

# Romaine Complex

## Environmental Impact Statement Summary



August 2008



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Hydro-Québec Production

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August 2008

Prepared by:

- Hydro-Québec Équipement
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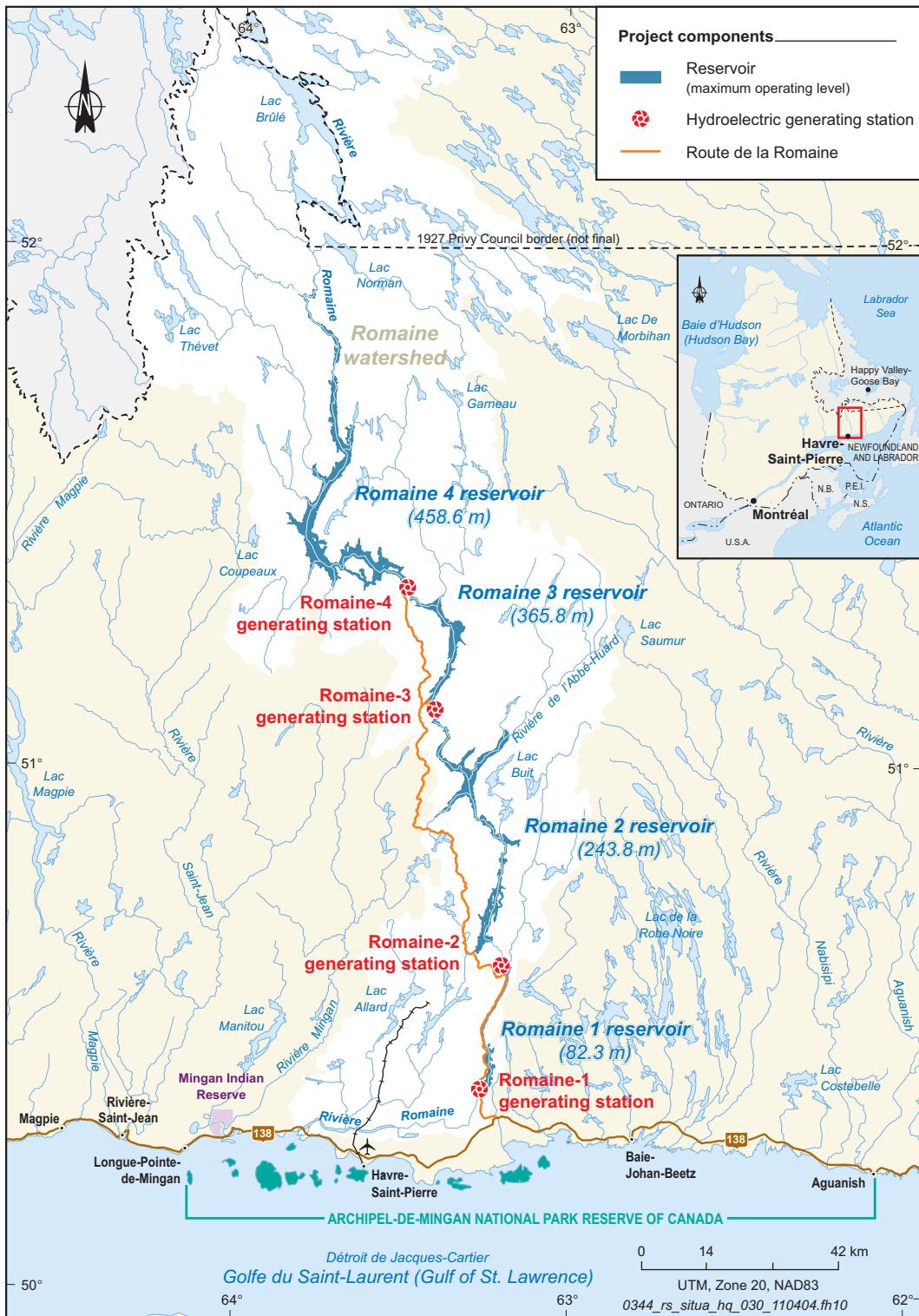
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## Project Location





# Introduction

This document summarizes the environmental impact assessment submitted to the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP) under section 31.1 of the *Environment Quality Act* (EQA) and to the Canadian Environmental Assessment Agency as part of the environmental assessment procedure set out in the *Canadian Environmental Assessment Act*.

Under section 4 of the *Regulation respecting environmental impact assessment and review*, an impact assessment prepared pursuant to section 31.1 of the EQA must be accompanied by a non-technical summary published separately. Federal guidelines for preparing the Romaine complex impact assessment also call for a summary.

This summary covers the following:

- Overview
- Project description
- Public participation and issues
- Description of the environment
- Impacts and mitigation/compensation/enhancement measures
- Environmental compliance assurance and monitoring

The full version of the environmental impact assessment for the Romaine complex and additional information may be consulted, in French, at [www.hydroquebec.com/romaine/documents/etude.html](http://www.hydroquebec.com/romaine/documents/etude.html).

# Overview

## 1.1 Project basics

Located in the Côte-Nord administrative region, the Romaine runs from the Laurentian Plateau southward to empty into the Golfe du Saint-Laurent (Gulf of St. Lawrence) about 15 km west of the town of Havre-Saint-Pierre. It flows entirely within Québec, its left bank from its headwaters to 52° N forming the 1927 Privy Council border with Labrador (not final). Hydro-Québec Production, a division of Hydro-Québec, plans to build a 1,550-MW hydroelectric complex on the Romaine. The entire complex will be located in the regional county municipality (RCM) of Minganie (see Project Location map).

The Romaine complex will include four hydroelectric developments (going downstream: Romaine-4, Romaine-3, Romaine-2 and Romaine-1) generating a total average annual output of 8.0 TWh. Each development will comprise a rockfill dam, a powerhouse equipped with two generating units and a spillway. Temporary bypasses will make it possible to carry out construction work in the dry. The project's four reservoirs will cover a total of 279 km<sup>2</sup> (see Map 1). Instream flow will be maintained at Romaine-4, Romaine-3 and Romaine-2 for the

protection of fish and habitats. Downstream of Romaine-1, the ecological instream flow regime will be more specifically designed to meet the needs of Atlantic salmon, which live in that part of the river.

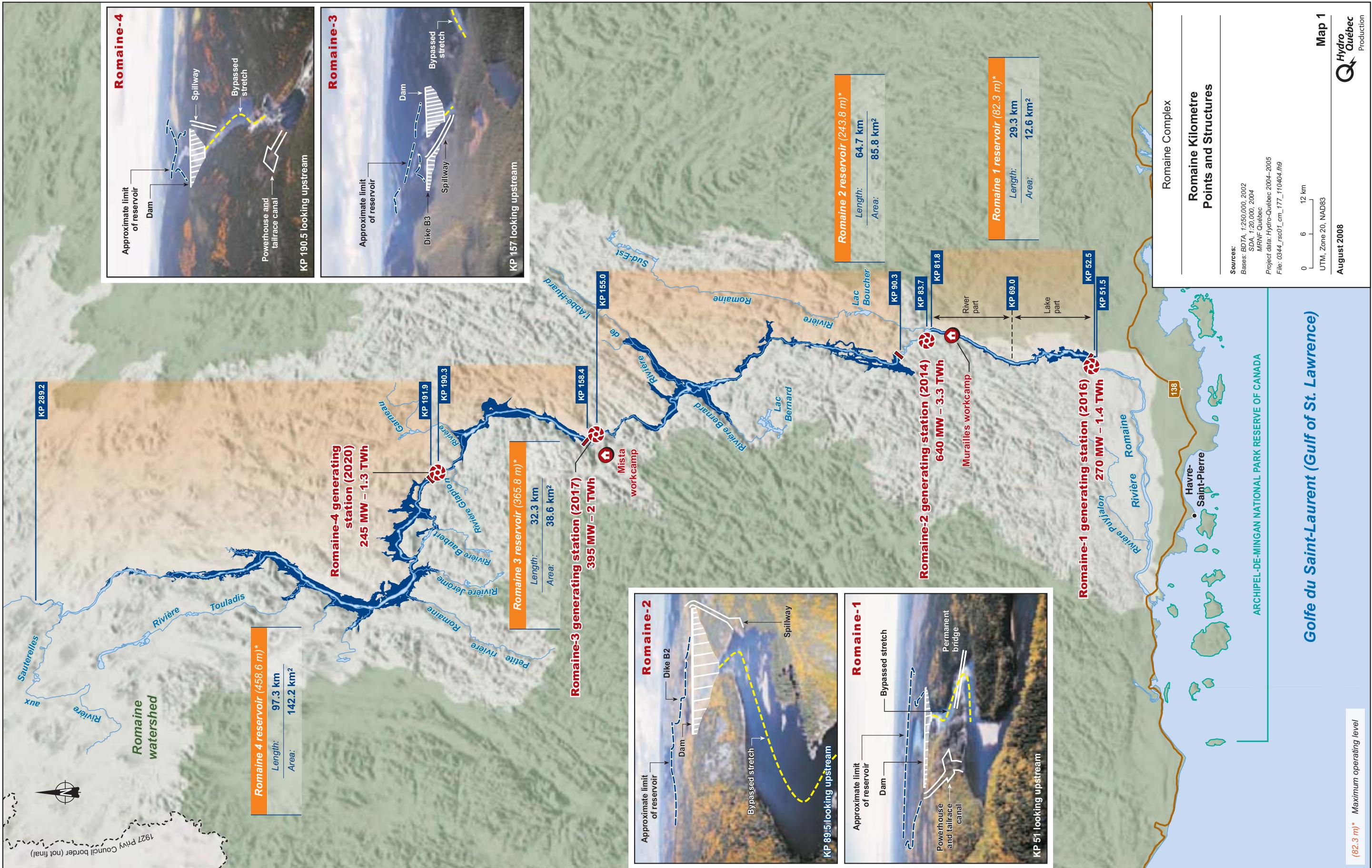
A permanent road about 150 km long, Route de la Romaine, must be built to link Highway 138 to the planned developments and to permanent housing for personnel operating the complex. Two temporary workcamps will also be built, one at kilometre 35.7 and the other at kilometre 118.0 of Route de la Romaine.

Romaine complex output will be carried over about 500 km of 315- and 735-kV lines to the existing Hydro-Québec TransÉnergie transmission system. A separate impact assessment will cover the powerhouse substations and new lines, all to be operated at 315 kV.

Construction of the complex will start as soon as the necessary government approvals have been issued. Under the proposed schedule, work will be carried out from 2009 to 2020, the first development to be commissioned in 2014 and the fourth in 2020 (see Figure 1). The project will cost an estimated \$6.5 billion.

*Figure 1: Romaine complex project schedule*

		Government approvals		Project schedule															
<b>Romaine-1</b>																			
<b>Romaine-2</b>																			
<b>Romaine-3</b>																			
<b>Romaine-4</b>																			
<b>Access roads</b>																			
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020					





## 1.2 Project justification

The Romaine project is included in the *Hydro-Québec Strategic Plan 2006–2010*, which the Government of Québec approved by order-in-council in 2007.

Hydro-Québec Production will sell Romaine complex generation under market conditions within and outside Québec, both growing markets. Following a typical development pattern for major hydropower projects carried out to date in Québec, Hydro-Québec Production exports will rise in the years after the Romaine generating stations are commissioned and then fall as Québec demand grows.

Hydro-Québec Production is very active on the electricity markets neighboring Québec (Ontario and the U.S. Northeast). This contributes to company profitability and to market efficiency in general. Such operations do not compromise security of supply within Québec, as Hydro-Québec regularly demonstrates to the Régie de l'énergie du Québec that it maintains sufficient reserves to meet the needs of the domestic market. The four Romaine generating stations will bring in an estimated \$872 million from exports in 2021 alone. Given projected revenue streams and expenses related to operating the complex, the project should generate a 13.3% return on shareholder's equity, an acceptable rate for Hydro-Québec.

Besides yielding appreciable revenue, Hydro-Québec exports help substantially reduce greenhouse gas (GHG) emissions by substituting a clean, renewable source of electricity for generation from coal- and natural-gas-fired power plants. The Romaine complex will help avoid the 3 million tonnes per year of GHG emissions that gas-fired plants of equal capacity would produce or 7.5 million tonnes from equivalent coal-fired plants.

Hydro-Québec Distribution, the main electric power distributor in Québec, projects that Québec market needs will grow by 14.6 TWh from 2007 to 2017. The trend in growth will thus be about 1% per year up to 2017. Forecasts also show peak power needs appearing in 2009–2010 and rising to 1,560 MW in 2016–2017. The Romaine complex could help meet those needs as soon as the first development is commissioned.

The project will have major economic spinoffs in Québec besides yielding significant revenue for the governments both of Québec and of Canada. Construction-related spending will total about

\$4.9 billion, including \$3.5 billion in Québec, of which \$1.3 billion will be spent in Côte-Nord. An estimated 33,410 person-years in jobs may be created or sustained, 11,224 person-years related to construction. Workers from the region will perform 60% of the construction work. About \$820 million in taxes will be generated by the project. The project will increase Hydro-Québec's contribution to the Generations Fund (devoted to reducing Québec's debt), to the public utilities tax and to dividend payments to the Government of Québec.

There is no reasonable alternative to the Romaine project. Inherent constraints mean that wind power cannot be considered an alternative despite its advantages as a renewable energy source with no air emissions. Wind generation contributes little to the power balance due to its intermittent, unpredictable nature, a major drawback since energy reserves must thus be maintained to ensure a steady, reliable supply of electricity. Nor is thermal generation (gas or coal) a conceivable alternative since Hydro-Québec Production bases its development on renewable energy sources. Similarly, nuclear power cannot be considered in the foreseeable future, while solar and geothermal energy depend upon progress in technology and are not competitive compared to the Romaine project.

## 1.3 Sustainable development

The purpose of sustainable development is to meet the needs of the present generation without compromising the ability of future generations to meet theirs. Hydro-Québec must thus ensure that electricity, a necessity, will contribute to the quality of life and security of future generations, while preserving the quality of the environment.

Hydro-Québec espoused the notion of sustainable development as early as 1989, following work by the World Commission on Environment and Development (1988). Two policies in particular reflect that commitment: *Our Environment* and *Our Social Role*.

In the first, Hydro-Québec undertakes to promote hydropower, other renewable energy sources and energy efficiency to meet the needs of its customers. Furthermore, in accordance with the *Sustainable Development Act*, passed by the Québec government in April 2006, Hydro-Québec is now preparing an action plan to incorporate the principles of sustainable development at all levels and in all aspects of its activities.

Three basic conditions must be met for Hydro-Québec to implement a hydropower project: it must be profitable, environmentally acceptable and well received by local communities. This approach adheres to the philosophy of the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP) and to the spirit of the *Canadian Environmental Assessment Act*. It is also in line with the objectives of MDDEP guidelines for the Romaine project: to maintain the integrity of the environment, to enhance social equity and to improve economic efficiency.

Regarding integrity of the environment, the analysis of Romaine complex impacts is based on a thorough investigation of the study area. Environmental components potentially affected by the project were generally covered by at least two field survey programs. The data collected made it possible to develop appropriate mitigation and compensation measures, and an environmental monitoring program with specific objectives for components that will undergo appreciable modifications or that are particularly sensitive.

Distributing the benefits of development fairly among communities and their members is another objective of the planned approach. Given the difficult socioeconomic context in Côte-Nord, the matter of economic spinoffs was immediately seen as a major issue and gave rise to numerous discussions. These led to developing various measures intended to maximize project benefits, including the development of regional expertise. Improving Côte-Nord worker qualifications and company know-how will have a lasting impact on employment and business there. In addition, building Route de la Romaine may favor local economic growth by providing access to the resources of a little-developed region.

As for economic efficiency, the Romaine complex will enable Hydro-Québec to provide electricity produced at a stable, competitive cost for several generations without importing fuel.

## 1.4 Partnering with communities

Numerous public consultations and discussions with local authorities have addressed the Romaine project. The meetings have helped the various stakeholders share their knowledge of the environment, express their concerns and expectations regarding the project, and guide its design.

Hydro-Québec has reached agreements with the RCM of Minganie and the Innu community of Natashquan (Nutashkuan) so that the host region can maximize project benefits. These partnerships are based on agreements of the same type signed for recent hydro-power projects.

Hydro-Québec has also presented the project to representatives of the Innu communities of Mingan (Ekuanitshit), La Romaine (Unaman-shipu) and Pakua-shipi.<sup>1</sup> On the whole, the reaction has been favorable. Hydro-Québec is holding ongoing discussions with these communities to reach impact and benefit agreements (IBAs), the prime goals of which are to promote Innu social and economic development, and to maintain *Innu Aitun*.<sup>2</sup>

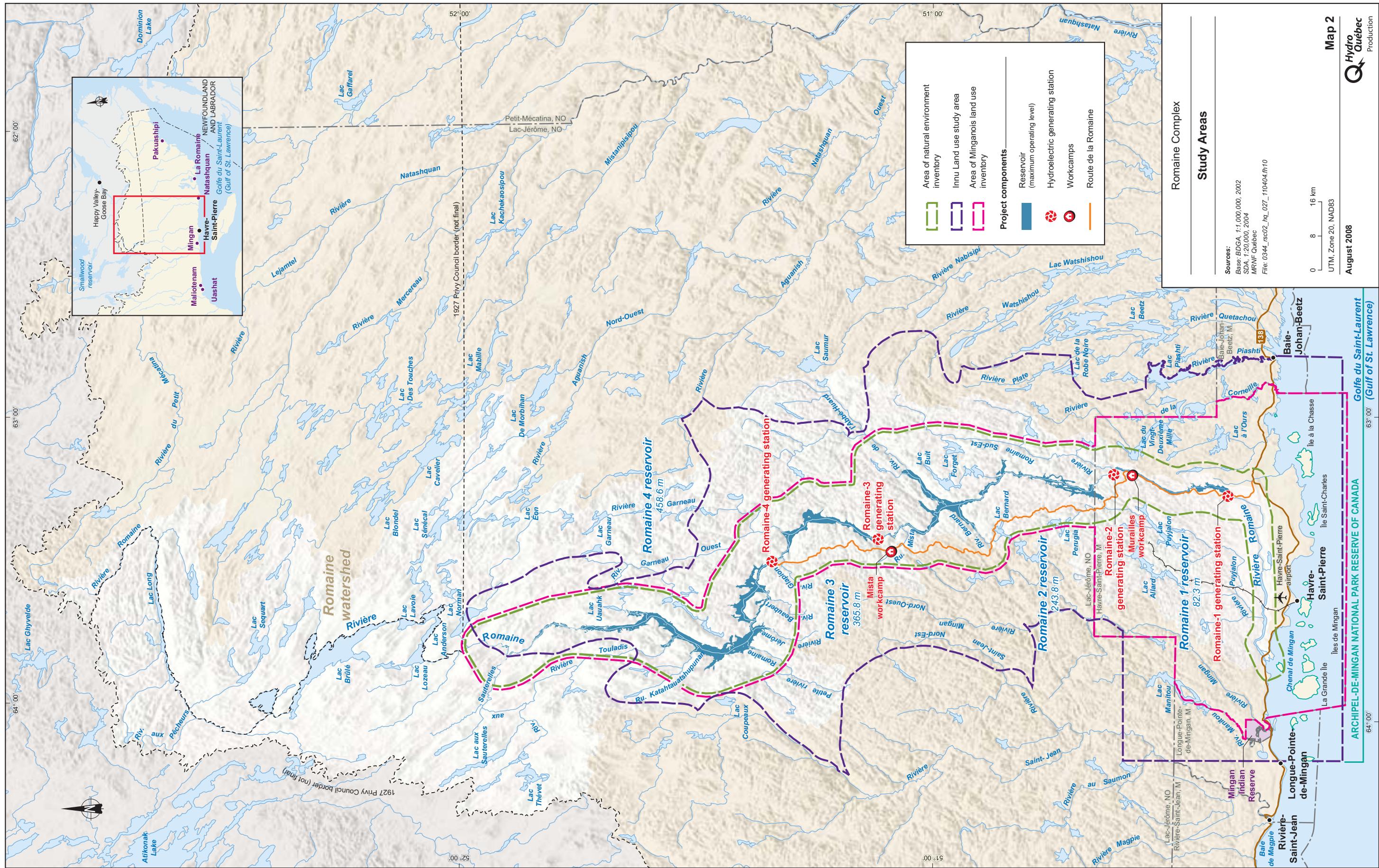
## 1.5 Study areas

The natural environment study area flanks 295 km of the Romaine from Labrador, based on the 1927 Privy Council border (not final), to its mouth. It is wider in places to include the mouths of major tributaries or corridors studied for Route de la Romaine (see Map 2). Given the importance of the sea environment, it also covers the area around the mouth of the Romaine and the Chenal de Mingan, which covers part of the Archipel de Mingan (see Map 3).

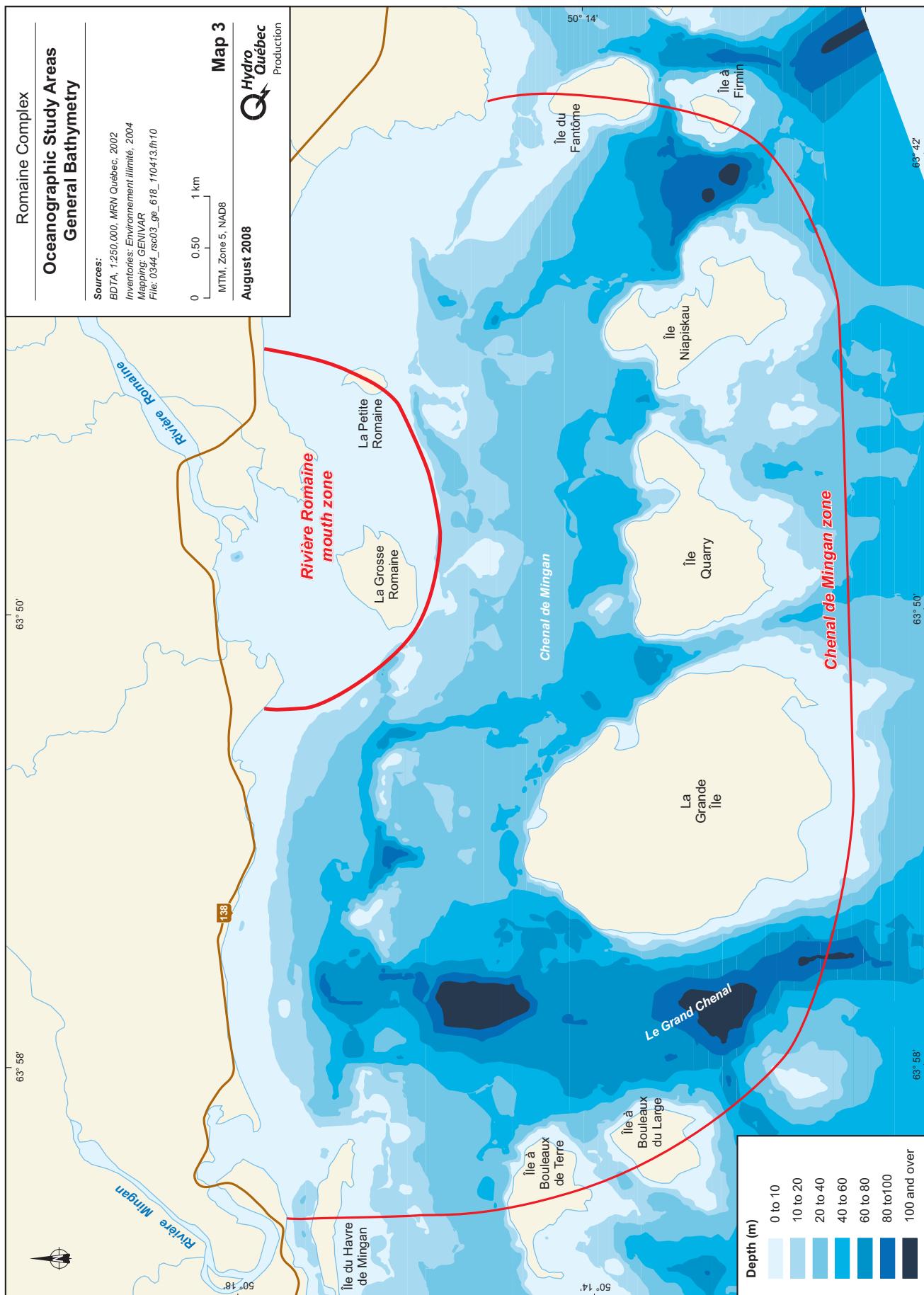
In the south, the Minganois<sup>3</sup> land use study area extends well beyond the natural environment study area. It follows the Havre-Saint-Pierre municipal boundary except to the west, where the Mingan Indian Reserve and part of the Rivière Manitou are excluded (see Map 2). Farther north, the boundary is the same as that of the natural environment study area. The Minganois study area may at times be regional in size (RCM of Minganie or Côte-Nord administrative region) in order to put things in context or to cover specific aspects.

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1. In compliance with federal guidelines on preparing the impact study, Hydro-Québec also considered the community of Uashat mak Mani-Utenam in Québec and the communities of Sheshatshit and Natuashish in Labrador. Information collected shows that these communities are not directly concerned by the project.
2. The notion of *Innu Aitun* ("Innu way of life") covers all activities linked to the culture, fundamental values and traditional lifestyle of the Innu and their special relationship to the land.
3. The term "Minganois" designates the non-Native population of the MRC de la Minganie, following usage in the French version of the impact assessment and its summary.







The Innu land use study area includes traplines 406, 406A, 410, 413, 414, 416, 416A, 417, 417A, 418A and 422 in the Mingan division of the Saguenay beaver reserve. It also includes the lower Romaine downstream of Grande Chute (KP 52.5), the mouth zone and coastal areas (see Map 2). To develop a contemporary land use model, traplines 403, 405, 407, 407A, 411, 415 and 418 were also included, as were the coastal strip and land south of the beaver reserve from the Rivière Manitou in the west to the Rivière Piashti in the east. For its socio-economic component, the study area corresponds to the Innu communities concerned: Mingan (Ekuanitshit), Natashaquan (Nutashkuan), La Romaine (Unaman-shipu) and Pakua-shipi.

# Project Description

## 2.1 Background

There have been numerous studies on developing the hydroelectric potential of the Romaine, particularly in 1921, 1950 and 1957. Hydro-Québec began studying the matter in 1967 with a project that already involved developing four sites.

From 1977 to 2000, Hydro-Québec conducted studies covering a range of options, including partial or total diversion of the Romaine or nearby rivers. Then in 2001, the company drafted a new design whereby a single run-of-river generating station would be built at KP 52.5 of the Romaine.

Through studies begun in 2004, the option initially envisaged in 1984 was finally confirmed. It involved developing the stepped profile of the Romaine, improving the design of structures, determining dam sites and setting the operating level of reservoirs (see Map 1). Variants were also studied

for generating station locations, the Route de la Romaine corridor and workcamp sites.

The project selected will not divert the river and limits the maximum operating level of the head reservoir so that the area flooded will not extend into Labrador, based on the 1927 Privy Council border (not final).

## 2.2 Developments

The Romaine complex comprises four developments, in the direction of flow designated as Romaine-4, Romaine-3, Romaine-2 and Romaine-1 (see Map 1).

### 2.2.1 Structures and reservoirs

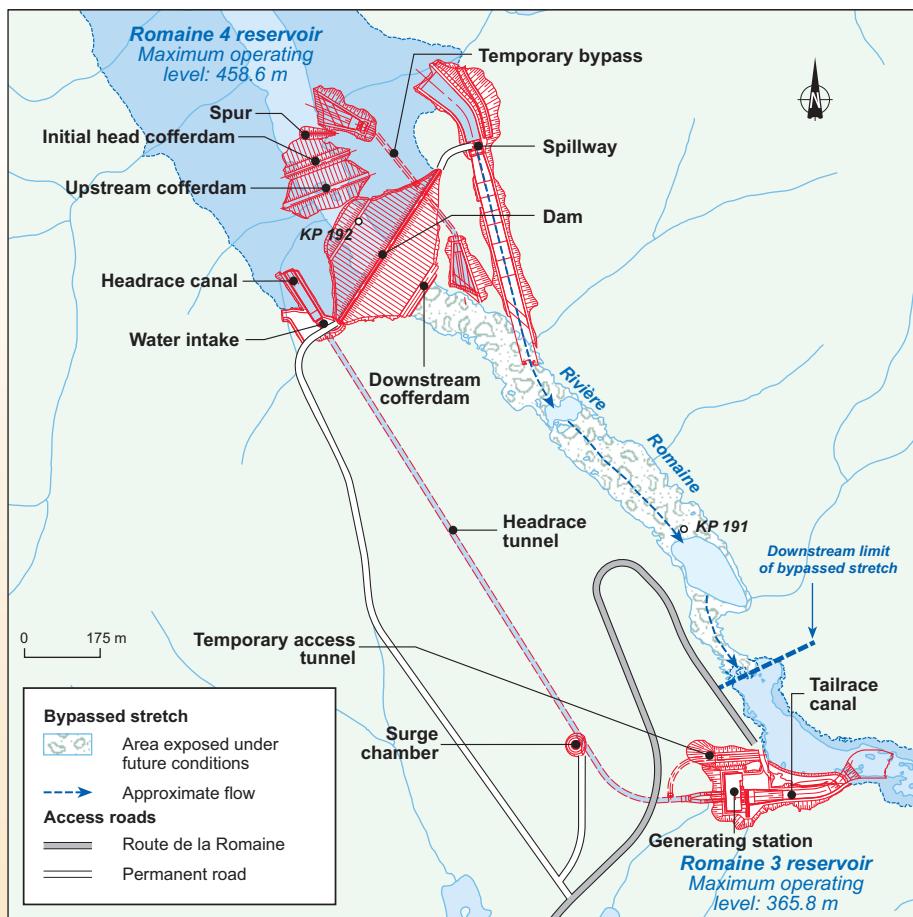
Table 1 gives the characteristics of the four developments. Figures 2 to 5 show how structures are arranged at each site developed.

Table 1: Key characteristics of project developments

Characteristic	Romaine-4	Romaine-3	Romaine-2	Romaine-1
<b>Dams</b>				
Location (KP)	191.9	158.4	90.3	52.5
Height (m)	87.3	92.0	121.0	37.6
Material added (m <sup>3</sup> )	2,139,800	2,652,900	3,337,000	323,800
Material removed (m <sup>3</sup> )	128,000	171,000	101,600	28,400
<b>Reservoirs</b>				
Maximum area (km <sup>2</sup> )	142.2	38.6	85.8	12.6
Maximum operating level (m)	458.6	365.8	243.8	82.3
Minimum operating level (m)	442.1	352.8	238.8	80.8
Maximum drawdown (m)	16.5	13.0	5.0 <sup>a</sup>	1.5
<b>Generating stations</b>				
Design flow (m <sup>3</sup> /s)	307	372	453	485
Instream flow (m <sup>3</sup> /s)	1.8	2.2	2.7	140 to 200
Installed capacity (MW)	245	395	640	270
Average annual energy (TWh)	1.3	2.0	3.3	1.4
Utilization factor	0.58	0.58	0.58	0.59
Year of commissioning	2020	2017	2014	2016

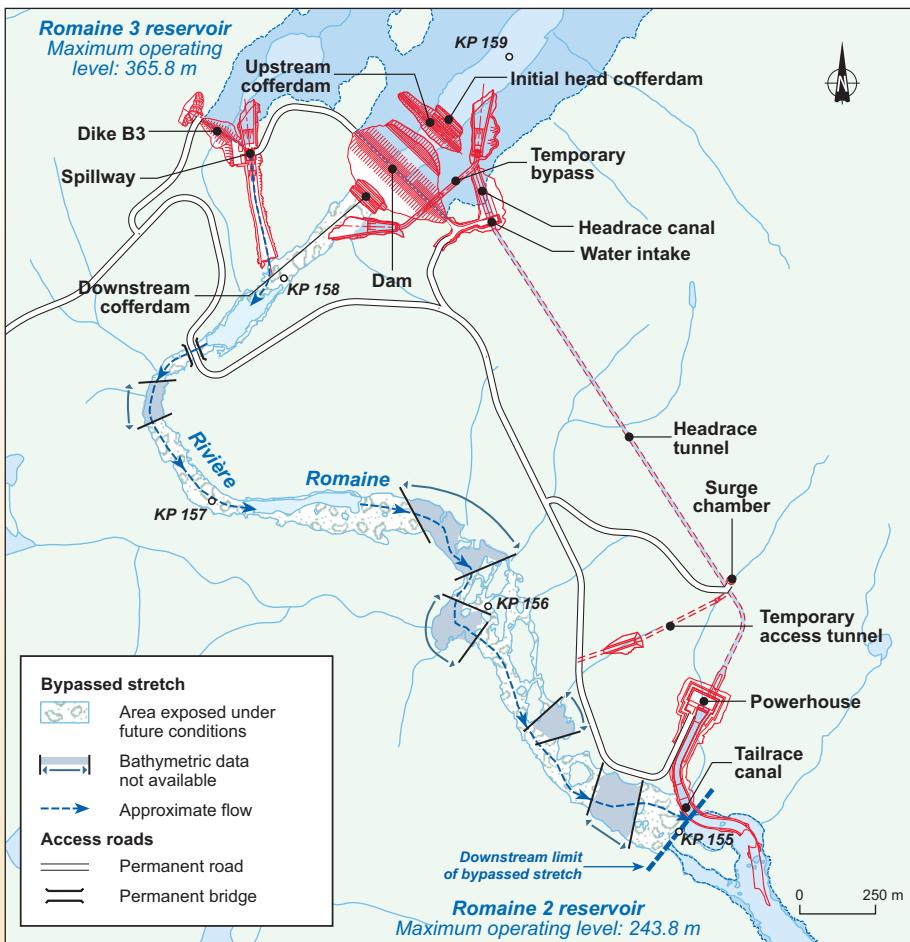
a. The drawdown will be 19.0 m prior to the commissioning of Romaine-4.

Figure 2: Romaine-4 development



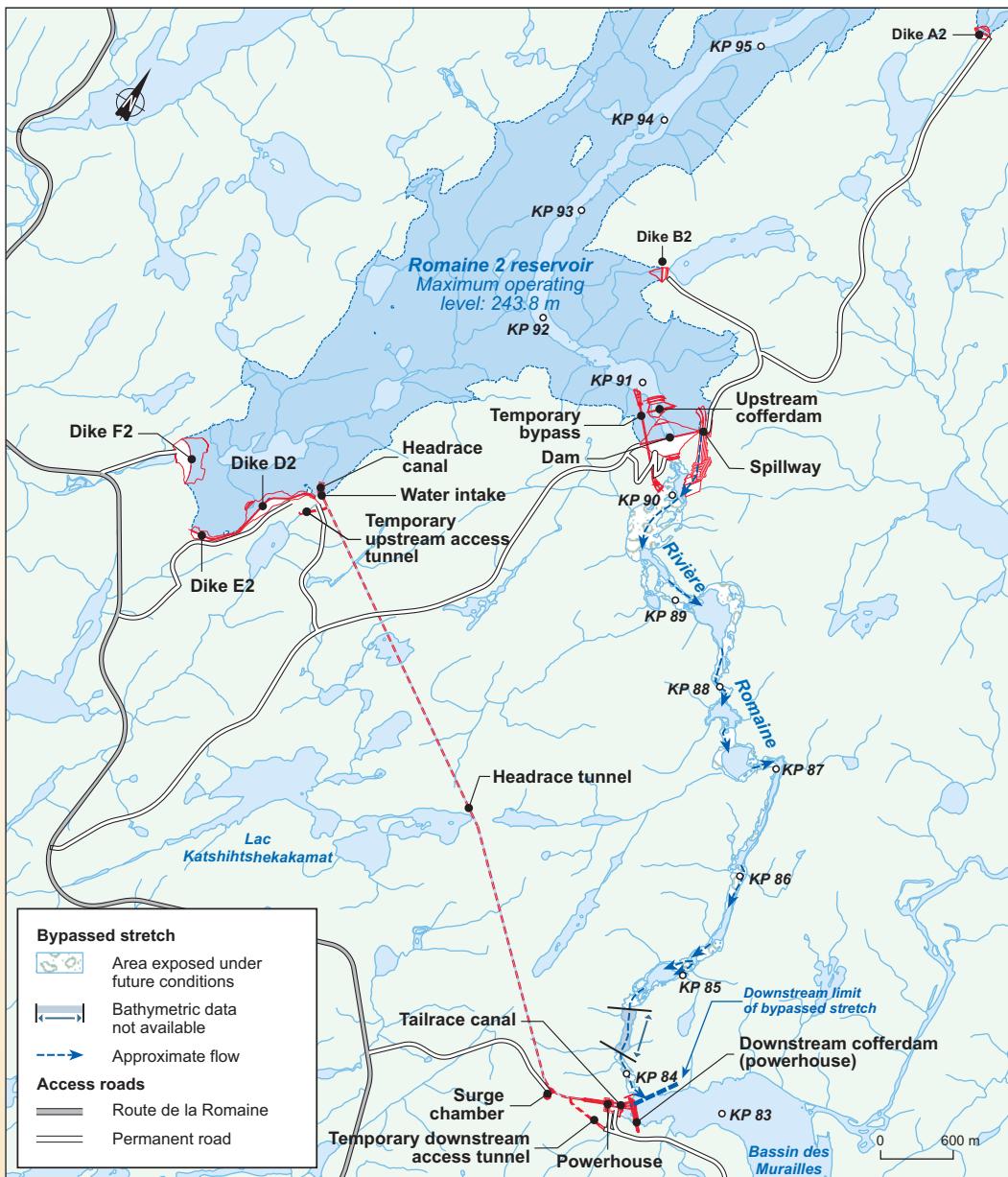
## Romaine-4

Figure 3: Romaine-3 development



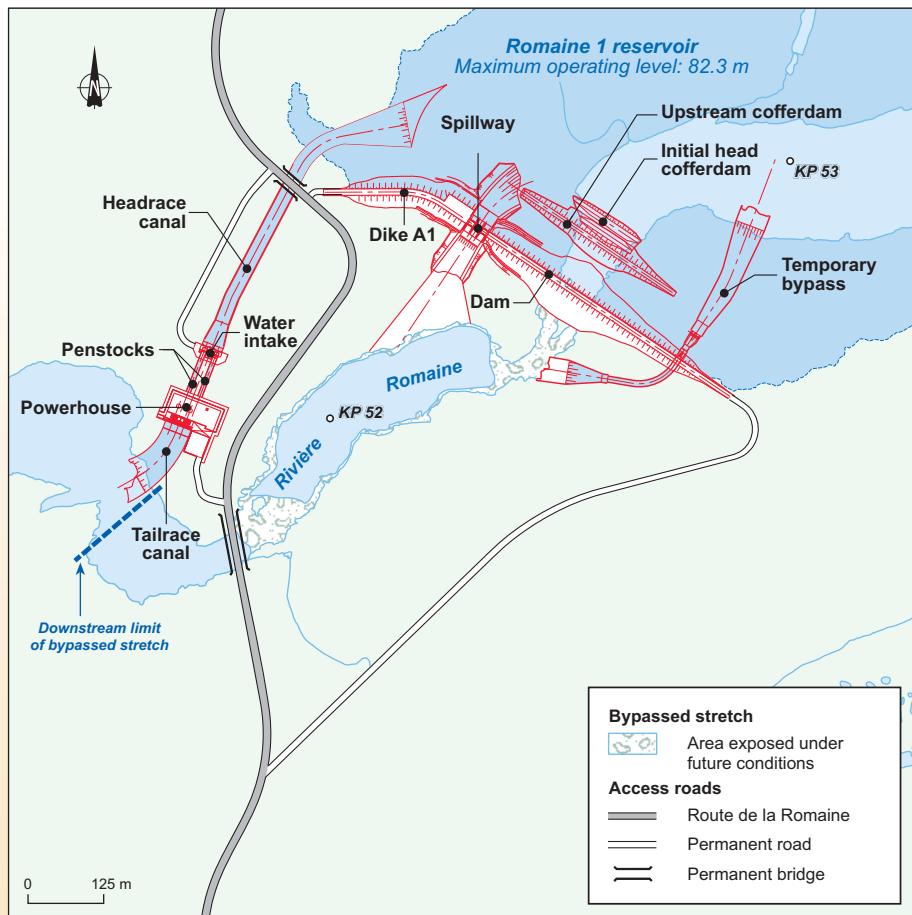
## Romaine-3

Figure 4: Romaine-2 development



## Romaine-2

Figure 5: Romaine-1 development



## Romaine-1

Each development will include a dam and reservoir. Dikes are also planned to close off secondary valleys: one dike each for Romaine-1 and Romaine-3, and five for Romaine-2.

Dams will consist of an embankment of compacted earth with the upstream side covered with a watertight concrete facing.

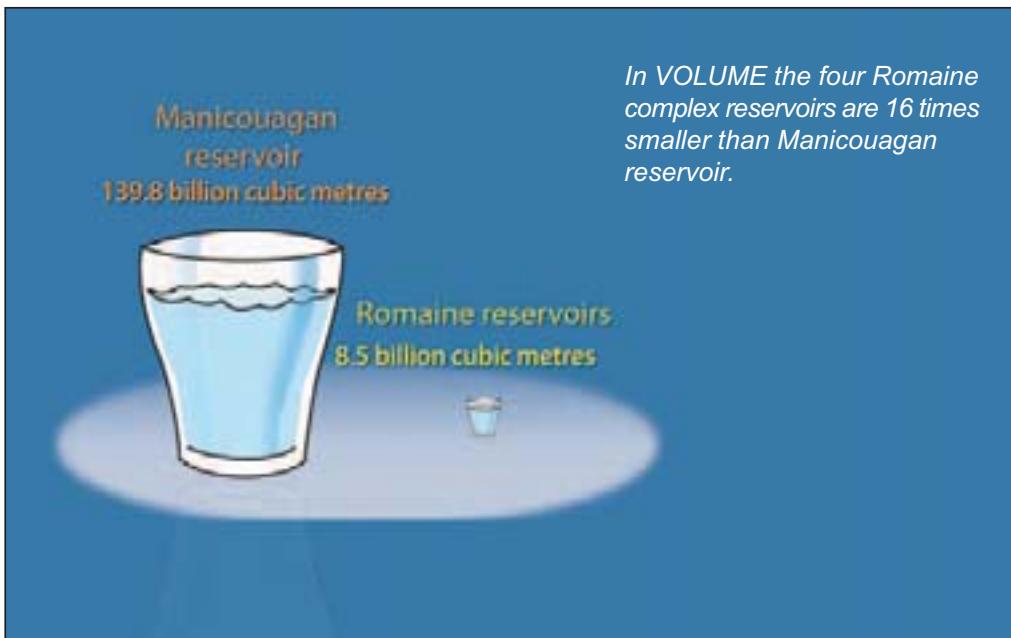
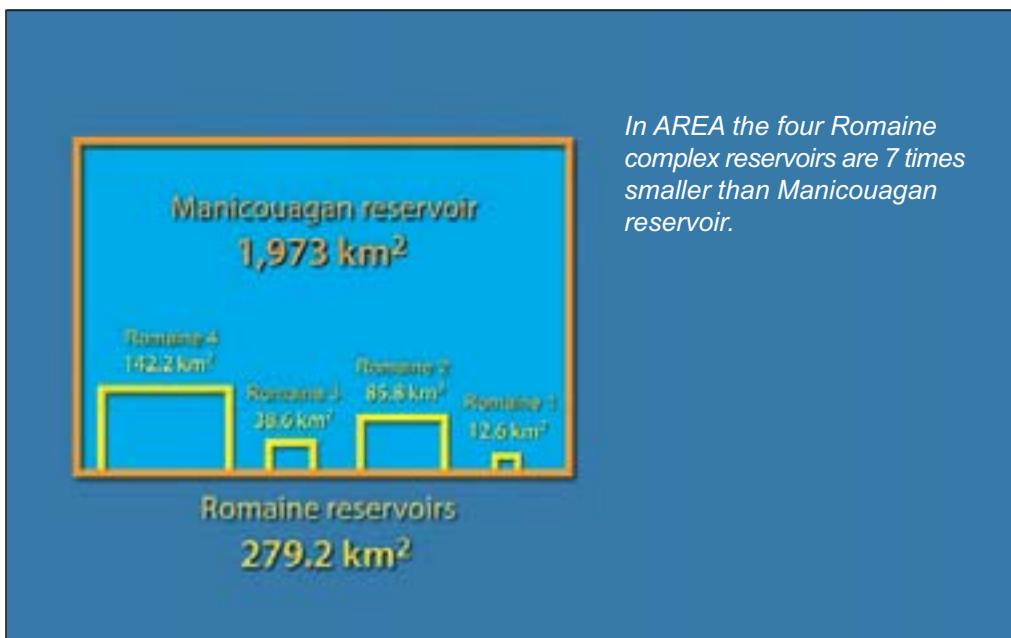
Romaine-4, Romaine-3 and Romaine-2 will all have a headrace canal, water intake, headrace tunnel and two penstocks, surge chamber, above-ground powerhouse and tailrace canal. Romaine-1 will have same structures except for the headrace tunnel and surge chamber. Each powerhouse will be equipped with two Francis turbine generating units. The installed capacity of the four powerhouses will total 1,550 MW. Given a utilization

factor of 0.59 for Romaine-1 and 0.58 for the other powerhouses, the Romaine project will generate an average of 8.0 TWh per year.

Each development will have a spillway with an intake channel, gates and outlet channel. A plunge pool will be built at the bottom of the outlet channel of the Romaine-2 spillway.

Romaine 4 reservoir will cover 142.2 km<sup>2</sup> at maximum operating level. Romaine 2 reservoir will be much smaller, covering 85.8 km<sup>2</sup>, while Romaine 3 and Romaine 1 reservoirs will respectively cover 38.6 km<sup>2</sup> and 12.6 km<sup>2</sup> (see Figure 6). Maximum drawdown, i.e., the range in reservoir level, becomes smaller the farther down the Romaine the development is located (see Table 1).

Figure 6: Romaine reservoirs compared to Manicouagan reservoir



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## 2.2.2 Ecological instream flow

Instream flow will be maintained downstream of each development. Since Atlantic salmon live in the reaches between Romaine-1 (the Grande Chute site at KP 52.5) and the mouth of the Romaine, the ecological instream flow regime there will be adjusted to the needs of salmon.

Instream flow down bypassed stretches,<sup>4</sup> i.e., the length of river between dam and powerhouse, will be 1.8 m<sup>3</sup>/s at Romaine-4, 2.2 m<sup>3</sup>/s at Romaine-3 and 2.7 m<sup>3</sup>/s at Romaine-2. There will be no instream flow down the bypassed stretch at Romaine-1 (KP 52.5 to 51.5) since it is very short and habitats there are of poor quality. Loss of fish habitat in the bypassed stretches will be offset by various compensation measures for brook trout and salmon.

Between the Romaine-1 tailrace canal and the mouth of the river, the following ecological instream flow regime will apply throughout the operation phase:

- June 7 to July 7 – 200 m<sup>3</sup>/s
- July 8 to October 15 – 170 m<sup>3</sup>/s
- October 16 to November 15 – 200 m<sup>3</sup>/s
- November 16 to June 6 – 140 m<sup>3</sup>/s

Note that the operating flow from Romaine-1 powerhouse usually ranges from 200 to 400 m<sup>3</sup>/s and is thus almost always greater than the planned instream flow.

During construction of the developments, before reservoir impoundment, temporary bypasses will help maintain instream flow downstream of the dams.

During stage one of Romaine 4 and Romaine 3 reservoir impoundment (lasting 61 and 125 days respectively under average runoff conditions), there will be no instream flow in the bypassed stretch of river at each of these developments. However, the ecological instream flow regime downstream of Romaine-1 will be maintained. During stage two of Romaine 2 reservoir impoundment (lasting 24 days under average runoff conditions), it will not be feasible to assure instream flow between Romaine-2 dam and the mouth (KP 90.3 to 0). Inflows will be only from tributaries along this stretch. Impacts of the lack of instream flow on habitat and fish will be offset by compensation measures and by an Atlantic salmon enhancement program (see Section 5.3.).

## 2.3 Main access road, secondary roads and dwellings

A permanent road will be built to reach the four sites of the Romaine complex. Route de la Romaine will branch off Highway 138 some 30 km east of Havre-Saint-Pierre. It will be 151.8 km long, first running east of the river up to Romaine-1, and then west of the river (see maps 4a and 4b). The entire length of this main access road will have a paved width of 6.6 m. Hydro-Québec will maintain it throughout both construction and operation of the complex (see Table 2).

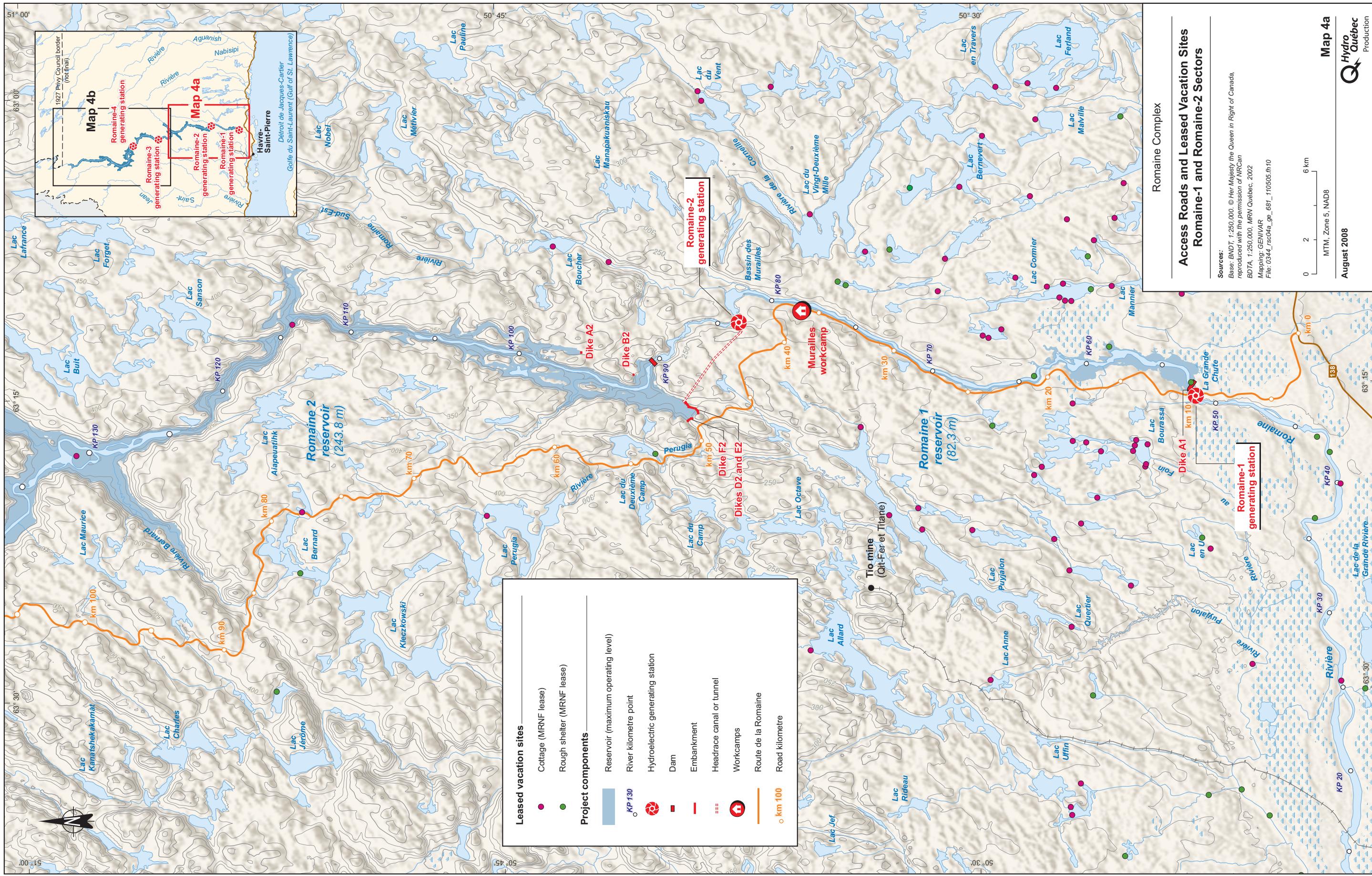
4. The bypassed stretches are respectively 1.6, 3.4 and 6.6 km long.

Table 2: Project roads and bridges

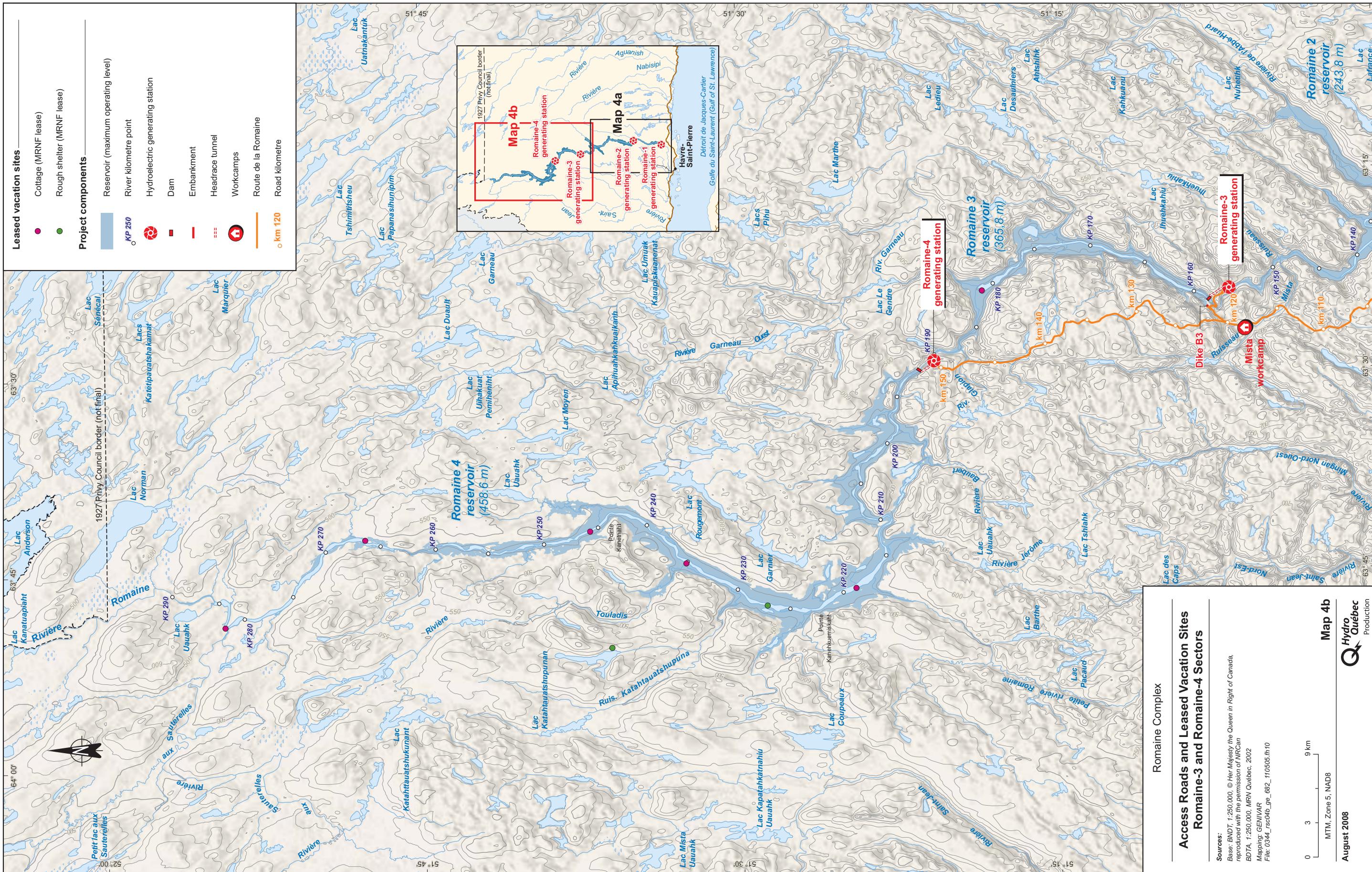
Site	Main access road (Route de la Romaine)	Access roads to structures	Access roads to jobsites and workcamps	Total
Romaine-1	10.0 km 1 bridge over Rivière Romaine (184 m long)	2.1 km	3.5 km	15.6 km
Romaine-2	37.8 km	21.2 km	18.8 km	77.8 km
Romaine-3	72.4 km 4 bridges (10 to 30 m long)	7.4 km 1 bridge over Rivière Romaine (50 m long)	11.0 km 1 bridge over Rivière Romaine (50 m long)	90.8 km
Romaine-4	31.6 km 1 bridge over Rivière Glapion (10 m long)	2.3 km	9.1 km	43.0 km
Total	151.8 km	33.0 km	42.4 km	227.2 km

Other permanent roads, generally quite short, will link Route de la Romaine to structures of the complex.

A permanent housing facility will be built to accommodate personnel operating the Romaine complex. It will be built near Romaine-3 next to Route de la Romaine.









## 2.4 Temporary facilities and construction work

Construction of the Romaine complex will start as soon as the necessary government approvals have been obtained. Based on the proposed schedule (see Figure 1), work will begin in 2009 and last until 2020. The number of workers will average 975 over that time, peaking at 1,600 to 2,400 workers on Romaine jobsites in the period from 2011 to 2016 (see Figure 7).

The first development will be commissioned in 2014 (Romaine-2) and the last in 2020 (Romaine-4).

Romaine 2 reservoir will be impounded first, in spring 2014. The operation will last four months. Romaine 1 reservoir will follow in summer 2016, with impoundment lasting two weeks. Romaine 3 reservoir will be impounded in 2016–2017 over a seven-month period and Romaine 4 in 2019–2020 over nine months.

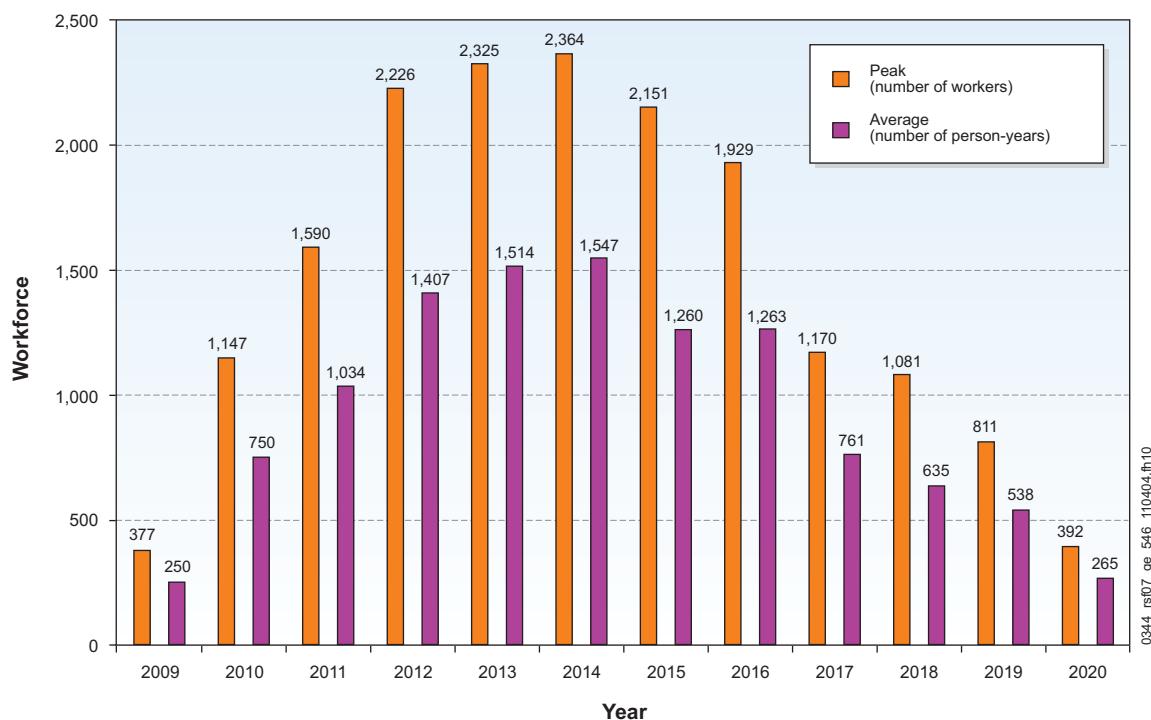
Merchantable conifers in areas the reservoirs are to cover will be harvested prior to impoundment. Hopes are to recover 754,500 m<sup>3</sup> of wood, but the terrain

presents major hurdles to logging and reaching that target will depend on prevailing weather conditions during the scheduled period (primarily in winter). For environmental reasons, the periphery of Romaine 1 reservoir will also be cleared and slash collected (see sections 5.3.2 and 5.4.5).

As with any hydropower project, the Romaine will entail blasting, grading, earthwork, concrete placement and constructing temporary infrastructure, e.g., temporary bypasses, roads and industrial areas (for concrete plants, workshops, stockpiles, etc.). Temporary services must also be planned to supply water and electricity, and to treat sewage and other wastes.

Borrow pits and quarries must be operated in order to build the structures and to manufacture concrete. It is anticipated that 311,400 m<sup>3</sup> of till, nearly 500,000 m<sup>3</sup> of sand and gravel, and over 14,000,000 m<sup>3</sup> of rock will be used. A major part of the material required will come from the 11,000,000 m<sup>3</sup> of rock to be excavated in order to build the structures. A number of sources of unconsolidated material or rock have been found near the work sites.

Figure 7: Projected workforce at Romaine jobsites



Hydro-Québec will install a checkpoint on Route de la Romaine just off Highway 138 in order to control jobsite access and to inform visitors of safety rules. Route de la Romaine will be gradually opened to the public as work progresses and following procedures designed to ensure the safety of users and workers.

Workers will lodge at two locations. Murailles workcamp at kilometre 35.7 of Route de la Romaine will accommodate workers assigned to building Romaine-1 and Romaine-2 (peaking at some 2,400 people). Mista workcamp at kilometre 118.0 will accommodate workers assigned to building Romaine-3 and Romaine-4 (peaking at some 1,700 people). Worker schedules will differ: 5 workdays followed by 2 days off at Murailles workcamp, and 35 straight workdays followed by 8 days off at Mista workcamp.

The workcamps and other temporary facilities will be dismantled once the work is completed. The sites will be restored and reforested.

## **2.5** **Hazard management**

Hydro-Québec has adopted dam safety guidelines to ensure that operation of its hydraulic structures does not expose individuals, property and the environment to unacceptable risks. Those guidelines comply with

the *Dam Safety Act* and its regulations. The company has a dam safety program that promotes preventive risk reduction measures. Such measures are based on integrated maintenance management and on flow management designed to ensure safe operation of dams, dikes and related facilities. Complementing the program are mitigation measures designed to reduce the consequences of ongoing or foreseeable events. The Hydro-Québec dam safety program has been approved by the MDDEP.

Hydro-Québec also maintains emergency arrangements in order to bring under control any incident requiring a quick, well-organized response. An emergency measures plan is developed based on the worst-case scenario: dam failure.

For the Romaine complex, any emergency will be managed by the Direction régionale – Manicouagan from the Baie-Comeau Regional Centre where the emergency coordination centre is located. Coordination centre officers may trigger alert procedures and ensure coordination with Québec's Sécurité civile sector and with provincial and municipal authorities.

The emergency measures plan and maps showing areas of maximum flooding will be submitted in due course to government authorities in order to obtain the approvals required under the *Dam Safety Act*.

# 3

## Public Participation and Issues

One of the three basic conditions for Hydro-Québec to implement hydropower projects is their acceptance by host communities. Hydro-Québec thus developed a communications program focusing on the participation of the communities concerned by the Romaine project.<sup>5</sup> Meetings organized under the program helped to raise major issues for the project and to promote its smooth integration into the communities.

### 3.1 Communications program

The program was designed to inform communities involved, to take stock of their concerns during the draft-design phase, and later, to make results public as the studies progressed. A number of means were used to achieve these objectives (see Table 3).

*Table 3: Communications activities*

Activity	Description
Information tour	When Hydro-Québec launched draft-design studies in May 2004, it conducted an information tour to Havre-Saint-Pierre, Natashquan and Longue-Pointe-de-Mingan during which nearly 250 people participated.
Meetings with elected officials and other community representatives	Hydro-Québec held some 20 meetings with elected officials from Minganie and local decision makers to provide them with information about the project and company practices.
Information and discussion panels (IDPs)	Hydro-Québec organized five IDPs between 2004 and 2008. Nearly 100 representatives from various organizations (the RCM, municipalities, ministries, citizens' associations, Innu band councils, economic development agencies, etc.) participated in the meetings, which provided a forum for discussing the project, studies, impacts and mitigation measures.
Workshops	Designed to supplement IDPs, workshops provided an opportunity for more detailed discussions on specific aspects and for looking at major issues more closely. Eight workshops were held between 2005 and 2008 on jobs and workforce training, economic spinoffs, increased access to the region, logging, the contract award process and subcontracting.
Open-house events	Eight open-house events were organized between 2005 and 2008 at Havre-Saint-Pierre, Sept-Îles, Longue-Pointe-de-Mingan and Natashquan. Specialists were on hand to talk about the project and answer questions from the public.
Other activities	Given the importance of economic spinoffs, employment and workforce training, Hydro-Québec organized a number of other activities (mealtime meetings, organized tours of other hydroelectric complexes, talks on economic spinoffs from other projects, meetings with students and youth groups, etc.) to clarify these issues, present company practices and learn about community concerns.
Targeted meetings	At the request of certain organizations, Hydro-Québec organized a number of meetings focused on subjects of interest to target groups (citizens' committees, chambers of commerce, businesspeople, specialized service organizations, recreation and tourism associations, etc.).

5. Hydro-Québec's communications program addresses both the Minganois and Innu; however, additional channels have been used for the Innu (see Section 3.2).

Besides these activities, Hydro-Québec used various other means to promote a better understanding of the project, to learn of community concerns and to leverage local (Minganois and Innu) traditional knowledge. Three information bulletins were thus distributed across the RCM of Minganie, information was posted on the Hydro-Québec website and disseminated by various channels in the media (press releases, interviews, advertising, etc.). From the draft-design phase, Hydro-Québec appointed a local community relations advisor to act as an intermediary between the project team and host communities.

### **3.2 Complementary activities for the Innu**

Hydro-Québec used additional channels to communicate with the Innu.

Thus, 36 public meetings or information and exchange workshops were organized in Innu communities between February 2004 and July 2008: 18 at Ekuaniitshit, 9 at Nutashkuan, 5 at Unaman-shipu and 4 at Pakua-shipi. Discussions covered the following subjects: main features and technical design of the project; the subjects and results of studies and field surveys; economic spinoffs, employment and training; life on the jobsite; logging operations; public health and mercury; wildlife; changes to Rivière Romaine flow; salmon; archaeology; the progress and results of Innu studies on land use, salmon fishing, traditional Innu knowledge and the socioeconomic environment; and project impacts. The meetings helped the Innu express their concerns regarding the project. Section 3.3 provides an overview of the main issues for the populations concerned.

Throughout the draft-design phase, Hydro-Québec held talks with several organizations representing Innu communities. The company met representatives of the band councils from Ekuaniitshit 5 times, Nutashkuan 14 times, Unaman-shipu 9 times, Pakua-shipi 7 times, the Assemblée Mamu Pakatatau Mamit 4 times and Corporation Nishipiminan 16 times.

To comply with federal guidelines on preparing the impact study, Hydro-Québec also held information meetings with Innu representatives from Uashat mak Mani-Utenam (four meetings) and with Innu Nation, which represents the Innu communities of Newfoundland and Labrador (three meetings). As study results show, however, the Innu of Labrador and Uashat mak Mani-Utenam do not use the Romaine complex study area.

### **3.3 Issues**

#### **Economic spinoffs, jobs and social impacts**

At the local and regional level, the Romaine project is creating great expectations with respect to jobs and economic spinoffs for businesses, municipalities and Innu band councils. This is a major issue for Minganois and Innu populations, public officials and other community stakeholders. Hydro-Québec has proposed a number of measures to maximize regional spinoffs, including job creation. A large portion of the estimated \$4.9 billion in construction expenditures will be spent in Côte-Nord on goods and services purchased and workers hired.

The social consequences of rapid economic development in a small community like Havre-Saint-Pierre also raise fears. Hydro-Québec thus plans measures for smoothly integrating the project, e.g., a community relations committee.

The project could spark the development of Innu companies and the training of a specialized Native workforce. The Innu, however, aware of their low level of formal education and lack of experience, wonder about their actual chances of participating in construction work. Training an Innu workforce and securing contracts suited to their skill sets is thus a key concern. Though economic spinoffs should favor better living conditions in Innu communities, some worry about the negative effects of higher income. Various measures are now being discussed as part of IBA negotiations to ensure that communities benefit from the socio-economic advantages of the project and are able to minimize negative impacts.

#### **Increased access, wildlife resource harvesting and vacationing**

Minganois land use is limited by the lack of road access, though it would be far from true to say that inland resources are of little interest. The Minganois repeatedly expressed their satisfaction at the idea that Route de la Romaine would facilitate their access to the area for hunting, fishing and vacationing. Regarding wildlife harvesting, maintaining moose hunting conditions is a major issue for the Minganois population. The Innu also view improved inland access favorably, especially since it could encourage the practice of *Innu Aitun*.

Intensified land use nevertheless raises fears among some users, both Minganois and Innu, especially with respect to potential disruption of the area's tranquillity (vacationing and competitive land use) and overharvesting of wildlife resources.

## **Romaine snowmobile crossings and ice conditions**

Snowmobiling is the primary means of traveling inland and major snowmobile trails cross the lower Romaine. Maintaining favorable conditions for crossing the Romaine on snowmobiles is thus a major issue for Minganois and Innu land users.

Assessing the impacts of Romaine complex operations on snowmobiling first required forecasting the characteristics of the Romaine ice cover. A number of simulations were thus run of ice conditions on the reservoirs and downstream of Romaine-1. Simulation results and conditions required for snowmobiling were discussed on a number of occasions with members of the Havre-Saint-Pierre snowmobile club. Further to these discussions, Hydro-Québec will build a snowmobile bridge near KP 15.5 of the Romaine and will allow snowmobilers to use the bridge built near Romaine-1 powerhouse. They will thus be able to cross the river once the snow cover is sufficient regardless of ice conditions.

## **Atlantic salmon and ecological instream flow**

Permanently sustaining salmon and maintaining fishing conditions are a major issue for local communities. In addition, the Innu are concerned by future interactions with non-Native anglers given the anticipated changes.

Like any major hydropower project, the Romaine project will primarily modify the natural hydrological regime of the river, reducing the magnitude of spring floods to fill the reservoirs and increasing flow in winter to meet energy needs.

The main purpose of the ecological instream flow regime downstream of Romaine-1 is to maintain the population of salmon, which presently swim up to Grande Chute (KP 52.5). The regime meets the needs of salmon throughout their life cycle and ensures that the complex operates in compatibility with this valued resource. Since the flow released by Romaine-1 depends on, and in a way influences, how the entire complex is operated, measures taken to accommodate salmon are incorporated into the project's design. A number of mitigation and compensation measures, and an enhancement program for Atlantic salmon are also planned and will be monitored over some 20 years to determine their effectiveness.

## **Fish communities and habitat**

The planned reservoirs will cover much of the length of the Romaine. Fish habitat, which now includes long fast-flowing sections, will be transformed into a largely lacustrine habitat, leading to a change in the relative abundance of species, to the detriment of brook trout. Furthermore, despite a substantially larger area of

habitat, loss of habitat will occur in the bypassed stretches. That loss will be offset, however, by developments in a number of Romaine watershed lakes and streams.

The project includes developments and measures affecting species valued by anglers. Keeping planned structures compatible with use of the area by anglers and maintaining productive fish habitat capacity are major issues.

## **Archipel-de-Mingan National Park Reserve of Canada, marine environment and commercial fishing**

Numerous tourists and vacationers come to Havre-Saint-Pierre in summer to enjoy the many attractions at the Archipel-de-Mingan National Park Reserve of Canada, whose prime objective is to preserve the ecological integrity of this natural heritage. The quality and abundance of commercial fishing resources at the mouth of the Romaine and in the Chenal de Mingan are also an issue for local industry.

Questions arise regarding how modifications to the Romaine hydrological regime will affect the freshwater plume in the Chenal de Mingan. Detailed studies were thus conducted on the influence of river inflows on the marine environment. Studies covered the vegetation, birds, snow crabs and three-dimensional modeling of plankton productivity to ensure that operating the complex alters neither ecological integrity around the archipelago nor marine resources.

## **Logging**

A major concern once clearing operations are completed is what to do with the wood, which is under the management of the Ministère des Ressources naturelles et de la Faune (MRNF). In productive forest stands where logging is technically and economically feasible, Hydro-Québec will ensure the recovery of merchantable timber, i.e., a maximum of 754,500 m<sup>3</sup>. There are high expectations of it being feasible to process the wood in the region.

Logging truck traffic and potential deterioration of Highway 138 are also a concern.

## **Woodland caribou and beaver**

Woodland caribou of the forest-dwelling ecotype live in the Romaine valley. This ecotype is considered vulnerable by provincial authorities and threatened by federal authorities. Forest-dwelling caribou are particularly sensitive to disturbances due to human presence and activity. They are highly valued by the Innu, who are worried about how the reservoirs will impact their movement.

The impact assessment thus pays close attention to forest-dwelling caribou. Hydro-Québec will monitor them over an extended study area for about 12 years.

Like caribou, the beaver is an animal highly valued by the Innu, who greatly fear the impact the reservoirs will have on small wildlife and on fur-bearing animals in general, but more specifically on beavers. An intensive trapping program is proposed in areas to be flooded to avoid the loss of beavers.

#### **Ancestral rights and Aboriginal title**

All Romaine complex components will be built on a territory subject to a comprehensive land claim by the Innu. The need for Innu consent has been raised by Innu stakeholders and is a major issue for the project.

However, ancestral rights and Aboriginal title are matters strictly under the jurisdiction of the governments of Québec and Canada. This matter is the subject of ongoing negotiations between the Innu and the competent bodies. In such a context, Hydro-Québec's practice is to reach impact and benefit agreements (IBAs) with the Native parties concerned in which the signatories concur that the agreements constitute neither a recognition nor a negation of ancestral rights and Aboriginal title.

# 4

## Description of the Environment

### 4.1 Physical environment

#### 4.1.1 Hydrography and hydrology

The Rivière Romaine drains an area of approximately 14,500 km<sup>2</sup>. With its source at an elevation of over 500 m north of Lac Long (KP 412 to 440), the Romaine empties into the Golfe du Saint-Laurent (Gulf of St. Lawrence) to the west of Havre-Saint-Pierre after running nearly 500 km in a generally southward direction (see Map 2). The portion of the Romaine studied (KP 0 to 295) is fed by some 20 tributaries including, from north to south, the Sauterelles, Petite Romaine, Abbé-Huard, Bernard, Romaine Sud-Est and Puyjalon.

In the upper part of its watershed, the river runs through several large lakes (Brûlé, Lavoie and Lozeau). The river is initially fairly flat and winding and then becomes straighter. Near KP 215, it turns to the

southeast and channels deeply through rocky highlands, dropping by nearly 300 m along these generally steep reaches, characterized by a series of waterfalls and rapids separated by stretches of calmer water.

Grande Chute (KP 52.5) marks the transition between the Laurentian Plateau and the coastal plain, where the Romaine now flows much more gently down a valley cut through loose sediment. Rock ledges at the mouth keep saltwater and the tide from going upstream.

The Romaine has a mean flow of 327 m<sup>3</sup>/s at its mouth in the Golfe du Saint-Laurent (Gulf of St. Lawrence). Spring flooding occurs from late April to late June, peaking in late May (mean flow of 1,530 m<sup>3</sup>/s at KP 16 where the Québec gauging station is located). The flow tapers down during summer to an average of 170 m<sup>3</sup>/s and then, between September and November, a second flood period may occur, less pronounced than in spring with a mean peak of 578 m<sup>3</sup>/s. Flow drops off most in the winter period, and is generally at its lowest around mid-April: 35 to 85 m<sup>3</sup>/s depending on the year.



Grande Chute



*Coastal plain*

#### 4.1.2 Geomorphology

The study area lies in two physiographic units: the coastal plain and the Laurentian Plateau (see Figure 8). The coastal plain stretches from the Golfe du Saint-Laurent (Gulf of St. Lawrence) to around Grande Chute (KP 52.5), where Romaine-1 dam is to be built. It is at a low elevation (less than 100 m), is gently rolling and generally has a thick drift cover over the rocky substrate. Vast peat bogs have developed there.

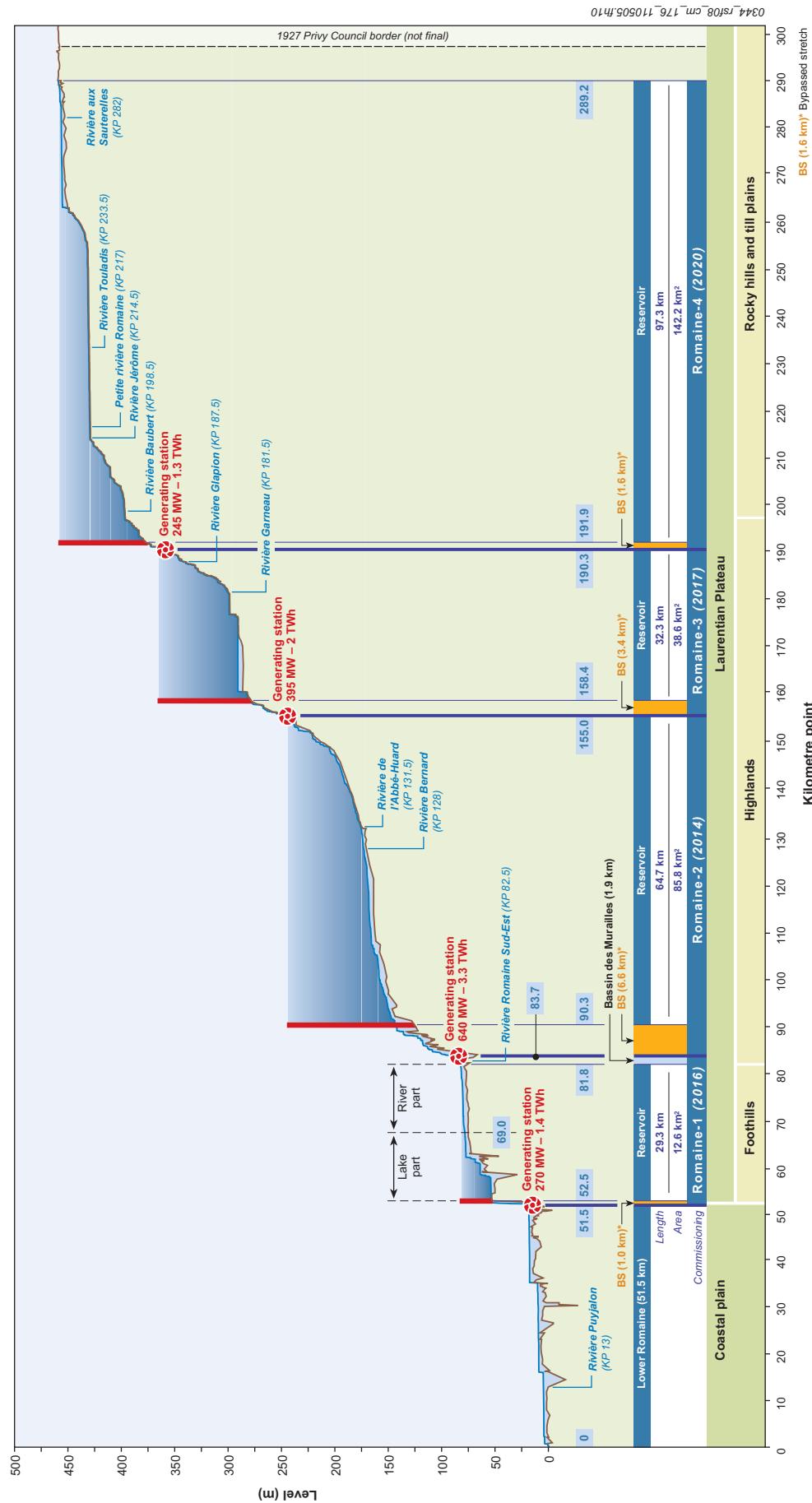
The Laurentian Plateau entirely covers the northern part of the study area. It is divided into three distinct sectors: the foothills, highlands, and till plains with rocky hills. Lying between the planned Romaine-1 and Romaine-2 dams, the foothills are not high, ranging from a few dozen metres in the south to over 150 m in the north. The river valley is shallow and the riverbed formed of terraced marine sediment. Between Romaine-2 and Romaine-4 dams stretch very rugged, deeply dissected rocky highlands rising to around 200 to 300 m. North of Romaine-4 dam, the relief is more subdued and the unconsolidated surface layer thicker. Up to the confluence with the Rivière aux Sauterelles (KP 282) extends the sector of low, flat hills, rarely over 100 m high. The discontinuous, but sometimes thick, drift cover consists of sand, gravel and till. Still farther north lies a vast rolling till plain with occasional low, rocky hills barely a few dozen metres high. The till there forms vast fields of drumlins with eskers rising at regular intervals.



*Highlands sector*

Unconsolidated material was deposited toward the end of the last Quaternary glaciation and during subsequent marine episodes. Deglaciation began around 10,000 years ago with the glacial retreat northward. Except for two terminal moraines (at KP 55 and 108), there are practically no glacial deposits in the coastal plain and foothills. Till becomes more abundant in the Romaine-4 sector and farther north, where more eskers, and sand and sandy gravel sediment are also found. Where Romaine 2 and Romaine 4 reservoirs are planned, glacial lakes helped form granular deposits (primarily sand).

Figure 8:  
*Rivière Romaine profile  
after development*





*Rocky hills*

After the glacial retreat, seawater flooded the coastal plain and northward up to Bassin des Murailles, leading to the depositing of a discontinuous cover of silt/clay sediment. That material was regularly covered by sand or sandy gravel from deltas and estuaries.

Once the sea receded and land was exposed, leaching of deposits rich in iron oxides led to the cementation of soil particles and the formation of indurated layers (orstein). In the coastal plain, the presence of fairly impervious layers contributed to the development of string fens.

The Romaine and its tributaries gradually cut into the Quaternary deposits, forming terraces and supplying immense amounts of alluvium. Fine alluvial materials (silt and clay) were carried out to sea, while part of the sand settled on former streambeds.

Since the profile of the Romaine has stabilized, erosion only occurs along certain stretches of its banks (10% of the banks). Downstream of Bassin des Murailles, somewhat more activity occurs on slopes of fine sediment (silt and clay) through slumping or landslides on higher slopes. Upstream, the primary agent of change is the slumping of unstable sand, sandy gravel and till slopes.

#### 4.1.3 Climate and water characteristics

The sea affects the climate in the south of the watershed, especially downstream of Grande Chute (KP 52.5), where the mean annual temperature (1°C), is higher than farther north (−3°C) and the number of freezing degree-days lower (1,400) than in the north (2,500). Precipitation is more abundant in the south (1,030 mm) than in the north (852 mm).

Downstream of Grande Chute, Romaine water temperature reaches the freezing point around November 10 and remains around 0°C in winter. The mean temperature peaks at 21°C to 23°C between mid-July and mid-August. The temperature cycle of water upstream of Grande Chute is quite similar to that downstream. Upstream, water reaches the freezing point slightly earlier in fall but warming starts along the entire river at about the same date in spring. Over the period from June to September, the mean water temperature is 14.5°C along the lower Romaine, 13°C at the Romaine-4 powerhouse site and 12°C near the upstream end of Romaine 4 reservoir.

The ice cover starts forming along the banks in early December and then gradually extends to the middle of the river. A number of stretches remain ice-free throughout winter, particularly along rapids and at waterfalls. In reaches downstream of Grande Chute, the ice is thickest in early April, i.e., 70 cm for a normal winter. The ice breaks up between the first and the third week of April.

Rivière Romaine water is colored, with low turbidity and carrying fairly little suspended matter. Physical and chemical properties vary little along the length of the river in the study area and are similar to those of other rivers in the region. Romaine water is slightly acidic, iron-rich, nutrient-poor and weakly mineralized. Most parameters meet water quality criteria for the protection of aquatic life, and lower pH values as well as higher iron values are not considered harmful to organisms.

#### 4.1.4 Physical oceanography

The marine zone includes the Rivière Romaine mouth zone and the Chenal de Mingan zone (see Map 3).

The mouth zone is a vast, shallow bay (over 25% exposed at low tide) extending out to two islands: Grosse Romaine and Petite Romaine. The Romaine empties into the bay through a permanently flowing main outlet (Chute de l'Auberge) and, only during flood flows, through two secondary outlets (Fausse Chute and Rivière Aisley). There two ledges, and Rapide à Brillant farther upstream, keep the tide from propagating up the Romaine. The mouth zone has several shoals and rocky islets, as well as three main channels, the middle one carrying water from the river to the Chenal de Mingan (see Figure 9).



*Mouth of the Romaine*

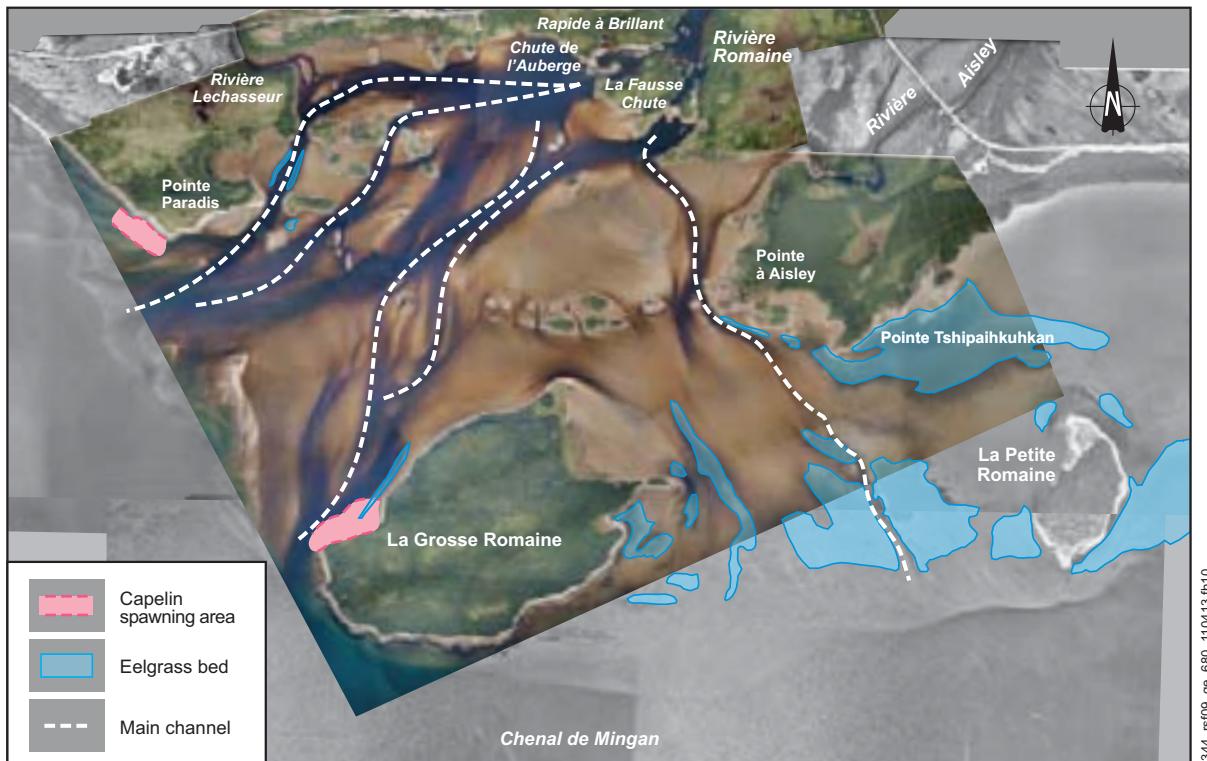
Mouth zone hydrodynamics are affected by the tide and by Romaine flow. During the spring flood, the mouth zone becomes a freshwater environment, except in deeper channels on its outer fringe. When flooding subsides, then during summer and fall, saltwater gradually penetrates from the bottom throughout the mouth zone and the water becomes stratified. Beneath the ice cover that is generally present from December to April, the water is stratified but salinity is lower at the surface than during the ice-free period.

With respect to sedimentology, the east of the mouth zone corresponds to a former delta, providing a stable environment with a substrate that currents are unlikely to reshape. The west of the mouth zone has a sandy bottom and is where sediment supplied directly by the Romaine passes. Sand is stirred up near the mouth by currents due to the river's flow and the tide, and on the outer fringe by tidal currents and the swell. The mouth zone is by and large a stable environment on a decadal scale. Changes to the nature of the substrate are limited to small areas. Sediment supplied by the Romaine is

then carried seaward where the delta is found. Sand first builds up on the slope and then slides down into the deep valley where it is trapped. Sand from the river does not replenish the shoreline.

The Chenal de Mingan is a coastal environment extending out to the Archipel de Mingan. It consists of a deep valley running east-west with perpendicular channels linking it to the Détroit de Jacques-Cartier. Rivière Romaine water may influence Chenal de Mingan surface water out to the archipelago. It forms a plume less than 0.5 m thick that sweeps across the area due to the tidal cycle and prevailing winds. The effect of the freshwater is to reduce surface salinity, make the water more colored, and slightly increase its temperature and turbidity, making the plume visible.

Figure 9: Rivière Romaine mouth zone



## 4.2 Biological environment

### 4.2.1 Fish

#### Fish communities

Twenty-two fish species have been found in the Romaine watershed (see Table 4).

Eighteen of these live in the main reaches of the Romaine, of which longnose sucker, brook trout and white sucker are the most abundant. The river's fish communities are relatively homogeneous, though species composition and relative abundance differ somewhat between the upper and lower Romaine. The lower reaches, downstream of Grande Chute, stand out the most. Atlantic salmon, American eel, rainbow smelt, two species of stickleback and logperch live there but not in the river farther upstream (see Map 5).

Going northward, brook trout become more abundant and red sucker appear to gradually replace white sucker. Lake trout are only found in the upstream part of the study area. Most species in the river show a pattern typical for populations in northern environments: slow growth and late sexual maturity.

Fourteen fish species have been reported in watershed tributaries. Communities are fairly homogeneous. Thirteen species have been found in lakes in the Romaine watershed, although almost 30% of the lakes are fishless. Community composition varies greatly from lake to lake.

Species of special interest in the study area include Atlantic salmon, found downstream of Grande Chute in the Romaine, Rivière Pujalon and short segments of two Pujalon tributaries, Rivière Bat-le-Diable and Rivière Allard (see Map 6). Romaine and Pujalon salmon populations differ genetically. There are a number of signs that salmon stocks in the Romaine are smaller in recent years compared to the early 1990s: reduced fishing success rate, lower spawning run numbers and fewer nests. The global habitat suitability index of the Romaine, one of the lowest in Côte-Nord, limits potential production in the river.

No Romaine watershed fish species comes under Québec's *Act respecting threatened or vulnerable species*. Landlocked Arctic char, found in two study area lakes, is listed among the species likely to be designated as threatened or vulnerable, though the state of Côte-Nord populations does not appear to be critical. Based on the list from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), there are no special-status fish species in the Romaine watershed.

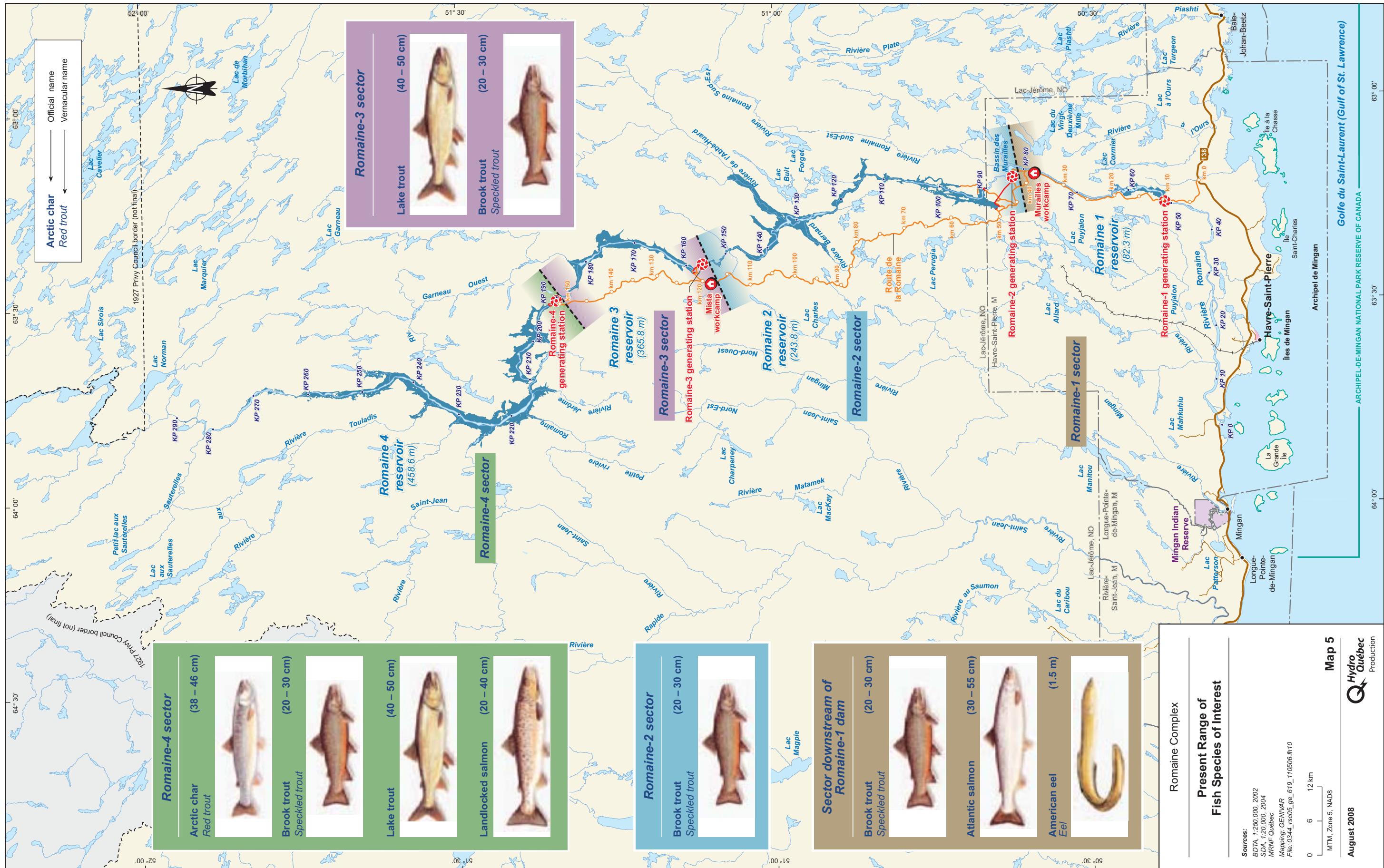
Table 4: Fish species caught in the Romaine watershed

Species	Romaine-4 sector			Romaine-3 sector			Romaine-2 sector			Romaine-1 sector		
	River	Tributaries	Lakes									
American eel										■	■	
Rainbow smelt										■		
Brook stickleback										■		
Ninespine stickleback										■		■
Fourspine stickleback										■		
Threespine stickleback	■	■					■			■	■	■
Blackspotted stickleback										■	■	
Logperch										■		
Northern pike	■	■	■	■		■	■	■	■	■		
Lake whitefish (dwarf) <sup>a</sup>			■			■						
Lake whitefish (normal) <sup>a</sup>	■		■	■		■	■			■		
Burbot	■	■		■	■	■	■	■		■	■	
Lake chub	■	■		■	■		■	■		■	■	
Round whitefish	■			■			■			■		
White sucker	■	■	■	■	■	■	■	■		■	■	■
Longnose sucker	■	■	■	■	■		■	■	■	■	■	
Pearl dace												
Longnose dace	■	■	■	■	■		■	■		■	■	
Arctic char			■									
Brook trout <sup>b</sup>	■	■	■	■	■		■	■	■	■	■	■
Landlocked salmon <sup>c</sup>	■	■	■					■				
Fallfish	■			■			■			■	■	
Atlantic salmon										■	■	
Lake trout	■		■	■		■						

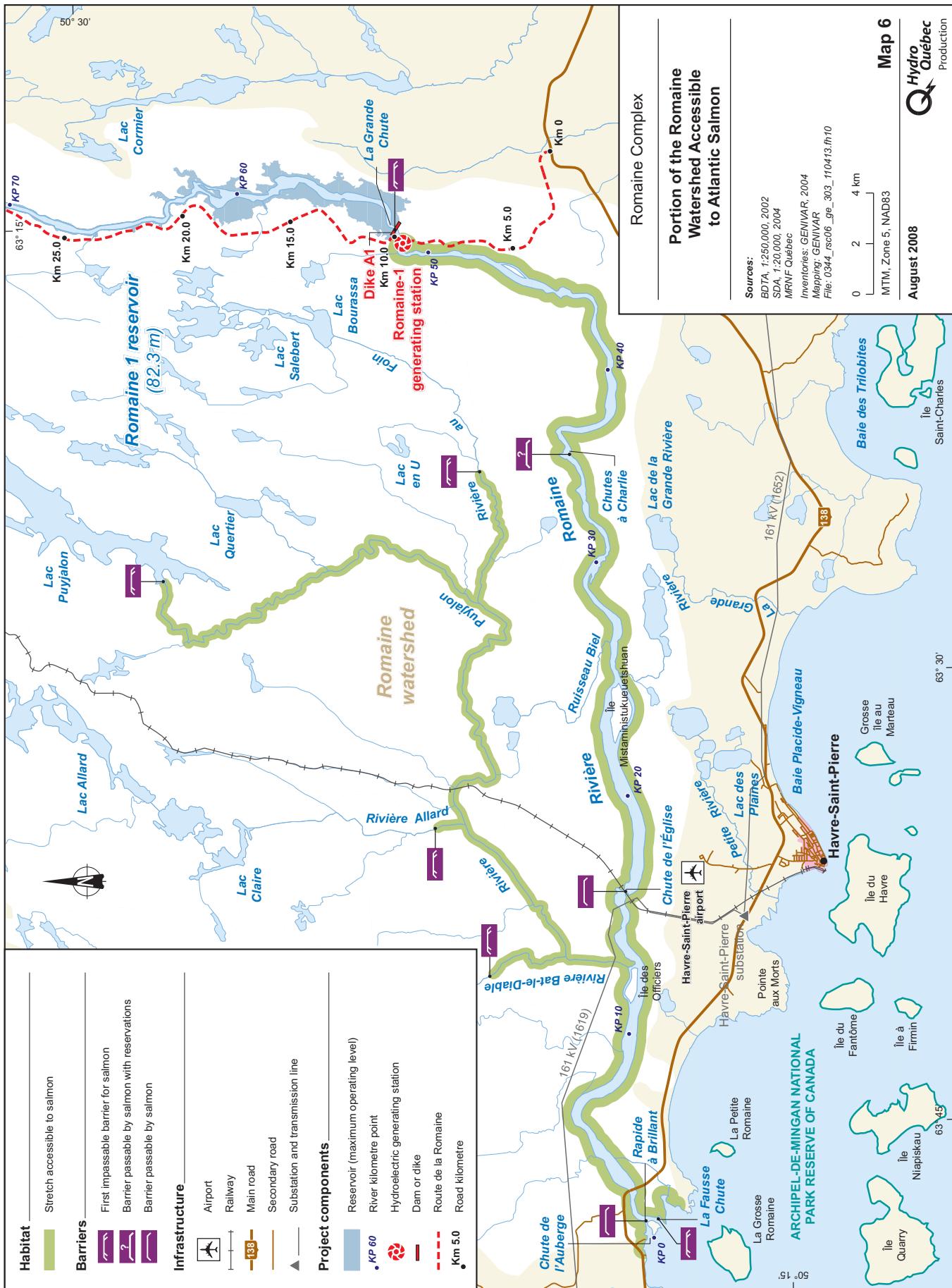
a. Normal and dwarf whitefish belong to the same species.

b. Anadromous brook trout are only present up to the first waterfall (KP 0.5).

c. Landlocked salmon, or “ouananiche,” is the permanently freshwater form of Atlantic salmon.







## Feeding and breeding habitats

In the Romaine, slow-moving waters (pools and channels) account for 89% of all aquatic habitats compared to 11% for fast-flowing waters (rapids and ledges). All fish species are most abundant in pools except the longnose dace, which is confined to ledges and rapids.

In tributaries, longnose dace and salmonids (brook trout, landlocked salmon and Atlantic salmon) live more in fast-water habitats, while most other species prefer calm-water habitats. In lakes, normal lake whitefish, arctic char, burbot and lake trout prefer water deeper than 4 m. On the other hand, northern pike, white sucker and brook trout prefer shallower water.

Table 5 gives the spawning period and spawning ground characteristics for a few species of special interest in the study area.

Atlantic salmon spawn in late October. The 24 Atlantic salmon spawning grounds surveyed are not all used every year due to the small population. Five spawning grounds are located in the Romaine (at KP 34.5, 46.2, 48.9, 51.3 and 51.4; the first three are the most used), and 19 in its tributaries.

## Mercury in fish

Naturally occurring in several forms in the environment, mercury may undergo various transformations. A case at hand is the natural process of decomposition, in aquatic systems, of organic material containing inorganic mercury, which leads to the production of methylmercury, which is easily assimilated by living organisms and increases in concentration at each trophic level of the food chain. Fish mercury levels are thus generally higher in piscivorous fish than in fish that feed on insects or plankton. Note that fish mercury levels may vary widely in the lakes and streams of the same region, and with the size, age and growth rate of the fish.

In natural Romaine watershed environments, mean total mercury levels for mainly non-piscivorous species 200 to 400 mm in length range from 0.10 to 0.19 mg/kg and are similar to those of the La Grande complex and Sainte-Marguerite complex. However, they are slightly lower than levels obtained in the Churchill watershed. The mean level of 0.38 mg/kg for 700-mm northern pike is fairly close to what is found at the Sainte-Marguerite complex but lower than levels measured in the La Grande complex and Churchill watershed. Lake trout (600 mm) is the only species in the Romaine watershed with a mean level (0.57 mg/kg) exceeding the Canadian standard for the marketing of fishery products (0.5 mg/kg).

Table 5: Spawning periods and spawning ground characteristics

Species	Spawning period	Number of spawning grounds observed	Flow facies	Substrate
Northern pike	May 25 – June 15	35	Floodplain	Grass-dominated vegetation
Sucker	June 10 – July 5	18	Ledge	Pebbles, cobbles and gravel
Brook trout	October 1 – 20	41	Ledges, channels and pools	Gravel, sand and pebbles
Lake whitefish	October 5 – 25	12	Ledges and pools	Pebbles, gravel, cobbles and boulders
Atlantic salmon	October 16 – 31	24	Ledges and channels	Pebbles, gravel and cobbles

## 4.2.2 Vegetation

The study area belongs to the eastern black spruce-moss bioclimatic domain. The forest cover is dominated by black spruce. Since it is not commercially logged, forest fire is the main ecosystem driver.

The coastal plain is covered by large peatland complexes and, to a lesser extent, by riparian wetlands composed mainly of swamps and shallow waters along the Romaine. Deciduous forests are primarily in the foothills. Moss-coniferous forests grow in the rocky highlands sector, while farther north, the rocky hills and till plains support black spruce-lichen forests, regenerating stands and deciduous forests.

Terrestrial environments form nearly 82% of the study area, wetlands nearly 10% and aquatic environments nearly 9%.

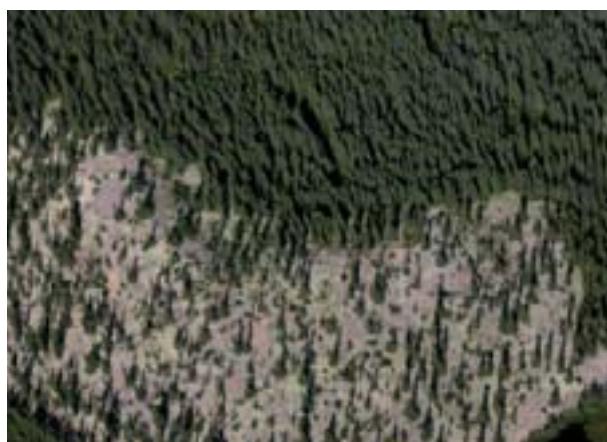
### Terrestrial environments

Coniferous forests, mainly black spruce-moss, cover nearly half (47%) of the study area. In the northern part, black spruce-lichen stands form an open forest with well-developed shrub and moss-lichen layers.

Mixed stands are not abundant (11%) and often surround the rare deciduous stands (2%) composed of white birch and trembling aspen. Deciduous forests have quite extensive shrub and grass layers, which are more diversified than those of coniferous forests. Recent burns, and older regenerating ones, occupy most of the remaining dry land.



*Black spruce-moss forest*



*Black spruce-lichen forest*

## Wetlands

Numerous large bogs cover the sand terraces of the coastal plain. Northern plateau bog systems characterize the region.



*Northern plateau bog system  
on the coastal plain*

Riparian environments, primarily swamps and grass beds, are not abundant. The largest are on the banks of the Romaine in the coastal plain and in the Romaine-4 sector where the topography and deposits are suited to the development of riparian wetlands, mainly swamps.



*Marshes and swamps*

In the coastal environments of the mouth zone, the shore is mainly formed of rocky flats, exposed at low tide and sometimes covered with seaweed. Eelgrass beds mainly grow in the east of the mouth zone.

## Vascular plants

More than 500 taxa of indigenous vascular plants belonging to 76 families have been reported in the study area.

Fifteen plant species listed under Québec's *Act respecting threatened or vulnerable species* or Canada's *Species at Risk Act* have been observed, including 13 only downstream of Grande Chute. Only dragon's mouth extends to the edge of the area to become Romaine 1 reservoir. The ostrich fern is only found within the boundaries of Romaine 2 reservoir and sand heather has only been seen on the southeast fringe of the planned Romaine 4 reservoir.



*Dragon's mouth*



*Ostrich fern*



*Sand heather*

#### 4.2.3

#### Terrestrial and semi-aquatic wildlife

The study area is influenced by a northern climate, resulting in low plant productivity. Thus animal populations are not as dense as elsewhere in Québec, with a species assemblage typical of wildlife in boreal forest plant communities.

Among special-status species, woodland caribou of the forest-dwelling ecotype and rock voles live in the study area.

##### Large wildlife

The presence of moose is a recent phenomenon in the study area, which is at the northern limit of their range. At 0.29 moose per 10 km<sup>2</sup>, winter density is among the lowest in Québec. The sparseness of food (shrubs and deciduous species), hunting and, to a lesser extent, predation by wolves and bears may be the main reasons for the lower density. Hunting is a particularly plausible explanation for the lower winter density of moose in the south of the study area, where browse stands are more abundant but relative ease of access tends to increase hunting pressure.



Moose

Caribou observed in the study area (all in the Romaine-2 sector) are of the forest-dwelling ecotype, but it is possible that migratory caribou (tundra ecotype) occasionally visit the northern part of the territory. The forest-dwelling ecotype is listed as special status, and caribou hunting has been prohibited in the RCM of Minganie since 1979.

Winter density in the study area is 0.37 caribou per 100 km<sup>2</sup>. Predation by wolves may partly explain the low density, caribou being very vulnerable to predation, while poaching and subsistence hunting may also play a role. Generally, caribou wintering grounds include mature, open, lichen-rich coniferous stands, while large bodies of water are used to travel, flee predators and rest.



Caribou

There were 35 chance sightings of black bears when traveling or conducting surveys not specifically for that species. Black bears seek out habitat that provide them with great quantities of food, especially berries and other energy-rich plant food. They thus prefer open, disturbed areas (burns), wetlands and deciduous or mixed forests, and shrubland.



Black bear

## Small wildlife

Estimated beaver colony density in the study area (1.2 colonies per 10 km<sup>2</sup>) is similar to that of Côte-Nord (1.8) and lower than the Québec average (2.3). On the other hand, Romaine 1 reservoir has a density of 5.6 colonies per 10 km<sup>2</sup>, considered high in Québec, due to the greater proportion of deciduous and mixed forests found there.



*Beaver dam and lodge*

Twenty-six species of small wildlife have been reported in the study area, the most abundant being the American marten, squirrels, snowshoe hare, weasels and grouse. Fur-bearing animals that are trapped appear to be more abundant in the Romaine-4 sector than any other sector.

Mixed and coniferous forests have the greatest species richness and the greatest abundance of fur-bearing animals and other species of special interest. Deciduous forests are mainly home to the snowshoe hare, ruffed grouse and weasels.

The banks of streams and rivers are especially sought out by the American marten, snowshoe hare, grouse, river otter and squirrels. Furthermore, streams and rivers often have shrubs along their banks, which provide food to prey species or groups of such species (ptarmigan, snowshoe hare, squirrels, very small mammals and moose), attracting predators like wolves, American martens and weasels.



*American marten*

The lynx, wolf and river otter, carnivores with large home ranges, live in areas where a high density of their prey is found. Thus they do not select a particular type of forest.

### 4.2.4 Amphibians and reptiles

Ten species of amphibians and reptiles have been confirmed to live in the study area, the most frequently observed being the American toad and mink frog. The number of species reported decreases going northward, with species richness being highest in riparian wetlands. No special-status amphibian or reptile species has been reported, those in the study area being typical of Moyenne-Côte-Nord and Basse-Côte-Nord species.

### 4.2.5 Birds

The Romaine lies in the black spruce-moss bioclimatic domain, one with the lowest number of species in Québec. The distribution of species generally varies with the distribution of habitats and with latitude, though some species are more adaptable and live in various areas and habitat types, e.g., the yellow-rumped warbler and American black duck.

A number of special-status bird species have been observed in the study area, including the harlequin duck, Barrow's goldeneye, bald eagle, golden eagle, peregrine falcon, short-eared owl, Bicknell's thrush and Caspian tern.



*Bald eagle and golden eagle*

## Waterfowl

The Romaine and planned reservoirs are used by 17 waterfowl species (geese, ducks and loons), and some 150 breeding pairs and 20 broods use these areas during the breeding period. The most abundant breeders are the common goldeneye, American black duck, common merganser, ring-necked duck and common loon. The estimated density of breeding pairs is highest (57 per 25 km<sup>2</sup>) on the coastal plain due to its productive habitats. That area will not be affected, however, by the hydroelectric developments. Densities are higher where Romaine 4 reservoir is planned than in other reservoir areas but still generally lower than in other Côte-Nord rivers.

## Raptors

Thirteen species of raptors and the common raven nest in the study area. The total number of confirmed breeding pairs of raptors is 47, and 33 occupied nesting sites have been discovered. The red-tailed hawk and osprey are the most abundant species. Raptors live in most study area sectors, but the northern harrier and short-eared owl are found only on the coastal plain.



Osprey

## Forest birds

Six species of woodpecker and 55 species of passerines have been sighted in the areas to be occupied by the four planned reservoirs. An estimated 97,000 breeding pairs of forest birds are found there. The most common species in the Romaine 2, Romaine 3 and Romaine 4 reservoir areas are the ruby-crowned kinglet, dark-eyed junco, Swainson's thrush and white-throated sparrow. In the Romaine 1 reservoir area, the white-throated sparrow is the most common bird.

## Other aquatic birds

During the surveys, there were casual sightings of 15 aquatic bird species, the most abundant being the greater and lesser yellowlegs, solitary sandpiper, spotted sandpiper, herring and other gulls, common tern, Arctic tern and double-crested cormorant. The number of species and abundance are greater in the coastal plain.

## Birds in the mouth zone

Sixty-two species have been sighted at the mouth of the Romaine. The most abundant include the American black duck, common eider, surf scoter, red-breasted merganser, double-crested cormorant, herring gull, common tern and Arctic tern. A number of species can be sighted at the mouth zone during migration. Certain areas of the mouth zone are much used for feeding. For example, the eelgrass beds between Grosse Romaine and Petite Romaine islands are the main feeding areas of Canada geese and dabbling ducks, while the area between Grosse Romaine and Pointe Paradis provides food to primarily molluscivorous diving ducks and piscivorous species like terns, mergansers and double-crested cormorants.

### 4.2.6

## Biological oceanography

### Aquatic habitats

Romaine mouth zone habitats include channels, tidal flats, rocky islets, aquatic beds and shallow trenches. They are influenced by tides and freshwater inflows, which lead to daily and seasonal variations in the physical characteristics of the water (salinity, temperature and level).

With its stable substrate and less variable salinity, the eastern part of the mouth zone is well suited to the development of eelgrass (see Figure 9). It is a feeding area for fish, other aquatic organisms and birds. Fish are also associated with the shallow, narrow channels, while benthic organisms live on the bottom in the channels and intertidal zone.

The complex bathymetry and mosaic of substrates in the Chenal de Mingan support a wide range of organisms, including mollusks, crustaceans, fish, seals and whales.

## Fish

The mouth zone has 36 fish species, the most abundant of which are the capelin, threespine stickleback, American eel, rainbow smelt and brook trout. Changing conditions in the mouth zone mean that the species composition of fish communities varies from season to season.

The mouth zone mainly serves as a feeding area for fish. The only reported spawning grounds are those of capelin (see Figure 9). The upstream part of the mouth zone also provides a wintering area for rainbow smelt and brook trout. The east channel with its eelgrass beds is a good habitat for smaller fish.

## Benthic fauna

The benthic fauna of the mouth zone is young and not very diverse. The spring flood results in an upheaval to the species composition of the benthos and even eliminates benthic fauna in certain areas (the west flats). When the flood flow subsides, the flats and channels are gradually repopulated by pioneer marine species and by species that tolerate a wide range of salinity.

A survey focused on edible mollusks showed that the little macoma and soft-shell clam are the dominant species, but the density of harvestable clams (50 mm or larger) is low. The highest densities of clams are found in the east channel.

The survey of snow crabs in the Chenal de Mingan shows that there is a resident population and a wide range of sizes. Small crabs live in the shallowest water and the size of specimens gradually increases with depth, with mature crabs living in the deepest water. The crabs belonging to the first two age classes (shell less than 7 mm wide) all come from stations west of Grosse Romaine, most being associated with the Rivière Romaine delta.

## Sea mammals

The Mingan Island Cetacean Study shows that the mouth zone and nearby waters are little used by sea mammals, specifically large whales. The sandy shoals of the mouth zone serve as occasional rest areas for gray and harbor seals. The Chenal de Mingan is used much more by a larger number of sea mammal species. There were chance sightings in 2004 of 415 sea mammals (362 seals, 30 harbor porpoises and 23 minke whales). The Chenal de Mingan is primarily a feeding area.

## 4.3

### Human environment

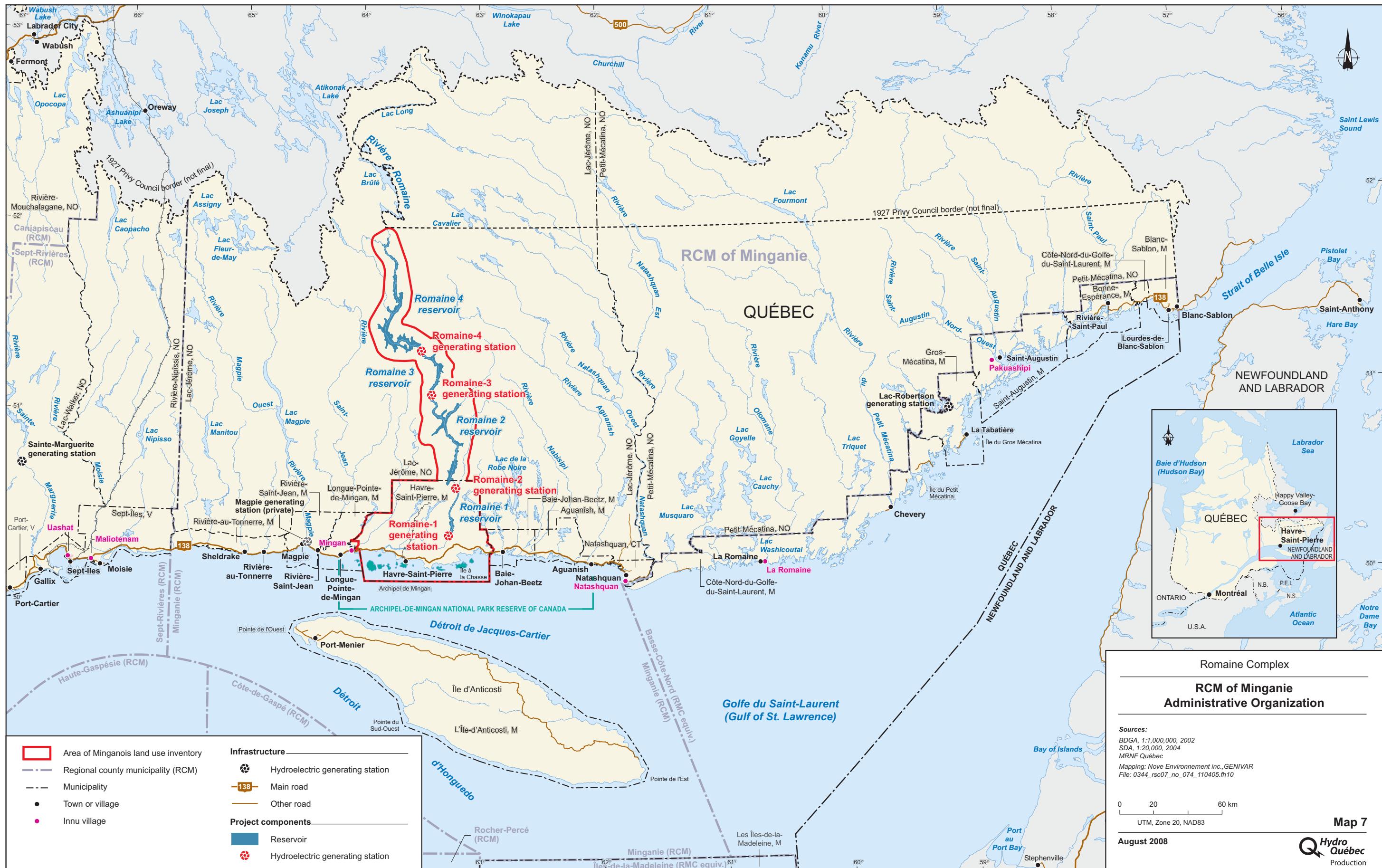
#### 4.3.1

##### Minganois communities

###### Settlements and land use

In pre-contact times, Native groups originating in western and central Québec were the first to occupy the upper basins of Côte-Nord rivers. Later, during the historic period (1500–1900), Native groups related to the Innu used the entire region for subsistence. On the other hand, the only Euro-Canadians present up to 1850 were trading company representatives and traveling merchants. The first villages gradually appeared on the coast in subsequent years, populated by the families of fishermen from Gaspésie, Newfoundland and Îles-de-la-Madeleine. Villagers harvested the sea and hunted inland.

Today, the study area is occupied by a string of settlements (see Map 7). The built environment is concentrated along the road on the Golfe du Saint-Laurent (Gulf of St. Lawrence) coast, where a number of cottage areas and the Municipality of Havre-Saint-Pierre are found. Outside the small coastal villages, practically no buildings exist. Permanent homes are not found inland, where users hunt, fish, trap and vacation.







Havre-Saint-Pierre

Highway 138 along the Golfe du Saint-Laurent (Gulf of St. Lawrence) is the only way of traveling by land between Côte-Nord and other regions of Québec. It runs eastward up to Natashquan. Havre-Saint-Pierre also has seaport facilities and an airport. There are very few secondary roads inland.



Highway 138

The study area is in the Côte-Nord administrative region, more specifically in the RCM of Minganie. Most of the study area is composed of lands in the domain of the State, and thus under MRNF jurisdiction. Public territory in the study area covers a vast zone where extensive, multi-purpose use of land and resources is planned. The status of the Romaine as a salmon river has earned it the designation of wildlife habitat. It is prohibited to develop private vacation facilities within 1 km of the Romaine from its mouth up to Grande Chute. Regarding the mouth zone, the master plan of the Archipel-de-Mingan National Park Reserve of Canada specifies the vocation of different parts of the park given conservation priorities and the potential for resource use and interpretation.

## Socioeconomic environment

### *Social profile and public health*

The RCM of Minganie had a population of 6,390 in 2006, of which 19% was Innu. Between 1996 and 2006, the RCM's Minganois (i.e., non-Native) population declined, as was the case for Côte-Nord as a whole. The Municipality of Havre-Saint-Pierre is the main urban centre of the RCM of Minganie, with a population of 3,150.

The level of education of the Minganois is below the Québec average. However, the Moyenne-Côte-Nord school board reports that many young dropouts quickly resume their studies.

Median family income in Côte-Nord (\$36,000) and in Minganie (\$35,700) is above the Québec median (\$31,700). Havre-Saint-Pierre stands out with a median family income of nearly \$62,500 in 2001.

Côte-Nord has two general hospitals, at Sept-Îles and Baie-Comeau. In Minganie, health services are mainly provided through the CSSS de la Minganie (the health and social services centre in Havre-Saint-Pierre) and through nine clinics scattered across the RCM.

Present levels of mercury exposure have been measured among residents of Havre-Saint-Pierre, Longue-Pointe-de-Mingan and the Mingan Indian Reserve (Ekuaniitshit). Levels are similar to those measured elsewhere in Québec: very low and presenting no health risk. In fact, they indicate that the population could benefit from eating more fish without running any mercury-related risk.<sup>6</sup>

Mean mercury levels for the various target groups are all lower than 1.0 ppm: 0.85 ppm in Havre-Saint-Pierre, 0.70 ppm in Longue-Pointe-de-Mingan and, for the general population, 0.48 ppm in the Mingan Indian Reserve. In those communities, mean levels for women between 18 and 39 are respectively 0.63 ppm, 0.33 ppm and 0.28 ppm. Measured levels are thus well below exposure levels at which initial symptoms appear among adults (50 ppm) or unborn children (10 to 15 ppm in the mother's hair).

6. Note that given present fish mercury levels in the study area, applying MDDEP standards for consumption with no health risk to the general adult population would lead to unrestricted consumption of lake whitefish (400 mm) and brook trout (300 mm), a maximum consumption of eight meals per month of northern pike (700 mm) and four meals per month of lake trout (600 mm).

## Economic activities

Mining, commercial fishing and tourism are the main economic sectors in Minganie. The primary sector accounts for 17.7% of jobs, well above the Québec average of 2.7%, and 19.5% of jobs are in the secondary sector, which is poorly developed, 95% of the RCM's raw materials being transformed elsewhere. Tertiary sector jobs (62.8%) are mainly in Havre-Saint-Pierre.

There are about ten companies with over 50 employees in Minganie, primarily in Havre-Saint-Pierre. QIT-Fer et Titane is the region's leading employer, with about 300 employees.

In 2004, commercial fishers in Moyenne-Côte-Nord ports (between Sept-Îles and Natashquan, including Anticosti) landed primarily mollusks and crustaceans (together, 96% of the catch). A dozen commercial fishing companies operate in the Romaine mouth zone and the Chenal de Mingan. The main species caught in the mouth are the soft-shell clam, waved whelk and rainbow smelt.

The study area contains no logging area covered by a timber supply and forest management agreement (TSFMA).

## Job market

Minganie has double the unemployment rate (17.2%) of Côte-Nord (8.2%) and of Québec as a whole (8.0%). Young people from 18 to 35 and non-graduates are particularly subject to unemployment. Seasonal unemployment is chronic, and the retention rate of specialized workers and young graduates remains low.

Over 2,700 construction workers lived in Côte-Nord in 2006, or 2% of the industry's workforce in Québec. The number of hours worked in the construction industry that year had dropped by about 65% compared to 2004 due to the end of certain major projects. At that time, there were 247 construction industry businesses established in Côte-Nord. However, the RCM of Minganie has few companies specialized in the trades generally needed for major hydropower projects.

## Recreation and tourism

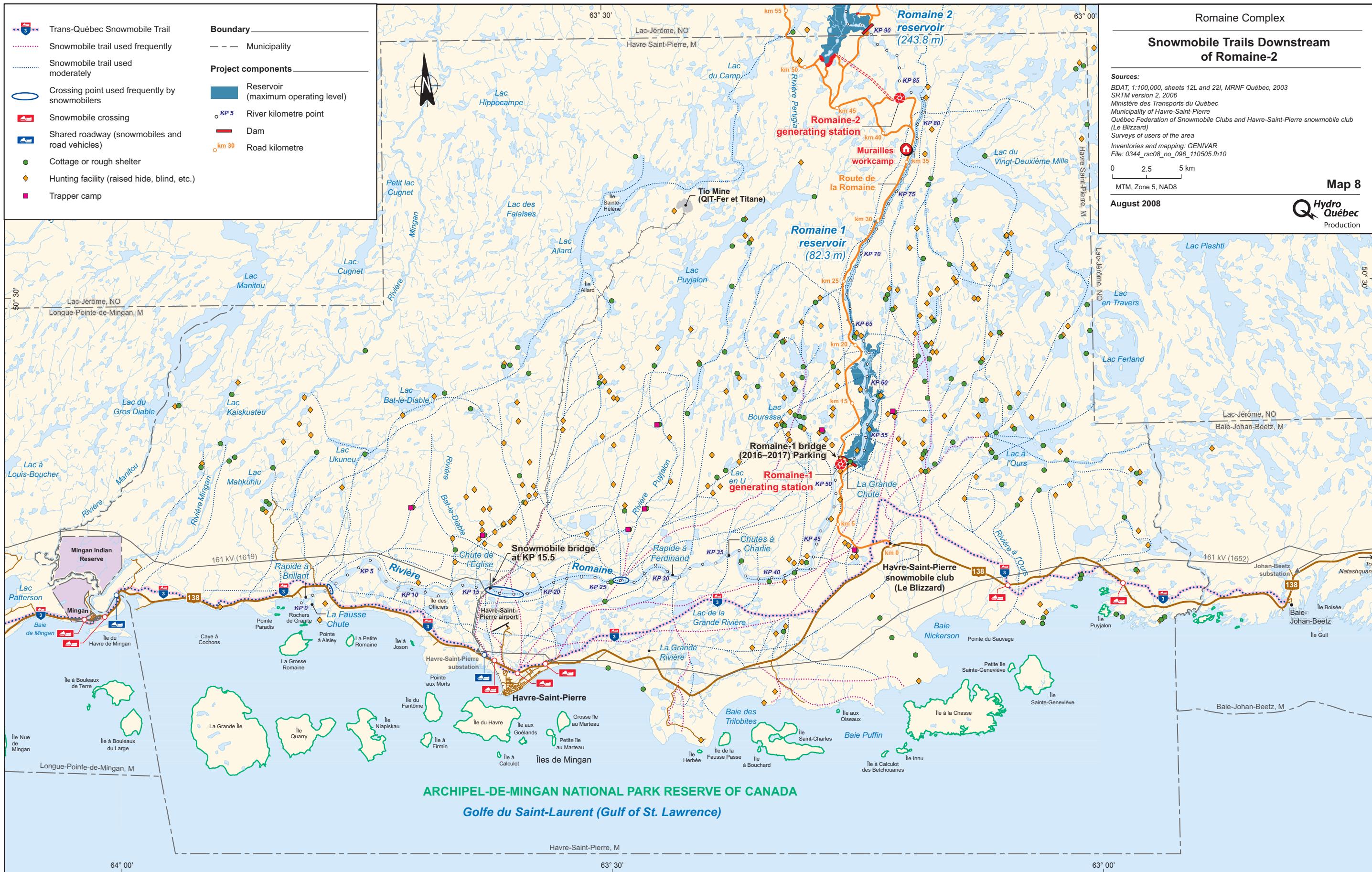
The Archipel-de-Mingan National Park Reserve of Canada drives regional tourism with just over 30,000 visitors per year.

On the Romaine and in its immediate vicinity, the recreational activities drawing the largest numbers are snowmobiling, hunting and fishing. There are very few buildings along the river: nine cottages and seven rough shelters under MRNF leases, and thirteen facilities not under lease.

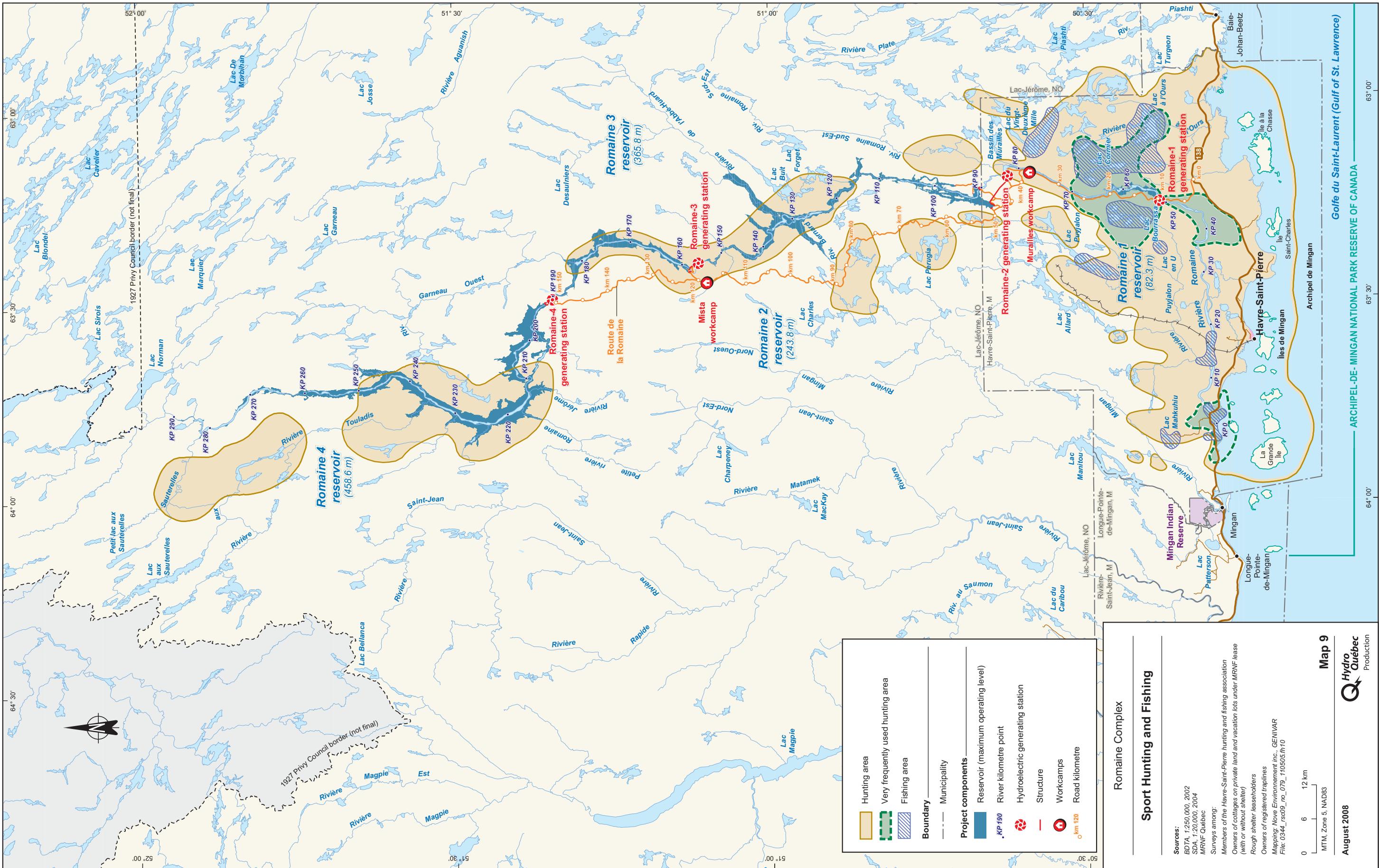
Running mainly on the northern side of Highway 138, Trans-Québec Snowmobile Trail 3 crosses the southern portion of the study area (see Map 8). That area is criss-crossed by many other snowmobile trails, some along or crossing the Romaine, mainly downstream of the planned Romaine-1 development. The Romaine is generally first crossed by snowmobiles during the first two weeks of December and the last crossings occur in the second half of March.



*Snowmobile crossing  
at KP 29 of the Romaine*









Though waterfowl and small game hunting are quite widespread in the study area, moose hunting is most popular. Caribou hunting is prohibited, while the black bear is a marginal game species. The hunting grounds most often used are found in three locations in the south of the study area: at the mouth of the Romaine, between Chutes à Charlie and Grande Chute, and in a vast area located to either side of the Romaine between KP 50 and 70 (see Map 9). Hunting grounds farther north are also used (KP 115 to 180 and KP 210 to 250). Some twenty traplines are within or overlap the study area.

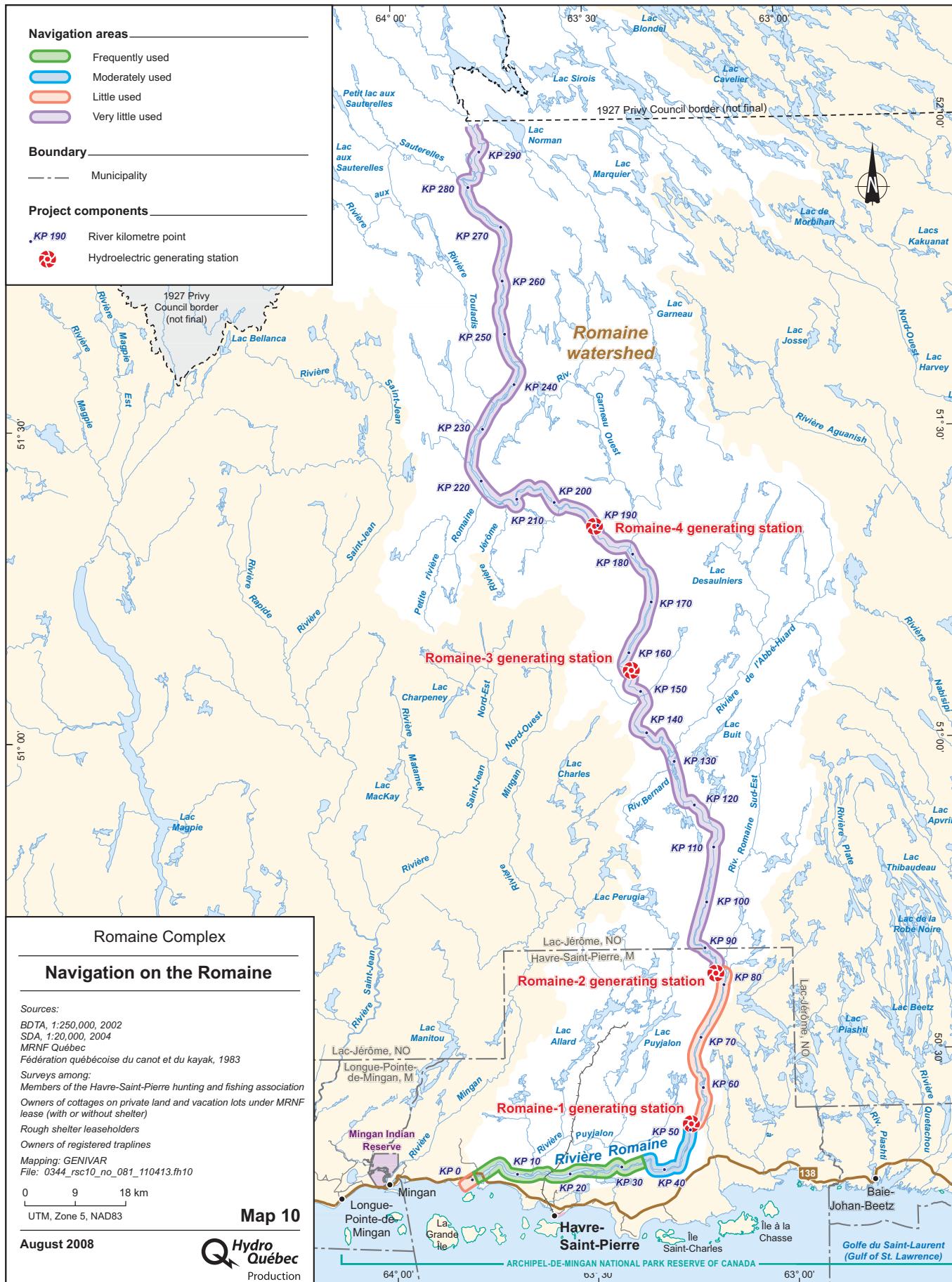
The species most sought out by recreational anglers are salmon and brook trout. In the study area, salmon fishing is practised on the Romaine (including the Pujalon), Mingan and Corneille rivers. On the

Romaine, it is limited to the lower reaches from the mouth to Grande Chute, the only part accessible to salmon. Salmon sport fishing success has declined since the early 1990s, as is generally the case in the Moyenne-Côte-Nord salmon zone. Every year there are about 30 salmon recreational anglers on the Romaine, mainly from Havre-Saint-Pierre.

In winter, ice fishing, mainly for brook trout, is carried out primarily on study area cottage lakes. Ice fishing is prohibited on the Romaine due to its status as a salmon river; however, it is practised on rivers joining the mouth of the Romaine, particularly the Lechasseur and Aisley. Generally 10 to 15 people fish on Rivière Aisley more or less regularly, depending on the abundance of the resource. Fishing is mainly for rainbow smelt.



*Chute de l'Église salmon fishing location  
at KP 16 of the Romaine*



Leisure activities practised in the study area include quad riding, forest hiking, trapping, berry picking, clam digging and boating. Boating is mainly on the lower Romaine up to Chutes à Charlie at KP 35 (see Map 10). Except for some sea kayaking at the mouth, recreational boating on the Romaine is mainly of a functional nature, related to hunting, fishing and vacationing.

Motorboats are most used. Long-distance recreational navigation by canoe or kayak is fairly marginal on the Romaine, especially since its canoe route is difficult to reach. The Fédération québécoise du canot et du kayak classifies the route as moderate to difficult (see Table 6).

*Table 6: Rapids, ledges, falls and portages on the Rivière Romaine*

Location	Characterization <sup>a</sup>
KP 263–260	Waterfalls, ledges, R-I, R-II and R-V rapids, and portages
KP 260–255	Whitewater
KP 213–203	R-I to R-III rapids
KP 196–181	Waterfalls, ledges, R-I to R-VI rapids and portages
KP 176	Waterfalls and portages
KP 160–145	Waterfalls, R-I to R-VI rapids and portages
KP 140–131	R-I and R-II rapids, and whitewater
KP 106–104	R-II rapids, ledges and portages
KP 99–96	R-I to R-III rapids
KP 93–83	Waterfalls, ledges, R-II to R-V rapids and portages
KP 63–61	Waterfalls and portages
KP 59–58	Waterfalls, R-V rapids and portages
KP 52.5–51	Waterfall, R-I and R-V rapids, and portage
KP 35	Waterfall and portage
KP 16	Waterfall and portage
KP 2–0	Waterfall, and R-II and R-V rapids

a. R-I: Navigation easy; weak current; small, regular waves  
 R-II: Navigation agitated; regular waves  
 R-III: Navigation difficult; strong, regular waves  
 R-IV: Navigation very difficult; very strong current; strong, irregular waves; small falls and ledges; dangerous obstacles  
 R-V: Navigation extremely difficult; falls and cascades; enormous waves; dangerous obstacles difficult to avoid  
 R-VI: Generally impassable in any type of craft; high risk of fatal accident

## 4.3.2 Innu communities

### Settlements and land use

The Innu communities concerned by the Romaine project are Mingan (Ekuanitshit), Natashquan (Nutashkuan), La Romaine (Unaman-shipu) and Pakua-shipi,<sup>7</sup> located in Basse-Côte-Nord (see Map 11). These communities are reserves, except for Pakua-shipi, which is considered by Indian and Northern Affairs Canada to be an Indian settlement.

The Innu were nomadic up to the mid-twentieth century, using coastal and inland resources, and traveling along the major rivers. Gradually, affiliation with various trading posts along the coast cemented the identity of distinct bands, each using a particular territory more than others. In the 1950s and 1960s, application of compulsory education legislation and the creation of reserves in Moyenne-Côte-Nord and Basse-Côte-Nord catalyzed the establishment of permanent settlements.

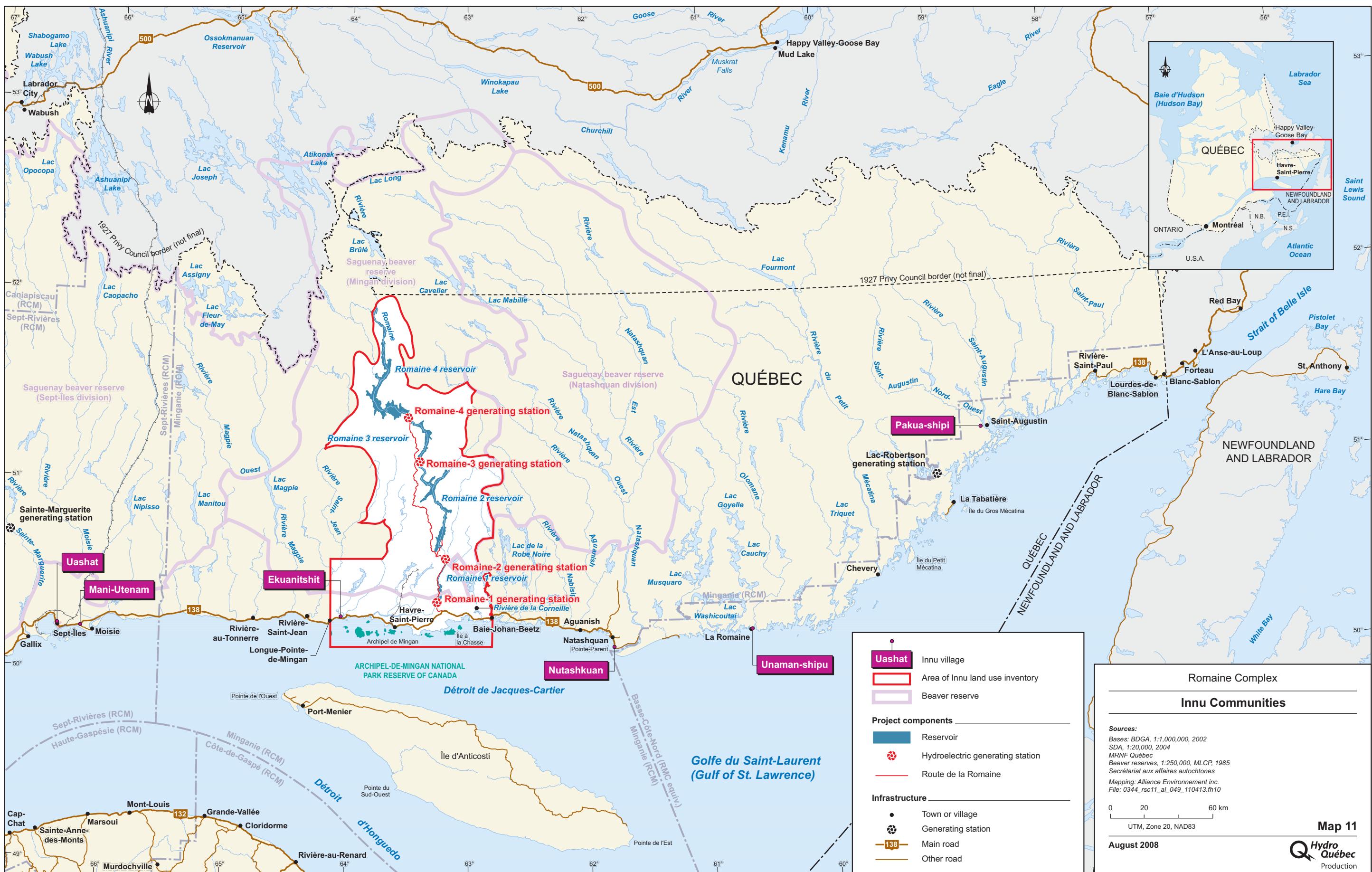
Ekuanitshit and Nutashkuan are presently the only communities that can be reached by Highway 138. Unaman-shipu and Pakua-shipi are accessible by land plane or seaplane, by boat or by the “White Trail” linking Aguanish and Blanc-Sablon by snowmobile.

Despite their more sedentary lifestyle today, the Innu continue to use the land to practice *Innu Aitun*, “the Innu way of life.” Those from Ekuanitshit and Nutashkuan in particular use, in whole or in part, the project study area and surrounding areas (see maps 12a and 12b).

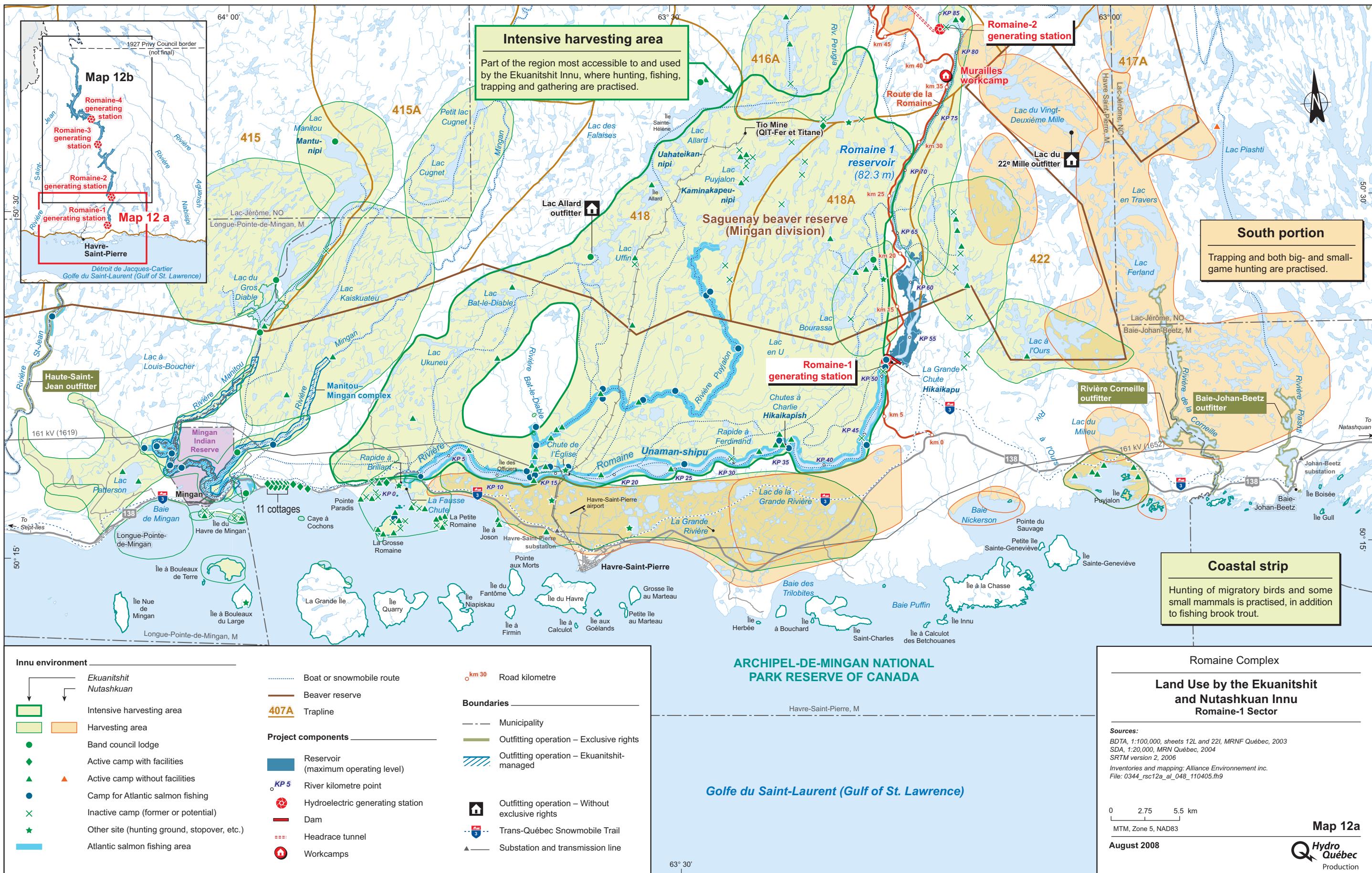


*Ekuanitshit*

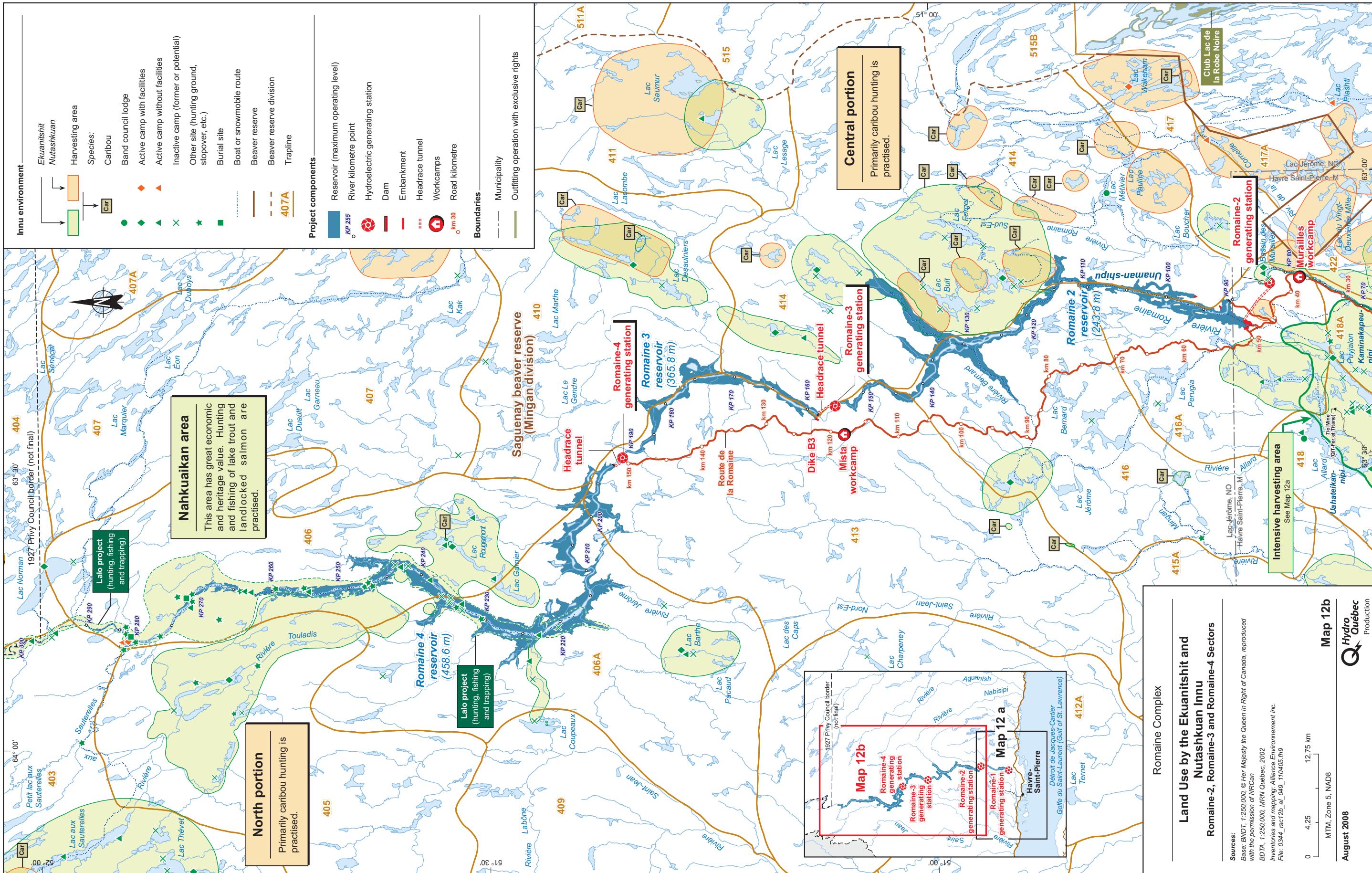
7. In compliance with federal guidelines on preparing the impact study, Hydro-Québec also considered the community of Uashat mak Mani-Utenam in Québec and the communities of Sheshatshit and Natuashish in Labrador. Information collected shows that these communities are not directly concerned by the project.













## **Ekuanitshit**

For the Ekuanitshit Innu, the Romaine watershed is where they carry out *Innu Aitun* activities: hunting and trapping fur-bearing animals, hunting migratory birds, fishing salmon and holding community and family gatherings.

The means of transportation now available to hunters (aircraft, snowmobile, ATV, etc.) have many advantages but are very costly, limiting their use.

The Rivière Romaine watershed includes a number of areas used for harvesting and other activities. The intensive harvesting area consists mainly of the Pujalon watershed and also includes Bourassa, Pujalon, Allard, Uffin and Bat-le-Diable lakes. Beaver trapping is an important activity. On the river itself, just downstream of Grande Chute, hunters primarily trap beaver and other fur-bearing animals like otters, muskrats and martens, but also hunt Canada geese, fish salmon and hunt small game. Farther upstream, other parts of the Romaine are used but less intensively. The Nahkuikan stretch from the mouth of Rivière Jérôme to Lac Brûlé, however, is worthy of note due to its great heritage value. Hunting is carried out there in fall, winter and spring, in addition to fishing lake trout and landlocked salmon.

The Ekuanitshit Innu make regular use of the coast, where they own at least ten cottages. Migratory birds (eiders, Canada geese and wild ducks) are hunted across the entire coastal region, from Rivière Jupitagon in the west to Rivière de la Corneille in the east. Small game is also hunted, particularly porcupines, and brook trout are fished.

Atlantic salmon fishing has played an important role in land use by the Côte-Nord Innu. It drew them together at the mouth of major rivers and helped them amass the food reserves (smoked salmon) indispensable for traveling inland. Then exclusive fishing rights were granted to private clubs and the Côte-Nord Innu were deprived of access to their traditional rivers (Saint-Jean, Mingan, Manitou, Romaine and others) until the early 1980s. Despite that, the Innu have continued to fish salmon.

At Ekuanitshit, salmon fishing now benefits from community management under the band council (official fishing permits, regulations on the use of fishing gear and quotas). Today, salmon fishing is more a social and cultural activity, and a matter of identity, than an real economic activity.

## **Nutashkuan**

The Nutashkuan Innu also use a vast territory, which stretches westward to the Romaine and includes part of the project study area. That part lies off the left bank of the Romaine and can be divided into three portions:

- The southern portion extends from the coast up to Wakeham, Forges, Pauline and Métivier lakes. It includes Lac du Milieu and Lac à l'Ours, as well as the lakes in the Rivière de la Corneille watershed (Vingt-Deuxième Mille, Travers, Ferland, etc.). Use of this portion for trapping or hunting small game, caribou and migratory birds is facilitated by means of transportation (Highway 138 and numerous snowmobile trails) in fairly gentle terrain.
- The central portion stretches north from Lac Pauline and Lac Métivier to the Rivière de l'Abbé-Huard watershed. The land there is rugged and much more difficult to reach than farther south.
- The northern portion extends up to the vast area dominated by Lac Brûlé, well beyond the study area. It includes Rivière des Sauterelles and Lac des Sauterelles.

## **Socioeconomic environment**

### *Social profile*

In 2006, the population of the four communities totaled 2,775 Innu. The more populated communities are Unaman-shipu (1,037) and Nutashkuan (917), and the less populated ones are Ekuanitshit (522) and Pakua-shipi (299). This Innu population has grown rapidly over the last two decades, but growth has recently been slower. The population is young, the majority less than 25 years of age, putting pressure on housing and employment.

The median income is about one-third less than for Québec as a whole, based on 2001 data. Slightly more than half that income is through employment. The portion of income from government transfer payments declined between 1996 and 2001.

The graduation rate is low. Vocational training programs are of increasing interest among the Innu.

### *Economic activities and job market*

Band council activities are at the centre of community economics. The band councils provide a large majority of the jobs in different departments, or community undertakings dependent upon them. Besides stable, permanent jobs in basic public services like health, education, administration and public works, the Innu hold seasonal or temporary jobs in construction, home renovation, commercial fishing, outfitting and retailing.

Regarding projects and prospects for developing the communities, people are relying on diversification of the economy in the commercial fishing, outfitting and tourism, forestry and energy sectors.

Key economic indicators are lower in Innu communities than among the non-Native population. The participation and employment rates are lower, and the unemployment rate higher. Surveys conducted at Ekuaniitshit, Nutashkuan, Unaman-shipu and Pakuashipi give the proportion of respondents without a job as 52.0%, 73.2%, 74.3% and 46.6% respectively.

Several dozen Innu workers have experience in construction but few hold qualifications and certifications for trades and occupations recognized by the Commission de la construction du Québec.

### 4.3.3 Archaeology

The lower Romaine basin (KP 0 to 82.5) covers the coastal plain and the rocky foothills of the Laurentian Plateau. Archaeological work carried out on the Laurentian shoreline over the past 40 years has unearthed several prehistoric and historic sites testifying to human occupation in the distant past and to archaeological wealth uncommon in Moyenne-Côte-Nord.

The intermediate Romaine basin (KP 82.5 to 197) is characterized by its rugged relief. Streams and rivers flow rapidly and have numerous barriers to navigation. Little archaeological and historical information exists regarding these reaches of the river.

The upper Romaine basin (KP 197 to 445) is a rolling plain with occasional flat, rocky hills and immense lakes. Those living in this region used not only the resources of the river, but also those of lakes and peatlands. Native groups there have hunted caribou, waterfowl and small game from time immemorial, while fishing year round. Fur-bearing animals were also hunted in this area, particularly from the nineteenth century onwards.

The study area includes 321 areas of special interest where 75 archaeological sites have been listed. On several sites, remains have been unearthed, e.g., dwellings and fireplaces, mainly dating back to the last century, some back to the seventeenth century and, in a few cases, back to pre-contact times (last four millennia).

### 4.3.4 Landscape

The study area landscape is part of the Lower North Shore Plateau natural province. There, the Romaine forms a valley varying considerably in width and depth. The part between the mouth and Chutes à Charlie is where the greatest number of nature watchers are found, practising recreational activities. Considered a scenic road, Highway 138 crosses the lowest stretch of the river and offers drivers an interesting view.



Highway 138 bridge

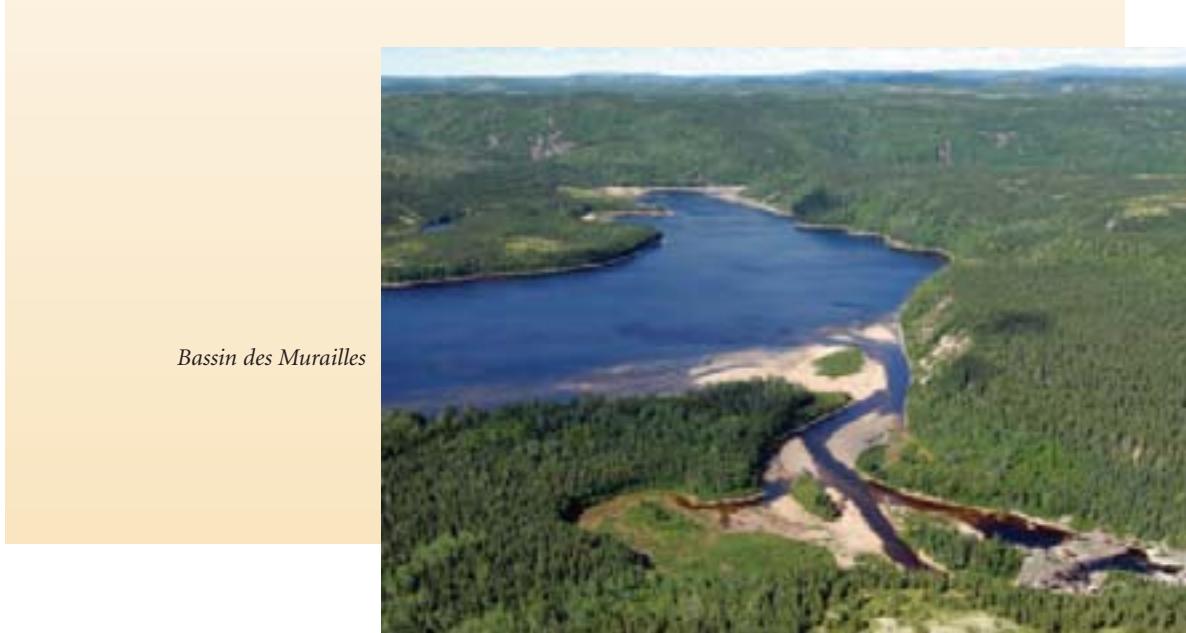
The notion of landscape is culturally encoded. For the Minganois, the main scenic features of the Romaine are the waterfalls and rapids found between the mouth and KP 52.5: Fausse Chute, Rapide à Brillant, Chute de l'Église, Chutes à Charlie and Grande Chute. To this list are added Nekau, Officiers and Mistaministukueuetshuan islands. The Bassin des Murailles is also of special interest since it stands out from the rest of the river and is valued by the population.

Unlike non-Natives, who notice and appreciate obstructions (waterfalls, rapids and escarpments), the Innu instead appreciate open, unobstructed landscapes that allow them to easily practice activities

(canoeing upstream and downstream, snowshoeing and snowmobiling) enabling the harvesting of wildlife resources. It is the Nahkuikan area beyond KP 215 of the Romaine that attracts them the most.



*Île Mistaministukueuetshuan*



# 5

## Impacts and Mitigation/Compensation/Enhancement Measures

### 5.1 Impact assessment method

Various aspects of the project may have impacts on components of the host environment. Sources of impacts relate either to the existence and operation of the developments (presence of reservoirs, structures, access roads and traffic, reservoir water management, etc.) or to construction work (building and presence of temporary structures, land clearing, blasting, waste management, construction machinery traffic, reservoir impoundment, workers present, project schedule, etc.). Project-related sources of impacts may lead to modifications to the physical environment, which in turn may have effects on components of the biological and human environments. Negative impacts may be mitigated through the standard environmental clauses that Hydro-Québec applies to all projects or by specific mitigation measures, which are specially designed for the particular project. Positive impacts may be optimized through enhancement measures, while compensation measures may be applied to certain environmental components after the assessment.

The impact assessment analyzes residual impacts on the biological and human environment, i.e., those remaining after mitigation and enhancement measures are applied. Such impacts may be negligible, minor, moderate or major.<sup>8</sup>

For most environmental components affected, impacts related to the existence and operation of the developments are presented first, followed by the usually temporary impacts due to construction work.<sup>9</sup>

As for modifications to the physical environment, those anticipated during the transitional operating period, i.e., the time between the commissioning of the first powerhouse (Romaine-2) and the fourth (Romaine-4), are also presented when necessary.

### 5.2 Modifications to the physical environment

#### 5.2.1 Hydrology and hydraulics

##### Operation phase

Creating and managing the four Romaine complex reservoirs will modify the hydrological and hydraulic regimes of the river between its mouth and the upstream end of Romaine 4 reservoir (KP 290). Creating the four reservoirs will raise the water level and submerge all the rapids. Except for the river section at the upstream end of Romaine 1 reservoir between KP 81.8 and 69 (see Figure 8), flow velocity in the reservoirs will be practically zero. The river part of Romaine 1 reservoir will have a flow velocity of at least 0.3 m/s. Romaine 4, Romaine 3 and Romaine 2 reservoirs will be managed so that their level is as close as possible to the maximum operating level at the outset of winter. Those reservoirs will be gradually drawn down during the winter so that their level is as low as possible before spring flooding starts. The reservoirs will then be filled and managed to minimize the risk of spillage at the four Romaine complex generating stations. Despite this, just over one year in three, spillage will occur at the end of the spring filling period. After the flood, the reservoirs will be kept close to their maximum level for the rest of the summer and fall. As for Romaine 1 reservoir, since it is small and Romaine-1 is operated as a run-of-river generating station, it may swing between its minimum and maximum level in a single day or over a few days. Romaine 4 reservoir level may range from 442.1 to 458.6 m (drawdown of 16.5 m), Romaine 3 from 352.8 to 365.8 m (13.0 m), Romaine 2 from 238.8 to 243.8 m (5.0 m) and Romaine 1 from 80.8 to 82.3 m (1.5 m).

8. The significance of an impact depends in turn on three assessment criteria: the magnitude of the impact (low, moderate or high), its scope (limited, local or regional) and its duration (short, medium or long).

9. The opposite is true for socioeconomic impacts since the most significant of such impacts are related to construction work.

Turbine flow at the generating stations will be adjusted to meet the energy demand and ecological instream flow requirements downstream of Romaine-1, and to maximize the output of the complex. Compared to present conditions, future flow will thus be higher in winter (December to April) and lower in spring (May and June). As under present conditions, the highest flows will still occur during the spring flood period. The flood will peak two to three weeks later than under present conditions. During summer and fall (July to November), flow will be fairly similar to what it is today. Turbine flow may vary on an hourly basis in response to energy demand.

To meet the requirements of Atlantic salmon, Romaine-1 will be operated so as to maintain the following flow downstream of the generating station:

- minimum of 140 m<sup>3</sup>/s from November 16 to June 6
- minimum of 200 m<sup>3</sup>/s from June 7 to July 7
- minimum of 170 m<sup>3</sup>/s from July 8 to October 15
- 200 m<sup>3</sup>/s from October 16 to November 15 (or higher if there is a major risk of spillage)

Except at Romaine-1, the bypassed stretches will have an instream flow equal to 1% of the mean annual flow, plus spillage when it occurs. Depending on the particular stretch or partial stretch of river, the water level will be 1.4 to 4.4 m lower. The instream flow will keep pools fairly deep, with a shallow flow of water over the rock ledges between them. Due to the sharp drop in elevation along the bypassed stretches, rapids and cascades will continue to flow over these rock ledges. Except when spills occur, there will be no flow along the bypassed stretch of Romaine-1. The deep pool found there will remain but there will be no turnover. The rapids will dry up and water will flow in the opposite direction along the river section downstream of the rapids.

The flow regime downstream of Romaine-1 will also be modified by operation of the complex. There will be less of a rise in water level during the spring flood than under present conditions. In summer, flow velocities and depths will remain similar to what they are presently. Near the powerhouse, there will be sharp variations at the time of generating unit startup or shutdown. Water level fluctuations will be about 1 m just downstream of the powerhouse but gradually taper out and lengthen in time going downstream. They will drop to 0.6 m at KP 46, to less than 0.15 m at KP 26 and will be imperceptible downstream of KP 16.

During the transitional operating period (i.e., from when Romaine 2 reservoir is full to when Romaine 4 reservoir is full), Romaine 2 reservoir will be operated with a drawdown of 19 m, providing sufficient storage to maintain instream flow downstream of KP 52.5. Since the Romaine complex will have less total storage during that period, more frequent and larger spills can be expected at that time.

### Construction phase

Except for a 24-day period (under average runoff conditions) during Romaine 2 reservoir impoundment, filling the reservoirs will not prevent maintenance of the ecological instream flow regime downstream of KP 52.5 (see Section 2.2.2). The developments downstream of the reservoir being filled will then be managed to ensure instream flow. Furthermore, the Romaine-1 and Romaine-2 temporary bypass tunnels may be used for a certain time to release the necessary flow. At all four developments, the spillway may also be used to release instream flow when the water level is high enough. For Romaine-2, Romaine-3 and Romaine-4, however, there will be a period when instream flow will not be maintained in the bypassed stretch (24 days, 125 days and 61 days, respectively, under average runoff conditions).

## 5.2.2

### Thermal regime

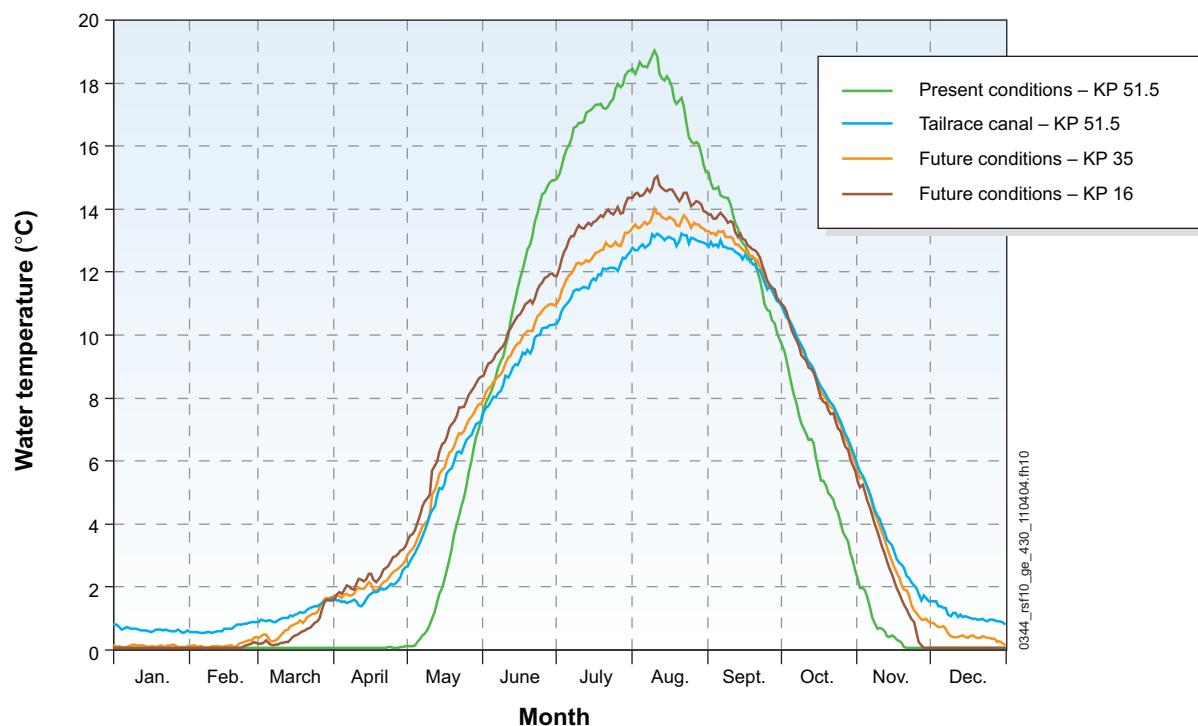
In Romaine 4, Romaine 3 and Romaine 2 reservoirs, and the deep part of Romaine 1 reservoir, thermal stratification will occur in winter and summer, and 4°C isothermy will occur in spring and fall. In winter, the water temperature will be 0°C beneath the ice cover and gradually increase with depth to between 3.3°C and 3.9°C in the deepest parts of the reservoirs. With spring warming, isothermy will be reached in May, and a reverse thermal stratification will appear in summer. Water temperature at the surface will peak at a value between 15°C and 21°C, depending on the reservoir, and decrease with depth to reach 4°C to 5°C. Except in Romaine 1 reservoir where the turnover time is shorter,<sup>10</sup> layers of cold water may approach the surface when strong wind episodes occur.

In the upstream part of Romaine 1 reservoir, flow velocity will prevent thermal stratification. Water temperature throughout the reservoir will approach

that of the water coming from Romaine-2. In winter, water will exit Romaine-2 powerhouse at 1.6°C to 2°C and gradually cool as it flows downstream, whereas in summer it will gradually warm as it flows downstream. Compared to the natural river water temperature, the top layer of water in Romaine 1 reservoir will be slightly cooler in summer and warmer in winter.

In the reaches downstream of Romaine-1, the water temperature will be similar to that of the water discharged by Romaine-1 powerhouse. In winter, it will range from 0.6°C to 1.8°C at the powerhouse and cool to 0°C around KP 38, while under present conditions, water remains at 0°C throughout these reaches. In spring, the water will begin to warm earlier but warming will be more gradual than under present conditions. The water will be cooler in summer. The temperature will reach 13°C at the powerhouse, which is about 6°C cooler than under present conditions. The water will gradually rise by about 1°C downstream (see Figure 10).

Figure 10: Water temperature downstream of Romaine-1 – Present and future conditions



10. The turnover time is 170 days for Romaine 4 reservoir, 97 days for Romaine 3 reservoir, 158 days for Romaine 2 reservoir and 6 days for Romaine 1 reservoir.

In short, from June to September, the average temperature of the top layer of water in Romaine 2, Romaine 3 and Romaine 4 reservoirs will be similar to, or slightly higher than, the natural river water temperature. The water will become colder as depth increases. Water in the top layer of all four reservoirs will be at a slightly higher temperature in winter and the difference compared to natural conditions will increase with depth. For the bypassed stretches, the upstream part of Romaine 1, Romaine 2 and Romaine 3 reservoirs, and the reaches downstream of Romaine-1, water will be cooler than under present conditions from mid-May to mid-September. For the rest of the year, its temperature will be higher than at present.

Modifications to the thermal regime of each reservoir will occur as soon as the developments are commissioned.

### 5.2.3 Ice regime

#### Operation phase

In winter, ice will form on Romaine 2, Romaine 3 and Romaine 4 reservoir slightly later than when it now forms on natural lakes in the region. The upstream end of Romaine 2 and Romaine 3 reservoirs will remain ice-free due to the higher temperature of the water from the powerhouse upstream. The flow of water may lead to areas of thinner ice or openings in the ice cover. Cracks will also form near the banks as the water level becomes lower during the winter.

Bassin des Murailles and the upstream part of Romaine 1 reservoir (KP 83.7 to 62) will remain ice-free throughout the winter. The deeper part will become covered with ice, thinner in certain areas. The ice will start to deteriorate in early March.

Except for the banks, the first six kilometres of the Romaine downstream of Romaine-1 (KP 51.5 to 45.5) will remain ice-free throughout the winter. Farther downstream, the ice cover will gradually extend toward the middle of the river, which will be entirely covered with ice from mid-January to sometime between late February and late March. The ice cover will react quickly, however, to any winter warm spell and open water could appear up to about 20 km downstream of the powerhouse. This does not occur under present conditions: the Romaine downstream of KP 51.5 remains entirely covered with ice throughout the winter, except at waterfalls. Overall, upstream of KP 35, numerous ice-free areas and warmer water may compromise the ice's carrying capacity. For an average spring, the ice will break up in mid-March, i.e., four weeks earlier than under present conditions.



*Ice at the mouth of the Romaine in January*

#### Transitional operating period

Over two winters (2014–2015 and 2015–2016), the complex will be operated without Romaine 3 and Romaine 4 reservoirs. Romaine 2 reservoir will then be entirely ice-covered, including its upstream end. It is unlikely that areas of thin ice will appear. The situation will be similar for Romaine 3 reservoir during winter 2017–2018, when it will be operated in the absence of Romaine 4 reservoir.

The main modifications to the ice regime downstream of KP 83.7 will occur once Romaine-2 is commissioned.

### 5.2.4 Geomorphology and sediment dynamics

#### Operation phase

Erosion will affect about 7% of all shores of the planned reservoirs. The shores of Romaine 2 and Romaine 3 reservoir should be spared since they are essentially rock. However some 15% of Romaine 4 reservoir shores (64 km) will be affected, along sandy terraces and dunes, in addition to 10% of Romaine 1 reservoir shores (15 km), where erosion will be very limited except along 1.5 km near KP 60.

There will be greater reshaping of shore slopes at Romaine 4 reservoir.

During the initial years after impoundment, scouring of surface soil will release particles into the reservoirs. The finest (silt and clay) will be carried to the mouth of the Romaine. Over the medium and long term, such erosion will not be greater than at present, given the small proportion of erosion-prone shores containing silt and clay. Sand input will accumulate not far from the shoreline of the reservoirs, which will act as large settling ponds given the greatly reduced flow velocity. The increased sand load will therefore not result in an increase in overall sediment movement.

Erosion will have little effect on the predominantly rock banks along the bypassed stretches, given the lower flow and water level. Less erosion is thus anticipated there, even in areas now eroding. The risk of erosion along a sandy gravel terrace facing the Romaine-2 spillway is considered negligible since the water discharged will be slowed down by a plunge pool at the spillway outlet.

The sediment balance along Romaine reaches downstream of Romaine-1 should remain unchanged overall but erosion will occur throughout the ice-free period and no longer mainly during floods. While flood control will reduce erosion in spring and fall, variations in flow during summer will increase the erosion of unstable slopes. An 8-km stretch downstream of KP 25 may also become more vulnerable to repeated wave action and supply small additional volumes of sand to the river. The loss of sediment input now provided during flood periods will be roughly offset by increased input during summer. In winter, increased flow and higher water levels will have no effect since shore and slope materials are frozen.

Overall, downstream of Romaine-1, the more regular flow and the end to sand input from farther upstream will result in certain modifications to sediment movement. There will be a temporary localized increase in sedimentation and a slow erosion of riverbed sandbanks. Since Romaine 1 reservoir will trap sand particles that are carried downstream of KP 52.5 under present conditions, the input at the mouth will be lower but spread over a longer period of the year.

### **Construction phase**

A temporary increase in suspended matter is anticipated downstream of Romaine-2 dam during the second stage of Romaine 2 reservoir impoundment (24 days under average runoff conditions). Total closing of the temporary bypass will mean that flow downstream will only come from Romaine tributaries. That greatly reduced flow will tend to increase erosion at the mouth of some of the tributaries but will reduce flood-related erosion during that period of the year compared to present conditions. Since sediment will be trapped in Romaine 2 reservoir, the river downstream of the dam will contain less during the second stage of impoundment than under present conditions. The concentration of suspended matter will nevertheless increase due to the reduced flow.

The risks of increased turbidity associated with construction also arise when building the initial and later cofferdams upstream of the Romaine-1 and Romaine-4 temporary bypass structures. Use of till as the building material may lead to fine particles in suspension but the small quantities in question at Romaine-1, the construction of a jetty at Romaine-4 and application of standard environmental clauses will minimize the quantities released.

During reservoir impoundment, bank caving may occur in certain types of slopes affected by the rising water. Submergence of riverside slopes and saturation of the material they contain may lead to abrupt changes in the equilibrium slope of materials and cause subsidence. This kind of erosion is related to material characteristics (porosity and cohesion) and to slope characteristics (composition, gradient and height). Caving during impoundment is most likely for sand or sand-and-gravel slopes with a gradient exceeding 30 degrees, especially those with no vegetation. When caving occurs, it does so suddenly, often during impoundment.

The zone mapped out as being at risk shows that, for most Romaine reservoirs, the increase in water level will have little effect on slope stability either due to the impervious or only slightly porous materials, or due to the low gradient of the terrain flooded. Sandy slopes whose characteristics make them prone to caving occur along a total length of 2.5 km in Romaine 1 reservoir, 4 km in Romaine 2 reservoir, less than 1 km in Romaine 3 reservoir and about 16 km in Romaine 4 reservoir. Recent observations during Péribonka reservoir impoundment lead one to believe that about 20% to 25% of the slopes at risk may subside.

No appreciable turbidity will result from such subsidence. The volume of sediment supplied to the reservoirs will be fairly low given that the slopes at risk are neither very high nor very deep. In addition, this material contains a relatively small fraction of fines, and only the shores of Romaine 1 reservoir contain silty sand that is likely to remain in suspension following subsidence. Lastly, the Romaine reservoirs contain enough water to dilute the fine sediment that may be found there during impoundment.

To avoid the risks of caving, slopes at risk will not be cleared.

## 5.2.5 Water quality

### Operation phase

No loss of water uses is anticipated during the operation phase of the complex, especially with regard to the protection of aquatic life, since water will remain of a quality suitable for sustaining aquatic organisms.

In the reservoirs, water quality will only be affected temporarily. Modifications to most physico-chemical parameters will peak between one and four years after impoundment starts and will have practically ended after about ten years. Not only will anticipated changes not harm aquatic organisms, a temporary increase in total phosphorus, and hence biological productivity, is expected, having a positive effect throughout the aquatic food chain.

Regarding the bypassed river stretches, the situation downstream of Romaine-1 will be monitored particularly closely, since in years with spillage, once such discharges stop, the lack of instream flow there will lead to lower dissolved-oxygen levels, especially in winter. Calculations show that, during the last month with an ice cover, oxygen levels may drop too low for fish living in the basin on this stretch. When the powerhouse is commissioned, this stretch will dry up. The extent of the problem will be assessed at that time and appropriate measures will be applied either to ensure conditions allowing aquatic wildlife to survive or to connect this area so fish can swim freely farther down the river.

The risk of gas supersaturation in water downstream of the Romaine-2 spillway, which has a plunge pool, was also assessed. Gas-supersaturated water can lead to fish mortality under certain conditions but, in this case, the risk of supersaturation would only exist at flow velocities exceeding  $250 \text{ m}^3/\text{s}$ . At such velocities, the rapids and cascades along the bypassed stretch would in all likelihood effectively degas the water. The risk of effects on fish is thus deemed very low.

### Construction phase

The temporary increase in suspended matter anticipated downstream of Romaine-2 dam during the second stage of impoundment (24 days under average runoff conditions) will not endanger fish populations. It is expected that water quality criteria for the protection of aquatic life will be maintained.

Overall, the construction of structures will only lead to limited, negligible, immediate modifications in water quality since standard environmental clauses will be applied and the compliance assurance program will remain in effect throughout the construction phase. Water quality will always remain suitable for sustaining aquatic organisms during construction of the complex.

## 5.2.6 Physical oceanography

### Operation phase

Water management at the developments will lead to physical modifications in the mouth zone. Overall, the aquatic environment will become less variable and more marine-like on an annual scale. There will be less sediment movement, making the substrate more stable in the central channel, the only way out to the delta located off the mouth zone.

Spring flows of  $500 \text{ m}^3/\text{s}$  or more during at least four consecutive weeks will occur half as often as under present conditions, i.e., one spring in two rather than every spring. Less frequent sustained floods will result in less freshening of mouth zone waters within the outer fringe and greater penetration of saltwater. Stratification of freshwater and brackish water over saltwater in the channels will thus continue year long, except during the spillage period.

With no sustained flood, current in the mouth zone will slacken, reducing sediment movement, which will already be lowered by the bed load trapped by the reservoirs. Sediment conditions will stabilize since there will be no more washing of sediment, particularly in the central channel. The aquatic habitat will vary less. Little modification is anticipated in the east and west channels, and near eelgrass beds. Lastly, there is no fear of any notable modification in the Chenal de Mingan.

## Construction phase

Construction activities should not lead to any particular change in either the mouth zone or the Chenal de Mingan. During reservoir impoundment, hydrological and physical conditions will be the same as those during an operation phase year without spillage.

### 5.2.7

#### Greenhouse gases

A rapid rise in gross carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) emissions is generally reported after reservoir impoundment, essentially due to decomposition of a fraction of the submerged organic matter. Emissions peak between two and four years after impoundment at values generally four to five times higher than emissions from natural lakes and rivers. Emissions then gradually return to their natural values over a period of ten years for CO<sub>2</sub> and five years for CH<sub>4</sub>.

The small land area flooded by the Romaine reservoirs and the relatively short turnover time of water in them are factors favoring low greenhouse gas (GHG) emissions. Gross annual emissions are anticipated to peak at about 150,000 to 475,000 tonnes of CO<sub>2</sub> eq. (CO<sub>2</sub> and CH<sub>4</sub>) and then drop to about 61,000 to 78,000 t per year. After a decade, emissions will approach those before impoundment. By comparison, anthropogenic sources in Québec (particularly due to the use of fossil fuels) produce an estimated 65,000,000 t per year of CO<sub>2</sub> alone.

With an annual energy output of 8 TWh, the Romaine complex will be among the top-performing energy sources in Québec, with gross annual emissions averaged over a century of roughly 1,400 to 4,000 t per terawatthour.

Life cycle studies of various electricity generation options indicate that total GHG emissions from a reservoir hydropower project are generally 30 to 70 times lower than a thermal power plant of equivalent capacity. These studies also reveal that all construction activities amount to less than 5% of total GHG emissions from a reservoir hydropower project.

## 5.3 Biological impacts

### 5.3.1

#### Fish

## Operation phase

#### *Fish communities*

Fish communities in the Romaine, its tributaries and lakes to be flooded will be modified by the creation of reservoirs, which will also appreciably increase the area of aquatic habitats. The reservoirs will form lacustrine ecosystems characterized by low flow velocity and wide variations in water level, except in Romaine 1 reservoir. At maximum operating level, the area of water will increase by 22,193 ha (+305%) to reach 29,471 ha.

Such modifications will favor species common in the region, e.g., lake whitefish, longnose sucker, burbot and lake chub, to the detriment of other species, including two valued salmonid species: brook trout and Arctic char. Planned mitigation measures will help expand a landlocked salmon population in Romaine 4 reservoir and enhance a lake trout population in Romaine 1 reservoir. Furthermore, two populations of Arctic char will be moved from the Romaine-4 sector to two Romaine watershed lakes unaffected by the project in order to preserve local biodiversity. Despite these measures, the significance of the project's impact on fish communities is deemed major since they will be permanently transformed. Compensation measures will be implemented to favor brook trout (seeding of several lakes and tributaries, and habitat development) and Arctic char (development of spawning grounds in the lakes where they will be relocated).

#### *Fish productivity*

The project will have an overall positive impact of moderate significance on fish productivity due to the increased area of aquatic habitat and the increased growth rate of populations. Higher water temperatures will favor the growth of fish in the Romaine-4, Romaine-3 and Romaine-2 sectors, whereas the opposite will occur in the Romaine-1 sector where slightly cooler temperatures are anticipated. Greater productivity is thus anticipated in the three upstream sectors and particularly in the Romaine-2 sector, while the net change in Romaine-1 productivity will be negative. Overall, annual fish production will increase by 22.03 t compared to present conditions.

The species for which the increase in productivity will be greatest are longnose sucker, lake whitefish and burbot. Conversely, white sucker, northern pike and brook trout productivity will be lower.

Measures planned for landlocked salmon, lake trout and Arctic char will result in increased productivity for those species. Regarding brook trout, seeding in the Romaine watershed in five lakes and eight tributaries unaffected by the project, and the development of habitats will partially offset anticipated losses of productivity in the river.

### *Spawning conditions*

Under present conditions, the quantity of breeding habitats largely exceeds the needs of the various species (except Atlantic salmon); only one-third of quality spawning grounds are used. Reservoir water management will eliminate a number of these spawning grounds and create new breeding areas. Most species will thus find replacement habitat in the reservoirs and newly accessible stretches of tributaries (especially northern pike, suckers and brook trout). The planned ecological instream flow regime downstream of Romaine-1 will protect the existing spawning grounds of Atlantic salmon and most other species except northern pike.

Modifications to water temperature will lead to a shift in the breeding period of certain species but should not affect reproductive success. Salmon are expected to spawn ten days later but eggs will hatch in less time due to the slightly higher water temperature in winter, the net result being fry that emerge at about the same time as under present conditions. Lastly, modifications to the sediment regime will have no negative effect on the quality of salmon spawning grounds downstream of Romaine-1.

In short, a moderate impact on fish breeding conditions is anticipated. Aside from the fact that a number of species will find new spawning sites, others will be supported by various mitigation and compensation measures. The seeding of landlocked salmon in two tributaries (encouraging adults to return there to spawn), the development of spawning grounds for Atlantic salmon, lake trout, brook trout and Arctic char, and the rehabilitation of a lake whitefish spawning grounds will help those species reproduce. There are no plans to develop northern pike spawning grounds downstream of Romaine-1 since that species preys upon young salmon.

### *Free movement of fish and passage through turbines and spillways*

A moderate impact is anticipated on the free movement of fish. The reservoirs will generally facilitate north-south movement compared to present conditions, especially in the central portion of the study area where numerous abrupt changes in elevation greatly fragment the river (see Figure 8).

Although more accessible under certain conditions, tributaries will be about 25% less accessible overall. The distribution of species upstream and downstream of Grande Chute will remain unchanged, as will the passability of obstructions downstream, except at Chutes à Charlie, where conditions may make it easier for Atlantic salmon to pass.

Mortality may result when fish pass through generating facilities, primarily due to sudden changes in water pressure and mechanical shock. Risks associated with passing down spillways are reduced by having stepped outlet channels that dissipate the water's energy and make drops lower. The significance of the anticipated impact is deemed minor since only a small fraction of the fish communities are exposed to the risk, and those species exclude Atlantic salmon, American eel and other species confined downstream of KP 52.5. Furthermore, experience at other hydroelectric complexes has shown that the phenomenon does not affect overall fish production.

### *Atlantic salmon*

The ecological instream flow regime downstream of Romaine-1 will help protect Atlantic salmon habitats.

During the spawning period (October 16 to November 15), a constant flow will be maintained to avoid disrupting spawner breeding activities. Operating restrictions will also mitigate the impacts of daily variations in flow on juvenile salmon during the winter period (November 16 to June 6) and summer period (July 8 to October 15).

Operating discharges from Romaine-1 powerhouse will modify the pattern of upstream migration in the Romaine. It is expected that the lack of a spring flood will mean that salmon will enter the river earlier (late May rather than mid-June), that conditions will be improved for passing obstructions so salmon will migrate upstream more quickly, and that a higher proportion of spawners will pass upstream of Chutes à Charlie at KP 35 (see Map 6). Three spawning grounds and three parr shelters will be developed upstream of the falls at KP 51, 49 and 45.

Other anticipated impacts mainly arise from a change in water temperature downstream of the Romaine-1 tailrace canal. It is estimated that the water temperature will be 0.1°C lower over the year on the whole, leading to a reduction in juvenile growth capacity of about 5.4% but having no appreciable consequences on populations. Modifications to the thermal regime will also affect the spawning period and the date eggs hatch, without significantly affecting the date on which fry emerge. The downstream migration of smolts and kelts will also be later by about one week in spring, so they will reach the sea at a time when temperatures are higher and food more abundant.

Overall, the anticipated impact on Atlantic salmon is deemed to be minor.

### *Mercury in fish*

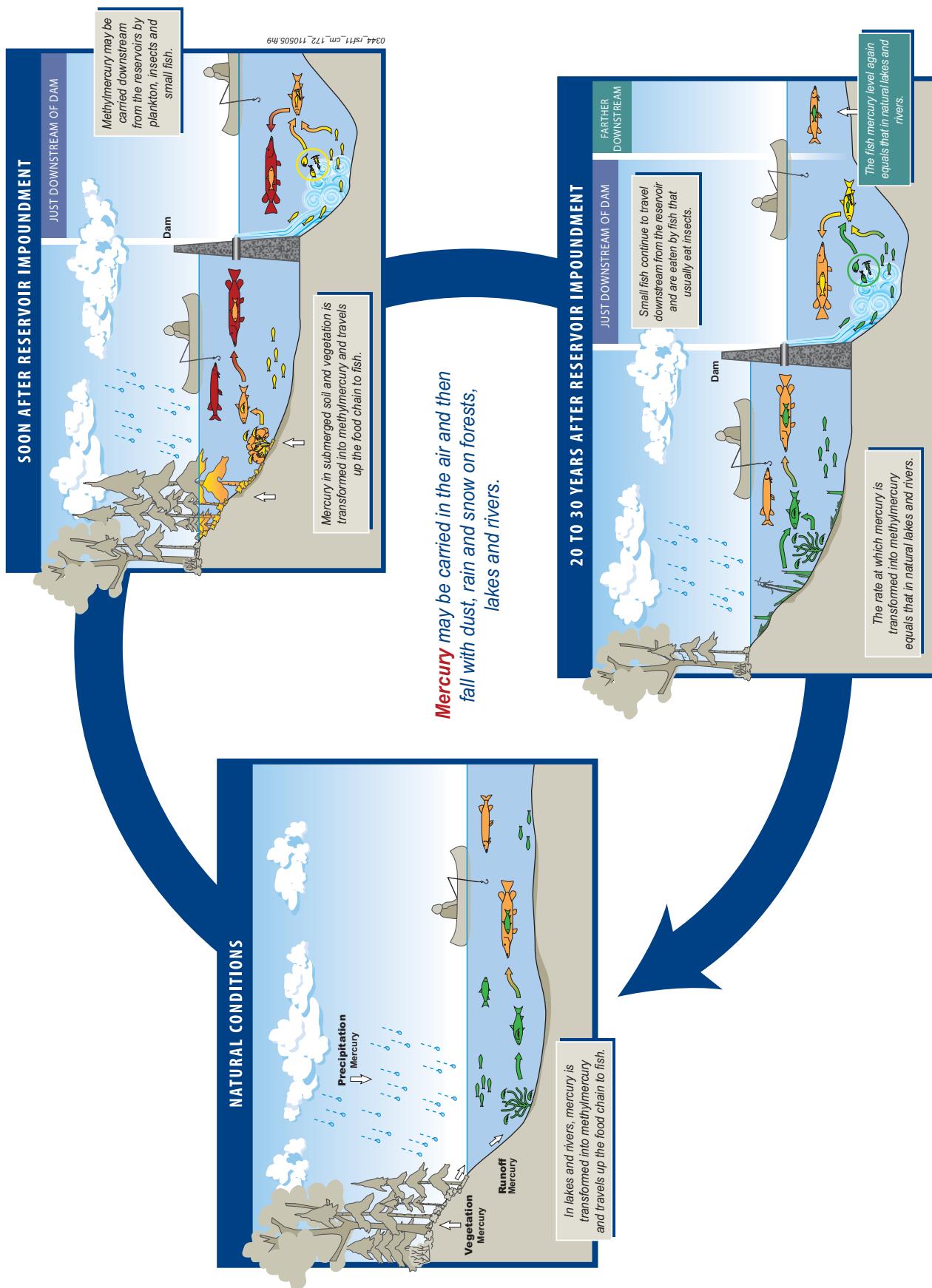
No impact on fish populations is anticipated due to the temporary increase in fish mercury levels. Increases due to the Romaine complex will be similar to or less than those caused by La Grande complex reservoirs, which had no effect on fish populations.

The increases in mercury level will be similar from reservoir to reservoir and range from threefold for brook trout (peaking around 0.5 mg/kg) to sevenfold for northern pike (peaking at 2.8 mg/kg). Levels will return to near-present values 20 to 24 years after impoundment for non-piscivorous species and 28 to 30 years after impoundment for piscivorous species (see Figure 11). The project will have no effect on adult salmon since most of their growth occurs in the sea.<sup>11</sup>

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11. Section 5.4.2 covers the effects on fish consumption and the additional risk to health.

Figure 11: Mercury cycle



## Construction phase

### *Fish habitat*

Building structures will lead to a temporary loss of habitat and a disruption to fish populations lasting one to five years depending on the sector. An estimated 17.7 ha of habitat will be temporarily lost at the site of structures. Various measures are planned to minimize the impacts. Fish trapped in areas being dewatered to build dams, dikes, and headrace and tailrace canals will be removed using fishing gear before the areas are completely drained. During dam construction, diverted water will temporarily flow into the bypassed stretches.

However, there will be no instream flow in the bypassed stretches during the first stage of Romaine 4 and Romaine 3 reservoir impoundment (respectively 61 and 125 days under average runoff conditions). Cold water in the remaining pools will still have a dissolved oxygen saturation rate adequate to ensure the survival of fish, which may either remain there, move downstream or swim up tributaries.

No instream flow can be maintained between Romaine-2 dam and the mouth during the second stage of Romaine 2 reservoir impoundment (24 days under average runoff conditions). Flow will then be from tributaries along those reaches and aquatic habitats in the lower Romaine (KP 52.5 to 0) will shrink temporarily in area by 38%. A mitigation measure (laying geotextile) applied the year prior to impoundment will prevent salmon from spawning in parts of spawning grounds that may dry up during that period in order to minimize the loss of eggs and fry. Compensation measures are also planned for Atlantic salmon like the development of spawning grounds and shelters for parrs and implementation of an enhancement program. That program should start before Romaine 2 reservoir impoundment and last about 20 years. A strong cohort of juveniles will be introduced to offset loss in production due to dried out salmon habitats. These measures will not only offset habitat losses but also restore the Romaine salmon population, now considered to be in a troubling situation.

Given the anticipated impacts and all the measures planned, the overall significance of the impact on salmon habitat is deemed moderate.

### *Free movement of fish*

Only a minor impact on the free movement of fish is anticipated during construction, primarily because the planned structures are on very steep stretches with such violent flow that fish movement is limited if not impossible. As for tributaries crossed by main and secondary access roads to jobsites, compliance with the *Regulation respecting standards of forest management for forests in the domain of the State* will ensure the free movement of fish at all times.

### *Fish stocks*

The presence of workers over the 11.5 years required to build the complex may result in increased fishing pressure, particularly on brook trout. That pressure could be further increased by recreational anglers who will gradually have access to the region at the same time over Route de la Romaine. To prevent overfishing, lakes near Route de la Romaine and Murailles and Mista workcamps may be seeded with brook trout.

Regarding salmon, weak river flow during the second stage of Romaine 2 reservoir impoundment will have effects similar to those during the operation phase. Quicker upstream migration may result in greater aggregations at the foot of obstructions and lead to overfishing. The resource manager will thus be informed of this so a close eye can be kept on the situation in order to protect the salmon.

The construction-related impact on fish stocks is deemed minor.

### **5.3.2**

### **Vegetation**

## **Operation phase**

### *Terrestrial environments*

The reservoirs, structures, access roads and permanent buildings will affect 21,746 ha of land or 6.4% of the study area terrestrial environment. Losses are mainly coniferous forests (12,021 ha), especially black spruce-lichen stands in the Romaine-4 sector and black spruce-moss stands in the Romaine-2, Romaine-3 and Romaine-4 sectors. The second type of land area most affected by the project is disturbed forests (3,579 ha), primarily recent burns.

Losses will lead to only a limited modification of the abundance and distribution of vegetation and no stand affected is of any special value. The impact on terrestrial vegetation is deemed moderate.

### *Wetlands*

The project will lead to the loss of 1,359 ha of wetlands: 649 ha of peatland and 710 ha of riparian wetlands. It is estimated, however, that an area of 733 ha around the reservoirs and bypassed stretches will naturally develop into riparian wetlands. Thus the net loss of wetlands is 626 ha or 1.6% of the study area's wetlands and primarily involves peatland.

Losses will be mitigated by clearing a 3-m strip around the edge of Romaine 1 reservoir and clearing certain portions of the shores of the other reservoirs. This will

facilitate plant recolonization and habitat development (see Figure 12). This measure gave good results at the La Grande complex, where transitional habitats support a great diversity of flora and fauna. The development of two or three bays in Romaine 1 reservoir is planned and should eventually help create 15 ha of wetlands. Such measures are primarily intended to maintain the habitat function of wetlands by establishing plant cover favoring flora and fauna. The recreational and educational function of wetlands will be enhanced in the study area due to increased access to the region. In short, the impact on wetlands is of moderate significance.

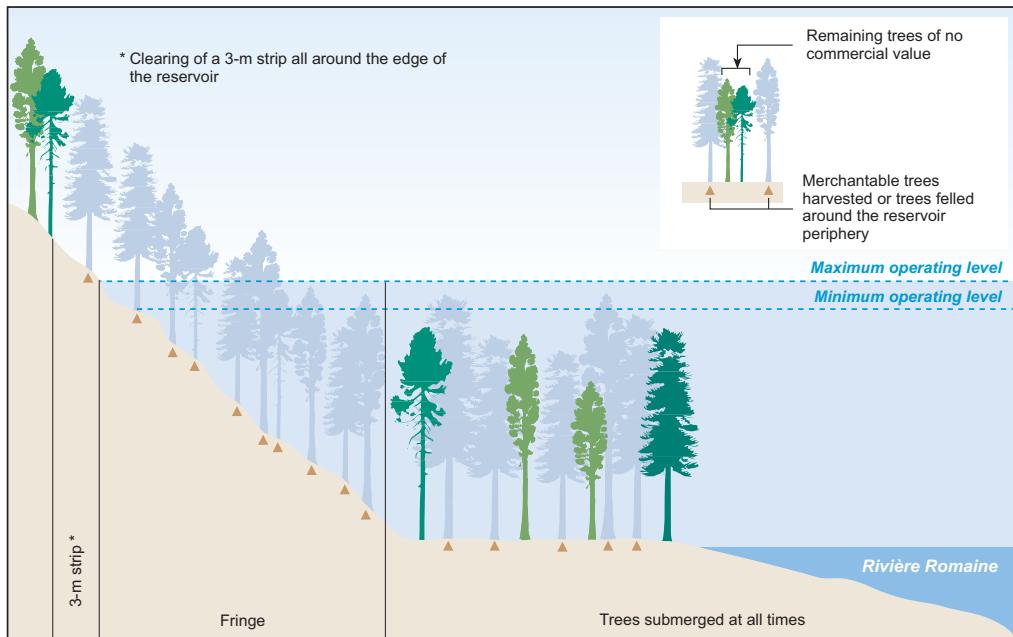
As a compensation measure to enhance the wildlife habitat function, about 100 ha of wetlands will be developed in borrow pits located in the sectors most affected (Romaine-2 and Romaine-3).



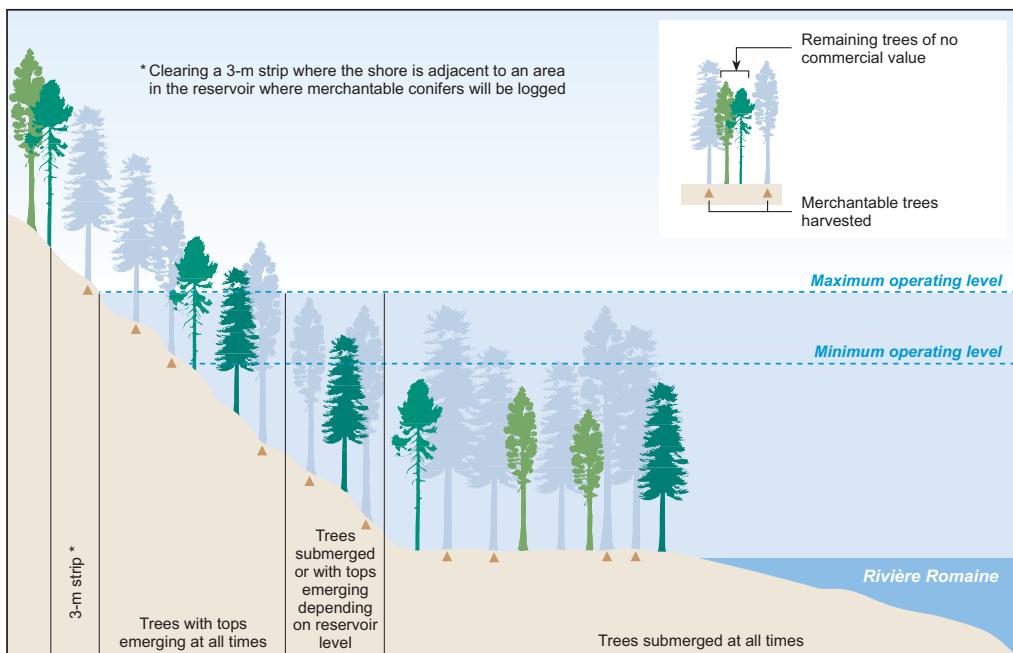
*Borrow pit converted  
into wetland at the  
Pérignonka development*

Figure 12: Clearing in future reservoir areas

**Romaine 1 reservoir**



**Romaine 2, Romaine 3 and Romaine 4 reservoirs**



### *Vascular plants*

Disturbance of the study area flora will be slight, with losses only affecting about ten species or 2% of plant diversity. Seven of the ten species are not abundant in the study area, being either naturally sporadic or at the limit of their range. Three others lack suitable environments. The impact is of moderate significance.

### *Special-status species*

Three special-status species are affected by the project: dragon's mouth, ostrich fern and sand heather.

A minor impact on dragon's mouth is anticipated since less than 1% of known populations (a few dozen individuals among thousands) may be affected by the existence of Romaine 1 reservoir. The project will thus have little effect on its status in the region.

A minor impact on ostrich fern is also anticipated due to a change in its range. The existence of Romaine 2 reservoir will result in the loss of two ostrich fern populations but a transplanting program will help maintain the species in the area. Since the plant is easy to transplant and cultivate, a population approaching the original number of individuals should exist about four years after transplanting.

A major drop (80%) in the sand heather population is anticipated when Romaine 4 reservoir is impounded. This impact will be mitigated, however, by a program to transplant mature heather and to grow the species from seed in a controlled environment. The residual impact is deemed moderate.

### **Construction phase**

#### *Terrestrial environments*

Temporary access roads, borrow pits, work areas, work camps and the temporary substation will result in the temporary loss of 596 ha of land (0.2% of the study area terrestrial environment), primarily mixed stands (182 ha) and coniferous stands (333 ha). Work areas will be restored at the end of the construction phase. This impact is deemed minor.

#### *Wetlands*

There will be a temporary loss of wetlands, primarily peatland, covering 56 ha (0.1% of the study area wetland environment). This is a minor impact.

### **5.3.3**

#### **Terrestrial and semi-aquatic wildlife**

##### **Operation phase**

###### *Large wildlife*

Moose, woodland caribou and bears will undergo an impact of moderate significance.

Slower moose population growth is anticipated due to loss of quality habitats and increased hunting. The wintering habitat of moose lies mainly in the area to be flooded, but moose will be able to use the reservoir ice cover to reach shoreline forests. Hunters will take advantage of increased access to the area provided by Route de la Romaine. That may increase pressure on the resource but also help better distribute the harvest, now concentrated in the south of the study area. Moose will benefit from mitigation and compensation measures to help develop wetlands.

Protected by their special status (vulnerable species in Québec and threatened species in Canada) and by the ban on hunting them in the study area, woodland caribou of the forest-dwelling ecotype are also valued by the Innu. Caribou have a low reproduction rate and are particularly sensitive to human disturbances. The project will change their distribution in the study area due to increased access to the region and to the disturbance. The road may facilitate harvesting, impede caribou movement by acting as a barrier, and increase the disturbance due to road traffic. Traffic should be light, however, during the operation phase (fewer than 50 vehicles per day). Losses of wintering habitats resulting from the reservoirs will have little effect on caribou, which use forests at higher altitudes more than the Romaine valley. In winter, the reservoirs may attract caribou by making their movement easier and reducing their vulnerability to predation by wolves. Increased use by caribou of the Sainte-Marguerite 3 reservoir area has been reported since the reservoir was created.

The Innu culture also values the black bear. The Romaine complex may affect its distribution in the study area since bears will have to leave areas to be flooded to live in surrounding areas where high-quality habitats are available. Route de la Romaine should not lead to a major increase in hunting and trapping since the annual harvest is now low. However, the road will increase the level of disturbance should sustained human presence result. Like moose, the black bear will benefit from mitigation and compensation measures involving the development of wetlands and riparian habitats.

### *Small wildlife*

A moderate impact is anticipated on small wildlife. Species will generally be affected by loss of habitat, to a greater or lesser extent depending on the species, and to improved opportunities to harvest more sought-after species. Practically all species will benefit from the planned development of wetlands. Another mitigation measure involves using wood debris from clearing to build shelters on reservoir shores. The shelters will be useful in cleared areas until the vegetation has regained its natural appearance.

Beaver are generally valued for subsistence harvesting and commercial trapping. The existence and management of the reservoirs may change their abundance and distribution due to loss of quality habitat (particularly in the Romaine-4 sector), to drawdown at the three upstream reservoirs and to daily fluctuations at Romaine 1 reservoir. Beaver do not like the unstable conditions created by drawdown and fluctuations in water level. The development of wetlands under various measures should nevertheless help mitigate the impact. It is unlikely that increased access would have a major effect on the abundance of beaver since trapping is less popular and the fur market has stagnated.

Changes to the abundance and distribution of other fur-bearing animals are also possible for the reasons mentioned above. It is likely that species with smaller home ranges (e.g., marten, squirrels, weasels, ermine, mink, muskrat, fox and very small mammals) will be more affected, while no impact is anticipated on species with very large ranges (e.g., wolf, lynx, otter, wolverine and fisher). Though there may be greater harvesting of species of particular interest to hunters and trappers (e.g., hare, porcupine and grouse), the project should not lead to changes in population dynamics. Studies conducted at Sainte-Marguerite 3 reservoir nine years after impoundment were unable to detect differences in the relative abundance of most documented species compared to pre-impoundment levels.

### **Construction phase**

#### *Large wildlife*

The construction-related impact on large wildlife is deemed moderate. Overall, the effects on habitats will be mitigated by applying standard environmental clauses and by restoring work areas after construction periods.

The distribution of moose and woodland caribou will change, and their mortality rate may rise. Changes in distribution will primarily be due to animals relocating to areas around the reservoirs at the time they are impounded, avoiding work areas until they regain a natural appearance and retreating from areas near activities to more peaceful ones. Impoundment-related relocation may affect the physical condition of some females before, during and after calving time. The retreat to surrounding land will result in a greater concentration of animals and thus greater vulnerability to predation. Flights over the reservoirs are planned during impoundment to spot animals in danger and take appropriate action if any are found. Increased movement of animals combined with increased road traffic (probably from 500 to 1,000 vehicles per day) may lead to a temporary rise in mortality due to collisions. Increased hunting pressure due to the presence of temporary access roads may have the same effect. The hunting pressure attributable to workers should, however, remain slight.

The black bear population may temporarily decrease during the work period. Romaine 4 and Romaine 3 reservoir impoundment is to occur in part during the winter. This will be the main source of impact given the species' hibernation period. At Romaine 2 reservoir, the rapid rise in water level during the spring flood may lead to the loss of individuals, which are more vulnerable at that time of year since they are leaving their dens with fat reserves at their lowest. The abundance of black bears, however, should not decrease appreciably in the study area as a whole.

#### *Small wildlife*

An impact of moderate significance is anticipated on small wildlife during the work period. The mitigation measures for large wildlife will also be applied to small wildlife.

The impact on beaver will be mainly due to reservoir impoundment and clearing operations since jobsite facilities will not be located near aquatic habitats. As with black bear, it is primarily the impoundment of Romaine 4, Romaine 3 and Romaine 2 reservoirs that may lead to a temporary decline in population. An intensive program of beaver trapping by the Innu is planned prior to impoundment. Temporary losses of terrestrial habitat will only affect beaver in the case of deciduous or mixed stands near aquatic environments where the species lives.

Generally, small fur-bearing animals will move to avoid areas disturbed by the work and will adapt their home range during that period. Their greater concentration and increased road traffic may then temporarily increase mortality due to predation and collisions. In spring, the impoundment of Romaine 4, Romaine 3 and Romaine 2 reservoirs will particularly threaten less mobile animals (very small mammals like the rock vole and porcupine), and most newborns, and possibly females, which will be confined to their burrows or dens. Lastly, slightly increased hunting of prized species may occur due to the presence of workers and of recreational hunters attracted by the region's greater accessibility.

#### 5.3.4

#### **Amphibians and reptiles**

##### **Operation phase**

Losses of terrestrial environments, wetlands and aquatic environments due to the reservoirs and access roads, as well as to water management, will lead to a limited change in the abundance and distribution of amphibians and reptiles in the study area, without impairing their population dynamics. The two-lined salamander will be especially affected by the loss of streams, which serve as habitat for the species, while woodland salamanders like the yellow-spotted salamander and blue-spotted salamander will be more affected by the loss of terrestrial environments. Mitigation and compensation measures designed to develop wetlands (clearing of Romaine 1 reservoir shores, partial clearing of the shores of the other reservoirs, the development of bays on Romaine 1 reservoir and the development of wetlands in borrow pits) will benefit several species. The road will fragment habitat, have a barrier effect and expose individuals to the dangers associated with road traffic.

The anticipated impact on amphibians and reptiles is deemed moderate.

##### **Construction phase**

Amphibians and reptiles will try to avoid areas disturbed by the work and temporary roads will lead to habitat fragmentation. The animals will then return to restored areas once they again have a natural appearance. Continuous traffic during the construction phase may also increase mortality.

Reservoir impoundment will cause part of the amphibian and reptile population to move to the surrounding area where the concentration of prey and predators may also lead to increased mortality. The effort to flee the flooded area will increase the vulnerability of

individuals. In the case of the winter impoundment of Romaine 4 and Romaine 3 reservoirs, hibernating amphibians and reptiles will be unable to flee the flooded area.

The impact associated with construction will be moderate.

#### 5.3.5

#### **Birds**

##### **Operation phase**

###### *Waterfowl*

Reservoir creation will lead to the loss of wetlands, which are important waterfowl breeding habitat. However, the losses will be mitigated by the creation of riparian wetlands (through mitigation and compensation measures designed to develop wetlands) and by potential regrowth on the shores of Romaine 4 reservoir. A decline in waterfowl breeding populations is nevertheless anticipated.

The transformation of the river and ponds into large bodies of water will result in a change in species composition to the advantage of dabbling over diving ducks, as the latter prefer rivers.

The main species affected by the project are not species of concern since their populations have been on the rise for some 20 years. In addition, since duck population density is low in the study area, adjacent areas may provide replacement habitat. The impact is deemed moderate.

###### *Raptors*

Loss of habitat in flooded areas will change the hunting grounds of raptors nesting in the study area, but the impact will probably be imperceptible given the vast area available. Though nesting sites (high trees and cliffs) will also be submerged, including eight occupied nests in the area of the planned reservoirs, the raptors can find replacement sites in surrounding areas. Two osprey platforms will nevertheless be built to mitigate the loss of two nests. The osprey is a species that reacts well to artificial structures. The impact is deemed moderate.

###### *Forest birds*

The loss of forest habitat and wetlands will limit available nesting sites and force birds to seek out replacement habitat near the reservoirs. Increased densities in these surrounding areas may lead to inter-specific competition and habitat saturation may cause a decline in local populations of forest birds.

Mitigation and compensation measures designed to develop wetlands will help create riparian habitats that will be used by forest birds. When the shores of the reservoirs are partially or totally cleared, snags will be left standing to provide nesting sites (both for forest birds and tree-nesting ducks) and a source of food for woodpeckers. Bay development work on Romaine 1 reservoir will also include the planting of shrubs attractive to forest birds. The overall impact of the project on forest birds is of moderate significance.

### *Other aquatic birds*

An impact of minor significance is anticipated for other aquatic birds since only a small proportion of breeding pairs should be affected by the project. Mitigation measures to help develop wetlands and the regrowth potential of Romaine 4 reservoir shores will help mitigate the effect of project-related loss of habitat.

### *Birds in the mouth zone*

Modification of the physical environment of the mouth zone (making it more stable and more sea-like) will help increase benthic community diversity and possibly maturity, at least one year out of two. The new conditions will benefit the fish and bird species that feed in the mouth. This will be especially true for shorebirds and other species that feed on benthic organisms and on fish (double-crested cormorant, terns, black guillemot, etc.) and molluscivorous species (common eider, scoter, scaup, etc.). This positive impact may nevertheless have no discernible effect on the abundance of birds in this area. The positive impact of the project on birds in the mouth zone is deemed minor.

### *Special-status species*

Two Barrow's goldeneye breeding pairs may be affected by the impoundment of Romaine 3 reservoir, which will flood two lakes where this species nests. The birds may still live on lakes in higher surrounding areas or use nest boxes to be installed in this sector. The impact is deemed minor.

The area to be flooded by Romaine 1 reservoir will be checked in 2012 before work begins. Studies on Innu knowledge revealed that a bald eagle nest was located near the mouth and a golden eagle nest near Bassin des Murailles. Based on information now available, both nests are apparently located outside the area of the planned reservoir. The presence of the short-eared owl in areas to be flooded will also be checked before work begins. Based on results, impacts on these species and mitigation measures will be reassessed.

## **Construction phase**

### *Waterfowl*

Clearing will result in the loss of trees that are potential nesting sites for tree-nesting ducks. However, snags will be left standing and some 60 nest boxes will be installed around the reservoirs near wetlands developed. Romaine 1 and Romaine 2 reservoir impoundment, scheduled for the spring and summer, will flood the nests of ground-nesting waterfowl. The lack of instream flow during the second stage of Romaine 2 reservoir impoundment may also mean that certain wetlands are unusable in May or June, potentially affecting about ten pairs of ducks. Overall, construction work will only affect a portion of waterfowl nests locally and for a limited period of time. This impact is deemed minor.



*Snags and nest box  
at the Pérignon development*



### *Raptors*

Clearing operations may overlap the breeding season of certain raptors. However, applying standard environmental clauses and, during the breeding season, establishing a protected area boundary (500 m) around two osprey nests in the area of Romaine 2 and Romaine 3 reservoirs will mitigate the impact. A third pair of osprey may be disturbed by construction of Route de la Romaine near Lac Bernard. A nesting platform will be erected nearby. The impact of construction work on raptors is of minor significance.



*Nesting platform  
at the Pérignonka development*



### *Forest birds*

Clearing operations on reservoir areas, along access roads and in the footprint of structures will disturb forest bird nesting. Reservoir clearing operations will start in fall or winter but will continue into spring and may thus extend into the breeding season of certain species. The most disturbance-sensitive species may also be troubled by noise, blasting and construction machinery traffic. The impact is deemed moderate.

### *Special-status species*

A protected area boundary (700 m) will be established during the breeding season around an occupied golden eagle nest located near a borrow pit. An unoccupied nest near a Romaine-4 sector fuel depot will be monitored. Should the golden eagle use it at the time work is to be done, the fuel depot will be closed to helicopters during the breeding season. Depot facilities will be removed after the generating station has been built. Given these measures, the impact is minor.

### **5.3.6**

### **Biological oceanography**

#### **Benthic fauna in the mouth zone**

A positive impact of moderate significance on benthic fauna is anticipated in the Rivière Romaine mouth zone. The benthic population is particularly sensitive to intense natural events like sustained flooding. The spring flood periodically washes out sediment, disrupting the benthic community. Gradual recolonization then occurs but diversity remains low. It is thus likely that greater stability in the mouth zone due to more regular Romaine flow will lead to more diverse benthic fauna, possibly reaching greater maturity. The soft-shell clam may benefit from such conditions and become more widespread.

Although organic debris will be trapped in the reservoirs, no appreciable loss of organic matter is anticipated for mouth zone communities. Sufficient supply for these populations will come from other sources: the lower Romaine (KP 0 to 51.5), the mouth zone itself and coastal slopes east and west of the mouth.

There will be no impact on eelgrass beds in the east of the mouth zone, where the highest density of clams is presently found, since that area is unaffected by flood flows. Eelgrass beds farther west should expand somewhat.

### *Food supply for the mouth zone fish*

A moderate positive impact is anticipated on feeding conditions for fish in the mouth zone. Conditions will be better one spring out of two when a more abundant and diverse benthic community that develops earlier will benefit bottom-feeding fish, particularly juvenile brook trout in spring. During years without sustained flooding, the presence of moving prey will benefit all fish species, including rainbow smelt. Marine species will also benefit from the earlier availability of moving and benthic species.

### *Spawning conditions in the mouth zone and the Chenal de Mingan*

No appreciable change is anticipated in spawning conditions in the mouth zone and the Chenal de Mingan. Conditions will continue to be attractive for capelin.

### *Chenal de Mingan plankton*

Flow management at the planned structures will not lead to any appreciable change to plankton production in the Chenal de Mingan. The slight increase in total plankton production projected by the simulation model should not be significant. Water from Détroit de Jacques-Cartier, uninfluenced by Rivière Romaine flow, plays the dominant role in the Chenal de Mingan plankton ecosystem.

Snow crab and other species of commercial interest in the Chenal de Mingan

The impact of Romaine development flow management will be negligible on Chenal de Mingan benthic habitats and biological resources, including snow crabs and other species of commercial interest. In this area, the only modifications related to water from the Romaine occur in the surface layer, with which no species of commercial interest is associated. The change in the river's hydrological regime will thus have no effect on bottom-dwelling species like the snow crab, whelk, American lobster and scallop.

### *Sea mammals*

A negligible impact is also anticipated on sea mammals in the mouth zone and the Chenal de Mingan. Prey species and habitats of mammals living in the Chenal de Mingan will remain unchanged. Anticipated modifications in the mouth zone will not have an adverse effect on the few individuals that use this habitat.

### *Archipel-de-Mingan National Park Reserve of Canada*

Given the foregoing, there will be no particular impact on the integrity of the Archipel-de-Mingan Reserve. The project will not affect abiotic components, swamps, high marshes or animal species living in the reserve. Nor will the project have any negative effect on communities or ecological processes in the aquatic environment around the reserve. The slight increase anticipated in the abundance and diversity of benthic fauna in the mouth zone will benefit fish and birds living there. However, that positive impact should have no effect on the abundance of birds.



*Archipel-de-Mingan National Park Reserve of Canada, Havre-Saint-Pierre Sector*

### **Construction phase**

Construction activities will have no appreciable impact on the biological oceanography of the mouth zone and the Chenal de Mingan. During reservoir impoundment, it is unlikely that spillage will occur in spring. Hydrological and physical conditions will thus be the same as those during an operation phase year without spillage.

## 5.4 Impacts on Minganois communities

### 5.4.1 Socioeconomic environment

#### Construction phase

##### *Jobs and the economy of Québec and Canada*

Romaine complex construction work will have a major positive impact on the Québec and Canadian economy, creating hundreds of jobs and generating tax revenues for both levels of government.

Construction spending will total \$4.9 billion, about 70% (\$3.5 billion) in Québec. The project should create or maintain 34,410 person-years of employment during construction, from 2009 to 2020.

During the same period, tax revenues (income tax on wages and other taxes) and related contributions (to the Québec Pension Plan and Canadian Employment Insurance Program) will yield \$571.3 million for the Québec government and \$250.2 million for the Canadian government, for a total of \$821.5 million.

##### *Jobs and regional economy*

A major positive impact is also anticipated on the Côte-Nord regional economy, which will benefit from substantial spinoffs in the form of business opportunities, company development and job creation. Furthermore, a number of measures implemented in cooperation with community stakeholders will optimize the participation of Côte-Nord companies and workers in the project.

A committee on regional economic spinoffs is thus planned, with Innu representatives and members from organizations active in the regional economy. The committee will monitor tendering and actual project spinoffs. A regional subcontracting provision will be included in contracts, some of which will be reserved for the region. A resource-person will liaise between businesses based in the region and outside companies.

Given these measures, an estimated \$1.3 billion of construction spending may go to Côte-Nord companies, and the participation rate of regional workers in contracts will be about 60%. In addition, there will be benefits under agreements reached between Hydro-Québec and Côte-Nord Minganois and Innu communities.

Direct employment related to building the complex will total 11,224 person-years, an average of 975 person-years over the 11.5 years of construction, with 20% for Hydro-Québec management and 11% for workcamp janitorial and food services. The peak periods will occur from 2011 to 2016 with a workforce of roughly 1,600 to 2,400 (see Figure 7). The contracts that may create or maintain the largest number of direct and indirect jobs at the regional level are for land clearing, road building, and installing and operating the workcamps.

Project spinoffs will foster the development of regional expertise. Carry-over effects have been noted at the Eastmain-1, Sainte-Marguerite-3 and Toulnustouc jobsites, where companies have improved their practices, enhanced staff skills and upgraded equipment, later enabling them to work in a larger market.

The demand for goods and services to build the complex should also boost commercial activity at Havre-Saint-Pierre, and help some companies to expand (e.g., lodging, restaurant and catering services) and others to diversify their activities and offer new services. The settling of workers and development of companies will create business opportunities for firms in the construction sector (residential and commercial buildings and infrastructure), while helping to create and maintain jobs.

Table 7: Jobs from Romaine complex construction

Job category	Proportion (%)	Number of person-years
Clerical, technical and managerial personnel (contractor management)	18.3	2,053
Clerical, technical and managerial personnel (Hydro-Québec management)	21.0	2,357
Janitorial and food services personnel	11.4	1,275
Surveillance and security personnel	3.6	399
Foremen	4.2	470
Loggers	0.7	80
Laborers	5.3	592
Carpenter-joiners	3.2	355
Mechanics	3.8	429
Equipment operators	6.9	779
Truck drivers	8.9	994
Electrical mechanics	2.9	329
Shot-firers	0.5	54
Drillers	0.8	87
Skilled laborers	4.1	455
Structural-steel workers	1.7	196
Rebar workers	1.1	118
Welders	0.6	62
Other trades	1.2	139
<b>Total</b>	<b>100.2</b>	<b>11,223</b>

### Social aspects

The project will have a positive impact of moderate significance at the social level. The impact is mainly due to lower unemployment, improved quality of life for workers and their families, and the arrival of new residents, resulting in a more dynamic Havre-Saint-Pierre and region.

Measures will also be implemented to optimize the project's social benefits. A community relations committee is thus planned with members from Havre-Saint-Pierre and the RCM of Minganie (Sûreté du Québec, CSSS de la Minganie, businesspeople, etc.), which will monitor the integration of workers in the Minganois community and propose any measures needed to ensure smooth relations. A resource person will assist the committee and work at getting information to the public. A communication program for workers will also be developed jointly with the CSSS de la Minganie, particularly to provide counseling in the event of employment termination or other difficulties.

Lastly, a website will be created to inform communities about the project, how it is progressing, and job openings in particular.

Job creation will reduce unemployment and improve life for workers and their families. Employment opportunities will particularly benefit young people and encourage some of them either to take special training or to pursue their studies.

Workers with long-term employment, with a young family or originally from the region and now returning are the ones most likely to settle. They will be a dynamic force benefiting the community and will help maintain or expand the various services offered, e.g., in health, education and commerce. Other workers, though living on the complex in workcamps, may visit Havre-Saint-Pierre and other towns when on leave or traveling. Follow-up studies for Sainte-Marguerite-3, Toulnustouc and other jobsites have not revealed any particular social issues related to the presence of workers in local communities.

Starting in 2015, the workforce will gradually decline until 2020, resulting in job losses or changes and lower income for some. The gradual scaling down will make job hunting easier than if all jobsite workers were suddenly laid off.

## Operation phase

### *Québec economy*

Besides revenues from taxes and related contributions, the Québec government will benefit from additional revenue related to electricity generation. This will have a positive impact of major significance on the Québec economy.

Specifically, the complex will result in a contribution to Québec's Generations Fund, intended to reduce the Québec debt. Payments into the Fund will rise as more power is generated by Hydro-Québec and are automatically indexed. The cumulative payment by the end of 2030, i.e., ten years after commissioning the fourth Romaine generating station, will total some \$489 million.

Hydro-Québec will also pay public utilities tax every year to the Québec government. By the end of 2030, the cumulative amount paid with respect to the complex will total about \$476 million.

### *Regional economy*

The project will have a positive impact of moderate significance on the regional economy.

It will create some 100 direct jobs for the operation and maintenance of the complex, and possibly indirect employment. A number of these workers may opt to settle in Minganie. The existence of the complex should also increase contract opportunities for companies and contribute to regional economic activity. To the extent possible, Hydro-Québec will give preference to hiring workers from the region and to purchasing goods and services in Côte-Nord.

By providing easier access to the interior, Route de la Romaine may also promote the development of recreation and tourism and thus help strengthen the regional economy. Use of Québec reservoirs for recreation and tourism rose to about 2,800,000 person-days in 1999 and about \$83 million in annual spending. In Côte-Nord, six outfitters operate on Hydro-Québec reservoirs. The reservoirs may thus support the development of recreation and tourism.

### *Social aspects*

Some workers involved in the operation and maintenance of the complex may settle in Minganie, mainly at Havre-Saint-Pierre. They may thus energize the town and help maintain or increase commercial activities and services. This positive impact is of moderate significance.

## 5.4.2

### Mercury and public health

#### Operation phase

Despite a major though temporary increase in fish mercury levels in environments modified by the complex, mercury exposure of local populations will change only slightly compared to today. A thorough health risk analysis has revealed that exposure will remain well below thresholds at which health effects may be feared. Thus no impact on the health of local populations is anticipated due to the temporary increase in fish mercury levels.

Given the negligible health risk, discussions with local public health authorities will address the pertinence and means of applying the following measures:

- Monitoring fish mercury levels and mercury exposure of local populations
- Reviewing fish consumption guidelines
- Distributing communication tools regarding the risks and benefits of eating fish
- Checking the effectiveness of communication tools

Present exposure of populations affected by the project (at Havre-Saint-Pierre, Longue-Pointe-de-Mingan and the Mingan Indian Reserve) is low, averaging less than 1 ppm, and similar to that of the Québec population at large. A survey of eating habits in these three communities shows that potential sources of mercury that will be affected by the project (Rivière Romaine fish and waterfowl) are not prized and will contribute little to mercury intake. Such sources account for 0% to 3.3% of mercury intake under present conditions, depending on the community.

Scenarios were developed to estimate future exposure. Besides anticipated peak fish mercury levels, the scenarios considered present fishing and fish consumption habits, the intention to fish in the reservoirs, the perception of mercury as a health risk, and experience acquired on the use of Sainte-Marguerite 3 reservoir as a source of fish.

Under the worst-case scenario, collective exposure will not increase appreciably following construction of the Romaine complex, with projected average exposure levels of about 1 ppm (1.21 ppm in Havre-Saint-Pierre, 0.99 ppm in Longue-Pointe-de-Mingan and 0.81 ppm in Mingan). Maximum anticipated individual exposure varies for the three communities from 5.0 to 7.4 ppm for adults in general, and from 0.4 to 0.9 ppm for women of childbearing age (18 to 39). Such levels remain below thresholds for potential health effects (10 to 15 ppm in the hair of children or in the hair of women who are pregnant, planning pregnancy or breast-feeding; 50 ppm in the hair of the general adult population). No additional mercury-related health risk is thus anticipated in the communities affected by the project.

Fishing and fish consumption remain a question of individual choice. To make sure that the level of exposure to mercury remains below prescribed thresholds, fish consumption guidelines will be regularly prepared by Hydro-Québec in cooperation with public health authorities and distributed in the communities affected by the project. During a certain period, the guidelines will recommend reducing the frequency of meals with fish. Consumption restrictions will vary over time as anticipated fish mercury levels vary, i.e., they will be less stringent during the initial years after impoundment, then become more so as fish mercury levels increase, after which they will gradually be relaxed back to the initial values. For the general adult population, restrictions will last from 15 to 28 years, depending on the species of fish and where it is caught. The communication channels used to promote awareness of the guidelines will be chosen jointly with local public health authorities on the basis of similar experiences in other Québec communities.

### **Construction phase**

Construction activities will have no particular effect on fish mercury levels. This period marks the beginning of the process described and assessed for the operation phase.

#### **5.4.3**

### **Sport hunting and fishing, and trapping**

#### **Operation phase**

##### ***Sport hunting***

Though creating the reservoirs will affect a number of hunting grounds, game species should remain equally abundant over the long term. The existence and use of Route de la Romaine near hunting facilities may have a number of drawbacks for hunters.

However, Route de la Romaine will make it easier to reach existing hunting grounds and will help reach new ones. Wildlife, especially moose, may thus be harvested over a larger area, extending primarily northward. Since the road will be opened gradually, this change will occur over a number of years.

Increased access to the region may attract new hunters. Still, low moose densities in these areas and the great distances to travel may be a disincentive. A moderate increase in hunting pressure, especially in the Romaine-4 sector, may thus be expected.

Sport hunting will be facilitated by a boat ramp built on the shore of each reservoir and a number of pulloffs along Route de la Romaine.<sup>12</sup> Mitigation measures for moose and black bear, and mitigation and compensation measures for birds will also help maintain good conditions for sport hunting. The residual impact is thus positive and of moderate significance.

##### ***Sport fishing***

Regarding Atlantic salmon fishing, it has been shown how Romaine flow management will lead to certain modifications, inducing anglers to adjust their fishing practices accordingly. There may thus be more fish in some locations upstream of Chutes à Charlie. The development of salmon spawning grounds and rearing habitat, and an enhancement program for the species, should support salmon sport fishing.



*Chutes à Charlie*

12. In winter, snow will be cleared from the road and from locations where no vehicles are parked at the same time.

Creating the reservoirs will result in the modification or disappearance of a number of brook trout, landlocked salmon and northern pike fishing sites, used by only a handful of anglers. Over the medium and long term, however, overall net fish production will increase in Romaine 2, Romaine 3 and Romaine 4 reservoirs, primarily due to larger populations of longnose sucker, lake whitefish and northern pike. Given planned mitigation measures for fish, reservoir creation will also improve lake trout and landlocked salmon fishing. Furthermore, a boat ramp built on each reservoir will encourage sport fishing. Wood debris in the reservoirs, and fears and consumption restrictions due to increased fish mercury levels, may make the reservoirs less attractive fishing destinations during the initial years after impoundment.

Route de la Romaine will make it easier to reach existing fishing sites and will gradually open up new areas for fishing. It may also help to establish an outfitting operation.

The new reservoirs and easier access to a number of water bodies may attract new anglers, leading to increased fishing pressure and some competition for the resource. Experience with past projects points to a moderate increase for water bodies that are readily accessible by road, and moderate to high increase for the reservoirs.

Despite the loss of a few fishing sites, the project will have an overall positive impact of moderate significance on sport fishing.

### *Trapping*

The project will cause the loss of some 5 km<sup>2</sup> of land the Minganois now use for trapping and will displace fur-bearing animals. Despite this, no appreciable effect is anticipated on the potential for harvesting of such animals.

A few trappers will be able to reach their traplines more easily over Route de la Romaine. The quality and tranquillity of the trapping experience may deteriorate somewhat, however, due to traffic and new users.

Given modifications to Romaine ice conditions, snowmobile access to certain parts of seven traplines will change. Hydro-Québec proposes a series of measures to mitigate this impact, primarily building a snowmobile bridge near KP 15.5 and authorizing use of the bridge at kilometre 9 of Route de la Romaine to cross the river by snowmobile (see Section 5.4.5).

A moderate impact on trapping activities is anticipated.

## **Construction phase**

### *Sport hunting*

Construction activities will have an impact on hunting grounds, particularly those for big game. Activities will temporarily disturb game and cause it to move to more peaceful areas. Hunters will thus have to adjust their practice and move with the game. Work-related disturbances will be mitigated by applying standard environmental clauses, particularly those governing noise, materials, traffic, air quality and blasting. The burning of wood debris during hunting periods will also be minimized.

Experience at other jobsites has shown that it is unlikely that the presence of workers will appreciably increase hunting pressure. Nevertheless, efforts will be made to promote worker awareness of existing regulations and of the activities of other hunters.

An impact of moderate significance on sport hunting is anticipated.

### *Sport fishing*

As with hunting, work-related nuisances will temporarily disturb the few anglers who fish near the work sites. This impact will be mitigated by applying standard environmental clauses.

In May and June 2014, during the second stage of Romaine 2 reservoir impoundment, there will be less flow in the stretch of the Romaine used by anglers, causing salmon to become concentrated at a number of locations, mainly upstream of Chutes à Charlie. That may lead to overfishing. To mitigate potential overfishing, resource monitoring and control solutions will be devised and implemented in cooperation with the resource manager and community partners.

Gradual opening of Route de la Romaine may encourage anglers to move northward and may attract new anglers to the study area. Studies conducted for the Sainte-Marguerite-3 and Toulnustouc projects have shown a sharp rise in use during the construction period, then more stable use after a few years.

The presence of workers may cause increased fishing pressure near the workcamps and the road. To mitigate this impact, workers will be made aware of the need to conduct their fishing activities in harmony with the activities of other users. Hydro-Québec will also encourage them to fish in selected bodies of water, which it will stock with fish regularly. The company may build temporary facilities (docks and boat ramps) and make available boats and other such equipment. Such measures proved effective in preventing increased fishing pressure on bodies of water near the Périponka jobsite.



*Fish stocking at the Péribonka development*



*Motorboats made available to Nemaska workers*

Given the planned mitigation measures, the impact of construction activities on sport fishing is deemed moderate.

#### *Trapping*

Building Romaine-1 structures and Route de la Romaine between Highway 138 and Romaine-1 may disturb the users of three traplines and result in a trapping experience of poorer quality. After applying standard environmental clauses and making workers aware of trappers' activities, the residual impact will be of moderate significance.

### **5.4.4 Commercial fishing**

#### **Operation phase**

Projected modifications in the Romaine mouth zone will not affect commercial marine resources negatively. No impact on commercial fishing of soft-shell clams and rainbow smelt is thus anticipated. This is also true for species harvested in the Chenal de Mingan and around the mouth.

#### **Construction phase**

Construction activities will not affect commercial marine resources negatively since there will be no appreciable change to conditions in the mouth zone and the Chenal de Mingan. No impact on commercial fishing is thus anticipated.

### **5.4.5 Recreation and tourism**

#### **Operation phase**

##### *Vacationing*

Eight cottages and three rough shelters will be lost when the reservoirs are impounded and Route de la Romaine is built. Hydro-Québec will propose compensation to the leaseholders affected. They may also reach agreement with the MRNF (Ministère des Ressources naturelles et de la Faune) on possible relocation elsewhere in the region.

The tranquillity of some ten cottage owners may be disturbed by traffic and possibly by new users once Route de la Romaine is open to the public. On the other hand, the road will make it much easier to reach existing vacation sites, making year-round travel quicker and safer, particularly during the spring thaw.

Certain stretches of reservoir shoreline may have vacationing potential, particularly since the permanent road and boat ramps to be built will make them fairly easy to reach. The road may also encourage vacationing on other bodies of water, though remoteness from major population centres may limit such development.

It is deemed that the project will have a positive impact of moderate significance on vacationing.

### ***Snowmobiling***

Changes to Romaine hydraulics and hydrology will modify the ice cover as of winter 2014–2015. Hydro-Québec will recommend that snowmobilers not cross or travel along the river or reservoirs. However, the company will propose a series of measures so snowmobilers can continue to cross the Romaine and reach their favorite areas safely.

A snowmobile bridge will thus be built by winter 2014–2015 near KP 15.5 after discussing the specifics with users of the area. As of winter 2016–2017, snowmobilers will also be able to cross the river over the bridge at kilometre 9 of Route de la Romaine.

For their safety, Hydro-Québec will open a stretch of trail on the south bank of the river, inform users regarding safe travel and erect appropriate signs. In addition, parking space near Romaine-1 structures and a number of pull-offs along Route de la Romaine will be made available to snowmobilers.

Note that Route de la Romaine will cross Trans-Québec Snowmobile Trail 3 and a few secondary trails. Since crossing at these intersections may be hazardous for both snowmobilers and road users, Hydro-Québec will erect appropriate signs.

A residual impact of moderate significance on snowmobiling is anticipated.

### ***Boating***

Present conditions for boating will be maintained downstream of Romaine-1 generating station, while the reservoirs will offer typical lake conditions farther upstream and will be easily navigable. In the three upstream reservoirs, water level fluctuations will occur over several weeks and thus will hardly be noticeable. The boat ramp on each reservoir will be designed to accommodate the fluctuation.

Floating wood debris may complicate reaching the water and impede boating on certain areas of Romaine 2, Romaine 3 and Romaine 4 reservoirs. This phenomenon will appear temporarily during the initial years of operation and will diminish over time. However, the fringe of Romaine 1 reservoir will be cleared and cleaned (see Figure 12). All slash there will be collected and burned. To ensure that a natural shoreline develops quickly, a 3-m strip will also be

cleared around the edge of Romaine 1 reservoir. The proposed measures will facilitate boating on these bodies of water. Furthermore, a portage will be made and signs set up so canoeists and kayakers can get around Romaine-1 structures.

Creating the reservoirs will submerge rapids, ledges and whitewater, some of potential interest for kayaking and canoeing. However, the Romaine is now little used by kayakers and canoeists, and some 25 other rivers in the Côte-Nord region are recognized by the Fédération québécoise du canot et du kayak and may meet the needs of enthusiasts. Transforming the Romaine will thus have no appreciable effect on the availability and practice of canoeing and whitewater sports in the region. Overall, the impact on boating is positive and of moderate significance, since the reservoirs and road will enable new water activities, while existing practices generally remain unchanged.

### ***Other tourism and recreational activities***

Route de la Romaine will improve access inland and help develop its tourism and recreational potential. A number of measures are planned to promote such development, particularly for sport hunting and fishing, boating and snowmobiling.

The water temperature downstream of Romaine-1 will be lower, however, making swimming conditions less attractive. This impact is nevertheless deemed minor.

### ***Construction phase***

#### ***Vacationing***

A dozen vacationers will be inconvenienced or disturbed by construction work, primarily in the Romaine-4 sector and near certain stretches of Route de la Romaine. Mitigated by applying standard environmental clauses, the impact is considered of minor significance.

#### ***Snowmobiling***

Construction of Romaine-1 structures will prevent snowmobiling in work areas, and clearing operations at Romaine 1 reservoir may hinder snowmobiles at certain locations. Elsewhere, construction of the complex will have little impact, except where trails intersect Route de la Romaine. Various measures (signs, trail rerouting, etc.) will be worked out with users to ensure their safety.

Increased road traffic due to construction work may also make it tricky to snowmobile across Highway 138, particularly at rush hour. Safety measures will be applied at appropriate locations in cooperation with the Ministère des Transports du Québec.

Given the planned mitigation measures, the impact of construction work on snowmobiling is considered minor.

#### *Boating*

Construction of structures will hinder boating along short stretches of the Romaine near work areas. Appropriate signs will warn canoeists and boaters not to cross safety perimeters. It will be strongly recommended not to boat on the reservoirs during impoundment. The public will be informed of impoundment dates.

During the second stage of Romaine 2 reservoir impoundment (lasting 24 days under average runoff conditions), reduced flow downstream of the powerhouse is likely to overlap boating season on the Romaine during a few weeks in May and June 2014. The reduced depth of water will particularly affect the most frequently used stretch downstream of Grande Chute, where motorboats will be restricted to a smaller area. A channel will still remain navigable for motorboats over most of the lower Romaine, except at a few locations upstream of Chute de l'Église (KP 16) where boating is already problematic under present conditions.

The residual impact on pleasure boating is deemed minor.

#### *Other tourism and recreational activities*

In summer 2009, Havre-Saint-Pierre will receive some 350 workers assigned to the initial Romaine complex work. Various measures, including renting rooms in local homes, cottages, student residences and other dwellings, should mitigate, or even eliminate, any negative effect of the project on Havre-Saint-Pierre's capacity to accommodate tourists. The presence of workers may even stimulate tourism in Havre-Saint-Pierre and Minganie.

Hydro-Québec will organize a few tours of jobsites, expanding the region's array of potential tourist activities.

The impact of construction work on tourism and recreational activities is deemed minor.

## **5.4.6**

### **Forests, mining activities and transportation infrastructure**

#### **Operation phase**

##### *Productive forest land*

Creating the reservoirs will lead to the permanent loss of 14,032 ha of accessible productive forest land and thus a loss of forestry potential.

Over the short term, recovery of merchantable timber in accordance with the *Forest Act* will largely offset the loss of forestry potential in the area. About 754,500 m<sup>3</sup> of timber is recoverable.

Over the long term, the likely compensation measure is financial compensation, which is presently under negotiation with the MRNF.

Given the lack of industrial logging in the area considered, the residual impact is negligible.

##### *Logging*

Route de la Romaine will provide access to new productive forest areas west of the Romaine. Given the low potential of forest resources, logging will still remain marginal and largely dependent on market fluctuations. There is thus a positive impact of minor significance.

##### *Mining activities*

Romaine-3 structures, the reservoir and the road leading there will result in total or partial loss of 28 claims. After considering the allotment for public development purposes, however, there will be no impact on claims granted on lands reserved to the State. At the time their rights were granted, holders were informed of the Romaine project and of the constraints that it entailed.

Route de la Romaine will allow prospectors to travel over a vast territory that is presently hard to reach. Furthermore, engineering studies carried out for the project will provide useful information on rock formations, which will make prospecting easier.

Overall, the project will have a positive impact of moderate significance on mining activities.

##### *Transportation infrastructure*

The project will have a positive impact of moderate significance on transportation infrastructure, as Route de la Romaine will open the interior about 150 km northward and make it easier to develop the territory. The increase in traffic on Highway 138 will be negligible during the operation phase.

## Construction phase

### *Mining activities*

Romaine-2 and Romaine-3 facilities and activities may limit prospecting for five years in certain parts of eight mining claims. Since prospecting can resume after the work on claims or parts of claims not occupied by permanent structures of the complex, the impact is deemed minor.

### *Transportation infrastructure*

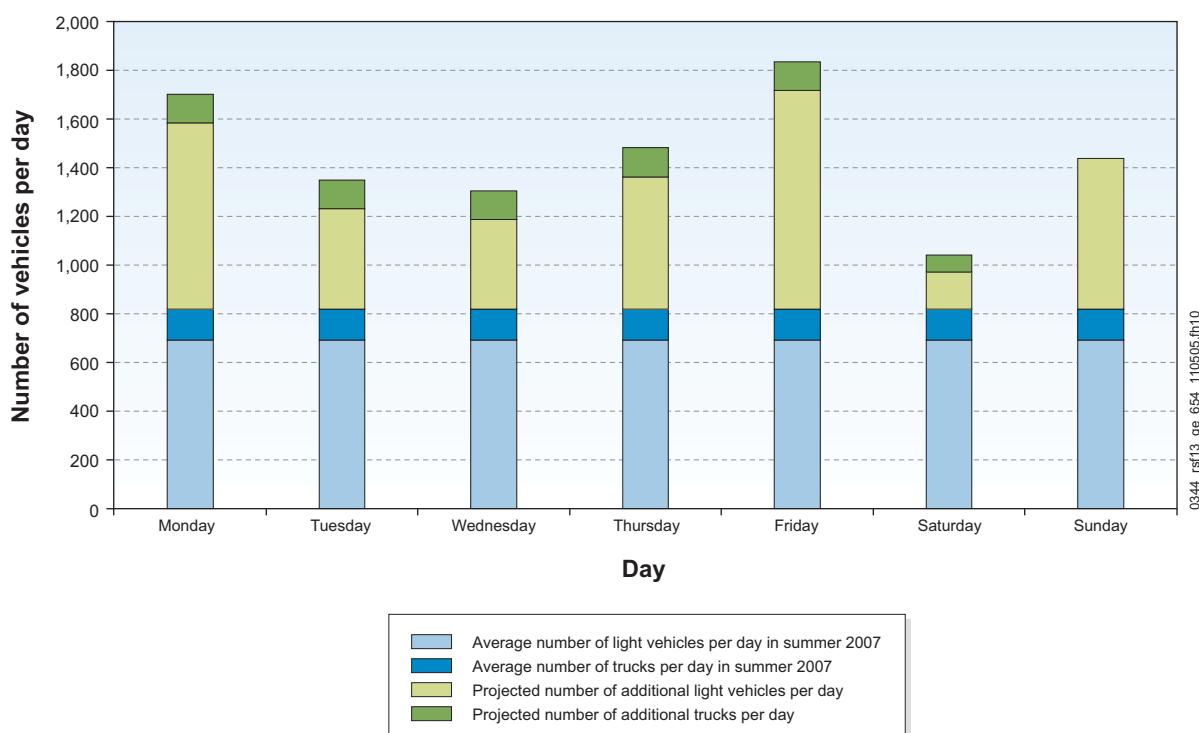
Over the entire duration of the work, the traffic due to construction of the complex will average an estimated 254 vehicles per day, including 34 trucks.

During peak periods in 2012 and 2013, there will be an estimated peak of about 22,000 additional trips per month over Highway 138 due to worker travel and shipments to supply the jobsites. The increase will peak at 1,150 vehicles on certain summer Fridays in 2012 and 2013 (see Figure 13). In these few specific situations, total daily traffic on Highway 138 will peak at 1,570 to 1,930 vehicles, with almost all of the traffic going west toward Sept-Îles.

More generally, from 2011 to 2016, during the months of April to November, the peak in additional Friday afternoon traffic will, if less than 89% of the extra traffic is during rush hour, result in a drop in service level from A to D, which remains acceptable. If more than 89% of the extra traffic is during rush hour, the service level will fall to E, which is a difficult situation but still acceptable. The capacity of Highway 138 will remain sufficient and there will be little change in the average speed of traffic. The drop in service level is essentially due to the high probability of traffic clumping. There will be much less of a drop in service level from 2009 to 2011 and from 2016 to 2020, and during the months of November to April from 2011 to 2016. The service level is expected to remain high when return traffic to jobsites peaks on Sunday afternoon and Monday morning.

Increased road traffic during construction of the Romaine complex will not lead to an appreciable change in the accident rate. However, Hydro-Québec will make workers aware of the need to follow highway safety rules and will take any necessary measures with the Sûreté du Québec to ensure the safety of Highway 138 users.

*Figure 13: Projected increase in Highway 138 traffic at Havre-Saint-Pierre in June 2013*



Noise, dust and fumes from worker and heavy-vehicle traffic may also inconvenience the population of towns crossed: Mingan, Longue-Pointe-de-Mingan, Rivière-Saint-Jean, Rivière-au-Tonnerre and Sheldrake. There is an ongoing impact study on noise from increased road traffic. Preliminary results indicate that, overall, the anticipated impact does not require specific mitigation measures. The traffic may also be a safety hazard for pedestrians. With the competent authorities, Hydro-Québec will determine measures to ensure public safety (increased policing, new signs, school crossing guards, etc.). Also for public safety, Hydro-Québec will find various ways to control public use of Route de la Romaine. A checkpoint along the road is thus being considered. When construction work is at its peak, use could be restricted or prohibited at certain times for reasons of safety. Hydro-Québec will provide a log of road traffic exiting its facilities.

No appreciable impact is anticipated on port and airport facilities.

The impact of construction activities on transportation infrastructure is deemed moderate.

## **5.5 Impacts on Innu communities**

### **5.5.1 Economic impacts**

#### **Construction phase**

Estimated at about \$1.3 billion for Côte-Nord, economic spinoffs from Romaine complex construction will result in Innu jobs, leading to a higher participation rate in the communities as the jobsite workforce grows.

Based on other projects, most Innu workers will probably hold jobs in workcamp janitorial and food services. In addition, some workers will find jobs in construction and forestry. The Innu workforce's lack of qualifications will, however, impede its access to specialized work. Some of the more educated workers may join Hydro-Québec or contractor office staff.

Hydro-Québec will agree to measures to promote Native workforce training and hiring under an impact and benefit agreement (IBA). In addition, it will hire an Innu employment counselor to promote the recruitment of Native workers and facilitate relations between those workers and companies participating in the project. Hydro-Québec will make contractors performing the work aware of the importance of promoting Native workforce participation. It will also organize information and job preparation workshops for those wishing to participate in the project.

Depending on the community, from one- to two-thirds of employable individuals have expressed interest in employment related to the project. Hydro-Québec will support efforts to create a work and living environment at the workcamps that encourages and rewards Innu participation in the project.

Participation in Romaine complex construction will also help the Innu improve their job skills, employability, qualifications and employment record. An improvement in the general job situation should attract young workers from the communities and gradually increase the number of Innu workers assigned to the project. Furthermore, business opportunities in the course of construction may help Innu enterprises develop and form ties with non-Native firms.

To strengthen Innu expertise and business capacity, Hydro-Québec will apply the usual enhancement measures to maximize regional spinoffs and, under an IBA, will implement measures to help Innu businesses obtain negotiated contracts. It will regularly inform band councils and Innu companies of contracts related to construction work. To promote business ties among the various stakeholders, a regional economic spinoff committee will be formed, with members from organizations active in the regional economy and Innu representatives. Through regular meetings, the committee will closely follow information on calls for tenders and keep track of the actual spinoffs from the project.

All such spinoffs, jobs and contracts will stimulate economic activity in Innu communities. Under the IBA, community and economic development measures agreed to with Innu partners will provide further direct project benefits.

This positive impact on the Ekuanitshit and Nutashkuan economy is of major significance. Effects will be felt somewhat less in the more distant communities of Unaman-shipu (moderate impact) and Pakua-shipi (minor impact).

#### **Operation phase**

As construction tapers off, there will be layoffs in the Innu workforce. Termination of employment will put downward pressure on the participation rate. Jobs created during the operation phase of the complex will, however, help mitigate the impacts as construction ends. Improved job skills, employability and qualifications will help the Innu workforce obtain the new jobs.

The experience a number of Innu companies gain during the construction phase may enable them to win contracts in the region in subsequent years.

Given the long-term economic effects of the project on Innu communities, the impact is deemed positive but of minor significance.

## 5.5.2 Social impacts

### Construction phase

The project will have a positive impact on Innu living conditions. It will help raise the income and purchasing power of an appreciable portion of the population for more than a decade. It will also affect numerous workers and their family members, a large proportion of whom now receive income security or employment insurance benefits. Some of the additional income may be spent on hunting, fishing and trapping.

Employment possibilities in the Romaine project may encourage some Innu young people to complete their secondary schooling and pursue studies leading to a trade or profession.

A number of community members fear, however, that higher income will lead some to buy more alcohol or drugs. Some of the Innu also fear that the departure of workers to the jobsites will lead to family tension. There will be social workers on the jobsites, who may spot workers in difficulty and, if needed, direct them to the appropriate services in the community. Hydro-Québec will develop a communication plan to inform the Innu communities regularly on how work is progressing and on project impact monitoring results. Members of the communities may participate in conducting such studies.

It is considered that the project will have an overall positive impact of moderate or minor significance on social aspects for the Innu communities concerned.

### Operation phase

Permanent modification of the Romaine will mark a loss to the Innu cultural heritage. Under an IBA, Hydro-Québec will thus agree to measures to conserve, develop and enhance Innu heritage, and to encourage *Innu Aitun*.

Again under an IBA, the means will be implemented for community and economic development to help acquire and maintain community facilities, and to improve services to the population.

It is considered that, over the long term, Romaine facility operation will have a somewhat positive impact overall on the living conditions of the Innu population concerned. The significance of the impact is deemed moderate in Ekuanitshit and Nutashkuan, and minor in Unaman-shipu and Pakua-shipi.

## 5.5.3 Land use

### Construction phase

Community land use by the Ekuanitshit Innu will be somewhat disturbed temporarily in certain locations at the time work is carried out. The construction of access roads and Romaine-1 structures, road transportation and traffic, and the presence of workers will disturb certain Innu harvesting activities. These potential impacts will be mitigated, however, by applying standard environmental clauses. Stocking lakes near the workcamps with brook trout will minimize the risk of competition for available fish between workers and the Innu. In addition, Romaine 4 reservoir clearing operations, and the recovery and disposal of wood debris there, will make the Nahkuikan area less attractive and less used during fall 2017 and fall 2018.

Boating will be disrupted for a few months downstream of Romaine-1 at the time of Romaine 2 reservoir impoundment (spring and summer 2014) since the river should be less than 1 m deep on certain stretches.

Furthermore, the Innu living in cottages on the east shore of the Rivière Mingan estuary will occasionally be disturbed by heavier traffic on Highway 138. The same is true for the Innu hunting Canada geese in the coastal plain to either side of Highway 138. The drawbacks of heavier road traffic may be largely avoided by shifting hunting activities to bays either farther away from Highway 138 or east of the Route de la Romaine exit: Baie de la Grande Hermine, Baie Nickerson and bays east of Baie-Johan-Beetz. In general, efforts will be made to inform Innu land users of the project schedule and nature of work so they can plan their activities accordingly.

Lastly, if a large proportion of hunters have a full-time job, food supplied from game may drop off and be less regular. Under an IBA, Hydro-Québec will help mitigate this impact by agreeing to measures to promote *Innu Aitun* among mixed hunters from Ekuanitshit and Nutashkuan not working on the jobsite. The impact on land use during construction is deemed of moderate significance for the Ekuanitshit Innu and of minor significance for the Nutashkuan Innu.

### Operation phase

Route de la Romaine will give the Innu easier access to certain areas already used and may attract them back to areas now abandoned for economic reasons. Access to harvesting areas farther from the road could also be facilitated through means developed with the Innu to promote *Innu Aitun*.

The land users who were consulted expressed interest in the new road, especially since it makes it feasible for the Innu to inexpensively reach Nahkuakan in the northern part of the study area. However, the completed project will change practices there. Romaine 4 reservoir will flood several Nahkuakan sites long used by the Innu.

It will also flood several areas where resources, especially beaver, otter, marten, smaller game, lake trout and Arctic char, are presently harvested. The reservoir will transform navigation conditions for Innu users. The stretch of river upstream of KP 213, which now has very few obstacles and portages, and is judged easy to travel, will become a reservoir, which may restrict navigation in small craft when windy.

Regarding common activities in the area, it must be remembered that, due to modified ice conditions in various locations, snowmobiling on the river and reservoirs is not recommended. A number of mitigation measures are planned, however, to facilitate snowmobiling, particularly a snowmobile bridge at KP 15.5 and permission to use the bridge at kilometre 9 of Route de la Romaine. Rivière Romaine boating conditions will not change to the point of disrupting activities on the river downstream of Romaine-1 generating station. The reservoirs will offer favorable navigation conditions but it will be necessary to use boats suited to large bodies of water.

Route de la Romaine will open up regions extending about 150 km inland. Combined with the reservoirs, such access may moderately encourage use of the region by non-Natives. Up to Bassin des Murailles, the proximity of Native and non-Native activities may become an issue. Increasingly competitive use of the region will be offset, however, by the enhanced practice of *Innu Aitun* to which the new road will give rise.

The road will make it less expensive for the Innu to hunt in the region in fall, winter and spring, and thus help supply game to the community for food. However, the Innu will tend to avoid the forest during the moose sport hunting season in early fall.

The Romaine project will have an overall positive impact of moderate significance on long-term land use by the Ekuaniitshit Innu. There will be a lesser impact, however, for the Nutashkuan Innu.

## 5.5.4 Atlantic salmon harvesting

### Construction phase

Initially, road construction work, especially in the area of Grande Chute, will disturb salmon fishing by the Innu, who will have to fish farther downstream. Easier access to the region may also attract non-Native recreational anglers, who may become an annoyance for the Innu, who are accustomed to relative tranquillity along the reaches between Chutes à Charlie and Grande Chute.

Work to build Romaine-1 will later lead to a major disturbance of Innu fishing at Grande Chute, inducing the Innu to temporarily shift their fishing activities to other parts of the river. Besides applying standard environmental clauses, various measures will be developed under an IBA to mitigate these impacts. Workers will be made aware of existing regulations and of traditional Innu activities, and Innu fishers will be informed of the work schedule.

At the time of Romaine 2 reservoir impoundment (spring and summer 2014), there will be reduced flow downstream. The impact of this on salmon fishing by the Innu is difficult to predict precisely but the Innu will doubtless have to adjust their present practices to the specific conditions that will then prevail. Reduced river flow will also lead to difficulties in boating and in reaching fishing sites. On the other hand, Route de la Romaine may be used under certain conditions by Innu fishers to reach salmon fishing grounds farther upstream, especially between Chutes à Charlie and Grande Chute.

An enhancement program will be initiated before Romaine 2 reservoir impoundment to offset the loss of salmon production that may occur during impoundment. The program will help maintain or improve the situation of Romaine salmon resources. A steering committee is planned to manage the Rivière Romaine salmon enhancement program. Representatives of local communities and the resource manager will be asked to serve on the committee.

Considering the measures planned, an impact of moderate significance is anticipated on Atlantic salmon fishing activities by the Innu in the Romaine watershed. The impact will primarily affect the community of Ekuaniitshit.

### **Operation phase**

Building Romaine-1 generating station will result in the loss of the Grande Chute salmon harvesting site. Planned developments and measures to preserve this resource will, however, ensure continued salmon fishing. Fishing will be improved by measures to be agreed to under an IBA.

Changes to salmon behavior due to Romaine flow control downstream of Romaine-1 (see impacts on Atlantic salmon in Section 5.3.1) will modify conditions under which the Innu fish, particularly at Chutes à Charlie. Fishers may have to make greater use of other suitable sites between Chutes à Charlie and Grande Chute. To facilitate adjustments, Innu fishers will be informed of changes to fishing conditions resulting from Romaine development flow management. As mentioned above, representatives of local communities and the resource manager will be asked to serve on the steering committee to be set up to manage the Rivière Romaine salmon enhancement program.

Route de la Romaine will make it much easier for recreational anglers to reach Grande Chute. To avoid potential disturbances or conflicts arising from the use of this fishing site, Innu fishers will tend to leave the site and direct their efforts to areas farther away. Measures to be worked out under an IBA will help support salmon fishing by the Ekuaniitshit Innu. The salmon enhancement program will also help mitigate the project's impact on Innu fishing. The disturbance to Atlantic salmon fishing at Grande Chute and modification of fishing conditions is an impact of moderate significance.

## **5.6 Impacts on the archaeological heritage**

### **Operation phase**

The hydroelectric developments and reservoirs will affect listed archaeological sites on and around the banks of the Romaine. For several of the sites, all information of interest has already been collected. Digs have yet to be conducted for 23 sites, but will be carried out before construction to avoid losing the information the sites contain.

The area covered by digs varies greatly from site to site. In all, digs or surveys will cover 1,461 m<sup>2</sup>, of which 761 m<sup>2</sup> are on prehistoric and historic sites, and 700 m<sup>2</sup> on one twentieth-century site (a Euro-Canadian trapper camp). Hydro-Québec intends to continue collaborating with the Innu and encouraging their participation in archaeological work.

Given the measures taken, the impact on the archaeological heritage is considered negligible.

Archaeological research results will be made public. Furthermore, in collaboration with community representatives, Hydro-Québec will participate in preserving this heritage.

### **Construction phase**

During construction, there may be chance finds of archaeological remains.

Various measures will then be taken for heritage protection. Besides applying pertinent environmental clauses, particularly the one on technological and architectural heritage and archaeological remains, the location of areas of archaeological potential will be marked on construction drawings, in addition to the boundaries of listed sites. Documents handed out to contractors will specify the necessary protective measures. They will specify such things as the respective roles of the contractor liaison officer, the jobsite environmental supervisor, the representative of the Innu band council of Ekuaniitshit and the Hydro-Québec archaeological specialist with respect to any digs to be conducted.

A minor impact on archaeological heritage is anticipated during construction.

## **5.7 Impacts on landscape**

### **Operation phase**

Grande Chute, a scenic feature for users of the area, will vanish due to the Romaine-1 development. In the more rarely visited area farther upstream, the project will make the waterfalls and rapids in the bypassed stretches less scenic, and reduce the quality of the Bassin des Murailles landscape. Flow management at the development will have a negligible impact on the appearance of waterfalls and rapids downstream of Romaine-1 dam.

The Romaine complex will introduce anthropogenic features (dams, powerhouses, dikes, spillways, etc.) into the landscape, some visible from the permanent road, reservoirs, river sections and bypassed stretches (see figures 14 and 15).

Creating the reservoirs will transform almost all Romaine riverscapes into lakescapes. The reservoirs will be new bodies of water with a scenic value comparable to a number of nearby lakes. During the initial years of operation, however, portions of the shores and other parts of Romaine 2, Romaine 3 and Romaine 4 reservoir will be dotted with partially submerged trees.

*Figure 14: Visual simulation of Romaine-1*



Figure 15: Visual simulation of Romaine-2



Clearing by natural forces will gradually diminish the visual impact of the flooded vegetation. Hydro-Québec will collect wood debris near hydraulic structures if it could hinder their operation. This measure will reduce the visual impact of such debris. The edge of Romaine 1 reservoir and a 3-m strip along the shore will be cleared and the wood debris collected.

Note in closing that Route de la Romaine will help users discover new, previously inaccessible landscapes. A few pull-offs built along the road will make it possible to enjoy views of the landscape.

Overall, the impact on landscape is deemed moderate.

#### **Construction phase**

Reduced flow downstream of Romaine-2 when impounding Romaine 1 and Romaine 2 reservoirs will temporarily reduce the size of waterfalls and rapids, as well as the aquatic area. Figure 16 illustrates the present situation at the Highway 138 bridge with a flow of 225 m<sup>3</sup> and gives a visual simulation of the situation during the second phase of Romaine 2 reservoir impoundment. Since this is a localized impact that will only be felt for a few months in 2014 and for two weeks in 2016, it is deemed minor.

Figure 16: Rivière Romaine at the Highway 138 bridge



Present situation



Visual simulation

## 5.8 Cumulative effects

Cumulative effects are changes to the environment due to the interaction of one action with other past, present or future actions. The following valued ecosystem components (VECs) were considered in analyzing the cumulative effects from the Romaine project:

- Atlantic salmon
- Moose
- Woodland caribou of the forest-dwelling ecotype
- Common tern and Arctic tern
- Wetlands
- Recreation and tourism
- Land use by the Ekuaniitshit and Nutashkuan Innu

Past, present and future regional projects, actions and events were exhaustively listed based on information provided by community stakeholders. The primary determining factors were identified for each VEC. They were generally limited in number given the lack of human activity in most of the region studied.

### 5.8.1 Atlantic salmon

Statistics on sport fishing and other indirect indicators show a downward trend in salmon stocks in the RCM of Minganie and the Côte-Nord administrative region over the past 30 years. This phenomenon is occurring in many rivers in eastern North America and the decline is continuing despite legislative and regulatory measures implemented to protect the resource and its habitat.

Salmon harvesting and the diminishing survival rate of salmon in the sea, generally attributed to increased predation and lower surface water temperatures, are likely the main causes of the declining populations. The situation in the Romaine is of some concern given that sport and subsistence fishing pressure remains high, while the salmon population is at a very low level. The impact of the Romaine project is nevertheless deemed of minor significance since essentially a 5% lower juvenile growth capacity is predicted and this should not appreciably influence the trend in stocks. The project will thus have a negligible effect on salmon at a regional level.

It is difficult to foresee how environmental factors in the sea will evolve. Fishing pressure may increase with increased access due to new roads, particularly the Kegaska–Vieux-Fort road toward Blanc-Sablon, but in principle, existing legislation should protect the resource. It is also known that various projects are being studied to create biodiversity reserves to protect salmon and restore its habitat in east Minganie.

There is thus no reasonable basis for predicting a cumulative effect on Atlantic salmon due to the project.

Hydro-Québec still intends to implement several mitigation measures and proposes that an enhancement program be initiated to improve the situation of salmon in the Romaine. A monitoring program is also planned (see Section 6).

### 5.8.2 Moose

Moose in the study area are a relatively recent phenomenon, only dating back to the 1960s. Resource managers now generally consider that populations are stable and healthy. Statistics confirm relative stability over the period studied based on available density estimates, and show minor variations, with a slight increase in harvest over the past five years based on sport hunting data.

Subsistence moose hunting is not widespread among the region's Innu communities, as caribou generally are the preferred game. Though practised by a relatively limited number of individuals, sport hunting is probably the factor that has most affected moose population trends in the study area. An analysis of present conditions has shown a relationship between the winter density of moose and hunting pressure in the south of the study area, where the species is less abundant despite a greater concentration of high-potential habitats.

An impact of moderate significance is anticipated, which will result in slower population growth and a probable shift in range due to the loss of quality habitats (flooding) and potentially increased harvest. Increased access to the interior over Route de la Romaine may lead to more evenly distributed hunting pressure and may attract more hunters to the region.

Only a moderate rise in hunting is anticipated, however, given the remoteness from major centres and the lower density of moose compared to other regions. Increased access may favor logging and mining but no such projects are presently planned.

The project to connect the Romaine complex to the transmission system will fragment large, exclusively coniferous forests and give rise to deciduous stands providing favorable moose habitat. There are projects under study for biodiversity reserves in the region. If they materialize, fully or partially, large areas of habitat would be protected.

No negative cumulative effect on moose is thus presently anticipated. Populations may be redistributed but nothing points to their diminishing.

### 5.8.3

#### Woodland caribou of the forest-dwelling ecotype

The forest-dwelling caribou is relatively scarce in Québec today. At the end of the twentieth century, its range had diminished everywhere in North America. A few large herds, from a few hundred to a few thousand caribou each, were formerly found in eastern Québec but gradually disappeared in the 1960s and 1970s. At workshops on Mingan ecological knowledge, attendees stated that caribou were everywhere in the 1960s, particularly along the Romaine, on islands and in peatland, and even in Havre-Saint-Pierre.

In 1979, caribou hunting was prohibited in the RCM of Minganie. The woodland caribou of the forest-dwelling ecotype was listed as a threatened species federally in 2002 and as a vulnerable species in Québec in 2005. In 2002, forest development guidelines addressing this species were established. An action plan to restore populations and a habitat development strategy are presently being prepared.

Excessive harvesting (sport hunting, subsistence hunting and poaching) is likely the major factor that influenced caribou numbers in Côte-Nord. Population levels have remained low, however, even after hunting was prohibited. The forest-dwelling caribou is a very sensitive species, particularly vulnerable to predation by wolves and disturbances from human activity.

Various measures have been taken to protect forest-dwelling caribou, and others are being prepared. It is conceivable that in the near future any forestry or other activity in the caribou's range will be carried out with a view to conserving the species and its habitat. The presence of forest-dwelling caribou is invoked to justify creating two of the planned biodiversity reserves in the region.

It is anticipated that the project will have an impact of moderate significance on forest-dwelling caribou, primarily by changing its distribution due to increased access to the region (possible harvesting) and disturbances (road traffic). The project to connect the Romaine complex will entail clearing rights-of-way that will fragment the mature coniferous forests sought out by caribou and will facilitate the movement of predators and humans. Thus roadways and lines potentially have a cumulative effect. Hydro-Québec therefore proposes to monitor caribou populations inside a study area that covers the project to connect the complex. By means of aerial surveys and telemetric monitoring, an assessment will be made of the region's caribou populations and their use of the area, and changes will be monitored during the construction phase and the initial years of the operation phase.

### 5.8.4

#### Common and Arctic tern

The common tern and Arctic tern have been studied as VECs given their interest for specialists. There will be no negative impact on terns due to the project and no cumulative effect on this component is thus anticipated.

Data analyzed shows major multiyear fluctuations at shelters in the area considered. Methodological differences at the time of the various surveys, as well as the low nesting site fidelity and very high mobility of terns, make it difficult to draw conclusions regarding population trends.

### 5.8.5

#### Wetlands

The evolution of wetlands was studied for the coastal plain of the RCM of Minganie, where they are mostly found and anthropogenic activity is greatest. The area covered by wetlands, about one-third of the zone considered, decreased by 0.2% (151 ha) during the study period (1989–1999). The loss is practically all due to expansion of road infrastructure, essentially to extending Highway 138 to Natashquan and building smaller roads.

Given the region's limited development, wetland losses to date do not presently seem to be a regional problem. A number of acts, regulations, and federal and provincial policies have come into effect in recent years to protect these fragile environments. The Archipel-de-Mingan National Park Reserve of Canada guarantees the protection of some of the wetlands in the zone studied.

The Romaine complex will result in the loss of 1,359 ha of wetlands, but an estimated 733 ha will develop naturally on the shores of the reservoirs after impoundment. The net loss will thus be 626 ha. Compensation measures for the project include developing wetlands in borrow pits once work is completed. This measure should create 100 ha of wetlands.

In the coming years, road construction, peat mining and bank erosion are the factors that would most likely to modify wetlands in the zone studied. The first two factors remain hypothetical. A peat mining project between Havre-Saint-Pierre and Natashquan is under study but may not materialize. However, Côte-Nord bank erosion is of major concern. Potential losses were estimated in the zone where this VEC was studied and, based on the worst-case scenario, erosion could affect 0.02% of the wetland area there by 2030.

Given the relative magnitude of the losses considered, no cumulative effect is anticipated on wetlands in the region. Mitigation measures and follow-up for this VEC are thus those established as part of the project.

### **5.8.6 Recreation and tourism**

The extension of Highway 138 to Havre-Saint-Pierre and then on to Natashquan, and the creation of the Archipel-de-Mingan National Park Reserve of Canada are the major factors that, over the past 30 years, have marked the development of recreation and tourism in the zone where this VEC was studied.

This development has resulted in growth and diversification of activity along the coast as the highway was gradually extended and the number of visitors grew, attracted by the reserve, now a key element in regional tourism (visits increased by more than 200% in 20 years). Due to the lack of road access, there has been appreciably less development inland than on the coast, though use has been rising over the years as the population's access to the Archipel de Mingan has become more restricted since the reserve was created. As desired by regional tourism players, the two main areas of development have been ecotourism and the harvesting of wildlife resources.

The coastal zone is presently very popular in summer, whereas the interior is a more frequent destination in fall and winter, in order to hunt and snowmobile. Hunting and fishing remain little developed due to difficult access and are mainly practised by people from the region.

The project will help improve access to the interior and will promote the development of not only hunting and fishing but also vacationing. Canoeing and kayaking will be possible on the reservoirs, while planned mitigation measures will enable snowmobilers to cross the Romaine regardless of ice conditions, which should extend the snowmobiling season.

Though the Romaine project should have an overall positive effect on recreation and tourism potential, the impact will probably have less weight from a long-term regional perspective than other projects long expected in the region. The main attractions drawing tourists to Minganie are, above all, coastal activities. From this standpoint, the highway extension to Blanc-Sablon, and the desired ferry link between Havre-Saint-Pierre, Port-Menier on Anticosti Island and Grande-Vallée in Gaspésie (visited annually by about 300,000 tourists compared to 30,000 in Minganie) will clearly have a much greater impact.

It is nevertheless anticipated that the Romaine project will have a positive cumulative effect on regional tourism, particularly on the development of activities inland. Mitigation and enhancement measures are planned to optimize such development, in addition to monitoring changes in land use.

### **5.8.7 Land use by the Ekuanitshit and Nutashkuan Innu<sup>13</sup>**

At a time of intensified research on contemporary land occupancy (1975), the Innu had already become much more sedentary. In the following years, increased access through the extension of Highway 138 and certain government measures were dominant factors in study area land use.

Use of the interior by the Ekuanitshit and Nutashkuan Innu is not as intensive as in the past. At the turn of the century, much of the Ekuanitshit Innu wildlife harvesting effort turned to the more accessible Pujalon and Manitou watersheds, where game is plentiful. The extension of Highway 138 gradually encouraged the Nutashkuan Innu to shift their activities westward, to the eastern portion of the Romaine watershed.

The extension of Highway 138 and the creation of the Archipel-de-Mingan National Park Reserve of Canada also encouraged use of the coastal strip and reinforced a very important activity for both communities: migratory bird hunting. At the same time, cottages were built along the coastline. Highway 138 and the park reserve had the same effect on the Minganois population, which also makes increasing use of the coast. Over time, each community adopted its own specific areas.

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13. Since no Innu users of the study area (Québec portion of the Romaine watershed) were residents of Unaman-shipu or Pakua-shipi, the study of cumulative effects only covers Ekuanitshit and Nutashkuan.

Other government actions and Native claims have a determining impact on *Innu Aitun*. The band councils thus become important stakeholders as managers of funds for wildlife harvesting activities, administrators of outfitting operations and associate managers of wildlife resources.

With this in mind, the Ekuanitshit Band Council implements measures to protect forest-dwelling caribou and Atlantic salmon. Salmon fishing is managed by official fishing permits and quotas. On the Rivière Romaine downstream of Grande Chute, the presence of non-Native anglers sometimes limits Native fishing. This is particularly true in the mouth zone. The Innu from both communities also fish in the region's lakes and other rivers, where brook trout, landlocked salmon and lake trout are the prized catch.

The project, and particularly Route de la Romaine, will facilitate *Innu Aitun* by encouraging travel northward and making the region accessible to a larger number of people, in particular to the elders, women and children. To a lesser extent, increased access due to the lines built to connect the complex will have a similar effect. As in the past, the Ekuanitshit Innu will have to rely increasingly on vehicles to use the region. On the Romaine, though salmon fishing will not be compromised, members of that community will have to adapt to new fishing conditions. For the Nutashkuan Innu, use of the Romaine watershed will be reinforced.

Access available over Route de la Romaine will also increase use by the Minganois. As occurred after the Archipel-de-Mingan National Park Reserve of Canada was created and after Highway 138 was extended, the anticipated effect of the project will be a tendency for the region to be tacitly divided up between the Innu and Minganois.

In general, the cumulative effects of the project on land use by the Innu seem likely to occur in a context of continuity with trends that have been developing over recent decades. Agreements and funds from the project will help Ekuanitshit and Nutashkuan Innu leaders strengthen their responsibilities and actions in the area of resource management and land use, for an increased practice of *Innu Aitun*. Various mitigation and enhancement measures to optimize this practice are included in agreements negotiated, or to be negotiated, with the Innu. A monitoring program is also planned on study area land use by the Innu.

# 6

## Environmental Compliance Assurance and Monitoring

### **6.1 Environmental compliance assurance**

Compliance assurance is exercised during the construction phase and consists in ensuring that all acts, regulations and Hydro-Québec guidelines are applied, and that specific environmental commitments and obligations are met.

Environmental protection measures set out by Hydro-Québec form an integral part of the contractual obligations and responsibilities imposed on companies to which it assigns work. Those companies are thus required to:

- Comply with Hydro-Québec environmental protection policies and directives
- Submit drawings of their jobsite facilities to Hydro-Québec so it can make sure that they comply with acts and regulations, and with environmental protection directives

In accordance with ISO 14001, Hydro-Québec also has an environmental monitoring plan, which includes a list of standard environmental clauses to be followed on jobsites.

### **6.2 Environmental monitoring**

Environmental monitoring is a means of validating the impact assessment, checking the effectiveness of mitigation, compensation and enhancement measures, and determining any necessary changes to those measures.

The environmental monitoring program for the Romaine complex will be developed in detail once the project is authorized. However, Hydro-Québec has already planned a general 32-year monitoring program lasting from 2009 to 2040 (see Table 8). The program is organized based on the environmental components affected by the project. It includes different monitoring methods based on the use of various means of measurement, including observations in the field, aerial surveys, opinion polls and investigations. Information collected will be made available to the government authorities concerned, and commitments will be made to release monitoring results to the public.

Table 8: Environmental monitoring program

Object of study	Future conditions																														
	2009	2010	2011	2012	2013	2014 <sup>a</sup>	2015	2016 <sup>b,c</sup>	2017 <sup>c</sup>	2018	2019 <sup>d</sup>	2020 <sup>d</sup>	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Present conditions																															
Thermal regime																															
Water quality																															
Fish																															
Mercury in fish																															
Vegetation																															
Terrestrial and semi-aquatic wildlife																															
Birds																															
Biological oceanography (Chenal de Mingan plankton)																															
Forests																															
Socioeconomic environment																															
Minganais land use																															
Imu communities																															

- a. Year of Romaine 2 reservoir impoundment
- b. Year of Romaine 1 reservoir impoundment
- c. Year of Romaine 3 reservoir impoundment
- d. Year of Romaine 4 reservoir impoundment

The following paragraphs give the objectives for each environmental component selected.

### **Thermal regime**

The purpose of the thermal regime monitoring program is to validate projected water temperatures downstream of Romaine-1 and Romaine-2 generating stations.

### **Water quality**

Romaine complex water quality monitoring covers the dissolved-oxygen level in the pool on the Romaine-1 bypassed stretch. Levels will be checked to see that they remain high enough in winter for the survival of fish that may be confined there.

### **Fish**

The monitoring program for fish communities and their habitat has the following objectives:

- Describe how the abundance of the various fish populations in the reservoirs and remaining river sections of the Romaine varies over time.
- Describe habitat use by reservoir fish.
- Assess the success of stocking operations and developments intended to increase the abundance of fish.
- Describe changes to the Atlantic salmon population, and to the use of natural and developed spawning sites downstream of Romaine-1.
- Check whether young Atlantic salmon wash up downstream of the Romaine-1 powerhouse and take corrective action if necessary.

Further objectives will be added for the Romaine salmon enhancement program once parameters and time lines for that program have been better defined, in collaboration with the various stakeholders involved.

### **Mercury in fish**

The monitoring of mercury at the Romaine complex relates to managing the potential health risk of consuming fish with higher mercury levels temporarily caused by creating the reservoirs. Since the anticipated additional risk is negligible, discussions with local public health authorities will determine the pertinence and effort to be deployed for each of the following points:

- Monitoring of fish mercury levels
- Monitoring of the local population's exposure to mercury
- Information on the risks and benefits of eating fish and follow-up on the effectiveness of this communication program.

### **Vegetation**

The first item in vegetation monitoring involves reservoir riparian wetlands. The purpose is to document wetland development, including validating the abiotic parameters (substrate, slope and vulnerability to erosion) used in assessing potential regrowth.

A specific vegetation monitoring program will verify how well vegetation becomes re-established subsequent to the various mitigation and compensation measures: clearing for riparian habitat regrowth, developments in bays, restoration of disturbed areas and revegetation.

The last monitoring item involves the effectiveness of the ostrich fern and sand heather transplanting programs.

### **Terrestrial and semi-aquatic wildlife**

Forest-dwelling woodland caribou monitoring has the following objectives:

- Determine precisely how the caribou use the environment.
- Assess the effect that building and operating structures has on caribou living in the study area.

The study area for monitoring forest-dwelling caribou will be more extensive than the project study area in order to include the lines connecting the Romaine complex to the transmission system, given the potential cumulative effects of the two projects and the very high mobility of forest-dwelling caribou.

Another item is the monitoring of wildlife during reservoir impoundment. The objective is to identify areas where problems may arise for wildlife and collect pertinent information. If animals in difficulty are sighted, appropriate measures will be taken.

### **Birds**

The bird monitoring program comprises the following activities:

- Check the impact of reservoir creation on waterfowl.
- Confirm whether breeding waterfowl use the developments made as mitigation or compensation measures.
- Monitor the use of nest boxes by tree-nesting ducks and the use of osprey platforms.
- Monitor the use of the golden eagle nest during construction.

### **Chenal de Mingan plankton**

Plankton monitoring involves the numerical model used to predict the effect of Romaine complex operation on plankton production in the Chenal de Mingan. It comprises the following activities:

- Validate by sampling the basic physical, chemical and biological parameters of the baseline three-dimensional model.
- Verify the main conclusions drawn from the model with respect to modifications to the Romaine hydrological regime.

### **Minganois socioeconomic environment**

The socioeconomic monitoring program has two main objectives:

- Document economic spinoffs.
- Determine the social effects of the project.

### **Minganois land use**

The purpose of monitoring land use by the Minganois is to verify whether conditions are maintained to ensure continued sport hunting, sport fishing, trapping, vacationing, snowmobiling and boating, and to verify use of the areas affected by the project. The effect of Route de la Romaine and the reservoir on these activities is also to be assessed.

Monitoring hunting and fishing by workers assigned to construction of the complex will also show the effectiveness of measures for controlling such activities in order to minimize impacts on land users.

### **Forests**

The forest monitoring program first includes verifying the condition of trees planted in areas disturbed by the work.

A specific item in forest monitoring is to track the evolution of wood debris and floating bogs on the reservoirs in order to determine any appropriate action to be taken.

### **Innu communities**

The program monitoring social and economic aspects in Innu communities more specifically covers economic spinoffs (job creation and businesses) and improvements to living conditions.

The purpose of the Innu land use monitoring program is to assess project impacts on conditions under which the communities of Ekuanitshit and Nutashkuan can practise *Innu Aitun* in the study area.





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