Environmental Effects Assessment

Annual Maintenance Dredging of the St. Lawrence Waterway (2016 – 2018)

EEA 2016, 2017 and 2018

Montréal to Cap Gribane

Under the *Canadian Environmental Assessment Act, 2012*

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Fisheries and Oceans Canada

Canadian Coast Guard

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Foreword

This environmental effects assessment (EEA) applies to the general annual maintenance dredging program in the St. Lawrence Waterway for the years 2016 to 2018 and covers all data relating to the various dredging projects to be undertaken during this period. In light of the relatively few changes observed each year in terms of the description of the environment and the project implementation conditions, it was agreed, jointly with the responsible authorities at Environment and Climate Change Canada (ECCC) and the Department of Fisheries and Oceans (DFO), that this report would remain valid over a three-year period starting in 2016. Additionally, to support conclusions as to the absence of any significant impact, it was agreed to perform sampling and characterization of the sediments in the areas requiring dredging and at the disposal sites, the results of which will be presented in the annual monitoring reports for the various projects scheduled as part of the dredging program.

The reader is invited to consult these monitoring reports, which will be issued upon completion of the sediment sampling and characterization campaigns. The will also note that the various locations, relevant facts, areas and outcomes involved may be listed or described in any number of orders, whether upstream or downstream, chronological, by order of importance or, in some cases, a combination of all three.

Throughout this report, reference is made to two types of shoals: sedimentary and scattered. Sedimentary shoals are the result of annual sedimentary phenomena prevailing in the St. Lawrence River and are made up almost entirely of sand and gravel. These types of shoals move along the Waterway bed, frequently in the form of dunes, and are quantifiable (in m^3). Scattered shoals are isolated and may be made up of any type of sediments or miscellaneous debris; these types of shoals are stable and smaller. Appendix A provides an overview of the approximate locations of the shoals generally identified in the various dredging areas as well as the disposal sites targeted for use.

This environmental effects assessment was prepared in accordance with the requirements of the *Canadian Environmental Assessment Act* (CEAA), *2012*. In addition, the Department of Fisheries and Oceans – Canadian Coast Guard (CCG) agrees to obtain all necessary environmental permissions and authorizations to which this project may be subject.

As in previous years, the CCG agrees to follow an annual compensation plan to offset the loss of fish or fish habitats at disposal site S-17 located north of the Lake Saint-Pierre waterway when that site is used.

Note that this EEA is based on content from the environmental assessment of the annual maintenance dredging project in the St. Lawrence Waterway for the preceding period, 2013-2015. Where possible, the information presented has been updated; where this was not the case, the previously reported data were incorporated into the current project analysis.

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Executive Summary

The St. Lawrence Waterway, which extends approximately 900 km from Montréal to the western tip of Anticosti Island, is the gateway to the country's main shipping route, hence its economic importance. The St. Lawrence River is also recognized the world over for the diversity and richness of its wildlife habitats. Fisheries and Oceans Canada – Canadian Coast Guard (CCG) is mandated to keep commercial shipping channels safe and accessible at all times. In Québec, the CCG is specifically responsible for the maintenance dredging program in the St. Lawrence Waterway between Montréal and Île-aux-Coudres, a segment that includes a series of artificial channels totalling approximately 210 km that must be maintained by dredging. As part of the federal environmental assessment process pursuant to the *Canadian Environmental Assessment Act* (CEAA), *2012*, the CCG, as the federal authority, has a duty to conduct the environmental studies required in order to conduct its annual maintenance dredging program.

Under its mandate, the CCG manages a variety of projects implemented between May and October of each year. The following description represents a typical year in the maintenance dredging program.

- The first dredging period runs from the last week of May through the end of August, potentially in all parts of the waterway. The work involves dredging approximately 11,500 m³ of sediments between Bécancour (buoy C33) and Batiscan (buoy D68) and around 210 hours of dredging to clear the scattered shoals between Montréal and Saint-Antoine. Based on bathymetric survey outcomes, approximately 2,000 m³ of sediments in Traverse Cap-Santé (buoy Q54) and 3,000 m³ of sediments in Traverse du Nord can also be dredged. All sedimentary shoals can be dredged during this initial dredging period using a clamshell dredge and/or a trailing suction hopper dredge, except in Traverse du Nord, where use of a trailing suction hopper dredge with doors in the hull or a split hull will be needed. The scattered shoals on the other hand must be dredged using a clamshell dredge due to technical constraints. In the interest of effectiveness and safety, the CCG expressly requires the use of a clamshell dredge, the pontoon of which is held in place by spuds, to dredge the scattered shoals at Deschaillons.
- The second dredging period runs from the third week of August to the end of October. The work involves dredging approximately 50,000 m³ in Traverse du Nord between buoys K136 and K91 using a trailing suction hopper dredge or dredge with doors in the hull or a split hull. Once again in the Bécancour-Batiscan area, accounting for approximately 8,500 m³ between buoys C33 and D68, the Contractor will have the option to use either a trailing suction hopper dredge or a clamshell dredge. Dredging of Lake Saint-Pierre (5,000 m³) will be carried out by either of the aforementioned dredge types during the month of October.

Sediments (sand, gravel, rocks) from hourly dredging of the scattered shoals between Montréal and St-Antoine will be deposited at authorized marine disposal sites (M-02, M-27, S-17, T-02, T-06, T-11, T-16 and X-04); the volume of these natural sediments is typically low, perhaps 2,000 to 3,000 m³. The miscellaneous debris typically dredged (tree trunks and branches, old buoys, scrap metal) will be kept and transported to the nearest dock and then trucked to either the Sorel dock or the Port of Québec for disposal by the CCG in accordance with current environmental guidelines.

Sediments dredged between Bécancour and Batiscan should contain sand of acceptable quality compatible with existing sediments at disposal site T-11 (Saint-Pierre-les-Becquets), where the sediments will be dumped in open water.

The same should hold for sediments dredged in Lake Saint-Pierre in the fall, which will likely be deposited at disposal site S-17 (Yamachiche-Nord) or, if the Contractor's equipment precludes the use of S-17 due to the shallow water there, at T-11.

Due to the potential disruption of fish habitats, in the event that disposal site S-17 (Yamachiche-Nord) in Lake Saint-Pierre is used, the project should also require authorization under section 35(2) of the Canadian *Fisheries Act*, subject to any amendments made to the act, which is administered by the Fisheries Protection Division (FPD). As stated in the foreword, when disposal site S-17 is used, the CCG agrees, as in previous years, to offset any loss of fish or fish habitat incurred at that disposal site. In October 2009, an agreement was negotiated in this regard with the Lake Saint-Pierre ZIP Committee to implement a project to restore Désy-Sylvestre Creek in order that 39,000 m^3 of sediments could be deposited at that disposal site.

Sediments dredged in the Traverse Cap-Santé area (around buoy Q54) should also contain good-quality sand compatible with existing sediments at approved disposal site X-04 (Donnacona).

Traverse du Nord is located between Saint-Jean-de-l'Île-d'Orléans and Cap Gribane downstream from the well-known Cap Tourmente. This is the maintained portion of the waterway most affected by the annual sedimentary phenomena downriver from Québec that forms shoals of coarse sediments (sand), accumulating in dunes. Sand accumulation in this area is due in large part to the occurrence of semi-diurnal tides. The mixing of fresh and salt water may also contribute to sediment accumulation at this point in the waterway. Over the years, the sediments dredged in Traverse du Nord have been made up of relatively good-quality sand compatible with the sediments located at the Banc Brûlé (X-02) and Sault-au-Cochon (X-03) disposal sites. However, it is to be noted that in recent years, occasional effect levels (OEL) for arsenic have been exceeded on a regular basis in samples collected in the dredging areas in Traverse du Nord and at the Sault-au-Cochon (X03) disposal site. To demonstrate that the sediments are harmless, a number of bioassays have been conducted samples collected in dredging areas that have exceeded OEL and even frequent effect levels (FEL). All analyses have shown that the sediments are considered harmless for the organisms tested, *Hyalella azteca* and *Eohaustorius estuarius*, two amphipods.

In light of the negative results produced from previous bioassays conducted on sediments with arsenic levels falling between the OEL and the probable effects level (PEL), Environment Canada ruled (on December 15, 2011) that bioassays need to be conducted only where the outcomes of chemical characterization with respect to arsenic show that the PEL has been exceeded. In the event that the OEL is exceeded for any other substance identified in the Criteria for the Assessment of Sediment Quality in Québec, bioassays would be required as prescribed by the Criteria.

Consequently, toxicity tests were carried out in 2012 when contamination levels exceeding the PEL and FEL were observed in samples from Traverse du Nord. Based on analysis, the sediments were classified as nontoxic for the organisms tested. No bioassays were necessary in relation to sampling between 2013 and 2015.

Arsenic levels exceeding the OEL for arsenic were also observed in Lake Saint-Pierre in 2011, and the bioassays conducted were negative. No analysis was required between 2012 and 2015 since any arsenic contamination observed was consistently below the PEL.

Note that the next analyses will be conducted in accordance with the latest recommendations for sediment sifting set out in the *Guide de caractérisation physico-chimique et toxicologique des sédiments* (MDDELCC and Environment Canada, 2015, comments review). Analyses will accordingly be conducted on sediments sifted to 2 mm rather than 180 µm prior to comparison with the evaluation criteria for sediment quality in Québec.

In conclusion, upon review of the various project components and impacts, we find that the effects of the proposed project will not be significant and will be mitigated through implementation of appropriate mitigation and compensation measures where applicable, compliance with current laws and regulations and implementation of a monitoring and work supervision program.

Based on these findings, the CCG concludes that implementation of this project is not likely to generate any significant adverse environmental effects subsequent to implementation of mitigation and compensation measures where necessary and of a monitoring program. As a result, no additional action appears necessary under the federal environmental effects assessment process.

1. Background

1.1 Legal framework

In the event that any federal laws referenced herein undergo review with ensuing potential impact in terms of their application to dredging activities, an addendum to this report may be produced.

The Canadian *Environmental Assessment Act* (CEAA), *2012*, governs application of the federal environmental effects assessment process. This is a self-assessment process through which federal authorities review the environmental impacts of projects falling within their decision-making responsibility or jurisdiction before proceeding with any irrevocable decisions in this regard.

The CEAA, 2012, specifies that a federal authority must not carry out a project on federal lands, or exercise any power or perform any duty or function conferred on it under any other act of Parliament that could permit a project to be carried out, in whole or in part, on federal lands, unless the authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects (sections 67 to 72).

The Department of Fisheries and Oceans – Canadian Coast Guard (CCG) is a federal authority whose mandate includes maintaining the waterway through dredging to ensure safe conditions for commercial shipping between Montréal and Cap Gribane. However, the Act defines a project as a physical activity related to a physical work. In the present case, because maintenance dredging is not a physical activity related to a physical work, the federal department is not under any obligation to assess the extent of any environmental effects. However, as a good corporate citizen, DFO-CCG decided to carry out an EEA of the maintenance dredging project in the St. Lawrence Waterway for the years 2016 to 2018.

As the federal authority concerning this project, the CCG conducted and coordinated the environmental effects assessment. Pursuant to the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (SOR/97-181), the CCG consulted the federal authorities that may have a designated legislative or regulatory power or be an expert federal authority under the project.

Environment and Climate Change Canada was consulted as an expert department in this regard, notably in relation to sediment quality. That department will be consulted further in relation to follow-up work involving sediment characterization. The provincial legal framework was also considered. Accordingly, the CCG also relied on the expertise of the provincial Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC) and Ministère de la Forêt, de la Faune et des Parcs (MFFP).

Species deemed threatened or vulnerable under Québec's *Act Respecting Threatened or Vulnerable Species* (ATVS) (chapter E-12.01) and wildlife species at risk under the *Species at Risk Act* (SARA) (S.C. 2002, c. 29) were taken into consideration.

Fisheries and Oceans Canada/Fisheries Protection Division (FPD) was also consulted as an expert department. Due to deterioration of the fish habitat, the potential deposit of sediments at disposal site S-17 in Lake Saint-Pierre is also subject to authorization under subsection 35(2) of the *Fisheries Act* administered by the FPD program (Government of Canada).

Further, the maintenance dredging work will be performed within the St. Lawrence Waterway, which falls under the jurisdiction of Transport Canada (TC) pursuant to the *Navigation Protection Act*
(NPA) (Government of Canada). As such, TC should also serve as an expert department in this matter. However, an agreement adopted previously under former subsection 5(2) of the *Navigable Waters Protection Act* (NWPA) grants an exemption for the performance of the present maintenance dredging activities as long as the dredging methods and disposal sites remain unchanged. In the event that significant changes are made to the activities, TC and the CCG must verify that this agreement is compliant.
Since the project does not appear on the list of designated projects established by regulation, this study serves as an environmental effects assessment within the framework of the CEAA.

For reasons of efficiency, it was decided to address all dredging operations during the years 2016, 2017 and 2018 in this environmental assessment. Impacts likely to be caused by this project (including the possible disposal of sediments in Lake Saint-Pierre) will be assessed, and the decision made will apply to all work performed during the three-year period.

Proponent and federal authority:

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Canadian Coast Guard
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1.2 Project rationale

Since establishment of the portion of the St. Lawrence Waterway between Montréal and Île-aux-Coudres (350 km), dredging activities intended to maintain the depths indicated on nautical charts have been carried out on a regular basis by the CCG for the benefit of commercial mariners and a number of ports in Quebec. The maintenance dredging of the St. Lawrence Waterway is a recurring annual activity conducted to clear the sediments (consisting mainly of sand) that form shoals posing a risk to navigation in certain sections (distributed over 210 km of artificial channel) of the waterway at different times of the year. Some areas (over a 40 km stretch) in these sections are subject to annual maintenance dredging due to their inherent hydrodynamic and sedimentary conditions. The remaining 140 km of this 350 km waterway are a natural channel that does not typically require any form of maintenance.

The marine industry in Quebec is a major driver of economic development and represents nearly 45 percent of international traffic in Canada (SODES, 2015). Some 5,000 vessels are tracked by the CCG each year, including deep draft oil tankers. More directly, dredging activities serve to ensure the safety of mariners and their cargo while also facilitating the movement of people and goods and contributing to economic development. These activities are also intended to protect the environment by minimizing the number of marine incidents. To maintain safe use of the waterway between Montréal and Cap Gribane year-round, dredging work is performed at different times of the year, from the last week of May through the month of October.

Table 1.1 on the following page sets out the sediment volumes dredged annually as part of waterway maintenance work between 1985 and 2015. More recent dredging work has targeted an annual average of approximately 80,000 m^3 of sediments. This figure accounts for around 1 percent of the volume of sediments dredged annually across Canada, which totals 8 to 9.6 million m^3 (Waterways Management, DFO-CCG, pers. comm.).

Table 1.1 Volumetric statistics on annual maintenance dredging of the waterway

ANNUAL MAINTENANCE DREDGING OF THE ST. LAWRENCE WATERWAY BETWEEN MONTRÉAL AND CAP GRIBANE, 1985-2012										
YEAR	ANNUAL VOLUME OF DREDGED SEDIMENTS BASED ON BATHYMETRIC DIFFERENCES IN THE CHANNEL (V_ch)									
	UNIT, PER CUBIC METRE, IN:									
	Mtl – Contrec.	Sorel	Lake Saint-Pierre	Bécancour – Batiscan		Trav. Cap-Santé	Trav. Nord I.O.	Subtotal	Other (1)	Grand total
2015 (16,17)	0	0	0	34,767		2,435	51,484	88,686	0	**88,686**
2014 (16)	0	0	0	18,424		2,845	55,945	77,214	0	**77,214**
2013 (16)	0	0	5,832	20,926		2,293	53,627	82,678	0	**82,678**
2012	0	0	0	21,026		2,312	52,694	76,032	0	**76,032**
YEAR	**Mtl – Contrec.**	**Sorel**	**Lake Saint-Pierre**	**Trois-Riv. – Bécancour**	**Champlain – Deschai.**	**Trav. Cap-Santé**	**Trav. Nord I.O.**	**Subtotal**	**Other (1)**	**Grand total**
2011 (15)	0	0	5,315	14,316	5,184	2,200	55,040	82,055	0	**82,055**
2010 (14)	0	0	0	13,179	5,511	3,000	53,032	74,722	0	**74,722**
2009 (12, 13)	0	0	11,401	19,633	2,286	2,500	49,616	85,436	1,440	**86,876**
2008 (11)	0	0	16,751	37,963	1,386	4,648	59,495	120,243	0	**120,243**
2007 (10)	0	0	21,563	19,670	3,155	3,104	57,652	105,144	0	**105,144**
2006	0	0	10,210	23,060	4,255	7,013	59,703	104,241	0	**104,241**
2005 (9)	0	0	13,536	23,893	2,698	1,000	64,433	105,560	0	**105,560**
2004	0	880	15,219	33,509	9,585	0	62,758	121,951	0	**121,951**
2003 (8)	0	0	18,150	28,857	6,988	0	76,470	130,465	0	**130,465**
2002 (7, 8)	0	0	12,397	40,442	9,478	0	67,784	130,101	0	**130,101**
2001 (6, 8)	0	0	23,997	30,298	2,758	0	86,969	144,022	0	**144,022**
2000 (8)	0	0	12,319	40,427	2,057	0	84,662	139,465	0	**139,465**
1999 (5)	51,496	0	20,253	61,846	11,410	0	87,709	232,714	0	**232,714**
1998 (4)	0	3,690	63,123	23,162	0	0	75,179	165,154	0	**165,154**
1997	0	1,141	5,000	27,779	213	3,560	78,331	116,024	0	**116,024**
1996	0	1,372	4,036	21,159	0	0	65,907	92,474	0	**92,474**

Table 1.1 Volumetric statistics on annual maintenance dredging of the waterway

YEAR	Mtl – Contrec.	Sorel	Lake Saint-Pierre	Trois-Riv. – Bécancour	Champlain – Deschai.	Cap- Santé	Trav. Nord I.O.	Subtotal	Other (1)	Grand total
1995	0	451	33,012	19,430	1,251	6,155	81,637	141,936	3,803	**145,739**
1994 (3)	0	2,839	34,356	15,293	979	6,919	65,348	125,734	2,879	**128,613**
1993	0	4,288	18,990	20,612	2,421	8,580	66,147	121,038	22,568	**143,606**
1992 (2)	0	4,881	53,276	31,456	2,442	8,013	71,746	171,814	0	**171,814**
1991	0	1,156	9,018	16,610	0	6,742	74,877	108,403	64,601	**173,004**
1990	0	0	41,807	19,723	0	7,035	57,342	125,907	61,109	**187,016**
1989	0	0	17,951	12,736	12,329	9,304	75,624	127,944	63,917	**191,861**
1988	0	30,029	54,270	14,334	0	5,518	73,591	177,742	0	**177,742**
1987	0	0	12,333	25,709	240	6,927	83,919	129,128	58,154	**187,282**
1986	0	1,910	1,800	2,200	640	14,098	118,989	139,637	59,624	**199,261**
1985	0	2,600	113,111	500	0	13,159	96,634	226,004	26,378	**252,382**

NOTES:

(1) Particularly concentrated in the Batiscan (E-12) and Yamachiche (D-15) anchorage areas.

(2) Includes a sediment volume dredged exceptionally to increase channel depth from 10.7 to 11.0 m CD over a width of 230 m between Montréal and Deschaillons (D-40).

(3) Anchorage surface area reduced at Batiscan (E-12).

(4) Includes 58,000 m³ dredged exceptionally to increase channel depth from 11.00 to 11.30 m between Sorel and Port St-François (Sorel/Lake St-Pierre).

(5) Includes 51,496 m³ (Mtl/Contrecoeur) and 58,453 m³ (Trois-Riv/Deschaillons) dredged exceptionally to increase channel depth selectively from 11.00 to 11.30 m.

(6) Depth for calculation of additional volumes between Montréal and Deschaillons adjusted from 30 cm to 20 cm.

(7) Depth for calculation of additional volumes between Montréal and Cap Gribane set at 20 cm for entire waterway.

(8) Traverse du Nord: includes sediment volume (V_ch) dredged hourly based on the V_ch /V_Cie ratio observed during main dredging.

(9) Reported volume of 1,000 m³ of sediments dredged in the waterway at Cap-Santé is approximate and corresponds to 30 hours of hourly dredging.

(10) Includes approximately 11,000 m³ of sediments dredged in Lake St-Pierre at locations requiring dredging every 3 to 4 years downstream from buoy S110 and upstream from buoy S27.

(11) Starting in 2000, rock falls have occurred periodically (every 2 to 3 years) in the area of Bécancour River (buoy C33); the sediment dredging volume this year reached 18,000 m³.

(12) The 2,500 m³ of sediments dredged at Cap-Santé represents 2 periods of hourly dredging at that location (44.50 hr + 24.00 hr = 68.5 hr).

(13) 1,440 m³ of sediments dredged in Batiscan anchorage area to achieve volume indicated in specifications.

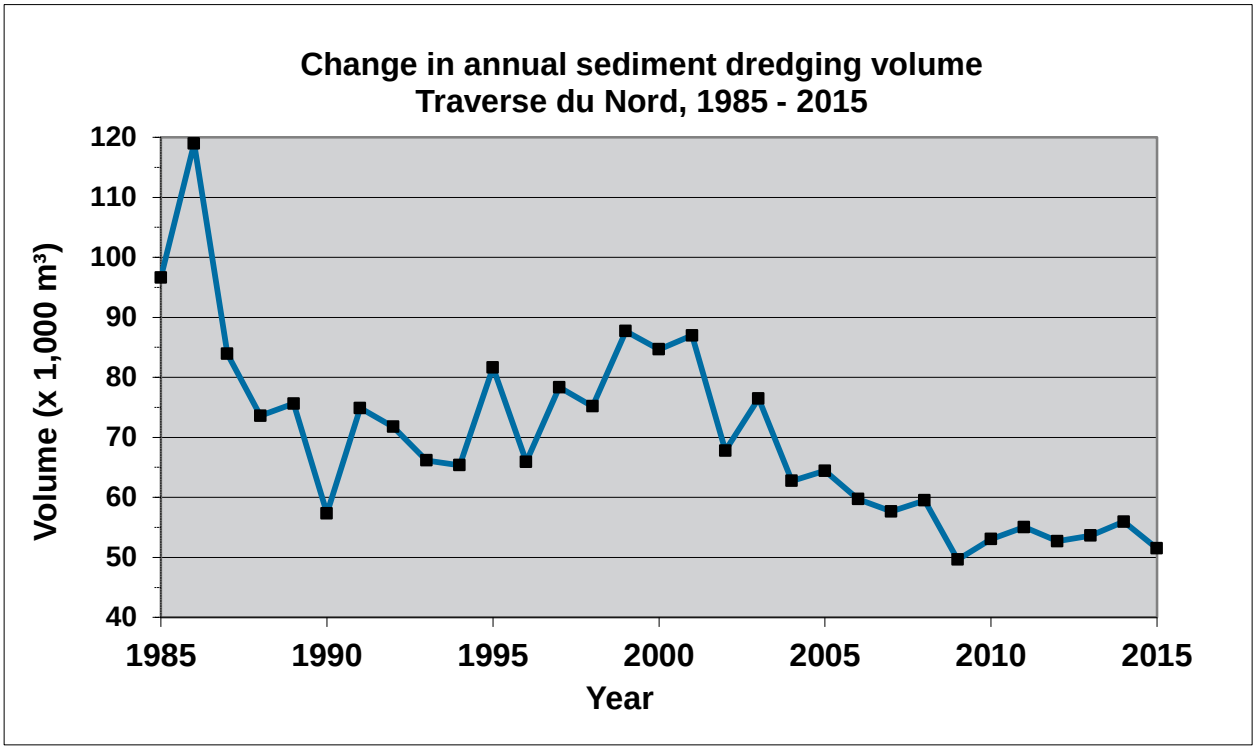
(14) The 3,000 m³ of sediments dredged at Cap-Santé represents 2 periods of hourly dredging at that location (40.50 hr + 41.75 hr = 82.25 hr).

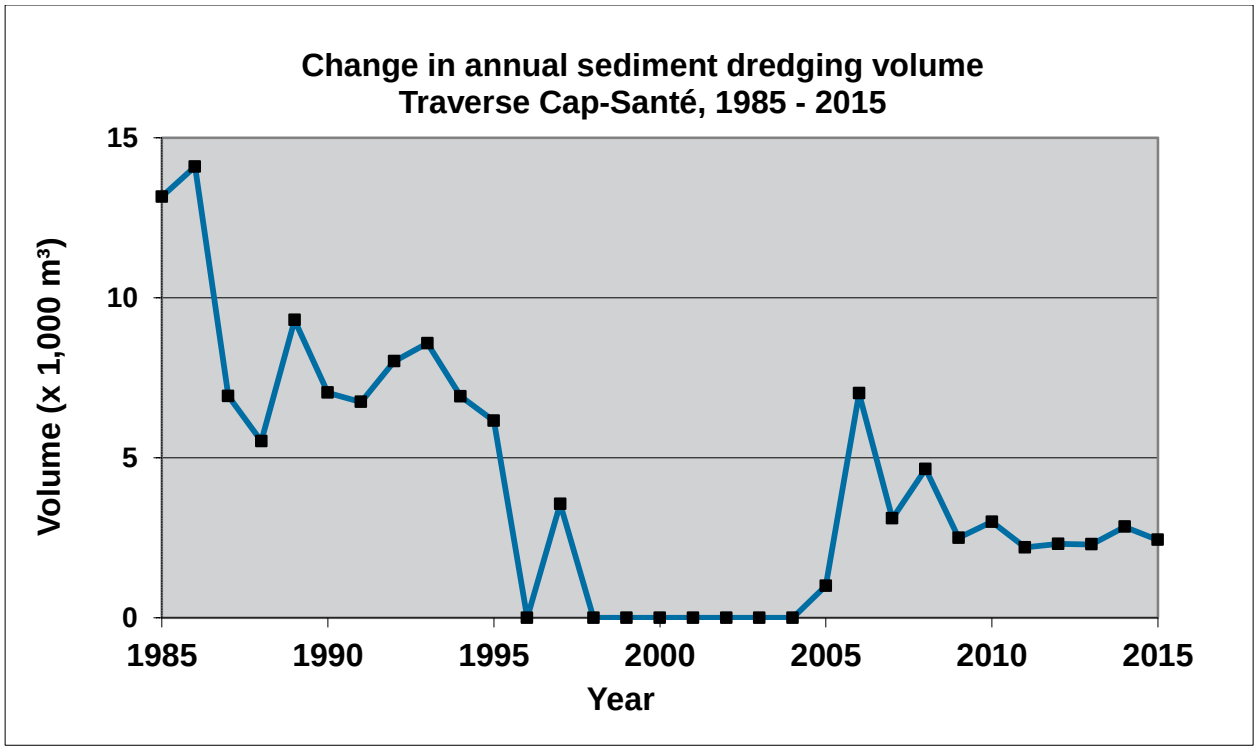
(15) The 2,200 m³ of sediments dredged at Cap-Santé represents 2 periods of hourly dredging at that location (43.80 hr + 36.25 hr = 80.05 hr).

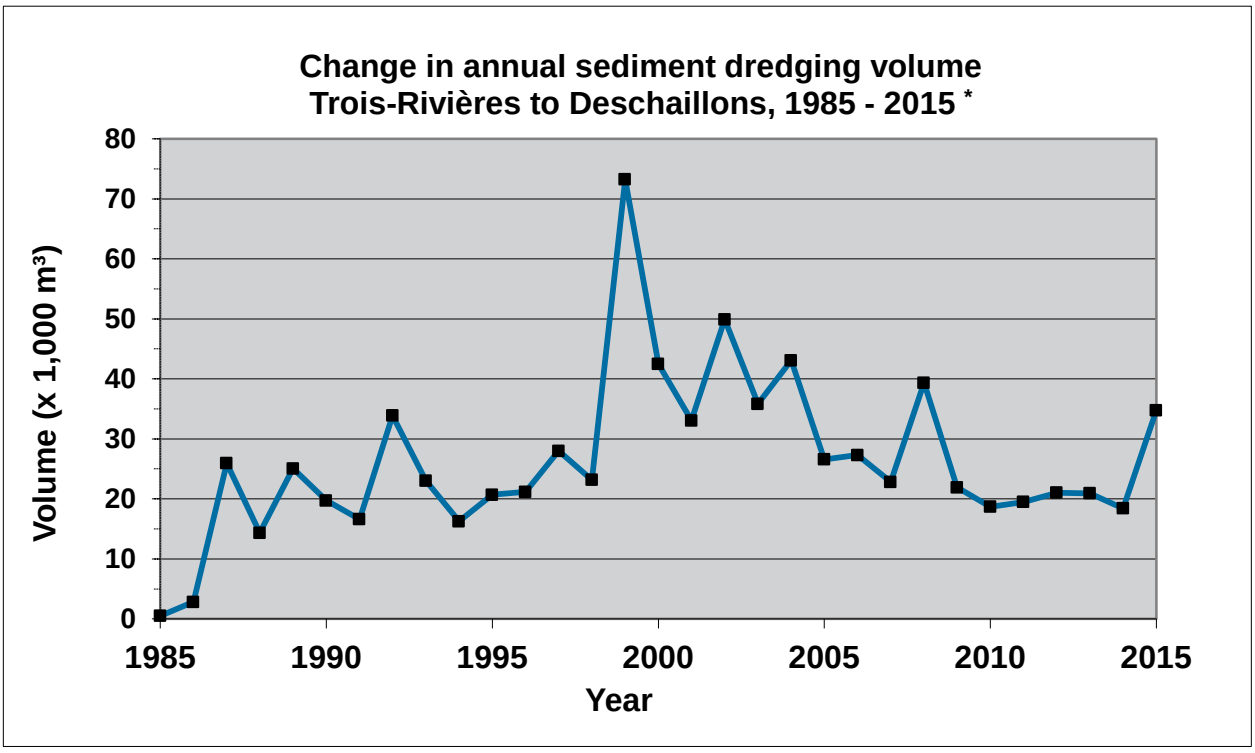
(16) Total at TN includes spring option and work performed during the 2nd period.

(17) A bank collapse at Bécancour resulted in 15,000 m³ of additional volume over average.

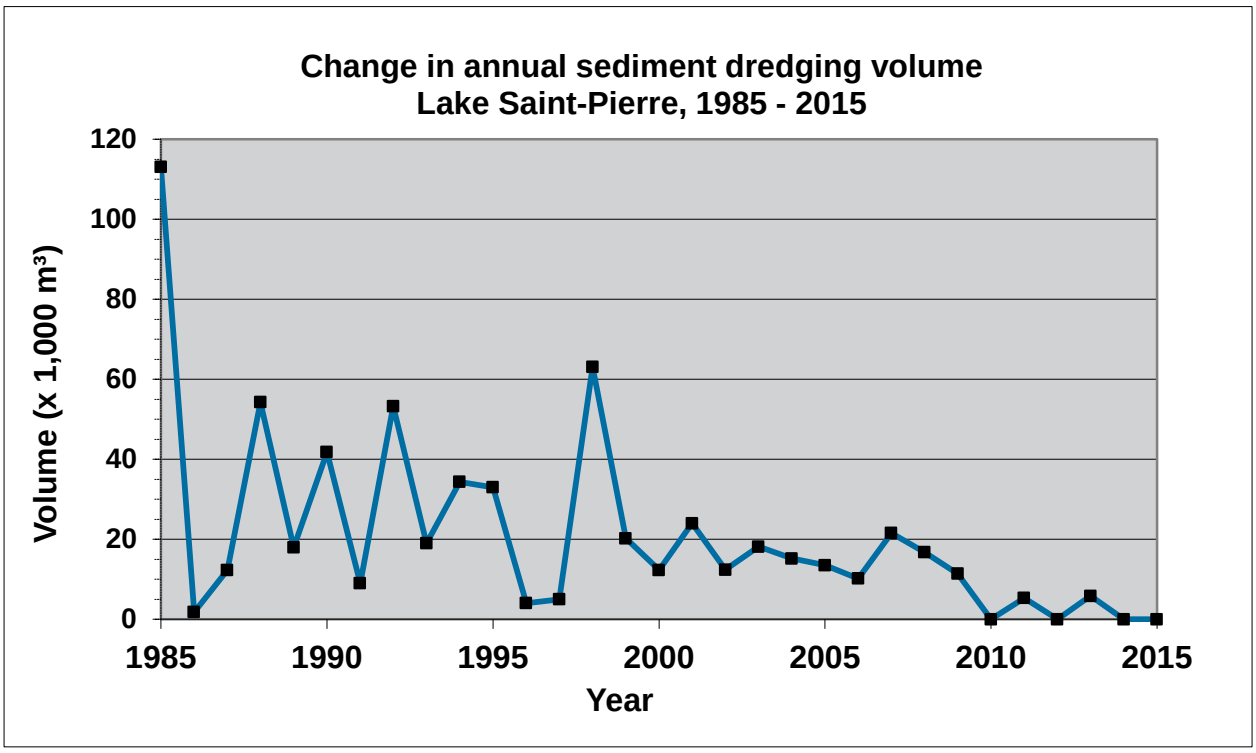
The following charts depict changes in annual sediment dredging volumes by area since 1985.







* From 1985 to 2011 inclusive, the chart depicts sediment dredging volumes between Trois-Rivières and Bécancour and between Champlain and Deschaillons. From 2012 to 2015, the volumes shown are from dredging between Bécancour and Batiscan.



2. Description of Project

The project involves performing annual maintenance dredging work in the St. Lawrence Waterway between Montréal and Cap Gribane during the years 2016, 2017 and 2018. This work will be carried out in the form of two dredging periods in accordance with contracts awarded to the private contractor.

1. The first dredging period runs from the last week of May through the end of August, with dredging potentially performed in all parts of the waterway. The work will consist of dredging approximately 11,500 m³ of sediments between Bécancour (buoy C33) and Batiscan (buoy D68) and approximately 210 hours of dredging to clear scattered shoals between Montréal and St-Antoine. Dredging of approximately 2,000 m³ of sediments in Traverse Cap-Santé (buoy Q54) and 3,000 m³ of sediments in Traverse du Nord will also be possible. All sedimentary shoals may be dredged during this initial dredging period using a clamshell dredge and/or a trailing suction hopper dredge, except in Traverse du Nord, where use of a trailing suction hopper dredge with doors in the hull or a split hull will be required. Scattered shoals, meanwhile, must be dredged using a clamshell dredge due to technical constraints. In the interest of effectiveness and safety, the CCG expressly requires the use of a clamshell dredge, the pontoon of which is held in place by spuds, to dredge the scattered shoals at Deschaillons.
2. The second dredging period will run from the third week of August to as late as the end of October. The work involves dredging approximately 50,000 m³ in Traverse du Nord between buoys K136 and K91 using a trailing suction hopper dredge or dredge with doors in the hull or a split hull. Once again in the Bécancour-Batiscan area, accounting for approximately 8,500 m³ between buoys C33 and D68, the Contractor will have the option to use either a trailing suction hopper dredge or a clamshell dredge. Dredging in Lake Saint-Pierre (5,000 m³) will be carried out by either of the aforementioned dredge types during the month of October.

2.1 Location and Dredging of Scattered and Sedimentary Shoals

2.1.1 Location

All bathymetric surveys to locate shoals for dredging will be conducted by the Canadian Hydrographic Service (CHS) under the direction and on behalf of the CCG. Appendix A provides an overview of the approximate locations of the sedimentary shoals requiring dredging and the disposal sites in the various dredging areas.

2.1.2 Anticipated dredging volumes and grades for sediments dredged

The grades applicable to the shoals requiring dredging will be based on the scope of sedimentation in the immediate area. The CCG has assigned preliminary grade values of 0.30 m below the depths advertised on nautical charts for scattered shoals and between 0.30 and 1.20 m for sedimentary shoals to be dredged between Montréal and St-Antoine. In Traverse du Nord, grades will range between 0.30 and 2.30 m, increasing in the downstream direction, since sedimentation is more significant in the downstream portion of this section.

The locations and quantities of shoals requiring dredging throughout the waterway are set out below for each of the two dredging periods:

1. First dredging period:

The scattered shoals subject to hourly dredging between Montréal and St-Antoine are dispersed throughout the shoal waters. The CCG has subdivided this portion of the waterway into five sections and forecast the approximate number of hours of dredging and number of scattered shoals in each section (see Table 2.1).

Table 2.1 Scattered shoals subject to hourly dredging between Montréal and St-Antoine

SECTION	DISPOSAL SITE	DREDGING HOURS	NUMBER OF SCATTERED SHOALS
Montréal (buoy M195) – Sorel (Tracy buoy)	M-02 and M-27	210	150
Sorel (Tracy buoy) – Trois-Rivières (buoy C63)	S-17		
Trois-Rivières (buoy C63) – Batiscan (buoy D56)	T-02, T-06 and T-11		
Batiscan (buoy D56) – Deschaillons (buoy D18)	T-16		
Cap-Santé (buoy Q54) – St-Antoine (Q16 + 3 km downstream)	X-04		

The approximate locations of the sedimentary shoals to be dredged by the cubic metre between the Bécancour and Traverse du Nord areas are provided in Appendix B. The sediment dredging volumes forecast by the CCG are set out in Table 2.2.

Table 2.2 Sedimentary shoals subject to dredging by the cubic metre between Bécancour and Traverse du Nord

DREDGING AREA	VOLUME (m^3) OF SEDIMENTARY SHOALS DREDGED	DISPOSAL SITE
Bécancour – Batiscan	**11,500**	T-11
Traverse Cap-Santé (buoy Q54)	**2,000**	X-04
Traverse du Nord	**3,000**	X-02 (max. 10,000 m^3) and X-03

2. Second dredging period:

The approximate locations of the sedimentary shoals to be dredged by the cubic metre in the Lake Saint-Pierre, Bécancour and Traverse du Nord areas are provided in Appendix B. The sediment dredging volumes forecast by the CCG are set out in Table 2.3. In Traverse du Nord, the surface area of sediments to be dredged accounts for barely 1% of the total area of that section, which measures 31 km long and 305 m wide.

Table 2.3 Sedimentary shoals subject to dredging by the cubic metre in Traverse du Nord, from Bécancour to Batiscan and in Lake Saint-Pierre

DREDGING AREA	VOLUME (m^3) OF SEDIMENTARY SHOALS DREDGED	DISPOSAL SITE
Traverse du Nord	50,000	X-02 (max. 10,000 m^3) and X-03
Bécancour-Batiscan	8,500	T-11
Lake Saint-Pierre	5,000	S-17 or T-11

2.1.3 Waterway depths advertised on nautical charts

The depths currently advertised or maintained (at CD) in the waterway between Montréal and Île-aux-Coudres as advertised on nautical charts are as follows:

- 10.70 m between Bickerdike wharf and Île-Sainte-Hélène buoy
- 11.00 m between Île-Sainte-Hélène buoy and buoy M177
- 11.30 m between buoy M177 and Batiscan (buoy D77)
- 11.00 m between Batiscan (buoy D77) and Deschaillons (buoy D46)
- 10.70 m between Deschaillons (buoy D46) and Saint-Augustin (buoy Q19)
- Saint-Augustin natural channel (buoy Q19) to Saint-Jean-de-l'Île-d'Orléans (buoy K136)
- 12.50 m between Saint-Jean-de-l'Île-d'Orléans (buoy K136) and Cap Gribane (buoy K91).

2.1.4 Nature of sediments to be dredged

The sediment particle size in the waterway remains comparable year over year. Overall and based on prior characterizations, the riverbed in the dredging areas is compact and made up of clayey silt from the post-glacial era. This substrate is covered by sand mixed with gravel accumulating in various places (sedimentary phenomena) and tipping forward to form dunes. The materials dredged throughout the waterway consist essentially of these types of sand and gravel.

The scattered shoals subject to hourly dredging between Montréal and St-Antoine are typically made up mainly of rocks, gravel, sand, etc. A certain amount of debris is also typically dredged; in the past, tree trunks or branches, old buoys, scrap metal, old ship anchors, pieces of concrete, abandoned vehicles and small boats, propane canisters and old metal barrels have all been dredged. This debris is retained for the CCG to dispose of in accordance with current laws and regulations.

Sediment samples will be collected before proceeding with the dredging work. Table 2.4 below provides preliminary information on sampling sites, the number of sediment samples collected and the types of analyses performed under the three annual campaigns (Bécancour and Traverse Cap-Santé, Traverse du Nord and Lake St-Pierre).

Table 2.4 Normal annual sampling campaigns for sediments to be dredged or deposited at disposal sites

Location (see Appendices A and B)	Anticipated Dredging Volume (m³)	Number and Type of Samples		Physical and Chemical Analyses	
		Ongoing	Control	Organic, Inorganic and Part. Size	Inorganic and Part. Size
Bécancour – Batiscan	20,000	8+2 (disposal site)	1	2	9
Traverse Cap-Santé	2,000	3+1 (disposal site)	1	1	4
Traverse du Nord	53,000	13+3 (disposal site)	2	4	14
Lake Saint-Pierre	5,000	6+2 (disposal site)	1	1	8
Subtotal		**38**	**5**	**8**	**35**
Total		**43**		**43**	

The quality of the sediments to be dredged between Montréal and Cap Gribane is relatively stable and comparable year over year. Based on data collected over the years, sediments subject to dredging in future years are expected to be of good quality according to the current criteria (EC and MDDEP, 2007).

However, it should be noted that occasional effect levels (OEL) for arsenic have been exceeded on a regular basis in samples collected in the dredging areas in Traverse du Nord. A number of Bioassays have been conducted and analyses have found all sediments to be non-toxic for the organisms tested. Due to the fact that the sediment samples have been collected in a section of the St. Lawrence River where the water is classified as brackish (≈ 0.5‰ – 3‰; EC and MDDEP, 2007), one freshwater and one marine organism were targeted, respectively *Hyalella azteca* and *Eohaustorius estuarius*, two amphipods.

Based on previous bioassays conducted on sediments with arsenic levels falling between the OEL and the probable effects level (PEL) and the fact that these bioassays proved negative, Environment Canada ruled (on December 15, 2011) that bioassays need to be conducted only where the outcomes of chemical characterization with respect to arsenic show that the PEL has been exceeded. In the event that the OEL is exceeded for any other substance identified in the Criteria for the Assessment of Sediment Quality in Quebec, bioassays would be required as prescribed by the Criteria.

Consequently, toxicity tests were carried out in 2012 when contamination levels exceeding the PEL and FEL were observed in samples from Traverse du Nord. Based on analysis, the sediments were classified as non-toxic for the organisms tested. No bioassays were necessary in relation to sampling between 2013 and 2015.

Arsenic levels exceeding the OEL for arsenic were also observed in Lake Saint-Pierre in 2011, and the bioassays conducted were negative. No analysis was required between 2012 and 2015 since observed arsenic contamination remained below the PEL.

2.1.5 Dredge types used

In light of the nature of the substrate to be dredged, use of a clamshell dredge will be required for hourly dredging of the scattered shoals between Montréal and St-Antoine. These may be made up of large rocks, sand and gravel, hard clay and some debris of various types. The clamshell dredge is also relatively effective for dredging soft, non-cohesive sediments such as those to be dredged between Bécancour and Batiscan, in Traverse Cap-Santé and in Lake Saint-Pierre. It has also been used many times previously to perform maintenance work in these areas with good results. The natural sediments dredged with a clamshell dredge are placed in open-hopper dredges, transported and deposited at disposal sites. All dredgeable debris is retained for the CCG to dispose of in accordance with current laws and regulations.

All sedimentary (sand and gravel) shoals in the waterway may be dredged using a trailing suction hopper dredge or dredge with doors in the hull or a split hull. This dredge requires at least 5 to 6 m of water to dump the dredged sediments. For this type of equipment, the use of authorized sites T-11 (Saint-Pierre-les-Becquets), X04 (Donnacona), X-02 and X-03 (Traverse du Nord), where depths exceed 6 m, is consequently required.

This type of dredge has been used many times upstream from Québec, including for selective dredging of shoals in 1998 in Lake Saint-Pierre and in 1999 between Bécancour and Batiscan; in 2001, 2003, 2004 and 2007 as part of maintenance dredging work in Lake Saint-Pierre and Traverse Cap-Santé and between Bécancour and Batiscan; and again in 2012, 2013, 2014 and 2015 in the Bécancour-to-Batiscan area. Use of this dredge type is always required for maintenance dredging in Traverse du Nord.

To ensure an effective and safe operation, the CCG requires the scattered shoals at Deschaillons to be cleared using a clamshell dredge, the pontoon of which is held in place by spuds, due to the nature of the substrate to be dredged and the strong current.

2.1.6 Work schedule

The dredging work will be conducted in sections, moving downstream. Scattered shoals are to be dredged for 10 to 12 hours a day, seven days a week, while sedimentary shoals are to be dredged 24 hours a day, seven days a week.

2.2 Options and Alternatives for Managing Dredged Sediments

Based on availability, requirements, aptitudes and environmental conditions and as well, any contamination levels, multiple management scenarios may be considered for disposing of the dredged sediments. They may be disposed of in open water, onshore or upland. In all three scenarios, depending on sediment contamination levels, it will be possible to dispose of them freely (without protection or containment measures), contain them partially or ensure highly secure containment. The following sections set out the main sediment management approaches to be considered for dredging the St Lawrence Waterway. Table 2.5 at the end of the section summarizes the alternatives and variants.

2.2.1 Aquatic environment

The occasional effects level (OEL) and the frequent effect level (FEL) are the two threshold values guiding the disposal of sediments from dredging work. These levels are based on the *Criteria for the Assessment of Sediment Quality in Quebec* (EC and MDDEP, 2007).

2.2.1.1 Dumping in open water

Dumping in open water may be considered as a management approach for natural sediments (sand, gravel and rocks) of any particle size as long as contaminant levels are relatively low and their disposal does not promote degradation of the quality of existing sediments or deterioration of marine habitats at a site.

Where the concentrations of all substances analyzed does not exceed the OEL (class 1) according to the *Criteria for the Assessment of Sediment Quality in Quebec*, sediments may be dumped freely in open water without any particular containment measures. During disposal operations for dredged sediments, measures need to be taken to minimize any increase in the concentration of suspended materials.

Class 2 sediments, that is, those with a contaminant concentration exceeding the OEL but not exceeding the FEL, may also be dumped in open water as long as it can be demonstrated via bioassays that the sediments are non-toxic to wildlife (EC and MDDEP, 2007). Additionally, the disposal must not promote deterioration of the receiving environment.

Dumping in open water is prohibited when concentrations in sediments exceed the FEL (class 3).

A review of the environmental conditions at a new disposal site must be conducted before proceeding with disposal in order to identify any constraints at the site and to ensure that the environmental effects on the selected site will be minimal. In scenarios involving open-water dumping sites that have been used for some time, it is generally preferable to continue using these sites already disrupted by activities of this nature as long as they remain relatively stable.

Open-water dumping sites are selected based on the characteristics of the sediments to be dumped and the prevailing conditions at the disposal site. In some cases, particularly with riverine environments, sites should ideally be dispersive, that is, promote the gradual resuspension of sediments and their return to the hydrosedimentary flow to provide for their natural dispersion. In other environments, generally including Lake Saint-Pierre, sites are selected for hydrodynamic conditions that allow for the long-term stability of deposits or, at least, a relatively stable environment to keep the sediments in place such that they are not resuspended too quickly to settle again in channels and port areas.

Although dredging is typically performed in a downstream direction, this approach may be modified where indicated by the sediment quality in some areas to allow for specific sequencing of open-water dumping to ensure that that lesser-quality sediments are be capped by better-quality sediments wherever possible. This approach promotes containment of sediments that should be isolated from the aquatic environment by capitalizing on the diverse characteristics within a single project in order to optimize environmental performance.

Open-water dumping may also be used as a temporary storage solution pending subsequent reuse of sediments. In this case, in addition to sediment stability over the medium term, site selection criteria should include ease of sediment recovery.

In the final analysis, open-water dumping would appear to be appropriate for sediments dredged in the waterway, with the exception of debris.

Of the various alternatives for the disposal of dredged sediments, open-water dumping is the least expensive. Disposal costs therefore relate only to the distance from the dredging area to the disposal site. This is the option regularly used over the years for maintenance work in the St. Lawrence Waterway. In addition to its economic advantage, this approach also helps to minimize any environmental or social

(public safety) impacts potentially associated with the upland transport and discharge of sediments. The new maritime strategy of the Government of Quebec was also consulted and did not specify any repercussions of sediment disposal in open water.

2.2.1.2 Sediment use for restoration, stabilization or creation of habitat enhancements

Based on multiple studies carried out in recent years, open-water dumping of dredged sediments can be associated with a policy for environmental development and improvement where the sediments are used for purposes of restoration, stabilization or creation of habitat enhancements.

These types of projects frequently call for very high volumes of sediments. Given that the objective of these projects is to achieve healthy habitats, they are not compatible with the use of sediments with contamination issues or physical characteristics that are incompatible with the immediate environment.

In the St. Lawrence corridor, there are a good number of examples where dredging deposits have proved ultimately beneficial for wildlife, although it must be added that this has often been more or less by chance. Such is the case, for example, at Île-aux-Sternes near Trois-Rivières and a number of islets located near the channel off of Contrecoeur.

In the Lake Saint-Pierre area, numerous potentially beneficial uses of sediments, including contaminated sediments, have been identified to date. One firm, Hamel, Beaulieu et associés (1989), identified three sites for the creation of islets or shoals for wildlife from dredged sediments. A subsequent study showed, however, that these locations were not conducive to this type of development in that they were located in areas with unstable ice cover, compromising the basic stability of these works. Moreover, access to the sites was questionable since the water depths were to shallow to accommodate navigation by tugboats or barges.

In 1991, another site in Lake Saint-Pierre (S-10) was proposed as favourable for the development of an islet and swamp conducive to wildlife. This development was intended to provide an acceptable solution for the disposal of sediments dredged at wharf no. 2 at Sorel. However, the cost of undertaking the work was prohibitive due to the fact that relocation of the sediments would require double handling since following dredging, the sediments would have to be moved again using pumps or another dredge. In light of the high cost and minimal anticipated environmental gains, the project was abandoned by the various partners at the time. It is important to understand that Lake Saint-Pierre already has 10,000 to 10,500 ha of grass beds, 4,000 ha of which is underwater. The Sorel Archipelago is also made up of 41 islands distributed over nearly 8,500 ha. The creation of a few hectares of grass beds or islands would consequently represent only a very marginal gain in the context of Lake Saint-Pierre, which is already a very rich environment.

The use of dredged sediments to nourish eroded islands (islands off of Sainte-Anne-de-Sorel), create the rock islands constructed in Lake Saint-Pierre or build up shoals (between the two marinas) provides alternatives associated with certain technical problems ranging from access to or the nature of the dredged sediments as well as environmental or social issues (different stakeholder groups not always having compatible interests). Note that sand is entirely unsuitable for restoring the artificial islets in Lake Saint-Pierre. These structures are made up of stones of various sizes, the smallest measuring approximately 30 cm in diameter and the largest weighing as much as 1 to 1.5 tonnes each. Furthermore, even if these alternatives were feasible, they would still be very costly, primarily due to the double handling of the sediments and their negative impact on the aquatic environment, since they all involve covering over natural habitats and other areas.

Although the sediments in the waterway are of good quality, the low annual dredging volumes and costs incurred make it an unfeasible solution at this time.

2.2.1.3 Capping

Capping is an effective and frequently used technique for managing contaminated sediments exhibiting potential toxicity (moderate to significant pollution). At these sites, the dredged sediments are entirely contained below the water level. Containment dramatically reduces water displacement between the aquatic environment and the sediments although it does not eliminate this phenomenon entirely. These low levels of displacement may contribute to maintaining the deposits in the physicochemical conditions that led pollutants to bind to the sediments.

This method is used mainly for managing contaminated sediments exhibiting potential toxicity. In light of the fact that the sediments to be dredged in the waterway are generally of good quality, this solution is inappropriate in the present case.

2.2.2 Onshore

2.2.2.1 Onshore disposal

Unrestricted onshore disposal is an option for uncontaminated sediments where local erosion conditions allow. Open onshore disposal is generally an option in the context of beneficial development, such as beach creation or nourishment, habitat establishment or enhancement, etc. Evidently, sediments used for this purpose must be entirely free of contaminants, and it is also important to ensure that their particle size meets the requirements of the proposed development.

This type of disposal, which is much costlier than open-water dumping, is not generally used by dredging companies except in collaboration with organizations promoting such developments. In this case, where indicated, the promoter identifies any requirements or restrictions, conducts the necessary technical studies, obtains environmental permits and absorbs the additional costs associated with project management activities.

It should be noted that scenarios involving nourishment of eroding beaches have impacts associated with the modification of natural habitat along the beach, including the loss of fish habitat, and with the modification, however significant, of the sedimentary regime along the beaches. We can presume that the sand deposited in eroding areas could accelerate the settlement rate at locations naturally conducive to sediment deposition. Consequently, these activities require preliminary studies and relatively complex design work along with technical and environmental assessments that exceed the framework of the typical dredging project. It is not feasible, nor is it desirable, at this time for the CCG to lead or to intervene as a proponent for these types of activities, which fall significantly outside of its scope and would take place on public or private land.

In the event that a proponent were interested in receiving dredged sediments to put to beneficial uses, it would have to assume responsibility for preliminary feasibility and design-related tasks as well as acquisitions, agreements, permits and completion of the coastal and site development work required for these activities. In this scenario, the CCG's responsibility would be limited to transporting the sediments to a transfer point designated by the proponent. Once again, the distance from the dredging site to the proponent's transfer point could compromise the project. Excessive distances would incur prohibitive costs. Additionally, the CCG, which works within certain constraints in its dredging activity calendar,

cannot tolerate too great a deviation (environmental constraints: spawning time, commercial fishing; technical constraints: silting of the waterway by a certain date, ice formation and retreat, etc.).

Prevailing current and wave conditions at the disposal sites, the physicochemical nature of the sediments requiring dredging and local bank sensitivity are additional factors to be considered when determining the feasibility of this option. Accordingly, it is important to note that the current, wave and ice conditions generally prevailing in the St. Lawrence, particularly throughout its fluvial portion, are rarely conducive to this type of approach. Lastly, any form of onshore disposal generates impacts on natural bottom areas and riparian habitats that must be taken into account.

2.2.2.2 Onshore containment

Onshore containment may be a sound solution for the relocation of sediments ranging from good to moderate quality (St. Lawrence Centre, 1992). This involves capping the sediments and stabilizing the deposit to protect it against local conditions through use of appropriate structures. In so doing, the sediments may be repurposed as backfill material for a project to build or expand a marine structure. Sediments may also be placed in a containment structure built for this purpose. In this case, onshore containment may be used to manage sediments not exhibiting high potential toxicity.

The costs of onshore containment may be moderated by depositing the sediments inside a work under construction. If a containment structure has to be built, however, the costs quickly become prohibitive.

In the present case, onshore containment is not a solution under initial consideration due to the physicochemical nature of the sediments. However, the sediments could be used as backfill or finishing material for a project to build or expand a marine structure.

Steps could be taken with various project proponents and environmental authorities to determine whether any onshore projects would be appropriate for accommodating dredged sediments over the next few years and to advise these parties of the ongoing availability of sandy material. For example, the Canadian Environmental Assessment Agency (CEAA) or the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC) could serve as a contact point for exchanging information with the various proponents.

2.2.3 Upland

2.2.3.1 Upland disposal

Upland disposal involves disposing of sediments at an upland site where they can be used as general fill material. This option may be considered for sediments with low contamination levels that comply with soil use criteria.

This is an alternative typically used as part of capital projects at ports (e.g. development of new pads), for related projects or possibly for projects located in port areas (road construction, grading). The costs could be minimal if the dredging is carried out nearby, since the dredged sediments can be deposited directly in place through use of discharge lines. If the dredging is performed using a mechanical dredge, the work becomes more complicated and expensive due to the additional handling required to offload the barges and transport the dredged sediments to their final destination.

Upland disposal may also be considered in a context of reclamation or recovery for other purposes (capping of landfill sites, various backfill projects, agricultural use, etc.). It is important to note, however, that the costs of this option can accelerate quickly if the sediments or sand has to be unloaded at a

harbour facility, stored, dried and then transported over land. Depending on the chemical quality of the sediments, they may be:

Used as capping material at a landfill

Excavated sediments with contaminant concentrations not exceeding criterion C of the *Politique de protection des sols et réhabilitation des terrains contaminés* [soil protection and contaminated land recovery policy] (Policy) (MDDEP, 1998) may be relocated to a technical landfill site.

Disposed of in a dry materials dump

Sediments with low contamination levels, i.e. not exceeding criterion B of the Policy, may be relocated to a dry materials dump as long as they do not emit any odour.

Used as fill material on commercial or industrial land

Excavated sediments with low contamination levels not exceeding criterion B of the Policy may be used as fill material on industrial or commercial land as long as their use does not increase the contamination level of the receiving land and the soil does not emit any perceptible odour. Accordingly, if the receiving land does not exhibit any contamination (with contamination not exceeding criterion A of the Policy), soil with contamination levels between criteria A and B may not be used as backfill. However, if the contamination level of the receiving land falls between criteria A and B or between criteria B and C, the use of soil with contamination levels between criteria A and B may be considered under the same parameters. In order to receive dredged sediments, the site owner must obtain authorization from the MDDELCC.

Used for agricultural purposes

Due the nature of the dredged sand in this case. it cannot be used for agricultural purposes.

The work in question involves dredging out in the waterway far from any port, making costs associated with distance a significant factor. In addition, although the drying process happens to be very fast in the present case since the sediments removed from the waterway are made up mainly of sand and gravel, temporary holding areas would have to be set up on a dock to store the sediments brought in out of the water. Use of a hydraulic dredge would require setting up a system to manage the high volumes of water that would be pumped with the sediments. Next, arrangements would have to be made for watertight trucks to transport the sediments to the disposal site.

Upland disposal is a very costly solution in comparison to open-water dumping when transportation costs (distance between dredging site and dock and between dock and sediment disposal site) are taken into account. It has been determined that transportation costs become very high when the distance between dock and disposal site exceeds 10 km. This does not take into account the costs of dredging, double or triple handling, disposal and, where required, construction of a holding tank. Moreover, the disposal site may have limited capacity to accommodate sediments.

Further, an assessment of the commercial potential of dredged sediments from the St. Lawrence has shown that the use of dredged sediments as abrasives is not an option as the dredged sand is blunted by the transportation mechanisms. On the other hand, their particle size makes them suitable for use in making concrete or for road maintenance or building. However, several borrow pits located between Montréal and Québec are already supplying suitable sand for construction work at affordable prices. For the CCG, recovering dredged sediments for this type of use would be a much more expensive and unsuitable option as the market in this regard appears rather limited.

Note that the CCG did consider this option as part of an exploratory study concerning sediments in Traverse du Nord (GHD Consultants Ltée, 2015a). The purpose of this study was to assess the potential and constraints associated with this option by exploring the relevant factors with a view to minimizing the impacts of upland disposal and defining the methodology and work required to manage sediments in this manner. From a financial viewpoint, this solution would not not appear to be advantageous for the CCG to opt for this solution unless a proponent seeking to reuse the sediments covers the cost and assumes responsibility for their upland management.

2.2.3.2 Upland secure containment

Upland secure containment involves depositing the sediments securely and permanently at an appropriate site. Upland secure containment of dredged sediments should typically be used only for highly contaminated sediments. This measure is generally used to provide appropriate environmental protection when dealing with this type of material. The main objective of upland secure containment is to create conditions that minimize both sediment loss and migration into the environment of the contaminants contained in the sediments. Disposal sites should therefore incorporate waterproof membranes or construction materials and a system for collecting and treating drainage water and leachate. As in the case of upland disposal, upland containment requires repeated handling because of the sediment drying and transportation processes. An authorized containment site is also required. The cost of this management solution is consequently very high.

In light of the good quality of the sediments dredged in the waterway, upland secure containment does not initially appear appropriate as a management option.

2.2.4 Sustainable development outlook

Of the various management alternatives and variants for dredged sediments, the upland sediment management scenario is generally associated with environmental impacts relating to transport of the sediments, such as greenhouse gas and other airborne emissions, noise, disruption and safety risks for residents along the trucking route, traffic congestion and stirring up of dust. This operation to relocate a large volume of sediments involves significant energy expenditure and airborne emissions.

Table 2.5 Advantages and disadvantages of dredged sediment management alternatives

	ENVIRONMENTAL ASPECTS		ECONOMIC ASPECTS		TECHNICAL ASPECTS		RECOMMENDATIONS
	Advantages	**Disadvantages**	**Advantages**	**Disadvantages**	**Advantages**	**Disadvantages**	
AQUATIC ENVIRONMENT							
Open-water dumping	- Class 1 sediments may be dumped. - Class 2 sediments may be dumped if it can be shown through bioassays that the sediments are non-toxic to wildlife.	- No reuse of dredged sediments. - An aquatic environment is modified (disrupted).	- Least expensive solution.		- All particle sizes are compatible. - Dredged sediments may be deposited directly via pipeline, barge or even hydraulic hopper dredge. - May be done in specific sequences based on sediment quality in the various dredging areas.		- Option used for many years at locally approved disposal sites. Since these sites have been used for years, any additional disruption with respect to previous deposits is minimal. - Enables completion of the work within the period prescribed and within constraints (environmental, meteorological and waterway safety-related).
Sediment use for restoration, stabilization or creation of habitat enhancements	- Beneficial for wildlife in some ways.	- Involves impact on existing habitats.		- May have very high implementation costs (double handling of sediments).		- Frequently involves very high volumes of sediments. - Areas in Lake Saint-Pierre are not conducive due to unstable ice cover. - Water in some places is too shallow to allow tugboat or barge access.	- Due to social constraints (the interests of one group of stakeholders not always being aligned to those of other groups) and technical disadvantages, this option is not ideal. - Additionally, this type of project must always be aligned timewise with other proponents' projects, which complicates implementation.
Capping	- Effective technique for managing contaminated sediments exhibiting potential toxicity.			- Highly variable in cost. - Excavation of underwater sites (where required) is more expensive than excavating near-shore containment facilities.		- Requires large volumes of uncontaminated coarse sediments for use as cover. Hydrodynamic conditions at the site must support sediment stability.	- Although feasible, this method appears inappropriate due to the good quality of the sediments to be dredged.
ONSHORE							
Onshore disposal		- Involves impact on existing habitats.		- More expensive than open-water dumping and excessive distances between dredging site and transhipment point lead to prohibitive costs. - Must be done in partnership with managers and proponents.		- In the St. Lawrence in general and its entire fluvial portion in particular, conditions are rarely conducive to this type of approach. - The dredging calendar must be coordinated with that of any development projects. - The need for preliminary studies, relatively complex design work and technical and environmental assessments exceeds the scope of the CCG's mandate.	- The CCG's responsibility would have to be limited to transporting the sediments to a transhipment point designated by the proponents and transporting the sediments to the planned development site. - The distance from the dredging site to the transhipment point could compromise the project. - The CCG works within certain constraints in its dredging activity calendar and consequently cannot tolerate too great a deviation (environmental constraints: spawning time, commercial fishing; technical constraints: silting of the waterway by a certain date, ice formation and retreat, etc.).

Table 2.5 Advantages and disadvantages of dredged sediment management alternatives (cont.)

	ENVIRONMENTAL ASPECTS		SOCIOECONOMIC ASPECTS		TECHNICAL ASPECTS		RECOMMENDATIONS
	Advantages	**Disadvantages**	**Advantages**	**Disadvantages**	**Advantages**	**Disadvantages**	
Onshore containment	- Sound solution for disposal of sediments of good to moderate quality.	- Involves impact on existing habitats.		- Costs may go up if a containment structure has to be built to accommodate the sediments.		- A containment system or dike must first be built around the entire affected area. - These sites are built in open water where they could constitute an obstruction to navigation.	In the present case, onshore containment is not a solution under consideration due to the physicochemical nature of the sediments.
UPLAND							
Upland disposal	- This option may be considered for sediments with low contamination levels that comply with soil use criteria. - May also be considered in a context of reclamation or recovery for other purposes (capping of landfill sites, various backfill projects, agricultural use, etc.). - This option avoids modifying (disrupting) an aquatic environment.	- May involve impact on existing land habitats.	- Costs may be low if the dredging is done nearby.	- This option becomes costly if the distance between the dredging site and the transhipment point is significant, if additional handling is required or if use of temporary dockside holding areas or watertight trucks for sediment transport is necessary. - Must be done in partnership with managers and proponents. If the CCG is responsible for all costs, this management option is not advantageous. However, it could be worthwhile considering if a third party agrees to cover all costs and take all necessary measures relating to proceeding with upland disposal and reuse of the sediments. - Potential disruption and impact on public safety in relation to trucking of sediments.	- The particle size of some sediments makes them suitable for use in making concrete or for road maintenance or building. This method is not appropriate for agricultural use.	- Increasing the distance between the dredging site and transhipment point also extends the duration of the dredging work. - For sediment transfer, the dock must have adequate technical characteristics to accommodate the dredge or barge. - For direct disposal at a site located away from the shore, the use of equipment supporting a hydraulic load is required. Use of a booster pump may be necessary. Measures to mitigate the impact of the presence of pumping lines must also be taken. - The use of dredged sediments as abrasives is not an option, as the dredged sand is blunted by the riverine transportation mechanisms.	- Due to the existence of multiple borrow pits between Montréal and Québec already supplying suitable sand for construction work at affordable prices, the recovery of these sediments becomes an expensive and inappropriate option for the CCG. In reality, the market in this regard appears rather limited. - If a proponent seeking to make use of the sediments assumed responsibility for the additional costs and measures required for this management approach, this option could be more financially advantageous for the CCG. - The CCG's responsibility would have to be limited to transporting the sediments to a transfer point designated by the proponent. - The distance between the dredging site and transhipment point could compromise the project as the CCG works within certain constraints in its dredging calendar and consequently cannot tolerate too great a deviation (environmental constraints: spawning time, commercial fishing; technical constraints: silting of the waterway by a certain date, ice formation and retreat, etc.). - Mixed management of the sediments (open-water dumping with upland disposal used secondarily) would be a potential alternative if the environmental and technical feasibility is not compromised.

Upland secure containment	- Best option for the disposal of highly contaminated sediments.			- The cost of this management solution is very high. Requires repeated handling (drying and transport). An authorized containment site is also required. Potential disruption and impact on public safety in relation to trucking of sediments.		- Development of disposal sites should include the use of waterproof membranes or construction materials and the collection and treatment of drainage water and leachate.	- Upland secure containment of dredged sediments should be used only for highly contaminated sediments. In light of the good quality of the sediments dredged in the waterway, upland secure containment does not initially appear appropriate as a management option.

2.3 Management Mode Chosen for Dredged Sediments

In light of the various environmental, social, financial and technical constraints and concerns, open-water dumping of the dredged sediments is the most appropriate solution within the context of this project. In addition, the sites used have already been disrupted, and annual monitoring (sediment characterization) has not raised any environmental concerns. The other options are associated with likely significant technical, financial and environmental constraints.

However, the CCG has been conducting an in-depth study of the upland management option for the sediments. The feasibility of this management approach has already been assessed concerning sediments in Traverse du Nord (GHD Consultants Ltée, 2015a). Based on prior characterizations, the study finds that the chemical nature of the sediments in that portion of the waterway does not create any constraints with respect to upland disposal in that the disposal is compatible with soil use criteria. It finds further that this management approach could be considered in addition to open-water dumping if a proponent were interested in receiving and repurposing the dredged sediments and assumed responsibility for all necessary measures and work relating to managing the sediments after their removal from the water. Moreover, prior to entering into any partnership in this regard, the proponent has to show the CCG that it has all permissions and facilities required to accept the sediments. While the CCG has expressed interest in this sediment disposal option, it is not planning to proceed further until it sees clear proof that this option is advantageous from the technical, financial and environment perspectives. In the event that the feasibility of this disposal option is demonstrated, the study nonetheless recommends use of mixed management (open-water disposal and upland management) so that the CCG retains its usage rights to the open-water disposal sites. The various impact mitigation measures listed in the study should be considered if this upland management option is used in relation to future dredging work.

Accordingly, for the 2016-2018 period, although the sediments at the dredging and disposal sites have not yet been characterized, it is presumed that the environmental quality of the sediments will support use of the same management approaches for the dredged sediments as in previous years, i.e. continued use of open-water dumping at authorized disposal sites. This conclusion is based on the fact that the overall quality of sediments dredged over the last 20 years has been very good with little year-over-year variation observed in terms of the nature of the dredged sediments. The sediments should still be characterized prior to each dredging operation to confirm the sediment management approach. In the event that the environmental quality of the sediments in dredging areas or at disposal sites did not support the management approach proposed above, then this approach could be reviewed.

An overview of the approximate locations of the disposal sites for dredged sediments in the St. Lawrence Waterway is provided in Appendix A.

2.3.1 Disposal sites

Appendix C sets out the locations of the 10 disposal sites to be used during the 2016-2018 period to dispose of all sediments dredged in the waterway: Vickers (M-02), Lanoraie (M-27), Yamachiche-Nord (S-17), Sainte-Angèle (T-02), Cap-de-la-Madeleine (T-06), Saint-Pierre-les-Becquets (T-11), Deschaillons (T-16), Donnacona (X-04), Banc Brûlé (X-02) and Sault-au-Cochon (X-03).

All of these disposal sites for sediments dredged in the waterway were identified several decades ago with the exception of site S-17 (Yamamiche-Nord) in Lake Saint-Pierre, which has been in use only since the late 1990s. For 20 or more years prior to that, sediments in Lake Saint-Pierre were dumped south of the channel around buoy S51.

All of the sediment disposal sites are located in areas where the bottom is classified as stable and the environment is least affected.

2.3.2 Sediment disposal

The sediments from hourly dredging of scattered and sedimentary shoals between Montréal and St-Antoine may be deposited at the following disposal sites located in the same region: M-02, M-27, S-17, T-02, T-06, T-11, T-16 and X-04. Their volume could reach approximately 2,000 to 3,000 m³ (V_ch). However, disposal area T-06 will be used only for the disposal of any large rocks that may be dredged between Lake Saint-Pierre and Bécancour.

Sediments from dredging by the cubic metre of sedimentary shoals between Lake Saint-Pierre and Cap Gribane (Traverse du Nord) may be deposited at disposal areas S-17, T-11, X-04, X-02 and X-03. Their volume may reach around 80,000 m³ (V_ch) with 50,000 m³ coming from Traverse du Nord.

2.3.2.1 Yamachiche-Nord (S-17)

Sediments dredged in Lake Saint-Pierre may be deposited at either or both of disposal sites S-17 and T-11. The choice of disposal site will depend on the equipment used by the contractor carrying out the work. The physicochemical quality of the dredged sediments will very likely be equivalent to that of dredged sediments in previous years. If site S-17 is used, the volume deposited will also be considered for the offsetting program for the current year or a subsequent year.

Site S-17 was proposed as a replacement for site S-16 (located south of the channel) under the auspices of an environmental study for the selective shoal dredging project in the waterway in 1997. Based on test fishing carried out in recent years, this site is not a critical or essential fish habitat. It is also not a frequent destination among users of the lake, including commercial fishers. This site has been used for maintenance dredging work since 1997. Site S-17 is situated on the north side of the channel approximately 2.5 km offshore (see Appendix C).

Based on physicochemical results compiled over the years, the substrate found at disposal site S-17 is made up partly of sand, silt and clay from the bottom of Lake Saint-Pierre as well as traces of gravel possibly from previous dumping activities. Based on the data collected within the last few years, the quality of the sediments at this site may be considered good in accordance with current criteria. Apart from excessive chromium levels observed in 2014 and 2015, all parameters are below OEL (EC and MDDEP, 2007). Moreover, concentrations remain below laboratory-based analytical detection limits for all organic compounds tested (PAHs and PCBs).

As part of the monitoring program for selective dredging of shoals in the waterway between Montréal and Cap-à-la-Roche, the conduct of fish fauna inventories has added to data on the use of site S-17 by fish (CJB Environnement inc. and Procéan inc., 2000). The test fishing program at disposal site S-17 was conducted to document any changes in fish populations before and after completion of the shoal dredging and sediment disposal work. The program data were collected over six sampling campaigns carried out between September 1997 and June 2000. Six variables were analyzed statistically in relation to catches per unit effort and number of species with a view to identifying any variations in use of the environment by fish wildlife. The data were analyzed first for all species combined and then for bottom-feeding species, the most likely to be affected by sediment disposal. In light of the sufficiently high number of catches, the white sucker and the shorthead redhorse in particular were subject to specific statistical analysis. The statistical tests performed collectively revealed little significant difference between the outcomes recorded at field stations and those at control stations except with respect to the shorthead redhorse. An increase in

catches per unit effort was noted for that species during one period (fall 1999) where sediments were deposited whereas catches decreased at the control stations.

Based on these outcomes, it does not appear that disposal at site S-17 in the fall of 1998 caused any decrease in use of the environment by fish wildlife during the study period. However, the significant increase in shorthead redhorse catches at field stations approximately a year following the disposal activities is difficult to interpret. It may be an actual increase in use of the environment by certain bottom-feeding species subsequent to gradual recolonization by benthic fauna.

After surveys conducted over a period of more than two years, the follow-up program on actual use of the environment by fish populations found that disposal activities at site S-17 had no negative impact. This follow-up consequently supported quantitative confirmation of the conclusions of the project environmental assessment, which predicted highly localized, reversible impact of little significance on aquatic wildlife (Procéan *et al.*, 1996).

Also noted was that, in general, neither of the two sites sampled (S-17 and control site) exhibits characteristics suggesting that it might be potential spawning grounds for species of recreational or commercial interest (yellow perch, walleye, sturgeon).

2.3.2.2 Saint-Pierre-les-Becquets (T-11)

A single sediment disposal site is being considered in the Bécancour-to-Batiscan area, at Saint-Pierre-les-Becquets (T-11) (see Appendix C). This large, deep site is situated approximately 1.2 km from the south shore and has been used on numerous occasions to dispose of dredged sediments during previous maintenance work in the Bécancour area. Site T-11 is located a good distance from a fishing area used by a commercial fisher. Based on discussions with that fisher, the activities have not driven away the resource or caused any harm to fishing gear.

The sediments at the disposal site are typically made up largely of sand. With regard to quality, data collected in recent years indicate that the quality of sediments at the disposal site may be classified as good in accordance with current criteria. Results exceeding the OEL (EC and MDDEP, 2007) have occasionally been observed, as in the case of lead in 2013 and chromium in 2001. Overall, all parameters comply with this criterion. Moreover, concentrations remain below laboratory-based analytical detection limits for all organic compounds tested (PAHs and PCBs).

2.3.2.3 Donnacona (X-04)

The site identified for disposal of sediments dredged in Traverse Cap-Santé is located north of the channel at Donnacona (X-04; see Appendix C). This site is very large, and only the upstream portion (X-04Ptie, located approximately 1.8 km from the north shore) of the site will be used. This location has been used many times to dispose of dredged sediments from previous dredging activities carried out in Traverse Cap-Santé.

The volume of dredged sediments to be deposited at X-04Ptie will not be large: over the next several years, around 2,000 m³ (V_ch) of sediments may be dumped there. This volume represents the dredging of a number of sedimentary shoals that have been forming over the last few years as no dredging was done in Traverse Cap-Santé between 1998 and 2004.

According to physicochemical characterizations carried out previously, sediments at disposal site X-04Ptie are made up of coarse sand with traces of gravel (>95%). Generally, no contaminants have been uplandd for all parameters analyzed.

2.3.2.4 Banc Brûlé (X-02) and Sault-au-Cochon (X-03)

Two disposal sites for dredged sediments will be used in Traverse du Nord. These sites lie southeast of the Banc Brûlé cul-de-sac (X-02) and at Sault-au-Cochon (X-03) approximately 1.5 km from the centre of the waterway toward the southeast (see Appendix C). These sites have been used for a number of years to dispose of dredged sediments from maintenance work in Traverse du Nord. The sites were selected after completion of a study in the 1970s by Laboratoire d'hydraulique Lasalle (1972).

Dredged sediments from a particular area will be dumped at the nearest disposal site. The volume of sediments dredged in Traverse du Nord could reach 50,000 m³ (V_ch). A maximum volume of 10,000 m^3 (V_Cie) of sediments will be deposited at the Banc Brûlé disposal site (X-02). All other sediments will be dumped at the Sault-au-Cochon disposal site (X-03).

The sediments at the disposal site southeast of the Banc Brûlé cul-de-sac (X-02) are generally made up of a combination of coarse sand and gravel with the remainder consisting of fine sand, silt and clay, and colloids. Samples collected from the site across from Sault-au-Cochon (X-03) are made up mainly of coarse sand with traces of gravel and of fine sand. Depending on where the sample was collected, such as in the central portion of the area delimited for disposal or along its perimeter, the nature of the sediments may be more heterogeneous from one year to the next.

Over the years, the levels of certain contaminants (arsenic, mercury, chromium, copper and nickel) at both sites have exceeded the OEL. It is reasonable to find that these high levels may relate to the fact that the sediments in question are presumably unworked post-glacial silt and clay that may naturally exhibit elevated levels for these metals. It should be noted that the highest metal concentrations remained lower or slightly higher than background levels reported for the fluvial portion of the St. Lawrence (EC and MDDEP, 2007).

Sediment samples collected in 2014 and 2015 at the Sault-au-Cochon disposal area (X-03) also had arsenic (As) levels exceeding the OEL but remaining below the FEL. However, the concentrations measured for all other metals analyzed were below either the OEL or the analytical detection limit, which is also below the OEL.

2.3.2.5 Other disposal sites (M-02, M-27, T-02, T-06 and T-16)

As noted previously, the scattered and sedimentary shoals from hourly dredging between Montréal and St-Antoine can be dumped at disposal areas M-02, M-27, T-02, T-06 and T-16. Little information has been collected on these sites. Since 2000, they have been used sporadically for disposing of small volumes consisting most frequently of rocks or boulders left behind by the ice in the navigation channel.

Some information on recent characterizations follows (Procéan *et al.*, 1996).

Site	Sampling Year	Characterization Results
M-02	1995	> OEL (arsenic, cadmium, copper, mercury, lead and zinc)
M-27	1992	> OEL (chromium)
T-02	1995	< OEL
T-06	1992	< OEL
T-16	Not available	Not available

2.3.3 Residual capacity of sediment disposal sites

The residual capacity of the disposal sites was evaluated by determining the available volume between a minimum (Zmin) and a maximum (Zmax) depth and also taking into account the depth level to be maintained during disposal (Zdredging). Table 2.6 sets out the characteristics of each disposal site available for the present project. According to these results, the residual capacity can potentially accommodate a number of years of use.

Depending on the equipment used to perform sediment disposal and with a view to making optimal use of the disposal sites, partial disposal sites S-17Ptie, T-11Ptie, X-04Ptie, X-02Ptie and X-03Ptie will be located well inside their larger respective sites. This is not necessary for the other disposal sites due to their limited size. The latest bathymetric data are provided in Appendix C.

2.3.4 Stability of sediment disposal sites

The stability of sediment disposal sites depends on tractive forces, or forces exerted by the water flow on the solid materials sitting on the bottom. Note that the waves can also influence sediment stability, particularly at shallow sites. The greater a site's exposure to significant fetch, that is, the greater the distance travelled by the wind over open water, the larger the resulting waves.

The study conducted by Procéan *et al.* (1996) under the auspices of a project to perform selective shoal dredging in the waterway sets out the process for evaluating the stability of certain sites. Based on interpretation of the hydrodynamic data, stability in terms of average tractive force was defined for flows in the St. Lawrence of 10,000 m^3/s and 13,000 m^3/s (with 50% and 10% recurrence respectively at Sorel). These data were intended mainly to support the comparative description and selection of disposal sites in absolute terms.

In the Montréal area (M-02 and M-27), the orbital currents generated by the waves are insufficient to mobilize the sediments significantly where they consist of sand. Site M-02 is of special interest because of its shelter and stability characteristics, among other parameters, as it is literally a depression set down several metres from the surrounding floor. This site is likely the vestiges of a rock borrow site. Site M-27, meanwhile, exhibits relatively good stability characteristics.

Surveys were performed at site S-17 between 1998 and 2001 that clearly demonstrated the stability of that site. The sediments deposited there were more or less still in place. Although annual surveys indicate that the sediment mounds have changed over time, the site may be considered stable.

In the eastern portion of Lake Saint-Pierre, the specific hydrodynamic conditions make it difficult to identify a disposal site offering a high level of stability for the materials. Site T-02 is considered less stable due to the shallow waters in that area, which make it more vulnerable to erosion when strong northeast or southwest winds develop. However, this site should be stable for coarser materials deposited as part of

hourly maintenance work. Based on previous studies, materials deposited at site T-06 could be dragged a short distance further down the channel. As a result, disposal site T-06 will be used only for dumping any large rocks dredged between Lake Saint-Pierre and Bécancour.

Site T-11 is being retained as a disposal site due to its significant capacity in comparison to other potential sites evaluated in the same area.

No information is available concerning the stability of site X-04.

In the Traverse du Nord area, due to the effect of the tides and strong currents that change direction, disposal sites X-02 and X-03 are likely subject to a certain amount of turbulence. Despite this, they appear to retain a relatively stable bathymetric profile.

Table 2.6 Characteristics of disposal sites usually used and available for the present project

Disposal site	Location	NAD83 coordinates; MTM: Zone 8*		Depth (m)			Residual capacity based on Zdredging (m^3)	Sediments deposited as percentage of residual capacity	Total area (m^2)	Nature of bottom	
		X	Y	Zmin	Zmax	Zdredging				Substrate identified during previous characterizations**	Material deposited between 2000 and 2015
M-02	Vickers / Montréal	303,423	5,045,482	2.4	10.3	2.4	76,749	0.5%	20,000	silty-clayey sand	rocks, cobble, clay
M-27	Lanoraie	325,659	5,088,335	1.8	6.0	2.4	401,827	0.1%	200,000	sand and gravel on clayey silt	rocks, sand, clay
S-17	Yamachiche Nord	360,867	5,123,336	1.8	4.6	2.4	1,630,979	0.2%	1,600,000	sand, silt and clay	sand
T-02	Sainte-Angèle	380,661	5,134,210	0.9	7.7	2.4	120,926	0.3%	190,000	sand, a little gravel and silt	rocks, sand, clay
T-06	Cap-de-la-Madeleine	383,376	5,138,528	2.0	10.4	2.4	3,006,479	0.1%	620,000	sand, gravel, silt and clay	rocks, cobble, clay
T-11	Saint-Pierre-les-Becquets	401,431	5,148,345	0.9	9.5	3.5	1,509,493	1.4%	760,000	sand with traces of silt and clay	sand, rocks
T-16	Deschaillons	412,321	5,159,760	0.2	7.8	2.4	600,205	0.1%	240,000	sand	rocks, cobble
X-04	Donnacona	210,286	5,169,242	7.2	10.9	7.5	581,528	0.4%	1,980,000	sand, a little gravel, traces of silt and clay	sand, rocks, gravel
X-02	Banc Brûlé	289,918	5,213,388	2.9	8.0	3.9	4,745,472	0.2%	2,610,000	sand with traces of gravel, silt and clay	sand
X-03	Sault-au-Cochon	295,822	5,225,541	3.6	12.1	4.6	3,953,645	1.3%	1,280,000	sand with traces of gravel, silt and clay	sand

* Coordinates of all disposal sites are provided in Appendix C.
** Information from Procéan *et al.* (1996), GHD Consultants Ltée (2015b, 2015c, 2015d) and Frenette *et al* . (1989) cited in St. Lawrence Centre (1996).
Zmin: Minimum current depth within disposal site perimeter.
Zmax: Maximum current depth within disposal site perimeter.
Zdredging: Depth to be maintained for dumped sediment as set out in dredging contracts.

2.3.5 Sediment transport mode

The debris dredged using a clamshell dredge will be transported to the nearest dock and then trucked to either the Sorel wharf or the Port of Québec for disposal by the CCG in accordance with current environmental guidelines.

Natural sediments (sand, gravel and rocks) dredged either at an hourly unit rate or by the cubic metre with a clamshell dredge will be transported in open-hopper dredges and dumped at authorized disposal sites.

Sediments dredged using a trailing suction hopper dredge will be loaded onto the dredge for transport and deposited at various appropriate disposal sites.

2.3.6 Sediment disposal mode

Bathymetric surveys are conducted annually at disposal sites S-17, T-11, X-04, X-02 and X-03. The remaining sites are surveyed on an as-used basis. The purpose of surveys is to identify locations (partial areas) among which sediments can be deposited as uniformly as possible. The locations of these partial disposal areas will be provided to the Contractor before the start of the work.

2.3.7 Disposal sequence

No particular disposal sequence will need to be followed under this project since the sediments dredged will most likely be sand of comparable quality. In addition, since the dredged sediments will be relatively coarse in terms of particle size, there will not be any fine sediments requiring capping.

3. Description of Environmental Aspects

The information found in the description of the environmental aspects is largely based on the environmental study conducted in advance of the selective dredging of shoals in the waterway between Montréal and Cap-à-la-Roche. The associated report was prepared for the CCG in 1996 by Procéan, Les Consultants Jacques Bérubé and G.D.G. Environnement.

3.1 Hydrodynamics, Ice and Sedimentation

3.1.1 Hydrology

Table 3.1 provides information on the mean annual flow at various locations along the river, and for certain tributaries, based on flow measurements taken at hydrometric stations.

No flow values are available for the St. Lawrence River below Lake Saint-Pierre due to the strong tidal influence. This influence can cause variations from the mean flow amounting to thousands of cubic metres per second during either flood or ebb tide.

Table 3.1 Mean annual flow in the St. Lawrence River and its main tributaries between Montréal and Deschaillons

Waterbody	Site	Drainage basin* (km^2)	Mean flow (m^3/s)	Measurement period

St. Lawrence	below Montréal**	923,000	9,930	1960-90
St. Lawrence	Sorel (above Richelieu)**	940,000	10,180	1960-90
Richelieu	outlet	23,720	402	1937-92
Yamaska	outlet	4,784	116	1983-92
Saint-François	outlet	10,228	219	1925-92
Nicolet	outlet	3,399	77	1966-92
Saint-Maurice	outlet	43,200	694	1924-92
Bécancour	outlet	2,620	64	1970-92
Batiscan	outlet	4,686	103	1931-92
Sainte-Anne	outlet	2,692	70	1919-92

**: The flow at some sites comes from a division of the currents making it impossible to determine the drainage basin area applicable to the sites in question.*

***: The stations below Montréal and at Sorel are virtual stations. The flow rates indicated were calculated by adding the mean annual flow values of all tributaries to the LaSalle station.*

The freshet in the St. Lawrence River generally starts in late March and continues into April and May. Following the freshet, flow rates decrease steadily through September, when they increase again slightly with the fall rains. January and February are the characteristic months of the winter low flows.

3.1.2 Tides

There are no tides between Montréal and Lake Saint-Pierre, but the water level there varies somewhat nonetheless, ranging between -0.1 m and +2.5 m above chart datum over the course of a year between the spring freshet and the late-summer low flow. Tidal phenomena become noticeable in Lake Saint-Pierre and then increase heading downstream.

The tidal range is the difference between the high water (high tide) and low water (low tide) marks. Between Trois-Rivières and Neuville, the tidal range varies between 0.5 m and 4.6 m, while the mean water level ranges from 1.2 to 2.5 m above chart datum (DFO, 2015). Table 3.2 sets out the tidal range at various locations in the river.

Table 3.2 Tidal range

Tide measurement site	Mean high tide range (m)	Spring tide range (m)
Trois-Rivières	0.2	0.5
Bécancour	0.5	1.0
Champlain	0.5	1.1
Batiscan	0.7	1.4
Deschaillons (Cap-à-la-Roche)	1.6	3.0
Grondines	1.8	2.5
Portneuf	3.1	4.1
Neuville	3.6	4.6

Table 3.2 Tidal range

Tide measurement site	Mean high tide range (m)	Spring tide range (m)
Québec (Lauzon)	4.4	6.2
Saint-François (I.O.)	4.8	6.7

Source: DFO (2015).

The tide is semi-diurnal, meaning that there are two high and two low tides daily.

The influence of the tide largely determines variations in current flow rate and intensity downstream from Trois-Rivières. The flow regime in that portion of the St. Lawrence varies considerably with the tide cycle. During flood (rising) tide, the currents may be reversed downstream or simply slowed down upstream. During ebb (falling) tide, the current accelerates throughout this section of the river.

Between Portneuf and Île-d'Orléans, the tidal influence increases and in the section below Portneuf, it becomes sufficient to reverse the current during flood (rising) tide. The combined action of the tide and the river flow creates strong (0 to 3.0 m/s) currents in addition to the mixing energy of the water from the various tributaries of the St. Lawrence that had distinct identities up to that point (Frenette *et al.*, 1989). According to the Fisheries and Oceans Canada (DFO) Atlas of Tidal Currents, the maximum current speed in this region is 2 m/s or 4 knots (DFO, 1997).

Since the influence of the tide continues to increase between Portneuf and Québec, this phenomenon results in increased mixing. However, the river remains freshwater (salinity less than 2 ppt) until it reaches the eastern tip of Île-d'Orléans. For the section between Portneuf and Île-d'Orléans, the residual velocity (net velocity over a tide cycle) yields a residence time of approximately two days. However, because of the significant velocities associated with the majority of the tide cycle, sedimentation can occur for only a few hours per cycle, at high water slack.

The area around the eastern tip of Île-d'Orléans exhibits the strongest semi-diurnal tides recorded in the entire St. Lawrence Estuary. The difference between low and high tides reaches 6.7 m during spring tides, dropping to less than 5 m during mean tides. The current associated with these water level variations varies between 0 and 2.0 m/s, with the main water flow being most significant in natural and artificial channels (including the waterway). As such, it is entirely normal to observe relatively calm areas, even near channels, in locations where the water is shallower.

The downstream current during ebb tide predominates over the upstream current during flood tide. This preponderance is due mainly to the fact that during each tide, the ebb tide stands for nearly two hours longer than the flood tide (Argus *et al.*, 1992). As the St. Lawrence broadens below Île-d'Orléans, the flood tide current flow becomes separated from that of the ebb tide current. Upwelling of the flood tide current occurs mainly on the north shore side, while the downstream flow from the drainage basin is generally occurs along the south shore.

The tidal currents arc through Traverse du Nord along the Île-d'Orléans shoreline and then shift to the centre of the main channel at Pointe-Saint-Jean. At mid-tide, during mean tides, the current flows at approximately 2 knots off of Pointe-Saint-Jean, and the flood current generally begins to upwell 20 minutes to one hour after low tide, while the ebb current from the Québec direction begins between high tide and one hour thereafter. Between the flats at Traverse du Nord and Cap-Brûlé, northeast of Île-d'Orléans, the tidal currents are influenced by the flow into and out of the Île-

d'Orléans channel. A cross-current effect results, which is moderate in the waters at Cap-Brûlé and only slight at the flats at Traverse du Nord. At mid-tide during mean tides, the current flows at approximately 2 knots at the flats of Traverse du Nord and 3 knots at the bank at Cap-Brûlé. The tidal current changes direction 20 to 40 minutes before high and low tide at Québec (DFO, 2007).

At Saint-François, Île-d'Orléans, the extreme high tide is approximately 7.6 m and the extreme low tide -0.6 m. The mean high and low tides are 5.5 m and 0.6 m respectively. The mean water level is 2.9 m. The maximum current speed is 3 knots. The upstream end of the estuary is in fact considered to be located off of Saint-François. In the Sault-au-Cochon area, the tidal heights are more or less similar to those at Saint-François, with the flood current ranging between 2.5 and 4 knots and ebb current flowing at approximately 3 to 4 knots.

3.1.3 Hydraulics

The current speed in the Montréal area varies widely depending on the water level and the morphology of a particular cross-section. The current speed is 4 to 6 knots in the Montréal area (between Île-Sainte-Hélène and Montréal Island), varies between 1 and 2 knots in the Lake Saint-Pierre area and reaches as high as 5 knots in the Cap-à-la-Roche (Deschaillons) area during ebb tide (DFO, 2009).

Annual sedimentation phenomena likely lead to the formation of shoals representing a risk for navigation in artificial portions of the waterway, particularly those in the Lake Saint-Pierre area, between Bécancour and Batiscan, and in Traverse Cap-Santé and Traverse du Nord, hence the necessity of annual maintenance dredging in these areas.

The water level in Lake Saint-Pierre is generally higher in spring than at other times of year, as is the current speed. The shoals representing a risk to navigation consequently appear more regularly in the fall when the current slows. Lake Saint-Pierre is also highly susceptible to ice jam formation in the winter.

Between Bécancour and Batiscan, the hydraulic regime is influenced by the river flow and the action of the semi-diurnal tides. The port facilities at the Port of Bécancour also appear to favour shoal formation in the waterway due to the artificial slowing of the current they seem to create. The current direction is always downstream between Bécancour and Batiscan. During flood tide, the currents weaken and promote the formation of sedimentary deposits. During ebb tide, strong currents develop, especially below the port facilities of the Port of Bécancour. These currents then slow quickly and dramatically at flood tide from approximately 1.2 m/s to 0.2 m/s.

Table 3.3 provides information on average current speed near the bottom, both in the channel and along the sides during both the low flow (September) and spring freshet (April) periods and by tidal phase for the portion below Bécancour River.

Table 3.3 Average current speed near bottom in the channel and side flats during flood and ebb tide below Bécancour

	FLOOD		EBB	
	Channel (m/s)	Flats (m/s)	Channel (m/s)	Flats (m/s)
APRIL	0.62	0.37	<1.00	0.37
SEPTEMBER	0.62	-0.12 South shore 0.75 North shore	1.00	0.37

Source: Long et al. *(1980).*

The river's mean annual flow rate (between 1981 and 1991) was estimated at 11,500 m^3/s at Trois-Rivières and 12,600 m^3/s at Québec.

Because the Traverse du Nord area is highly influenced by tidal action, the reader is invited to refer to the preceding section, "Tides," for information on the associated hydraulic phenomena.

Ice cover on the portion of the St. Lawrence between Montréal and Cap Gribane is present from early December through mid-April. This ice cover is characteristic of fresh water. The ice shelf becomes attached to the upper portion of the tidal flat and fluctuates with the tides. Drifting ice either adheres to the intertidal ice or breaks away from it depending on the current, temperature and wave conditions.

3.1.4 Bathymetry and morphology

In the upstream portion of the waterway, the channel runs past the Port of Montréal as far as Pointe-aux-Trembles with the Boucherville Islands lying to the south, which are separated from the south shore by the southern channel. At Pointe-aux-Trembles, the navigable waterway shifts from the north shore to the south shore, crossing between the Varennes, Sainte-Thérèse and Aux Vaches islands. At the confluence of Rivière des Prairies, the river is a little more than 2 km wide, with the main channel running along the south shore and a secondary channel along the north shore. The two channels are separated further downstream by the Verchères Islands. At Contrecœur, the main channel returns to the centre, separated from the southern channel by the Contrecœur Islands. A third channel is located to the north. At Lanoraie, these three channels converge.

The upstream portion of Lake Saint-Pierre is characterized by broadening of the cross-section and the presence of numerous large islands.

Reaching Trois-Rivières, the channel runs successively by the Port of Trois-Rivières and the mouth of Saint-Maurice River and onward to Cap-de-la-Madeleine past the shallower waters and side flats on the south side.

At Cap-de-la-Madeleine, the channel's centre line then turns toward the south shore as far as the mouth of Bécancour River, where the channel is bordered to the north by the Provencher flats. From there, the channel turns northward again, running along the north shore from the Bécancour wharf onwards.

Below the Bécancour wharf, the river widens to accommodate the Gentilly flats, which measure some 6 km long and 2 km across. These flats are separated from the south shore flats by a channel with a maximum depth of approximately 7 m.

At Pointe-à-la-Citrouille, the channel returns to a central position until it reaches the mouth of Batiscan River. The southern part of the channel is characterized by broad flats called the Saint-Pierre flats. The channel then deviates toward the south, running along the south shore to Cap-Lévrard, where it is delineated to the north by the Sainte-Anne flats.

From Cap-à-la-Roche to Québec, the channel runs more or less down the centre of the St. Lawrence River. The channel then continues along the south side of Île-d'Orléans. From the eastern tip of the island, it turns toward Cap-Brûlé and then runs along the north shore of the St. Lawrence River as far as Île-aux-Coudres.

The water depths below chart datum currently maintained in the waterway between Montréal and Île-aux-Coudres are identified in subsection 2.1.3 titled "Published depths in the waterway indicated on the nautical charts."

3.1.5 Erosion and sedimentation processes

3.1.5.1 Waterway

The current general position of the navigable waterway near the south shore is most likely attributable to the fact that the non-cohesive sediments along the south shore have promoted the deepening of the channel at this location rather than to the north, where the clayey post-glacial silt is less vulnerable to erosion (Cremer, 1979).

Between Montréal and Lake Saint-Pierre, the bottom is made up of materials including sand and gravel, which are relatively immobile due to their fairly large mean particle size. Some of the sand is carried downstream and deposited in area C-69 (Verchères) and other locations in the form of sand dunes. The finest sand, which is generally not vulnerable to erosion due to its cohesive properties, is carried suspended over greater distances and forms sediment outside of the channel in shallower areas with a slower flow. Most of the sediments are displaced during the spring freshet, with minimal sediment movement occurring in low-flow conditions.

In addition to the river itself, its major tributaries on the south shore, including the Richelieu, the Yamaska and the Saint-François, move a large quantity of sediments either suspended or as bed load. The sand transported by these rivers is then drawn into the main channel flow and carried onward to Lake Saint-Pierre. The slowing of the flow rate below the Sorel Islands results in the deposit of sand pushed downstream by the current.

As a result, Lake Saint-Pierre receives a high volume of sediments, with interannual sediment input of 3,300,000 t/year at its inflow and 4,800,000 t/year at its outflow. This input consists mainly of suspended sediments. The increase in the estimated sediment load in Lake Saint-Pierre (1,500,000 t/year) alone accounts for 58 percent of the total estimated load in the Montréal region. The bed load as a proportion of the total load is not in fact known, but Frenette et Frenette (1992) estimated it at 2 percent.

Downstream from Lake Saint-Pierre, the channel cuts through a number of highly diverse types of glacial and post-glacial deposits. These ancient deposits are made up of cohesive silt and clay, delta deposits and glacial tills.

The sandy component contributes to feeding the dune clusters located at various places in this area. Only the very coarse portion (gravel, cobble and blocks) cannot be dragged along by the current, at least in low-flow conditions, when the current does not generate sufficient tractive force to pick it up.

As noted previously, the sediment load is 4,800,000 t/year at Trois-Rivières. This value reaches 5,200,000 t/year at Champlain and 5,800,000 t/year at Deschambault. The estimated bed load remains 2 percent of the total load.

The results set out in Table 3.4 show that clay and silt are displaced in suspended form. For fine sand, the ratio of shear velocity to fall rate increases as the materials move downstream, implying that the percentage of sediments moving in suspended form also increases in a downstream direction. Medium and coarse sand and gravel is transported mainly as bed load.

Maintenance dredging between Bécancour and Batiscan is likely made necessary in large part by sediment loading of the main tributaries (Saint-Maurice, Bécancour, Batiscan and Sainte-Anne), which contributes to the ongoing formation of the sand dune zones occurring in this area. Inputs from Saint-Maurice River combine with those already carried by the St. Lawrence River, increasing the actual load to the point that it exceeds the river's transport capacity, resulting in deposits.

Table 3.4 Sediment transport by suspension (April 1976 freshet)

SITE	SHEAR VELOCITY u* (m/s)	CLAY	SILT	<-----SAND----->			GRAVEL
		0.002	0.016	0.125	0.250	0.500	1.00
		<---SHEAR VELOCITY/FALL RATE--->					
Montréal - Pier 1	0.082	71071	1111	18.38	4.89	1.65	0.80
Montréal - Frontenac	0.080	68681	1073	17.76	4.73	1.59	0.78
Pointe-aux-Trembles	0.061	52999	-828	13.70	3.65	1.23	0.60
Varennes	0.064	55485	867	14.35	3.82	1.28	0.63
Verchères	0.061	52594	822	13.60	3.62	1.22	0.60
Contrecœur	0.062	53242	832	13.77	3.66	1.23	0.60
Lanoraie	0.055	47066	735	12.17	3.24	1.09	0.53
Tracy	0.040	34910	545	9.03	2.40	0.81	0.40
Sorel	0.060	51536	805	13.33	3.55	1.19	0.58
Île-de-Grâce	0.058	50249	785	12.99	3.46	1.16	0.57
Saint-François River	0.042	35916	561	9.29	2.47	0.83	0.41
Yamachiche	0.038	32583	509	8.42	2.24	0.75	0.37
Nicolet River	0.003	2867	45	0.74	0.20	0.07	0.03
Port-Saint-François	0.046	39380	615	10.18	2.71	0.91	0.45
Trois-Rivières	0.073	63074	986	16.31	4.34	1.46	0.71
Bécancour River	0.074	63665	995	16.46	4.38	1.47	0.72

Table 3.4 Sediment transport by suspension (April 1976 freshet)

SITE	SHEAR VELOCITY u* (m/s)	CLAY	SILT	<-----SAND----->			GRAVEL
		0.002	0.016	0.125	0.250	0.500	1.00
		<---SHEAR VELOCITY/FALL RATE--->					
Champlain	0.082	70609	1103	18.26	4.86	1.64	0.80
Batiscan	0.112	96837	1513	25.04	6.66	2.24	1.10
Cap-à-la-Roche	0.101	87317	1364	22.58	6.01	2.02	0.99

**: A shear velocity/fall rate ratio greater than 1 means that the sediments become suspended.*

The sedimentation phenomenon in the Traverse du Nord area results from the combined action of the currents and tides, waves, wind, ice, sediment transport, etc. The disposal sites have been purposely designated at locations where dumped sediments are highly unlikely to return to the waterway while also posing as little harm as possible to fish habitats.

3.1.5.2 Areas adjacent to the channel

Since the river flow is concentrated mainly in the waterway, the areas adjacent to the channel accommodate only a small proportion of the total flow. Current speeds in these areas are consequently relatively weak, and the resulting tractive force is much lesser than in the waterway.

In Lake Saint-Pierre, the areas outside of the main channel are favourable for fine particle sedimentation. However, the sedimentation rate is likely low and variable (Frenette *et al.*, 1989).

Further downstream, flats bordering on the waterway, such as the Gentilly or Saint-Pierre flats, are sedimentation areas for fine-grained sediments (fine sand, silt and clay). The Bécancour wharf contributes to the accumulation of fine sediments in the southern portion of the Gentilly flats.

3.2 Water Quality

The area above Lake Saint-Pierre is fed by two main water masses. One of these, made up of green water, comes from the Great Lakes. It runs along the south side of the river and through the main archipelagoes (Boucherville, Varennes and Contrecœur) as well as the southern shores of the Verchères Islands. It is characterized by low turbidity, high mineralization and low nutrient content. The other water mass, carrying brown water, originates in the Ottawa River. It flows through the northern half of the river and mixes with water from Rivière des Prairies. This water mass, which runs across the surface of the Canadian Shield, exhibits high turbidity and low mineralization.

The water quality in Lake Saint-Pierre varies widely from area to area due to the presence of multiple water masses in the lake and since Lake Saint-Pierre exhibits low mixing. The northern portion is a mass of brown water originating mainly from the Ottawa River before flowing through Rivière des Prairies, Rivière des Mille Îles and Rivière de l'Assomption. The source of the green water mass, meanwhile, is in the Great Lakes. The four major Québec tributaries – Richelieu, Yamaska, Saint-François and Nicolet – and the secondary tributaries entering from the north and south are sometimes considered main water masses.

The area below Lake Saint-Pierre is characterized by the presence of three water masses with differing physical and chemical characteristics. On the south side, water quality is influenced by

inputs from tributaries on the south shore. Nutrient, metal and suspended solids (SS) levels are generally high in this area. Through the centre of the river flows the green water from the Montréal region, which continues in this manner to Trois-Rivières via the navigable waterway. Below the mouth of Saint-Maurice River, the brown water of that tributary flows along the north shore to Grondines, where the various water masses begin to mix.

Water quality varies considerably over time and space. Hydrological and climatic factors can exacerbate the negative effects of human activity on water quality in the fluvial section.

Between 1999 and 2002, the MDDEP (today the MDDELCC) carried out a study of the bacteriological quality of the water at 48 sites between Montréal and Île-d'Orléans. Between 2003 and 2009, 16 of these sites were selected as potential bathing sites in the St. Lawrence and subjected to weekly monitoring between late June and late August (Hébert, 2010). As noted in the report on this monitoring program, non-disinfected discharge in the Montréal region coming from treatment plants in Montréal, Longueuil and Repentigny compromises recreational use of a large portion of the river, essentially in and immediately north of the waterway. This contamination is perceptible as far as Lake Saint-Pierre, after which the quality gradually improves again. There are nevertheless numerous pockets where the bacteriological quality of the water is good or even excellent. Where the use of sites for bathing is periodically compromised, the bacteriological contamination is frequently associated with precipitation occurring one to two days prior to sampling. Care must consequently be taken when comparing the bacteriological quality of a site year over year or comparing the interannual percentage at sites exhibiting good bacteriological quality.

It was concluded from this bacteriological study of the water that the bacteriological quality of the river water in 2009 had improved slightly over 2008 but that several sites offered little potential for bathing due to non-disinfected discharge from the Montréal region. The bacteriological quality of the river water also continues to depend on the frequency and intensity of precipitation and the resulting sewer overflow. As a result, this factor has varied greatly since 2003 based on precipitation. This situation is unlikely to change until remedial measures are taken including the construction of additional retention ponds in the Québec area and addition of disinfection equipment in Montréal (Hébert, 2010).

The water quality portrait of the river can also be expressed using an index of the bacteriological and physicochemical quality of the water compiled for the various stations located between Montréal and the western tip of Île d'Orléans. This index covers six variables: total phosphorus, fecal coliforms, SS, ammonium-nitrogen, nitrites/nitrates and "total" chlorophyll. Based on this index, the water quality of the Beauharnois Canal (above the study area) during the summers of 2008 through 2010 was accordingly classified as "good" (Hébert, 2013). Downstream, deterioration of water quality was observed between Varennes and Sorel; however, slight improvement was noted in Lake Saint-Pierre, although the water remained classified as "questionable" as far as the Bécancour area (Hébert, 2013). Most of the stations in the Québec area fell within the "satisfactory" category.

Evaluation data for this index for the summer season between 2012 and 2014 are set out in Figure 3.1 (MDDELCC, 2015a). The same quality variations as during the 2008-2010 period are generally observed upstream and downstream; during the 2012-2014 period, however, more stations fall into the "good" or "satisfactory" category.

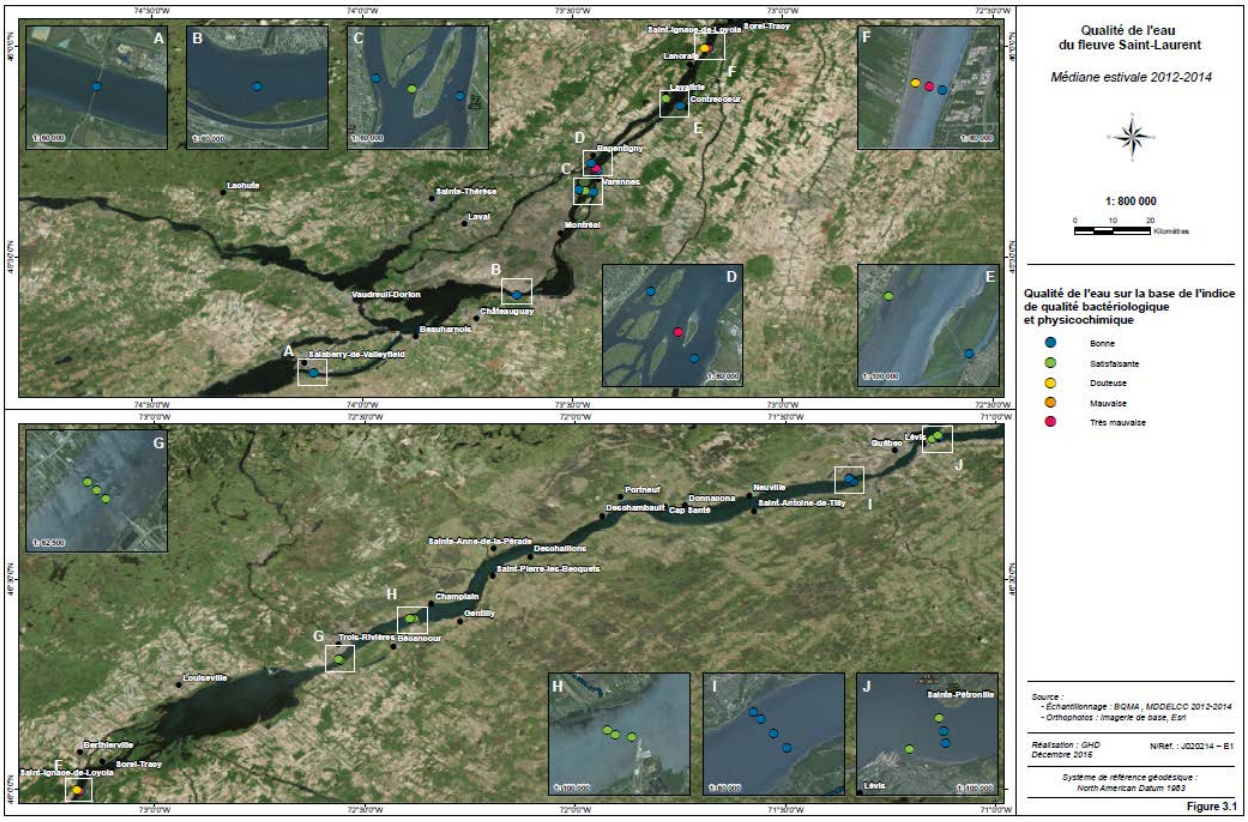


Figure 3.1 Water Quality in the St. Lawrence River

SS concentrations increase very noticeably, specifically in areas where fresh and salt water mix. Consequently, SS concentrations between Île d'Orléans and Cap Gribane generally vary between 25 mg/l and 70 mg/l but also easily reach 200 or even 400 mg/l (Centreau, 1975; Frenette and Verrette, 1976). It is important to note that these are general mean values compiled over a long period. Over the short term, however, such as in spring or during storms, local SS concentrations can climb much higher, easily exceeding 1000 mg/l.

For example, while monitoring water quality in 1996 in the Traverse du Nord area (Les Consultants Jacques Bérubé inc., 1997a), average SS concentrations in water samples collected at the reference stations were relatively high, measuring 64 mg/l on the surface, 78 mg/l at mid-depth and 144 mg/l one metre from the bottom. These values are comparable to those reported in the literature.

Table 3.5 summarizes the representative background values for that area. Very wide variations are clearly notable in these values at all depths, with values ranging, for example, between 25 mg/l and nearly 700 mg/l. It is also important to note that these measurements were taken during relatively calm periods. For safety reasons, no measurements were taken during inclement weather when SS concentrations may have been higher.

Table 3.5 Natural SS concentrations in water samples collected at various depths around the perimeter of the zone of influence – Traverse du Nord area (in mg/l)

	AVERAGE	STANDARD DEVIATION	MINIMUM	MAXIMUM	NUMBER OF SAMPLES
SURFACE	64	51	28	315	47
MID-DEPTH	78	48	31	187	17
BOTTOM	144	111	25	677	47

During the 1993 campaign also in the Traverse du Nord area, SS concentrations in the channel prior to the start of work ranged between 39 mg/l and 278 mg/l (Canadian Coast Guard, 1993). During dredging, the concentrations observed in the turbidity plume varied between 184 mg/l and 215 mg/l. It would appear that the increase in SS noted during the dredging work in 1993 was relatively low and could conceivably be classified as a natural variation potentially observed in that area.

Based on the results of water quality monitoring during previous dredging, human activity should not be expected to cause any increase exceeding the Canadian Water Quality Guidelines for the Protection of Aquatic Life, that is, an increase in suspended sediments of more than 25 mg/l where the total particulate matter concentration on the bottom is less than 250 mg/l and exposure is for a short duration. Where the bottom concentrations are higher than 250 mg/l, human activity should not cause the suspended sediments to exceed the total particulate matter concentration on the bottom by more than 10 percent (CCME, 1994).

3.3 Aquatic and Riparian Vegetation

In the sections between Montréal and St-Antoine and in Traverse du Nord, the “Aquatic Vegetation” thematic map of the Fish Habitat Management Information System (FHAMIS) indicates the presence of marshes, aquatic grass beds, wet meadows colonized by prairie cord grass (*Spartina pectinata*) and swamps on most neighbouring banks (including the north and south shores of the river and the islands) (DFO, 2011). Note that the FHAMIS website was shut down on November 25, 2013, so there have been no data updates since then.

3.4 Invertebrates

Monitoring of the benthic communities around Lake Saint-Pierre has revealed that this ecosystem is home to a diverse, abundant range of benthic fauna made up of more than 60 families (Savage *et al.*, 2013). However, slightly more than 75 percent of these organisms fall into five families: amphipod crustaceans (*Gammaridea*), aquatic worms (*Oligochaeta*), midge larvae (*Chironomidea*), isopod crustaceans (*Asellidae*) and mayfly larvae (*Caenidae*). The composition of these communities is shaped by inputs from tributary rivers. Aquatic worms and insects are dominant in these locations. Monitoring has also revealed greater diversity around the islands in the Berthier-Sorel archipelago than on the north and south shores of Lake Saint-Pierre (Savage *et al.*, 2013). With regard to mollusks, preliminary data from Environment Canada (2012) show that their relative abundance is greater at the stations sampled on the south shore of Lake Saint-Pierre than at those on the north shore. Genovese (2015) also observed greater species richness among mollusks on the south shore than on the north. That study also demonstrated a link between water quality

degradation in tributary plumes and the composition of mollusk communities. The bivalves observed most frequently (70 percent or more of sampling stations) were *Sphaerium* sp., *Pisidium* sp. and *Elliptio complanata* (Genovese, 2015).

The composition of communities in low marshes in the section between Montréal and Sorel is similar to that observed in Lake Saint-Pierre (Savage *et al.*, 2013). The same three taxa dominate in this area (*Gammaridea*, *Oligochaeta* and *Chironomidea*). Near the stations among the Sainte-Thérèse and Contrecoeur islands, the effect on communities of the plume from the City of Montréal treatment plant is notable: aquatic worms from the *Oligochaeta* class known to tolerate pollution constitute the majority here (Savage *et al*., 2013).

The “Invertebrates” thematic map of the FHAMIS (Appendix D) identifies an annual aggregation of the softshell clam (*Mya arenaria*) from Cap Saint-Ignace eastward toward L’Islet-sur-Mer (DFO, 2011). However, this population is not exploited.

3.5 Fish and Aquatic Habitat

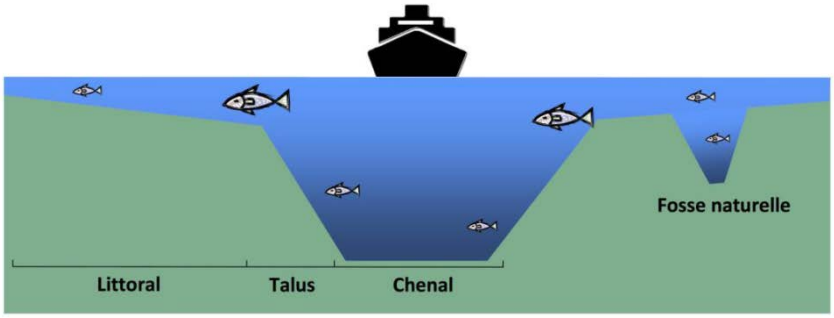
Requests were submitted to the various regional branches for information on fish and their habitats. Sampling results from 2007 to 2009 with the *Lampsilis* research vessel and occurrence data from fishing by the Réseau de suivi ichtyologique du Saint-Laurent [St. Lawrence ichthyological monitoring network] (RSI) and the Réseau d’inventaire des poissons de l’estuaire [estuary fish inventory network] (RIPE) were used for information on species using the river portion under study. The St. Lawrence Global Observatory (SLGO) distributes these data in the form of interactive maps (http://slgo.ca/bio/).

Fish habitats are protected under the Quebec *Regulation respecting wildlife habitats* wherever fish may occur below the two-year high-water mark. Based on this legal definition, fish habitats are not mapped on an official wildlife habitat plan as is done for other types of protected wildlife habitats.

Lastly, the “Fish” thematic maps of the FHAMIS were consulted despite the existence of more recent information. Unfortunately, the data contained in this map atlas date back to 2006 for the fluvial portion of the St. Lawrence and 2001 for the portion covering its seawaters.

3.5.1 Navigation channel and deep habitats of the river

Until recently, few data on the fish communities using the St. Lawrence navigation channel were available, and that environment was thought to be inhospitable for these species. An inventory of a significant part of the channel (Lake Saint-François to Batiscan) was conducted successfully between 2007 and 2009 using *Lampsilis* and provided details on the use of this and other deep habitats in the river (Figure 3.2) by fish (De la Chenelière *et al.*, 2015).



Source: De la Chenelière *et al. (2015).*

Figure 3.2 Types of habitats inventoried in the fluvial portion of the St. Lawrence

The greatest number of species, 40, was sampled in the littoral zone. Although the channel was identified as the poorest habitat, 27 species were counted there nonetheless. The outcomes of this study also show that the fish community using the channel is separate from those using other habitats. In fact, based on the study analysis, each type of habitat appears to accommodate a distinct community. Table 1 in Appendix D provides information on the main fish species found in the fluvial portion of the St. Lawrence based on the occurrences reported by De la Chenelière *et al.* (2015) in these four habitats. Summary information on the characteristics of the habitats and breeding areas and the spawning periods for these species are also provided.

The stations located in the channel and the natural ditches revealed a high prevalence of lake sturgeon (*Acipenser fluvescens*) (at 85 percent and 90 percent of stations respectively), sauger (*Stizostedion canadense*), walleye (*Stizostedion vitreum*) and channel catfish (*Ictalurus punctatus*). The study also demonstrated the use of these two habitats by juvenile stages of multiple species, including the lake sturgeon, channel catfish and American shad (*Alosa sapidissima*). The natural ditch habitat was used more frequently by lake sturgeon more than 30 years old.

3.5.2 Montréal above Lake Saint-Pierre

Starting in 1995, fish communities were sampled at approximately 800 stations in six areas of the St. Lawrence above Québec: Lake Saint-François, Lake Saint-Louis, Montréal-Sorel, Lake Saint-Pierre and its archipelago, Bécancour-Batiscan and Grondines–Saint-Nicolas. This sampling, carried out under the auspices of the RSI at the Ministère des Forêts, de la Faune et des Parcs (MFFP), has made it possible to track changes over time in communities and populations. A total of 80 species were counted throughout these areas using gillnets and seines (MFFP, 1995-2014).

Net fishing is used to determine actual species abundance. Identifying the presence of spawning grounds is not a possibility as this type of fishing is done in the fall. Seine fishing is done along the shore and nearshore at depths of 1.5 to 2 m. These areas are a significant distance from the study areas. In the area between Montréal and Sorel, fishing was carried out in 1995, 2001, 2003 and 2010. The most recent fishing results from the RSI sampling campaigns in the Montréal-to-Sorel section are set out in Table 3.6.

Moreover, in 2007 and 2009, trawl fishing was done in this area near the disposal sites and in the channel. This information identifies and confirms the presence and abundance of species for a 100 m trawl at a certain time of year. As set out previously (section 3.5.1), based on recent trawling sampling campaigns, there is life in the area, and it cannot be said that the site is inhospitable.

Table 3.6 Results of most recent RSI sampling campaigns in the section between Montréal and Sorel

Area	Year	Gear	Number of Stations	Number of Individuals	Number of Species
Montréal - Sorel	2010	net	47	400	18
Lake Saint-Pierre archipelago	2010	net	54	1863	28
		seine	52	11648	42

A total of 55 fish species were collected during RSI sampling between Montréal and Sorel (MFFP, 1995-2014). The species present in the Montréal region spawn mainly in the spring and early summer. More than 40 spawning grounds are found in the channels and around the numerous islands scattered throughout the river between Montréal and Lanoraie. Additionally, a potential spawning site for multiple species – burbot (*Lota lota*), Northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), bowfin (*Amia calva*), carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*), brown bullhead (*Ameiurus nebulosus*), channel catfish, black crappie (*Pomoxis nigromaculatus*), redeye fish (*Ambloplites rupestris*) and pumpkinseed (*Lepomis gibbosus*) – is located near the Longueuil recreational harbour (MRNF, 2007a). As reported by Étienne Drouin of the MFFP (pers. comm., December 2015), a foraging territory for juvenile lake sturgeon may be located at Longueuil near disposal site M-02. It is to be noted that this disposal site has been used frequently in the past and that it will accommodate small quantities of coarser sediments (rocks and gravel), which should not have any significant impact on that species. The shallow water and channels around the Boucherville islands and in the La Batture area at Pointe-aux-Trembles may be additional locations of especially important spawning grounds in the Montréal/Longueuil region. The yellow perch is one of the most abundant species using this area.

3.5.3 Lake Saint-Pierre

In the Lake Saint-Pierre area, RSI sampling campaigns were conducted in 1995, 1997, 2002, 2007, 2009, 2011 and 2013. The most recent fishing results for Lake Saint-Pierre are set out in Table 3.7.

Table 3.7 Results of most recent RSI sampling campaigns in Lake Saint-Pierre

Area	Year	Gear	Number of Stations	Number of Individuals	Number of Species
Lake Saint-Pierre	2013	net	114	4071	33
		seine	58	13494	44

A total of 84 species of freshwater fish were counted in Lake Saint-Pierre (Lake Saint-Pierre ZIP Committee, 2015) out of a possible 118 species present in Quebec as a whole (MDDEP and MRNF, 2011). These 84 species belong to 25 families, the most commonly represented being cyprinids (chub and carp), percids (yellow perch and walleye), catostomids (suckers), centrarchids (sunfish) and salmonids (trout and whitefish).

In addition to the fish species listed above, the Atlantic sturgeon (*Acipenser oxyrinchus*), American shad, Atlantic tomcod (*Microgadus tomcod*) and striped bass (*Morone saxatilis*); two stocking species, the rainbow trout (*Salmo gairdneri*) and the brown trout (*Salmo trutta*); and one occasional

species, the brook trout (*Salvelinus fontinalis*) are also prevalent in Lake Saint-Pierre. Lake Saint-Pierre appears to be home to more than 71 percent of the freshwater species in Quebec, effectively illustrating the great diversity of its fish fauna (Lake Saint-Pierre ZIP Committee, 2015). Due largely to this abundance and diversity, fishing is a very popular activity in the Lake Saint-Pierre area.

The wetlands in Lake Saint-Pierre provide important habitats for aquatic wildlife (spawning grounds, nursery sites, feeding grounds, nesting and staging areas) to the point that Lake Saint-Pierre is often viewed as a huge spawning ground for freshwater species. However, the locations of spawning grounds and nursery sites vary depending on the species, depth, water level, current velocity, type of substrate and presence of vegetation (Langlois *et al.*, 1992). The majority of actual spawning grounds, that is, sites where species spawning or eggs have been directly observed, are found in the Berthier-Sorel archipelago and along the shores around the lake with vegetation zones that flood in the spring. Flowing water sites located below the spillways across the channels at the Berthier-Sorel islands are likely spawning grounds for walleye, lake sturgeon, channel catfish and white sucker. Northern pike, yellow perch and brown bullhead, meanwhile, are associated with wet meadows, shrub swamps and deep marshes respectively.

In addition, areas where the water is deeper than 3 to 4 m are classified by the MFFP as essential for survival of lake sturgeon, walleye and northern pike and therefore require protection. The water in these areas is likely the least susceptible to significant warming during the summer season. These summer habitats cover 20 percent of the total area of Lake Saint-Pierre.

Meanwhile, scientific trawl fishing carried out in the fall of 2007 by the MRNF (2008) revealed the presence of a highly important habitat for lake sturgeon and channel catfish south of Île aux Sternes (Marcel-Léger ecological reserve). These data also showed major aggregations of fish around the perimeter of vessel traffic areas, for example, in the Yamachiche anchorage and in deep ditches.

The MFFP continues its work to identify sensitive areas in terms of fish habitat.

3.5.4 From below Lake Saint-Pierre to Saint-Antoine

The areas sampled in this section of the river under the auspices of the RSI, or from Bécancour to Batiscan and Grondines to Saint-Nicolas, have been reported to host 40 species (MFFP, 1995-2014). The most recent fishing results from the RSI sampling campaigns in this section are set out in Table 3.8. In the Bécancour-to-Batiscan area, based on net fishing results from 2012, the shorthead redhorse is most prevalent with 306 individuals throughout that territory, followed by the walleye (210), sauger (208), channel catfish (146) and yellow perch (138) (MFFP, 1995-2014).

Between 2009 and 2014, test fishing was done under the RIPE on the river's north shore near Cap-Santé. This annual monitoring revealed the presence of 57 species. Of the 77,357 individuals inventoried, the American shad was the most abundant (34.7 percent of catches), followed by the alewife (*Alosa pseudoharengus*) (15 percent), rainbow smelt (*Osmerus mordax*) (11.8 percent) and yellow perch (7.5 percent) (MRNF, 2009-2014).

Table 3.8 Results of most recent RSI sampling campaigns from below Lake Saint-Pierre to Saint-Nicolas

Area	Year	Gear	Number of Stations	Number of Individuals	Number of Species
Bécancour-Batiscan	2012	net	64	1663	26
		seine	57	5859	38
Grondines-Saint-Nicolas	2006	net	40	959	18
		seine	54	3240	21

Based on scientific trawl fishing done in 2008 between the port of Trois-Rivières and Batiscan by the MRNF (2008), observations in that area, as detailed in section 3.5.1, were similar to those for Lake Saint-Pierre.

According to Therrien *et al.* (1991), actual (four) and potential spawning grounds were identified in the Lake Saint-Pierre (downstream)/Grondines section of the St. Lawrence River for 12 fish species (brown bullhead, channel catfish, red eye fish, pumpkinseed, sauger, lake sturgeon, northern pike, whitefish, black crappie, white sucker, yellow perch and Atlantic tomcod).

Three actual spawning grounds are used by the northern pike. Located nearshore, the first is immediately across from Pointe-du-Lac near the north shore of the St. Lawrence, the second at the confluence of Nicolet River and the third in the first bay below the discharge outlet of the former Gentilly-2 nuclear power plant. The fourth actual spawning ground, used by the yellow perch, was identified on the north shore of the St. Lawrence east of Sainte-Anne River. Note that a study conducted by G.D.G. Environnement (1993) indicated the presence of a yellow perch spawning ground and nursery site in the bay between Gentilly River and the discharge outlet of the former nuclear plant.

Only the lake sturgeon is a source of some concern in that area. However, according to Therrien *et al.* (1991), no actual spawning grounds were identified in the fluvial portion for that species. A single potential spawning ground was identified near the north shore across from Pointe-du-Lac at the Lake Saint-Pierre outflow.

However, an actual spawning ground exists in the middle of Saint-Maurice River approximately 125 m below the La Gabelle generating station (Lamontagne *et al.*, 1988). The presumed migration and reproduction period among brood fish generally runs from mid-May to mid-June (Fortin *et al.*, 1992). A St. Lawrence River/Saint-Maurice River migration corridor consequently appears to be used by lake sturgeon from as far away as the greater Montréal area (G.D.G. Environnement, 1993).

Above Traverse Cap-Santé, at Portneuf, DFO (2011) reported an unfished aggregation of Atlantic sturgeon. A rainbow smelt breeding area has also been identified across from Cap-Santé and extending downstream as far as Neuville. This area may have the characteristics of a potential spawning ground. Note that it is located outside of the navigable waterway although inside the boundaries of disposal site X-04. However, undertaking work in that area would not interfere with the reproductive season, which is concentrated in the spring, generally May, while the work would most likely be performed in June.

Five migratory species are of interest in terms of using the river as a migration corridor to access breeding areas: the Atlantic sturgeon, American eel (*Anguilla rostrata*), American shad, Atlantic salmon (*Salmo salar*) and Atlantic tomcod.

3.5.5 Summary – Montréal to Saint-Antoine

Overall, the channel section between Montréal and Saint-Antoine does not represent an area conducive to spawning among the main species identified. Disposal sites S-17 and T-11 also do not exhibit the spawning ground characteristics sought by these species. With specific regard to site S-17, spring surveys carried out between September 1997 and June 2000 did not reveal any signs of spawning activity at that site (CJB Environment inc. and Procéan inc., 2000). The nearest spawning grounds are located around the perimeter of Lake Saint-Pierre a good distance (more than 2 kilometres) from the zone of influence of this disposal site. As for site T-11, there are no areas exhibiting characteristics conducive to fish reproduction between the site and the channel within the zone of potential influence below that site.

3.5.6 Traverse du Nord

RIPE test fishing done upstream (Saint-Nicolas station) and downstream (Saint-Irénée and Rivière-Ouelle stations) in the Traverse du Nord area between 2009 and 2013 revealed the presence of 66 fish species (MRNF, 2009-2014). Table 3.9 provides information on the most abundant species at each station.

Table 3.9 Results of RIPE test fishing between 2009 and 2013 – Saint-Nicolas, Saint-Irénée and Rivière-Ouelle stations

Station	Total Individuals Caught	Most Abundant Species	% of Catch
Saint-Nicolas (2009-2013)	51,822	American shad	27.19
		Channel catfish	20.16
		Longnose sucker	12.32
		Walleye	8.92
Saint-Irénée (2009-2010-2012-2013)	1,899,349	Capelin	80.55
		Atlantic herring	12.27
		Rainbow smelt	6.63
		Atlantic tomcod	0.28
Rivière-Ouelle (2009-2013)	288,931	Atlantic tomcod	73.41
		Rainbow smelt	15.6
		Striped bass	4.57
		American eel	3.67

DFO (2011) reports the presence or observation of 18 fish species in the Traverse du Nord area: American shad, American eel, channel catfish, walleye, sauger, rainbow smelt, three-spine stickleback (*Gasterosteus aculeatus*), blackspotted stickleback (*Gasterosteus wheatlandi*), lake sturgeon, Atlantic sturgeon, banded killifish (*Fundulus diaphanus*), alewife, northern pike, whitefish (*Coregonus clupeaformis*), white sucker, longnose sucker, yellow perch and Atlantic tomcod. A description of prevalence and observations for each of these species is set out in Table 2 of Appendix D.

According to the expert departments consulted and as set out in Table 2 of Appendix D, no spawning grounds are known to be located near the affected areas in Traverse du Nord. The main species using the pelagic environment as a nursery site are the Atlantic tomcod, rainbow smelt and American shad (Gagnon *et al.*, 1993). According to the FHAMIS maps, during the summer, an aggregation of young-of-the year (larvae) of American shad develops below the eastern tip of Île d'Orléans and extends to L'Islet-sur-Mer. The young-of-the-year (larvae) of the Atlantic tomcod and rainbow smelt are not specifically mentioned on the maps, but this area is nonetheless likely conducive to serving as an occupancy and reproduction area for those species (DFO, 2011).

FHAMIS does report areas of aggregation of certain species. Lake sturgeon may aggregate more around Île Madame and south of Île au Ruau (DFO, 2011). The Atlantic sturgeon, meanwhile, appears to occupy a broader area extending along the entire south shore and opposite Sault-au-Cochon. The maps also indicate the presence of other species, such as the whitefish (aggregated to the north of Île d'Orléans, around Sainte-Anne-de-Beaupré and along the entire south shore as far as L'Islet-sur-Mer), banded killifish (exclusively in a small area above Berthier-sur-Mer), alewife (aggregated along the north shore in the Sault-au-Cochon area) and Atlantic tomcod (larvae aggregation).

Numerous species use the pelagic environment during adulthood with the main species including the Atlantic tomcod, smelt, whitefish, sauger and walleye (Gagnon *et al.*, 1993). A relatively significant density of juvenile Atlantic sturgeon and lake sturgeon also appears to occur near Île Madame. These young sturgeon probably use the area as foraging territory from June to September. An aggregation site for the Atlantic sturgeon is also found north of Îles aux Grues, around Sault-au-Cochon, in the deep channel known as Traverse du Milieu (Hatin and Caron, 2002). That site is adjacent to the Sault-au-Cochon disposal site (X-03).

The FHAMIS maps show only foraging territory for the walleye in the study area. This territory may extend to both sides of Île d'Orléans and then become gradually concentrated toward the south shore.

A few species, among them the American eel and American shad, are found in the Traverse du Nord area during migration. However, most of these would be migrating along the south shore or have completed their migration by the time of the work period. Eel outmigration occurs in August and September. Although the migration corridor of this species extends across the river's entire width, eels tend to aggregate in the southern part of the river immediately east of Île d'Orléans. On the north shore, eels follow a narrow corridor.

3.6 Marine Mammals

Data from the Bas-Saint-Laurent Marine Mammals Ecowatch Network (ROMM) do not contain any mention of mammals in the area between Montréal and Cap Gribane or in Traverse du Nord (ROMMBSL, 2015). Any presence of marine mammals between Île d'Orléans and Cap Gribane is incidental. However, the beluga whale (*Delphinapterus leucas*) used to come up the estuary as far as the Québec region. The harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) do not generally come up any further into the estuary than L'Islet-sur-Mer.

3.7 Avifauna and Habitat

Many significant bird colonies and Canadian Important Bird Areas (CIBAs) are associated with the St. Lawrence within the section under study. Descriptions of these areas are provided in Appendix E.

Moreover, the islands and archipelagoes located below Montréal, including those at Varennes, Verchères and Contrecœur under the jurisdiction of the Canadian Wildlife Service (CWS), are very rich in avifauna. The avifauna aggregation periods correspond to annual migrations, occurring from the third week of August to late November for the fall migration and from late March to mid-May for the spring migration.

Many species nest in the **Lake Saint-Pierre** area between late April and late June. To date, 291 bird species have been counted at Lake Saint-Pierre, of which 131 nest there and 41 more may also use it as a nesting site (Lake Saint-Pierre ZIP Committee, 2015). The Lake Saint-Pierre flood plain is also the largest staging area in the St. Lawrence for waterfowl in Québec (Lake Saint-Pierre ZIP Committee, 2015). Two heron colonies, at Grande-Île and Bois-du-Boulé, are also found in this area. The colony at Grande-Île may in fact be the largest in North America, with 1,300 nests counted there (Lake Saint-Pierre ZIP Committee, 2015).

According to the wildlife habitat maps produced by the MRNF (2007b) under the Québec *Act respecting the conservation and development of wildlife*, the Gentilly flats and the riverbanks between the confluence of Bécancour River and the Bécancour wharf are protected under law as these habitats are located entirely on public domain lands and meet the definition of areas of concentration of migratory waterfowl. In the Traverse du Nord area, areas of waterfowl concentration also appear to exist along the entire south shore of the river, around Île d'Orléans and along the entire north shore of the river from Beaupré to Cap Tourmente and around Saint-Tite-des-Caps. Also according to the maps, two heron colonies and other bird colonies are located in this area.

With respect to significant habitats, it should be noted that the Cap Tourmente National Wildlife Area and **Lake Saint-Pierre** were added to the *List of Wetlands of International Importance* (Ramsar List) in 1981 and 1998 respectively (Convention on Wetlands of International Importance, 2010 and 2011).

3.8 Species at Risk

To maintain compliance with the federal *Species at Risk Act* (SARA) and the Québec *Act respecting threatened or vulnerable species* (LEMV), a review of species at risk was conducted for the Montréal-to-St-Antoine area and in Traverse du Nord. SARA has three schedules establishing the status of various species. Schedule 1 sets out the official "List of Wildlife Species at Risk" in Canada, while the other two schedules cover species whose status is pending review. Based on recommendations from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), species are classified according to the following categories: extirpated, endangered, threatened or of special concern.

Based on the databases consulted, Table 3.10 sets out a list of species whose geographic range overlaps the study area and whose habitat requirements are likely met by the characteristics of the study area. This assessment of potential presence was conducted for species with federal status,

under either SARA or COSEWIC, and/or provincial status under Quebec's list of threatened or vulnerable wildlife species or list of wildlife species likely to be designated as such.

It should be noted, however, that since the dredging work will take place strictly in the waterway and materials will be dumped in open water, only aquatic species were taken into account. That being the case, a number of species at risk that are associated with aquatic environments (amphibians, snakes, turtles and birds) and could use habitats near the river were excluded from the analysis since they are unlikely to be present in the dredging areas or at the sediment disposal sites. Flora species were also not considered due to the fact that none of the submerged plants potentially found in the shallowest areas (1.5 to 2 m) of the disposal sites is at risk.

At the same time, a request was submitted to the Centre de données sur le patrimoine naturel du Québec (CDPNQ) for information on occurrences in and surrounding the study area. The CDPNQ database contains information on occurrences of species at risk throughout Québec, including threatened and vulnerable species and species likely to be designated as such. The CDPNQ does not maintain an inventory but rather compiles the information submitted to it. As a result, the absence of information on any species in this database should not be interpreted as confirmation of the absence of that species, as it could simply mean that the species has not been inventoried in a particular area. Only information in the database concerning aquatic species was considered. Information pertaining to areas outside of the Montréal-to-Cap Gribane section or to onshore habitats or species whose habitats are sometimes associated with aquatic environments (e.g. certain amphibians) was also disregarded.

Upon reviewing the occurrences of wildlife species at risk in and around the dredging areas and disposal sites (M-02, M-27, S-17, T-02, T-06, T-11, T-16, X-02, X-03 and X-04), a number of species were found likely to be influenced by the dredging or disposal activities. These include the copper redhorse between Montréal and Lake Saint-Pierre, the American shad, bridle shiner and channel darter in Lake Saint-Pierre, and the Atlantic sturgeon in Traverse du Nord. Appendix G provides information on the locations of species at risk by area.

Table 3.10 List of species classified by the federal or provincial government as at risk and potentially prevalent in the Montréal-to-St-Antoine area or Traverse du Nord

Species		Federal Status		Provincial Status[1]	CDNPQ Mentions[2]				
English Name	Latin Name	COSEWIC	SARA		MTL-LSP	LSP	TR-CAP	CAP-STA	TN
American shad	*Alosa sapidissima*	-	-	Vulnerable	x	x	x		
American eel	*Anguilla rostrata*	Threatened	None	LDTV					
Alewife floater	*Anodonta implicata*	-	-	LDTV					x
Striped bass, St. Lawrence population	*Morone saxatilis*	Endangered	Extirpated (Schedule 1)	-					

Table 3.10 List of species classified by the federal or provincial government as at risk and potentially prevalent in the Montréal-to-St-Antoine area or Traverse du Nord

Species		Federal Status		Provincial Status[1]	CDNPQ Mentions[2]				
English Name	Latin Name	COSEWIC	SARA		MTL-LSP	LSP	TR-CAP	CAP-STA	TN
Stonecat	*Noturus flavus*	-	-	LDTV	x	x	x		x
Copper redhorse	*Moxostoma hubbsi*	Endangered	Endangered (Schedule 1)	Threatened	x	x	x		
River redhorse	*Moxostoma carinatum*	Of special concern	Of special concern (Schedule 1)	Vulnerable					
Eastern sand darter	*Ammocrypta pellucida*	Threatened	Threatened (Schedule 1)	Threatened	x	x	x		
Elephantear	*Elliptio crassidens*	-	-	LDTV	x	x	x	x	x
Spike	*Elliptio dilatata*	-	-	LDTV	x	x		x	x
Rainbow smelt, southern St. Lawrence Estuary population	*Osmerus mordax*	-	-	Vulnerable					
Lake sturgeon, Great Lakes and Upper St. Lawrence population	*Acipenser fulvescens*	Threatened	None	LDTV	x				
Atlantic sturgeon	*Acipenser oxyrhynchus*	Threatened	-	LDTV					x
Channel darter	*Percina copelandi*	Threatened	Threatened (Schedule 1)	Vulnerable	x	x	x	x	
Northern brook lamprey	*Ichthyomyzon fossor*	Of special concern	Of special concern (Schedule 1)	Threatened					
Fragile papershell	*Leptodea fragilis*	-	-	LDTV					
Porbeagle	*Lamna nasus*	Endangered	None	LDTV					
Bridle shiner	*Notropis bifrenatus*	Of special concern	Of special concern (Schedule 1)	Vulnerable	x	x	x	x	
Brassy minnow	*Hybognathus hankinsoni*	-	-	LDTV					

Table 3.10 List of species classified by the federal or provincial government as at risk and potentially prevalent in the Montréal-to-St-Antoine area or Traverse du Nord

Species		Federal Status		Provincial Status[1]	CDNPQ Mentions[2]				
English Name	Latin Name	COSEWIC	SARA		MTL-LSP	LSP	TR-CAP	CAP-STA	TN
Hickorynut	*Obovaria olivaria*	Endangered	None	LDTV	x	x	x	x	x
Pink heelsplitter	*Potamilus alatus*	-	-	LDTV					
Northern map turtle	*Graptemys geographica*	Of special concern	Of special concern (Schedule 1)	Vulnerable					

1: LDTV: Likely to be designated as threatened or vulnerable

2: "MTL-LSP" = Montréal–Lake Saint-Pierre section; "LSP" = Lake Saint-Pierre; "TR-CAP" = Trois-Rivières–Cap-Santé section; "CAP-STA" = Cap-Santé–Saint-Antoine section; "TN" = Traverse du Nord

It should be noted that some species are not listed in any of the three schedules and have not been assigned any risk level but are pending consultation for addition to Schedule 1.

3.8.1.1 Under federal law and COSEWIC

3.8.1.1.1 Extirpated species

According to Schedule 1 of SARA, the St. Lawrence population of the striped bass was designated as extirpated subsequent to its disappearance from that river in the late 1960s (Robitaille *et al.*, 2011). Robitaille *et al*. (2011) report, based on data collected between 1944 and 1962, a decrease in the range of that fish coinciding with the expansion of maintenance dredging activities in Traverse du Nord. However, a reintroduction program has been ongoing since 2002, and an increase in the number of individuals in the new population has been observed. Stocked striped bass also appear to have been reproducing successfully within the range formerly occupied by the extirpated population (COSEWIC, 2012). Immature individuals may be present in the Québec area from July to October and broodstock fish from November to June. This species used the river as a migration corridor at one time (Beaulieu, 1985). The locations of striped bass spawning grounds have never been precisely identified. However, analysis of their migratory behaviour and collection of larvae of the species indicate that they were reproducing in the Lake Saint-Pierre area. These authors suggest that the Sorel-to-Québec section was used mainly for spawning and early in the life cycle, or from fall (spawning run season) through early summer (with larvae likely leaving the area toward the end of June).

3.8.1.1.2 Endangered species

The category of endangered species, according to COSEWIC and Schedule 1 of SARA, includes the copper redhorse. This endemic species is the only fish with a range exclusive to Québec. This range is also very small, being limited to the St. Lawrence River and a handful of its tributaries. At

this time, Richelieu River is the only watercourse in which reproductive activities have been confirmed.

As designated, the critical habitat includes the only two known spawning grounds of the copper redhorse, both found in Richelieu River, below the Saint-Ours dam and in the Chambly rapids. Spawning takes place from mid-June through early July, when the water temperature ranges between 18°C and 26°C (DFO, 2012).

The range of the copper redhorse includes the area between Vaudreuil and the Lake Saint-Pierre outflow. Potential spawning grounds in the Lavaltrie-Contrecœur (Île Hervieux) area have been identified, although their use by the copper redhorse cannot be confirmed (Vachon and Chagnon, 2004, cited in DFO, 2012).

The known spawning grounds are located in flowing water at depths of between 0.75 m and 2.0 m. The heterogeneous substrate is made up of fine to coarse rocks and gravel and, in some cases, heavier rocks stuck in the clay (La Haye *et al.*, 1992; Mongeau *et al.*, 1992; Boulet *et al.*, 1995; Boulet *et al.*, 1996; Dumont *et al.*, 1997, cited in DFO, 2012).

Meanwhile, the porbeagle (*Lamna nasus*), an endangered species according to COSEWIC, appears to occur throughout the Gulf of St. Lawrence as well as in the St. Lawrence Estuary. The prevalence of this species varies from season to season and depending on migration. It prefers continental shelves but is also known to make use of both deeper and shallower waters. It prefers temperatures between 1°C and 18°C. The species is estimated to have experienced a 90 percent decline since the 1960s, its main threat apparently being overfishing. Although quotas have been reduced and fishing prohibited in breeding areas, under the current management plan, the life cycle characteristics of the porbeagle, including late maturity and a low reproductive rate, make this species especially vulnerable to overexploitation.

Designated as endangered by COSEWIC in May 2011, the hickorynut (*Obovaria olivaria*) has no status under SARA at this time. However, it is protected under the federal *Fisheries Act*. In Canada, the hickorynut has a discontinuous range throughout the Great Lakes and St. Lawrence River drainage basin from Lake Huron to Québec. The species generally occurs on sandy substrates in relatively deep (typically at least 2 to 3 m) water where the current is moderate to strong (COSEWIC, 2011).

Since 1998, live specimens and shells of recently dead individuals have been collected from locations including the lower St. Lawrence River between Trois-Rivières and Québec. Within the last several decades, population units may have disappeared between Montréal and Trois-Rivières (COSEWIC, 2011). According to COSEWIC (2011), real or imminent threats to populations and habitats include zebra mussel and quagga mussel infestation, disappearance of the host species (lake sturgeon), barriers to host movement (dams) and degradation of water quality.

According to the MFFP (Annie Paquet, pers. comm., June 2012), the area between Trois-Rivières and Saint-Augustin, near Québec, is vulnerable for this species, particularly from Grondines to Portneuf/Cap-Santé, which is home to the largest populations in Canada. During net fishing in 2006 under the auspices of the RSI, live adult specimens were collected in the Portneuf area relatively close to the channel.

Paquet (pers. comm., June 2012) suggested that “this mussel species is adapted to deep water and dredging work should, where possible, be minimized in this area to avoid harming its habitat.” It should be noted that the usual dredging area is located more than 2 km from the mussel habitat (Appendices A and G). Moreover, should dredging prove necessary near these habitats, it will be performed for the purpose of maintaining the safety of mariners and their cargo.

3.8.1.1.3 Threatened species

The presence of the eastern sand darter (*Ammocrypta pellucida*), a species designated as threatened by COSEWIC and listed in Schedule 1 of SARA, has been observed in the St. Lawrence River near Sorel, Lake Saint-Pierre, Lac des Deux-Montagnes, the rivers Châteauguay, L’Assomption, Yamaska, Saint-François, Yamachiche, Gentilly, Richelieu, Chenal aux Ours, Bécancour and aux Orignaux and Petite Rivière du Chêne. Its ideal habitats are watercourses, rivers and lakes with sandy bottoms (and a current weak enough to leave the sand in place but strong enough to prevent siltation), and it prefers clear water without (or with scattered) vegetation.

The channel darter (*Percina copelandi*) is also designated as a threatened species by COSEWIC and Schedule 1 of SARA. In Quebec, a number of disjunct populations are found in tributaries of the St. Lawrence River. To date, the species has been inventoried in Montérégie, Estrie, Chaudière-Appalaches, Mauricie, Centre-du-Québec, Lanaudière and Outaouais. The Chambly rapids appear at this time to be the sole location in Québec with a relatively high population, although several dozen individuals were captured in the Gatineau River in 1999 and Farmer’s Rapids appears to be used as a breeding site. In Québec, channel darter capture sites are generally characterized by a bottom made up mainly of sand and partially covered by gravel, cobble and boulders with a low-to-nil current velocity and a depth of less than 60 cm.

The lake sturgeon, a species designated as threatened by COSEWIC, is mainly a freshwater fish, although it is also found in the brackish waters of the St. Lawrence River. This species is prevalent in lakes and major rivers in western Québec from James Bay in the north as far as the brackish portion of the St. Lawrence River, notably in the Montmagny area. It is currently believed that the species is at risk in the St. Lawrence River, for it remains abundant at only a few highly localized sites and exhibits a recruitment gap. The population in the section of the fluvial corridor between Lake Saint-Louis and Lake Saint-Pierre is characterized by a high mortality rate attributed to commercial exploitation as well as high natural mortality possibly linked to high water pollution levels in this area. Spawning sites are rare and of poor quality. Its habitat consists of major rivers and lakes. Spawning grounds are typically found in areas with a current, occasionally in shallower water in lakes, and are made up of rocky and gravel bottoms (Bernatchez and Giroux, 2000). The restrictions in place since 2000 under the management plan for the lake sturgeon commercial fishery in the St. Lawrence River appear to have had positive impact on this population. This is because, in addition to seeing the return of the species to previously abandoned spawning grounds, monitoring indicators point toward gradual recovery of the species across all life cycle stages (Dumont *et al.*, 2013).

The Atlantic sturgeon is another species designated as threatened by COSEWIC. This anadromous migratory fish spends most of its life at sea, primarily in the Portneuf section of the St. Lawrence and in the estuary as far as the gulf. In Quebec it is found as far as Blanc-Sablon. Its spawning sites are not yet known. However, the transition zone between fresh and salt water in the St. Lawrence Estuary, mainly between Saint-Jean (Île d’Orléans) and Cap-Saint-Ignace, represents an important

habitat for the feeding and rearing of juveniles (DFO, 2013). Since the disposal site south of Île Madame appears dispersive, its use has been prohibited since 2009. Sediments deposited there were generating impact on that habitat. Sediments that would have gone to that site are now distributed between sites X-02 and X-03.

The American eel, a species designated as threatened by COSEWIC, is a catadromous species. It reproduces in the Sargasso Sea in the Atlantic Ocean. Young eels then begin migrating toward freshwater habitats in North America and Europe, where they grow to adulthood. After several years, the adult eels undertake a return migration in order to reproduce at sea. Adult eels using the St. Lawrence River leave their freshwater habitats to migrate to sea during the summer and fall. They burrow in the sediments during the day and then travel passively on the current at night. Inversely, elvers arriving from the sea make their appearance around mid-June, when they swim back up the St. Lawrence River to gain access to the rivers and lakes that serve as their freshwater habitats.

3.8.1.1.4 Species of special concern

The river redhorse, (*Moxostoma carinatum*), which falls in the risk category of special concern, is a fish species in the study area listed in Schedule 1 of SARA and classified by COSEWIC. Two clearly distinct populations are known, one in the Ottawa River mainly between Gatineau and Carillon and the other, with even fewer individuals, in Richelieu River below Chambly. A few river redhorse individuals have also been captured recently (after 1963) in the Yamaska, Noire and Saint-François rivers as well as in the St. Lawrence River. The river redhorse is associated with the deep waters of midsize rivers with a summer temperature exceeding 20°C. It spawns in flowing water on limestone rock bottoms free of siltation. It feeds on benthic organisms which it locates visually and sucks off of the bottom, such as small shellfish, insect larvae and, on occasion, crayfish.

In Canada, the range of the northern brook lamprey (*Ichthyomyzon fossor*), a species of special concern according to COSEWIC and listed in Schedule 1 of SARA, extends from Manitoba to Quebec, where it is found in the St. Lawrence River and in the Gatineau, Trout (Huntingdon), Hinchinbrooke (Hinchinbrooke), Saint-François and Sainte-Anne (east of Trois-Rivières) rivers. It appears to have disappeared from Yamaska River (near Saint-Césaire), where it had been observed in large numbers in 1949. The northern brook lamprey inhabits creeks, small rivers and turbid sections of major rivers. It seems to avoid stagnant water and ponds as well as small brooks, larger rivers and lakes. It seeks out a moderately soft substrate and is not found on muddy or firm, sandy bottoms. During the spawning period, it builds a nest underneath large rocks on a sand and gravel bottom.

The bridle shiner (*Notropis bifrenatus*) is also designated as a species of special concern by COSEWIC and Schedule 1 of SARA. The bridle shiner is found in the St. Lawrence River as far as the Trois-Rivières area, including Lake Saint-Pierre, Lake Saint-Louis and Mille-Îles River. Since the dredging work will be limited to the channel itself, this species is unlikely to be affected. Its preferred habitats are slow watercourses, lagoons and, occasionally, lakes. It also prefers clear water, although it can sometimes occur in moderately turbid water. It cannot tolerate an acidic environment. It is found in areas with abundant submerged vegetation.

The northern map turtle (*Graptemys geographica*), which is designated as a species of special concern by COSEWIC and listed in Schedule 1 of SARA, is found only in North America. The northern boundary of its range is in Canada. This species is prevalent only in southeastern Ontario and southern Québec, where it is associated with the Great Lakes and St. Lawrence River watershed. It lives in the most densely populated areas of these provinces. In Quebec, it has been inventoried mainly along the Ottawa and Richelieu rivers. However, it has two main populations, one in Lac des Deux Montagnes and the other in Ottawa River. A number of individuals have also been observed in Lake Champlain. A few specimens were recently observed in the St. Lawrence River around Québec and Portneuf. The northern map turtle is essentially aquatic. It prefers vast expanses of open water – like lakes and rivers – with soft bottoms offering many locations with sun exposure and rich aquatic vegetation. The only incursions onto dry land are undertaken by females, which go ashore to lay eggs in the spring. This turtle makes frequent use of exposure sites away from the shore, such as emergent rocks and stumps. The species may sun itself in groups, with individuals sometimes stacked up against one another ready to dive into the water at the least sign of trouble. These turtles are timid and are rather difficult to approach: as soon as they sense that humans are near, they promptly return to the water. Their diet is highly varied but includes large quantities of mollusks, mainly gastropods. Mating takes place in spring or fall, and the female lays its eggs (10 to 16 on average) in June. Hatching occurs in late summer (MFFP, 2010a).

3.8.1.2 Under provincial law

Under the LEMV, eight fish species are designated as threatened or vulnerable in Quebec, five being listed as vulnerable and three as threatened. This does not include the list of species likely to be designated as threatened or vulnerable, which includes 25 species, subspecies or populations. The following species have been confirmed as occurring within the study area.

3.8.1.2.1 Species designated as vulnerable

The species designated as vulnerable include the American shad. In Quebec, this species is found from the upper St. Lawrence River to the gulf during migration. In the spring, it swims back up the estuary to reach its spawning grounds in the Ottawa River. The only known spawning area in the entire St. Lawrence River system is located just below the Carillon hydroelectric generating station. The species is prevalent in rivers only during the ice-free period while the temperature is above 4°C, spending the rest of the year in marine shoal waters and environments where zooplankton are abundant. Its spawning grounds are typically found in broad, shallow (0.5 - 3.0 m deep) areas with a current speed of 0.2 to 1.0 m/s and a sandy, gravel or cobble substrate. It avoids white water, gyres and highly turbulent areas.

The rainbow smelt, southern St. Lawrence Estuary population, which is found between Lévis and Sainte-Anne-des-Monts, was designated as a vulnerable species in March 2005. The south shore population is currently known to spawn in Ruisseau de l'Église (Beaumont) and Rivière Ouelle, at the confluence of Rivière du Loup (Rivière-du-Loup) and in Rivière Fouquette (near Rivière-du-Loup). Spawning grounds are typically located near the upper limit of the tidal influence in areas where the substrate is ideally made up of gravel and pebbles.

The river redhorse, the channel darter, the bridle shiner and the northern map turtle are also designated as vulnerable species (covered previously under SARA).

3.8.1.2.2 Species designated as threatened

The category of species designated as threatened includes the copper redhorse, the eastern sand darter and the northern brook lamprey (covered previously under SARA).

3.8.1.2.3 Species likely to be designated as threatened or vulnerable

The brassy minnow (*Hybognathus hankinsoni*) is prevalent in water bodies in several Canadian provinces. In Quebec, its range is peripheral and dispersed among a handful of regions. Its presence has been reported in certain tributaries of the Ottawa River, a few places around Sherbrooke and a little further east as far as Etchemin River. This species is consequently very rare in Quebec in that it has been classified as abundant in a single location, Ruisseau à Charette, south of Pointe-Fortune (west of Montréal). Although inventories were conducted in the 1960s and 1970s, the brassy minnow has not been inventoried in Lac des Deux-Montagnes or three of its main tributaries. The fish is found in clear, well oxygenated water in agricultural areas.

The stonecat (*Noturus flavus*) has the same status at the provincial level, although it has no status federally. This species is generally found from the Ottawa River and the St. Lawrence River and its tributaries to as far as Montmagny below Québec. The habitat of this species is typically characterized by depths of 30 cm or less and coarse substrates made up mainly of rocks and loose boulders. The species prefers current speeds of up to 30 cm/s but is also found in environments with a very strong current.

The lake sturgeon, porbeagle and American eel, covered previously under SARA and COSEWIC, also appear on the list of fish species likely to be designated at threatened or vulnerable. The aforementioned species at risk may occur in the study area. However, the work period will not interfere with the spawning periods of these species, as described in Table 1 of Appendix F.

In addition to the hickorynut, covered previously, CDPNQ mentions have been reported in the river section under study above this area (e.g. Lac des Deux-Montagnes) for five other freshwater mussel species likely to be designated as threatened or vulnerable: the alewife floater (*Anodonta implicata*), elephantear (*Elliptio crassidens*), spike (*Elliptio dilatata*), fragile papershell (*Leptodea fragilis*) and pink heelsplitter (*Potamilus alatus*). Freshwater mussels generally adapt to a broad range of habitats as long as the environment remains sufficiently stable over time (Paquet *et al.*, 2005).

The habitat requirements specific to each species are quite variable. The alewife floater uses major rivers and coastal lakes and is found in sand, silt and gravel substrates (Cummings and Cordeiro, 2011). The elephantear is found primarily in watercourses with a moderate to weak current (Desroches and Picard, 2013) on substrates of muddy or rocky sand. The spike appears to prefer large watercourses with muddy or rocky bottoms (Desroches and Picard, 2013). Although the average depth associated with the elephantear is 0.5 to 3 m (McCormick, 2012) and that associated with the spike is 0.6 to 7.3 m (Minnesota Department of Natural Resources, 2016), some CDPNQ mentions indicate the presence of both species from the *Elliptio* genus at depths exceeding 10 m. The aquatic environments in which the fragile papershell is found, meanwhile, vary in terms of size and current (Mulcrone, 2006). In Quebec, the pink heelsplitter appears to frequent only Lac des Deux-Montagnes west of Montréal and Lake Saint-Pierre (Desroches and Picard, 2013). Both of the preceding species are typically found on sandy or silty bottoms (Desroches and Picard, 2013).

3.9 Recreational activities

3.9.1 Sport fishery

3.9.1.1 Montréal above Lake Saint-Pierre

In the Montréal region as far as Lake Saint-Pierre, sport fishing is probably done on a small scale throughout the fluvial portion, although it takes place mainly in the lakes located to the west. Maritime traffic and limited access to the watercourse are likely the main reasons for this. No fishers' organizations are known to be active on the river in Lanaudière, but wildlife protection officers report significant fishing. Fishing for walleye predominates in the Sorel area, although it is also done elsewhere. Sport fishing could be widespread in the section between Montréal and Berthier, but access in that location is limited and fishers must be equipped with dependable vessels to cope with the current, which is strong in places, and wind. Recreational fishers have a "La pêche à la carte autour de Montréal" public access map indicating access sites. This map also provides information on fish species likely to be caught in various locations. This recreational activity appears to have increased in Parc national des Îles-de-Boucherville. The most abundant catches are likely recorded from mid-May to mid-June.

3.9.1.2 Lake Saint-Pierre

Lake Saint-Pierre has been a community fishing area (air faunique communautaire, AFC) since 2005. An AFC is a new approach to managing the sport fishery established under the provisions of sections 85, 86 and 86.1 of the Quebec *Act respecting the conservation and development of wildlife*. The AFC confers special status on a wildlife territory by delegating the management of sport fishing activities in a public water body. This management approach enables the implementation of a series of measures to maintain or improve the quality of sport fishing in a particular water body. The dominant species in fishers' catches are the sauger and walleye (Pascale Dombrowski, pers. comm., 2015). The muskellunge, channel catfish and lake sturgeon are also caught occasionally.

Fishing areas in Lake Saint-Pierre vary from season to season, with methods ranging from open water fishing from boats (84.1%) to wading (12.3%) and wharf fishing (3.6%). Wharf fishing is done at Sorel, Saint-Ignace-de-Loyola and Port-Saint-François. Wading is done at various locations in the Berthier islands, at the confluence of Nicolet River and at the tip of the lake. Open-water fishing areas are scattered along the length of the waterway and near certain islands (Municonsult, 2002). According to the Lake Saint-Pierre AFC, there were 24,000 sport fishers and a total of 300,000 fishing days in 1986. By 2006, these figures dropped to 10,000 fishers and 95,000 fishing days. In 2007, 29,708 fishers used the Lake Saint-Pierre AFC, and a total of 17,100 permits were issued. (The total number of permits does not reflect 6,843 spouses and 5,765 children.) In the 2008-2009 season, a total of 29,673 fishers used the Lake Saint-Pierre AFC, including 6,166 spouses and 4,455 children (Corporation de gestion et de développement de la pêche sportive au lac Saint-Pierre, 2009). The individuals and organizations consulted in 2015 were unable to provide updated information on fishing activity.

3.9.1.3 Lake Saint-Pierre outflow

Sport fishing is also practised at the confluences of the Saint-Maurice, Batiscan and Sainte-Anne rivers, at the Champlain wharf and nearshore across from Deschaillons (MRNF, 2010).

Sport fishing in the St. Lawrence Estuary is much less widespread than in the fluvial portion.

3.9.2 Hunting and trapping

Hunting is practised mainly on islands. The Boucherville islands were a popular hunting area before the park was established. Hunting is no longer allowed there. However, hunting remains popular in the fall in the Varennes and Contrecœur archipelagos. Other popular hunting areas are located around Îles aux Grues and Îles aux Oies, on the south shore from Montmagny to Cap Saint-Ignace and at Cap-Tourmente.

In the section downstream from Lake Saint-Pierre, meanwhile, sport hunting is practised in numerous marshes and grass beds. The Carignan Island area and the Gentilly flats are preferred areas for harvesting waterfowl. Further east, the Saint-Pierre-les-Becquets area (south shore) and the shoreline areas east of Sainte-Anne River (north shore) offer the greatest potential for migratory bird hunting.

Trapping activities also take place in the Lake Saint-Pierre area. Trappers focus mainly on the southern part of the archipelago, Lavallière Bay and along the south shore between that bay and Longue Pointe (Roche ltée and Procéan inc., 1991). Also of note is frog hunting, particularly in the eastern part of the archipelago (Lake Saint-Pierre ZIP Committee, 2012).

3.9.3 Nautical activities

Boating is the main recreational activity associated directly with the river. However, boating remains limited due to significant maritime traffic, a unidirectional current and the presence of islands and flats.

A series of recreational boating infrastructures (boat launches, docks and marinas) provides access to the river and its shores. The “St. Lawrence Info” interactive map is one tool that can be used to locate these infrastructures (http://slgo.ca/infosl/). Marinas support cruising between the recreational facilities in the Lake Saint-Pierre/Trois-Rivières areas and those at Montréal.

3.9.3.1 Montréal upstream from Lake Saint-Pierre

Downstream from the Montréal region as far as Lake Saint-Pierre, boating is not very common. Although the western part of the upstream end of the study area is highly urbanized, no public beaches are reported to be officially open along the river. Even the Boucherville islands, which are intended in part for recreation, have no bathing site. However, several projects are being considered by municipalities in this area with a view to providing new river access to their citizens in places where the water quality is adequate for bathing. In the meantime, the river water downstream from the treatment plant outlets in Montréal, Longueuil and Repentigny is not recommended for bathing due to the poor bacteriological quality of the water at these locations (see section 3.2).

3.9.3.2 Lake Saint-Pierre

Lake Saint-Pierre has a navigable surface area of at least 136.8 km^2 with a depth of at least 1.85 m (Hamel *et al*., 1989). It should be noted that many boat launches are left out of the water during the

low-flow period and the water is not deep enough for recreational boating in certain access channels.

3.9.3.3 Lake Saint-Pierre outflow

Multiple boat launches, docks and marinas are also located around the Lake Saint-Pierre outflow to facilitate recreational boating in that area. At Trois-Rivières, there is a beach at the confluence of Saint-Maurice River in Parc de l'île Saint-Quentin.

From Québec onward, recreational boating differs from that on the water upstream as this area is where the influence of tides, currents, bathymetry, waves and wind begins. The St. Lawrence River, and in particular the Montmagny archipelago, offers significant potential for recreational boaters. However, strong currents and occasionally violent winds mean that boaters must take extra care. The recreational boating season runs mainly from late June through early September.

3.10 Commercial Fishery

Commercial fishing has all but disappeared from the area between the Montréal region and Lake Saint-Pierre. It is done mainly in the lakes upstream from there, notably in Lake Saint-Louis and the Laprairie Basin. Some 80 to 85 percent of freshwater commercial fishing in Quebec takes place in Lake Saint-Pierre (Roche ltée and Procéan inc., 1991).

3.10.1 Lake Saint-Pierre

In 2005, from the perspective of a sustainable fishery, a joint advisory committee for the management of fish stocks in Lake Saint-Pierre (made up of representatives of government and local bodies, including MAPAQ, MRNF [Faune Québec], commercial and sport fishers associations, Fédération québécoise de la faune, Fédération des pourvoyeurs du Québec, processors and universities) recommended significantly reducing yellow perch catches to maintain the security of stocks and the quality of fishing over the next five to seven years. For this reason, MAPAQ bought back 17 of the 36 commercial fishing licences that were valid at that time. The number of available licences then stood at 19. In 2006, the number of available licences dropped to 18, with 17 fishers exercising their commercial fishing rights in the area (one fisher held two licences). In 2007, these figures remained unchanged. In 2008, 12 commercial fishing licences were bought back, reducing the number of licences to six. In 2012, a five-year moratorium was issued on the commercial and sport fisheries for yellow perch in Lake Saint-Pierre to limit the population decline (De la Chenelière *et al.*, 2014). In 2013, the territory affected by this moratorium was extended to Saint-Pierre-les-Becquets.

Fishers in this area catch mainly brown bullhead, American eel (for the European market), channel catfish, carp and lake sturgeon. Species for which commercial fishing is permitted are the American eel, brown bullhead, channel catfish and lake sturgeon – the most commonly fished – as well as the whitefish, carp, panfish, burbot, suckers, crayfish, silver and shorthead redhorse, black crappie and bowfin.

Fishing sites change with the seasons. Fishing dates and gear vary depending on the fish species. The fishery opening date depends on the gear type used and may also vary from year to year. It is consequently necessary to consult the fishery management plan as approved by the Council of

Ministers and published in the *Gazette officielle du Québec* (for 2015-2016[*]). The gear used to catch fish in the Lake Saint-Pierre area is gillnets and hoopnets. The use of night lines, which were used to fish for sturgeon, has been prohibited since 1988. Crayfish traps may be used to fish for crayfish.

Aboriginal people practise subsistence fishing within the limits of the Odanak reserve located on the Saint-François River 32 kilometres east of Sorel. As in other areas, the most commonly fished species are the yellow perch, brown bullhead, northern pike, walleye, lake sturgeon and bass (Stephanie Lachance, pers. comm., December 2015). The impact of this activity is marginal.

MAPAQ cannot confirm a distance between fishers and the work performed as fishing licences specify only the fishing area (Lake Saint-Pierre, Saint-François Bay, Lake Saint-Pierre archipelago). Fishers can consequently put their gear out anywhere within the area. Of course, the fishers cooperate in terms of maintaining a distance amongst themselves.

As indicated previously, test fishing done at disposal site S-17 and certain other sites revealed the presence of lake sturgeon, one species likely to raise concerns. Sampling at some nearby stations under the RSI also revealed the presence of lake sturgeon and walleye (MFFP, 1995-2014). Based on results, however, site S-17 does not generally exhibit characteristics leading to the assumption that it may be a potential spawning ground for any commercial species (yellow perch, walleye, sturgeon).

3.10.2 Lake Saint-Pierre outflow

In the section between the Laviolette bridge (including Batiscan and Bécancour) and the eastern tip of Île d'Orléans, fishing is done with gillnets, hoopnets and crayfish cages. Allowed species are the American shad, American eel, brown bullhead, channel catfish, carp, panfish, crayfish, whitefish, northern pike, burbot, black crappie, white sucker, longnose sucker, Atlantic tomcod, lake sturgeon, walleye, round hickorynut, bowfin, silver redhorse and shorthead redhorse.

Site T-11 at Saint-Pierre-les-Becquets is located a good distance from a fishing area used by a commercial fisher. Based on previous discussions with this fisher, the work would not drive away the resource or harm any fishing gear as the site is far enough away.

Commercial fishing is relatively minor in the Traverse Cap-Santé area. Fishers may use the following shared sites: between Deschaillons and Saint-Antoine-de-Tilly on the south shore of the river, and between Donnacona and Neuville on the north shore. The gear used is the hoopnet and gillnet.

Commercial fishing is relatively significant in the Traverse du Nord area. According to information collected in December 2015, five commercial fishers are active in this portion of the river, all species combined. The main species fished are the lake sturgeon, Atlantic sturgeon, rainbow smelt, American eel, channel catfish, carp and Atlantic tomcod. The primary fishing sites lie between Île au Ruau and the south shore, and south of Île Madame and Grosse Île, as well as north of Île aux Grues and along the south shore around Île aux Grues and Île aux Oies. These fishing areas are consequently located a good distance from the disposal sites used for the dredged sediments.

[*] http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=13&file=1543-F.PDF

Fishers may also hold commercial fishing licences authorizing them to fish off the eastern tip of Île d'Orléans and along the south side of the channel.

The fishing gear used in the Traverse du Nord area is the trap, gillnet and seine.

3.11 Protected Natural Heritage

3.11.1 Montréal upstream from Lake Saint-Pierre

Numerous sites exhibiting ecological potential are located between Montréal and Lake Saint-Pierre. The main protected areas are the provincial Parc national des Îles-de-Boucherville and the federal Îles de Contrecœur National Wildlife Area and Île de Saint-Ours Migratory Bird Sanctuary. These sites were established to protect wildlife, with a focus on aquatic birds and semi-aquatic mammals. Besides these officially protected areas, there are numerous other areas of recognized ecological interest in the Montréal/Longueuil region.

3.11.2 Lake Saint-Pierre

Lake Saint-Pierre is one of the main constituents of the St. Lawrence lowlands. A large portion, or 90 percent, of the territory has remained wild. With its rich wetland, it is also a staging area for migratory birds. On November 9, 2000, UNESCO recognized Lake Saint-Pierre as a Biosphere Reserve. It is characterized by the following:

- Last freshwater basin of the St. Lawrence River
- Largest floodplain of the St. Lawrence River
- Largest archipelago in the St. Lawrence River, with 103 islands
- Territory remaining 90 percent natural
- 20 percent of all marshes in the St. Lawrence River
- More than 40 percent of wetlands in the St. Lawrence River
- Of the 400 bird species observed in Quebec, 291 (73%) have been seen at Lake Saint-Pierre, 131 nest there and 41 probably use it as a nesting site
- Largest heron colon in North America, with more than 1,300 nests counted
- Largest migratory waterfowl staging area in the St. Lawrence River
- Twenty-seven rare plant species
- First spring staging area of the snow goose in the St. Lawrence River

Only a handful of natural environments in the Lake Saint-Pierre area are protected under law. The Marcel-Léger ecological reserve at Île aux Sternes, established in October 1981 across from the municipality of Pointe-du-Lac, is an artificial island approximately 20 ha in size. Originally created in 1965, it is administered by the MDDELCC. The Nicolet Bird Sanctuary, part of the Ramsar site at Lake Saint-Pierre and of the Nicolet/Baie-du-Febvre IBA, is federally recognized as a protected area. Multiple conservation and development projects are also planned due to the importance of the floodplain and its many natural environments that are home to highly rich and diverse wildlife.

3.11.3 Downstream from Québec

Several conservation areas are located on both sides of Traverse du Nord. The Cap Tourmente National Wildlife Area, located on the north shore, is a Ramsar site. The territory covered by this reserve stretches from Saint-Joachim to Cap-Tourmente. Meanwhile, Grosse Île has been named the Grosse Île and the Irish Memorial National Historic Site. Two migratory bird sanctuaries are also located on the south shore: one at Montmagny, at the confluence of Rivière du Sud, and the other in the municipality of Cap-Saint-Ignace a little further east.

3.12 Quality of Life

The dredging areas and open-water disposal sites are all located a significant distance from inhabited areas.

Nevertheless, some residents of Valdor Island in Champlain have expressed concerns to the CCG in the past in relation to the sound, visual and olfactory nuisance caused by the floating equipment deployed by the contractor to accommodate its employees while dredging is going on.

3.13 Use of the Territory

A dozen municipalities are located on the shores of the St. Lawrence River between Montréal and Lake Saint-Pierre. The shorelines of two neighbourhoods on Montréal Island, Rivière-des-Prairies–Pointe-aux-Trembles and Mercier–Hochelaga-Maisonneuve, as well as that of Montréal-Est are occupied mainly by Port of Montréal facilities. This is a highly industrialized area. In Rivière-des-Prairies–Pointe-aux-Trembles and Montréal-Est, industrial development is focused mainly on the petrochemical industry. Along the south shore, a high concentration of industry is found in Varennes and Contrecœur. Industrialization elsewhere along the north and south shores in this fluvial section is much less significant, and the land is used more for urban development, tourism and agriculture.

In this section of the St. Lawrence River, recreational tourism activities associated with the river are concentrated primarily in the Montréal/Longueuil area. Major tourism centres include the Old Port of Montréal, Sainte-Hélène and Notre-Dame islands, the Longueuil shoreline and the Boucherville islands.

The Lake Saint-Pierre region is home to four regional county municipalities (RCMs): D'Autray, Maskinongé, Nicolet-Yamaska and Pierre-De Saurel. Together, these RCMs account for 30 or more municipalities, nearly 20 of which border on the river. The concerns of RCMs in the region relate mainly to conservation and development of the region's recreational tourism and ecological potential (Hamel *et al.*, 1989).

Water sports, fishing, hunting and waterfowl watching are the main attractions of the Lake Saint-Pierre region. Traffic to the Baie-du-Febvre area, however, also demonstrates notable public interest in ecotourism (Burton, 1991). The preferred sites for avifauna observation are in the Baie-du-Febvre and Saint-Barthélémy areas, while interpretation paths have been developed on Île de la Commune at Berthier. Cruises among the Berthier-Sorel islands are also offered, departing and landing at Berthierville and Sainte-Anne-de-Sorel.

Around the Lake Saint-Pierre outflow, this section flows through the administrative regions of Mauricie, Capitale-Nationale, Centre-du-Québec and Chaudière-Appalaches. On the north shore, in

addition to the city of Trois-Rivières, two RCMs lie along the St. Lawrence River, Les Chenaux and Portneuf. This section also flows past two RCMs on the south shore, Bécancour and Lotbinière.

Two sites constitute the main recreational tourism destinations along the river. In the Vieux Trois-Rivières area lie port facilities that are very popular among the local population and visitors alike during the summer season. The many recreational activities organized there help to draw large numbers of people. A skating rink is also built there in the winter. At the confluence of Saint-Maurice River, Parc de l'île Saint-Quentin provides extensive offerings for the use of visitors, including a biking trail, picnic areas, a pool, a beach and a canoeing and sailing centre. Cross-country and skating trails and sliding hills are major attractions in the area in the winter.

The main resort destinations on the south shore are the Port-Saint-François area and the confluence of Bécancour River, both of which have strong recreational potential. Approximately 50 cottages are also located there. On the north shore, another 30 or more cottages are located in the Valdor Island area.

The RCMs of Île-d'Orléans and La Côte-de-Beaupré lie north of the dredging area in Traverse du Nord. South of the dredging area, the city of Lévis and the RCMs of Bellechasse and Montmagny are located on the south shore.

3.14 Water Intakes

Nearly half the population of the province of Quebec depends on the St. Lawrence River for its drinking water supply (MDDELCC, 2015b). The fluvial corridor between Lake Saint-François and Île d'Orléans supplies 59 municipal drinking water distribution systems, 52 of them between Cornwall and Trois-Rivières and seven between Bécancour and Québec (MDDELCC, 2015c).

The main municipalities using the fluvial section between Montréal and Lake Saint-Pierre as their drinking water source include Longueuil, Varennes, Saint-Amable, Sainte-Julie, Verchères, Contrecœur and Lavaltrie.

In the Lake Saint-Pierre area, only the municipality of Berthierville depends on the St. Lawrence River for its drinking water. The Berthierville filtration plant supplies the municipalities of Berthierville, Sainte-Geneviève-de-Berthier, La Visitation-de-l'île-Dupas and Saint-Ignace-de-Loyola.

Downstream from Lake Saint-Pierre, municipalities getting their supply of drinking water directly from the river include Bécancour, Sainte-Marie-de-Blandford, Saint-Augustin-de-Desmaures, Québec (Sainte-Foy area) and Lévis (Lauzon, Lévis and Saint-Romuald areas).

3.15 Maritime Traffic

Commercial shipping is a major activity on the St. Lawrence River. The St. Lawrence – Great Lakes trade corridor is the fourth-largest economic area in North America after California, Texas and New York (SODES, 2015). Montréal's port area serves as the main hub of commercial maritime activity on the St. Lawrence River in Quebec. It is essential to keep Traverse du Nord clear to maintain access to this area as well as to the Québec port area. Additionally, the presence of barriers or shoals can obstruct the passage of vessels and, consequently, increase the risk of maritime and environmental incidents while also helping to drive up shipping costs.

4. Environmental Impact of Project

4.1 Impact of Sediment Dredging

4.1.1 Hydrodynamics, ice and sedimentation

No anticipated impact. The hydrological conditions observed in the study area will not be affected by this maintenance dredging due to the very small surface area involved.

4.1.2 Water quality

4.1.2.1 Clamshell dredge

Excavating sediments in the dredging areas may result in the temporary resuspension of fine particles; however, based on previously conducted studies, the dredged sediments in all areas targeted for maintenance dredging contain very low levels of fine particles. For example, during the characterization campaign of 2015, sediments requiring dredging in the Bécancour area were made up almost entirely of sand with traces of silt and clay. In actuality, the potential effects on water quality are very limited over time and space. As a result, the sand making up the majority of the dredged sediments will likely be deposited a very short distance from the work site. The impact of dredging on water quality in terms of an increase in SS related to the dispersion of the fine fraction is classified as negligible due to the very short distances and durations involved. Samples collected around Traverse Cap-Santé in 2014 were also made up almost entirely of sand with traces of silt.

Samples collected previously in the Lake Saint-Pierre area also contained only very low amounts of fine particles, being made up more than 97 percent of sand with traces of gravel, silt and clay in 2015.

To evaluate the actual significance of any changes in water quality related to sediment dredging and dumping operations, a water quality monitoring program was implemented during maintenance work in September 1997 in Lake Saint-Pierre (Les Consultants Jacques Bérubé inc., 1997b).

The main objective of this monitoring program was to confirm the extent of increases in turbidity and SS levels in the water caused by sediment dredging and dumping activities, specifically at disposal site S-17, as this was the first use of that site.

Some information was also collected concerning the centre of Lake Saint-Pierre as well as dredging site D-14 located southwest of Yamachiche and adjacent areas not disturbed by the ongoing activities.

The dredged sediments contained very low levels of fine particles, being made up 1 percent of silt and clay. It was consequently anticipated that the abovementioned potential effects on water quality would in fact be very limited over time and space. As a result, the sand dispersed as part of the work will likely be deposited within a very short distance of the work site.

Table 4.1 sets out the turbidity measurements taken at the disposal site before, during and after sediment release. It can be seen that the mean turbidity values observed before, during and after the second release were both very low and highly comparable against one another (being 7.9, 9.5 and 8.1 NTU). It is also important to note that, based on the observations made on-site at the time

of data collection, the measurements were in fact taken in the plume of influence of the deposit: all samples were collected in the backwater area where a certain amount of floating plant debris could be seen.

These very low results are not surprising in that the dredged sediments, made up of 98-99 percent of sand, settle back down in the immediate proximity of the work site and tend not to remain suspended in the water column.

Table 4.1 also sets out the results of turbidity measurements in water samples collected behind the dredge and in the zone undisturbed by the dredging work. The mean turbidity values in the water samples collected behind the dredge were relatively low at 5.9 NTU. Note that the mean, minimum and maximum values recorded are similar to those obtained in the peripheral zone unaffected by the work.

In summary, monitoring of water quality in area D-14 shows that on average, the turbidity and SS values recorded before and after release are comparable to one another and fall within the range of natural variability for this section of the St. Lawrence River.

The results of sampling behind the dredge, meanwhile, are comparable to those recorded for peripheral areas. These results indicate that dredging does not drive up turbidity or SS values significantly.

The potential effects on water quality described in monitoring reports for the work in 1997 were in fact imperceptible. The use of a clamshell dredge for maintenance dredging in Lake Saint-Pierre consequently did not have any impact on water quality either at the dredging site or at disposal site S-17.

Table 4.1 Turbidity measurements in water samples collected at the disposal site, behind the dredge and in the zone undisturbed by dredging (1997, in NTU)

	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM	NUMBER OF SAMPLES
Before 1st release	11.0	1.9	8.8	19.1	51
During 1st release	n/a	n/a	n/a	n/a	n/a
After 1st release	12.0	1.0	10.5	14.2	10
Before 2nd release	7.9	1.1	6.2	9.0	5
During 2nd release	9.5	0.8	8.8	10.6	5
After 2nd release	8.1	1.0	6.7	11.3	38
Downriver from dredge (zone of influence)	5.9	2.0	2.5	7.8	8
On periphery of zone of influence	6.9	0.4	6.6	7.2	2

Transporting dredged sediments to the disposal site can also become a source of increased turbidity from SS due to the loss of sediments via the barge doors. The extent of these losses does not appear to have been documented and would vary depending on the state of the gear used. However, this source of impact may be ruled out by using barges that are adequately watertight.

The impact would then be negligible to nil and, if it did occur, of short duration. Barge watertightness is a requirement set out in the technical specifications for the project in this regard.

4.1.2.2 Trailing suction hopper dredge (with doors in hull or split hull)

An intensive monitoring program was followed during dredging work in Traverse du Nord in 1996 (Les Consultants Jacques Bérubé inc., 1997a). Results showed that the use of a trailing suction hopper dredge has very minimal impact on water quality during either dredging or open-water dumping of the sediments.

On average, the SS concentrations in the water samples collected behind the dredge were similar to those in the samples collected around the periphery. However, the maximum values were slightly higher both on the surface and in deep water. It should be noted, however, that these elevated values were rare in that only two samples out of 165 collected on the surface and four out of 124 collected in deep water exceeded the maximum background values. These results indicate that dredging does not drive up SS values continuously but rather very sporadically.

Traverse du Nord is located at the point in the St. Lawrence River where fresh and salt water intermingle. This area, referred to as the river's "turbidity zone," naturally exhibits SS values that are both very high and highly variable. Any SS increases generated by dredging are sporadic, limited in area and, with a few exceptions, within the range of natural variation that might be observed in the area at the time of the work.

Water quality was also monitored during maintenance dredging in 1993. A preliminary series of measurements was taken before the dredging operations and then a second series during the work in areas G-14 and G-15. The focus in this case was on assessing dissolved and total concentrations of SS and arsenic before and during the maintenance work in Traverse du Nord (Canadian Coast Guard, 1993).

Although this campaign was not highly intensive, certain conclusions may be drawn from the results recorded. SS concentrations in the channel before the start of the work ranged between 39 mg/l and 278 mg/l. During dredging, the concentrations observed in the turbidity plume varied between 184 mg/l and 215 mg/l. It appears that the increase in SS noted during the dredging work in 1993 was relatively low and could conceivably be classified as a natural variation potentially observed in that area. With respect to dissolved arsenic, all samples analyzed had content levels below the detection limit of the analysis method (0.002 mg/l). Total arsenic concentrations, meanwhile, did not exceed the detection limit and were therefore well below the maximum total concentration recommended by the Canadian Council of Ministers of the Environment (Canadian Water Quality Guideline) of 0.05 mg/l.

As noted previously, based on the outcomes of water quality monitoring during previous dredging, it is reasonable to assume that human activities will not cause any increase exceeding the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 1994).

Any resuspension caused by the dredging work should consequently be relatively minor and confined. The impact on water quality may therefore be deemed minor.

4.1.3 Aquatic and Riparian Vegetation

Grass beds, marshes, wet meadows and swamps are located a good distance from the dredging sites. No significant impact is anticipated on aquatic vegetation, since no dredging work will be done near the shore where grass beds and marshes are located.

4.1.4 Invertebrates

The aggregation of softshell clams from Cap-Saint-Ignace onward is located a good distance from the dredging sites. Consequently, no impact is anticipated. This population is also not exploited.

4.1.5 Fish fauna and aquatic habitat

The potential effects of higher turbidity and SS levels vary depending on the species and an individual's developmental stage as well as on the characteristics of the environment in which the higher levels occur. Organisms exposed regularly to turbidity increases attributable to natural causes generally tolerate any increases caused by dredging activities more readily. It is important to note that natural phenomena lead to increases in turbidity and SS levels comparable to those caused by dredging. Storms and high water, for example, are among the natural phenomena that can increase turbidity significantly, as they occur over a much broader area and occasionally extend over a longer duration than dredging activities (Environment Canada, 1994).

Significant degradation of the environment due to the sediment resuspension typically associated with dredging is unlikely even if large volumes of sediments are dredged (which is not the case in the present project) (Peddicord, 1980, cited in Environment Canada, 1994). This is because the turbidity levels generated by dredging are well below lethality thresholds for the majority of species and, more importantly, extend over shorter time periods than the durations recognized as lethal for larvae and adults.

The vulnerability of fish to higher SS levels varies depending on the species and developmental stage. According to Appleby and Scarrat (1989), filter-feeding fish are less tolerant than other species, while species living in clear water are generally less tolerant that species living in naturally turbid water. Similarly, estuarian species generally appear much more tolerant of high turbidity conditions. Palermo *et al.* (1990) and Appleby and Scarrat (1989) note that suspended sediment concentrations of 500 mg/l and even 1000 mg/l at a distance of 500 m from the dredge may be considered safe for fish, especially since fish are mobile species and able to avoid unfavourable conditions (Environment Canada, 1994).

In general, dredging operations will in all likelihood temporarily and locally drive away fish that use the affected area.

Little work has been undertaken to assess the extent to which dredging activities modify fish migration corridors and patterns. However, although the studies conducted by Palermo *et al.* (1990) are detailed, they do not lead to the conclusion that dredging has any significant impact on fish migration. Consequently, it appears unlikely that the work will disrupt migration of the eel, American shad or Atlantic tomcod, since on one hand, the area affected by the work will be very small and will not exceed the limits of the channel, and on the other, any increase in SS levels in the water will be very low, if not imperceptible, given the coarse nature of the sediments dredged in recent years.

Dredging in the waterway will have only very minor effect on the fish using that area. Most of the resuspended sediments settle less than 200 m downriver from the work, which will also extend over only a very short time frame in each area requiring dredging. Lastly, with their mobility, juvenile and adult fish will be able to avoid the turbidity plume, whether they live in the river permanently or are migrating through the area.

The Bécancour/Batiscan area is characterized by an actual spawning site used by the yellow perch. The breeding period of this species runs from mid-April through early May. Based on the available information, a certain number of potential spawning grounds have also been identified in this area. However, the St. Lawrence Waterway is not generally conducive to spawning. Due to the distance between the known actual and potential spawning areas and the waterway, sediments resuspended during dredging are unlikely to significantly affect the reproductive capacity of species present in the area or their use of that environment. The zone of influence of the dredging work will not interfere with this type of biological activity since the very limited effects of dredging will remain concentrated inside the navigable waterway boundaries.

The dredging activities starting in the fourth week of May in the waters between Bécancour and Batiscan and in Traverse Cap-Santé will not result in any perceptible changes to the aquatic habitats or biological activities essential to the maintenance of fish fauna in the affected area. The direct impact of dredging on aquatic wildlife may consequently be deemed negligible. The dredging area in Traverse Cap-Santé is located more than 2 km from the confluence of Jacques-Cartier River, thereby minimizing any potential impact on the salmon return up that river.

Given that the impact on water quality will be negligible and the direct impact of the dredging operations will be one-time and temporary, the overall impact on aquatic wildlife and its habitat is deemed very minor.

4.1.6 Avifauna and habitat

Birds appear to become quickly accustomed to the presence and comings and goings of the vessels and gear used for the dredging work and to the continuous noise generated by the pumps and gear motors. In the case at hand, the areas supporting waterfowl nesting are all located on the foreshore a good distance from the work areas and beyond the zone of influence of the activity. It should be noted that any areas of waterfowl concentration on the river are situated a significant distance from the waterway. Additionally, since birds are able to move about, no impact is anticipated in relation to the areas of concentration occurring on the south shore of Île d'Orléans and encroaching on the navigable waterway. Consequently, the anticipated impact is nil.

4.1.7 Marine mammals

Since any presence of marine mammals between Île d'Orléans and Cap Gribane is accidental and the ROMM (2015) has not reported any marine mammals in the study area, no impact is anticipated in this regard.

4.1.8 Species at risk

In general, dredging operations will in all likelihood temporarily and very locally drive away fish that use the area affected by dredging movements and operations. In addition, the waterway is not a habitat conducive to breeding among these fish species. Moreover, the species found in the

Traverse du Nord area are in all likelihood tolerant of SS increases, since they live in an area where SS concentrations are naturally highly variable and very high.

Although larger hickorynut populations are prevalent in the Cap-Santé area, the area usually dredged is located more than 2 km upstream from that aggregation site.

It can therefore be assumed that the project will have only negligible to non-existent impact on any species at risk.

4.1.9 Recreational activities

4.1.9.1 Sport fishery

The dredging work is limited to the navigable waterway and consequently should not interfere with sport fishing. No impact is anticipated.

4.1.9.2 Hunting and trapping

The dredging work is limited to the navigable waterway and consequently should not interfere with hunting or trapping activities. No impact is anticipated.

4.1.9.3 Nautical activities

Recreational boaters on Lake Saint-Pierre and in the St. Lawrence in general are generally accustomed to seeing dredging vessels and gear since maintenance dredging is done there annually. This impact is deemed negligible.

4.1.10 Commercial fishery

The dredging work is limited to the navigable waterway and consequently should not interfere with commercial fishing activities as commercial fishing is prohibited in the waterway so as not to disrupt commercial shipping. No impact on this aspect of the environment is consequently anticipated.

During a survey conducted in the spring of 2005, commercial fishers in the **Bécancour** area had also indicated that their main concern was the disruption of sturgeon fishing. Since the most lucrative fishing activity begins around June 14 and continues for a limited period, starting sediment dredging by the cubic metre at a unit rate beginning in the last week of May should enable completion of the work by mid-June. As a result, the dredging work should not interfere with the first few days of fishing, which are critical for fishers. The same will apply to work in the **Lake Saint-Pierre** area. Since the work there will begin in the fourth week of September, the first few days of the fall commercial fishery (which opens on September 14) will not be affected.

Moreover, as recommended in the preliminary review of the report on annual maintenance dredging of the St. Lawrence Waterway (2005) between Montréal and Deschaillons (CJB Environment inc., 2005), environmental monitoring and follow-up were incorporated into the dredging work performed in the spring of 2005 with a view to addressing the concerns of commercial fishers in regard to the source of debris interfering with operation of their fishing gear, particularly in the spring and including the maintenance dredging period in the waterway between **Bécancour and Batiscan**. This environmental follow-up, conducted in the spring of 2005, showed that the dredged sediments

were made up mainly of sand without any presence of vegetation or other debris that might become entangled in the nets of commercial fishers. No impact is anticipated in this regard.

With regard to dredging at an hourly rate, this one-time work will involve only very low volumes over a short time frame and consequently will not disrupt the activities of commercial fishers. It can also be performed outside of periods generally followed and imposed by constraints relating to certain biological or commercial activities. The calendar submitted to the contractor provides for performance of the hourly dredging between Montréal and St-Antoine after dredging by the cubic metre. The work, which should take four to five work weeks, will start in the Montréal area and then progress downstream.

With respect to dredging in the **Traverse Cap-Santé** area, the commercial fishing areas lie outside of the zone of influence of the work. The work will be performed immediately before or after the first dredging period and should take approximately 40 hours.

At most, the work will have the same effect as the regular passage of commercial vessels. In the Traverse du Nord area, since the work is limited to the navigable waterway, it will not disrupt commercial fishing activities. Fishers holding fishing licences in the proximity of Île Madame and buoy K131 will be permitted to fish south of the waterway.

Consequently, no impact on this aspect of the environment is anticipated.

4.1.11 Protected natural heritage

No anticipated impact.

4.1.12 Quality of life

With regard to the sediment dredging itself, no impact is anticipated, since the dredging work will be limited to the waterway.

However, residents of Valdor Island in Champlain have expressed certain concerns to the CCG in the past in relation to sound, visual and olfactory nuisance. In response to this, the CCG undertook observation and measurement activities in the summer of 2006 during dredging in the Bécancour/Batiscan area.

The sound, visual and olfactory investigation conducted in the summer of 2006 during maintenance dredging in the Champlain area confirmed that the contractors performing the dredging work complied with current standards applicable to sound levels and that the visual and olfactory aspects of the dredging itself were not likely to raise concerns. However, the investigation showed that the issues raised had more to do with the temporary nearshore anchorage of related equipment used for purposes such as housing work crews. The presence of related equipment is associated strictly with dredging work performed using a clamshell dredge. Although these activities are of a short duration, it is acknowledged that they may create certain nuisances for residents with properties located near the waterway.

To mitigate this situation, the CCG raised awareness among contractors about this issue at a meeting held before awarding the contract. The CCG will continue its efforts to raise contractor awareness about this issue by holding a meeting before the start of work. Steps shall be taken to reduce and minimize, wherever possible, any noise or nuisance caused by related equipment

(tugboat displacement, presence of floating structures used to accommodate workers, light emissions directed at the shore, use of generators on the shore side of structures) as recommended in the study commissioned by the CCG, the final report on which was submitted by CJB Environment in 2007. Upon request, the CCG will also keep residents informed concerning any changes in the work or measures implemented to improve conditions.

4.1.13 Use of the territory

No impact anticipated since the dredging work will be limited to the navigable waterway.

4.1.14 Water intakes

No impact anticipated since no water intakes are located inside the zone of influence of the work.

4.1.15 Maritime traffic

The presence of dredging equipment in the navigation channel may obstruct the passage of maritime traffic. Vessels may have to manoeuvre to avoid the floating worksite. However, the contractor will also move all of its equipment regularly to accommodate the passage of wide-beam vessels. The dredging work may also require the relocation of certain buoys. Notices to mariners will be issued to prevent any conflicts or risk of accidents. Dredges and tugs will also remain in continuous contact with CCG Marine Communications & Traffic Services (MCTS). The equipment will also be marked in accordance with current regulations. It should be noted that the purpose of the work is to ensure navigation safety in the St. Lawrence River by maintaining the depths published on nautical charts and that the presence of shoals can obstruct the passage of vessels and, consequently, increase the risk of maritime and environmental incidents.

4.2 Impact of Open-Water Dumping of Sediments

4.2.1 Hydrodynamics, ice and sedimentation

According to a scale-model study conducted by Laboratoire d'hydraulique LaSalle (1972), sediment transport should not cause any obstruction of secondary channels. As a result, no impact on hydrodynamics, ice or sedimentation is anticipated.

4.2.2 Sediment quality

The dredged sediments will be made up of high-quality sand. The nature of the sediments requiring dredging is also generally compatible with that of existing sediments at the disposal sites. The sediment chemistry at the disposal sites is comparable to that of the sediments to be dredged.

During dumping, dispersion of a very small proportion of the sediments is likely to occur outside of the disposal site itself. Monitoring results in 1996 (Les Consultants Jacques Bérubé inc., 1997a/b) also confirmed that the increase in turbidity below the disposal site was very minor and within the range of natural variation. Clearly, a quantity this small will not contribute to significant degradation of the overall quality of the environment. This is because any quantity likely to be resuspended during the work appears minimal in comparison to the significant turbulence and resuspension caused by the waves and tides.

As observed over the years, the chemical quality of existing sediments at the disposal sites (T-11 and S-17) is comparable or less than that of the sediments to be deposited there. The dumped sediments will mix with existing sediments at the sites or even serve to cap lesser-quality sediments. No impact is anticipated in this regard.

With respect to their physical nature, the sediments deposited at site T-11 and potentially at site S-17 will likely be similar in particle size or slightly coarser than existing sediments at these sites. Highly localized changes are consequently anticipated in this regard. Overall, impact will be minor and highly localized.

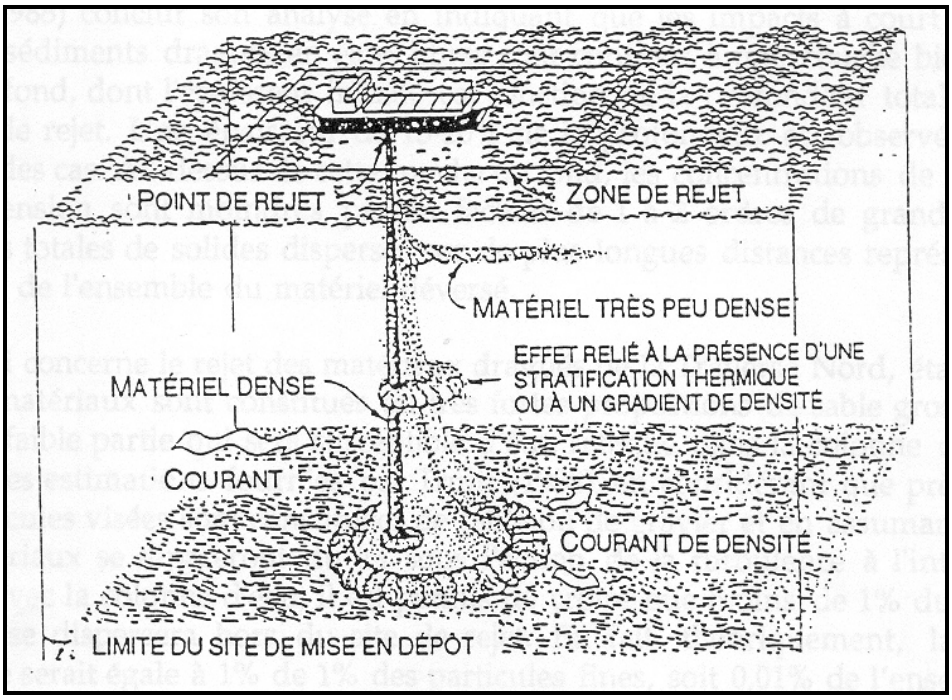
The sediments dredged in Traverse Cap-Santé are typically made up of high-quality sand similar in particle size to existing sediments at disposal site X-04. Impact is negligible and highly localized.

According to the scale-model study by Laboratoire d'hydraulique LaSalle (1972), sediments deposited at disposal site X-03 (Sault-au-Cochon) rarely tend to relocate outside of the site. Although no scale-model studies have been conducted on disposal site X-02 southeast of the Banc-Brûlé cul-de-sac, hydrodynamic conditions will presumably be such that any sediments deposited there will be very unlikely to relocate, since the site is located outside of the channels, where tidal currents are strongest. Open-water dumping will be permissible for all of these sediments. Any overall impact on riverbed quality will consequently be minor.

4.2.3 Water quality

Environmental concerns with respect to open-water dumping relate mainly to dispersion of a portion of the deposited sediments, or relocation of some of the sediments outside of the disposal site boundaries. Multiple studies have been carried out on this issue since the 1960s. In fact, research was conducted from the late 1960s through the early 1970s with a view to more effectively describing, quantifying and modelling the behaviour of dredged sediments dumped in open water. The outcomes of this research were then consistently validated. The behaviour of sediments dumped from barges has been described by a series of authors, who have for the most part identified three stages or phases of transport (Truitt, 1988). Figure 4.1 sets out these three transport phases in diagram format.

3. The convective descent of the sediments, which come down in a dense jet. Regardless of their cohesiveness, the sediments will behave in this manner in an entrainment phase before entering into a sedimentation phase, where the velocity of the cloud is essentially a function of the inherent fall rates of the various particles of which it is constituted.



Source: Truitt, 1988 (cited in CJB Environment inc., 2009)

Figure 4.1 Sediment behaviour during open-water dumping

4. Bottom impact of the mass followed by formation of a density current radiating outward from the point of impact and picking up any sediment that did not settle at the moment of impact. The sediment carried in this density current is mixed into the lower layers of the water column and eventually settles rapidly after the energy has dissipated.

5. Passive or long-term diffusion involving mainly fine particles which separated from the jet during descent due to the turbulence caused by contact between the jet and the water column. This last fraction of sediment made up of fine particles is what travels furthest.

A series of field studies was conducted to determine the behaviour of sediments dumped in open water with the notable objective of estimating the proportion of sediments potentially carried over great distances. Truitt (1988) provides an overview of the many publications addressing this topic for which quantitative results are available. A summary of the key data from these various studies is presented in Table 4.2.

Table 4.2 Summary of studies of sediment behaviour during open-water dumping

Source	Site Studied	Depth (m)	Current (cm/s)	Sediment Type	Dredge Type	Dumping Type	Volume per Release (m^3)	Monitoring Technique	Loss in Water Column (% of Volume Dumped)
Gordon (1974)	Long Island Sound	18-20	6-30	Silt/clay	Clamshell dredge	Open-hopper dredge	900-2300	Turbidimeter	1
Sustar and Wakeman (1977) Cited in Truitt, 1988	Carquinez*	14	9-24	Silt/clay	Trailing suction hopper dredge		1000	Turbidimeter and SS measurement	1-5
Bokuniewicz *et al.* (1978) Cited in Truitt, 1988	Ashtabula (Lake Erie)	15-18	0-21	Sandy silt	Trailing suction hopper dredge		690	Turbidimeter and SS measurement	1**
	New York Bight	26	6-24	Marine silt	Trailing suction hopper dredge		6000	Turbidimeter and SS measurement	1**
	Saybrook (Long Island Sound)	52	21-70	Marine silt	Clamshell dredge	Open-hopper dredge	1100	Turbidimeter and SS measurement	1**
	Elliot Bay	67	0-21	Sandy silt	Clamshell dredge	Open-hopper dredge	380-535	Turbidimeter and SS measurement	1**
	Rochester (Lake Ontario)	17-45	0-21	Silt	Trailing suction hopper dredge		690	Turbidimeter and SS measurement	1**
Tavolaro (1982) Cited in Truitt, 1988	New York Bight	15-25	Unknown	Silt/clay	Clamshell dredge	Open-hopper dredge	1375-3000	Mass balance	3.7
Truitt (1986)	Duwamish Waterway	20-21	6	Silt/clay	Clamshell dredge	Open-hopper dredge	840	SS measurement and mass balance	2-4

Source: Truitt, 1988 (cited in CJB Environment inc., 2009)

** Selected data from another site included by author. ** Synthesis of all sites reported by author.*

Truitt (1988) concluded his analysis by noting that the short-term impact of dredged sediment disposal in open water is confined to a well-defined layer near the bottom, the initial thickness of which depends on total water depth at the disposal site. A thickness of 15 percent to 20 percent of the total is observed in the majority of cases. Above this bottom layer, the suspended sediment concentrations drop by one to two orders of magnitude, while the total quantity of material dispersed over longer distances accounts for 1 percent to 5 percent of all dumped sediments.

With regard to the disposal of dredged sediments in the Bécancour area, in light of the fact that the sediments normally contain a high proportion of coarse sand, only a very tiny proportion is likely to be held back in the water column. Based on the estimates provided by Truitt (1988), taking into account the fact that more than 94 percent of the particles in question are made up of sand, and assuming that less than 6 percent of the sediments will separate from the jet due to the turbulence created by jet contact with the water column, the dispersed fraction would presumably correspond to 2 percent of fine particles, meaning that 99.88 percent of all sediments released will be confined to the open-water disposal site.

As with dredging, assuming that the dredged sediments in all areas contain very low levels of fine particles, the potential impact on water quality will in fact be very limited over time and space. The impact of disposal on water quality is deemed negligible due to the very limited area and short duration involved. A follow-up program implemented to monitor changes in water quality during the work carried out in 1997 (for additional information, see subsection 4.1.2) revealed that on average, the turbidity and SS values recorded before and after release were mutually comparable and fell within the range of natural variation for this section of the St. Lawrence River.

With regard to the disposal of dredged sediments in Traverse du Nord, in light of the fact that the sediments contain a high proportion of sand and gravel, only a very tiny proportion is likely to be held back in the water column. Based on the estimates provided by Truitt (1988), taking into account the fact that more than 98 percent of the particles in question are made up of sand or gravel and assuming that 2 percent of the sediments will separate from the jet due to the turbulence created by jet contact with the water column, the dispersed fraction would presumably correspond to 2 percent of fine particles, meaning that 99.82 percent of all sediments released will be confined to the open-water disposal site. The dispersed fraction will correspond theoretically to 1 percent to 2 percent of fine particles, or 0.02 percent of dumped sediments overall. The results of the monitoring campaign carried out in the summer of 1996 indicated that use of a trailing suction hopper dredge for dredging Traverse du Nord had very little impact on water quality in relation to sediment disposal in open water (Les Consultants Jacques Bérubé inc., 1997a).

Meanwhile, the measurements taken at the various disposal sites before, during and after release indicate that the SS values obtained before, during and after release are mutually comparable. The SS increases generated by disposal are sporadic, applicable to a limited area and within the range of natural variation observed in the area.

Based on the monitoring of water quality in relation to disposal, increases in turbidity or SS levels will presumably be comparable with those recorded previously and will fall within the range of natural variation for peripheral zones. Consequently, human activities should not cause any increase in suspended sediments exceeding the SS management criteria applicable to dredging.

The resuspension of sediments during open-water dumping will therefore be minor and of short duration. Any overall impact on water quality will consequently be negligible.

4.2.4 Aquatic and riparian vegetation

No significant impact is anticipated on aquatic or riparian vegetation, since no dredging work will be done near the shore where grass beds, marshes, wet meadows and swamps are located. Consequently, no direct impact on these resources is anticipated.

4.2.5 Marine mammals

As noted previously, since any occurrence of marine mammals between Île d'Orléans and Cap Gribane is incidental, impact is deemed to be nil.

4.2.6 Fish fauna, invertebrates and aquatic habitat

Aquatic wildlife may be affected by increased water turbidity in relation to disposal of dredged sediments. Due to their mobility, however, fish are able to temporarily avoid areas with elevated SS concentrations. As noted previously, increases will be very minor and of short duration. Moreover, the species prevalent in the area are likely highly tolerant of at least some increase in turbidity and SS levels. The impact on pelagic species is in all likelihood nil.

The disposal sites for soft sediments are located far from the known aggregation and spawning areas of fish fauna:

- Site S-17 was selected based on information supplied by local commercial fishers, who report that their fishing activities over or in the proximity of that site are limited. The six fish fauna inventories conducted between 1997 and 2000 as part of the monitoring program for selective dredging of shoals in the waterway between Montréal and Cap-à-la-Roche uphold this theory concerning the use of site S-17 by fish (CJB Environment inc. and Procéan inc., 2000). At that time, it was concluded beyond doubt that site S-17 was not a preferred feeding ground for any fish species, since no recaptures had been recorded during six fishing campaigns at that location (either from day to day within any individual campaign or from one campaign to the next). There was also no indication that the site was used as a spawning ground by any species of recreational or commercial interest (yellow perch, walleye, sturgeon). The closest spawning grounds are located around Lake Saint-Pierre more than 2 km from the zone of influence of this disposal site (CJB Environment inc. and Procéan inc., 2000).
- Site T-11 has been used for many years and is located a good distance from a fishing area used by a commercial fisher. Based on previous discussions with that fisher, the activities have not driven away the resource or caused any harm to fishing gear. There are also no zones exhibiting characteristics conducive to fish breeding between the site and the channel or within the potential zone of influence downriver from this site (CJB Environment inc. and Procéan inc., 2000).
- It is also important to note that at disposal sites designated under the project in the Traverse du Nord area, the current speed, reversals in current direction due to the tides, the waves and the wind are all factors resulting in highly precarious stability of the existing substrate for benthic fauna. For example, based on the results of an inventory of the

benthic fauna in the Banc du Cap Brûlé area (near the channel in the area of site X-02), no benthic organisms were counted in any of the four sandy-type sampling stations visited (CJB Environment inc., 2001). For the Traverse du Nord area, it can therefore be assumed that twice-daily turbulence episodes and storms render the sand unlikely to attract abundant, sessile benthic fauna and, furthermore, serve as factors in the resuspension and shifting of materials on the riverbed, acting more or less continuously and on a much grander scale than the annual sediment disposal associated with maintenance dredging. It should be noted that, given the sector occupied by the softshell clam aggregation in the area, no impact is anticipated.

Fish that feed on benthic fauna (bottom feeders) appear more likely to be affected by the release of sediments. In principle, they could be affected indirectly due to burial of the benthic fauna serving as their food source. Based on environmental monitoring of dredging projects, however, the surface benthic community has been observed to quickly recover naturally. This impact is therefore temporary, since following the settlement of dredged sediments, disposal sites are generally recolonized through vertical migration of buried organisms and horizontal migration of organisms from adjacent areas through either active displacement or passive displacement from the movement of water masses. As a result, the speed of recolonization varies depending on the thickness of the deposit and the comparability of the new sediments to existing sediments in the area. From a theoretical perspective, in areas where the deposited sediment layer is less than 15 cm thick, Wilber (1992) observes that abundance values for benthic fauna return to comparability with their starting values within two weeks. In areas where the deposited sediment layer exceeds 15 cm in thickness, meanwhile, recovery can take up to 20 weeks. It should be noted that these observations were made in an estuarine environment where the released sediments were 40 percent sand and 50 percent silt, which differs from the conditions observed in the present case. In practical terms, with respect to the dredging work between Montréal and Cap-Santé, recolonization of the bottom at site T-11 and colonization of the new substrates at site S-17 will take place gradually, potentially extending over a period of weeks. In the Traverse du Nord area, the predicted rebound toward previous conditions must take into consideration the high degree of turbulence and strong currents that tend to disperse and shift not only the released sediments but also all existing sediments on the river bottom. This environment will rapidly take in and “absorb” the released sediments, distributing them gradually throughout the environment, while at the same time, movement of the water masses due to the tides and currents in this area will help to distribute benthic organisms just as quickly over the entire available environment.

The impact on the benthos and bottom-feeding fish depends on the size of the foraging territory temporarily affected. In the case at hand, taking into account the fact that the disposal sites used under the present project have been used regularly for many years, the ecosystem has presumably adapted to this situation and to the fact that the availability of certain isolated areas may temporarily be limited. Additionally, since the affected area is very small, the intended deposits are unlikely to have any significant or measurable impact on bottom-feeding fish populations.

Finally, the decrease in water depth subsequent to the deposit of dredged sediments could have consequences if the selected site represents a recognized summer habitat for fish species that use trenches where the coldest water is found. However, this constraint was taken into consideration when selecting disposal sites, and sites believed to be summer habitats were avoided. Consequently, no loss of this type of habitat is anticipated as a result of sediment deposits.

As for longer-term effects on the fish habitat of the presence of sediments, based on analysis of the outcomes of six test fishing campaigns conducted between 1997 and 2000 under the follow-up program for selective dredging of shoals in the waterway between Montréal and Cap-à-la-Roche, it is clearly evident that site S-17 is not used as preferred foraging territory by any fish species and that the release at site S-17 in the fall of 1998 of a large volume of postglacial sand and clay was not responsible for any significant changes in the use of site S-17 by fish fauna.

However, in the event that disposal site S-17 is used in relation to dredging work in Lake Saint-Pierre, the Fisheries Protection Division (FPD) finds that the release of dredged sediments in Lake Saint-Pierre in a section of site S-17 never previously used to deposit dredged materials would cause deterioration of foraging territory and summer shelter (deep waters) for the lake sturgeon, walleye and northern pike attributable to modification of the substrate and the depth at the immersion site. Permission under subsection 35(2) of the *Fisheries Act*, subject to any amendments thereto, is consequently required for use of site S-17 to dispose of sediments. For this reason, the CCG agrees to continue the compensation project initiated with the objective of upholding the principle of no net loss of fish habitat.

Lastly, although the FHAMIS identifies disposal site X-04 as being in a breeding area and potential spawning ground for the rainbow smelt (DFO, 2011), use of the site would not cause any major impact in relation to these aspects, as the breeding season of the rainbow smelt is in the spring – typically May extending occasionally to April or June – and the dredging work is scheduled to take place after the end of May, mainly in September and October.

Overall, in light of its low intensity and temporary nature, any impact on bottom-feeding species is deemed minor.

4.2.7 Avifauna and habitat

As noted previously, avifauna is likely to be disturbed locally and temporarily by the operation of floating equipment in the dumping areas since these sites are located near areas of concentration of that resource. However, Campbell (1988) reports that waterfowl continued to brood 50 m from a dredge in operation. Pelletier (1994) reports that a female goose brooded throughout work being performed 30 m from a disposal site. Finally, Ward (1981) notes that even intense (85,000 m^3/d) dredging activity had only a minor effect on bird distribution.

Site S-17 is located within a major fall staging area for the common goldeneye and scaup (Benoît *et al.*, 1988). In the fall, the work could have impact on these birds. However, as noted previously, waterfowl appear to become accustomed very quickly to the presence of dredging equipment. Disposal site T-11, meanwhile, is not located within proximity of any significant avifauna habitats. The critical waterfowl habitats closest to that site are located primarily in the Gentilly flats area. No significant disturbance of the avian community is consequently anticipated at site T-11. The same applies to site X-04.

In the Traverse du Nord area, riparian habitats where birds aggregate also should not be affected, as these are located a good distance from the disposal sites.

No impact on avifauna or its habitat is therefore anticipated.

4.2.8 Species at risk

Disposal in grass beds could result in destruction of the watercourse bed and disruption of the feeding and growth functions. However, the disposal sites used for the dredging have been used many times to dispose of dredged sediments during previous maintenance work in these areas.

Additionally, due to their mobility, fish are able to temporarily avoid areas with elevated SS concentrations. It may therefore be assumed that the project will have only negligible to inexistent impact on any species at risk at the disposal sites.

To protect the hickorynut in the Cap-Santé area, which is vulnerable for that species, Pacquet (pers. comm., MRNF, June 2012) notes that "...ideally and where possible, sediments should be released at slack water in the interest of protecting this species..." However, since no occurrences of wildlife have been identified within a radius of 500 m around all disposal sites, including site X-04, since the volumes released at site X-04 will be small and since the sediments requiring dredging in this area contain very low levels of fine particles, the potential effects of the dispersion plume will in fact be very limited over time and space. The impact of deposition is deemed negligible.

4.2.9 Recreational activities

At the disposal sites between Montréal and St-Antoine, sport fishers could be affected to some extent by the movement of the floating equipment. However, disposal site S-17 will not interfere directly with the areas used for sport fishing from boats as reported by Municonsult (2002). Site T-11 is not located near any sport fishing areas. Sport fishing in the area is done mainly around the Gentilly flats. Site X-04, meanwhile, is located a good distance from any areas potentially used for sport fishing. Consequently, no impact on this recreational activity is anticipated.

The overall impact on sport fishing is deemed to be minor and of short duration. The disposal sites in the Traverse du Nord area are situated a good distance from any areas potentially used for hunting or sport fishing. The dredge will rarely travel outside of the channel and should not pose a disruption to recreational boating.

The disposal of sediments should not interfere with hunting activities, which take place mainly along the foreshore a fair distance from the disposal sites. Similarly, no impact is anticipated on trapping, as no activities of this nature take place within the proximity of the disposal sites.

Nor will the presence of the disposal sites for dredged sediments become an obstacle for recreational boaters.

4.2.10 Commercial fishery

The disposal sites are adjacent to the navigable waterway and consequently should not interfere with commercial fishing activities as commercial fishing is prohibited in the waterway so as not to disrupt commercial shipping. Additionally, the work will at most have the same effect as the regular passage of commercial vessels. Consequently, no impact on this aspect of the environment is anticipated.

4.2.11 Protected natural heritage

No anticipated impact.

4.2.12 Quality of life

The disposal activities will have the same effect as the regular passage of vessels. The impact of this on quality of life is therefore negligible.

4.2.13 Use of the territory

No anticipated impact.

4.2.14 Water intakes

No anticipated impact.

4.2.15 Maritime traffic

The movement of the clamshell dredge and the suction hopper dredge between the dredging areas and the disposal sites will have no significant impact on maritime traffic. Notices to mariners will be issued to prevent any conflicts or risk of accidents. CCG Marine Communications & Traffic Services (MCTS) will also coordinate and manage maritime traffic while the work is going on. The equipment will also be marked in accordance with current regulations.

4.3 Impact of Upland Disposal of Debris

Miscellaneous debris (tree trunks and branches, old winter buoys, scrap metal, etc.) will be transported to the nearest dock and then trucked to the Sorel wharf, the Port of Québec or other port or dock designated by the CCG for disposal by the CCG in accordance with current environmental guidelines. No impact is anticipated in this regard.

4.4 Impact of Onshore or Upland Disposal of Sediments

In light of the preferred solution identified in this report – open-water dumping of the sediments – the impact of these alternative disposal methods was not evaluated. This task may be undertaken by any contractor seeking to carry out a project involving the onshore or upland disposal of the sediments.

5. Waste Management

The unauthorized release of hazardous waste (oil, sewage, etc.) into the water or on land in relation to the work will not be tolerated. The disposal of waste shall comply with current guidelines with a view to protecting the environment.

In principle, no waste will be generated. No significant impact is anticipated on biological resources or human activities as long as the contractor complies with current regulations governing waste management.

6. Accidents and Malfunctions

Potential accidents or malfunctions under the waterway maintenance dredging project relate mainly to the risk of toxic spills associated with the presence of the dredging equipment in the St. Lawrence River. All measures shall be taken to minimize the risk of a toxic spill into the water.

In the event of an equipment malfunction or a spill, emergency measures shall be followed to control the situation and, where applicable, the malfunction shall be repaired immediately. The affected zone contaminated by the toxicants shall be subject to containment measures and cleaned up, and the contaminated material shall be removed and taken to an authorized site by a specialized service provider.

Incidents shall be reported to the CCG alert network (1-800-363-4735), the Environment and Climate Change Canada emergencies centre (1-866-28-2333), the MDDELCC (1-866-694-5454) and the site supervisor.

7. Mitigation Measures

The project as proposed, involving the open-water dumping of sediments, has very limited impact overall. Additionally, in light of monitoring results from 1996 and 1997 under the monitoring program for selective dredging of shoals in the waterway between Montréal and Cap-à-la-Roche and subsequent annual follow-up to characterize the sediments, no specific mitigation measures are proposed.

7.1 Preventive Actions

The following preventive actions will be taken nevertheless to prevent any potential impact:

- The work will be performed outside of periods deemed vulnerable for wildlife.
- The contractor will be required to use an accurate positioning system such as DGPS or DGPS-OTF to ensure that the areas dredged are limited to those set out in the specifications and that the sediments are released at the intended sites.
- Notices to shipping will be issued to inform mariners of the presence of dredges in the waterway.
- CCG MCTS will also coordinate and manage maritime traffic while dredging work is going on.
- The contractors will ensure that the dredging equipment used is in good operating condition to minimize leaks and the risk of malfunctions potentially leading to a spill. It is also recommended that contractors ensure that their equipment is clean free of invasive species and such.
- Machinery shall be washed, serviced and refuelled in such a way as to prevent any deleterious substances from entering the water.
- Toxicants shall be handled with care, stored following precautions and disposed of appropriately to prevent spills into the water.

- The contractor shall identify the risks of spills of toxic substances to be used or stored for the duration of the work. It shall have preventive and safety measures in place as well as a contingency plan to be implemented in the event of a spill. An emergency kit shall be available onboard at all times during the work.
- With respect to the concerns of certain riparian landowners in Champlain in relation to possible nuisance associated with temporary nearshore anchorage of related equipment used for purposes such as housing work crews (this issue potentially occurring on occasion when the work is performed using a clamshell dredge), the CCG will continue its efforts to raise contractor awareness about this issue by holding a meeting before the start of work. Steps shall be taken where appropriate to reduce and minimize, wherever possible, any noise or nuisance caused by related equipment (tugboat displacement, presence of floating structures used to accommodate workers, light emissions directed at the shore, use of generators on the shore side of structures) as recommended in the study commissioned by the CCG, the final report on which was submitted by CJB Environment in 2007. Upon request, the CCG will also keep residents informed concerning any changes in the work or measures implemented to improve conditions.
- Since the sturgeon commercial fishery at Saint-Pierre-les-Becquets opens around June 14 each year, the portion of the work in the Bécancour-to-Batiscan area should ideally be completed before that date or, if necessary, stopped for the first few days of fishing. In Lake Saint-Pierre, the dredging work should not disrupt the fall sturgeon fishery starting around September 14, as dredging typically begins there after that date.
- The data in the St. Lawrence Dredging Activities Planning Registry (http://planstlaurent.qc.ca/en/uses/dredging_activities.html) will be regularly updated so that the public can know in advance about upcoming projects and any concerns can be brought to the direct attention of proponents and regulatory agencies early in the planning process. This registry is a primary source of information for interest groups and the general public.

7.2 Fish Habitat Compensation (Lake Saint-Pierre)

In the event that disposal site S-17 is used during hourly dredging work or dredging by the cubic metre, the Department has determined that due to deterioration of the fish habitat in the Lake Saint-Pierre area, the project should require authorization under subsection 35(2) of the *Fisheries Act* administered by the FPD. The issue of authorizations under subsection 35(2) is subject to approval of a compensation project by the FPD.

The CCG therefore agrees to continue the compensation project where applicable to offset habitat losses incurred at disposal site S-17 due to the release of any dredged sediments at that site.

It should be noted that in 2006, the FHMB (since replaced by the FPD) approved the proposal submitted by the CCG enabling recourse to a compensation approach via a habitat bank for the disruption of fish habitat at disposal site S-17 in relation to annual maintenance dredging of the St. Lawrence Waterway in the Lake Saint-Pierre area (banking). This approach will provide for banking of preapproved compensation projects for potential future releases, thereby avoiding the challenges of obtaining FPD approval of projects within the very short time frame between submission of the environmental effects assessment report and the start of the work as such, as well as ensuring the availability of offsetting projects prior to issuing authorizations under the *Fisheries Act* and creating the necessary flexibility in response to variations in the volume of

sediments released at site S-17 from year to year. For operational purposes, the CCG agrees to generate an annual report setting out the anticipated dredged sediment volumes, the actual volumes released at site S-17, the amounts allocated to compensation, any work already performed, etc. This information will be updated continuously and reviewed on a regular basis by the FPD.

An agreement was finalized between the CCG and the ZIP Committee of Lake Saint-Pierre on October 27, 2009. This agreement, which is still in force, grants a credit for the dumping of 39,000 m^3 of sediments at disposal site S-17 in Lake Saint-Pierre starting in 2010. In exchange, the CCG will continue the compensation project involving the restoration of two branches of Désy-Sylvestre Creek in the municipality of Saint-Cuthbert bordering on Lake Saint-Pierre.

8. Residual and Cumulative Impacts

8.1 Residual Project Impacts

Following implementation of the measures set out in the work plan and the mitigation measures mentioned previously, the residual impact on the environment of the project for annual maintenance dredging between Montréal and Cap Gribane and open-water dumping at the various approved sites (M02, M-27, S-17, T-02, T-06, T-11, T-16, X-04, X-02 and X-03) will be very minor and temporary.

It is understood that if disposal site S-17 is used in relation to the dredging work, and due to the anticipated impact on fish habitat, the CCG will continue the compensation project initiated for the purpose of upholding the principle of no net loss of fish habitat.

8.2 Cumulative Impacts

Human activities can cause environmental changes that, in combination with other (present, past or future) human actions, may interact and trigger changes of varying degrees of importance. These changes observed are called cumulative impacts.

The only impacts likely to combine with the effects of the project or other ongoing or previous activities relate mainly to disruptions affecting water quality, aquatic habitat and, indirectly, aquatic wildlife.

Changes to water quality resulting from the project combine with other changes associated with spills from multiple anthropogenic and natural sources. The project impacts are also likely to combine with the effects of other dredging work carried out locally. However, it should be noted that the dredging work in the St. Lawrence River is done relatively infrequently and involves only very low volumes. It should also be noted that the volumes dredged under the present project are not significant and are made up of coarse sediments that, as discussed previously, will have little effect on water quality either through dredging or disposal. Overall, the relative contribution of maintenance dredging to water quality is negligible. Moreover, the anticipated work will not introduce any new materials into the St. Lawrence River and will simply displace sediments that are already part of the aquatic environment.

In addition to maintaining the CCG's follow-up program concerning the physicochemical quality of the sediments to be dredged and changes in bathymetry, regular consultations are held with the departments involved and with users of the St. Lawrence River as part of implementation of the St. Lawrence Action Plan (SLAP). The mandate of the SLAP Working Group on the Integrated Management of Dredging and Sediments includes ensuring adequate protection of ecosystems and public health while also supporting the development of navigation in the St. Lawrence (SLAP, 2014).

9. Environmental Monitoring and Follow-Up Program

9.1 Environmental Monitoring Program

To ensure that the dredged sediments are released at the disposal sites designated for that purpose, the CCG will monitor the work using an electronic monitoring system linked to Marine Communications & Traffic Services via the AIS system, which will allow CCG representatives to continuously (24 h/day, 7 days/week) monitor dredge movements, including travel to the various disposal sites.

The CCG will also implement a program to monitor completed work through use of bathymetric surveys in dredging areas before and after the work followed by regular surveys of disposal sites.

9.2 Environmental Follow-Up Program

9.2.1 Previous follow-up

A major environmental follow-up program on water quality was implemented in 1996 (Les Consultants Jacques Bérubé inc., 1997a/b). Based on its outcomes, which indicated that the work had no impact on water quality, repeated implementation of this environmental follow-up program is not planned.

Meanwhile, studies to evaluate various options for the disposal and/or reuse of dredged sediments from the viewpoint of sustainable development as well as a study on sediment dynamics in the estuarine transition zone have been carried out by the FHMB and the CCG in relation to disposal site X-01 (Île Madame), which has not been used since 2009, and sites X-02 and X03.

9.2.2 Monitoring of dredging areas

The CCG has an annual follow-up program in place in the dredging areas that involves the use of bathymetric surveys. These surveys are conducted in the spring after the break-up, in the summer before and after dredging and, finally, in the fall to check the condition of the channel before the arrival of winter.

Samples are collected every year to confirm the physicochemical quality of the sand to be dredged to determine its compatibility with the disposal sites. Following analysis of the physicochemical properties of the samples of sediments to be dredged, their environmental quality can be determined. The sediment sampling protocol and the outcomes of these follow-up actions are detailed in separate reports.

The criteria followed for determining the sediment management approach are the *Criteria for Evaluating Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation* (EC and MDDEP, 2007) specially developed for sediments in the Laurentian Channel. Criteria have been adopted independently for fresh water and salt water in the St. Lawrence River. For brackish water, according to this document, the more restrictive of each parameter from the criteria for fresh water and salt water shall be applicable. This is the approach followed under the present characterization study since, as specified in this document, the brackish zone is considered to start at the eastern tip of Île d'Orléans and end at Île aux Coudres.

The management framework is the management of sediments resulting from dredging within the meaning of the quality criteria; therefore the threshold values used to determine the sediment management approach shall be the occasional effect level (OEL) and frequent effect level (FEL) in accordance with the following contamination classes:

Class 1: If the concentrations of all analyzed substances are below the OEL, then the probability of detecting harmful biological effects is relatively low. The sediments may be submerged in open water or used for other purposes as long as their release does not deteriorate the receiving environment.

Class 2: If the concentrations of one or more analyzed substances exceed the OEL but falls below the FEL, the probability of detecting harmful biological effects is relatively high. The discharge of dredged materials in open water may be considered a valid option only if appropriate toxicity tests demonstrate that the sediments are harmless to the receiving environment. The release of these sediments in open water also must not contribute to deterioration of the receiving environment. Characterization of the receiving site is then required.

Class 3: If the concentrations of one or more analyzed substances exceed the FEL, the probability of measuring harmful biological effects is very high. Discharge in open water is prohibited. The sediments must instead be either treated or safely contained.

The reader is invited to consult the follow-up information for each dredging area in this report, which will be issued following the three sediment sampling campaigns to be conducted in 2016, 2017 and 2018 in the various sections of the waterway, thereby confirming the management approach for the dredged sediments.

Follow-up bathymetric surveys are also conducted regularly at the open-water disposal sites to track sediment deposition patterns and/or site changes.

9.2.3 Follow-up of compensation project

In relation to use of disposal site S-17, the compensation project applicable to Désy-Sylvestre Creek in the municipality of Saint-Cuthbert bordering on Lake Saint-Pierre was recently completed and approved by the FPD on February 16, 2016. No other follow-up activities are planned for this project.

10. Conclusion

Since establishment of the portion of the St. Lawrence Waterway between Montréal and Île-aux-Coudres (350 km), dredging activities intended to maintain the effectiveness and safety of commercial shipping have been carried out on a regular basis by the CCG for the benefit of the shipping industry and ports on the St. Lawrence. Maintenance dredging of this portion of the St. Lawrence Waterway is a recurring annual activity carried out to clear the sediments (consisting mainly of sand) that form shoals posing a risk to navigation in certain sections (distributed over 210 km of artificial channel) of the waterway at different times of the year. Some areas (over a 40 km stretch) in these sections are subject to relatively more significant annual maintenance dredging due to their inherent hydrodynamic and sedimentary conditions. The remaining 170 km of this portion of the waterway are a natural channel that does not typically require any form of maintenance.

As a federal authority, the CCG has produced an environmental effects assessment, valid for the 2016-2018 period, and will perform work to characterize the dredged sediments and the disposal sites and document the work in annual monitoring reports used to validate conclusions as to the insignificant effects of each proposed project.

All work will be carried out using clamshell and trailing suction hopper dredges. Use of the latter dredge type will be required for work in Traverse du Nord, while dredging of the scattered shoals in designated areas at Deschaillons will have to be done with a clamshell dredge held in place by spuds (for reasons of safety and efficiency).

The management approach adopted for execution of the waterway maintenance dredging project in 2016-2018 is open-water dumping with recurring use of existing sites. In addition to appearing acceptable in terms of environmental effects, this management approach is economically the most advantageous for the CCG at this time and also complies with the recommendations prescribed by Environment Canada and the MDDEP (2007) in the *Criteria for Evaluating Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation*.

The upland disposal option, meanwhile, is currently under study by the CCG but has not been designated as a management approach for the 2016-2018 period due primarily to the existence of a dredging contract providing strictly for the open-water dumping of sediments. Other potential management approaches, such as restoration, capping, wildlife habitat restoration or creation, and upland containment, are associated with too many technical, economic and environmental constraints to allow for their consideration from the perspective of sustainable development.

For a number of years, the physicochemical characteristics of the dredged sediments have been virtually identical year over year. The chemical quality of existing sediments at the disposal sites is generally comparable to that of the sediments that will be deposited there. With respect to their physical nature, the sediments deposited at the sites will likely be similar in particle size to existing sediments at these sites. The overall impact will be minor, highly localized and temporary.

Overall, it appears that the annual maintenance dredging program proposed herein will be implemented in compliance with the recommendations set out in the various documents prepared over recent years by Environment Canada and the MDDEP (today called Environment and Climate Change Canada and MDDELCC respectively). This compliance extends to all major aspects of a

dredging project, including sediment characterization and classification, selection of disposal sites in consultation with local users, choice of management approaches for the dredged sediments and the actual execution of the dredging and disposal operations. Additionally, in the event that work is performed in the Lake Saint-Pierre area and disposal site S-17 is used, compensation measures to offset any habitat loss at that site will be adopted and implemented.

The effects of the proposed project will not be significant and will be offset through implementation of appropriate mitigation and compensation measures where applicable, compliance with current laws and regulations and implementation of a work monitoring and supervision program.

In light of these findings, the Department of Fisheries and Oceans Canada – Canadian Coast Guard concludes that implementation of this project is not likely to generate any significant adverse environmental effects subsequent to implementation of mitigation and compensation measures where necessary and of a monitoring program. As a result, no additional action appears necessary under the federal environmental assessment and review process.

Source	Target
Figure 3-1	Figure 3-1
Qualité de l'eau du fleuve Saint-Laurent Médiane estivale 2012-2014 Kilomètres Qualité de l'eau sur la base de l'indice de qualité bactériologique et physicochimique Bonne Satisfaisante Douteuse Mauvaise Très mauvaise Source: -Échantillonnage : BQMA, MODELCC 2013-2014 - Orthophotos : Imagerie de base, Esri Réalisation : GHD N/Réf.: J020214 – E1 Décembre 2106 Système de référence géodésique : North American Datum 1963	Water Quality in the St. Lawrence River Summer median 2012-2014 Kilometres Water quality based on bacteriological and physicochemical quality index Good Satisfactory Questionable Poor Very poor Source: - Sampling: BQMA, MDDELCC 2013-2014 - Orthophotos: Baseline imagery, ESRI Produced by: GHD Ref.: J020214 – E1 December 2016 Geodetic reference system: North American Datum 1963
Figure 3-2	Figure 3-2
Fosse naturelle Littoral Talus Chenal	Natural ditch Shore Slope Channel
Figure 4-1	Figure 4-1
POINT DE REJET ZONE DE REJET MATÉRIEL DENSE COURANT LIMITE DU SITE DE MISE EN DÉPÔT MATÉRIEL TRES PEU DENSE EFFET RELIÉ À LA PRÉSENCE D'UNE STRATIFICATION THERMIQUE OU À UN GRADIENT DE DENSITÉ COURANT DE DENSITÉ	DEPOSIT POINT DEPOSIT ZONE DENSE MATERIAL CURRENT DISPOSAL SITE BOUNDARY VERY LIGHT MATERIAL EFFECT ASSOCIATED WITH THERMAL STRATIFICATION OR DENSITY GRADIENT DENSITY CURRENT

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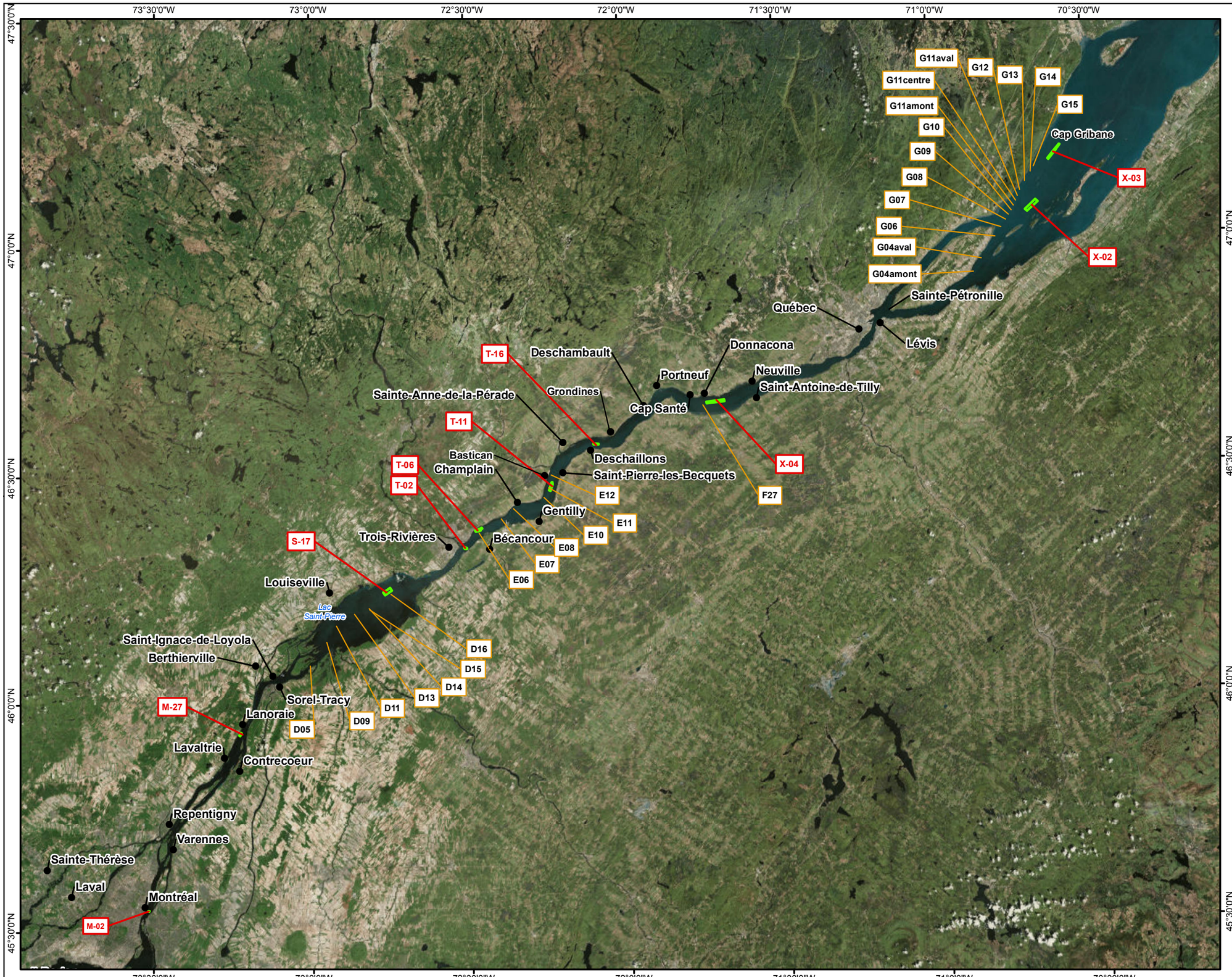
gilbert.rondeau@mffp.gouv.qc.ca

Appendices

Appendix A
Overview of Dredging Areas and Disposal Sites

Vue d'ensemble sur les aires de dragage et les sites de mise en dépôt

Dragage d'entretien annuel de la voie navigable du Saint-Laurent (années 2016 à 2018) De Montréal à Cap Gribane



1: 900 000

0 10 20 Kilomètres

Secteur susceptible d'être dragué

Site de mise en dépôt

Source :
- *Secteurs et sites de mise en dépôt : MPO*
- *Orthophotos : Imagerie de base, Esri*

Réalisation : GHD
Janvier 2016

N/Réf. : J020214 – E1

Système de référence géodésique : North American Datum 1983

Projection : Mercator transverse modifiée zone 8

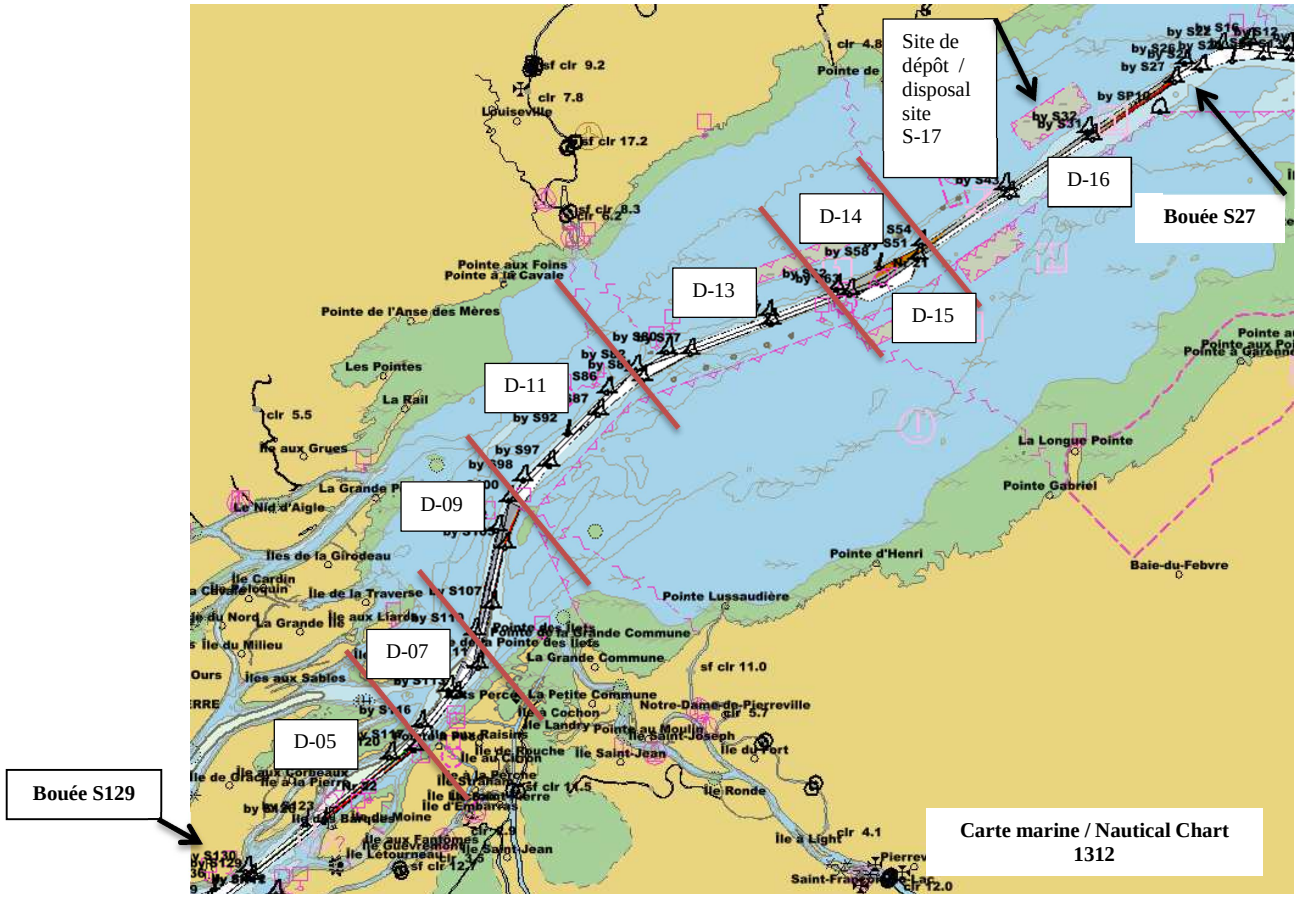
Annexe A

Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Lac Saint-Pierre

Localisation des secteurs et site de dépôt / Sectors and disposal site



Secteurs à draguer et site de dépôt / dredged sectors and disposal site

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

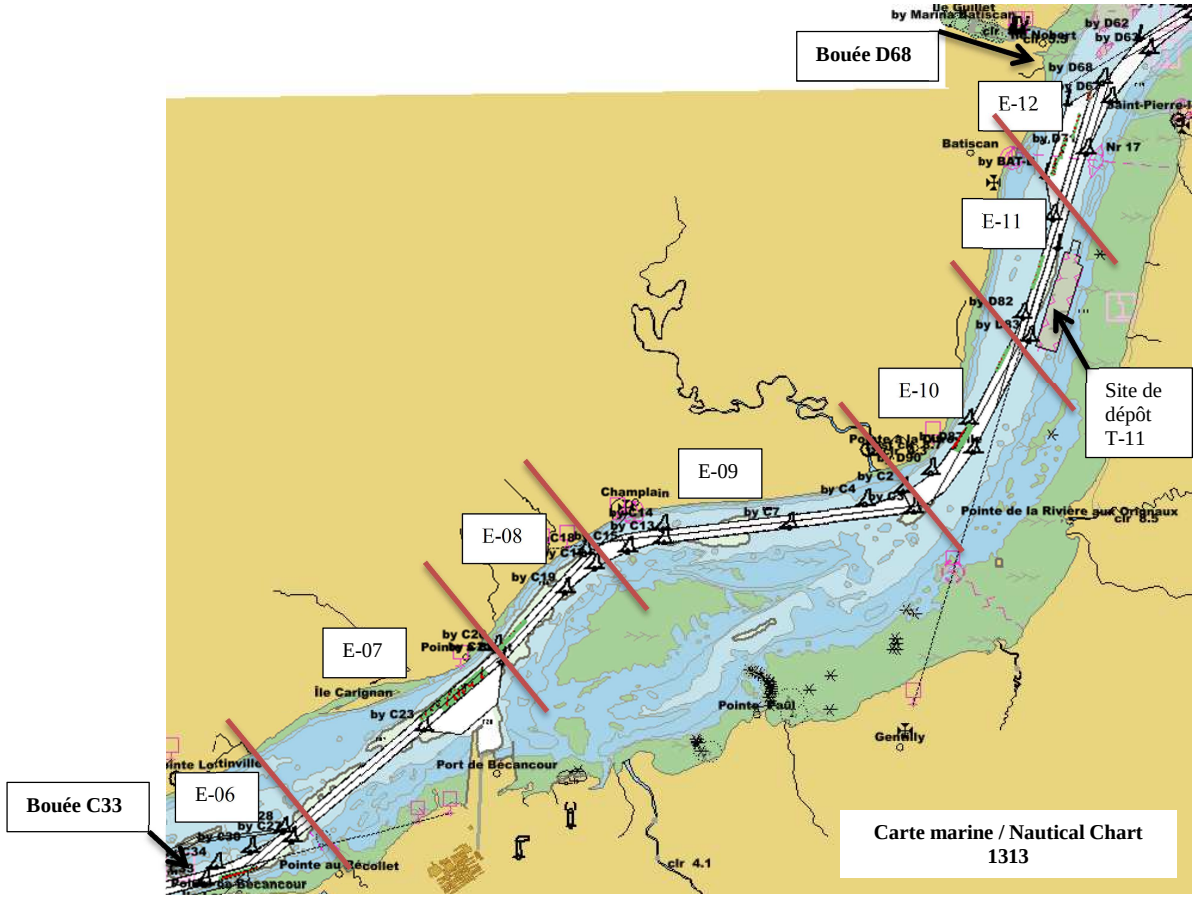
Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Bécancour à Batiscan

Localisation des secteurs et site de dépôt / Sectors and disposal site



Secteurs à draguer et site de dépôt / dredged sectors and disposal site

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

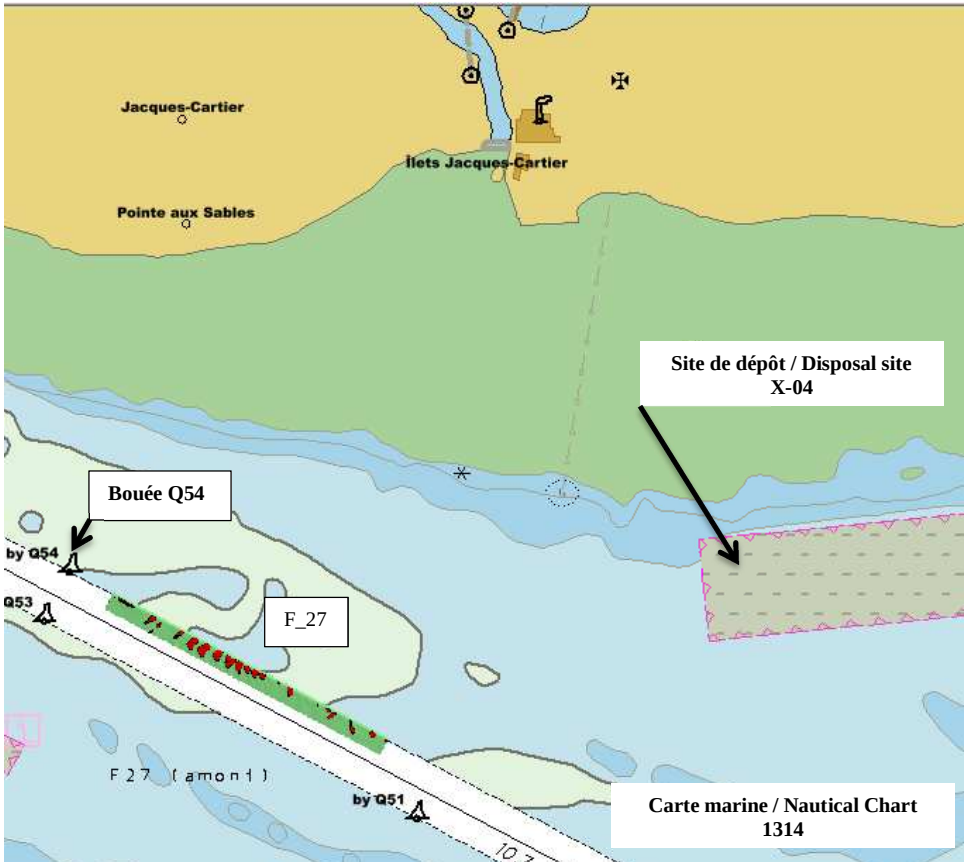
Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse Cap-Santé

Localisation des secteurs et site de dépôt / Sectors and disposal site



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

Secteur à draguer et site de dépôt /
Dredged sector and disposal site

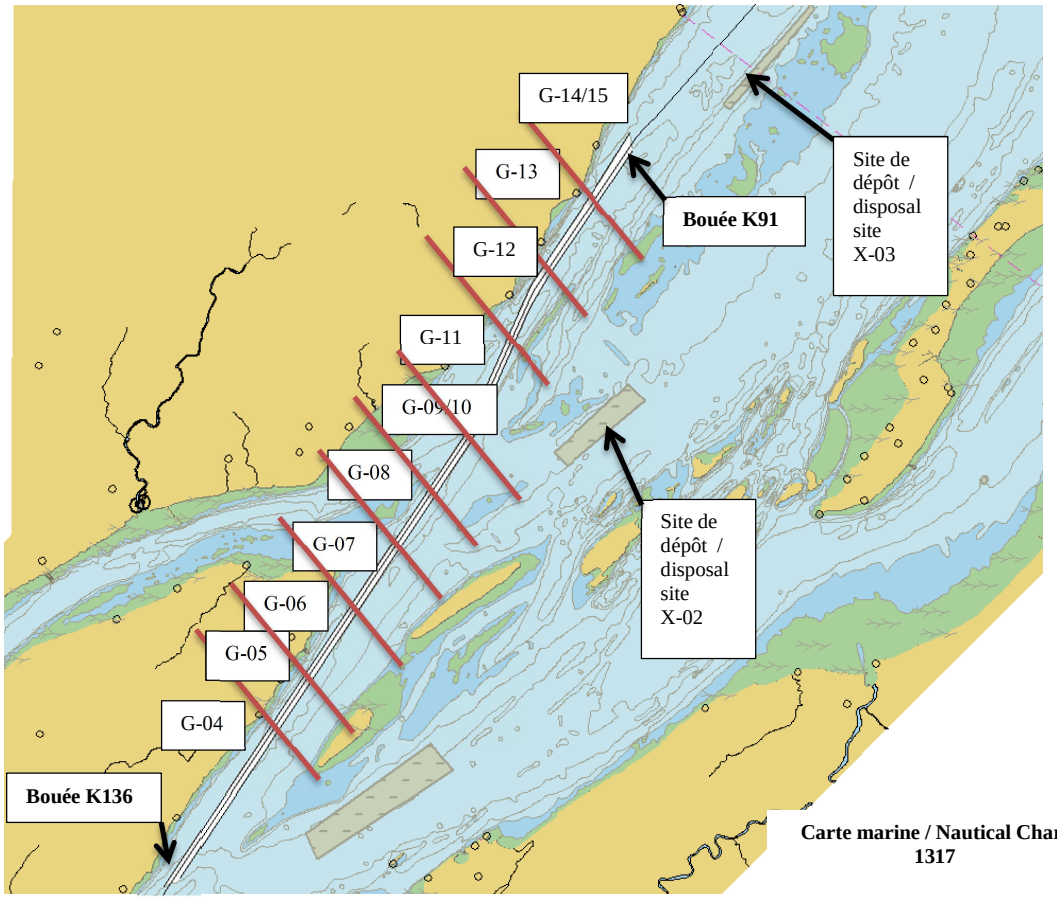
Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Localisation des secteurs et sites de dépôt / Sectors and disposal sites



Carte marine / Nautical Chart 1317

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

Secteurs à draguer et sites de dépôt / dredged sectors and disposal sites

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

Appendix B
Dredging Areas in Lake Saint-Pierre, between Bécancour and Batiscan, in Traverse Cap-Santé and in Traverse du Nord

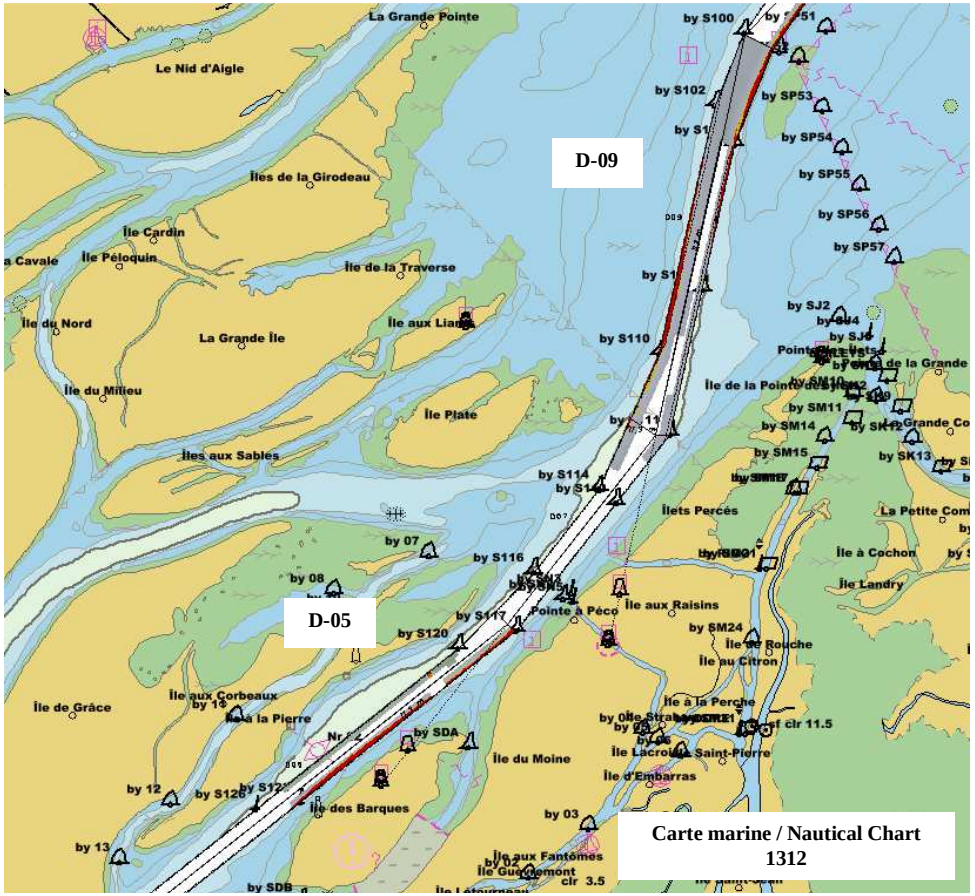
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Lac Saint-Pierre

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



D-05,09 Secteurs à draguer / dredged sectors

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

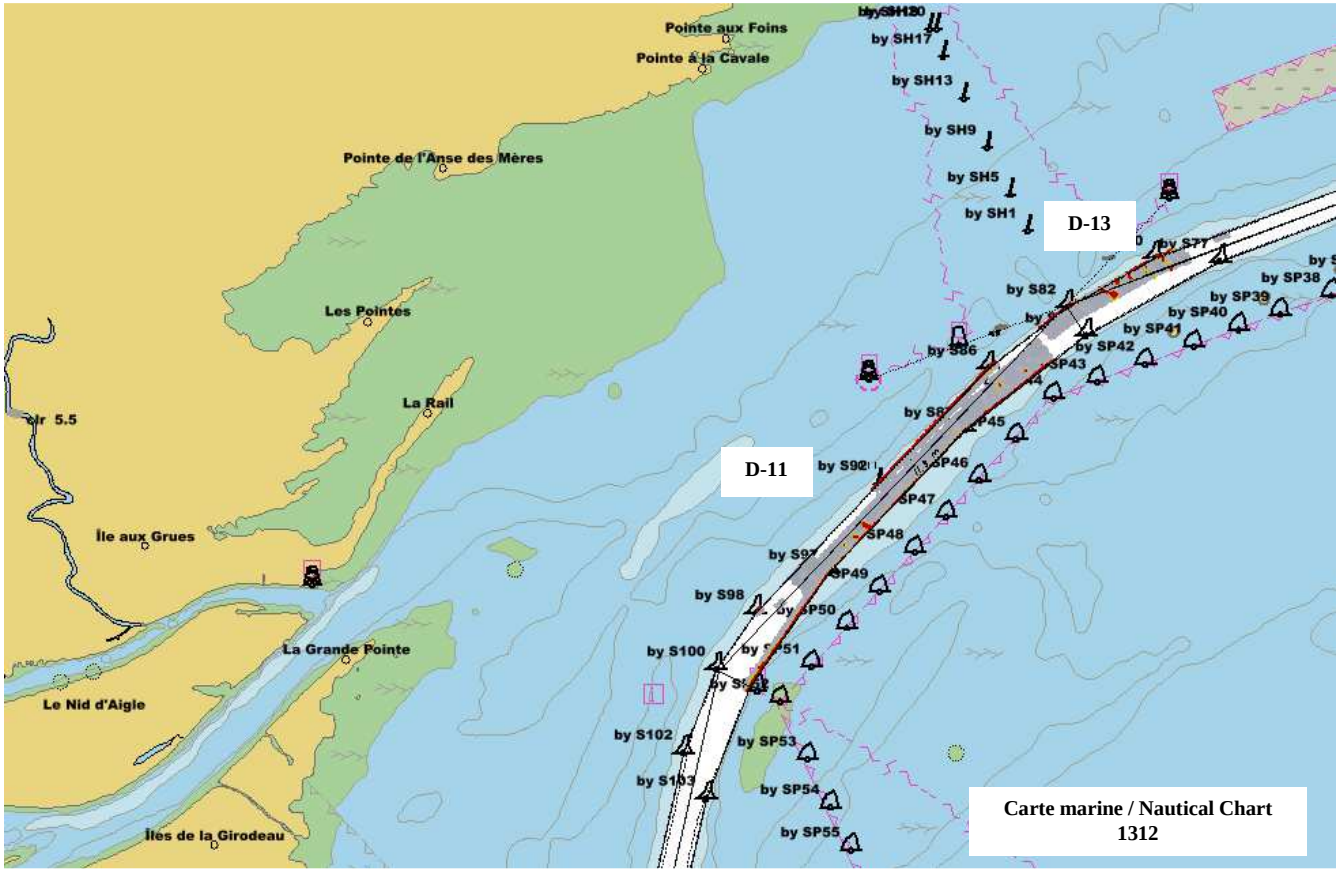
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Lac Saint-Pierre

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



D-11,13 Secteurs à draguer / dredged sectors

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

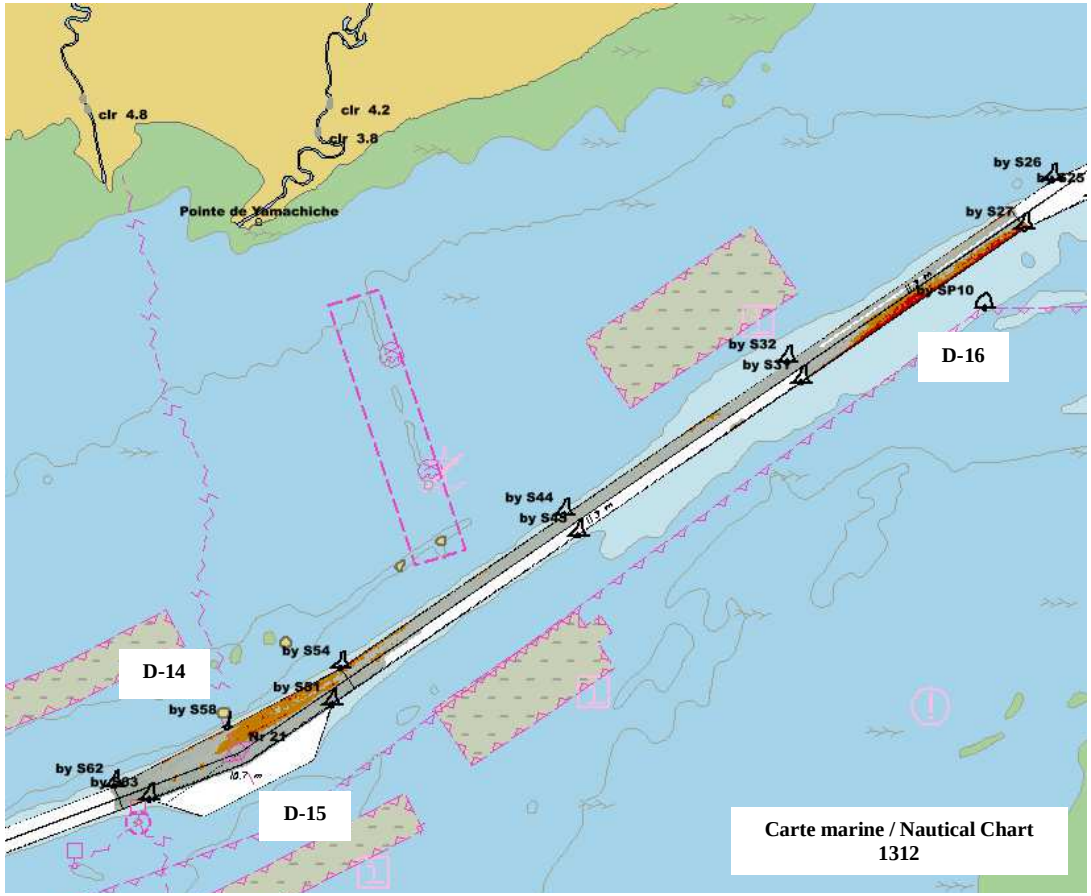
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Lac Saint-Pierre

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

D-14,15,16 Secteurs à draguer / dredged sectors

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

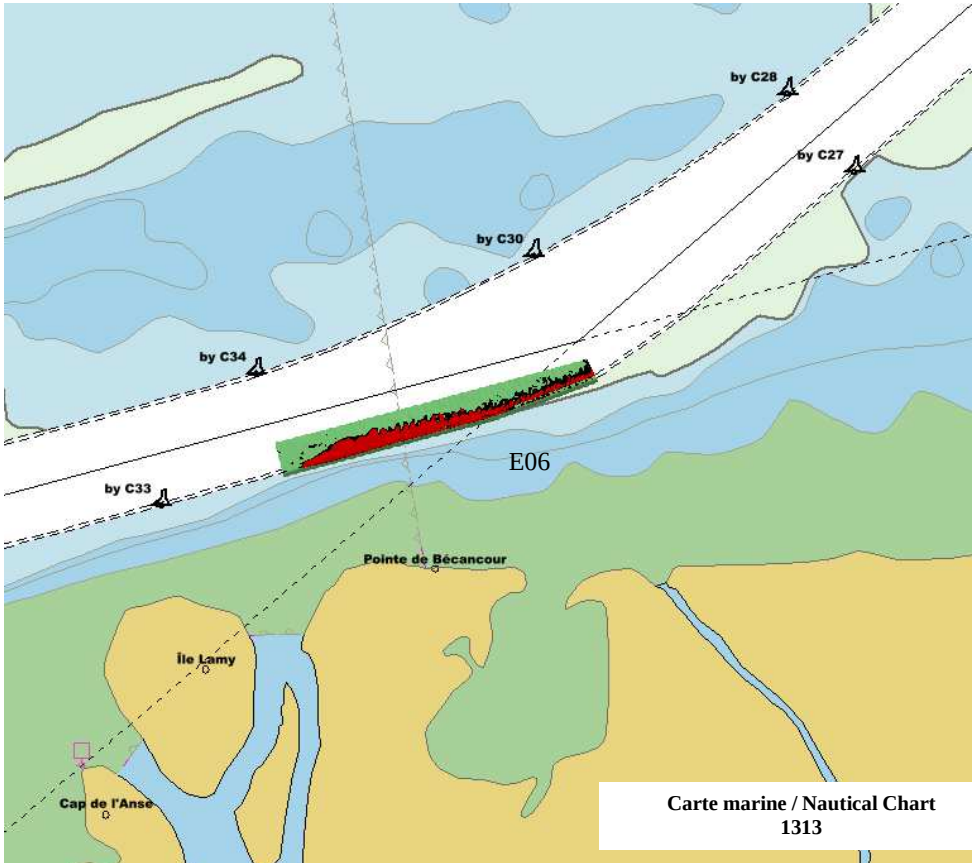
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Bécancour à Batiscan

Année / Year 2014 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

E-06 Secteur à draguer / dredged sector

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

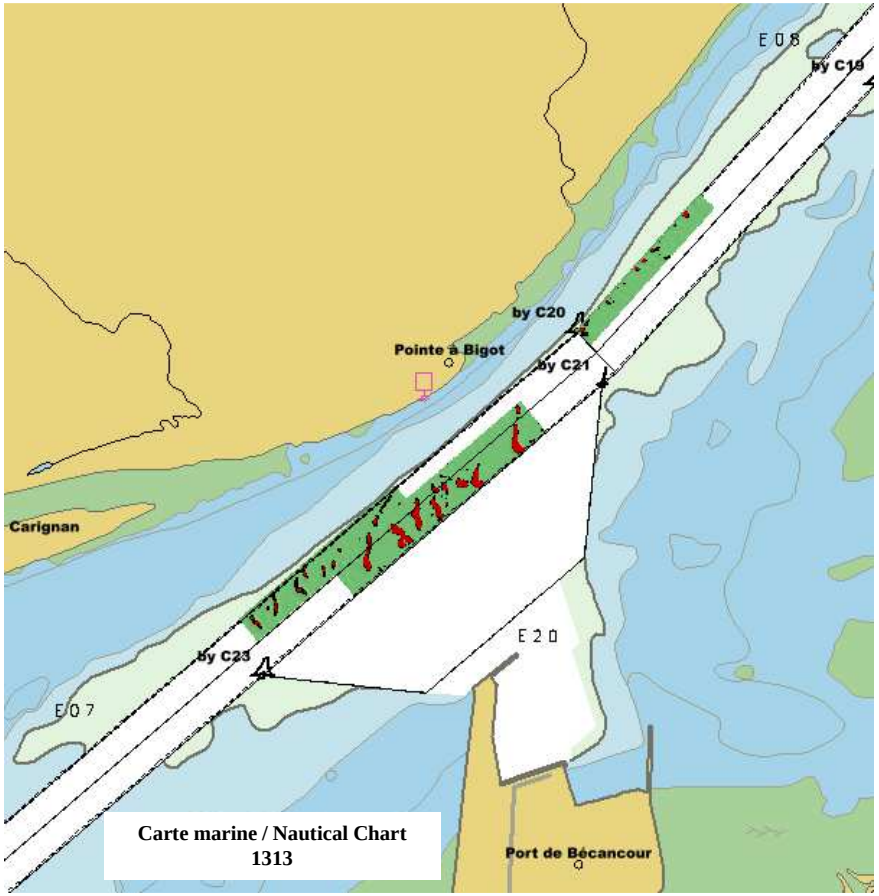
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Bécancour à Batiscan

Année / Year 2014 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

E-07,08 Secteurs à draguer / dredged sectors

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

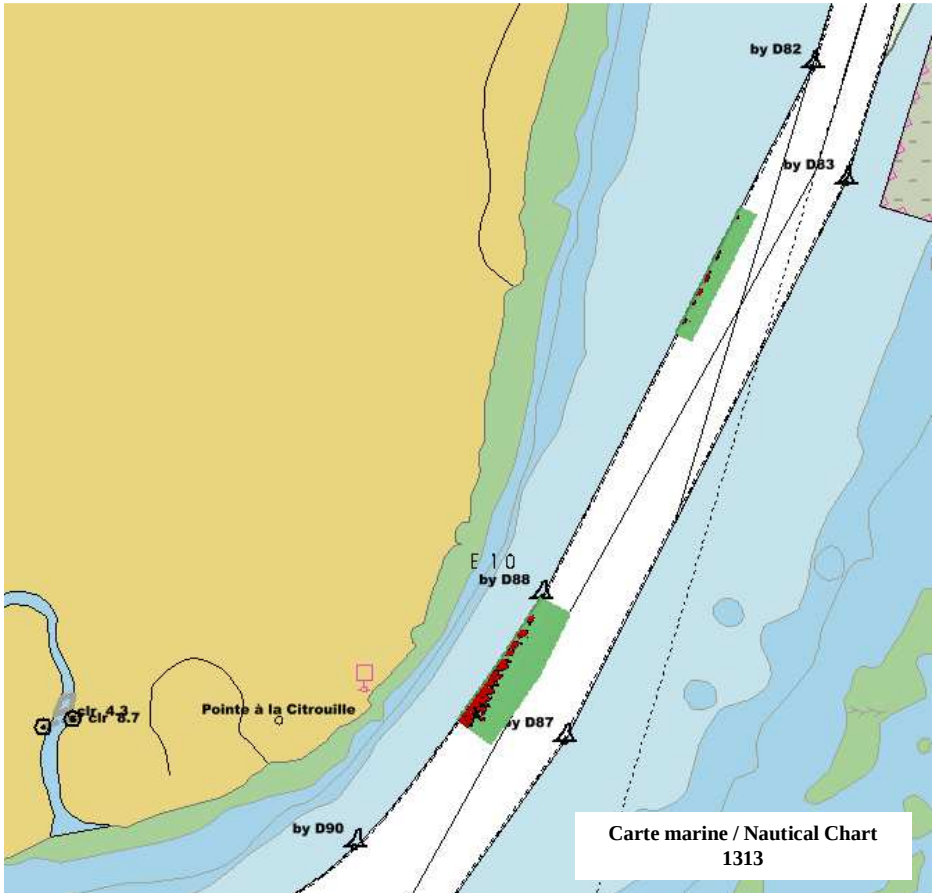
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Bécancour à Batiscan

Année / Year 2014 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

E-10 Secteur à draguer / dredged sector

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

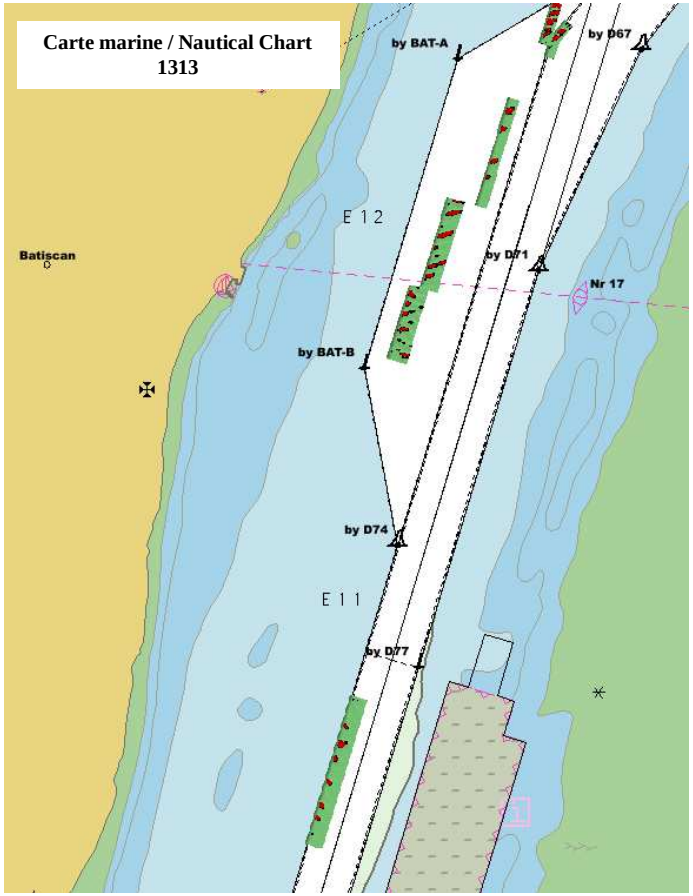
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Bécancour à Batiscan

Année / Year 2014 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

E-11,12 Secteurs à draguer / dredged sectors

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

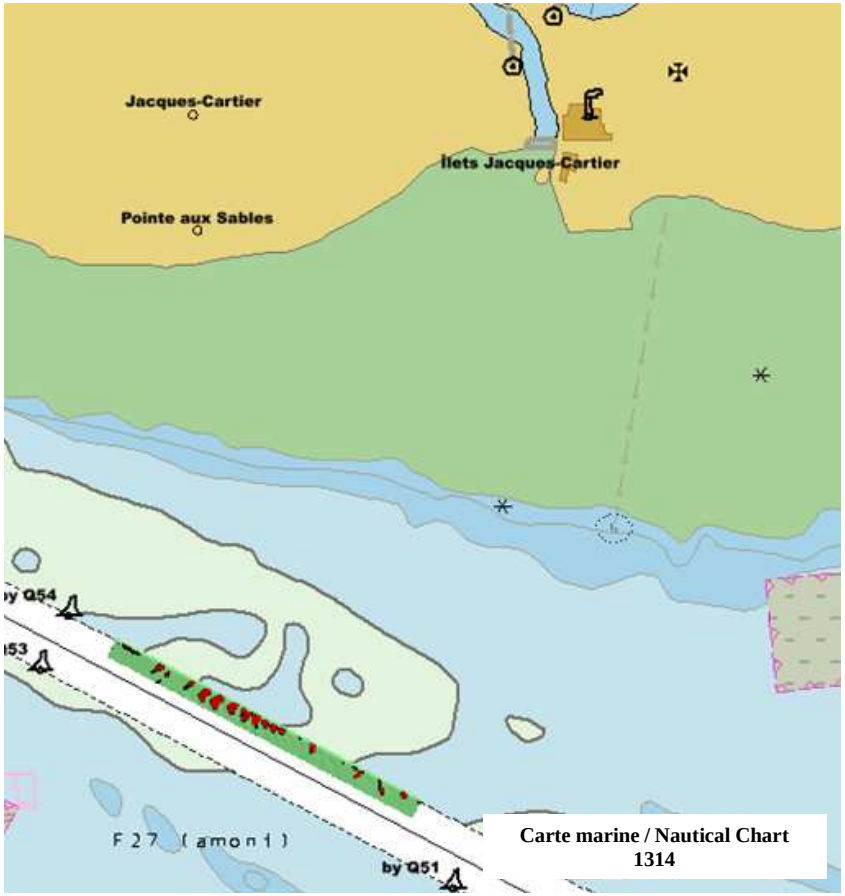
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse Cap-Santé

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Carte marine / Nautical Chart 1314

F-27 Secteur à draguer / Dredged sector

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

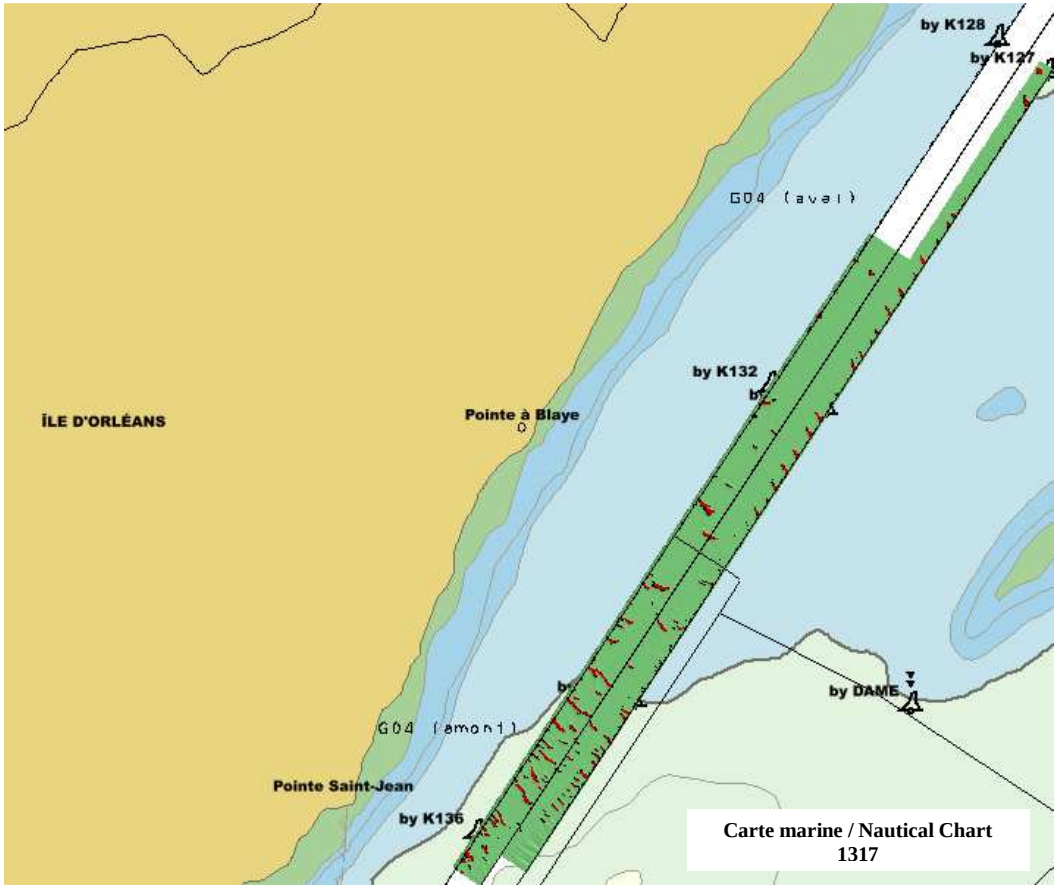
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

G-04 Secteur à draguer / dredged sector

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

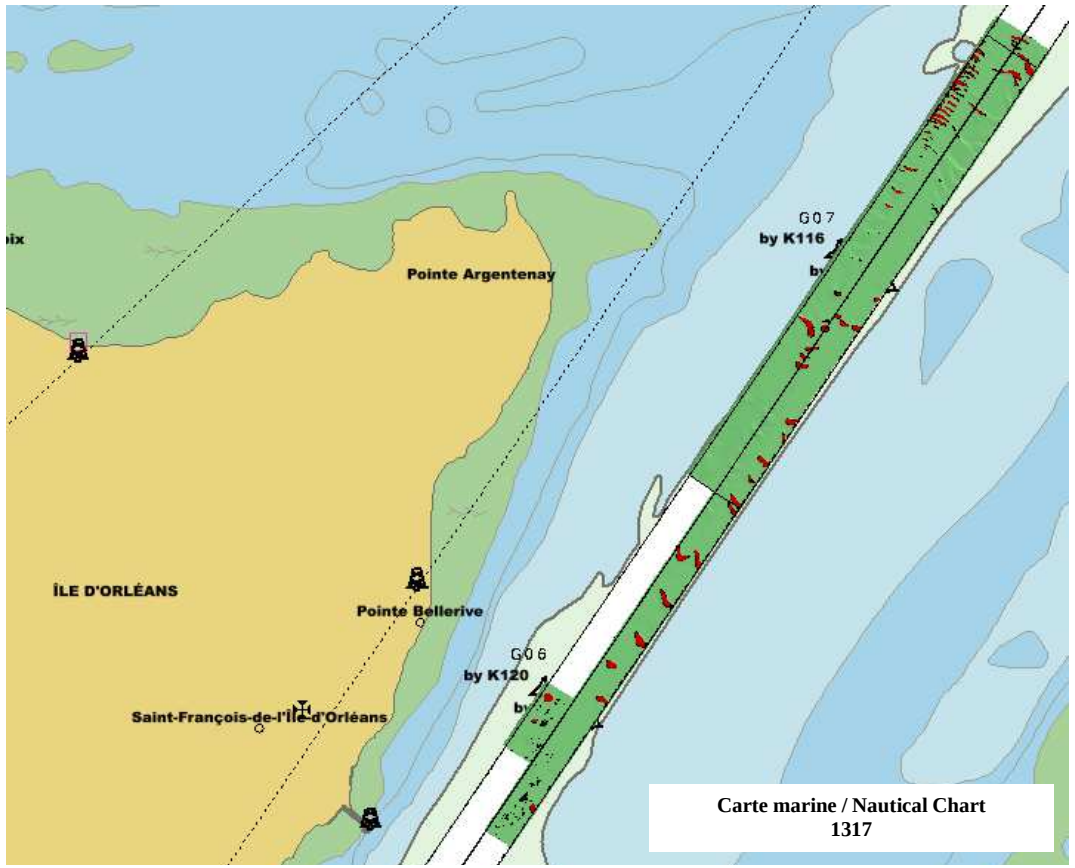
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

G-06,07 Secteurs à draguer / dredged sectors

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

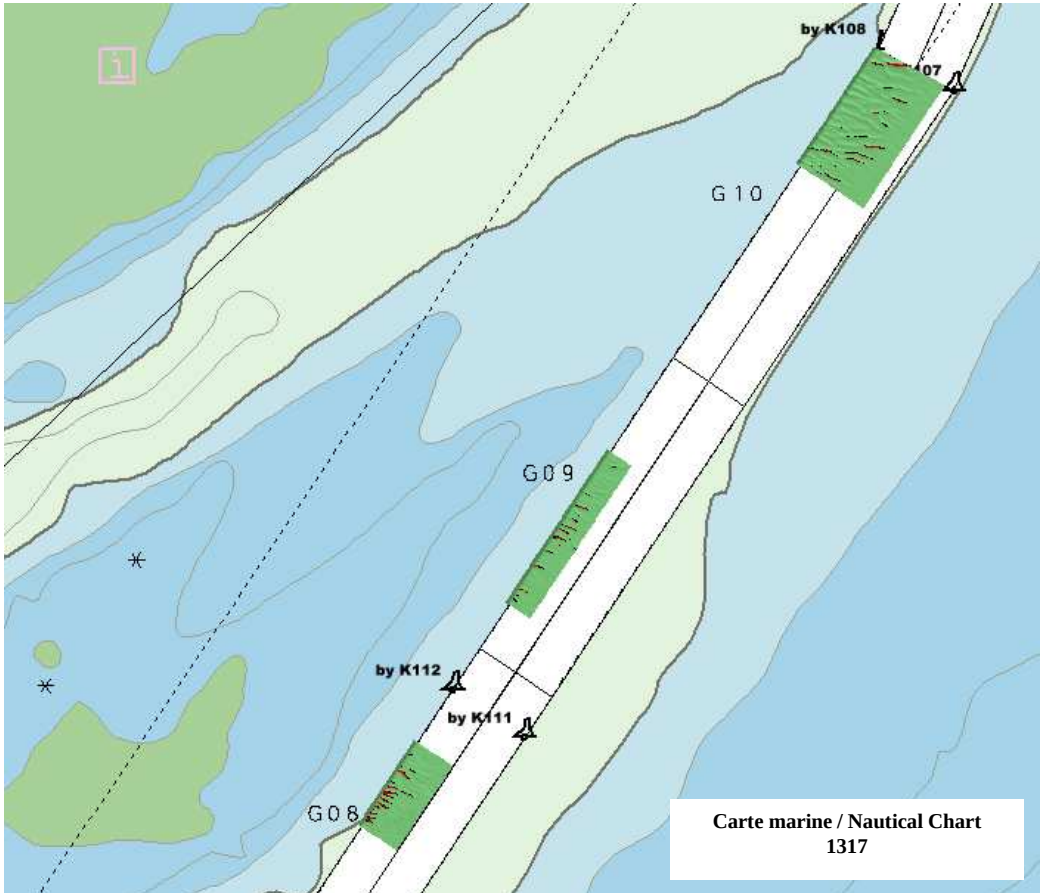
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Année / Year 2014 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

G-08,09,10 Secteurs à draguer / dredged sectors

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

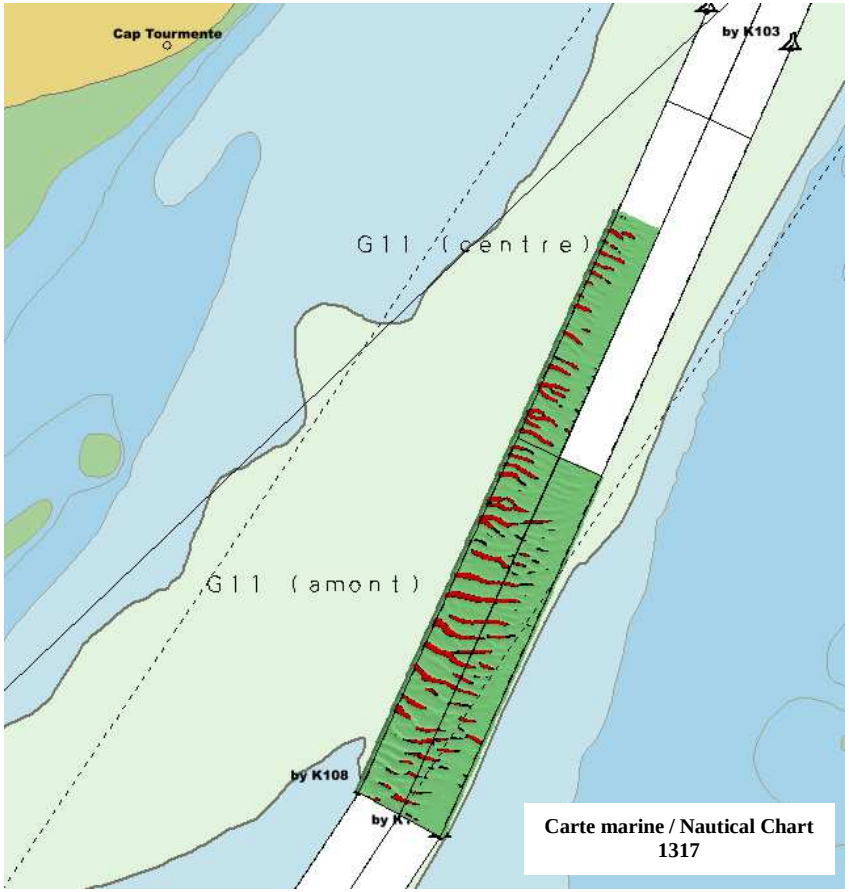
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

G-11 Secteur à draguer / dredged sector

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

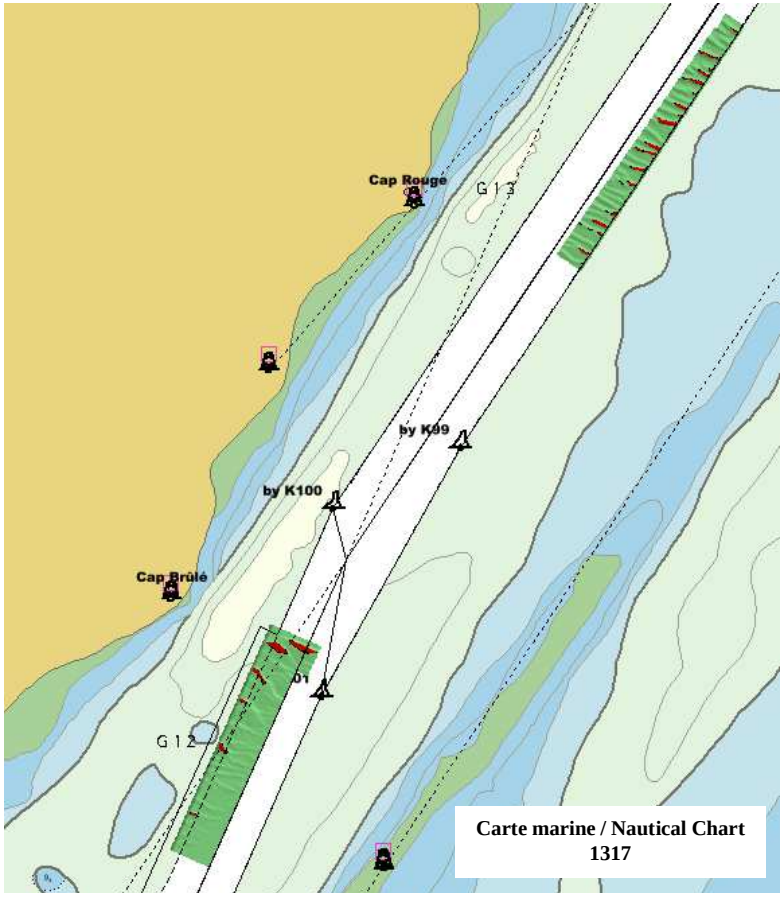
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

G-12,13 Secteurs à draguer / dredged sectors

Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

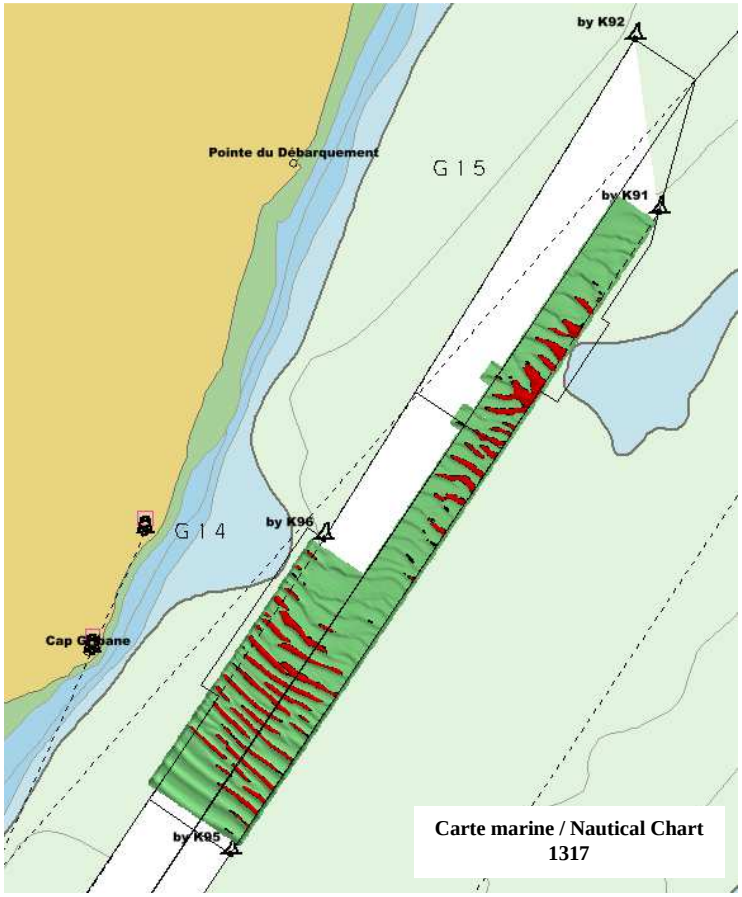
Voie navigable du St-Laurent / St-Laurent Waterway

Programme d'entretien annuel / Annual Maintenance Program

Traverse du Nord

Année / Year 2015 (exemple/example)

Endroit approximatif des sédiments à draguer au m³ / Approximate location of dredged sediments at m³



G-14,15 Secteurs à draguer / dredged sectors

Pêches et Océans Canada, Garde côtière
Région du Centre et de l'Arctique
Programme GCC
Gestion des voies navigables

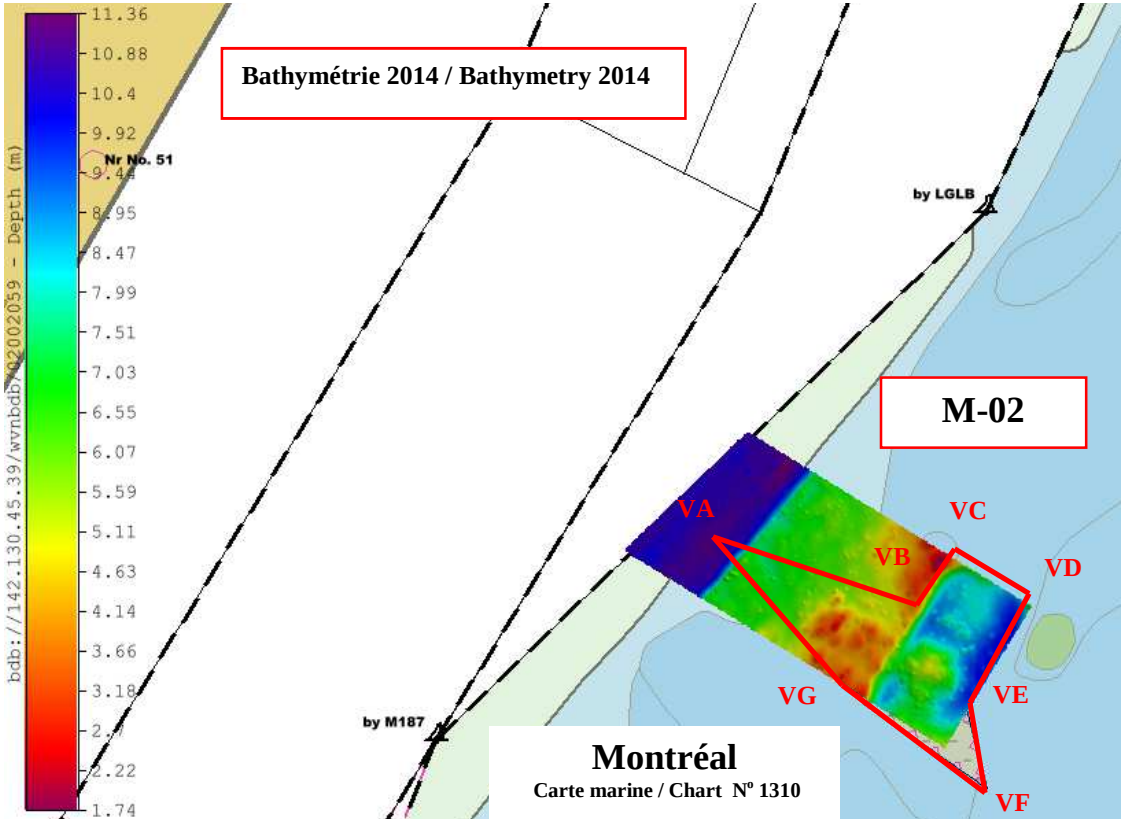
Fisheries and Oceans Canada,
Coast Coast Guard
Central and Arctic Region
CCG Programs
Waterways Management

Appendix C
Location and Bathymetry of Disposal Sites

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : M-02 (Vickers)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)	
N°	X	Y
VA	303 423	5 045 482
VB	303 587	5 045 425
VC	303 618	5 045 474
VD	303 677	5 045 438
VE	303 626	5 045 354
VF	303 645	5 045 280
VG	303 537	5 045 355

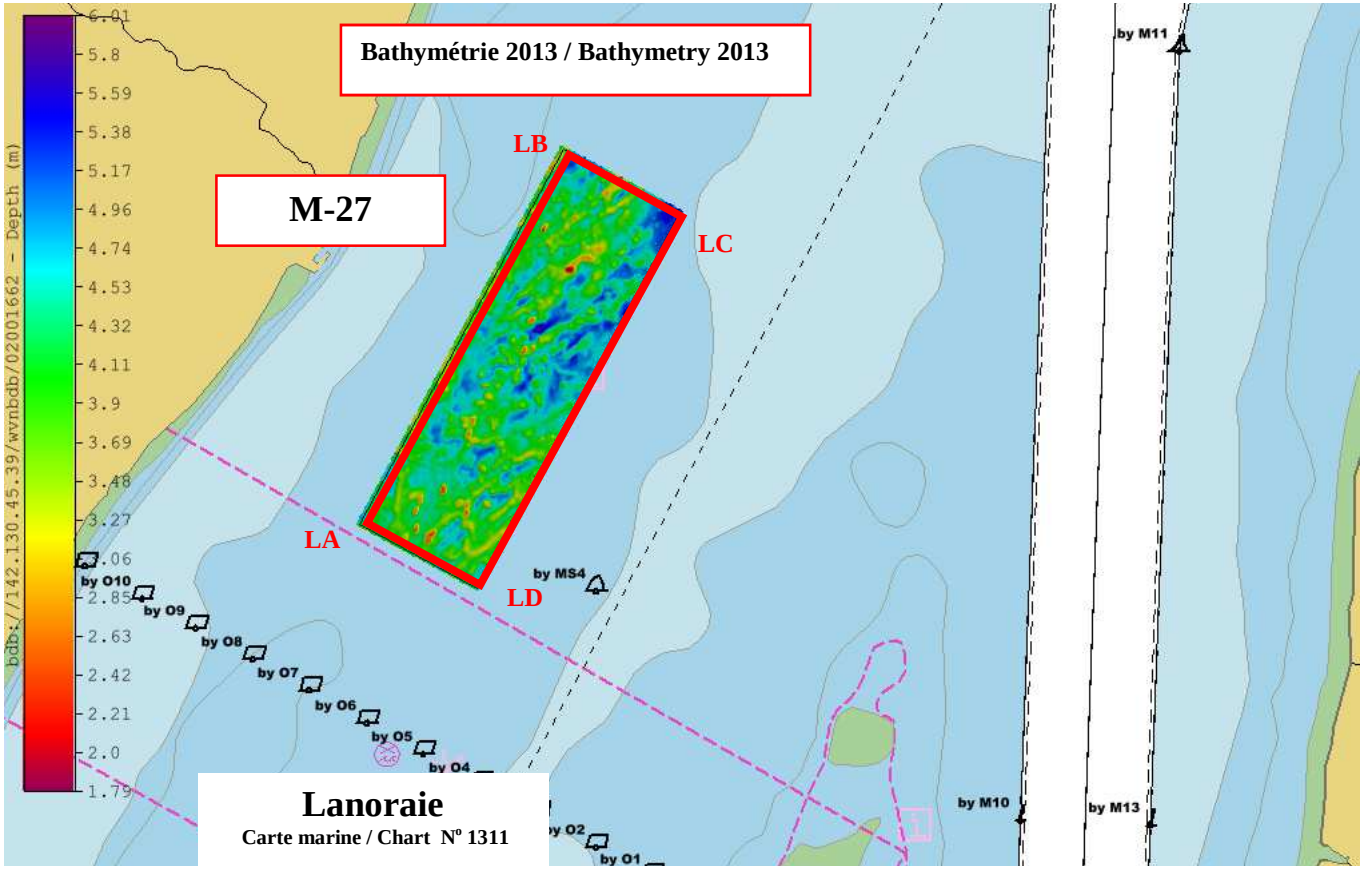
REMARQUES / REMARKS

Superficie totale / Global area: 0,02 km²

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : M-27 (Lanoraie)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)	
N°	X	Y
LA	325 659	5 088 335
LB	326 040	5 089 039
LC	326 260	5 088 920
LD	325 879	5 088 216

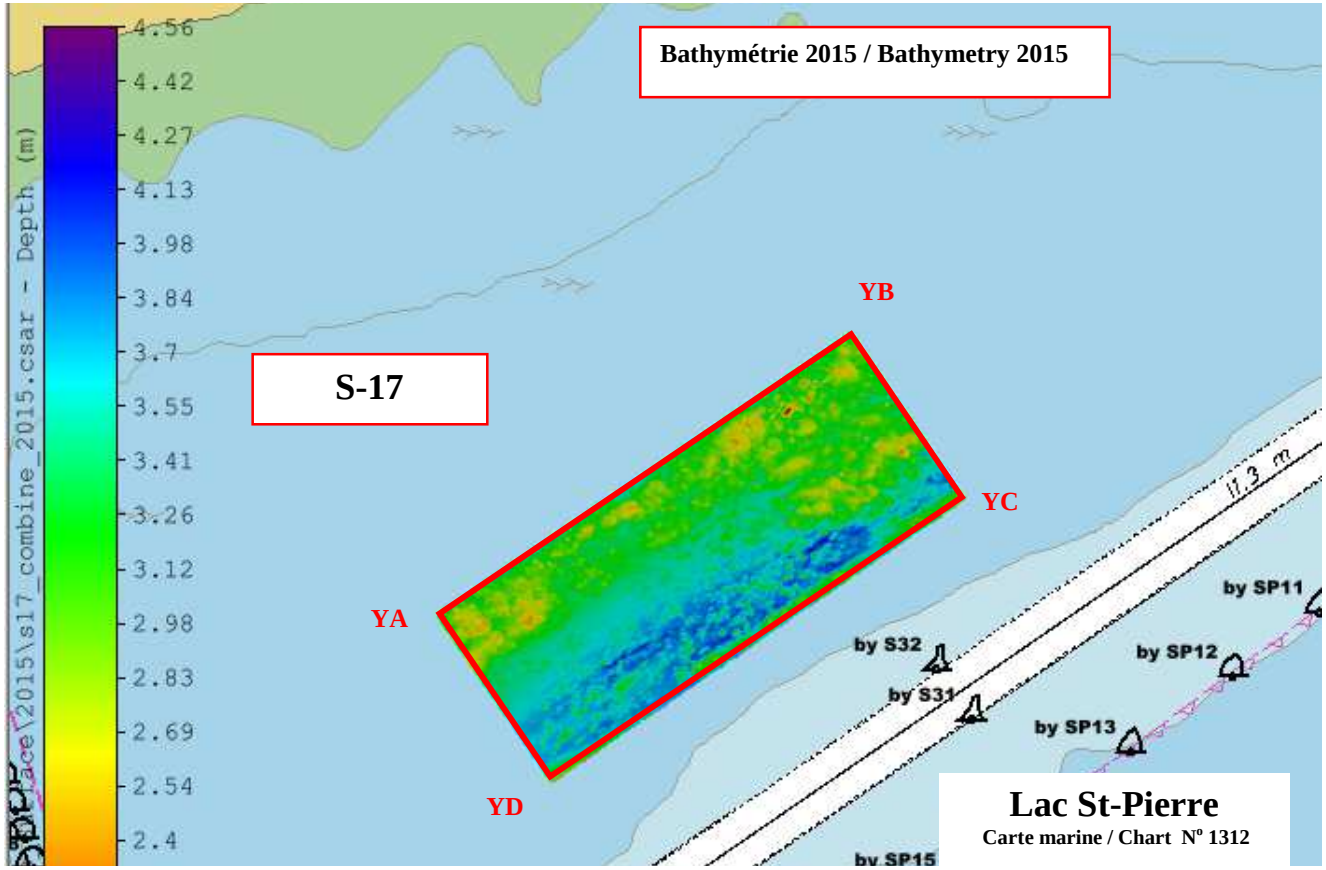
REMARQUES / REMARKS

Superficie totale / Global area: 0,20 km²

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : S-17 (Yamachiche nord)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)	
N°	X	Y
YA	360 867	5 123 336
YB	362 516	5 124 467
YC	362 968	5 123 808
YD	361 319	5 122 676

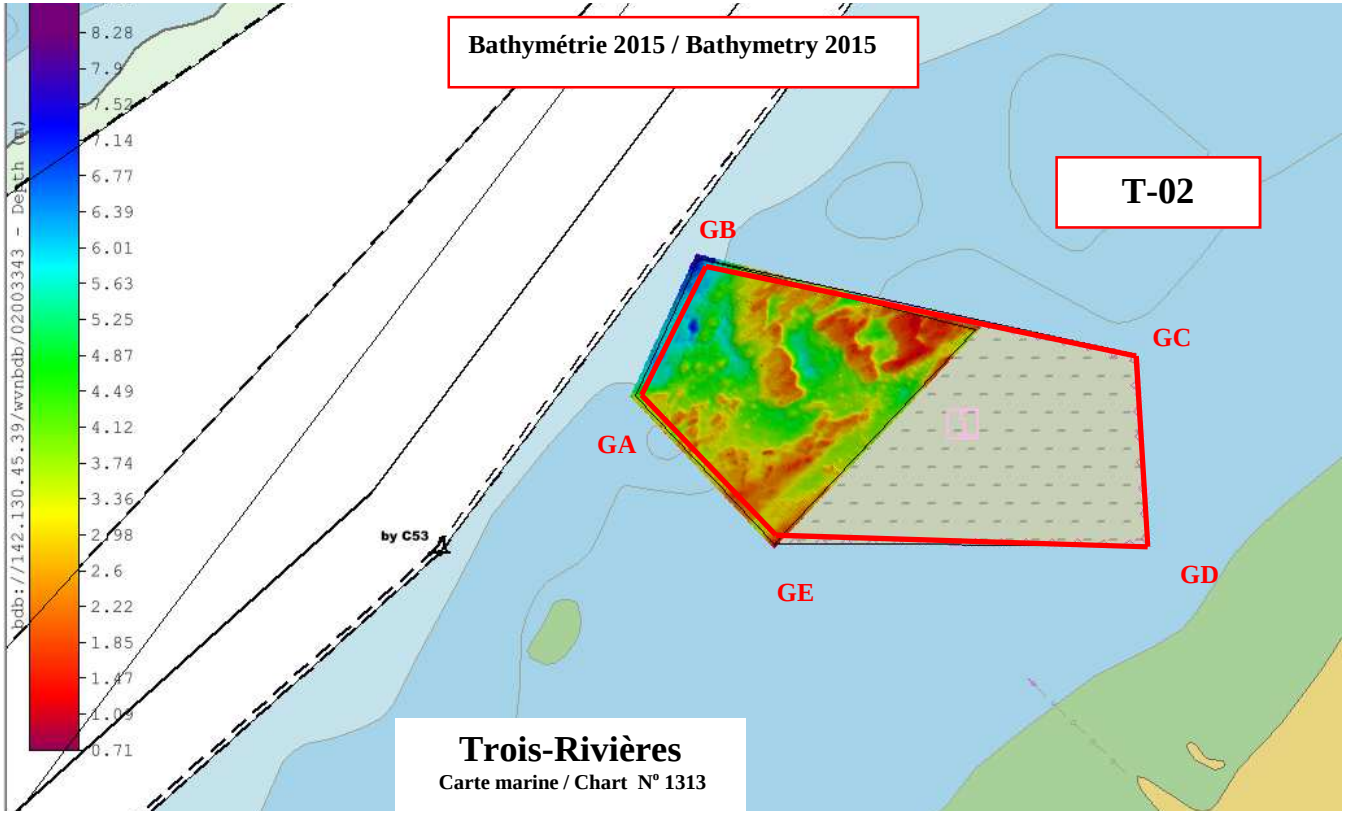
REMARQUES / REMARKS

Superficie totale / Global area: 1,60 km²

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : T-02 (Ste-Angèle)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)	
N°	X	Y
GA	380 661	5 134 210
GB	380 746	5 134 394
GC	381 332	5 134 265
GD	381 348	5 134 010
GE	380 847	5 134 012

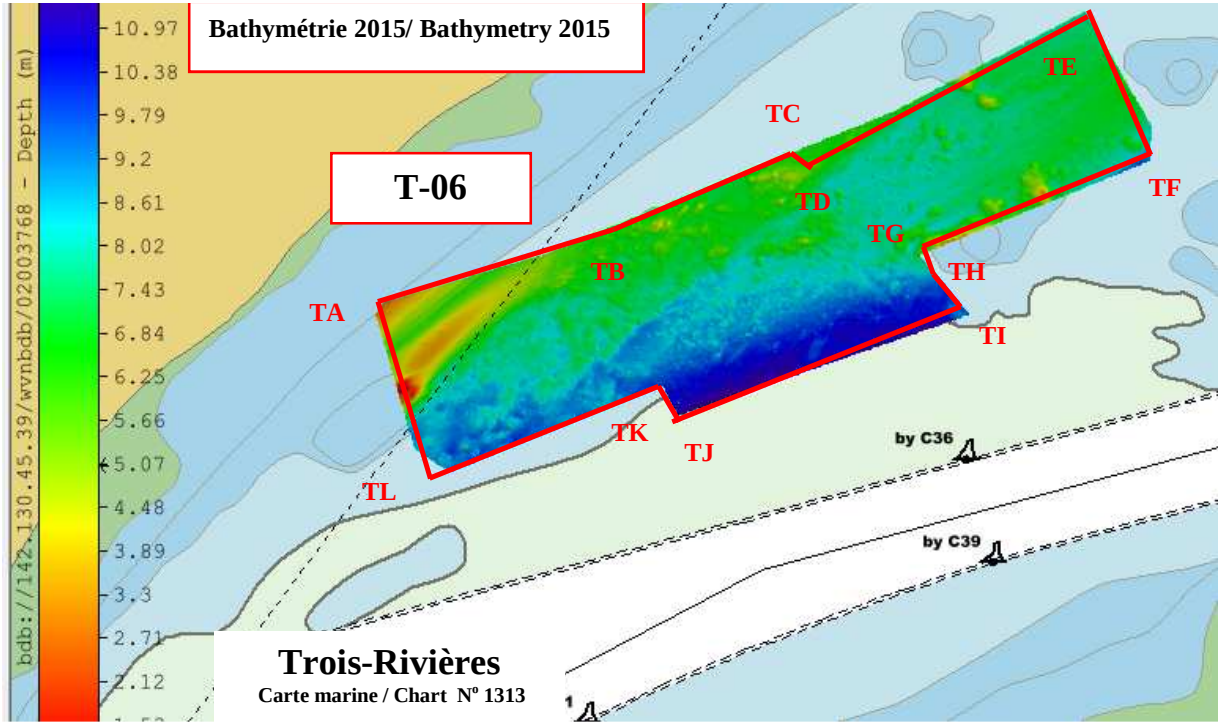
REMARQUES / REMARKS

Superficie totale / Global area: 0,19 km²

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : T-06 (Cap-de-la-Madeleine)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)	
N°	X	Y
TA	383 376	5 138 528
TB	383 958	5 138 696
TC	384 315	5 138 873
TD	384 354	5 138 850
TE	384 982	5 139 182
TF	385 112	5 138 935
TG	384 577	5 138 654
TH	384 587	5 138 614
TI	384 692	5 138 513
TJ	384 077	5 138 314
TK	384 041	5 138 369
TL	383 460	5 138 223

REMARQUES / REMARKS

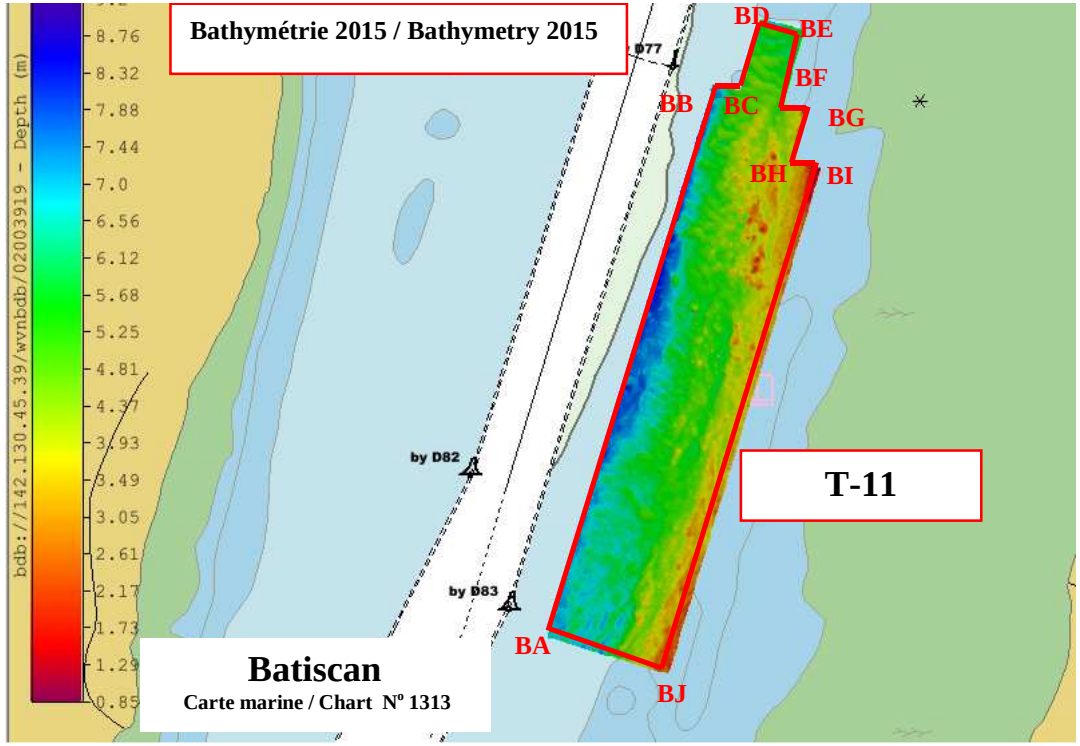
Superficie totale / Global area: 0,62 km²

NOTE : Site utilisé pour dépôt de roches de plus de 30 cm de diamètre / Site used to deposit rocks of more than 30 cm diameter

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : T-11 (St-Pierre Les Becquets)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)	
Nº	X	Y
BA	401 431	5 148 345
BB	401 970	5 150 125
BC	402 054	5 150 101
BD	402 124	5 150 335
BE	402 250	5 150 299
BF	402 182	5 150 061
BG	402 257	5 150 038
BH	402 211	5 149 885
BI	402 306	5 149 856
BJ	401 814	5 148 229

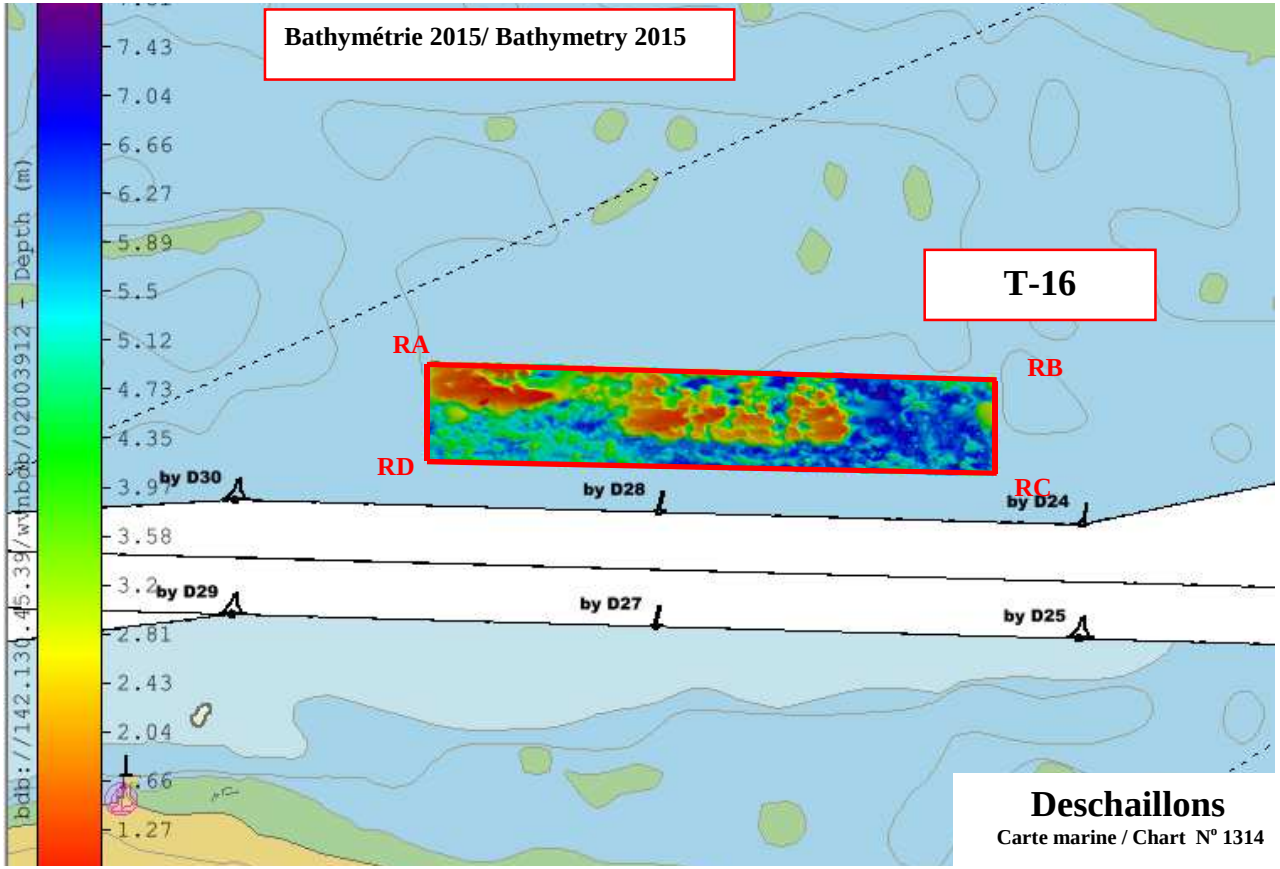
REMARQUES / REMARKS

Superficie totale / Global area: 0,76 km²

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : T-16 (Deschaillons)



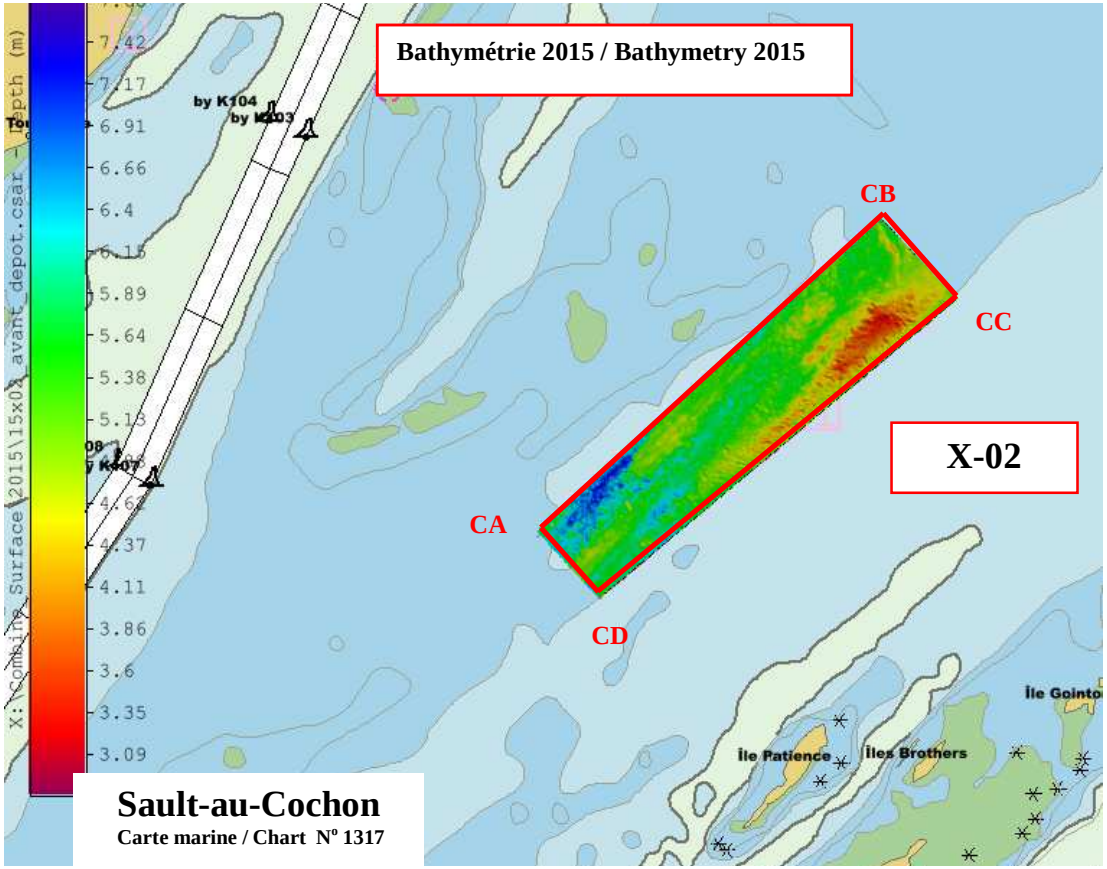
POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 8)		REMARQUES / REMARKS
Nº	X	Y	
RA	412 321	5 159 760	Superficie totale / Global area: 0,24 km²
RB	413 521	5 159 726	
RC	413 515	5 159 526	
RD	412 316	5 159 560	

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018

Traverse du nord

Localisation aire de mise en dépôt / Disposal area localisation : X-02 (Brulé)



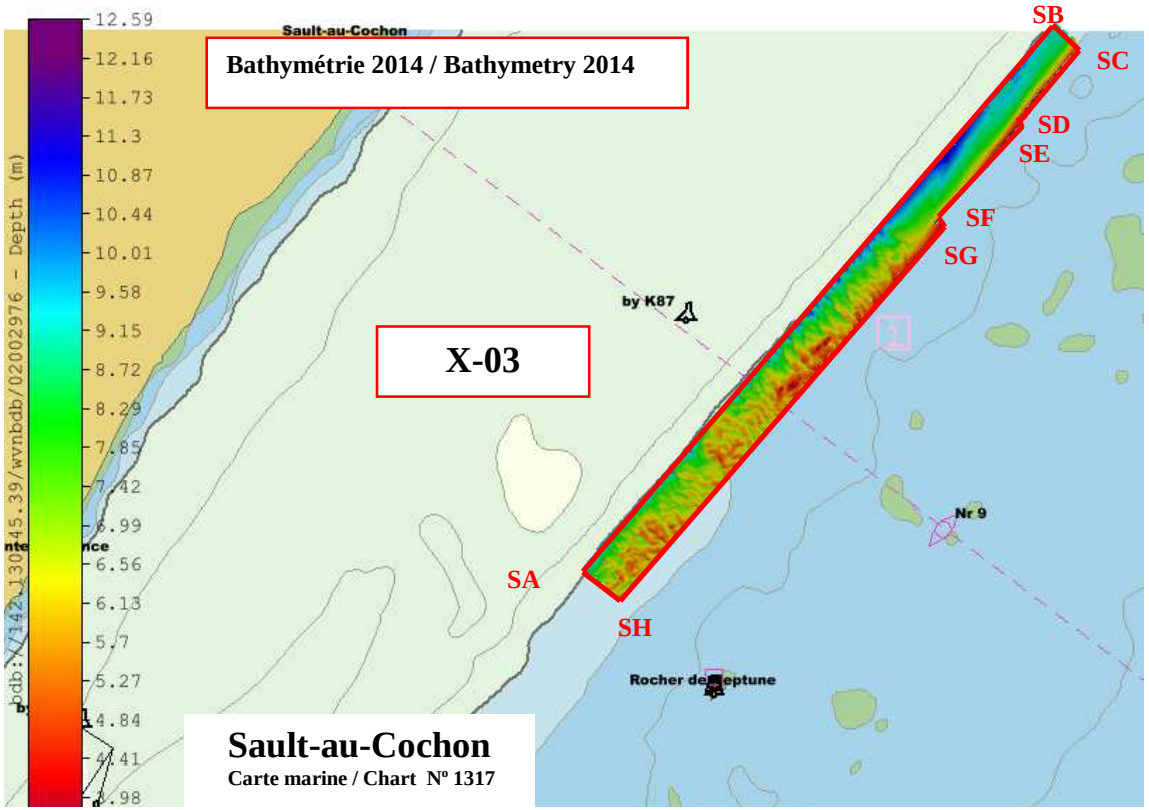
POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 7)		REMARQUES / REMARKS
N°	X	Y	
CA	289 918	5 213 388	Superficie totale / Global area: 2,61 km²
CB	292 495	5215 730	
CC	293 064	5 215 143	
CD	290 382	5 212 893	

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018

Traverse du nord

Localisation aire de mise en dépôt / Disposal area localisation : X-03 (Sault-au-Cochon)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 7)	
Nº	X	Y
SA	295 822	5 225 541
SB	298 807	5 228 987
SC	298 958	5 228 856
SD	298 617	5 228 443
SE	298 640	5 228 423
SF	298 042	5 227 732
SG	298 088	5 227 691
SH	296 053	5 225 341

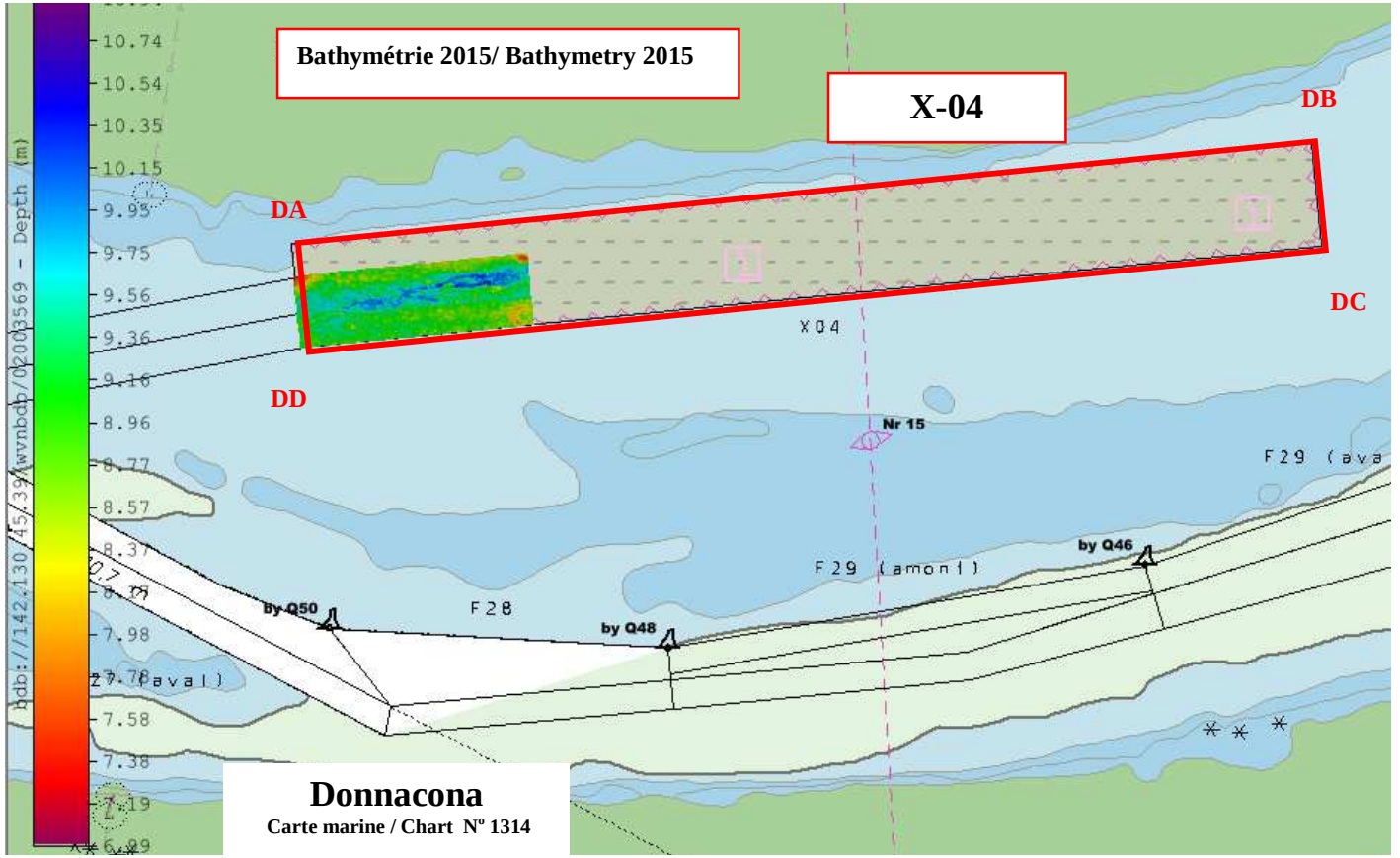
REMARQUES / REMARKS

Superficie totale / Global area: 1,28 km²

Voie navigable du St-Laurent / St-Laurent Waterway
Programme d'entretien annuel / Annual Maintenance Program

Année/Year 2016 à 2018 **Montréal à/to Cap-Santé**

Localisation aire de mise en dépôt / Disposal area localisation : X-04 (Donnacona)



POINTS	COORDONNÉES / COORDINATES (NAD 83 ; MTM ; ZONE 7)	
N°	X	Y
DA	210 286	5 169 242
DB	214 665	5 169 676
DC	214 709	5 169 228
DD	210 330	5 168 794

REMARQUES / REMARKS

Superficie totale / Global area: 1,98 km²

Appendix D
Fish Fauna and Aquatic Habitat

Synthèse des caractéristiques des habitats et des périodes de reproduction des principales espèces de poissons

Espèces[1,2]	Habitat[3]				Caractéristiques des habitats et des aires de reproduction[4]	Période de fraie[4]
	L	T	C	FN		
Alose savoureuse	x	x			Milieu marin et fraie dans les rivières. Au Québec, deux frayères sont confirmées (rivière des Outaouais et rivière des Prairies) et trois autres sont présumées ailleurs dans le fleuve Saint-Laurent[5].	Fin mai et juin
Barbotte brune	x				Fraie autour des rives, des lacs, dans les baies et à l'embouchure des ruisseaux, dans les zones de végétation inondable.	Mai et juin
Barbue de rivière				x	Vit en eau claire et profonde à fond de sable et de gravier des lacs et des grandes rivières. Fraie dans les eaux vives.	Juin et juillet
Chevalier blanc				x	Fréquente les cours d'eau au courant lent et possédant de longues et profondes fosses. Plus fréquent en rivières qu'en lacs. Fraie en eau froide.	Début de juin
Chevalier rouge	x	x	x	x	Fraie sur un fond graveleux des petits cours d'eau et des rivières.	Fin mai
Doré jaune	x			x	Fraie dans les fonds propres et graveleux situés en eaux courantes, peu profondes et bien oxygénées.	Début avril à la fin juin
Doré noir			x	x	Fraie en eau peu profonde, sur un fond de gravier.	Mai à juin
Esturgeon jaune	x		x	x	Fraie dans les zones d'eaux courantes. Les sites d'eaux vives localisés en aval des reversoirs coupant les chenaux des îles de Berthier-Sorel seraient propices à la fraie de l'esturgeon jaune.	Mai et juin
Fouille-roche zébré	x				Fraie en eau peu profonde sur des hauts-fonds sablonneux.	Juin et juillet
Lamproie argentée				x	Fraie sur le gravier de grandes rivières.	Mai et juin
Laquaiche argentée	x				Fraie dans les rivières de faibles profondeurs et ayant des eaux claires.	Avril et mai
Méné émeraude	x				Vit en surface et au large des grandes rivières.	Juin à août
Meunier noir	x			x	Fraie dans les petits cours d'eau graveleux et à courant modéré, de même que sur les rives des lacs.	Mai au début juin
Omisco	x			x	Fraie en cours d'eau peu profonds sur fond rocailleux.	Mai
Perchaude	x				Fraie dans des eaux peu profondes, par exemple des zones d'inondation, pourvues de végétation, de racines ou de branches submergées.	Mi-avril au début mai
Queue à tache noire	x			x	Fraie dans les lacs ou à l'embouchure de rivières sur fonds sablonneux ou graveleux et en eau claire.	Juin et juillet

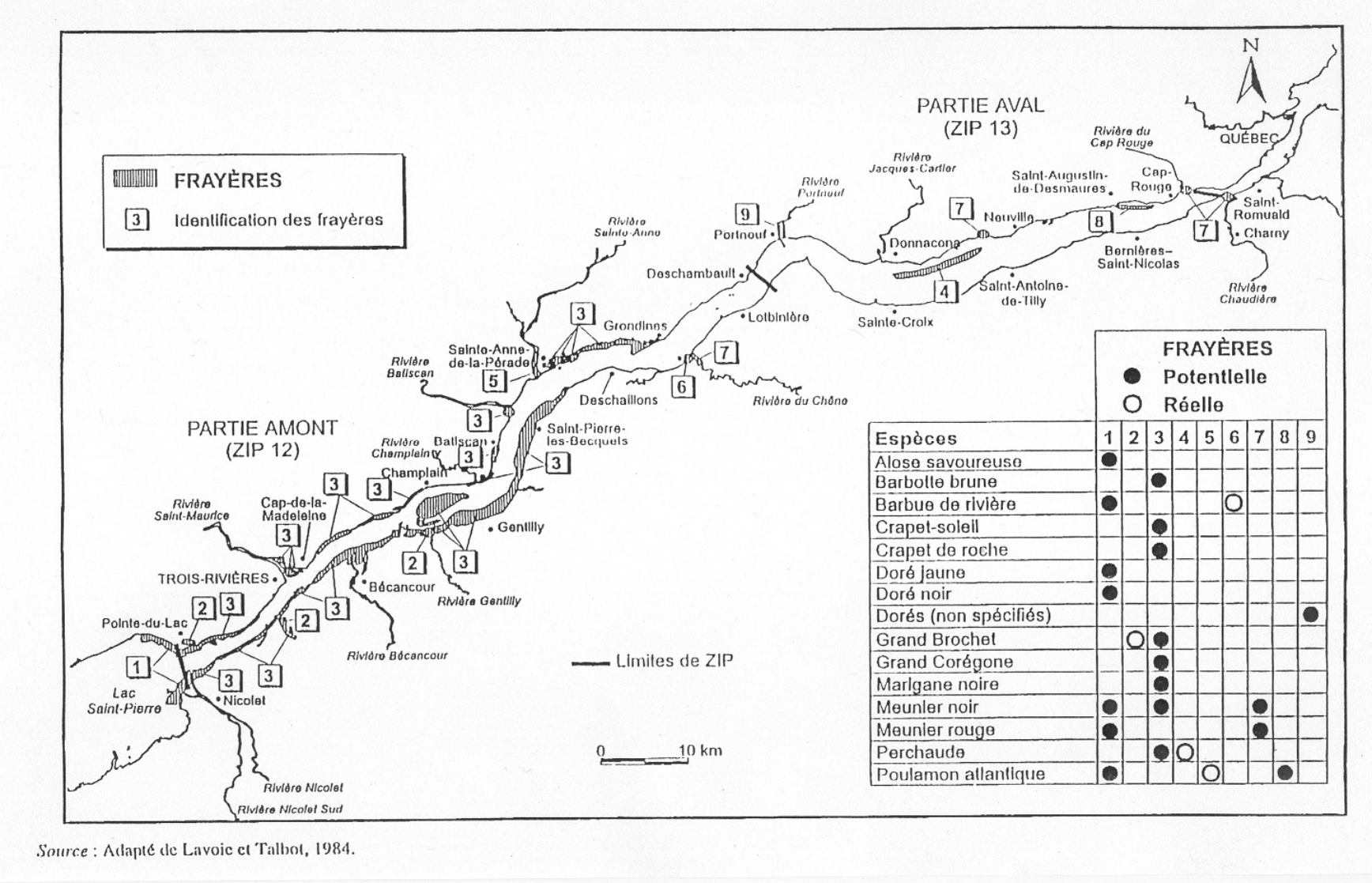
1 : Espèces retrouvées dans ≥50% des stations échantillonnées par DeLaChenelière et al. (2015).

2 : Le gobie à taches noires fait également partie des espèces retrouvées dans ≥50% des stations échantillonnées par DeLaChenelière et al. (2015) pour les habitats L, T et FN. Cette espèce exotique envahissante n'a pas été considérée dans la présente évaluation.

3 : Habitats échantillonnés par DeLaChenelière et al. (2015) :L=littoral; T=talus; C=chenal; FN=fosses naturelles.

4 : Sources : Bernatchez et Giroux (2000)

5 : Source : MFFP (2010b).



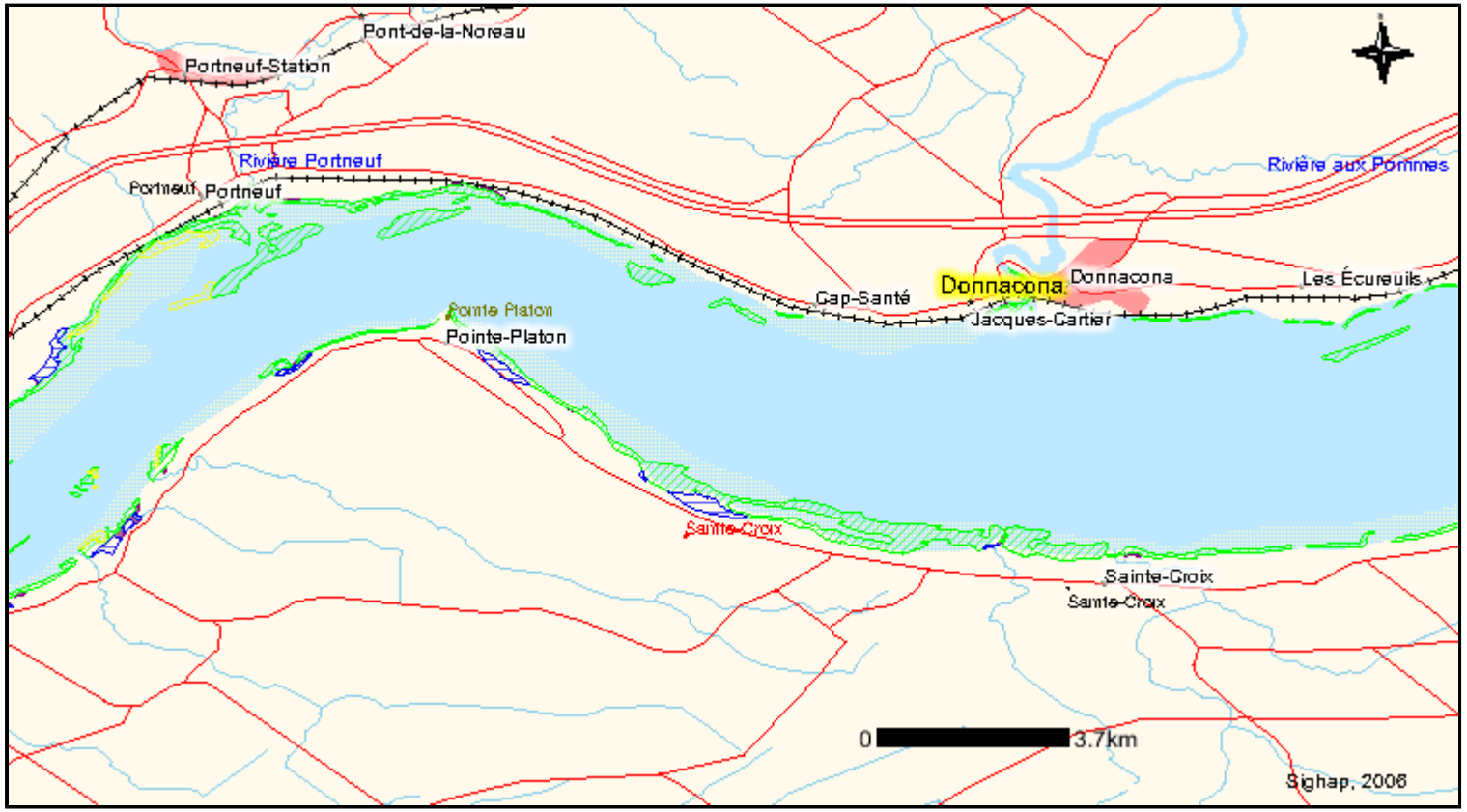
Source : Adapté de Lavoie et Talbot, 1984.

Localisation des frayères réelles et potentielles dans le secteur d'étude Trois-Rivières-Bécancour

SIGHAP - Végétation aquatique

46° 43' 22" N, 071° 55' 22" O

46° 43' 22" N, 071° 40' 23" O



46° 35' 07" N, 071° 55' 22" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 35' 07" N, 071° 40' 23" O

Légende

Herbier aquatique Présence

-//

Marécage Présence

Non déterminée//

Marais Présence

Non déterminée//

Prairie humide Présence

-//

Pêches et Océans Canada

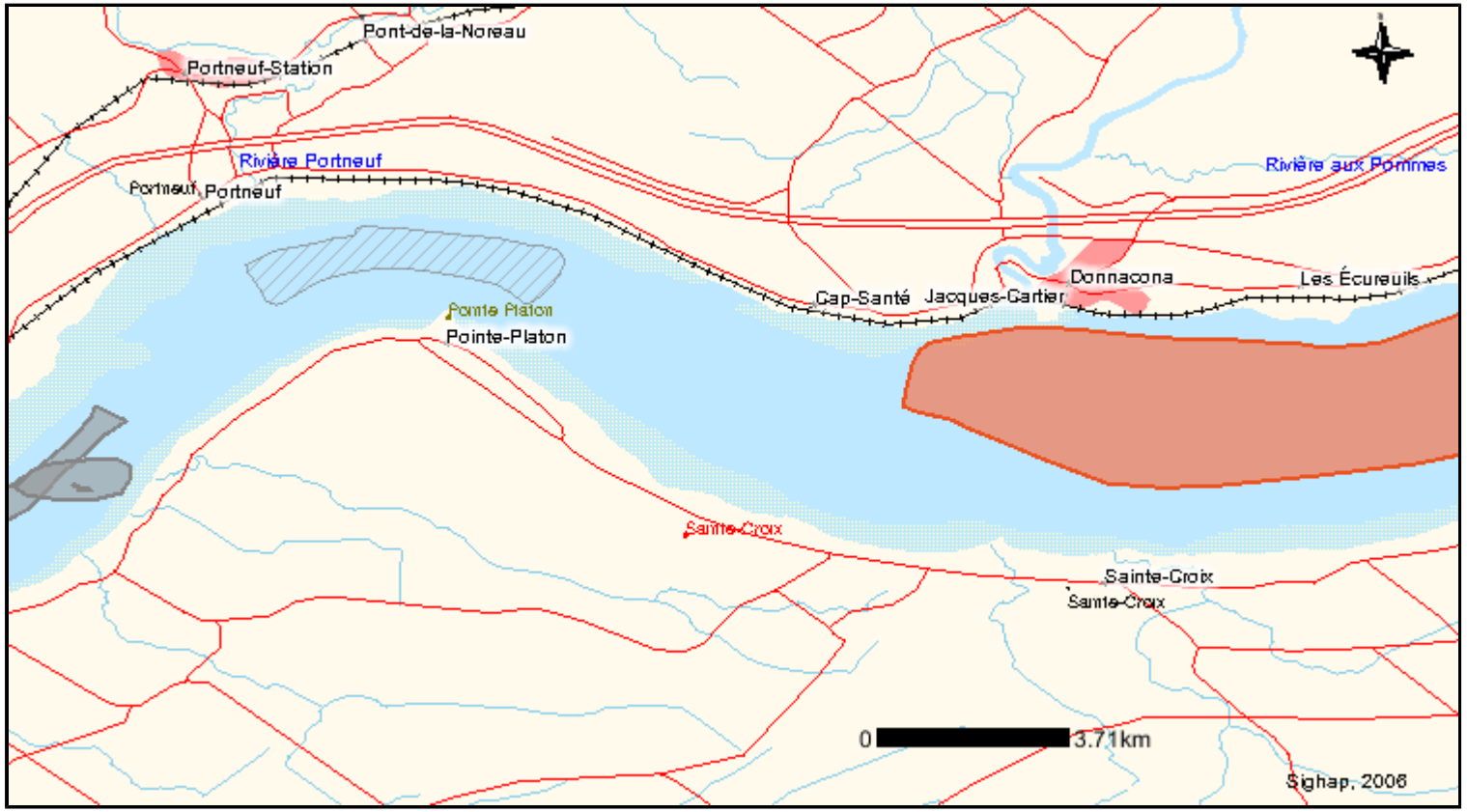
Fisheries and Oceans Canada

Canada

SIGHAP - Poissons

46° 43' 22" N, 071° 55' 22" O

46° 43' 22" N, 071° 40' 23" O



46° 35' 06" N, 071° 55' 22" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 35' 06" N, 071° 40' 23" O

Légende

Éperlan arc-en-ciel Présence

Aire de reproduction/Frayère potentielle/Non déterminée

Esturgeon noir Présence

Aire de reproduction/Frayère potentielle/Non déterminée

Concentration/Non exploitée/Non déterminée

Pêches et Océans Canada

Fisheries and Oceans Canada

Canada

Résumé de l'information présentée sur les cartes SIGHAP du MPO à la hauteur de la Traverse du Nord

Espèces	Observations	Présence de l'espèce	Aire de reproduction	Aire d'alimentation / concentration
Alose savoureuse	Présence de l'espèce à la hauteur de Saint-Jean I.O. Observations d'aire de reproduction / frayère potentielle au printemps dans le secteur Sainte-Anne-de-Beaupré et Beaupré ainsi qu'au nord de l'I.O.	Été/Automne : au nord de l'I.O. et dans tout le secteur à l'étude à partir de la pointe est de l'I.O. Printemps/Été : étroite bande le long de la rive sud du fleuve	Frayère potentielle en rive nord du fleuve, jusqu'à Cap-Brûlé ainsi qu'au nord de l'I.O. Rive sud du fleuve, jusqu'à Berthier-sur-Mer Concentration de larves en été : de l'I.O. jusqu'à l'Île-aux-Oies. Du centre du fleuve allant jusqu'à Cap-Gribane sur la rive nord	ND / ND
Anguille d'Amérique	ND	Automne : Se concentre dans la portion sud du fleuve et emprunte un étroit corridor sur la rive nord Été : dans tout le secteur à l'étude	ND	ND / ND
Barbue de rivière	Observations entre Berthier-sur-Mer et Montmagny, à l'été et l'automne	ND	ND	ND / ND
Doré jaune	Observations en face de Montmagny, à l'automne	ND	Frayère potentielle, rive nord du fleuve, jusqu'à Cap-Brûlé ainsi qu'au nord de l'I.O. Frayère potentielle, rive sud du fleuve, jusqu'à Berthier-sur-Mer	Dans l'ensemble du secteur à l'étude, mais atteignant Beaupré comme limite sur la rive nord, à l'été et l'automne / ND
Doré noir	Dans l'ensemble du secteur à l'étude, mais particulièrement en rive sud, en face de Berthier-sur-Mer à Montmagny,	Dans l'ensemble du secteur à l'étude, mais atteignant Cap-Rouge comme limite sur la rive nord	Au nord de l'I.O.	ND / ND
Doré sp.	ND	ND	Rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / ND
Éperlan arc-en-ciel	Dans l'ensemble du secteur à l'étude, mais davantage au centre ou en rive sur du fleuve (été et automne)	Dans l'ensemble du secteur à l'étude, en été	Dans l'ensemble du secteur à l'étude, sans atteindre Sault-au-Cochon sur la rive nord	ND / ND

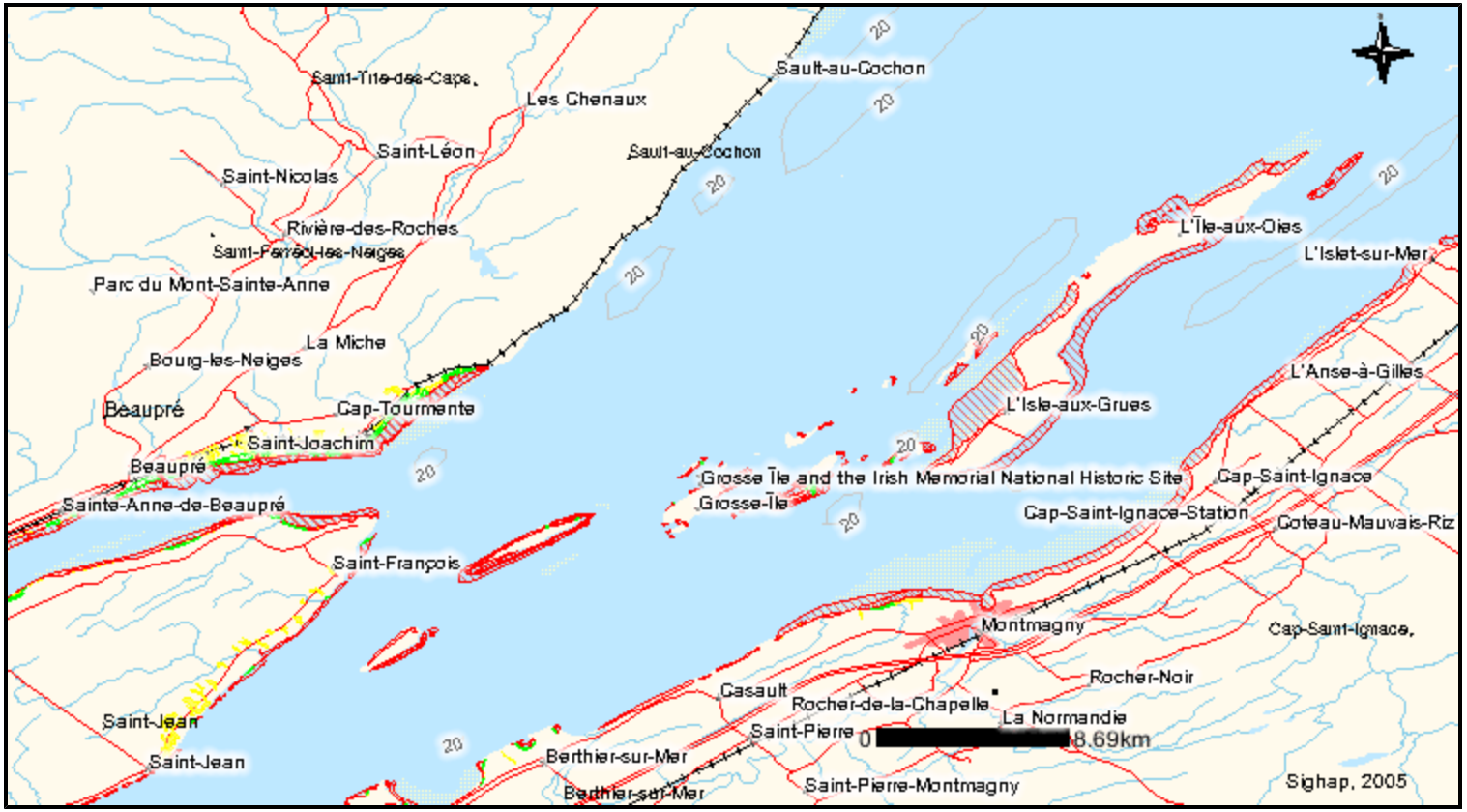
Espèces	Observations	Présence de l'espèce	Aire de reproduction	Aire d'alimentation / concentration
Épinoche à trois épines	Observations entre Saint-François, I.O. et Berthier-sur-Mer, à l'automne	Dans l'ensemble du secteur à l'étude, mais atteint la rive sud en amont de Montmagny	ND	ND / ND
Épinoche tachetée	ND	De la pointe est de l'I.O. se prolongeant sur toute la rive nord du fleuve et à partir de L'Anse-à-Gilles sur la rive sud	ND	ND / ND
Esturgeon jaune	Particulièrement au sud de la pointe de l'I.O. et à l'ouest de Montmagny	Des deux côtés de l'I.O. et sur la rive sud	Rive nord du fleuve, jusqu'à Cap-Brûlé ainsi qu'au nord de l'I.O. Rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / Exploitée, au nord et au sud de l'île Madame, au sud de l'île au Ruau et au nord de la pointe de l'I.O.
Esturgeon noir	Entre Berthier et Cap-Saint-Ignace et en face de l'Île-aux-Oies	Dans l'ensemble du secteur à l'étude	Sur la rive nord de l'I.O.	ND / Sur toute la rive sud ainsi que vis-à-vis Sault-au-Cochon
Fondule barré	ND	Dans l'ensemble du secteur à l'étude, mais atteignant Saint-Joachim sur la rive nord du fleuve	ND	ND / Une petite zone en amont de Berthier-sur-Mer
Gaspareau	Observations à la hauteur de Berthier	Dans l'ensemble du secteur à l'étude	Frayère potentielle, rive nord du fleuve, jusqu'à Cap-Brûlé ainsi qu'au nord de l'I.O. Frayère potentielle, rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / Sur la rive nord du fleuve, à l'est de Cap-Gribane, non exploitée
Grand brochet		Rive sud du fleuve, jusqu'en amont de Montmagny	Rive nord du fleuve, jusqu'à Cap-Brûlé Rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / ND
Grand corégone	En face de Berthier-sur-Mer	Dans l'ensemble du secteur à l'étude	ND	ND / Au nord de l'I.O., en face de Beaupré Sur toute la rive sud, non exploitée

Espèces	Observations	Présence de l'espèce	Aire de reproduction	Aire d'alimentation / concentration
Meunier noir	En amont de la ligne rejoignant Cap-Tourment et L'Anse-à-Gilles	En amont de la ligne rejoignant Cap-Tourmente et L'Islet-sur-Mer	Frayère connue, rive nord I.O. et en face de Saint-Joachim Frayère potentielle, dans les secteurs de Beaupré à Cap-Tourmente et sur la rive sud de l'I.O. (Pointe Dauphine)	ND / ND
Meunier rouge	Dans l'ensemble du secteur à l'étude, mais particulièrement en rive sud, en face de Berthier à Montmagny	Dans l'ensemble du secteur à l'étude	Frayère connue, rive nord I.O. et en face de Saint-Joachim Frayère potentielle, jusqu'à Cap-Brûlé, sur la rive nord de l'I.O. et sur la rive sud de l'I.O. (Pointe Dauphine) Rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / ND
Meunier sp.	ND	ND	Rive nord du fleuve, jusqu'à Cap-Brûlé Rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / ND
Perchaude	À Beaupré, en amont de Berthier et en amont de Montmagny	Sur la rive sud du fleuve, jusqu' en amont de Montmagny	Rive nord du fleuve, jusqu'à Cap-Brûlé et sur la rive nord de l'I.O. Rive sud du fleuve, jusqu'à Berthier-sur-Mer	ND / ND
Poulamon atlantique	Pratiquement dans l'ensemble du secteur à l'étude	Dans l'ensemble du secteur à l'étude	Pratiquement dans l'ensemble du secteur à l'étude, jusqu'à la hauteur de Cap-Gribane	ND / Aire de concentration de larves en été

Carte SIGHAP - Végétation aquatique

47° 13' 47" N, 070° 56' 48" O

47° 13' 47" N, 070° 21' 39" O



46° 54' 26" N, 070° 56' 48" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 26" N, 070° 21' 39" O

Légende

Marécage Présence

Non déterminée//

Marais Présence

Non déterminée//

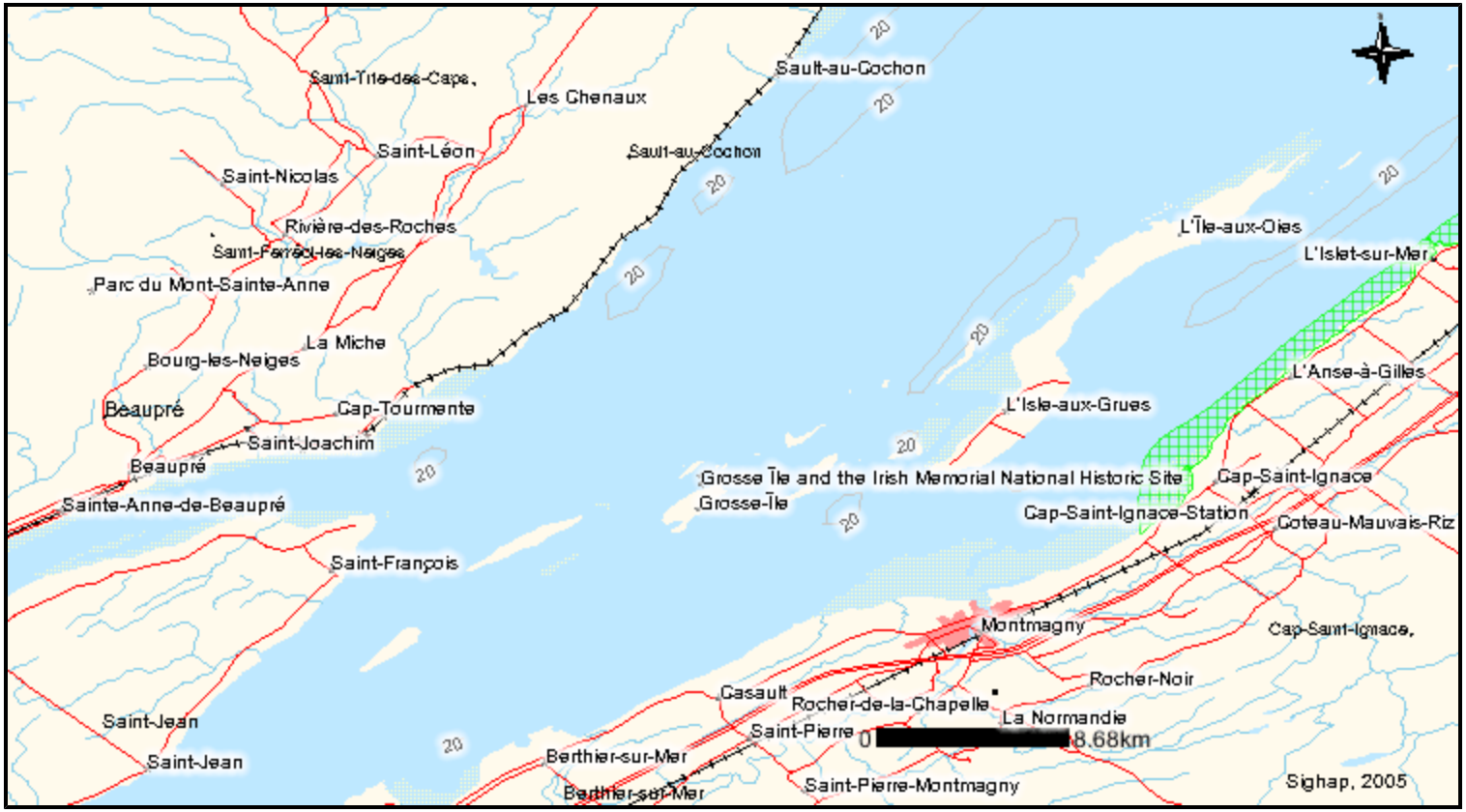
Prairie humide Présence

-//

Carte SIGHAP - Invertébrés

47° 13' 47" N, 070° 56' 47" O

47° 13' 47" N, 070° 21' 40" O



46° 54' 26" N, 070° 56' 47" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 26" N, 070° 21' 40" O

Légende

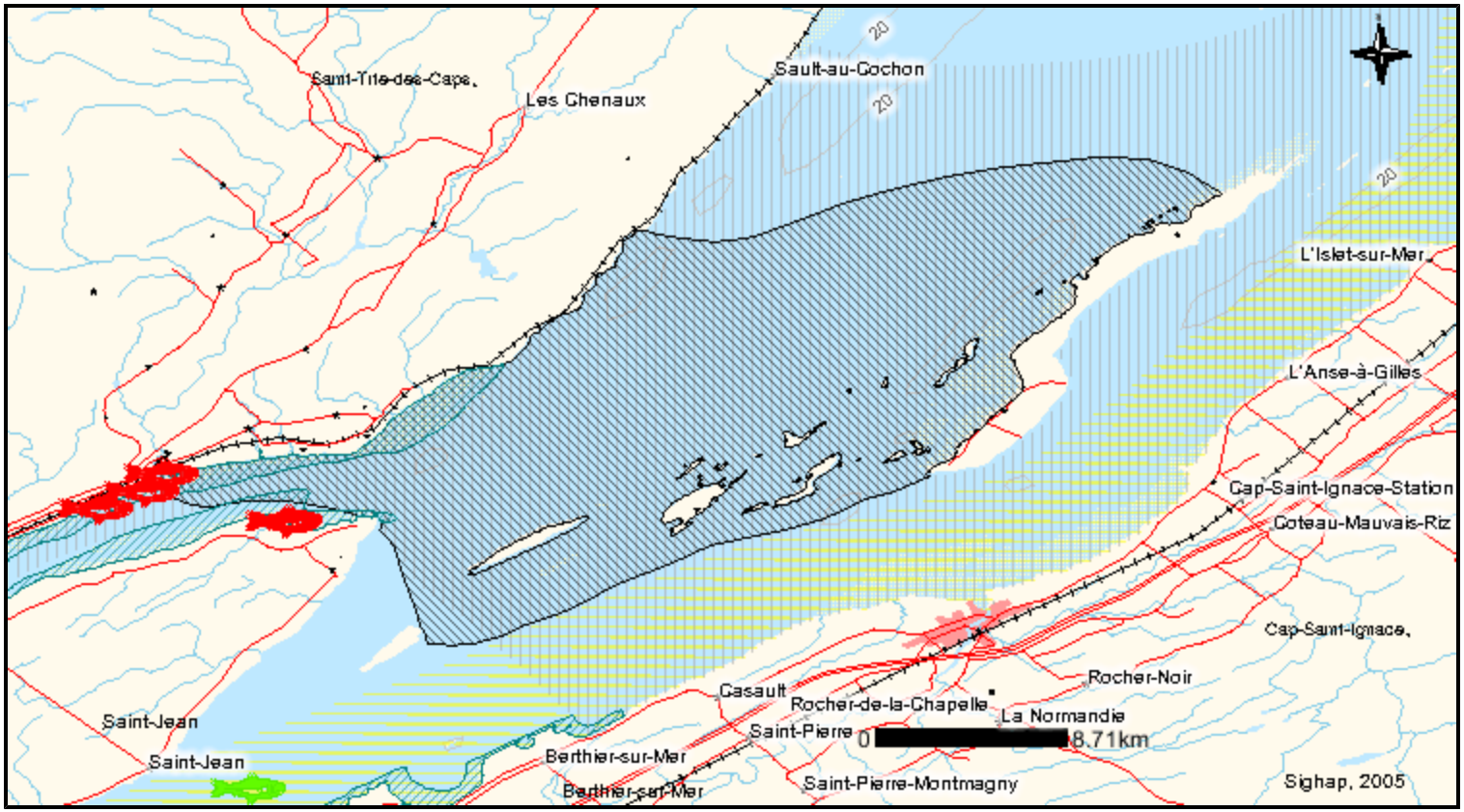
Mye commune Présence

Concentration/Non exploitée/Annuelle

Carte SIGHAP - Alose savoureuse

47° 13' 48" N, 070° 56' 50" O

47° 13' 48" N, 070° 21' 37" O



46° 54' 25" N, 070° 56' 50" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 25" N, 070° 21' 37" O

Légende

Alose savoureuse Observations

- Présence de l'espèce//Non déterminée
- Aire de reproduction/Frayère potentielle/Printemps

Alose savoureuse Présence

- Présence de l'espèce//Printemps - Été
- Présence de l'espèce//Été - Automne
- Aire de reproduction/Concentration de larves/Été
- Aire de reproduction/Frayère potentielle/Non déterminée

Pêches et Océans Canada

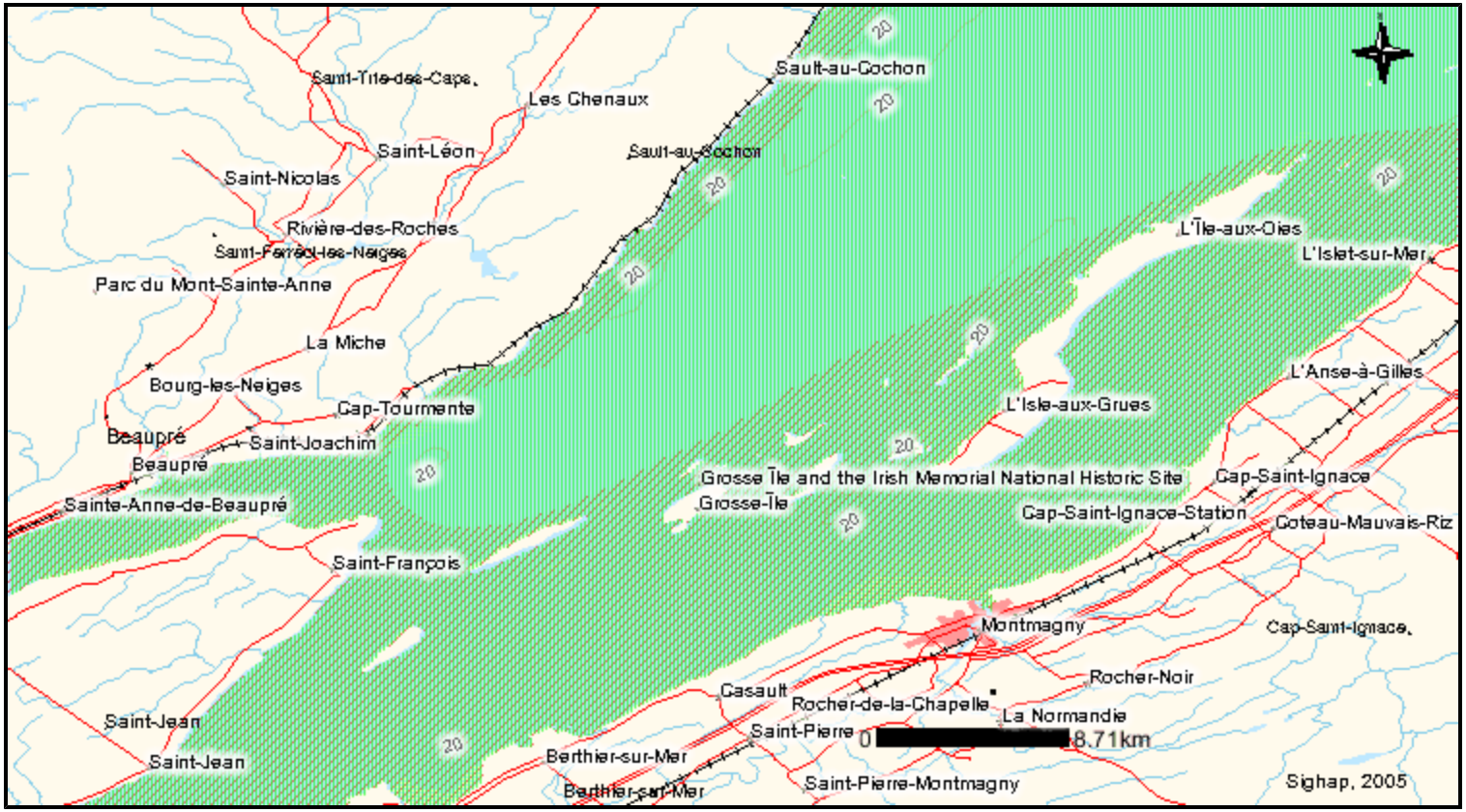
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Anguille d'Amérique

47° 13' 49" N, 070° 56' 51" O

47° 13' 49" N, 070° 21' 37" O



46° 54' 24" N, 070° 56' 51" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 24" N, 070° 21' 37" O

Légende

Anguille d'Amérique Présence

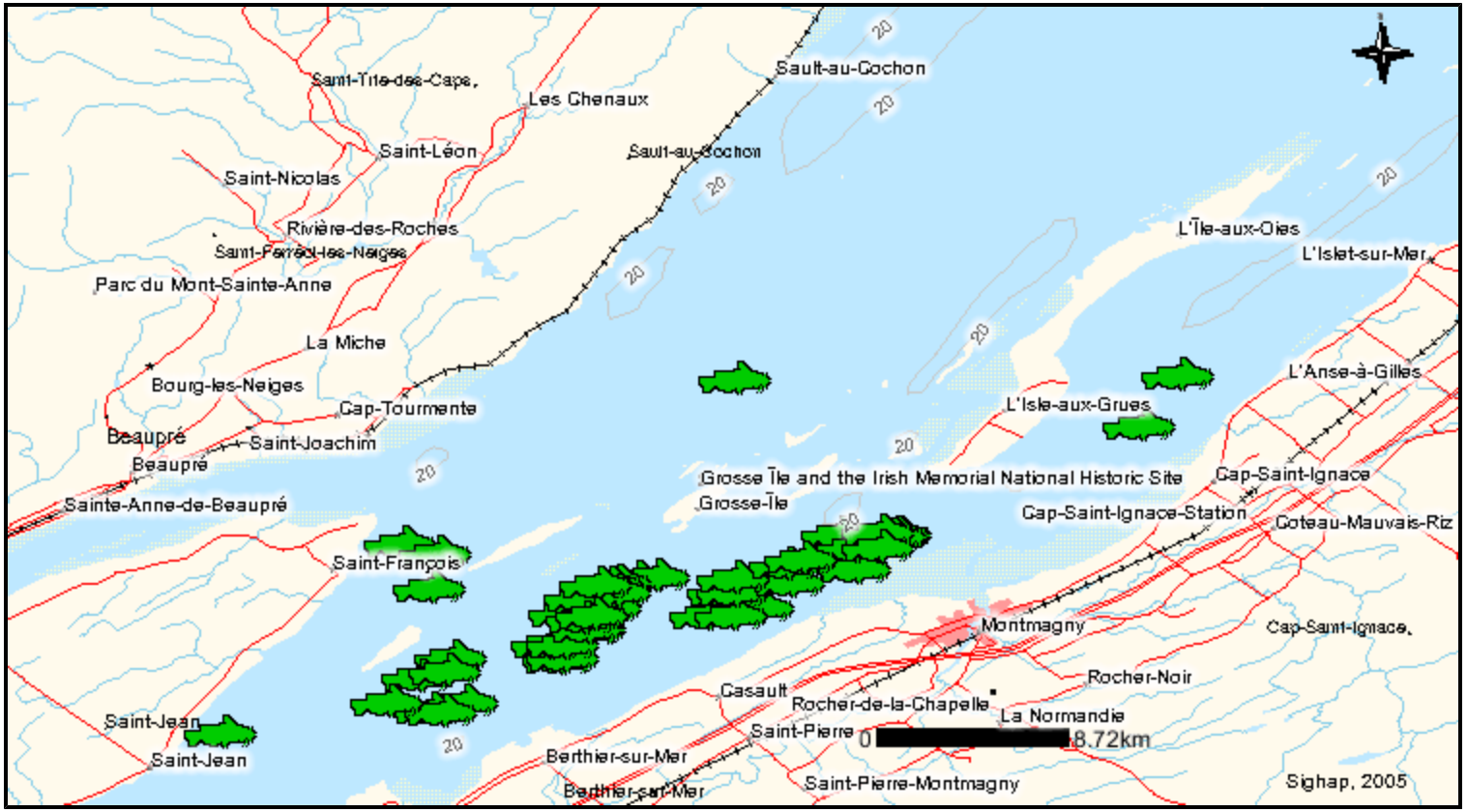
Présence de l'espèce//Automne

Présence de l'espèce//Été

Carte SIGHAP - Barbue de rivière

47° 13' 49" N, 070° 56' 51" O

47° 13' 49" N, 070° 21' 36" O



46° 54' 24" N, 070° 56' 51" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 24" N, 070° 21' 36" O

Légende

Barbue de rivière Observations

Pêches et Océans Canada

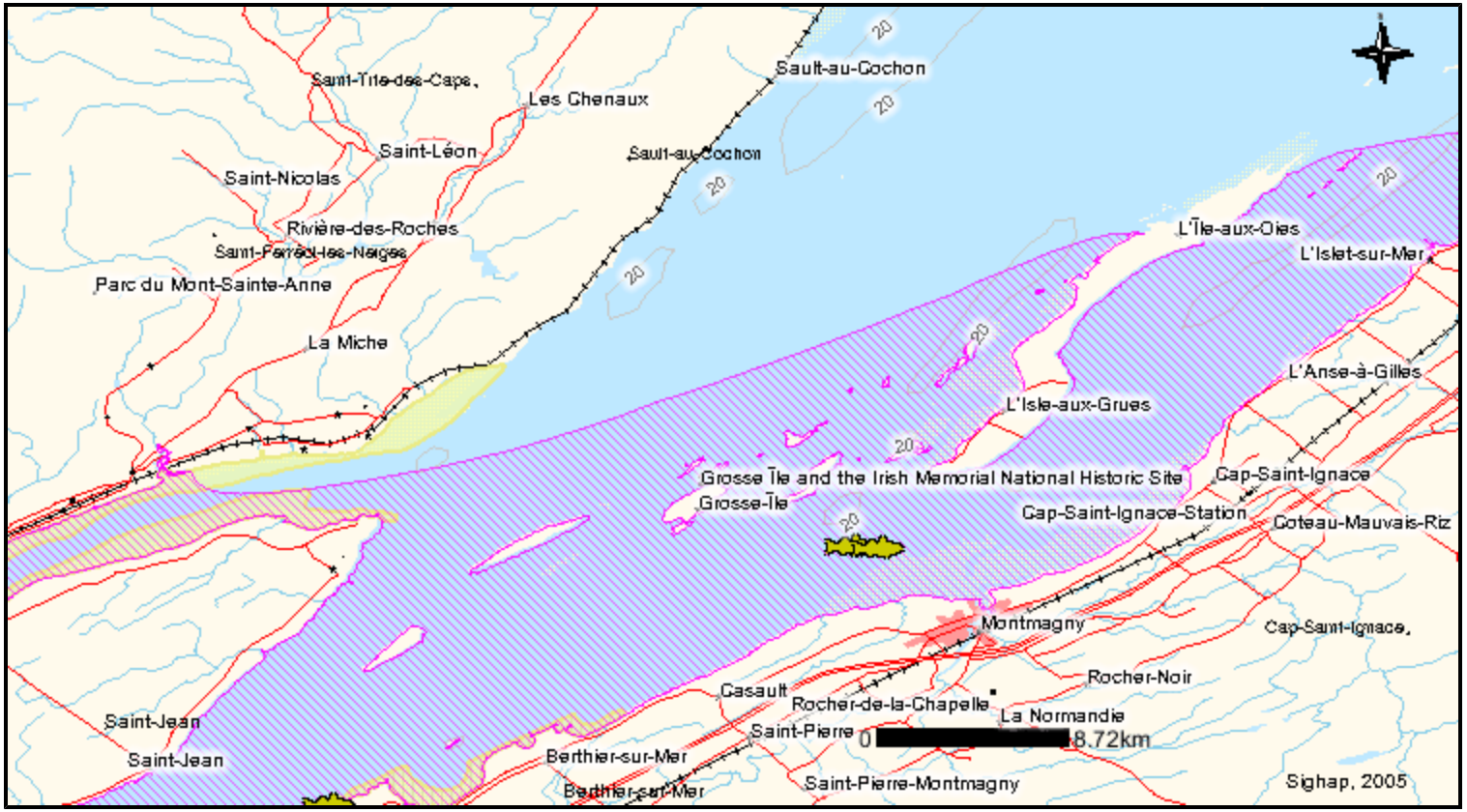
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Doré jaune et Doré sp.

47° 13' 50" N, 070° 56' 52" O

47° 13' 50" N, 070° 21' 35" O



46° 54' 23" N, 070° 56' 52" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 23" N, 070° 21' 35" O

Légende

- Doré jaune Observations
- Doré jaune Présence
  - Aire de reproduction
  - Aire d'alimentation
  - Présence de l'espèce
- Doré sp. Présence
  - Aire de reproduction
  - Présence de l'espèce

Pêches et Océans Canada

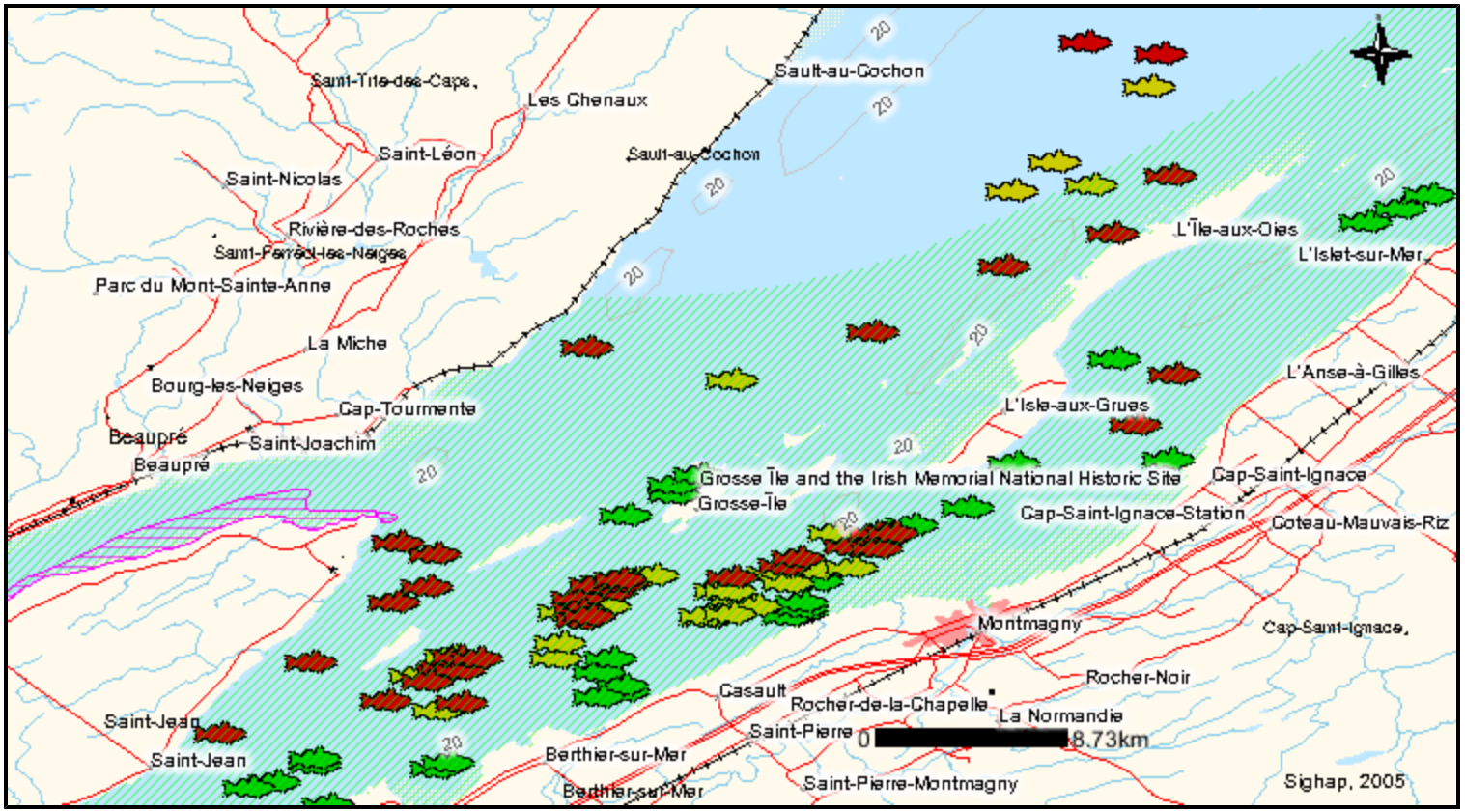
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Doré noir

47° 13' 50" N, 070° 56' 53" O

47° 13' 50" N, 070° 21' 35" O



46° 54' 23" N, 070° 56' 53" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 23" N, 070° 21' 35" O

Légende

Doré noir Présence

Présence de l'espèce//Été - Automne

Aire de reproduction/Frayère potentielle/Non déterminée

Doré noir Observations

Présence de l'espèce//Non déterminée

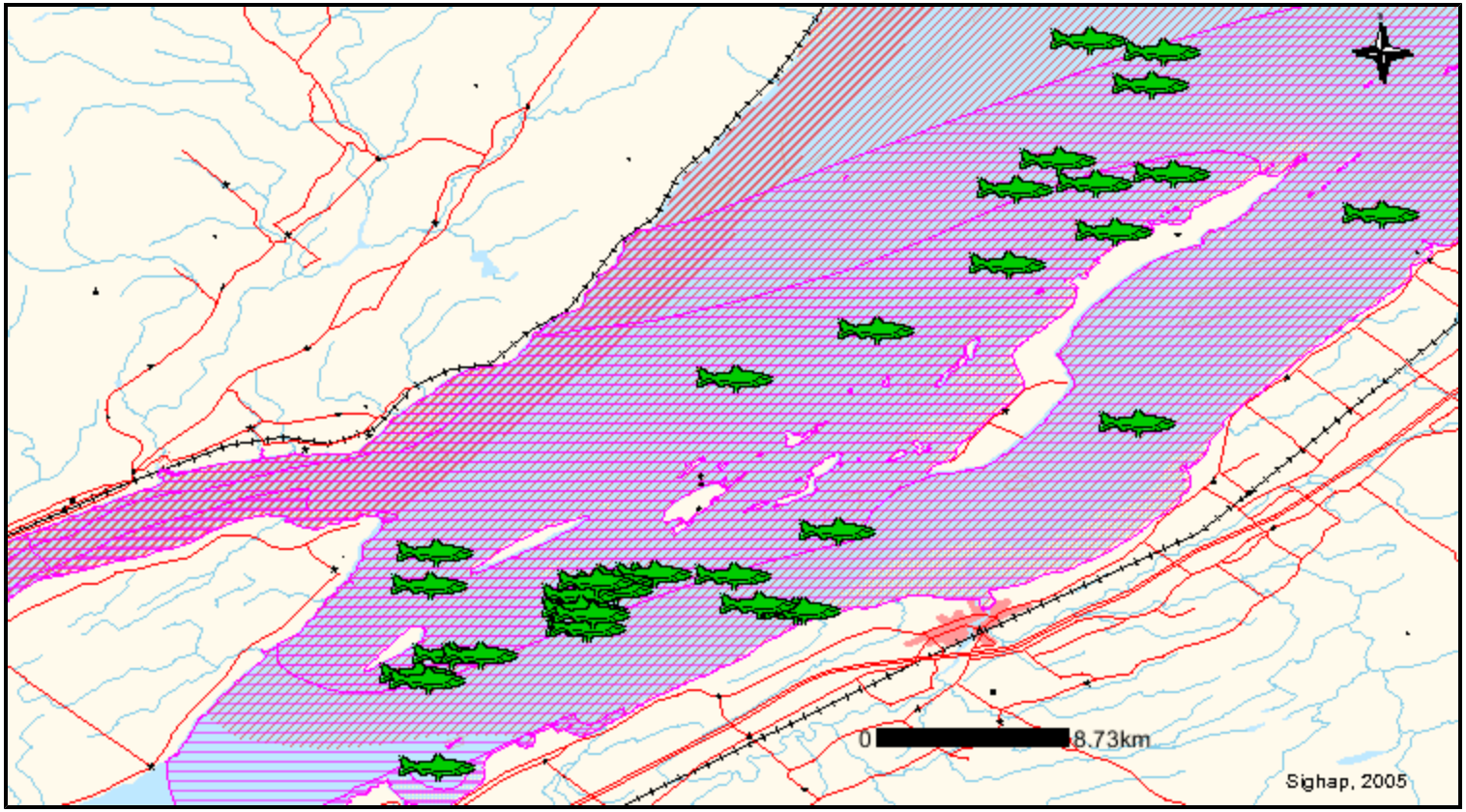
Présence de l'espèce//Été

Présence de l'espèce//Automne

Carte SIGHAP - Éperlan arc-en-ciel

47° 13' 50" N, 070° 56' 53" O

47° 13' 50" N, 070° 21' 34" O



46° 54' 23" N, 070° 56' 53" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 23" N, 070° 21' 34" O

Légende

Éperlan arc-en-ciel Observations

Éperlan arc-en-ciel Présence

Aire de reproduction

Aire d'alimentation

Concentration

Présence de l'espèce

Pêches et Océans Canada

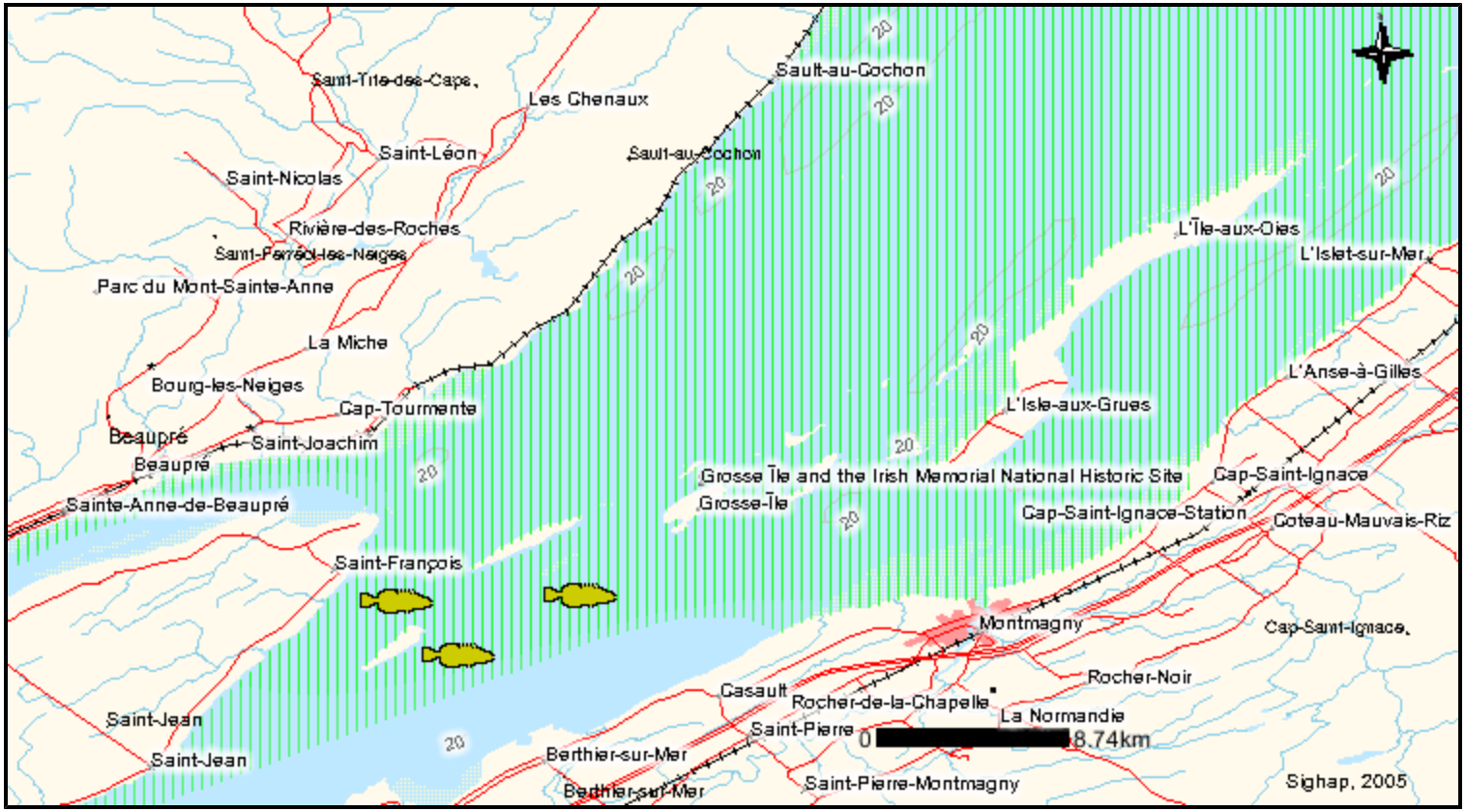
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Épinoche à trois épines

47° 13' 51" N, 070° 56' 54" O

47° 13' 51" N, 070° 21' 33" O



46° 54' 22" N, 070° 56' 54" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 22" N, 070° 21' 33" O

Légende

Épinoche à trois épines Observations

Épinoche à trois épines Présence

Aire de reproduction

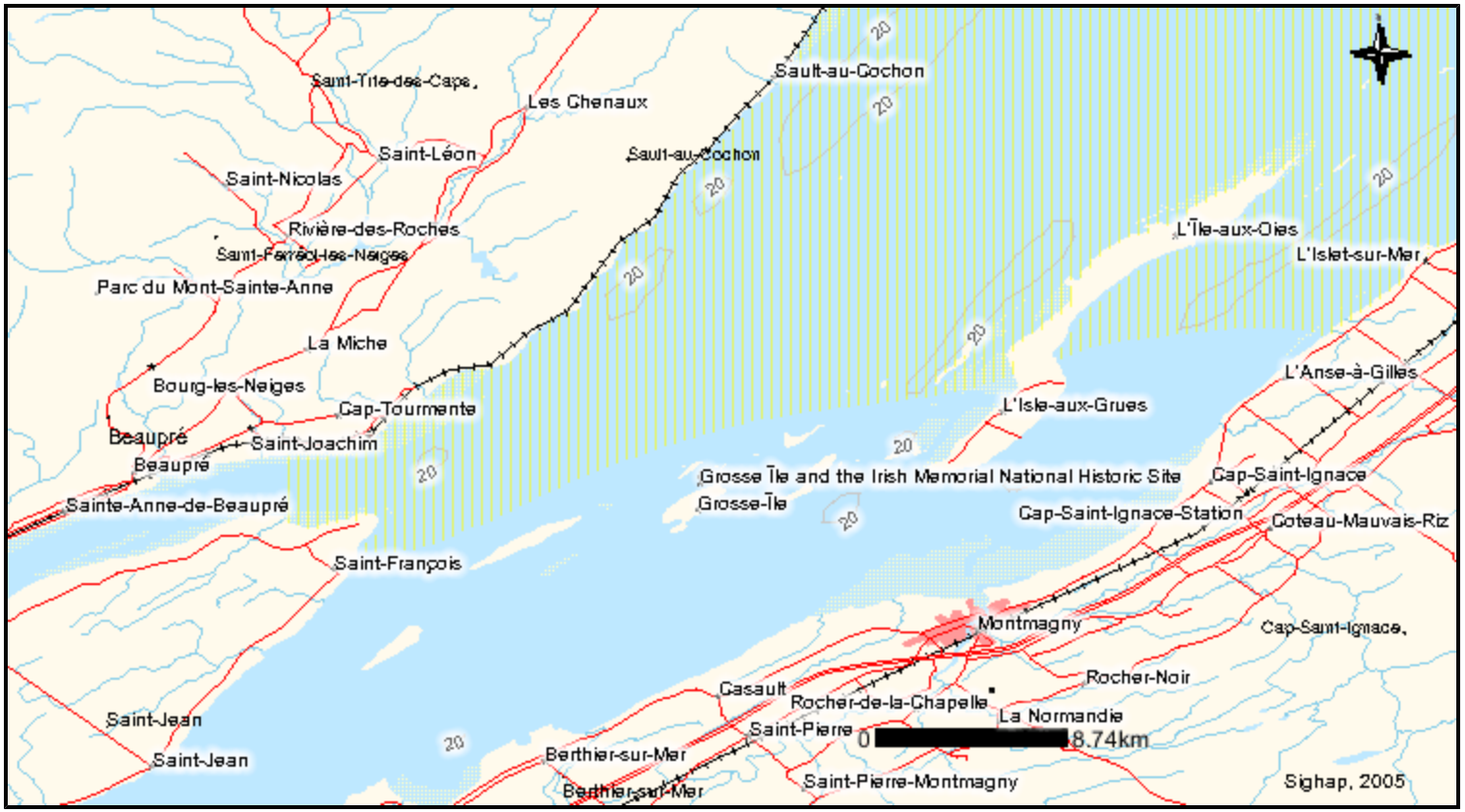
Aire d'alimentation

Présence de l'espèce

Carte SIGHAP - Épinoche tachetée

47° 13' 51" N, 070° 56' 55" O

47° 13' 51" N, 070° 21' 33" O



46° 54' 22" N, 070° 56' 55" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 22" N, 070° 21' 33" O

Légende

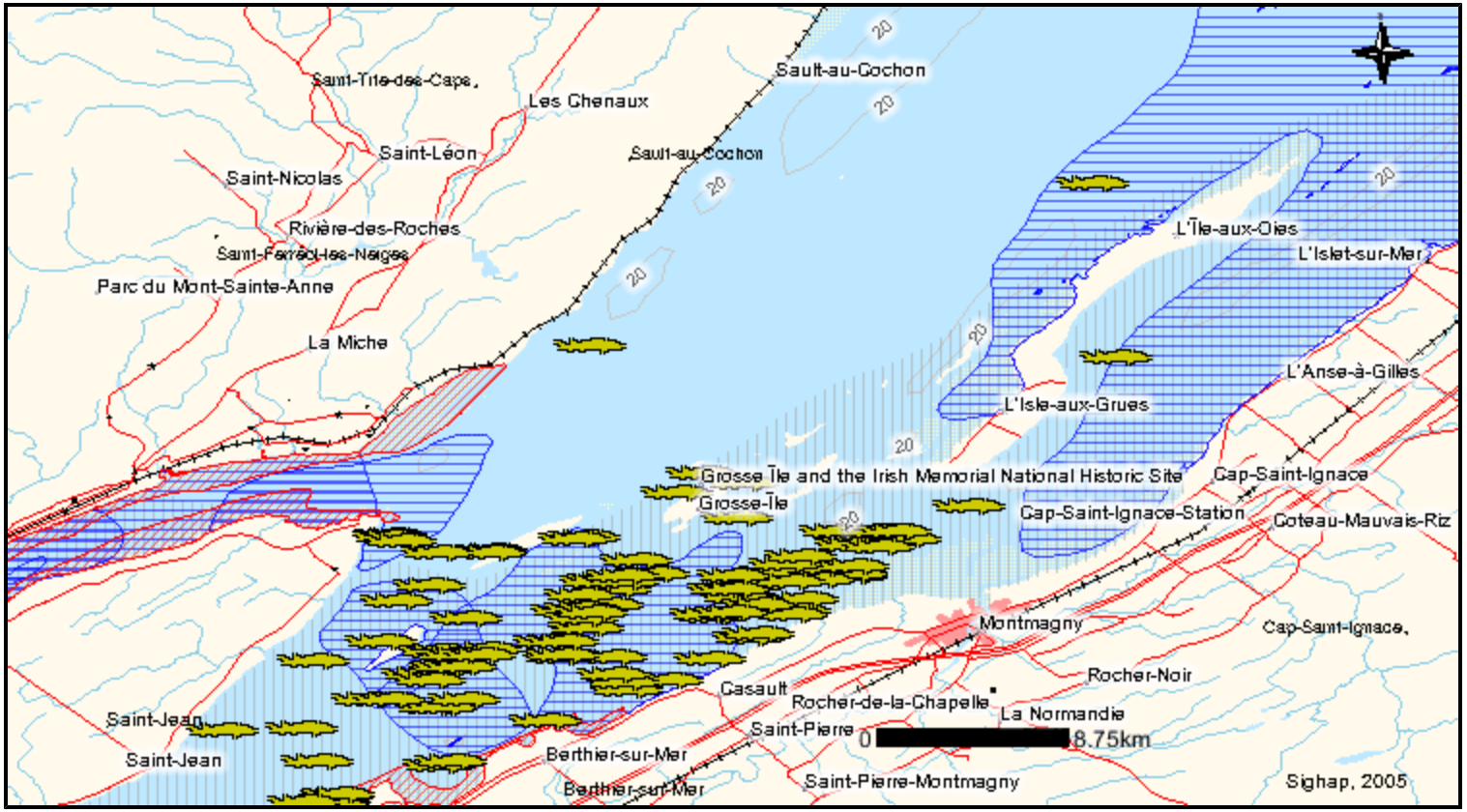
Épinoche tachetée Présence

- Aire de reproduction
- Aire d'alimentation
- Présence de l'espèce

Carte SIGHAP - Esturgeon jaune

47° 13' 51" N, 070° 56' 55" O

47° 13' 51" N, 070° 21' 32" O



46° 54' 22" N, 070° 56' 55" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 22" N, 070° 21' 32" O

Légende

- Esturgeon jaune Observations
- Esturgeon jaune Présence
- Aire de reproduction
- Aire d'alimentation
- Concentration
- Présence de l'espèce

Pêches et Océans Canada

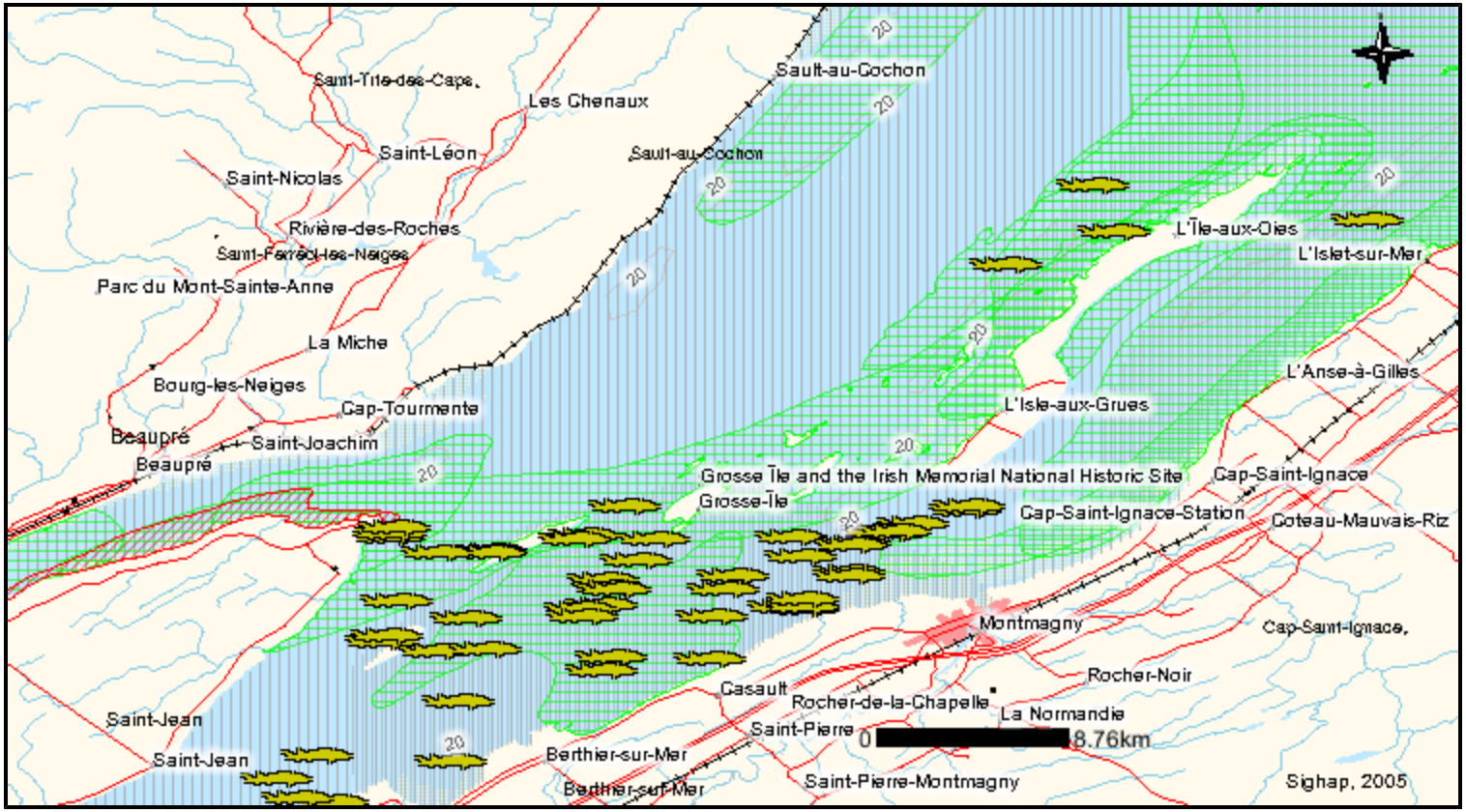
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Esturgeon noir

47° 13' 52" N, 070° 56' 56" O

47° 13' 52" N, 070° 21' 31" O



46° 54' 21" N, 070° 56' 56" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 21" N, 070° 21' 31" O

Légende

- Esturgeon noir Observations
- Esturgeon noir Présence
- Aire de reproduction
- Aire d'alimentation
- Concentration
- Présence de l'espèce

Pêches et Océans Canada

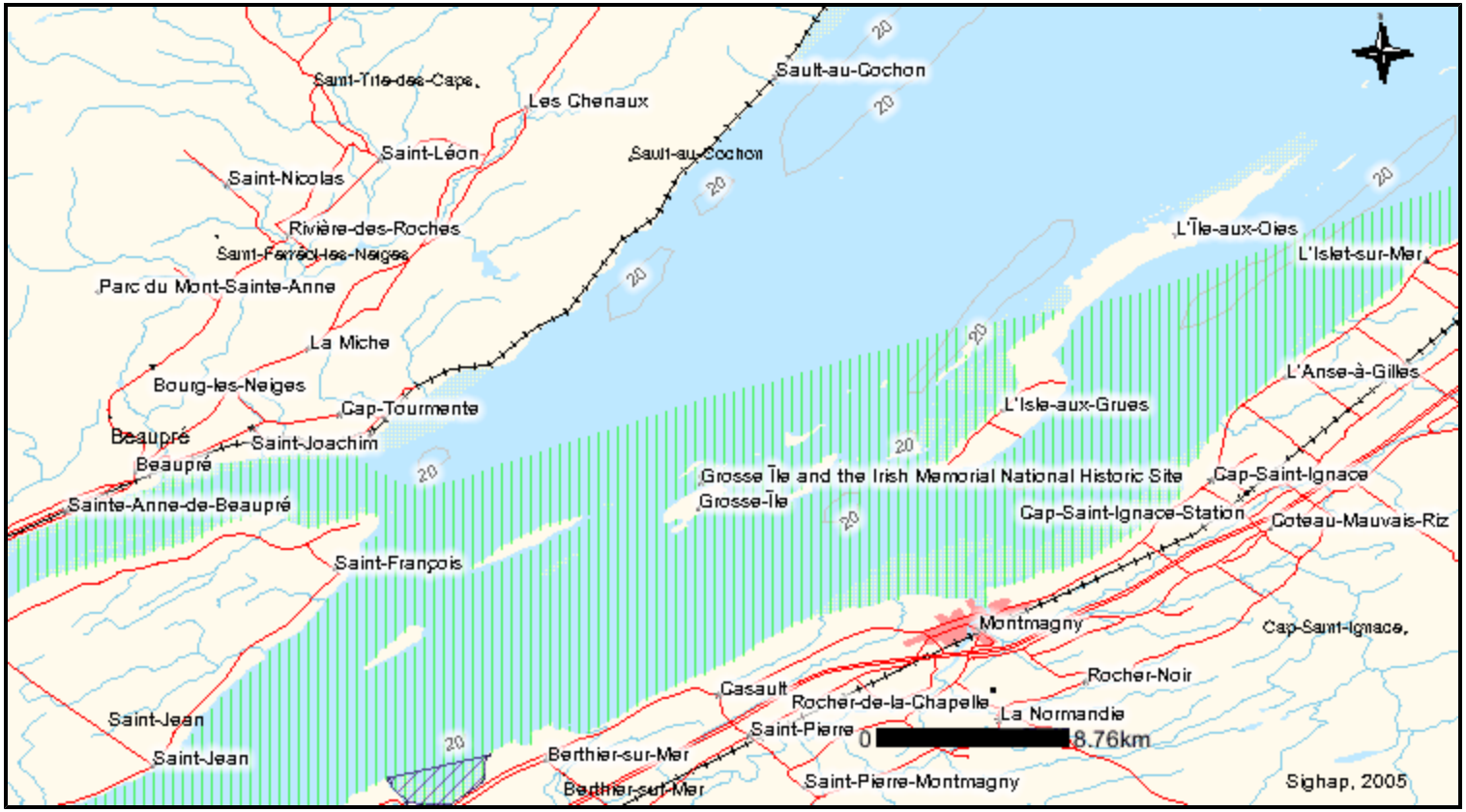
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Fondule barré

47° 13' 52" N, 070° 56' 57" O

47° 13' 52" N, 070° 21' 31" O



46° 54' 21" N, 070° 56' 57" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 21" N, 070° 21' 31" O

Légende

Fondule barré Présence

- Aire de reproduction
- Aire d'alimentation
- Concentration
- Présence de l'espèce

Pêches et Océans Canada

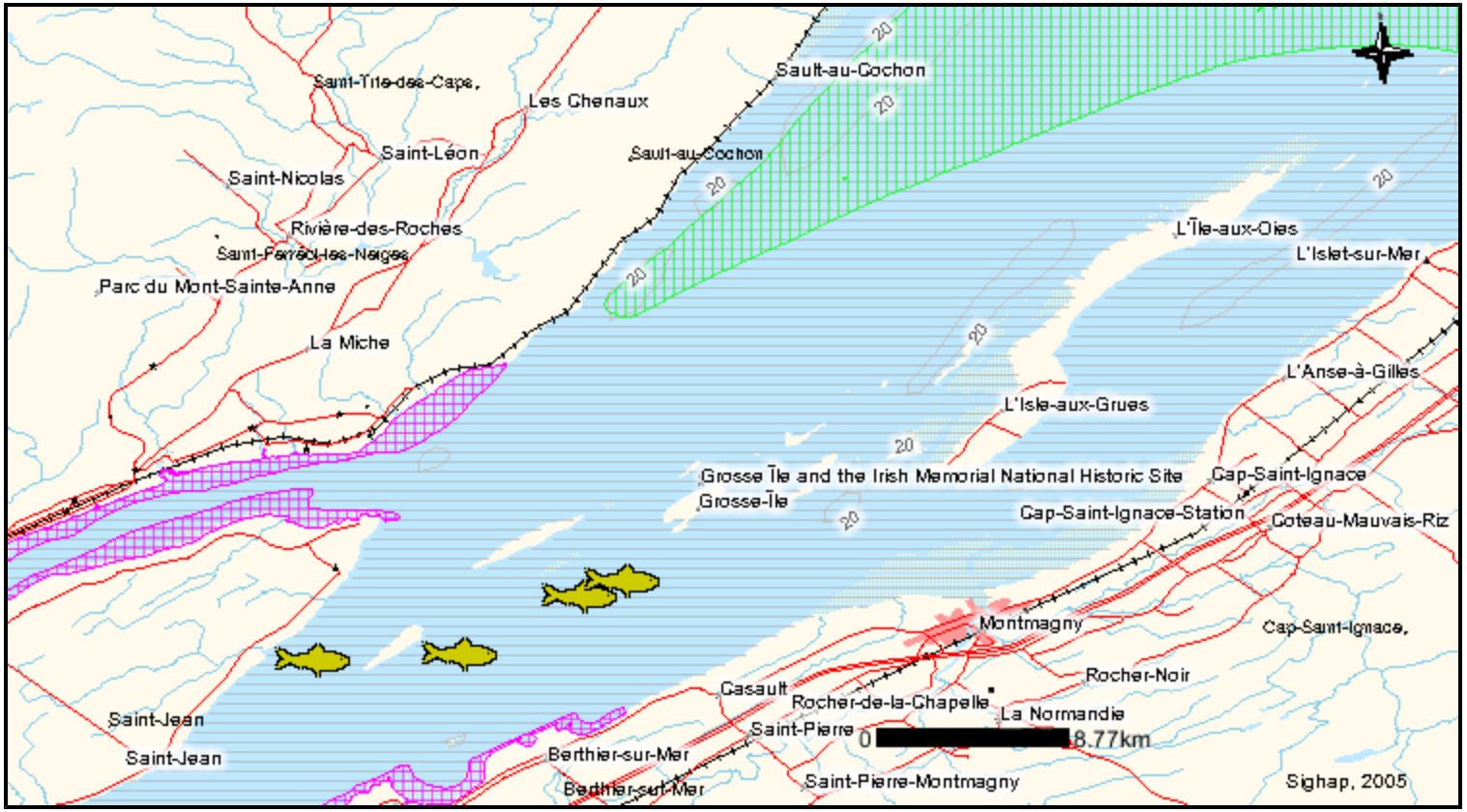
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Gaspareau

47° 13' 53" N, 070° 56' 57" O

47° 13' 53" N, 070° 21' 30" O



46° 54' 20" N, 070° 56' 57" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 20" N, 070° 21' 30" O

Légende

- Gaspareau Observations
- Gaspareau Présence
- Aire de reproduction
- Aire d'alimentation
- Concentration
- Présence de l'espèce

Pêches et Océans Canada

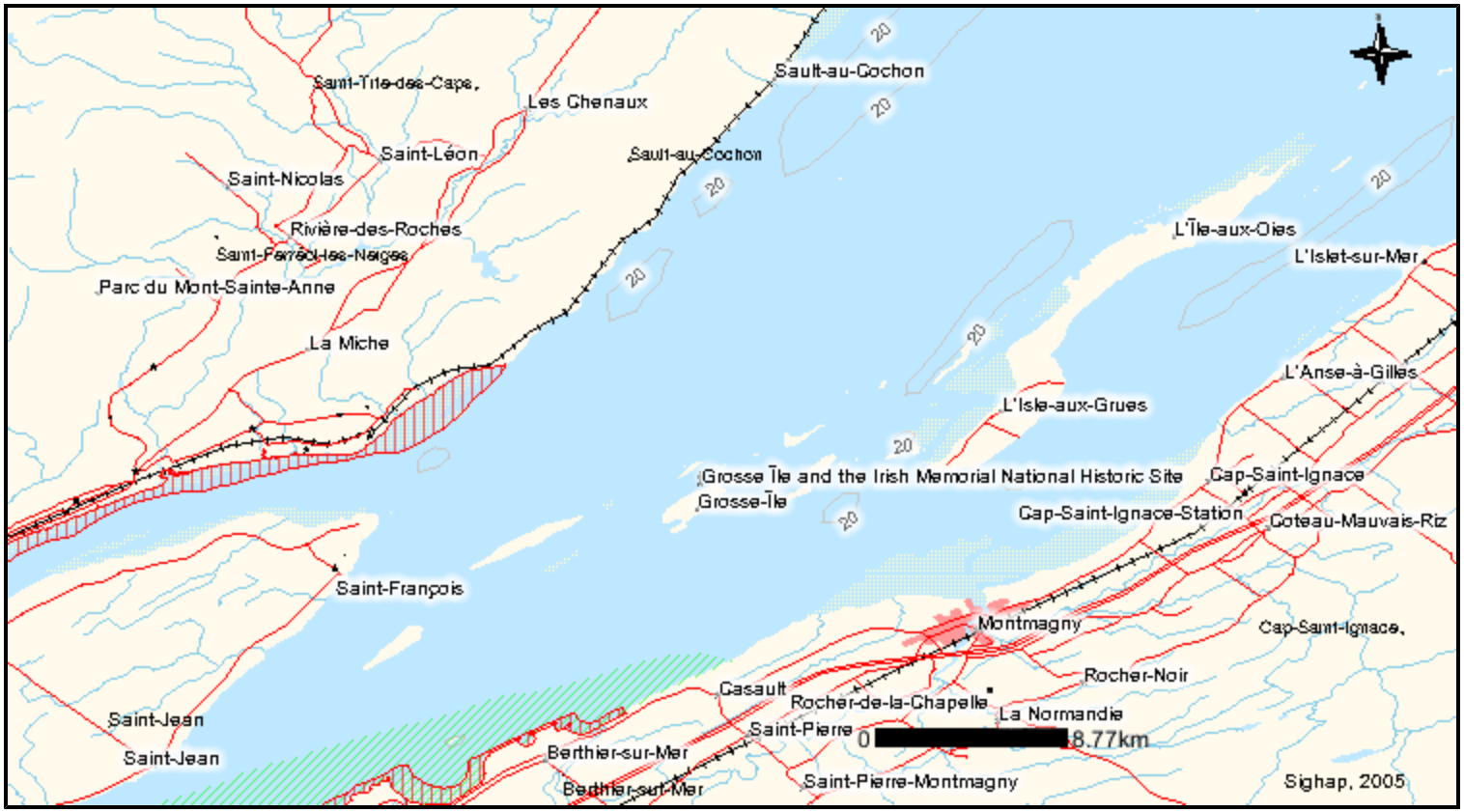
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Grand brochet

47° 13' 53" N, 070° 56' 58" O

47° 13' 53" N, 070° 21' 29" O



46° 54' 20" N, 070° 56' 58" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 20" N, 070° 21' 29" O

Légende

Grand brochet Présence

- Aire de reproduction
- Aire d'alimentation
- Présence de l'espèce

Pêches et Océans Canada

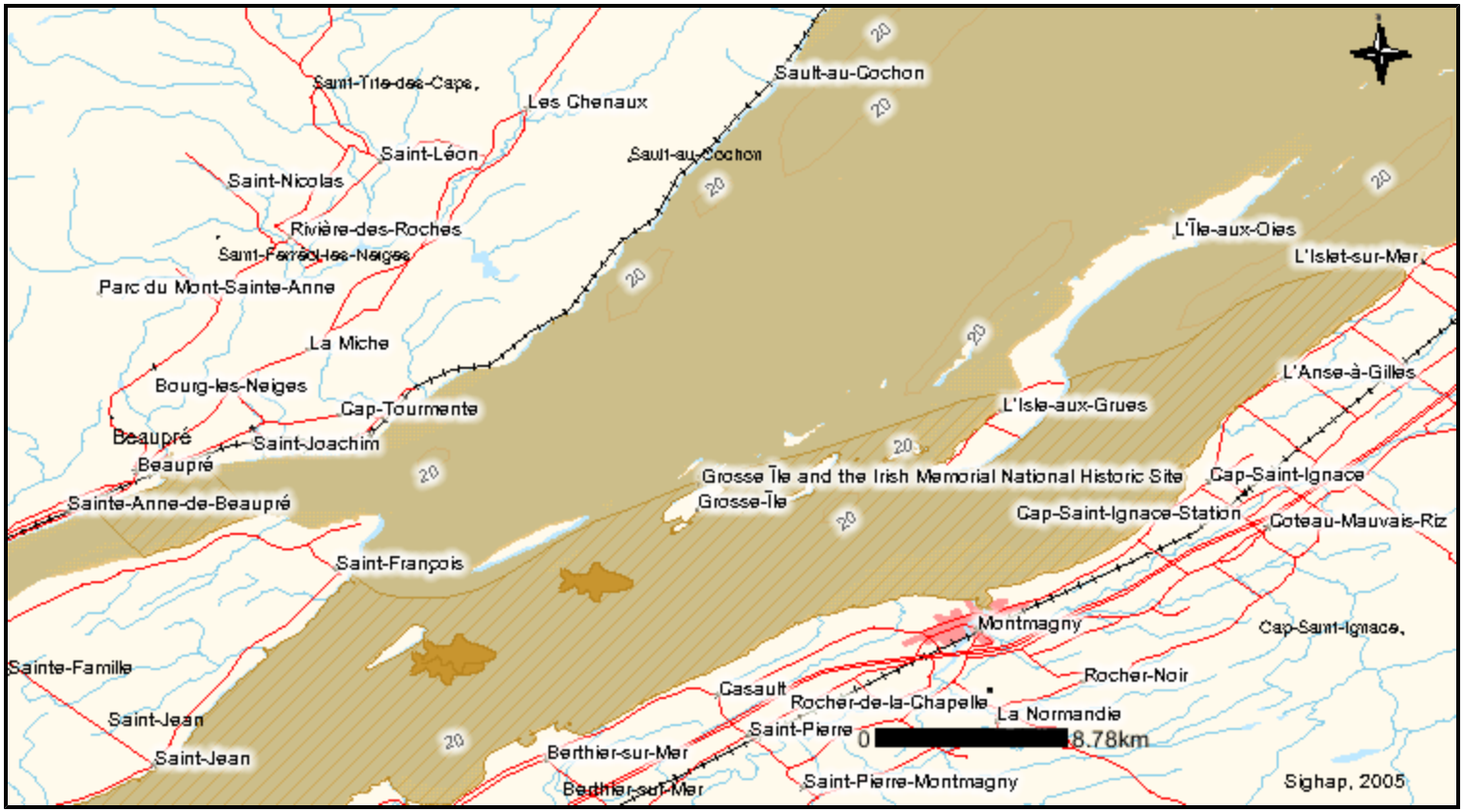
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Grand corégone

47° 13' 53" N, 070° 56' 59" O

47° 13' 53" N, 070° 21' 29" O



46° 54' 20" N, 070° 56' 59" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 20" N, 070° 21' 29" O

Légende

Grand corégone Observations

Présence de l'espèce//Automne

Grand corégone Présence

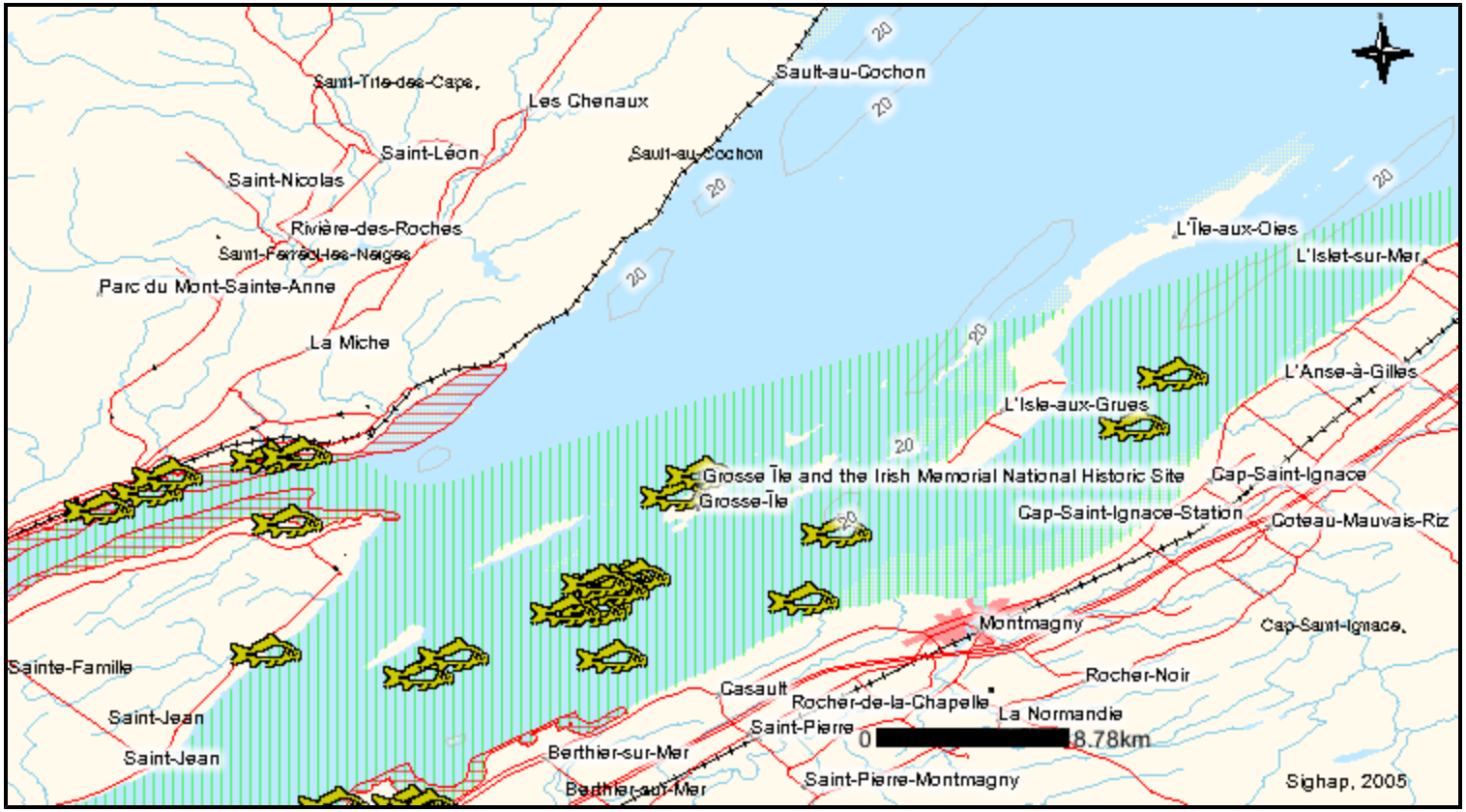
Présence de l'espèce//Non déterminée

Concentration/Non exploitée/Été

Carte SIGHAP - Meunier noir

47° 13' 54" N, 070° 56' 59" O

47° 13' 54" N, 070° 21' 28" O



46° 54' 19" N, 070° 56' 59" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 19" N, 070° 21' 28" O

Légende

- Meunier noir Observations
- Meunier noir Présence
- Aire de reproduction
- Aire d'alimentation
- Présence de l'espèce

Pêches et Océans Canada

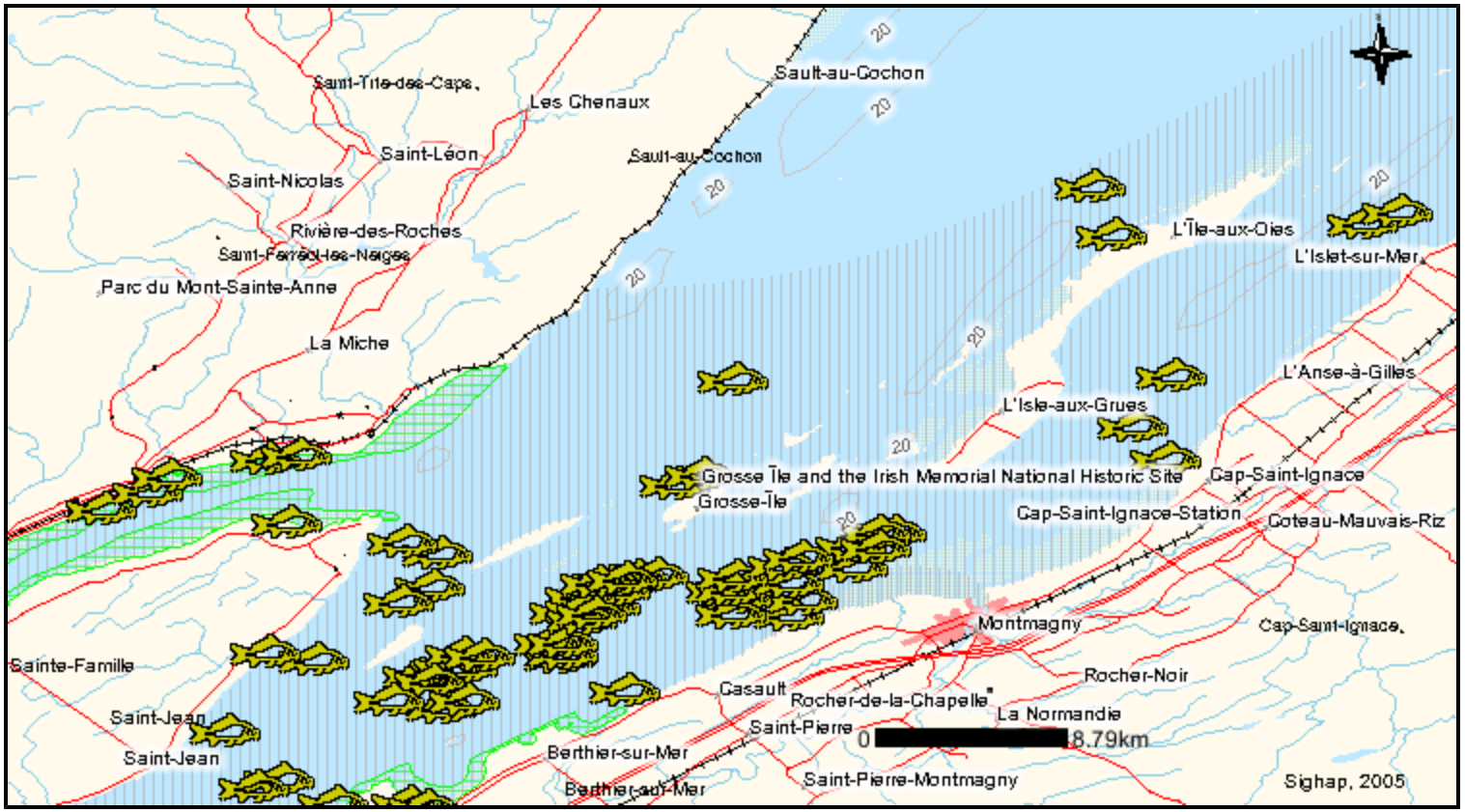
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Meunier rouge

47° 13' 54" N, 070° 57' 00" O

47° 13' 54" N, 070° 21' 27" O



46° 54' 19" N, 070° 57' 00" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 19" N, 070° 21' 27" O

Légende

Meunier rouge Observations

Meunier rouge Présence

Aire de reproduction

Présence de l'espèce

Pêches et Océans Canada

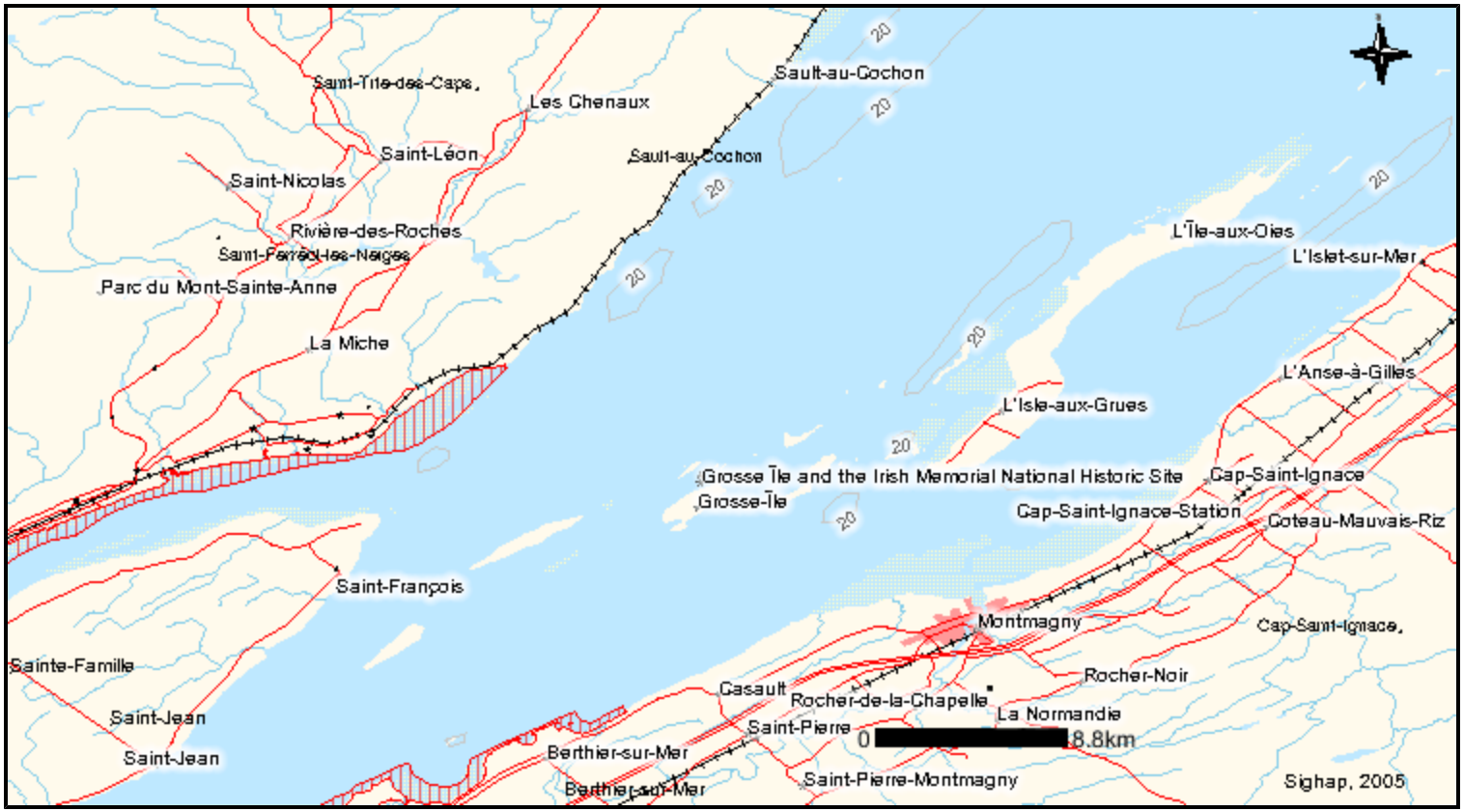
Fisheries and Oceans Canada

Canada

Carte SIGHAP - Meunier sp.

47° 13' 55" N, 070° 57' 01" O

47° 13' 55" N, 070° 21' 27" O



46° 54' 18" N, 070° 57' 01" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 18" N, 070° 21' 27" O

Légende

Meunier sp. Présence

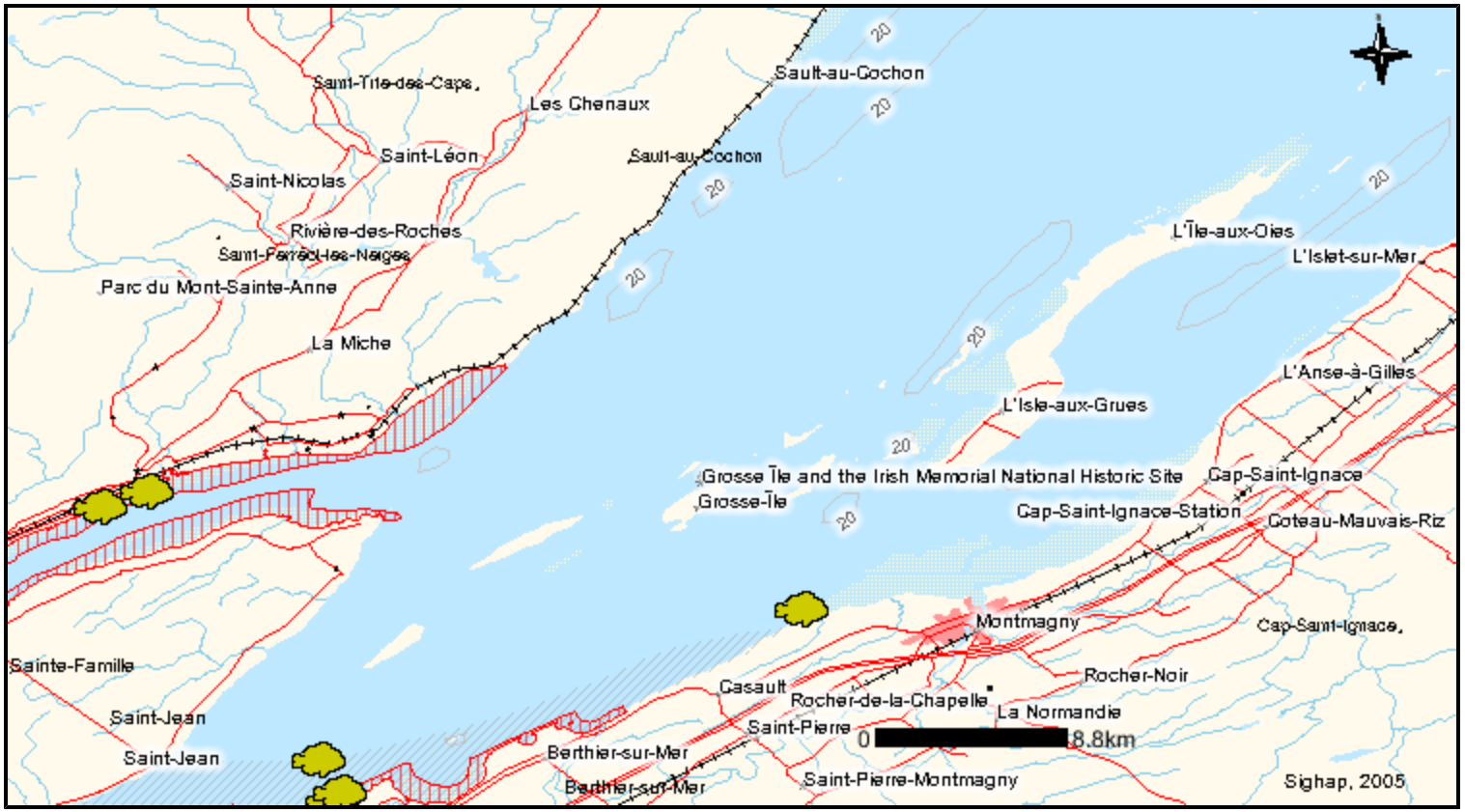
Aire de reproduction

Présence de l'espèce

Carte SIGHAP - Perchaude

47° 13' 55" N, 070° 57' 01" O

47° 13' 55" N, 070° 21' 26" O



46° 54' 18" N, 070° 57' 01" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 18" N, 070° 21' 26" O

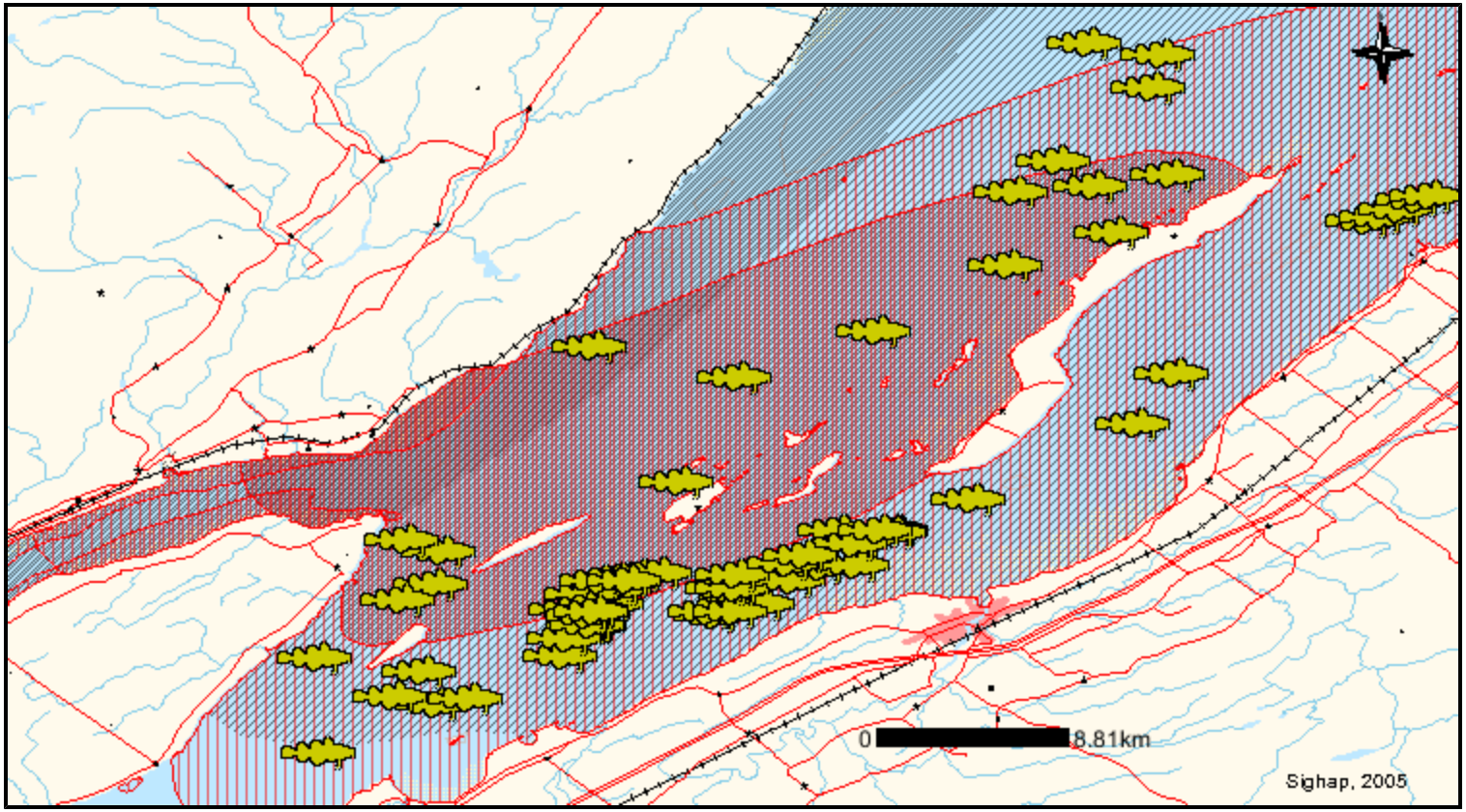
Légende

- Perchaude Observations
- Perchaude Présence
- Aire de reproduction
- Aire d'alimentation
- Présence de l'espèce

Carte SIGHAP - Poulamon atlantique

47° 13' 55" N, 070° 57' 02" O

47° 13' 55" N, 070° 21' 25" O



46° 54' 18" N, 070° 57' 02" O

Surface de référence géodésique : NAD 83, Coordonnées géographiques

46° 54' 18" N, 070° 21' 25" O

Légende

Poulamon atlantique Observations

Poulamon atlantique Présence

Aire de reproduction

Aire d'alimentation

Concentration

Présence de l'espèce

Appendix E
Avifauna and Habitat

Colonies d'oiseaux retrouvées de Montréal à l'aval du lac Saint-Pierre

Nom	Localisation		Caractéristique	Année de recensement
	Latitude	Longitude		
Île Masta	45°39'03"N	73°27'49"W	2 nids de goéland marin	1992
Île Deslauriers	45°42'43"N	73°26'27"W	17 nids de goéland marin, 3 nids de goéland argenté, 5080 nids de goéland à bec cerclé, 83 nids de bihoreau gris	2003
Îles Robinet	45°44'21"N	73°25'43"W	5 couples de sterne pierregarin	1979
Île aux Ragominaires	45°44'33"N	73°24'54"W	1 couple de goéland marin	1979
Île Bouchard	45°49'12"N	73°19'13"W	18 nids de grand héron	2001
Chenal de Terrebonne	45°51'04"N	73°15'41"W	colonie de taille indéterminée de guifette noire	1989
Île aux Rongeurs	45°52'13"N	73°14'57"W	1 couple de goéland marin	1979
Îlets à Lefebvre	45°53'20"N	73°13'47"W	1 couple de goéland marin et 12 852 nids de goéland à bec cerclé	2003
Île Saint-Ours	45°54'52"N	73°13'25"W	25 nids de sterne pierregarin	1999
Îlot Ouest de l'Île Saint-Ours	45°55'39"N	73°13'08"W	30 nids de sterne pierregarin	1989
Grande île de Sorel	46°07'35"N	73°00'59"W	1310 nids de grand héron et 3 nids de grande aigrette	2001
			141 nids de bihoreau gris	1992
Trou de la batture aux Carpes	46°08'15"N	72°59'53"W	colonie de taille indéterminée de guifette noire	1989
Baie des Îlets (lac Saint-Pierre)	46°07'22"N	72°55'56"W	colonie de taille indéterminée de guifette noire	1989
Îlets du lac Saint-Pierre	le long de la voie maritime		2 nids de goéland argenté, 234 nids de goéland à bec cerclé, 3 couples de sterne pierregarin, 488 nids de cormoran à aigrette	2003

Source : Service canadien de la faune (contacté par Robert Hamelin et Associés inc. en 2004)

Zones importantes pour la conservation des oiseaux au Canada (ZICO) retrouvées de Montréal à l'amont du lac Saint-Pierre

Nom	Localisation		Catégorie	Caractéristique
	Latitude	Longitude		
Île Deslauriers, Varennes	45,717° N	73,433° O	Significative au niveau mondial	La plus importante colonie de goélands à bec cerclé au Québec (51 667 couples recensés en 2000) Population de bihoreaux gris en croissance Colonie d'hirondelles de rivage Nombreux canards chipeaux et autres espèces de sauvagines nicheurs
Réserve nationale de faune des Îles-de-Contrecoeur, Contrecoeur	45,867° N	73,25° O	Significative au niveau mondial	Site de nidification significatif pour le goéland à bec cerclé Importante aire de nidification pour les canards barboteurs Grande diversité d'oiseaux nichant dans les marais

Source: www.bsc-eoc.org

Zones importantes pour la conservation des oiseaux dans les secteurs du lac Saint-Pierre et entre Bécancour et Batiscan

Nom	Localisation		Catégorie	Caractéristique
	Latitude	Longitude		
La Grande Île, Berthierville	46,083° N	73,167° O	Significative au niveau national	Importante héronnière Important site pour le bihoreau gris Une grande partie de l'Île est désignée Refuge faunique de la Grande Île et est la propriété du gouvernement du Québec
Plaine inondable de Saint-Barthélemy, Saint-Barthélemy	46,183° N	73,133° O	Significative aux niveaux mondial, continental et national	Importante aire de repos au printemps pour la grande oie des neiges, la bernache du Canada et le canard pilet À l'automne, le site accueille 2000 canards noirs
Centre du lac Saint-Pierre, Sorel	46,2° N	72,867° O	Significative au niveau continental	À l'automne, le site est utilisé par un grand nombre de canards
Nicolet et Baie-du-Fèbvre, Nicolet	46,2° N	72,667° O	Significative au niveau mondial	La plus importante aire de repos au printemps pour la bernache du Canada et les canards barboteurs. Le site est fréquenté par un nombre significatif de grandes oies des neiges (500 000 individus recensés en 1998) À l'automne le site est utilisé par plusieurs espèces d'oiseaux aquatiques Site fréquenté par trois espèces en situation précaire au Québec: le hibou des marais (susceptible d'être désignée), le petit blongios (vulnérable) et le faucon pèlerin (vulnérable)

Soure:www.bsc-eoc.org

Colonies d'oiseaux retrouvées dans le secteur de la Traverse du Nord

Île de Bellechasse	8 nids de goéland marin, 433 nids de goéland argentés, 496 nids de goélands à bec cerclé, 96 nids de cormoran à aigrettes	2003
	38 nids de sterne pierregarin	1997
Île Patience	9 couples de goéland marin, 415 couples de goéland argenté	2003
Île Gointon	4 couples de goéland marin, 165 couples de goéland argenté	2003
Île à Durand	4 couples de goéland marin, 176 couples de goéland argenté, 671 couples de goélands à bec cerclé	2003
Île de la Corneille	2 couples de goéland marin, 25 couples de goéland argenté	1971
	4 nids de bihoreau à couronne noire	1992
	79 nids de grand héron	2001
Île à l'Oignon	4 couples de goéland marin, 207 couples de goéland argenté	1990
Île Brothers	2 couples de goéland marin, 426 couples de goéland argenté	2003
	un minimum de 4 nids de bihoreau à couronne noire et 20 nids de grand héron	2003
Île aux Brisants du Cap Brûlé	7 nids de goéland marin, 147 nids de cormoran à aigrettes	1990

Source : Service canadien de la faune (contacté par Robert Hamelin et Associés inc. en 2004)

Zones importantes pour la conservation des oiseaux dans le secteur de la Traverse du Nord

Nom	Localisation		Catégorie	Caractéristique
	Latitude	Longitude		
Batture de Beauport et chenal de l'Île d'Orléans	46,883° N	71,15° O	Significative au niveau mondial	Au printemps et à l'automne le site est fréquenté par un grand nombre d'espèces de sauvagine et de limicoles.
				Site important pour la grande oie des neiges, le canard noir et le bécasseau semipalmé
				À l'occasion, le grèbe esclavon et le garrot d'Islande, considérés comme rares au Québec, peuvent y être observés
Cap Tourmente, Saint-Joachim	47,067° N	70,8° O	Significative au niveau mondial	Accueille une forte proportion de la population de grandes oies des neiges à l'automne et une proportion significative au printemps
				Au total, plus de 250 espèces d'oiseaux ont été recensées à l'intérieur de la réserve.
				Réserve nationale de faune depuis 1978 et est la propriété du gouvernement canadien
Saint-Vallier	46,900°N	70,849°O	Significative au niveau mondial	Au printemps, le site est fréquenté par un nombre significatif de grandes oies des neiges (50 000 individus recensés au cours d'une journée en 1995)
				Site fréquenté par d'autres espèces de sauvagine et par plusieurs limicoles

Source: www.bsc-eoc.org

Appendix F
Spawning Characteristics of Species at Risk

Caractéristiques de fraie des espèces en situation précaire

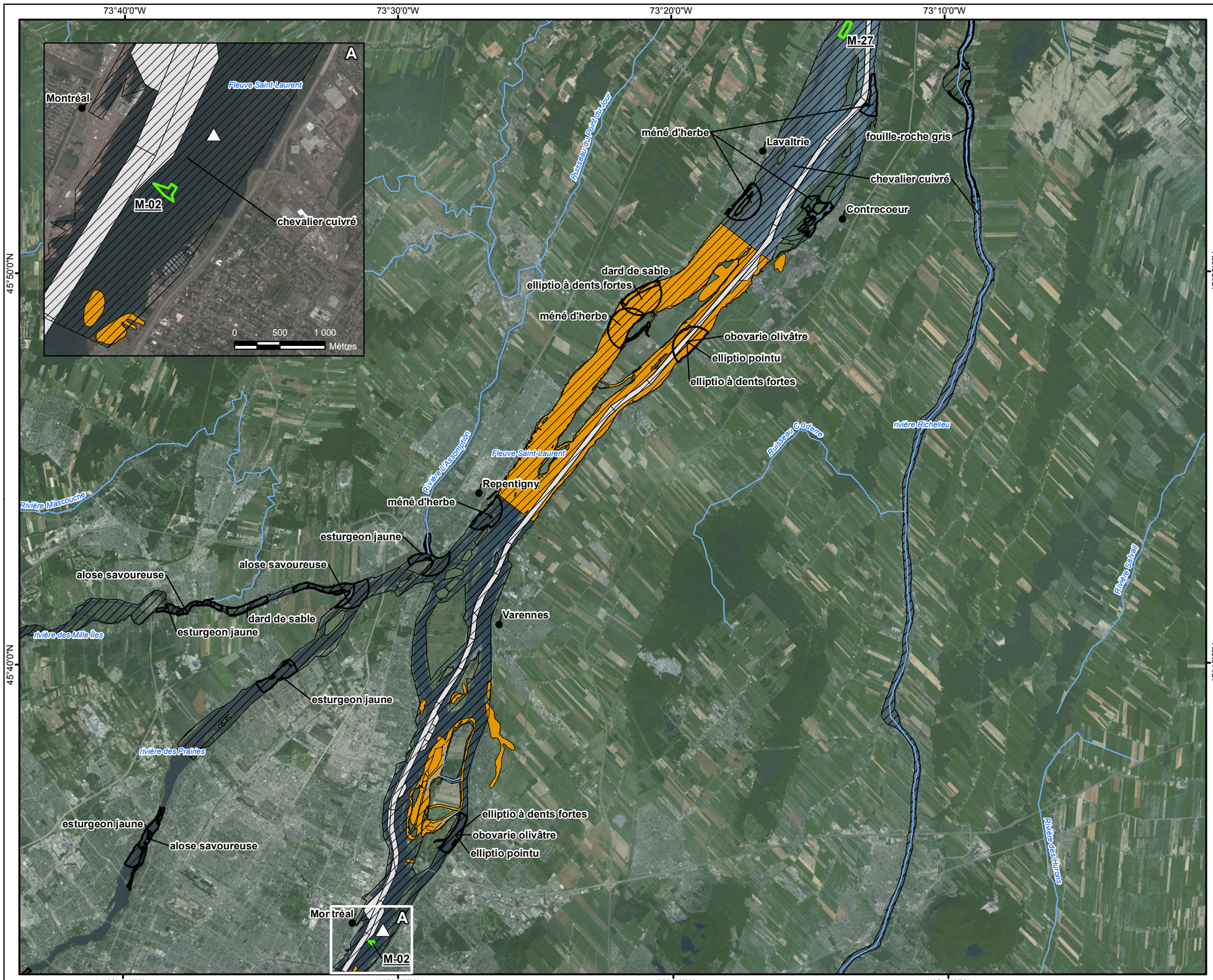
Espèce	Période de reproduction	Type de frayère
Alose savoureuse	Printemps, fin mai et juin.	Fraie habituellement dans des secteurs larges et peu profonds (0,5 à 3,0 m), vitesse de courant de 0,2 à 1,0 m/s et substrat de sable, gravier ou galet. Rivières, rarement ou pas du tout en lacs. Au Québec, essentiellement dans la région de Montréal.
Anguille d'Amérique	Entre février et avril.	Se reproduit dans la mer des Sargasses, dans l'océan Atlantique.
Bar rayé	À la fin du printemps.	Le frai a lieu en rivière.
Chat-fou des rapides	Juin à juillet.	Fraie dans des sites peu profonds et rocheux en rivières et en lacs
Chevalier cuivré	De la fin de juin au début de juillet.	Seules deux frayères (archipel de Chambly et bief aval du barrage de Saint-Ours) sont connues, et une aire d'alevinage (Saint-Marc-sur-Richelieu) a été identifiée dans la rivière Richelieu.
Chevalier de rivière	Fin du printemps.	Le frai a lieu à des températures variant entre 17 et 20ºC dans des habitats peu profonds faits de rapides ou de bancs où le courant est de modéré à rapide et le substrat grossier (gravier, galets).
Dard de sable	Entre le mois de mai et la mi-août.	La température de l'eau varie de 14,4 à 24,4^{0}C. Pour la fraie, nécessite un substrat bien oxygéné, composé de sable et dépourvu de sédiments fins.
Éperlan arc-en-ciel, population du sud de l'estuaire du Saint-Laurent	Printemps, généralement mai, parfois avril ou juin.	Préférentiellement rivières à fond de gravier et de cailloux, également embouchure des cours d'eau, hauts-fonds graveleux des lacs ou directement dans fleuve Saint-Laurent et rivière Saguenay.
Esturgeon jaune, population des Grands Lacs – du haut Saint-Laurent	Printemps, mai et juin.	Eau peu profonde (0,6 à 4,9 m) et à courant rapide aux fonds d'argile dure, de sable, de gravier et de blocs rocheux. Principalement en rivières, parfois dans les lacs.
Esturgeon noir	Entre la fin de mai et le début de juillet.	Fraie dans les profondeurs de 0,6 m à 4,5 m (lac) ou de 11 m à 12,8 m (mer), dans les endroits à courant rapide et dans une eau à température variant de 13 à 18 ^{o}C.
Fouille-roche gris	Au printemps ou au début de l'été.	En période de frai, il migre vers des zones rocheuses à courant moyen ou rapide.
Lamproie du Nord	Avril à juin.	Dans un courant rapide et un substrat de gravier grossier ou de roches.
Maraîche	Fin septembre jusqu'en novembre.	Préfère les plates-formes continentales, mais peut également fréquenter les zones plus profondes ou moins profondes. Préfère les températures inférieures à 18°C jusqu'à 1°C
Méné d'herbe	À la fin du printemps ou durant l'été.	Dans une eau dont la température devient chaude, entre 14°C et 27°C. Les œufs sont dispersés dans la végétation et ne font l'objet d'aucun soin de leurs géniteurs.
Méné laiton	À la fin du printemps ou durant l'été.	Les œufs adhésifs sont déposés en eau calme et s'attachent à la végétation.

Sources : MFFP, 2015; Scott et Crossman, 1974; Bernatchez et Giroux, 2000.

Appendix G
Species at Risk by Area

Zones de reproduction du poisson à proximité des aires de mise en dépôt et espèces fauniques en situation précaire présentant un potentiel de présence dans le secteur selon les occurrences du CDPNQ

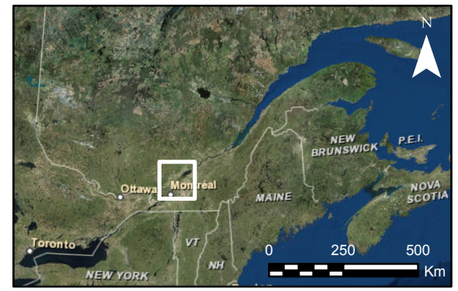
Dragage d'entretien annuel
de la voie navigable du Saint-Laurent
(années 2016 à 2018)
De Montréal à Cap Gribane



1: 175 000

0 5 10 Kilomètres

- Villes
- Rivière/Ruisseau
- Mention d'espèces en situation précaire
- Site de mise en dépôt
- Chenal
- Frayère
- Frayère



Source :
- *Hydrographie : MERN, téléchargement janv 2016*
- *Frayères : MFFP Montérégie, Décembre 2015,*
- *Mention d'espèces en situation précaire : CDPNQ, déc. 2015*
- *Secteurs et sites de mise en dépôt : MPO*
- *Orthophotos : Imagerie de base, Esri (3 juillet 2010)*

Réalisation : GHD
Janvier 2016

N/Réf. : J020214 – E1

Système de référence géodésique :
North American Datum 1983

Projection : Mercator transverse modifiée zone 8

Zones de reproduction du poisson à proximité des aires de mise en dépôt et espèces fauniques en situation précaire présentant un potentiel de présence dans le secteur selon les occurrences du CDPNQ

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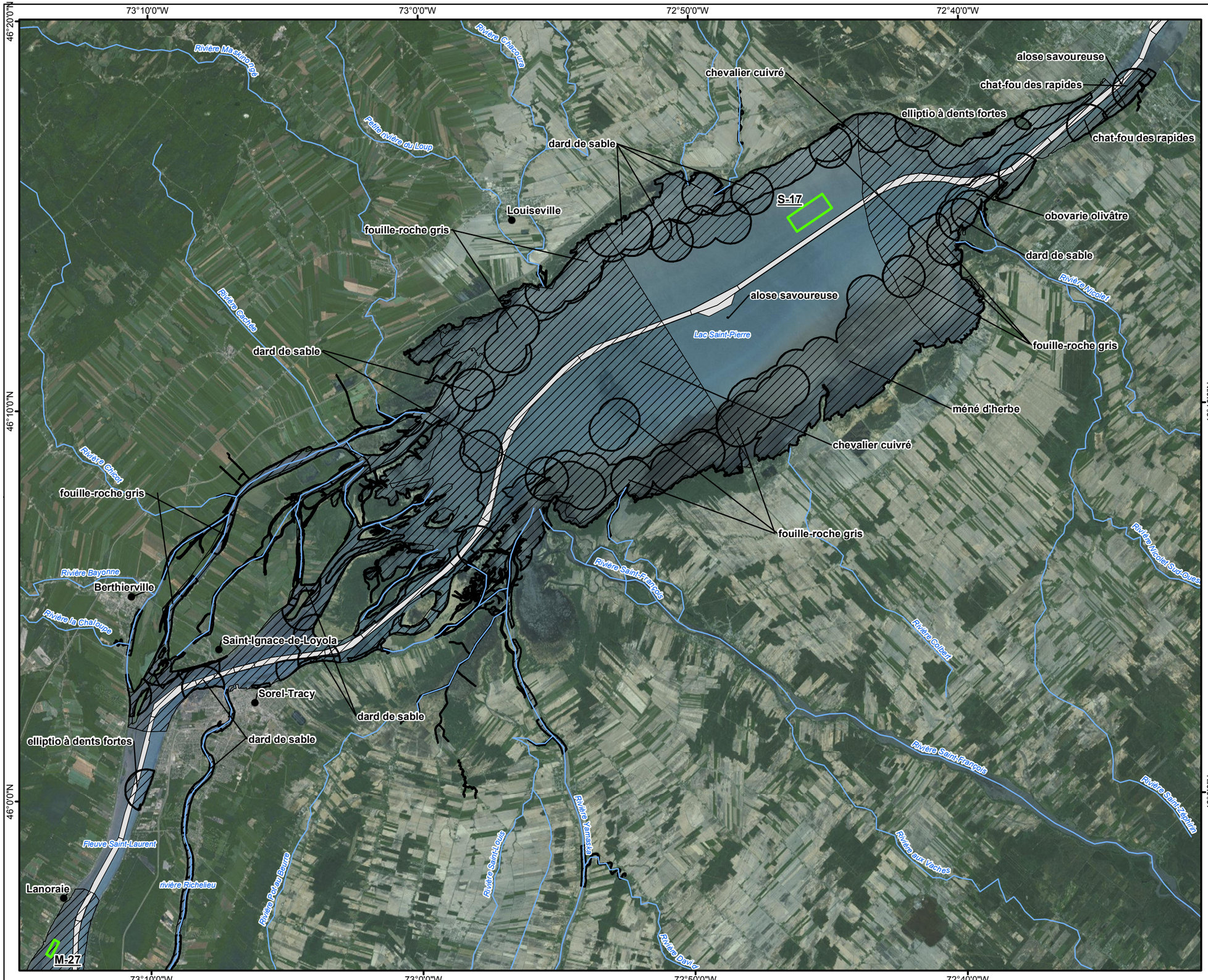

1: 175 000

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- Villes
- Rivière/Ruisseau
- Mention d'espèces en situation précaire
- Site de mise en dépôt
- Chenal

Source :
- *Hydrographie : MERN, téléchargement janv 2016*
- *Mention d'espèces en situation précaire : CDPNQ, déc. 2015*
- *Secteurs et sites de mise en dépôt : MPO*
- *Orthophotos : Imagerie de base, Esri (3 juillet 2010)*

Réalisation : GHD N/Réf. : J020214 – E1
Janvier 2016

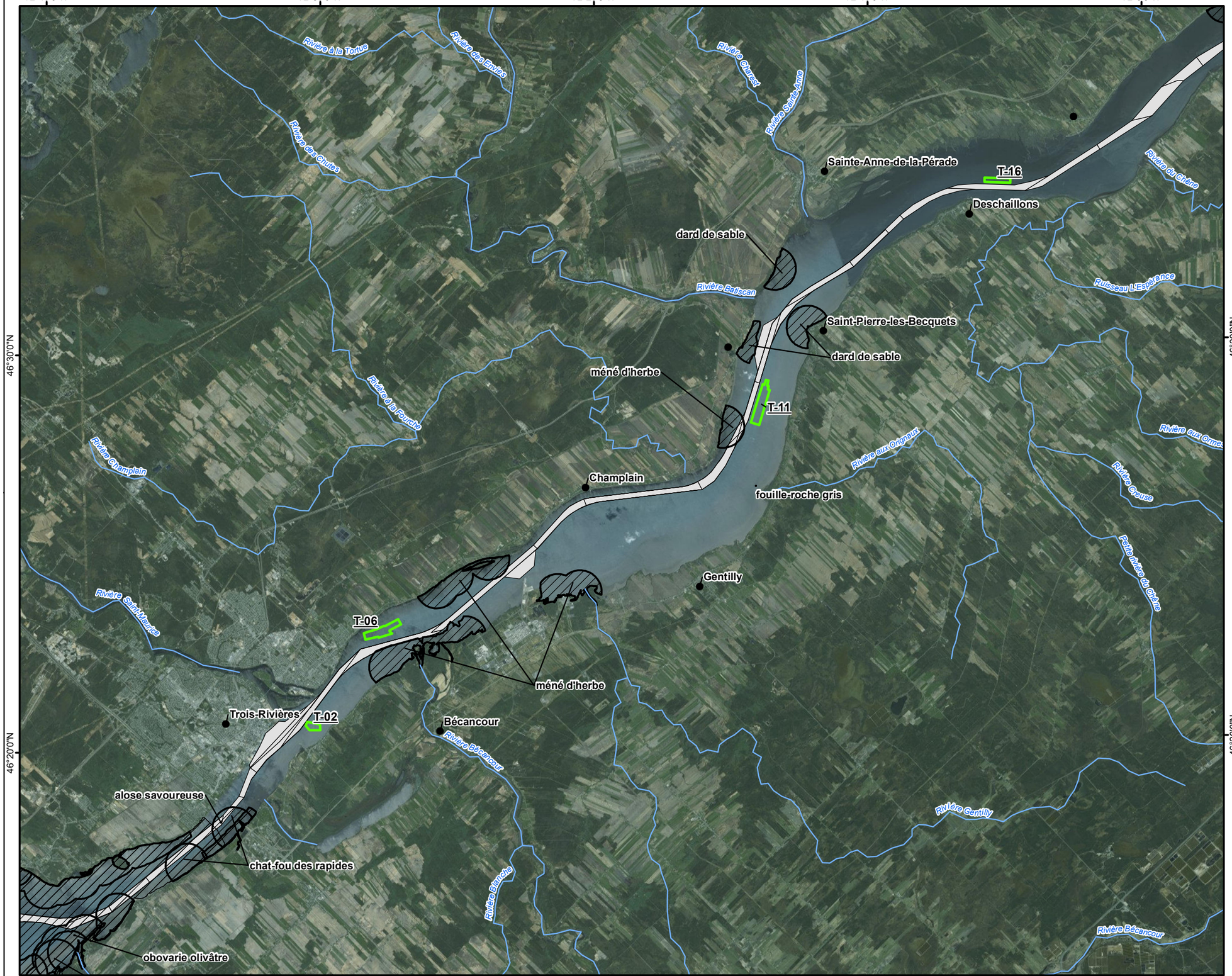
Système de référence géodésique :
North American Datum 1983

Projection : Mercator transverse modifiée zone 8

Annexe G (2 de 5)

Zones de reproduction du poisson à proximité des aires de mise en dépôt et espèces fauniques en situation précaire présentant un potentiel de présence dans le secteur selon les occurrences du CDPNQ

Dragage d'entretien annuel de la voie navigable du Saint-Laurent (années 2016 à 2018) De Montréal à Cap Gribane



1: 175 000

0 5 10 Kilomètres

- Villes
- Rivière/Ruisseau
- Mention d'espèces en situation précaire
- Site de mise en dépôt
- Chenal

Source :
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- *Mention d'espèces en situation précaire : CDPNQ, déc. 2015*
- *Secteurs et sites de mise en dépôt : MPO*
- *Orthophotos : Imagerie de base, Esri (3 juillet 2010)*

Réalisation : GHD N/Réf. : J020214 – E1
Janvier 2016

Système de référence géodésique : North American Datum 1983

Projection : Mercator transverse modifiée zone 8

Annexe G (3 de 5)

Zones de reproduction du poisson à proximité des aires de mise en dépôt et espèces fauniques en situation précaire présentant un potentiel de présence dans le secteur selon les occurrences du CDPNQ

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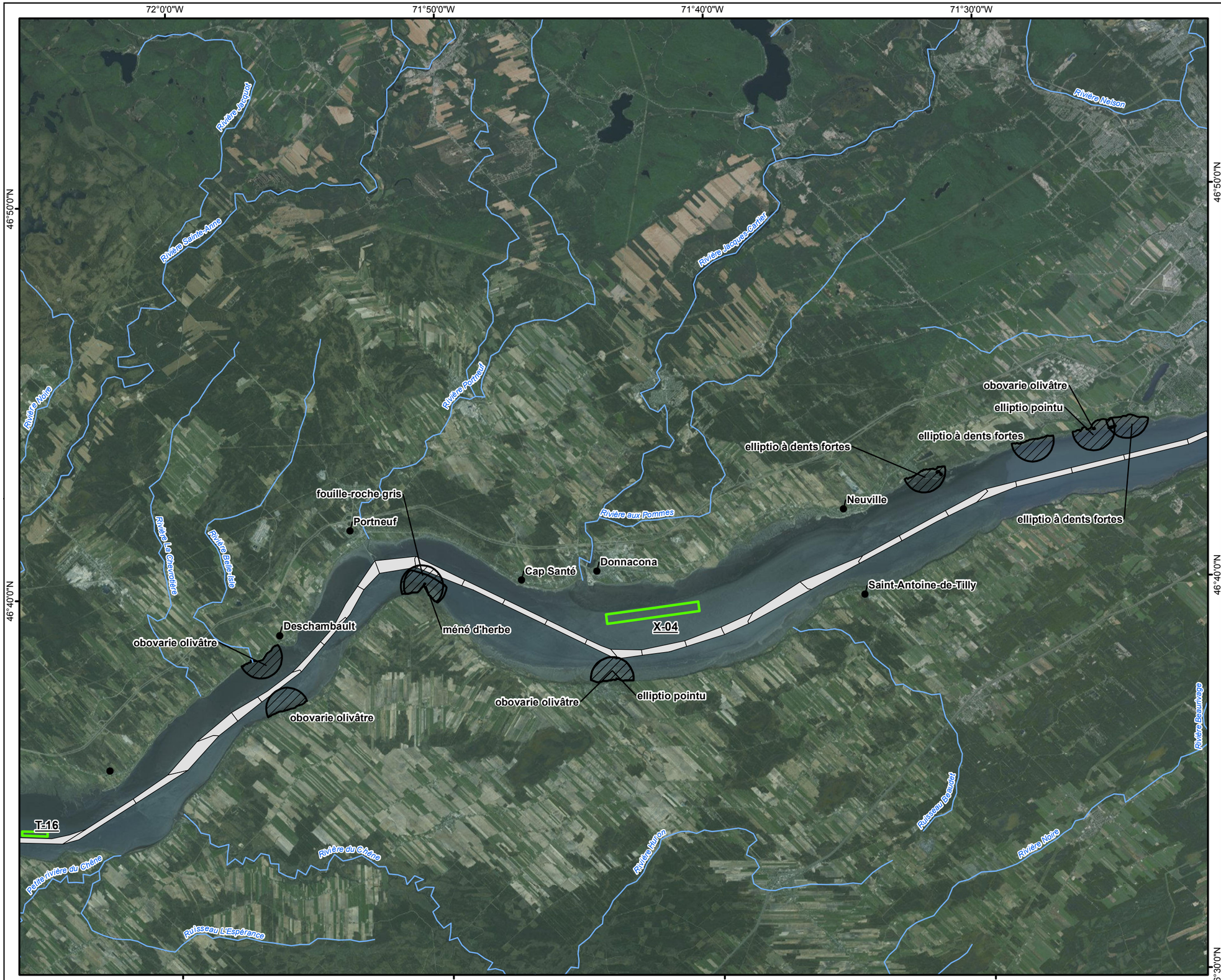

1: 175 000

0 5 10 Kilomètres

- Villes
- Rivière/Ruisseau
- Mention d'espèces en situation précaire
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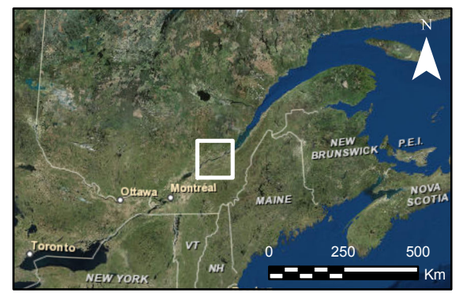
- Chenal



Source :
- *Hydrographie : MERN, téléchargement janv 2016*
- *Mention d'espèces en situation précaire : CDPNQ, déc. 2015*
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Réalisation : GHD
Janvier 2016

N/Réf. : J020214 – E1

Système de référence géodésique :
North American Datum 1983

Projection : Mercator transverse modifiée zone 8

71°0'0"W 70°50'0"W 70°40'0"W 70°30'0"W 70°20'0"W

47°10'0"N 47°0'0"N

Rivière Boisé
Rivière Lombrette
Rivière Jean-Lacoste
Rivière Sainte-Anne
Rivière du Sault à la Puce
Rivière Boyer
Rivière du Sud
Rivière Montjeau
Rivière des Perdrix
Bras Saint-Nicolas

Cap-Gribane
X-03
X-02
esturgeon noir
Sainte-Anne-de-Beaupré
Cap-St-Ignace
elliptio pointu
Saint-François
esturgeon noir
Montmagny
Sainte-Famille
chat-fou des rapides
esturgeon noir
anodonte du gaspareau
chat-fou des rapides
elliptio à dents fortes
obovarie olivâtre
anodonte du gaspareau
elliptio à dents fortes
Saint-Laurent

Zones de reproduction du poisson à proximité des aires de mise en dépôt et espèces fauniques en situation précaire présentant un potentiel de présence dans le secteur selon les occurrences du CDPNQ

Dragage d'entretien annuel
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De Montréal à Cap Gribane

N
W E
S

1: 175 000

0 5 10 Kilomètres

- Villes
- Rivière/Ruisseau
- Mention d'espèces en situation précaire
- Site de mise en dépôt
- Chenal

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- *Secteurs et sites de mise en dépôt : MPO*
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Système de référence géodésique :
North American Datum 1983

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Annexe G (5 de 5)

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