



**ORIENTATION DOCUMENT ON INTEGRATED  
MANAGEMENT OF DREDGING  
ON THE ST. LAWRENCE RIVER**

**SUPPORTING DOCUMENT FOR THE  
SUSTAINABLE NAVIGATION STRATEGY OF  
THE NAVIGATION CONSENSUS BUILDING COMMITTEE**

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**WORKING GROUP ON THE INTEGRATED MANAGEMENT  
OF DREDGING AND SEDIMENTS**

**Canada** 

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## 1. Introduction

The St. Lawrence River is one of the world's largest watercourses. Sourced in the Great Lakes, it flows over a distance of 1500 km before reaching the Gulf of St. Lawrence and emptying into the Atlantic Ocean. The St. Lawrence ranks 16th in the world for its mean annual flow of 12 600 m<sup>3</sup>/s near Quebec City (St. Lawrence Centre, 1996b). This fluvial environment is rich in diverse habitats, but it is also an essential waterway. In 1991, the Canadian Coast Guard registered nearly 10 000 commercial ship transits (barges and bulk cargo vessels) on the river, and nearly 870 passenger ships (St. Lawrence Centre, 1996a). According to estimates, in the 1990s, an average of nearly 100 million metric tons of cargo was transported each year on the St. Lawrence and handled in its commercial ports (Villeneuve and Quilliam, 1999).

The St. Lawrence has played an important role in the economic growth of Eastern Canada. Its shores are today home to nearly 70% of Quebec's population and 75% of its industry (St. Lawrence Vision 2000, 1998). There are also several commercial ports, including those of Port-Cartier, Sept-Îles, Montreal-Contrecoeur, Trois-Rivières and Quebec City, which are among the largest. In 1998, maritime activities on the St. Lawrence generated \$3.2 billion in economic spin-offs and maintained 26 000 direct and indirect jobs in the province. As for recreational boating, a recent study estimated the direct economic spin-offs for Quebec at \$1.7 billion per year and the number of direct jobs supported by this activity at 8000.

The St. Lawrence also plays a vital role in the economy of the Great Lakes region. The river is the backbone of a larger geographic and economic ecosystem, the St. Lawrence–Great Lakes system, which offers access to the continent's vast inland market.

This extensive use of the river and its resources does have negative consequences, however. The frequency and scope of human activities generate a multitude of relatively worrisome effects on the fluvial environment, particularly in ecologically sensitive zones like wetlands, the estuary and mudflats. Use of the river, whether for commercial or recreational purposes, can compromise the integrity of these ecosystems, which have great economic, recreational and aesthetic value. Dredging activities can have an impact on wildlife habitats or cause changes to the hydrological system, limiting fish migration, for example. Moreover, in the case of contaminated sediment, inappropriate management or treatment may place the environment at risk.

Environmental objectives are not necessarily incompatible with economic ones, however. A balanced approach is ideal. If the value of the environmental resources of a region or port could be established during the initial planning stages of a dredging project, for example, the work could be more easily accomplished even while reconciling the economic aspects with the imperatives of protecting the environment.

This is all the more important given the increasing complexity of managing dredging activity due to factors such as rapid changes in transportation practices, greater sensitivity to the environment, and the aggravation of environmental problems affecting shore areas. In this context, management may be the source of disputes throughout the different stages of a dredging project.

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The aim of this document is to propose measures for improving the management of dredging activities in Quebec so as to adequately protect the environment and ensure the quality of life, health and safety of Quebecers, in the short term and also for future generations, while developing navigation on the St. Lawrence River.

## **2. Integrated Approach to Dredging Management**

The Working Group on the Integrated Management of Dredging and Sediment has been tasked with:

- ✍ developing a general framework for the integrated management of dredging activity and sediment on the St. Lawrence River, in order to give greater consideration to environmental, economic, social and institutional objectives and requirements; and
- ✍ to implement this integrated approach, proposing concrete tools intended to facilitate decision making, improve communication with the public and assess the social and economic consequences of the proposed measures.

An integrated-management approach should be understood as the organization of all dredging operations and related activities, including sediment management, according to a set of rules and processes to which all the stakeholders adhere, and which are defined in accordance with sustainable-development objectives. The intended purpose is to facilitate cooperation during the planning and performance of dredging and sediment-management operations, and to enable the selection of options that are the most acceptable to the community and the most realistic in terms of sediment quality and impacts on wildlife habitats.

The integrated-management approach should therefore be based on integration and cooperation in the application of the decision-making processes in effect in Quebec regarding various aspects of dredging. It should also consider the value of the riverside and coastal environments affected by this activity. This decision-making framework should include an analysis of all aspects of the local environment (physical, biological, socio-economic, cultural, etc.), benefit from the advantages of long-term planning, and rely on specific knowledge regarding the possibilities of regional dredging management (potential logistical restrictions and options for wildlife development sites, secure containment of contaminated sediments and beneficial use of dredged material). Rooted in a comprehensive perspective and better scientific knowledge, this management approach should be based on an overall vision that includes the justification for the project, an assessment of the potential environmental impacts of the dredging activities, sediment-management options, selection of disposal sites, and environmental and compliance monitoring. It should also ensure there is appropriate sharing of information among the various agencies responsible for project assessment, promoters and the general public.

Inspired by the American document, *The Dredging Process in the United States: An Action Plan for Improvement*, produced by the Interagency Working Group on the Dredging Process

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(1994), the Working Group studied the existing planning, assessment and authorization processes for dredging projects in Quebec and proposed solutions to improve the situation.

First, however, the Working Group agreed that certain findings and principles had to be the basis for the recommendations developed, and had to be behind the commitment of federal and provincial departments, ministries and agencies leading the development of an integrated-management approach to dredging on the St. Lawrence River.

## **Findings**

- ✍ The maritime transportation network is essential to the Quebec economy. Its port infrastructures and facilities, which are an important link in the chain of intermodal transportation, will only be profitable and competitive if dredging is performed at the right time and at the best possible cost.
- ✍ Given the growing importance of pleasure boating and its infrastructures for the Quebec economy, whether in terms of tourism or as a recreational activity for the local population, we must protect existing infrastructures and ensure that all further development respects the environment.
- ✍ Coastal, marine and freshwater resources must be protected and, where necessary, restored, because they offer great economic and environmental potential.
- ✍ The multiplicity of policy statements, regulations and legislation currently makes it difficult to achieve the objective of sustainable development on the St. Lawrence.
- ✍ Concerted planning involving all levels of government and a common, standardized approach are essential to the development and maintenance of ports, access channels and the waterway. Such planning makes it possible to ensure continued economic growth and to protect and restore aquatic resources.

## **Principles**

- ✍ The project planning, assessment and authorization processes must, whenever possible, be appropriate and efficient and adhere to projected time lines.
- ✍ Management of dredging and sediment must be the focus of regional planning and the result of cooperation among the federal and provincial departments, ministries and agencies concerned, port authorities, interest groups, the shipping industry, the pleasure boating community and the general public.
- ✍ Those responsible for managing dredged material must play a greater role in the planning of other activities (industrial, municipal, agricultural) affecting the same watersheds, so as to emphasize the importance of controlling point- and diffuse sources of pollutants that can contaminate sediments.



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✍ Dredged materials can be a resource and it is appropriate to encourage reclamation (beneficial-use) projects, particularly for the creation of wetlands or the regeneration of beaches, to the extent that they conform to environmental, economic and social imperatives.

### **3. Identification of the Problems and Suggested Courses of Action to Improve Dredging-Management Processes**

Based on these principles and the recommendations issued by the Interagency Working Group on the Dredging Process in the United States, the Working Group has identified the main problems related to dredging management in Quebec and offered solutions to improve the situation. The 17 recommendations adopted in this study seek to improve the existing planning, assessment and authorization processes for dredging projects or to make them more efficient. This involves exhaustive planning, in which the public plays a greater role, effective communication between federal and provincial departments, ministries and agencies, and the opportunity of accessing the best possible tools to study projects in detail and make informed decisions. Each of the proposed recommendations pertains to one of the following three components:

- 1) Improve the planning mechanisms related to dredging activities and sediment management;
- 2) Improve cooperation within the application of existing environmental-assessment systems;
- 3) Develop an approach intended to reduce the scientific uncertainties related to dredging.

#### **3.1 Improve the planning mechanisms related to dredging activities and sediment management**

##### **The Problem:**

Cooperation among promoters and regulators of dredging projects is sometimes lacking during the planning stages and this has negative consequences on effective management:

- ✍ Some of the stakeholders (promoters, federal departments and provincial ministries and agencies, the public) are not involved early enough in planning projects. Sometimes, concerns or questions are raised at an advanced stage in the authorization process, resulting in disputes that delay the study of projects and, ultimately, their realization.
  - ✍ Decisions made while planning a dredging project are often based on an incomplete analysis of the issue due to the inaccessibility of all the useful information. The scientific uncertainties of some aspects of a project or its overall cumulative impacts and the lack
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of knowledge of the value the population attaches to certain components of the local environment also sometimes act as impediments to a complete analysis.

- ✍ At present, the analysis of alternative solutions to dredging or the analysis of dredging project variants are not systematically incorporated into the planning. Consequently, regional sediment-management solutions cannot be considered or the decisions made in the initial planning phase rarely recommend sediment-reclamation options.
- ✍ There are no links between long-term planning of dredging projects and the management of other human activities affecting the same watershed. More specifically, despite the increased control exercised over upstream pollution, the quality of downstream sediments remains worrisome due to past contamination and inputs of active sources of pollutants, whether point or diffuse. In addition, shoreline erosion can cause silting up in dredging sectors downstream.
- ✍ The lack of understanding of the environmental-assessment and authorization processes and the unpredictability of the time required by some of these processes often lead to confusion regarding requirements and approaches, making planning difficult.
- ✍ Application of the concepts of *cumulative environmental impacts* and *sustainable development* to dredging activities also acts as a major impediment to project planning.

### **Suggested Course of Action:**

Improvement of the planning process is needed. The interests and concerns of all stakeholders should be taken into account, with the objective of achieving equilibrium between economic development and the protection of St. Lawrence ecosystems. Better planning of dredging activities should enable all groups to get involved in the integrated management of these activities.

By encouraging stakeholders to participate and communicate from the earliest stages of planning a dredging project, it would be possible to define anticipated problems sooner, thus avoiding delays. In addition, the planning process should provide for the creation of consensus-building tables around which all the players could share their concerns and thus participate in solving problems before they give rise to disputes. Here are the main concepts that should be taken into account:

- ✍ The planning process should reflect the environmental, social and economic situation of the region concerned and take account of the scope of a project.
- ✍ The project planning, assessment and approval processes should be flexible enough to adapt to technological progress, new scientific data or changes in the economic or social climate and efficiently incorporate any new factor into the decision-making processes.

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- ✍ A mechanism should be developed to facilitate cooperation among the groups in the initial stages of a project and in the medium- and long-term regional planning of dredging activities.
  - ✍ Public participation in the planning process should be more extensive in order that people can better understand and properly consider a projection's rationale, its potential impact on the regional economy, environmental considerations, sediment-management options, and the role and responsibilities of government departments, ministries and agencies.
  - ✍ The planning work related to dredging activities should respect federal and provincial dredging policies, regulations and legislation.
  - ✍ All stakeholders should make a commitment to participate actively in drafting and implementing the recommendations ensuing from the planning process.

Projects are currently assessed on a case-by-case basis, resulting in fragmented and unintegrated planning. The four recommendations below are meant to improve the planning process, and to allow for better regional management.

## **Recommendation 1**

### **Create a Planning Committee mandated to provide the necessary information and policies for producing regional plans for dredging on the St. Lawrence.**

The Planning Committee's responsibilities would involve:

- ✍ promoting the drafting, updating and integration of the various five-year dredging plans, with the aim of producing a comprehensive and continuous picture of dredging activities on the St. Lawrence;
  - ✍ establishing the terms for stakeholder participation in dredging activities on a regional basis;
  - ✍ ensuring that dredging project management plans provide for short- and long-term solutions, consider methods that make it possible to reduce dredging, and maximize the possibility of sediment reclamation, where appropriate;
  - ✍ promoting the advantages of the mechanisms put in place for the integrated-management of dredging activities (time savings, economies of scale, sharing of scientific information, reduction of impact study costs) to all stakeholders, including the public;
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- ✍ facilitate the assimilation of concepts such as *cumulative environmental impacts* and *sustainable development* to dredging activities on the St. Lawrence in order to reconcile economic and environmental objectives.

## **Recommendation 2**

### **Produce a guide intended to facilitate long-term planning of dredging activities and the drafting of regional dredging-management plans.**

The Planning Committee should produce a guide intended to facilitate the long-term planning of dredging activities on the St. Lawrence. Such a guide (including case studies) would help promoters to plan their dredging projects in terms of integration into regional management plans. The guide would focus on the following points:

- ✍ Participation by all players, including the public, in the planning process.
- ✍ Cooperation and communication among government authorities.
- ✍ Management of disposal sites for dredged material:
  - selection of disposal sites;
  - collection of raw data;
  - verification of compliance with permits and authorizations;
  - environmental-compliance monitoring of the work;
  - coordination of environmental site monitoring.
- ✍ Technical and administrative questions related to the management of dredging activities.

A dredging and sediment-quality database would be a very useful tool for management, particularly when drafting five-year plans. Different options should be examined for creating such a database and for evaluating its maintenance and operating costs.

## **Recommendation 3**

### **Develop an information and public-awareness mechanism intended to facilitate stakeholder participation in planning dredging activities.**

The Planning Committee should establish a mechanism to encourage and facilitate participation by interest groups in planning dredging activities. To this end, it should:

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- ✍ establish the conditions whereby these groups (fishermen, conservation organizations, representatives of the shipping industry and the port sector, environmental and community groups, etc.) could take part in project planning;
  - ✍ provide information to and collect comments from the public on the regional dredging plans, explaining the reasons for the projects, the planning, assessment and authorization processes, possible environmental and socio-economic impacts, and potential solutions for managing or reclaiming the dredged material.

#### **Recommendation 4**

**Ensure that the Planning Committee works in conjunction with the federal and provincial authorities responsible for point-source and diffuse pollution control, to increase their awareness of sediment contamination and its effects on the environment and on dredging activities, and encourage them to implement appropriate action plans.**

In the long term, upstream pollution control could mitigate sediment contamination problems. Through the Planning Committee, the players responsible for managing dredged materials should point up the importance of controlling point- and diffuse pollution sources to reducing sediment contamination. Information sessions or workshops could be organized to increase awareness within the departments, ministries and agencies concerned. By extension, this recommendation affects environmental problems related to other human activities in the same watersheds, particularly the problem of shoreline erosion, which would have consequences on the silting up of downstream dredging sectors.

Environment Canada and the Ministère de l'Environnement du Québec should continue to offer their support to the implementation of management plans for contaminated-sediment sites on the St. Lawrence. The partnership role of the ZIP (Priority Intervention Zone) Committees is also worth mentioning and supporting in this regard, because their contribution has led to major commitments for sediment restoration in several regions of the St. Lawrence.

#### **3.2 Improve cooperation within the context of applying environmental-assessment systems to dredging projects**

##### **The Problem:**

In Quebec, there are two environmental assessment systems applicable to dredging work, one under the responsibility of the Government of Quebec and the other under the federal government. There is a certain lack of cooperation between the responsible public bodies with regard to their respective requirements and concerns. Better cooperation is needed between these two systems to avoid undue delays in obtaining the authorizations required and to ensure equity in the treatment of cases.

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There is a lack of communication between political authorities and promoters regarding the requirements of each system and this can sometimes create the misunderstandings that lead to conflicts. Such situations are not conducive to speeding up processing times. Similarly, requirements made of promoters can vary according to the level of government assessing the project.

Various interest groups, especially the public, have been asking to be kept informed of the dredging projects to be carried out on the St. Lawrence for some time now. They want to be able to discuss them with the responsible government authorities or promoters from the earliest stages of the environmental-assessment process.

Everyone agrees on the need for better definitions of the concepts of *cumulative environmental impacts* and *sustainable development*, and that they be incorporated into the drafting and authorization processes for dredging projects on the St. Lawrence.

### **Suggested Course of Action:**

Most of the above-mentioned problems could probably be resolved by improving communication and cooperation among the various interest groups and through more broad-based participation. The five recommendations listed below are therefore proposed.

#### **Recommendation 5**

##### **Create an environmental assessment advisory committee for dredging on the St. Lawrence.**

The federal and provincial departments, ministries and agencies should create an Environmental Assessment Advisory Committee to foster cooperation in the application of the environmental-assessment systems to dredging projects on the St. Lawrence. To this end, the Advisory Committee should establish a mechanism to facilitate the exchange of information.

#### **Recommendation 6**

##### **Inform promoters of the requirements for producing impact studies of dredging projects on the St. Lawrence.**

The Advisory Committee should support the responsible federal departments and agencies in drafting a document specifying what information should appear in the impact studies and setting out the dredging-related problems. With such a document, promoters could produce exhaustive and precise impact assessments that satisfy all federal requirements for issuing the necessary permits or for conducting the other phases prescribed by their respective legal obligations.

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The document should also highlight the advantages for promoters of meeting with the federal departments and agencies to clarify the requirements to which they are subject and of consulting the public early in the process.

Advice should also be given on the development and implementation of environmental monitoring and compliance programs for dredging projects and sediment management.

Since the Ministère de l'Environnement du Québec has issued two sectoral policy statements on the environmental impact assessment of dredging projects, the Advisory Committee should ensure cooperation between the two levels of government in producing documents that are consistent, out of a concern for the equitable treatment of promoters.

Moreover, to disseminate adequate information on the legislative framework governing dredging activities and sediment management, the Advisory Committee should, as necessary, update the Environment Canada document, *Legislative Framework for Sediment Management in Quebec*.

#### **Recommendation 7**

##### **Standardize approaches to avoid problems in the application of the different environmental-assessment systems to dredging projects.**

In collaboration with the responsible authorities, the Advisory Committee should propose approaches for dredging projects on the St. Lawrence to the federal and provincial governments. This applies particularly to the methods to be used for assessing habitat loss and cumulative environmental impacts, calculating compensation for habitat loss or developing monitoring programs. Such standardized approaches are necessary out of a concern for equity, so that all promoters, according to the scope and nature of their projects, have to satisfy the same requirements, regardless of whether their project is subject to the federal or the provincial environmental-assessment system.

#### **Recommendation 8**

##### **Encourage public involvement in the environmental assessment of dredging projects.**

Based on an analysis of the existing situation, the Advisory Committee should propose means to promote the public's participation in the environmental assessment of dredging projects.

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## **Recommendation 9**

### **Foster communication and cooperation among the departments, ministries and agencies responsible for applying the different environmental-assessment systems to dredging projects on the St. Lawrence.**

The Advisory Committee should propose mechanisms to improve communication and cooperation among the government authorities responsible for applying the different environmental-assessment systems to St. Lawrence dredging projects. These mechanisms should be developed in consideration of existing ones and in terms of respective government jurisdictions, particularly information sharing, management of environmental assessment systems and deadlines for notices to be provided.

### **3.3 Approach intended to reduce the scientific uncertainties of dredging**

#### **The Problem:**

Dredging operations involve the management of varying quantities of sediment in an environmentally sound manner. In Quebec, there are a number of management tools for dredged material. Although these tools take account of the complexity of sediment chemistry and the environmental conditions specific to each disposal site, and while they provide information on the environmental impacts of dredging, the scientific assessments still entail a certain degree of uncertainty. It is essential to reduce these uncertainties, but also to understand their causes, so that the best possible information is available when it comes time to make decisions.

Thus, while certain environmental and human health effects can be measured and assessed easily (e.g. mortality observed in laboratory animals), others are more difficult to quantify (e.g. the effects of contaminant bioaccumulation in animal tissues). Managers must be able to rely on precise and accurate data regarding a range of acute, sublethal and chronic effects in order to make the decisions that will ensure that ecosystems and human health are adequately protected. The work is complex due to the fact that research results can sometimes reveal a host of effects, some of which are contradictory.

Managers currently use a combination of tools to assess the risks and make decisions. However, the risk assessment process is more complicated than merely using simple numerical criteria because of the many calculations, data and hypotheses required.

Governments are currently studying risk assessment and management methods that would allow for human health and the environment to be protected and regulatory decisions to be made. These methods could be incorporated into the integrated-management framework for dredging activities. In the meantime, managers must continue to make decisions on a site-by-site basis, using the information obtained from the best assessment tools at their disposal.



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## **Suggested Course of Action:**

The improvement of impact-assessment tools and their application are essential to the integrated-management framework for dredging and sediment. The following eight recommendations are meant to reduce the scientific uncertainties that influence planning in the management of dredging activities, and thus enhance decision making.

### **Recommendation 10**

#### **Create a committee for cooperation and monitoring of applied research in dredging.**

The Committee should serve as a forum to guide, promote and monitor applied research projects that would increase the contribution of science to the management of dredging operations on the St. Lawrence.

The Committee's principal role would be to:

- ✍ support and monitor the drafting of recommendations intended to improve the efficiency of the environmental-assessment, mitigation and compensation processes and measures;
- ✍ promote the establishment of other applied research projects, which could improve understanding of the effects and repercussions of this maritime activity on the local environment and upgrade the performance of dredging equipment and techniques;
- ✍ communicate the results of the research to the Planning Committee and the Environmental Assessment Advisory Committee.

### **Recommendation 11**

#### **Define a set of common decision-making rules for assessing dredging activities and sediment management on the St. Lawrence.**

The drafting of shared rules for the assessment of dredging activities is intended as a prudent approach and a practical method to ensure sound dredging management, in accordance with the laws and regulations in force, current scientific knowledge and best practices in environmental assessment. In particular, these rules would consist of a necessary series of steps to follow in the chemical and biological assessment of sediments to determine the environmental acceptability of a project. These rules should be defined in a guide containing a schematic representation of the links that exist between the various assessment stages, public policies and legal and regulatory obligations, technical considerations, rules of interpretation, and assessment tools and methods (similar to Environment Canada's *Dredged Material Disposal in the Sea – Dredged Material Assessment Framework* or the USEPA *Testing Manual for Ocean Disposal*).

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The guide should propose a progressive assessment approach aimed at ensuring that the presence of potentially deleterious substances in the aquatic environment can in no case reach concentrations in excess of established levels for water, sediments and organic tissues. The procedure should promote the use of the best economic methods for assessing and managing dredging activities on the St. Lawrence River.

The guide should present the decision-making process for dredging projects and sediment disposal, including physical and chemical characterizations of the sediment, toxicity assessment, studies of the physical behaviour of the materials at dredging and disposal sites, the environmental knowledge required to study possible impacts and mitigation measures, the evaluation and selection of alternative solutions, and benchmarks for environmental and compliance monitoring of the project.

## **Recommendation 12**

### **Define or improve the different sediment quality assessment tools, including ecotoxicological ones.**

When reviewing the *Interim Criteria for Quality Assessment of St. Lawrence River Sediment*, the departments and agencies concerned should examine the relevance of including notions of risks to human health and ecosystems in terms of ecotoxicology and bioaccumulation of contaminants in dredged material. These additional considerations would improve the scope of the decision-support tools for assessing the risks associated with dredging.

A work plan should be prepared to help pilot an adequate review of the current St. Lawrence sediment quality criteria, by incorporating the background noises of certain metals in problem sectors of the river.

To this end, the recommendations of the workshop held in October 2000 to review the Interim Criteria and that appear in the final proceedings are listed below. These recommendations should be given priority consideration:

- ✍ Identify the appropriate analytical methods for measuring natural chemical concentrations and determine sediment quality assessment criteria; these methods could more accurately measure the potential bioavailability of contaminants associated with the sediments.
- ✍ List the factors influencing metal concentrations in sediments and their bioavailability (grain size, organic matter, etc.) and recommend that they be systematically measured and recorded during sampling.
- ✍ Include recent data on natural concentrations in the review and revisit the discrimination levels selected to define criteria thresholds. For example, the 90th screening level concentration (SLC) percentile could be replaced by the 95th percentile, as in Ontario.

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This would make Level 3 less severe, because it would affect 95% of species rather than 90%. Also, improve documentation on the use of these values in salt water and incorporate criteria that take account of bioaccumulation. The industrial waste and mineral ores detected incidentally in the aquatic environment should be the focus of special attention.

Data are already available on background noise in the fluvial (freshwater) section of the St. Lawrence (freshwater), but this work remains to be done for the upper estuary (saltwater).

A discussion of the applicability of the interim sediment quality criteria to postglacial clays has become necessary due to the high cost associated with their secure containment. The so-called “natural” concentrations of metals in these materials are high in relation to the criteria, particularly for chromium, nickel and copper.

The document entitled *Interim Criteria for Quality Assessment of St. Lawrence River Sediment* also provides for a specific or more detailed ecotoxicological assessment approach when the concentration of a substance in sediments is found to be in Class 4 (i.e. exceeding Level 3 [TET]) or even Class 3 (between Level 2 [MET] and Level 3 [TET]).

Such an approach should be designed to allow for assessments that consider all the advantages and disadvantages of the methods chosen. Research projects are currently under way around the world and these efforts should bring some consistency to analytical methods.

The scientific context is thus favourable to the design of a sediment quality assessment framework. This work also provides the opportunity to validate existing assessment tools (interim criteria, toxicity tests, etc.), especially for cases of intermediate contamination (Class 3).

Finally, regarding the sampling, conservation and physical/chemical analyses of sediments, it is important to have recourse to common guides that are up-to-date and take account of the needs established over the last few years.

### **Recommendation 13**

#### **Improve and develop contaminated-sediment management technologies.**

The two governments, in collaboration with dredging project promoters, universities and research centres, should get involved in improving the existing tools and developing technologies to find new solutions, as well as updating material-management practices. Among other measures, they should pursue research on sediment containment, subaquatic isolation (i.e. capping), decontamination, other leading-edge technologies and reclamation of dredged materials (particularly for agriculture or to create wildlife habitats). Effective technologies have already been tested and are available. Field experiments should make it possible to improve these technologies and design new ones.

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A handbook on sediment disposal and containment is essential to encourage promoters in the development of original and creative sediment-management methods. The issue of managing uncontaminated sediment should also be included in such a guide.

#### **Recommendation 14**

##### **Better assess the impacts of dredging activities on fish habitats.**

In general, governments and other players should intensify their efforts to improve the impact assessment of dredging projects on the productive capacity of marine, estuarine and freshwater fish habitats, according to the different characteristics of the local environments and the different dredging methods, for each of the following types of sites:

- ✍ the dredging site, making a distinction between maintenance dredging and capital dredging;
- ✍ the disposal site, making a distinction between dispersive and non-dispersive sites, and involving the notion of recurring use of the same site.

In this assessment, it is important to put into perspective the relative impact of dredging compared to natural phenomena, such as seasonal flooding and periods of high winds.

For example:

- ✍ Disposal criteria for uncontaminated sediment have been established for the fluvial section of the St. Lawrence River (i.e. stable sites). It would be useful to define criteria applicable to other cases, such as unstable sites like those found in the fluvial estuary or upper estuary.
- ✍ The Île Madame disposal site monitoring project is intended to document the related impacts of the disposal of dredged materials, both in physical and biological (benthos + fish) terms. The aim of this project is to develop criteria for the protection of fish habitat during sediment disposal in open water at a site considered to be dispersive. It will also contribute to refining the methods, protocols and procedures applicable to the management of other sites along the St. Lawrence. It will lead to a better understanding of the related environmental issues of sediment disposal and help to determine what additional studies are required. Impact monitoring of these projects is also a key element in the integrated management of dredging activities, in the medium-term.
- ✍ About 75 000 m<sup>3</sup> of sediment is dredged annually to maintain the waterway in the North Traverse sector, where there is considerable natural sediment accumulation. This is an opportune time to verify the presence (identification and quantification) of fish larvae in the materials (sediments and overflow) excavated by the self-supporting suction dredge used in the North Traverse, to better assess the impacts of this activity.

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- ✍ A study should be conducted to assess the environmental interactions of major deposits in the Île Madame sector and to find alternative disposal areas, as needed (new project or new policy).
  - ✍ The particles resuspended during dredging and disposal activities represent a little understood and little quantified stress for the aquatic ecosystem affected. Studies should be conducted to assess the environmental impacts of these resuspended particles, particularly on benthos and phytoplankton.
  - ✍ Dredging and aquatic disposal of dredged spoil can diminish the productive capacity of fish habitats, particularly in terms of the criteria defined in the *Fisheries Act*. These habitat losses are difficult to quantify. Studies should be carried out to establish credible scientific benchmarks for assessing the impacts of such projects.

## **Recommendation 15**

### **Continue the modelling work on the St. Lawrence River so as to be able to analyze sediment transport mechanisms and improve impact assessment of dredging projects.**

As part of the St. Lawrence Vision 2000 Action Plan – Phase III and thanks to the International Joint Commission (IJC), 2D modelling was undertaken to simulate most of the physical features of the fluvial section of the St. Lawrence. The digital model depicts the topography of the river bed and banks and includes a description of the substratum as well as emergent and submerged vegetation. Scenario-based modelling would make it possible to simulate currents and water levels. These results should be examined to determine if they could improve our knowledge of the impacts of possible future dredging projects. In particular, the results could be used to quantify the impact of physical changes on the ecosystem or to simulate the transport of sediments in the St. Lawrence system.

For example:

- ✍ Over the past 150 years, dredging of the waterway has had repercussions on the fluvial ecosystem. These effects have given rise to numerous myths which have never been verified. It would be possible to quantify the impact of channelling the river by hydrodynamic modelling of its topography before the very first alterations in 1844. Certain characteristics of the river in its initial state might be revealed, including water levels, currents and even the distribution of different types of habitats.
  - ✍ Hydrodynamic modelling integrates the basic data necessary to simulate the transport and fate of sediments in the river. This type of modelling has to take account of several parameters related directly to the material dredged or discharged (type of sediment, type of contaminant) and also to the local environment (bathymetry, flow, speed and direction of currents, characteristics of aquatic plants, etc.). With reliable sediment transport
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forecasting, it would be possible to determine which ecosystems are vulnerable to open-water discharges and resuspension of sediments. Such a model could also be used for accidental spills of petroleum products.

## **Recommendation 16**

### **Reassess the possibility of adding value to materials dredged from the St. Lawrence.**

Studies have already been conducted to assess the possibilities of creating wildlife habitats in different sectors of the St. Lawrence using dredged sediments: wildlife development sites in the Quebec City region, islands in Lake St. Pierre, development of banks in the Boucherville Islands and in Contrecoeur, and wildlife islands in Lake St. Louis.

Almost all of these studies concluded that the actual or potential quantities of sediment generated by each of these projects, taken in isolation, were insufficient for the wildlife development sites envisioned. They also proved that the transportation costs from the dredging sites to the planned wildlife habitat sites were very often too high. The Consensus Building and Monitoring Committee on Applied Research in Dredging should therefore reconsider these studies in the light of the new data generated by regional planning, despite the contamination of a portion of these sediments. It should also study other possibilities for the beneficial use of dredged sediments, such as:

- ✍ soil enrichment;
- ✍ beach restoration;
- ✍ shoreline stabilization.

The project involves several phases. A review of the literature has already been performed and a map has been drawn to determine, locate and assess habitat losses. To complete this information, the intention is to produce an inventory of projects implemented elsewhere (and which could be carried out here) or which have already been proposed for the St. Lawrence. Depending on the volume of sediments that would eventually be available, projects that are technically feasible in the river should be proposed, while setting out the restrictions associated with them.

Promoters will be invited to look further during their environmental assessment study to include the possibility of reclaiming sediments. The aim would be to favour those options having the least impact among those considered feasible, accounting for economic constraints. For example, this recommendation could be incorporated into the impact study guideline or the integrated-management decision tree. The possibility of authorizing projects on the basis of environmental objectives could be considered as a way of giving contractors more latitude, allowing them to offer sediment management options at competitive costs compared to discharge in open water.

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The financial participation of the promoter departments in the performance of technology demonstration projects involving substantial investments could assist in marketing reclamation possibilities for dredged material.

## **Recommendation 17**

### **Improve tools for assessing cumulative environmental impacts.**

The combined impacts of various human activities can result in interactions that produce cumulative impacts, the nature and scope of which may be different from the effects of each activity individually. These combined impacts, which can be the result of past, current or future projects or activities, must not be considered as a new class of environmental impact, and they may vary spatially and temporally. The notion of cumulative impacts simply recognizes all of the complex conditions whereby the effects of various projects and activities result in spatial and temporal interactions and combinations. The environmental assessment processes of both levels of government already account for cumulative impacts, to some extent: it would appear logical to do so. However, the current techniques for assessment and management of these impacts do not always allow them to be predicted or controlled appropriately.

The importance of examining the cumulative environmental impacts of dredging projects in the St. Lawrence has been raised in recent years, particularly during assessment of the selective dredging project in the shallows of the St. Lawrence waterway between Montréal and Cap à la Roche. Ideally, such an assessment should necessarily use better tools for evaluating cumulative environmental impacts. One of the first steps in the review of these tools should involve an analysis of the approach proposed in the *Reference Guide: Addressing Cumulative Environmental Effects*, by the Canadian Environmental Assessment Agency (1994), to verify whether it is applicable to dredging projects on the St. Lawrence.

## **4. Conclusion**

Inasmuch as a balance is sought between the economic- and environment-related objectives of navigation, the development of an integrated approach to the management of dredging activities appears to be essential to achieving the objectives of sustainable navigation on the St. Lawrence. From this perspective, cooperation among all those concerned, including the public, could reconcile the concerns and interests of each and reduce sources of conflict.

This document has highlighted the problems related to dredging and offered solutions adapted to the situation in Quebec, presenting 17 recommendations for improving the management of dredging and dredged material on the St. Lawrence. They take account of existing laws and regulations, and are intended to enhance management practices with the ultimate aim of achieving an integrated-management approach.

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The recommendations can be grouped under three major themes:

- 1) Improvement of planning mechanisms related to dredging and sediment management;
- 2) Improvement of cooperation within the application of existing environmental-assessment systems;
- 3) Development of an approach intended to reduce the scientific uncertainties related to dredging.

These major themes are the concern of a variety of stakeholders (managers, promoters, scientists, environmental groups). It is therefore proposed that three distinct committees be struck — Planning, Environmental Assessment, and Cooperation and Monitoring of Applied Research — to carry out the recommendations associated with each theme.