REGIONAL ASSESSMENT
POINTE-DU-LAC–DESCHAMBAULT

Regional Assessment
Pointe-du-Lac–Deschambault

Priority Intervention Zone 12

Jean Robitaille

Edited by Marie-José Auclair
St. Lawrence Centre
Environment Canada – Quebec Region

October 1998

NOTE TO READERS

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

Correct citation for this publication:
Robitaille, J. 1998. *Regional Assessment: Pointe-du-Lac–Deschambault. Priority Intervention Zone 12*. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre. 86 pages.

Published by Authority of the Minister of the Environment

Catalogue No. En40-216/41-1998E
ISBN 0-662-27358-3

Production Team

St. Lawrence Centre

Design and Writing	Jean Robitaille, Consultant
Editing and Co-ordination	Marie-José Auclair
ZIP Writing Team	Alain Armellin Jean-François Bibeault Guy R. Fortin Anne Jourdain Pierre Mousseau Marc Pelletier
Cartographic Analysis and Illustrations	Marcel Houle
Linguistic Revision and Page Layout	Patricia Potvin
Centre de Santé Publique du Québec	Josée Chartrand Jean-François Duchesne Denis Gauvin

Contributors

Ministère de l'Environnement et de la Faune	
Aquatic Ecosystems Branch	Yves Lefebvre
Mauricie–Bois-Francs Regional Branch	Yves Mailhot
Environment Canada	
Environmental Protection Branch	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	Claire Laliberté
Mauricie–Bois-Francs Public Health Branch	Guy Lévesque Louis Dionne

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 Burton, Sylvie Coad, Patricia Houle, Claire Laliberté, Francine Richard, Jean-Yves Roy, Maryse Vaillancourt and Gordon Walsh.

We would also like to thank everyone from the sectoral and regional offices of the departments concerned who were involved in reviewing this report.

Preface

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

The goal of St. Lawrence Vision 2000 (SLV 2000) is to conserve and protect the St. Lawrence River and the Saguenay River, so that people living along their shores can reclaim use of these rivers in a manner compatible with sustainable development.

The Priority Intervention Zones program — better known by its French acronym ZIP (zones d'intervention prioritaire) *— is a major element of the Community Involvement component of the St. Lawrence Vision 2000 action plan.*

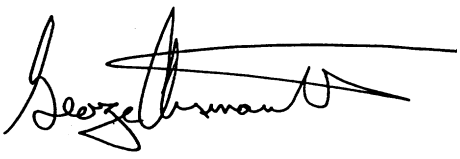
Through the ZIP program, riverside communities are invited to play an active part in achieving the objectives aimed at restoring the St. Lawrence and Saguenay rivers.

The program enables 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 River.

We are pleased to present this assessment report 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 SLV 2000.

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

J. P. Gauthier
Regional Director General
Quebec Region
Environment Canada
Co-chair, St. Lawrence Vision 2000



Georges Arsenault
Assistant Deputy Minister
Wildlife Resources and Parks
Ministère de l'Environnement et de la Faune
Co-chair, St. Lawrence Vision 2000

Management Perspective

The ZIP Program is a federal-provincial initiative involving stakeholders and shoreline communities in implementing measures to restore the St. Lawrence River. The program has three phases: producing a regional assessment report on the state of a specific area of the St. Lawrence, consulting shoreline partners in setting priorities for action, and developing an ecological rehabilitation action plan (ERAP).

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

The process of gathering and analysing data area by area has never before been undertaken for the entire St. Lawrence. 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 offer 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 team remains nonetheless convinced that an enlightened and thoughtful overview of each study area can be presented without further delay. This initial assessment is therefore intended to be a discussion paper that will serve as a starting point for the shoreline partners in each study area.

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. Ce programme comporte trois grandes étapes, soit l'élaboration d'un bilan environnemental sur l'état du Saint-Laurent 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 Saint-Laurent. 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 Pointe-du-Lac–Deschambault sector (ZIP 12) corresponds to the upstream portion of the Trois-Rivières–Bécancour study area. The tidal influence in this stretch of the St. Lawrence River is reflected in the water-level changes that occur twice a day. Since the amplitude of the freshwater tides is weak, however, they have a limited effect on riparian habitats, whose structure and composition resemble those of areas farther upriver.

Trois-Rivières, formerly an outpost for the fur trade, grew into a steel industry town following the discovery of a major iron deposit. Logging and the pulp and paper industry, supplied with timber from the hinterland which had to be floated down the Saint-Maurice River, were long the backbone of the Mauricie region's economy. The growing role of Bécancour as an industrial centre, combined with the slowdown in the pulp and paper sector, has acted as a damper on the economy of Trois-Rivières in recent decades.

Local industries, especially the pulp and paper and steel sectors, have contributed to the contamination of the St. Lawrence River and its tributaries. However, flow conditions in the estuary are not conducive to the accumulation of large amounts of toxic substances in sediments, except in port areas and at the mouths of some rivers. Furthermore, most industrial plants have implemented wastewater treatment measures. A large segment of the riverside population is now connected to a sewer system and wastewater treatment facilities. Nonetheless, the bacteriological quality of the water still leaves much to be desired, especially in the vicinity of Trois-Rivières, and water-contact activities (swimming, seadooing, water-skiing, windsurfing) are not encouraged.

The construction and use of the ship channel appear to have affected fishery resources in this section of the St. Lawrence. Several species of fish that migrate between fresh water and salt water to complete their life cycle have suffered drastic declines in abundance. The commercial fishery has survived, but the most important species from a harvesting standpoint (Atlantic sturgeon, American eel, Yellow perch) are experiencing difficulty.

The study area has numerous tourist attractions, including the beautiful riverscapes and cliff-top views; however, the recreation and tourism sites and facilities are distributed somewhat unevenly. Moreover, there is no integrated tourist network which would make it possible to capitalize on the sector’s natural assets. Recreational boating services are likely to keep expanding.

The Ile Saint-Quentin park, which was very popular up until the 1970s and more or less deserted in later years, has been “rediscovered.” Measures have been taken to protect its shores, and interpretation of natural heritage components is provided for visitors. The island's popularity appears to be paving the way for other initiatives of this type.

Résumé

Le secteur Pointe-du-Lac–Deschambault (ZIP 12) correspond à la partie amont du secteur d'étude Trois-Rivières–Bécancour.Cette section du Saint-Laurent marque l'apparition des marées, qui engendrent deux fois par jour des variations du niveau d'eau. Ces marées d'eau douce ont cependant peu d'amplitude et n'affectent pas de façon marquée les habitats riverains, qui présentent une structure et une composition semblables à ce qu'on observe dans les portions du Saint-Laurent sises en amont.

L'occupation humaine du territoire s'est faite surtout à partir de Trois-Rivières, un avant-poste établi pour la traite des fourrures qui est devenu un centre de sidérurgie à la suite de la découverte d'un gisement de fer. L'exploitation forestière et l'industrie des pâtes et papiers, alimentées via la rivière Saint-Maurice par les immenses étendues boisées de l'arrière-pays, ont longtemps soutenu l'économie de la Mauricie. La création d'un nouveau foyer industriel à Bécancour, conjuguée à un ralentissement dans le secteur des pâtes et papiers, ont enlevé de la vigueur à l'économie trifluvienne au cours des dernières décennies.

Les industries du secteur, surtout papetières et sidérurgiques, ont contribué à la contamination du Saint-Laurent et de ses affluents. Cependant, les conditions d'écoulement dans l'estuaire fluvial n'ont pas permis d'accumulation importante des substances toxiques dans les sédiments, sauf dans les zones portuaires et à l'embouchure de certaines rivières. Les industries ont pour la plupart pris des mesures pour assainir leurs effluents. Une partie importante de la population riveraine est maintenant desservie par des réseaux collecteurs d'eaux usées et des stations d'épuration. Cependant, la qualité bactériologique de l'eau laisse encore à désirer, notamment à proximité de Trois-Rivières, et les activités de contact (baignade, motomarine, ski nautique, planche à voile) sont déconseillées.

L'aménagement et l'utilisation du chenal de navigation semblent avoir affecté les ressources halieutiques de cette partie du Saint-Laurent. Plusieurs espèces de poissons circulant entre l'eau douce et l'eau salée pour compléter leur cycle vital auraient subi des baisses marquées

de leur abondance. La pêche commerciale est encore pratiquée dans le secteur mais les espèces les plus importantes pour cette activité (Esturgeon jaune, Anguille d'Amérique, Perchaude) seraient en difficulté.

Le secteur est bien pourvu en attraits touristiques; les paysages offerts par le fleuve et ses falaises sont appréciés. Cependant, la répartition des points d'intérêt et des équipements récréo-touristiques est inégale. Par ailleurs, il n'existe pas de véritable réseau touristique intégré qui permette de tirer le meilleur parti possible de ces atouts. Le développement de services au plaisanciers semble promis à la croissance.

Le parc de l'île Saint-Quentin, très fréquenté jusqu'aux années 1970 mais délaissé par la suite, connaît une nouvelle vie. Des mesures ont été prises pour protéger ses berges et les composantes naturelles du site sont l'objet d'interprétation. La popularité du site semble paver la voie à des projets de même nature.

Table of Contents

List of Figures

List of Tables

CHAPTER 1 The St. Lawrence, Then and Now

For the great majority of Quebecers, the mere mention of the St. Lawrence evokes a deep-seated feeling of belonging to the land traversed by its waters on its way from the Great Lakes to the sea. The pictures that spring to mind are those of a mighty river, fertile plains on either side, shady banks and rich wildlife.

The country was born on the banks of the river, as still evident today in the division of land — a vestige of the seigneurial system. In those days, people had to learn to live with the whims of the St. Lawrence, including spring flooding. In return, it provided the European settlers, still struggling with unreliable harvests, with a sure supply of fish and a crucial means of communication linking the first towns and villages that grew up along its banks.

With time, forests gave way to farmland, and then towns and cities sprang up. Until that point, the low population density and the very size of the St. Lawrence meant that human use of the river had had virtually no impact on its resources. But things would soon change. The first major impact appears to have been caused by logging and the beginnings of industrialization, in the nineteenth century; this included the floating of timber down the Ottawa River and the St. Lawrence to Quebec City, the building of dams and sawmills along tributaries, and the construction and commissioning of the first hydro-electric power plants.

The pace of change accelerated in the twentieth century, with the construction of major dams on the St. Lawrence, controlling its flow, and with shipping channels and then the St. Lawrence Seaway. More and more industries were established near towns, often right on the river. The proximity of the waterway offered several advantages: it reduced the cost of transporting raw materials, solved water supply problems and provided an easy way of getting rid of waste.

The St. Lawrence gradually succumbed to these numerous onslaughts. A few informed observers noted that some animal populations were declining and suggested that the reason was habitat degradation. Their warnings aroused little public interest, however.

Public awareness was sharply raised in the early 1970s with the realization that mercury contamination of fish was not just an abstract research topic but a real risk to which some Native peoples and many sport fishers were exposed. As the list of toxic substances reported in the aquatic environment continued to grow, the general public changed its perception and put the environment at the top of its list of priorities. There is virtually unanimous agreement now that the comforts afforded by an industrial society have a drawback: unbridled exploitation of resources and increasing levels of contaminants will eventually threaten all forms of life, including human beings.

Most industrialized countries have now agreed to base their economies on sustainable development. Profit alone can no longer govern human activity. Given the fragile nature of our environment and the limitations of our planet, sustainable economic development must ensure that scarce resources are used for a variety of purposes; it must also take into account the quality of life of human beings and promote the maintenance of biological diversity.

CHAPTER 2 The ZIP Program

Starting in the 1960s, growing public awareness of the degradation of the Great Lakes and the St. Lawrence and Saguenay rivers, along with the urgency of the situation, prompted governments to take concrete, joint action. This paved the way for the 1972 *Great Lakes Water Quality Agreement*. A 1987 amendment added a local use restoration program (Remedial Action Plans, or RAPs). In 1988, the eight American states concerned and the provinces of Ontario and Quebec signed the *Great Lakes Charter* and an agreement to control toxic discharges into the Great Lakes Basin. In response to the poor quality of the waters of the St. Lawrence and its tributaries, the Quebec government launched its own wastewater treatment program (PAEQ) in 1978.

In 1989, the federal and Quebec governments decided to combine their efforts under the St. Lawrence Action Plan, which was renewed in 1994 as St. Lawrence Vision 2000 (SLV 2000). One of the objectives of this action plan is to produce a complete state of the environment report on the Quebec portion of the St. Lawrence River. Under the *Priority Intervention Zones* (or ZIP) program, the St. Lawrence has been divided into 23 sectors, or ZIPs, grouped, as required, into *study areas* (Figure 1) within which community stakeholders are encouraged to work together to restore and protect the St. Lawrence and harmonize use of the river.

As part of the groundwork for public consultations, SLV 2000 partners review current knowledge about the state of the environment in each study area, and the findings are compiled in four technical reports.[1] This report summarizes the detailed data on ZIP 12, referred to in the following pages as the *Pointe-du-Lac–Deschambault sector* or the *study area (*the upstream segment of the Trois-Rivières–Bécancour study area: ZIP 12 and 13) to provide an overall

[1] The technical reports deal with the physico-chemical aspects of the water and sediments (Pelletier and Fortin, 1998), the biological communities (Armellin and Mousseau, 1998), socio-economic aspects (Jourdain and Bibeault, 1998) and human health issues (Chartrand et al., 1998).

assessment of this stretch of the river, its resources, present and future uses, and the associated constraints.

The document is intended above all for stakeholders of this segment of the St. Lawrence, and summarizes the main points of the available scientific and technical literature with the aim of allowing them to participate actively in the discussions and the process of defining priorities for action.

The information presented here should provide the foundation for a common vision of the situation in the study area, thereby paving the way for concerted action by the partners.

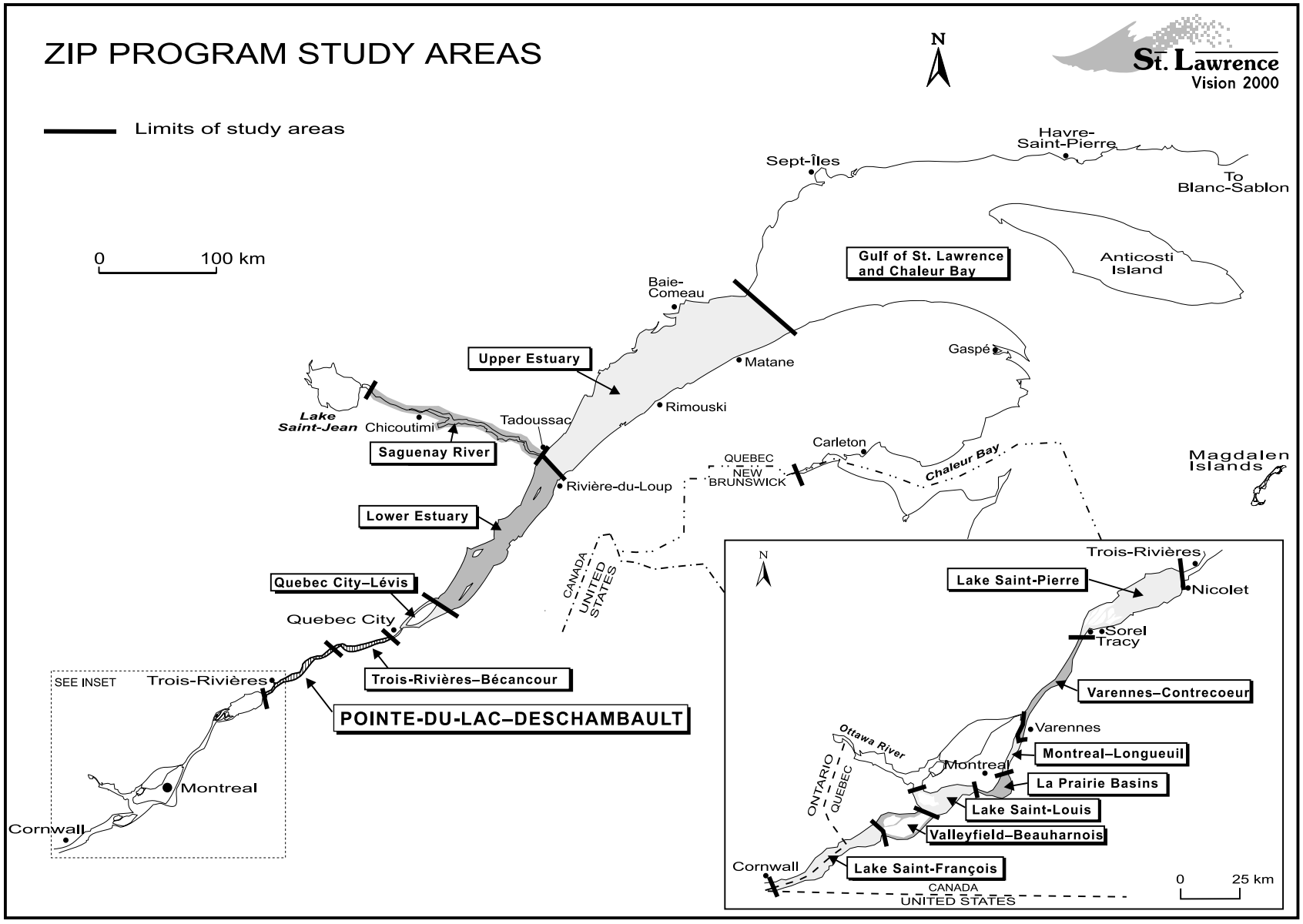


Figure 1 ZIP Program study areas

CHAPTER 3 Characterization of the Study Area

At the end of the last ice age, several thousand years ago, southern Quebec and Ontario were covered by a major inland arm of the sea. As the ice receded, the earth's crust gradually rebounded, exposing some land areas and isolating salt water in the huge basins that now form the Great Lakes.

Over thousands of years, the river carved out its bed in the unconsolidated deposits and clay that settled at the bottom of the former inland sea. This fertile plain, known as the St. Lawrence Lowlands, is bounded by the Canadian Shield to the north and by the Appalachian Mountains to the south.

The sector of interest here corresponds to the upstream segment (ZIP 12) of the Trois-Rivières–Bécancour (ZIP 12 and 13) study area. It stretches from the outlet of Lake Saint-Pierre to the Richelieu Rapids, namely from Pointe-du-Lac to Deschambault (Figure 2).

The outstanding feature of this part of the St. Lawrence is unquestionably the influence of the marine environment, in the form of the tides that propagate into the freshwater section of the river. In Lake Saint-Pierre and other upstream sections of the St. Lawrence River, the largest variations in water levels are seasonal. But in the narrow corridor forming the *Fluvial Estuary*, the biggest fluctuations in water level occur twice a day in response to the ocean-generated tides.

This fundamental characteristic of the sector has a multitude of effects on the physical parameters of the aquatic and riparian habitats, the plants and animals living in them and the way of life of riverside residents.

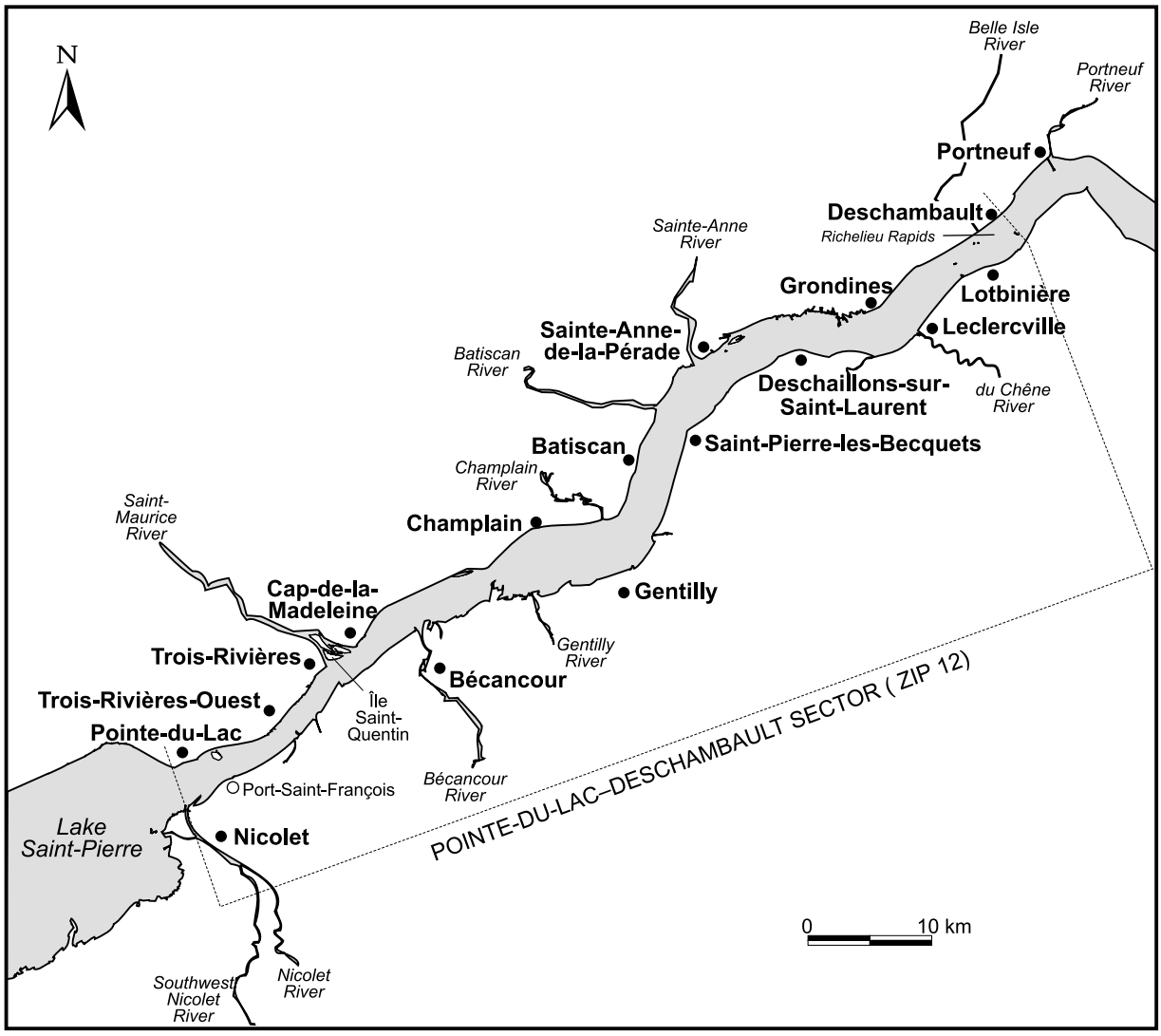


Figure 2 Pointe-du-Lac–Deschambault (ZIP 12) study area

3.1 Physical Environment

The Great Lakes are fed by precipitation collected in a drainage basin of 1.2 million km^2. What they cannot hold flows to the sea by way of the St. Lawrence River, at an average rate of 6850 cubic metres per second (m^3/s) as it leaves Lake Ontario.

From Lake Ontario, the St. Lawrence runs between Ontario and the state of New York and then through southern Quebec. Owing to the differing topography and characteristics of the substratum, the river's appearance changes as it passes from one region to another. The water flow speeds up in narrow places and slows down where the river channel widens into riverine lakes Saint-François, Saint-Louis and Saint-Pierre. The Fluvial Estuary, which begins at the outlet of Lake Saint-Pierre — the last and biggest of these river lakes — is lined with low riverbanks that gradually rise to form tall cliffs in the vicinity of Quebec City.

This section of the St. Lawrence River does not have many islands, but there are a few shoals. The mouths of some tributaries, such as the Sainte-Anne and Bécancour rivers, sometimes become silted up.

3.1.1 Water masses and river flow

There are three main water masses in the river at the outlet of Lake Saint-Pierre. Flowing in the centre of the river is the virtually intact mass of green waters from the Great Lakes, bordered on either side by mixing zones where these waters and tributary waters co-mingle. The tributaries on the north side are the Ottawa, L'Assomption and Maskinongé rivers; those on the south are the Richelieu, Saint-François and Yamaska rivers. At their points of confluence with the Fluvial Estuary, the tributaries form plumes in the St. Lawrence that vary in size according to their respective discharge rates and the tide. The plume of the Saint-Maurice River can sometimes be seen from as far away as Champlain. These three water masses flow side by side as far as Portneuf, where the stirring action of the tide mixes them together.

The annual mean discharge of the St. Lawrence River, which is approximately 10 820 m^3/s at the outlet of Lake Saint-Pierre, increases by about 9% in the Pointe-du-Lac–Deschambault sector because of the inflows from several tributaries, including the Saint-Maurice River (695 m^3/s), the Batiscan River (95 m^3/s), the Sainte-Anne River (66 m^3/s) and the Bécancour River (56 m^3/s). At the downstream limit of the sector, the river discharge rises to about 11 800 m^3/s (annual mean discharge).

Compared with the water mass coming from the Great Lakes, which is regulated for the most part by water control structures, the contribution of tributaries to the St. Lawrence River discharge is subject to wide seasonal fluctuations. During flood periods, the Saint-Maurice, Nicolet, Batiscan, Bécancour and Sainte-Anne rivers attain discharge rates several times higher than during their low water periods. When swollen by spring freshets, these rivers can influence the flow dynamics of the St. Lawrence River in and around where they meet up with the St. Lawrence.

Seasonal variations in the inflows of tributaries also affect the size of their plumes — which usually reach their maximum extent during freshets — in the St. Lawrence River.[2] The Saint-Maurice River plume, for example, extends sometimes as far as Champlain.

3.1.2 Tides

Water flow in this part of the river depends not only on the discharge collected from the drainage basin, but also on the ebb and flow of tides.[3]

Originating in the Gulf of St. Lawrence, the tide moves up the estuary twice a day and propagates into fresh water. The resulting changes in water level are determined by the shape of the channel and the section of river through which the water must pass. When the tidal flow goes through the funnel formed by the Upper Estuary (from the Saguenay River to Ile d'Orléans), it gradually increases in amplitude to a maximum at Quebec City (tidal range[4] of 5.8 m during spring tides). Between Quebec City and Lake Saint-Pierre, the tidal influence gradually diminishes. At Trois-Rivières and Port-Saint-François, the associated variations in water level do not exceed 30 cm.

---

[2] The largest plume areas measured on aerial photographs are 320 ha for the Sainte-Anne River, 303 ha for the Saint-Maurice River, 192 ha for the Batiscan River and 84 ha for the Nicolet River.

[3] Flow at a given point and time *(instantaneous discharge)* is a combination of *tidal discharge* and *river (*or *residual) discharge* coming from the watershed farther upstream.

[4] *Tidal range* is the difference in water level between successive high or low tides.

Independently of the inflows from the watershed (residual discharge), which the tides either amplify or attenuate depending on their phase, the tidal flow continually changes the instantaneous discharge rates of the river. Although barely perceptible at the upper limit of the estuary, the tidal discharge gradually increases further downstream. At Port-Saint-François, at the outlet of Lake Saint-Pierre, the tidal discharge is approximately 3600 m^3/s, whereas the residual discharge is about 11 000 m^3/s. The tidal discharge increases quickly moving in a seaward direction, to 11 300 m^3/s at Grondines, 30 500 m^3/s at Donnacona and 65 000 m^3/s at Quebec City. When the tidal discharge and the river discharge are both at their maximums and both going in the same direction, the instantaneous discharge rises to approximately 75 000 m^3/s off Ile d'Orléans.

The tidal flow changes as it moves up the estuary. High tides move faster than low tides. The variation in time between the two tidal phases increases as one goes upstream. At Trois-Rivières, the tide rises in two hours, but takes ten hours to ebb.

3.1.3 Flow characteristics

The speed and direction of the river current are determined by the river and tidal discharges. At flood tide (rising tide), the water flow is merely slowed down in the upper half of the Fluvial Estuary, which corresponds approximately to the Pointe-du-Lac–Deschambault sector, whereas it reverses direction further downstream. At ebb tide (falling tide), the current flows downstream throughout the Fluvial Estuary, but the speeds can vary depending on the tidal phase and the location.

A study carried out during low-water periods (9600 m^3/s) revealed that the tides reduced surface current speeds in the channel by about one-third at Trois-Rivières (0.88 m/s at ebb tide; 0.57 m/s at flood tide)[5]. Around Batiscan, where the river narrows, the decrease in speed is even more pronounced and the flow velocities become almost negligible when the tide rises

[5] These figures are given merely as an indication, since flow speeds are affected by the magnitude of the tides and river discharge.

(1.05 m/s at ebb tide; 0.08 m/s at flood tide). In the area of Deschaillons, the flow direction is reversed (1.58 m/s at ebb tide; 0.1 m/s in a landward direction at flood tide). At the channel bottom, the drop in current velocity or the reversal of direction associated with the flood tide is even more pronounced.

In narrow parts of the river where the tidal discharge is substantial, the water flow can reach great speeds. In the Richelieu Rapids, for instance, it exceeds 10 m/s at ebb tide. Velocities of between 4.6 and 7.4 m/s have been measured between these rapids and Quebec City.

3.1.4 Particle transport and sedimentation

Little is known about the sediment regime in the St. Lawrence River because of the complexity of the topic. It would entail studying a multitude of sediment sources, tide-induced reversals of the river current and the transport of material by ice in the spring[6].

When the river is ice-free, sediment transport occurs in two ways: coarse particles (sand and gravel) are carried along the bottom of the river by the current; fine particles (silt and clay) are carried in suspension throughout the water column. The suspended sediment discharge of the water mass is approximately 4.8 million tonnes per year at Trois-Rivières and 6.5 million at Quebec City.

The main inputs of suspended matter to the river by tributaries in the Pointe-du-Lac–Deschambault are as follows: Saint-Maurice River (400 000 tonnes/year), Bécancour River (190 000 tonnes/year), Batiscan River (170 000 tonnes/year) and Sainte-Anne River (110 000 tonnes/year). Between about 50% and 60% of the annual sediment load is transported in the spring and between 15% and 25% in the fall.

Not much is known about the river bottom in the Fluvial Estuary; detailed studies have dealt solely with the upstream section, between Pointe-du-Lac and Grondines.

---

[6] Particles of all sizes, including rocks weighing up to several kilograms, are transported by ice in the spring.

The geology of the Pointe-du-Lac–Deschambault sector is characterized by a gradual rise in the position of the bedrock between Lake Saint-Pierre, where it lies more than 100 m below the unconsolidated deposits, and the Bécancour and Gentilly areas, where it crops out in certain places along the shore. These outcrops are overlain by unconsolidated deposits of varying grain-size distribution and origin[7]. At Deschaillons, the river flows directly over the bedrock or tills overlying the bedrock. In this section of the river, the bottom substrate varies considerably.

The bottom of the ship channel is covered with granular materials (boulders, gravel and sand). Sand accumulations are often shaped into dunes by the current.

Outside the channel, fine sediments tend to accumulate more on the south side of the river. Slightly stronger currents on the north side limit deposition. The main areas of fine particle sedimentation are downstream of the Bécancour wharf, especially on the Gentilly and Saint-Pierre flats.

Approximately 44 km of natural shoreline along the Fluvial Estuary are unstable and subject to erosion, with most of this total (77%) being in the study area. The percentage of eroded riverbanks is especially high in Saint-Pierre-les-Becquets (64%) and Grondines (43%). The main erosion agents are wind-generated waves, tides, river currents and ice, particularly during periods of abnormally high water level in the winter.

In Saint-Antoine-de-Tilly, a short way downstream from the study area, the riparian forest fringe still bears the scars of two high-water periods in the 1920s and 1970s. Over the past 30 years, the extent and the frequency of bank overflows have increased, especially in winter.

3.2 Biological Environment

Although the natural environment in and around the Fluvial Estuary has changed quite a lot over the last few centuries, it is still possible to reconstruct its original features.

---

[7] These unsolidated deposits are primarily *tills* (glacial and periglacial sediments), clay silts, mixed sediments (Champlain Sea sediments) and sand from stream terraces.

3.2.1 Vegetation and habitats

In the absence of human activity, the clay soils along the Fluvial Estuary of the St. Lawrence River would typically support Sugar maple stands with Basswood or Yellow birch. The great forests that must have covered the cliffs originally have largely been replaced along the river by farm land, although a few remnants of the forests still exist farther inland.

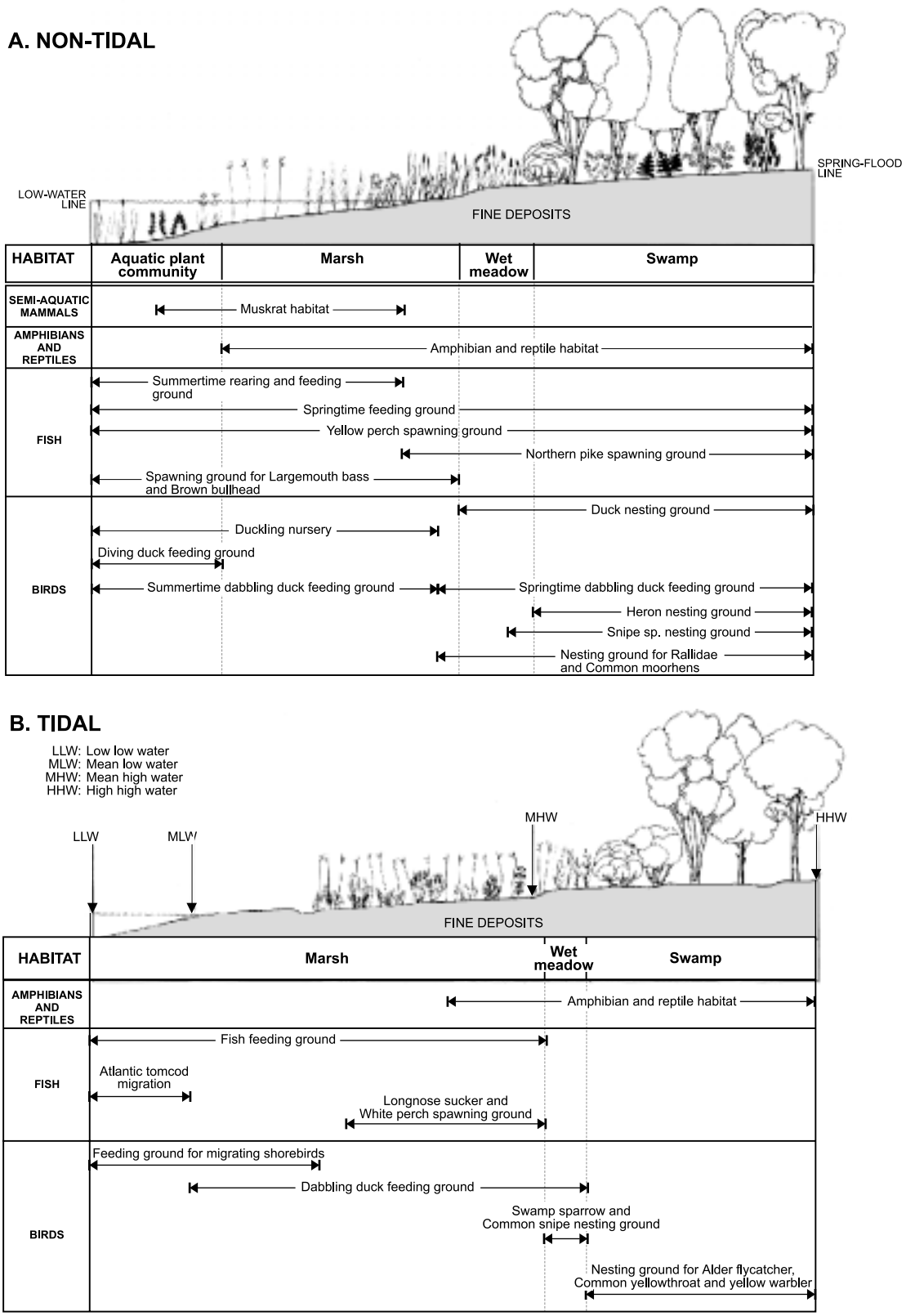
The shores of Lake Saint-Pierre slope gradually, which permits extensive flooding during spring runoffs. In a seaward direction along the Fluvial Estuary, there is a gradual transition from these low riverbanks to erosion scarps and then increasingly high cliffs.

The composition of the shoreline vegetation also shows a longitudinal gradient. At the outlet of Lake Saint-Pierre, there are *non-tidal wetlands* (Figure 3), where the spring floods have a preponderant influence on the type of plant species that are present. In the Batiscan area, *tidal wetlands* begin to appear; they feature plant species that are adapted to being alternately submerged and exposed to air, twice a day.

The non-tidal wetlands include aquatic plant communities, marshes, wet meadows and swamps. Wet meadows and swamps are submerged only during spring flooding.

The tidal wetlands include an area of unvegetated mudflats, marsh, wet meadows, which are submerged during spring tides, and swamp, which the water reaches and covers only during the highest annual tides, in the spring. The area exposed to the tides is characterized by a predominance of American bulrushes in the marsh, less diverse plant communities and an absence of exclusively freshwater plant associations.

The Pointe-du-Lac–Deschambault sector comprises 70% of the wetlands in the Trois-Rivières–Quebec City segment, including all of the non-tidal wetlands (3345 ha) in the Fluvial Estuary, mostly located along the south shore, and about 487 ha of the tidal wetlands, distributed almost equally on both sides of the river.



Source: Adapted from Couillard and Grondin, 1986; Gratton and Dubreuil, 1990; UQCN, 1993; Auger et al., 1984; SLC and Université Laval, 1992.

Figure 3 Zonation of wetlands in the upstream portion of the Fluvial Estuary and use by wildlife

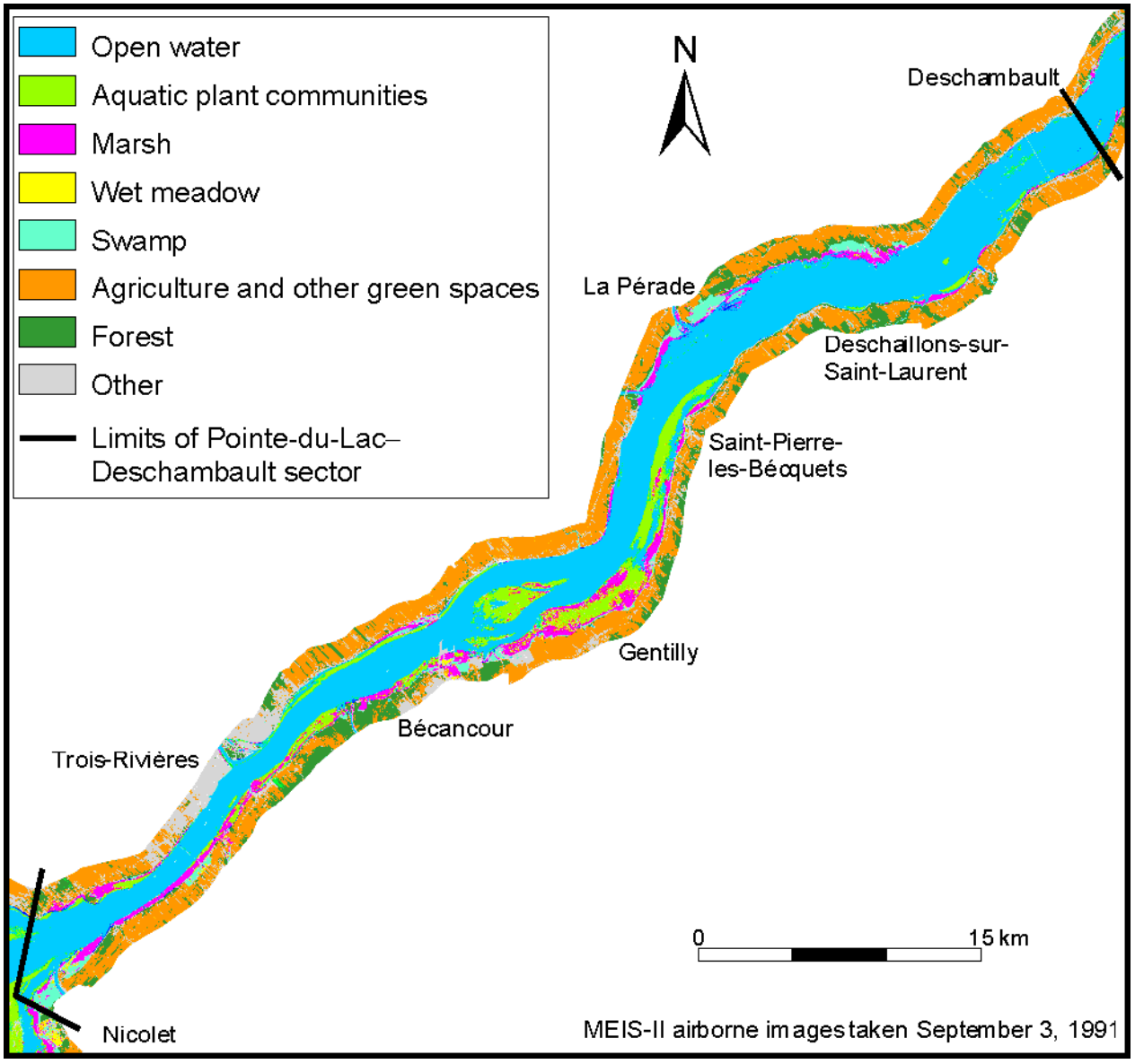
Aquatic plant communities are numerous and well developed as far seaward as Leclercville (Figure 4), covering an area of about 2860 ha in total. The most extensive stretches of this type of habitat (over 500 ha) are found on the broad flats at Gentilly, east of the river of the same name. Smaller beds of aquatic plants occur elsewhere, in the fine sediment deposits at the mouths of tributaries. American tapegrass, a plant adapted to the current and capable of establishing itself at a depth of up to seven metres, dominates almost all of the aquatic plant communities. It often grows alongside American bulrush, Broad-leaved arrowhead, Great bulrush, River bulrush and Richardson's pondweed. In areas sheltered from the current, other species are more common: Richardson's pondweed, Northern water-milfoil, American water plantain and Coontail.

The accumulation of fine sediment deposits allows for the development of emergent plant marshes, which occupy an area of less than 500 ha in the sector, particularly on the south shore. American bulrush is the most common species in these habitats, although some communities are dominated by Great bulrush, River bulrush, Broad-leaved arrowhead, Broad-leaved cattail or Giant bur-reed.

Wet meadows, which form a narrow strip along the riverbanks in places, are made up primarily of Reed phalaris and Bluejoint communities. The principal wet meadows are on the south shore, upstream from Gentilly.

The sector's swamps are comprised mostly of stands of Silver maple and Eastern cottonwood rather than shrubs. Shrub swamps are not numerous and are found mostly in the vicinity of Grondines. They comprise mainly willows and button-bush.

Tidal and non-tidal freshwater wetlands as a whole are important wildlife habitats. However, tidal wetlands are less suitable breeding areas for certain animal, such as fish, because the early life stages (eggs and larvae) cannot survive in an environment characterized by a continuous cycle of submergence and exposure to air. By contrast, these wetlands are good feeding areas for organisms that move with the tide.



Source: Létourneau and Jean, 1996.

Figure 4 Distribution of wetlands in the Pointe-du-Lac–Deschambault sector in summer 1991

3.2.2 Benthos

The term *benthos* comprises all organisms, both plants and animals, that live on, within or attached to the bottom.

The study of benthic animals yields highly useful information for describing aquatic habitats. On the one hand, these organisms are at the base of the food chain and their abundance is a significant condition for the establishment of populations of higher organisms such as fish or birds. As well, the distribution of benthic animals in the environment is highly dependent on local conditions (presence of aquatic plant beds, nature of bottom, depth) and individual species' requirements in this respect; one species may live almost exclusively in aquatic plant beds, while another will seek areas where there is no vegetation.

The benthos of the Fluvial Estuary is composed primarily of representatives of six main taxonomic groups: midges (56 species of Chironomidea), gastropods (33 species), oligochaetes (28 species), Sphaeriidea (27 species), caddisflies (22 species of Trichoptera) and Hirudinea (20 species). Gastropods, the most abundant of the molluscs, are dominated by the ubiquitous faucet snail, *Bithynia tentaculata*.

A study of the benthos of the Gentilly area showed a strong correlation between the distribution of benthic species or their community structure and certain environmental parameters, particularly depth, current speed and sediment type. Four main benthic habitats can be identified on the basis of these parameters along an axis perpendicular to the river channel. The sublittoral zone and the shoals constitute the richest habitat. The slow currents that characterize these habitats allow fine particles to settle out. Mudflats provide the best conditions for the establishment of a diversified and abundant benthic wildlife.

3.2.3 Fish

The Fluvial Estuary is home to as many fish species as other sections of the St. Lawrence River.[8] A high percentage of these species, however, comprise only a small number of specimens. The reason for this may be that fewer species form true populations in the Fluvial

[8] According to surveys, there are 43 fish species between Pointe-du-Lac and the Laviolette Bridge, slightly fewer species than in the eastern portion of Lake Saint-Pierre, with 51 species.

Estuary. In the study area, there is a smaller range of aquatic habitats, especially aquatic plant communities, compared with Lake Saint-Pierre and its archipelago.

Although the total area of riparian habitats is limited, many fish species spawn in the upstream part of the Fluvial Estuary in areas where the tidal range is insignificant. There are fewer potential spawning grounds downriver from Gentilly because of the periods of emergence, sediment disturbance and changes in water levels, flow speeds and temperature, which prevent incubation of the eggs of most fish species. However, some species spawn in a few tributaries accessible from the river. At least 15 or so species, such as Walleye and Atlantic tomcod, spawn in the Fluvial Estuary or connecting tributaries.

The Portneuf area may be important for the reproduction of Atlantic sturgeon, which are commercially fished in the Upper Estuary. Routine catches of these large fish on both sides of the river, at the foot of the Richelieu Rapids and at Grondines, together with recent surveys, indicate that their spawning grounds are close by.

At Gentilly, the dominant species in the fish communities are Yellow perch, carp, Walleye and Northern pike. Most of the other fish species are much less abundant (generally less than 5% of total catches).

Environmental factors have a decisive effect on the composition of fish communities. South of the navigation channel, experimental gillnet fishing has revealed that Yellow perch, carp and Northern pike are clearly dominant in *lentic* (still water) habitats. In *lotic* (flowing water) areas, Yellow perch are still the most plentiful species, followed by carp, Walleye and suckers. North of the channel, lotic areas predominate and the most common species are Lake sturgeon, Walleye and Sauger.

One of the prime characteristics of the Fluvial Estuary is that it forms a common migratory corridor for all diadromous species[9] that use the St. Lawrence basin upstream from Quebec City. To complete their full life cycle and reproduce, all of these fish species must follow

this route in both directions. Consequently, the abundance of diadromous species in estuary waters fluctuates with the seasons, according to their migration patterns.

There is cause for concern about the status of certain species populations, especially Lake sturgeon, Atlantic sturgeon and Yellow perch. The Lake sturgeon has a high mortality rate because of commercial fishing, poaching and the effects of pollution. Although certain indicators, such as the stable volume of landings or the sequence of cohorts, suggest that the Lake sturgeon population tolerates this overfishing better than expected, their situation is still worrisome.

3.2.4 Birds

The Fluvial Estuary is visited by many birds, which nest there or stopover during their migrations. Of the more than 240 species observed in this region, about 153 are apt to nest in the area.[10] Most of the birds directly associated with the riparian and aquatic habitats of the St. Lawrence River (108 species out of 115) visit the Fluvial Estuary at one time or another during the year, and 69 of them breed there.

The Canada goose, nine species of dabbling duck[11] and four species of diving duck[12] may nest in the study area. The main brood-rearing areas are on the south shore, and extend from Paul Point to Orignaux River, from Bécancour River to Paul Point and from Nicolet to Sainte-Angèle-de-Laval.

Waterfowl are particularly numerous in the study area during migrations (Figure 5). In fact, the Fluvial Estuary lies between two major staging areas, at Lake Saint-Pierre and Cap Tourmente.

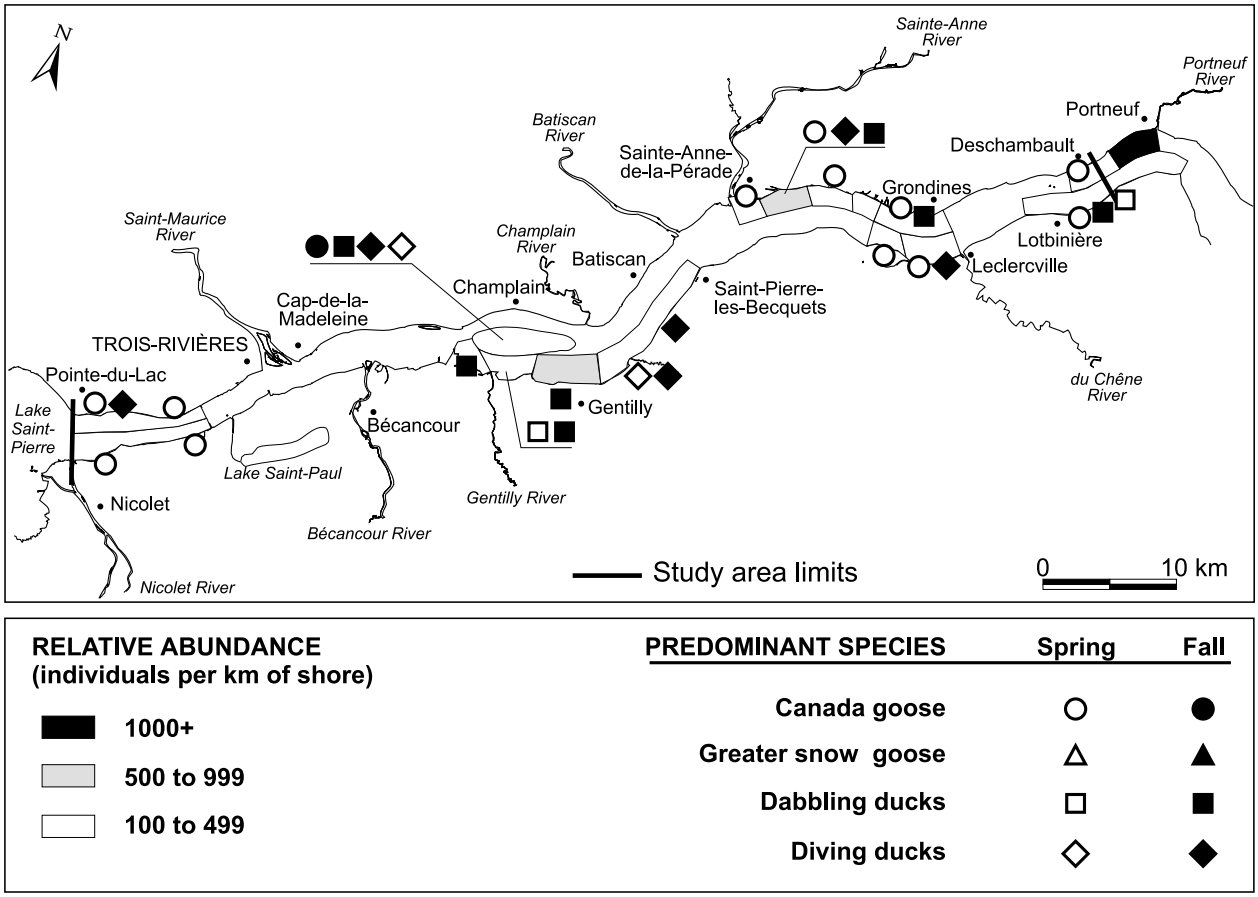
---

9 *Diadromous* refers to all species that migrate between fresh water and the sea to compete their life cycle. Almost all St. Lawrence River diadromous fish are anadromous, in that they spawn in fresh water and mature in salt water. A single *catadromous* species, the American eel, migrates in the opposite direction.

10 In all, 104 of these species are confirmed breeders, 34 are probable breeders, and 15 are possible breeders.

11 The most common species in the area are the American black duck, Northern pintail, Blue-winged teal, and Mallard. The other nesting birds are the Gadwall, American wigeon, Northern shoveler, Green-winged teal, and Wood duck.

12 Ring-necked ducks, Common goldeneyes, Hooded mergansers and Common mergansers may nest in the estuary, but this has yet to be confirmed.



Source: Ouellet, 1992.

Figure 5 Main staging areas for migrating waterfowl

During the 1980s, the areas most frequented by dabbling ducks in the spring were the riparian aquatic beds across from Gentilly. Other concentrations of waterfowl may be observed upstream from the Laviolette Bridge (near both shores), downstream from the Sainte-Anne River, upstream from Grondines and upstream from Leclercville. Since the end of the 1980s, Snow geese have been seen more and more frequently in the Fluvial Estuary.

There is a different mix of waterfowl in the study area during the fall migrations. Ducks are slightly more abundant than in the spring, with diving ducks being more numerous.

The main waterfowl gathering areas in the fall are downstream from the Sainte-Anne River, and on the Gentilly shoreline and mudflats upstream from Leclercville. In winter, there are no waterfowl in the region.

There are few bird colonies in the sector owing to the scarcity of islands and islets. A colony of Common terns flourished on Ile aux Sternes during the 1970s but disappeared in the 1980s when the unvegetated sites that these birds seek out for nesting gradually became colonized by vegetation. A colony of Ring-billed gulls took their place, then disappeared also. In the early 1980s, the sector's only known bird colony was a colony of Black terns in a bulrush marsh on Ile aux Sternes. A colony of Ring-billed gulls settled briefly on lands owned by the Kruger Inc. paper manufacturing company in Trois-Rivières, but abandoned the site in 1995.

At the beginning of August, groups of migrating shore birds can be seen here and there in muddy and sandy shore areas. Semipalmated sandpipers are by far the most abundant species (88%), followed by Lesser yellowlegs and Least sandpipers.

3.3 Human Occupation

Before French colonists arrived on the banks of the St. Lawrence River, the region was occupied by Aboriginal nations. The south shore was occupied primarily by the Abenaki and the north shore by Algonquin Indians.

The founding of Trois-Rivières as an outpost for the fur trade in 1634 fostered the establishment of several *seigneuries* between there and Quebec City. Lots granted to the tenant farmers stretched in long strips backs from the river[13] to give as many settlers as possible access to the river for transportation and fishing purposes.

Industrial activity got under way at Trois-Rivières when iron ore was discovered in the area in the early 18th century and the first forges were established. During the British regime, the area experienced further development under the impetus of the timber trade with England.

---

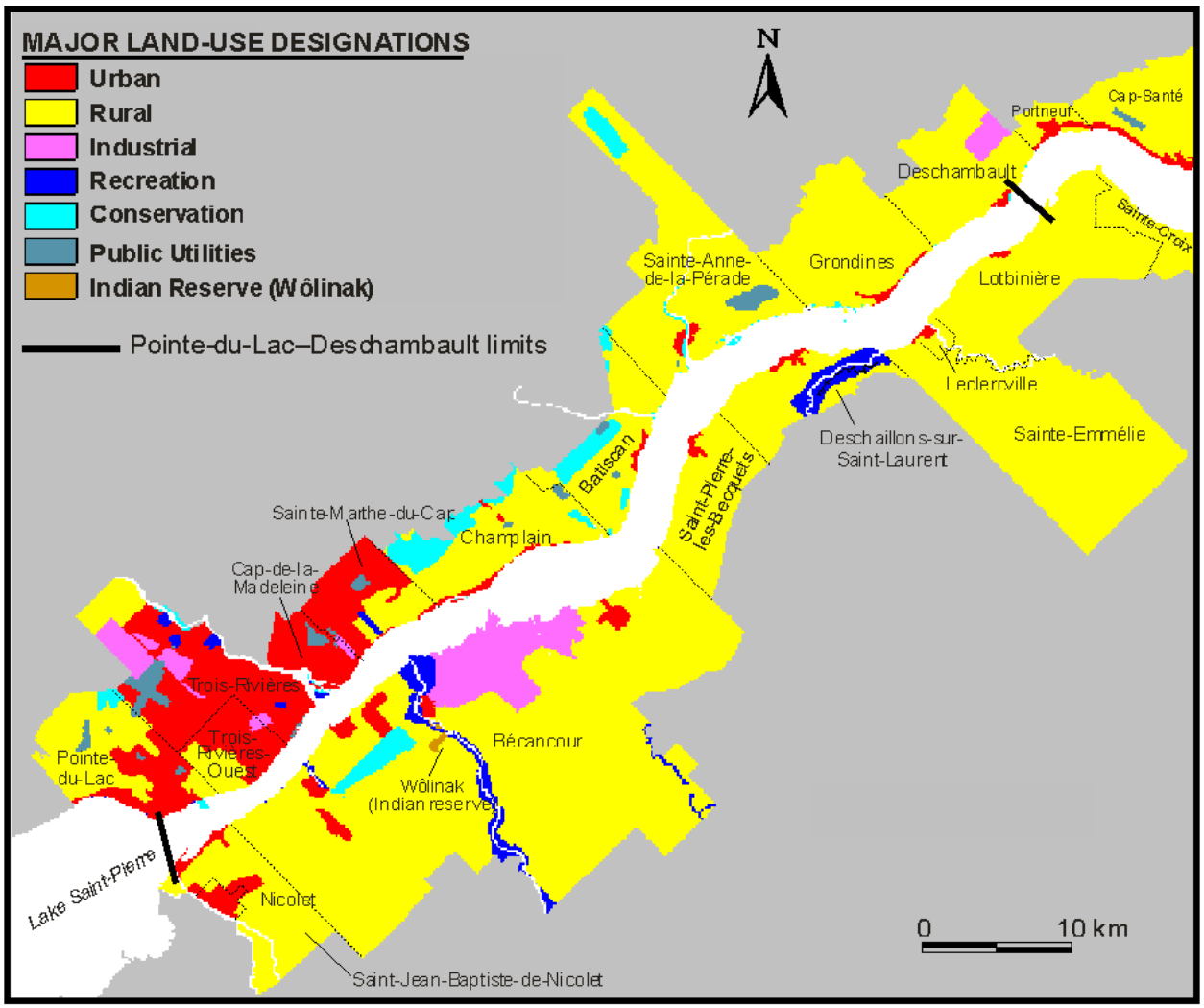
[13] The strip pattern typical of Quebec's rural landscape can still be seen in the area today from the air.

The Saint-Maurice River provided access to the hinterland and its vast forests, and logs were floated downriver to supply sawmills established at various locations in the watershed, including Trois-Rivières. The lumber industry gave way in the 20th century to the paper industry, and pulp and paper are still the main pillar of the Trois-Rivières economy. As a result, the area has been hit hard by the slowdowns that have marked this industry since the 1980s, resulting in numerous plant closings and a high unemployment rate. Trois-Rivières has also lost a share of the region's industrial activity to the Bécancour industrial park and port on the south shore, where several metallurgical and chemical plants have been established. The local highway system and the Laviolette Bridge have favoured suburban development and urban sprawl — a phenomenon shared by many North American cities.

From a planning perspective, most of the region is devoted to rural uses (Figure 6), which account for 58% of the land area, greatly exceeding urban (9%) and other uses.

Most of the rural land along the north shore of the estuary is covered by forest. On the south shore, a higher percentage of rural land is devoted to agriculture. Dairy farming is the main agricultural activity, followed by livestock production (slaughter hogs and cattle) and grain production. Corn is also grown, but less intensively than in the area south of Lake Saint-Pierre.

The sector, covering an area of 1346 km^2, has a population of 146 800 living in 18 municipalities and an Indian reserve (Table 1). The population density of the sector as a whole is 109 inhabitants/km^2. The most densely populated area is Cap-de-la-Madeleine (1933 inhabitants/km^2) and the least densely populated is Sainte-Emmélie (2 inhabitants/km^2).



Source: Francheville RCM, 1992; Portneuf RCM, 1988; Nicolet–Yamaska RCM, 1986; Bécancour RCM, 1988; Lotbinière RCM, 1989.

Figure 6 Land-use designations in the riverside municipalities of the Pointe-du-Lac–Deschambault sector

Table 1
Population and land area of sector municipalities in 1996

Municipality	*Population*	*Land area (km^2)*	*Population density (inhabitants / km^2)*
North Shore			
Pointe-du-Lac	6 197	62.3	99.5
Trois-Rivières-Ouest	22 886	28.8	796.0
Trois-Rivières	48 419	77.8	622.3
Cap-de-la-Madeleine	33 438	17.3	1932.8
Sainte-Marthe-du-Cap	6 150	40.8	150.6
Champlain	1 608	58.1	27.7
Batiscan	891	44.0	20.2
Sainte-Anne-de-la-Pérade	2 181	108.6	20.1
Grondines	718	67.7	10.6
Deschambault	1 240	55.4	22.4
Subtotal	*123 728*	*560.8*	*220.6*
South Shore			
Nicolet	4 352	5.6	774.4
Saint-Jean-Baptiste-de-Nicolet	3 076	47.2	65.2
Bécancour	11 489	434.3	26.5
Saint-Pierre-les-Becquets	1 336	46.9	28.5
Deschaillons-sur-Saint-Laurent	1 060	36.2	29.3
Sainte-Emmélie	322	132.2	2.4
Leclercville	295	3.3	90.5
Lotbinière	1 008	78.5	12.8
Wôlinak Indian Reservation	147	0.6	237.1
Subtotal	*23 085*	*784.7*	*29.4*
Total	**146 813**	**1 346**	**109.1**

Source: Statistics Canada database, 1996.

CHAPTER 4 Main Effects of Human Activities on the Environment

Human activities have caused changes in the sector. The most significant of these are outlined in the following section.

4.1 Contamination

For a long time, the St. Lawrence was considered a convenient and inexpensive dump site for wastewater. Industries, municipalities and agricultural operations discharged effluents and drainage water into the river untreated, until the effects of the pollution could no longer be ignored. The magnitude of the problem forced governments to monitor effluent and establish standards for the concentrations of substances discharged into watercourses. However, many substances have persisted in the environment and continue to be a source of contamination many years after they were originally discharged.

The volume and type of effluent determine its impact on the environment. For example, industrial plants are usually the main sources of toxic chemicals, while municipal sewage contributes to bacterial contamination and boosts biological productivity considerably: this, among other things, can lead to the rapid growth of algae and give water a foul odour that turns people off swimming and other recreational activities. Agricultural activities can degrade the aquatic environment through runoff of fine soil particles, fertilizer and pesticides.

4.1.1 Sources of contamination

The biggest point source inputs of contaminants into the Fluvial Estuary are believed to be the St. Lawrence River itself at the outlet of Lake Saint-Pierre, local industrial discharges,

tributaries[14] and municipal effluents. Added to these point sources are other sources, termed *nonpoint* sources because they do not have a specific point of entry into the aquatic environment. Groundwater and runoff in urban, industrial and agricultural areas, hazardous waste disposal sites and other contaminated sites, and atmospheric deposition are nonpoint sources of contaminants. The relative contribution of each of these nonpoint sources is difficult to quantify at this time.

Another potential source of contamination is accidental spills of various polluting substances. Such incidents may arise during transshipment operations in the sector's two ports (see Section 4.3.2).

4.1.1.1 *Fluvial inputs*

For decades, the Fluvial Estuary area has received inputs of contaminants from sources throughout the Great Lakes–St. Lawrence River basin farther upstream. On its way to the sea, the St. Lawrence River passes through many major urban areas and industrial centres, in particular Cornwall–Massena, Salaberry-de-Valleyfield, Beauharnois–Melocheville, Montreal–Longueuil and Sorel–Tracy.

Table 2 is a compilation of available data on the main sources of certain contaminants that reach the Fluvial Estuary. Although this synthesis only covers a small set of parameters and contains incomplete information on the sources of many substances, it gives an idea of the relative importance of the inputs. It clearly indicates that most of the metals are carried by the river from upstream. In the case of lead, local sources (industries, tributaries and municipal effluents) account for no more than 7% of total inputs.

The river transports a large number of substances into the study area from upstream. Calculations of these inputs, or *mass balances*, were done for nitrogen, phosphorus and suspended solids (SS) in 1990 and 1991, before several sewage treatment plants along the river went into operation.

---

[14] The tributaries, which collect both nonpoint-source pollution and inputs from all sources within their drainage basins, are considered here as if they were point sources along the St. Lawrence River; see Section 4.1.1.4.

According to these analyses, the quantity of nitrogen transported by the St. Lawrence River during the summer increases gradually in a seaward direction between Montreal and Trois-Rivières, and remains fairly stable from there onwards (about 280 tonnes per day at Quebec City). By comparison, the mass loadings of phosphorus and suspended solids keep increasing all the way downriver, as far as Quebec City.

Table 2
Main sources of certain contaminants entering the Fluvial Estuary*

	Inputs by Source							
Parameter	*St. Lawrence River (upstream)*		*Industries*		*Tributaries*		*Municipal effluents*	
	kg/year	%	kg/year	%	kg/year	%	kg/year	%
Metals								
Cadmium	7 658	(96%)	n/a		332	(4%)	n/a	
Cobalt	109 062	(98%)	n/a		2 457	(2%)	n/a	
Chromium	527 223	(99%)	1 314	(< 1%)	223	(< 1%)	n/a	
Copper	368 497	(97%)	1 240	(< 1%)	9 347	(2%)	3 546	(1%)
Nickel	345 711	(97%)	1 873	(1%)	6 753	(2%)	n/a	
Lead	129 461	(93%)	1 703	(1%)	2 303	(1%)	6 314	(5%)
Zinc	861 584	(98%)	9 031	(1%)	199	(< 1%)	12 775	(1%)
Organic Substances								
PCBs*	54	(94%)	n/a		3.5	(6%)	n/a	
PAHs	7 025	(93%)	n/a		499	(7%)	n/a	

Source: Proulx, 1993a and b; SLV 2000 Intervention, 1996; 1997; Asseau-INRS, 1992.

* Data from early 1990s, except for 1996–97 industrial inputs.

Note: To obtain an estimate of total PCBs, multiply this number by a factor of 4. The total annual fluvial input of PCBs is thus 216 kg.

A similar exercise provided the estimates of inputs of metals and organic contaminants presented in Table 2. The metal loads, which are clearly greater than the loads of

organic substances, include a natural component which derives from the geochemical nature of the basin, along with the contribution resulting from human activities.

The *anthropogenic enrichment factor (AEF)*, calculated for metals in sediment, is a ratio of the measured level to the background concentration. Concentration profiles obtained from analyses of sediment cores are used to track temporal trends in fluvial inputs of contaminants. In the Montreal area, contaminant inputs to aquatic habitats from human activities appear to have peaked in the 1960s and 1970s and then decreased substantially. Data gathered in the Sorel delta area indicate that the AEF for metals peaked in 1981. This was attributed to the resuspension of contaminated sediments caused by riverbed erosion farther upstream.

4.1.1.2 *Industries*

Although process waters used to be discharged directly into the river without any restrictions, industrial plant discharges today are strictly regulated and monitored. Many effluents are now channelled into sewer systems and municipal treatment plants. In addition, some plants have either closed or upgraded their facilities, which has led to a reduction in environmental releases of toxic substances.

Industrial effluents. The St. Lawrence Action Plan, renewed as the St. Lawrence Vision 2000 (SLV 2000) plan, targeted 16 industrial plants in the Pointe-du-Lac–Deschambault sector as a priority for action in terms of reducing discharges of toxic substances. Ten of these plants (Figure 7, Table 3) are located in the Fluvial Estuary between Pointe-du-Lac and Deschambault and discharge their effluents directly into the St. Lawrence or near the mouth of one of its tributaries[15] A brief outline of the activities of these industries and the toxicity of their

[15] Two other SLV 2000 plants located near the St. Lawrence River are not mentioned here. The Lauralco Inc. aluminum smelter in Deschambault does not discharge industrial process water under normal conditions. The SKW Canada Inc. plant in Bécancour uses a process that does not produce effluent.

releases into the aquatic environment appears below. Other plants targeted by SLV 2000 are located along the upper reaches of certain tributaries[16] (see Section 4.2.1.4).

Table 3
Riverside industrial plants targeted under St. Lawrence Vision 2000 that discharge effluents into the Pointe-du-Lac–Deschambault sector

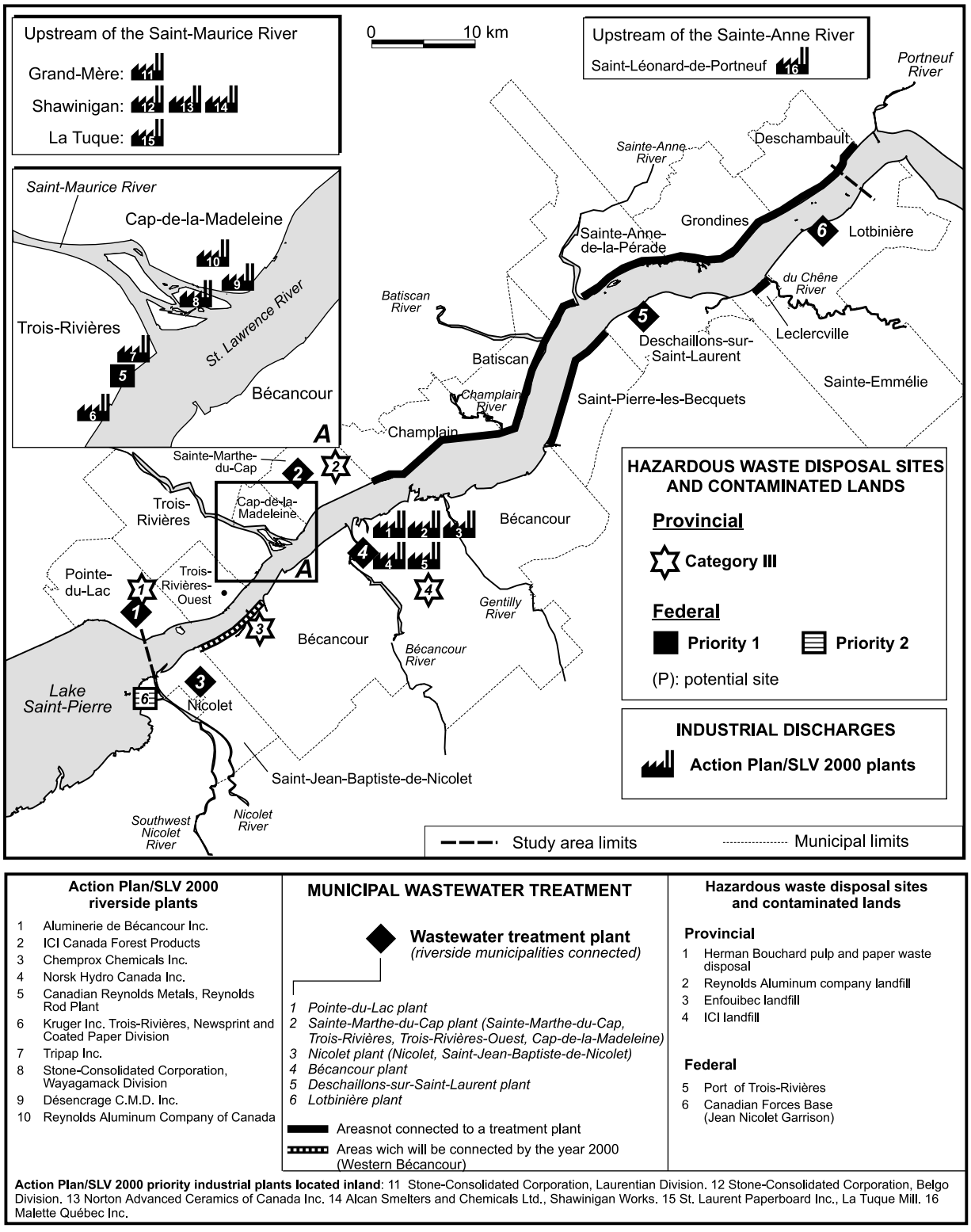
Municipality	*Plant*	*Products*
Bécancour	Aluminerie de Bécancour Inc.	Aluminum ingots, slabs and billets
	ICI Canada Forest Products	Chlorine, caustic soda, hydrochloric acid, hydrogen and sodium hypochlorite
	Chemprox Chemical Inc	Hydrogen peroxide
	Norsk Hydro Canada Inc.	Pure magnesium and magnesium alloys
	Canadian Reynolds Metals Company, Reynolds Rod Division	Aluminum rods and remelt ingots
Trois-Rivières	Stone-Consolidated Corporation, Wayagamack Division	Specialty papers, pulp bales, directory paper and other thin papers
	Kruger Inc.	Newsprint, coated papers and specialty papers
	Tripap Inc. (formerly CPFP Inc.)	Specialty papers
Cap-de-la-Madeleine	Reynolds Aluminum Company of Canada	Aluminum sheet
	Désencrage C.M.D. Inc.	De-inked pulp

Source: SLV 2000 Intervention, 1996 and 1997.

Chemprox Chemical Inc. in Bécancour manufactures hydrogen peroxide. Its industrial wastewater is treated and then discharged into the St. Lawrence River. Domestic wastewater is channelled to the municipal sewage system via the Bécancour industrial park sanitary drainage system. In 1993, the effluent flow rate was 206 m^3/day, but the toxicity level was low. According

[16] Five plants are located along the upper reaches of the Saint-Maurice River and one is on the Sainte-Anne River.

to samples taken at the time, the most problematic substances were nitrites and nitrates. No major changes have been made to the wastewater treatment system since 1993.



Source: Jourdain and Bibeault, 1998; Pelletier and Fortin, 1998; MENVIQ, 1991a and b.

Figure 7 Main local sources of contamination and municipal wastewater treatment facilities in the Pointe-du-Lac–Deschambault sector

The *Norsk Hydro Canada Inc.* plant in Bécancour produces magnesium. Its effluent is treated so that liquid and gaseous discharges can be recirculated back to the process stream. Domestic wastewater is discharged through the Bécancour industrial park sewer system. Indirect cooling waters are channelled to the river via a ditch around the plant, following analysis of pH level, conductivity and oxidation-reduction potential. During a 1995 inspection, the calculated Chimiotox index was lower than the average for plants targeted under SLV 2000. Bioassays conducted on liquid discharges found no toxicity in the company's effluent.

The *Canadian Reynolds Metals Company, Reynolds Rod Division* in Bécancour manufactures aluminum rods. Its industrial wastewater is treated by ultrafiltration, then aerated in cooling towers to lower the oxygen demand. After treatment, the wastewater is discharged into an industrial ditch that leads to the St. Lawrence River. The company's Chimiotox index is among the lowest of the SLV 2000-targeted plants.

In February 1994, *Tripap Inc.* reopened the *Canadian Pacific Forest Products Ltd.* (CPFP) plant in Trois-Rivières that had closed in June 1992. The plant manufactures specialty papers. The main industrial effluent undergoes primary treatment in a flotation system, and then secondary treatment using activated sludge. This effluent is discharged directly into the river. An exhaustive characterization of plant effluents was carried out in 1990 under the St. Lawrence Action Plan. The industrial processes have been modified since the plant reopened, and as such, the estimates of effluent toxicity are probably no longer representative of the current situation. According to data provided by the company itself, copper and linolenic acid are present in the wastewater after treatment. The Chimiotox index fell by 99.7% between 1988 and 1995. In 1990, the plant's discharges were among the most toxic of Action Plan-targeted industries. Production-process changes made by Tripap and the implementation of secondary treatment seem to have altered the situation considerably. According to bioassays carried out by the company in 1995, the final effluent is no longer toxic.

Stone-Consolidated Corporation in Trois-Rivières produces specialty papers, pulp bales and directory paper from mechanical and kraft pulps manufactured on site. Wastewater undergoes secondary biological treatment in sequential reactors and is discharged into the St. Lawrence and Saint-Maurice rivers on both sides of La Potherie Island. Domestic wastewater is mixed with the industrial wastewater. According to data provided by the company, the main toxic substances discharged are mineral oil and grease, dioxins and furans. The Chimiotox index declined by 77% between 1988 and 1995. According to three series of biological assays carried out as recently as 1994, this plant accounted for some of the most toxic effluents discharged into the St. Lawrence River as a whole. However, the plant's effluents have not been sampled since secondary treatment was introduced in 1995. It is therefore possible that current toxicity levels are lower.

The *Kruger Inc. Newsprint and Coated Paper Division* in Trois-Rivières manufactures newsprint, specialty papers and coated papers from four types of pulp, two of which are produced on site. All process waters go to a collector and then to primary and secondary treatment facilities. The treated wastewater is discharged into the river. In 1995, the two main toxic substances in the effluent were copper and aluminum. The Chimiotox index fell by about 63% between 1989 and 1995 despite a 25% jump in production in 1991. The program undertaken to reduce fresh water use and the introduction of secondary treatment have helped to remove all effluent toxicity.

The *Reynolds Aluminum Company of Canada* plant in Cap-de-la-Madeleine manufactures aluminum sheet from sheet ingot and aluminum scrap. Sanitary sewage, rainwater, process water and cooling water are discharged to the Cap-de-la-Madeleine public sewer system. These waters are then treated in the aeration lagoons of the regional treatment plant in Sainte-Marthe-du-Cap and released to the river. In 1990, oil and grease were the main toxic substances in the effluent. The installation of a cooling water recirculation system and an oil recovery system helped reduce the Chimiotox index by 89% between 1988 and 1995.

The *Désencrage C.M.D. Inc.* plant in Cap-de-la-Madeleine recycles various waste paper materials into newsprint pulp. The plant's effluent undergoes secondary treatment. Process water is recirculated in two clarifiers. A settling tank is used for primary treatment of the industrial wastewater, which then undergoes secondary activated-sludge treatment and is released to the St. Lawrence River. According to data collected in 1995, the Chimiotox index for the effluent is relatively low. Bioassays of the final effluent confirmed that it is not toxic.

Hazardous waste sites. In addition to their effluent, industrial plants produce hazardous waste which they dispose of at land-based sites. In the long run, these sites can add to the contamination of the aquatic environment, since some substances may flow overland or migrate into the groundwater, eventually ending up in streams and rivers. Inventories of many industrial waste disposal sites that pose environmental or public health risks have been conducted in the study area by the Quebec Environment Ministry (MENVIQ) or Environment Canada (Table 4). Six of the sites present a low risk of contamination for the St. Lawrence River and its tributaries (Figure 7). Contaminated sites far from the St. Lawrence and its tributaries pose less risk of contamination of aquatic habitats, although they place major limitations on land use.

Table 4
Hazardous waste disposal sites between Pointe-du-Lac and Deschambault

Location	*Site and type of waste*	*Classification*	*Owner*	*Main contaminants*
Provincial Inventory				
Pointe-du-Lac	*Pulp and paper waste disposal site* – dry material and sludge from pulp and paper clarifiers*	III	H. Bouchard	Heavy metals
Trois-Rivières-Ouest	*Former Trois-Rivières dump* – domestic and industrial waste	II	City of Trois-Rivières	–
Trois-Rivières	*Delorme Construction dump* – dry material and sludge from pulp and paper clarifiers	III	P. Charbonneau	Heavy metals
Sainte-Marthe-du-Cap	*Reynolds Aluminum Company of Canada dump* – inks, aluminum foil, glue and paper*	III	R. Dumas	Inks, plastics, oil and metals

Table 4 (continued)

Location	*Site and type of waste*	*Classification*	*Owner*	*Main contaminants*
Bécancour	*Former Bécancour dump* – household garbage and dry industrial material	II	M. F. Guérard	–
	ICI Canada dump – dry material and sludges*	III	Bécancour industrial park	Industrial waste, asbestos fibres and brine sludge
	Enfouibec – solid industrial waste*	III	Yvon Lemay Inc.	Hydrocarbons
	Dépôts de Matériaux Secs Yvon Lemay – industrial waste	III	Yvon Lemay Inc.	Hydrocarbons
Champlain	*Former Champlain dump* – domestic, commercial and industrial waste	III	Municipality of Champlain	–
Federal Inventory				
Nicolet	Canadian Forces Base, Jean Nicolet Garrison*	Priority 2	Department of National Defence	Oil, munitions
Trois-Rivières	Port of Trois-Rivières*	Priority 1	Canada Ports Corporation	Oil, heavy metals
Bécancour	Gentilly 2 Nuclear Power Station (storage areas)	Priority 2 (potential contamination)	Atomic Energy of Canada Limited	Tritium

Source: MENVIQ, 1991a and b; D'Aragon, Desbiens, Halde and Associates and Roche Ltd. 1992.

Provincial classifications: I – high risk of contaminating the aquatic environment; II – medium risk; III – low risk.

*Sites posing a risk of contamination for the St. Lawrence River and its tributaries.

4.1.1.3 *Municipal wastewater discharges*

In 1997, it was estimated that 80% of the population in the area between Pointe-du-Lac and Deschambault Point, or 117 440 residents in 10 municipalities (Table 5), were served by six treatment plants (Figure 7). Wastewater treatment is to be implemented in the western sector of Bécancour by the year 2000, thereby serving an additional 4610 people.

Table 5
Wastewater treatment in riverside municipalities of the Pointe-du-Lac–Deschambault sector in 1997 and 1998

Treatment plant (other municipalities served)	*Start-up year*	*Treated flow (m^3/day)*	*Population served*
Pointe-du-Lac	1990	1 313	3 183
Sainte-Marthe-du-Cap (Trois-Rivières, Trois-Rivières-Ouest, Cap-de-la-Madeleine)	1994	87 000	102 943
Nicolet (Saint-Jean-Baptiste-de-Nicolet)	1997	9000	6 348
Bécancour	1997 for Bécancour, Gentilly, Sainte-Angèle, Sainte-Gertrude, Saint-Grégoire and Précieux-Sang	2 590	3 290
	Western sector to be added by the year 2000	*4 546*	*4 610*
Deschaillons-sur-Saint-Laurent	1994	619	1 207
Lotbinière	1988	182	469

Source: MAM, 1997.

Four of these treatment plants were inspected; their operations were found to be satisfactory in that the reduction of suspended solids and biochemical oxygen demand (BOD_5) met provincial Ministry of Environment and Wildlife (MEF) standards. However, their wastewater treatment methods do not remove all micro-organisms. During heavy rains the collector system for the Sainte-Marthe-du-Cap treatment plant may become overloaded, allowing untreated sewage to enter the river at a series of overflow points.

Some municipalities, especially on the north shore, are not served by wastewater treatment plants and release raw wastewater into the river (Figure 7).

4.1.1.4 *Tributaries*

Industrial and municipal effluents are collected by some tributaries from point sources in their watersheds and transported to the St. Lawrence. Tributaries are also the main pathway into the aquatic environment for fertilizers and pesticides used on farms, surface runoff from urban areas and leachates from contaminated sites (see Section 4.1.1.2). In contrast to industrial and municipal waste, which is released from point sources, these types of pollution are diffuse. For example, the rain, snowmelt and irrigation water that seeps through ploughed fields carries nutrients and pesticides to rivers via a multitude of channels, ditches and streams.

The water quality of Quebec's main rivers has been monitored in recent years by the MEF. Samples are taken regularly from a network of fixed stations to measure certain standard descriptors, or *conventional parameters*, such as biological oxygen demand (BOD_5), suspended solids (SS), phosphorus, nitrogen and fecal coliforms.

This information is used to sketch profiles of the present situation of some of the sector's major tributaries, particularly the Nicolet, Saint-Maurice, Bécancour and Sainte-Anne rivers.

Saint-Maurice River. The watershed of this river, which has a mean annual flow of 671 m^3/s, covers 43 427 km^2, making it one of the largest drainage basins in southern Quebec. Forest covers 85% of this land area. In 1992, there were 80 447 permanent residents in the watershed, 58% of whom are served by a wastewater treatment plant.[17]

Logging is the mainstay of the local economy (40 companies). There are a total of 132 industrial plants in the drainage basin, half of them in the Shawinigan area. These include three SLV 2000 priority plants: *Stone-Consolidated Corporation, Belgo Division; Alcan Smelters and Chemicals Ltd., Shawinigan Works*; and *Norton Advanced Ceramics of Canada Inc*. The two other SLV 2000 plants in the basin are in Grand-Mère *(Stone-Consolidated Corporation, Laurentian Division)* and La Tuque *(St. Laurent Paperboard Inc.)* (Figure 7).

---

[17] These data do not take into account urban areas at the mouth of the river (Trois-Rivières, Trois-Rivières-Ouest, Cap-de-la-Madeleine and Sainte-Marthe-du-Cap) that use the same wastewater treatment plant. However, the wastewater from these municipalities can affect the Saint-Maurice River if overflows occur too frequently.

In 1985, the water quality at the mouth of the Saint-Maurice River was considerably impaired owing to the cumulative effects of environmental releases of toxic substances. In Shawinigan, the waters of the Shawinigan River, which are heavily contaminated with mercury, hexachlorobenzene (HCB) and resin acids, flow into the Saint-Maurice River. Rivers and streams in this area collect industrial effluents and flow near industrial waste disposal sites. High mercury and PAH concentrations have been measured in Saint-Maurice River sediments downstream from Shawinigan. In the lower reaches of the river, the sediment deposits are heavily contaminated with metals (cadmium, chromium, copper, nickel and zinc).

Near the mouth of the Saint-Maurice River, large increases in suspended solids and biological oxygen demand have been reported in the summer. Fecal coliform levels increase in the water mass as it flows along the eastern side of Saint-Christophe Island, where overflows of Trois-Rivières wastewater can occur.

In the early 1990s, water quality at the mouth of the Saint-Maurice River was adequate for the protection of aquatic life, but bacterial contamination precluded water-contact recreational activities. Urban wastewater treatment initiatives in Shawinigan and Trois-Rivières and the new provincial regulations governing the pulp and paper industry have probably given rise to further improvements in recent years.

Sainte-Anne River. The Sainte-Anne River drains an area of 2694 km^2 in size and empties into the St. Lawrence River at Sainte-Anne-de-la-Pérade. Its mean annual discharge is 50.6 m^3/s. Forest covers 85% of the drainage basin and logging is the leading economic activity. There are 57 companies (forest, metallurgy and agri-food industries) in the Sainte-Anne River basin, half of them in the Saint-Raymond region. A pulp and paper mill *(Malette Québec Inc.)* at Saint-Léonard-de-Portneuf discharges its effluent into the Sainte-Anne River (Figure 7). Agricultural activity in the drainage basin has decreased, except for hog production, which quadrupled between 1976 and 1991.

In 1985, the Sainte-Anne River was in a state of advanced degradation, which constrained water use in populated and agricultural areas. In the early 1990s, high turbidity, suspended solids, iron and aluminum levels were still being recorded at the mouth of the river in

summer. The lower reaches of the river also contained the highest counts of fecal coliform bacteria (450 fc/100 mL). Since 1979, the concentrations of nitrites and nitrates, total nitrogen and phosphorus carried in suspension have declined markedly, apparently because of the smaller total acreage under cultivation. The Sainte-Anne River tributaries (Blanche, Noire and Charest rivers) are heavily polluted by agricultural activities and their water quality is either questionable or poor. Drainage basin improvement will require, in addition to municipal and industrial wastewater treatment, improved agricultural practices (manure spreading and cattle access to riverbanks).

Nicolet River. This river has two main branches (Nicolet and Southwest Nicolet branches) that are joined a few kilometres upstream from the river mouth. The drainage basin covers 3398 km^2 and the river has a mean annual flow rate of 74 m^3/s.

In 1991, there were 91 600 residents and 242 manufacturing plants in the area drained by the Nicolet River. Agriculture is a major activity in this region in terms of its impact on the aquatic environment. Hog production increased by 46% between 1976 and 1986. The expansion of pig farming has been accompanied by an increase in corn production, corn being the basic feed for pigs.

Water quality is deteriorating all along the Southwest Nicolet branch because of agricultural, industrial and urban activities. By contrast, water quality has improved in the other branch of the river the further downstream one goes, because contamination sources along this segment are mainly in the upstream part. For many years, the Nicolet River has transported to the St. Lawrence large quantities of nitrogen and phosphorus generated by the intensive agricultural activities carried out in its drainage basin. However, the water quality reportedly improved between 1979 and 1992, primarily thanks to urban and industrial wastewater treatment.

The sediments at the river mouth are contaminated with pesticides, particularly DDT.

Bécancour River. At Bécancour, the Bécancour River, which drains an area of 2616 km^2, empties into the St. Lawrence River with a mean annual discharge rate of 58 m^3/s. The area of the Bécancour River basin is about half forest and half agricultural land. There are some 235 companies in the basin, with about 50 of these possibly polluting the water.

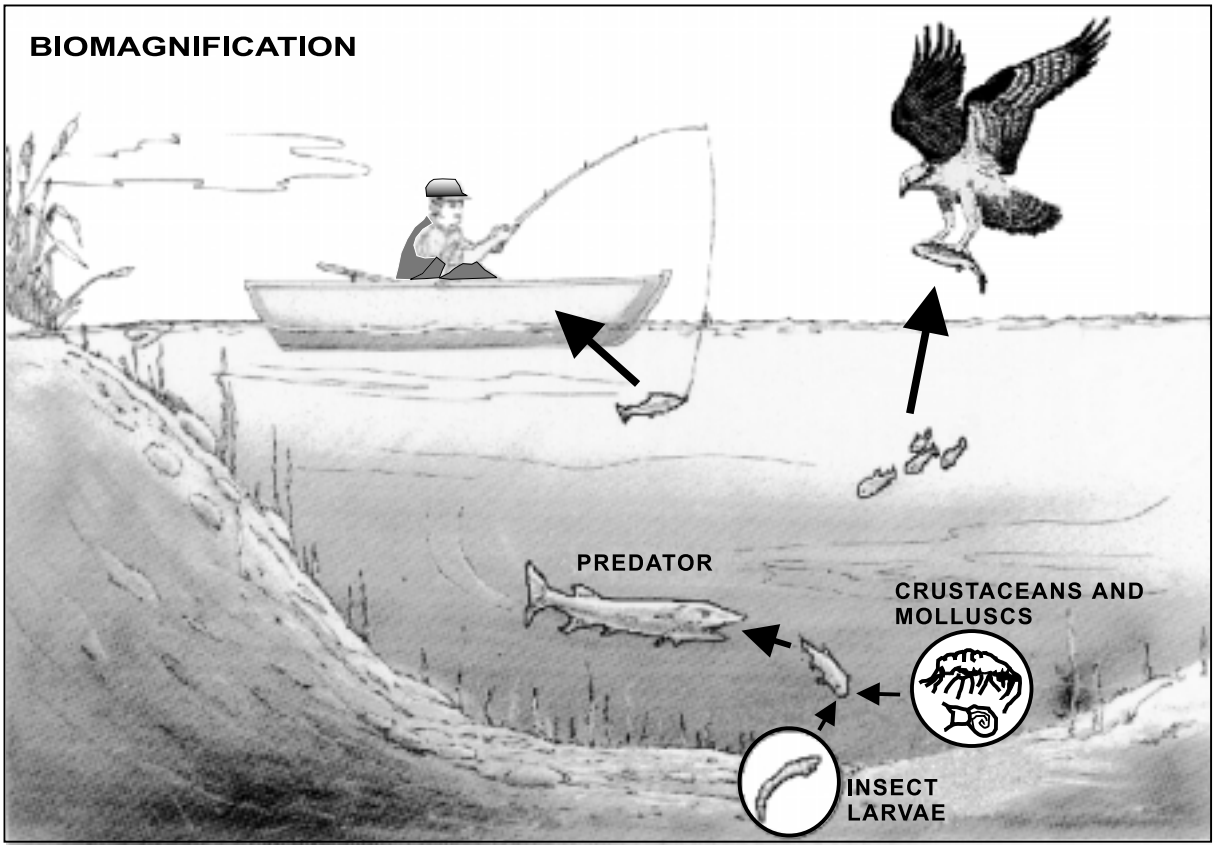
Water quality improved significantly between 1979 and 1989 after efforts were made to treat agricultural, urban and industrial wastewater. However, problems with untreated urban wastewater and nonpoint-source agricultural pollution persisted to the end of the 1980s. Between 1979 and 1985, frequent exceedances of standards for total phosphorus and nitrogen, which cause nutrient enrichment of water, were recorded at the mouth of the Bécancour River. Several wastewater treatment plants using phosphate removal processes (Black Lake, Plessisville, Princeville, Halifax-Sud and Lyster) have been established in recent years. Recent urban, industrial and agricultural cleanup efforts have probably helped to improve the state of the river.

4.1.2 Impact of contamination on the aquatic environment

Whatever their origin, the pollutants found in the aquatic environment present varying degrees of risk to the normal functioning of living organisms. Certain types of contamination have no lasting effects, and the quality of the environment improves rapidly as soon as the discharges stop. This is the case, for example, with bacterial pollution, nutrient enrichment of waters or highly soluble substances that are carried to the sea by the current. Some fairly insoluble pollutants that are chemically stable in their original forms or as environmental degradation products adsorb to particles and can accumulate in sediments over long periods. These persistent substances can be found in high concentrations in living organisms.

The concentration of a toxic substance may increase in an organism throughout its life, a phenomenon known as *bioaccumulation*. It can also increase from one link in the food chain to another by the process of *biomagnification*. Substances are thus gradually transferred to predators (fish, birds or mammals) occupying higher levels of the food web, reaching high concentrations in these animals (Figure 8).

For researchers seeking to confirm the presence of a product in the environment, biomagnification can provide useful clues. Analyses of the flesh of predator fish or birds can sometimes reveal the presence of contaminants in quantities too small to be directly detectable in the water, even with the best analytical techniques.



Many invertebrates such as aquatic insect larvae, molluscs and crustaceans live on the bottom of waterways. They accumulate in their tissues the toxic substances attached to the sediments or adsorbed to suspended matter. They are then eaten by organisms that occupy a higher position in the food chain, such as Yellow perch, which are in turn eaten by larger predators such as Northern pike or Walleye, by fish-eating birds such as Osprey, or by humans. From one link to the next in the food chain, toxic substances accumulate in increasingly larger concentrations.

Source: SLC, 1990.

Figure 8 Phenomenon of biomagnification

Criteria such as the quality of water, sediments and aquatic organisms are used to determine the extent of contamination of the aquatic environment and the resulting loss of its associated uses (Appendix 2).

4.1.2.1 *Water*

The available data on water quality and concentrations of toxic substances in the Fluvial Estuary cover mainly the Pointe-du-Lac–Deschambault sector. In most cases, samples were not taken with the aim of determining the variations that might be caused by the tides or hydrological conditions. Careful interpretation is also required because continuous flow changes may affect the measured concentrations. For example, sediment disturbance can resuspend particle-associated contaminants within the water column and have a localized and temporary effect on water quality.

Some information is available on seasonal changes in water quality parameters. Concentrations of nitrites and nitrates in the St. Lawrence River water decrease in the summer because these substances are taken up by growing plants. Suspended solids, turbidity and total phosphorus are other parameters that reveal seasonal cycles related to flow conditions or to the state of aquatic vegetation.

River mouths, even under natural conditions, generally have turbidity zones resulting from the prevailing hydrodynamic conditions. This phenomenon is even more pronounced in deforested drainage basins, where water quickly drains off the cleared land. Agricultural and forest soil erosion tend to boost the input of suspended sediment to rivers.

The turbidity level is higher in that part of the Fluvial Estuary downstream from Grondines, compared with the area upstream. Water for human consumption therefore requires greater filtration and disinfection, but supply is not affected.

Total phosphorus concentrations in the water are usually higher at the outlet of Lake Saint-Pierre, which receives inflows from tributaries that drain vast expanses of farm land. Between 1985 and 1990, the total-phosphorus criterion for the protection of aquatic life was exceeded regularly at stations located near the outlet of Lake Saint-Pierre. The frequency of exceedances tends to decrease slightly, but remains high, in a downstream direction.

Data collected in 1990 and 1991 at Trois-Rivières and Gentilly showed no exceedances of the criteria for biochemical oxygen demand (BOD_5), chlorides, nitrogen, nitrites and nitrates, pH and dissolved oxygen.

Data on bacterial quality cover the period from 1990 to 1996. In the early 1990s, before regional wastewater treatment plants were established, coliform bacteria levels in the water tended to exceed the quality criterion for swimming more often in the upstream part than in the downstream part of the study area (criterion exceeded by 40–80% at Trois-Rivières versus 30% at Neuville). A localized increase in coliforms was noted at the time along the north shore of the river across from Gentilly, in an area that received discharges of untreated municipal wastewater from Trois-Rivières and Cap-de-la-Madeleine. Coliform levels measured between 1990 and 1996 showed similar trends because the treated wastewater was not disinfected. Overall, coliform levels still exhibit a decreasing pattern going from the north shore to the south shore, and heading in a downstream direction.

One of the main water quality problems in the late 1980s had to do with concentrations of copper, chromium and lead, which placed aquatic organisms at risk (chronic toxicity). Data gathered in the early 1990s in the area around Port-Saint-François raised concerns about the presence of PCBs, PAHs and the organochlorine pesticide DDT. The PCBs and PAHs exceeded the raw water quality criterion, while the PCBs and DDT posed a contamination risk for aquatic organisms. The elevated DDT concentrations in the water could be explained by past spraying of the chemical on farm land, south of Lake Saint-Pierre.

4.1.2.2 *Sediments*

A number of contaminants bind to suspended particles in the water, which tend to settle to the bottom in areas where the current is slower. This is how deposits of contaminated sediment form on the river bed, creating a potential source of contamination for living organisms. Depositional zones often correspond to aquatic plant beds, which are home to benthic organisms occupying the base of the food chain. The presence of contaminated sediments represents a

potential threat to the fish, birds and mammals that feed at these sites, and ultimately for the hunters and fishers who eat them.

Little information is available on sediment contamination in the Fluvial Estuary, except in port areas. The data also goes back many years and may no longer be representative of the current situation. Most often the data contains information on concentrations of metals, but not on organic contaminants (PCBs and PAHs). According to the information available, sediments in the port areas of Bécancour and Trois-Rivières[18] were contaminated enough to have minor effects on benthic organism communities.

4.1.2.3 *Biota*

The available information on the contamination of biota in aquatic habitats is contained in several studies, each having a different objective, though none focusing on the distribution of contaminants in the study area. Furthermore, these sampling surveys were spread out over a fairly lengthy period of time (20 or so years), which could limit the usefulness of the picture provided here. The information should therefore be viewed with caution.

Benthos is the group that best lends itself to an assessment of the state of aquatic habitats in various parts of the study area. Since these organisms are not very mobile, their degree of contamination reflects local conditions of contamination by toxic substances. Changes in the composition of benthic communites in affected environments can also be more easily quantified than among higher, more mobile animals.

Benthic communities sampled in the Fluvial Estuary in the 1970s were by and large in good condition. The deterioration of communities was observed at a few sites, which were dominated by pollution-tolerant organisms (oligochaetes and tubificids). The affected sites were at the mouths or plumes of the Saint-Maurice, Gentilly, Champlain, Batiscan and Chêne rivers.

---

[18] The contaminated areas include the site occupied by Kruger Inc., the basin by the elevators, the Sainte-Angèle dredged material zone, the site occupied by Canadian Pacific Forest Products Ltd. (now Tripap Inc.), and the Saint-Quentin Island and Sainte-Marthe-du-Cap marina.

The information available on fish contamination mainly concerns three metals: mercury, arsenic and lead. In the late 1970s, mercury concentrations in the flesh of certain fish in the sector were found to exceed the marketing standard. These exceedances were observed primarily in piscivorous (fish-eating) fish (Northern pike, Walleye, Sauger and Smallmouth bass). However, in the riverine lakes of the St. Lawrence, mercury concentrations in these species have shown a marked decrease over the past two decades. A similar decrease should be found in the study area.

At the end of the 1980s, mercury concentrations in the tissue of fish from the Fluvial Estuary only reached high levels in large specimens.[19] During the same period, high mercury levels were also detected in Walleye caught in the Sainte-Anne River and in Northern pike from the Saint-Maurice River. An Arctic charr caught in the Batiscan River was heavily contaminated with lead.

Studies done in the early 1990s revealed contaminant concentrations in waterfowl that do not, overall, present a problem for the integrity of these bird populations, nor for the health of people who eat this game. However, a sample of 17 ducks[20] taken in fall 1991 in the downstream part of the Fluvial Estuary showed concentrations of organochlorine substances, particularly PCBs, that exceeded the federal marketing standard for fowl.

4.1.3 Effects of contamination on human health

Based on the available information, there is currently little risk to human health from contamination, as long as people comply with the recommendations and advisories issued for certain activities.

---

[19] In the late 1980s, mercury concentrations exceeded the marketing standard for Sauger longer than 225 mm, Walleye longer than 425 mm and Northern pike longer than 610 mm.

[20] The birds sampled, which were probably migrating, were American black ducks (4), Lesser scaups (11), a Greater scaup and a Surf scoter.

4.1.3.1 *Fish and game consumption*

Riverside residents are primarily exposed to the contaminants present in the aquatic environment when they eat fish. No study has been carried out in the sector on the consumption of St. Lawrence River fish and the potential consequences for human health. However, research conducted in other regions (sport fishers in the Montreal and Lake Saint-Pierre regions and commercial fishers of the Lower North Shore) suggests that the health risk associated with eating fish from the St. Lawrence is negligible under current conditions of exposure (contamination level of specimens, ingested quantities and species concerned).

Nevertheless, regular consumption of large amounts of fish caught in the study area may pose health hazards, particularly from mercury. According to the guide prepared by the provincial Ministry of Environment and Wildlife (MEF) and the Ministry of Health and Social Services (MSSS), sport fishers may eat the fish they catch in the study area. However, moderation is advised, especially with regard to the largest specimens of predatory fish. Depending on the species, the fish size and the catch site, the maximum number of meals that can be eaten with no risk of contamination varies between one and eight per month. In the study area, the most stringent restrictions apply to Northern pike, Walleye, Smallmouth bass and, above all, American eel, which young children and pregnant or nursing women are advised not to eat. As long as people abide by the recommendations concerning consumption (number of meals) and preparation of fish[21] and avoid eating fish with external abnormalities[22], the health risks are negligible, based on current knowledge.

A pilot study involving 40 sport fishers in the Montreal area indicated, moreover, that people who ate a lot of of fish from the St. Lawrence (about six meals of 230 g per month) had higher body burdens of mercury, PCBs and DDE (a degradation product of DDT) than did

---

[21] Because organochlorines tend to concentrate in the fatty parts of fish, it is possible to reduce the quantity ingested by not eating the skin, viscera and fatty parts. It is recommended that the cooking juices not be eaten either.

[22] Parasites and external abnormalities may sometimes be prevalent in fish taken from the St. Lawrence. Most fish parasites are not harmful to humans. As a precaution, however, the flesh should be thoroughly cooked and the skin and viscera should not be eaten. It is also recommended that people not eat fish that have external abnormalities (ulcerating dermatitis, dermal growths, oral papilloma etc)

individuals who ate only one meal per month. However, all of the fishers, except one, had concentrations below the guidelines recommended by Health Canada. The one exception exceeded the recommended level for PCBs.

In short, the risk of contamination from fish consumption is negligible, provided that people abide by consumption advisories. In addition to providing a good source of protein, vitamins and minerals, fish offers some protection against cardiovascular disorders. Moreover, for pregnant and nursing women, the polyunsaturated fatty acids and nutrients in fish meet essential requirements for the fetal nervous system and for babies during their first months.

With regard to waterfowl, Health Canada believes that the consumption of duck breast meat poses no risk to human health. The main advisory concerns lead shot, which should be removed from the flesh before cooking. As an additional precaution, cooking methods that remove as much fat as possible may be used. The meat should also be cooked thoroughly to avoid any risk of microbiological or parasitic contamination.

It should be kept in mind that fishing and hunting enthusiasts derive benefits from these sports, which can be relaxing and good for their well-being.

4.1.3.2 *Water consumption*

Bécancour is the only municipality in the Pointe-du-Lac–Deschambault sector that draws its drinking water from the river. Treatment of this water before distribution eliminates all pathogenic micro-organisms and gives it an acceptable appearance. Physical, chemical and microbiological analyses confirm that the water complies with provincial standards and federal regulations. No outbreaks of illness related to water consumption were reported in Bécancour between 1989 and 1997.

Trihalomethanes and other chlorination by-products, some of which are thought to be carcinogenic, are of particular concern because drinking water is the principal source of exposure

to them. However, changes in the drinking water treatment methods at the Bécancour plant[23] have reduced the amount of chlorination by-products generated.

4.1.3.3 *Recreational activities*

None of the riverside beaches in the Pointe-du-Lac–Deschambault sector were included in the MEF's beach water quality monitoring program in 1997. The area is therefore not part of a regular bacteriological sampling network. However, the water quality at four public beaches — Port-Saint-François (Saint-Jean-Baptiste-de-Nicolet), Saint-Quentin Island (Trois-Rivières), Petite-Floride (Bécancour) and Deschaillons — was assessed in a recent study. The Deschaillons beach was the only beach where the water quality was satisfactory for direct water-contact activities (swimming, windsurfing, personal watercraft use and water-skiing). Analyses carried out by the MEF also revealed that the water quality at the Trois-Rivières and Bécancour port sampling stations was mediocre and unsuitable for water-contact activities.

Recent analyses are the only way to have an accurate assessment of the risks; however, it is safe to assume that water-contact activities are not recommended throughout the study area. Before deciding to engage in one of these sports, users should check whether the water quality is adequate by contacting local authorities (MEF, Public Health Branch or municipalities). Exposure to contaminated water can cause health problems, such as gastro-enteritis and skin, eye and ear infections.

4.1.3.4 *Bécancour industrial area*

The air quality near the Bécancour industrial area was studied in 1995 and 1996 to determine whether it posed a risk for Bécancour and Gentilly residents. The detected atmospheric contaminants (PAHs, dioxins, furans, PCBs, volatile organic compounds and certain radioactive elements) were all present in concentrations below the toxic effect thresholds. The study

---

[23] Ozone is used instead of chlorine in the first stage of oxidation and both substances are used together in the final disinfection stage.

findings indicate that the low concentrations of these substances do not increase the risk of cancer or other disorders for the local population.

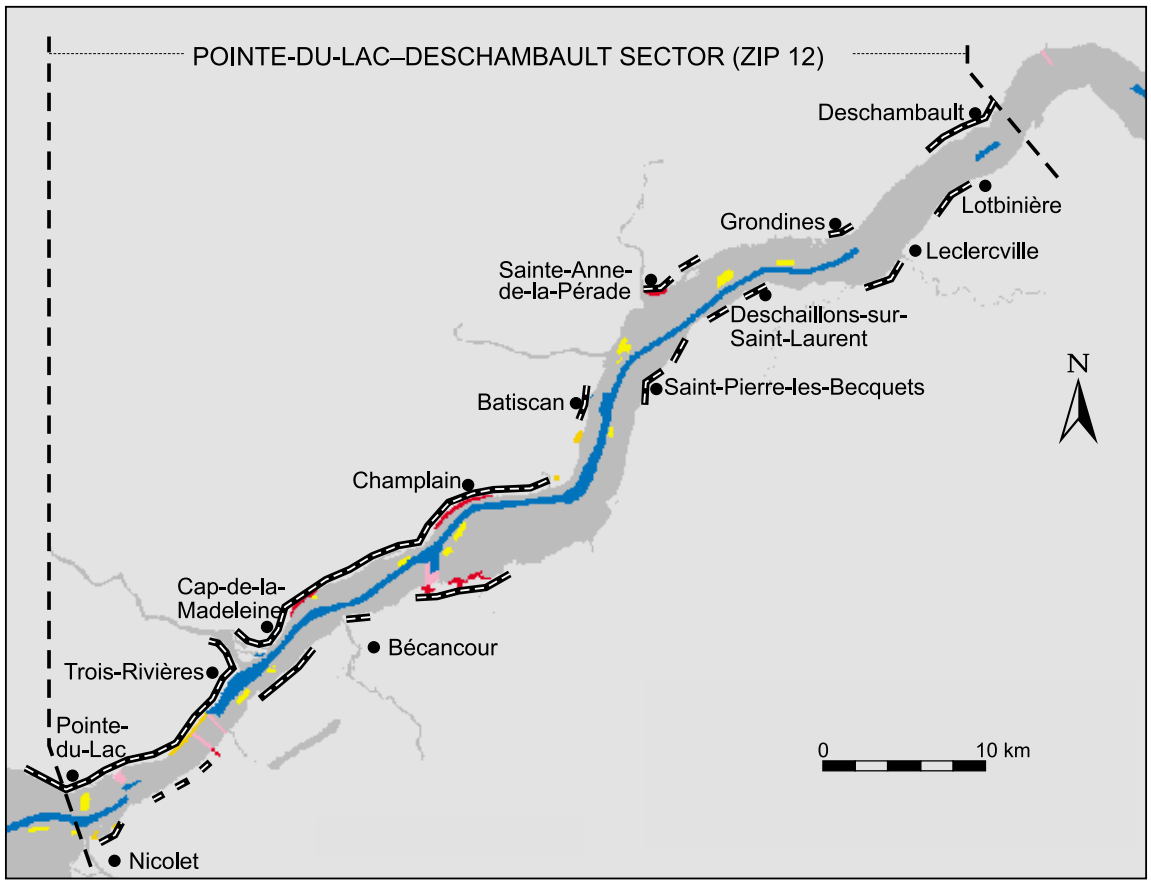
4.2 Physical Changes in Aquatic and Riparian Environments

Over a period of four decades (from 1945 to 1984), large areas of the aquatic and riparian habitats of the St. Lawrence River between Pointe-du-Lac and Deschambault were encroached upon or altered (Table 6, Figure 9). In all, 3665 ha (or 37 km^2) of wetlands were filled in or disturbed in various ways, including land drainage, construction of flow regulation structures, dredging activities or disposal of dredged materials.

Table 6
Extent of physical changes to aquatic and riparian habitats between Pointe-du-Lac and Deschambault (1945 to 1984)

	Environment Affected (in hectares)					
Type of change	*Denuded mudflats*	*Aquatic plant beds*	*Marsh and wet meadows*	*Swamp*	*Deep water*	*Total*
Landfill	0	7	76	91	0	174
Drainage	0	15	47	12	0	74
Dumping of dredged material	0	0	0	0	393	393
Dredging	0	0	0	0	2872	2872
Flow modifications	0	63	37	0	52	152
Total	**0**	**85**	**160**	**103**	**3317**	**3665**

Source: Data from Robitaille et al. 1988, digitized by the St. Lawrence Centre.



MODIFICATIONS	SURFACE AREA AFFECTED (HECTARES), BY ENVIRONMENT TYPE				
	Aquatic plant communities	Marsh and wet meadow	Swamp	Deep water	TOTAL
Filling	7	76	91	--	**174**
Draining	15	47	12	--	**74**
Dredging	--	--	--	2872	**2872**
Dumping of dredged material	--	--	--	393	**393**
Filling and flow modification	63	37	--	52	**152**
Other modifications (built-up banks)	--	--	--	--	--
TOTAL	**85**	**160**	**103**	**3317**	**3665**

Source: Robitaille et al., 1988; Argus, 1996.

Figure 9 Changes in aquatic and riparian habitats and shoreline conversion

Most of these changes (91% of the area of affected aquatic and riparian habitats), however, are difficult to confirm because they occurred in deep water. These include changes made to the river itself through construction of the ship channel in the 1950s, its subsequent maintenance and the dumping of dredged material at designated sites. Today, there is good reason to believe that these activities and the use of the channel by ships have had a significant impact on the natural environment.

The ship channel is 250 m wide at the narrowest spot and at least 11 m deep.[24] Maintaining the channel requires frequent dredging in areas where sand accumulates. Between Quebec City and Trois-Rivières, a volume of 65 000 m^3 of material must be dredged every year on average. Maintenance dredging is required most often in the Batiscan anchorage area, the Bécancour channel, the Cap Santé crossing and the Portneuf anchorage area.

In addition to the immediate effects of dredging and dredged material dumping in localized areas, the deepening of the channel caused the water flow to concentrate there, reducing exchanges between the middle of the river and the shore. Furthermore, the passage of ships creates waves that contribute to riverbank erosion and degrade riparian plant communities.

As well, major changes occurred in the landings (volume) and geographic distribution of many commercially harvested fish species in the Fluvial Estuary during the period when the ship channel was being built and put into service. Most migrating diadromous fish — including Atlantic tomcod, American eel, Atlantic sturgeon, American shad and Striped bass — that moved through this section of the river to complete their life cycle have been affected. The Striped bass disappeared from the St. Lawrence in the early 1960s.

According to recent reports, about 35%, or 66 km of shoreline in the study area has been converted or developed.[25] Natural shorelines have disappeared or been altered mainly in the

---

[24] The Montreal Port Corporation is planning to carry out selective dredging of the shoals between Montreal and Cap à la Roche near Deschaillons. This work will ensure a minimum water depth of 11.3 m in the ship channel. The amount to be dredged will be approximately 200 000 m^3.

[25] A shoreline is defined as converted (or “artificial”) if it has been reshaped or had permanent structures such as walls or wharfs built on it.

area around Trois-Rivières and the Bécancour industrial area (Figure 9). The north shore of the river has been affected slightly more (44% of the shoreline) than has the south shore (24%).

The Pointe-du-Lac–Deschambault sector has also been affected by localized changes in the thermal regime around the discharge site for cooling waters from the Gentilly 2 nuclear power station. When the power station reactor is operating at full capacity, the discharge of cooling water can reach 2.1 million m^3 per day. Under these conditions, river water in the vicinity can heat up by approximately 12°C locally. A thermal plume forms a few hundred metres downstream from the power station and can stretch a further 6 km downriver when the reactor is operating at full capacity.

One of the effects of the rise in temperature is an increase in bacterial activity in the sediments and changes in the benthic fauna. In the thermal plume of Gentilly 1, the mollusc community has been affected over an area of 381 000 m^2 (38.1 ha). Gastropods have disappeared completely since the power station began operating.

Certain types of fish — particularly Arctic charr, Channel catfish, Smallmouth bass, Black crappie and Quillback carpsucker — seem to be attracted by these warmer waters, while others, such as White suckers, seem to avoid them. The special temperature conditions in this area affect the physiology of the species living there. For example, Northern pike living in the hot water discharge canal have been observed to reach sexual maturity about two weeks earlier than specimens of the same species living under normal temperature conditions in the surrounding waters. However, when reactor shutdowns occur in winter, this can affect fish living in the thermal plume. During such a shutdown in 1997, a large fishkill occurred and was attributed to the sudden drop in temperature.

The ice-free area is visited by a few ducks in winter and commercial fishers also go there to fish.

In addition, the cooling water undergoes a coarse screening and filtration through a rotary strainer before it circulates through the power station canals. The equipment kills a large

number of fish. It has been estimated that some 163 000 fish of various species, or 2.5 tonnes in total, had been killed each year by the end of the 1980s.

4.3 Other Pressures on Resources

Other processes may undoubtedly have an impact on the natural environment of the study area. However, it is difficult at this time to assess the effects.

4.3.1 Introduced or expanding species

Today, it is known that the introduction of new species into an ecosystem, a fairly widespread practice in the last century, can have a significant impact on indigenous flora and fauna. Many people are familiar with the case of the House sparrow and the European starling, introduced species which are now integrated with the local fauna. Some examples of fish species that have been introduced locally are Brown trout, Rainbow trout and carp.

With regard to some more recent invaders, the process of colonization or expansion is still ongoing and the overall consequences of their advent have not yet been assessed.

Purple loosestrife is an introduced plant species that is currently expanding. It tends to colonize marshes and wet meadows, displacing indigenous plants such as Reed canary-grass, Prairie cordgrass and Bluejoint.

The Northern crayfish (*Orconectes virilis)* was recently introduced into the waters of the St. Lawrence River by sport fishers using it as bait to catch bass. This newcomer's impact is difficult to assess because little is currently known about native crayfish populations. It is known, however, that Northern crayfish have displaced the indigenous populations in Lake Saint-Louis. This invader species may be a carrier of crayfish plague, which has decimated European crayfish populations. The indigenous populations of the St. Lawrence River appear not to have developed this disease.

Two other invertebrates, molluscs in this case, are currently invading the St. Lawrence River. The Zebra mussel has colonized the Great Lakes–St. Lawrence system from its

starting point in Lake St. Clair in Ontario; it is believed to be displacing mostly native bivalves. By contrast, other benthic invertebrates have benefited from its presence and are increasing in number. A more recent newcomer, the Quagga mussel, is having a similar effect.

Recent surveys clearly show that the Zebra mussel population in the Fluvial Estuary has grown substantially. For example, the density of mussels attached to the walls of the Bécancour wharf has risen from 15 per m^2 in 1991 to 8700 per m^2 in 1996. One of the most noticeable problems arising from this overabundance of Zebra mussels is that they clog water intakes. At the Gentilly 2 power station, the spread of mussels has had to be monitored in the cooling water intake channel, the pumping station and the internal conduits. Chlorinating the water seems to be one way to prevent the mussels from attaching themselves to the pipes.

4.3.2 Environmental accidents

Certain sites in the study area are subject to natural environmental accidents, such as floods or landslides. Since 1986, civil authorities have recorded nearly 15 such events in the sector, especially in the Bécancour area. The areas most at risk are urban centres at the mouths of rivers.

Accidents can also occur as a result of human activities. Evaluating the risks, both for public health and for the environment, is a difficult task because the parameters involved vary depending on the type of accident and, in the case of accidental spills, on the type of products concerned.

Heavy ship traffic poses the risk of an environmental accident which could affect a large river section and the shoreline. The St. Lawrence Seaway and ship channel is one of the most challenging navigable waterways in the world. The channel is narrow and winding; ship manoeuvring is sometimes complicated by winds, currents, tides and ice. Although vessel traffic has decreased in the last few years, about 5000 ship transits are still recorded each year. Safety precautions are absolutely essential given the volume of hazardous products transshipped in the sector’s two ports.

Between 1971 and 1996, 102 spills of hazardous substances were reported in the sector. A high percentage of these spills occurred in the ports during transshipment operations. Since the 1970s, 27 shipping accidents have occurred in the vicinity of the Trois-Rivières port. All of them involved flammable products, but none placed the riverside population in danger or caused health problems.

CHAPTER 5 Sector Resources and Assets

Despite the alterations of the natural environment caused by human occupation and human activities, the study area still has many resources that are closely linked to the St. Lawrence. These assets need to be factored in to ensure a comprehensive assessment.

5.1 Recreation and Tourism

In recent years, there has been a strong upswing in recreation and tourism in the study area, fuelled in part by the need to diversify the economy and by increased public awareness of the natural environment. Interest in recreation and tourism activities has led to the founding of several local organizations whose objectives are to protect, showcase or develop various regional attractions.

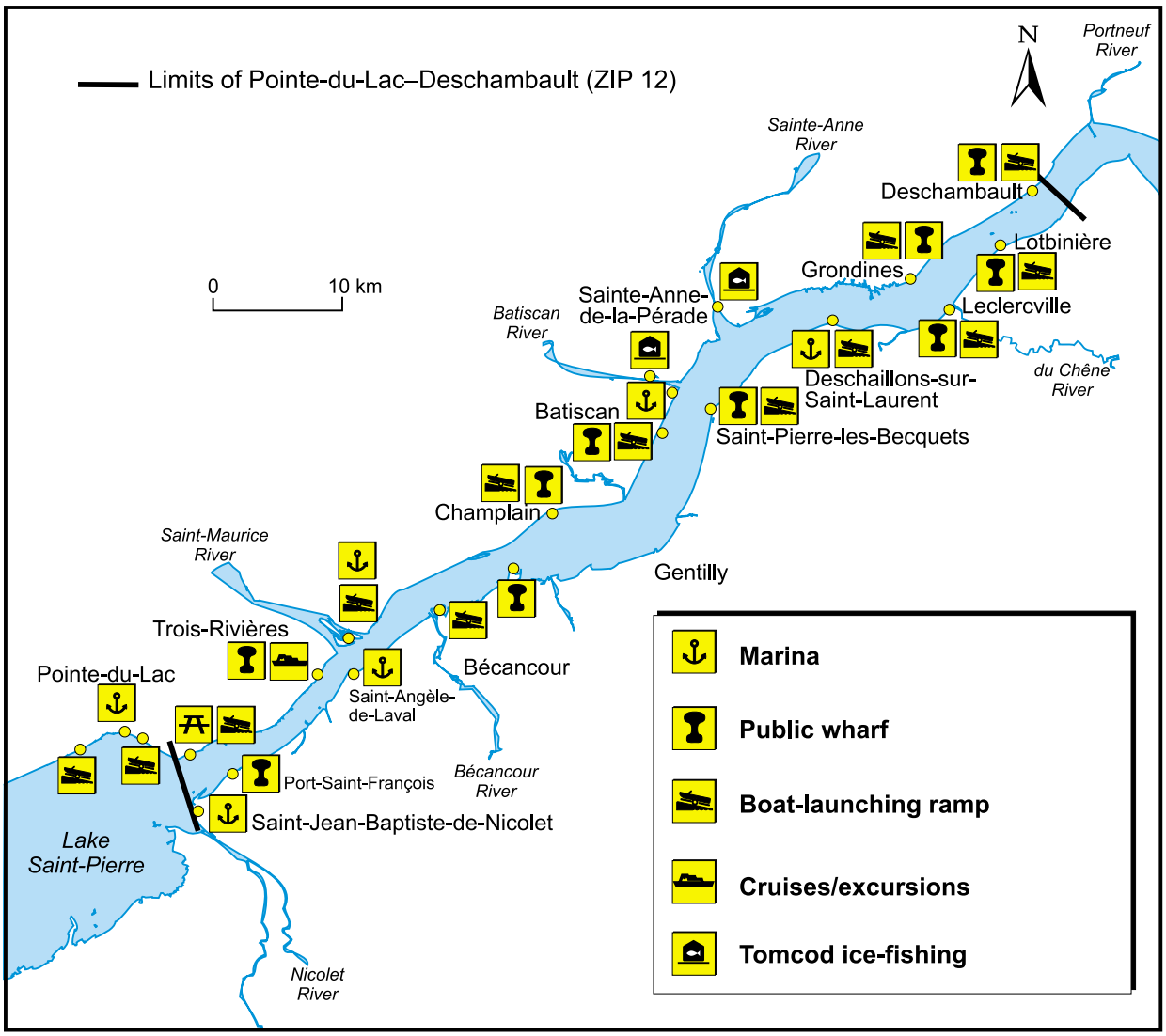
5.1.1 Landscapes

In the Pointe-du-Lac–Deschambault sector, nature lovers will find peaceful rural settings and beautiful landscapes at a number of sites along the river and from atop the river cliffs. Highways 132 and 138 on either side of the river give tourists travelling through the region breath-taking views of this splendid countryside, dotted with picturesque, heritage-rich villages. Resorts still operating in the area are the legacy of an earlier time when riverside areas were popular with vacationers. In 1995, there were still 1381 cottages and a number of campgrounds in the sector.

Hydro-Quebec’s project of a few years ago to build a power transmission line over the river provoked an outcry that persuaded the Crown corporation to build an underwater power line instead. This episode clearly demonstrates how attached the riverside residents are to the region’s scenic landscapes and their preservation.

5.1.2 Pleasure boating

In 1996, there were six marinas in the sector (with a total of 585 berths) and 20 or so boat launching ramps and public wharfs (Figure 10). Most of the marinas are located in Trois-Rivières and the surrounding area; boaters can sail from there to Lake Saint-Pierre.



Source: Tourisme Québec and Tourisme Mauricie–Bois Francs, 1996; Ministere du Tourisme and Office du Tourisme et des Congrès de la CUQ, 1996; Québec Yachting, 1995; Fédération de la Voile du Québec, 1990; Daigle, 1996; Armellin and Mousseau, 1998.

Figure 10 Boating infrastructure and main access points to fishing

The upsurge in activity at the Trois-Rivières marina in recent years is a sign of the increasing popularity of pleasure boating. In 1996, 38 000 people went on boat tours from there. It is also estimated that between 4500 and 5000 boat owners use the waterway every year. Some riverside municipalities plan to purchase federal government wharfs, such as Batiscan and Portneuf, to develop them for recreational boating purposes.

Boating activities call for caution. In 1996, the Canadian Coast Guard had to intervene in 53 incidents involving pleasure craft, most of them motor boats, between Yamachiche and Grondines. The main problems were mechanical breakdowns or groundings which were usually caused by the boaters' negligence: lack of knowledge or poor judgment, alcohol consumption or failure to wear lifejackets. Incidents of this type can result in injuries, hypothermia, psychological distress and sometimes drownings. Since 1991, two drownings have occurred in the sector during recreational activities.

5.1.3 Hunting and sport fishing

Sport fishing in the St. Lawrence River is no longer carried out to the same extent it once was. Just a few decades ago, Rainbow smelt swam up the Fluvial Estuary in October and November as far as Deschaillons. It became a ritual for crowds of fishers to gather on village wharfs to catch the migrating smelt. Striped bass passed through this part of the river every fall to spend the winter in Lake Saint-Pierre. Sport fishers also looked forward to this seasonal upriver migration and followed the fish in boats. Ice fishing for Atlantic tomcod was another of the sector's attractions, carried out in December and January from huts on the frozen Sainte-Anne, Batiscan or Saint-Maurice rivers, or on the ice cover along the St. Lawrence River banks as far as Lake Saint-Pierre.

Nowadays, the river has far fewer resources to offer fishers. Most sport fishers prefer to fish in the backcountry, particularly for Brook charr.

Winter tomcod fishing is still practised in Batiscan and in Sainte-Anne-de-la-Pérade, in particular, where it generates a lot of business for outfitters, hotel/motel owners and

restaurants. Annual economic spinoffs in Sainte-Anne-de-la-Pérade in the 1980s amounted to approximately $2.5 million, but then tapered off as the Atlantic tomcod became less plentiful. The abundance of this fish undergoes wide fluctuations, which appear to be linked to spawning conditions: access to the Sainte-Anne River spawning grounds is sometimes hindered by silting-up at the river mouth. In recent years, there have been about 35 000 fishers every winter, a clear indication of the popularity of this activity.

Waterfowl is the main interest of hunters in the study area. During the period from 1977 to 1981, close to 28 000 ducks were bagged between Pointe-du-Lac and Grondines. This stretch is one of three prime hunting segments along the St. Lawrence River in terms of the harvest of Northern shovelers, Red-breasted mergansers, Hooded mergansers, Ring-necked ducks, Common goldeneyes, Buffleheads, White-winged scoters and Surf scoters. The flats at Gentilly and Bécancour are favourite destinations for hunters. Hunting is also good at other waterfowl gathering places.

5.1.4 Bird watching

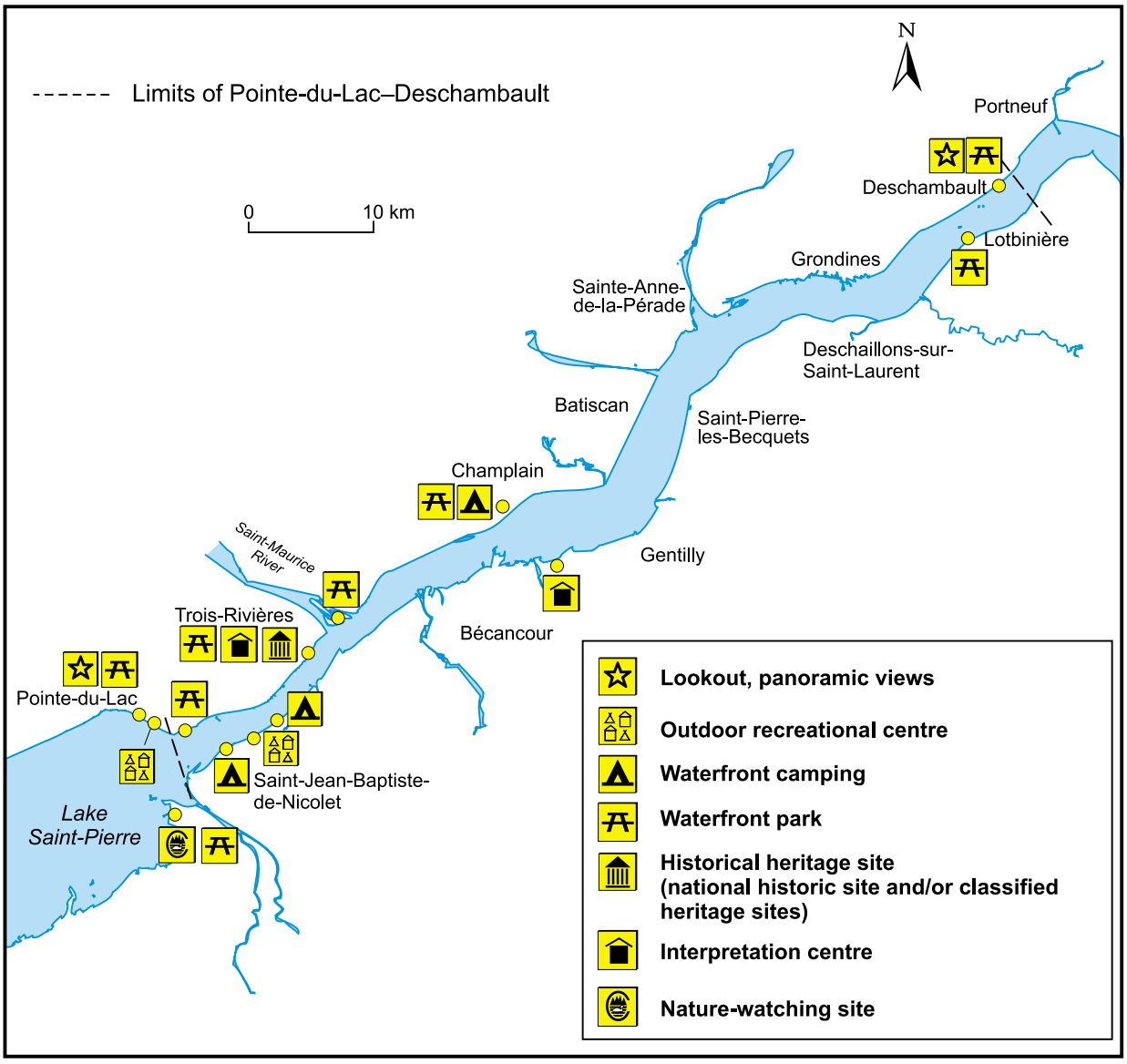
Bird watching is a popular recreational activity throughout the Fluvial Estuary. Bird-watching clubs in Trois-Rivières and Quebec City organize field trips to the area.

Prime bird-watching sites on the north shore are Saint-Eugène marsh (Pointe-du-Lac), Ile aux Sternes, Ile Saint-Quentin, Taureau flats (Cap-de-la-Madeleine), Deschambault wharf; south shore sites include Port-Saint-François wharf, Godefroy River, the site of the future Léon Provancher Ecological Reserve, and Sainte-Angèle-de-Laval wharf.

5.1.5 Recreational areas

Most of the sector's parks and recreational attractions are in Trois-Rivières (Figure 11). Many activities (including the *Trois-Rivières : Ville Maritime* festival in August) take place in the Trois-Rivières harbour park, where there is also a boat tour service. The city is home to

several museums, historic sites and interpretation centres (Forges du Saint-Maurice and the Centre d'Interprétation des Pâtes et Papiers featuring the pulp and paper industry).



Source: Office du Tourism et des Congrès de la Région de Québec, 1996; Environment Canada, 1996.

Figure 11 Recreation areas and facilities

One of the most popular sites is Ile Saint-Quentin Park at the mouth of the Saint-Maurice River. This 46-hectare park contains habitats that are representative of the islands. Visitors can see a forest of Silver maples and Eastern cottonwoods and many species of birds, amphibians and small mammals. People used to flock to Ile Saint-Quentin, which was acquired by the city of Trois-Rivières in 1934, to swim in the river. However, this activity came to an end in the 1970s and the site was abandoned. Only the island's marina has continued to attract boaters.

A push to restore the park began once measures were taken to stop riverbank erosion. Improvements, including pathways, a pool and picnic areas, were then made to restore the park's suitability for recreational pursuits. Efforts have been made more recently to turn Ile Saint-Quentin into a regional park devoted to ecotourism. The park achieved this objective when it became a satellite station in the Biosphere network.

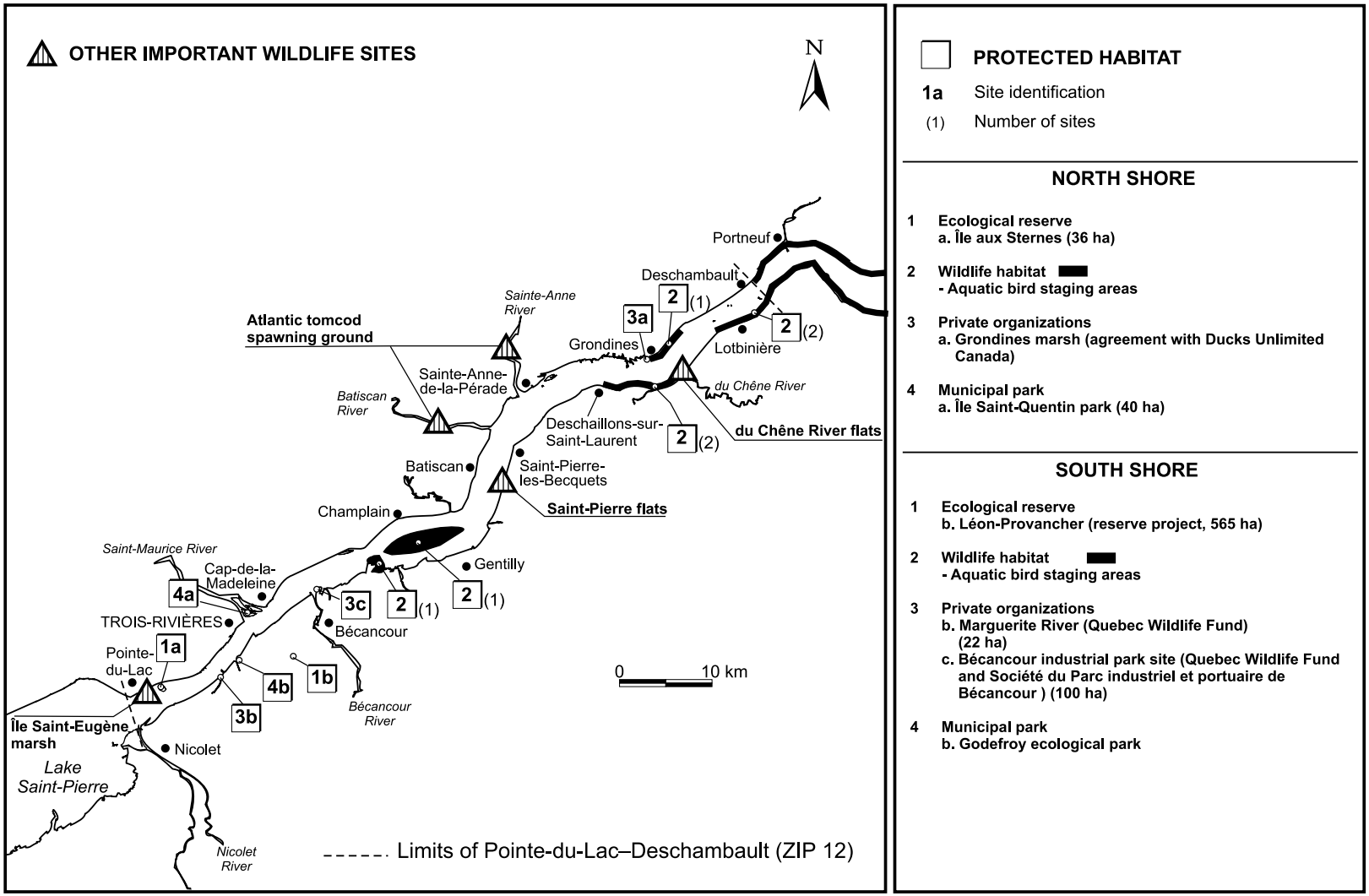
5.2 Biodiversity, Conservation and Habitat Enhancement

The study area has many valuable wetlands, some of which — ecological reserves, wildlife habitats or sites owned by private organizations dedicated to nature conservation — enjoy legal protection (Figure 12).

Set up in 1981, the Ile aux Sternes ecological reserve is a 36-hectare artificial island that was created in 1965 from dredged material. After the island was formed in 1967, it was left alone to allow scientists to monitor the various stages of plant and animal colonization.

The Léon Provancher Ecological Reserve is expected to open soon on a south shore site across from Trois-Rivières. It will provide protection for 565 ha of peatland, swamps, peaty banks, scrubland and riparian forest around Lake Saint-Paul. These habitats are not located on the St. Lawrence River itself, but along a former arm of the river.

Some of the waterfowl gathering areas and fish habitats on the public lands in the study area have *wildlife habitat* status, which is intended to limit disturbances.



Source: MEF, 1995; MLCP, 1993; Gagnon, 1997; Laniel, 1997; Vallée, 1997; Langevin, 1996; UQCN, 1993; 1988; Corporation pour le Développement de l'Île Saint-Quentin, 1995.

Figure 12 Protected areas and other major wildlife sites in the Pointe-du-Lac–Deschambault sector

One of the objectives of the park on Ile Saint-Quentin (see Section 5.1.5) is to protect ecosystems that are representative of the island within a context of sustainable development. The island has a Silver maple stand, a marsh and open scrubland. The marsh and the swamp serve as an area where fish can spawn in still water and waterfowl can rest, build nests and rear their young. There are also semi-aquatic mammals such as Muskrat and American mink.

The sector also features three privately-owned sites where conservation organizations provide protection for the ecological heritage. These sites are Marguerite River, the mouth of the Bécancour River, and Grondines marsh.

Four other important wildlife sites do not have protection: the Saint-Pierre flats, the Chêne River flat and the Atlantic tomcod spawning grounds in the Sainte-Anne and Batiscan rivers. Work was carried out at the Ile Saint-Eugène marsh at Pointe-du-Lac to make it easier for fish to circulate between the marsh and the river during spawning and fry-rearing periods.

The species that are found in the Fluvial Estuary[26] and that have priority status under St. Lawrence Vision 2000 (see Appendix 1) include 17 plants, one amphibian, two reptiles, seven fish[27] and 13 birds (six of which nest locally).

5.3 Commercial Fishing

Commercial fishing is an activity with close links to the river, particularly along the estuary. It developed out of the subsistence fishing practised in the early days of New France when settlers fished in the river from the lots of land they were granted. Their sales of surplus fish in local markets evolved into the commercial fishing trade. In Quebec, commercial landings of fish have been recorded on a county-by-county basis since 1917. A more stringent regulatory framework was imposed on commercial fishing starting in the 1960s.

---

[26] The Fluvial Estuary is comprised of Priority Intervention Zone (ZIP) 12 (Pointe-du-Lac–Deschambault study area) and ZIP 13 (Pontneuf–Saint-Nicolas study area).

[27] Striped bass, which have disappeared, are not included in this total.

The size of commercial catches is often, and wrongly, thought to be solely dependent on the abundance of fish in the area, for which they serve as an indicator in some respects. Obviously, the commercial fishery could not exist if the resource were not in plentiful supply. But, like any business, commercial fishing is still subject to socio-economic constraints. The fisher's investment in equipment and labour is only worthwhile if the price fetched for catches is enough to cover expenses and provide an adequate living.

The Fluvial Estuary is part of the migratory route of many diadromous fish species and has experienced periods of intense commercial fishing in the 20th century. Between 1935 and 1939, at the height of the Depression, the scarcity of jobs and the food requirements of the poverty-stricken population led to an unprecedented increase in the number of commercial fishers in Quebec. Total annual landings of fish[28] in the Fluvial Estuary varied between 600 and 700 tonnes, with half of this total coming from the counties of Portneuf and Champlain. Based on what is known today, it can be assumed that the fish populations could not have held up for long under the heavy harvesting pressure from these unusual socio-economic conditions. However, the impact of overfishing did not have time to be felt because increased employment at the start of World War II helped reduce fishing effort beginning in 1939.

The fishery in this part of the river has been greatly affected by changes in the abundance of various fish species that occurred when the ship channel was built (see Section 4.2).

Two commercially harvested species in the St. Lawrence, Atlantic sturgeon and Atlantic tomcod, are of particular interest in the Fluvial Estuary, which seems to be their main spawning area. The area around the Richelieu Rapids is one of the freshwater sites where catches of Atlantic sturgeon have been reported most regularly. The St. Lawrence River stock may have been overfished between 1957 and 1967 when the Portneuf wharf, built at the same time as the ship channel, hindered the migration of spawners.

---

[28] The predominant species were American eel and probably tomcod, which were combined with other species rather than counted separately, followed by whitefish, Walleye, Northern pike and Lake sturgeon.

For a long time, Atlantic tomcod, which are caught beneath the ice on the flats with hoop nets, were the main species taken by commercial fishers between Quebec City and Trois-Rivières. However, since 1993, commercial fishing for Atlantic tomcod has been permitted only between the mouths of the Sainte-Anne and Batiscan rivers, or upstream from the latter, following two sharp declines in abundance since the late 1980s.

Nowadays, commercial fish catches in this section of the St. Lawrence comprise mainly American eel, Lake sturgeon, Yellow perch, Brown bullhead, Northern pike, Channel catfish, carp and suckers. Commercial fishing has an uncertain future given the grave concerns of fishery managers regarding the situation of the three main harvested species (American eel, Lake sturgeon and Yellow perch).

A special kind of driftnet fishery for American shad is carried out on a small scale in the spring around Laviolette Bridge.

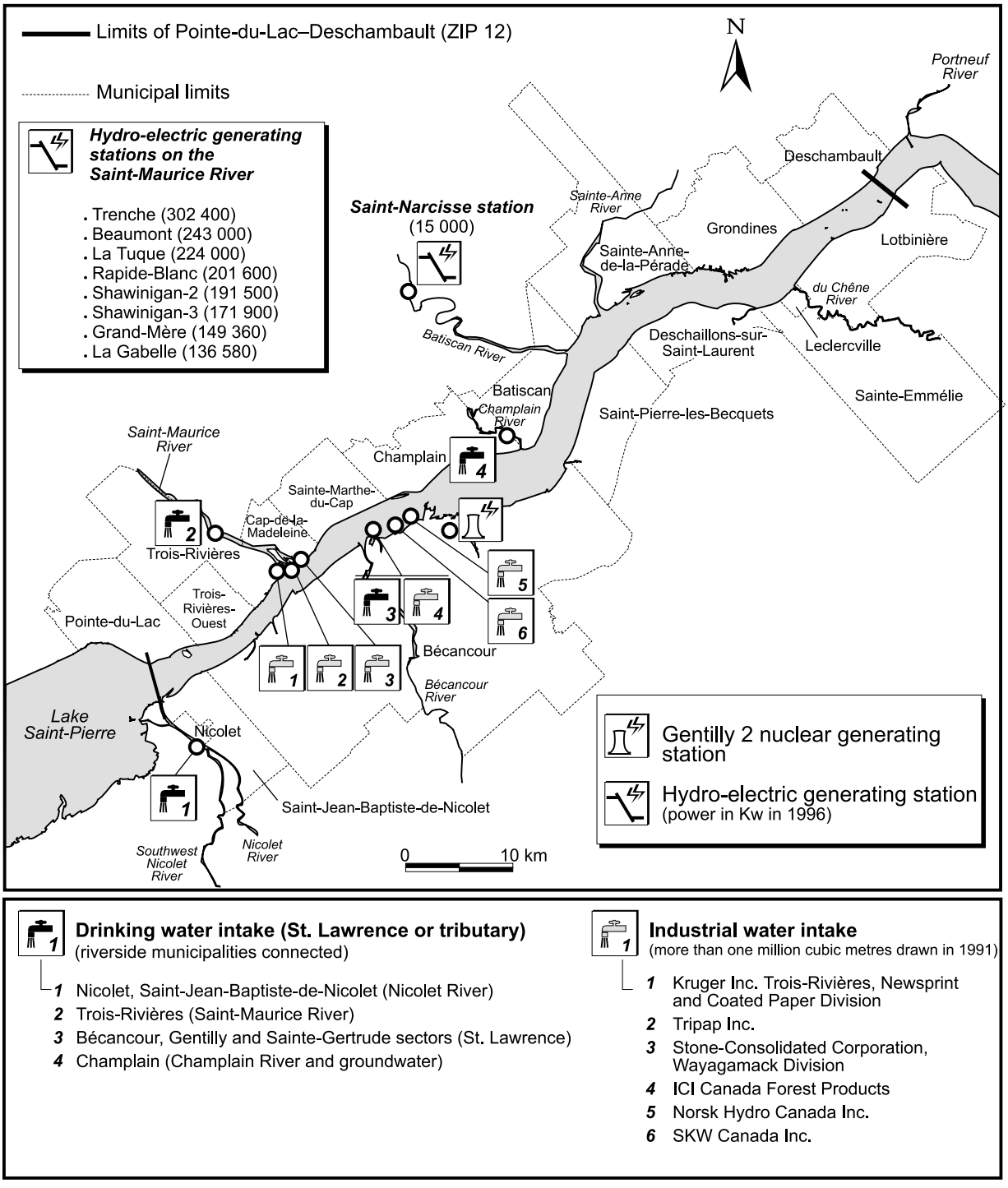
In addition to fish, two species of crayfish are commercially harvested. Landings of crayfish vary greatly from year to year because of the difficulty fishers face in selling this product.

5.4 Utilitarian Use of the Waterway

Proximity to a large waterway provides numerous benefits that are easily forgotten in an area blessed in this respect.

5.4.1 Water supply

The availability of abundant supplies of good quality water is a definite benefit for municipalities and industry alike (Figure 13).



Source: Jourdain and Bibeault, 1998.

Figure 13 Utilitarian use of the water

Municipalities in the sector draw most of their drinking water from tributaries of the St. Lawrence River[29] or the water table. Only Bécancour draws its water from the St. Lawrence (see Section 4.1.3.2).

More water is withdrawn for industrial processes than for municipal uses. In the study area, five industries use more than one million cubic metres of water every year, for a total of 103 m^3.

The biggest consumer of water for public utility purposes is the Gentilly 2 power station. To cool its reactor during operations, it uses 779 million m^3 of water per year.

5.4.2 Shipping

The sector uses the ship channel from two ports, at Trois-Rivières and Bécancour, which play an essential role for industry and are used mostly for exports. In 1996, approximately 3.7 million tonnes of cargo was transshipped through these ports. The port of Trois-Rivières is used mainly for shipping grain and mineral ore, while the port of Bécancour serves mostly the local aluminum smelters.

[29] Saint-Maurice (Trois-Rivières), Champlain (Champlain) and Nicolet (Nicolet and Saint-Jean-Baptiste-de-Nicolet) rivers.

CHAPTER 6 Strategies for Sustainable Development

Sustainable development of the Pointe-du-Lac–Deschambault sector involves protecting the existing biodiversity and promoting a variety of water-related uses, thus enhancing the quality of life of riverside residents.

6.1 Main Challenges

It is imperative that certain key issues in the sector be taken into consideration during the drafting of action plans.

6.1.1 Reducing contamination

Rapid flow conditions in the Fluvial Estuary generally limit the accumulation of contaminants for any length of time. The only sites with polluted sediments are the port areas (Trois-Rivières and Bécancour) and some tributary mouths. Since discharges of every kind are now monitored, the contamination of water, sediments and living organisms is less serious than it once was. Most industries have improved their effluent treatment systems to reduce toxicity.

Most of the riverside population is served by a wastewater treatment system, and this service will be implemented in Bécancour by the year 2000. However, the available data shows that the bacteriological quality of the water is somewhat impaired; water-contact activities are therefore not to be recommended.

Stakeholders should therefore stay on track while forging ahead with cleanup efforts not only in the river but also in local tributaries that drain agricultural and urban areas.

6.1.2 Protecting habitats, wildlife resources and biodiversity

At a time when many organizations are working together to prevent the disappearance of natural habitats and the depletion of the world’s biodiversity heritage, it is important that this joint action be extended to the natural components of the St. Lawrence River.

There are special habitats, some of them teeming with wildlife, all along the shores of the Fluvial Estuary. Aside from the areas around Trois-Rivières and Bécancour, habitat losses on these shores have generally occurred on a small scale, compared with the losses around Montreal, for example. However, the construction of the ship channel radically altered the aquatic environment and not all of the associated ecological consequences are known. Since the estuary is also the main migratory route for all diadromous fish in the St. Lawrence River, the facilities built to improve river navigation likely had a particularly significant impact on fish resources in the sector.

Dredging must still be done to maintain the channel, but dredging techniques need to be closely monitored. Riverbank erosion in certain places will also have to be stemmed to limit habitat losses.

Certain fish species in the sector, particularly Lake sturgeon, American eel and Yellow perch, are heavily fished. The sustainability of these resources can only be guaranteed if sound fish population management principles are followed.

6.1.3 Reconciling recreation and tourism development with habitat protection

All of the effort invested in restoring the river can only be fully appreciated by riverside residents if they have ready access to the water body and can enjoy all of its resources and rich diversity. The movement already under way to reclaim the river for recreational and tourism activities should therefore be encouraged.

In the Pointe-du-Lac–Deschambault sector, Ile Saint-Quentin Park stands out as one of the most interesting projects aimed at harmonizing recreation and tourism development with habitat protection. This initial goal has been broadened to include objectives related to popularizing science and raising public awareness of the problems of natural habitat conservation.

Most of the sector’s recreational facilities are concentrated in the Trois-Rivières area at present. There is no truly integrated tourism network that could fully capitalize on the region’s natural assets and heritage.

Developing such a network and establishing complementary facilities — to promote pleasure boating, for example — outside the existing hubs of tourism and recreation are options that should be considered for the future. A better integration of recreation and tourism would foster optimal development of the region's resources and could lead to greater economic spinoffs.

However, the future expansion of recreation and tourism activities must be co-ordinated to ensure that the activities harmonize with natural habitats and do not adversely affect the quality of life of riverside residents.

6.2 Time for Action

To refocus planning related to the use of the water body and bring it in line with the objectives of sustainable development, many aspects of the above-mentioned problems should be kept in mind. Besides the limitations that certain uses impose on resources, leading inevitably to conflicts among users, the permanency of certain changes that have taken place (and cannot realistically be reversed) must be taken into account. For example, the reconfiguration of the river channel for marine navigation purposes represents an irreversible constraint from the standpoint of planning. Vigilance is required, nonetheless, to prevent further harm from being done.

Consideration might also be given to continuing the actions already launched to protect existing natural habitats or enhance wildlife habitats.

To ensure that habitats are not degraded further as a result of short-sighted decisions made in response to the concerns of special interest groups, it is important to weigh various land development options carefully.

These issues need to be assessed and discussed, in full knowledge of the facts, by all groups interested in the river and the local quality of life, so that the strategies which are eventually adopted suit the entire community. Table 7 provides a preliminary outline for discussing suitable development options for the water bodies in the sector.

Following such discussions, it should be possible to co-ordinate water use in keeping with the goal of preventing further degradation of natural habitats and restoring certain sites.

Once a consensus has been reached on priorities for action, it will be easier to come up with a concrete action plan with which partners will be happy to comply.

Developing this sector is an exciting challenge and the already noticeable improvements — wastewater treatment, for example — provide incentive to keep up the good work. However, co-operation is still an essential part of this undertaking.

Table 7
Main sustainable development issues in the Pointe-du-Lac–Deschambault sector

Issue: Reduction in Contamination	*Main Impact on the Water Body and its Resources*	*Assessment of Present Situation Relative to Sustainable Development Objectives*	*Sustainable Development Strategies*
Industrial and municipal effluents have been discharged untreated into the river for decades. Tributaries drain urban and agricultural land areas.	Contamination by untreated wastewater causes a whole series of negative impacts on the aquatic environment. Sediments in port areas or at the mouths of tributaries have been contaminated by urban and industrial activities in Trois-Rivières, the Saint-Maurice River basin and the Bécancour area. Chemical contaminants have been detected in the water, and coliform bacteria restrict water-contact activities. There are high concentrations of mercury in certain fish species.	**Biodiversity:** Pollution is reducing the populations of many species and changing the structure of living communities. Species that tolerate this habitat degradation are becoming predominant. **Uses:** Contamination restricts use of the environment (fish consumption and health risks associated with swimming or other water activities). **Quality of life:** Pollution is causing loss of enjoyment of the water body for riverside residents. It has an indirect impact on recreation potential by limiting the exercise of certain activities.	Industrial and municipal wastewater treatment programs have helped to reduce pollution. It is essential that these actions be continued. **Biodiversity:** The effects of degradation caused by pollution may be reversible over the long term, depending on the type of substances released and how long they have been present in aquatic habitats and organisms. **Uses:** The most effective way to reduce the losses of use resulting from pollution is to control discharges at source by all users (industrial, residential and commercial). Effective municipal wastewater treatment methods and overflow control are essential to cleaning up the environment and fully reclaiming it. Improved agricultural practices promote soil conservation and decrease contaminant inputs to watercourses. **Quality of life:** Pollution control can allow communities to once again benefit from all the advantages of living near a water body.

Issue: Habitat and Resource Protection; Rehabilitation of Degraded Areas	*Main Impact on the Water Body and its Resources*	*Assessment of Present Situation Relative to Sustainable Development Objectives*	*Sustainable Development Strategies*
The most serious changes in the sector are aquatic habitat alterations caused by construction of the ship channel. Riverbank changes resulting from encroachment and in-filling have occurred mainly around Trois-Rivières and Bécancour.	Changes to aquatic habitats may have contributed to the decline of inland fisheries in tidal waters. The effect of the changes on the fisheries may have been compounded by the Fluvial Estuary's role as a migratory route for diadromous fish. The disappearance of natural riverbanks spells the loss of habitats suitable for flora and fauna.	**Biodiversity:** Many biological communities (especially riparian and aquatic communities) have declined in abundance and diversity because of habitat alterations. The distribution of many fish species has been altered. The disappearance of the Striped bass may be linked to these changes. In certain places, ship-generated waves erode riverbanks and cause riparian habitats to retreat. **Uses:** Some uses, such as commercial and sport fishing, are restricted owing to the decreased resource abundance, not only in the sector but also farther upstream and downstream. Fishing itself may endanger certain species (Lake sturgeon, American eel and Yellow perch) if catches are excessive. **Quality of life:** Aside from commercial and sport fishers, riverside residents do not seem to have been affected by the scarcely visible but significant changes to aquatic habitats. Ship traffic may limit pleasure boating in some places.	**Biodiversity:** Changes in the river flow to facilitate marine shipping are irreversible. However, maintenance dredging and dredged material disposal methods need to be studied to prevent losses of important wildlife habitats. Certain measures can improve diversity along the riverbanks: restoration of degraded riverbanks; protection from erosion; conservation of existing natural habitats and wildlife enhancements. The project under way on Ile Saint-Quentin at Trois-Rivières proves that such initiatives are possible and that they elicit public interest. **Uses and quality of life:** The restoration or improvement of certain populations of fish species (Striped bass, Rainbow smelt, Atlantic tomcod and Atlantic sturgeon) could be a significant gain. Sound management of existing fish resources is required to ensure sustainability. Regulatory measures are already in place (catch limits and minimum legal size), but users must agree to comply with them if they are to be effective.

Issue: Harmonizing Recreation and Tourism Development with the Natural Environment	*Main Impact on the Water Body and Its Resources*	*Assessment of the Present Situation Relative to Sustainable Development Objectives*	*Sustainable Development Strategies*
	Recreation and tourism development and efforts to capitalize on the region's assets are hampered by several problems: private ownership of waterfront land, contaminated sites, and unequal distribution of facilities in the sector.	**Biodiversity:** In general, natural habitats and animal populations tolerate the presence of humans. A number of species are amenable to moderate sport fishing and hunting. The development of recreation and tourism infrastructures may affect certain components of natural habitats. Heavy use of water bodies may have an impact on living communities. **Uses:** There appears to be a strong demand for additional boating services. However, the presence of a large number of boats and the noise they create can become a nuisance for other users and riverside residents. Recreational boating is governed by safety regulations. Hunting and fishing are regulated as well. **Quality of life:** The opportunity to engage in water-based recreational activities contributes to the well-being of riverside residents and attracts tourists. Recreation and tourism activities can generate substantial economic spinoffs.	**Biodiversity:** Wildlife habitat protection ensures that animal and plant populations and the recreational activities that depend on them will be maintained. In cases where recreation and tourism might affect natural habitats, compliance guidelines should be established and users made more aware of conservation. **Uses:** Pleasure boating, hunting and fishing must be controlled to prevent conflict with other habitat uses (use by wildlife, public access to water bodies and public safety). Planning must take into account certain nature interpretation and observation activities, which are increasing in popularity. **Quality of life:** Various boating, open-air and nature observation-related activities can further enhance tourist attractions (e.g. Ile Saint-Quentin Park). Recreation and tourism facilities and their locations and operating methods should be chosen wisely so as not to degrade the natural and human environment.

References

Argus (Les Consultants en Environnement Inc.). 1996. *Restauration naturelle des rives du Saint-Laurent. Tronçon 3 : de Nicolet à Saint-Antoine-de-Tilly (rive sud), de Pointe-du-Lac à Neuville (rive nord). Tronçon 4 : de Saint-Antoine-de-Tilly à Saint-Vallier (rive sud), de Neuville à Saint-Joachim (cap Tourmente) (rive nord).* Map. Prepared for Environment Canada, Canadian Wildlife Service, Department of Transport, James Bay Energy Corporation, and Ducks Unlimited Canada.

Armellin, A., and P. Mousseau. 1998. *Synthèse et analyse des connaissances sur les aspects biologiques du secteur d'étude Trois-Rivières–Bécancour*. Technical Report, Priority Intervention Zones (ZIP) 12 and 13. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre.

Asseau-INRS. 1992. *Bilan des apports toxiques et inventaire des usages du fleuve Saint-Laurent*. Volumes 1 to 7. Prepared for Environment Canada, Conservation and Protection, Quebec Region, St. Lawrence Centre.

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.* Technical Report. Ministère du Loisir, de la Chasse et de la Pêche, Service Archipel.

Bécancour RCM – Bécancour Regional County Municipality. 1988. *Schéma d'aménagement*.

Chartrand, J., J. F. Duchesne, and D. Gauvin. 1998. *Synthèse des connaissances sur les risques à la santé humaines reliés aux usages du fleuve Saint-Laurent dans le secteur d'étude Trois-Rivières–Bécancour.* Technical Report, Priority Intervention Zones (ZIP) 12 and 13. Ministère de la Santé *et des Services Sociaux du Québec – Centre de Santé Publique de Québec, Direction de la santé publique Mauricie–Bois-Francs, and Health Canada.*

Corporation pour le Développement de l'Île Saint-Quentin. 1995. *OIKOS : Complexe écotouristique de l'Île Saint-Quentin*.

Couillard, L., and P. Grondin. 1986. *La végétation des milieux humides du Québec*. Les Publications du Québec.

Daigle, R. 1996. *Répertoire Socio-écologique*. Environment Canada, Environmental Protection Branch.

D'Aragon, Desbiens, Halde and Associates and Roche Ltd. 1992. *Inventaire des terrains fédéraux potentiellement contaminés au Québec*. Final Report. Environment Canada.

Environment Canada. 1996. 1994 Municipal Water Use Database. Water and Habitat Conservation Branch, Canadian Wildlife Service, Environment Canada. Ottawa.

Fédération de la Voile du Québec. 1990. *Guide Nautique du Saint-Laurent*.

Francheville RCM – Francheville Regional County Municipality. 1992. *Schéma d'aménagement*.

Gagnon, G. 1997. Personal communication. Environment Canada – Quebec Region, Environmental Protection Branch.

Gratton, L., and C. Dubreuil. 1990. *Portrait de la végétation et de la flore du Saint-Laurent*. Ministère de l'Environnement du Québec, Direction de la conservation et du patrimoine écologique, and Environment Canada, Canadian Wildlife Service.

Jourdain, A., and J. F. Bibeault. 1998. *Synthèse des connaissances sur les aspects socio-économiques du secteur d'étude Trois-Rivières-Bécancour*. Technical Report, Priority Intervention Zones (ZIP) 12 and 13. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre.

Langevin, R. 1996. Personal communication. Environment Canada – Quebec Region, Environmental Conservation, Canadian Wildlife Service.

Laniel, J.-P. 1997. Personal communication. Ducks Unlimited Canada.

Létourneau, G., and M. Jean. 1996. *Cartographie des marais, marécages et herbiers aquatiques le long du Saint-Laurent par télédétection aéroportée*. Scientific and Technical Report ST-61. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre.

Lotbinière RCM – Lotbinière Regional County Municipality. 1989. *Schéma d'aménagement*.

MAM – Ministère des Affaires Municipales du Québec. 1997. *Programme d'assainissement des eaux, liste des projets*. Direction de l'assainissement urbain.

MEF – Ministère de l'Environnement et de la Faune. 1995. *Les réserves écologiques : des habitats protégés au naturel*. Series of fact sheets. Government of Quebec.

MENVIQ – Ministère de l'Environnement du Québec. 1991a. *Inventaire des lieux d'élimination de déchets dangereux au Québec, région 16 : Montérégie*. Direction des substances dangereuses.

MENVIQ – Ministère de l'Environnement du Québec. 1991b. *Inventaire des lieux d'élimination de déchets dangereux au Québec, région 04 : Mauricie/Bois-Francs*. Direction des substances dangereuses.

Ministère du Tourisme and Office du Tourisme et des Congrès de la CUQ. 1996. *La région de Québec, une histoire d'amour*. Tourist Guide 1996-97.

MLCP – Ministère du Loisir, de la Chasse et de la Pêche. 1993. *Plan de gestion de la pêche 1993-1994 pour le sud du Québec*. Government of Quebec.

Nicolet–Yamaska RCM – Nicolet–Yamaska Regional County Municipality. 1986. *Schéma d'aménagement*.

Office du Tourisme et des Congrès de la Région de Québec. 1996. Tourist Guide: Greater Quebec Area 1996-97.

Ouellet, G. 1992. Unpublished data on migrating waterfowl. Ministère du Loisir, de la Chasse et de la Pêche, Direction régionale Mauricie–Bois-Francs.

Pelletier, M., and G. R. Fortin. 1998. *Synthèse des connaissances sur les aspects physiques et chimiques de l'eau et des sédiments du secteur d'étude Trois-Rivières–Bécancour*. Technical Report, Priority Intervention Zones (ZIP) 12 and 13. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre.

Portneuf RCM – Portneuf Regional County Municipality. 1988. *Schéma d'aménagement*.

Proulx, S. 1993a. *Évaluation des sources d'apports toxiques au fleuve Saint-Laurent - Rapport de données*. Environment Canada, Conservation and Protection, Quebec Region, St. Lawrence Centre.

Proulx, S. 1993b. *Évaluation des sources d'apports toxiques en provenance des tributaires du fleuve Saint-Laurent. Priorisation des tributaires*. Environment Canada, Conservation and Protection, Quebec Region, St. Lawrence Centre.

Québec Yachting. 1995. *Guide des marinas*.

Robitaille, J. A., Y. Vigneault, G. Shooner, C. Pommerleau, 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*. Canadian Technical Report of Fisheries and Aquatic Sciences 1608.

SLC and Université Laval – St. Lawrence Centre and Laval University. 1992. *A Mosaic of Habitats: Freshwater and Brackish Ecosystems*. Environmental Atlas of the St. Lawrence, "St. Lawrence UPDATE" series. Environment Canada, Conservation and Protection – Quebec Region, St. Lawrence Centre, Knowledge of the State of the Environment Branch.

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

SLV 2000 Intervention. 1997. *Industrial Plants. Highlights*. Fact sheets on the 56 priority plants of the St. Lawrence Vision 2000 action plan. Published under the Protection component of the St. Lawrence Vision 2000 action plan. Government of Quebec, Government of Canada.

SLV 2000 Intervention. 1996. *Industrial Plants. Highlights*. Fact sheets on the 50 priority plants of the St. Lawrence Action Plan. Published under the Protection component of the St. Lawrence Vision 2000 action plan. Government of Quebec, Government of Canada.

Statistics Canada. 1996 Census database.

Tourisme Québec and Tourisme Mauricie–Bois-Francs. 1996. Mauricie–Bois-Francs. Tourist Guide 1996-97.

UQCN – Union Québécoise pour la Conservation de la Nature. 1993. *Guide des milieux humides du Québec: des sites prioritaires à protéger*. Map.

UQCN – Union Québécoise pour la Conservation de la Nature. 1988. *Les milieux humides du Québec: des sites prioritaires à protéger*. Map.

Vallée, N. 1997. Personal communication. Ministère de l'Environnement et de la Faune, Direction de la conservation et du patrimoine écologique.

Appendices

1 St. Lawrence Vision 2000 (SLV 2000) Priority Species Found in the Pointe-du-Lac–Deschambault Sector

Common or scientific name	*Type of distribution or local status*
Plants (17 of the 110 priority species)	
Annual wildrice	Endemic, Fluvial Estuary of the St. Lawrence
Clammy hedge-hyssop	Endemic, Fluvial Estuary of the St. Lawrence
Coast cockspur	Peripheral North
Coast willow-weed	Endemic, Fluvial Estuary of the St. Lawrence
Dotted smartweed	Disjunct
Eaton's beggarticks	Disjunct
Estuary pipewort	Disjunct
Great Plains flatsedge	Peripheral North
Greene's rush	Peripheral North
Obedient plant	Peripheral North
Philadelphia fleabane	Endemic in northeastern America
Shreve's iris	Disjunct
Spotted water hemlock	Endemic, Fluvial Estuary of the St. Lawrence
St. Lawrence waterhorehound	Endemic, Fluvial Estuary of the St. Lawrence
Victorin's fringed-gentian	Endemic, Fluvial Estuary of the St. Lawrence
Virginia waterhorehound	Peripheral North
Yellowseed false pimpernel	Disjunct
Fish (8 of the 14 priority species)	
American eel	Migratory, catadromous
American shad	Migratory, anadromous
Atlantic sturgeon	Migratory, anadromous
Striped bass	Migratory, anadromous
Atlantic tomcod	Migratory, anadromous
Lake sturgeon	Migratory, freshwater
River redhorse	Resident, freshwater
Channel darter	Resident, freshwater
Amphibians and reptiles (3 of the 6 priority species)	
Western chorus frog	Presence confirmed
Wood turtle	Presence confirmed
Spotted turtle	Presence confirmed

Name	*Type of distribution or local status*
Birds (13 of the 19 priority species)	
Horned Grebe	Migrant
Least Bittern	Possible breeder
Northern Pintail	Confirmed breeder
Blue-winged Teal	Confirmed breeder
Barrow's Goldeneye	Migrant
Bald Eagle	Present in summer
Peregrine Falcon	Confirmed breeder
Common Moorhen	Confirmed breeder
Caspian Tern	Visitor
Red-headed Woodpecker	Present in summer
Sedge Wren	Present in summer
Loggerhead Shrike	Confirmed breeder
Grasshopper Sparrow	Visitor

2 Environmental Quality Criteria
(for assessing loss of use)

Ecosystem Component	*Reference Criterion*	*Objective*
WATER	Raw water (untreated water taken directly from a body of water) (MENVIQ, 1990)	Protect the health of persons who may both drink water directly from a body of water and eat aquatic organisms caught there throughout their lives.
	Contamination of aquatic organisms (MENVIQ, 1990)	Protect human health from the risks associated with consumption of aquatic organisms.
	Aquatic life (chronic toxicity) (MENVIQ, 1990)	Protect aquatic organisms and their offspring and wildlife that feed on such organisms.
	Recreational activities (direct contact) (MENVIQ, 1990)	Protect human health in the context of recreational activities involving total body contact with the water (e.g. swimming and windsurfing).
SEDIMENTS	No effect threshold (NET) (SLC and MENVIQ, 1992)	Contaminant levels are below those at which any effects on benthic organisms are observed.
	Minor effect threshold (MET) (SLC and MENVIQ, 1992)	Contaminant levels exceed those at which minor but tolerable effects are observed in most benthic organisms.
	Toxic effect threshold (TET) (SLC and MENVIQ, 1992)	Contaminant levels exceed those at which harmful effects are observed in most benthic organisms.
AQUATIC ORGANISMS	Protection of aquatic life (IJC, 1987)	Protect the health of fish-eating aquatic organisms.
	Fish and poultry marketing guidelines (Health and Welfare Canada, 1985)	Maximum acceptable contaminant levels in the tissues of fish, molluscs, crustaceans and poultry sold for consumption.
	Freshwater sport fish consumption guidelines (MSSS and MENVIQ, 1993)	Prevent harmful effects on human health from eating contaminated fish, molluscs and crustaceans.

References

Government of Canada. 1971. *Food and Drugs Act and Regulations*. Queen's Printer.

Health and Welfare Canada. 1985. *Canadian Guidelines for Chemical Contaminants in Fish and Fish Products*. Food and Drugs Act and Regulations.

IJC – International Joint Commission. 1987. *A conceptual approach for the application of biological indicators of ecosystem quality in the Great Lakes basin. A joint effort of the International Joint Commission and the Great Lakes Fishery Commission*. Report submitted to the Great Lakes Science Advisory Board.

MENVIQ – Ministère de l'Environnement du Québec. 1990, rev. 1992. *Critères de qualité de l'eau*. Service d'évaluation des rejets toxiques et Direction de la qualité des cours d'eau.

MSSS and MENVIQ – Ministère de la Santé et des Services Sociaux and Ministère de l'Environnement du Québec. 1993. *Guide de consommation du poisson de pêche sportive en eau douce*.

SLC and MENVIQ – St. Lawrence Centre and Ministère de l'Environnement du Québec. 1992. *Interim Criteria for Quality Assessment of St. Lawrence River Sediment*. Environment Canada and Ministère de l'Environnement.

3 Glossary

Anthropogenic: Effect resulting from human activity that transforms the natural environment.

Benthos: All organisms living in contact with the bottom of a body of water, divided into phytobenthos (plants) and zoobenthos (animals).

Biocenosis (or **biological community):** All the animals and plants living in a biotope.

Biomass: Total mass of living organisms, taken either globally or in systematic groups by surface or volume unit, in a given biotope at a given moment (e.g. plant, insect, herbivore, carnivore biomass).

Biotope: A limited region characterized by certain physical and chemical characteristics that provide an environment suitable for the development of living organisms (i.e. a biocenosis).

Community: All the living organisms, both plant and animal, occupying the same biotope.

Discharge: Volume of water carried by a watercourse, conduit, etc., in a given unit of time, generally expressed in cubic metres per second (m^3/s) or, in small watersheds, as litres per second (L/s).

Distribution – **peripheral:** Refers to a species that lives at the edge of its geographic range.

sporadic (or disjunct): Refers to species found in an area or areas remote from their main range.

endemic: Refers to a species that is confined to a particular area.

Drainage basin: The entire continental land area drained by a river system, that is, the total precipitation catchment and drainage area; also called *watershed*.

Ecosystem: An entire physical and chemical environment (biotope) and all the living organisms (biocenosis) living there and able continue doing so indefinitely by virtue of matter and energy inputs.

Effluent: Any liquid released from a source of pollution, whether a residential area (domestic outfall) or industrial plants (industrial outfall). Point-source effluents (sewers): liquid pollutants discharged at a given location.

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

Minimum flow: Lowest level of water flowing in a watercourse.

Nonpoint-source pollution: Diffuse discharge of pollutants into a given environment. Agricultural run-off is non-point-source pollution, since fertilizers and pesticides are spread over large areas.

Nutrient: Simple substance absorbed by plants and used in photosynthesis. Basic nutrients are nitrates, phosphates and silicates.

Sediment: Particles of soil and other solids formed by the weathering of rocks and other chemical or biological processes, and transported by air, water or ice.

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

Spawning ground: Place where fish gather to breed.

Suspended solids: Small particles of solid matter (> 0.45 m) floating in a liquid.; also called *Suspended sediments* (see Sediment).

Tributary: Watercourse that empties into a larger river, or into a lake.

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

Turbidity: Cloudiness of a liquid due to the presence of fine suspended matter (clay, silt or micro-organisms).

Waterfowl: Collective term for ducks and geese.

Water mass: Volume of water having 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 Quebec. 1981. *Dictionnaire de l'Eau*. Association Québecoise 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 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.