture and industry <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	YES	YES	No additional water or sediment monitoring required.
13. Degradation of phytoplankton and zooplankton populations <i>Further Study - Canada</i> <i>Unknown - U.S.</i>	NOT SPECIFIED	NOT SPECIFIED	RESEARCH NEED: - need to determine impairment status and causes (if impaired) prior to defining monitoring requirements for water or sediment.
14. Loss of fish and wildlife habitat <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	YES	NOT SPECIFIED	RESEARCH NEED: - whether or not sedimentation and/or erosion is contributing to impairment.
15. Transboundary contamination <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	NO		RECOMMENDED MONITORING: - have sufficient knowledge regarding the hydrology and hydraulics but require long-term joint U.S./Canada monitoring program to determine accurate flux of chemicals both upstream-downstream and cross-stream; the existing Niagara River Protocol should be considered for application to a joint St. Lawrence monitoring program; it is recommended to start monitoring in one channel only; the list of chemicals would include PCBs and mercury but must be more fully defined.
16. Remediation Activities	NO		RECOMMENDED MONITORING: - a sediment monitoring program is currently being developed for the clean-up at the Superfund Sites which will include pre-remediation monitoring, however, a multi-agency workgroup is recommended for immediate start up in order to start work for the 1993 season; a multi-agency mechanism should be considered in order to quickly assess and correct impacts during the remediation process; likewise, following remediation, assessment of effectiveness will need to be undertaken; all clean-up activities affecting the river will require specific monitoring programs developed based on a similar pre-, during and post-remediation assessment.
17. Mass balance assessment	NO		RECOMMENDED MONITORING: - mass balance data needs should be incorporated into all long-term monitoring programs; current needs relate primarily to chemical fluxes in the river but detailed mass balance studies are recommended for post-remediation of Superfund and RAP remedial activities.
18. Regulatory program needs	YES	NO	RESEARCH NEED: - do current water and sediment standards provide adequate level of protection for this area?; what is relationship between effluent limits and ambient standards/guidelines beyond the end-of-the-pipe?; as effluent limits are revised, zones of impact should be determined and monitored.

NA - not applicable

Note: in U.S., impairment status for dredging applies to maintenance dredging.

POINT and Non-POINT SOURCE MONITORING:

TABLE 2. Framework matrix summarizing monitoring status, recommended monitoring activities and research needs with respect to point and non-point source monitoring in support of relevant issues.

ISSUE and IMPAIRMENT STATUS	POINT/ NON-POINT	IS IT BEING MONITORED?	IS IT ADEQUATE?	WHAT MORE IS REQUIRED?
1. Restrictions on fish and wildlife consumption <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	P NP	YES YES	NO NO	RECOMMENDED MONITORING: - mercury & PCBs from non-point sources need to be monitored; OCs (mirex and dioxins) need to be monitored from both point and non-point; groundwater monitoring of OCs required.
2. Tainting of fish and wildlife flavour <i>Further Study - Canada</i> <i>Not Impaired - U.S.</i>	P NP	NO NA	- NA	RECOMMENDED MONITORING: - tainting of fish not monitored but should be, if impaired then more intensive monitoring of sources of phenolics may be required.
3. Degradation of fish and wildlife populations <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	P NP	YES YES	NO NO	RESEARCH NEED: - need data re: linkage between sources of chemicals and populations (including PCBs and fluorides).
4. Fish tumours or other deformities <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	P NP	YES YES	NO NO	RESEARCH NEED: - need to establish relationships between sources of chemicals and tumours then develop appropriate point and non-point source monitoring.
5. Bird or animal deformities or reproductive problems <i>Further Study - Canada</i> <i>Likely Impaired - U.S.</i>	P NP	NO NO	- -	RECOMMENDED MONITORING: - as per issues 3 and 4.
6. Degradation of benthos <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	P NP	YES NO	? -	Workgroup could not reach a consensus on the adequacy of source monitoring for this issue.
7. Restrictions on dredging <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	P NP	YES NO	YES -	RECOMMENDED MONITORING: - need to develop monitoring program to measure flux of volatiles from non-point (sediments).
8. Eutrophication or undesirable algae <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	P NP	YES NO	YES -	RECOMMENDED MONITORING: - nutrients from non-point sources including agriculture and stormwater need to be monitored.
9. Restrictions on drinking water or taste and odour problems <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	P NP	YES YES	? NO	RECOMMENDED MONITORING: - may need to monitor possible breakdown products in public water supplies.
10. Beach closings <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	P NP	- YES	- YES	RECOMMENDED MONITORING: - non-point sources of bacteria to the river need to be monitored.

ISSUE and IMPAIRMENT STATUS	POINT/ NON-POINT	IS IT BEING MONITORED?	IS IT ADEQUATE?	WHAT MORE IS REQUIRED?
11. Degradation of aesthetics <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	P NP	YES NO	NO -	RECOMMENDED MONITORING: - aesthetics degradation from sources is not monitored other than on an ad hoc basis.
12. Added costs to agriculture and industry <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	P NP	YES NO	NO -	RECOMMENDED MONITORING: - as per issue #1; need to determine impact to agriculture (cattle) from non-point source fluoride contamination.
13. Degradation of phytoplankton and zooplankton populations <i>Further Study - Canada</i> <i>Unknown - U.S.</i>	P NP	NA	NA	No point or non-point source monitoring required.
14. Loss of fish and wildlife habitat <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	P NP	NA	NA	No point or non-point source monitoring required.
15. Transboundary contamination <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	P NP	NO NO	- -	RECOMMENDED MONITORING: - sediment and atmospheric sources and pathways require monitoring for PCBs, Hg, PAHs and/or fluorides to determine transboundary flux (across river and downstream); need to determine relative contributions from point vs. non-point sources
16. Remediation Activities	P NP	YES NO	NO -	RECOMMENDED MONITORING: - need to critically evaluate all monitoring plans for remediation of sites; need to address the need to cover sites during remediation in order to prevent airborne PCB flux; air monitoring must be incorporated into remediation plans at remediation sites.
17. Mass balance assessment	P NP	NO NO	- -	RECOMMENDED MONITORING: - mass balance studies are critical to determine the relative contributions and degree of impact from point vs. non-point sources. They are particularly important to determine when clean-up is adequate; determining fate of pollutants; assisting with the development of post-clean-up monitoring programs.
18. Regulatory program needs	P NP	YES NO	NO -	RECOMMENDED MONITORING: - need to develop an overall 'Master Plan' of monitoring requirements by all agencies in order to conserve resources (efficiencies).

NA - not applicable

Note: in U.S., impairment status for dredging applies to maintenance dredging.

3.3 Biological Monitoring

Table 3 summarizes the results of discussions from the Biological Workgroup according to the framework matrix.

TABLE 3. Framework matrix summarizing monitoring status, recommended monitoring activities and research needs with respect to biological monitoring in support of relevant issues.

ISSUE and IMPAIRMENT STATUS	IS IT BEING MONITORED?	IS IT ADEQUATE?	WHAT MORE IS REQUIRED?
1. Restrictions on fish and wildlife consumption <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	YES	NO	RESEARCH NEED: - consumption rates and human health effects. RECOMMENDED MONITORING: -being monitored but different agencies use different species and protocols; short term program is good, however, need better lake-wide and long-term monitoring programs; need baseline data, AOC-wide data and more site-specific data; sport and commercial fish species (yellow perch, walleye, pike, smallmouth bass, catfish, brown bullheads) should be monitored every 2 to 3 years and wildlife (mallard, black, scaup, turtles and bullfrogs) every 3 to 4 years.
2. Tainting of fish and wildlife flavour <i>Further Study - Canada</i> <i>Not Impaired - U.S.</i>	YES	YES	Monitored in Ontario only but considered adequate overall.
3. Degradation of fish and wildlife populations <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	YES	NO	RESEARCH NEED: - relationship between chemicals and populations need to be determined. RECOMMENDED MONITORING: - need to establish baseline conditions and regular monitoring for fish and wildlife communities, populations and indicator species; frequency of current fish population monitoring (N.Y.) is inadequate.
4. Fish tumours or other deformities <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	YES	NO	RESEARCH NEED: - specific linkages between chemicals (PAHs) and tumours need to be established. RECOMMENDED MONITORING: - data available for walleye only, need additional data for this species and other species.
5. Bird or animal deformities or reproductive problems <i>Further Study - Canada</i> <i>Likely Impaired - U.S.</i>	NO	-	No specific monitoring activities recommended.
6. Degradation of benthos <i>Impaired - Canada</i> <i>Likely Impaired - U.S.</i>	YES	NO	RECOMMENDED MONITORING: - only occasional surveys conducted, need regular monitoring and must account for impacts due to zebra mussels.
7. Restrictions on dredging <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	NA	NA	NA

ISSUE and IMPAIRMENT STATUS	IS IT BEING MONITORED?	IS IT ADEQUATE?	WHAT MORE IS REQUIRED?
8. Eutrophication or undesirable algae <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	-	-	This issue was not dealt with.
9. Restrictions on drinking water or taste and odour problems <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	NA	NA	NA
10. Beach closings <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	NA	NA	NA
11. Degradation of aesthetics <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	NA	NA	NA
12. Added costs to agriculture and industry <i>Impaired - Canada</i> <i>Not Impaired - U.S.</i>	NA	NA	NA
13. Degradation of phytoplankton and zooplankton populations <i>Further Study - Canada</i> <i>Unknown - U.S.</i>	NO	-	The workgroup could not reach consensus regarding the need for monitoring although it is recognized that these form an important component of the food chain.
14. Loss of fish and wildlife habitat <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	YES	NO	RESEARCH/MANAGEMENT NEED: - require a comprehensive plan for fish habitat including wetlands; need research on the impact of water levels. RECOMMENDED MONITORING: - wetlands monitored in Ontario on routine basis and critical habitat in N.Y. occasionally, a long-term program is required to monitor the extent and condition of fish habitat; must monitor impacts due to water levels.
15. Transboundary contamination <i>Impaired - Canada</i> <i>Impaired - U.S.</i>	NO	-	RECOMMENDED MONITORING: - may need monitoring of biota with respect to possible transboundary impacts (note: workgroup did not reach consensus and, hence much additional discussion is needed).
16. Remediation Activities	NO	-	RECOMMENDED MONITORING: - biomonitoring programs should be developed and occur pre-, during and post remedial activities; both long-term monitoring to determine overall condition of AOC and site specific remediation monitoring is required.
17. Mass balance assessment	-	-	This issue was not dealt with.
18. Regulatory program needs	-	-	This issue was not dealt with.

NA - not applicable;

Note: in U.S., impairment status for dredging applies to maintenance dredging.

AGENCY	WHAT is being monitored?	Location	Duration	# stations
NYSDEC:	(Part 1 of 3-part health risk assessment associated with GM remediation) Fish tissue monitored for organochlorine, PCBs, dioxins, furans and heavy metal contamination Purpose: Remediation Agency: Cooperative effort between DEC/Akwesasne/St. Regis contact: Ron Sloan(NYSDEC) or Ken Jock (St. Regis)	AOC	1988 - Report completed April 1990	12 stations
	(Part 2 of 3...)(In conjunction with the Department of Health) Wildlife tissue analyzed for PCBs, dioxins, dibenzofurans, chlorinated hydrocarbon pesticides and heavy metals. Purpose: Remediation Agency: Cooperative effort between DEC/Akwesasne/St. Regis Contact: Larry Skinner (NYSDEC) or Ken Jock (St. Regis)	AOC	87/88 - Report completed Oct. 1992	
	(Part 3 of 3...)(Department of Health) PCBs in Human breast milk Purpose: Remediation Agency: DOH/Akwesasne Contact: E. Fitzgerald, NYSDOH	AOC	Report completed 1992	
	Health risk assessments: based on three separate studies (as part of RI/FS at GM on fish tissue, wildlife tissue and breast milk) an overall health risk summary is to be published in 1994. Additional monitoring may be indicated. Agency: Cooperative effort among NYDEC/NYSDOH/GM/EPA/Mohawk Nation at Akwesasne Contacts: Larry Skinner (NYSDEC) Anthony Forli (NYSDOH), Ken Jock (Akwesasne)	AOC	1994	
	Monitor flow, BOD, TSS, O&G, Al, Fe, CN, Zn, Phenols, PAH, Cl ₂ , pH, temperature, As, PCB, fecal coliform, plus 8 organic action levels Purpose: Regulatory self monitoring program Contact: Bruce Butler (NYSDEC)	Reynold's Metals (SPDES permit # NY0000132)	Monthly reporting	4 outfalls
	Monitor flow, TSS, O&G, Fe, Cu, Zn, Al, CN, PCB, PAH, pH, temperature, Cl ₂ , BOD, fecal coliform, 5 organics and numerous Action Levels, plus groundwater monitoring program Purpose: Regulatory self monitoring program Contact: Bruce Butler (NYSDEC)	ALCOA (SPDES permit # NY0001732)	Monthly reporting (passed 1990, 1991 toxicity testing)	4 outfalls
	Monitor flow, CBOD, TSS, COD, TOC, PCBs, T.Phenol, Cr, Cu, Fe, Al, O&G, pH, temperature, Cl ₂ , and 5 organic action levels Purpose: Regulatory self monitoring program Contact: Bruce Butler (NYSDEC)	General Motors (SPDES permit # NY0000540)	Monthly reporting	3 outfalls
	Monitor flow, BOD, TSS, SS, TKN, NH ₃ , pH, temperature, fecal coliform Purpose: Regulatory self monitoring program Contact: Bruce Butler (NYSDEC)	Massena(V) STP (SPDES permit # NY0031194)	Monthly reporting	1 outfall
	Annual water column analyses: (as part of Rotating Intensive Basin Studies-RI/BS) Purpose: annual water column chemistry assessment Contact: Jeff Myers (NYSDEC)	St. Lawrence River at Moses Power Dam	annually (4-5 times)	one site of 31 statewide

1994

MONITORING AND RESEARCH ACTIVITIES ON THE ST. LAWRENCE RIVER AT CORNWALL/MASSENA
Version: July 1994

AGENCY	WHAT is being monitored?	Location	Duration	# stations
	<p>Rotating Intensive Basin Studies (RIBS): Includes:</p> <ul style="list-style-type: none"> -conventional and toxic water quality parameters in water column samples -biological sampling: (macroinvertebrate community evaluation); toxicity testing; and some fish tissue analyses as coor. w/Div. of F&W work -occasional bottom sediments analyses <p>Purpose: ambient surface water monitoring and assessment program</p> <p>Contact: Jeff Myers/Bob Bode</p>	4 of 6 sites are in the Massena area, in 4 rivers: St. Lawrence, Grasse, Raquette, St. Regis	Basin monitored for two consecutive years in a 6 - year cycle: Done 1991-1992; Next 1997-1998	Three of the four sites in Massena area are projected for continued future analyses
	<p>Fish/wildlife/health risk assessments associated with river sediment remediation & overall AOC assessment:</p> <p>Purpose: perform pre/during/post remediation studies and monitoring including "caged fish study" resident species PCB analyses, PCB water column, suspended solids transport, sediment characterization (core & surface), young-of-the-year, macroinvertebrate community evaluation, fish and wildlife population, and habitat assessments</p> <p>Contact: Larry Skinner (NYSDEC), Don Hesler (NYSDEC), for ALCOA & Reynolds, John Dergosits (NYSDEC) for GM, Anthony Forti (NYSDOH), Ken Jock (Akwesasne), Frank Estabrooks</p>	Initial site is Grasse River dredging of PCBs (IRM) planned for 1994. (6 miles upstream of St. Lawrence)	Site specific and long-term	To define controls and downstream sites
	<p>Fish Tissue Monitoring: Analyses performed for heavy metals and organochlorines. Data is evaluated by NYSDOH for health risk advisories.</p> <p>Contact: Larry Skinner (NYSDEC) & Antony Forti (NYSDOH)</p>	St. Law., Grasse & Raquette Rivers	Regular Monitoring	
	<p>Cooperative air monitoring of heavy metals</p> <p>Agency: NYSDEC/St. Regis</p> <p>contact: Ted Davis (NYSDEC), Les Benedict (St. Regis)</p>	AOC	6-day schedule	
	VOCs on Raquette Point. Styrene is primary target.		1 x sample. 10 total days during summer season-a screening program for '92.	
	<p>Vegetation sampling for fluoride content.</p> <p>Purpose: Vegetation analyses as related to industrial fluoride air emission compliance</p> <p>Agency: NYSDEC/NYSDOH/ and Akwesasne</p> <p>Contact: David W. Prosser (NYSDEC)</p>	Akwesasne Reserve, Cornwall Island, and Massena /Cornwall area	Done annually since 1970, with gradually increased number of stations	28 total (4 on Reserve, 3 on Cornwall Island)

MONITORING AND RESEARCH ACTIVITIES ON THE ST. LAWRENCE RIVER AT CORNWALL/MASSENA
Version: July 1994

AGENCY	WHAT is being monitored?	Location	Duration	# stations
	Toxic and Conventional water quality parameters in water column samples. Occasional bottom sediment analyses and biological sampling (macro-invertebrate community evaluation, tissues analyses, toxicity testing). RIBS program - Rotating Intensive Basin Studies) Ambient Surface Water Monitoring Program Contact : Jeffrey Myers	St. Lawrence at Massena Power Canal, occasional multimedia Network monitoring in the St. Lawrence River Drainage Basin	4 water column samples/ yr. Network sites will be selected for 1997-1998 sampling	1 site, intensive network sites not yet decided
	Young-of-the-Year Analyses : Monitoring of spottail Shiners monitored for organochlorines; Also look at H2, As, PAHs, chlorobenzenes. Final Report in preparation. Contact: Larry Skinner	Downstream of each major industry (3) in Massena.	On a five-year cycle	A minimum of 4 locations, 8 sites
	Bioaccumulation monitoring to determine the effects of discharge on aquatic life. Contact: Peter Mack	At ALCOA & Reynolds SPDES outfalls		
	Mobile air lab: (NYSDEC) Using TAGA mobile laboratory (Trace Atmospheric Gas Analyzer) to monitor ambient air quality. Purpose: Ambient monitoring targeted at HF gas, PAHs, and VOCs (styrene) as appropriate Contact: S.H. Mo and Les Benedict	Massena Area	Annually since 1988	10-15-mobile unit
	Site remediation air sampling: remediation activities ongoing at ALCOA & Reynolds; GM to proceed Purpose: evaluate air quality during remediation and afterwards for effectiveness and safety. PCB volatiles considered here. Contact: Phil Galvin (NYSDEC)	Hazardous waste remedial sites	construct season and project end	
	Site remediation soil sampling: ALCOA & Reynolds ongoing; GM to proceed. Purpose: assess effectiveness of onsite remedial actions Contacts: Gregg Townsend (NYSDEC) for ALCOA; Phil Waite (NYSDEC) for Reynolds; John Dergosits (NYSDEC) for GM.	ALCOA, GM Reynolds hazardous waste sites on facility property	as part of remedial actions according to Record on Decisions (RODs); GM is NPL site	
	PCB Bioaccumulation Analyses: Purpose: assess PCB bioaccumulation and calculate uptake rates if any. Reports completed -no sign. statistical change; no uptake calculated. Contact: Ed Kuzia	At ALCOA and Reynolds' point source discharge (SPDES) outfalls	Reynolds report completed 1/26/94; ALCOA reports 7/92, 9/92 and 10/92	ALCOA=3 Reynolds=3

MONITORING AND RESEARCH ACTIVITIES ON THE ST. LAWRENCE RIVER AT CORNWALL/MASSENA
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AGENCY	WHAT is being monitored?	Location	Duration	# stations
	Contaminated river sediment and water quality sampling: Purpose: to assess status and effectiveness before, during, and after contaminated sediment removal. Includes biomonitoring (bio-uptake, toxicity testing and benthic community evaluations) and water & sediment chemistry analyses Contacts: Bill Daigle & Don Hessler (NYSDEC overview at ALCOA and Reynolds before construction); John Dergosits & Frank Estabrooks (overview during/after construction including entire GM project)	Grasse River seg. as contm. by ALCOA; St. Lawrence River segments contam. by GM and Reynolds	part of remedial actions according to EPA orders and Record on Decisions	ALCOA's Interim Remedial Measure (IRM) in Grasse R. proceeding for July 1994. Reynolds and GM plan to remove sediment during 8-10/94. (DEC may perform monitor. beyond plans). ALCOA, Reynolds & GM plans under review.
	High volume air monitoring: for particulates, heavy metals and fluoride. Agency: Cooperative effort Contacts: Phil Galvin/Bill Smolin, Les Benedict	AOC	once/week sample for 6 full days (24 hr. sampling)	1-part of statewide network
	Chemical residues in waterfowl. Statewide project Contact: David Maysack		1995 (repeats projects conducted in 1984-1985)	
EPA/ Reynolds (as part of the unilateral CERCLA 106 order)	Water and sediment quality studies Purpose: Remediation Contact: Lisa Carson	St. Lawrence and Raquette Rivers	September 1990	
EPA/ ALCOA (as part of the unilateral CERCLA 106 order)	Water and sediment quality studies. Purpose: Remediation Contact: Lisa Carson	Grasse River, Massena Power Canal, Robinson Creek	Fall 1991	
U.S. Fish and Wildlife Service	National Contaminant Bioassay			
EPA/ NYSDEC/ ALCOA/ GM/ Reynolds	In addition to the numerous investigations that have been/ are being performed at GM/ ALCOA/ Reynolds, multi-media monitoring will be necessary during the remedial implementation at the various hazardous waste sites to assure the protection of public health and safety. Purpose: Remediation Contact: Darrel Sweredoski (NYSDEC) Lisa Carson (USEPA)	AOC		
U.S. E.P.A. - Region II	National Dioxin Study: Soils, sediments, fish and shellfish were sampled and analyzed to determine the extent of 2,3,7,8-TCDD in various categories of potentially contaminated facilities, pesticides use areas and background sites. Purpose: Ambient monitoring Agency: Office of Water Contact: Darvene Adams	Several sites were located around Lake Ontario, the closest to the St. Lawrence River basin is Cape Vincent, New York.	1984 & 1985	

MONITORING AND RESEARCH ACTIVITIES ON THE ST. LAWRENCE RIVER AT CORNWALL/MASSENA
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AGENCY	WHAT is being monitored?	Location	Duration	# stations
	National Bioaccumulation Study: Composite fish samples (whole body bottom feeder and sport fish filets) were sampled and analyzed for 60 bioaccumulative compounds. Purpose: Ambient Monitoring Contact: Darvene Adams	4 sites were in the St. Lawrence River Basin - Grassw River at Massena, Oswegatchie River at Newton Falls, Raquette River at Massena and the St. Lawrence at Ogdensburg.	1987	
	Environmental Monitoring and Assessment Program (EMAP): The "ecological health of the Great Lakes system will be determined by conducting surveys consisting of sediment, water and biota sampling, chemical analyses, toxicity tests, habitat analyses and biological indicators. Purpose: Ambient monitoring Contact: Darvene Adams	Great Lakes Region	The program is currently gathering existing data in the Great Lakes region; it is anticipated that field data will begin in 1993.	
	National Pollutant Discharge Elimination System (NPDES): Representative samples of a discharge are obtained and chemical and/or toxicity tests as required in the discharge permit are run; this is done on a self-monitoring basis and also by US EPA at facilities designated as "major" dischargers. Purpose: Regulatory Contact: John Ciancia (908) 321-6688			
	Resource Conservation and Recovery Act (RCRA): Sampling of drums, lagoons, soils, etc. may be conducted at active facilities that either generate, treat, store, transport or dispose of hazardous waste. Purpose: Regulatory Contact: John Ciancia (908) 321-6688			
	Superfund Sites: Monitoring of chemical contaminants in sediments, surface water, and biota. Purpose: To determine the extent of contamination in the rivers adjacent to each facility and to provide data upon which to base cleanup decisions for each area. Monitoring at GM for PCBs; at ALCOA and Reynolds for PCBs, fluoride, cyanide, PAHs, aluminum, limited dioxins and furans. Contact: Lisa Carson	In the stretches of the St. Lawrence, Raquette, and Grasse Rivers adjacent to and downgradient of the Reynolds, GM-Central Foundry and ALCOA Superfund sites in Massena, NY.	Additional monitoring will be performed prior to, during, and after remediation of each of the three sites.	

ANNEX 4: WORK GROUP SESSION FRAMEWORK

ISSUE	IS IT BEING MONITORED?		IS IT ADEQUATE ?	WHAT MORE IS REQUIRED?		
	YES / NO	TYPE	YES / NO	TYPE	MEDIA	TOOLS
1. Restrictions on fish and wildlife consumption						
2. Tainting of fish and wildlife flavour						
3. Degradation of fish and wildlife populations						
4. Fish tumours or other deformities						
5. Bird or animal deformities or reproductive problems						
6. Degradation of benthos						
7. Restrictions on dredging						
8. Eutrophication or undesirable algae						
9. Restrictions on drinking water or taste and odour problems						
10. Beach closings						
11. Degradation of aesthetics						
12. Added costs to agriculture and industry						
13. Degradation of phytoplankton and zooplankton populations						
14. Loss of fish and wildlife habitat						
15. Transboundary contamination						
16. Remediation						
17. Mass balance assessment						
18. Regulatory program needs						

* TYPES OF MONITORING

ST - Spatial Trends
 TT - Temporal Trends
 SS - Spatial Site-Specific
 TS - Temporal Site-Specific
 E - Exploratory
 R - Research
 L - Loadings

** MEDIA

eg. - Whole Water
 - Filtered Water
 - Bottom Sediment
 - MFO enzyme
 - Mussels
 - etc.

*** TOOLS

eg. - Modelling
 - G.I.S. Data Base
 - Guidelines/Standards
 - etc.

Central New York

The Business Journal

No. 4

YOUR BUSINESS ADVISER

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Top Ranks:
Travel Agencies

\$40M Aquarium Slated for Massena

By Paul Allen

Journal Staff

25 **MASSENA**—The St. Lawrence Aquarium and Ecological Center in Massena has reached an agreement in principle with the New York Power Authority for significant funding of a new \$40-million aquarium. Its promoters expect that the proposed 50,000-sq-ft. tourist and research facility will bring new life to the region's tourism industry.

John Feeley, president and CEO of the St. Lawrence Aquarium and Ecological Center, says, "We believe that we'll have thousands of visi-

tors every year. We'll infuse \$10-\$15 million into the regional economy on an annual basis and generate upwards of \$1 million in new tax revenues for the region. It's a project that will certainly have a positive impact on the region's economy," he says.

NYPA agreed to provide major funding for the facility as part of its efforts to obtain a new federal license for its St. Lawrence-FDR Power Project. The project's current license expires in 2003. The Authority expects to submit an application for a new license to the Federal Energy Regulatory Commission by 2001.

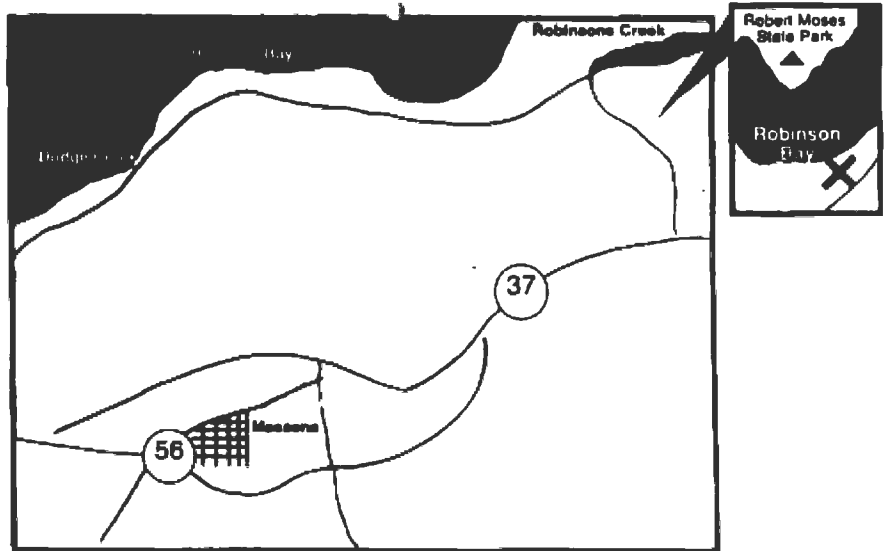
Jack Murphy, media-relations director for the NYPA, says that while funding for the aquarium isn't a requirement for obtaining a new license, it is something the Power Authority, as a major presence in the region, feels compelled to do. "We wanted to help the local area meet some of its needs, desires, and wants, with the idea of NYPA being an integral part of the community. Since the aquarium was high on the list, we arranged to provide a site for the aquarium on Robinson Bay and we've proposed to donate up to \$20 million to the project."

Feeley says that without the
See Aquarium, page 2

NYPA's involvement, "we simply wouldn't have a project." Feeley says the proposed facility will be dedicated to educa-

"For a watershed that drains 23 percent of the world's fresh water, there has been very little research conducted here."

John Feeley
President and CEO
St. Lawrence Aquarium
and Ecological Center



The map above shows the city of Massena and the St. Lawrence River (at the top of the map). The St. Lawrence Aquarium and Ecological Center, shown in the small map, is located north and east of Massena.

tion and research. "Research concerning the St. Lawrence River is something that is badly needed," he noted. "For a watershed that drains 23 percent of the world's fresh water, there has been very little research conducted here. This project will have a major research facility that will be owned and operated by Clarkson University. Clarkson has publicly stated that within 10 years it will be the Western Hemisphere's foremost freshwater research facility."

Anthony Collins, vice president for academic affairs at Clarkson, says the

research facility will "look at problems associated with great rivers, focusing on the St. Lawrence, but will have implications of all the great rivers of the world." Problems the facility plans to research include ecological and environmental issues, traffic management on the river, international border disputes, and navigation issues. Collins says he anticipates the research center to involve all four schools at Clarkson—Engineering, Business,

Science, and Liberal Arts—and expects the facility to collaborate with other institutions and researchers from around the world.

Feeley says the tentative date for the facility's groundbreaking will be in the spring of 2001, and he expects the facility (whose working name is the St. Lawrence Aquarium and Environmental Research Institute) to be open to the public by the summer of 2003.

Scientists Meet to Discuss Bi-National St. Lawrence River-Lake Ontario Research Initiative

On September 11, 1998, approximately twenty scientists from the U.S. and Canada met in Buffalo to discuss the need for a bi-national research project focusing on the St. Lawrence River and Lake Ontario ecosystem. The group consisted of interested participants from state and federal management agencies as well as members from the *St. Lawrence River-Lake Ontario Research Initiative (SLRLO)*. The meeting was held in conjunction with the Lake Ontario Research and Management Workshop hosted by UB's Great Lakes Program and sponsored by the U.S. Environmental Protection Agency.

The *SLRLO* Initiative was launched this year by the New York Great Lakes Research Consortium to develop and promote an integrated, large-scale collaborative project which focuses Canadian and U.S. research efforts on Lake Ontario and the St. Lawrence River. According to the Consortium's Research Director, Dr. Tom Young, "the St. Lawrence River-Lake Ontario ecosystem has not been the subject of a

comprehensive, multi-disciplinary research study since the International Field Year of the Great Lakes (IFYGL). Excellent lake-wide programs (e.g., LONAS, LOTT) have been undertaken subsequent to IFYGL and we draw on these efforts and build on them, but we



are also pushing for an ecosystem level of effort that truly addresses the interactions among multiple management issues. The Great Lakes community needs to demonstrate what it means by the *ecosystem approach* to managing the lakes, and the St. Lawrence River-Lake Ontario ecosystem is a perfect place to do it!"

While the *SLRLO* group is interested in advancing the state of the science, the focus of the Initiative is on the key management needs of the Parties responsible for managing the Niagara River-Lake Ontario-St. Lawrence River ecosystem. Thus, their research program grows out of a set of management issues and questions associated with such activities as the Niagara River Toxic Management Plan and RAP, the Lake Ontario LaMP, the Lake Ontario Fish Community Objectives, St. Lawrence River management issues, and RAPs within the Lake Ontario and St. Lawrence River sys-

tems. Approximately forty researchers from *SLRLO* are actively working to address these questions associated with such topics as risk assessment and management of toxic chemicals, ecosystem dynamics, sportfisheries management, lake levels, sustainable economic development, nearshore productivity, drinking water quality, and land use impacts. At this latest meeting, the group focused their discussion on toxic chemicals. Members of the *SLRLO* group are developing computer models to understand and predict the pathways and fate of PCBs and other contaminants in the St. Lawrence River and Lake Ontario ecosystem. These models will help managers forecast the effectiveness of their control strategies by predicting the future concentrations of chemicals in the system given various source reduction scenarios.

The activities of the *SLRLO* Initiative are led by a steering committee comprised of representatives of the participating organizations including Jack P. Manno, New York Great Lakes Research Consortium; Joseph V. DePinto, University of Buffalo Great Lakes Program; John Hassett, SUNY College of Environmental Science and Forestry; David Lean, University of Ottawa; Jeffrey Ridal, St. Lawrence River Institute of Sciences; Don Mackay, Environmental Modeling Center, Trent University; and Joseph Makarewicz, SUNY Brockport. The New York Sea Grant Institute is also a participating organization in the Initiative. For more information, contact: The Great Lakes Research Consortium at (315) 470-6816 or visit our website at <http://www.esf.edu/gllrc/slrlo>. □

The focus of the Initiative is on the key management needs of the parties responsible for managing the Niagara River-Lake Ontario-St. Lawrence River ecosystem.

Bi-national St. Lawrence River-Lake Ontario (SLRLO) Research Initiative

Steering Committee:

Jack P. Manno, New York Great Lakes Research Consortium
Joseph V. DePinto, University of Buffalo Great Lake Program
John Hassett, SUNY College of Environmental Science and Forestry
Joseph Makarewicz, SUNY Brockport
David Lean, University of Ottawa
Jeffrey Ridal, St. Lawrence River Institute of Sciences
Don Mackay, Environmental Modeling Center, Trent University



THE SLRLO INITIATIVE

The SLRLO initiative is a binational, multidisciplinary research partnership to advance understanding of Lake Ontario and the St. Lawrence River ecosystem. Our interests lie not only in the science but in how scientific information is accessed and used by government and the public in making critical environmental management decisions. Thus, our research program grows out of a set of management issues associated with such activities as the Niagara River Toxic Management Plan and Remedial Action Plan (RAP), the Lake Ontario Lakewide Management Plan (LaMP), the Lake Ontario Fish Community Objectives, and various St. Lawrence River management programs and Remedial Action Plans. The Lake Ontario - St. Lawrence River ecosystem has not been the subject of a comprehensive, multi-disciplinary research study since the International Field Year of the Great Lakes (IFYGL) in the 1970s, and much has changed since then in terms of ecosystem conditions, our ability to measure and model them, and techniques for communicating science to managers and the public. It is time to draw on the excellent lake-wide assessment programs (e.g., LONAS, LOTT) that have been undertaken since IFYGL for an ecosystem level of effort that addresses the interactions among multiple management issues. The Great Lakes community needs to demonstrate what it means by the "Ecosystem Approach" to managing the lakes, and the Lake Ontario - St. Lawrence River ecosystem is a perfect place to do it. The following is an outline of our research agenda.

Risk Assessment and Risk Management of Toxic Chemicals

The Lake Ontario LAMP will identify likely sources of critical pollutants, and determine which actions are most likely to achieve the greatest contaminant reductions at the lowest costs. A comprehensive research and monitoring program is needed to accurately make this determination.

The Research Questions:

- What is the relative contribution of source categories (Niagara River, Hamilton Harbor, other tributaries, point sources, atmospheric deposition, etc.) to the concentration of toxic chemicals of concern (PCBs, dioxins/furans, mirex, DDT and its metabolites, dieldrin, and Hg) in water, sediments, and biota of the system.
- What is the quantitative spatial and temporal relationship between these loadings and the concentrations in water, sediments and biota? Can we quantify the relationship between remedial actions in the areas of concern (AOCs) and the system-wide response?

The Great Lakes are plagued by problems associated with persistent organic pollutants and other chemicals which exist in our environment and are known to have toxic effects in living organisms alone or in synergy with other chemicals. There is direct or indirect evidence that PCBs, DDT and its metabolites, mirex, and dioxins/furans are degrading fish and wildlife populations and their habitat, causing animal deformities or reproductive problems, and prompting restrictions on consumption of fish and wildlife by humans.

The Research Questions:

- Are the fish and wildlife (fish-eating mammals and birds) in Lake Ontario and the St. Lawrence River subject to effects of exposure to toxic contaminants that are impairing their normal functioning within the ecosystem, and how much source reduction of these contaminants is necessary to eliminate those effects?
- Can we eat the fish? When can we eat the fish? and What can we do to hasten the progress toward that end?

Solids Dynamics

The relationship between primary productivity and the fate and transport of contaminants is important for understanding and predicting the effects of management actions that address contaminant problems. Halogenated Organic Contaminants (HOCs) tend to sorb onto particles in the water column. Algae make up a large portion of these solids. The system's solids dynamics have changed considerably since it was last quantified in the early 80's. We hypothesize that mirex and mirex/photomirex ratios in various segments of Lake Ontario can be used as a unique and independent "tracer" of the solids (sorbent) dynamics in the system, much as one would use a mass balance of a radionuclide like ^{137}Cs . A new sorbent dynamics budget for the system needs to be determined using this approach along with other more conventional methods.

Sportfisheries Management

The carrying capacity of Lake Ontario for top predator fish is determined by nutrient loading and processing efficiency, and the maximum level of salmonid stocking that the lake can sustain.

- Are nutrient control and fish management objectives antagonistic in Lake Ontario and can we develop a model to aid decision-making in both management arenas?
- How many and of what species of sport fish should we stock to maximize the carrying capacity of the lake and river without endangering the sustainability of the sport fishery?
- Is there a possibility to manage the fishery so that there is a balance between the off-shore and near-shore fishery?
- Are bird populations (especially cormorants in the eastern basin) having a significant detrimental impact on the sport fishery and how can this problem be best managed?
- What is the current economic value of the sport fishery? How important are fish consumption advisories and a reduced abundance of large (chinook) salmon to the attractiveness and economic viability of the sport fishery?

Understanding and Managing Lake Levels

- Can we predict water level fluctuations in Lake Ontario and the river from antecedent weather?
- How can this capability be used to help manage the detrimental impacts of extremely high or low water levels?
- What water level risk management options are there and which would produce the most benefits?
- Can we control water levels to avoid flooding and erosion and to maximize power generation without losing the beneficial effects of periodic flooding and draining on wetland integrity and diversity?

Nearshore Productivity

In Lake Ontario, significant differences exist between the nearshore and offshore (open-water) biotic communities. These differences and interrelationships are neither well understood nor quantified. We need to determine the spatial extent of the nearshore community and develop an understanding of the physical, chemical, and biological factors which control the establishment and maintenance of the nearshore-offshore gradients.

- Does the productivity in the nearshore of Lake Ontario make an important and significant contribution to the overall lake productivity?
- Do significant differences exist in biotic communities and productivity between the north and south nearshore areas of Lake Ontario, again due to temperature and hydrodynamic factors?

Aquatic Nuisance Species

Zebra mussels may cause a shift in the energy flow through this ecosystem toward a benthic food chain and away from a pelagic food chain.

- How is the zebra mussel (and other aquatic nuisance species) invasion of Lake Ontario and the St. Lawrence River impacting sport fish production? How is it impacting contaminant cycling and bioaccumulation in the food chain?
- Is there an economic loss resulting from aquatic nuisance species invasions and can we quantify it?
- What impacts are zebra mussels in Lake Ontario having on energy, organic carbon, and particle flow through the ecosystem and how are these impacts affecting food chain bioaccumulation of bioaccumulative chemicals of concern (BCCs)?

Indicators of Progress

- If we set certain goals (IJC refers to them as "Desired Outcomes") for the Niagara River-Lake Ontario-St. Lawrence River ecosystem, what are the best indicators of progress toward those goals and can we design and implement a monitoring program that will allow us to effectively measure progress and communicate it to our stakeholders?

Drinking Water Quality

- What is the risk of off-taste and odor, disinfection by-products, pathogenic contamination (*Cryptosporidium*, *Giardia*, etc.) of drinking water sources in the system? For sources at risk, what risk management measures can and should be taken?
- What is the economic value of this system for supplying drinking water and what will be the cost of meeting new safe drinking water standards relative to the above and other contaminants?

Public Participation and Open Modeling

Advances in environmental visualization and electronic communication combine to make it possible to use models in a more open fashion as part of a public participation process. Lake Ontario-St. Lawrence modeling efforts can be designed with public interface and participation in mind throughout the process.

- Can open modeling increase participation and improve communication between managers and the public?
- Will the interactive Internet display of model predictions for alternative management decisions help develop shared understandings of complex environmental processes.
- Can public participation extend to the modeling process itself, and how is this best done?

About the Participating Organizations...



**Great
Lakes
Research
Consortium**

The **Great Lakes Research Consortium** brings academic institutions together to focus and coordinate research on the Great Lakes. It is an organization made up of over 250 faculty from Universities and Colleges in New York and Canada. The principal goals of the Consortium are to facilitate research and scholarship on Great Lakes problems, to provide opportunities for training and education of students on issues related to the Great Lakes, and to disseminate important information and research findings gathered through the endeavors of the Consortium and its member institutions. *For more information, visit us on the web at: www.esf.edu/glrc.*

The mission of the **Great Lakes Program** is to develop, evaluate, and synthesize scientific and technical knowledge on the Great Lakes ecosystem in support of public education and policy formation. In carrying out this mission, the Great Lakes Program attempts to involve UB faculty from a wide range of fields in multidisciplinary research and graduate education on the Great Lakes. Among the fields the Program has involved in Great Lakes research are: engineering, health sciences, natural sciences, social sciences, planning, and law. The Great Lakes Program has thirty-five faculty affiliates representing six faculties or decanal units. *For more information, visit us on the web at: wings.buffalo.edu/glp*



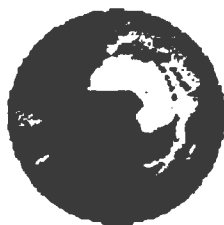
great lakes program



St. Lawrence River Institute of Environmental Sciences

Large river ecosystems, such as that of the St. Lawrence, face numerous unique and poorly understood stresses that require a trans-disciplinary and international research effort to identify effective solutions. The St. Lawrence River Institute of Environmental Sciences, a non-profit organization with strong roots in the community, aims to increase understanding of large river ecosystems and their management around the world. To that end, the Institute will use the St. Lawrence as a natural laboratory to carry out trans-disciplinary research that integrates environmental and resource management; public policy; social sciences; environmental research; and environmental effects on human health. *For more information, visit us on the web at: www.glen-net.ca/slries*

New York Sea Grant Institute is part of a national network of universities meeting the challenging environmental and economic needs of Americans in the coastal ocean and Great Lakes regions. Unique among the 29 Sea Grant programs nationwide because of its marine and Great Lakes shorelines, New York Sea Grant engages in research, education, and technology transfer to promote the understanding, sustainable development, and conservation of our diverse coastal resources. This network facilitates the transfer of research-based information to a great variety of coastal user groups, which include businesses, federal, state and local government decision-makers and managers, the media and the interested public. *For more information, visit us on the web at: flounder.seagrantsunysb.edu/*



The Environmental Modelling Centre at Trent University was established as part of Environmental and Resource Studies at Trent University and is supported by a consortium of industrial partners and NSERC. The objective of the Centre is to understand and quantitatively predict the pathways of contaminant transport and the resulting exposure, often through the use of computer programs which mimic or model the chemicals' behaviour. When we can establish a quantitative link between sources, exposure, and the risk of effects we are in a stronger position to control sources to acceptably low levels, avoiding the problems of unacceptable contamination from excessive sources on the one hand, and uneconomic, unnecessary regulations on the other. *For more information, visit us on the web at: www.trentu.ca/envmodel*

The purpose of the **Randolph G. Pack Environmental Institute** is to enhance our ability to create and disseminate knowledge about environmental concerns of high public interest. We particularly seek to advance the state of knowledge about environmental policy and regulation and focus on how democratic public decisions affecting the natural environment are made. The Institute concentrates on such topics as public participation, environmental equity, and sustainable development and supports an array of interdisciplinary environmental interests that presently include: environmental policy and democratic processes, environmental modeling and risk analysis, water and wetland resource studies, and environmental and community land planning. The Institute promotes these interests through research and service activity in community, state, national, and international venues

Those interested in participating or would like more information should contact the Consortium at jpmanno@mailbox.syr.edu.

Participants in the Bi-national LOSLR Research Initiative

Environmental Modelling

Joseph Atkinson	SUNY Buffalo	
Joseph DePinto	Great Lakes Program, University of Buffalo	
Don Mackay	Trent University	
Eva Webster	Trent University	
Ellen Bentzen	Trent University	
Brendan Hickey	Trent University	
Lynne Milford	Trent University	
Matthew MacLeod	Trent University	
Jean Morin	INRS-Eau	Participant in the former IREE program
Michel LeClerc	INRS-Eau	Participant in the former IREE program
Thomas Young	Clarkson University	

Atmospheric Transport

Michael Milligan,	SUNY Fredonia
-------------------	---------------

Environmental Chemistry

Marc Amyot	University Quebec
John Hassett	SUNY College of Environmental Science and Forestry
Jeff Ridal	St. Lawrence Institute of Environmental Sciences

Environmental Policy, Education

John Felleman	SUNY ESF
Jack Manno	Great Lakes Research Consortium
Richard Smardon	SUNY ESF
David White	NY Sea Great Extension, SUNY Oswego

Remediation Technology

Ronald Scrudato	SUNY Oswego
G. Yull Rhee	SUNY Albany

Human Health and Toxicology

Brian Bush	SUNY Albany
Jeff Chiarenzelli	SUNY Oswego
Bernadette Pinel-Alloul	University de Montreal, Groupe de Recherche Interuniversitaire en Limnologie (GRIL)

Biology, Limnology and Fisheries

James Haynes	SUNY Brockport
David Lean	University of Ottawa
Joseph Makarewicz	SUNY Brockport
Edward Mills	Cornell University
Lars Rudstam	Cornell University
James Thorp	Clarkson U
Jack Mattice	New York Sea Grant, SUNY Stony Brook
Yong Cao	UNIVERSITY of Toronto at Scarborough

Geology

Ann Isley	SUNY Oswego
-----------	-------------

Current Participants in the Bi-national SLRLO Research Initiative

Environmental Modeling

Joseph Atkinson
SUNY Buffalo, Dept. of Civil, Structural and
Environmental Engineering
atkinson@acsu.buffalo.edu
716-645-2114 x2326

Joseph V. DePinto
Great Lakes Program, University at Buffalo
716-645-2088 x2325, fax: 726-645-3667
depinto@eng.buffalo.edu

**Don Mackay, Eva Webster, Ellen Bentzen
Brendan Hickie, Lynne Milford**
Trent University
Env. & Resource Studies
705-748-1489, fax 705-748-1569
dmackay@trentu.ca

Matthew MacLeod
Trent University
Environmental Modelling Centre
705 748-1056, fax: 705 748-1569
mmacleod@trentu.ca

Jean Morin and Michel LeClerc
INRS-Eau
418-654-3762, fax : 418-654-2600
Jean_Morin@inrs-eau.quebec.ca

Thomas C. Young
Clarkson University
Civil & Environmental Engineering
315-268-4430/ 6529, fax: x7636
tcyoung@draco.clarkson.edu

Atmospheric Transport

Michael Milligan
SUNY Fredonia
Department of Chemistry
716-673-3500
milligan@fredonia.edu

Environmental Chemistry

Marc Amyot
University of Quebec
INRS-Eau
418-654-2542, fax: 418-654-2600
marc_amyot@inrs-eau.quebec.ca

John P. Hassett
Chemistry Department
SUNY College of Environmental Science and
Forestry
(315) 470-6827, fax: 315 470-6856
jphasset@mailbox.syr.edu

Jeff Ridal
St. Lawrence River
Institute of Environmental Sciences
613-936-6620 fax: 613-936-1803
jridal@mail2.glen-net.ca

Environmental Policy, Education

John P. Felleman
SUNY ESF
Dept. of Environmental Studies
315-470-6915, fax: 315-470-6550
felleman@mailbox.syr.edu

Jack P. Manno
Great Lakes Research Consortium
SUNY ESF
315-470-6816, fax: 315-470-6970
jpmanno@mailbox.syr.edu

Richard C. Smardon
SUNY ESF
Environmental Studies
315-470-6576
rsmardon@mailbox.syr.edu

David G. White
NY Sea Grant Extension
SUNY Oswego
315-341-3042, fax: 315-341-2954
dwhite@cce.cornell.edu

Remediation Technology

Ronald J. Scrudato
SUNY Oswego
SUNY Environmental Research Center
315-341-3639 x2883
scrudato@oswego.edu

G. Yuli Rhee
SUNY Albany
Wadsworth Ctr
School of Public Health
518-473-8035
rhee@wadsworth.org

Human Health & Toxicology

Brian Bush
SUNY Albany
Wadsworth Ctr, Schl of Public Hlth
bbush@wadsworth.org
518-473-7582 257-2014, fax 257-2039

Jeff Chiarenzelli
Environmental Research Center
SUNY@Oswego
(315) 341-2891, fax (315) 341-5346
chiarenz@oswego.edu

Bernadette Pinel-Alloul
Universite de Montreal, Groupe de Recherche
Interuniversitaire en Limnologie (GRIL),
514-343-6784, fax: 514-343-6216
pinelb@ere.umontreal.ca

Biology, Limnology and Fisheries

James M. Haynes
SUNY Brockport
716-395-5783
jhaynes@brockport.edu

David Lean
University of Ottawa, Department of Biology
613-562-5800 ext 6349, 613-562-5486
dlean@science.uottawa.ca

Joseph Makarewicz
Center for Applied Science and Aquaculture
SUNY Brockport
716-395-5747x2193, fax: 716-395-2741
Jmakarew@brockport.edu

Edward Mills
Cornell University Biological Field Station
315-633-9243, fax: 315-633-2358
elm5@cornell.edu

Lars Rudstam
Cornell University Biological Field Station
315-633-9243, fax: 315-633-2358
lgr1@cornell.edu

James H. Thorp
Clarkson University
315-268-6544, fax: 315-268-6670
thorp@agent.clarkson.edu

Jack Mattice
Director, New York Sea Grant
SUNY Stony Brook
516-632-6905
jmatrice@ccmail.sunysb.edu

Don Stewart
SUNY ESF
djstewart@mailbox.syr.edu
315-470-6924 Fax: 6934

John Farrell
SUNY ESF
Ellis Island International Laboratory
jmf Farrell@mailbox.syr.edu
315-470-6990

Geology

Ann Isley
SUNY Oswego
315-341-3065

Those interested in participating or would like more information should contact the Consortium at jpmanno@mailbox.syr.edu.

Directory of Albany SBRP Projects

Project 1: PCBs and the Well-being of Mohawk Children and Youth: Growth, Development, and Cognitive/Behavior Functioning.

PI: Lawrence Schell, LMS77@cnsibm.albany.edu, (518)442-4714, Fax (518)442-5710.

Joan Newman, JMN46@cnsvox.albany.edu, Fax(518)442-5710.

Director of Field Staff: Alice Tarbell, ferp@slc.com, (518)358-9223, Fax (518)358-9282.

Field Staff: Priscilla Worswick, Dawn David, Agnes (Sweets) Jacobs and Claudette Peters (Admin).

Project 2: Bio-psychosocial Well-Being Among Akwesasne Residents.

PIs: Azara L. Santiago-Rivera, Azara@cnsvox.albany.edu, (518)442-5038, Fax (518)443-5953 and Gayle Morse, GM2897@cnsvox.albany.edu, Fax (518)442-4953.

Director of Field Staff: Alice Tarbell, FERP@SLIC.COM, (518)358-9223, Fax (518)358-9282. Project Interviewers and staff: Trudy Lauzon, Lora Lee LaFrance, Mark Martin, Cynthia Benedict (Core), and Claudette Peters (Admin).

Project 3: Neurochemical, Neurobehavioral and Endocrine effects of Developmental Exposure of Rats to Individual PCB Congeners.

PI: Richard F. Seegal, seegal@wadsworth.org, (518)473-4378, Fax (518)486-1505.

Project 4: Studies on the Mechanisms Responsible for the Cognitive Impairment Caused by Exposure to Polychlorinated Biphenyls.

PI: David Carpenter, carpent@cnsvox.albany.edu, (518)257-2025, Fax (518)257-2026.

Project 5: Studies of the Alterations in Estrogen Metabolism Caused by Exposure to Polychlorinated Biphenyls.

PI: David Spink, david.spink@wadsworth.org, (518)486-2532, Fax (518)474-8590.

Project 6: Estrogenicity in Human Breast Cells.

PI: John Gierthy, gierthy@wadsworth.org, (518)474-8195, Fax (518)486-1505.

Project 7: Combined Bioassay-Chemical Fractionation Scheme for the Determination of Toxic Chemicals in Sediments from the St. Lawrence River.

PI: Patrick O'Keefe, pwo01@health.state.ny.us, (518)473-3378, Fax (518)473-2895.

Project 8: Bioremediation of PCB-Contaminated Sediments in the St. Lawrence River.

PI: G-Yull Rhee, rhee@wadsworth.org, (518) 473-8035 Fax: (518) 486-2697.

Project 9: Advanced Oxidative Technologies

A. Photocatalytic Remediation of PCB-Contaminated Water and Sediment: Novel Catalysts and Potential Solar Applications

PI: ChiaSwee Hong, hongc@wadsworth.org, (518) 473-7299 Fax (518) 473-2895

B. Electrochemical Peroxidation

PI: Ronald Scrudato, scrudato@oswego.cdu, (315)341-3639, Fax (315)341-5346.

Project 10: Supercritical Fluid Technology For Remediation of PCB/PAH Contaminated Soils and Sediments.

PI: Lawrence L. Tavlarides, lrdewey@summon2.syr.cdu, (315) 443-1883,

Fax: (315) 443-2559

Akwesasne Task Force on the Environment

Ken Jock, (518)358-5937, www.slic.com/atfe/atfe.htm

Administrative Core

PI: David O. Carpenter, Carpent@cnsvox.albany.edu, (518) 257-2025

Fax: (518) 257-2026.

Epidemiology Core

PI: Maria J. Schymura, mjs08@health.state.ny.us, (518) 474-2255, Fax: (518) 474-2086.

Director of Field Staff: Alice Tarbell, ferp@slic.com, (518)358-9223, Fax (518)358-9282.

Field Staff: Priscilla Worswick, Dawn David, Agnes (Sweets) Jacobs, Trudy Lauzon, Lora Lee LaFrance, Mark Martin, Cynthia Benedict, and Claudette Peters (Admin).

Grandparents Project

Director of Field Staff: Alice Tarbell, FERP@SLIC.COM, (518)358-9223,

Fax (518)358-9282.

Project Interviewers and staff: Trudy Lauzon, Priscilla Worswick Agnes (Sweets) Jacobs and Claudette Peters (Admin).

Technology Transfer Core

PI: Ronald Scrudato, scrudato@oswego.cdu, (315)341-3639, Fax: (315)341-5346.

Laboratory Services Core

PI: Anthony DeCaprio, apd04@health.state.ny.us, (518)257-2027, Fax: (518) 257-2028.

Student Training Core

PI: David O. Carpenter, Carpent@cnsvox.albany.edu, (518)257-2025 Fax: (518)257-2026.

OCCURRENCE OF THE ODOUR COMPOUNDS, 2-METHYLISOBORNEOL AND GEOSMIN IN EASTERN LAKE ONTARIO AND THE UPPER ST. LAWRENCE RIVER

Jeffrey J. Ridal*†, Brian Brownlee‡, and David R.S. Lean*†

*St. Lawrence River Institute of Environmental Sciences, 1111 Montreal Rd., Cornwall, Ontario
K6H 1E1

†Department of Biology, University of Ottawa, Ottawa, Ontario

‡National Water Research Institute, 867 Lakeshore Road, Burlington, Ontario, L7R 4A6

Running title: Occurrence of Odour Compounds in Lake Ontario and Upper St Lawrence River

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St. Lawrence River Institute of
Environmental Sciences

avenue McConnell Avenue, Cornwall, Ontario K6H 4K8

DRAFT

ABSTRACT

The incidence of geosmin (*trans,trans*-1,10-dimethyl-9-decalol) and 2-methylisoborneol (MIB, 1,2,7,7-tetramethyl-*exo*-bicyclo[2.2.1]heptan-2-ol) was investigated in Lake Ontario and Upper St. Lawrence River water in the fall of 1996 and 1997. Gas chromatography-mass spectrometry was used for quantitation and confirmation of the presence of these compounds in water samples. Both geosmin and MIB were detected in river water samples at concentrations ranging from 5-20 ng/L and 2-25 ng/L, respectively. The compounds were detected in southern coastal lake water which serves as a source to the St Lawrence River, but not in mid-lake samples. Similar levels of geosmin and MIB were detected in untreated Lake St Lawrence water, and in samples taken following pre-chlorination for zebra mussel control, and following conventional treatment at a water filtration plant.

KEY WORDS: taste and odour compounds, geosmin, MIB, Lake Ontario, St Lawrence River

INTRODUCTION

Taste and odour in water supplies is a common problem worldwide, and the Laurentian Great Lakes are no exception. Geosmin and 2-methylisoborneol (MIB) are probably the two most commonly reported odour compounds (Mallevalle and Suffet 1987). These two compounds have been cited as the cause of off-flavours in water and aquatic biota in many countries, e.g., Japan, Australia, South Africa, United States, and Canada. Geosmin was identified in western Lake Ontario water by Brownlee *et al.* (1984), and Vogel *et al.* (1997) have recently reported on MIB in the Chicago area of L. Michigan.

Geosmin and MIB are produced by actinomycetes (Gerber 1979) and cyanophytes (Slater and Blok 1983a, Person 1988). They occur in lakes, reservoirs and rivers. Generally, geosmin is more likely to be found in the water column (planktonic) (Slater and Blok 1983b, Jones and Korth 1995), and MIB in the sediments (benthic) (Izaguirre *et al.* 1983, Vogel *et al.* 1997). They possess musty, earthy odours, are very potent, and have reported odour threshold concentrations of 4 ng/L (geosmin) and 15 ng/L (MIB) (Young *et al.* 1996). Neither compound induced a mutagenic response in the "Ames test" (TA98 and TA100 strains of *Salmonella typhimurium*) at concentrations up to cytotoxic levels, approximately six orders of magnitude greater than the odour threshold concentrations (Dionigi *et al.* 1993).

In recent years, taste and odour problems associated with drinking water have become widespread along the Great Lakes and St. Lawrence River system (Lange and Wittmeyer 1997; Vogel *et al.*

Ridal

Table 1: Characteristics and concentrations of geosmin and MIB in water samples taken September 1996.

Sampling Site	Water Temp (°C)	No. of Replicates	Sniff Test Results	Nominal	
				Concentration (ng/L) Geosmin	MIB
Lake Ontario					
Station 1					
surface	20.8	2	sweet	<0.5	<0.5
15 35 m		1	oily, sweet	<0.5	<0.5
Station 2	21.8	2	camphor, musty	5	10
St. Lawrence River					
Station 3	21.8	1	sweet, faint	<0.5	3
Station 4	21.7	2	earthy	20	25
Station 5	21.7	2	earthy, musty	5	15

N.D., not detectable. Limit of detection for 18 L sample was 0.1 ng/L. All surface samples except where otherwise noted. Surface water temperatures ranged from 20.8 - 21.8 °C.

Table 2: Characteristics and concentrations of geosmin and MIB in water samples taken in water from Lake St. Lawrence and in treated Cornwall drinking water, October 1996 and 1997.

Sampling Site	No. Of Replicates	Sniff Test Results	Nominal Concentration (ng/L)	
			Geosmin	MIB
1996				
at intake (untreated)	3	earthy	8	6
pre-chlorinated water	3	earthy, clay	10	8
after sand filtration	3	earthy	10	8
1997				
at intake (untreated)	3	earthy, musty	35	32
after pre-chlorination	3	earthy, beety	35	30

N.D., not detectable. Limit of detection for 2 L sample was 2 ng/L. Water temperatures at intake ranged 14.5 -16.5 °C in 1996 and 15.0-17.5 °C in 1997.

Clean Water/Clean Air Bond Act

Great Lakes

Project Name: Erosion and Nonpoint Source Protection

Grant Recipient: St. Regis Mohawk Tribe

Project Description: The project will install 400 feet of rock rip rap to provide secondary control of shore line erosion at Raquette Point on the St. Lawrence River. A shoreline buffer strip and trees will also be planted to prevent erosion. Streambank erosion is causing lead and other contaminants to enter the River from a disposal site containing dredged materials from the construction of the St. Lawrence Seaway.

Total Project Cost: \$117,124

Eligible Project Cost: \$117,124

Bond Act Share: \$ 53,244

Reason for Selection:

1. **Environmental benefit:** Fishing and fish consumption are impaired in the River due to contaminated sediments. By preventing erosion at the waste disposal site, contaminants will be precluded from entering the St. Lawrence and further degrading water quality.
2. **Evaluation factors:** The project is a technically viable, cost-effective method of reducing shoreline erosion. The applicant has the experience and ability to undertake and maintain the project.
3. **Significance/role in implementing management plan:** The remediation of contaminated sediments and the restoration, protection and enhancement of aquatic habitat are two of the highest priorities addressed in the St. Lawrence River at Massena Remedial Action Plan which is the local activity associated with the NYSDEC Great Lakes Management Program.

Project No. 1998WQI2128

Project type: Nonagricultural Nonpoint Source
Abatement and Control

County: Franklin

DEC Region: 5

8074 BSE
(CORNWALL WEST)

STATE OF
DEPARTMENT





Contaminated Sediments News



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CS News is produced by the EPA
Office of Science and Technology
(OST) to exchange information on
contaminated sediments and to
increase communication among
interested parties. To obtain copies
of this report or to contribute
information, contact Jane Marshall
Farris, EPA OST, Mail Code 4305,
401 M Street S.W., Washington,
DC 20460 or (202) 260-9907.
To be added to the mailing list or
to make changes to your address,
please fax your request to Jane
Marshall Farris at (202) 260-9830.

EPA's Contaminated Sediment Management Strategy Published

To address the ecological and human health risks that contaminated sediment poses in many U.S. watersheds, the Agency has published *EPA's Contaminated Sediment Management Strategy*.

Also available for review, through the Office of Water Docket (202 260-3027), is the *Response to Public Comments Document*.

The Strategy is an EPA workplan describing actions the Agency believes are needed to bring about consideration and reduction of risks posed by contaminated sediments. In it, EPA summarizes its understanding of the extent and severity of sediment contamination, including uncertainties about the dimension of the problem and describes the cross-program policy framework in which EPA intends to promote consideration and reduction of ecological and human health risks posed by sediment contamination.

The Strategy establishes four goals:

- 1) To control sources of sediment contamination and prevent increases in the volume of contaminated sediment.
- 2) To reduce the volume of existing (in-place) contaminated sediment.
- 3) To ensure that sediment dredging and dredged material disposal are managed in an environmentally sound manner.
- 4) To develop a range of scientifically sound sediment management tools for use in pollution prevention, source

control, remediation and dredged material management.

EPA's Contaminated Sediment Management Strategy sets forth a plan to accomplish a number of key actions.

- Agency programs will use consistent and scientifically sound sediment assessment methods in their prevention or remediation processes.
- Agency programs will use the first *National Sediment Quality Survey Report to Congress* (EPA 823-R-97-006) and future biennial updates to target chemicals and watersheds for further assessment, pollution prevention, and remediation.
- Where watersheds are clean, EPA will prevent sediment contamination through point and nonpoint source controls, promoting best management practices, and by testing new pesticides and other chemicals to ensure that they will not contaminate sediment.
- Where watersheds are being contaminated, EPA will take appropriate action through its point and nonpoint source control programs to reduce or eliminate contaminant inputs.
- Where watersheds are already contaminated, EPA will develop risk management strategies and implement source controls.



Continued on page 3

During its first year, the project determined that the optimal means of transporting material to the site would be large bags made of synthetic fabric that holds 400-800 cubic meters of material. Barges would haul the containers from a dredging site to the ocean isolation site, where they would be released to fall freely to the abyssal seafloor. Container walls and seams would be strong enough not to tear during release from the barge and the subsequent 5,000-meter descent and impact on the abyssal seafloor.

Only one probable pathway for contaminants to enter the productive surface ecosystem was identified: the eggs of certain abyssal fish. However, the quantity of transport would be negligible.

Monitoring System Designed

In the last year, the project has identified several types of sensors and platforms that could be used to monitor the isolation site for possible leakage. The monitoring system architecture was formulated (see the drawing on page 2) to deploy, operate, maintain, and retrieve data from the sensor suite. This was challenging due to the levels of measurement sensitivity and the stability required in the high pressures and low temperatures of the abyssal regions.

For More Information

Findings of Years One and Two addressing the engineering system and environmental consequences of such a contami-

nated dredged material management concept are available in NRL reports and conference proceedings; peer-reviewed papers are in publication. Findings of Year Three will soon be published in NRL reports.

For more information, contact Philip Valent of the Naval Research Laboratory at (228) 688-4650, by fax at (228) 688-4093, or by e-mail at phil.valent@nrlssc.navy.mil.

Ordering the Proceedings of the 1996 National Sediment Bioaccumulation Conference

The proceedings of the National Sediment Bioaccumulation Conference sponsored by EPA's Office of Science and Technology (OST) and Office of Research and Development in September 1996 are now available from EPA. The document number is EPA-823-R-98-002.

To order a copy, contact:

U.S. Environmental Protection Agency
National Center for Environmental Publications and Information
P.O. Box 42419
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Copies of EPA's *Contaminated Sediment Management Strategy* (document number EPA-823-R-98-001) are available from:

U.S. Environmental Protection Agency
National Center for Environmental Publications and Information
11029 Kenwood Road, Building 5
Cincinnati, Ohio, 45242.

Copies may be ordered by phone at (800) 490-9198; by fax at (513) 489-8695; or on the Internet at <http://www.epa.gov/ncepihom/orderpub.html>. The Strategy can be viewed or downloaded from the Office of Science and Technology's home page, at <http://www.epa.gov/ost/cs/>.

The document can be viewed or downloaded from OST's home page at www.epa.gov/ost/cs/confloc.html.

Questions about the proceedings may be directed to OST at (202) 260-7055.

