REGIONAL ASSESSMENT
LA PRAIRIE BASINS

Regional Assessment
La Prairie Basins
(Lachine Rapids, Greater and Lesser La Prairie Basins)

Priority Intervention Zones 7 and 8

Jean Robitaille

Revised by Marie-José Auclair
St. Lawrence Centre
Environment Canada - Québec Region

April 1997

NOTE TO READERS

Reports on Priority Intervention Zones (known as ZIPs) are produced as part of the St. Lawrence Vision 2000 action plan by Environment Canada's St. Lawrence Centre, in conjunction with Fisheries and Oceans, Health Canada, the Ministère de la Santé et des Services Sociaux du Québec and its partners, and the Ministère de l'Environnement et de la Faune du Québec.

Correct citation for this publication:
Robitaille, J. 1997. *Regional Assessment–La Prairie Basins. Priority Intervention Zones 7 and 8*. Environment Canada - Quebec Region, Environmental Conservation, St. Lawrence Centre. 100 pages.

Published by authority of the Minister of the Environment

Cat. No. En40-216/24E
ISBN 0-662-25755-3

Production Team

St. Lawrence Centre

Design and Writing	Jean Robitaille Bureau d'Écologie Appliquée
Co-ordination and Editing	Marie-José Auclair
ZIP Working Group	Alain Armellin Jean-François Bibeault Guy Fortin Nathalie Gratton Pierre Mousseau Stéphane Lorrain Marc Pelletier
Maps and Illustrations	Marcel Houle
Copyediting	Patricia Potvin
Translation	Betty Howell
Text Layout	Samim Esmail

Centre de Santé Publique du Québec	Josée Chartrand Jean-François Duchesne Denis Gauvin

Contributors

Ministère de l'Environnement et de la Faune du Québec

Direction des Ecosystèmes Aquatiques	Denis Brouillette Isabelle Guay Carole Lachapelle Denis Laliberté Yves Lefebvre Francine Richard
Direction Régionale de la Montérégie	Jean Hubert François Rocheleau Bruno Bélanger Serge Rainville
Direction Régionale de Montréal	Pierre Bilodeau Guylaine Pépin Yves Valiquette

Canadian Heritage

Parks Canada, Quebec Region	François Granger

Environment Canada

Environmental Protection Branch	Caroll Bélanger Élie Fédida Alain Latreille
Canadian Wildlife Service	Léo-Guy de Repentigny
Health Canada	Richard Carrier Sylvie Coad Louis L'Arrivée

Ministère de la Santé et des Services Sociaux du Québec	Claire Laliberté (resource person)
Direction de la Santé Publique Montréal-Centre	Tom Kosatsky Louis Drouin
Direction de la Santé Publique de la Montérégie	Louis Jacques Gaétan Carrier

Acknowledgments

We wish to acknowledge the close working relationship that has developed among St. Lawrence Vision 2000 partners on the Community Involvement Co-ordinating Committee, through the participation of Jean-Yves Roy, Jean Burton, Sophie de Villers, Maryse Vaillancourt, Claire Laliberté, Francine Richard, Daniel Robitaille, Patricia Houle and Gordon Walsh.

We would also like to take this opportunity to express our appreciation to the staff of the various offices and branches of the different ministries who were involved in reviewing this report.

Preface

In April 1994, the governments of Canada and Québec approved a four-year action plan to carry on the work of the St. Lawrence Action Plan.

The goal of St. Lawrence Vision 2000 is to conserve and protect the St. Lawrence and Saguenay rivers in order to restore their use to the people who live along their shores in the spirit of sustainable development.

The Priority Intervention Zones Program – better known by its French acronym ZIP *– is a major element of the Community Involvement component of the St. Lawrence Vision 2000 action plan.*

Through the ZIP program, riverside communities are invited to play an active role in restoring the St. Lawrence and Saguenay rivers.

The program urges various community partners, non-governmental organizations and citizens' committees to work together to identify common priorities for the conservation and restoration of the St. Lawrence.

We are pleased to present this assessment, which reports on the uses, resources and main environmental problems specific to this area. It has been prepared using all the data available from the various federal departments and provincial ministries involved in St. Lawrence Vision 2000.

We hope it will prompt a more enlightened public debate based on information that is as objective as possible, and that the debate will help the various partners involved to develop and implement a plan of action for restoration of the area in question.

François Guimont
Regional Director General
Quebec Region
Environment Canada
Co-Chair, St. Lawrence Vision 2000

Georges Arsenault
Assistant Deputy Minister, Wildlife and Parks
Direction Générale de la Ressource Faunique et des Parcs
Ministère de l'Environnement et de la Faune du Québec
Co-Chair, St. Lawrence Vision 2000

Blank page

Management Perspective

The Priority Intervention Zones program (known as the ZIP program) is a joint initiative of the federal and provincial governments involving riverside communities in the implementation of rehabilitation measures for the St. Lawrence River and the Saguenay River. The program has three phases: production of a local-level assessment report on the St. Lawrence, consultations with riverside partners and identification of intervention priorities, and development of an ecological rehabilitation action plan or ERAP.

The regional assessment report is a synthesis of four technical reports on the biological, physico-chemical, socio-economic and human health aspects of the study area. These reports are prepared by the federal and provincial partners of the St. Lawrence Vision 2000 action plan, as part of its Community Involvement component.

This process of gathering and analysing data on a local scale is a first for the St. Lawrence and Saguenay system. The technical reports go a step further, assessing our knowledge of the current state of a given area based on known quality criteria.

The challenge, then, is to advance a scientific opinion based on the available information. The pitfalls are numerous: the data were collected for other purposes, the geographic and temporal coverage is less than ideal, and the chemical analysis methods are not standardized, to name but a few.

The ZIP work team remains nonetheless convinced that an enlightened and thoughtful overview of each study area can be presented without further delay. This first assessment, written for the riverside partners in each study area, thereby constitutes a starting point and discussion paper.

Perspective de gestion

Le programme des Zones d'intervention prioritaire (ZIP) relève le défi de la concertation entre les gouvernements fédéral et provincial et de l'implication communautaire des partenaires riverains, en vue de mettre en oeuvre des mesures de réhabilitation du Saint-Laurent et du Saguenay. Ce programme comporte trois grandes étapes, soit l'élaboration d'un bilan environnemental sur l'état du fleuve à l'échelle locale, la consultation de partenaires riverains, avec l'identification de priorités d'intervention, et l'élaboration d'un plan d'action et de réhabilitation écologique (PARE).

Un bilan régional est établi à partir d'une synthèse des quatre rapports techniques portant sur les aspects biologiques, physico-chimiques, socio-économiques et sur la santé humaine du secteur étudié. Ces rapports sont préparés par les partenaires fédéraux et provinciaux du plan d'action Saint-Laurent Vision 2000, dans le cadre du volet Implication communautaire.

La cueillette et l'analyse des données existantes à l'échelle locale constituent une première pour l'ensemble du fleuve Saint-Laurent et de la rivière Saguenay. Les rapports techniques vont plus loin encore, en proposant un bilan des connaissances sur l'état actuel d'un secteur à partir de critères de qualité connus.

Le défi consiste donc à poser un jugement scientifique fondé sur l'information disponible. Les embûches sont nombreuses : les données ont été recueillies à d'autres fins, la couverture spatiale ou temporelle n'est pas idéale, les méthodes d'analyses chimiques ne sont pas uniformes, etc.

L'équipe de travail ZIP demeure convaincue qu'il est possible de poser, sans plus attendre, un regard éclairé et prudent sur chaque secteur. Cette première évaluation constitue un point de départ et un document de base rédigé à l'intention des partenaires riverains de chaque secteur d'étude.

Abstract

The La Prairie Basins study area (ZIPs 7 and 8) includes the section of the St. Lawrence River that extends from LaSalle to the Southwest district of Montreal on the north shore and from Sainte-Catherine to Saint-Lambert on the south shore. The river's discharge — consisting mainly of waters from the Great Lakes and, to a lesser extent, some of the waters of the Ottawa River — flows first through the Lachine Rapids and then into the Greater La Prairie Basin. Two artificial bodies of water, both created to enable ships to make a detour around the rapids, are connected here. The Lachine Canal, built in the 1820s, attracted a large number of industrial plants to its banks, making it for more than a century the source of industrial development on Montreal Island. Today, contamination of the canal's bottom and banks limits their development. The Lesser La Prairie Basin is a portion of the river that, since the 1950s, has been isolated from the river main stem by the St. Lawrence, where the water level is controlled.

Here, the St. Lawrence passes through its most densely urbanized segment between Lake Ontario and the sea. Except for a few sites on the islands, no natural riverbanks remain. Nevertheless, the aquatic environment has escaped much of the disturbance and on certain islands, protected by their difficult access, terrestrial habitats have persisted in near-original condition.

Through this area pass contaminants from upstream, i.e. the Great Lakes, the international section of the St. Lawrence and Quebec sections located upstream. Still, the water quality in the rapids and the Greater La Prairie Basin is generally good. The relatively fast flow prevents contaminated sediments from accumulating in the area. The diversion of municipal wastewater to treatment plants between 1988 and 1995, coupled with industrial cleanup programs, have helped improve the quality of the aquatic environment. This trend should continue and promote the practice of some recreational activities.

The slow-flowing waters of the lesser basin and the presence of three small tributaries into which flow a large number of non-point pollution sources (agricultural, urban and industrial)

may delay the return of conditions conducive to aquatic organisms and hinder some recreational uses of this body of water.

The La Prairie Basins area offers an extremely interesting degree of biodiversity. The Lachine Rapids has the last genuine stretch of whitewater in the St. Lawrence and is home to unique aquatic habitats. Fish that migrate over long distances must use this section to complete their life cycle. The islands are home to diversified animal and plant communities.

The last few years have seen an increase in recreational activities, particularly in the Lachine Rapids. It is important to attempt to reconcile the development of certain recreational activities with the protection of these significant natural assets.

Résumé

Le secteur d'étude Bassins de La Prairie (ZIP 7 et 8) comprend la section du fleuve Saint-Laurent qui s'étend de LaSalle à l'arrondissement Sud-Ouest de Montréal, sur la rive nord, et de Sainte-Catherine à Saint-Lambert, sur la rive sud. Le débit fluvial, constitué surtout des masses d'eau en provenance des Grands Lacs et, dans une moindre mesure, d'une partie de celles de lla rivière des Outaouais, s'engage d'abord dans les rapides de Lachine, puis dans le grand bassin de La Prairie ; se rattachent à cet ensemble deux plans d'eau artificiels, créés l'un et l'autre comme voies de contournement des rapides par les navires. Le canal de Lachine, aménagé dans les années 1820, a accueilli dans son voisinage un grand nombre d'usines, qui ont fait de cette zone le creuset de l'activité industrielle sur l'île de Montréal pendant plus d'un siècle. Aujourd'hui, le fond du canal et les terrains avoisinants sont contaminés, ce qui impose des contraintes à leur mise en valeur. Quant au petit bassin de La Prairie, il s'agit d'une portion du fleuve réservée au passage des navires, le long de la rive droite, où le niveau d'eau est contrôlé.

Le fleuve chemine ici dans la portion la plus urbanisée de territoire entre le lac Ontario et la mer ; les sections de rives à l'état naturel ont pratiquement disparu, hormis en quelques endroits, dont le pourtour des îles. Cependant, le milieu aquatique a pu échapper en bonne partie aux perturbations et les habitats terrestres sur certaines îles, protégées par un accès difficile, ont pu subsister dans un état proche de leur condition originelle.

Ce secteur voit transiter des contaminants provenant de l'amont, c'est-à-dire, des Grands Lacs, du tronçon international du Saint-Laurent ou de sections québécoises situées en amont. Cependant, la qualité de l'eau est en général bonne dans les rapides et le grand bassin de La Prairie ; les conditions d'écoulement plutôt rapides font en sorte qu'il se produise peu d'accumulation de contaminants dans les sédiments. Le raccordement des effluents municipaux à des usines de traitement, entre 1988 et 1995, ont contribué à une amélioration de la qualité bactériologique de l'eau du fleuve, qui devrait se poursuivre et favoriser l'expansion de certaines activités récréatives.

Les conditions de faible débit dans le petit bassin et la présence de trois petits tributaires, qui captent dans leur bassin un grand nombre de sources diffuses de pollution (agriculture, terrains industriels ou sites contaminés), pourrait retarder le retour de conditions propices aux organismes du milieu aquatique et à certains usages récréatifs de ce plan d'eau.

En règle générale, les apports de contaminants vers le secteur des bassins de La Prairie ont considérablement régressé et une amélioration de la qualité des milieux aquatiques, déjà perceptible dans les portions à écoulement rapide, devrait peu à peu se faire sentir aussi dans les zones lentes.

Le secteur des bassins de La Prairie présente un grand intérêt au plan de la biodiversité. Les rapides de Lachine constituent la dernière véritable section d'eaux vives du Saint-Laurent et ils recèlent, à ce titre, des habitats aquatiques uniques. Des poissons migrateurs de longue distance doivent emprunter ce tronçon pour compléter leur cycle vital. Par ailleurs, les îles abritent des communautés animales et végétales diversifiées.

Il est important de veiller à concilier le développement de certaines activités récréatives avec la sauvegarde de ces atouts naturels de premier plan.

Table of Contents

List of Figures

List of Tables

xx

blank page

CHAPTER 1 The St. Lawrence River, Then and Now

For most Quebecers, the mere mention of the St. Lawrence River evokes a deep feeling of attachment to the lands crossed by these waters as they flow from the Great Lakes toward the sea. The images that come to mind are of a mighty river flowing past fertile plains and along shady riverbanks that shelter abundant wildlife.

The country was born along the banks of this river, as is still evident in the division of land, a vestige of the seigneurial system. In those days, the settlers had to live with the spring flooding of the St. Lawrence. In return, the river provided the European settlers, whose harvests were still unreliable, with a steady supply of fish and an ideal way of communicating between the first towns and villages along the river.

In time, the forests gave way to farmlands and then towns sprang up. Until then, the low population density and the very size of the river meant that human use of the river had virtually no effect on its resources. But a great change was about to occur. The first major impact seems to have been caused by forestry operations and the burgeoning industrialization in the 19th century: log driving from the Ottawa River to Quebec City, the appearance of dams and sawmills along tributaries, and the building and commissioning of the first hydroelectric power stations.

The pace of such changes accelerated in the 20th century with the construction of large dams on the river itself to control its flow, ship channels and, finally, the Seaway. Growing numbers of industries set up on the outskirts of cities, preferably at riverside sites. The proximity of a water course was beneficial in several respects. It reduced the cost of transporting raw materials, provided a supply of water and allowed easy discharge of effluents and waste.

The St. Lawrence gradually succumbed to the accumulated abuse. A few informed observers noted that certain animal species were becoming less abundant and suggested that the disruption of habitats was to blame. However, their warnings mainly went unheeded.

Public opinion was roused in the early 1970s, when people realized that mercury contamination of fish was not an abstract research topic but a serious risk to which some Native peoples and many sport fishers were exposed. As the list of toxic substances found in the aquatic environment grew longer, the general public came to put the quality of the environment at the top of its list of concerns. There is now virtually unanimous agreement that the comforts afforded by an industrial society have a downside: the unbridled exploitation of resources and increasing pollution are long-term threats to all forms of life, including human beings.

Most industrialized countries have now agreed to base their economic activities on sustainable development. The profit motive alone can no longer dictate human activity. In view of the fragility of our environment and the limitations of our planet, sustainable economic activity must ensure that our resources are used for a variety of purposes. The quality of life of human beings must also be taken into account, and the maintenance of biological diversity promoted.

CHAPTER 2 The Priority Intervention Zones Program

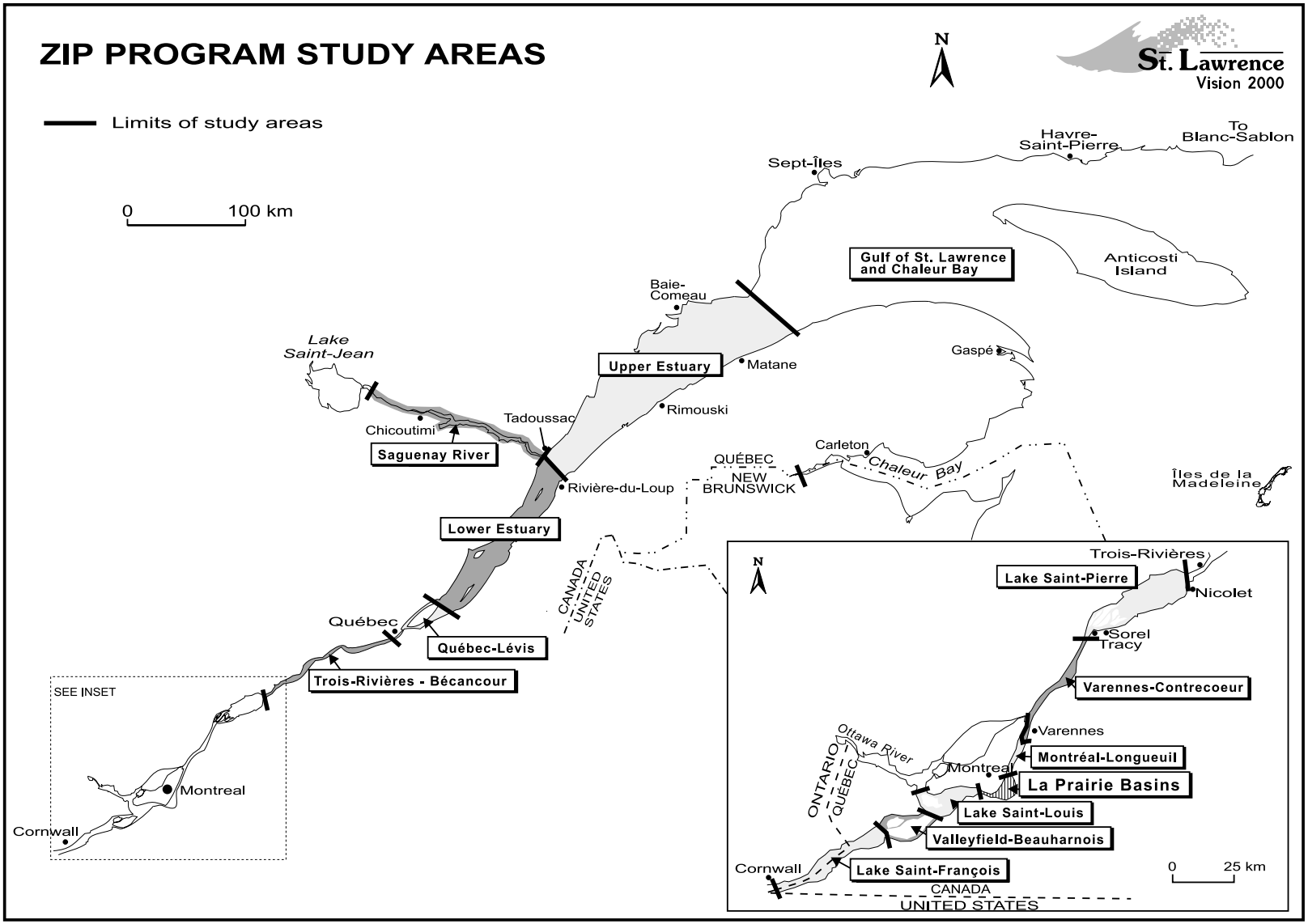
Starting in the 1960s, public opinion was gradually made aware of the deterioration of the natural environments of the Great Lakes and St. Lawrence. Given the urgency of the situation, governments decided to take concrete joint action. One of the first such actions was in 1972, with the signing of the *Canada-U.S. Great Lakes Water Quality Agreement*. This agreement was amended in 1987 to include a program to restore use of the river according to plans designed and implemented at the local level (Remedial Action Plans (RAP*)*, for each Area of Concern (AOC*)*). In 1988, eight American states and the provinces of Ontario and Quebec agreed to limit toxic discharges to the Great Lakes basin and created the *Great Lakes Charter*. Concerned by the poor quality of the river's waters, the Quebec government launched its wastewater treatment program (PAEQ) in 1978.

In 1989, the governments of Canada and Quebec agreed to harmonize their activities under the framework of the St. Lawrence Action Plan, extended in 1994 under the name of St. Lawrence Vision 2000 (SLV 2000) action plan. One of the objectives of the Action Plan, that has been maintained in SLV 2000, was the preparation of a comprehensive assessment of the environment in the Quebec stretch of the river. The Priority Intervention Zones *(ZIP)* program divided the St. Lawrence into 23 sections or ZIPs, combined as needed into *study areas* (Figure 1). Within these zones, efforts are being made on a local scale to promote collaboration among various parties as to restoring and protecting the river and harmonizing its uses.

To prepare for these consultations, the SLV 2000 partners begin with a review of knowledge of each study area, which is the subject of four technical reports[1]. This assessment report contains a summary of detailed information on ZIPs 7 and 8, identified together in the pages that follow as the *La Prairie Basins area* or simply *study area.* It offers an overall evaluation of this stretch of the river, its resources, existing or potential uses, and the constraints associated with them.

---

[1] These reports deal respectively with the physico-chemical aspects of the waters and sediments (Fortin et al., 1997), the biological environment (Armellin et al., 1997), relevant socio-economic aspects (Bibeault et al., 1997), and human health (Chartrand et al., 1997).



Source: Priority Intervention Zones Program - SLV 2000.

Figure 1 ZIP Program study areas

This report is therefore intended primarily for stakeholders in this portion of the St. Lawrence. It offers an overview of the scientific and technical information available so that they can take an active part in discussing and choosing intervention priorities.

The information presented here may serve as a basis for a common perception of the situation in this area, and, it is hoped, clear the way for joint action by the partners.

CHAPTER 3 Characterization of the Study Area

At the end of the last ice age, several thousand years ago, a large sea covered southern Quebec and Ontario. As the glaciers retreated, the earth's crust gradually rose. This isolated the immense basins that became the Great Lakes from salt water.

As the millennia passed, the river carved a bed in the unconsolidated sediments and clays that had been left on the floor of the ancient arm of the sea. This fertile plain, known as the St. Lawrence Lowlands, is bordered by the Canadian Shield to the north and the Appalachian Mountains to the south.

The area of interest extends from LaSalle to the Southwest district of Montreal on the north shore of the St. Lawrence, and from Sainte-Catherine to Saint-Lambert on the south shore. It includes the Lachine Rapids and the La Prairie Basin, which are divided into the greater and lesser basins to distinguish two aquatic environments separated by a dike and apparently relatively isolated from each other. Added to these bodies of water is the Lachine Canal, an entirely man-made aquatic environment (Figure 2).

The characteristic feature of this portion of the St. Lawrence is clearly the rapids. It has played a decisive role in human settlement while allowing a bit of wild nature to be preserved in the immediate vicinity of the city. The riparian environment is, however, one of the most urbanized along the entire St. Lawrence River.

3.1 Physical Environment

Fed by the precipitation from a watershed of 1.2 million km^2 in area, the Great Lakes discharge their overflow into the sea through the St. Lawrence River, flowing at a rate of 6850 m^3/s, on average, as it exits Lake Ontario.

From Lake Ontario, the St. Lawrence flows for some 170 km between the Province of Ontario and New York State before reaching Quebec. The river enters through Lake Saint-François, then passes the Beauharnois area before reaching Lake Saint-Louis.

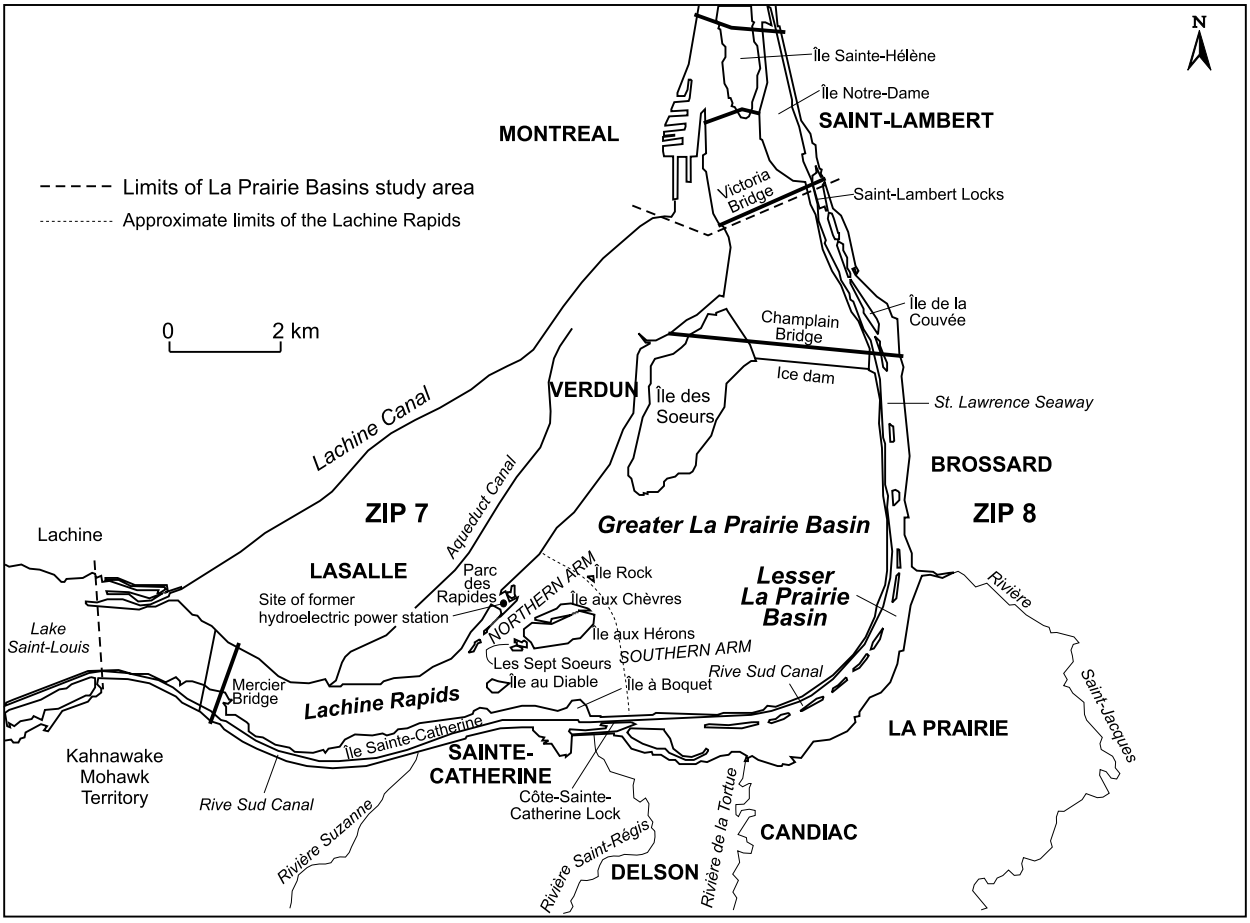


Figure 2 La Prairie Basins study area

3.1.1 Water masses

While the tributaries contribute little to the flow between Lake Ontario and Lake Saint-Louis, the latter body of water, located just upstream of the study area, receives inflows from a major watercourse, the Ottawa River. Only a portion of the waters of this river joins the St. Lawrence at Lake Saint-Louis through the Vaudreuil and Sainte-Anne canals and then passes into the Lachine Rapids and the Greater La Prairie Basin. The rest of the Ottawa River follows the des Prairies and Mille Iles rivers to reach the eastern tip of Montreal Island.

The contribution of the Ottawa River is significant not only because of its flow[1] (or discharge), but also because of its chemical composition. Most of the basin of this river is located in the Canadian Shield, and this contributes certain chemical characteristics to its water that clearly distinguish the waters from those of the Great Lakes[2].

The two water masses, that of the Great Lakes and that of the Ottawa River, flow for considerable distances before being completely mixed. In the Greater La Prairie Basin, we have detected the existence of a mixing zone along the north shore, while the centre and the south shore are characterized by water typical of the Great Lakes plus the contribution of local tributaries. The relative size of the two water masses varies according to flow levels, especially those of the Ottawa River.

Tributaries contribute little to the discharge rate in the study zone (7 m^3/s, or less than 0.07% of the river flow). The three largest tributaries flow into the Lesser La Prairie Basin; these are the Saint-Régis, de la Tortue and Saint-Jacques (or Saint-Lambert) rivers.

3.1.2 Flow, particulate load and sediment deposition

The main flow of the river reaches the study area through the Lachine Rapids, which is 6.8 km long and has a drop in level of 10.6 m. The current velocity achieved at the bottom of the rapids is more than 3 m/s. Fine particles carried by the water cannot be deposited at this location, where only the coarsest materials, gravels, pebbles and cobbles, remain. The depth is 5 m on average, although some trenches may be up to 10 m deep.

The Greater La Prairie Basin begins at the foot of the rapids. Scattered near its entrance are several islands. Some of them (aux Hérons, aux Chèvres and au Diable islands) have sufficient elevation to be safe from spring flooding. Others, like the Sept-Soeurs archipelago, Ile

---

[1] The average flow of the Ottawa River, for a whole year, is about 2000 m^3/s; but unlike the inflow from the Great Lakes, which is regulated by a number of dams, the discharge of the Ottawa can vary substantially by season. The discharge rate averages 800 m^3/s in low water conditions and 6500 m^3/s during floods. Moreover, in the past it has even exceeded 9000 m^3/s, which is almost equivalent to the mean discharge of the St. Lawrence at LaSalle (9780 m^3/s).

[2] The water of the Ottawa River, is brown in color, less mineralized, less conductive and more turbid (murky) than the green water of the Great Lakes.

Rock and numerous rocky islets, may be partially or completely submerged, depending on the intensity of floods.

When it reaches this location, the flow is slowed and divides on either side of Ile aux Hérons. Somewhat farther downstream, the northern arm is divided again by Ile des Soeurs (Nuns' Island). The waters are rejoined at the outlet of the greater basin, at the Victoria Bridge. In these channels, current velocity is between 1.0 and 1.8 m/s during flooding, but falls to 0.75 to 0.90 m/s in the summer. Outside these flow channels, the greater basin contains aquatic habitats that can be described as semi-lacustrine. The basin is less than 4 m deep for about 60% of its area. Because of the slow current, fine materials carried to this point by the flow may be deposited on the bottom, promoting the establishment of aquatic plant communities over the long term.

In this stretch of the river, the nature of the bottom differs from one shore to the other. Fine materials tend to be found along the south shore, while the substrate of the north shore is generally more coarse. Little sediment deposition has been noted in the centre.

Originally, the flow must have been slow and the slope of the banks along the south shore quite gradual. The natural conditions in this part of the study area were disrupted during construction of the St. Lawrence Seaway and the creation of what is now called the lesser basin (see section 4.1).

The area's other body of water, the Lachine Canal, is an artificial aquatic environment created as a detour for ships around the rapids in the 19th century. At the present time, the Lachine Rapids and the Greater La Prairie Basin account for most of the river's flow. The Lachine Canal and the south shore canal divert only a very small part of the flow (less than 2%).

Table 1 summarizes some characteristics of the La Prairie Basins area, in its present state.

Table 1
Some physical characteristics of the La Prairie Basins area

Surface area of the sector (km^2)	171
Surface area of water (km^2)	53
Length (km) north shore	16
Length (km) south shore	25
Minimum width (km) (rapids)	1
Maximum width (km) - greater basin	6.3
Mean annual flow rate (m^3/s)	
- rapids and greater basin	9780
- south shore canal and lesser basin	149
- tributaries of lesser basin	7
- Lachine Canal	13
- total at the outlet of area	9949

3.2 Biological Environment

For a passerby stopping at the water's edge, the existing landscape and incessant rumble of the city make it difficult to imagine how the river and its shores looked before settlement. Buildings, highways, bridges and transmission lines intrude on every side, recalling that at this point, the St. Lawrence has experienced the heavy hand of the neighbouring metropolis.

One might think that there is nothing natural left in this concrete and steel setting. Yet some habitats have survived to the present, continuing to support diversified flora and fauna that are worth preserving.

3.2.1 Vegetation and habitats

In this part of Quebec, the natural woodlands would consist of Sugar maple stands with hickory. However, most such stands have long since disappeared from the study area. The shores of the river have also been rebuilt, so that natural plant associations have disappeared.

All that now remains of the original plant communities can be found in a few rare sites that have somehow escaped disturbance because they are located on one of the islands. Such

locations harbour natural plant groupings, which are characterized by great diversity[3]. According to a list prepared as part of the St. Lawrence Vision 2000 action plan, there are some 17 plant species in the study area for which protection measures would appear to be desirable (Appendix 1).

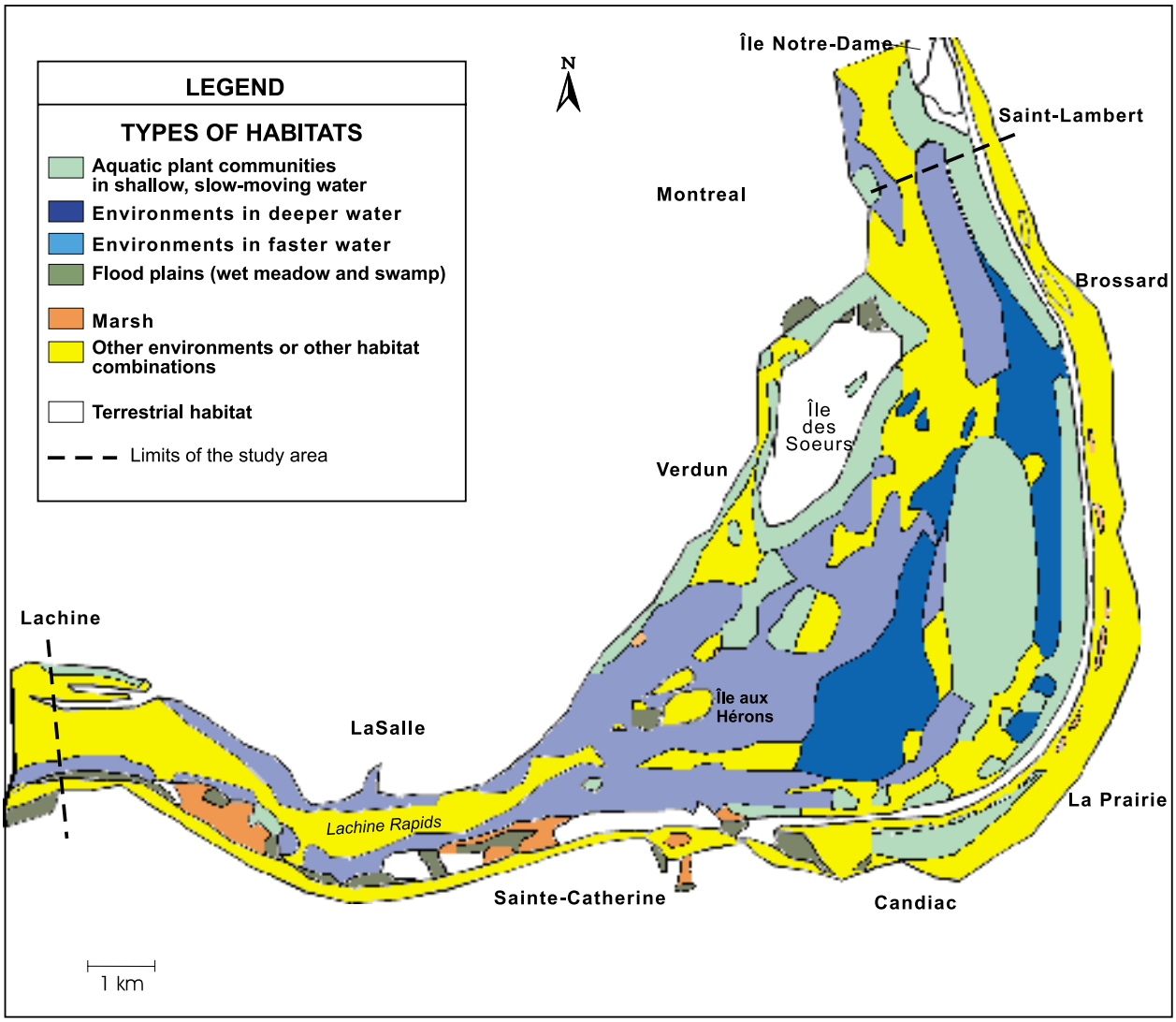
The microclimate enjoyed by some islands in the Lachine Rapids, especially Ile aux Hérons, Ile aux Chèvres, Ile au Diable and the Sept Soeurs archipelago, favours the growth of plants that are rare in Quebec. For instance, there are a number of mature stands of Common hackberry, with those on Ile aux Hérons believed to be the largest in Quebec.

The last segments of natural shores in the study area are found mainly around the islands (Figure 3). There is also a small section of wet meadows near the old LaSalle hydroelectric power station, on Ile Rock, and on the south shore, in a widening of the St. Lawrence Seaway upstream from the Sainte-Catherine Lock. Wooded swamps, which usually feature Silver maple, Red ash, Eastern cottonwood and some willow species, are still found only on Ile des Soeurs, in the Récré-O-Parc in Sainte-Catherine, and on the Sept Soeurs archipelago.

There are a few marshes left near the Mercier Bridge, on the Kahnawake Mohawk reserve. There are stands of Broadfruit burreed, Broadleaf arrowhead, Narrowleaf cattail and S*cirpus fluviatilis*.

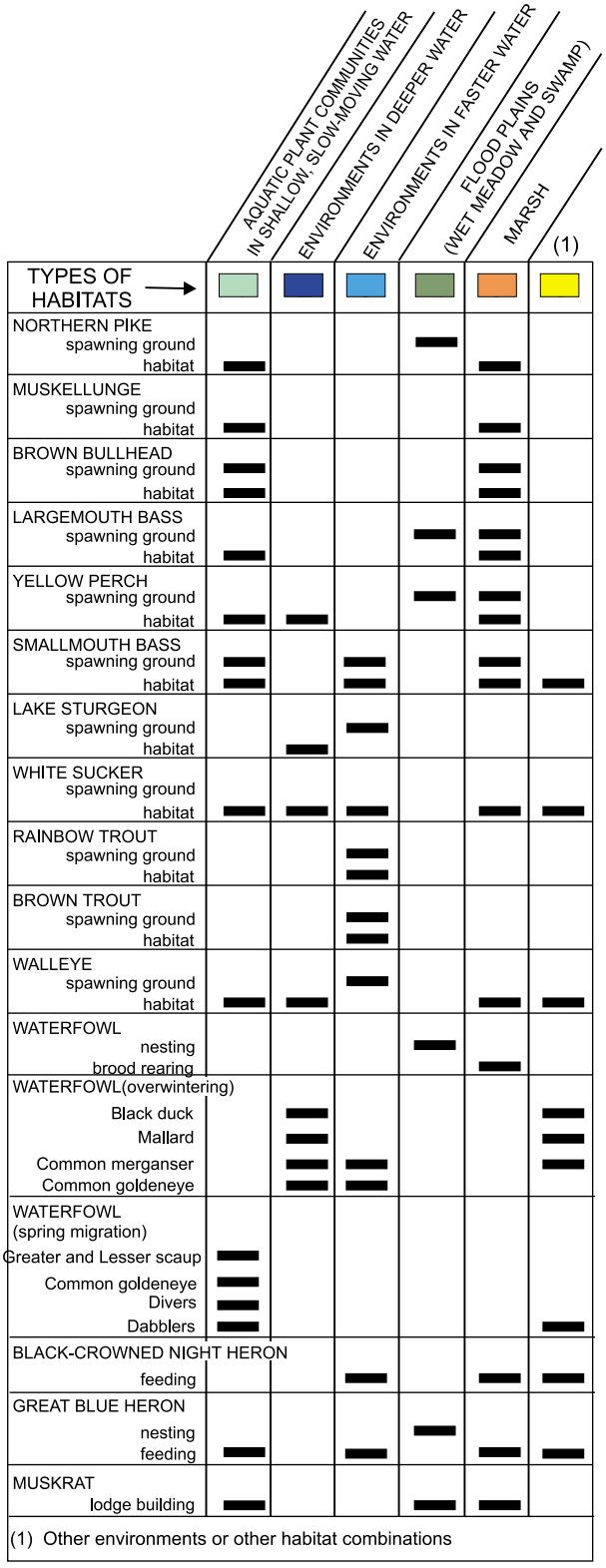
The aquatic plant communities were not as affected as the land-based and riparian vegetation. They cover about 1624 ha in area and constitute the main type of aquatic habitat in the area, especially in the Greater La Prairie Basin. There are few aquatic plants in the Lachine Rapids, due to the strength of the current. But starting at the inlet to the greater basin, we see the first groups of Sago pondweed, a species typical in green waters and that can cope with moderate currents. Where the flow is even slower, there are large aquatic plant communities dominated by American eelgrass and Shortspike watermilfoil. At the shallower locations are Grassleaf mudplantain and American waterplantain. The two largest aquatic plant communities are located in the centre of the greater basin and between the Ile aux Hérons and Ile des Soeurs.

[3] The presence of some 368 species of plants has been reported on Ile des Soeurs and some 336 on the islands in the Lachine Rapids.



Source: Adapted from Auger et al., 1984, and MLCP, 1984.

Figure 3 Aquatic and riparian habitats


AQUATIC PLANT COMMUNITIES IN SHALLOW, SLOW-MOVING WATER
ENVIRONMENTS IN DEEPER WATER
ENVIRONMENTS IN FASTER WATER
FLOOD PLAINS (WET MEADOW AND SWAMP)
MARSH
(1)
TYPES OF HABITATS
NORTHERN PIKE spawning ground habitat
MUSKELLUNGE spawning ground habitat
BROWN BULLHEAD spawning ground habitat
LARGEMOUTH BASS spawning ground habitat
YELLOW PERCH spawning ground habitat
SMALLMOUTH BASS spawning ground habitat
LAKE STURGEON spawning ground habitat
WHITE SUCKER spawning ground habitat
RAINBOW TROUT spawning ground habitat
BROWN TROUT spawning ground habitat
WALLEYE spawning ground habitat
WATERFOWL nesting brood rearing
WATERFOWL(overwintering)
Black duck
Mallard
Common merganser
Common goldeneye
WATERFOWL (spring migration)
Greater and Lesser scaup
Common goldeneye
Divers
Dabblers
BLACK-CROWNED NIGHT HERON feeding
GREAT BLUE HERON nesting feeding
MUSKRAT lodge building
(1) Other environments or other habitat combinations

The study area is most interesting in that it offers a varied mosaic of aquatic habitats, from rapids to extremely slow-flowing waters and large aquatic plant communities (Figure 3). Furthermore, the terrestrial and riparian habitats of several islands are still close to their untouched state. The wide scope of habitat conditions, which has allowed a varied flora and fauna to become established, makes the study area one of the most important along the St. Lawrence with respect to biodiversity.

Table 2 shows the area of the various types of wetland habitats in the study area in 1986.

Table 2
Surface area (ha) of wetland habitats in the study area

Habitat	*Lachine Rapids*	*Greater and Lesser La Prairie Basins*	*Total*
Aquatic plant communities	278.4	1346.1	1624.5
Marsh	11.0	1.4	12.4
Wet meadows	1.7	3.7	5.4
Swamp	23.7	40.4	64.1
Total	**314.8**	**1391.6**	**1706.4**

3.2.2 Benthos

The term *benthos* is used to describe all the organisms, plant and animal, which live on the river bottom, attach themselves to it or bury themselves in it.

By studying benthic animals, it becomes possible to compile extremely useful information for describing aquatic habitats. First, these organisms are at the bottom of the food chain and must be abundant for populations of higher organisms, fish and birds, to become established. Second, the distribution of benthic animals in the environment depends a great deal on local conditions (presence of aquatic plant communities, nature of the bottom, water depth) and the specific requirements of each species. Some may be found solely in aquatic plant communities, while others instead seek out zones where vegetation is absent.

Surveys of benthos have been conducted in the study area, mainly as part of the Archipel Project in the 1980s. This study led to the description of some thirty typical habitats[4] in the waters surrounding Montreal. Eleven of these habitats are represented in the Lachine Rapids and the greater basin. The environmental variables most closely linked to benthos composition are the type of water (brown or green), the nature of the bottom, current velocity and depth.

In the rapids and at the centre of the greater basin, the current is strong and the riverbed coarse. At these locations, benthos is neither abundant nor diversified. Insects are the main group of organisms present. The zones with weaker currents are home to more dense and varied communities, in which molluscs predominate.

In calm zones, the benthos is more abundant in the aquatic plant communities than in open water, although the same species are found in both locations. It appears that the conditions prevailing in aquatic plant communities during the summer promote the abundance of certain groups[5] more than others.

3.2.3 Fish

Sixty-six species of fish have been reported in the study area, fewer than in some fluvial lakes but comparable to the number in other sections of the river between the study area and Lake Saint-Pierre.

The fish community is typical of that in a body of water of average productivity and is dominated by four species: Northern pike, Yellow perch, White sucker and Walleye. Although it is similar in composition to nearby waters, two particular features nevertheless distinguish it.

The dominance of Yellow perch over the whole community is less pronounced here than elsewhere. Although the species is omnipresent, its density here is lower. Its abundance varies greatly within the area, depending on local conditions.

The second characteristic is the presence of species closely associated with rapids. Of all the rapids that still existed along the St. Lawrence at the dawn of the 20th century, the Lachine

[4] In what is defined as a standard habitat, the same composition of benthos species is found, whatever the location.

[5] Among others, amphipods (small crustaceans) and larvae of chironimids (a specific sub-group of flies).

Rapids are the only ones which have not been lost to hydroelectric development. In the Montreal archipelago, these rapids are well known as fishing sites for Lake sturgeon and introduced salmonids[6]. Although some species of the latter group seem to breed in the rapids themselves, most specimens caught by sport fishers come from stocking done each year (see section 5.2.3). Furthermore, this river section is also part of the migration route of several species (including Lake sturgeon, American eel and American shad).

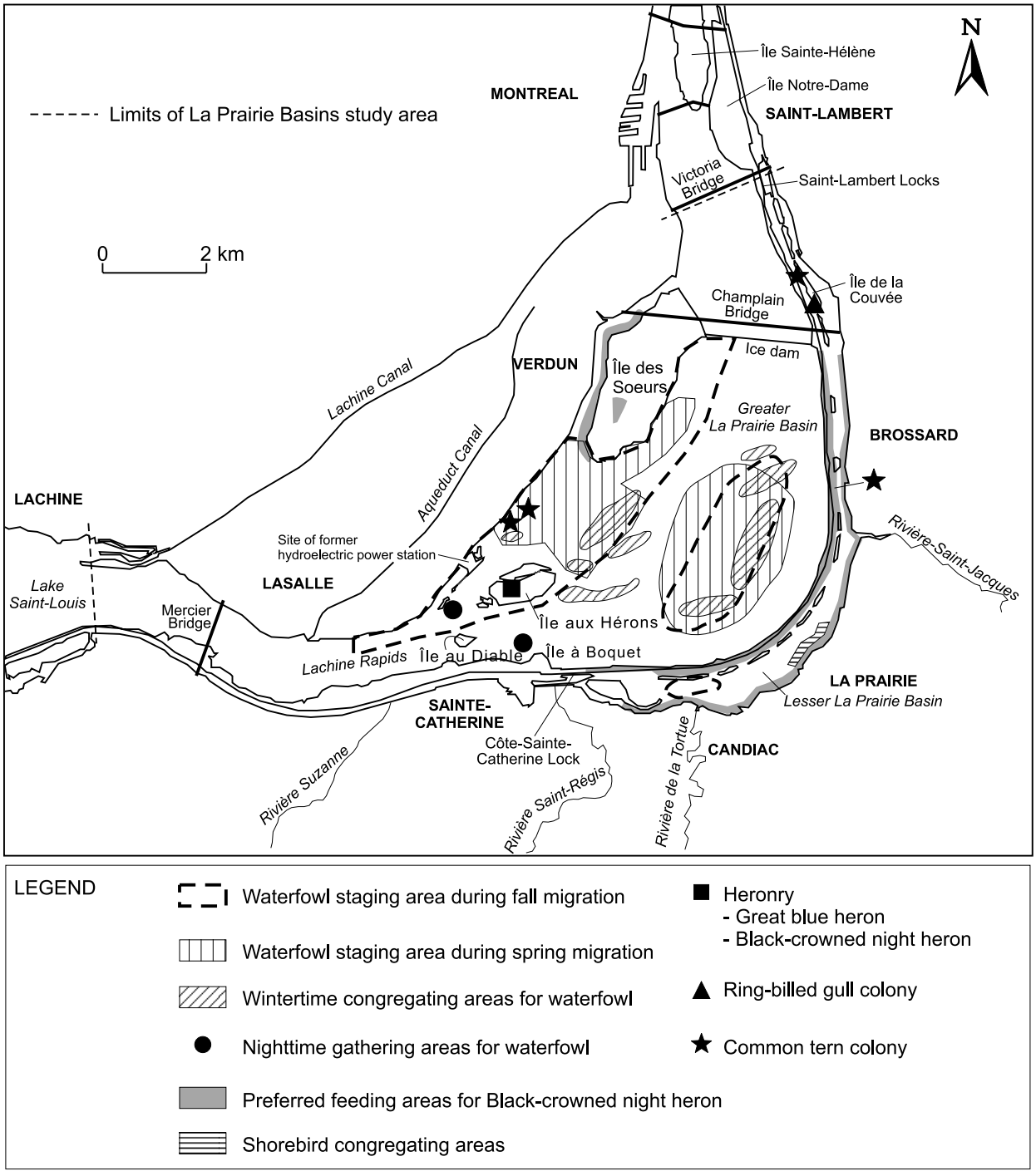
The rapids and the greater basin offer a varied assemblage of habitats suitable for spawning, fry rearing and feeding, in both fast-running and calm waters. Some portions of the aquatic plant communities have disappeared, but it is mainly the riparian habitats, preferred by several fish species for breeding, that have been the most profoundly disturbed (see section 4.1).

3.2.4 Birds

Several groups of aquatic birds frequent the study area throughout the year, attracted by the fast-running waters, islands, large aquatic plant communities and, during the winter, the ice-free areas (Figure 4).

It is estimated that about 2000 ducks spend the winter in portions of the rapids and greater basin where the current keeps the river from freezing over. The main overwintering species are the Common goldeneye and Common merganser. There are also regular reports of Black ducks and Mallards and occasional sightings of the Northern pintail**,** Hooded merganser and Canada goose.

[6] Mainly Rainbow trout and Brown trout.



Source: Adapted from Roche et Associés Ltd., 1985; Léveillé, 1996; Gratton and Mousseau, 1989; Mousseau, 1984; Brousseau, 1981.

Figure 4 Main areas frequented by birds

Ice conditions obviously affect the distribution of ducks, but other factors also seem to have some influence. For example, diving ducks look for areas of slow (less than 75 cm/s), shallow water (less than 3 m) and submerged plants. Overwintering ducks gather at certain sites[7] to spend the night.

During the spring migration period, from mid-March to mid-June, gatherings of diving ducks can be observed downstream from Ile aux Hérons, south of Ile des Soeurs and in the centre of the greater basin. The main visitors are, in order of abundance, the Lesser scaup, Greater scaup, Common merganser and Common goldeneye.

Some species, such as the American black duck, Mallard, Northern pintail, Blue-winged teal, Northern shoveler, Gadwall and American wigeon nest on islands[8]. Disruption seems to limit nesting because the sites most used for this purpose are also the most isolated. For example, Ile des Soeurs, which offers plant cover that is suitable for nesting waterfowl, has few such broods.

During the fall migration, from mid-August to mid-December, the largest concentrations are in the centre of the greater basin and the portion of the lesser basin downstream of Sainte-Catherine. The species present at these locations are mainly the American black duck, Mallard**,** American wigeon**,** Northern pintail, Common goldeneye and scaup species.

Also found in the study area are several colonies of aquatic birds. Ile aux Hérons, at the foot of the rapids, was so named because it has long been the home of a large heronry. The number of Great blue heron broods seems to have fluctuated over the years as a function of the state of neighbouring colonies, accessible feeding areas and the number of trees available for the construction of nests. In 1993 there were some 394 nesting pairs. The island is also home to the largest colony of Black-crowned night herons in Quebec (510 active nests). Great blue herons seem to feed mainly in the marshes of Lake Saint-Louis, whereas night herons appear to prefer to look for food along the Seaway dike.

---

[7] The two main nighttime gathering sites are just off the Boquet peninsula (south shore) and Ile Joe-Ouellette, near the jetty of the old LaSalle hydroelectric power station.

[8] The sites most used for nesting are au Diable, aux Hérons and des Soeurs islands, and the dike for the St. Lawrence Seaway and its small islands.

The Ring-billed gull, a species that is expanding in the Great Lakes and St. Lawrence basin, nests in large numbers on Ile de la Couvée, in the lesser basin (more than 30 000 nests in 1994). Furthermore, the study area has a few small groups and two large colonies of Common tern. The former colony, which has about fifty nests, occupies two islets downstream of the former LaSalle hydroelectric power station; the second, with about 30 nests, is located on a specially-developed islet in the Seaway, just off Brossard.

Only one site, opposite La Prairie, in the lesser basin, attracts migrating shore birds. At this location, mixed groups of Lesser yellowlegs and Semipalmated sandpiper have been sighted, numbering about 1700 individuals. This appears to be the largest migratory staging ground in the region for birds of this group. It is estimated that half the birds passing between Cornwall and Lake Saint-Pierre stop at this location during migration.

3.2.5 Other animals

There is no systematic inventory available of amphibians and reptiles in the study zone, but we do know that it is included in the range of five species of urodela (salamanders and newts), eight anura (frogs, tree-frogs and toads), three turtles and two snakes. These include two species that have been classified as priorities under SLV 2000. The Map turtle is considered rare throughout southwest Quebec, while the Northern chorus frog has been reported only in the Saint-Jacques River basin.

There is no historical data on the abundance of animals that we can use to calculate changes in the sizes of the populations; nor can we link their presumed decline to a particular factor. Nevertheless, there is a consensus among herpetologists as to the close dependency between these animals and their habitat. It is therefore reasonable to assume that the disappearance of wetlands may have negatively affected these populations.

Among mammals, the Muskrat is the most common species in the aquatic and riparian habitats of the study area. This rodent appears to most frequent those areas where the shores are suitable for digging burrows. Such conditions are found along the Tortue, Saint-Jacques and Saint-Régis rivers, in the Sainte-Catherine Récré-O-Parc and along the right shore of

the lesser basin, between Sainte-Catherine and the Champlain Bridge. Muskrats are also found in some swamps and marshes upstream from the Récré-O-Parc and along the Seaway dike, where they tend to build lodges. Many Muskrat were being trapped up until the end of the 1980s, when a drop in the price of pelts seems to have made this activity less attractive.

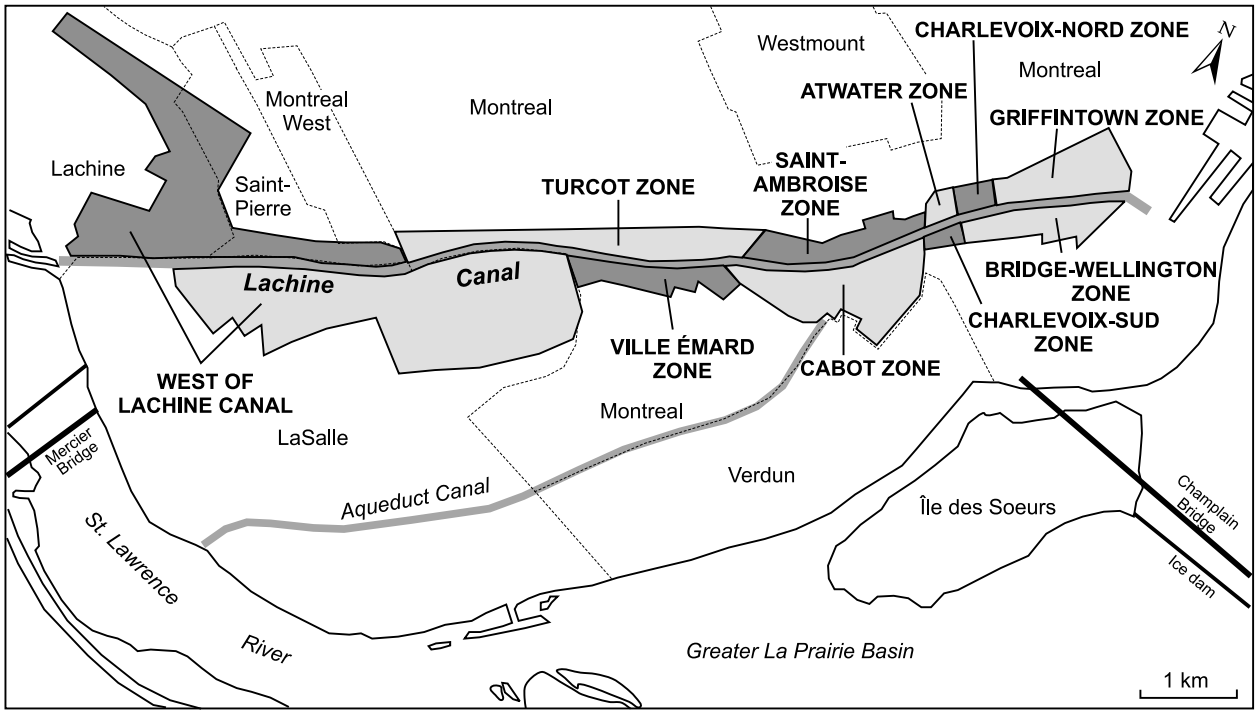
3.3 Human Occupation

The Lachine Rapids brought an end to Jacques Cartier's efforts to find a western passage. This obstacle to navigation constituted one of the prime reasons for the founding of Ville-Marie later on and also for establishment of the Port of Montreal, at the end of the navigable river channel. As the hub of railway transportation of merchandise to Western Canada and the northeastern United States, Montreal's industrial activity sprang up around the port and then continued along the Lachine Canal. At one point, there were 252 industrial plants standing on the canal's banks.

By giving large-tonnage ships access to the Great Lakes, the St. Lawrence Seaway, built between 1954 and 1959, was to change the activities of the Port of Montreal and, as a result, those of neighbouring industrial districts.

Bridge construction and the expansion of the main highway networks in the 1960s promoted urban sprawl. Not only did the residential suburbs grow, but there was also a redeployment of industrial activity toward the periphery, especially the south shore.

This restructuring of the urban framework occurred to the south of the river by encroaching on farmland and riparian habitats, then invading farmland farther inland. At the same time, north shore municipalities saw their industrial activity decline. Their residents, affected by unemployment, became poorer, and the exodus of young people left an aging population. Only in recent years has new development begun, this time based on light industry and service companies. The area surrounding the Lachine Canal (Figure 5) remains important in terms of economic activity; in 1990, it was home to 550 companies in various sectors (industrial, services, etc.), and accounted for some 9500 jobs.



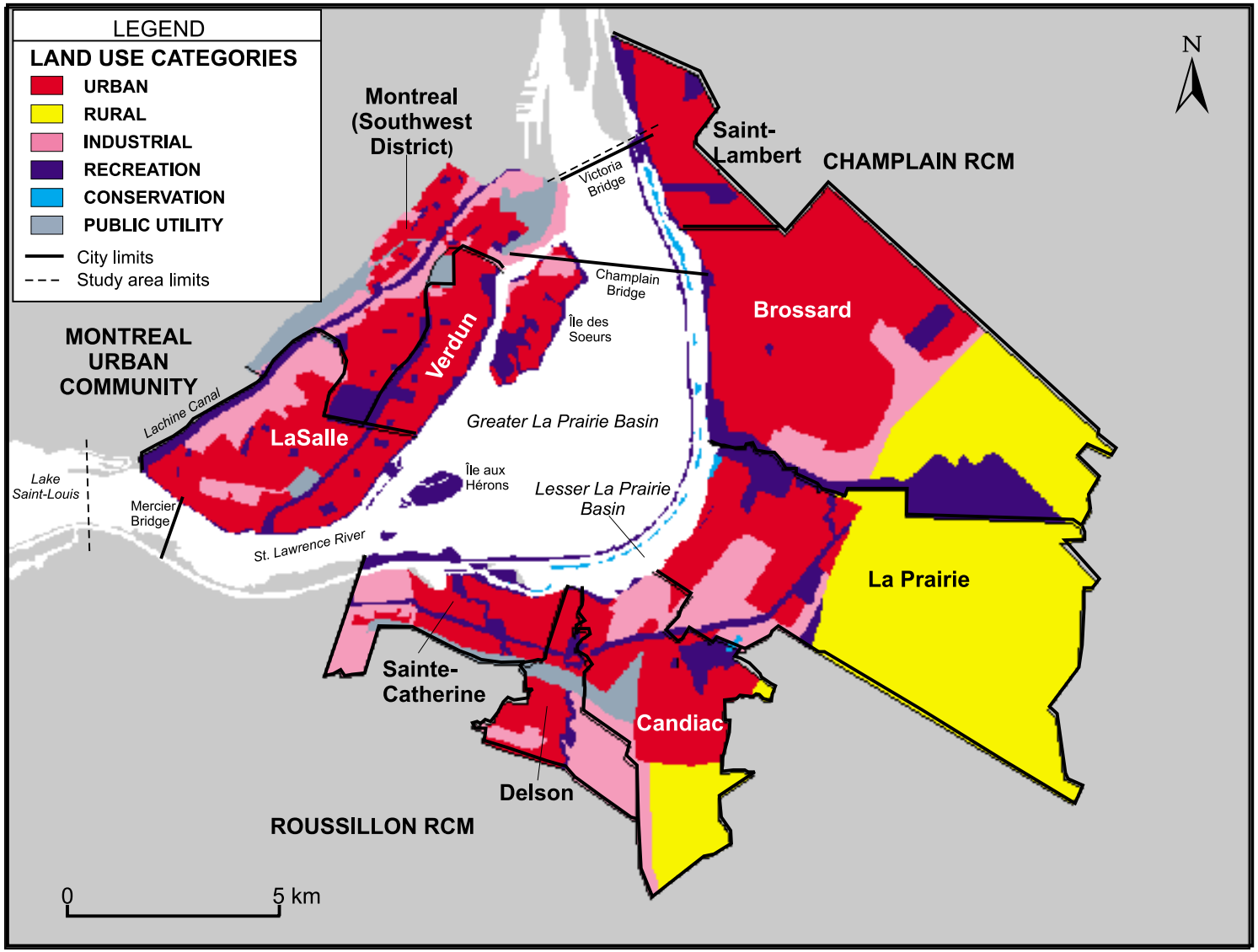
Source: City of Montreal, 1991b.

Figure 5 Industrial zones on the banks of the Lachine Canal

At the present time, the general trend toward sprawl continues, although it has slowed somewhat. South shore suburbs are developing in the direction of La Prairie, Delson and Sainte-Catherine.

In 1991, the riverside municipalities of the study area had more than 330 400 inhabitants, of whom 61% were living on the north shore. The occupation density varied between 343 and 5025 inhabitants/km^2, as observed in La Prairie and the Southwest Montreal district, respectively.

In terms of land-use planning, the urban designation now dominates, accounting for 44% of the area (Figure 6); farming, to the south, ranks second (25%), but is being pressured by urban development, judging by the trend to dezoning farmlands.



Source: Bibeault et al., 1997. Adapted from: Champlain RCM (Regional County Municipality), 1986; Roussillon RCM, 1988; Montreal Urban Community, 1986; City of Montreal, 1992; Ville Lasalle, 1989; City of Verdun, 1989.

Figure 6 Land use in riverside municipalities

The industrial sector accounts for 14% of the available space, mainly along the Lachine Canal, on Montreal Island, and in the municipal industrial parks on the south shore. Lastly, recreational use (14% of the surface area) is common along the river's shoreline and in some inland areas (Lachine Canal, river promenades, cycling paths).

CHAPTER 4 Main Effects of Human Activities on the Environment

Human activity has degraded or eliminated many habitats in aquatic and riparian environments on the outskirts of the city.

4.1 The Physical Modification of Aquatic and Riparian Environments

In the La Prairie Basins area, the disturbances that seem to have had the most impact on the natural environment are physical modifications. These take the form of fill deposited to transform a swampy zone considered useless by developers into building lots, and diking done to protect a property from flooding. There are various structures (bridges, pilings, tower bases, dams, ice dams, docks and others) installed in the river or on its shores, with consequences for flow conditions. Then there is the dredging and dumping of fill, which can modify the configuration of the river bottom and the distribution of sediments. In some cases, the structures that affect natural resources in an area may be located at some remove, either upstream or downstream.

All these changes can contribute to the impoverishment of the environment. A natural riverbank usually has a very gentle slope and the substrate and vegetation are arranged in such a way that the transition between land and aquatic environments occurs gradually. Such peripheral riparian habitats are very rich in fauna: mammals, birds, fish, amphibians and reptiles frequent these areas to breed, find shelter or feed.

Filling causes these environments to disappear. Slopes become abrupt, eliminating the transition zone; coarse materials, arranged so as to resist the current, no longer allow vegetation to flourish. Not only fauna and flora disappear from the filling sites: there is also a reduction in the abundance and diversity of adjacent terrestrial and aquatic environments. Degraded riverbanks are much poorer and less productive habitats than segments preserved in their natural state.

Some riparian habitats subject to spring flooding play an important role as spawning grounds. In spring, a number of fish species leave the cold waters of the river to breed in flooded

fields. Incubation of eggs and growth of fry occur faster in these calm, shallow waters, quickly warmed by the sun. As a result, flood control has the effect of limiting the reproduction of a number of fish species.

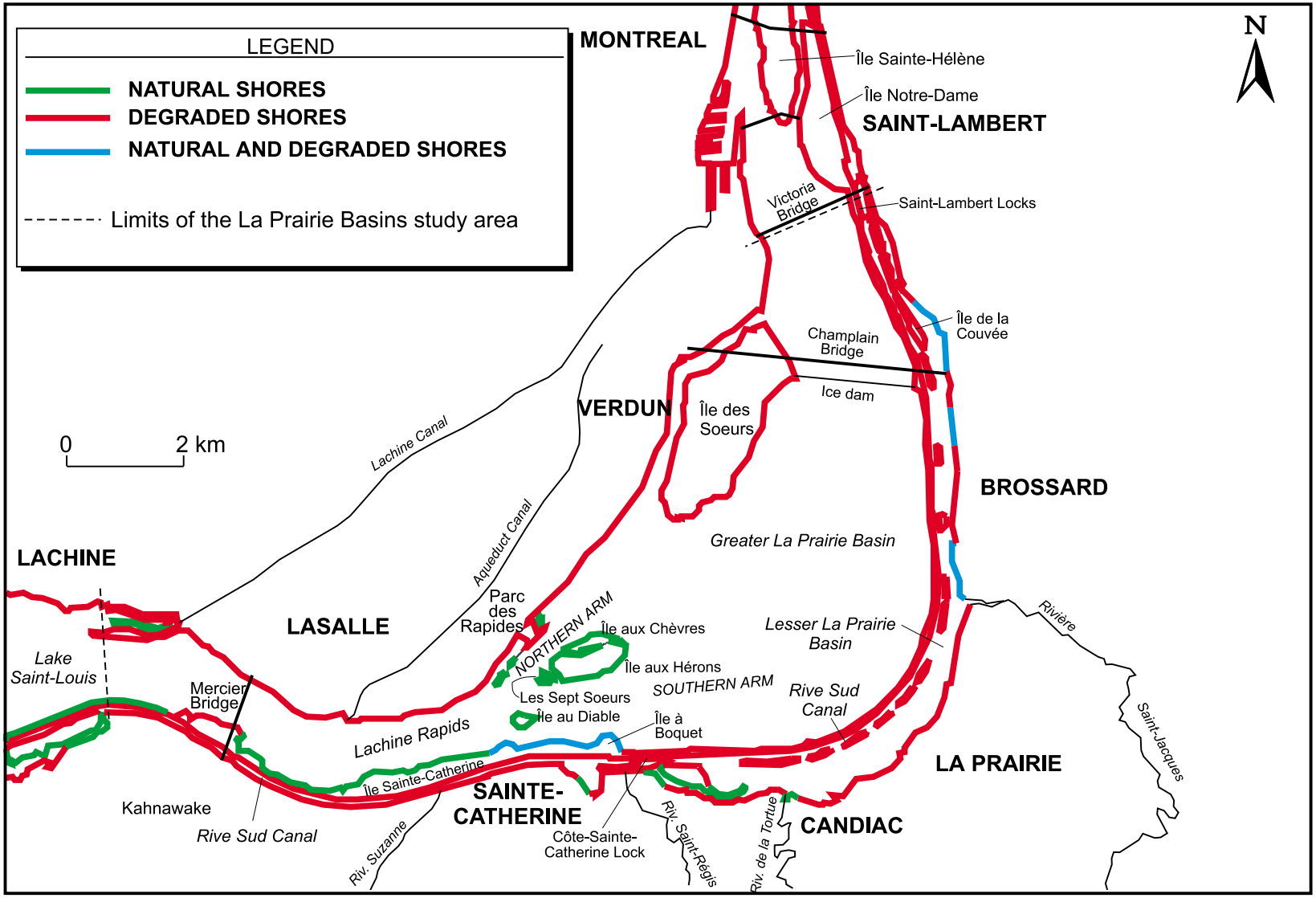
That portion of the St. Lawrence along Montreal Island is the most degraded course between Lake Ontario and the sea. The tentacular growth of the city has multiplied reasons and opportunities for encroachment on the river. Little by little, roads, bridges, transmission lines, residential and industrial buildings, parks and marinas have caused natural environments to disappear.

Though their cumulative effect is great, it is virtually impossible to assess the consequences of such encroachment, taken one at a time. The first transformations, dating back to the 18th and 19th centuries, were not large in scale and their effect was probably local. The pace of change and its scale intensified during the 20th century, however.

Today, it is estimated that at least 84% of the river's shores along the Lachine Rapids and the Greater and Lesser La Prairie Basins are degraded (Table 3). The largest section of remaining natural shores are found around the islands of the Lachine Rapids, along the Kahnawake Native Reserve, on one of the Seaway islands opposite Sainte-Catherine, and south of the Lesser La Prairie Basin (Figure 7).

Table 3
Length of the riverbanks in three sections of the study area and proportion that has been modified by humans

Body of water	*Length of shores (km)*	*Degraded riverbanks (%)*
Lachine Rapids	23	63
Greater La Prairie Basin	26	100
Lesser La Prairie Basin	79	85
Total	**128**	**84**



Source: ARGUS Environmental Consultants Inc., 1996; Clavet, 1983.

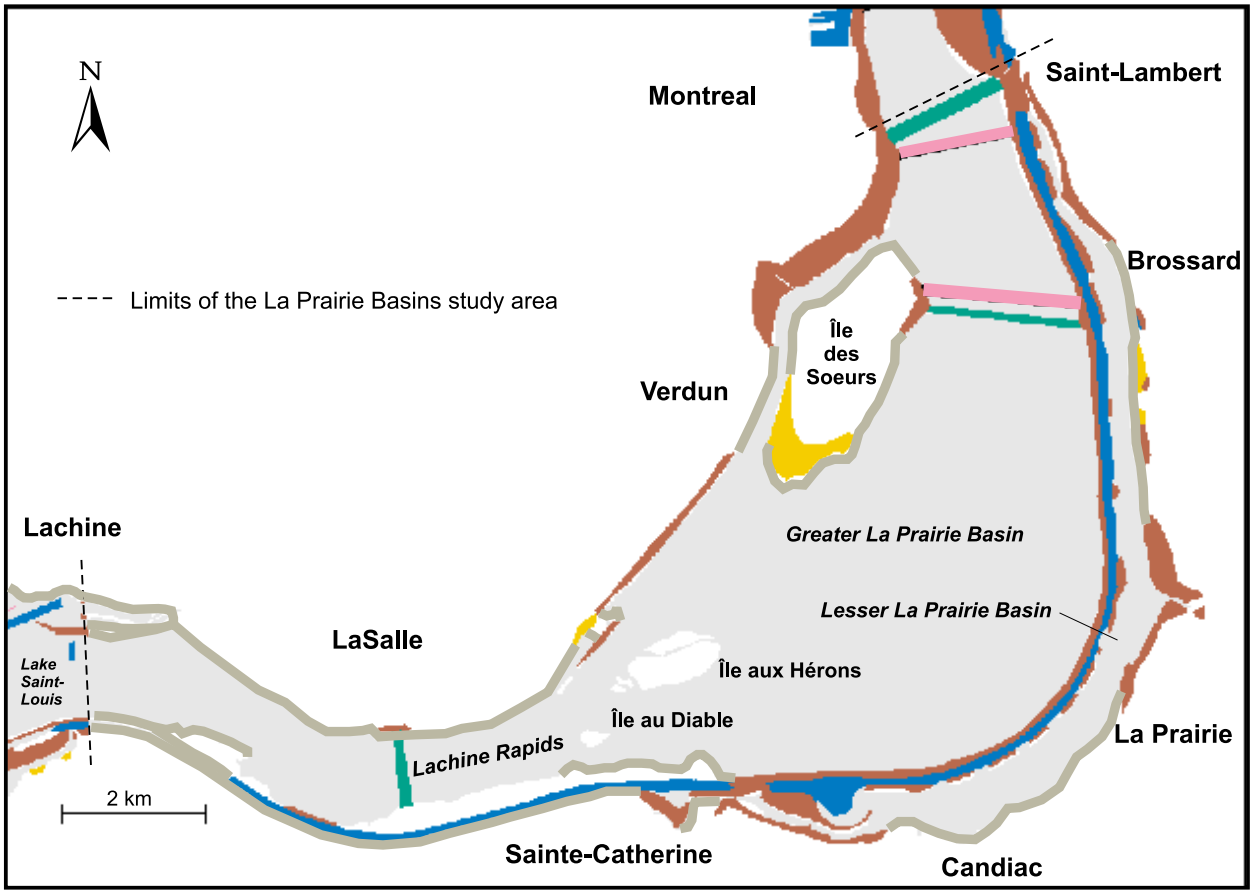
Figure 7 Distribution of natural and degraded shores

There are only a few small areas of marshes, swamps and wet meadows left. The loss of riparian and aquatic habitats, estimated at more than 1000 ha (of which 700 ha is aquatic plant communities) between 1945 and 1984 alone, has undeniably affected biological communities (Figure 8). Aquatic plant communities have been reduced by an estimated 30%, while the marshes and wet meadows have been reduced by 80%. Encroachement on swamps has resulted in a 15% loss.

In the study area, the largest modification of the aquatic environment seems to have been the construction of the St. Lawrence Seaway and the creation of the lesser basin, between 1954 and 1959. Aquatic and riparian habitats were then isolated from the greater basin by a long dike linking Ile Notre-Dame to Boquet peninsula. A navigable channel some 8.6 m deep was dug along this dike, on the right bank, and the fill was used to create islets dividing the Seaway from the remainder of the lesser basin. The shipping channel opens on to the canal on the south shore, dug between Sainte-Catherine and Kahnawake. The first lock, at Saint-Lambert, enables ships to enter the Seaway in the lesser basin; a second, at Sainte-Catherine, gives them access to the canal on the south shore to reach Lake Saint-Louis.

The lesser basin is shallow (less than 2.5 m outside the navigable channel) and its flow rate is minimal (less than 149 m^3/s). Since current velocity is low (about 10 cm/s), suspended matter tends to accumulate and form a layer of silt on the bottom. The lesser basin serves as a kind of sediment sink. A number of toxic substances, bound to particles, have accumulated in this artificial body of water since it was created (see section 4.2.2.2).

Around the lesser basin, the dumping of materials during construction of the St. Lawrence Seaway and then Highway 132 has caused most of the natural riverbanks to disappear. Furthermore, the management of water levels for Seaway maintenance after the shipping season causes damage to the banks. Annual work requires the water level to be lowered and then raised quickly when the ice cover is formed, tearing vegetation from the shores in the process.



MODIFICATION	AREA AFFECTED (ha), BY TYPE OF ENVIRONMENT				
	Aquatic plant community	Marsh and wet meadows	Swamp	Deep water	TOTAL
Backfilling	351	79	6	167	603
Drainage	70	0	6	0	76
Dredging	276	0	0	0	276
Flow modification	0	0	0	76	76
Backfilling and flow modification	0	0	0	47	47
Other modification (degraded shore)	--	--	--	--	--
TOTAL	697	79	12	290	1078

Source: Adapted from Armellin et al., 1997; Robitaille et al., 1988; ARGUS Environmental Consultants Inc., 1996; Clavet, 1983.

Figure 8 Physical modification of aquatic and riparian habitats since 1945

The small artificial islands created between the navigable channel and the remainder of the lesser basin are today acknowledged to have some value as wildlife habitats. Some fish spawn around these islands, which are also used as nesting sites by ducks, gulls, terns and some shorebirds. However, this positive assessment does not account for the losses incurred when the lesser basin was created, which have never been evaluated. For the fish in the greater basin, in particular, construction of the dike has probably cut access to calm and shallow waters that are especially suited for spawning and rearing fry. A major decline in catches of Brown bullhead, a fish that spawns along the shore, occurred during construction of the St. Lawrence Seaway.

Excavation of the Lachine Canal, an artificial aquatic habitat some 13.4 km long linking Lake Saint-Louis and the Port of Montreal, took place between 1821 and 1825. The structure was later enlarged and redesigned on two occasions. Initially intended as a detour around the Lachine Canal for ships, the canal then became the site of an extremely important industrial complex. A large number of industries opened in the vicinity and for decades discharged their untreated wastewater into the canal. Used less and less by vessels once the St. Lawrence Seaway was opened in 1959, the Lachine Canal was finally closed to navigation in 1970. It is fed by the waters of Lake Saint-Louis through the Lachine basin. The discharge rate in the canal is 13 m^3/s.

Among other major disruptions of the aquatic habitats in recent decades have been the construction of Highway 132 (south shore), the Bonaventure Autoroute, parking lots for Expo 67 (the site of today's Techno Parc) and the Adacport, the installation of the Brossard main sewer and fill work on Ile des Soeurs. The latter, which took place between 1964 and 1976, caused serious losses of natural habitat. It is estimated that 90% of the marshes and aquatic plant communities, which are prime habitats for waterfowl and fish, have been replaced by residential complexes.

4.2 Contamination

For a long time, the river was considered a convenient and inexpensive way of getting rid of wasterwater. Industries, municipalities and farms simply dumped their effluents and

drainage water into the river without treatment, until the effects of the pollution caused by this practice became evident. The scale of the problem forced governments to monitor effluents and establish standards for the concentrations of substances being discharged. However, a number of products had become fixed in the environment, in one way or another, and continue to contaminate it years after being discharged.

The volume and nature of the effluents determine their effects on the environment. Industries are usually the main sources of toxic chemicals, while municipal waste contributes to bacterial contamination and a sharp increase in biological output. This can have the effect of causing a proliferation of algae and stinking water that is hardly appealing to swimmers. Farming can also contribute to water enrichment, while causing pesticides used for crop treatments to enter the aquatic environment in runoff.

4.2.1 Sources of contamination

It is estimated that the largest sources of contamination in the La Prairie Basins are inputs from upstream (coming from the Great Lakes, for example), local industries, municipal effluents and tributaries[1]. It is likely that surface runoff from the urban environment, hazardous waste sites, inputs of fertilizer and pesticides from farming activities, and atmospheric transport also contribute to contamination of the aquatic environment. The contribution of these sources, difficult to evaluate at this time, is treated here as being part of the tributary loading.

For the Lesser La Prairie Basin and the Lachine Canal, environments in which the flow is reduced, the preponderant influence of local sources (industrial and municipal effluents) is obvious.

4.2.1.1 *Fluvial inputs*

The St. Lawrence itself carries a large number of substances captured upstream. The calculation of these inputs, known as a *mass balance*, was done for nitrogen, phosphorus and

[1] The tributaries, which in fact include non-point inputs and inflows from all sources situated in their basin, are treated here as if they were specific inflows coming from the shores of the river.

suspended matter in 1990 and 1991 — that is, before municipal and industrial effluents from the study area were sent to treatment facilities. These estimates show that the lowest concentrations of these three substances were observed in the Valleyfield–Brossard section, and their levels in the river water increased as it moved downstream, especially between Montreal and Trois-Rivières.

With respect to inputs of metals and organic substances, the load estimates available are based on levels measured at the inlet to Lake Saint-François, to which are added the contribution of tributaries and that of the industries targeted by the St. Lawrence Action Plan (Table 4). Inputs of PCBs shown in this table are essentially of human origin, while one half the PAHs come from natural sources (e.g. forest fires).

Table 4
Mean annual inputs of contaminants to the La Prairie Basins area, from the river and its tributaries, based on data collected in 1990, 1991 and 1992 (annual loads in kg/year)

Substances	*River (at Cornwall)*	*Tributaries*	*Action Plan plants*	*Total*
Metals				
Cadmium	4 206	452	281	4 939
Cobalt	43 690	5 196	-	48 886
Chromium	363 606	20 285	3	383 894
Copper	168 015	14 800	687	183 502
Lead	52 352	5 461	-	57 813
Nickel	354 987	13 749	-	368 736
Zinc	597 995	45 703	19 307	663 005
Organic substances				
PCBs	29.0	3.5	Unknown	32.5
Total PAHs	2298.0	215.4	Unknown	2513.4

On the other hand, metal loads, which are much higher, consist of a natural fraction that depends on the geochemistry of the basin, to which is added a contribution from human activities. The *anthropic enrichment factor* calculated for the metals is a ratio of the measured levels to natural concentrations.

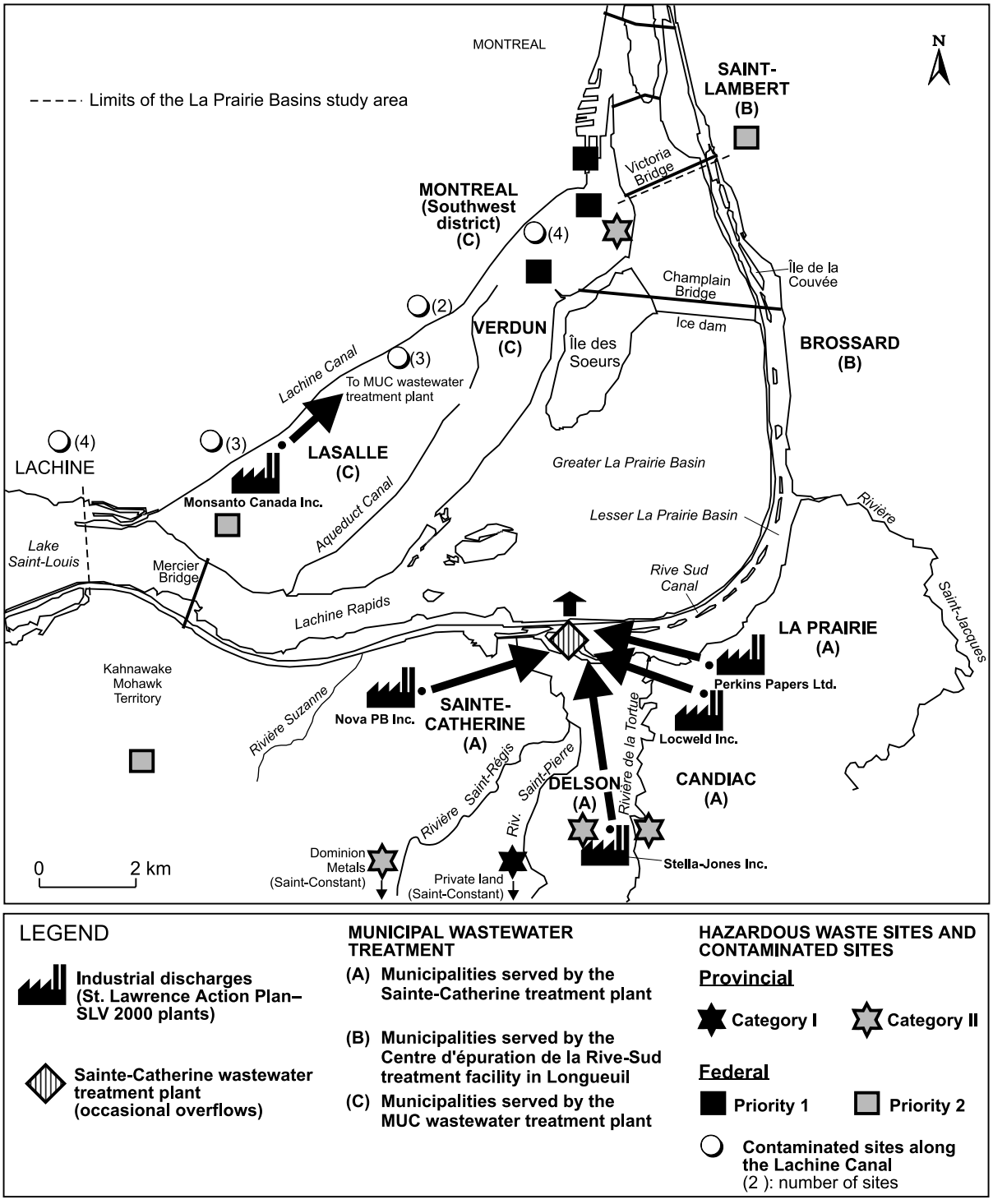
The metal levels observed in sediments deposited over a long period on the bottom of Lake Saint-Louis, just upstream of the study area, offer some insight into the history of the changes that have occurred over the years in the water coming from the Lachine Rapids. According to this information, which allows us to go back in time to an age when there was virtually no industrial activity, chromium and nickel were present in the water in quantities slightly above natural levels (enrichment factors of 2.0 and 1.9, respectively) in the early 1990s, while zinc and cadmium were 3.5 and 6.7 times more concentrated than in the natural waters because of human activity.

4.2.1.2 *Industries*

The study area, particularly Montreal Island, has long been industrialized. Whereas industrial process waters were once discharged directly into the river, plant discharges today are the subject of more careful regulation and monitoring. Many effluents are now redirected to sewer systems and municipal wastewater treatment plants. Some establishments have closed their doors or improved their facilities, in both cases causing a reduction of toxic discharges into the environment. However, many pollutants have accumulated over the years in the sediment deposition zones and still remain there. The most obvious examples of this are the Lachine Canal and the Lesser La Prairie Basin.

Industrial effluents. Five of the industries identified as priorities under the St. Lawrence Action Plan and then SLV 2000 in terms of discharge reduction are located in the study area (Figure 9). In 1990, the loading of toxic substances being released into the aquatic environment in their effluents was low. The cleanup measures applied to these facilities has reduced the toxicity of their effluents between 1988 and 1995.

The Monsanto Canada Inc. facilities are located near the Lachine Canal. This organic chemical plant manufactured resins, plasticizers, styrene polymer salts, maleic acid salts and herbicides. However, between 1988 and 1996, the company closed a number of production units. Herbicides are produced in a closed-loop system, with no discharges. The process water generated by other processes may have served in washing reactors, in cooling or in certain phases



Source: Bibeault et al., 1997; Fortin et al., 1997.

Figure 9 Main local sources of contamination of the La Prairie Basins

of product purification. At the present time, the effluent undergoes a settling process; oils, plasticizers and resins are removed and it is neutralized before being discharged to the LaSalle main sewer. It would have then been discharged to the Greater La Prairie Basin until August 1995, but is now connected to the Montreal Urban Community wastewater treatment plant.

The Locweld Inc. plant, on the south shore, manufactures and galvanizes steel parts for use in making towers. The effluents have undergone treatment since the early 1980s. The process waters are treated by neutralization, precipitation and filtration. The treated effluents are then discharged to the municipal sewer system in Candiac, linked since 1991 to the Sainte-Catherine wastewater treatment plant. Before the introduction of control measures, the discharges of this plant would have contributed to the heavy metal contamination of the Lesser La Prairie Basin. However, the company's efforts have brought about a major reduction in toxic discharges.

Perkins Papers Ltd. manufactures table napkins, paper tablecloths, paper handkerchiefs and toilet paper. This company treats its own process water, which is sent to the Candiac sewer system and then the Sainte-Catherine wastewater treatment plant. The toxic substances found most in the effluents of this type of plant are dioxins, furans, resin acids, and certain organic compounds.

The Nova PB. Inc. and Stella-Jones Inc. plants are just two of the 56 plants added to the original 50 with start-up of the St. Lawrence Vision 2000 action plan. Discharges at these plants have not been subject to recent characterization. The Stella-Jones Inc. plant treats wood with oil-based preservatives (creosote and pentachlorophenol) and water-soluble salts (chromated copper arsenate). Based on effluent characterizations performed in 1984 and 1989, it was estimated that this plant might be a major source of chlorinated dioxins and chlorophenols released to the environment. Plant discharges should be characterized in 1997. Furthermore, there is a problem of soil and groundwater contamination from pentachlorophenol (PCP) at the Stella-Jones plant. Runoff from the plant site[2] and leachate water from the piles of treated wood are flowing into the Saint-Pierre and de la Tortue rivers.

[2] These lots still belong to Domtar, which remains responsible for runoff.

The Nova PB Inc. plant in Sainte-Catherine is a lead refinery. The plant's process waters are treated locally before being reused. According to the company's records, effluents in 1995 contained mainly sulphates, lead and zinc. However, the company expects to discharge no industrial effluents starting in 1997; as such, there is no need for an exhaustive characterization study of this site.

Contaminated sites. In addition to effluents, industries produce hazardous wastes which are disposed of in dumps. In the long term, these sites can also contribute to contamination of the aquatic environment. Some products may leak and migrate to the water table, ultimately ending up in watercourses.

There are ten contaminated land sites in the area under study (Table 5). These are another two, in Saint-Constant, outside the study area (Figure 9) which may contribute to the contamination of the Lesser La Prairie Basin through one of its tributaries.

The presence of industry on the banks of the Lachine Canal has long caused the contamination of neighbouring lands. Soil and groundwater characterization work carried out in the early 1990s identified 16 sites where restoration work would be necessary if the sites are to be reused for agricultural, residential or recreational purposes (Table 5). The sediments in the canal, polluted by heavy metals and PCBs, are also a potential source of contamination of the aquatic environment.

Generally speaking, the contaminated sites at some distance from the river and its tributaries present less risk of affecting the aquatic environments. Nevertheless, these sites seriously limit use of the affected land.

4.2.1.3 *Municipal discharges*

Virtually the whole population of the study area is served by municipal sewer systems whose effluent, for the most part, flowed into the river untreated until the late 1980s. At the time, the outfalls of nine municipalities on the north shore discharged into the Greater La Prairie Basin and eight on the south shore into the lesser basin.

Table 5
Contaminated sites in the La Prairie Basins area

Location/Jurisdiction	*Owner*	*Main contaminants*	*Classification by potential risk*
A. MINISTÈRE DE L'ENVIRONNEMENT ET DE LA FAUNE DU QUÉBEC (GERLED sites)			
North shore			
Southern tip and southwest of Ile des Soeurs	Several private owners	Heavy metals, phenols, PAHs	III
Former site of Adacport	City of Montreal	Heavy metals, oils and greases	II
Landfill site for contaminated soils in LaSalle	Cintec Environnement Inc.	Heavy metals, PAHs and oils and greases	III
South shore			
Site of former sanitary landfill in Delson	City of Delson	Phenols, iron, lead, zinc	II
Domtar Inc. site in Delson	Domtar Inc.	Pentachlorophenol, creosote, arsenic, copper and chromium	II
B. FEDERAL GOVERNMENT			
North shore			
Bed of Lachine Canal	Heritage Canada	Heavy metals and PCBs	Not classified
Banks of Lachine Canal*	Heritage Canada	Heavy metals	Not classified
Mouth of the Lachine Canal	Transport Canada	Heavy metals, oils and greases	Priority 1
Via Rail - Montreal Maintenance Centre	Canadian National	Heavy metals, oils and greases, hydrocarbons	Priority 1
Via Rail - Pointe-Saint-Charles Yards	Canadian National	Hydrocarbons, heavy metals	Priority 1
Naval Technology Testing Centre in LaSalle	National Defence	Hydrocarbons, solvents	Priority 2 (potential)
South shore			
Saint-Lambert Marshalling Yard	Canadian National	Hydrocarbons	Priority 2
Patton landfill site	Northen and Indian Affairs	Mercury, cyanide, phenols, PAHs and PCBs	Priority 2

Source: D'Aragon, Desbiens, Halde et associés Ltd. and Roche Ltd., 1992; MENVIQ, 1991a; 1991b; Hubert, 1996; Leblanc, 1996; Pépin, 1996; Robert, 1996; Pelletier, 1997; Areco Canada Inc., 1993.

Note: The classification of each site with respect to environmental risks (right column) is determined by the agency with jurisdiction.

* This installation was not classified in the inventory conducted by D'Aragon, Desbiens, Halde et associés. The banks of the Lachine Canal have been the subject of a characterization study (soil and groundwater) conducted by Environcorp in 1990 and Areco Canada Inc. in 1993.

Three wastewater treatment plants have been built since 1988, to which the main sewers of the municipalities in the study area have been gradually connected. The last connections on Montreal Island were made in 1995. Wastewater is sent to the Montreal Urban Community (MUC) treatment plant, which has been in service since 1988 and is located at the eastern tip of Montreal Island. On the south shore, municipalities are connected to the Centre d'épuration de la Rive-Sud (CÉRS) (south shore treatment centre), with one plant located on Ile Charron in Longueuil (1992) and a regional plant in Sainte-Catherine (1990). The latter is the only one to discharge its treated waters into the Greater La Prairie Basin, at the foot of the Lachine Rapids (Figure 9). The outflows of the other two stations (MUC and CÉRS) reach the river downstream of the La Prairie Basins area.

In principle, municipal discharges should no longer constitute a problem for this stretch of the river. However, during heavy rains, stormwater collected by the MUC domestic sewer system overloads the system, causing untreated water to be spilled through a series of overflow structures along the river. Moreover, the processing capacity of the Sainte-Catherine treatment centre, which uses an activated sludge system, is not always able to meet demand. This also causes spills of untreated wastewater at the foot of the Lachine Rapids. The frequency of such spills (23% in 1993, 30% in 1995) earned the station a low rating during two performance evaluations by the Ministère de l'Environnement et de la Faune.

Once this last problem is solved, the quality of the environment in the greater basin should improve quite quickly. However, the lesser basin may remain subject to the effects of past discharges for a long time to come, because of the very long residence time of sediments and contaminants in this location.

Moreover, although the treatments applied to the wastewater reduce the quantity of micro-organisms it contains, it does not eliminate them completely.

4.2.1.4 *Tributaries*

Several rivers collect the effluents from industries and municipalities in their drainage basin at specific points in their course and carry them to the St. Lawrence. The tributaries are also the main gateway to the aquatic environment for fertilizers and pesticides used on farmlands,

surface runoff from urban environments and leachates from hazardous waste sites (see the section on contaminated sites, in 4.2.1.2). Unlike the irregular discharges from factories and municipal sewers, such pollution appears in a *non-point* or *diffuse* manner. Meltwater, rainwater and irrigation water which travel through croplands, through an infinity of trenches, ditches and streams, transport nutrients and pesticides to the rivers.

Fed mainly by Lake Saint-Louis, through the Rive Sud Canal, the lesser basin also receives water from three tributaries in the study area – the Saint-Régis, de la Tortue and Saint-Jacques (or Saint-Lambert) rivers – which drain farm, urban and industrial lands. These small watercourses contribute only 5% of the flow in the lesser basin, but are undoubtedly major sources of contamination for this body of water.

There are several industries in the Saint-Jacques (or Saint-Lambert) and Saint-Régis river basins. The drainage basin of the de la Tortue River was subjected to an intense application of pesticides in 1983. Fifteen of the 28 pesticides considered most toxic, including chlordane and endosulfan, were present in its basin at a rate above 1 kg/ha at that time.

In the southern part of the study area, there are some twenty small farms of an average 48 hectares in size. According to farm census information, about 300 ha of crops were treated in 1991 with pesticides, essentially herbicides. Atrazine, one of the products found in high concentrations at the mouth of the de la Tortue River, is a herbicide used mainly in corn fields. Diazinon, lindane and endosulfan, also found in these watercourses, are insecticides.

4.2.2 Effects of contamination on the aquatic environment

Whatever their origin, the pollutants found in the aquatic environment present risks of varying degrees to the normal functioning of living organisms. Some types of pollution do not have persistent effects, and the quality of the environment improves rapidly as soon as they are no longer being discharged. That is the case, for example, of bacterial pollution, the enriching of water by nutrients or highly soluble substances that are almost entirely carried by the current to the sea. Some relatively insoluble pollutants can, however, concentrate in sediments and organisms because they are chemically stable in their original form or as by-products of

decomposition in the environment. Substances that persist in the environment may be found in high concentrations in living organisms.

Levels of toxic substances can increase in an organism throughout its lifetime, a phenomenon known as *bioaccumulation*. But it can also increase from one link to the next in the food chain by the process known as *biomagnification*. Substances are gradually transferred to predators (fish, birds or mammals) on higher rungs of the food ladder, reaching high concentration in these animals (Figure 10).

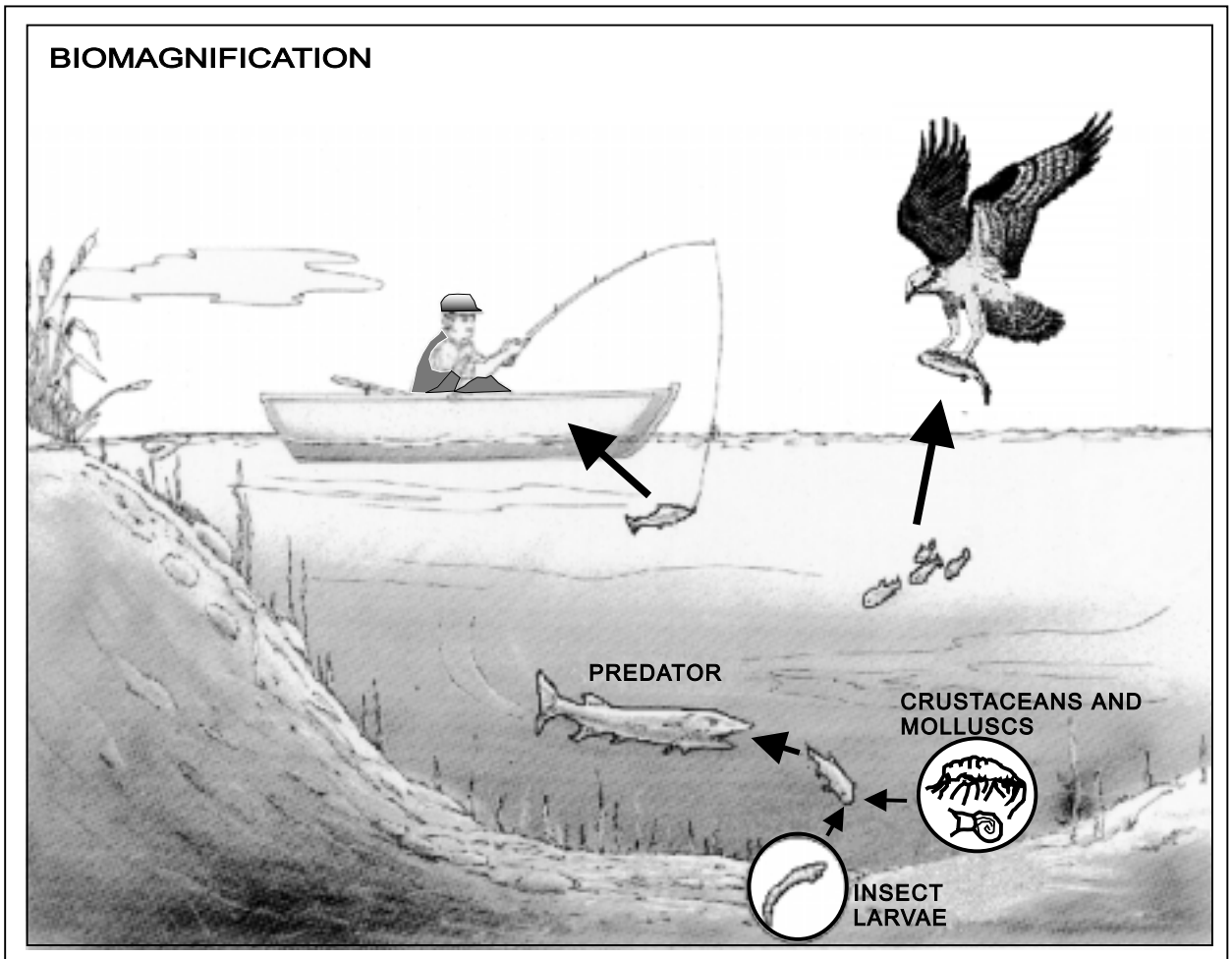
For researchers who wish to confirm the presence of a product in the environment, biomagnification can provide useful indicators. Thus, analysis of the flesh of predators, fish or birds, sometimes reveals the presence of contaminants that are present in the water in quantities too small to be detected there directly, even with the best analysis techniques.

The criteria used to evaluate the extent of the contamination of the aquatic environment and losses of use that results from it are the quality of the water, sediment and organisms (Appendix 2).

4.2.2.1 *Water*

At the present time, there are gaps in the data used to assess the quality of water and establish what uses are possible. The small number of sampling stations and their distribution limit the scope of the evaluation that can be made. Furthermore, some measurements date from the 1985-1993 period, before the connection of sewer systems to treatment plants. They are probably not representative of the present situation, which should be better, at least in the greater basin, as the result of the cleanup measures implemented. Finally, visits to sampling stations in the monitoring networks are too infrequent to detect seasonal fluctuations.

Generally speaking, water quality seems quite good in the rapids and greater basin in bacteriological and chemical terms. In the early 1990s, some deterioration in the bacteriological quality of the water in the lower section of the study area was observed, due to the Saint-Pierre outfall (between Ile des Soeurs and Montreal) and sewer overflows. In 1992 and 1993, there were reports of the criteria for the protection of aquatic life being exceeded in the plume of this outfall



Many invertebrates, such as aquatic insect larvae, molluscs and crustaceans, live on the bottom of water bodies. In their tissues, they accumulate the toxic substances attached to the sediments or adsorbed to suspended matter. These small organisms are then eaten by others higher up the food chain, like Yellow perch, which are in turn eaten by larger predators such as Northern pike or walleye, or by fish-eating birds like the Osprey or by humans. From one link to the next in the food chain, toxic substances accumulate in increasingly larger concentrations.

Source: Adapted from St. Lawrence Centre, 1990.

Figure 10 Biomagnification

with respect to iron, copper, chromium, lead and zinc. Since 1995, the outfall has been connected to the MUC system.

There were reports of arsenic concentrations being higher than the quality criterion for raw water[3] and the criterion for protection of aquatic life. However, the generally higher concentrations of this metal measured in the whole Great Lakes–St. Lawrence system suggest that most of the arsenic present in the water comes from natural sources, rather than human activities.

According to data collected in 1991 and 1992, the water was of good bacteriological quality when it entered the Rive Sud Canal, but became polluted by the time it reached the downstream end of the lesser basin. Recreational activities involving contact with the water are therefore not recommended in the Lesser La Prairie Basin.

Concentrations of suspended matter and phosphorus at this location reached levels considered harmful to aquatic life at the time the municipal sewers were being connected to the Sainte-Catherine and Longueuil wastewater treatment plants. Enrichment of the watercourses in nutrients such as phosphorus can result in the proliferation of aquatic plants and, when they decompose, reduction of dissolved oxygen content. These conditions are unfavourable to aquatic species and make the water smelly and unappealing.

In most of the study area, the concentrations of organic substances present in the water are not a problem. Of the 18th substances analysed in the water of the greater basin between 1985 and 1990, only two were commonly detected[4] and all were in concentrations below the most restrictive criterion.

Three tributaries of the lesser basin, the Saint-Régis, de la Tortue and Saint-Jacques rivers, which drain some farmlands, were contaminated by a number of organic pesticides in 1988. Two of these, atrazine and diazinon, reached toxic concentrations for organisms that are exposed to them continuously.

---

[3] That is, untreated water taken directly from the body of water, treated and intended for human consumption; the criterion is also intended for the protection of human health associated with the consumption of organisms (fish, molluscs or others) that live in this body of water.

[4] Both these substances are organochlorine pesticides, α-BHC and γ-BHC (lindane).

In all probability, the connection of the sewers and the cleanup programs implemented by several industrial plants have had the effect of reducing local inputs of a number of substances in the study area. However, there is no recent data confirming this assumed improvement in water quality.

In the Lachine Basin, at the head of the Lachine Canal, the water quality in 1990 was generally good, with the exception of some high values for lead, copper, total phosphorus and sometimes chromium likely to be harmful to aquatic life. Also, concentrations of fecal coliform in some samples reached the threshold above which contact recreational activities are no longer advisable. In the canal itself, the quality of the water has deteriorated somewhat. Average concentrations of cadmium, copper, lead and total phosphorus reached or slightly exceeded the aquatic life protection criterion. The average concentration of fecal coliform was below the quality criterion for recreational activities, however.

4.2.2.2 *Sediments*

A number of contaminants bind to particles suspended in the water and tend to be deposited on the bottom in areas where the current slows down. This results in beds of contaminated sediments that can contribute to the contamination of organisms in the environment. Zones of sediment deposition often correspond to aquatic plant communities, usually heavily used by benthic organisms, which are themselves at the bottom of the food chain. The presence of contaminated sediments could eventually pose a risk for the fish, birds or mammals that feed at these locations and ultimately for the hunter or fisher who then consumes them.

According to available information, there is little permanent sediment deposition in the greater basin. The only zone in which contaminated sediments have been found is located near the dike and dam of the old LaSalle hydroelectric power station. The data, from the late 1970s, indicate high concentrations of heavy metals (copper, chromium, mercury, lead and zinc). No recent study provides information on whether the level or extent of the contamination at this location has changed.

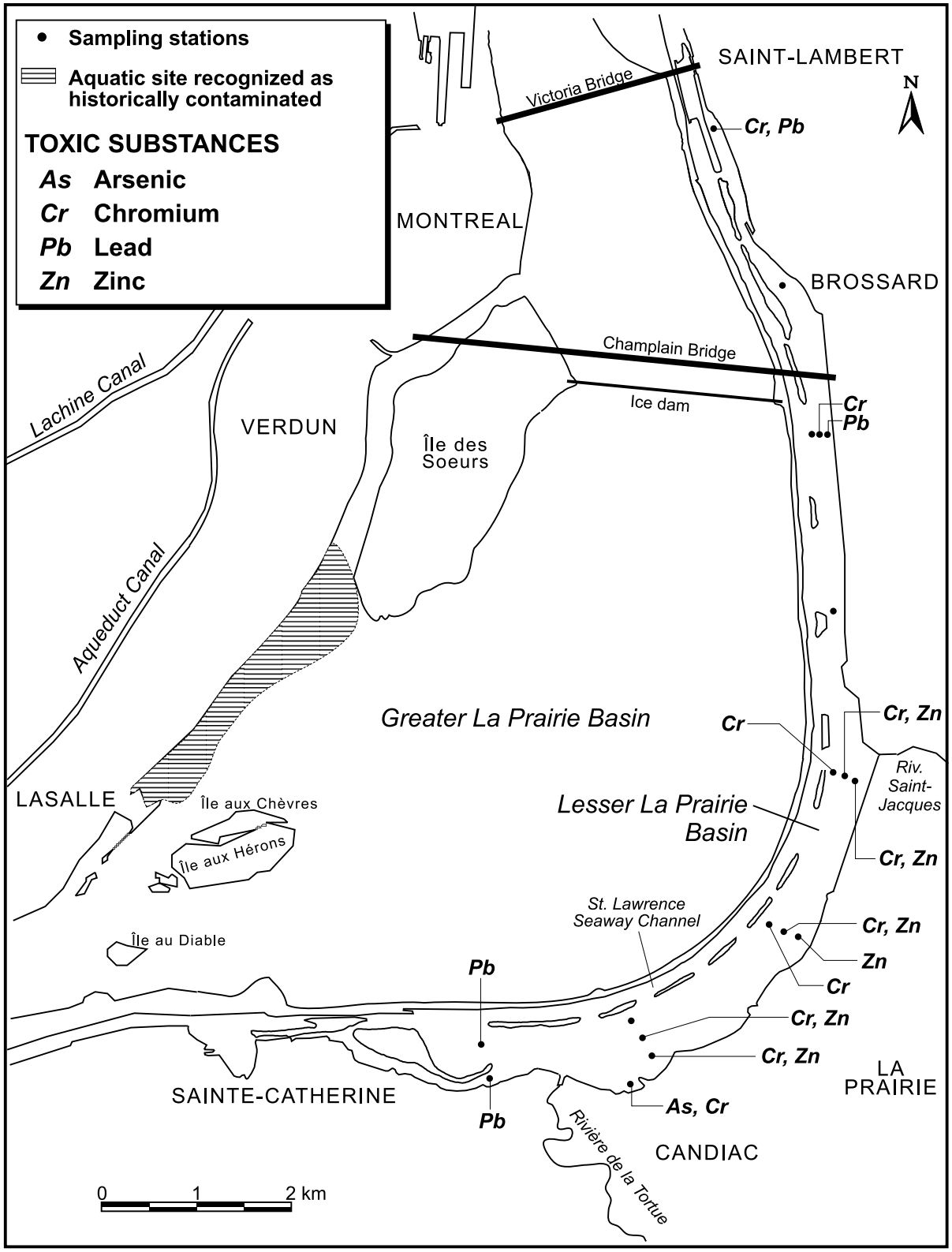
The contamination of sediments in the lesser basin was studied in 1987, and thus before municipalities and industries were connected to the main sewer. There are no more recent measurements with which to assess the effects of a reduction in contaminant inputs on the quality of sediments. It is important to realize, therefore, that the portrait now drawn of this situation is incomplete.

According to available data, the lesser basin presents a suspected level of sediment pollution throughout that could be described as moderate for PCBs, DDE, arsenic and several heavy metals. It is thought that the lesser basin acts as a sink for certain substances coming from upstream. At certain locations, the projected pollution level would be high for arsenic, chromium, lead and zinc (Figure 11), which would also come from other sources, probably tributaries, industrial effluents and the outfalls of municipal sewers. Some data suggest that the Candiac outfall may have been the source of the contamination by arsenic, PAHs, some chlorobenzenes, organochlorinated pesticides and some PCBs.

The bottom of the Lachine Canal is covered with sediments that are heavily contaminated with heavy metals (chromium, copper, lead and zinc) at concentrations that could disrupt the benthic fauna. The layer of heavily-contaminated sediments is an average of 26-cm thick, and there is a total volume of about 122 000 m^3. High concentrations of mercury have also been measured, especially in the upstream section of the canal, and PCBs in the downstream section.

4.2.2.3 *Living organisms*

Information available on the contamination of the aquatic environment comes from a number of studies conducted for different purposes. None was particularly interested in the distribution of the contamination within the study area. Furthermore, sampling campaigns were spread over a rather long time period (some twenty years), limiting the scope of the portrait painted here. The greatest prudence should be applied to any interpretation until surveys updating this information have been conducted.



Source: Lavalin, 1989; Fortin et al., 1997.

Figure 11 Toxic substances whose levels in the Lesser La Prairie Basin in 1987 may disrupt benthic fauna

For three groups of organisms (plants, fish and birds), there is data that confirms the presence of contaminants, without it being possible, however, to establish links with anomalies in individuals or populations. Thus, a study from 1977 revealed that some metals, such as barium, beryllium, cadmium, cobalt, copper, manganese, strontium, vanadium and zinc, were then present in the aquatic plants in high concentrations. Samples of five species of plants collected in 1992 in the lesser basin show that some concentrations of copper, iron, manganese and zinc in plant tissues were still much higher than the levels of cadmium, chromium, nickel and lead. There is no standard or critical value available, however, to evaluate the possible effects of these contaminants on these plant populations.

In 1976, the flesh of sampled fish contained certain contaminants, but only mercury was found in high enough concentrations in some species to prohibit their sale. In general, it is the predator fish (Smallmouth bass and Walleye), especially large specimens, that present the highest levels. More recently, in 1991, analyses of mercury in Rainbow and Brown trout caught in the Lachine Rapids showed that the limit set for human consumption (marketing standard) was respected. However, the flesh of the largest individuals contained mercury levels that exceeded the recommended threshold for the protection of fish and fish-eating mammals.

In the Lachine Canal, analyses done in 1993 on Rock bass, Pumpkinseed and Yellow perch showed that mercury and lead concentrations were below the limit values for marketing. However, mercury levels were above this limit in the flesh of Northern pike.

In the greater basin, PCB levels measured in 1975 exceeded the marketing standards in the flesh of White sucker, Lake sturgeon and Shorthead redhorse. However, in the early 1990s, no organic substance reached critical levels in fish in the Lachine Rapids or Canal. Other studies on the contamination of St. Lawrence fish have indicated a reduction in mercury and PCB contamination of fish in the fluvial lakes. All signs suggest that the contamination of fish in the study area is following the same trend.

Although the levels of fish contamination do not reach disturbing levels, the contaminants could nevertheless exert a sublethal effect on animal populations. The existence of this effect is suggested by perceptible deviations in certain parameters of the dynamics of two populations of Yellow perch living, respectively, in the Greater and Lesser La Prairie Basins. The

Yellow perch in the lesser basin, which is noticeably more contaminated, are in worse condition than those of the greater basin, according to a whole series of indicators (growth, size, fertility by size or weight, liver volume).

Analyses conducted in the late 1970s revealed the presence of mercury in the flesh of the Spotted sandpiper, a shore bird, and of DDT, DDE, mirex and dieldrin in the eggs of Ring-billed gulls. Other samples, taken in the colony on Ile de la Couvée in 1978 and 1979, revealed the presence of a number of heavy metals and organochlorine products. None of the concentrations reached a level affecting reproduction (eggshell thinning or deformities in nestlings). Analysis of Black-crowned night heron eggs showed that the individuals on Ile aux Hérons were less contaminated than those in the Great Lakes or in Atlantic coastal colonies. Furthermore, a study of the organochlorine content of Great blue heron eggs collected in 1991 from four colonies[5] along the St. Lawrence suggests that the concentrations of mirex, photomirex and octochlorostyrene tend to diminish from upstream to downstream.

Benthic fauna are the most appropriate for assessing the quality of aquatic habitats within various parts of the study area. Since such organisms move little, their degree of contamination gives a good idea of the distribution of toxic products. Moreover, benthic communities in the disturbed environments show changes in their composition that can be more easily quantified than in more mobile, higher animals.

In a general study of benthos using historic data from the Archipel Project, the composition of communities at certain sites was compared to that found in a healthy habitat of the same type. The conclusion was that the benthic communities were in a state that could be described as acceptable to very satisfactory in the Lachine Rapids and greater basin, except for one zone close to the shore in LaSalle. This site had already been identified as disturbed in 1977.

In the lesser basin, the samples of benthos taken in 1975 and 1976 indicated that the communities were degraded at certain locations, including the mouth of the de la Tortue River and off Brossard. These disturbed sites were characterized by a dominance of molluscs and tubificid worms, which are indicators of organic pollution. Another study conducted in 1977

[5] The heronries were located at Lake Saint-François, Lake Saint-Louis, in the Lachine Rapids and Lake Saint-Pierre.

reported high concentrations of lead in mussels collected at the Saint-Lambert Locks, and mercury in those collected at the mouth of the Saint-Jacques River.

One researcher was interested more recently (in the early 1990s) in a particular sub-group of benthos, chironomid larvae (insects), as pollution indicators. It was found that the frequency of deformities of antennae and certain mouth parts in these organisms was substantially higher at the mouth of the Saint-Jacques River, an area of the lesser basin known to be contaminated.

As for water enrichment, this phenomenon is mainly apparent in the lesser basin. The shallow waters, very slow flow and inputs of phosphorus from the tributaries have contributed to increasing plant production. A proliferation of aquatic plants and filamentous algae has been observed. The fish communities have gradually modified to adapt to the new conditions. They can now be distinguished from those in the greater basin by a dominance of bass and sunfish, species that are typical of very productive water. Fish kills were reported in the lesser basin in the 1970s, but their cause was never determined.

4.2.3 Effects of contamination on human health

According to the information available, contamination poses little risk to human health at this time, as long as the recommendations regarding certain activities are respected.

4.2.3.1 *Consumption of fish and game*

Regular consumption of large amounts of fish from the study area could entail certain risks for human health, mainly because of the presence of mercury. According to a guide prepared by the Ministere de l'Environnement et de la Faune (MEF) and the Quebec health and social services ministry, sport fishers can consume what they catch from the study area. However, moderation seems appropriate, especially for the large predator fish. The number of servings of fish not to be exceeded in order to avoid exposure to the effects of contaminants varies from one to eight per month, depending on the species, size of the fish and fishing site. In the Montreal region, the most stringent restrictions apply to Northern pike, walleye species, Smallmouth bass and especially the American eel, which pregnant and nursing women and young children are

advised to avoid. If the recommendations as to the number of meals and ways of preparing the fish are followed[6], and specimens that present external anomalies are not eaten[7], the risks to health are negligible.

A 1995 pilot study conducted among 40 sport fishers in the Montreal region showed that mercury concentrations, PCBs and DDE (a product resulting from the decomposition of DDT) were higher in the tissues of heavy consumers of river fish (about six meals of 230 g per month), than in the tissues of light consumers (one meal per month). However, in all but one fisher, the levels were below those recommended by Health Canada. The limit for PCBs was exceeded in one person.

To summarize, the risks of contamination are small if the consumption guidelines are followed. Consumption of fish offers a number of benefits: protein, vitamins, minerals, prevention of cardio-vascular disease and, for pregnant women, the polyunsaturated fatty acids and nutrients necessary for the development of the nervous system of the fetus. Pregnant women should avoid consuming American eel, however.

No contaminant levels that would justify limiting their consumption have been found in waterfowl[8]. There are precautions to observe concerning lead shot, which must be removed before cooking. This advice is, of course, unrelated to environmental contamination.

Finally, it must be remembered that fishing and hunting are activities that contribute to the relaxation and the well-being of those who engage in them, and these are also factors to be taken into consideration.

---

[6] Since organochlorines tend to accumulate in fish fat, it is possible to reduce ingestion of these substances by not eating the skin, viscera and fat portions; it is not advisable to eat the cooking juices, either.

[7] The prevalence of parasites or external anomalies may sometimes be high in fish from the river. Most fish parasites pose no danger to humans. As a preventive measure, however, it is advisable to cook the flesh thoroughly and not to eat the skin or viscera. It is also recommended not to eat fish with external anomalies (ulcerous dermatitis, dermal masses, oral papillomas, etc.).

[8] Although contaminant levels are low, it is possible, as an additional precaution, to use cooking methods that eliminate as much fat as possible. To eliminate any risk of parasite or microbial contamination, the meat should be well done.

4.2.3.2 *Consumption of water*

The whole population (330 000 people) of the study area and a good proportion of the residents of the island of Montreal are served by a network of aqueducts that draw water from Lake Saint-Louis and the Greater and Lesser La Prairie Basins (see 5.3.1). This water is of good quality and meets government standards. There was no epidemic associated with drinking water reported between 1989 and 1995.

In all cases, the water treatment includes chlorination. Public health authorities are interested in a chlorination by-product, trihalomethanes (THM), which are probably carcinogenic for human beings. Analysis confirms that THM levels are well below the recommended levels and that there is therefore no problem in this respect. It may be possible to reduce the THM levels even further by improving the quality of the raw water and changing treatment processes.

4.2.3.3 *Recreational activities*

Although there are no beaches on the St. Lawrence at this time, the bacteriological quality of the water of the greater basin would allow swimming and other contact activities (windsurfing, water skiing, jet skis, etc.), especially upstream from Ile des Soeurs. Data from 1993 — that is, before all municipal sewers were connected — suggests that the quality of the water, in bacteriological terms, varies according to time and place. It is likely that the situation has improved in this respect since the last municipal sewers were connected to the treatment system in 1995. However, there is still a problem with the Sainte-Catherine wastewater treatment plant, whose operation is occasionally inadequate. It is probably not recommended to engage in recreational activities involving contact with the water in the effluent plume of this plant. The same applies to the lesser basin.

Since only recent analyses allow us to assess the risks fairly, caution is recommended with respect to the activities that involve contact with river water. Before engaging in such activities, people should contact local authorities (Ministère de l'Environnement et de la Faune, public health departments, municipalities) for information on water quality. Those who expose themselves to contaminated water run the risk of getting gastrointestinal illnesses and skin, eye and ear infections.

There is a semi-artificial beach at the Récré-O-Parc in Sainte-Catherine. The water here comes from the river and is chlorinated. Tests performed in 1996 confirm that it is of excellent quality for swimming.

4.3 Other Pressures on Resources

Other processes can undeniably affect the natural environment of the study area, to a degree that it is difficult to assess at this time.

4.3.1 Introduced and expanding species

We know today that the introduction of new species into an ecosystem, a rather common practice in the last century, can have marked effects on indigenous flora and fauna. Most people are familiar with the English sparrow and European starling, two species that have now become part of the local fauna. Among fish, the Brown trout, Rainbow trout and carp are also contributions from outside to local fish communities.

For some of the more recent invaders, the process of colonization or expansion is still underway, and the repercussions of their arrival have not yet been fully assessed.

Among plants, Purple loosestrife is currently expanding. This introduced species tends to colonize marshes and wetlands, displacing indigenous plants like the Reed canarygrass, Prairie cordgrass and Bluejoint. The Common reed, a species indigenous to North America, has been spreading throughout Quebec since the 1970s. It multiplies through its rhizomes and colonizes disturbed land and drainage ditches, forming dense stands and excluding other species.

Two invertebrates, both molluscs, are now invading the St. Lawrence. The Zebra mussel has colonized the Great Lakes–St. Lawrence system from Lake St. Clair in Ontario. It displaces indigenous bivalves, especially the family of Unionidae. The Quagga mussel, whose invasion began more recently, appears to have similar effects. The far-reaching repercussions of the appearance of these two species on the ecosystems has not yet been fully described. The most noted disadvantage to date has been the blocking of water intakes.

Among birds, the Ring-billed gull has been the most aggressively expanding species in the Montreal region for the last twenty years. Its numbers seem to be stabilizing, according to the number of nests in the Ile de la Couvée colony. This opportunistic species has exploited human modification of the environment. Some individuals have learned to feed from garbage (dumps, garbage cans in public areas), and groups are frequently observed in fields, following tractors as they plow. When they gather in large numbers, these gulls can cause local problems with water quality.

4.3.2 Overexploitation and disturbance of wildlife

Other types of pressure can limit the abundance of fauna. An example is overfishing, a phenomenon which seems to have affected mainly Lake sturgeon, commercially fished in the waters of the Montreal archipelago. Sturgeon caught in the Greater La Prairie Basin are intercepted during their migration between spawning and feeding grounds.

The human presence can also have negative effects on some nesting birds, which do not tolerate disturbance during this time. This includes herons. The arrival of a visitor can easily cause a panic reaction in a colony, leaving the eggs at the mercy of gulls or causing a fatal fall from the nest by baby herons. In some species of ducks, eggs are laid and incubated only in isolated locations, safe from disturbance. Nesting success is much lower in places where humans or animals may appear.

The concern of naturalists about the harmful effects of the uncontrolled expansion of certain recreational activities (blimp flyovers, jet skis and other water craft, and hikers) near nesting sites is understandable. It is essential that guidelines accompany these practices.

4.3.3 Environmental accidents

In the study area, the risks of natural disasters (floods, landslides) is considered negligible. On the other hand, accidents associated with human activities are possible. Evaluating the risks for human health as well as for the environment in general is difficult because the parameters vary according to the type of incident and, in the case of spills, the nature of the products concerned.

The transport or storage of hazardous products near the river carries some risk. At least eight oil spills have been reported in the portion of the St. Lawrence Seaway that crosses the study area. However, in case of a major spill, the configuration of the Seaway itself would limit the dispersal of such substances.

CHAPTER 5 Area Resources and Assets

In spite of the changes imposed upon the natural environment by the presence and activities of humans, the study area is still generously endowed with assets intimately associated with the river. In all fairness, these assets ought also to be represented in this assessment report.

5.1 Recreation and Tourism

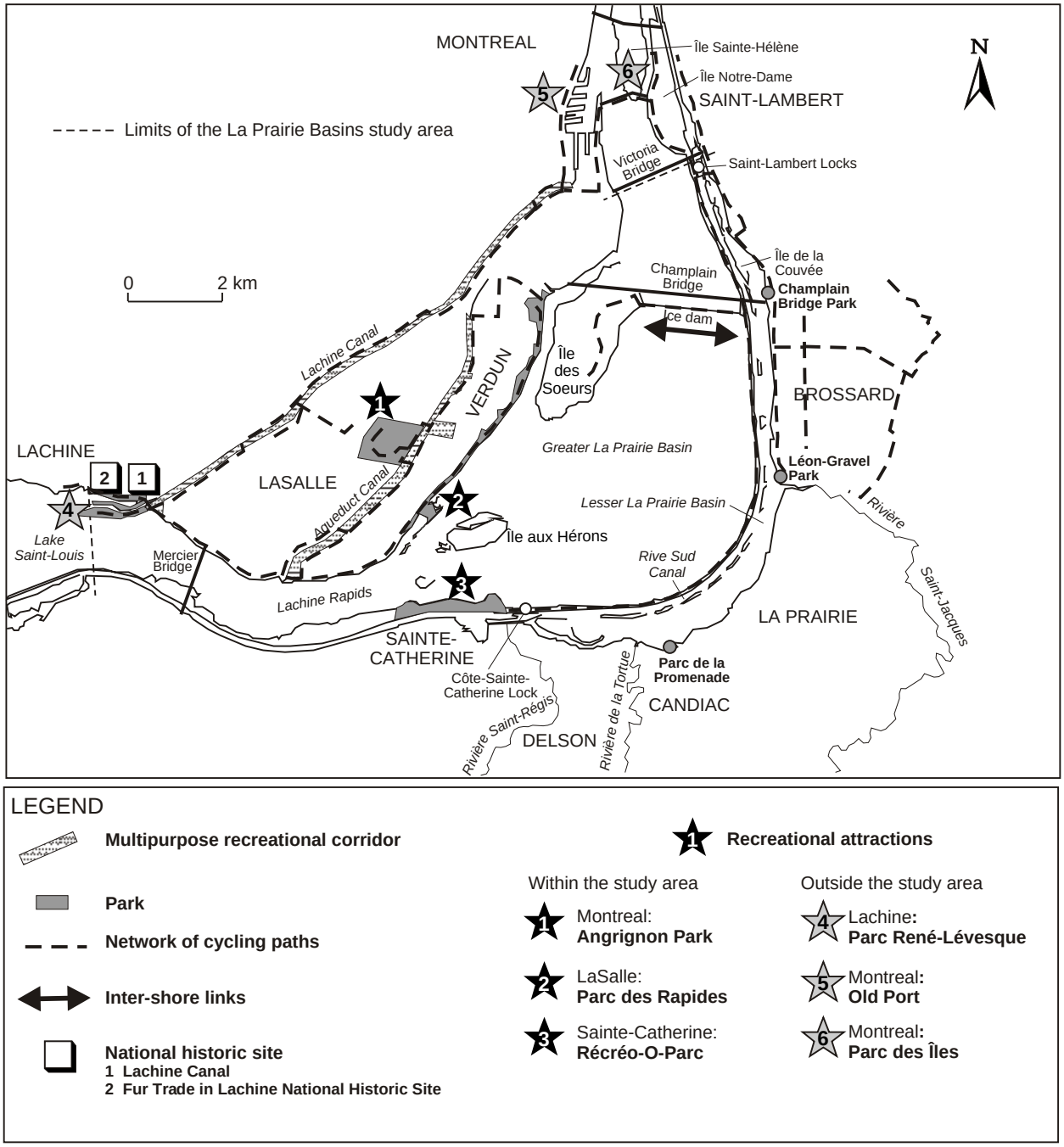
The essentially urban nature of the study area limits certain recreational and tourist functions usually associated with the presence of a body of water in a rural setting. For example, nature-centred cottages or accommodations are rare. Most of the hundred or so cottages inventoried are located on aux Hérons and aux Chèvres islands.

Moreover, the infrastructures that allowed urban sprawl cut off direct access to the water and limit the recreational uses of the waterfront area, especially on the south shore. With the exception of the Récré-O-Parc in Sainte-Catherine and the Seaway dike separating the two La Prairie basins, public access to the water is limited; Highway 132 restricts direct access. On the north shore, access is easier in Verdun and LaSalle, but the Bonaventure Autoroute cuts off access to the river in the Southwest district.

However, there are a number of interesting sites for tourists in the area. The only ones that are directly associated with the water are the Lachine Rapids, in terms of natural phenomena, and the Lachine Canal, for its historic interest. The Lachine Canal National Historic Site is a monument to the development of industrial activity in Montreal and development of trade with Ontario and Western Canada.

5.1.1 Recreational parks

About 14% of the sector's surface area is designated for recreation; the main attractions are shown in Figure 12. On Montreal Island is the Lachine Canal National Historic Site, under federal jurisdiction, and a network of municipal parks near the river. The largest is Parc des Rapides, from which visitors can admire the rapids and historic landmarks.



Source: Bibeault et al., 1997.

Figure 12 Recreational attractions and corridors

On the south shore, the parks are more widely scattered because of the highways and other major infrastructures located near the water. The largest park (Récré-O-Parc) is located in Sainte-Catherine. It is popular for picnicking or for such activities as fishing, cycling, cross-country skiing or bird watching, and has a pond with a beach. This park is the only one in the study area that is of any regional interest.

It is estimated that participation in recreational activities has increased over the last ten years. Estimates of the most recent participation rates for summer (1994) and winter (1981) activities are summarized in Table 6. In 1994, the main parks in the study area are thought to have had at least 262 000 visitors[1]. The parks located on Montreal Island (Lachine Basin and Canal, Riverside) are sought out by strollers, while swimming is the main attraction of the Récré-O-Parc in Sainte-Catherine.

Table 6
Recreational visits to the river and its shores between the Mercier Bridge and the eastern tip of Montreal Island

Activity	*Visits (x 1000 person-days*	*% of Montreal Island*
Summer (1994 data)		
Hiking, bird-watching, picnics	446	57
Boating	64	35
Fishing	48	40
Swimming	37	35
Water-skiing	11	41
Winter (1981 data)		
Cross-country skiing	44	54
Snow-shoeing	6	33

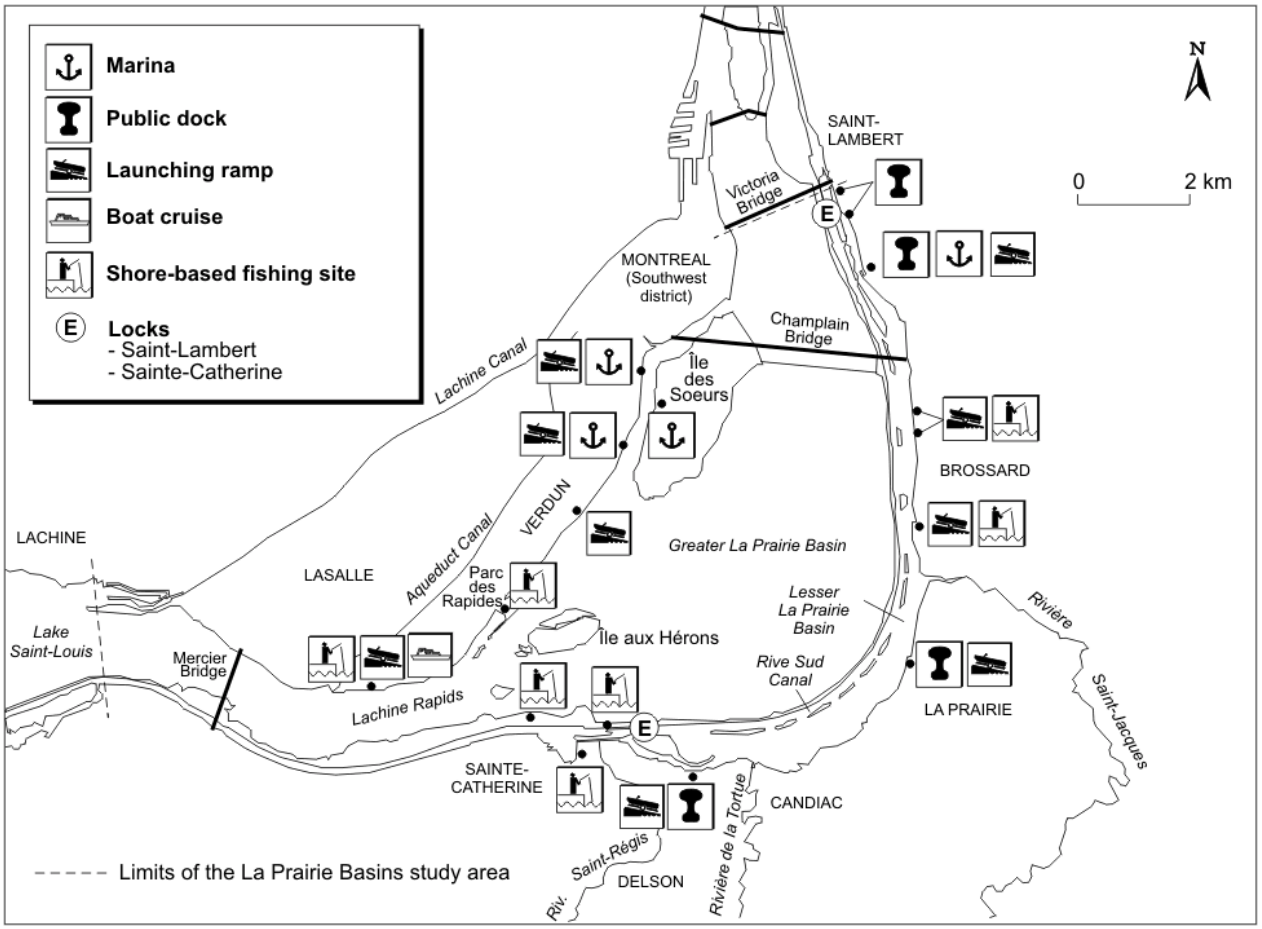
Source: MLCP, 1992; INRS-Urbanisation and Jolicoeur et Associés, 1994, cited in Tecsult 1995.

Overall, people who come to participate in recreational activities along the river seem to appreciate the section that extends from the La Prairie Basins area to the eastern end of Montreal Island. Some 68% of them report that they are satisfied with their visits.

[1] Added to this number should be the hundreds of thousands of people who come each year to visit the banks of the Lachine Canal without visiting the welcome centre.

5.1.2 Pleasure boating

The study area is not one of the most suitable for pleasure boating because of the rapids. Nevertheless, there are a number of marinas, most of them private, as well as boat-launching ramps (Figure 13).



Source: Bibeault, J.-F., A. Jourdain, and N. Gratton, 1996; MLCP, 1990.

Figure 13 Infrastructures for boating and main access points for fishing

The greater basin is used by recreational boaters, hunters and fishers and by vessels offering short trips, excursions or rafting on the Lachine Rapids from the Old Port. Rafting has become much more popular in recent years, and concern is growing about its impacts on the integrity of the natural environment of the rapids and their islands. The growing number of jet skis is contributing to congestion on the water, and the noise they make may upset some animal species.

These activities require a certain amount of care. In 1995, the Coast Guard had to intervene in some 143 incidents involving pleasure boaters, most often motor boats between the Lachine Rapids and Repentigny. The main problems were mechanical breakdowns or boats running aground, most often as the result of negligence: lack of knowledge or judgment, consumption of alcohol and failure to carry floatation gear. In some cases, these incidents are likely to result in injuries, hypothermia, psychological problems or sometimes even drowning. From 1989 to 1995, five deaths by drowning were reported as a result of recreational activities in the La Prairie Basins area.

5.1.3 Sport hunting and fishing

In the late 1970s, an estimated 15 000 water birds were harvested each fall by hunters in the area corresponding to Lake Saint-Louis and the La Prairie Basins. These birds were mainly dabbling ducks (44%) and diving ducks (38%). All hunting sites are found in the Greater La Prairie Basin. The two main sites are close to Boquet peninsula and between Ile aux Hérons and Ile des Soeurs.

Sport fishing is mainly concentrated on Yellow perch, Smallmouth bass and Northern pike. As in other bodies of water in the Montreal region, perch ranks first in terms of numbers caught, although its pre-eminence is less pronounced here. The area is distinguished by the presence of rapids, which offer fishing sites for salmonids, Sauger and Lake sturgeon. Several thousand Rainbow trout and Brown trout are regularly released in the rapids or greater basin to support this recreational activity. Since 1993, the stocked Rainbow trout are sterile. This measure offers two advantages: On the one hand, these individuals grow faster than others, and, on the other, it prevents the downstream dispersal and establishment of this exotic species, which could compete with indigenous salmonids (Brook trout, Arctic char and Atlantic salmon).

People fish in the Récré-O-Parc in Sainte-Catherine and in the lesser basin, along the south shore. What few access points there are to the water are located in Sainte-Catherine, Brossard and La Prairie (Figure 13). In winter, ice-fishing is popular near Sainte-Catherine.

5.1.4 Bird watching

The sites that are best suited to bird watching are found in Parc des Rapides, in LaSalle, on Ile des Soeurs, at the Sainte-Catherine Lock, along the Seaway dike, and on the ice dam upstream of the Champlain Bridge. During winter, Ile des Soeurs is a favourite spot for ornithologists with an interest in nocturnal raptors.

5.2 Biodiversity, Habitat Conservation and Wildlife Conservation

Rare, threatened or sensitive species are important elements in biodiversity because of their unique nature or precarious situation. The study area harbours 37 of the 155 priority species for protection under St. Lawrence Vision 2000, which includes 17 plant species, 5 fishes, 1 amphibian, 1 reptile and 13 bird species (Appendix 1).

Conservation is not highly developed in the La Prairie Basins area and is limited to the Seaway islands.

The Lachine Rapids islands, especially Ile aux Hérons, are of great ecological value. Rare plant species and groupings and the presence of the largest colony of Black-crowned night herons make the islands unique. Although the necessity of conserving them is unanimously accepted by naturalists, these islands have no legal protection at this time. They are considered priorities under the St. Lawrence Vision 2000 action plan. The Montreal Urban Community and the City of LaSalle plan to integrate them into existing or future parks.

Until measures are taken to protect these sites, it is feared that their integrity, which up to now, has been safeguarded by difficulty of access, may be compromised by the rapid development of certain recreational activities (blimp flyovers, boat trips down the rapids, etc.).

The status of wildlife habitat has recently been granted to important fish habitats and congregating areas in the greater and lesser basins. This status is intended to prevent the sites from being modified. There are zones that are protected because they are frequented by aquatic birds on the south shore of Ile des Soeurs, at the mouth of the de la Tortue River, and in the centre of the greater basin, where there is a large aquatic plant community (Figure 14). Furthermore, two

migrating bird sanctuaries ensure tranquillity for colonial species during the nesting period. The first, on Ile aux Hérons, covers the whole width of the river downstream of the Lachine Rapids (622 ha); it was created in 1937 to protect the Great blue heron and Black-crowned night heron. The sanctuary on Ile de la Couvée (17 ha) includes four islands in the Seaway between the Champlain and Victoria bridges; since 1986, it has protected the colony of Ring-billed gulls.

In recent years, nesting by waterfowl and Common terns whas been favoured by work carried out on the Seaway islands. The Parc des Rapides in LaSalle and the wetlands at the mouth of the Saint-Jacques River in the lesser basin have been restored.

5.3 Utilization of Water Bodies

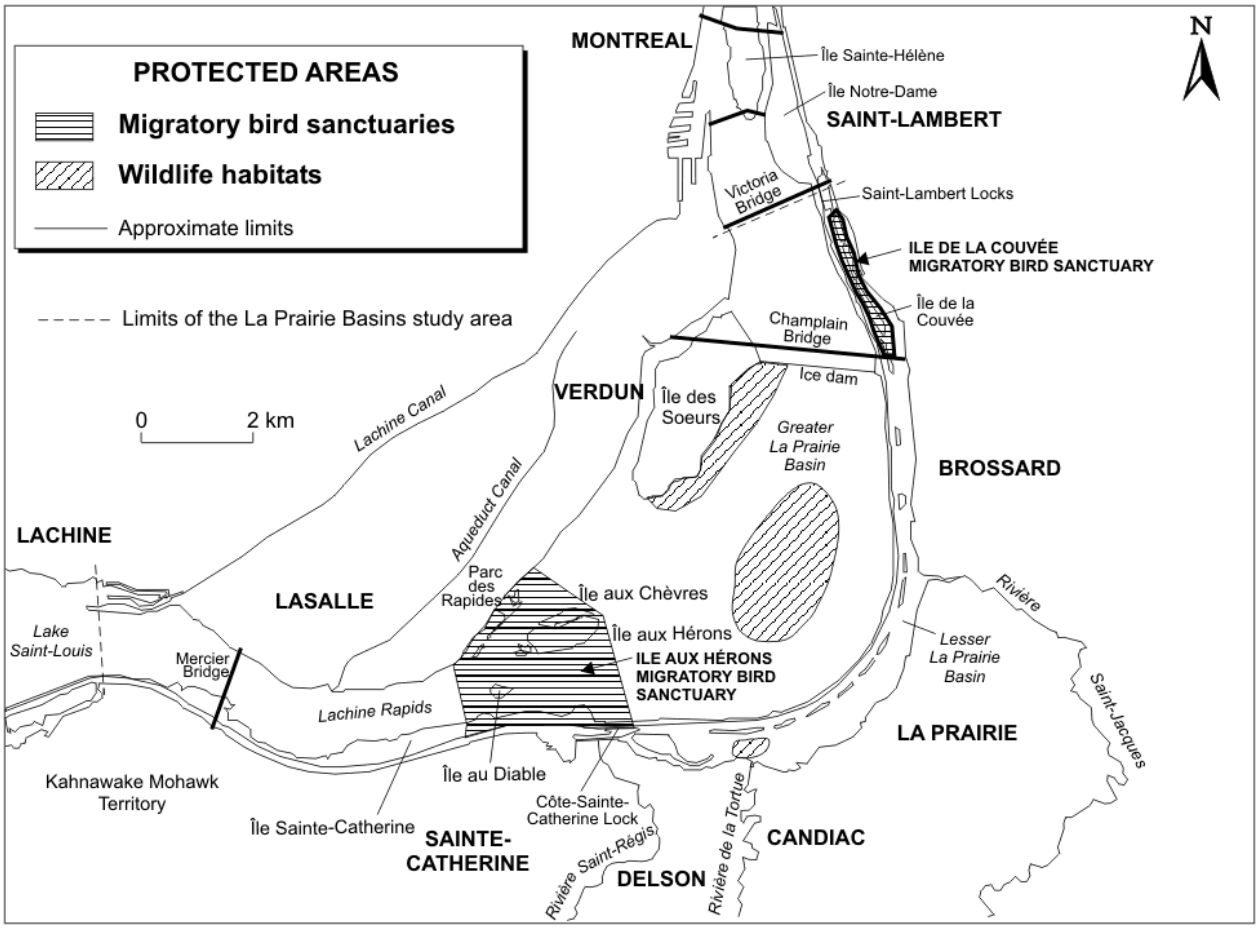
The proximity of a large watercourse carries a number of advantages that are easily overlooked in a country that is spoiled in this respect.

5.3.1 Water supply

The very availability of quality water in such abundance is one of the facts that we take for granted, even though many countries do not have such easy access to this resource.

The entire population of the study area (330 000 people) is connected to the system of aqueducts supplying five stations in Saint-Lambert, La Prairie, Candiac, Montreal and Lachine (Figure 15). A good proportion of Montreal Island (about 1.5 million people), extending beyond the study area, obtains water from these water intakes. In 1995, the daily flow provided to all these systems totaled 197 000 m^3.

Some industries depend on a regular supply of water for a multitude of processes. In 1995, nine plants in the study area drew more than one million cubic metres of water annually.



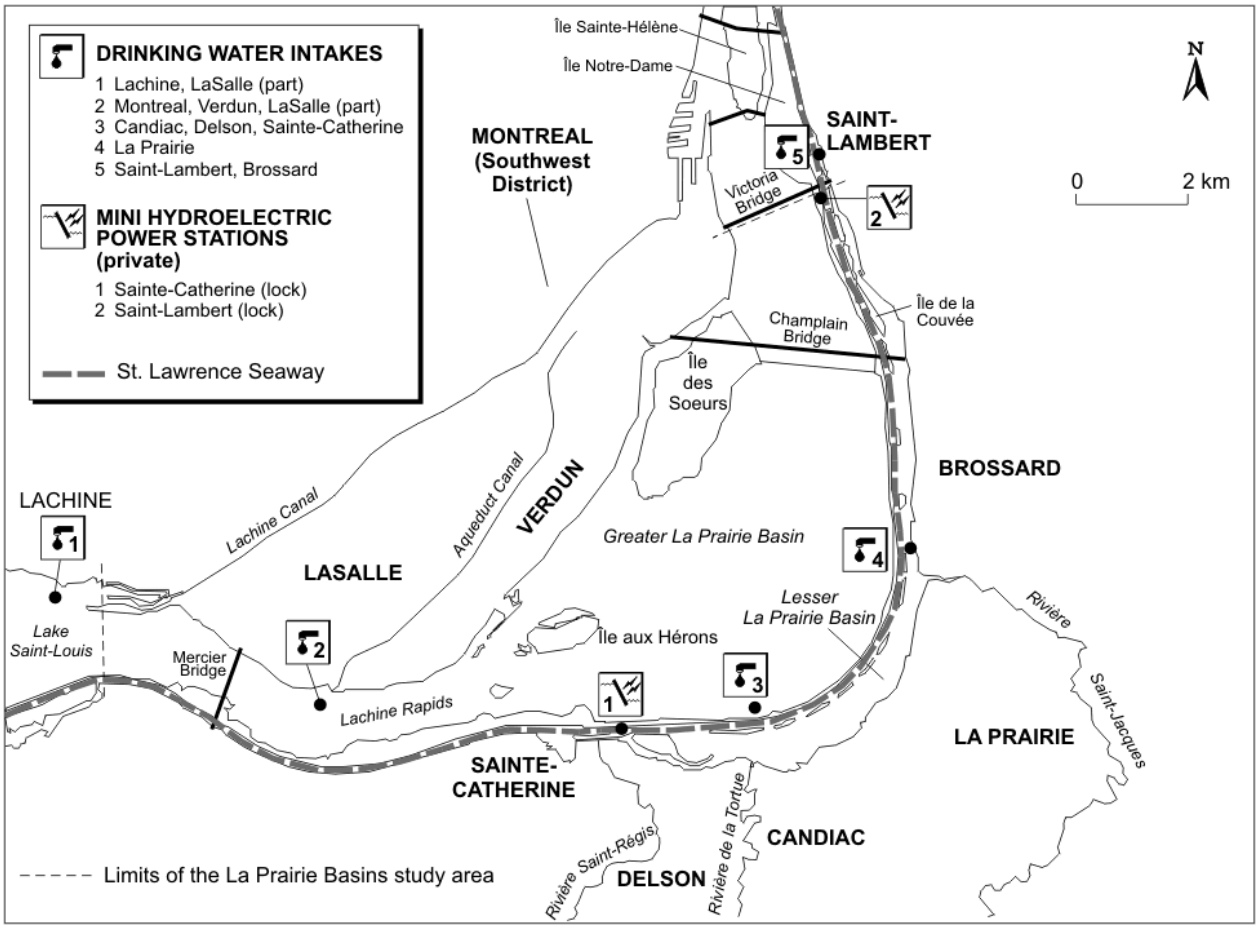
Source: CWS, 1990; Léveillé, 1996.

Figure 14 Protected areas

5.3.2 Shipping

Construction of the St. Lawrence Seaway entailed the major reorganization of the aquatic habitat; the environmental consequences have already been described (see 4.1). The effect was to introduce a major infrastructure with long-term repercussions on economic activities throughout the Great Lakes–St. Lawrence basin.

The construction works, unprecedented in scope, extended from 1954 to 1959. In spring 1959, the St. Lawrence Seaway along the south shore of Montreal replaced the Lachine Canal as the route around the rapids.



Source: Bibeault, J.-F., A. Jourdain, N. Gratton, 1996.

Figure 15 Utilitarian functions of the water

It was estimated that 38 million tonnes of merchandise, especially bulk cargo (47% of tonnage) and grain (34%) passed through this route. In 1994, revenues from tolls and transit fees amounted to $45 million.

5.3.3 Electricity production

In recent years, two small run-of-water hydroelectric power stations were built along the St. Lawrence Seaway. The first is located near the Sainte-Catherine Lock; it can generate 9.6 MW of electricity from the water circulating in the Rive Sud Canal and the Lesser La Prairie Basin.

A second power station of the same type is located at the Saint-Lambert Locks, downstream of the study area.

5.4 Commercial Fishing

Commercial fishing in the waters of the Montreal archipelago was a flourishing activity in the past, particularly between 1929 and 1939, during the Depression. Today, it has declined considerably, as a result of tighter regulation, the prohibition of the sale of some contaminated species, and the declining abundance of the resource, much of which is allocated to anglers. In 1991, there were only two commercial fishers of food fish, species such as Lake sturgeon, sunfish, bullhead and carp. Catches of Lake sturgeon, the most sought-after species, are said to have reached, and on some occasions exceeded, 20 tonnes in the last decade. However, catches of this species and the yields of this fishery have been declining since 1991. There are a number of signs suggesting that the St. Lawrence sturgeon has been overfished, and its aquatic habitats are being disturbed.

There are also 16 fishers of baitfish in the study area, whose catches are also declining, but for quite different reasons. The demand from sports fishers seems to have declined as a result of restrictions recently imposed in fishing regulations governing the use of live bait.

CHAPTER 6 Issues Relating to Sustainable Development in the La Prairie Basins Area

Sustainable development of the La Prairie Basins area demands the protection of the existing biodiversity, while favouring the multiplicity of uses of the river for riverside residents, to enhance their quality of life.

6.1 Main Issues

Among the means of achieving sustainable development in the La Prairie Basins Area, certain elements should predominate.

6.1.1 Protecting habitats and biodiversity; rehabilitating wetlands

At a time when ecologists are redoubling their efforts to prevent the disappearance of natural habitats, which are essential to biodiversity, many citizens realize that they too can contribute to preserving our genetic heritage by simply taking care of a piece of land they pass by daily.

By safeguarding our existing natural environments, we are contributing to the maintenance or to the increase of the environment's biodiversity. As a natural environment, the Lachine Rapids constitute an asset for the area because this type of habitat is unique along the St. Lawrence, attracting wildlife adapted to fast-moving water not found elsewhere. Some fish species (Lake sturgeon, American eel, American shad) are compelled to migrate through this area to complete their life cycle.

The greater basin offers the slow-water habitats and large beds of aquatic plant communities prefered by other species.

The islands that are scattered in the lower reaches of the rapids and the inlet to the greater basin have mostly escaped the city's clutches, due to their small size and difficulty of access. Natural vegetation has persisted, and birds, especially herons, are able to maintain large

colonies quite close to an urban environment. On the other hand, there are no real measures to protect the last intact natural environments in this area.

The natural shores that remain are found around the Lachine Rapids islands, along the Kahnawake Native reserve, on an island in the Seaway opposite Sainte-Catherine, and south of the Lesser La Prairie Basin.

Some small islands that are sheltered from disruption are used as nesting sites by aquatic birds. Work has already been done to improve the quality of these wildlife habitats on the small islands in the Seaway, in Parc des Rapides in LaSalle and at the mouth of the Saint-Jacques River, and in the Lesser La Prairie Basin; further such efforts should continue and be extended to other sites.

While the strictly aquatic habitats and most of the islands were saved, the natural shores of the river have been seriously degraded by development. Fill activities, flood control and the construction of a multitude of different structures have led to the loss of most of the wetlands (marshes, wet meadows and swamps), which are wildlife habitats of prime importance. The possibility of restoring some of these wetlands should be considered.

6.1.2 Harmonizing recreation and tourist development with the natural environment

Existing parks are municipal and their function is primarily recreational. Owing to the undeniable attractiveness of the Lachine Rapids area, a reorientation toward conserving and naturalizing certain components of the existing park network would be desirable. Combined with an improvement in inter-park and inter-shore links, such a shift would enhance the current network through diversification.

Given the growing influx of visitors to the section of the rapids which harbour plant and animal populations of great interest, it is vital that users be made aware of the need to respect the natural environment so that their presence does not disrupt the animal populations. Guidelines are urgently needed that would allow for the harmonious coexistence of two of the area’s major assets.

6.1.3 Reducing contamination

The Lachine Rapids and the greater basin, where current velocity is higher, do not seem to have accumulated toxic substances. Discharges of all kinds are now monitored and contamination of the water, sediments and living organisms appears to be less severe than in the past. However, data available on this subject is fragmentary or several years old.

Major cleanup efforts at the industrial and municipal level have been undertaken since the late 1980s. It is nevertheless important not to relax efforts in this regard, because what has been achieved remains fragile and requires constant attention.

The monitoring of wastewater treatment plant operations (especially at Sainte-Catherine) is necessary in order to ensure good water quality with respect to bacteria. Non-point sources of contaminants associated with some small tributaries should also be monitored.

The creation of the lesser basin, an artificial body of slow-flowing water, seems to have promoted the accumulation of contaminants that industries, municipal effluents and tributaries contributed in the past. The phosphorus concentration in the water is a cause for concern for aquatic life, as are atrazine and diazinon at the mouths of tributaries. Contaminants tend to accumulate in the sediments that are trapped in the lesser basin. A review of farming practices in the territory drained by the tributaries of the lesser basin would no doubt contribute to reducing inputs of pesticides and nutrients to this body of water.

The sediments that cover the bottom of the Lachine Canal are also contaminated. A joint federal-provincial commission on the project to decontaminate the Lachine Canal recently concluded that the sediments do not now present a risk to public health and recommend not intervening. This conclusion has been endorsed by the Canadian Government. However, should the canal be reopened to navigation, it would be necessary to assess the risks emanating from the resuspension of sediments.

6.1.4 Improving access to the river

All the efforts devoted to restoring the river can only be fully appreciated by riverside residents if they have easy access to the water. Existing infrastructures are in many cases one of

the main hindrances to access. In the La Prairie Basins area, there is still room for improvement in this respect, especially on the south shore.

6.2 Toward the Sustainable Development of the Water Body

To direct policies for the use of these bodies of water to achieve the objectives of sustainable development, it is important to bear in mind several aspects of the issues mentioned thus far. Besides the limitations that some uses impose on resources, inevitably leading to conflicts between users, it is necessary to take into account the permanence of certain changes that it would be unrealistic to reverse. The highways, St. Lawrence Seaway dike, bridges and other structures already in place constitute constraints that should be considered irreversible in any planning exercise. On the other hand, it is possible to consider giving greater importance to protection of the natural inhabitants still present, the renaturalization of certain appropriate sites and the improvement of wildlife habitats.

To avoid hasty decisions made in response to special interests and that may further disturb this environment, it is important to carefully weigh the various development options.

These issues must be evaluated and discussed in full knowledge of the facts by groups interested in the river and the quality of life in their environment so that the policies adopted suit the whole community. Table 7 provides an initial background against which to discuss the desirable development directions for the area’s bodies of water.

It should be possible, at the end of these exchanges of opinion, to orchestrate the uses in such a way as to limit any additional damage to the natural environment and begin the rehabilitation of certain sites. Once a consensus on the priorities has been established, it will be simpler to translate them into a concrete action plan, one which the partners willingly support.

Restoring the riverside environments in this predominantly urban area constitutes a major challenge, but it is not unrealistic. We can see potential in the conservation of natural environments and perceptible improvements in the quality of the aquatic environment. Clearly, co-operation remains essential to this undertaking.

Table 7
Issues relating to the sustainable development of the La Prairie Basins

Characteristics of the study area	*Main effects on the river and its resources*	*Current situation with respect to sustainable development*	*Toward sustainable development*
Encroachment on aquatic and riparian environments The natural shores of the river have been severely degraded by filling and the construction of many infrastructures, causing wetlands to disappear. Creation of the Lesser La Prairie Basin, isolated from the rest of the river.	Destruction of the natural transition zone from the terrestrial environment to the aquatic environment, which is a prime wildlife habitat. Disappearance or reduced abundance of a number of animal and plant species. Loss of natural elements from the landscape and reduced access to the river. Amplification of the problem of contamination in the lesser basin.	**Biodiversity**: Several biological communities (terrestrial, riparian and aquatic) have experienced drops in abundance and diversity in response to the destruction or modification of these environments. **Uses**: Several uses have been restricted by the changes: commercial and sport fishing (abundance of the resource and access to fishing sites), summer cottages, nature activities, etc. **Quality of life**: The density of occupation and proximity of major roads generate a number of disruptive factors. The river is still part of the landscape, but its accessibility is often reduced and the degraded riverbanks are not very inviting. On the south shore, except for the Récré-O-Parc in Sainte-Catherine and the Seaway strip separating the two La Prairie basins, there is little public access to the river: Highway 132 limits direct access. On the north shore, access is easier in Verdun and LaSalle, but the Bonaventure Autoroute in the Southwest district cuts off direct access to the river.	**Biodiversity**: A return to natural conditions is impossible. However, some measures may lead to an improvement in biodiversity: restoration of banks, planting of trees or shrubs, creation of habitats, wildlife improvements. Priority should be given to protecting existing natural environments, especially those associated with the Lachine Rapids, which have a unique ecological character. Most of the remaining natural shores are found on the islands in the rapids, along the Kahnawake Reserve, on an island in the Seaway opposite Sainte-Catherine and along the south shore of the Lesser La Prairie Basin. Steps have already been taken to improve the quality of certain wildlife habitats (on the small islands in the Seaway, the Parc des Rapides in LaSalle, and at the mouth of the Saint-Jacques River in the Lesser La Prairie Basin) and such efforts may continue and be extended to other sites. **Uses and quality of life**: Accessible green spaces along the water which respect the environmental integrity of the shores, and a more diversified fauna, would substantially improve the quality of life.

Characteristics of the study area	*Main effects on the river and its resources*	*Current situation with respect to sustainable development*	*Toward sustainable development*
Pollution (industrial and municipal effluents and farming activities) For decades, industrial and municipal effluents were dumped into the river without being treated. Tributaries on the south shore drain farmlands, cities and industrial facilities.	Contamination by untreated wastewater has a whole series of negative effects on the aquatic environment. Industrial and municipal cleanup programs have helped to educe inputs of toxic substances to the environment. However, the Lesser La Prairie Basin and the Lachine Canal are major sinks for contaminated sediments and nutrients. Untreated municipal effluent contributes to microbial pollution and increased nutrients. The tributaries carry along fertilizers and pesticides used on farmlands.	**Biodiversity**: Pollution causes a reduction in the population numbers of many species and modifies the structure of living communities. Species that can tolerate this degraded environment become predominant. In the study area, the effects of contaminants are essentially perceptible in the lesser basin and Lachine Canal. **Uses**: Contamination of the environment results in restrictions on the use of the environment: fish consumption, risk to health from swimming and other water activities. The discharge of nutrients in farming and municipal activities results in eutrophication, where the environment is so conducive, and this causes harm to aquatic species and pleasure boaters and leads to aesthetic problems and unpleasant odours. **Quality of life**: Pollution leads to a loss of enjoyment of the water for riverside residents. It has indirect impacts on recreational potential by limiting activities that involve contact with the water.	**Biodiversity**: The disruptive effects of pollution are reversible in the relatively long term, depending on the nature of the substances discharged and their residence time in the environment and in aquatic organisms. **Uses**: The most effective way of limiting loss of use due to pollution is to control effluent discharge at the source among all users of the water (industrial, residential and commercial). More effective treatment processes for municipal wastewater are indispensable to restoring the environment to health and recover recreational activities that involve contact with the water, such as swimming and windsurfing. On the south shore, improved farming practices promote soil conservation, thus reducing inputs of contaminants to watercourses. **Quality of life**: Pollution control restores to communities all the benefits of living near to the river and generates a sense of pride.
Hunting, fishing	Construction of infrastructures to serve	**Biodiversity**: In general, animal populations	**Biodiversity**: The protection of wildlife

Characteristics of the study area	*Main effects on the river and its resources*	*Current situation with respect to sustainable development*	*Toward sustainable development*
and recreational tourism The area is appropriate for hunting and fishing activities. Recreational tourism focuses on pleasure boating, cruises, visits to the riverside and island parks, outdoor activities and observation of nature. The Lachine Rapids allow adventure rafting. The Lachine Canal is of historic and heritage value, and its banks are frequented by cyclist and strollers.	boating activities may destroy aquatic and riparian habitats. The rapid development of recreational activities in the area in recent years places at risk the biological integrity of the Lachine Rapids and its islands. Pleasure boating can be a source of bacteriological and chemical contamination and cause noise pollution or aesthetic annoyances.	can tolerate exploitation fairly well. The St. Lawrence Lake sturgeon has been heavily fished by commercial interests. Installation of boating facilities can affect wildlife and plant habitats. A more intense use of the river can have repercussions on the integrity of the natural environment of the rapids and its islands; motorboat traffic and engine noise can harm some animal species by disturbing certain activities essential for their survival (e.g. waterfowl nesting and brood rearing and feeding). **Uses**: The growing number of motorboats contributes to congestion on the river. Pleasure boating is governed by safety rules. Hunting and fishing are also regulated. **Quality of life**: Engaging in these activities on the river also contributes to the well-being of riverside residents and attracts tourists. Recreational and tourist activities can also generate significant economic spinoffs.	habitats will ensure the survival of animal and plant populations and the leisure activities that depend on them. **Uses**: Pleasure boating, hunting and fishing must be properly controlled to avoid conflicts (disturbance of wildlife, public access to the river, safety) with other uses of the environment. The growing popularity of nature watching and interpretation activities should be taken into account. **Quality of life**: Activities such as boating, outdoor activities and nature watching can promote the development of tourist attractions. The facilities required for these activities and their operation must be chosen wisely and located so as not to spoil the natural environment or lifestyle.

References

Armellin, A., P. Mousseau, and P. Turgeon. 1997. *Synthèse des connaissances sur les communautés biologiques du secteur d'étude Bassins de La Prairie (rapides de Lachine, grand et petit bassins de La Prairie*). Environment Canada, Quebec Region, Environmental Conservation, St. Lawrence Centre. Technical report. Priority Intervention Zones 7 and 8. 224 pages.

Areco Canada Inc. 1993. *Caractérisation chimique des berges du canal de Lachine*. Dossier No. 93-200. Environment Canada, Canadian Parks Services.

Association Touristique Régionale de la Montérégie (ATR). 1996. *Guide touristique : Montérégie*. 1996-97 edition. Ministère du Tourisme du Québec.

Auger, D., M. Bureau, J. Dubé, Y. Gravel, J. Leclerc, G. Lépine, M. Léveillé, P. Ragault, and M. Rousseau. 1984. *La faune et son habitat : Problématique, synthèse des études et éléments de solution*. Ministère du Loisir, de la Chasse et de la Pêche, Service Archipel. Technical report.

Bibeault, J.F., N. Gratton, and A. Jourdain. 1997. *Synthèse des connaissances sur les aspects socio-économiques du secteur d'étude Bassins de La Prairie (rapides de Lachine, grand et petit bassins de La Prairie*. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre. Technical report. Priority Intervention Zones 7 and 8. 188 pages.

Brousseau, P. 1981. *Distribution et abondance des oiseaux de rivage le long du Saint-Laurent, section Cornwall-La Pocatière*. Environment Canada, Canadian Wildlife Service.

Canadian Wildlife Service. 1990. *Documents sur les refuges d'oiseaux migrateurs et les réserves nationales de faune au Québec*. Environment Canada.

City of Montreal. 1992. *Plan directeur de l'arrondissement Sud-Ouest*. Projet du Plan d'urbanisme. Bureau du Plan d'Urbanisme, Service de l'habitation et du développement urbain.

City of Montreal. 1991. *Le plan des abords du canal Lachine*. Service de l'habitation et du développement urbain.

City of Verdun. 1989. *Plan d'urbanisme*.

Clavet, D. 1983. *Caractéristiques physiques des rives*. Ministère du Loisir, de la Chasse et de la Pêche, Service Archipel.

D'Aragon, Desbiens, Halde et Associés Ltée and Roche Ltée. 1992. *Inventaire des terrains fédéraux potentiellement contaminés au Québec, Rapport final*. Environment Canada.

Fortin, G.R., S. Lorrain, and M. Pelletier. 1997. *Synthèse des connaissances sur les aspects physiques et chimiques de l'eau et des sédiments du secteur d'étude Bassins de La Prairie (rapides de Lachine, grand et petit bassins de La Prairie).* Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre. Technical report. Priority Intervention Zones 7 and 8. 170 pages.

Gratton, L., and P. Mousseau. 1989. *Suivi environnemental. Aménagement d'un îlot de la Voie maritime du Saint-Laurent, au niveau de Brossard*. Louise Gratton Enr. for Environment Canada, Conservation and Protection.

Hubert, J. 1996. Personal communication. Direction régionale de la Montérégie, ministère de l'Environnement et de la Faune.

Lavalin. 1989. *Sites aquatiques contaminés du Saint-Laurent : Inventaire et priorisation.* Lavalin Environnement.

Leblanc, D. 1996. Personal communication. Direction régionale de Montréal, ministère de l'Environnement et de la Faune.

Les Consultants en Environnement ARGUS Inc. 1996. *Restauration naturelle des rives du Saint-Laurent. Tronçon 1 : de Dundee à Boucherville (rive sud), de Rivière-Beaudette à Repentigny (rive nord).* For Environment Canada, Canadian Wildlife Service, Ministère des Transports, James Bay Energy Corporation, and Ducks Unlimited. Cartographic document.

Léveillé, M. 1996. Personal communication. Ministère de l'Environnement et de la Faune, Direction régionale de la Montérégie.

Ministère de l'Environnement du Québec (MENVIQ) .1991a. *Inventaire des lieux d'élimination de déchets dangereux au Québec, Région 16 : Montérégie.*

Ministère de l'Environnement du Québec (MENVIQ). 1991b. *Inventaire des lieux d'élimination de déchets dangereux au Québec, Région 06: Montréal, Région 14 : Lanaudière*.

Ministère du Loisir, de la Chasse et de la Pêche (MLCP). 1992. *Services journaliers de pêche dans la région de Montréal*. Government of Québec.

Ministère du Loisir, de la Chasse et de la Pêche du Québec (MLCP). 1990. *La pêche autour de Montréal, près de 200 points d'accès*. Carte de la Direction régionale de Montréal, 1990.

Ministère du Loisir, de la Chasse et de la Pêche du Québec (MLCP). 1984. *Synthèse des études bioilogiques et des études sur le loisir : Atlas cartographique*. Direction générale de Montréal, Service Archipel.

Montreal Urban Community (MUC). *Schéma d'aménagement*. Service de planification du territoire.

Mousseau, P. 1984. Établissement du goéland à bec cerclé , *Larus delawarensis*, au Québec. *Can. Field Nat.* 98: 29-37.

Pelletier, A. 1997. Personal communication. Environment Canada, Environmental Protection Branch.

Pépin, G. 1996. Personal communication. Direction régionale de Montréal, MEF.

Regional County Municipality (RCM) of Champlain. 1986. *Schéma d'aménagement*. Champlain RCM.

Regional County Municipality (RCM) of Roussillon. 1988. *Schéma d'aménagement*. Daniel Arbour et Associés.

Robert, P. 1996. Personal communication. Direction régionale de la Montérégie, MEF.

Robitaille, J.-A., Y. Vigneault, G. Shooner, C. Pomerleau, and Y. Mailhot. 1988. *Modifications physiques de l'habitat du poisson dans le Saint-Laurent de 1945 à 1984 et effets sur les pêches commerciales*. Fisheries and Oceans. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1608.

Roche et Associés lteé. 1985. *Rapport des études environnementales. Volume 7 : Dossier cartographique*. For Hydro-Québec, Direction Environnement. Impact study.

St. Lawrence Centre. 1990. *Toxics in the St. Lawrence: An Invisible but Real Threat.* Environment Canada, Conservation and Protection, Quebec Region, Montreal. "St. Lawrence UPDATE" series. Fact sheet on the state of the St. Lawrence River.

Tecsult Inc. 1995. *Étude des usages et des ressources biophysiques de la rivière des Prairies, du lac Saint-Louis et du tronçon fluvial du Saint-Laurent*. Final report. Montreal Urban Community, and Government of Québec. Multiple pages plus appendices relative to investigation by INRS-Urbanisation and Jolicoeur et Associés Inc., 1994.

Ville de LaSalle. 1989. *Règlement du plan d'urbanisme*. Daniel Arbour et Associés.

Appendices

Blank page

1 St. Lawrence Vision 2000 (SLV 2000) Action Plan Priority Species Present in the La Prairie Basins area

Name	*Type of distribution or status in the area*
Plants (17 of 110 priority species)	
American waterwillow	Northern periphery
Canada garlic	Northern periphery
False mermaidweed	Sporadic
Green dragon	Northern periphery
Hairy wildrye	Northern periphery
Lizard's tail	Northern periphery
Meadow dropseed	Northern periphery
Narrowleaf vervain	Northern periphery
Northern watermeal	Northern periphery
Seaside brookweed	Northern periphery
Softhair marbleseed	Northern periphery
Switchgrass	Northern periphery
Troublesome sedge	Northern periphery
Virginia mountainmint	Northern periphery
Whorled yellow loosestrife	Northern periphery
Yellow giant hyssop	Northern periphery
Yellow pimpernel	Northern periphery
Fish (5 of 14 priority species)	
American eel	Migrant
American shad	Migrant
Copper redhorse	Resident, presence not confirmed
Lake sturgeon	Resident and migrant during breeding period
River redhorse	Resident
Amphibians and Reptiles (2 of 6 priority species)	
Map turtle	Observed on south shore
Northern chorus frog	Observed on south shore

Name	*Type of distribution or status in the area*
Birds (13 of 19 priority species)	
Bald eagle	Migrant
Barrow's goldeneye	Migrant
Blue-winged teal	Confirmed nester
Caspian tern	Visitor
Cerulean warbler	Migrant
Common moorhen	Nester outside ZIP
Grasshopper sparrow	Confirmed nester
Horned grebe	Migrant
Least bittern	Probable nester
Northern pintail	Confirmed nester
Peregrine falcon	Confirmed nester
Redheaded woodpecker	Migrant
Sedge wren	Nester outside ZIP

2 Environmental Quality Criteria
(for assessing loss of use)

Ecosystem Components	*Reference Criteria*	*Objectives*
WATER	Raw water (untreated, drawn directly from a body of water) (MENVIQ, 1990)	Protect the health of a person who may both drink water directly from a body of water and eat aquatic organisms caught there throughout his or her life.
	Contamination of aquatic organisms (MENVIQ, 1990)	Protect human health, which could be endangered by eating aquatic organisms.
	Aquatic life (chronic toxicity) (MENVIQ, 1990)	Protect aquatic organisms and their offspring, as well as wildlife that eat them.
	Recreational activities (primary contact) (MENVIQ, 1990)	Protect the health of humans engaging in a recreational activity in which the entire body is regularly in contact with water, such as swimming or windsurfing.
SEDIMENT	No effect threshold (NET) (SLC and MENVIQ, 1992)	Contaminant levels below which no effect is observed on benthic organisms.
	Minimal effect threshold (MET) (SLC and MENVIQ, 1992)	Contaminant levels above which minor but tolerable effects on most benthic organisms are observed
	Toxic effect threshold (TET) (SLC and MENVIQ, 1992)	Contaminant levels above which effects harmful to most benthic organisms are observed.
AQUATIC ORGANISMS	Fish marketing guidelines (Health and Welfare Canada, 1985)	Prescribe maximum contaminant levels in fish, and shellfish acceptable for sale.
	Fish consumption regulations (MENVIQ and MSSS, 1993)	Prevent harmful effects of contaminants on human health associated with the consumption of fish, and shellfish.

3 Glossary

Anthropic: Effect resulting from human activities causing a transformation of the natural environment.

Benthos: The plants (phytobenthos) and animals (zoobenthos) that inhabit the bottom of a body of water.

Biomass: The total mass of living organisms — as a whole or by formal grouping, surface unit or volume — existing within a biotope at a given time. This includes any biological material: plants, insects, herbivores, carnivores, and so forth.

Community: All plants and animals occupying the same biotope.

Discharge: Volume of water running in a water course, pipe, etc. in a given time. Usually expressed in cubic metres per second (m^3/s), and sometimes in L/s for small drainage basins. Also called *flow*.

Drainage basin: The geographical catchment area from which the waters (originating as precipitation) of a particular watercourse or body of water are drawn. Also called *watershed or hydrographic basin.*

Ecosystem productivity: Biomass produced annually to maintain balance between animal and plant populations.

Ecosystem: Entire physico-chemical environment (biotope) together with the living beings in it (biocenosis), which can perpetuate itself indefinitely with inputs of matter and energy.

Effluent: General term for any liquid discharged by a pollution source, whether from sourced in inhabited areas (main sewer) or industrial facilities (industrial outfall). Outfalls: places from which liquid pollutants are discharged.

Extreme low water: The lowest flow of a water course.

Habitat: Ecological framework in which an organism, a species, a population or a group of species lives.

Non-point source pollution: Pollutants indirectly introduced into a given environment. Agricultural pollution is non-point source pollution, since fertilizers and pesticides are spread over wide areas. Also called *diffuse pollution.*

Nutrients: Elements assimilated by plants during photosynthesis. The main nutrients are nitrates, phosphates and silicates.

Peripheral distribution: Used to describe a species located on the periphery of its range.

Primary production: Amount of organic matter produced by autotrophic organisms in a given period.

Secondary production: Amount of organic matter produced by heterotrophic organisms in a given period.

Sediment regime: Set of streamflow characteristics that influence sediment transport, deposition and erosion.

Sediments: Solid fragmented material formed by the weathering of rocks or other chemical or biological processes, which is transported or deposited by air, water or ice

Spawning ground: Place where fish gather to breed.

Sporadic distribution: Used to describe a species whose distribution is discontinuous.

Suspended solids: Small particles of solid matter (> 0.45 μm) floating in a liquid. Also called *suspended matter* (see sediments).

Turbid: Used to describe water containing a high concentration of suspended matter.

Turbidity: Cloudy condition of a liquid due to the presence of fine suspended matter (clay, silt, microoganisms).

Waterfowl: Collective name for geese and ducks.

Water mass: Volume of water with relatively homogeneous physical and chemical properties.

References

Demayo, A., and E. Watt. 1993. *Glossary of Water Terms*. Canadian Water Resources Association with Environment Canada

Drainville, G. 1970. Le fjord du Saguenay. II. La faune ichtyologique et les conditions écologiques. *Naturaliste Canadien* 97: 623-666.

Government of Québec. 1981. *Dictionnaire de l'eau*. Association québécoise des techniques de l'eau. Cahiers de l'Office de la langue française. Éditeur officiel du Québec.

Parent, S. 1990. *Dictionnaire des sciences de l'environnement*. Éditions Broquet inc., Ottawa.

Ramade, F. 1993. *Dictionnaire encyclopédique de l'écologie et des sciences de l'environnement.* Édiscience international, Paris.

Translation Bureau and Canadian Permanent Committee on Geographical Names. 1987. *Generic Terms in Canada's Geographical Names.* Terminology Bulletin 176. Canadian Government Publishing Centre.