



Construction of the

Sainte-Marguerite-3

Hydroelectric Development

1994-2002

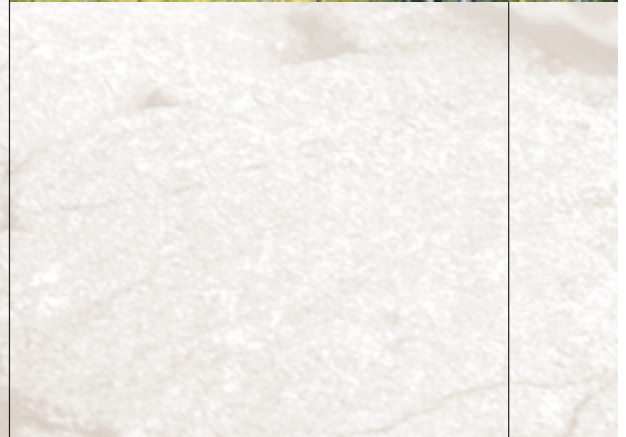
Environmental Highlights



An Overall Success



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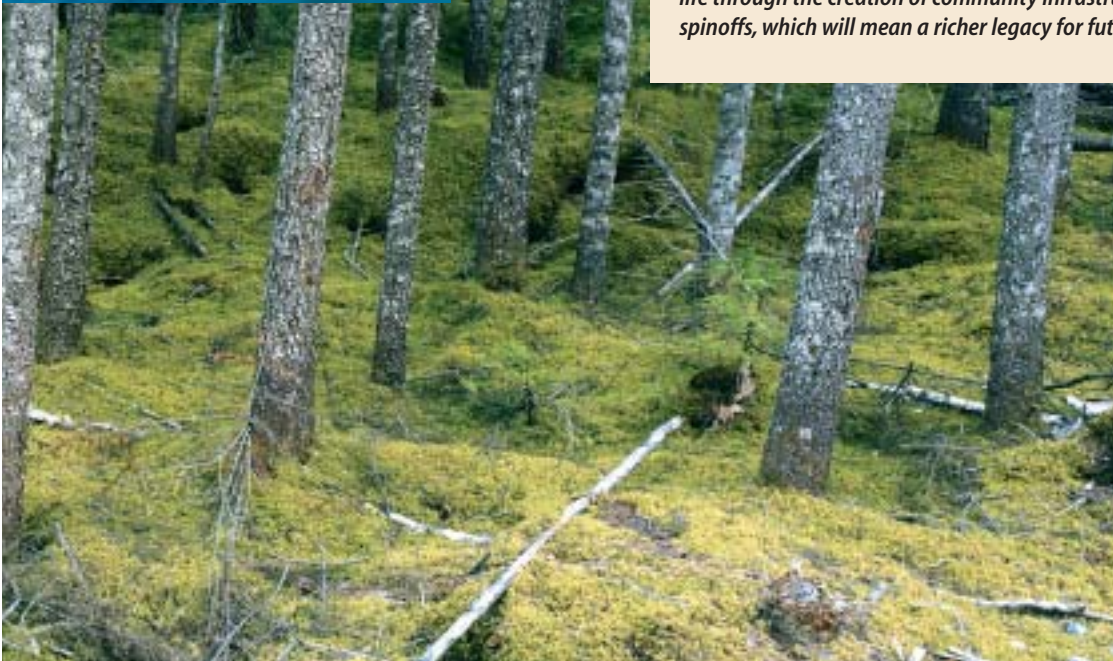


Once completed, the Sainte-Marguerite-3 hydroelectric plant will supply 2.7 TWh of electricity. This project has been developed with a concern for optimum integration into the natural environment and local communities, and in a spirit of sustainable development.

Numerous studies provided valuable scientific knowledge about the region's fauna, flora and history—bird nesting areas, for example, and use of the land over the last four millennia. This knowledge should help improve the protection and management of natural resources.

In addition, the application of mitigation and compensation measures has had significant spinoffs for the local economy. It has also made the back country more accessible and financed the improvement of many community facilities.

With Sainte-Marguerite-3, Hydro-Québec has demonstrated that major capital projects like this one can stimulate regional economies in a way that is respectful of the environment. There can be no doubt that the project has improved the local residents' quality of life through the creation of community infrastructures and other spinoffs, which will mean a richer legacy for future generations.



The Sainte-Marguerite-3 Hydroelectric Development



Sainte-Marguerite River



The Sainte-Marguerite River runs 280 km from north to south as far as the Gulf of St. Lawrence. Two hydroelectric generating stations belonging to independent power producers have already been built near the mouth: Sainte-Marguerite-1 (capacity: 28.5 MW) and Sainte-Marguerite-2 (capacity: 17.6 MW). The new Denis-Perron dam is located further inland. Its reservoir runs a length of 140 km and covers 253 km².

The Sainte-Marguerite River, with its deep, narrow valley and substantial natural vertical drop, was an ideal site for hydroelectric development on the North Shore of the St. Lawrence; in fact, it already had two hydroelectric generating stations. It was only in 1994, however, after seven years of studies, that Hydro-Québec finally began building a dam on the river.

Sainte-Marguerite-3 generating station, which has two generating units with a total capacity of 882 MW, is scheduled for commissioning in 2003. Its output will be used essentially to meet Québec energy needs and will be added to the 31,174 MW which Hydro-Québec is currently able to supply. The plant is designed to accommodate a third generating unit in a subsequent phase.

The \$2-billion project was eagerly awaited by business people and economic stakeholders in the region, where the unemployment rate remains particularly high. Nevertheless, any hydroelectric development inevitably has impacts on the wildlife, resources and users of the area affected.

Hydro-Québec expended considerable efforts to keep these impacts to a minimum, and included environmental and social considerations at every stage of the project. The initiative was planned in a spirit of sustainable development, so as to preserve the environment for local communities and for future generations. The biophysical environment will return to a natural balance after about 10 years.



Denis-Perron Dam

A hydroelectric generating station like Sainte-Marguerite-3 makes use of a renewable resource that does not produce air pollutants; in addition, its greenhouse gas emissions are approximately 30 times lower than those of gas-fired power plants, and 90 times lower than those of coal-fired facilities.



Site of the dam in 1993



Signing of the Uashat Mak Mani-Utenam Agreement

Starting in 1994, Hydro-Québec signed several agreements with the regional authorities and economic stakeholders. Three main objectives were set: implement measures to mitigate the environmental and social impacts; award compensation for irreversible disturbances caused by the dam; and create regional enhancement.

Uashat Mak Mani-Utenam (1994) Agreement

The Uashat Mak Mani-Utenam Agreement, signed with the Innu community of Uashat-Maliotenam, provides for \$20.9 million (in discounted 1994 dollars) in compensation to be paid over a period of 50 years. In addition, a maximum of \$10 million was budgeted for remedial measures during construction. Responsibility for these measures was assigned to the Sainte-Marguerite remedial works corporation (SOTRAC**), which is run jointly by the Innus and Hydro-Québec.

Integrated Enhancement Program (IEP)

Funding of \$28 million was made available to local communities in 1995 to support regional development and environmental enhancement.

Matimek ZEC**

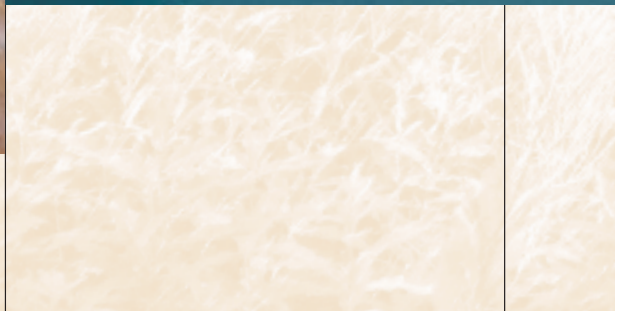
Since Denis-Perron dam lies within the territory of the Matimek ZEC (controlled harvesting zone), Hydro-Québec and the Sept-Iles hunting and fishing association signed an agreement that provided for better access to Sainte-Marguerite 2 reservoir and also provided the association with an administrative structure for the duration of the construction.

* Société des travaux de correction

** Zone d'exploitation contrôlée

The studies and work carried out by Hydro-Québec have had a number of concrete benefits: new scientific knowledge, improved access to the area, and regional development. This brochure provides a review of those benefits.

From Scientific Knowledge to Impact Reduction



The environmental follow-up studies conducted by Hydro-Québec during construction were intended to assess the negative effects of the project on the local environment and the effectiveness of the measures adopted to mitigate them. They also yielded new scientific knowledge and contributed to improved management of local resources.

Many of the studies examined the impacts of the impoundment of Sainte-Marguerite 3 reservoir, which turned land and river habitats into lake habitats. These studies demonstrated that no rare or endangered species was affected by the project.



Photo: Pierre Dupuis



Barrow's goldeneye

This duck was first observed nesting in Québec in the 1998 inventory. It was not previously known to breed in eastern North America. However, it had long been suspected that these migratory birds, which nest in Iceland and winter in the St. Lawrence estuary and along the coast of the Atlantic provinces and Maine, also came to Québec to build their nests. As it happens, a similar observation was made at the same time in the Saguenay region by the Canadian Wildlife Service.

Photo: Alain Hogue



Golden eagle

Between 1994 and 2002, 15 sites containing 44 eagles' nests were discovered. Since the follow-up began, the most favorable breeding year for the six pairs of golden eagles observed in the region has been 2000, when seven eaglets were born. This success coincided with the peak in abundance of the snowshoe hare, a prime prey whose presence is subject to cyclical variations. Along with the bald eagle and peregrine falcon, the golden eagle is one of the three birds of prey species observed in the Sainte-Marguerite drainage basin that are considered vulnerable. However, these three species were not disturbed by the reservoir impoundment.

In 1994, Hydro-Québec began an inventory of avifauna to monitor its distribution and abundance in the Sainte-Marguerite basin before and during impoundment. Two groups of species were studied particularly closely: waterfowl, which was going to lose about 350 hectares of nesting habitat, and birds of prey, some species of which were likely to be designated as vulnerable.

Altogether, 19 species of waterfowl were identified. The most abundant species in the region are common goldeneye, Canada goose, American black duck, ring-necked duck, common merganser and surf scoter. Following impoundment, the abundance of waterfowl pairs fell from 250 to 80 between 1997 and 2002. Since the habitat was not saturated, the birds displaced by the project seemed able to nest in other nearby areas. The submergence of some parts even appears to have had a positive impact, as it increased the surface area of aquatic sites available for resting and feeding. These bodies of water also offer moulting grounds for certain species.

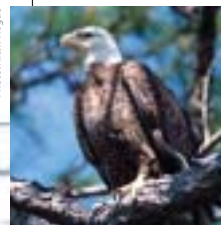
The birds of prey observed in the reservoir zone are the golden eagle, osprey, red-tailed hawk, barred owl, American kestrel, northern harrier and great horned owl. In 1997, a northern hawk owl was also sighted for the first time in the region. A decline in the osprey's use of the reservoir was noted, however. Other species seem to have been little disturbed, generally speaking, by the reservoir impoundment, even though part of their hunting grounds has been flooded.

Photo: Claude Madéau



Birds

Photo: Alain Hogue



Bald eagle



Attaching a collar

Two types of radio-collars were used in the study. Conventional VHF-type collars allowed remote monitoring, while other collars were equipped with GPS. The animals were tracked by helicopter, according to the major stages in their annual cycle.



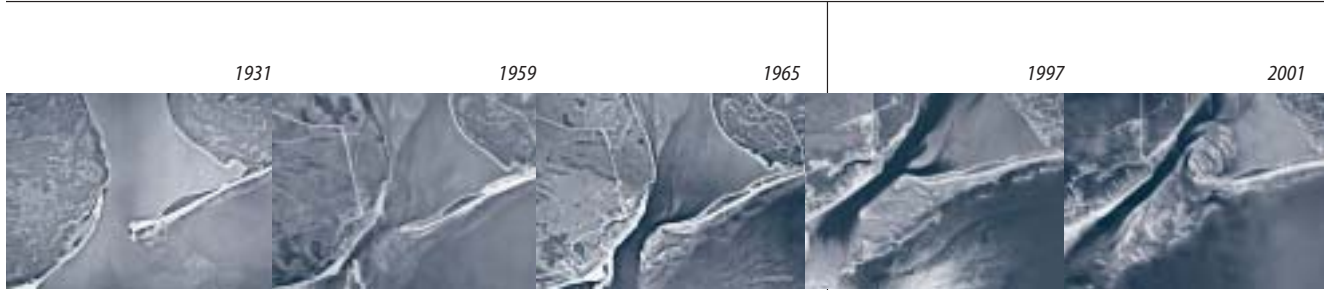
Regardless of the season, a number of moose equipped with radio-collars crossed the reservoir. This new body of water therefore does not constitute an impassable barrier that could lead to the creation of two sub-populations.

The creation of a 253-km² reservoir meant that some stands of trees particularly sought after by moose in winter, such as aspen and birch, were submerged. Biologists feared that this change would have a serious effect on these large mammals, since their range was generally estimated at about 10 km². Basic research on the species was therefore begun in 1994, in cooperation with the provincial Department of Environment and Wildlife. This research looked at the fecundity of the females and the movements of some 20 animals equipped with radio-collars over a seven-year period.

Contrary to expectations, the research showed that the moose's range fluctuated tremendously from one individual to the next. The area used in a year varied from 10 km² to 400 km², for an average of 100 km². Moreover, no variation in the females' fecundity was noted as reservoir impoundment progressed. Since they are able to explore large areas, the moose managed to adapt to the flooding of part of their range.

Moose





The estuary from 1931 to the present

As these photographs show, the estuary morphology changes continually under natural conditions. The length of the spit of land does not depend on the flow of the Sainte-Marguerite, but is affected mainly by storms blowing from the east. These exceptionally strong storms are also considered responsible for the erosion that occurred during filling and, more recently, for the spread of the sandy delta behind the spit.

Smelt

To evaluate the impact of the impoundment on aquatic fauna, 2,890 fish were caught between 1998 and 2001. Rainbow smelt accounted for 95% of the catches. This anadromous species lives and feeds in salt water, but spawns every year in fresh water.



The filling of Sainte-Marguerite 3 reservoir from 1998 to 2001 brought about a temporary 76% reduction in freshwater inflow into the Sainte-Marguerite estuary. A number of oceanographic studies have been conducted since 1997 to evaluate the impact of this change in flow on the estuary morphology and aquatic fauna.

During filling, the water level in the estuary at low tide fell by amounts ranging from 0.22 m at the mouth to 0.43 m at the head. These decreases had a stabilizing effect on the estuary banks and had no major impact on freshwater or saltwater habitats. In fact, the basin upstream from the estuary remained a freshwater environment at all times.

Sainte-Marguerite estuary

Since the rainbow smelt spawned upstream from a rocky sill 6.7 km from the mouth of the river, biologists feared that the reduction in flow during filling would make it impossible for them to get past this barrier. However, the various fishing campaigns carried out over the years confirmed that the impoundment had not prevented rainbow smelt from migrating upstream to spawn. These studies also helped locate the spawning grounds, which vary from year to year depending on the river flow, and yielded the observation that smelt had spawned there from 1998 to 2002. The cutoff of flow during impoundment therefore had no impact on smelt breeding.

Sainte-Marguerite Estuary

Development of spawning grounds

A number of spawning grounds like the one shown here were developed on a tributary of Lac à Moi to improve brook trout spawning conditions. This type of spawning ground is set in a pool and the right size of gravel is added to promote egg laying and hatching. The boulders around the rim ensure optimum water flow and protect the pool in high water periods.



To offset the changes in fish habitat and enhance the quality of sport fishing, À Toi, À Moi and Hélène lakes were stocked with fish. Several thousand brook trout fry, produced by spawners caught in the region, were released in these lakes, along with nearly 2,000 adult breeders.



Cascading pools on a tributary of Lac à Toi

Alternatively, cascading pools can be used to improve brook trout spawning grounds. Such pools were set up in some tributaries of Hall Lake and Lac à Toi. Their shape is well suited to small streams, where the flow velocity, water depth and presence of impassable obstacles limit brook trout breeding. Here, too, gravel of the appropriate size for egg laying and hatching was laid.

As a result of these developments, carried out in 1999, a natural brook trout breeding process began in 2000 and the fishing potential of the Matimek ZEC was increased.

Brook Trout



Because the Moisie is a very wide, deep river, scientists turned to a hydroacoustic detection method that had been used on the Pacific coast to count salmon. Based on the same principle as sonar, this method involves emitting sound waves that reverberate against obstacles, such as salmon, producing an echo that can be analyzed.



As a result of Hydro-Québec's monitoring of the Moisie salmon populations between 1992 (6,711 salmon) and 1998 (4,583 salmon), the estimated salmon count in the river was revised downward, as were fishing quotas. The reason for this decline is still not known, but a similar phenomenon has been observed in most salmon rivers around the North Atlantic, despite substantial restrictions on catches in salt water. Everything points to a sizable increase in natural mortality during the salmon's ocean migration.

The Sainte-Marguerite-3 hydroelectric development originally called for the diversion of two tributaries of the Moisie River, namely the Aux Pékans and Carheil rivers. Located at the head of the Moisie basin, these two rivers are not used by salmon because of falls that block the way. However, it was feared that a 13% reduction in the Moisie's flow following the diversion might lead to habitat losses for young salmon and reduce the quality of fishing in some parts of the river.

Knowing the importance of the Moisie River salmon, Hydro-Québec carried out numerous studies that yielded a much greater understanding of the dynamics of the river's salmon population. Although the diversion project was ultimately not authorized, the new knowledge has been of considerable help to managers of this resource.



Moisie River Salmon

Mercury



Fish consumption map and guide

Hydro-Québec, in collaboration with the North Shore health and social services board, has published a map for fishermen. This map indicates, for each type of environment and each species of fish, the maximum quantity that may be consumed in order to benefit from the high nutritional value of fish without exceeding the safe level of mercury exposure.

Reservoir creation raises the water level and submerges a large quantity of terrestrial organic matter, which then decomposes, leading to the release of methylmercury. This form of mercury accumulates in the flesh of fish and can pose a health risk to people who consume it in large amounts. Sampling campaigns were therefore carried out to monitor the evolution of this phenomenon before and after impoundment.

Since mercury is assimilated by all aquatic organisms, its accumulation increases with each level of the food chain. Fish that feed on insects or plankton, such as lake whitefish, are affected less than piscivorous fish such as pike. Mercury concentrations in the flesh of fish also vary according to size. However, this increase in mercury levels is only temporary. After peaking 5 to 10 years following impoundment, concentrations decline, returning to normal after 20 to 30 years, depending on the species.

The sampling showed that fish mercury levels in Sainte-Marguerite 3 reservoir have risen compared with their initial values. Even considering this phenomenon, fish consumption still offers health benefits. As well, Hydro-Québec has built access roads to alternative fishing lakes.



Sainte-Marguerite 2 reservoir

The filling of Sainte-Marguerite 3 reservoir brought about a temporary increase in organic matter and in certain metals in Sainte-Marguerite 2 reservoir.

Sampling carried out over the years in Sainte-Marguerite 2 reservoir showed that the water was suitable for recreational activities but was not fit for drinking, owing to higher-than-normal aluminum concentrations. Consequently, even though this metal is very low in toxicity, Hydro-Québec distributed bottled water to the affected users throughout the impoundment phase. In addition, the town of Clarke City, which drew its supply from Sainte-Marguerite 2 reservoir, was connected by a new aqueduct to the Sept-Îles drinking water supply system.

Water Quality

Planting

Since 1997, Hydro-Québec has had some 765,000 green alder, black spruce and jack pine seedlings planted to accelerate the site restoration process. This number should reach 1,040,000 by 2006.



To offset the loss of forest land caused by the reservoir impoundment, Hydro-Québec and the provincial Department of Natural Resources undertook a series of forest studies. These led to a better understanding of the North Shore boreal forest, which can now be managed more efficiently.



Recovery of merchantable timber

From 1995 to 1997, a \$10-million contract awarded to Uniforêt allowed that company to recover 550,000 m³ of merchantable timber on the reservoir land. The slash from the recovered wood was burned in 1998, while the remaining floating debris is collected regularly at the dam. Some bays in the reservoir were cleared to promote fishing and recreational activities.

Forest



This brochure, published by Hydro-Québec in 2001, summarizes the knowledge acquired from archaeological digs along the Sainte-Marguerite River. It tells the story of the region based on the principal artifacts unearthed, most of which are on display at the Shaputuan Museum—or centre for transmitting Innu culture—in Sept-Îles.

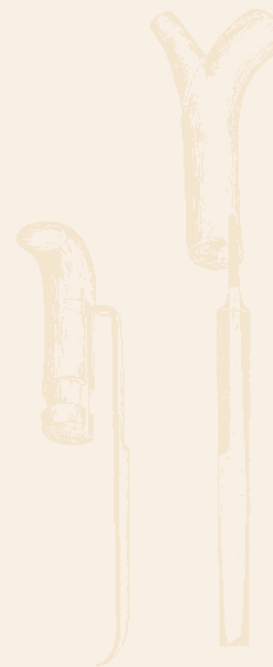
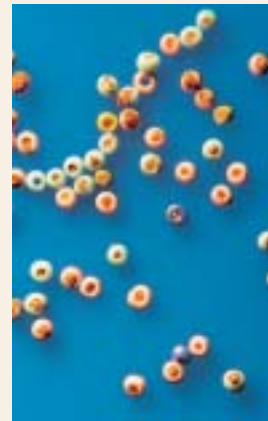


On the basis of the discovery of a projectile head and several stone fragments, remnants no doubt from the manufacturing of this type of tool, the earliest use of the Sainte-Marguerite region can be dated back 4,000 years. All the other sites attest to more recent occupation, estimated at less than 2,000 years.



Archaeology

The Sainte-Marguerite region had never been the subject of archaeological excavations before the Sainte-Marguerite-3 project was launched. However, with the submersion of various land areas, any vestiges of their use by local populations were liable to disappear forever. Between 1988 and 1998, archaeologists discovered 67 sites, 12 of which underwent intensive excavations. Thousands of artifacts, the remains of numerous hearths and traces of habitation were gathered and analyzed. The research thus permitted the first-ever documentation of human occupation in this river valley on the North Shore of the St. Lawrence.





“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Brundtland Commission, 1987

The greenhouse gas emissions, per kWh, from hydro-electric generating stations like Sainte-Marguerite-3 are approximately 30 times lower than those of gas-fired thermal power plants and about 90 times lower than those of coal-fired plants. These figures take into account emissions generated by facility construction and reservoir creation. With this project, Québec avoids annual CO₂ emissions equivalent to those produced by approximately 300,000 cars and thereby contributes to the fight against global warming.

Improved Access to the Back Country

Road to the generating station

In 1994, a new 86-km road was built between the coast and Sainte-Marguerite-3 generating station. This highway, which makes inland access much easier, is extended by logging roads. The regional authorities would eventually like to connect it to Highway 389, which runs between Baie-Comeau and Fermont, in order to create an inland loop between Baie-Comeau and Sept-Îles and establish a tourist route that would provide access to the Groulx Mountains and other scenic attractions.



Boat ramp on Sainte-Marguerite 2 reservoir

Before the development of the Sainte-Marguerite-3 hydroelectric project, the inland region was seldom visited. The development has promoted the extension of the road system and, as a result, the use of the land for recreational and commercial purposes.

In the past five years, use of the area north of the Hydro-Québec camp (km 64) has grown twenty-fold. The peak periods coincide with summer vacations and hunting seasons for big and small game.

The new road system encourages resort development, particularly north of the Port-Cartier–Sept-Îles wildlife reserve. User activity, previously concentrated around Sainte-Marguerite 2 reservoir, now extends over an area that stretches more than 100 km north from Highway 138 and goes well beyond the boundary of the Sainte-Marguerite River drainage basin. Innu use of the land has also grown, since the road system provides access to traplines that were worked very little up to now. Therefore, a number of trapping camps have been set up in the Sainte-Marguerite basin since the highway opened.

To facilitate recreational activities, Hydro-Québec built a boat ramp, with parking, on the banks of Sainte-Marguerite 2 reservoir. The Sainte-Marguerite SOTRAC, together with Hydro-Québec, funded the same type of facility on Sainte-Marguerite 3 reservoir.

Benefits of the Agreement with the Innus

Moisie River camp



Camp at Mitaine Lake

Innu trapping and community camps

Funds were provided for the construction of several trapping camps and four community camps in the Sainte-Marguerite and Moisie basin. The camp along the Moisie was set up as a place for elders to fish for salmon. Its construction enabled young Innus to become familiar with a new Scandinavian building technique using logs.



Snowmobile trails

Between 1996 and 2000, 170 km of snowmobile trails were built. In addition to offsetting the loss of some winter routes that used to be passable on the Sainte-Marguerite downstream from the generating station, these trails facilitate access to many Innu traplines and to the most remote corners of the region, such as the area around Grand lac Germain.

The Uashat Mak Mani-Utenam (1994) Agreement, signed by Hydro-Québec and the Innu community of Uashat-Maliotenam, has meant improved land-use conditions and the construction of new facilities for the Innu community.

Pilgrimage site dedicated to Saint Anne

In 1996, improvements were made to the Innu pilgrimage site dedicated to Saint Anne, at Cousin Lake. A chapel and a service building were erected, and the existing buildings were renovated.



Shaputuan Museum

The compensation funds paid out to the Innu community, along with the remedial works funding made available to the Sainte-Marguerite SOTRAC, made various projects possible, such as the construction of this museum dedicated to the transmission of Innu culture. Opened in 1998, the museum houses a permanent exhibition of the principal remains discovered in the region. Shaputuan means "big tent with two doors."



Project for reintegrating young Innu dropouts

The Nutshimiu Aitun program, dedicated to the handing-down of Innu culture, enabled eight young people to spend three months living in the bush with a few elders in 1998, in order to renew contact with their language and traditional pursuits. In 1999, the program provided eight Innus aged 18 to 25 with 12 weeks' training in tanning caribou hides.



The Innu II

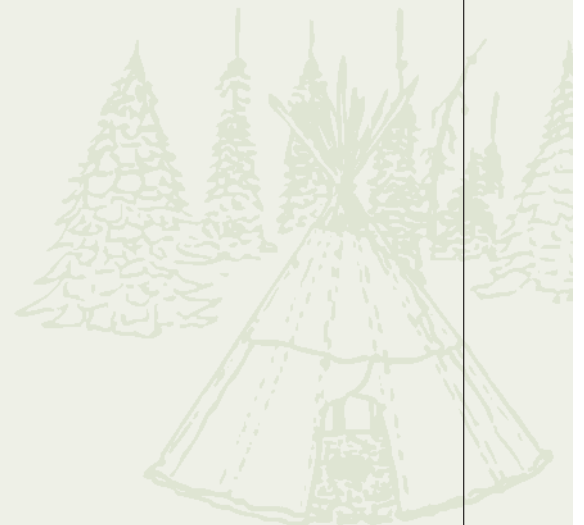
This boat, specially designed to navigate in between floating logs and submerged trees, was originally bought for site cleanup around the edge of the reservoir. It is now used to carry Innus to their traplines.

The funds granted under the Agreement have also contributed to building or renovating a great many housing units in Uashat and Maliotenam, and to building new business establishments that have created jobs in the community (Sobey's and a Unitotal gas station). They have also helped finance projects designed to improve residents' quality of life, including a home for the disabled in Uashat.



Sports facilities

Ever since an arena was built in Maliotenam, youngsters can play hockey or practise figure skating, and the various North Shore Innu communities are able to organize hockey tournaments. The arena is also used by non-Aboriginal communities in the region. As well, two public swimming pools were built in Uashat and Maliotenam. These facilities have improved the two communities' quality of life.



Major Investments in the Region under the Integrated Enhancement Program

New drinking water treatment units in Sept-Îles

New units were added to the Sept-Îles plant to improve drinking water treatment. This improvement should make it possible to eliminate 90% of the trihalomethanes present in the water.



Historic sites in Rivière-Pentecôte

A number of improvements were made to enhance the historic 19th-century sites in Rivière-Pentecôte. These included refurbishing the sawmill, carrying out exterior work on the Louis-Langlois museum, laying out a trail with observation posts along the Pentecôte River estuary and building a campground.

Hydro-Québec's Integrated Enhancement Program (IEP) has helped finance numerous projects intended to improve the quality of the environment and of municipal infrastructures as well as to support regional development, including the reopening of the Uniforêt pulp mill in Port-Cartier.



Construction of a drinking water treatment plant in Port-Cartier

The construction of a treatment plant in Port-Cartier assures town residents of good-quality drinking water. Previously, the water periodically showed levels of coliform bacteria and turbidity in excess of government standards.





Panoramic boardwalk in Gallix

The funds provided to Gallix were used to consolidate the riverbanks, clean up the shoreline of Labrie Lake and build a panoramic boardwalk in Souvenir Park. Stone riprap was laid to protect the park from erosion.



Promenade du vieux quai in Sept-Îles

The boardwalk along the old pier in Sept-Îles was extended to the pleasure craft boat ramp, where a new park was built.



Local Economic Spinoffs

Local spinoffs 1994-2002

\$160 million in contracts awarded locally, out of a total \$790 million

\$500 million in funds injected
(salaries, goods and services, agreements with local communities)

1,400 workers at construction peak (1995)

660 person-years

Employed 69% of the total regional work force

Employed 80% of the regional work force in the construction industry

Support for regional employment

The Sainte-Marguerite-3 project has contributed to the region's economic development. As a result of the splitting of some contracts and the use of subcontractors, the project created more local jobs during construction than had been expected.

Improvement of local business expertise

The project has also had a longer-term impact on the expertise of local companies. Several Innu companies secured contracts negotiated individually on the jobsite, and new companies, like Innu Construction, were formed.

Pulp and paper

A \$5-million loan, granted by the town of Port-Cartier to Uniforêt under the IEP, enabled the forest company to reopen its pulp mill and maintain some 300 jobs for seven years. However, Uniforêt had to shut down mill operations in February 2001.



Innu surveyors

In 1996, workplace internships lasting 16 to 50 weeks enabled 13 young Innus (aged 18 to 25) to gain experience as technicians or clerical employees. According to a follow-up study conducted by the Band Council starting in 1998, 6 of the 13 interns went back to school afterwards, and 9 held jobs from 1998 to 2001.



Improvements in the quality of the Innu work force

The Sainte-Marguerite-3 project has also contributed to the economic development of the Innu community. Not only did it create jobs for Innus during construction, it has had a longer-term impact on work force skills. Innu workers represented, on average, some 30 person-years from 1994 to 2002. In addition, 26 Innus acquired construction trade cards.



Young Innu trainee

In 1996, a training jobsite allowed 16 Innus to gain experience during construction of the access road to Sainte-Marguerite-3.



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