TRANSPORT CANADA

Port of Gaspé – Sandy Beach Sediment Remediation Project

Environmental Impact Assessment filed with the *Ministre du Développement durable, de l'Environnement et des Parcs*

Screening presented to Transport Canada and Fisheries and Oceans Canada

Main Report and Appendices

March 2012

Presented by

DESSAU

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1 INTRODUCTION

1.1 Context

1.1.1 Project Location and Study Area

The Port of Gaspé – Sandy Beach is located on the south shore of the Gaspé harbour, at the eastern end of the Gaspé Peninsula and approximately 3 km east of the city of Gaspé. It is connected to the road network via Route 132 and Rue du Quai. The port facilities are also connected to the Gaspé-Chandler leg of the rail network (owned by the *Corporation du Chemin de fer de la Gaspésie* and run by *Chemin de fer de la Matapédia et du Golfe*).

The project's study area is delineated by the mouths of the York and Dartmouth rivers to the west, the Gaspé harbour's northern shore (including the Penouille peninsula) to the north, the Sandy Beach sand bar (also known as Boom Defence) to the east and approximately 1.5 km south of Route 132 to the south, as shown in Figure 1[1]. This study area was established to define the inventory boundaries deemed sufficient to identify the direct and indirect impacts likely to be generated by the work. The project intervention area refers to the sector most directly concerned by the project's sediment remediation activities and includes the commercial wharf and the adjacent port facilities (up to Route 132).

1.1.2 Project Proponent

The project proponent and responsible authority for this project is Transport Canada (TC), whose address is:

Transport Canada
Programs Group, Quebec Region
Environmental Affairs
Regional office - Dorval - 3rd floor - Room 3119
700, Leigh Capréol
Mail stop: NHE
Dorval (Quebec) H4Y 1G7

Contact person:

Pascale Couroux-Smith
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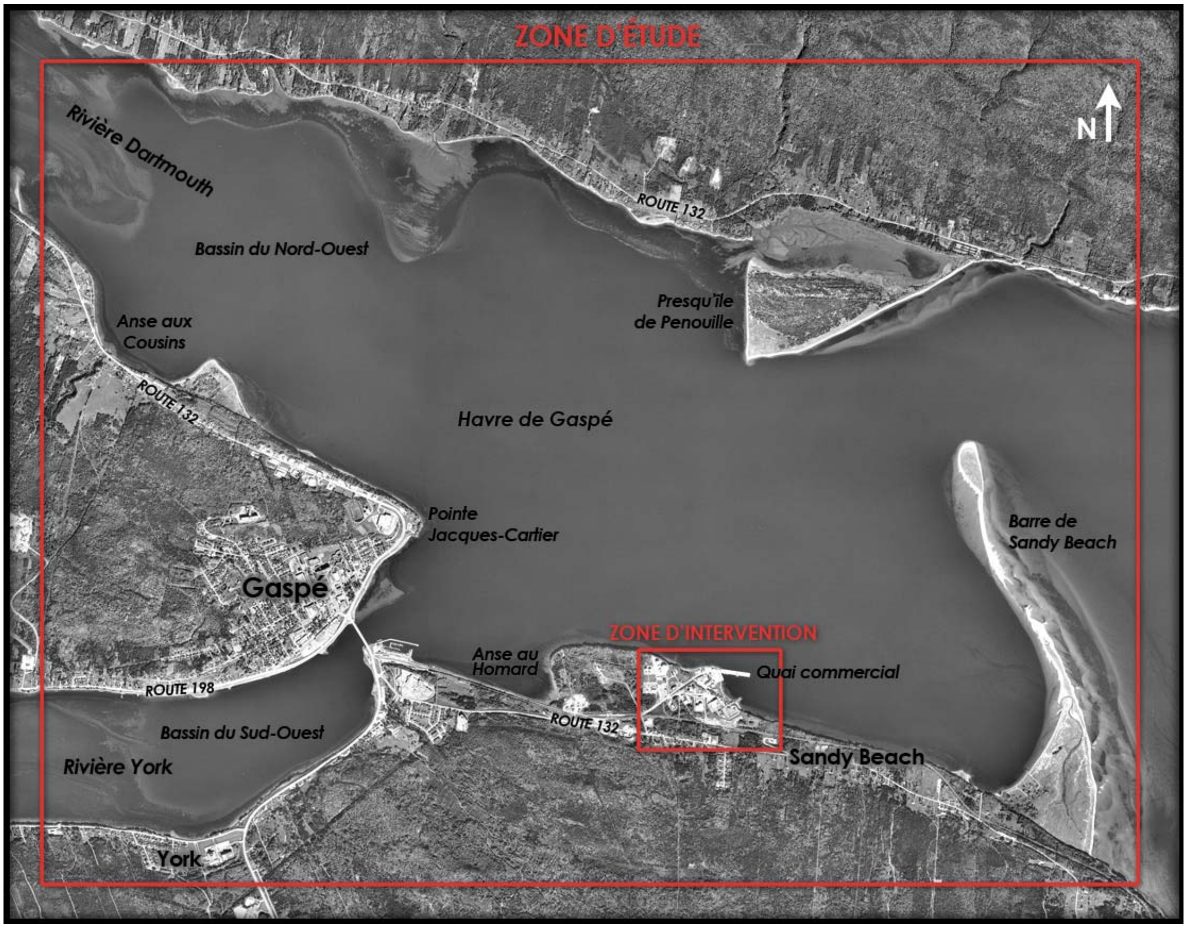
[1] When deemed appropriate, the study area will exceed the above-defined territory to cover environmental effects likely to occur beyond this area. For example, effects associated with sediment transportation activities.

FIGURE 1: LOCATION OF THE STUDY AREA



Orthophotograph no. Q01823-120 and Q01823-122,

1.1.3 Project Justification

The commercial wharf at the Port of Gaspé – Sandy Beach has had an industrial and commercial vocation for more than a century. Over the years, several companies used the wharf to tranship various goods, including Xstrata (formerly Noranda, then Falconbridge), which transhipped copper and sulphuric acid there for over 40 years.

In the last 15 years, various environmental studies (Beak, 1998; Environnement Illimité, 2001, 2002 and 2005; QSAR *et al*. 2002 and QSAR, 2003) have highlighted an environment exposure pathway associated with the presence of polycyclic aromatic hydrocarbons (PAH) and copper in the sediment. The most problematic areas are south of the wharf. The high copper concentrations found in the sediment are due to the transhipment of copper ore until 2002. The source(s) of PAH contamination has not been determined. However, it could be linked to the use of creosote-treated wood in the building of the wharf crib (former structure), petroleum product transhipment activities at the commercial wharf, fishing activities and military activities during the Second World War.

In light of these studies, and given the extent of the sediment contamination and its potential negative effects on the aquatic environment, the goal of the project is to remediate the sediment south of the commercial wharf. In so doing, Transport Canada is fulfilling its government obligations regarding the management of contaminated sites.

The results of the toxicity tests on marine organisms were used to set the intervention levels (integrated effect level, or IEL[2]) for copper (2 400 mg/kg) and PAH (5 mg/kg). The IELs were set in accordance with the principles of use and application described in the *Interim Criteria for Quality Assessment of St. Lawrence River Sediment* (St. Lawrence Centre, 1992), and were used to delineate the sediment dredging area. The integrated effect levels also respect the principles of the application framework for the remediation of contaminated sites set out in the most recent *Criteria for the Assessment of Sediment Quality in Quebec (2007)*.

The area to remediate is approximately 60 000 m² and is located between the commercial wharf to the north, the shore to the west, the Chantier Naval Forillon shipyard's slipway to the south, and out to sea, about 270 m from the slipway (see Figure 2). The volume of sediment to remediate is estimated to be approximately 37 700 m^3 (volume in place, not bulked). A new characterization of the sector to remediate was carried out in September 2011, to validate the surface area and volume of sediment to dredge. The results of this characterization will be submitted to the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP) once available.

1.1.4 Specific Approach

The approach used during the call for tenders process aims to target the option that is best suited to the site and the most attractive from a technological, economic, social and environmental standpoint. No preferable intervention scenario was chosen, so as to avoid favouring one remediation approach over another during the tendering process. Rather, the project description presents a set of potential intervention activities that will be combined to develop a preferable solution, by the providers of potential services invited to tender for the project. The proposals they make will be evaluated according to the performance specifications to be developed, namely based on the set remediation objectives.

The goal of this approach is to welcome all potential proposals in order to identify an intervention scenario that attains the project objectives at least cost and in the best possible timeframe. It will also

[2] The IELS were specifically calculated in the commercial wharf sector, in the framework of an ecotoxicological assessment (QSAR *et al*., 2002). Different toxicity tests were performed on marine organisms (indicator species) in contact with the sediment or porewater from the wharf area as well as a control zone (Penouille peninsula). These tests determined the concentration of copper and total PAH in the sediment or porewater causing a negative effect on the behaviour, development and survival of the organisms.

be important for the selected proposal to release Transport Canada of all future liability concerning the dredged sediment.

1.2 Legal Framework for the Environmental Assessment

1.2.1 Canadian Environmental Assessment Act (CEAA)

The *Canadian Environmental Assessment Act* (CEAA) sets out the responsibilities and procedures for the environmental assessment of projects involving the federal government. It therefore establishes a guideline that standardizes the environmental assessment processes used to determine the environmental effects of projects from the planning stage onward. The CEAA applies to projects for which the federal government has decision-making authority, either as a proponent, land administrator, source of funding or regulator.

In the framework of the Port of Gaspé – Sandy Beach sediment remediation project, Transport Canada holds decision-making authority as project proponent. Transport Canada is therefore the project's main responsible authority under the CEAA.

Subject to the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (SOR/97-181), Transport Canada was required to consult federal authorities that may have legislative or regulatory power prescribed by regulation or act as an expert federal authority in the framework of the project. Besides Transport Canada, Fisheries and Oceans Canada (DFO) will be the sole responsible authority in this environmental assessment given that it will need to issue authorization subject to subsection 35(2) of the *Fisheries Act*. Two federal departments and an agency are also involved in this file as expert departments: Environment Canada, Health Canada, and Parks Canada (agency). As the responsible authority, Transport Canada is in charge of coordinating the file and consulting the expert departments and agency.

Given that the project is not subject to the CEAA's *Comprehensive Study List Regulations* (SOR/94-638), the environmental assessment will be a "screening".

This study constitutes the environmental screening assessment required by the federal legal framework.

SOURCE :
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Projet

Transports Canada

PROJET DE RESTAURATION DE SÉDIMENTS AU PORT DE GASPÉ – SANDY BEACH

Titre

FIGURE 2
DÉLIMITATION DES ZONES D'INTERVENTION ET DE DRAGAGE

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045	P001130	0162	045	EI	0102	01

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1.2.2 *Loi sur la qualité de l'environnement* (LQE)

An environmental impact assessment is commissioned, subject to the application of Section IV.1 of the *Loi sur la qualité de l'environnement* du Québec (LQE) (L.R.Q., c. Q-2) and subsection b) of Section 2 of the *Règlement sur l'évaluation et l'examen des impacts sur l'environnement* (R.R.Q., c. Q-2, r.9).

Transport Canada sent the MDDEP's *Direction des évaluations environnementales* a project notification, signed on June 18, 2009. The directive set out in Section 31.2 of the LQE was transmitted by the MDDEP on July 14, 2009. The file number for the directive, entitled *Directive pour le projet de restauration de sédiments contaminés au port de Gaspé – Sandy Beach*, is 3211-02-263.

This study constitutes the environmental impact assessment required in Quebec's legal framework.

2 PROJECT DESCRIPTION

2.1 Remediation Options and Intervention Scenarios Studied

In 2005 and 2006, Dessau (then Dessau-Soprin) produced two reports that presented sediment remediation options and gave a detailed description of the intervention scenarios that were pre-selected in the framework of the Port of Gaspé – Sandy Beach sediment remediation project (Dessau-Soprin, 2005 and 2006).

2.1.1 Remediation Options

First, remediation options were selected based on the summary of the baseline data and a review of the scientific literature. Out of a total 14 remediation options considered, four were retained:

- Option 1: capping the sediment (encapsulation);
- Option 2: dredging, dewatering (or not) and containment in a highly secure cell to be built in an aquatic section of the intervention site;
- Option 3: dredging, dewatering (or not) and containment in a secure burial cell to be built on dry land, on Transport Canada or Xstrata (then Noranda) property;
- Option 4: dredging, dewatering (or not) and containment in an existing commercial burial cell for contaminated soil.

An inventory of the possible technologies was then taken, based on the identified remediation options. These technologies were sorted into four categories: environmental protection, extraction methods, primary management of the dredged material and final management of the dredged material.

2.1.2 Intervention Scenarios

Five intervention scenarios were developed and analyzed, based on the selected remediation scenarios and the applicable technologies. The intervention scenarios are:

- Scenario 1: dredging, partial encapsulation onsite and on-shore disposal of the dredged sediment in a highly secure containment cell;
- Scenario 2: dredging and on-shore disposal of the dredged sediment in a highly secure containment cell;
- Scenario 3: dredging, dewatering and final management of the sediment in a secure burial cell to be built in Murdochville, at the tailings site of Xstrata's former mine site;
- Scenario 4: dredging and disposal of the humid sediment in a secure burial cell to be built in Murdochville, at the tailings site;

- Scenario 5: dredging, dewatering and final management of the sediment in an existing commercial burial cell for contaminated soil.

2.2 Analysis of the Intervention Scenarios

2.2.1 Intervention Scenario Comparison Criteria

In the Dessau-Soprin report (2006) presenting a detailed description of the selected intervention scenarios, eight discriminatory criteria were use to compare the scenarios, which led to each scenario being given a performance rating. The criteria were:

1. Definitive nature of the solution;
2. Rapidity of the intervention in the aquatic environment;
3. Minimization of loss of aquatic habitat;
4. Minimization of public nuisance;
5. Technical reliability;
6. Reusable infrastructures;
7. Facility of obtaining permits;
8. Minimization of costs.

The overall performance of each scenario was determined by adding up the scores for each of the eight criteria, but also by evaluating the number of times, for each scenario, a criterion had a higher or lower performance than the others. As such, the desired scenario is the one with the highest overall performance, but also the one whose criteria had the best performance among the other scenarios.

According to the summary of the multicriteria analysis, the recommended intervention scenario with the best overall performance is Scenario 2: dredging and on-shore disposal of the dredged sediment in a highly secure containment cell, followed closely by Scenario 4: dredging and disposal of the humid sediment in a secure burial cell to be built in Murdochville, at the tailings site.

2.2.2 Intervention Scenario Proposed in 2006

While the summary of the multicriteria analysis recommended Scenario 2, Transport Canada selected Scenario 5 for the Port of Gaspé – Sandy Beach sediment remediation project. This is due to Transport Canada's policies regarding long-term liability, which ruled out scenarios 1 and 2. Encapsulation and on-shore disposal would require Transport Canada to remain liable for the contaminated sediment. Moreover, these scenarios require the acquisition of properties on which to build onshore cells, which is not in line with departmental policies to favour the transfer of facilities, not their acquisition, as well as wishes expressed during the consultations to discuss the remediation options. Scenarios 3 and 4 were not selected because the final management of the sediment in Murdochville would require Transport Canada to remain liable for PAH contamination. This situation was not acceptable to Transport Canada, as it does not wish to remain liable for the sediment following the project. The Department is opting for the final management of the sediment.

The intervention scenario selected at the time (Scenario 5) included, without being limited to:

- Dredging (mechanical or hydraulic) of 37 700 m^3 (volume in place, not bulked) of the sediment on the south side of the commercial wharf;
- Building a temporary access ramp to unload the dredged material, if needed, to compensate for use of the wharf;
- Building dewatering basins for the dredged sediment;
- Dewatering the dredged sediment;
- Transporting the sediment to an authorized disposal site;
- Final management of the sediment in an existing commercial burial cell for contaminated soil according to the different contamination levels) (lower than A, A-B, B-C, higher than C)[3].

Due to the high cost of the selected solution, the impacts generated by transporting the sediment over long distances and the possibility of giving the sediment a second life (valorization), Transport Canada is also considering the possibility of using sediment treatment as a variant to remediation. If a high-performance technology is available, sediment treatment could be selected to reduce the level of contamination prior to its final management. This environmental assessment must therefore consider the following aspects with regard to the possibility of treating the sediment:

- Parameters of the treatment technology;
- Identification of the treatment site;
- Storage of the sediment, if applicable.

It must be noted that the sediment (considered soil once dewatered or treated, if applicable) can be transported to the final management site by truck, train or boat, or a combination of these means of transportation.

In May of 2009, a public information session was held in Gaspé in the framework of the environmental assessment process. The session aimed to inform the public of the sediment

[3] These contamination levels refer to the criteria set out in the *Politique de protection des sols et de réhabilitation des terrains contaminés* (MDDEP, 1998).

remediation scenario retained at the time as well as the application of the project's environmental assessment process.

2.3 Review of the Sediment Treatment Methods

The review of the sediment treatment options examined in 2005 did not reveal an acceptable solution for the treatment of the mixed contamination found in the sediment at Sandy Beach, which led to the proposal that the sediment be buried in a commercial cell (see Section 2.2). Due to the high cost of the selected solution, the impacts generated by transporting the sediment over long distances (nearly 1 000 km) and the possibility of giving the sediment a second life (valorization), Transport Canada decided to reconsider the treatment options available. The Department asked Dessau and the *Centre d'excellence de Montréal en réhabilitation de sites* (CEMRS) to produce three separate reviews of the existing treatment options. The first, carried out by Dessau in October 2008, mainly covered technologies for which suppliers existed and would therefore be available immediately. This review weighed the following treatment options:

- Solidification/stabilization with a cement additive;
- Physicochemical separation, essentially washing methods;
- Electrokinetics;
- Phytorestoration;
- Active encapsulation.

Of these options, only physicochemical separation was retained, for the reason that it would meet the remediation objectives. The review also determined that at least three firms were able to offer a treatment technology of this type: Dragage Verreault, CleanEarth Technologies and Innoventé.

The second study, completed by CEMRS in August of 2009, assessed the feasibility of using the three physicochemical separation technologies, indexed by Dessau in 2008, to treat the sediment. The team of CEMRS experts first defined the analytical needs, developed a sampling protocol, recommended the tests and analyses required to optimize the performance of the potential solutions and indentified laboratories capable of doing so. The experts then supervised and reviewed the analyses and results obtained in order to transmit these to seven potential proponents of this type of technology (including the three identified by Dessau) and thus confirm their interest in and ability to treat the sediment. Finally, the CEMRS team analyzed technologies that would permit the off-site treatment of PAH and copper-contaminated sediment and presented their recommendations. The study results revealed that only three of the seven proponents who were contacted currently have the treatment technologies potentially capable of treating PAH and copper-contaminated sediment. Three others expressed interest in submitting a proposal during a call for tenders, but none had a technology to present at the time. The last proponent contacted has a treatment technology available, but not one suited to copper particulate contamination. Finally, the CEMRS team believes that consideration should be given to having the copper removed by conventional techniques such as flotation and gravity separation, while PAH could be reduced through washing or chemical oxidation.

The third study, completed in June 2011, aimed to broaden the search and check if new technologies had become available since 2008. It also helped identify and present existing sediment dewatering options. The study weighed the following treatment options:

- Physicochemical separation, mainly chemical extraction:
  - Acid-based extraction
  - Solvent-based extraction
  - Separation and washing
  - Solidification and stabilization
- Heat-based:
  - Incineration
  - Pyrolysis
  - Thermal desorption
  - Vitrification

The 2011 study also helped identify and describe the following sediment dewatering methods:

- Physical separation:
  - Screening
  - Sand auger
  - Hydrocyclone
  - Final settling tank/thickener
- Passive dewatering (in a basin or in thin layers)
- Mechanical dewatering:
  - Belt filter
  - Filter press
  - Centrifuge
  - Geo Tubes®

The dewatering options are briefly presented in Section 2.5.2.4, as well as in Table 1 in Appendix B. All of these treatment options are summarized in Section 2.5.2.7, as well as in Table 2 in Appendix B.

2.4 Review of the Analysis Process

As the reviews of the existing treatment technologies revealed the diversity of the treatment options available, Transport Canada decided to rethink the approach favoured in 2006, which involved identifying a single preferable scenario.

Given the complexity of the work to remediate the sediment south of the commercial wharf on Sandy Beach, the considerable cost and the wide range of dewatering and treatment options, Transport Canada decided on an intervention-based approach for the environmental assessment. Thanks to the use of performance specifications based namely on the desired post-remediation results, this new approach will lead to the selection of a supplier that offers the best intervention scenario at the best possible cost.

This environmental impact assessment therefore presents a series of potential intervention activities. Depending on the supplier selected, only some of these activities may be carried out.

2.5 Detailed Description of the Potential Intervention Activities

The remediation work will be carried out by combining some of the potential intervention activities presented in the sections that follow. The activities and their final combination will be determined based on the supplier who best meets the performance specifications developed in accordance with the desired remediation objectives.

The following sections describe the various potential intervention activities proposed, according to the three main work phases: pre-work, work execution and post-work.

2.5.1 Pre-Work Phase

2.5.1.1 Contractor Mobilization and Site Setup

The contractor's mobilization and the site setup will require the following facilities and work:

- Installation of a trailer for the general contractor (office and warehouse), a trailer for the project owner (or his/her representative) and a trailer for the workers (eating area and shelter in case of inclement weather);
- Electrical and telephone hook-up for the trailers;
- Installation of sanitary services;
- Setup of material storage areas;
- Setup of parking and machinery fuelling areas;
- Setup of a truck washing area.

2.5.1.2 Transportation of Equipment and Material

Site organization will include mobilizing conventional heavy machinery at the appropriate time. This includes equipment that may be required to transport, build and set up infrastructures, prepare the storage surface, dredge, dewater and eventually treat the sediment. Since the dredging work could be spread over two consecutive years, additional equipment mobilization (namely dredging) may be necessary.

2.5.1.3 Setting the Environmental Baseline

In the event that properties are used to build a dewatering area, a dewatering unit or set up mobile treatment units, an environmental baseline will first be established. More specifically, the soil and groundwater will be characterized before the properties are used and immediately after the work is completed. Soil and groundwater samples must be taken in accordance with the *Guide de caractérisation des terrains* and the *Guide d'échantillonnage à des fins d'analyses environnementales du Québec* (books 3 and 5, groundwater and soil sampling). The analyses conducted on each soil and groundwater sample may include, among others: metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg), PAH, PCB, chloride and C_{10}-C_{50}.

In the event that such a sampling plan is required, it will be filed with the MDDEP once available.

2.5.1.4 Construction of a Temporary Landing Pier and Road

In the event that it is necessary to compensate for the use of the commercial wharf during the transhipment of the sediment, a temporary landing pier could be built to unload the dredged material. The landing pier will be designed beforehand, with a focus on keeping its encroachment on the fish habitat to a minimum while adequately meeting the technical and safety needs of the workers.

The location of the temporary landing pier has not been specified to date. However, it is important to consider the following:

- If the landing pier must be built in the dredging area, a targeted dredge (before the dredging work is set to begin) could be carried out at the site of the future pier to remove the sediment. The sediment could also be removed when the pier is dismantled.
- If the landing pier is to be located outside the dredging area, the site must be restored once the work is completed.
- The landing pier must not come into conflict with the extension of the shipyard's slipway under water (this extension is shown on the map in Appendix A).

If a landing pier is built, a temporary road may be required to connect the pier to the local transportation network.

2.5.1.5 Setup of the Dewatering Area or Unit

Dewatering Area

In the event that a passive dewatering option is selected, dewatering areas must also be set up. The characteristics of these areas will vary depending on whether the dredging is mechanical or hydraulic.

Mechanical Dredging

According to the simulation in its *Description détaillée des scénarios d'intervention sélectionnés* report (detailed description of the selected intervention scenarios, Dessau-Soprin, 2006), the construction of a dredged sediment dewatering basin will require an approximately 20 000 m^3 excavation and a 7 500 m^2 effective dewatering surface. With a storage volume of 25 000 m^3, it would be designed to facilitate sediment handling and must be completed before the dredging work is set to begin. This basin will need to be watertight to keep contaminants from migrating to the outside and to ensure that the water generated by the sediment dewatering process is collected. The collected water must be analyzed to identify the best management method (treatment, disposal in an authorized site, etc.). A temporary cover (geomembrane) could be installed if necessary (on the surface of the piled material) to limit the infiltration of rainwater and prevent erosion (wind dispersal of the stored soil).

If needed, the dewatering basin could be set up on the properties south of the former site of Xstrata's sulphuric acid storage tanks and the shipyard[4]. However, if a basin is required, its exact location will need to be determined[5]. Observation wells will be installed upstream and downstream to monitor the quality of the groundwater.

Given that this basin is only temporary, the excavated material that cannot be used to build the basin (outer banks, reinforcement of the access roads, etc., depending on the type material) will be stored (location to be determined). Once the dewatering process is complete, these materials can be reused to backfill the basin so long as they meet the applicable standards.

Hydraulic Dredging

Hydraulic dredging of the sediment may also require the building of a dewatering basin (initially used for decantation), but one that is significantly larger than the basin required for mechanical dredging. Like the basin above, this basin must be watertight, facilitate sediment handling and be completed before the dredging work is set to begin. The water generated by the sediment dewatering process

[4] The proposal to use these properties stems from Scenario 5 in the Dessau-Soprin report (2006). There may be changes depending on the project's design.

[5] It must be noted that if the soil at the basin site is contaminated above level C of the MDDEP's *Politique de protection des sols et de réhabilitation des terrains contaminés* (MDDEP, 1998) (see Section 4.1.3.2: *Qualité des sols de surface*), it must be disposed of in accordance with the requirements of the policy's excavated contaminated soil management grid.

will be collected and analyzed to identify the best management method (treatment, disposal at an authorized site, etc.).

Given the size of such a basin, its potential location remains to be determined. Observation wells will be installed upstream and downstream to monitor the quality of the groundwater. However, as mentioned for mechanical dredging, the excavated material that cannot be used to build the basin will be stored temporarily (location to be determined). Once the dewatering process is complete, this material can be reused in accordance with the regulations.

Dewatering Unit

In the event that a physical separation or mechanical dewatering option is selected, a space must be prepared to receive the equipment associated with these options. The surface area required will depend on the needs of the selected option. A watertight temporary storage basin may also be required as a buffer between the dredging of the sediment and the treatment capacity of the dewatering option selected. The size of the basin will take into account the type of dredging work, daily dredging capacity and the capacity of the dewatering unit.

2.5.1.6 *Setup of the Water Storage and Treatment System*

A water storage and treatment system may be required to adequately manage the effluent generated during the different project steps (dewatering basin, truck washing area, etc.). With regard to sediment treatment, the supplier who is eventually selected must meet all the regulatory requirements for the use of the technology and must cover the management of the wastewater generated by the system (temporary storage basin and treatment unit).

This system (basin) could be set up on the properties south of the former site of Xstrata's sulphuric acid storage tanks and the shipyard. It could be installed near the sediment dewatering basin to reduce the pumping distance between the basin and the water storage and treatment system.

2.5.1.7 *Preparation of the Sediment Storage Area*

It may be necessary to store the dredged sediment, dewatered or not, near the port facilities before the sediment is transported to its final management site. In that event, the location of the storage area will need to be determined.

2.5.1.8 *Reinforcement of the Temporary Roads*

The existing gravel roads may need to be reinforced to bear the weight of the many truckloads required to transport the sediment. Reinforcement could include the addition of granular material. Geotextiles may need to be laid between the existing soil and the backfill in some areas.

2.5.1.9 Setup of the Sediment Treatment Unit

If the sediment is treated near the dredging site, a surface area to be determined (based on the selected option) will need to be prepared for the setting up of the treatment unit. Since contaminated sediment will be handled at this site, the surface must be watertight and the channelled runoff must be collected and analyzed to identify the best management method (treatment, disposal at an authorized site, etc.).

2.5.2 Work Execution Phase

2.5.2.1 Sediment Dredging

Mechanical Dredging

The work involves the mechanical dredging of approximately 37 700 m³ of sediment. Mechanical dredging may, for example, be carried out with a clamshell bucket mounted on a barge. The bucket will excavate the sediment and drop it onto a second barge.

The sediment will be loaded onto watertight barges to prevent the loss of material during transportation. During the dredging operations, the contractor must refrain from emptying the barge overflow into the environment, which would release sediment-laden water into the dredging area. However, pumping the barge's supernatant into the bay may be authorized, if tests are performed and the quality of the water respects the criteria set by the competent authorities. If the pumping of the overflow is authorized, this operation must be carried out in the presence of the site's environmental compliance supervisor, as mandated by Transport Canada.

The dredging work may be spread over two consecutive years. At a dredging pace of approximately 300 m³ onsite/day, working 10 hours per day, dredging is estimated to take approximately 125 days in total, or 62.5 days during each of the two dredging years. If the work is carried out 6 days a week, dredging will take about 10.5 weeks per year. Since the work will be carried out in an industrial sector, it could be performed in two shifts (6:00 a.m. to 2:00 p.m. and 2:00 p.m. to 10:00 p.m., for example), thus reducing the length of the intervention to about 5 weeks/year. Note, however, that it is also possible for the dredging work to be carried out 24 hours a day, 7 days a week during periods in which no restrictions are imposed for the protection of certain aquatic species. The planning of the dredging activities will take such restriction periods into account.

Turbidity Curtain

The design of the mechanical dredging work will include, when possible, the installation of a turbidity curtain around the work area during dredging, if conditions inside the work area permit. The curtain should limit the suspended matter from escaping the confined area. It must be held in place vertically with floaters or anchors attached to the dredge in the upper part and to the ballasts in the lower part. It must also isolate the work area from the peripheral areas at all times and must be adjusted to cover the majority of the water column based on site conditions and the manufacturer's recommendations, both at low and high tide.

According to Francingues and Palermo (2005) and Elastec/American Marine (2005), the use of turbidity curtains may be difficult, if not impossible, when certain parameters cannot be respected:

- Difference in tide levels. A tide of 0.3 m requires 0.3 to 0.6 m of clearance under the curtain to keep it from being torn away. In the bay of Gaspé, the tide varies by 1.9 m.
- Flow velocity under 0.5 m/s. The curtains lose effectiveness in stronger currents. According to Groupe-Conseil LaSalle (2010), the bay of Gaspé bay's flow velocity is less than 0.5 m/s.
- Water depth in the installation area. The curtains lose effectiveness beyond 4-6 m in depth. In the dredging area, the bathymetry varies from less than 1 m to over 13 m.
- Low to medium wind conditions. The curtains lose effectiveness in strong wind conditions. Episodes of strong winds are to be expected in the work area while average wind speed throughout the year varies between 50 and 84 km/h.
- Curtain shape. It is important that curtains installed in "U" shapes be no more than 150 to 500 m in length and curtains installed in circular and oval shapes be no more than 300 to 900 m in length.

It may therefore be difficult to install and maintain turbidity curtains in certain parts of the dredging area due to the physical conditions of the job site.

Nonetheless, if turbidity curtains are used, the enclosure will need to include a buffer zone extending beyond the one directly targeted by the work, to keep the curtain from being damaged (ripped away, torn, etc.) or displaced during the movements of the dredge or bucket. What is more, the work must be supervised so that the necessary adjustments can be made to the curtain to keep the suspended matter from escaping the confined area. Such adjustments may be required in the event, among others, of a rise in water level (due to the tide) or the movement of the water masses (due to the currents). The turbidity curtain must keep the suspended matter inside the confined area while having the highest possible hydraulic conductivity. The curtain may only be removed once the water quality inside the work area is comparable to the water quality outside the curtain. A wait period of minimum 24 hours is required between the end of the dredging work and the removal of the curtain.

A suspended particulate matter (SPM) monitoring program will be implemented to ensure that SPM concentrations outside the curtain respect the applicable standards.

Hydraulic Dredging

Hydraulic dredging involves aspirating the sediment. A pump hooked to a suction hose (sling) provides the power needed to lift and vacuum the material. The head of the sling can be fitted, in some cases, with a cutterhead that breaks up the sediment, making it easier to aspirate. Several cutterhead models are available on the market, most designed to limit sediment resuspension.

After it is extracted from the sea floor, the sediment is pumped in the form of sludge and transported by pipe to a barge or to the dewatering basin (or buffer). The pipe is generally flexible and buoyant until it reaches the shore, then rigid for land transportation to the basin.

The use of turbidity curtains is not planned for this type of dredging, unless the results of the SPM monitoring reveal that the applicable standards are exceeded.

At a dredging pace of approximately 200 m^3 onsite/day, working 10 hours per day, dredging is estimated to take approximately 19 days. If the work is carried out 6 days a week, dredging can be completed in a little over 3 weeks. Note, however, that it is also possible for the dredging work to be carried out 24 hours a day, 7 days a week during periods in which no restrictions are imposed for the protection of certain aquatic species. The planning of the dredging activities will take such restriction periods into consideration.

2.5.2.2 *Transporting the Sediment between the Dredging Area and the Offloading to Shore Area*

The dredged sediment will be transported between the dredging area and the offloading to shore area by watertight barges, either motorized or pulled by boats adapted for this type of task. The contractor must keep from overloading the barges to ensure that the barge overflow does not return contaminated sediment to the environment. The barges will be docked at the commercial wharf for unloading. Hydraulic shovels can be used to load the sediment into dump trucks for transportation. If the sediment contains a significant volume of water, the dump trucks may need to be watertight.

2.5.2.3 *Transporting the Sediment to the Dewatering Basin or Unit*

The dredged sediment will be transported between the commercial wharf or temporary landing pier and the dewatering basin or unit by dump trucks equipped with splashguards. If the sediment contains a large volume of water, the dump trucks may need to be watertight. The sediment can be loaded by hydraulic shovel on the commercial wharf or temporary landing pier, with the load then dumped directly into the dewatering basin or the dewatering or treatment unit's buffer tank.

2.5.2.4 Sediment Dewatering

If dewatering is required, it will be carried out according to one of the three main approaches considered: physical separation, passive dewatering and mechanical dewatering. A combination of these approaches may also be favoured to increase dryness. The equipment and activities associated with each of these approaches are described below.

Physical Separation

Physical separation involves mechanically segregating the dredged material based on its physical properties (size and/or density). It removes debris, blocks of material, gravel, then sand, to reach the fine fraction. The coarse fraction (> 0.08 mm) generally requires little or no additional dewatering. The fine fraction is then directed to the other dewatering modules, thus significantly reducing the volumes to be treated. Physical separation also helps reduce the volume of contaminated material since contamination is generally associated with the fine fraction. It must be noted that physical separation, in the specific case of the Sandy Beach project, is an integral part of the physicochemical treatment technologies, which include a treatment chain that comprises one or several of the technologies described in this section (USEPA, 1999).

Physical separation generally does not require a large right-of-way if the dewatering chain is capable of treating the output generated by the dredging work. It may therefore be necessary to design a dewatering chain with a certain redundancy of the equipment. Otherwise, a buffer tank will be required so as not to slow the dredging work. This tank can be relatively large, depending on the disparity between dredging capacity and dewatering capacity.

The different types of equipment used to physically separate the sediment can be employed individually or combined in multiple ways in a dewatering chain to reach the set objectives. The equipment includes, without being limited to:

- Screening, which removes the large material and debris, such as blocks, gravel, bark, pieces of plastic and other;
- A sand auger (horizontal or inclined), which separates the fine and coarse fractions;
- A hydrocyclone, which, thanks to its vortex effect, separates the heavy particles from the fine;
- Final settling tank/thickener, to decant the sediment.

Table 1 in Appendix B provides more information about the different types of equipment.

Passive Dewatering

Passive dewatering uses drainage and natural evaporation to lower the sediment's moisture content. Drainage can be gravity-based or accelerated through the use of vacuum pumps, for example. Mechanical means (such as digging trenches at the surface of the sediment, removing layers of dried sediment, etc.) can also be used to accelerate or facilitate the drying process (USEPA, 1994).

Passive dewatering requires the building of one or several basins (with a large surface area) to contain all of the dredged sediment. The water can drain at the surface of the sediment (supernatant), under the surface (percolation through the walls or bed of the basin, horizontal drains) or through the use of vertical drains and wet wells (USEPA, 1994). It is important to assess the quality of the drainage water before the work begins to determine if it requires treatment prior to its disposal. Evaporation helps reduce the amount of water in the sediment and the moisture content of the sediment exposed to the air. A layer of dried sediment forms gradually at the surface and must be removed to allow the underlying sediment to dry. When a layer of dry sediment forms, it limits water evaporation in the next layer.

A variation of this type of dewatering involves spreading the sediment in thin layers (generally 300 to 600 mm) on a watertight or draining surface (if the quality of the drainage water permits). This technique requires large surfaces, but accelerates the dewatering process.

If this technique is used, the dewatering process could take more than one year, regardless of the type of dredging chosen.

Mechanical Dewatering

Mechanical dewatering involves using equipment to crush or press the sediment or draw off the water. This dewatering method is commonly used on municipal or industrial sludge as well as in the mining industry. Generally, mechanical dewatering increases the dryness of the sediment by up to 70% (USEPA, 1994). To improve the performance of this type dewatering, it is necessary to add polymers to coagulate the fine particles. For organic sludge, the dosage is generally low (< 0.1% by mass), but for inorganic material, it can be significantly higher (USEPA, 1994).

The different types of equipment used to mechanically dewater the sediment can be employed individually or combined in multiple ways in a dewatering chain to reach the set objectives. The equipment includes, without being limited to:

- A belt filter, which presses the sediment between permeable belts;
- A filter press, which pressure injects the sediment onto filter plates;
- Centrifuges that use rotating units that expel the water from the sediment by centrifugal force;

- Geo Tubes®, geotextile tubes designed specifically to retain and trap solid particles in the sludge and let the liquid escape through permeable walls.

Table 1 in Appendix B provides more information about the different types of equipment.

2.5.2.5 *Liquid Effluent Management*

As concerns effluents, water of adequate quality can be disposed of in the environment. Water analyses will be conducted to validate water quality prior to its disposal. If these analyses reveal that the water is contaminated, there are two management options available: using a treatment designed to bring the contamination level below the applicable standards or to pump the water and send it to a site authorized for its final management. If a treatment is used, the location of such a system will need to be determined. The only difference between the two types of dredging is in the volume of water that needs to be treated. Hydraulic dredging is expected to produce a larger volume of water.

2.5.2.6 *Transporting the Dewatered Sediment to the Storage Surface*

If dewatering techniques are used, the sediment can be removed and transported to the storage surface (location to be determined) to ensure that the dry surface layer is removed on a daily basis.

Once the sediment is unloaded, a wheel loader could be used to put it into piles prior to the sediment`s treatment or eventual re-loading and transportation to the final management site.

2.5.2.7 *Sediment Treatment*

The sediment's treatment will depend on the treatment's capacity to significantly reduce copper and PAH concentrations, allowing the sediment to be valorized or, at minimum, reduce the volume of sediment that will require final disposal in a burial cell for contaminated soil. With the data gathered to date, it is not possible to establish the efficiency of the various existing technologies in reducing the level of contamination in the Sandy Beach sediment. The technologies identified and analyzed during the reviews conducted in 2008, 2009 and 2011 by Dessau and CEMRS are presented hereinafter for informative purposes and to consider all specific impacts that could be associated with any of these technologies. The objective is to ensure that the environmental impact assessment covers all potentially applicable treatment options. It must also be noted that these technologies can be applied individually or combined to form a treatment chain that will increase their effectiveness.

Pyshicochemical Treatment

Treatment technologies in this category use the physical and/or chemical properties of the contaminants or contaminated matrix to destroy (chemically convert), separate or contain the contamination. In the physical processes, the contamination is transferred from one phase to another. In the chemical processes, the chemical structure and behaviour of the contaminants are modified through chemical reactions to produce compounds that are less toxic or easier to separate from the original matrix. Generally, these treatments are economically viable and can be completed in a relatively short time span. The necessary equipment is accessible and their integration in a treatment chain requires only minimal design. Moreover, this type of treatment is not energy-intensive (EUGRIS, 2011). The physicochemical treatments can be applied alone or in combination with others to form a treatment chain.

The physicochemical treatments potentially capable of treating the contaminants found in the sediment to be dredged include, but are not necessarily limited to:

- Physical separation, which involves detaching the contaminants from the material on which they are found through mechanical means;
- Washing, which involves extracting the contaminants through physical separation of the fine and coarse particles on the basis that certain contaminants are associated with certain particle size-fractions in the soil and that these contaminants can be removed by washing in a solution.
- Acid-based chemical extraction, which involves modifying the pH in order to solubilize the heavy metals.
- Chemical extraction with organic solvents, which involves extracting the organic contaminants.
- Solidification/stabilization, which involves stabilizing the contaminants in a cement matrix.

Table 2 in Appendix B provides more information about the different types of equipment.

Heat Treatment

Heat treatments use heat to increase volatility, burn, break down, destroy or melt the contaminants. They offer a relatively short treatment time, but are generally more costly due to energy and equipment costs. Investment in capital and operating costs are both significant for this type of treatment. It must be noted that, with the exception of vitrification, all the other types of heat treatment should be combined with a physicochemical treatment to eliminate the copper that will remain in the resulting ashes.

The heat treatments potentially capable of treating the contaminants found in the sediment to be dredged include, but are not necessarily limited to:

- Incineration, which involves destroying the organic contaminants by volatilization or combustion in the presence of oxygen and very high temperatures.
- Pyrolysis, which involves chemically breaking down the organic compounds by heating the sediment in the absence of oxygen and at temperatures above 430^{o} C.

- Thermal desorption, which involves volatizing the water and organic contaminants by exposing the sediment to temperatures from 90° C to 560° C, depending on the nature of the contaminants.

- Vitrification, which involves forming a vitrified matrix by heating at high temperature (over 1 600° C). The organic compounds are vitrified and the inorganic compounds are immobilized in the matrix.

Table 2 in Appendix B provides more information about the different types of equipment.

2.5.2.8 *Sediment Transportation and Final Management*

Transportation

The means of transportation considered to carry the sediment to a commercial disposal site for its final management or valorization includes marine, road and rail transportation or a combination of the three. The contractor will be responsible for obtaining the permit(s) required to transport the sediment to the management site, regardless of the means of transportation selected.

<u>Marine Transportation</u>

If the sediment is transported by ship to the port nearest the site of its final management or valorization, the dredged sediment will be loaded directly on a barge. If it is dewatered or treated onsite, it will be loaded on trucks at the storage site, then transported to the commercial wharf. The sediment will then be loaded, by hydraulic shovel or crane, on a barge docked at the wharf, after which it will be transported to the Port of Grande-Anse (La Baie, for final management at the Parc Environnemental AES), the Port of Trois-Rivières (Trois-Rivières, for final management at Horizon Environnement or EnfouiBec), the Port of Montréal (Montréal, for final management at Cintec) or any other destination for its valorization or final management. Once arrived at the destination, the sediment will be loaded on trucks by hydraulic shovel or crane for transportation to the commercial disposal or valorization site.

Road Transportation

If the sediment is transported overland, it will be loaded on trucks at the storage surface with a wheel loader. The sediment could be transported to the Parc Environnemental AES (Larouche, 700 km), Horizon Environnement (Grandes-Piles, 820 km), Enfouibec (Bécancour, 820 km) or Cintec (Montréal, 930 km) or any other destination for its valorization or final management.

Rail Transportation

If the sediment is transported by train, it will be loaded on rail cars at the storage surface with a wheel loader. If it is to be disposed of in an existing commercial site, the cars will be directed to the Jonquière railroad station (Saguenay, for final management at the Parc Environnemental AES), the Garneau train station (Shawinigan, for final management at Horizon Environnement), the Bécancour train station (Bécancour, for disposal at EnfouiBec), Montréal (railroad station to be determined, for final management at Cintec) or any other destination for its valorization or final management.

The sediment will then be loaded on trucks by hydraulic shovel or crane for transportation to the commercial disposal or valorization site selected for its final management.

Note that two or three of these means of transportation can be combined, depending on the volume of sediment to transport and the contamination level.

Final Management

The dredged sediment must be managed according to the provisions of the MDDEP's *Règlement sur le stockage et les centres de transfert de sols contaminés* (RSCTAC) and the *Politique de protection des sols et de réhabilitation des terrains contaminés* (hereinafter "Policy") (MDDEP, 1998). Several final management sites were identified in this study. The official choice of the final management site remains at the discretion of the contractor who will be selected to carry out the work.

Part of the sediment to be dredged has copper contamination levels that exceed level C of the Policy's criteria and sometimes even the standards in Appendix I of the *Règlement sur l'enfouissement des sols contaminés* (RESC). The level of PAH contamination is below level C of the Policy's criteria. If not treated to reduce its level of contamination, the sediment's final management will only be possible in commercial disposal sites authorized to receive it. In 2010, a minimum of four sites were identified as authorized to receive soil contaminated above level C of the Policy's criteria. They are:

- Services Environnementaux AES (Larouche, Saguenay);
- Enfouibec (Bécancour, Centre-du-Québec);
- Horizon (Grandes-Piles, Mauricie);
- Cintec (Montréal).

Treating the sediment could reduce the level of contamination. For part of the sediment, the contamination level could be reduced below level C of the Policy's criteria. Under the Government of Quebec's *Règlement sur l'enfouissement et l'incinération des matières résiduelles* (REIMR), engineered landfill sites (*lieux d'enfouissement technique* or LET) are authorized to receive soil whose contamination level falls below the standards of Appendix I of the *Règlement sur la protection et la réhabilitation des terrains* (RPRT) (level B of the Policy's criteria) for volatile organic compounds and the standards of Appendix II of the RPRT (level C of the Policy's criteria) for other contaminants. However, the REIMR stipulates that, to be used as capping material, the soil must have permanent hydraulic conductivity that is at minimum 1 x 10^{-4} cm/s and have at maximum 20% of the weight of the particles at a particle diameter equal to or less than 0.08 mm. Since the sediment to be dredged does not meet this second requirement, the dewatered or treated sediment (thereafter considered soil) can only be sent to an engineered landfill site if it is buried directly and not used as a daily capping material. The engineered landfill site closest to the Port of Gaspé – Sandy Beach with the capacity to receive the sediment, once treated, is the Saint-Alphonse landfill, located north of the municipality of Caplan (approximately 200 km from the Port of Gaspé – Sandy Beach).

Treated sediment whose contamination level is below level A of the Policy's criteria, subject to the latter, can be reused (valorized) without restriction on any type of property. However, in order to protect the receiving environment, the treated sediment will be tested for chloride prior to its valorization.

2.5.3 Post-Work Phase

2.5.3.1 Dismantling of the Temporary Landing Pier and Road

If a temporary landing pier and/or road were built to compensate for the use of the commercial wharf, both will be dismantled once the work is completed.

2.5.3.2 Dismantling of the Dewatering Basins or Unit

Once the dewatering work is completed, the geomembranes used on the walls and floor of the basin will be removed, cleaned and disposed of offsite, in an authorized location. The excavated and temporarily stored material will be backfilled and compacted to restore the area to its original state.

If a dewatering unit is used, the buffer tank will be dismantled in the same manner as the dewatering basins. The dewatering unit will be cleaned, dismantled and returned to the facilities of the contractor that owns the technology. All non-reusable residue must be disposed of offsite, in a location authorized to receive it. If the property on which the dewatering basins or units were built had to be modified, it must be returned, as much as possible, to its original state.

2.5.3.3 Dismantling of the Treatment Unit

Once the work is completed, the various components of the selected treatment unit must be cleaned, dismantled and returned to the facilities of the contractor that owns the technology.

2.5.3.4 *Reclamation of the Terrestrial Sites*

Site reclamation generally involves cleaning and removing all excess material, dismantling the cleaning area, removing debris and waste and disconnecting the temporary connections to public utilities, if necessary, as well as replanting cleared areas.

For sites that underwent an initial characterization campaign, new samples will be taken to check the quality of the soil and groundwater once the work is completed. This must be done before the contractor's demobilization so that corrective measures can be taken if the soil at the site has been contaminated.

Only those sites that required initial clearing will be replanted, by seeding indigenous species compatible with the environment.

2.5.3.5 *Verification of the Environmental State of the Sites Following the Work*

If required, the soil and groundwater will be characterized on the properties used to dewater and treat the sediment, after the structures have been dismantled. The soil and groundwater samples will be taken in accordance with the *Guide de caractérisation des terrains* and the *Guide d'échantillonnage à des fins d'analyses environnementales du Québec* (books 3 and 5, soil and groundwater sampling). The analyses conducted on each soil and groundwater sample should cover the same parameters that were analyzed during the setting of the baseline.

In the event that such a sampling plan is required, it will be submitted to the MDDEP once available.

2.5.3.6 *Contractor Demobilization*

Demobilization generally includes removing the temporary infrastructures and heavy machinery. More precisely:

- Demobilizing the construction trailers, removing the temporary signage and safety barriers and restoring the site, including the trailer, truck washing and machinery parking areas;
- Removing all machinery used for the work.
- In the event that the sediment is treated to reduce the contamination level, the main post-work activity would be to dismantle the mobile treatment units.

2.6 Summary of the Main Differences between Mechanical and Hydraulic Dredging

The differences between mechanical and hydraulic dredging are:

- If a dewatering basin is used, transporting the mechanically dredged sediment to the basin will require transhipment at the commercial wharf and transportation by truck. Hydraulic dredging only requires an inflow pipe.
- If it is not possible to use the commercial wharf to tranship the sediment due to usage conflicts, a temporary landing pier and road will compensate for any wharf usage that may be required for mechanical dredging.
- The surface area required for a dewatering basin is markedly smaller for mechanical dredging, since hydraulic dredging generates a large volume of water.
- Hydraulic dredging generates a larger volume of liquid effluent to manage.
- Mechanical dredging causes greater sediment resuspension than hydraulic dredging.

2.7 Project Implementation Steps and Work Schedule

The steps that must be taken prior to the start of the remediation project will extend from 2011 until the winter of 2014. These steps include the environmental impact assessment, detail engineering, applications for authorization, preparation of the plans and specifications and the call for tenders process. The sediment remediation project will take place between 2014 and 2016. Once the work is completed, the mollusc monitoring program will continue until 2017. The compensation project approved by the DFO to make up for the loss of fish habitat will be implemented. A project follow-up program must also be implemented.

3 COMMUNICATION ACTIVITIES

3.1 Pre-Project Consultation Activities

In order to comply with the contaminated sediment management practices set out in the *Interim Criteria for Quality Assessment of St. Lawrence River Sediment* (St. Lawrence Centre, 1992), the technical committee was tasked with coordinating the study to assess the risk to human health and the environment (QSAR *et al*., 2002) in order to decide at which level of contaminant concentration an intervention would be appropriate. The technical committee then worked on developing different contaminated sediment management scenarios to identify the scenario that would solve the contaminated sediment problem, including the technical studies required to develop the final remediation project. The committee acted by informing and consulting the local stakeholders. The project's technical committee, made up of Transport Canada, Xstrata, Environment Canada and Public Works and Government Services Canada (PWGSC) began consulting the *Comité de concertation de la Baie de Gaspé* (CCBG) in 2001. The CCBG, a non-profit organization dedicated to the integrated management of Baie-de-Gaspé, with a focus on sustainable development, is made up of representatives of the fishing, aquaculture, tourism, environmental protection and economic development sectors as well as municipal, federal and provincial representatives, representatives of the Micmac nation of Gespeg and local citizens. This consultative committee has carried out numerous interventions since 2001, with the most notable being the annual project to clean the bay's banks.

The technical committee met with the members of the CCBG on several occasions to obtain information and invite comments after indentifying the remediation options and pre-selecting the intervention scenarios. This approach is in keeping with the process to consult local representatives at every step of the development of a sediment remediation project at the Port of Gaspé – Sandy Beach. Table 1 presents the technical committee's meetings and exchanges with the CCBG since 2001. The CCBG has since been disbanded.

TABLE 1: HISTORY OF THE TECHNICAL COMMITTEE'S MEETINGS AND EXCHANGES WITH THE *COMITÉ DE CONCERTATION DE LA BAIE DE GASPÉ*

Action	Date	Subject
Meeting with the CCBG and the public	November 6, 2001	- Presenting the joint Transport Canada and Xstrata approach to the contaminated sediment problem in the area surrounding the Gaspé wharf: conducting an assessment of the risk to the environment and human health - Inviting comments and answering questions
Meeting with the CCBG and the public	June 18, 2002	- Presenting the methodology used to assess the contaminated sediment's risk to the environment and human health - Presenting the results of this risk assessment - Presenting the next steps
Letter from the CCBG to Transport Canada and Xstrata	July 8, 2002	The CCBG said that is appreciates the opportunity to comment on the risk assessment and mentioned that a subcommittee was formed for this purpose.
Letter from the CCBG to Transport Canada	October 29, 2002	The CCBG submitted its comments on the report outlining the assessment of the risk the copper-contaminated sediment poses to the environment and human health
Meeting with the CCBG and the public	November 6, 2003	- Reviewing the actions taken since the meeting in June 2002 - Responding to all comments from the public - Presenting the next steps in developing a remediation project
Letter from Transport Canada (on behalf of the technical committee) to the CCBG	November 21, 2003	Submitting the answers to the comments made by the CCBG in October 2002
Letter from Transport Canada (on behalf of the technical committee) to the CCBG	July 27, 2004	Providing information about the project's progress and schedule
Meeting with the CCBG (core group)	November 23, 2004	- Presenting the work plan to determine the remediation options - Agreeing on interactions with the CCBG to carry out the mandate given to Dessau-Soprin
Meeting with the CCBG (core group)	July 7, 2005	- Presenting the remediation options considered for the development of intervention scenarios - Presenting the technologies applicable to the remediation options considered - Presenting the pre-selected intervention scenarios - Presenting the next project steps - Submitting the *Identification des options de restauration et présélection des scénarios* report (identification of remediation options and pre-selection of scenarios)
Letter from the CCBG to Transport Canada (on behalf of the technical committee)	November 8, 2005	- CCBG's comments on the *Identification des options de restauration et présélection des scénarios* report

TABLE 1 (CONTINUED): HISTORY OF THE TECHNICAL COMMITTEE'S MEETINGS AND EXCHANGES WITH THE *COMITÉ DE CONCERTATION DE LA BAIE DE GASPÉ*

Action	Date	Subject
Letter from Transport Canada to the CCBG (technical committee)	December 2, 2005	- Acknowledgement of receipt of the letter from the CCBG and clarifications of the approach taken to select an intervention scenario.
Letter from Transport Canada to the CCBG (technical committee)	June 12, 2006	Transmission of documents: - *Description détaillés des scénarios d'interventions sélectionnés* (detailed description of the selected intervention scenarios) report - *Aspects sédimentologiques et caractérisation des habitats aquatiques et du milieu physique* (sedimentological aspects and characterization of the aquatic habitats and physical environment) report - Addenda to the sedimentological aspects report
Meeting with the CCBG (core group)	June 21, 2006	- Taking stock of the project's progress - Review Dessau-Soprin's individual meetings with the CCBG representatives to invite their comments and concerns about the pre-selected intervention scenarios - Presenting the actions underway and those to come
Telephone and e-mail exchanges between Transport Canada (on behalf of the technical committee) and the CCBG (coordinator)	2006, 2007, 2008	- Providing general information about the project's progress, namely the negotiations between Transport Canada and Xstrata to reach a financial agreement
Meeting with the CCBG (core group)	June 10, 2008	- Taking stock of the project's progress (namely the selected scenario), presenting the next steps and discussing the means of communication/exchange of information between Transport Canada and the CCBG to follow up on the file

3.2 Consultation Activities in the Framework of the Environmental Assessment

Transport Canada held two public information sessions in Gaspé in the context of this project's environmental assessment. The first was held at the beginning of the environmental assessment, on May 20, 2009, to present the project to the population of Gaspé and invite their comments and concerns. A summary description of the physical, biological and human environments was also presented. The second information session was held on July 15, 2010 to present, among other things, the results of the numerical modeling of the sediment's dispersal during the dredging work. The participants' comments and concerns were also collected to complete the project's environmental assessment. Invitations to attend the public information sessions were sent to the Micmac nation of Gespeg band council. None of the community members attended these sessions.

During the course of these communication activities, Transport Canada was always careful to note the comments and concerns expressed by the CCBG, users and citizens in attendance in order to respond to the extent possible. Comments and concerns included:

- Encroachment on the marine environment and loss of fish habitat due to a permanent installation on shore.
- Resuspension of the sediment during the remediation work and its potential impact on mussel and scallop farms in the Dartmouth river sector;
- The possibility of confining the most contaminated sediment onsite;
- Future risks associated with the sediment whose contamination levels fall below the remediation thresholds and will therefore not be dredged;
- The possibility of a potential conflict with other development projects (ex. cruise ship terminal), port operations or people who use this area, such as pleasure boaters and fishers;
- Ensure that the public participates in the different planning stages and eventually the project's execution.

Transport Canada has always made an effort to respond to the concerns expressed by citizens during the different project steps. As such, Transport Canada did not hesitate, for example, to modify the selection criteria in designing the project, add valued environmental components and/or mitigation measures to the environmental assessment or conduct a specific study to gain more extensive knowledge of sediment dispersal, for example.

It must also be noted that a notice of commencement for the environmental assessment of the Port of Gaspé – Sandy Beach sediment remediation project was published on February 11, 2009 in the Canadian Environmental Assessment Registry (CEAR), accessible on the Canadian Environmental Assessment Agency (CEAA) Web site, reference number 09-01-46043.

Finally, over the next year, Transport Canada plans to:

- Develop and disseminate a communication plan to keep the population informed of the project's development;
- Meet with the Gaspé harbour`s mussel and scallop farmers to present the environmental mollusc monitoring program developed in the framework of the project;

4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

4.1 Scope of the Project

The scope of the sediment remediation project at the Port of Gaspé – Sandy Beach includes pre-work, work execution and post-work activities. The remediation project will be a combination of several of the activities listed below. This list is the most exhaustive possible, in order to cover all of the remediation options that could be proposed in the call for tenders.

4.1.1 Pre-Work Phase

- Mobilizing the contractor and preparing the job site;
- Transporting the equipment and materials;
- Setting the environmental baseline;
- Building a temporary landing pier and/or road (for unloading the dredged material, to compensate for the use of the commercial wharf, if necessary);
- Setting up the dewatering area or unit;
- Setting up the storage area and water treatment system;
- Preparing the storage area for the dewatered or treated sediment;
- Reinforcing the temporary roads;
- Setting up the sediment treatment unit.

4.1.2 Work Execution Phase

- Dredging the sediment, which involves mechanically or hydraulically dredging approximately 37 700 m^3 (volume in place, no bulked) of sediment on the south side of the commercial wharf (see Figure 7);
- Transporting the sediment from the dredging area to the offloading to shore area, including transhipment;
- Transporting the sediment to the dewatering basin or unit;
- Dewatering the sediment;
- Managing the liquid effluent;
- Transporting the dewatered sediment to the storage surface;
- Treating the sediment;
- Transporting the sediment (by truck, train or boat, or a combination of the three) and final management.

4.1.3 Post-Work Phase

- Dismantling the temporary landing pier and road;
- Dismantling the dewatering basins or unit;
- Dismantling the treatment unit;
- Restoring the terrestrial environments;
- Checking the baseline of the sites after the work is completed (soil, water and sediment characterization, if required);
- Demobilizing the contractor

4.2 Factors to be Considered

The environmental impact assessment includes studying the following factors listed in subsections 16(1) *a)* to *e)* of the CEAA:

- The environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- The significance of the environmental effects;
- Comments from the public that are received in accordance with the environmental impact assessment;
- Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;
- Residual effects and their significance;
- The need for monitoring and follow-up programs.

4.3 Scope of the Factors to be Considered

4.3.1 Valued Environmental Components

Valued environmental components (VEC) are attributes of the receiving environment that are important from a physical, ecological, social or economic standpoint or for which there is public concern. VECs identified in the framework of the sediment remediation project at the Port of Gaspé – Sandy Beach are presented in Table 2:

TABLE 2: VALUED ENVIRONMENTAL COMPONENTS

Physical environment	**Valued environmental component**
	- Air quality - Ground surface - Soil and sediment quality - Equilibrium profile and slopes - Surface and groundwater quality - Hydraulic and sedimentological conditions
Biological environment	**Valued environmental component**
	- Terrestrial, riparian and aquatic vegetation - Fish and their habitat - Marine mammals and terrestrial wildlife - Terrestrial, riparian and aquatic habitats - Species at risk - Endangered or vulnerable species or species likely to be so designated
Human environment	**Valued environmental component**
	- Sound climate - Commercial and industrial activities - Fishing and aquaculture - Tourist and recreational activities - Public and user safety - Landscape - Commercial and industrial infrastructures - Road and rail networks - Navigation

4.3.2 Environmental Effects on the Project

In the framework of the environmental impact assessment, the environmental risks that could affect the project must be described and the expected effects of these environmental risks must be documented. For this project, extreme weather conditions at the dredging site, which could affect the project schedule, transportation conditions, etc. must be taken into consideration.

4.3.3 Space and Time Limits

The environmental assessment will take into consideration the project's potential effects in the space and time limits that correspond with the sectors and periods in which the project could interact with (or have an effect on) environmental components. The study area presented in Figure 1 (see Chapter 1) was delineated to identify the direct and indirect environmental effects likely to be generated by the project.

5 DESCRIPTION OF THE ENVIRONMENT

This chapter describes the study area's environment. The description includes the valued environmental components (VEC), which make up the biophysical and socioeconomic aspects associated with the environment that were deemed significant in the framework of this study.

The information on the physical, biological and human environments is unique to the dredging area, the intervention area or the study area. However, in the absence of data specific to these areas, the information may apply to the bay of Gaspé in general or even the Gulf of St. Lawrence. If so, this distinction will be mentioned.

The reader is invited to consult figures 1 and 2 as well as the property and port facilities map in Appendix A in order to situate some of the components described in the following sections.

5.1 Physical Environment

5.1.1 Meteorology

Unless otherwise indicated, the meteorological information presented in this study was obtained from the Environment Canada meteorological station located at the Gaspé airport. The statistical data used in this section covers the period between 1971 and 2000 (Environment Canada, 2009). It must be noted, however, that due to the distance between the Gaspé airport and the Gaspé harbour (approximately 6.5 km), it is expected that there will be differences between the data collected at the airport and the prevalent reality at the Gaspé harbour. When available, the data that is presented was collected at the harbour.

5.1.1.1 Wind Conditions

Dominant winds (monthly wind direction average) at the Gaspé airport meteorological station are from the west from September to March inclusively and from the east from April to August inclusively. Average monthly wind speeds are similar throughout the year, varying from 9 to 13 km/h. Maximum recorded hourly speeds vary between 50 and 84 km/h throughout the year, while maximum recorded gales vary between 85 and 122 km/h. In Gaspé, winds over 50 km/h are more frequent between October and April.

However, as mentioned earlier, given the distance and the physiographic differences between the Gaspé airport site and the Gaspé harbour site, it is expected that wind conditions will differ between these two sites. Certain information about these differences may have been taken from the Koutitonsky *et al*. study (2001), but only apply to the fall season. Moreover, the data was collected during a single sampling campaign (from September to November). In the framework of this study, winds were measured at the northern end of the Sandy Beach sand bar, every 20 minutes between

September 25 and November 13, 2000. A comparison was also conducted by Koutitonsky *et al*. (2001) with data obtained by Environment Canada at the Gaspé airport meteorological station.

The study revealed that dominant winds blow from the west at the airport and from the northwest in the bay for the period under study. At the Gaspé harbour, it appears that the dominant winds follow the longitudinal axis of the harbour, although a non-negligible occurrence (10%) of northeasterly winds has been noted, which blow with more velocity than winds from the northwest. Again according to the results obtained by Koutitonsky *et al*. (2001), wind speeds are generally between 18 and 36 km/h (occasionally reaching 55 km/h when from the northeast) in the harbour, while winds are an average of 9 to 13 km/h at the airport (monthly average taken from the Environment Canada data) or 7 to 22 km/h [values obtained by Koutitonsky *et al*. (2001)].

5.1.1.2 Precipitation

The average monthly precipitation varies between 59 mm and 112.8 mm, with the low end recorded during the month of February and the high end during the month of December. The spring period (March and April), the month of July and the fall period (October to December) receive greater precipitation (average monthly precipitation varying between 102.9 mm and 112.8 mm), while the winter periods (January and February) and summer periods (with the exception of July, therefore May, June, August and September) are the driest (average monthly precipitation varying between 59 mm and 91.2 mm). Note that between December and March, only 15% to 30% of the precipitation falls in liquid form (rain and sleet).

5.1.1.3 Air Quality

The Gaspésie-Îles-de-la-Madeleine administrative region has still not been included in the air quality measurement program implemented by the MDDEP (MDDEP, 2012). This program focuses on urban regions at higher risk of air pollutant concentrations.

Nonetheless, it is possible to maintain that, compared to the province’s main urban centers, the Gaspé sector has relatively good air quality. Gaspé’s surrounding area does not have any heavy industrial activity except for quarries, sandpits and forestry activities. These activities primarily generate dust whose effects are mainly felt locally. Besides these, the main sources of air pollution are associated with overland and marine transportation as well as heating (fuel oil and wood).

In the more local area of the Gaspé wharf, there is a cluster of industrial activities (storage, marine transhipment), transportation activities (marine, rail and road) and residential activities. All are susceptible of generating dust and fine particles that may affect local air quality. However, it must be noted that the wind conditions are of sufficient force and constancy to quickly disperse any air pollution generated in this sector.

5.1.2 Topography

Land surfaces in the study area (to the south, west and north) are characterized by a rolling topography with the elevation rising from the watercourses inland. These elevations reach 140 m in the south (approximate 1.5 km southeast of the commercial wharf), 184 m in the west (approximately 2.5 km southwest of Pointe Jacques-Cartier) and 357 m in the north (approximately 4 km northeast of Pointe de Penouille).

The study area also has three relatively flat land surfaces with little elevation. These are in the area around the commercial wharf, where elevations do not exceed 20 m: the Sandy Beach sand bar, whose elevation is only 2 to 5 m and Pointe de Penouille, whose elevation does not exceed 5 m.

The land surfaces in the intervention area have a 3 to 10 m elevation in relation to mean sea level. They have a relatively flat topography and their terrain is not very rugged.

The commercial wharf's surface course is at an elevation of 2.3 m relative to mean sea level.

5.1.3 Stratigraphy and Soil Quality

The information in this section was mainly taken from the comprehensive environmental soil and groundwater characterization conducted on Rue du Quai by Technorem (2004), as well as the complementary environmental soil characterization conducted on Rue du Quai and lot 1-1-1 in Gaspé by Mission HGE (2009). Some complementary information was obtained from articles in the local and national press.

5.1.3.1 Stratigraphic Context

Although the information available in the Technorem (2004) and Mission HGE (2009) studies mainly concerns the axis of Rue du Quai, as well as a riverside lot to the north of Rue du Quai, on properties owned by Transport Canada, they help draw a profile of the stratigraphy of the ground surface. The profile is based on the results of approximately 56 boreholes made by Technorem, Mission HGE and other companies during previous studies referenced in the Technorem study.

The boreholes can be divided into four groups:

- Those along the shore perpendicular to the wharf, on a northeast/southwest axis (by Technorem);
- Those along the shore to the west of the wharf and north of Rue du Quai (by Mission HGE);
- Those following the axis of Rue du Quai (northwest/southeast) from the wharf to where the road forks south to reach Route 132 (by Technorem and Mission HGE);

- Those covering the section of Rue du Quai between where it forks and Route 132 (by Technorem and Mission HGE).

The surveys conducted along the shore cover the Gaspé harbour to the southern end of the fishing wharf. The stratigraphy is divided into two broad wholes: the northern end from the harbour to the main wharf, then the main wharf to the southern end of the fishing wharf. The northern section is characterized by sand fill with a small amount of silt and gravel, 2 to 3 m thick, resting on natural soil comprised of medium to coarse sand, with or without the presence of gravel. The southern part is characterized by a first layer of backfill that is approximately 1 m thick and made up of silty sand with gravel. A second layer of backfill, 1 to 2.5 m thick, is made up of sand with some gravel and silt lens. A third layer of backfill, approximately 1 m thick, is made up of clayey to sandy silt with some gravel. This backfill rests on natural soil made up of sand to silty sand with the presence of shells in the southwest.

The surveys conducted along the shore west of the wharf, on Transport Canada's properties, have a homogeneous stratigraphy characterized by sand and brown gravel backfill with variable proportions of silt, 1.5 to 2.25 m thick on a natural deposit of silty gray sand with some gravel. The natural deposit is still present at the bottom of the boreholes, at a depth of 5.25 m.

The results of the surveys conducted on the axis of Rue du Quai show three broad statigraphic sectors: the southwestern end (near the wharf), the middle section of the road and the northeastern end (where Rue du Quai forks to reach Route 132). The southwestern end is characterized by the presence of 2 to 3 m thick backfill made up of sand with silt and gravel in variable proportions. It rests on natural soil made up of medium to coarse sand with gravel. In the middle section, the backfill is made up of sandy silt with gravely silt between 0.5 and 2.0 m thick. This material rests directly on basement rock comprised of shale. The southwestern section contains the two above-mentioned types of backfill, starting with sandy silt, from a few centimetres to approximately 2.0 m thick, on sand with silt and gravel, whose thickness also varies from a few centimetres to approximately 2.0 metres. This backfill rests on natural soil whose composition varies from west to east, from silty clay (on shale in the central part) to sandy silt and finally sand to silty sand in the east with the local presence of gravel. There is also the presence of an organic horizon between the backfill and part of the natural soil made up of silty clay and sandy silt.

Finally, for the section from Rue du Quai to Route 132, the soil is made up of backfill (2 to 3 m thick) of silty sand with a small amount of gravel and pebbles in the northern half. This backfill rests on natural soil from sandy silt to fine and silty sand. The southern half (nearer to Route 132) has the same type of backfill, although it is covered by a first layer of gravelly sand with 40% stone blocks (1 to 2 m thick). This backfill rests on natural soil made up sandy silt with a small amount of gravel and pebbles, followed by clayey silt, starting at 4 m in depth to the maximum depth of the boreholes, 5.25 m.

5.1.3.2 *Surface Soil Quality*

The area around the Port of Gaspé – Sandy Beach has been used for industrial purposes for several decades. This use, which includes storing copper ore and various petroleum products, carries a significant risk of contaminating the surface soil in the Port of Gaspé – Sandy Beach area. The Technorem (2004) and Mission HGE (2009) studies, while specific to the immediate area of Rue du Quai and the Transport Canada properties to the south and west of the wharf, confirm the presence of various contaminants in the surface soil, including:

- Petroleum hydrocarbons (C_{10}-C_{50}) whose concentrations frequently exceed the MDDEP's criteria C and even, in certain cases, criteria D, representing the allowable soil limit in an authorized site. This contaminant, mainly found in the first 1.5 m of soil, can reach a depth of 3 m in certain areas.
- PAHs exceeding the MDDEP's criteria C, essentially concerning 1,3-dimethylnaphtalene, associated with the presence of petroleum hydrocarbons, were found in a few places. This contaminant is generally found at a depth of 1 to 2 m.
- Copper in concentrations exceeding the MDDEP's criteria C and even criteria D was detected in most of the sampled surfaces. This contaminant is mainly found near the surface (at a depth of 0 to 1 m), but sometimes also up to 2.5 m.
- Finally, sulphur was also detected in concentrations exceeding the MDDEP's criteria C in several locations along Rue du Quai.

It should be mentioned that in October 2010, Xstrata announced the end of its contaminated soil remediation work in the Sandy Beach sector (Xstrata, 2010).

5.1.4 Hydrography and Hydrogeology

5.1.4.1 *Hydrographic Context*

There are watercourses in the study area. In addition to the Dartmouth and York rivers, a few watercourses break up the land surfaces described in Section 5.1.2. According to the information taken from topographic map 22A16-200-0101 – Gaspé, a single watercourse is found in the southern part of the study area. It flows into the southwestern basin (corresponding to the mouth of the York river). The western part has a watercourse that flows into l'Anse-aux-Cousins (shown in Figure 1, Chapter 1). The northern part of the study area has five watercourses that empty into the harbour. Two of these cross the sloping northeastern part and are therefore relatively hemmed in.

There is no watercourse in the intervention area. The surface water drains toward l'Anse au Homard (shown in Figure 1, Chapter 1) in the western portion and toward the Gaspé harbour in the eastern portion. A drainage divide is located in the area of the Rue Cotton axis. The only flow bed in the intervention zone is the ditch running from north of the former Xstrata warehouse to l'Anse au Homard. This ditch drains the water from the drainage ditches along the railway between Rue Cotton and approximately 120 m west of the former warehouse.

5.1.4.2 *Hydrogeological Context*

According to the studies conducted by Technorem (2004), Arrakis (2007) and Mission HGE (2009), the sector's groundwater was observed at depths from 0.2 to 3.3 m, generally flowing north-northeast toward the bay of Gaspé. Three hydrostratigraphic units were identified:

- A superior unit in the southwestern and northeastern sectors corresponding to the saturated part of the backfill and the natural units found there (surface aquifer);
- A unit in the central part of the sector within a silty clay unit with low permeability (aquitard);
- A unit in the central part, at a low depth, in the presence of basement rock made up of shale (friable and weathered).

In the aquifer classification recommended by the MDDEP, Gaspé's sandstone aquifer, which is part of the sector under study, is qualified as class II because it is a running source of drinking water for many Sandy Beach residents.

5.1.5 Water Quality

5.1.5.1 *Surface Water Quality*

The only watercourses that reach the Gaspé harbour in the Sandy Beach wharf sector are small streams that drain the ditches of the *Chemins de fer de la Gaspésie* railway and road southeast of the slipway. No water quality data is available for these watercourses.

The Technorem (2004), Dessau (2005), Arrakis (2007) and Mission HGE (2009) studies demonstrated (see next section) that the contamination found in the groundwater (petroleum hydrocarbons, metals such as copper and chloride) could reach the surface water in the Gaspé harbour through migration. There is no information available to verify this hypothesis, however.

5.1.5.2 *Groundwater Quality*

The results of the Technorem (2004), Dessau (2005), Arrakis (2007) and Mission HGE (2009) studies conducted in the Rue du Quai sector as well as along the wharf give an idea of the groundwater quality. According to these four studies, the main contaminants found in the groundwater in this area include:

- C_{10}-C_{50} petroleum hydrocarbons, mainly found near the Gaspé harbour, but only detected in 2004 and 2005 in the axis and near Rue du Quai and in 2009, near the shore to the south of the wharf. The Arakkis study, which covers all of the wells around Rue du Quai, does not report that this parameter was exceeded;

- Fluoranthene (PAH) in the fishing wharf sector;
- Metals, mainly copper, detected in the water of several observation wells, in addition to nickel, chromium, selenium and zinc. Note that during the campaign carried out by Dessau in 2005, the copper concentrations were markedly lower. A single sample exceeded the MDDEP criteria for *Résurgence dans les eaux de surface ou infiltration dans les égouts* (resurgence in surface water or infiltration in sewers), compared to 14 samples in 2004. However, the Arrakis study in 2007 shows that the MDDEP's usage criteria for copper was exceeded in 11 samples throughout the Rue du Quai axis, but also along the wharf;
- Chloride was also found in significant concentrations near the Gaspé harbour.

5.1.5.3 *Physicochemical Characteristics of the Water in the Gaspé Harbour*

According to the results obtained on September 20, 2001 by QSAR *et al.* (2002) at 14 sampling stations in the Gaspé harbour, the water is relatively homogeneous throughout the area under study. In fact, readings taken between 60 and 150 minutes after high tide showed similar characteristics. The water mass is saline (≈ 28.6 ‰), warm (≈ 12 ˚C), well-oxygenated (≈ 8.3 mg/L dissolved oxygen) and slightly basic (pH ≈ 8.5) (QSAR *et al.*, 2002). The conditions at this phase of the tide are well-mixed, with the lower water layers (average of 9.8 metres in depth) only showing slight differences with the characteristics of the surface water (average of 0.8 metres in depth). The lower water layers are more saline (≈ 29.0 ‰) and colder (≈ 11 ˚C). Also, according to QSAR *et al.* (2002), there are no significant differences between the dissolved oxygen, conductivity and pH readings for the lower water layers as compared to the surface water.

Savard (2002) described two pycnoclines (tight vertical density gradient due to salinity and/or temperature) that could explain the slight differences noted by QSAR *et al.* (2002). A first pycnocline was found at approximately 2 m in depth. The surface layer has a temperature of 13˚ C and a salinity of 25 ‰, while the underlying layer (2 m to 18 m in depth) has a temperature of 9˚ C and a salinity of 27 ‰. This intermediate layer is separated from the ground layer by a second pycnocline beyond which the temperature drops to 2˚ C and the salinity rises to 32 ‰. Savard (2002) also notes that the thickness of the brackish surface layer varies depending on the volume from the outflow of the Dartmouth and York rivers, but does not go exceed 5 m. During periods of low outflow from the rivers, it can disappear and the Gaspé harbour is left with an approximately 20 m thick layer of brackish water over a more saline and colder layer. This last stratification is prevalent in the Gulf of St. Lawrence (Savard, 2002).

As for suspended particulate matter (SPM) concentrations, data obtained by Sundby in 1974 and cited in Couillard (1987) indicate that, in the Gulf of St. Lawrence, concentrations are generally between 0.1 and 3 mg/L. More specifically for the bay of Gaspé, these concentrations are between 0.5 and 1.0 mg/L (Gagnon *et al.*, 1997).

Tamigneaux and Thomas (2004) analyzed SPM concentrations in the water at eight stations in the Gaspé harbour between August 22 and November 21, 2000. These stations are mainly located in the northwestern basin (mouth of the Dartmouth river). However, one station is located directly west of Pointe de Penouille and another is directly west of the southern part of the Sandy Beach sand bar. Average concentrations recorded at these two stations (nearest the dredging area) are presented in Table 3. Although the SPM load is slightly higher than what was reported by Gagnon *et al*. (1997), it is still relatively low. The difference may be due to the fact that the data in this last study applies to the entire bay of Gaspé while the Tamigneaux and Thomas (2004) data targets the Gaspé harbour, where the Dartmouth and York rivers undoubtedly contribute to the higher SPM load. As expected, samples with the highest SPM concentrations (ceiling value) were taken near the mouth of the Dartmouth river (data not shown). SPM concentrations are expected to be higher during the flood period for the Dartmouth and York rivers (April and May), although no data for this period is available for the Gaspé harbour.

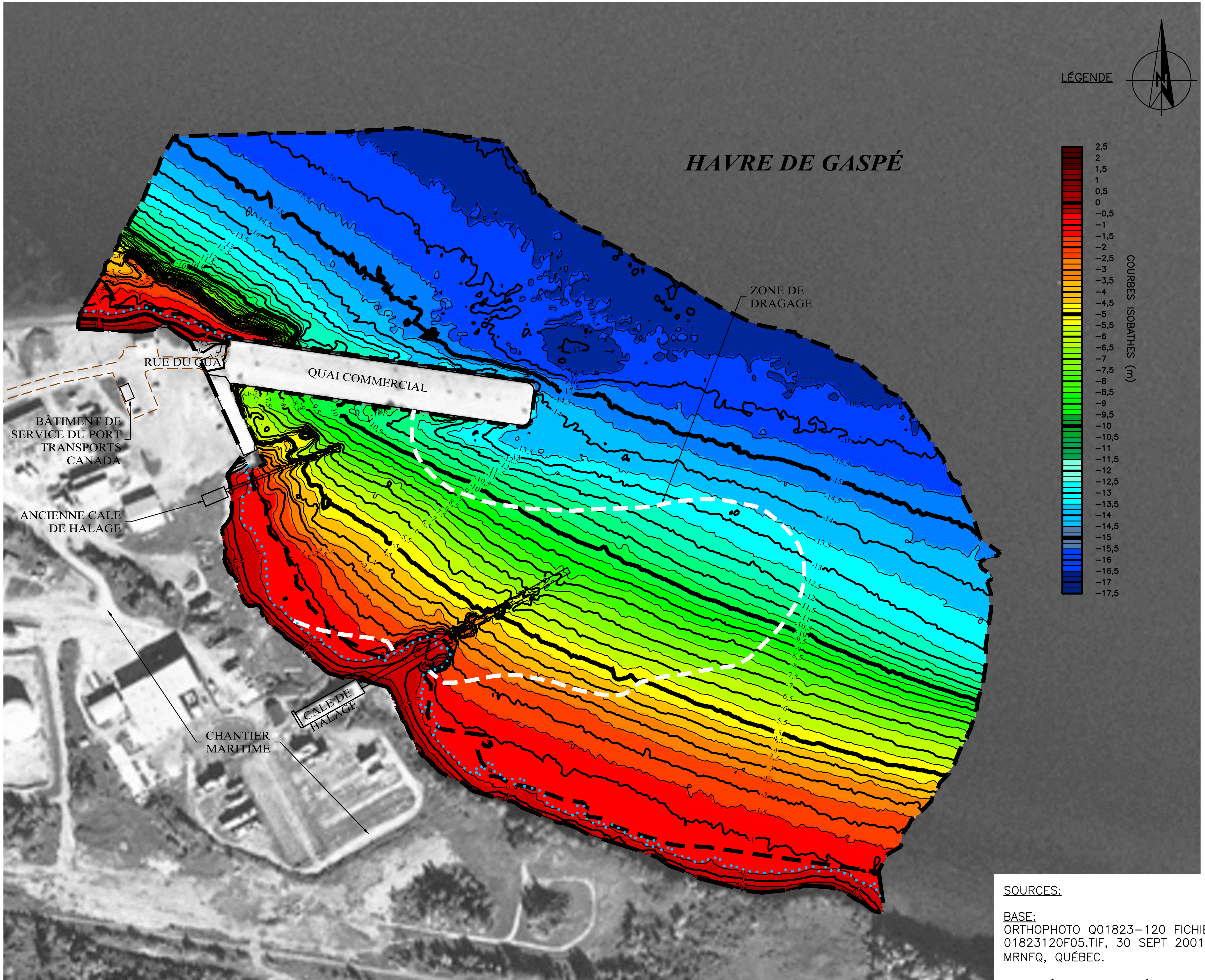
TABLE 3: SPM CONCENTRATIONS RECORDED IN THE GASPÉ HARBOUR FROM AUGUST TO NOVEMBER 2000 (TAMIGNEAUX AND THOMAS, 2004)

Depth (m)	Concentrations (mg/L)	
	West of the Sandy Beach sand bar	West of Pointe de Penouille
2	1.78	2.13
5	1.58	2.08
10	1.56	2.14
15	2.59	-

During the dredging work along the north face of the commercial wharf in 2001, water samples were taken inside and outside the turbidity curtain (ballasted so that it rested on the harbour bed) in the dredging area (Robert Hamelin & associés, 2001). These samples revealed SPM concentrations between < 4 mg/L and 6 mg/L at 1 m in depth and between < 4 mg/L and 9 mg/L at 8 m in depth outside the confined area during the work (no samples were taken outside the work periods). Inside the confined area, these concentrations were between 16 mg/L and 55 mg/L at 1 m in depth and between 36 mg/L and 62 mg/L at 8 m in depth.

5.1.6 Bathymetry

The bathymetric data presented in this section was taken from the bathymetric survey conducted by PWGSC on November 17 and 18, 2004. The resulting isohypses and isobaths, represented in relation to the ordnance datum, are presented in Figure 3.



LÉGENDE :

- ZONE DE DRAGAGE
- COURBES ISOBATHES ET ISOHYPSES (m)
- LIMITE DU RELEVÉ BATHYMÉTRIQUE (TPSGC, 2004)
- LIMITE DU RELEVÉ TERRESTRE PAR GPS (TPSGC, 2004)
- LLWLT – BASSE MER INFÉRIEURE, GRANDE MARÉE

NOTES :

- MTM ZONE 5, NAD 83.
- SYSTÈME DE RÉFÉRENCE ALTIMÉTRIQUE: NMM–29 (MSL)

SOURCES:

BASE:
ORTHOPHOTO Q01823–120 FICHIER 01823120F05.TIF, 30 SEPT 2001, MRNFQ, QUÉBEC.

BATHYMÉTRIE ET RELEVÉ TERRESTRE PAR GPS:
TPSGC, NOVEMBRE 2004.

Projet

Transports Canada

PROJET DE RESTAURATION DE SÉDIMENTS AU PORT DE GASPÉ – SANDY BEACH

Titre

FIGURE 3
COURBES ISOHYPSES ET ISOBATHES DE LA ZONE DE DRAGAGE

DESSAU

Dessau inc.
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Préparé B. Vallée	Discipline Environnement	Chargé de projet C. Marcotte
Dessiné F. B./J.-M.R.	Échelle 1 : 3 000	Extrait de: Rév.:
Vérifié S. Côté	Date 2012-03-22	

Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
045	P001130	0162	068	EI	0103	01

G:\045\P001130\CAD\Actif.162\045–P001130–0162EI–0103–01.dwg

In the commercial wharf sector, the sea floor generally slopes downward (approximately 19°) with an average gradient of approximately 3% from the shore to an elevation of -1.5 m, followed by an average gradient of approximately 5% to an elevation of -15 m in relation to ordnance datum (MSL-29). The slope then generally levels to approximately 2% up to the limits of the area covered by the bathymetry, at an elevation of approximately -16.5 m.

The sea floor in the wharf sector is relatively flat, with some exceptions:

- The right-of-way of the shipyard's slipway, which extends 180 m from the high water line (large tide) and interrupts the relatively uniform surface of the sea floor;
- The rights-of-way of the former slipway and the former wharf south of the current wharf, which have been dismantled and are invisible from the surface, but show up in the bathymetric survey.

The bathymetry in the intervention area (see Figure 3) is characterized by a maximum sea floor elevation of 0.53 m and a minimum elevation of -13.60 m (Dessau-Soprin, 2005).

5.1.7 Tides

Tides in the Gaspé harbour are mixed semi-diurnal. The semi-diurnal variation (tide twice per day) is therefore modulated by the diurnal variation (daily tide). The average tide range is 1.2 m and the maximum tide range is 1.7 m (Environnement Illimité, 2005). Tide levels at the commercial wharf, in relation to chart datum (CD) and ordnance datum, are presented in Table 4.

TABLE 4: TIDE LEVELS AT THE COMMERCIAL WHARF

Acronym	Tide level	Water level above chart datum (CD) (m)	Geodetic elevation (MSL-29) (m)
HHWLT	Highest high water, large tide	2.000	+1.093
HHWMT	Highest high water, mean tide	1.600	+0.693
MWL	Mean water level	1.000	+0.093
MSL	Mean sea level	0.907	+0.000
LLWMT	Lowest low water, mean tide	0.500	-0.407
LLWLT	Lowest low water, large tide	0.300	-0.607
CD	Chart datum	0.000	-0.907

5.1.8 Ice Regime

The predominant type of ice found in the bay of Gaspé is first-year ice (ice formed during a single winter season, over 30 cm thick). Ice can form in the bay of Gaspé starting in the month of December (frequency over 30 years of sea ice, from 1% to 15%), and is usually present (approximately 50% frequency) toward the end of December. The ice begins to recede toward late March-early April, is significantly reduced by mid-April and completely gone in early May, based on over 30 years of presence of sea ice (Dessau-Soprin, 2005).

Ice that is an average of 56 cm thick (between 1974 and 1986) (maximum 96 cm, minimum 10 cm) was observed at the ice measuring station in Caraquet (New Brunswick), located on the south shore of Baie des Chaleurs, approximately 120 km south of the commercial wharf. The type of ice at the station is the same as observed in the Gaspé harbour. However, the ice in the Caraquet sector lasts slightly longer, present on average from mid-December to the end of April (Dessau-Soprin, 2005).

5.1.9 Current Measurement

In the framework of the characterization conducted in November 2004 (Environnement Illimité, 2005), physical data was collected to develop a conceptual model describing the movement of the water masses in the commercial wharf's immediate surroundings. As observed, surface movement (at a depth of 0 to 10 m) is incurred by a northwesterly wind [dominant wind according to Koutitonsky *et al*. (2001)] traveling at speeds of 5 to 7.5 m/s, which creates a current that generally flows toward the Sandy Beach sand bar (east, southeast) and has a flow velocity from 5 to 20 cm/s. Directly southeast of the wharf, surface movement appears to be influenced by the tidal cycle. During ebb tide (outgoing tide), the current moves south-southeast and turns northeast during rising tide (incoming tide). The current in the intermediate layer (at a depth of over 10 m) also has a flow velocity from 5 to 20 cm/s, but generally moves west (rising up toward the surface flow) and is not affected by the rising or ebb tide in the Gaspé harbour, between the Sandy Beach sand bar and the commercial wharf.

Moreover, Koutitonsky *et al.* (2001) claim that the wind's effect on the movement pattern is more pronounced in the bay than in the harbour. Despite the very large gridding (therefore low-resolution) of the numerical model presented for the Gaspé harbour in this study and the fact that no measurements were taken in the commercial wharf sector, certain interesting observations can be made about the wind's effects on the 0-10 m and 10-20 m layers (speeds estimated based on the figures by Koutitonsky *et al.*, 2001):

- **In low wind conditions**, the rising tide causes slow movement in the 0 to 10 m layer (< 0.05 m/s), in a counterclockwise direction east of the commercial wharf, and a stronger current (0.10 to 0.15 m/s) from the approach channel (between the Sandy Beach sand bar and Pointe de Penouille) toward the mouth of the York river. By ebb tide, the counterclockwise cell disappears in the eastern part of the harbour and the entire flow (< 0.05 m/s) in this part travels north. In the rest of the harbour, the current speed is approximately 0.05 m/s. The flow velocity can rise to 0.20 m/s in the approach channel, during both ebb and rising tide. In the 10 to 20 m layer, current speeds are markedly lower. Despite the model's very low coverage in the harbour (none of the modellings cover the central and eastern part of the harbour), the water circulates in a northwesterly direction during rising tide, at speeds below 0.02 m/s. At ebb tide, it moves north and northeast at similar speeds.

- In northwesterly wind conditions (7 m/s), that is, in conditions similar to those observed during the field season conducted by Environnement Illimité (2005), the rising tide again causes slow, counterclockwise movement in the eastern part of the harbour (near the wharf) at a speed of < 0.05 m/s in the 0 to 10 m layer. In the northern part of the harbour, the currents in this layer move toward the mouth of the Dartmouth river at a little over 0.05 m/s. At ebb tide, the currents are stronger, between 0.05 and 0.10 m/s in the wharf area. The water flows east before turning north along the Sandy Beach sand bar and borrowing the approach channel. In the rest of the harbour, the flow is generally directed east at speeds between 0.02 and 0.10 m/s, with speeds reaching up to 0.15 m/s in the approach channel. In the underlying layer (10 to 20 m), the rising tide generates movement toward the west at speeds reaching 0.05 m/s. Ebb tide causes movement to the south and east in the eastern part of the harbour and west in the central part. Speeds vary between 0.02 and 0.05 m/s.
- In northeasterly wind conditions (7 m/s), the 0 to 10 m layer in the commercial wharf sector is characterized, during rising tide, by a flow of less than 0.10 m/s toward the south and west, along the shore. From the centre of the harbour and toward the west, this layer moves west and northwest (mouth of the Dartmouth river) at similar speeds, except at the mouths of the rivers, where speeds reach over 0.10 m/s. At ebb tide (0 to 10 m layer), there appears to be a clockwise cell circulating at low speed (< 0.05 m/s) in the eastern part of the harbour. The flow in the rest of the harbour is directed east at speeds of 0.05 m/s. For the 10 to 20 m layer, the rising tide causes the water to move northwest (mouth of the Dartmouth river) at speeds from 0.02 to 0.05 m/s while at ebb tide, the flow is directed northeast at similar speeds.
- In southeasterly wind conditions, in the 0 to 10 m layer, from the eastern part of the harbour, the rising tide generates counterclockwise movement at speeds under 0.05 m/s. From the approach channel, the water flows in part toward the commercial wharf (speeds reaching 0.10 m/s) while the other part is directed west at speeds between 0.05 and 0.10 m/s. Still in the 0 to 10 m layer, the ebb tide generates a clockwise flow east of the wharf at speeds reaching 0.10 m/s along the south shore, but not exceeding 0.02 m/s elsewhere. In the rest of the harbour, the water moves toward the approach channel. In the 10 to 20 m layer, a low current (< 0.02 m/s) moves east and southeast during rising tide and southeast and east at ebb tide, at speeds of approximately 0.05 m/s.

More generally, the Environnement Illimité (2005) study indicates that the usual flow pattern alternates between rising tide, when the current directed toward the west flows along the Gaspé harbour's north shore, and ebb tide, when the current directed seaward flows along the Gaspé harbour's south shore and the Sandy Beach sand bar. However, this pattern can change depending on the combination of tidal currents, currents generated by local winds and the inflow of freshwater from the Dartmouth, York and Saint-Jean rivers (the latter is located east of the study area), the main factors affecting current measurement in the Gaspé harbour (Savard, 2002). According to the data collected in the Gaspé harbour, this sector has very low currents, from 0.05 to 0.20 m/s (Koutitonsky, 2001; Environnement Illimité, 2005).

5.1.10 Sediment Hydrodynamics

The Environnement Illimité (2005) report concludes that, given the low currents recorded in the Gaspé harbour, an eventual plume of suspended sediment could move a distance of 1 to 2 km during a tidal cycle. In conditions similar to those observed during the characterization work [strong winds from the northwest – with northwesterly winds being dominant, according to Koutitonsky *et al.* (2001)], a plume of suspended sediment would be carried to the Sandy Beach sand bar by the surface layer, then caught in the flow of the intermediate layer traveling west. This to-and-fro motion, with a resultant to the northeast, would make it unlikely for the dispersal of an eventual plume to affect the mussel farming sectors at the mouth of the Dartmouth river, located over 2.5 km northwest, or Pointe de Penouille, located 2.5 km north of the study area.

Groupe-Conseil LaSalle inc. (2010) report on the numerical modelling of the dredged material's dispersal also shows low flow velocity in the studied area, with values not exceeding 0.1 m/s in the immediate Port of Gaspé– Sandy Beach area. Greater flow velocity was observed in the narrow passage bordered by the Sandy Beach point and the Penouille peninsula. Simulations of the dredging work show that the maximum encroachment of the generated plume would be limited to the work area's periphery, extending at most 1 km southeast. The coarser sediment (sand and silt), which comprises over 50% of the dredged sediment, will quickly settle at the job site. Although the finer sediment will remain suspended in the water column, local dilution will help reach allowable concentrations not far from the work area.

5.1.11 Physicochemical Characteristics of the Sediment

5.1.11.1 Stratigraphic Context

Table 5 presents a compilation of the results of the particle-size analyses conducted on all samples taken by core drilling in the commercial wharf since 1997. An illustration of the distribution of the different substrates in the dredging area is presented in Figure 4.

On average, the dredging area contains sand and silt with traces of gravel and clay. The compilation of the particle-size analyses show that sediment in the intervention zone is made up of, on average, 58% coarse particles (gravel and sand) and 42% fine particles (silt and clay). The sectors with the coarsest sediment are located near the wharf, along the shore, within a 5 to 20 m strip, as well as in steeply sloping sectors in the aquatic environment. These sectors are generally made up of gravely sand with a small amount of silt and traces of clay (approximately 10% to 40% gravel) on the shore and around the wharf. The sediment is generally finer (sand and silt with traces of gravel and clay) outside the previously identified areas.

Generally, the gravel and fine particle content (silt and clay) of the sediment on the bank and around the wharf, which is usually more coarse, decreases with the depth of the sediment layer (maximum depth sampled: 150 cm). The proportion of sand in the sediment therefore rises as we move downward in these areas. This is likely due to the washout of fine particles at the surface in areas disturbed by the tide and/or boats, and the natural gravimetric segregation of the sediment due to the movement of the waves and tides (graded bedding). The particle size of the generally fine sediment (sand and silt with traces of clay) moving seaward is more or less homogeneous throughout the sampled depth.

TABLEAU 5 : GRANULOMÉTRIE ET HUMIDITÉ DES SÉDIMENTS DANS LA ZONE DE DRAGAGE

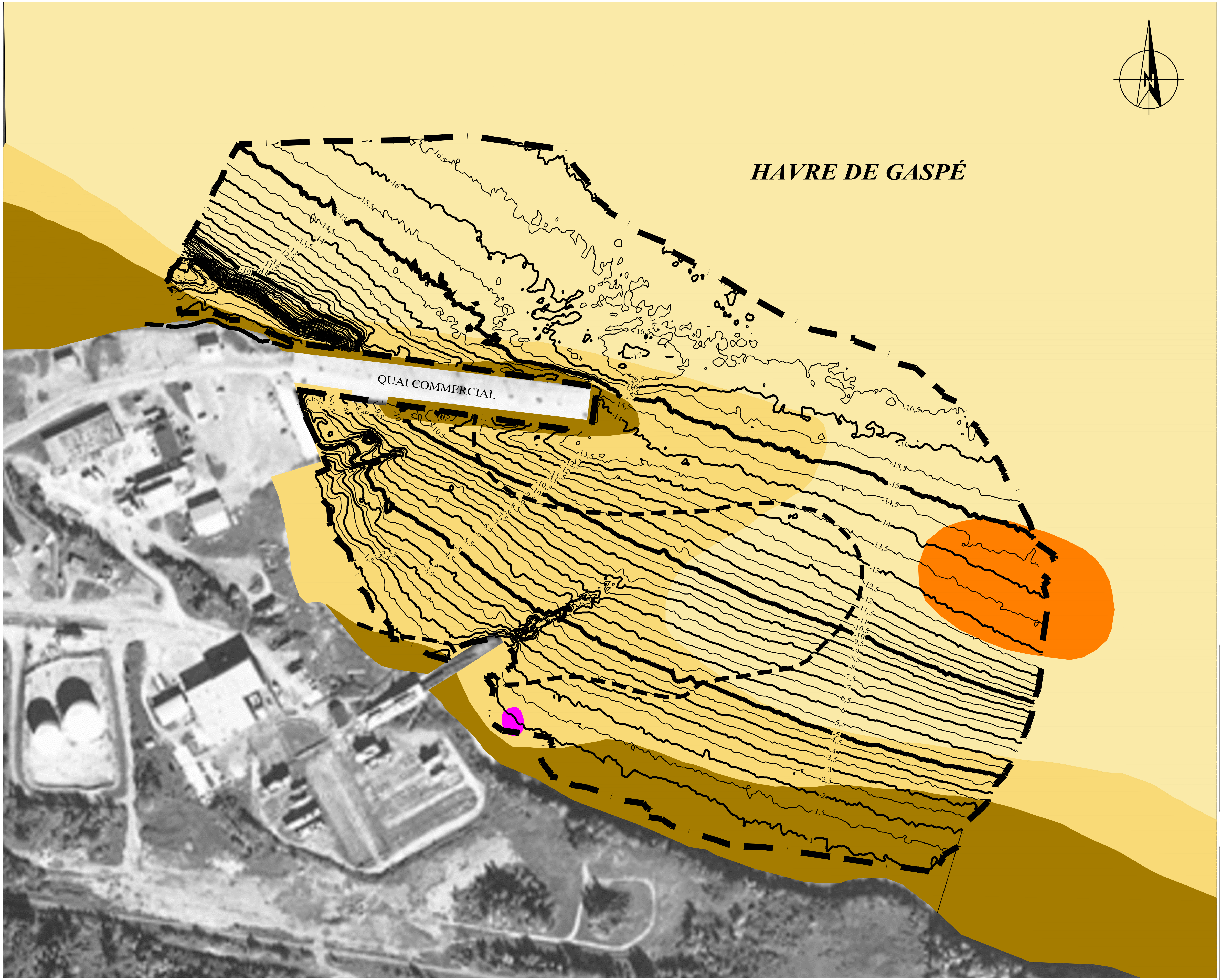
	Zone de dragage		Zone A[2]	Zone B[2]	Zone C[2]
	Superficie de la zone de dragage (m²)		52 050	2 450	5 250
GRANULOMÉTRIE	Profondeur de dragage (m)		0.6	0.95	0.8
	Moyennes des pourcentages de masse jusqu'à la profondeur de dragage[1]	% moyen gravier	2.7	1.7	16.6
		% moyen sable	54.0	59.9	55.2
		% moyen silt	36.4	33.9	25.1
		% moyen argile	6.9	4.5	3.2
		% moyen particules grossières (sable + gravier)	56.7	61.6	71.8
		% moyen particules fines (silt + argile)	43.3	38.4	28.2
HUMIDITÉ	Moyennes des pourcentages de masse jusqu'à la profondeur de dragage	% moyen humidité	39.8	48.2	43.5
		% moyen siccité	60.2	51.8	56.5

Notes:

1 - Fuseaux granulométriques établis selon le système de classification Wentworth (1922).

2 - Voir la figure 8 pour la délimitation de cette zone.

3 - Moyenne pondérée établie selon la superficie relative de chaque zone (A à C) par rapport à la superficie totale de l'ensemble de la zone de dragage.



LÉGENDE :

- ZONE DE DRAGAGE
- LIMITE DU RELEVÉ BATHYMÉTRIQUE (TPSGC, 2004)
- COURBES ISOBATHES ET ISOHYPSES (m)

TYPE DE SUBSTRAT:

- GRAVIER
- SABLE
- ARGILE
- SABLE ET GRAVIER
- ROC

SOURCES :

NATURE DU SUBSTRAT:
– RAPPORT CARACTÉRISATION COMPLÉMENTAIRE, MAI 2005, ENVIRONNEMENT ILLIMITÉ INC.

BASE:
– ORTHOPHOTO Q01823-120 FICHIER 01823120F05.TIF, 30 SEPT 2001, MRNFQ, QUÉBEC.

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FIGURE 4
NATURE DU SUBSTRAT DANS LA ZONE DE DRAGAGE

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Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
045	P001130	0162	068	EI	0104	01

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It must be noted that pebbles over 100 mm were not included in the particle-size analyses conducted during the characterization work[6]. Divers in the area to be remediated reported the presence of garbage, logs, stones and other. These particle-size analyses therefore show a larger proportion of fine particles than the site's actual conditions. Moreover, surface dryness, which has a larger proportion of coarse particles, is likely to be slightly higher than presented in the results.

Table 5 shows that the weighted average of the sediment's humidity inside the intervention area, up to the projected dredging depth (60 to 95 cm, depending on the area) is approximately 40% (or 60% dryness).

The exact depth of the bedrock inside the dredging area is unknown. However, a rock outcrop can be seen by video approximately 20 m south of the end of the dredging area, south of the wharf, and directly east of the shipyard's slipway (Environnement Illimité, 2005). Rock outcrops can also be seen on land along the shore, east of the slipway, at the river escarpment. According to boring work carried out in 1985 to build the commercial wharf, the bedrock in this area lies under a 1.7 to 7.0 m layer of sediment (as-built plans, reconstruction of the Gaspé - Sandy Beach wharf, 1988). The bedrock would therefore be at a greater depth than the planned dredging floor, from 60 to 95 cm.

5.1.11.2 *Chemical Grade of the Sediment*

Intervention Level [Integrated Effect Level (IEL)]

In the framework of an ecotoxicological evaluation, integrated effect levels (IEL) for copper and total PAH were specifically calculated in the commercial wharf sector (QSAR *et al.*, 2002). Different toxicity tests were performed on marine organisms (indicator species) in contact with the sediment or the porewater originating from the wharf area, on the one hand and the control zone (Penouille peninsula) on the other. These tests determined at what level copper and total PAH in the sediment or porewater has a negative effect on the behaviour, development or survival of these organisms.

The IEL was set at 2 400 mg/kg for copper and 5 mg/kg for total PAH. These levels, which were used to delineate the dredging area, represent the threshold limit to attain during the sediment remediation work at the Port of Gaspé – Sandy Beach.

Chemical Characterization of the Sediment

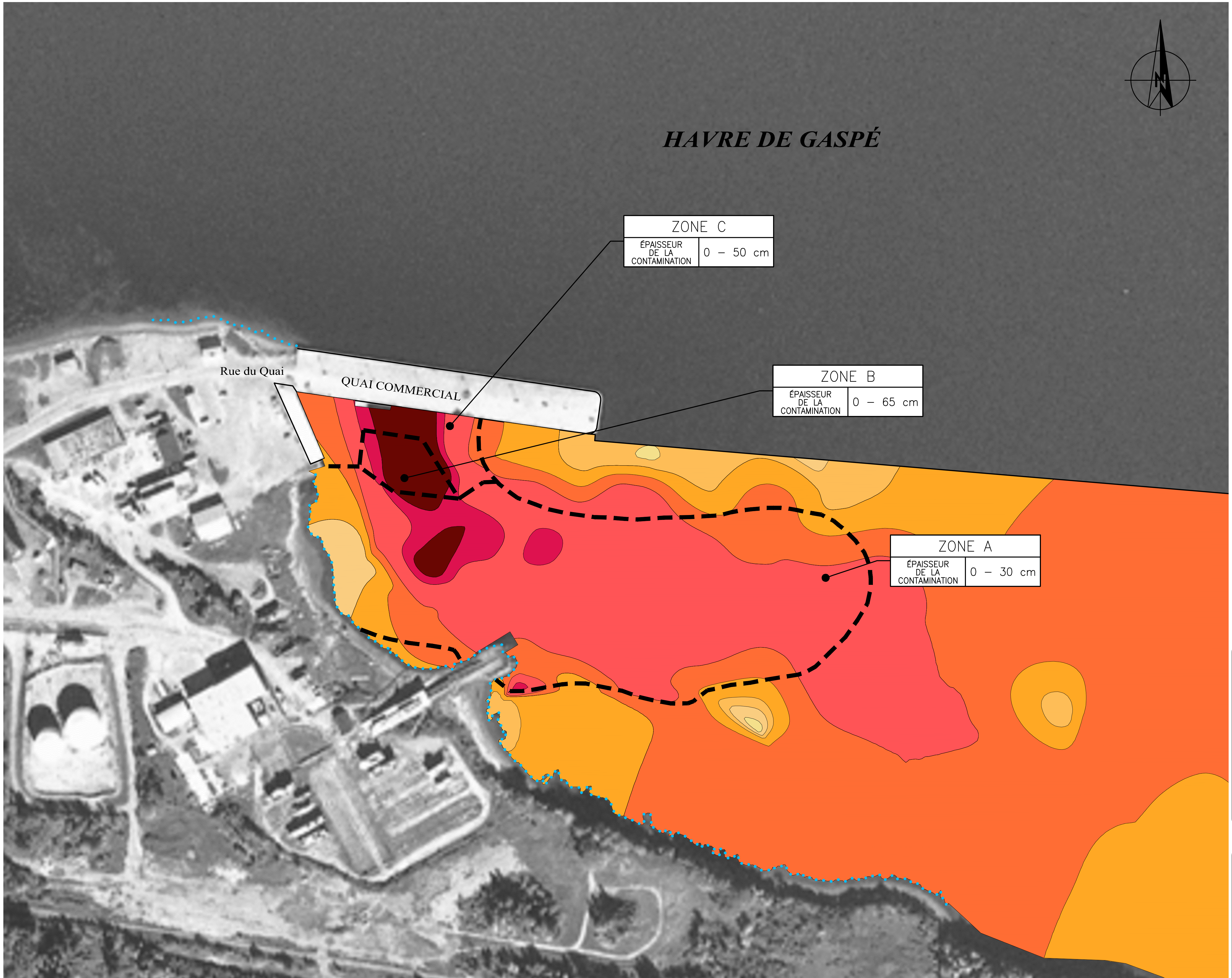
A compilation of the results of the chemical analyses for copper and total PAH on the surface samples taken during previous studies conducted for the Port of Gaspé –Sandy Beach sediment remediation project, as compiled by Environnement Illimité (2005), is presented in figures 5 and 6. These figures show the distribution of copper and total PAH contamination, based on isotropic kriging of the concentrations. It should be noted that the copper distribution (Figure 5) does not include the

[6] The sediment samples were taken with manual corers, 10 and 12 cm in diameter.

results of the Beak characterization (1998). According to Environnement Illimité, these results were excluded since the results of the most recent characterization campaigns [2001, 2002 and 2004 (published in 2005)] provided adequate coverage. Although this graphic representation seems to imply a total PAH contamination (Figure 6) exceeding the IEL directly north of the slipway, outside the dredging area, these results do not represent the reality of the terrain. In fact, this sector was excluded from the dredging area because 1) its substrate is made up of pebbles (Environnement Illimité, 2005); 2) the contamination is associated with finer size fractions (< 1.7 mm) (Gosselin *et al*., 1999); and 3) no samples were taken in this area during previous studies (no contamination confirmed).

Figure 7 presents the thickness of the contaminated sediment as well as the thickness of the sediment to dredge (determined based on the planned overdredging and the specification of the dredging equipment available for the site's bathymetric conditions). There are three separate zones. The first (Zone A) covers the entire area south of the fishing wharf and is characterized by contamination thickness exceeding the IEL for copper and/or total PAH, at 0.30 m. The second (Zone B) is located across from the fishing wharf, at the centre of the dredging area. The copper and/or total PAH concentrations exceeding the IEL in this zone are in the 0 to 0.65 m layer of sediment. Finally, the third zone (Zone C) is right next to the wharf and the contamination exceeding the IEL for copper and/or total PAH affects the first 0.50 m. Generally, the highest copper and/or total PAH concentrations are found at the surface of the sediment (0 to 15 cm).

The contaminated sectors whose copper and total PAH levels exceed the IEL are located south of the commercial wharf. There is evidence of a distribution pattern for the copper, whose plume extends toward the Sandy Beach sand bar. The main area in which the copper-contaminated sediment exceeds the IEL (from 2 400 mg/kg to 5 800 mg/kg) is located 150 m west of the end of the commercial wharf and extends 135 m south from the wharf, for a total surface area of approximately 5 500 m². There is also a smaller area whose copper concentrations exceed the IEL directly southeast of the slipway. This area covers 100 m².



LÉGENDE :

- ZONE DE DRAGAGE

ISOCONCENTRATION ESTIMÉE DU CUIVRE

- 0 < 28 mg/kg
- 28 < 86 mg/kg
- 86 < 172 mg/kg
- 172 < 430 mg/kg
- 430 < 860 mg/kg
- 860 < 2000 mg/kg
- 2000 < 2400 mg/kg
- > 2400 mg/kg
- LLWLT – BASSE MER INFÉRIEURE, GRANDE MARÉE

SOURCES :

ISOCONTOURS CUIVRE:
– RAPPORT CARACTÉRISATION COMPLÉMENTAIRE, MAI 2005, ENVIRONNEMENT ILLIMITÉ INC.

BASE:
– ORTHOPHOTO Q01823-120 FICHIER 01823120F05.TIF, 30 SEPT 2001, MRNFQ, QUÉBEC.

RÉSULTATS D'ANALYSES CHIMIQUES:
– ENVIRONNEMENT ILLIMITÉ INC., 2005
– ENVIRONNEMENT ILLIMITÉ INC., 2002
– ENVIRONNEMENT ILLIMITÉ INC., 2001

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FIGURE 5
ISOCONTOURS DES CONCENTRATIONS EN CUIVRE

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Vérifié S. Côté

Discipline Environnement
Échelle 1 : 3 000
Date 2012-03-22

Chargé de projet C. Marcotte
Extrait de: Rév.:

Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
045	P001130	0162	068	EI	0105	01

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LÉGENDE :

ZONE DE DRAGAGE

ISOCONCENTRATION ESTIMÉE DES HAP TOTAUX

- 0 < 1 mg/kg
- 1 < 5 mg/kg
- 5 < 10 mg/kg
- > 10 mg/kg

LLWLT – BASSE MER INFÉRIEURE, GRANDE MARÉE

SOURCES :

ISOCONTOURS HAP:
– RAPPORT CARACTÉRISATION COMPLÉMENTAIRE, MAI 2005, ENVIRONNEMENT ILLIMITÉ INC., MODIFIÉS PAR DESSAU INC., 2009.

BASE:
– ORTHOPHOTO Q01823–120 FICHIER 01823120F05.TIF, 30 SEPT 2001, MRNFQ, QUÉBEC.

RÉSULTATS D'ANALYSES CHIMIQUES:
– ENVIRONNEMENT ILLIMITÉ INC., 2005
– ENVIRONNEMENT ILLIMITÉ INC., 2002
– ENVIRONNEMENT ILLIMITÉ INC., 2001
– BEAK INC., 1998

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FIGURE 6
ISOCONTOURS DES CONCENTRATIONS EN HAP TOTAUX

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Vérifié S. Côté	Date 2012-03-22	

Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
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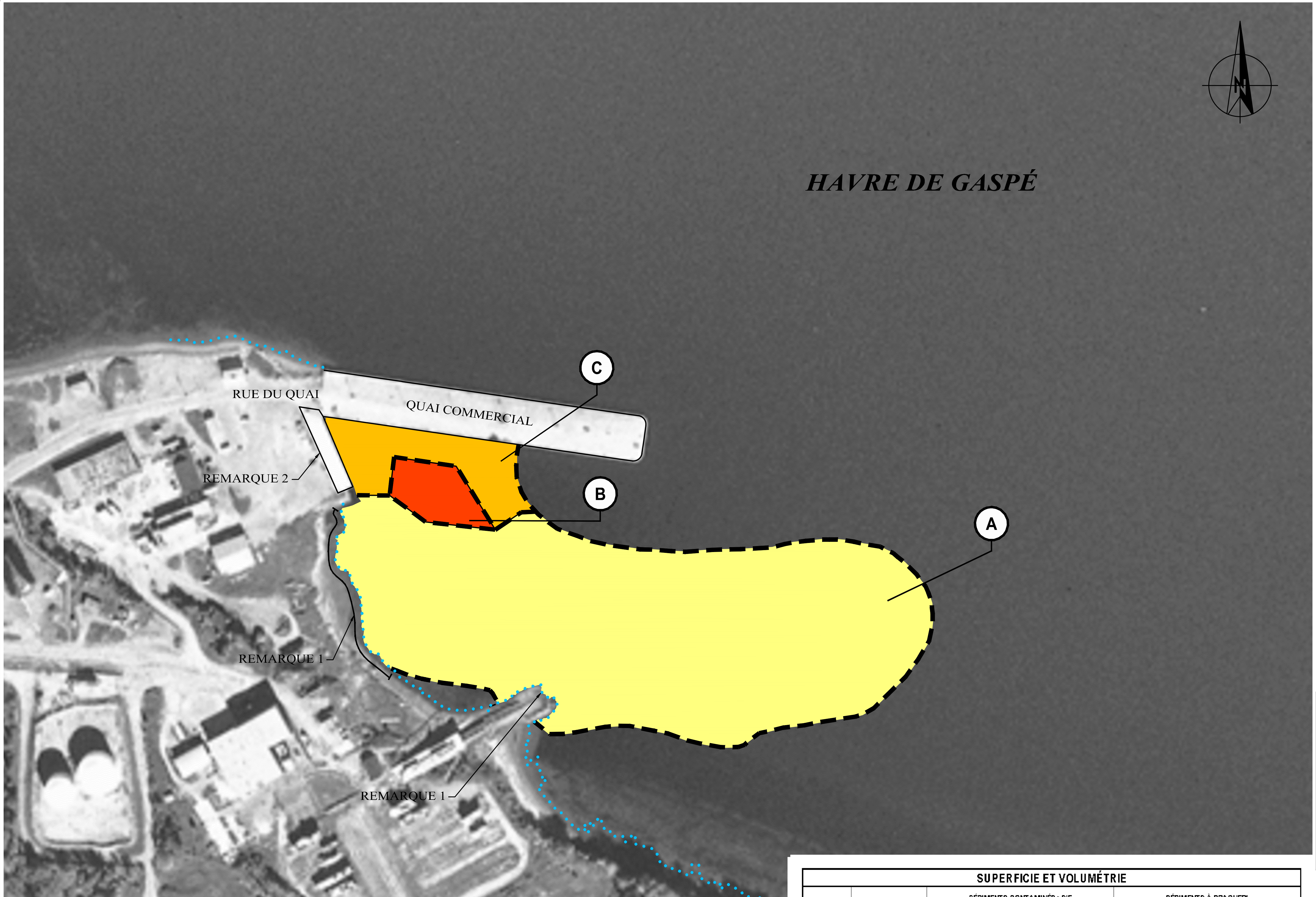

LÉGENDE :

- ZONE DE DRAGAGE
- ÉPAISSEUR DE LA CONTAMINATION: 0–30 cm
- ÉPAISSEUR DE LA CONTAMINATION: 0–50 cm
- ÉPAISSEUR DE LA CONTAMINATION: 0–65 cm
- LLWLT – BASSE MER INFÉRIEURE, GRANDE MARÉE

NOTES :
– MTM ZONE 5, NAD 83.
– SYSTÈME DE RÉFÉRENCE ALTIMÉTRIQUE: NMM–29.

SOURCES :

BASE:
ORTHOPHOTO Q01823–120 FICHIER 01823120F05.TIF, 30 SEPT 2001, MRNFQ, QUÉBEC.

REMARQUES:

1 Limite de la zone présumée contaminée (>SIE) établie à l'emplacement de la basse mer inférieure - grande marée (à l'extérieur de la zone de marnage).

2 L'épaisseur et le niveau de contamination des sédiments sous le quai des pêcheurs est inconnue.

SUPERFICIE ET VOLUMÉTRIE

ZONE	SUPERFICIE (m²)	SÉDIMENTS CONTAMINÉS >SIE		SÉDIMENTS À DRAGUER[1]	
		ÉPAISSEUR (cm)	VOLUME EN PLACE (m³)	ÉPAISSEUR (cm)	VOLUME EN PLACE (m³)
A	52 050	30	15 600	60	31 200
B	2 450	65	1 600	95	2 300
C	5 250	50	2 600	80	4 200
TOTAL	59 750	MOYENNE PONDÉRÉE: 33	19 800	MOYENNE PONDÉRÉE: 63	37 700

Note 1: Déterminé en fonction de la précision des équipements de dragage disponibles pour les conditions bathymétriques du site.

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FIGURE 7
ÉPAISSEUR DES SÉDIMENTS CONTAMINÉS DANS LA ZONE DE DRAGAGE

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Vérifié S. Côté	Date 2012-03-22		

Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
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These two copper-contaminated areas are included in the more extensive area containing sediment whose total PAH concentrations exceed the IEL. The latter area covers nearly 60 000 m², therefore comprising the entire dredging area. It begins directly south of the commercial wharf, between the shore and approximately 100 m west of the end of the wharf and extends south until about 65 m south of the wharf, where it extends east until approximately 470 metres from shore. No PAH distribution pattern was noted south of the commercial wharf. Rather, high point values are observed (nugget effect). The values that exceed the IEL vary between 5.28 mg/kg and 119.73 mg/kg.

Note that the sediment outside the dredging area is not completely exempt of copper and total PAH contamination. In fact, the environmental characterization reports published in 1998, 2001, 2002 and 2005 indicate the presence of contaminants in the sediment outside the dredging area, namely to the north and east of the wharf. However, it was demonstrated that the level of contamination in this sediment is below the IEL set by the QSAR *et al.* (2002) study, which explains why it was not included in the dredging area (Dessau-Soprin and Environnement Illimité, 2007).

Average Sediment Contamination Level for Land Management

In order to determine the dredged sediment's level of contamination for final management, the weighted average concentration was calculated for copper, total PAH and each of the 16 PAH congeners. These average weighted concentrations are presented in Table 6. According to the calculations, it appears that for the entire dredging area, the average sediment contamination level is 767 mg/kg for copper and 12.2 mg/kg for total PAH. For copper, this level of contamination is slightly higher than level C of the criteria set out in the MDDEP Policy (500 mg/kg), but significantly lower than the standard in Appendix 1 of the *Règlement sur l'enfouissement des sols contaminés* (RESC) (2 500 mg/kg). For each of the 16 PAH congeners, since there are no criteria or standards for total PAH, the average level of contamination is very low and either lower than or equal to level B of the Policy's applicable criteria for most of the congeners. It must be mentioned that the slight exceedence of criteria B (1 mg/kg) for benzo(b+j+k)fluoranthene (1.3 mg/kg) is not significant since it can be attributed to each of the isomers (b, j or k). A separate analysis of the concentration of each isomer would permit a shared distribution of the total concentration, so that each respects the MDDEP Policy's 1 mg/kg criteria.

TABLEAU 6 : CONCENTRATIONS MOYENNES PONDÉRÉES PAR ZONE D'INTERVENTION POUR LE CUIVRE, LES HAP TOTAUX ET LES 16 CONGÉNÈRES DES HAP

Zone de dragage	Identification	A	B	C
	Superficies (m²)	52 050	2 450	5 250
	Profondeur du plancher de dragage (m)	0.3	0.65	0.5
	Profondeur de dragage (incluant surdragage de 300mm) (m)	0.6	0.95	0.8
	Volume en place à draguer (incluant surdragage de 300 mm) (m³)	31 200	2 300	4 200

Paramètres		Unités	Politique[1]			RESC[2]	SIE[3]	Concentrations moyennes pondérées[4]		
			A	B	C	Annexe 1				
Cuivre		mg/kg	40	100	500	2 500	2 400	634	2288	1374
HAP totaux[6]		mg/kg	-	-	-	-	5	11.7	14.6	16.4
HAP 16 congénères	Acénaphtène	mg/kg	0,1	10	100	100	-	0.2	0.2	0.2
	Acénaphthylène	mg/kg	0,1	10	100	100	-	0.0	0.1	0.1
	Anthracène	mg/kg	0,1	10	100	100	-	0.5	0.6	0.8
	Benzo(a)anthracène	mg/kg	0,1	1	10	34	-	0.9	1.3	1.4
	Benzo (a) pyrène	mg/kg	0,1	1	10	34	-	0.7	0.9	0.9
	Benzo (b+k+j) fluoranthène	mg/kg	0,1	1	10	136	-	1.2	1.8	1.8
	Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	-	0.1	0.0	0.0
	Benzo (g,h,i) pérylène	mg/kg	0,1	1	10	18	-	0.4	0.5	0.5
	Chrysène	mg/kg	0,1	1	10	34	-	0.8	1.1	1.2
	Dibenzo(ah)anthracène	mg/kg	0,1	1	10	82	-	0.1	0.1	0.2
	Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	-	0.0	0.0	0.0
	Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	-	0.0	0.0	0.0
	Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	-	0.0	0.0	0.0
	1,2-Benzanthracène-7,12-diméthyl	mg/kg	0,1	1	10	34	-	0.0	0.0	0.0
	Fluoranthène	mg/kg	0,1	10	100	100	-	2.2	2.7	3.3
	Fluorène	mg/kg	0,1	10	100	100	-	0.3	0.3	0.4
	Indeno (1,2,3-cd) pyrène	mg/kg	0,1	1	10	34	-	0.4	0.5	0.5
	3-Méthylcholanthrène	mg/kg	0,1	1	10	150	-	0.0	0.0	0.0
	Naphtalène	mg/kg	0,1	5	50	56	-	0.3	0.2	0.2
	Phénanthrène	mg/kg	0,1	5	50	56	-	1.8	1.8	2.0
	Pyrène	mg/kg	0,1	10	100	100	-	1.7	2.5	2.9
	2-Méthylnaphtalène	mg/kg	0,1	1	10	56	-	0.1	0.0	0.0

Notes :

1 Politique de protection des sols et de réhabilitation des terrains contaminés (MDDEP).
2 Règlement sur l'enfouissement des sols contaminés (RESC) (Gouvernement du Québec).
3 SIE = Seuil intégré d'effet.
4 Concentrations moyennes pondérées selon le volume représenté par chaque échantillon prélevé dans le cadre des études antérieures, sur la base des polygones de Thiessen générés pour l'ensemble des stations et de l'épaisseur calculs, le niveau de contamination des sédiments de surface a été considéré jusqu'à la profondeur du plancher de dragage. Ensuite, pour les sédiments compris à l'intérieur de la couche de surdragage (300 mm), en l'absence de r niveau de contamination nul a été considéré.
5 Moyenne pour l'ensemble, pondérée selon le volume à draguer pour chaque zone de contamination (A à C).
6 Sommation des 16 congénères, aucun critère applicable pour la sommation.
\- Aucun critère ou norme disponible.
-- Non applicable.
5.9 Concentration dans la plage B-C des critères de la Politique.
300 Concentration supérieure au niveau C des critères de la Politique.
300 Concentration supérieure aux normes de l'annexe 1 du RESC.

5.2 Biological Environment

Where available, Appendix C includes the spatialization of the species or any other type of information mentioned in this section.

5.2.1 Flora

5.2.1.1 *Aquatic Vegetation*

The aquatic vegetation in the bay of Gaspé is comprised of various types of grass beds that serve as substrate, shelter and food for several animal species. The infralittoral[7] is made up of submerged vegetation, mainly red algae (*Rhodophyta*). The littoral, the area that is flooded and unwatered daily, is made up of green algae (*Chlorophyta*), brown algae (*Phaeophyceae)* and eel grass (*Zostera marina*). Eelgrass is the dominant vascular plant in the shallow water of the bay of Gaspé (including the harbour). According to the Fish Habitat Management Information System (FHAMIS), a large proportion of the area around the bay of Gaspé is characterized by the presence of eelgrass beds (DFO, 2002), as found in the project's study area. Only flooded at high tide, the bay of Gaspé supralittoral is comprised of riparian vegetation and a few chlorophyta (QSAR *et al.*, 2002).

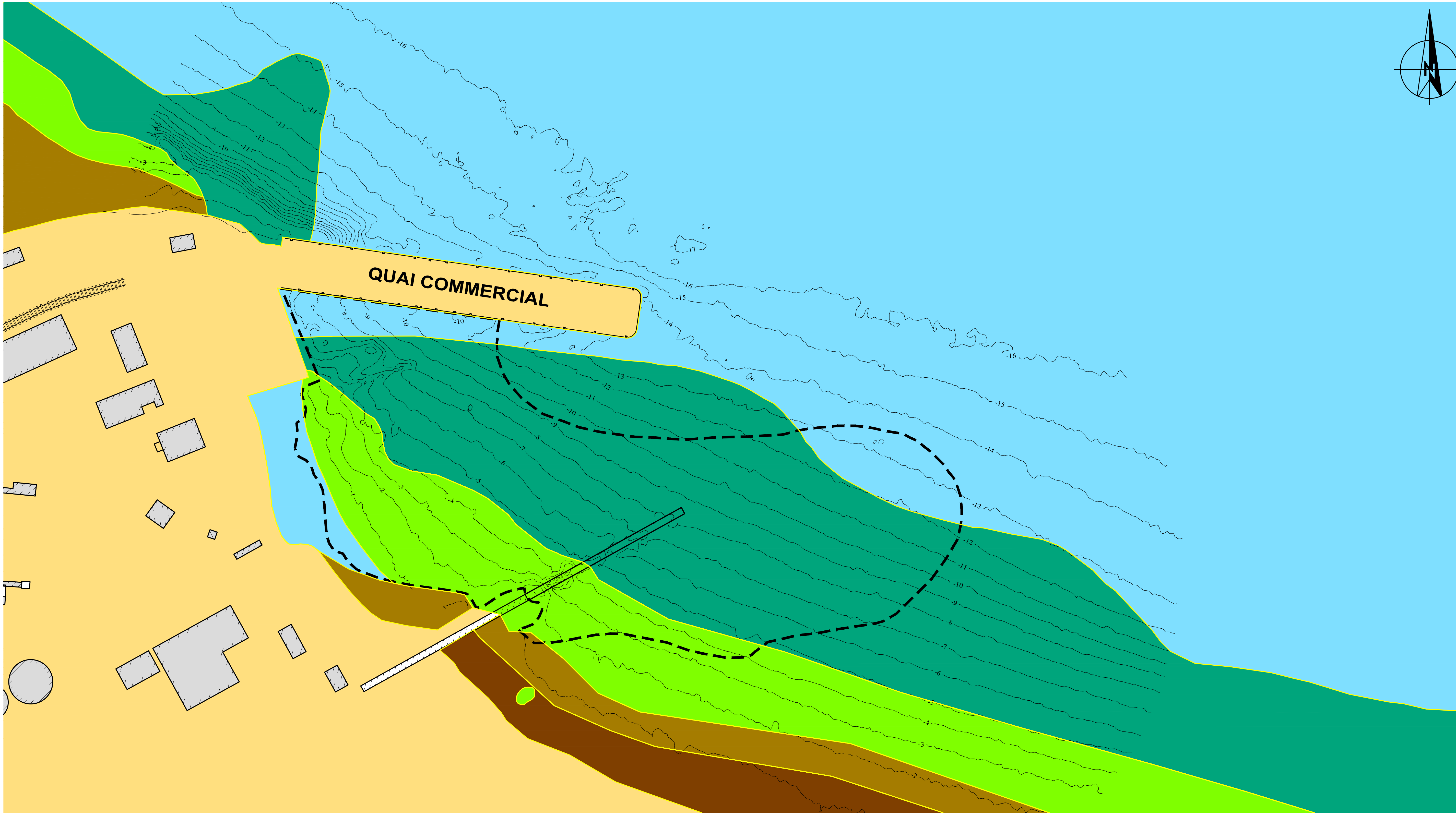
An inventory of the aquatic vegetation in the intervention area was conducted by Environnement Illimité in the fall of 2004 (Environnement Illimité, 2005). This characterization was carried out with the help of an underwater camera from a boat traveling along several transects perpendicular to shore.

The aquatic vegetation found in the intervention area can be divided into four main types of grass beds, defined by the presence of these distinct species:

- Sea cabbage;
- Eelgrass;
- Brown algae;
- Mixed (eelgrass and brown algae).

These plant communities are distributed by type of substrate, depth and tolerance to unwatering (see Figure 8). A description of the characteristics of these four grass beds is presented below.

[7] Corresponds to the submerged area whose upper fringe may be unwatered at high spring tide.



LÉGENDE :

TYPES D'HERBIER

- ALGUES BRUNES
- MIXTE (ALGUES BRUNES ET ZOSTÈRES)
- ZOSTÈRES
- LAMINAIRES
- SANS VÉGÉTATION

- LIMITE ZONE DE DRAGAGE
- CONTOUR BATHYMÉTRIQUE (m)

SOURCE :
– ENVIRONNEMENT ILLIMITÉ, MARS 2005.

Projet

Transports Canada

PROJET DE RESTAURATION DE SÉDIMENTS AU PORT DE GASPÉ – SANDY BEACH

Titre

FIGURE 8
DISTRIBUTION DES HERBIERS AQUATIQUES

DESSAU

Dessau inc.
1080, Côte du Beaver Hall, bureau 300
Montréal (Québec) H2Z 1S8
Téléphone : 514.281.1010
Télécopieur : 514.798.8790

Préparé C. Gaudette
Dessiné F. B./J.-M.R.
Vérifié S. Côté

Discipline Environnement
Échelle 1 : 2 500
Date 2012-03-22

Chargé de projet C. Marcotte
Extrait de: Rév.:

Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
045	P001130	0162	068	EI	0108	01

G:\045\P001130\CAD\Actif.162\045-P001130-0162EI-0108-01.dwg

Sea Cabbage Bed

Sea cabbages are algae with a cylindrical stem supporting a wavy lamella that can grow several metres in length. Depending on the clearness of the water, their length can vary between 2 and 7 m. In the intervention area, they grow in a clayey substrate at a depth of 4.5 to 12 m (Environnement Illimité, 2005).

In the Gulf of St. Lawrence, there are four main species of sea cabbage, grouped by depth: *Alaria esculenta* and *Saccorhiza dermatodea* in shallow water (< 7 m) and *Agarum cribrosum* and *Laminaria Longicruris* in deeper water (< 18 m). These algae require a solid substrate, such as stones or pebbles spread relatively densely over the sea floor. Sea cabbages tend to be more concentrated in areas with an abundance of rocks or structures to which they can affix themselves (Environnement Illimité, 2005).

Eelgrass Bed

In the intervention area, the eelgrass bed (*Zostera marina*) extends just below the tidal zone, up to 4.5 m in depth in relation to mean sea level (geodetic). This plant community is located approximately 25 to 75 m from the shore, in a fine substrate mainly made up of sand with a relatively large proportion of clay. Eelgrass usually grows to between 10 and 30 cm in height. This grass bed is relatively dense and covers all substrate made up of sand or loam (Environnement Illimité, 2005).

The eelgrass bed is considered to be a highly productive aquatic habitat and plays a vital physical role in the marine environment by stabilizing the sediment. It also has a number of important biological functions, including providing a surface for colonization by other plant or wildlife species. This habitat is used by several bird, fish and invertebrate species, for food, breeding, shelter and rearing young (Environnement Illimité, 2005).

Brown Algae Bed

Brown algae (*Fucus* sp.) is mainly found inside the intertidal[8] zone, in exposed rocky areas (between 0.6 and – 0.6 m). They are made up of a frond divided into flat strips and a short stem with an adhesive sucker. These algae are short (15 to 20 cm), but can be very dense and completely cover the substrate of certain rocky sectors. In the intervention area, they grow along the shore (Environnement Illimité, 2005).

[8] The area on sea coasts between the highest and lowest tidal levels.

Mixed Bed

Below the intertidal zone, the vegetation is mixed, composed mainly of brown algae and eelgrass, whose density varies by type of substrate. This mixed grass bed is located in a rocky environment with sand or clay lenses that are home to eelgrass (Environnement Illimité, 2005). In the intervention area, a first strip of mixed grass, approximately 25 m wide, is found along the shore immediately north of the slipway. A second strip is located east of the other, along the brown algae bed. These algae do not grow very tall. Brown algae from the *Fucus* genus affix themselves to the rocks in large number. The more the substrate is rocky, the larger the proportion of brown algae (Environnement Illimité, 2005).

According to CIMA (2010), the DFO confirmed that the four grass beds mentioned above are part of a large seagrass area extending approximately 2.5 km from the Port of Gaspé – Sandy Beach, up the Sandy Beach sand bar.

5.2.1.2 *Riparian Vegetation*

Salt Marsh

The accumulation of fine deposits in the shallow water at the mouths of the rivers or along the littoral, sheltered from waves and currents, favours the formation of salt marshes inside the bay of Gaspé. These environments, which are very productive and have great ecological significance, serve, among other things, as waterfowl nesting areas. Inside the study area, tidal salt marshes are found in the bay and on the Penouille peninsula, up to the base of the Sandy Beach sand bar (see Figure B-1 in Appendix C) (Limoges, 2001 and DFO, 2002). This base, made up of a large, triangle-shaped sand deposit, forms a salt marsh that is flooded at high tide and is crossed by a stream. There are no salt marshes inside the intervention area (DFO, 2002).

Coastal Upland Meadow

The Sandy Beach sand bar and the Penouille peninsula in the study area contain herbaceous vegetation dominated by halophilous[9] plants. Some of these, such as sand ryegrass (*Elymus arenarius*) and beachgrass (*Ammophila breviligulata*), help stabilize coastal sand dunes (QSAR *et al.*, 2002).

[9] An organism living in a saline environment.

5.2.1.3 *Terrestrial Vegetation*

The study area is located in the balsam fir-yellow birch bioclimatic domain (Leboeuf, 2007). Terrestrial vegetation, disturbed by anthropogenic activities, is poorly represented in the intervention area. It is mainly concentrated south of the former site of Xstrata's sulphuric acid storage tanks and the shipyard, where there are uncultivated plants and shrubs as well as an uncultivated stand of shade-intolerant hardwoods.

5.2.1.4 *Plant Species that are Threatened, Vulnerable or Likely to Be So Designated*

The presence or absence, in the study area, of plant species that are threatened, vulnerable or likely to be so designated was documented with the help of the *Centre de données sur le patrimoine naturel du Québec* (CDPNQ)[10] database.

A species is considered threatened when its extirpation is expected. It is considered vulnerable when its survival is precarious even if its extirpation is not expected (MDDEP, 2008).

A species designated as threatened or vulnerable is:

- A species protected under the *Loi sur les espèces menacées ou vulnérables* (Government of Québec, 2009a);
- A species identified in the *Règlement sur les espèces floristiques menacées ou vulnérables et leurs habitats* (Government of Québec, 2009b).

According to the CDPNQ, no plant species that are threatened, vulnerable or likely to be so designated were found in the study area or within its area of influence (CDPNQ, 2009a).

5.2.1.5 *Endangered Plant Species*

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild Canadian species, subspecies, varieties or other designatable units that are suspected of being at risk of extinction or extirpation. The *Species at Risk Act* (SARA) is a key federal government commitment to prevent wildlife species designated by COSEWIC from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife

[10] It is important to mention that the CDPNQ data stems from different sources and has been gradually integrated since 1988. Part of the existing data has yet to be incorporated. Consequently, the information provided may be incomplete. Furthermore, the database does not distinguish between the portions of territory recognized as not containing those species and those not inventoried. For these reasons, the CDPNQ's opinion about the presence, absence or status of at-risk species at a given site is never definitive and should not be considered a substitute for field inventories.

species and the conservation of their biological diversity. The Species at Risk Public Registry is a source of information and documents on species at risk in Canada[11].

The risk categories assigned by COSEWIC to species at risk are:

- Extinct: a wildlife species that no longer exists;
- Extirpated: a wildlife species that no longer exists in the wild in Canada, but exists elsewhere;
- Endangered: a wildlife species facing imminent extirpation or extinction;
- Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction;
- Special Concern: those species that are particularly sensitive to human activities or natural events.

According to the Species at Risk Public Registry, no at-risk plant species are found in the study area (Government of Canada, 2007).

5.2.2 Wildlife and Habitats

5.2.2.1 Benthic Invertebrates

Several benthic invertebrate species are found in the bay of Gaspé: polychaetes (*Polychaeta*), rock crab (*Cancer irroratus*), edible crab (*Cancer pagurus*), snow crab (*Chionoecetes opilio*), American lobster (*Homarus americanus*), blue mussel (*Mytilus edulis*), softshell clam (*Mya arenaria*), green sea urchin (*Strongylocentrotus droebachiensis*), Icelandic scallop (*Chlamys islandica*) and sea scallop (*Placopecten magellanicus*) (see figures B-2 to B-8 in Appendix C) (QSAR *et al.*, 2002 and DFO, 2007[12]). According to a study conducted by CIMA in 2010, the four following species have commercial value and are found in the Gaspé harbour:

[11] It must be noted that the registry's distribution maps are based on limited information. They do not represent an in-depth and complete inventory of the actual distribution of a given species. Moreover, the distribution maps were designed for national and regional use. As such, they are not appropriate for local use.

[12] This information should not be considered a consultation by the DFO for the purposes of an environmental assessment. The lack of information on the maps does not signify the absence of fish habitats at risk of being destroyed, degraded or disturbed. Special attention should be placed on the study sector based on the expected impacts. Additional research and field inventories and surveys would be necessary to complete the available information.

- Rock crab, whose distribution range covers the entirety of the Gaspé harbour, including the dredging area. Rock crabs breed in the fall and the female carries the eggs approximately one year. After she lays the eggs, the larvae are released into the water column, where they remain from mid-June to mid-September before settling.

- American lobster, whose distribution range covers a large strip along the south shore of the Gaspé harbour and possibly part of the dredging area. Breeding and egg hatching occurs in the summer and the larvae can remain in the harbour throughout the season. The location of nurseries in the sector is not known.

- Blue mussel. In the Atlantic region, eggs are usually laid from mid-May to late September. Blue mussels are mainly observed in the Gaspé harbour in the spring, from early May to late June. Egg laying may also occur in the fall in some sectors. Farmed mussels have a more predictable laying period, normally occurring (according to information obtained from MAPAQ) between July 15 and 31. Laying is followed by the larvae feeding in the water column for 3 to 4 weeks, before settling on a substrate. Farmed mussels are harvested in the winter and spring, from December to May.

- Sea scallop, which is not found in large number in the Gaspé harbour. However, there are scallop farms in the northwest basin. Breeding is generally stimulated by a drop in water temperature, therefore usually from summer to fall. More specifically, in Gaspésie, breeding is observed from mid-August to mid-September. The larvae move around for 4 to 6 weeks, before settling on a substrate. According to information obtained from MAPAQ, farmed scallops are harvested in winter and spring.

Environnement Illimité took an inventory of the benthic invertebrates inside the intervention area in the fall of 2004 (Environnement Illimité, 2005). This characterization was conducted with an underwater camera from a boat traveling along several transects perpendicular to the shore. Observations made during the field season helped identify the generalized presence of common starfish (*Asterias rubens*) in denuded deepwater areas and in sea cabbage and eelgrass beds. Their presence is likely tied to the abundance of periwinkle-type gastropods (*Littorina* sp.) in these same environments. Moreover, large, but localized concentrations of small crustaceans (*Gammarus* sp.) were observed, mainly in the eelgrass beds and around sea cabbage specimens. A few rock crabs were also noted in eelgrass beds.

5.2.2.2 Ichtyofauna and Habitat

The bay of Gaspé has a rich and diverse ichtyofauna. It must be noted that there are larger numbers of ground fish than fish species found in shallow water. According to the DFO database (2007)[13], several fish species were inventoried in the bay of Gaspé (see figures B-9 to B-16 in Appendix C).

These may be found inside the intervention area. Table 7 presents the fish species found in the bay of Gaspé, as well as their breeding period (DFO, 2007).

TABLE 7: FISH SPECIES IN THE BAY OF GASPÉ

Common name	Latin name	Breeding period[13]
American eel	*Anguilla rostrata*	Unknown*
Capelin	*Mallotus villosus*	Mid-May to mid-July
Rainbow smelt	*Osmerus mordax*	Mid-May to late June
Atlantic herring	*Clupea harengus*	Spring and fall
Atlantic mackerel	*Scomber scombrus*	Summer
White hake	*Urophycis tenuis*	June
Atlantic cod	*Gadus morhua*	Spring*
Brook trout	*Salvelinus fontinalis*	Late August to October**
Atlantic salmon	*Salmo salar*	October-November

* Breeding occurs at open sea, more specifically in the Sargasso Sea in the case of the American eel.
** The restriction period for this species also lasts from May 15 to 30 to protect the brook trout during its spawning run.

A brief description of the life cycle of these species, taken from CIMA + (2010) follows:

- The American eel (*Anguilla rostrata*) can live in a wide variety of habitats and saline conditions. Toward the end of their lives, the adults return to the Sargasso Sea to spawn one final time and die. This migration to their spawning grounds occurs from August to November. The elvers are then carried by the Gulf Stream from the Sargasso Sea to the Gulf of St. Lawrence, which they reach in early summer. While this species was designated of special concern by COSEWIC, specimens were observed in grass beds during field surveys conducted by the Department of Fisheries and Oceans in June and September, 2005 to 2008.
- Capelin (*Mallotus villosus*) usually spawns in the bay of Gaspé from mid-May to late June. Spawning grounds observed in the area are concentrated on the eastern and western beaches of the Sandy Beach sand bar. Egg incubation usually takes 2 to 3 weeks.
- Rainbow smelt (*Osmerus mordax*), an anadromous species, is found in the pelagic areas of estuaries and coastal marine waters. Smelt begins migrating toward rivers in the spring, with the spawning run beginning in mid-April and lasting until late May. Spawning occurs between mid-May and the end of June.
- Atlantic herring (*Clupea harengus*), which is usually pelagic, approaches the coast during its breeding season, which varies by population. Usually, spawning occurs in the spring, in shallow water. However, certain populations lay their eggs in the summer or fall or in deeper water. In

[13] However, the main known spawning grounds and annual juvenile gathering sites in the bay of Gaspé are not in the intervention area. (Environnement Illimité, 2005).

shallow water, the eggs are often affixed to aquatic vegetation. Fisheries and Oceans Canada identified two breeding sites north of the harbour. Other sites may exist.

- Atlantic mackerel *(Scomber scombrus*) is fished for sport from the Gaspé - Sandy Beach wharf. Its breeding ground in the area is mainly in the bay of Gaspé. The area near the wharf could be considered a feeding ground since Atlantic mackerel follows schools of capelin there. The peak of the feeding season is in the spring, while spawning usually occurs in the summer, from mid-June to mid-July.
- White hake (*Urophycis tenuis*) is a pelagic fish that uses the entire bay of Gaspé as its spawning ground, between June and September. White hake is fished commercially in large number in the region, mainly during the spring and fall.
- Atlantic cod (*Gadus morhua*) is also designated a species of special concern by COSEWIC. Spawning from March to April, the resulting larvae remain in the water column for a certain time. Then, at the juvenile stage (from 1 to 4 years of age), they settle at the bottom. During field seasons conducted in June 2008 by the DFO, cod was found in the eelgrass beds of Rivière St-Jean and Pointe Penouille.
- Brook trout (*Salvelinus fontinalis*) is found in estuaries and coastal marine waters. However, this species returns to the river to breed in the summer. In the Gaspé harbour area, migration occurs from mid-May to late June, while spawning occurs from late August to October.
- Atlantic salmon (*Salmo salar*). Adults migrate from the open sea to their river spawning grounds between spring and fall. Spawning takes place in late fall (October-November) and the eggs usually hatch in the spring, between April and May. The smolts feed in the river estuaries starting in May.

Furthermore, as the intervention area includes an eelgrass bed, it would be possible to inventory other fish species, such as lumpfish (*Cyclopterus lumpus*), three-spined stickleback (*Gasterosteus aculeatus*), tomcod (*Microgadus tomcod*), banded killifish (*Fundulus diaphanus*) and American plaice (*Hippoglossoides platessoides)*. No fish species were noted in the intervention area during video surveys conducted by Environnement Illimité (2005). However, during a field visit in June 2009 by the DFO, numerous fry were observed near the Gaspé – Sandy Beach wharf [personal communication by Judith Leblanc (DFO) presented in CIMA+, 2010].

Eelgrass beds are of great ecological significance, according to CIMA+ (2010):

- They stabilize the sediment and play a significant role in the development of coastal marshes;

- The feed and shelter a wide variety of benthic invertebrates, including polychaetes, gastropods, swimming invertebrates (sideswimmers), bivalve molluscs (including softshell clam), rock crab and common starfish (CIMA, 2010);
- They are used as a shelter and rearing ground by various aquatic species, including smooth flounder, winter flounder, herring and smelt (CIMA, 2010);
- They are used as a habitat by small ichthyological species (stickleback, mummichog and banded killifish), which are then prey for predatory species;
- They can be used as a feeding, nursery and rearing ground for numerous ichthyological species (eel, silverside and grubby);
- They are one of the basic components of the food chain in the littoral and estuary environments, whether alive or dead. In fact, their decomposition attracts microorganisms that serve as food for small invertebrates, which are also an important link in the local food chain.

The majority of the fish in the bay of Gaspé spawn in the spring or fall. Some species passing through cross the bay of Gaspé to reach rivers upstream to breed, such as Atlantic salmon, which spawns in the York and Dartmouth rivers. Other species living in the bay also travel up these rivers during the spawning period: sea lamprey (*Petromyzon marinus*), brook trout and potentially rainbow smelt. The Sandy Beach sand bar and the Penouille peninsula are regular spawning grounds for capelin, while the bay of Gaspé's coasts are potential breeding grounds for a number of species. The York and Dartmouth river estuaries are known breeding grounds of the nine-spined stickleback (*Pungitius pungitius*). Atlantic mackerel's breeding grounds are in the central part of the bay of Gaspé, as are white hake's presumed breeding grounds (QSAR *et al.,* 2002).

Finally, it is important to mention that the intervention area is not a choice habitat for the majority of the fish species living in the bay of Gaspé. The fact that the seabed is agitated by the propulsion systems of boats may be a constraint in maintaining an environment that can support, in a stable and sustained manner, the breeding and rearing activities essential to the survival or production of a fish stock (Environnement Illimité, 2005). That being said, this environment is frequented by certain species and conducive to feeding.

5.2.2.3 Marine Mammals

Rich in food favoured by marine mammals, the bay of Gaspé is known to be one of Quebec's best whale and marine mammal watching sites. According to the *Réseau d'observation des mammifères marins* (ROMM), several whale and seal species are seen either seasonally or on a regular basis. Table 8 lists the marine mammal species seen in the bay of Gaspé and potentially found in the study area (ROMM, 2009).

TABLE 8: MARINE MAMMAL SPECIES IN THE BAY OF GASPÉ

Common name	Latin name
White-beaked dolphin	*Lagenorhynchus albirostris*
Atlantic white-sided dolphin	*Lagenorhynchus acutus*
Humpback whale	*Megaptera novaeangliae*
Blue whale[1]	*Balaenoptera musculus*
Fin whale[2]	*Balaenoptera physalus*
Harbour porpoise	*Phocoena phocoena*
Minke whale	*Balanoptera acutorostrata*
Hooded seal	*Cystophora cristata*
Harbour seal	*Phoca vitulina*
Grey seal	*Halichoerus grypus*

Source: ROMM, 2009

[1] Species designated endangered, according to the SARA.

[2] Species designated of special concern, according to the SARA.

No marine mammals were inventoried in the intervention area when Environnement Illimité (2005) conducted its video surveys. According to ROMM (Stéphanie Pieddesaux, observer, personal communication on May 12, 2009), minke whales and harbour porpoises may be present around this area. However, information collected during the public information session held on May 20, 2009 in Gaspé indicates that there is little likelihood of finding minke whales in the intervention area.

5.2.2.4 *Herpetofauna*

According to the Biodiversity Portrait of the St. Lawrence (Environment Canada, 2002), six species of amphibians are found in the bay of Gaspé sector, and therefore potentially in the study area (see Table 9).

TABLE 9: AMPHIBIAN SPECIES IN THE BAY OF GASPÉ

Common name	Latin name
American toad	*Bufo americanus*
Wood frog	*Rana sylvatica*
Mink frog	*Rana septentrionalis*
Leopard frog	*Rana pipiens*
Green frog	*Rana clamitans*
Blue-spotted salamander	*Ambystoma laterale*

Source: Environment Canada, 2002

Note that the leatherback turtle (*Dermochelys coriacea*), an endangered species according to the SARA, is also found in the bay of Gaspé (ROMM, 2009).

5.2.2.5 *Avifauna*

The wide variety of habitats in the bay of Gaspé attracts several groups of birds. Various anatidae and shorebird feeding, resting and nesting grounds, used during migration, were inventoried. The area includes a large number of wildlife habitats that are known concentration sites for waterfowl, cliff-dwelling bird colonies or colonies of birds on an island or peninsula and protected under the *Loi sur la conservation et la mise en valeur de la faune* and its *Règlement sur les habitats fauniques* (Government of Quebec, 2009d/e).

A total of six waterfowl concentration sites are found in the study area (see Figure B-17 in Appendix C) (MRNF, 2007), used by different species of geese (*Anser* sp, *Branta* sp.) and ducks. The concentration site closest to the commercial wharf (approximately 1.6 km) is located on either side of the Sandy Beach sand bar (no. 02-11-0289-1998). The other sites are located along the eastern side of the Sandy Beach sand bar, along the north shore of the Gaspé harbour and the mouth of the Dartmouth river.

A colony of birds on an island or peninsula is also found in the area around the Sandy Beach sand bar, at the Sandy Beach point (no. 14-11-0003-1992). Alcids and different tern, gull and cormorant species were inventoried, in addition to the common eider (*Somateria mollissima*), Northern gannet (*Morus bassanus*), red-throated loon (*Gavia stellata*) and Leach's storm-petrel (*Oceanodroma leucorhoa*). In fact, the Sandy Beach point is known for its colonies of herring gull and great black-backed gulls (*Larus argentatus* and *Larus marinus*), common terns (*Sterna hirundo*) and common eiders (Limoges, 2001). Over 180 common tern nests, 36 common eider nests, 150 herring gull nests and 150 great black-backed gull nests were inventoried there in 2008 [Canadian Wildlife Service (CWS) 2009].

A second cliff-dwelling bird colony is found along the northern shore of the city of Gaspé, in the Pointe Jacques-Cartier area (no. 14-11-0032-1989) (Pointe Jacques-Cartier is shown on the map in

Figure 1, Chapter 1). The bird species indentified in this area are essentially the same as those inventoried in the above-mentioned colony of birds on an island or peninsula. The CWS (2009) has also counted several black guillemot (*Cepphus grylle*) couples, possibly nesting on the steep slope of Pointe Jacques-Cartier, as well as 291 double-crested cormorant (*Phalacrocorax auritus*) nests in the surrounding trees.

The bay of Gaspé is an integral part of an Important Bird Area (IBA) of Canada, the Baie-de-Gaspé IBA (no. QC037G). A total of 242 km^2, the Baie-de-Gaspé IBA covers the bay of Gaspé and its cliffs, the Sandy Beach sand bar and the Penouille peninsula, as well as the estuaries of three salmon rivers: York, Dartmouth and Saint-Jean (the latter is located east of the study area).

This IBA is considered to be of global significance due to the populations of long-tailed duck (*Clangula hyemalis*) and brant (*Branta bernicla*) which make up 1% or more of the world's population during their stop in the bay of Gaspé. This site is also of continental significance for two species of diving ducks at risk, the harlequin duck (*Histrionicus histrionicus*) and Barrow's goldeneye (*Bucephala islandica*).

Many birds species use the York, Dartmouth and Saint-Jean river estuaries during their migratory period, such as the brant and three species of birds of prey: the short-eared owl (*Asio flammeus*), a species at risk of being designated endangered or threatened, the peregrine falcon (*Falco peregrinus anatum*) and bald eagle (*Haliaeetus leucocephalus*), two species designated as vulnerable. During the summer, these estuaries are used by the nesting populations of several marsh birds, including the yellow rail (*Coturnicops noveboracensis*), a species deemed of special concern under the *Species at Risk Act* (SARA).

Since the intervention area includes an eelgrass bed, it is possible to count several species of tip-up and diving ducks that use it as a feeding ground, including the brant. Common eiders seek out periwinkles, which are often very abundant in these areas (Environnement Illimité, 2005). However, the possibility of finding these species inside the intervention area is low, given the anthropogenic and disturbed nature of the area.

5.2.2.6 *Wildlife Species that are Threatened, Vulnerable or Likely to Be So Designated*

The presence or absence, in the study area, of wildlife species that are threatened, vulnerable or likely to be so designated was determined with the help of the CDPNQ[14] database.

A species is considered threatened when its extirpation is expected. It is considered vulnerable when its survival is precarious even if its extirpation is not expected (MDDEP, 2008).

A species designated as threatened or vulnerable is:

- A species protected under the *Loi sur les espèces menacées ou vulnérables* (Government of Québec, 2009a);
- A species identified in the *Règlement sur les espèces floristiques menacées ou vulnérables et leurs habitats* (Government of Québec, 2009b).

According to the CDPNQ, no wildlife species designated as threatened or vulnerable were inventoried in the study area or within any of the project's areas of influence. Nonetheless, a few species likely to be designated threatened or vulnerable were inventoried: the yellow rail, eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), Eastern pipistrelle (*Perimyotis subflavus*), Gaspé shrew (*Sorex gaspensis*), southern bog lemming (*Synaptomys cooperi*) and Maritime ringlet butterfly (*Coenonympha nipisiquit*) (CDPNQ, 2009b).

Yellow rails usually nest in marshes dominated by sedge grass (*Carex* sp.), herbaceous plants and rushes (*Juncus* sp.). They are also found in wet meadows, the flood plains of watercourses, in peat bogs and in the dryer areas around salt marshes or estuaries (Government of Canada, 2007). The Eastern red bat and the hoary bat live in coniferous, mixed and deciduous forests and feed above watercourses, rivers and clearings. The Eastern pipistrelle prefers pastures and watercourses as well as sparse forests. The Gaspé shrew is found in deciduous and coniferous forests, as well as near fast-moving water and on moss-covered rock slopes. The southern bog lemming favours peat bogs, herbaceous marshes, mixed forests and wet woodlands (Prescott and Richard, 1996). The Maritime ringlet butterfly is only found in salt marshes (Government of Canada, 2007). The types of habitats these species favour are found in the study area, but not the intervention area.

[14] It is important to mention that the CDPNQ data stems from different sources and has been gradually integrated since 1988. Part of the existing data has yet to be incorporated. Consequently, the information provided may be incomplete. Furthermore, the database does not distinguish between the portions of territory recognized as not containing those species and those not inventoried. For these reasons, the CDPNQ's opinion about the presence, absence or status of at-risk species at a given site is never definitive and should not be considered a substitute for field inventories.

5.2.2.7 *Wildlife Species at Risk*

According to the Species at Risk Public Registry, two marine mammals, three bird species and one insect species designated at risk are found in the bay of Gaspé and also potentially in the study area (Government of Canada, 2007) (See Table 10).

TABLE 10: LIST OF WILDLIFE SPECIES AT RISK IN THE BAY OF GASPÉ ACCORDING TO THE SPECIES AT RISK PUBLIC REGISTRY

Class	Common name	Latin name	Status
Mammal	North Atlantic right whale	*Eubalaena glacialis*	Endangered
Mammal	Blue whale (Atlantic population)	*Balaenoptera musculus*	Endangered
Bird	Harlequin duck (Eastern population)	*Histrionicus histrionicus*	Special concern
Bird	Barrow's goldeneye (Eastern population)	*Bucephala islandica*	Special concern
Bird	Yellow rail	*Coturnicops noveboracensis*	Special concern
Insect	Monarch butterfly	*Danaus plexippus*	Special concern

Source: Government of Canada, 2007.

As previously mentioned, the list of species at risk cited by the Species at Risk Public Registry for a given territory is not complete (see footnote no. 11 at the bottom of page 80). As such, the list of wildlife species presented in Table 10 is not exhaustive. According to ROMM (2009), the fin whale, a species of special concern, and the leatherback turtle, an endangered species, are also present in the bay of Gaspé. Moreover, according to the CDPNQ, the Maritime ringlet butterfly, an endangered species, is also found in the bay of Gaspé, in the Forillon National Park of Canada (CDPNQ, 2009b). These species are therefore potentially present in the study area.

The right whale is a migratory species found in coastal and temperate waters. It has been observed in both shallow water and water up to 180 m in depth. It generally spends the summer feeding in cold and temperate waters in the northern part of its distribution range. In the winter, it favours waters south of the United States. The blue whale is found in coastal waters and the open sea. The Atlantic population is usually inventoried in estuaries and shallow coastal regions, where the mixing of the water is highly conducive to krill production. The fin whale is found in temperate, arctic and subarctic waters. It is seen, among other places, in the Gulf of St. Lawrence. It is often observed along the coasts and in certain bays (Government of Canada, 2007).

The harlequin duck spends most of the year along the coast. In the spring, it heads inland to breed along fast-moving watercourses. In the winter, it is found on off-shore islands, headlands and rock faces. It feeds near coasts and rock reefs. In Quebec, the Eastern population of Barrow’s goldeneye is found in fir and white birch stands. These birds seem to prefer small, high-altitude lakes north of the Gulf of St. Lawrence. Outside of the breeding season, they spend part of the year along the coasts of the estuary and gulf (Government of Canada, 2007).

The yellow rail habitat is described in Section 5.2.2.6.

Monarchs frequent places where common milkweed (*Asclepias syriaca*), their main source of food, grows (Government of Canada, 2007).

When not nesting, the leatherback turtle travels great distances and is often found in temperate waters. In Canada, it is frequently observed on the coast from June to October. This sea turtle is therefore found on the coasts of the Gulf of St. Lawrence (Government of Canada, 2007).

As mentioned by the members of the CCBG during a meeting, the right whale, blue whale and fin whale do not frequent the waters of the study area. On the other hand, the habitats of the leatherback turtle, harlequin duck, Barrow's goldeneye, yellow rail and monarch butterfly are found in the study area. However, the potential of finding these species inside the intervention area are low, given the anthropogenic and disturbed nature of the area.

Finally, note that Fisheries and Oceans Canada, in the comments made on September 2011, reports that Atlantic salmon (*Salmo salar*), described in Section 5.2.2.2, has been designated a species of special concern by COSEWIC, even though it has not yet been entered in Appendix 1 of the SARA.

5.3 Human Environment

5.3.1 Administrative Framework

The City of Gaspé, which is part of the Gaspésie–Îles-de-la-Madeleine administrative region, belongs to the Côte-de-Gaspé regional county municipality (MRC), consisting of 5 municipalities and two territories without municipal organization. The municipal council is made up of a mayor and six councillors, representing the six districts that make up the city of Gaspé:

- District no. 1: Saint-Maurice de l'Échouerie, Petit-Cap, Pointe-Jaune, Anse-à-Valleau;
- District no. 2: Rivière-au-Renard;
- District no. 3: Anse-au-Griffon, Cap-des-Rosiers, Forillon, Cap-aux-Os;
- District no. 4: Saint-Majorique, Wakeham, Pointe-Navarre;
- District no. 5: Gaspé;
- District no. 6: York, Haldimand, Douglastown.

The Sandy Beach sector belongs to district no. 6.

5.3.2 Socio-Economic Profile

Economically, the Gaspé region is characterized by the exploitation of natural resources, more specifically fishing, forestry and mining. The Côte-de-Gaspé MRC's economy is based mainly on the exploitation and primary processing of these natural resources, as well as services (such as provincial and federal government services) and tourism. Due to its strategic location on the Gaspé harbour, and served by its port infrastructures, the city of Gaspé offers regional and extra-regional clients a wide variety of services and businesses. The city of Gaspé is therefore an urban centre of economic activity on the Gaspé Peninsula.

Demographically, the city's population fell approximately 0.8% between 2001 and 2006. The population was 14 819 in 2006 and its density was 13.2 inhabitants per square kilometre. The native language of most city of Gaspé residents is French and a large proportion of the population only uses this language. The city's unemployment rate is 13.8% and the median income is $21,822 (Statistics Canada, 2009).

5.3.3 Land Use

The Port of Gaspé – Sandy Beach is an industrial area. The dredging work will be carried out on a private water lot owned by Succession Carpenter. As for the work on land, the definitive location will be determined once the contractor is selected.

5.3.4 Commercial and Industrial Infrastructures

The main infrastructures located in the dredging area are the commercial wharf (made of steel sheet piling and a concrete apron), the fishing wharf on pilings (which was recently demolished), the Forillon shipyard's active slipway and a seawater intake for a lobster pound, comprised of a flexible, above-ground pipe. The demolition of the fishing wharf will be completed by March 31, 2012 and will be replaced by rock fill to strengthen the bank.

The height of the commercial wharf's deck is 3.17 m above chart datum, or 2.26 m with respect to mean sea level (MSL-29). Two berths are used, measuring 175 and 180 m (Transport Canada, 2009). It must be mentioned that the underground pipes used to transport Ultramar and Irving's petroleum products as well as the underground pipe used to transport Xstrata's sulphuric acid (no longer in use), are located under the commercial wharf. The presence and exact location of the underwater infrastructures must be confirmed before any work is carried out. These infrastructures namely include the extension of the shipyard's slipway, the right-of-way of the former slipway and the seawater intake for the lobster pound.

The Port of Gaspé – Sandy Beach is accessible 12 months per year, sometimes with the help of an ice-breaker. The port is currently used to tranship petroleum products and general cargo, load aggregates, export wind turbine blades, fuel federal ships belonging to Fisheries and Oceans

Canada, including Canadian Coast Guard ships and unload salt used for road de-icing. It is also used for fishing and aquaculture activities (Transport Canada, 2009).

The intervention area defined in the framework of the project includes several Irving and Ultramar storage tanks, the city of Gaspé's wastewater treatment plant, the lobster pound as well as various administrative, commercial and industrial buildings.

5.3.5 Residences

There are residences and apartment buildings on the port site, at the intersection of Route 132 and Rue du Quai (part of lot C1-6) (roughly 700 m from the work area), at the intersection of Rue du Quai and Rue Cotton (part of lot C1-2) (roughly 700 m from the work area), at the end of Rue Cotton (lot A5-3) (roughly 1 000 m from the work area), on Rue Quigley (lots C2-1-1 and C2-1-2) (roughly 430 m from the work area) and on Rue du Chantier-Maritime (part of 5-4-2-7) (less than 100 m from the work area). It must be noted that several residences located north of Route 132 (overlooking the port site), approximately 475 m from the work area (as the crow flies), are visible from the commercial wharf and the properties to the south of the former site of Xstrata's sulphuric acid storage tanks and the shipyard.

5.3.6 Road and Rail Networks

The intervention area is crossed by Route 132 (Montée de Sandy Beach) in the east-west axis and by Rue du Quai in the southwest-northeast axis. Apart from these larger roads in the intervention area, secondary streets (Chantier-Maritime, Cotton and Quigley) also cross the port site. Finally, the Gaspé-Chandler leg of the railway, owned by the *Corporation du Chemin de fer de la Gaspésie* (operated by *Chemin de fer de la Matapédia et du Golfe*) crosses the study area from east to west, in addition to serving the Port of Gaspé – Sandy Beach.

5.3.7 Navigation

According to Mr. Weston White, port director at the Port of Gaspé – Sandy Beach, two fishing boats and three mussel farm boats use the commercial wharf on a daily basis from May to October. The Canadian Coast Card docks there on a weekly basis. Boats owned by Ultramar and Construction DJL dock at the wharf approximately twice a month. Three Xstrata boats docked at the commercial wharf between March and July 2009. However, it must be noted that Xstrata has now ceased all activity at the commercial wharf. Only cruise ships carrying less than 1 000 passengers still use the wharf at Gaspé – Sandy Beach. Larger ships drop anchor in the harbour and use small craft to ferry passengers between the cruise ship and the Gaspé marina (Weston White, personal communication, July 29, 2009).

5.3.8 Fishing and Aquaculture

Scallop farming is practiced in the bay of Gaspé. Several Icelandic scallop and sea scallop colonies (adults and juveniles) are present in the bay, but only one farm is currently operated. Sea scallop is the predominant species. The majority of the commercial scallop farm sites are located east of the Sandy Beach sand bar (QSAR *et al.*, 2002), near Pointe de Penouille (therefore outside the intervention area). However, one farm site is located west of the Sandy Beach sand bar (see Appendix C, Figure B-18). This site, in operation since November 2009, is owned by Fermes Marines de Gaspé. A total of two million molluscs were put in the water in the fall of 2010 and another 2.5 million plus are expected to be added in 2011. The first harvest should be in the fall of 2011 (Radio-Gaspésie, 2010).

Mussels are also farmed in the bay of Gaspé, as the bay is very conductive to mussel growth. For this reason, MAPAQ considers this area a priority for the development of the industry in Gaspésie (Jacques Sénéchal, Canadian Shellfish Sanitation Program, personal communication, July 9, 2009). The study area contains several mussel farms run by Les Moules de Gaspé, Les Moules Forillon and Les Moules de l'Est. They are all located at the mouth of the Dartmouth river, in the part of the harbour that is commonly referred to as the "northwest basin" (MAPAQ, 2009). These sites are therefore located west of the line formed by Pointe Jacques-Cartier and Pointe Penouille, outside the intervention area (see Figure B-18 in Appendix C). A single mussel farm was active in 2011. It must be mentioned that mussel harvesting in the harbour is usually forbidden, for all active mussel farms, from late March to early May and from June to late August, due to the presence of toxic algae[15]. Moreover, the bacteriological quality of the water in the harbour is sometimes problematic due to the activities of the city of Gaspé's wastewater treatment plant. During periods of heavy rain, the treatment plant is occasionally forced to discharge untreated excess water directly into the environment.

Of all the molluscs found in the bay of Gaspé, the species most commonly gathered and consumed by the population is the softshell clam.

While the groundfish crisis caused by declining stocks has affected the regional economy, commercial fishing is still practiced in the bay of Gaspé. Shrimp, lobster and rock crab are the main catches. There are also a number of active edible crab fishers. Lobster is only fished commercially in the Gaspé harbour (Gilles Lapointe, MAPAQ, personal communication, July 27, 2009). In 2011, the lobster management plan set the number of fishing days at 69, between April 23 and June 30. The fishing area located near the Gaspé – Sandy Beach wharf (20A) was used by 24 permit holders,

[15] Note that all of the shellfish areas (sectors where molluscs live or sectors conducive to their growth) in the study area are closed. Each mussel, scallop or oyster harvest in an active site must be approved by Environment Canada, through the Canadian Shellfish Sanitation Program (Jacques Sénéchal, Canadian Shellfish Sanitation Program, personal communication, July 9, 2009).

including three from the Micmacs of Gespeg community. Fisheries and Oceans Canada (personal communication, 2011) believes that there is no lobster fishing upstream of the Sandy Beach sand bar.

Rock crab is subject to limited fishing in the Gaspé harbour. Three permits are held by the Micmacs of Gespeg community, and one of these permit holders apparently fishes in the inner bay, possibly in the area upstream of the Sandy Beach sand bar. The authorized fishing period in 2011 was from July 23 to September 30 and the total allowable catches for fishing area 12 F, the closest to the Sandy Beach wharf, was 163 tons.

Mackerel fishing, a popular activity for the local population, is practiced on the wharfs, including on the commercial wharf at the Port of Gaspé – Sandy Beach. Capelin and sea trout are fished in the harbour in the spring. In the winter, rainbow smelt is fished (ice fishing) at the mouths of the Dartmouth and York rivers (QSAR, 2009).

5.3.9 Recreational and Tourist Activities

The Forillon National Park of Canada is located in the northern part of the study area. It offers hiking and bird watching, among other activities. Recreational activities in the Gaspé harbour include pleasure boating, cruises, sea kayaking, windsurfing, kite boarding and scuba diving. There is also swimming on the beaches of Penouille (on the Penouille peninsula) and Sandy Beach (on the Sandy Beach sand bar, also called Boom Defence). The latter area is widely used by the region's inhabitants and tourists. The western side of the sand bar is the most frequented.

Finally, a bike path that is part of the Route verte du Québec is located in the southern part of the intervention area, south of the railway owned by the *Corporation du chemin de fer de la Gaspésie*.

5.3.10 Development Projects

5.3.10.1 Fishing Wharf

In 2011, Transport Canada began dismantling the former fishing wharf south of the commercial wharf. This wharf, comprised of a reinforced concrete slab on a steel structure and wood crib, was demolished along its length and its former location was strengthened with rock fill. This project was completed in early 2012.

5.3.10.2 Stabilization of the Banks in the Approach to the Gaspé – Sandy Beach Wharf

Following the storm that hit the Gaspé region on December 6, 2010, a section of the Transport Canada (TC) storage property, located along the approach to the Gaspé – Sandy Beach wharf, eroded and sunk in certain places. The aim of the project is to protect and level this property with rock fill. The work will involve levelling the eroded areas. A membrane will then be laid, followed by different categories of quarry stones to stabilize the area and protect it from eventual disturbances. The rock fill will consist of a layer of crusher run stones followed by filtering stones and then finally a layer of 1 to 3 MT and 3 to 5 MT of armour stones. This project should be completed by late winter 2012.

5.3.11 Sound Climate

The Port of Gaspé – Sandy Beach is approximately 3 km from downtown Gaspé. Several residences are located along Route 132, in the southern part of the intervention area (approximately 550 m from the commercial wharf). Several residences are also located within the port facilities (225 and 725 m from the commercial wharf). Dominant noise in the intervention area is generated in large part by port and industrial activities (namely the conveyors used for the DJL company's granular material). Traffic on Route 132 and railway traffic also raise the sound level in the area.

Dominants winds that blow from west to east between September and March direct sounds toward the sea during this period. From April to August, the opposite occurs, with dominant winds blowing from the east.

The City of Gaspé's nuisance by-law (no. 736-99) covers noise-related nuisances. It bans the use of motor-driven machines or equipment likely to generate noise that may disturb neighbouring residents between the hours of 10:00 p.m. and 6:00 a.m. However, it is possible to obtain authorization from the municipal council to carry out night work. To apply, the incumbent must demonstrate that the activities will not significantly increase the average ambient noise level.

5.3.12 Heritage and Archaeology

Natural Heritage

The Sandy Beach sand bar, located approximately 2 km east of the commercial wharf, belongs to the MRNF, which has given it a conservation vocation. It is also the subject of conservation efforts by the City of Gaspé and the MRC of Côte-de-Gaspé. Accessible via a dirt road from Route 132, the sand bar is a total of 74 ha and forms a narrow arrow of sand approximately 130 m wide and 3 km long, leading to an islet that can be reached on foot at low tide. The base of the arrow widens into a large, triangle-shaped sand deposit. This base becomes a flooded salt marsh at high tide.

Forillon National Park of Canada, located approximately 2.5 km north of the commercial wharf, includes the Penouille peninsula, which has several plant communities and a diverse flora that grows according to the nature of the dune substrate, the silica content of the sand and the thickness of the organic soil. Like the Sandy Beach sand bar, this sand formation is home to a salt marsh.

Cultural Heritage and Archaeology

The study area includes a number of historic monuments. In downtown Gaspé, there is the Jacques de Lesseps monument, the *Place de la découverte* monument and the Jacques-Cartier cross, which celebrate Gaspé's history and culture (Tourisme Gaspé, s.d.). The *Ministère de la Culture, des Communications et de la Condition féminine* (MCCCF)'s *Répertoire du patrimoine culturel du Québec* lists two historic monuments in downtown Gaspé: the Christ-Roi cathedral and Maison William-Wakehan. The Directory of Designations of National Historic Significance mentions the Monument-à-Jacques-Cartier National Historic Site, also located in this area. There are no historic monuments protected by the *Loi sur les biens culturels* in the intervention area. It must be noted that the bunkers on the properties southeast of the shipyard are not formally recognized (Marc Dupont, City of Gaspé's planning department, personal communication, November 18, 2009).

During the Second World War, the Sandy Beach sand bar was the site of the Fort Ramsay naval base. In 1942, over 3 000 men were stationed there. The site included maritime defences, fuel tanks, jetties, magazines, workshops, a marine railway, communication facilities and a hydroplane hangar with an apron (Veterans Affairs Canada, 2006). Today, only a few remnants are left of this base.

According to the *Inventaire des sites archéologiques du Québec*, there are four archaeological sites inside the study area (Stéphanie Nostedt, MCCCF, personal communication, July 30, 2009). A first archaeological site is located in the city of Gaspé area, south of the mouth of the York river (site no. DeDc-2). Artefacts (16 flakes) were found on this prehistoric Amerindian site. A second archaeological site, the Beaudry site, is located north of the mouth of the Dartmouth river (site no. DfDc-12). A flake and an Amerindian knife were discovered there.

The two other archaeological sites are located in the Forillon National Park of Canada, more precisely, in the Penouille peninsula area. One is located in the middle of the peninsula (site no. DfDc-1). A wide variety of artefacts was discovered on this prehistoric Amerindian (Palaeoindian, Archaic, silvicultural) and Euro-Quebec site. Structures such as dugout shelters, a dumping ground, grave pit, oven, cutting shed and main surface shelter were discovered. The Lapointe site (site no. DfDc-3) is located at the northeastern end of Baie de Penouille. This prehistoric Amerindian and Euro-Quebec site (1800-1899) contains several lithic Amerindian artefacts. No other archaeological sites are located in the intervention area.

As for Aboriginal peoples, the Gaspé peninsula is home to the Micmac nation. The Micmacs of Gespeg (approximately 700 members) live within the city of Gaspé. Their Band Council meeting place is approximately 12 kilometres west of the Port of Gaspé – Sandy Beach. It must be noted that Micmacs of Gespeg do not live on a native reserve, but within the city limits.

5.3.13 Landscape

The Port of Gaspé – Sandy Beach has an uncomplicated landscape, characteristic of the villages in the Gaspé region. The urban fabric is quite homogeneous, not very dense and mainly clustered along Route 132. The visual field is very open. The landscape is marked by natural spaces, the Gaspé harbour and an irregular topography with several relatively significant differences in level. Generally, the terrain in the intervention area slopes down to the Gaspé harbour, in a southwest-northeast axis. The commercial wharf is visible from houses north of Route 132, overlooking the port site.

5.3.14 Aboriginal Communities

The Aboriginal communities living in Gaspésie all belong to the Micmac nation, which is part of the larger Algonquian family. The Micmacs of Gaspésie are divided into three bands, two of which live on reservations, in Ristigouche (Listuguj) and Maria (Gesgapegiag). The third band lives among the white community of Gaspé and most of these 500 or so members live in Pointe-Navarre and the surrounding parishes, approximately 11 km northeast of Port of Gaspé – Sandy Beach, on the south shore of the Dartmouth river.

The Gaspé Aboriginal community was recognized in 1972 and gained self-governing status after signing a framework agreement in 1999. In 2001, the three communities in Gaspésie formed a political and administrative organization called the Mi'gmawei Mawiomi Secretariat, whose objectives include developing common services, building relationships with non-native partners and preparing negotiations for a comprehensive land claim agreement.

The Gaspé community's main economic activities are fishing, art and handicrafts, tourism and various goods and services in the Gaspé region. This community also operates several fishing boats as well as a Micmac interpretation site.

6 ENVIRONMENTAL EFFECT ASSESSMENT METHOD

The methodology for assessing environmental effects is divided into two broad steps, identifying the effects and assessing the effects.

Identifying the effects involves determining the components of the physical, biological and human environments likely to be affected by the project activities. This step is carried out with the help of an interrelations table, which lists the components of the environment (x axis) and the project's activities (y axis).

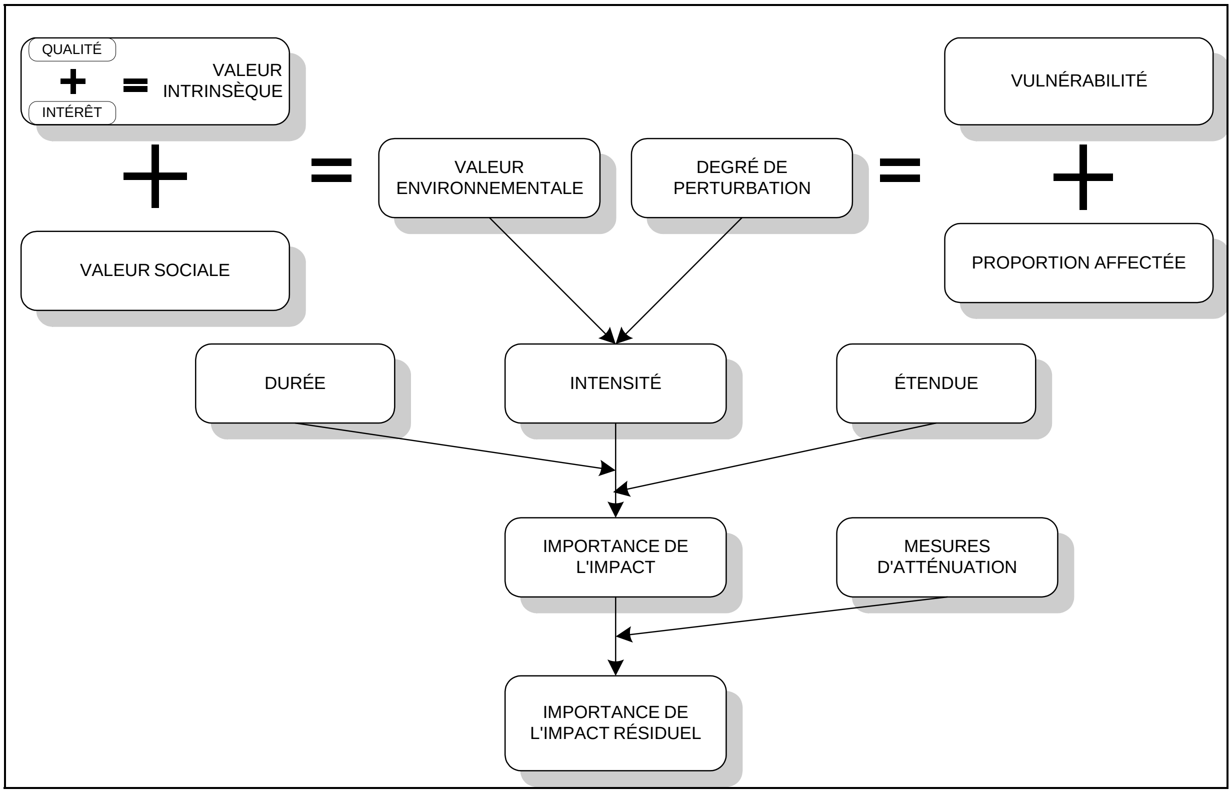
Assessing the effects involves defining the significance of the effects associated with the project's execution. The significance of an effect on an environmental component is based on three parameters: intensity, duration and extent.

The first step in determining the significance of an effect involves putting the environmental value of the component in relation to the expected degree of disturbance, which determines the intensity of the effect. The second step involves assessing the duration of the effect to determine a duration/intensity index. The third step involves assessing the significance of the effect in relation to its extent.

Finally, the significance of the residual effects is assessed, taking the mitigation measures into consideration.

The methodology used to assess the environmental effects is graphically illustrated in Figure 9.

FIGURE 9: METHODOLOGY USED TO ASSESS AN ENVIRONMENTAL EFFECT



6.1 Determination of the Significance of an Environmental Effect

6.1.1 Intensity of the Effect

The first step in determining the significance of an effect involves putting the environmental value of the component in relation to the expected degree of disturbance.

Environmental Value

Environmental value is the importance of a component in its environment. It is determined, on one hand, by the opinion of experts and, on the other, by the social value demonstrated by popular, legal and political interest in this component. The four value classes are:

Very high: a component with a very high value is recognized by an act or regulation, giving it a specific status that strongly limits any intervention likely to affect the integrity of the component (ex.: endangered or vulnerable species);

High: a component is considered of high value when its conservation and protection is subject to consensus between experts and all interests concerned. High value can also be attributed to a unique or rare component;

Medium: a component is considered of medium value when its protection, conservation or integrity is of little importance or is not the subject of consensus between experts and the public concerned;

Low: a component is considered of low value when its protection, conservation or integrity is of very little or no importance to experts and the public concerned.

Degree of Disturbance

Degree of disturbance assesses the scope of the negative changes to the structural and functional characteristics of the component affected by the project. There are three degrees of disturbance:

High: when the intervention leads to the loss or modification of all or the main characteristics unique to the affected component, risking the loss of its identity;

Medium: when the intervention leads to the loss or modification of certain characteristics unique to the affected component, which could reduce its qualities without compromising its identity;

Low: when the intervention does not significantly change the characteristics unique to the affected component, so that its identity remains intact, without significantly deteriorating its qualities.

Intensity

Associating the environmental value and degree of disturbance helps determine the first parameter used to assess the significance of the effect, intensity. This varies from high to low, as seen in the assessment grid in Table 11.

TABLE 11: EFFECT INTENSITY ASSESSMENT GRID

Degree of disturbance	Value			
	Very high	High	Medium	Low
High	High	High	Medium	Medium
Medium	High	High	Medium	Low
Low	Medium	Medium	Low	Low

6.1.2 Duration/Intensity Index

The second step in determining the significance of an effect involves putting the duration of the effect in relation to its intensity to establish a duration/intensity index.

Duration of the Effect

Duration is the time dimension of the effect. It is, relatively-speaking, the period of time during which the consequences of an intervention will affect the component concerned. The time period can be permanent, temporary or momentary:

Permanent: the effect has consequences that last the service life of the infrastructure or are irreversible;

Temporary: the effect is felt during a project activity or, at most, during the project's execution;

Momentary: the effect promptly disappears (in less than one week in the case of the present project).

Duration/Intensity Index

Associating the duration of the effect and the pre-determined intensity helps establish the second parameter used to assess the significance of the effect: the **duration/intensity index**. It varies from high to low, as seen in the assessment grid in Table 12.

TABLE 12: DURATION/INTENSITY INDEX ASSESSMENT GRID

Duration	Intensity		
	High	Medium	Low
Permanent	High	High	Medium
Temporary	High	Medium	Low
Momentary	Medium	Low	Low

6.1.3 Significance of the Effect

The third and final step in determining the significance of an effect involves putting its extent in relation to the duration/intensity index.

Extent of the Effect

Extent is the spatial dimension of the effect generated by an intervention in the environment. It refers to the distance or surface area affected by the disturbance. Extent can be regional, local or isolated:

Regional: extent is considered regional when the intervention affects one or several environmental components at a considerable distance from the project or when it affects an area that is considered “regional” (region of Gaspé, in the case of the present project);

Local: extent is considered local when the intervention affects a relatively restricted area, a certain number of components of the same nature near the project or an area that is considered “local” (ex.: port of Gaspé or harbour, in the case of the present project);

Isolated: extent is considered isolated when the intervention affects only one environmental component near the project or when the disturbance is felt in a reduced or well-contained space on the site or in the area around the project.

Associating the extent of the effect and the pre-determined duration/intensity index helps determine the significance of the environmental effect, which can be qualified as major, medium or minor:

Major: major significance means that the effect is permanent and that it affects the integrity, diversity and sustainability of the component. A major effect considerably or irrevocably alters the quality of the environment;

Medium: medium significance means considerable repercussions on the affected component, leading to a partial alteration of its nature and use, without affecting its sustainability;

Minor: minor significance means reduced repercussions on the affected component, leading to a minor alteration of its quality and use.

The significance of the effect is determined based on the assessment grid in Table 13.

TABLE 13: EFFECT SIGNIFICANCE ASSESSMENT GRID[16]

Extent	Duration/intensity index		
	High	Medium	Low
Regional	Major	Major	Medium
Local	Major	Medium	Minor
Isolated	Medium	Minor	Minor

6.2 Mitigation Measures and Residual Environmental Effects

After identifying and assessing the environmental effects, mitigation measures are identified to reduce their significance. These measures aim to diminish or correct the negative effects in order to better integrate the project in its environment.

Applying mitigation measures allows the significance of the environmental effects to be reassessed. They subsequently become **residual environmental effects**, or the effect that remains after the mitigation measures have been applied. The two types of residual effects that can remain are “significant” or “non-significant”:

Non-significant residual effect: residual effect that is deemed of medium or minor significance based on the grid in Table 13;

Significant residual effects: despite the application of mitigation measures, the residual effect remains of major significance, based on the grid in Table 13.

[16] According to the CEAA, an effect can be *significant* or *non-significant.* An effect of major significance will be qualified as significant and an effect of medium or minor significance will be qualified as non-significant. These two categories will be used to determine the significance of the residual effects.

7 ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

7.1 Identification of the Project's Potential Effects

The project's potential effects were identified based on the grid in Table 14. It presents the components that were included in the description of the environment (x axis) (see Chapter 5) and the activities tied to the project execution steps (y axis) (see Section 2.4).

In identifying the potential effects, the following factors were considered:

- Technical characteristics of the project and planned work methods;
- Knowledge of the area;
- Information taken from similar projects;
- The population's concerns about the project.

7.2 Assessment of the Project's Potential Effects

As mentioned in Chapter 6, assessing an effect involves determining its significance based on three parameters: intensity (relating the environmental value of the components with the expected degree of disturbance), the duration of the effect and its extent.

The following sections describe the rationale for the value attributed to the environmental components. There are four environmental value levels: very high, high, medium and low. Value is determined based on the opinion of experts as well as the social value demonstrated by popular, legal and political interest in the component.

7.2.1 Environmental Value of the Components

Air Quality

Air quality refers to dust and contaminants generated by transportation and the circulation of vehicles and machinery as well as excavation and earthwork. It also refers to odour emitted from the sediment during handling due to the release of gas produced by anaerobic degradation. As the work will be carried out in an industrial environment, this component was given a *medium* environmental value.

TABLEAU 14 : IDENTIFICATION DES EFFETS POTENTIELS DU PROJET AVANT L'APPLICATION DES MESURES D'ATTÉNUATION

√ = effet négatif potentiel + = effet positif	SOURCES D'EFFETS ENVIRONNEMENTAUX																						
	Phase de pré-travaux									Phase de réalisation des travaux								Phase de post-travaux					
COMPOSANTES ENVIRONNEMENTALES	Mobilisation de l'entrepreneur et installation du chantier	Transport des équipements et des matériaux	Établissement de l'état de référence environnementale	Aménagement d'un débarcadère et d'un chemin temporaires	Aménagement de l'aire ou de l'unité d'assèchement	Aménagement du dispositif d'entreposage et de traitement des eaux	Préparation de l'aire d'entreposage des sédiments asséchés ou traités	Renforcement des chemins temporaires	Aménagement de l'unité de traitement des sédiments	Dragage des sédiments	Transport entre la zone de dragage et l'aire de déchargement à terre	Transport des sédiments vers le bassin ou l'unité d'assèchement	Assèchement des sédiments	Gestion des effluents liquides	Transport des sédiments asséchés vers la surface d'entreposage	Traitement des sédiments	Transport et gestion finale des sédiments	Démantèlement du débarcadère et du chemin temporaires	Démantèlement des bassins ou de l'unité d'assèchement	Démantèlement de l'unité de traitement	Remise en état des lieux terrestres	Vérification de l'état environnemental des lieux suite aux travaux	Démobilisation de l'entrepreneur
MILIEU PHYSIQUE																							
Qualité de l'air	√	√		√	√	√	√	√	√	√		√	√		√	√	√	√	√	√	√		√
Surface du sol	√		√	√	√	√	√	√	√												√	√	
Qualité du sol et des sédiments	√	√	√	√						√ et +		√	√	√	√	√ et +	√	√	√	√	+	√	
Profil et pentes d'équilibre				√	√	√	√			√													
Qualité des eaux de surface et souterraines			√	√						√	√		√	√		√		√				√	
Conditions hydrauliques et sédimentologiques				√						√								+					
MILIEU BIOLOGIQUE																							
Végétation terrestre, riveraine et aquatique			√	√	√	√	√			√													
Poisson et son habitat				√						√	√							+					
Faune aquatique (autres) et son habitat				√						√	√							+					
Faune et habitat terrestre	√			√	√	√	√																
Habitats riverains				√						√								√					
Espèces en péril, menacées, vulnérables ou susceptibles d'être ainsi désignée																							
MILIEU HUMAIN																							
Climat sonore (espace résidentiel)	√	√	√	√	√	√	√	√	√	√		√			√	√	√	√	√	√	√	√	√
Activités commerciales et industrielles					√	√	√			√		√					√						
Pêche et aquaculture										√													
Activités récréotouristiques																							
Sécurité du public et des usagers	√	√		√	√	√	√	√	√	√		√	√		√	√	√	√	√	√	√		√
Paysage																							
Infrastructures commerciales et industrielles										√													
Réseaux routier et ferroviaire	√	√		√				√				√			√		√						√
Navigation		√		√						√	√						√						

Ground Surface

The ground surface is made up of the upper soil horizon. Some work will strip the organic horizon and the movements of machinery or vehicles will compact the horizons left in place. Denuded soil is more vulnerable to water erosion and the lack of organic horizon makes plant recolonization more difficult. As the work area is mainly used for industrial purposes, this component was given a *low* environmental value.

Soil and Sediment Quality

Soil and sediment quality is determined based on the soil or sediment's natural physicochemical characteristics. For example, an abnormal concentration of a chemical component in the soil or sediment can alter its quality, with possible repercussions on flora, fauna and human activities. The quality of the soil or sediment can be altered by the accidental spillage of petroleum or other products during the fuelling of vehicles and machinery. As the work zone is mainly used for industrial purposes and the sediment in the intervention area is of poor quality, this component was given a *low* environmental value.

Equilibrium Profile and Slopes

The equilibrium profile and slopes refer to the property's natural topography and soil stability during and after the work. Excavation and earthwork change the equilibrium slope and water conditions. It is therefore important to level the soil and build stable side slopes to prevent erosion. Due mainly to concerns about the stability of the banks during the construction of the dewatering basin and the stability of the shore in the intervention area, this component was given a *medium* environmental value.

Surface and Groundwater Quality

Surface and groundwater quality is a component that includes all of the physicochemical characteristics of the harbour (more specifically the intervention area) and the underground water table. This component is valued due to the water's associated uses, and with regard to aquaculture activities practiced in the study area. It must be noted that there are no wells or potable water intakes in the intervention area and that swimming is not practiced there. Surface and groundwater quality was therefore given a *medium* environmental value.

Hydraulic and Sedimentological Conditions

Hydraulic and sedimentological conditions include different parameters that designate the characteristics of flow (water depth, flow velocity, etc.) and the transportation of sediment in the intervention area. Given their possible effect on bank stability and modification of the aquatic habitat, but also due to low currents in the intervention area, these parameters were given a *medium* environmental value.

Riparian and Aquatic Vegetation

Riparian and aquatic vegetation plays a key role in stabilizing the banks and seabed. Several wildlife species (ichtyofauna, benthic invertebrates, herpetofauna, avifauna and mammals) also use it as spawning, feeding and rearing grounds. Riparian vegetation is mainly found in the salt marshes and upland meadow of the Sandy Beach sand bar and the Penouille peninsula. These are located over 2 km from the intervention area. As for aquatic vegetation, the intervention area contains four types: sea cabbage, eelgrass, mixed and brown algae. These seagrass beds are part of a larger bed that spreads about 2.5 km from the wharf to the Sandy Beach sand bar. This component was given a *high* environmental value.

Terrestrial Vegetation

Terrestrial vegetation is mainly found on the properties south of the former site of Xstrata's sulphuric acid storage tanks and also south of the shipyard (uncultivated plants and shrubs as well as an uncultivated stand of shade-intolerant hardwoods). This gives the industrial environment a natural aspect that is valued by the population. However, the terrestrial vegetation does not have any exceptional characteristics. This component was therefore given a *medium* environmental value.

Fish and its Habitat

The Gaspé harbour is a productive and diverse environment, in which demersal species are more abundant than pelagic species, namely: anadromous brook trout, Atlantic salmon, smelt, herring and mackerel. However, the intervention area is not a choice habitat for most fish species living in the bay of Gaspé. In fact, the seabed being agitated by the propulsions systems of boats may be a constraint in maintaining an environment that can support, in a stable and sustained manner, the breeding and rearing activities essential to the survival or production of a fish stock. That being said, it remains an environment that is frequented by certain species of fish and is conducive to feeding. It should be noted that no spawning grounds or sites of annual juvenile concentrations are found in the intervention area. This component was given a *high* environmental value.

Other Aquatic Wildlife and its Habitat

Other aquatic wildlife includes benthic invertebrates, marine mammals and aquatic birds that live in the harbour. From the bay of Gaspé, the harbour is a productive and diverse environment, with experts and fishers agreeing on the importance of the identified species. The intervention area is used by common benthic invertebrates (rock crab, American lobster, blue mussel, sea scallop), but few marine mammals and aquatic birds. Nonetheless, this component was given a *high* environmental value.

Riparian Habitats

Riparian habitats are formed by the harbour and its shores. They are home to aquatic birds as well as herpetofauna. It is important to remember that the intervention area is not a choice habitat for most species living in the bay of Gaspé. This is due to the seabed being agitated by the propulsions systems of boats, which may be a constraint in maintaining an environment that can support, in a stable and sustained manner, the breeding and rearing activities essential to the survival or production of a fish stock. That being said, it remains an environment that is frequented by certain species of fish and is conducive to feeding. Both experts and fishers agree on the importance of the habitat and the species they support, which is why this component was given a *high* environmental value.

Terrestrial Wildlife and its Habitat

Terrestrial wildlife and its habitat include known and potential wildlife species and habitats, including forest birds and mammals and their environment. Given that the environment is greatly disturbed by anthropogenic activities in the intervention area, this component was given a *low* environmental value.

Special Status Plant and Wildlife Species

Special status plant and wildlife species include species that are designated threatened or vulnerable or likely to be so designated, as well as species at risk. Due to their interest by experts and the protection provided by legislation, this component was given a *very high* environmental value.

Sound Climate

Sound climate covers all noise generated by commercial and industrial activities carried out in the Port of Gaspé – Sandy Beach, as well as by traffic on nearby Route 132. It must be noted that the work will be carried out in an industrial sector and that the dominant winds blow seaward from September to March, which could reduce noise perception by people living and working upstream. Due to the presence of several residences on the port site itself and along Route 132 (residences overlooking the port site), this component was given a *medium* environmental value.

Commercial and Industrial Activities

Commercial and industrial activities include the use of the commercial wharf (namely by Ultramar and Construction DJL boats, the Canadian Coast Guard boat and fishing and aquaculture boats) and all activities taking place at the Port of Gaspé – Sandy Beach. As it is directly related to the companies' operation, this component was given a *high* environmental value.

Navigation

Navigation activities mainly include the daily outings of several fishing boats and boats used for mussel farming. Besides these, the Coast Guard docks at the wharf on a weekly basis while the Ultramar and Construction DJL boats dock approximately twice a month. These ships require free access to the port facilities and sufficient space for docking and undocking. This component was given a *high* environmental value.

Fishing and Aquaculture

Commercial lobster fishing and mackerel, capelin, sea trout and rainbow smelt fishing are practiced in the Gaspé harbour. The study area also includes several mussel farming sites. This component was given a *high* environmental value due to the local economy generated by these activities as well as the enjoyment and relaxation sport fishing provides.

Recreational and Tourist Activities

Recreational and tourist activities cover activities carried out in the study area, such as bicycling (on the Route verte du Québec, located in the southern part of the intervention area), pleasure boating, cruises, sea kayaking, windsurfing, kite boarding, scuba diving, swimming (on the beaches of Penouille and the Sandy Beach sand bar), as well as hiking and flora and fauna observation on the Penouille peninsula and the Sandy Beach sand bar. These activities, carried out in a natural setting, are valued by the population for the pleasure and relaxation they provide. That is why this component was given a *high* environmental value.

Public and User Safety

Public and user safety was given a *very high* environmental value due to its impact on the population's well-being and quality of life. Activities related to the remediation work, namely transportation and traffic, may affect public safety.

Landscape

The landscape is comprised of an industrial unit (port) and the Gaspé harbour, which is appreciated by the population. The presence of vegetation south of the former site of Xstrata's sulphuric acid storage tanks and the shipyard (uncultivated plants and shrubs as well as an uncultivated stand of shade-intolerant hardwoods) and the water contribute to the natural aspect of this component, within an industrial area. Landscape was therefore given a *medium* environmental value.

Commercial and Industrial infrastructures

Commercial and industrial infrastructures include the commercial wharf, the Forillon shipyard's slipway, the seawater intake for the lobster pound and underground pipes and tanks used by Ultramar and Irving to transport and store their petroleum products. They also include the City of Gaspé's wastewater treatment plant and several administrative, commercial and industrial buildings. These infrastructures are necessary to keep the activities and companies running smoothly. This component was therefore given a *high* environmental value.

Road and Rail Networks

Road and rail networks include roadways (Route 132 and Quai, Cotton, du Chantier-Maritime and Quigley streets) and the *Corporation du chemin de fer de la Gaspésie*'s railways. These networks are required for the smooth operation of commercial and industrial activities and are given a *high* environmental value.

The environmental values given to the components are summarized in Table 15.

TABLE 15: ENVIRONMENTAL VALUE ATTRIBUTED TO THE ENVIRONMENTAL COMPONENTS

Environmental component	Environmental value
Physical environment	
Air quality	Medium
Ground surface	Low
Soil and sediment quality	Low
Equilibrium profile and slopes	Medium
Surface and groundwater quality	Medium
Hydraulic and sedimentological conditions	Medium
Biological environment	
Riparian and aquatic vegetation	High
Terrestrial vegetation	Medium
Fish and its habitat	High
Aquatic wildlife (other) and its habitat	High
Terrestrial wildlife and its habitat	Low
Riparian habitats	High
Special status plant and wildlife species	Very high
Human environment	
Population and land use	
Sound climate (residential space)	Medium
Commercial and industrial activities	High
Navigation	High
Fishing and aquaculture	High
Recreational and tourist activities	High
Public and user safety	Very high
Landscape	Medium
Infrastructures	
Commercial and industrial infrastructures	High
Road and rail networks	High

7.2.2 Summary of the Environmental Effects Analysis

Table 16 presents a summary of the analysis of the potential environmental effects, mitigation measures and assessment of residual effects that could remain after mitigation measures are applied in the framework of the Port of Gaspé – Sandy Beach sediment remediation project.

The following subsections give a more detailed description of the project’s two main impacts, which are associated with the dredging work required in the framework of the Port of Gaspé sediment remediation project: the resuspension of potentially contaminated sediment and the destruction of habitats used by fish and other aquatic species.

7.2.2.1 *Sediment Resuspension*

Sediment could be resuspended during the dredging work when the clamshell bucket impacts the seabed or penetrates the layer of sediment, when sediment is returned to the environment as the bucket is raised or from the barge overflow (mechanical dredging) or due to the action of the cutterhead on the hydraulic dredger. The impacts associated with sediment resuspension are:

- Increase in suspended particulate matter (SPM) concentrations in the water column, and;
- Transportation of the contaminant (copper and PAH) in the water column.

These two impacts could also have indirect effects on the quality of the habitat used by fish and other aquatic species, as well as on mussel and scallop farming activities presently carried out in the bay of Gaspé. Mussels feed by filtration and may bioaccumulate the contaminants carried by the water. The higher concentration of SPM may also affect respiration (deposits on the gills).

As defined in Table 16, this impact was nonetheless categorized as isolated and of minor importance, mainly due to the results of the numerical modeling conducted by Groupe-Conseil Lasalle on the dispersal of the dredged sediment (2010). The results show that the majority of the particles (over 54%) are composed of coarse sand and silt that would settle in the immediate area around the dredger. The finer silt particles and all the clay represent a relatively small volume, thus favouring their dilution and quickly lowering SPM and contaminant concentrations below allowable levels. The results also show that the plume generated by the work, when the dredge is not sheltered by the wharf, does not exceed 900 m in length and that this distance is reduced by at least half when the dredge is sheltered from currents by the wharf.

General good job site management practices and the more specific measures presented in Section 7.3.1.4 are considered sufficient to ensure that sediment resuspension is no more than an non-significant residual impact.

7.2.2.2 *Destruction of the Habitat Used by Fish and Other Aquatic Species*

The destruction of the habitat used by fish and other aquatic species is directly related to the dredging work, which will disturb the sediment and lead to the loss of the seagrass beds in the work area (52 106 m^2, approximately 87% of the total surface area to be dredged). The destruction is also indirectly related to the deposit of suspended matter in areas seaward of the work area. For fish specifically, these sea beds can be used as rearing and feeding grounds by species likely to be found in the work area, namely brook trout, capelin, smelt, mackerel, herring, American sand launce, various stickleback species, mummichog, silverside, tomcod, sculpin, rock gunnel, smooth and winter flounder, banded killfish, white hake and American eel.

The habitats of fish and other aquatic species that will be destroyed during the dredging work represent a 59 714 m^2 surface area (100% of the dredged surface area), corresponding to the boundary of the dredging area illustrated in Figure 8, for a total volume of 37 700 m^3. In addition to general good job site management practices and the more specific mitigation measures described in sections 7.3.2.1 and 7.3.2.2, a compensation project is planned for this surface area, as presented in Section 7.4.

As for the deposit of suspended particles in the areas seaward of the work area, general good job site management practices and the more specific measures presented in Section 7.3.1.4 will limit the deposit of suspended particles on existing habitats located downstream of the work area, for the same reasons given in the previous subsection (Groupe-Conseil Lasalle modeling study (2010)).

Applying these measures and the compensation project will help ensure that the dredging-related destruction of the habitat used by fish and other aquatic species is no more than a non-significant residual impact.

7.3 Mitigation Measures

The mitigation measures aim to diminish or correct the project's potential environmental effects. Mitigation can include modifying the project's planning, design, engineering or management. However, it is important to note that this project was designed to reduce, to the extent possible, any negative environmental effects on the receiving environment.

The identification of the mitigation measures presented in this section refer to the physical (P), biological (B) and human (H) environments.

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
PRE-WORK	Contractor mobilization and site setup	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the work to prepare the material storage area and vehicle and machinery parking, washing and fuelling areas.	Low	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
				Alteration of the natural drainage due to the circulation of vehicles and machinery.	Low	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Biological	Wildlife and terrestrial habitat	Disturbance of the terrestrial habitat and wildlife due to the clearing and levelling work required to prepare the job site.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.2.3	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of accidents caused by general job site activities and the circulation of machinery.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
			Road and rail networks	Disruption of traffic on the public roads (Route 132 and Rue du Quai) and on the access roads at the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant
	Transportation of equipment and material	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
			Road and rail networks	Disruption of traffic on the public roads (Route 132 and Rue du Quai) and on the access roads at the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant
			Navigation	Possible disruption of local navigation and possible wharf access conflicts due to the transhipment of equipment and material at the wharf and the circulation of boats used for the project.	High	Medium	High	Momentary	Medium	Isolated	Minor	See Section 7.3.3.6	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
PRE-WORK	Setting the environmental baseline	Physical	Ground surface	Alteration of the ground surface during characterization work carried out to set the baseline.	Low	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Soil and sediment quality	Risk of soil contamination by the machinery used to take the soil samples.	Low	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Surface and groundwater quality	Risk of groundwater contamination by the machinery used for the soil and groundwater characterization when digging a trench or installing an observation well.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Biological	Terrestrial vegetation	Damage to the terrestrial vegetation when installing characterization equipment and digging trenches.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.2.1	Non-significant
		Human	Sound climate	Increase in noise level due to the operation of the machinery and boring equipment used to characterize the soil and groundwater.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
	Construction of a temporary landing pier and road	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the work to prepare a surface course and a connection to the existing roads.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
				Alteration of the natural drainage due to the circulation of the vehicles and machinery.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Equilibrium profile and slopes	Alteration of the profile during the work to build the landing pier.	Medium	High	Medium	Temporary	Medium	Isolated	Minor	None	Non-significant
			Surface and groundwater quality	Risk of contaminating the water in the harbour due to oil or other contaminants leaking or being accidentally spilled from the machinery used to build the temporary pier.	Medium	Medium	Medium	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Hydraulic and sedimentological conditions	Risk of altering the currents around the temporary landing pier.	Medium	Medium	Medium	Temporary	Low	Isolated	Minor	None	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
PRE-WORK	Construction of a temporary landing pier and road	Biological	Riparian and aquatic vegetation	Destruction of aquatic and riparian vegetation during the construction of the landing pier.	High	High	High	Temporary	High	Isolated	Medium	None	Non-significant
			Fish and their habitat	Possible disturbance of fish species and temporary loss of habitat surface area due to the construction of the landing pier.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.2.2	Non-significant
			Aquatic wildlife (other) and their habitat	Possible destruction of less mobile wildlife species and temporary loss of habitat surface area due to the construction of the landing pier.	High	High	High	Temporary	High	Isolated	Medium	See Section 7.3.2.2	Non-significant
			Wildlife and terrestrial habitat	Disturbance due to noise generated by the construction equipment and the cutting of trees and shrubs (if necessary).	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.2.3	Non-significant
			Riparian habitats	Disturbance of the riparian habitats during the construction of the landing pier.	High	High	High	Temporary	High	Isolated	Medium	None	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of accidents caused by general job site activities and the circulation of machinery.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
			Landscape	Deterioration of the visual aspect due the presence of the construction site for the temporary landing pier and road.	Medium	Low	Low	Temporary	Low	Isolated	Minor	None	Non-significant
			Road and rail networks	Disruption of traffic on Rue du Quai and the access roads on the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant
			Navigation	Disruption of navigation during the work to build the landing pier.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.6	Non-significant
	Setup of the dewatering area and unit	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery, construction equipment and the dewatering unit.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the work to excavate the basin and build the related banks and ditches.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Equilibrium profile and slopes	Alteration of the profile during the excavation work.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.3	Non-significant
		Biological	Terrestrial vegetation	Destruction of terrestrial vegetation during the work to excavate the basin or prepare the surfaces required for the dewatering unit.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.2.1	Non-significant
			Wildlife and terrestrial habitats	Disturbance due to noise generated by the construction equipment, the cutting of trees and shrubs (if necessary) and the operation of a dewatering unit.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.2.3	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
PRE-WORK	Setup of the dewatering area and unit	Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery, construction equipment and the dewatering unit, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Commercial and industrial activities	Occupation of significant surface areas that can no longer be accessed for commercial or industrial activities for the duration of the work.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.2	Non-significant
			Public and user safety	Risk of accidents caused by general job site activities and the circulation of machinery.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
	Setup of the water storage and treatment system	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the work to excavate the water storage and treatment system and build the related banks and ditches.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Equilibrium profile and slopes	Alteration of the profile during the excavation work.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.3	Non-significant
		Biological	Terrestrial vegetation	Destruction of terrestrial vegetation during the work to excavate the water storage and treatment system.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.2.1	Non-significant
			Wildlife and terrestrial habitat	Disturbance of the terrestrial wildlife and habitats due to noise generated by the construction equipment and the cutting of trees and shrubs (if necessary).	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.2.3	Non-significant
	Setup of the water storage and treatment system	Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Commercial and industrial activities	The storage area for the dewatered sediment will occupy a surface area that can no longer be accessed for commercial or industrial activities for the duration of the work.	High	Low	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.3.2	Non-significant
			Public and user safety	Risk of accidents caused by general job site activities and the circulation of machinery.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
PRE-WORK	Preparation of the dewatered and treated sediment storage area	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the levelling work to prepare the storage area.	Low	Medium	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Equilibrium profile and slopes	Alteration of the profile during the levelling work required to prepare the storage area.	Medium	Medium	Medium	Momentary	Low	Isolated	Minor	None	Non-significant
		Biological	Terrestrial vegetation	Destruction of terrestrial vegetation during the levelling work to prepare the storage area.	Medium	Medium	Medium	Momentary	Low	Isolated	Minor	See Section 7.3.2.1	Non-significant
			Wildlife and terrestrial habitat	Disturbance of the terrestrial wildlife and habitats due to noise generated by the construction equipment and the cutting of trees and shrubs (if necessary).	Low	Medium	Low	Momentary	Low	Isolated	Minor	See Section 7.3.2.3	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Commercial and industrial activities	The storage area for the dewatered sediment will occupy a surface area that can no longer be accessed for commercial or industrial activities for the duration of the work.	High	Low	Medium	Momentary	Low	Isolated	Minor	See Section 7.3.3.2	Non-significant
	Reinforcement of the temporary roads	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the work to reinforce and level the existing roads.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
			Road and rail networks	Disruption of traffic on Rue du Quai and on the access roads at the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
PRE-WORK	Setup of the sediment treatment unit	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration of the ground surface during the levelling work to set up the treatment unit.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of accidents during the site setup work and due to the circulation of machinery.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
WORK EXECUTION	Sediment dredging	Physical	Air quality	Emission of air pollution due to the operation of the machinery.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
				Possible emission of odours due to handling of the sediment, caused by the release of gas produced by anaerobic degradation (smell of sulphur).	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of sediment contamination due to oil or other contaminants leaking or being accidentally spilled from the machinery used to install the turbidity curtains and dredge the sediment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Risk of contaminating the uncontaminated sediment due to the dispersal and deposit of contaminated sediment.	Low	Medium	Low	Permanent	Medium	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Equilibrium profile and slopes	Alteration of the harbour's bottom profile in the dredging area (the equilibrium slope of the escarpments will be preserved, however, slope 3:1).	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	None	Non-significant
			Surface and groundwater quality	Risk of contaminating the water in the harbour due to oil or other contaminants leaking or being accidentally spilled from the machinery used to install the turbidity curtains and dredge the sediment.	Medium	Medium	Medium	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Resuspension of the sediment when the clamshell bucket impacts the seabed or penetrates the layer of sediment, in the event that sediment is returned to the environment when the bucket is raised or from the barge overflow (mechanical dredging) or due to the action of the cutterhead (hydraulic dredging).	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Resuspension of the sediment due to perforation of the pipe used to transport the dredged sediment to a sedimentation site (hydraulic dredging).	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Hydraulic and sedimentological conditions	Risk of altering the currents in the dredging area due to changing the harbour's bottom profile.	Medium	Low	Low	Temporary	Low	Isolated	Minor	None	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
WORK EXECUTION	Sediment dredging	Biological	Riparian and aquatic vegetation	Destruction of aquatic and riparian vegetation during the installation of the turbidity curtains and during dredging.	High	High	High	Temporary	High	Isolated	Medium	See Section 7.3.2.1 et 7.4	Non-significant
			Fish and their habitat	Disturbance and/or death of fish present in the aquatic vegetation during the dredging work. Destruction of the fish habitat due to the loss of the seagrass beds in the work sector and the deposit of suspended particles in the sectors seaward of the work area.	High	High	High	Temporary	High	Isolated	Medium	See Section 7.3.2.2 et 7.4	Non-significant
			Aquatic wildlife (other) and their habitat	Disturbance and/or death of benthic invertebrates present in the sediment or aquatic vegetation during the dredging work. Destruction of their habitat due to disturbing the sediment, the loss of the seagrass beds in the work sector and the deposit of suspended particles in the sectors seaward of the work area.	High	High	High	Temporary	High	Isolated	Medium	See Section 7.3.2.2	Non-significant
			Riparian habitats	Disturbance of riparian habitats during the installation of the turbidity curtains and during dredging.	High	Medium	High	Temporary	High	Isolated	Medium	None	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Commercial and industrial activities	Disruption of transhipping activities at the commercial wharf during dredging.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.2	Non-significant
			Fishing and aquaculture	Conflict over use of the space south of the commercial wharf during dredging.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.2	Non-significant
			Public and user safety	Risk of accident (overturning, drowning) due to the circulation of barges and different craft used for site supervision.	Very high	Low	Medium	Temporary	Medium	Isolated	Medium	See Section 7.3.3.3	Non-significant
			Commercial and industrial infrastructures	Risk of damaging the shipyard's slipway.	High	High	High	Temporary	High	Isolated	Medium	See Section 7.3.3.4	Non-significant
				Risk of contaminating the water intake for the lobster pound with suspended particulate matter.	High	High	High	Temporary	High	Isolated	Medium	See Section 7.3.3.4	Non-significant
			Navigation	Disruption of local navigation due to the presence of the dredging area and activities.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.6	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
WORK EXECUTION	Transporting the sediment between the dredging area and the offloading to shore area	Physical	Surface water quality	Risk of contaminating the surface water due to the contaminated sediment spilling from the barge or an accidental petroleum hydrocarbon leak from the boat.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Biological	Fish and their habitat	Possible disturbance of the fish species and their habitat due to the movements of the boats and the possible spilling of contaminated sediment.	High	Low	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.2.2	Non-significant
			Aquatic wildlife (other) and their habitat	Possible disturbance of the habitat used by other aquatic species due to the possible spilling of contaminated sediment.	High	Low	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.2.2	Non-significant
		Human	Navigation	Possible disruption of day-to-day port activities by the additional circulation of boats used to transport the dredged sediment to the wharf and for its transhipment.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.6	Non-significant
	Transporting the sediment to the dewatering basin or unit	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
				Possible emission of odours due to handling of the sediment, caused by the release of gas produced by anaerobic degradation (smell of sulphur).	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the construction equipment or dredged sediment being spilled.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Risk of soil contamination due to the spilling of contaminated sediment during transhipment, perforation of the pipe used to transport the sediment to the dewatering basin (hydraulic dredging) and transportation of the dredged sediment (mechanical dredging).	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Commercial and industrial activities	Disruption of transhipping activities at the commercial wharf during dredging.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.2	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
			Road and rail networks	Disruption of traffic on Rue du Quai and the access roads on the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
WORK EXECUTION	Sediment dewatering	Physical	Air quality	Possible emission of odours due to handling of the sediment, caused by the release of gas produced by anaerobic degradation (smell of sulphur).	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to the contaminants from the dewatering basin or unit migrating to the underground water table.	Medium	High	Medium	Temporary	Medium	Local	Medium	See Section 7.3.1.4	Non-significant
			Surface and groundwater quality	Risk of groundwater contamination due to the contaminants from the dewatering basin or unit migrating to the underground water table.	Medium	High	Medium	Temporary	Medium	Local	Medium	See Section 7.3.1.4	Non-significant
		Human	Public and user safety	Risk of falling from a height when working around the dewatering basin.	Very high	Low	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.3.3	Non-significant
	Management of the liquid effluent	Physical	Soil and sediment quality	Risk of soil contamination due to the leak or accidental spill of contaminated water.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Surface and groundwater quality	Risk of groundwater contamination due to the leak or accidental spill of contaminated water.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.4	Non-significant
	Transporting the dewatered sediment to the storage surface	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Risk of soil contamination due to sediment spilling during its transportation to the warehouse.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
			Road and rail networks	Disruption of traffic on Rue du Quai and the access roads on the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
WORK EXECUTION	Sediment treatment	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment and the use of heat treatments.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to the leak or accidental spill of contaminated water or a product required for treatment (solvents, acids, etc.).	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Reduction in sediment contamination level.	Low	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	None	Positive effect
			Surface and groundwater quality	Risk of groundwater and surface water contamination due to the leak or accidental spill of contaminated water or a product required for treatment (solvents, acids, etc.)	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery, construction equipment and treatment units, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of accidents caused by the operation of the machinery and chemical products used during the treatment of the sediment.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
	Sediment transportation and final management	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
				Risk of soil contamination due to sediment spilling during its transportation to the final disposal site.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Commercial and industrial activities	Possible disruption of port activities at the Gaspé - Sandy Beach wharf if boats are used to transport the sediment.	High	Medium	High	Temporary	High	Isolated	Medium	See Section 7.3.3.2	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
WORK EXECUTION	Sediment transportation and final management	Human	Road and rail networks	Disruption of traffic on the public roads (Route 132 and Rue du Quai) and on the access roads at the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant
			Navigation	Disruption of port activities at the Gaspé - Sandy Beach wharf if boats are used to transport the sediment (during transhipment).	High	Low	Medium	Momentary	Low	Local	Minor	See Section 7.3.3.6	Non-significant
POST-WORK	Dismantling of the temporary landing pier and road	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Medium	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Surface and groundwater quality	Risk of contaminating the water in the harbour due to oil or other contaminants leaking or being accidentally spilled from the machinery used.	Medium	Medium	Medium	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Hydraulic and sedimentological conditions	The dismantling of the landing pier will return the hydraulic conditions to their pre-work state.	Medium	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	None	Positive effect
		Biological	Fish and their habitat	The dismantling of the landing pier will favour the restoration of the fish habitat in the occupied sector.	High	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	None	Positive effect
			Aquatic wildlife (other) and their habitat	The dismantling of the landing pier will permit the recolonization of the sector occupied by other aquatic species.	High	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	None	Positive effect
			Riparian habitats	Disturbance of the riparian habitats during the dismantling of the landing pier.	High	Medium	High	Temporary	High	Isolated	Medium	None	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
	Dismantling of the dewatering basins or unit	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
POST-WORK	Dismantling of the treatment unit	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Soil and sediment quality	Risk of soil contamination due to oil or other contaminants leaking or being accidentally spilled from the heavy machinery and construction equipment.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public and user safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.3	Non-significant
	Reclamation of the terrestrial sites	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
			Ground surface	Alteration the ground surface during the work to restore the material storage area and vehicle and machine parking, washing and fuelling areas.	Low	Medium	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Soil and sediment quality	New soil samples will be taken to check the quality of the soil after the work is completed. Corrective measures will be implemented by the contractor if the soil is contaminated.	Low	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	None	Positive effect
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public safety	Risk of machinery and construction equipment-related accidents.	Very high	Low	Medium	Temporary	Medium	Isolated	Medium	See Section 7.3.3.3	Non-significant
	Verification of the environmental state of the sites following the work	Physical	Ground surface	Alteration of the ground surface during the characterization work to determine the site's environmental state.	Low	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.2	Non-significant
			Soil and sediment quality	Risk of soil contamination by the machinery used to take the soil samples.	Low	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
			Surface and groundwater quality	Risk of groundwater contamination by the machinery used for the soil and groundwater characterization work when digging a trench or installing an observation well.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.1.4	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of the machinery and boring equipment required to characterize the soil and groundwater.	Medium	Low	Low	Momentary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant

TABLE 16: SUMMARY OF THE ANALYSIS OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF THE PORT OF GASPÉ – SANDY BEACH SEDIMENT REMEDIATION PROJECT

Source of the environmental effect		Environmental effect			Value	Degree of disturbance	Intensity of the effect	Duration of the effect	Duration/ intensity index	Extent of the effect	Significance of the effect	Mitigation measures	Significance of the residual effect
Phase	Activity	Environment	Environmental component	Description									
POST-WORK	Contractor demobilization	Physical	Air quality	Emission of air pollution and dust due to the operation of heavy machinery and construction equipment.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.1.1	Non-significant
		Human	Sound climate (residential space)	Increase in noise level due to the operation of heavy machinery and construction equipment, added to the ambient sound levels.	Medium	Low	Low	Temporary	Low	Isolated	Minor	See Section 7.3.3.1	Non-significant
			Public safety	Risk of machinery-related accidents.	Very high	Low	Medium	Temporary	Medium	Isolated	Minor	See Section 7.3.3.3	Non-significant
			Road and rail networks	Disruption of traffic on the public roads (Route 132 and Rue du Quai) and on the access roads at the port site.	High	Low	Medium	Temporary	Medium	Local	Medium	See Section 7.3.3.5	Non-significant

7.3.1 Physical Environment

7.3.1.1 *Air Quality*

P1 Shut off construction equipment and trucks when not in use.

P2 Use machinery, equipment and vehicles in good operating condition to minimize the emission of atmospheric contaminants.

P3 During transportation, material containing fine particles must be covered with securely attached tarpaulins.

P4 If the contractor needs to use a dust-supressant (other than water), it must be certified by the *Bureau de normalisation du Québec.*

P5 Visually monitor dust emissions and take action to control these when needed.

P6 Set a 15 km/h speed limit on the job site.

P7 Prohibit the burning of waste in an open fire.

P8 Strictly limit the handling of the dredged sediment to reduce odour emissions. If the odours cause complaints, consider using chemical or biological neutralizing agents.

P9 If a heat treatment option is selected, ensure that the company has the necessary certificate of authorization to operate the technology and covers atmospheric emissions.

7.3.1.2 *Ground Surface*

P10 Strictly limit stripping, clearing, excavating, backfilling and levelling in the work areas in order to respect the site's natural topography and prevent erosion.

P11 Ensure that measures are taken to limit the erosion of the denuded soil and excavated material generated during the pre-work phase to keep suspended matter from reaching the harbour. If necessary, cover the denuded surfaces or piles of material.

P12 Avoid creating ruts and compacting the soil, which reduces runoff of the surface water and its infiltration in the soil, by using vehicles adapted to the bearing capacity of the ground and avoiding driving over wet ground. Limit the use of heavy machinery on erodible, fragile, sloping ground or ground with a low load-bearing capacity.

P13 Direct the runoff and drainage water so that it bypasses erosion-sensitive areas. If these areas cannot be avoided, erect some type of protection (berm, diversion trench, etc.).

7.3.1.3 *Equilibrium Profile and Slopes*

P14 The slopes of the basins' excavation trench and the landing pier's backfill must be designed to minimize the risk of collapse (slight slope).

P15 After dismantling the dewatering basin, level the work area and excavated material storage area in accordance with the environment's initial topography. Restore the drainage and stabilize erosion-sensitive areas.

7.3.1.4 Soil and Sediment Quality/Surface and Groundwater Quality

General

P16 At the commencement of the work, the contractor must present an emergency response plan in the event of an accidental contaminant spill (other than the dredged material). Ensure that the plan contains, at minimum, a response diagram and notification structure and is placed in an easily accessible location in plain view of all workers.

P17 Have the necessary response equipment on hand in the event of an accidental contaminant spill, including a catchment device for free-floating material that can be quickly deployed, such as booms (in the event of petroleum product spills), as well as silt fences and/or hay bales (to contain contaminated sediment accidentally spilled on the ground and prevent fine particles from the erosion of temporary piles of excavated material and reworked sectors from migrating toward terrestrial and aquatic areas).

P18 Continuously supervise all handling of fuel, oil, other petroleum products or contaminants, including transfilling, to avoid accidental spills.

P19 In the event of a spill, immediately notify the people responsible. Also immediately notify Environment Canada's emergency service (1-866-283-2333) and *Urgence Environnement du Québec* (1-866-694-5454) for a land spill and/or the Canadian Coast Guard – marine pollution (1-800-363-4735) for a spill in the bay or harbour.

P20 Do not dispose of debris, waste, garbage, materials, etc. in the harbour and take measures to prevent all contamination of the hydrous environment.

Terrestrial Environment

P21 Before the work begins, identify a machinery maintenance and hazardous material handling and storage area. This site must be at least 30 m from the shore.

P22 Plan for the implementation of works and measures (geomembrane, leachwater catchment system, etc.) to ensure the watertightness of the basins and thus keep contaminants from migrating toward the underlying soil and water table.

P23 Store, dispose of or treat the water from the dewatering unit, truck washing area and treatment system in accordance with the legislation in force.

P24 Keep the construction equipment and trucks in perfect operating condition. Conduct a daily check for contaminant leaks (oil, etc.) on the material and repair any mechanical problems immediately.

P25 On a daily basis, collect and sort the different waste that is generated, according to whether it is recoverable residual material, residual material to be sent for disposal within the meaning of the *Règlement sur l'enfouissement et l'incinération des matières résiduelles* or hazardous residual material (HRM) within the meaning of the *Règlement sur les matières dangereuses* in effect.

P26 If, during the excavation work, the soil shows any signs of contamination (stains, odour, presence of debris, etc.), immediately stop the work and notify the site supervisor.

P27 Manage the contaminated soil and excavated material in sites authorized by the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), in accordance with the *Politique de protection des sols et de réhabilitation des terrains contaminés* and the *Règlement sur l'enfouissement des sols contaminés* (RESC).

P28 A copy of all weight tickets issued at the different disposal, treatment or valorization sites must be submitted to the site supervisor.

P29 The transportation of the contaminated soil must respect the *Règlement sur le transport des matières dangereuses* (provincial regulation) and the *Transportation of Dangerous Goods Regulations* (federal regulation).

Aquatic Environment

P30 Whenever possible, install a turbidity curtain to limit the dispersal of the mechanically dredged material and ensure that the contractor is capable of repairing the curtains onsite, if needed, in a short timeframe.

P31 Visually supervise in real time and monitor the concentration of suspended particulate matter (SPM) generated by the work in the water outside the turbidity curtains.

P32 The contractor must adjust the speed at which the bucket is raised to the surface and out of the water to reduce the loss of material as much as possible. The contractor will be informed of the importance of working carefully. The contractor must also avoid needlessly resuspending disturbed sediment, namely by refraining from making abrupt movements, levelling the seabed with the bucket (mechanical dredging) or creating ripple marks (hydraulic dredging).

P33 The contractor must suspend the dredging work in inclement weather (storms, violent winds) to limit sediment dispersal.

P34 The barges used to transport the excavated material must be watertight to prevent the loss of material during transportation. During the dredging operations, the contractor must refrain from emptying the barge overflow into the environment, which would release sediment-laden water into the dredging area.

P35 If the sediment is treated, ensure that the selected company has the necessary certificate of authorization to operate the technology, which covers liquid effluents, before the work is set to begin.

7.3.2 Biological Environment

7.3.2.1 Terrestrial, Riparian and Aquatic Vegetation

B1 Do not, under any circumstances, overstep the project's right-of-way and take particular care with trees and shrubs in close proximity to the work area.

B2 Limit tree removal (if necessary) and brush clearing in the project's right-of-way.

B3 Limit encroachment on the riparian and marine environments when planning the temporary works required for the project.

B4 Do not drive on the strip under the crowns of trees and shrubs near the work area and protect these by installing snow fences, a ring of planks or any other protection considered to be effective.

B5 When the work is complete, encourage the return of vegetation by planting the denuded surfaces (namely the dewatering basin) with indigenous species (shrubs and herbaceous plants) compatible with the environment.

7.3.2.2 *Fish, Other Aquatic Wildlife and its Habitat*

B6 If the intervention area is to be confined, take the necessary measures (ex. hitting the surface of the water with the bucket of the mechanical shovel) to scare the fish and thus prevent them from becoming trapped in the enclosure. If needed, use fishing gear (seine nets or gillnets) to capture any live fish trapped in the dredging area and release them in open water. Obtain the necessary permits from Fisheries and Oceans Canada before making such catches.

B7 In order to protect the aquatic habitats that may be used as feeding or rearing grounds by numerous species, the contractor must respect the following restriction periods, during which dredging work is prohibited:

- Brook trout: May 15th to June 30th;
- Rainbow smelt: May 15th to June 30th;
- Capelin: May 15th to June 30th.

7.3.2.3 *Wildlife and Terrestrial Habitat*

B8 Do any clearing work (if necessary) before the breeding and brooding period for forest bird species, usually between May 1st and August 1st.

7.3.3 Human Environment

7.3.3.1 *Sound Climate (Residential Space)*

H1 Ensure that all of the machinery and equipment that is used respects the standards for sound levels.

7.3.3.2 *Commercial and Industrial Activities/Fishing and Aquaculture*

H2 Implement an information program for wharf users (commercial and industrial boats, the Canadian Coast Guard and fishing and aquaculture boats). The contractor must keep the wharfinger informed of project activities and notify this person, in advance and on a regular basis, of the progress and nature of the work.

H3 Maintain the conditions required for the use of the commercial wharf (by commercial and industrial boats, the Canadian Coast Guard and fishing and aquaculture boats).

H4 Ensure that the surface areas of the sites selected for the installation of basins and other equipment to dewater and/or treat the sediment do not interfere with existing commercial and industrial activities, the expansion of a business or setup of a new business.

H5 If necessary, install a temporary water intake for the lobster pound. This intake will need to be moved outside the dredging area, to a location with little possibility of being affected by the migration of suspended particulate matter.

7.3.3.3 Public and User Safety

H6 Put up clear signs indicating the constraints imposed by the work (blocked road, detour, no parking, etc.) to ensure the safety of public road users at all times.

H7 Issue notices to shipping to ensure safe navigation.

H8 Ensure that the chemical and petroleum products stored at the site are carefully managed and monitored so as to prevent all spills, leaks or fires that could affect the health and safety of shoreline residents.

H9 If the sediment is treated, ensure that the company respects the clauses of the certificate of authorization to operate the technology, which clearly indicates the nature of the authorized products, their quantities and management (storage and handling).

7.3.3.4 Commercial and Industrial Infrastructures

H10 Check for the presence of underground infrastructures (pipes and cables, extension of the shipyard's slipway, right-of-way of the former slipway, sea intake for the lobster pound) before setting up the job site.

7.3.3.5 Road and Rail Networks

H11 Ensure that the public roads are kept clean throughout the project. Wash mud from all vehicles and construction equipment in the washing area before heading onto the roads.

H12 Always keep the roads that are used during the project in good condition and take measures to ensure that they can be used and crossed without any problem by other users.

7.3.3.6 Navigation

H13 Notify the wharf managers and users in advance of the schedule and nature of the activities planned at the wharf.

7.4 Compensation Project

A compensation project to make up for the loss of the habitat used by fish and other aquatic species is planned in the framework of the Port of Gaspé – Sandy Beach sediment remediation work. The project will involve rehabilitating the eelgrass and sea cabbage beds currently found in the work area.

According to the surveys that were conducted, a total of 59 714 m^2 of aquatic habitat will be affected, comprised almost entirely of seagrass beds (52 106 m^2). In the proposed compensation project, an equivalent surface area will be implemented after the work is completed. This project could include the following steps:

- Set a baseline before the work begins to determine the density and surface area of the seagrass beds to recreate and define the nature of the substrate that sea cabbage uses as an anchor in order to develop a method to secure these plants;
- Define the method for establishing the eelgrass beds (use of donor beds vs. harvesting eelgrass from the work site before dredging begins) and sea cabbage beds (keeping the rocks and blocks in place or creating anchoring reefs). A permit will first be obtained from DFO in the event that the eelgrass harvesting option is retained;
- Establishing the eelgrass and sea cabbage beds, waiting one (1) year after the end of the dredging work before beginning the rehabilitation work, to ensure that the sector has reached an equilibrium that will favour the return of vegetation;
- Develop a 2 to 3 year monitoring program to evaluate the success of the compensation project and make corrections when necessary.

The exact terms of the compensation project will be agreed upon with the DFO.

7.5 Summary of Residual Effects

Residual effects are anticipated effects on the environment that are expected to remain after the application of the mitigation measures and the compensation project described in the previous section.

The summary of the environmental effects, presented in Table 16, shows that the Port of Gaspé – Sandy Beach sediment remediation project will have low or medium-level negative effects. All of these effects will be qualified as non-significant following the application of the mitigation measures and the compensation project for the loss of aquatic habitat.

On the other hand, removing the contaminated sediment and implementing the compensation project will have the following positive effects:

- Improvement of the physicochemical characteristics of the sediment south of the commercial wharf;
- Elimination of the risk of deteriorating the harbour's water quality;
- Improvement of the quality of the riparian and aquatic habitats;
- Improvement of the quality of the local environment, due to the remediation.

8 OTHER PROJECT EFFECTS

8.1 Cumulative Effects

Cumulative effects are environmental effects resulting from the combination of a project's direct or indirect effects with those of other projects or activities, whether previous, current, planned or, at the limit, foreseeable. The *Canadian Environmental Assessment Act* requires the analysis of cumulative effects in the framework of the environmental assessment of projects under Section 16(1)(a).

Assessing cumulative effects is slightly different from assessing direct effects. For example, cumulative effects are assessed over a larger territory (regional), over a longer period of time, past and future, while taking into account interactions with other past, present and future actions, not only those caused by the single action being examined. Despite these differences, assessing cumulative effects is fundamentally similar to assessing direct environmental effects and the practices developed for the latter are often used.

The aim of analyzing cumulative effects is to:

- Determine if the effect generated by the project under study gradually accumulates with the effects of other past, present or future actions;
- Determine if the project's effects, combined with the other effects, risks significantly altering the valued environmental components, now or in the future, following the application of the mitigation measures for the project.

Only residual effects are considered in the assessment of cumulative effects. It should be noted that the analysis of the project's environmental effects (see Chapter 7) shows that all of the residual effects are non-significant.

The known development projects in the intervention area are described in Section 5.3.10. They are:

- Dismantling the former fishing wharf south of the commercial wharf. The work is underway and must be completed in March 2012. The banks will be strengthened with rock fill. The main potential impacts associated with this project are:
  - debris falling into the fish habitat;
  - temporary suspension of sediment during the work;
  - temporary increase in truck traffic on the local road network to transport the residue to a disposal site and transport the stone needed for the rock fill;
  - temporary increase in local sound levels and dust (when demolishing the wharf);
  - possible loss of an area of aquatic habitat due to adding rock fill.

- Stabilizing the banks at the Gaspé – Sandy Beach wharf approach, which must be started and completed in 2012. The majority of the activities associated with this project will take place on dry land, not in the water of the bay. The main potential impacts associated with this project are:
    - disturbing the ground surface due to the earthwork required and the use of heavy machinery;
    - temporary increase in truck traffic to transport the granular material (rock fill) required to stabilize the banks;
    - temporary increase in local sound levels and dust;
    - possible loss of an area of aquatic habitat due to adding rock fill.

The field work associated with remediating the sediment will not be initiated until 2014. As such, the temporary impacts associated with the two projects above will not have cumulative effects with those caused by the remediation work. As for the loss of aquatic habitat, as long as the proposed compensation project is carried out after the remediation work is completed, there will be no cumulative effects with the losses caused by the two aforementioned projects.

8.2 Project Effects on the Sustainable Use of Renewable Resources

All of the project's residual effects on the receiving environment are deemed non-significant. Most are temporary. Therefore, the renewable resources likely to be affected will return to their original state, that is, their state prior to the work. The project could have a temporary effect on air, water, soil and sediment quality, but will not affect their sustainable use. Generally, the project will in no way threaten the integrity of the receiving ecosystem (complexity, diversity, stability and resilience) and will not affect the productive capacity of any renewable resource. Neither will the activities associated with the project's execution adversely affect the ecosystem's carrying or assimilative capacity. In fact, the project will improve the physicochemical characteristics of the sediment south of the commercial wharf and reduce the risk of deteriorating the harbour's water quality.

8.3 Environmental Effects on the Project

It is unlikely that the environment will have a significant effect on the project, since the dredging work is planned for the summer period. However, extreme weather conditions at the dredging site could generally affect the project schedule. To ensure the safety of the workers and prevent navigation-related incidents (ex.: overturning a barge), work on the water must be stopped in adverse weather conditions (heavy storms, violent winds). Note also that such extreme weather conditions could eventually disrupt the dewatering and treatment of the sediment, depending on the selected technology. A weather station could be set up at the port site to monitor the weather conditions.

8.4 Effects of Accidental Spills and Environmental Emergency Plan

Construction sites are always susceptible to technical failure or potential accidents that could cause environmental emergencies, such as contaminant spills or leaks. Several of these failures or potential accidents are minor and have no major consequences on the environment. For example, equipment malfunction could slow the work due to the need for repairs, but will not have a serious impact on the environment.

Using machinery and equipment in good operating condition will limit the risk of technical failure. What is more, implementing an environmental emergency plan will help adequately manage all situations that present risks for the environment due to spills or leaks caused by accidents or equipment breakdown.

The contractor will be responsible for developing an environmental emergency plan, by completing the following steps when planning the job site:

- Appointing a job superintendant;
- Drawing up the emergency response plan (includes identifying risks, the actions to take, the responsibilities and contact information of the people involved, the contact information of the organizations to notify in the event of an emergency, the communication network, the incident report and location of the emergency equipment) – a checklist of this plan can be handed out to all workers or people who may access the job site;
- Train the people involved;
- Practice if necessary.

9 MONITORING AND FOLLOW-UP PROGRAMS

9.1 Environmental Monitoring

The environmental monitoring program consists of a set of measures to monitor the activities that generate environmental effects and ensure that the established mitigation measures are implemented and are effective. The project proponent, in this case Transport Canada, is responsible for applying the general environmental monitoring program for the sediment dredging and management project. However, in the event that the sediment is treated, the company operating the technology will be responsible for monitoring its potential environmental effects. The specialized firm hired by PWGSC to supervise the site will be responsible for validating the contractor's results and, if necessary, taking certain measures.

9.1.1 General Monitoring Activities

To ensure that the environmental measures proposed in this environmental screening assessment are respected, the proponent will intervene in three ways:

- By first integrating special provisions in the call for tenders specifications to ensure that the environment is protected. The proponent will make sure that all of the proposed mitigation measures are included in the plans and specifications. These provisions will be an integral part of the contracts that will be awarded to the contractors;
- By requiring the chosen contractor to develop an environmental emergency plan. This plan must, at minimum, cover all the components mentioned in sections 9.1.2, 9.1.3 and 9.1.4 as well as all other components Transport Canada deems pertinent. This plan must be approved by TC before the work begins;
- By integrating environmental clauses (including those stipulated in the certificate of authorization) in the construction work monitoring plan. Transport Canada will ensure that this plan is completed before the work begins, that the contractor understands the monitoring activities as well as the tasks and responsibilities of each team member assigned to the project.

While the work is carried out, the site supervisor appointed by Transport Canada is in charge of ensuring that the environmental measures are respected. The supervisor must also ensure that these measures are effective and, if necessary, inform Transport Canada and make sure that the contractor proposes alternative protection measures. The environmental monitoring form in Appendix D will help the site supervisor follow the application of the mitigation measures. This report must be submitted to Transport Canada and the MDDEP once the work is completed.

9.1.2 Monitoring of the Dredging Work

Besides the general monitoring activities, activities specific to the dredging work are proposed and will include controlling:

- The speed at which the dredge is raised (if the mechanical dredging option is chosen) to minimize sediment suspension;
- The effectiveness of the turbidity curtains at containing the suspended sediment, if the mechanical dredging option is chosen. A protocol will be developed to monitor the water column during the dredging work, and will combine visual observation from shore, the wharf and the dredge throughout the work period as well as follow-up of the SPM and contaminants (Cu and PAH dissolved in the water) outside the turbidity curtain. The protocol will be submitted to the MEDDEP once available;
- The installation of the turbidity curtain according to the manufacturer's recommendations to ensure that it isolates the work area, as best, effectively and continuously as possible. Check if adjustments are required when water levels rise due to the tide or water masses move due to the currents.

9.1.3 Monitoring of the Contaminated Sediment Management

9.1.3.1 Sediment Dewatering

Besides the general monitoring activities, activities specific to the dewatering work are proposed and will include controlling:

- The quality of the water discharged from the dewatering basin and unit, in the event that such a unit is used. The discharged water must respect the regulations in effect;
- The condition of the storage surfaces or basin to ensure their watertightness;
- The condition of the mechanical dewatering equipment to avoid all unscheduled work stoppages;
- The adequate management of the debris collected, if the physical separation option is chosen.

9.1.3.2 Physicochemical Sediment Treatment

Besides the general monitoring activities, activities specific to physicochemical treatment are proposed and will include controlling:

- The quality of the discharge water (supplier's responsibility). The water must respect the regulations in effect;
- The quality of the treated sediment (supplier's responsibility);
- The condition of the treatment equipment to avoid all accidents or spillage leading to unscheduled work stoppages;
- The management of hazardous goods required for the treatment and equipment maintenance.

9.1.3.3 Heat Sediment Treatment

Besides the general monitoring activities, activities specific to heat treatment are proposed and will include controlling:

- The quality of the discharge water (supplier's responsibility). The water must respect the regulations in effect;
- The quality of the air emissions (supplier's responsibility). The air quality must respect the regulations in effect;
- The quality of the treated sediment (supplier's responsibility);
- The condition of the treatment equipment to avoid all accidents or spillage leading to unscheduled work stoppages;
- The management of hazardous goods required for the treatment and equipment maintenance.

9.1.4 Monitoring of the Sediment Transportation

Besides the general monitoring activities, activities specific to the transportation of the sediment are proposed and will include controlling:

- The operating condition of the transportation vehicles to avoid all breakdown;
- The watertightness of the transportation vehicles to avoid all leaks of the transported material;
- The effectiveness of the splashguards installed on the trucks;
- Transhipment activities at the wharf to ensure that the sediment is transferred in a way that minimizes the risk of sediment being released into the water;
- Receiving slips issued by the site selected for the disposal or final valorization of the treated sediment. The contractor must supply proof of compliance from this site.

9.2 Environmental Follow-Up

Environmental follow-up is an approach that monitors the evolution of certain components affected by the project and checks the accuracy of the forecasts and environmental issues identified. It also helps check the short, medium and long-term effectiveness of the mitigation measures planned in the environmental assessment, and for which uncertainty remains.

This project will involve two separate follow-up programs, a program to follow up on the contamination and various biological parameters in scallops and mussels and a program to validate the success of the fish habitat compensation project, regarding the rehabilitation of the eelgrass and sea cabbage beds at the dredging site.

The follow-up program for the contamination and biological parameters in scallops and mussels is currently being prepared by a committee made up of two researchers from Fisheries and Oceans Canada, a project manager from the *Centre d'innovation de l'aquaculture et des pêches du Québec* (MERINOV) and an environmental officer from Transport Canada. In short, the committee is expected to target four sampling sites within the Gaspé harbour. The mussels and scallops used for the follow-up will either be from farms that already operate sites (with their consent) or experimental sites that will be set up in the harbour. Composite samples will be taken to conduct copper and PAH analyses. This follow-up will begin in 2012 or 2013 and end in the year following the dredging activities. The follow-up of Cu and PAH in organisms will be conducted monthly between May and December, with the exception of the dredging periods, during which the frequency will be increased to twice monthly. Moreover, during each sampling period, the mussels and scallops in the cages will be counted and measured. Finally, three times a year (before dredging, after dredging and at the end of the year), organisms will be collected to measure the weight of their flesh and shell.

The details of the follow-up program associated with the rehabilitation of the eelgrass and sea cabbage beds has not yet been defined, but will very likely involve scuba diving, video transects and density readings (qualitative or quantitative) at several stations, conducted approximately three times in five years.

The detailed follow-up programs will be submitted to the MDDEP once available.

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DESSAU

Appendix A Map of the Property and Port Facilities

CE DOCUMENT D'INGÉNIERIE EST LA PROPRIÉTÉ DE DESSAU ET EST PROTÉGÉ PAR LA LOI. IL EST DESTINÉ EXCLUSIVEMENT AUX FINS QUI Y SONT MENTIONNÉES. TOUTE REPRODUCTION OU ADAPTATION, PARTIELLE OU TOTALE, EN EST STRICTEMENT PROHIBÉE SANS AVOIR PRÉALABLEMENT OBTENU L'AUTORISATION ÉCRITE DE DESSAU.

Notes

- LIMITE DE PROPRIÉTÉ
- VOIE FERRÉE
- CONDUITE SOUTERRAINE DE PRODUITS PÉTROLIERS
- CONDUITE SOUTERRAINE/AÉRIENNE D'ACIDE (XSTRATA)
- CHEMIN D'ACCÈS (GRAVIER OU ASPHALTE)
- ÉMISSAIRE – STATION D'ÉPURATION DES EAUX – VILLE DE GASPÉ
- INFRASTRUCTURE PORTUAIRE

SOURCE:
– DESSAU–SOPRIN, 2005.
(LIVRABLE 4.2) PLAN 1: PLAN DE PROPRIÉTÉ ET INFRASTRUCTURES EXISTANTES

RÉV.	A - M - J DATE	DESCRIPTION	Préparé Par	Vérifié Par

ÉMISSIONS / RÉVISIONS

TOUTES LES DIMENSIONS DEVRONT ÊTRE PRISES ET VÉRIFIÉES AVANT DE COMMENCER LES TRAVAUX

Sceaux

Client

Transports Canada

Références du client

Projet

PROJET DE RESTAURATION DE SÉDIMENTS AU PORT DE GASPÉ - SANDY BEACH

Titre

ANNEXE A
PLAN DE PROPRIÉTÉ ET INSTALLATIONS PORTUAIRES

DESSAU

Dessau inc.
1080, côte du Beaver Hall, bureau 300
Montréal (Québec) H2Z 1S8
Téléphone : 514.281.1010
Télécopieur : 514.798.8790

Préparé	C. Gaudette	Discipline	Environnement
Dessiné	F. Boudreau	Échelle	1 : 2 000
Vérifié	S. Côté	Date	2012-02-22

Chargé de projet: C. Marcotte

No. de séquence: de

Serv. maître	Projet	Lot	Sous-Lot	Disc.	Nº Dessin	Rév.
045	P001130	0162	068	EI	0110	01

FORMAT A1

Appendix B Brief Description of the Dewatering and Treatment Technologies

TABLEAU 1 : PRÉSENTATION DES TECHNOLOGIES D'ASSÈCHEMENT CONSIDÉRÉES

Type d'assèchement	Technologie d'assèchement	Description sommaire
Passif	En bassin	Assèchement à l'air libre des sédiments dans un ou des bassins d'entreposage drainants ou imperméables. On procède à l'enlèvement successif de couches de sédiments asséchés.
	En couches minces	Disposition des sédiments en couches minces (généralement 300 à 600 mm) sur surface drainante ou imperméable et assèchement avec ou sans retournement/brassage.
Séparation physique	Criblage	Technique utilisant des tamis (fixes, vibrants, rotatifs ou autres) ou tapis roulant lavés ou non par des jets d'eau et qui permet de retirer les particules grossière et autres débris. Mentionnons les types de cribles suivants: • Le crible scalpeur qui peut être une grille fixe à travers laquelle les sédiments passent, mais sur laquelle les débris sont retenus; • Le crible à barres qui consiste en une surface inclinée composée de barres espacées régulièrement à travers laquelle les sédiments sont déversés; • Le tamis cylindrique qui consiste en un grillage en forme de cylindre légèrement incliné et tournant sur lui-même dans lequel les matériaux grossiers sont emprisonnés; • Le tamis vibrant qui consiste en une grille dont la taille des mailles est uniforme et qui vibre pour défaire les agrégats et faire progresser les matériaux grossiers vers une zone de décharge.
	Vis à sable	Dispositif muni d'un puisard à la base d'une tarière installée en angle ou à l'horizontal qui achemine le sable et autres particules grossières vers un convoyeur ou une aire d'entreposage temporaire. Les particules fines et la matière organique sont évacuées du puisard par un trop-plein. Le puisard peut également permettre la circulation à contre-courant afin d'améliorer la séparation de la fraction fine et de la fraction sableuse. Une variante consiste à laisser s'accumuler la fraction sableuse dans le puisard et à évacuer celle-ci à l'aide d'une pelle hydraulique ou autre équipement de terrassement. La taille du matériel décantant dans le puisard est contrôlée par le débit de sortie des sédiments dragués. Ainsi, le sable fin peut également être évacué avec les particules fines. Cela permet d'augmenter la perméabilité du matériel qui subira davantage d'assèchement, mais diminue également la compressibilité de celui-ci (Estes *et al.*, 2004). Ce type d'équipement permet d'obtenir une fraction sableuse avec une siccité jusqu'à 80 % (USEPA, 1999).

TABLEAU 1 : PRÉSENTATION DES TECHNOLOGIES D'ASSÈCHEMENT CONSIDÉRÉES

Type d'assèchement	Technologie d'assèchement	Description sommaire
Séparation Physique (suite)	Hydrocyclone	Équipement conique dans lequel la boue est injectée de façon tangentielle et dans lequel les matériaux grossiers s'écoulent en spirale vers la base du cône. Les matériaux fins et légers (incluant une bonne partie de l'eau) migrent quant à eux vers le centre du cône et sont expulsées par le trop-plein situé au sommet. Si les sédiments sont sableux, le matériel sortant à la base peut présenter un taux d'humidité relativement bas (Estes *et al.*, 2004). En fonction du type de matériaux dragués, il peut être avantageux de le munir d'une gaine intérieure pour augmenter sa résistance à l'abrasion.
	Clarificateur / bac d'épaississement	Enceinte destinée à recevoir la boue afin de permettre une décantation des particules et un épaississement du matériel. L'eau clarifiée est évacuée par une surverse et les sédiments épaissis sont pompés par le fond de l'enceinte. Une injection de polymères dans les sédiments peut s'effectuer avant la décantation.
Mécanique	Filtre presse	Expulse l'eau des sédiments en les chargeant et les emprisonnant entre deux filtres verticaux et en créant une pression hydraulique. Une série de filtres cordés horizontalement sont généralement utilisés. La pression de la boue entrant dans le système est la force motrice de ce système de filtration. La boue est pompée sous pression entre deux plaques et l'eau est expulsée à travers le filtre vers la zone de drainage. Lorsque la pression voulue est atteinte dans le filtre (généralement autour de 100 psi), le pompage est arrêté, de l'air est soufflé à travers le gâteau de filtration pour l'assécher et ce dernier est déversé sur un convoyeur pour l'évacuer. Dans le cas de projets avec des sols ou sédiments contaminés, l'épaisseur des gâteaux est généralement de l'ordre de 2,5 à 7,5 cm (USEPA, 1999).

TABLEAU 1 : PRÉSENTATION DES TECHNOLOGIES D'ASSÈCHEMENT CONSIDÉRÉES

Type d'assèchement	Technologie d'assèchement	Description sommaire
Mécanique (suite)	Filtre à bande	Équipement pressant les sédiments entre deux filtres en toile monofilament tissée dans un système de rouleaux de différents diamètres. Ils possèdent généralement trois « zones » : une zone de drainage gravitaire, une zone à faible pression et une zone de haute pression. Dans la zone de drainage gravitaire, l'eau s'écoule librement du matériel à travers la toile de la courroie filtrante. Une herse permet également de répartir le matériel sur la courroie pour faciliter l'écoulement. Le matériel se déverse ensuite sur une courroie sous-jacente pour entrer dans la zone à faible pression. Il est ensuite emprisonné entre deux courroies roulant en chicane autour d'une série de rouleaux de dimension moyenne. Dans la zone de haute pression, la dimension des rouleaux est moindre et les chicanes sont plus rapprochées (Estes *et al.*, 2004). Les courroies sont configurées pour faire en sorte qu'elles y progressent à des vitesses légèrement différentes de façon à exercer un cisaillement sur le matériel et à extraire une plus grande quantité d'eau (Englis et Hunter, 2010). L'eau expulsée du matériel s'écoule à travers les courroies et est récupérée sous le filtre à bande. La courroie filtrante est constamment lavée à l'aide de jets d'eau à haute pression pour éviter le colmatage. Ce type d'équipement peut accepter des boues dont la siccité varie de 1 à 40 % (USEPA, 1999). Par contre, la siccité finale (40 à 50 %) est plus faible que dans le cas d'un filtre presse (50 à 65 %). Ces valeurs sont fonction de la densité des solides présents dans le matériel ainsi que de la compression atteignable par les équipements utilisés (Estes *et al.*, 2004).
	Centrifugeuse	Équipement utilisant la force centrifuge pour séparer les matériaux de densité différente par mouvement de rotation rapide sur un pivot central. . Elles sont généralement équipées d'une tarière à l'intérieur du boîtier. Celle-ci permet d'acheminer les particules accumulées sur la paroi interne vers un déversoir à l'extrémité du boîtier. Une centrifugeuse requiert une alimentation relativement constante, nécessitant généralement un bassin de rétention des boues pour l'assurer. Elles sont utilisées pour l'assèchement de la fraction fine des sédiments, mais peuvent également servir à la séparation granulométrique par l'ajustement de certains paramètres d'opération. La boue entrant dans une centrifugeuse peut avoir une siccité variant de 1 à 70 %, mais celle-ci doit être uniforme (USEPA, 1999).

TABLEAU 1 : PRÉSENTATION DES TECHNOLOGIES D'ASSÈCHEMENT CONSIDÉRÉES

Type d'assèchement	Technologie d'assèchement	Description sommaire
Mécanique (suite)	Géotubes	Tubes de géotextile spécialement conçus pour emprisonner et retenir les solides tout en laissant les liquides s'échapper par les parois perméables. Ils sont fabriqués à partir de fils de polypropylène ou de polyester tissés, ce qui les rend inertes et inattaquables par des contaminants chimiques acides ou alcalins. Les textiles tissés sont cousus ensemble de façon à leur fournir une grande résistance aux tensions. Les espaces entre les filaments permettent à l'eau de s'échapper tout en conservant les particules solides traitées à l'aide de polymères à l'intérieur. Chaque tube peut être fabriqué sur mesure et comporter plusieurs entrées de façon à assurer une distribution uniforme de la boue à l'intérieur. Les tubes peuvent être empilés les uns sur les autres pour limiter l'empiétement et augmenter la consolidation du matériel. Le degré de dessiccation des sédiments qui peut être atteint dépend de la capacité de l'eau à se frayer un chemin entre les particules pour être expulsée entre les filaments (Englis et Hunter, 2010). Il est nécessaire d'ajouter des polymères afin de favoriser la floculation des particules. L'ajout de polymères se fait en ligne avant l'acheminement des boues vers les Géotube®. Le mélange passe par la suite par une chambre de mélange (chicanes de tuyaux) afin de permettre la floculation (Terratube, 2011).

TABLEAU 2 PRÉSENTATION DES TECHNOLOGIES DE TRAITEMENT CONSIDÉRÉES

Catégorie de traitement	Technologie de traitement	Description sommaire
Physique / chimique	Extraction chimique	Dissolution des contaminants dans un mélange de solvants ou d'acides puis séparation des contaminants et des agents extracteurs. **L'extraction à l'acide** (acide chlorhydrique généralement) est utilisée lorsque la contamination à traiter comprend des métaux lourds. Les particules grossières des sédiments sont d'abord retirées par séparation physique. L'acide est ensuite ajouté aux sédiments dans une unité de traitement. Le temps de contact varie en fonction du type de sédiment, du type de contaminants et de la concentration des contaminants, mais se situe généralement entre 10 et 40 minutes (FRTR, 2011). **L'extraction à l'aide de solvants** utilise quant à elle des solvants organiques tels que le méthanol, l'éthanol, l'alcool d'isopropyl, l'hexane ou l'éthylène-diamine comme agent d'extraction (Reis *et al*., 2007). Elle est fréquemment utilisée en combinaison avec d'autres technologies de traitement telles que la solidification/stabilisation, l'incinération ou le lavage de sédiments en fonction des conditions propres au site. Elle peut également être utilisée comme seule technologie de traitement dans certains cas. Le procédé utilisé est similaire à celui décrit pour l'extraction à l'acide.
	Séparation et lavage	Concentration des contaminants solides par moyens physiques et chimiques visant à détacher les contaminants des matériaux sur lesquels ou dans lesquels ils se trouvent. Le processus de base consiste en la séparation des particules selon certaines caractéristiques, telles que la taille, la forme, la densité et la solubilité des particules. Ce principe est fondé sur le fait que certains contaminants sont associés avec certaines fractions dans les sols, et que ces contaminants peuvent être retirés par lavage dans une solution. L'équipement utilisé est communément rencontré dans un grand nombre de procédés de l'industrie minière. La première étape du procédé est la préparation des sols, qui comprend la séparation, l'enlèvement et le lavage à haute pression des particules grossières. L'étape suivante consiste en la préparation physique des particules. Selon les résultats des essais de traitabilité, les étapes de séparation utilisées sont une combinaison de modules de séparation selon différentes tailles de particules, de modules de séparation selon les densités des particules et de modules d'assèchement. Suite à cette séparation, les contaminants sont extraits de la matrice du sol en utilisant une solution conçue pour les contaminants présents. Les résidus de solution produits par cette activité sont traités chimiquement comme une eau contaminée, avec des filtres variés, pour enfin produire un effluent qui respecte les normes de rejet applicables.

TABLEAU 2 PRÉSENTATION DES TECHNOLOGIES DE TRAITEMENT CONSIDÉRÉES

Catégorie de traitement	Technologie de traitement	Description sommaire
Physique / chimique (suite)	Solidification / stabilisation	Emprisonnement des contaminants dans une matrice cohérente (solidification) et/ou immobilisation des contaminants par réaction chimique. Les déblais de dragage sont placés dans une cuve de traitement, qui permet de les faire passer par plusieurs étapes de traitement, notamment une étape de déshydratation, une étape d'élimination des débris, une étape de fixation, de stabilisation, et de solidification, une étape de durcissement, pour finir par une étape de déchargement. L'étape de fixation, de stabilisation, et de solidification consiste à ajouter un **additif de type ciment** (ciment Portland) ainsi que d'autres additifs destinés à stabiliser lesdits déblais de dragage par fixation et solidification chimiques, afin de former le remblai. L'eau étant requise pour hydrater le ciment, la procédure de déshydratation des sédiments contaminés n'est pas nécessairement requise ou elle peut n'être faite qu'en partie. La procédure d'élimination des débris pourrait aussi être éliminée si ces derniers ne sont pas présents dans les sédiments.
Thermique	Incinération	Combustion (en présence d'oxygène) des contaminants organiques à haute température (870 à 1 200°C). Des combustibles auxiliaires sont utilisés afin d'initier et de soutenir la combustion. L'efficacité des procédés d'incinération atteint les 99,99 % (FRTR, 2011). Il existe quatre principaux types d'incinérateurs soit le four rotatif, le four à lit fluidisé, l'injection de liquide et le four à infrarouge (EUGRIS, 2011). Les coûts associés à l'incinération sont élevés, et ce, principalement en raison de la forte consommation d'énergie. Cette technologie demande par ailleurs que les sédiments à traiter présentent un très faible taux d'humidité et, par conséquent, un assèchement préalable des sédiments (Maguire Group, 2002).
	Pyrolyse	Décomposition chimique des contaminants organiques par chauffage en l'absence d'oxygène, à des températures supérieures à 430 °C. Cette condition permet la séparation des matériaux en une fraction organique gazeuse et une fraction inorganique (sels, métaux, particules) carbonisée. La pyrolyse est généralement utilisée pour traiter des concentrations élevées de contaminants organiques qui ne sont pas propices à une incinération conventionnelle (Maguire Group, 2002). Des fours rotatifs, des fours à lit fluidisé et la destruction à l'aide de sels fondus sont utilisés pour la pyrolyse (FRTR, 2011). Tout comme l'incinération, la pyrolyse exige un taux d'humidité très faible dans les sédiments à traiter, ce qui demande un assèchement préalable (Maguire Group, 2002).

TABLEAU 2 PRÉSENTATION DES TECHNOLOGIES DE TRAITEMENT CONSIDÉRÉES

Catégorie de traitement	Technologie de traitement	Description sommaire
Thermique (suite)	Désorption thermique	Chauffage des sédiments afin de volatiliser l'eau et les contaminants organiques à des températures moyennement élevées. Deux catégories de technologies de désorption thermiques sont disponibles, soit celles à haute température et celles à basse température. Les contaminants à volatiliser dictent le type de système à utiliser en fonction de leur point d'ébullition. Les systèmes à haute température utilisent des températures entre 320 °C et 560 °C. À ces températures, un grand nombre de contaminants organiques sont volatilisés, de même que certains contaminants inorganiques tels que le mercure. Les systèmes à basse température utilisent quant à eux des températures entre 90 °C et 320 °C (EUGRIS, 2011). Ces températures ne volatilisent pas les métaux. La plupart des unités de désorption thermique disponibles sur le marché sont des fours rotatifs ou des vis thermales (Maguire Group, 2002).
	Vitrification	Création d'un solide non-cristallin par la fusion à haute température (> 1 600 °C) à l'intérieur de laquelle les composés inorganiques sont immobilisés. Les composés organiques sont détruits par pyrolyse ou oxydation et certains métaux (mercure par exemple) peuvent être volatilisés en partie durant la fusion du matériel. Le « verre » ainsi obtenu est non-toxique et peut être recyclé ou enfoui lorsque la réglementation le permet. Il peut être brisé à l'aide de marteaux pneumatique conventionnels ou à l'aide d'un concasseur pour faciliter le transport et la mise en place du matériel. La matrice vitrifiée a démontré une grande résistance à la lixiviation (USEPA, 2004; Impact Services, 2010). La vitrification est toutefois une des technologies les plus coûteuses (Maguire Group, 2002). Généralement, les sédiments sont tout d'abord asséchés pour atteindre un taux maximum d'humidité d'environ 45 à 55 % (USEPA, 2004). Les sédiments sont ensuite placés dans le compartiment de fusion (conteneur, four rotatif ou autre). Ils sont alors chauffés à l'aide d'une torche à plasma ou d'électrodes insérées dans le matériel (du graphite est alors utilisé en surface des sédiments entre les électrodes pour augmenter la conductivité électrique) entre lesquelles on fait circuler un fort courant. La forte augmentation de température du matériel permet la fusion du matériel (Reis *et al*., 2007). Une fois le matériel complètement fondu, le courant est coupé puis le matériel est mis à refroidir. Cette période de refroidissement peut s'avérer assez longue (Maguire Group, 2002). Le résultat est une matrice vitrifiée avec des inclusions de minéraux cristallisés ressemblant vaguement à une obsidienne (Impact Services, 2010).

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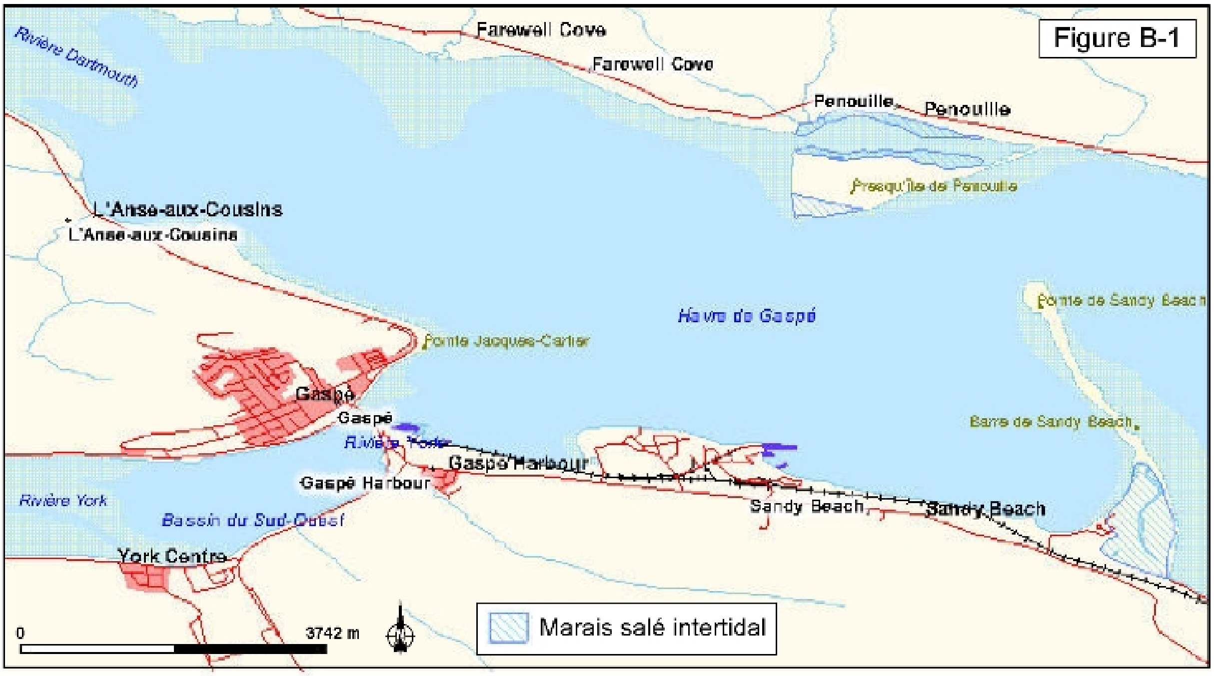
Appendix C Spatialization of the Biological Components



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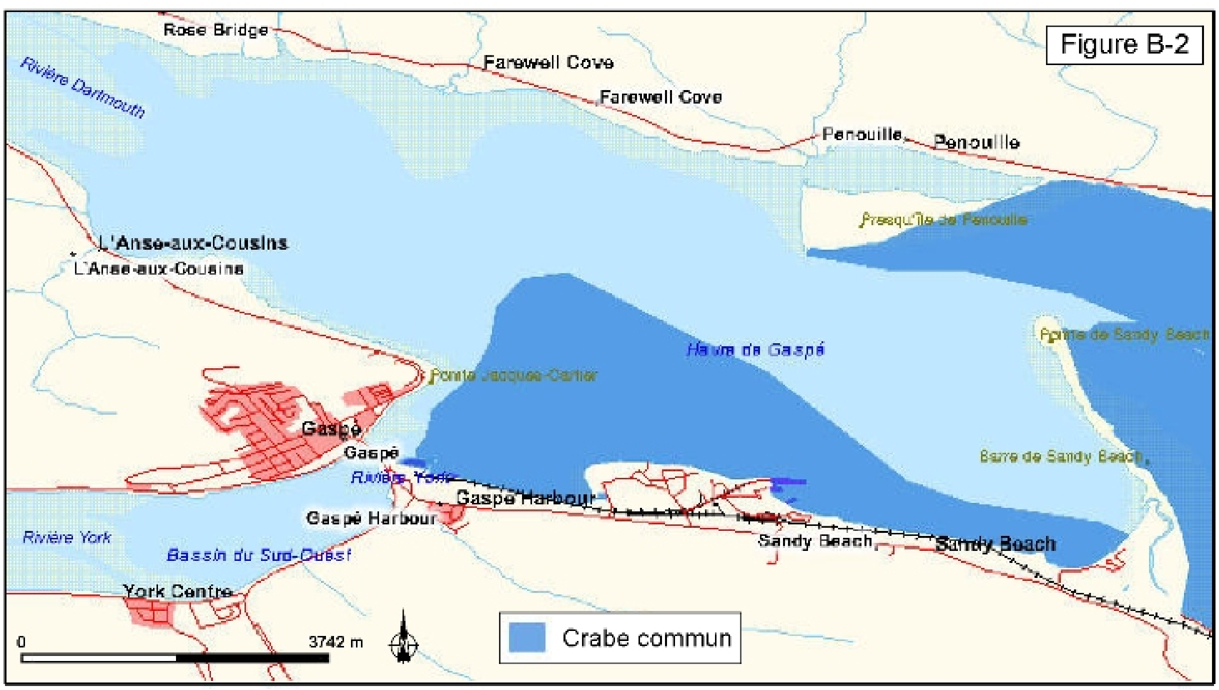

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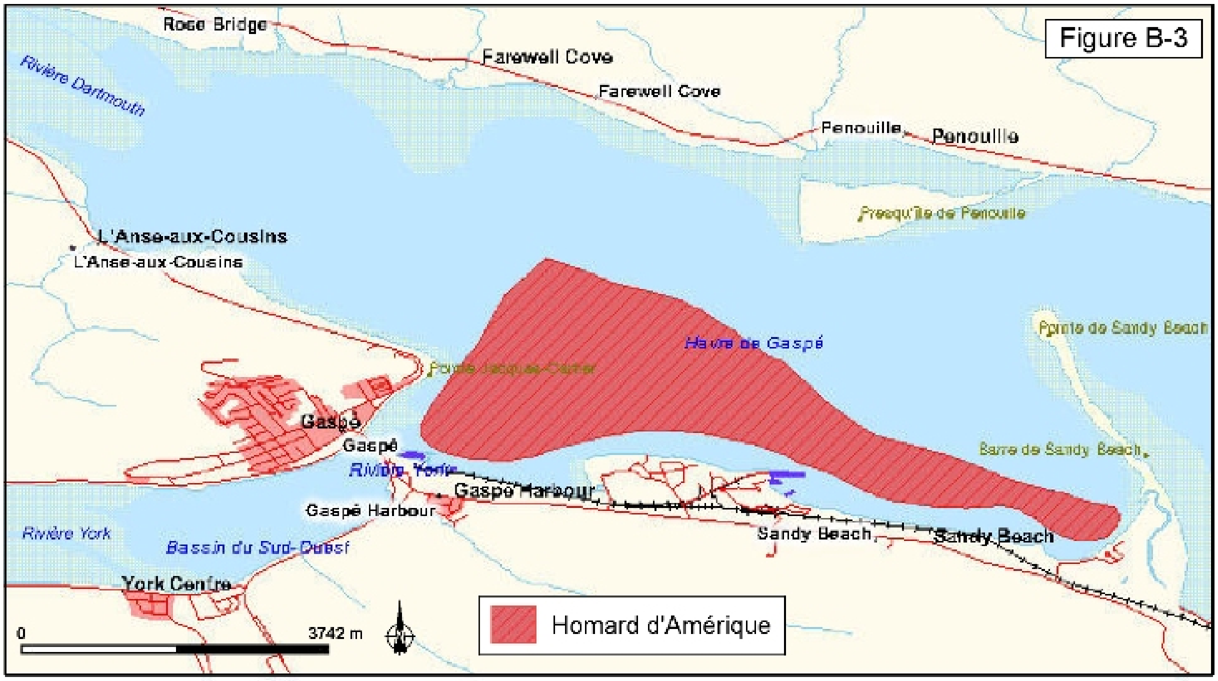

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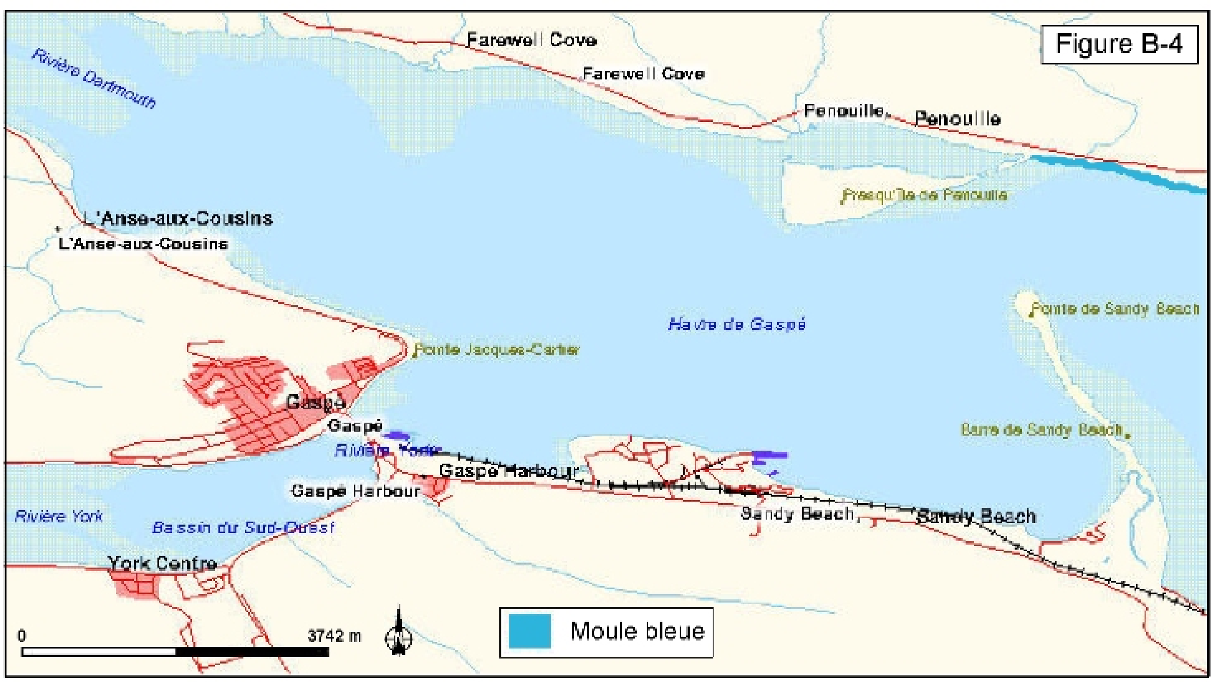

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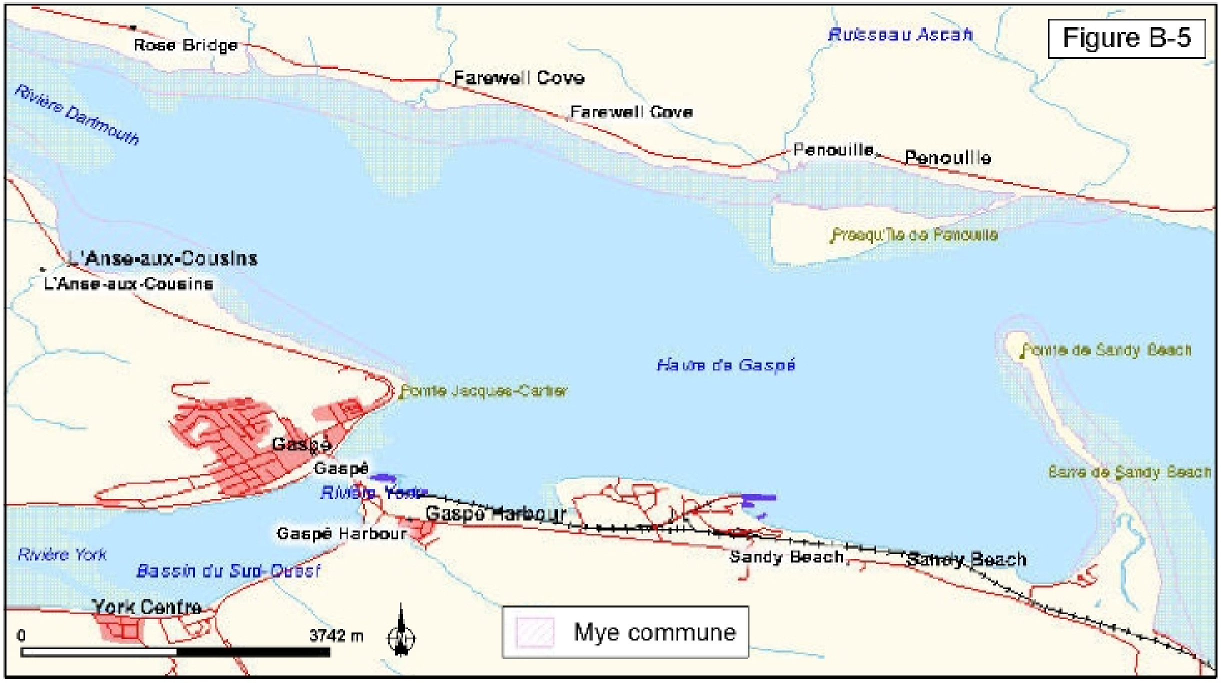

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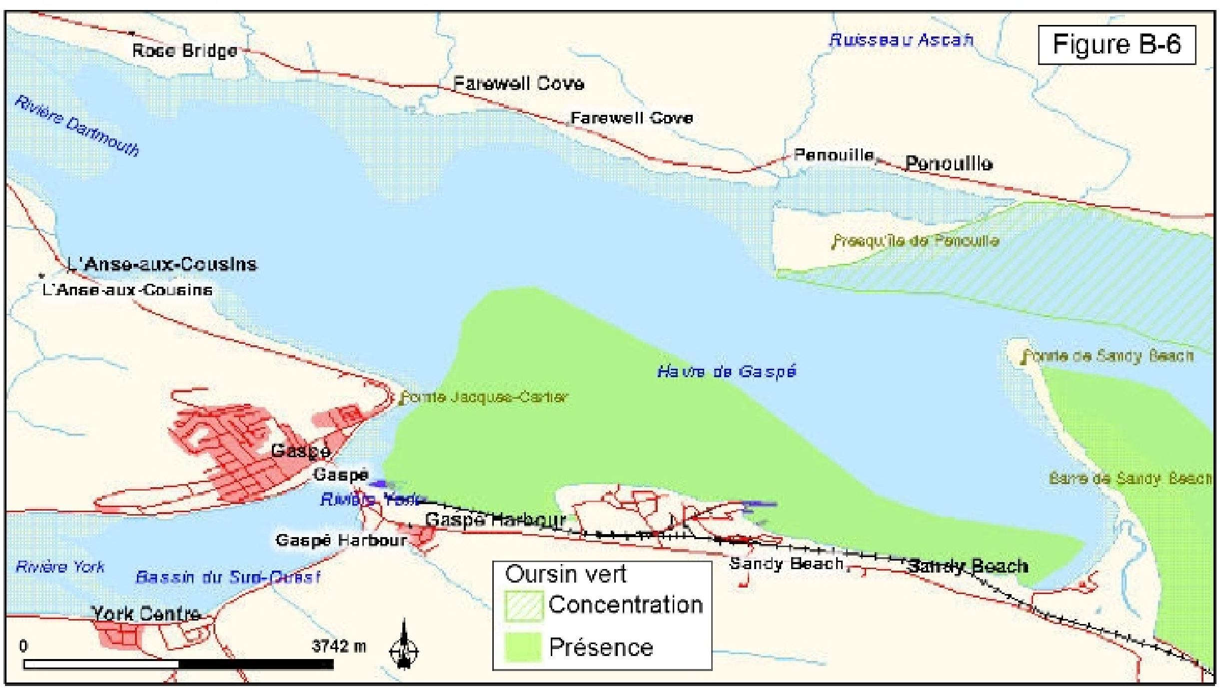

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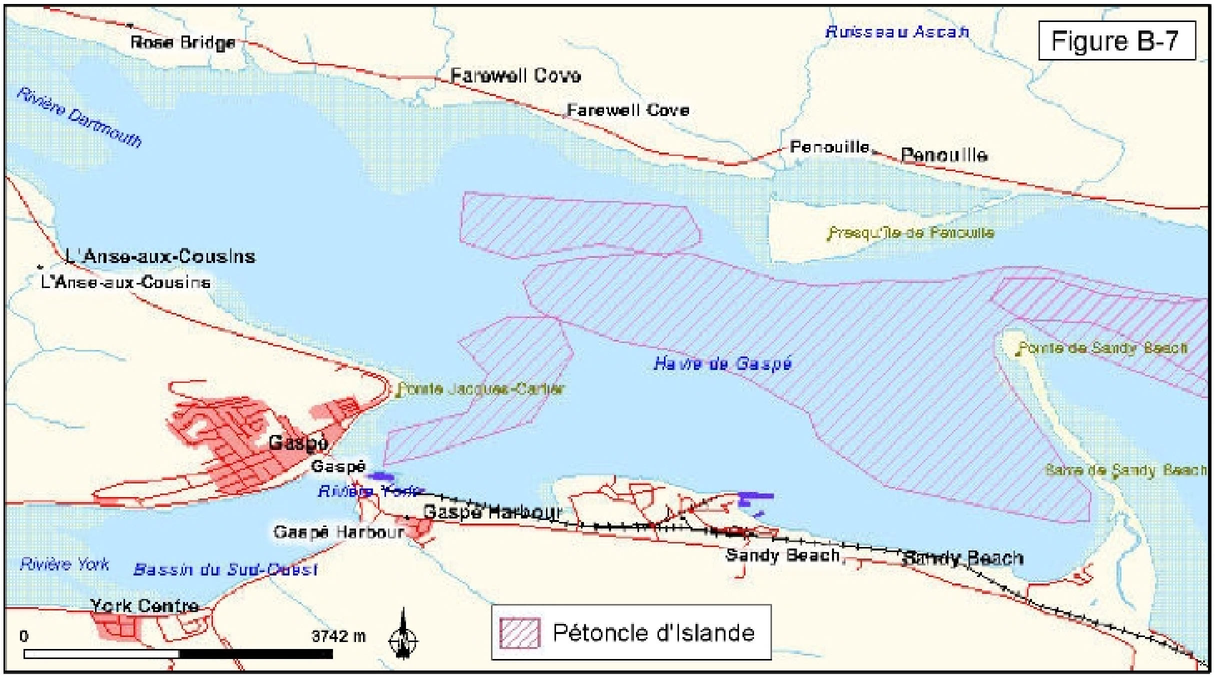

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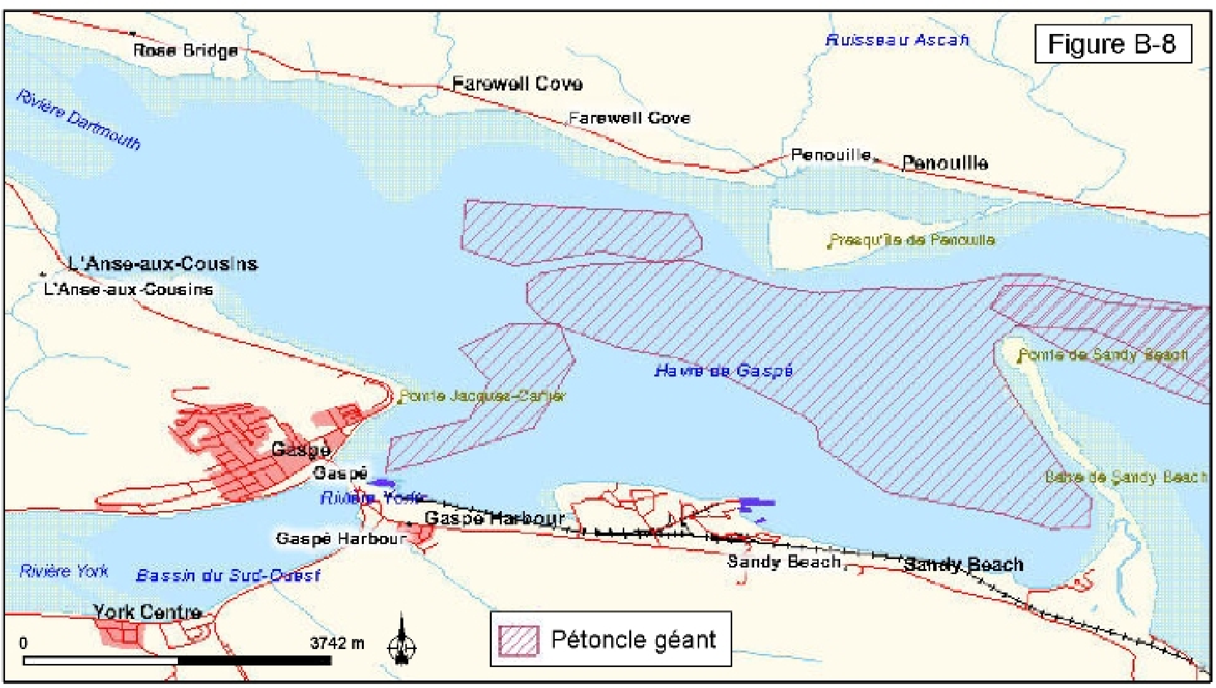

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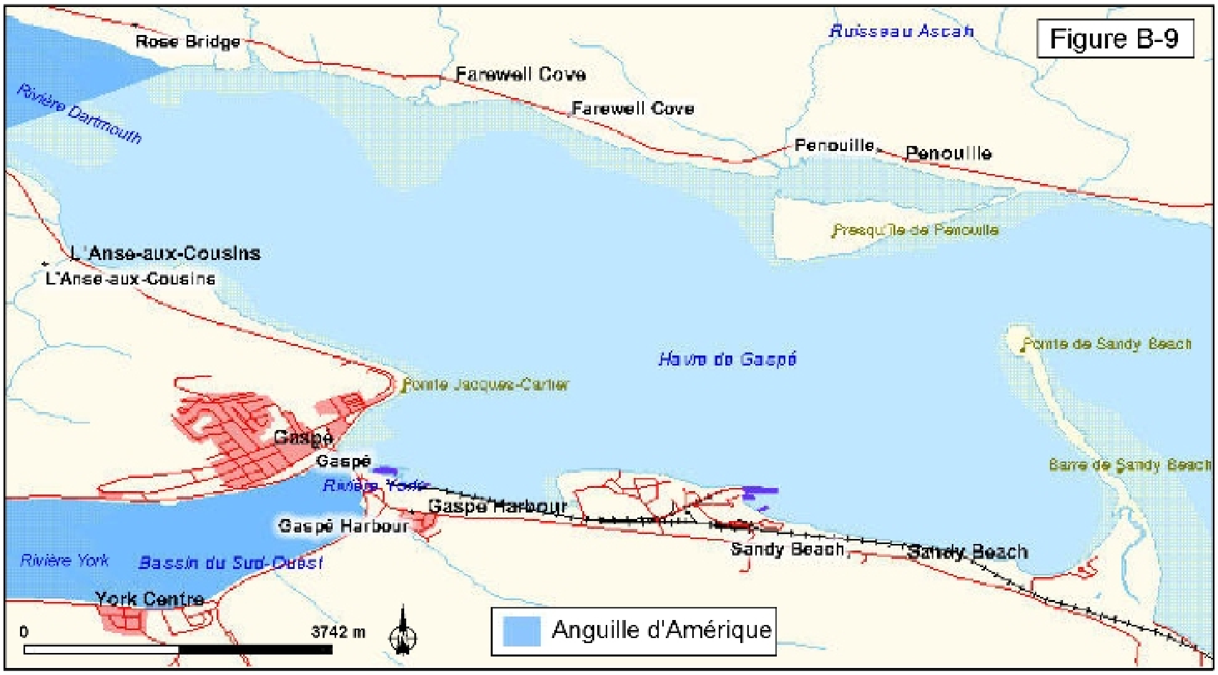

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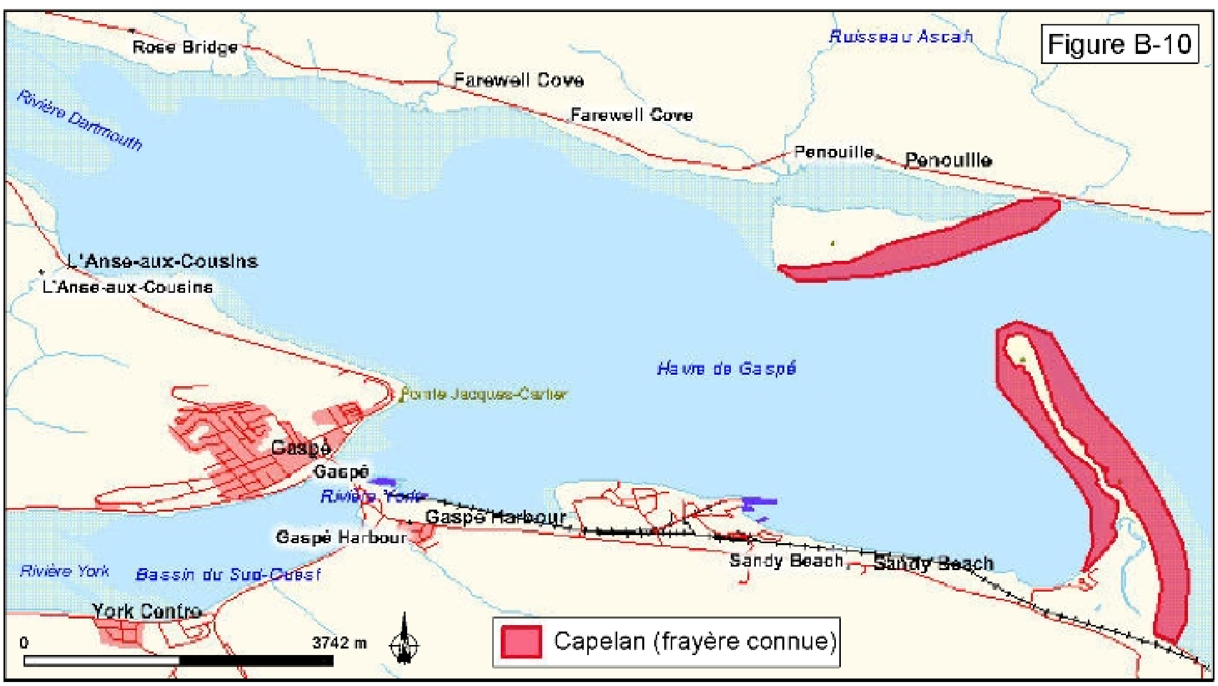

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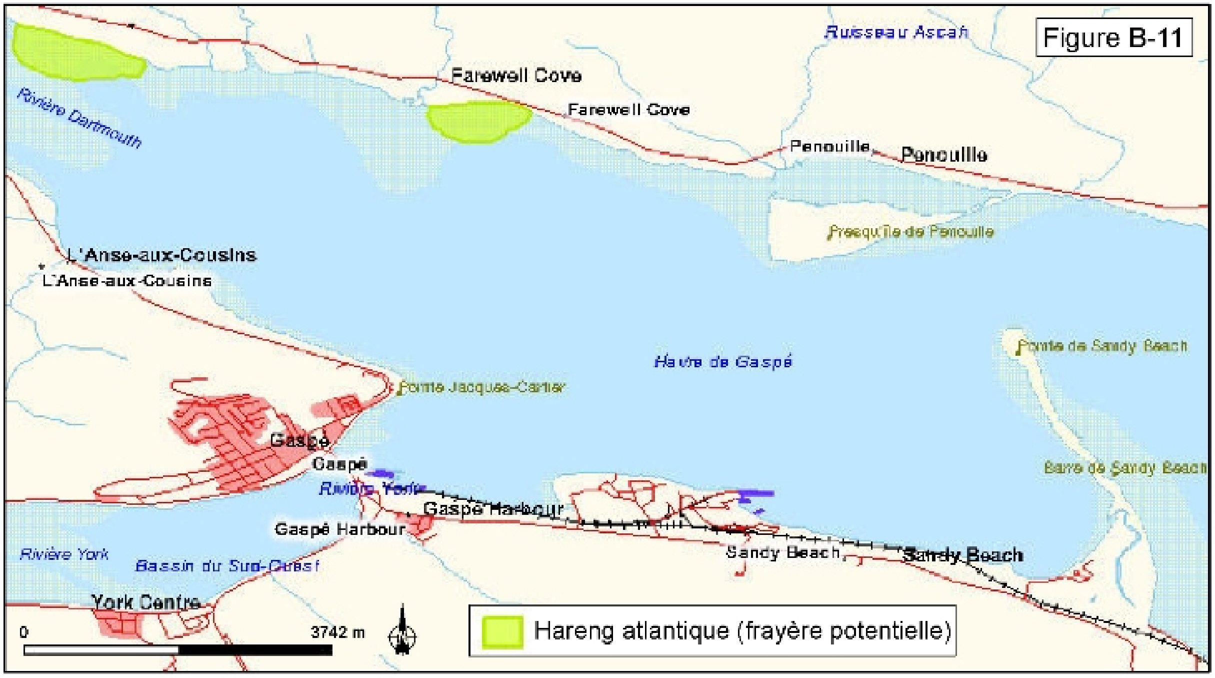

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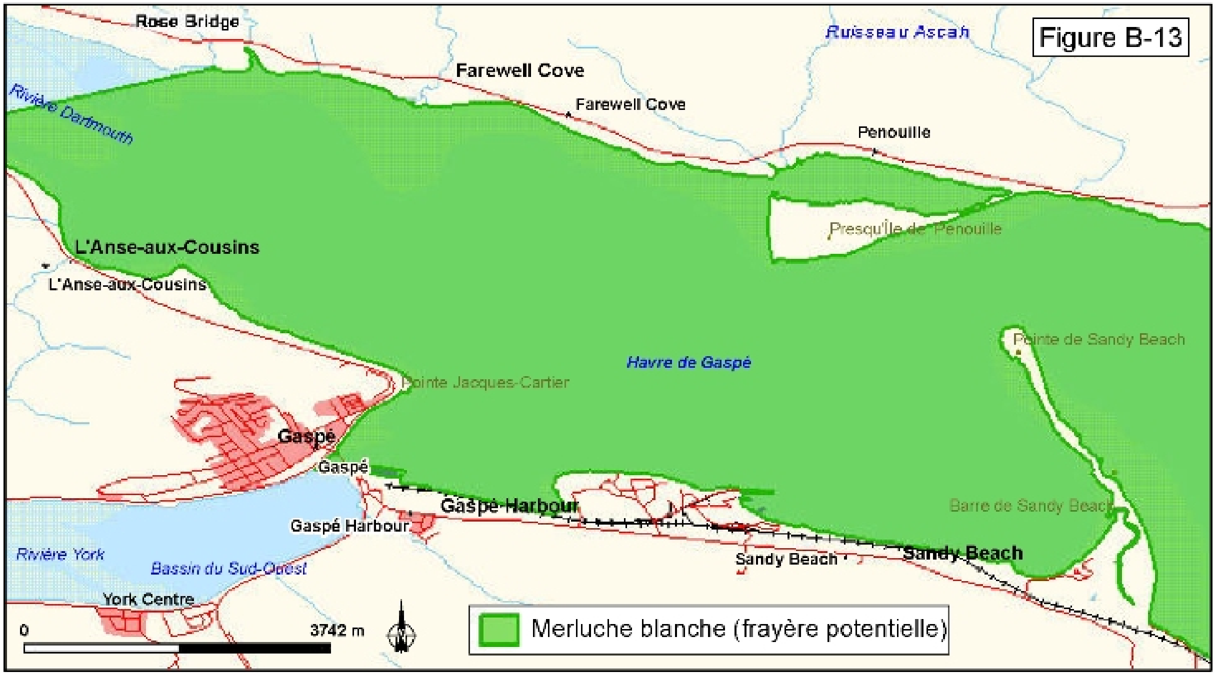

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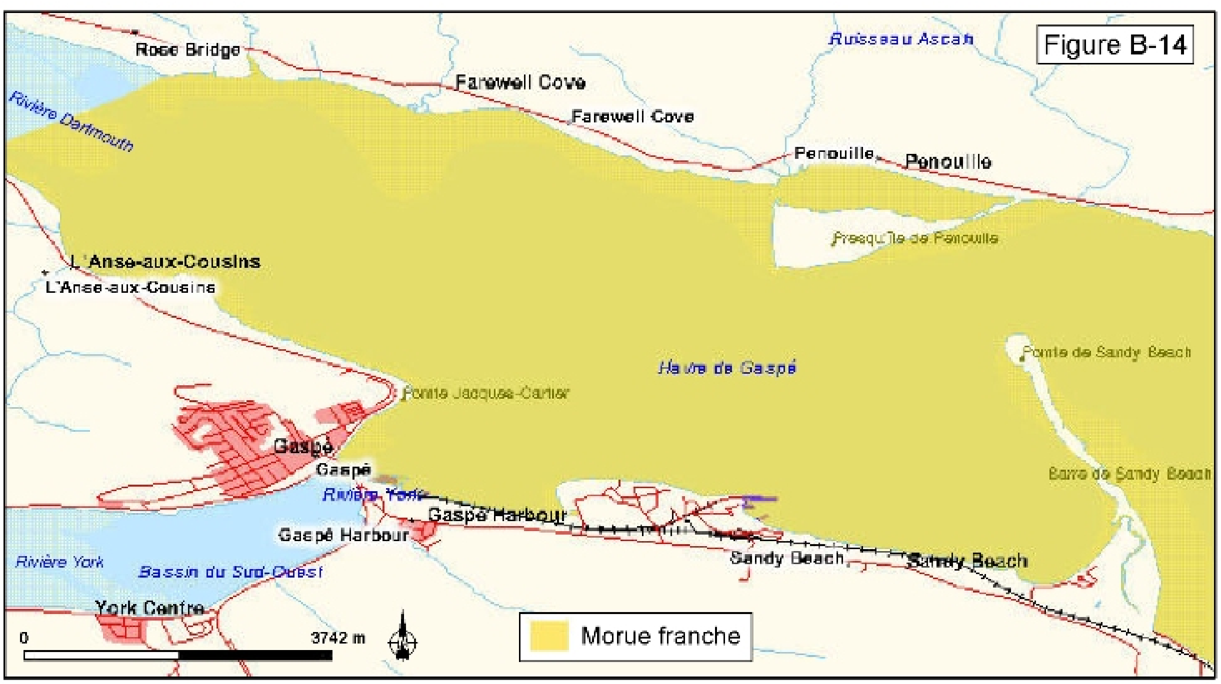

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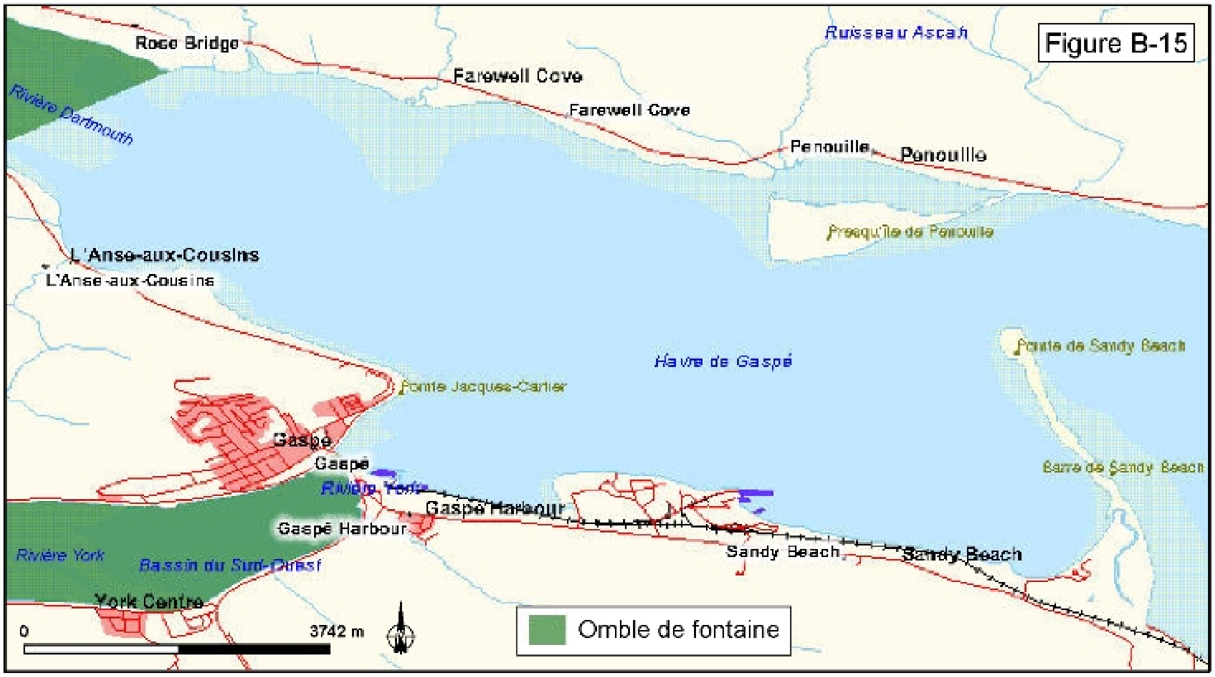

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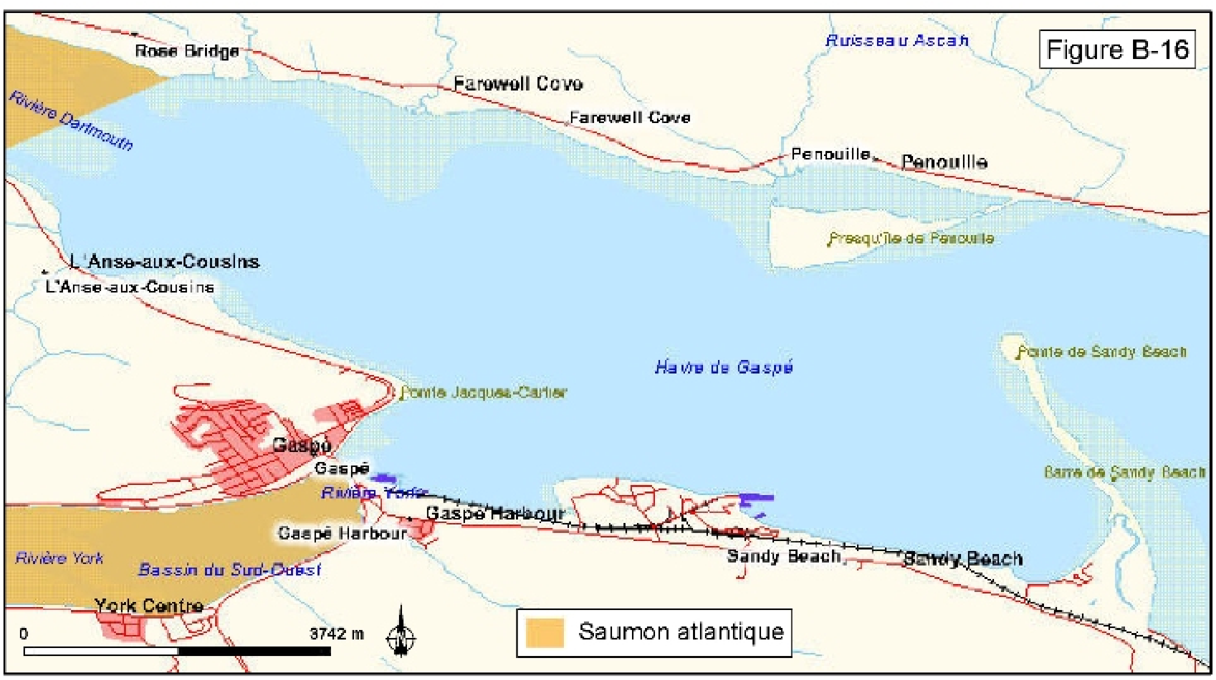

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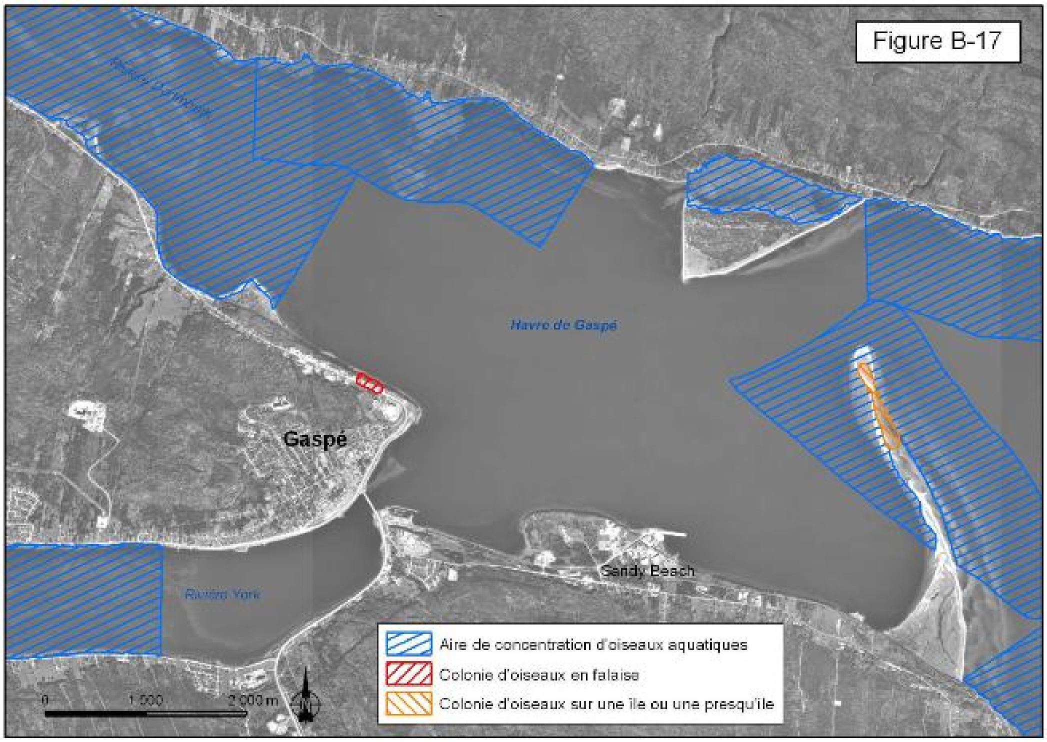
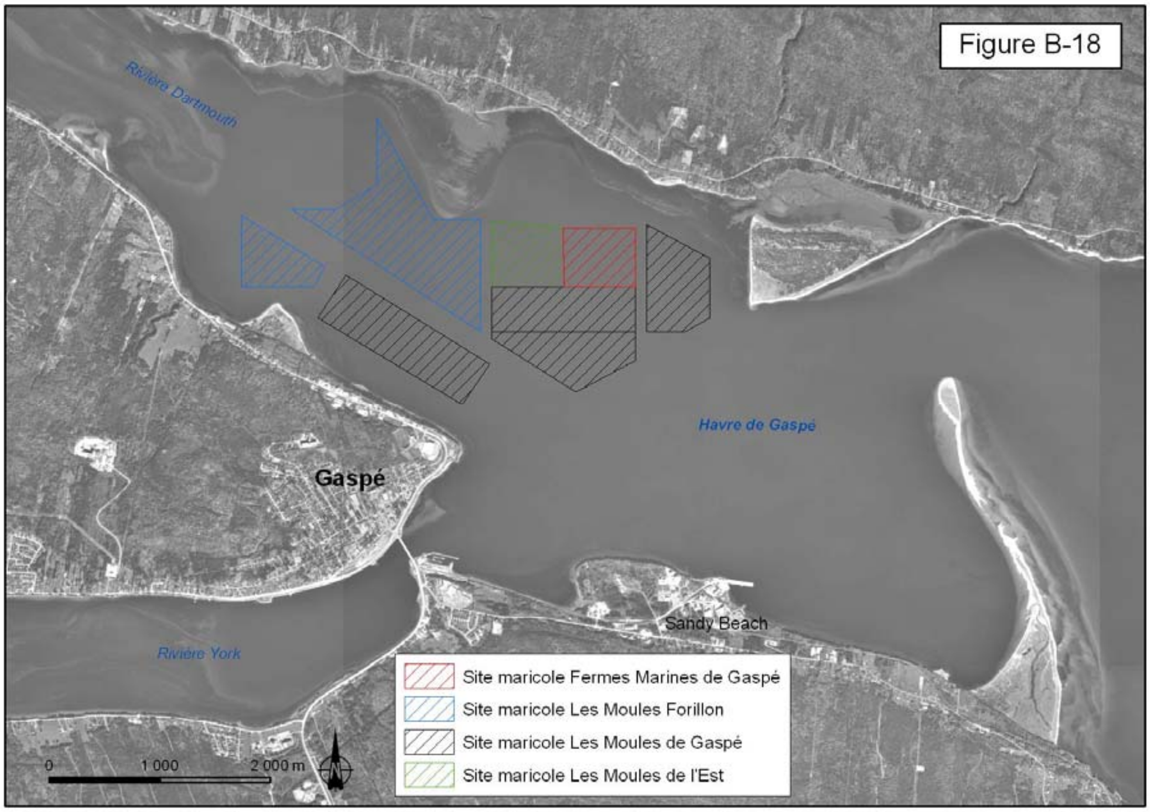


Source: MRNF, 2007



Source: MAPAQ, 2009

Appendix D Environmental Monitoring Form

Environmental Monitoring Form

This environmental monitoring form, to ensure the respect of the mitigation measures, must be completed by the site supervisor and submitted to Transport Canada and the MDDEP once the work is completed.

PROJECT IDENTIFICATION		
Port of Gaspé – Sandy Beach sediment remediation project		
Date of the work:		
Date of the monitoring:		
Monitoring activity performed:	☐	Site visit during the work
	☐	Other monitoring activity (specify):

MONITORING ACTIVITY	FREQUENCY	APPLIED Y or N	COMMENTS
AIR QUALITY			
Shut off construction equipment and trucks when not in use.	D		
Use machinery, equipment and vehicles in good operating condition to minimize the emission of atmospheric contaminants.	D		
During transportation, material containing fine particles must be covered with securely attached tarpaulins.	WA		
If the contractor needs to use a dust-control liquid (other than water), it must be certified by the *Bureau de normalisation du Québec*.	WA		
Visually monitor dust emissions and take action to control these when needed.	D		
Set a 15 km/h speed limit on the job site.	D		
Prohibit the burning of waste in an open fire.	D		
Strictly limit the handling of the dredged sediment to reduce odour emissions. If the odours cause complaints, consider using chemical or biological neutralizing agents.	WA		
If a heat treatment option is selected, ensure that the company has the necessary certificate of authorization to operate the technology and covers atmospheric emissions.	BW		
GROUND SURFACE			
Strictly limit stripping, clearing, excavating, backfilling and levelling in the work areas in order to respect the site's natural topography and prevent erosion.	WA		
Ensure that measures are taken to limit the erosion of the denuded soil and excavated material generated during the pre-work phase to keep suspended matter from reaching the harbour. If necessary, cover the denuded surfaces or piles of material.	D		
Avoid creating ruts and compacting the soil, which reduces runoff of the surface water and its infiltration in the soil, by using vehicles adapted to the bearing capacity of the ground and avoiding driving over wet ground. Limit the use of heavy machinery on erodible, fragile, sloping ground or ground with a low load-bearing capacity.	D		
Direct the runoff and drainage water so that it bypasses erosion-sensitive areas. If these areas cannot be avoided, erect some type of protection (berm, diversion trench,	WA		

MONITORING ACTIVITY	FREQUENCY	APPLIED Y or N	COMMENTS
etc.).			
EQUILIBRIUM PROFILE AND SLOPES			
The slopes of the basins' excavation trench and the landing pier's backfill must be designed to minimize the risk of collapse (slight slope).	WA		
After dismantling the dewatering basin, level the work area and excavated material storage area in accordance with the environment's initial topography. Restore the drainage and stabilize erosion-sensitive areas.	EW		
SOIL AND SEDIMENT QUALITY/SURFACE AND GROUNDWATER QUALITY			
At the commencement of the work, the contractor must present an emergency response plan in the event of an accidental contaminant spill (other than the dredged material). Ensure that the plan contains, at minimum, a response diagram and notification structure and is placed in an easily accessible location in plain view of all workers.	BW		
Have the necessary response equipment on hand in the event of an accidental contaminant spill, including a catchment device for free-floating material that can be quickly deployed, such as booms (in the event of petroleum product spills), as well as silt fences and/or hay bales (to contain contaminated sediment accidentally spilled on the ground and prevent fine particles from the erosion of temporary piles of excavated material and reworked sectors from migrating toward terrestrial and aquatic areas).	D		
Continuously supervise all handling of fuel, oil, other petroleum products or contaminants, including transfilling, to avoid accidental spills.	WA		
In the event of a spill, immediately notify the people responsible. Also immediately notify Environment Canada's emergency service (1 866 283 2333) and *Urgence Environnement du Québec* (1-866-694-5454) for a land spill and/or the Canadian Coast Guard – marine pollution (1-800-363-4735) for a spill in the bay or harbour.	WA		
Do not dispose of debris, waste, garbage, materials, etc. in the harbour and take measures to prevent all contamination of the hydrous environment.	D		
Before the work begins, identify a machinery maintenance and hazardous material handling and storage area. This site must be at least 30 m from the shore.	BW		
Plan for the implementation of works and measures (geomembrane, leachwater catchment system, etc.) to ensure the watertightness of the basins and thus keep contaminants from migrating toward the underlying soil and water table.	BW		
Store, dispose of or treat the water from the dewatering unit, truck washing area and treatment system in accordance with the legislation in force.	WA		
Keep the construction equipment and trucks in perfect operating condition. Conduct a daily check for contaminant leaks (oil, etc.) on the material and repair any mechanical problems immediately.	D		
On a daily basis, collect and sort the different waste that is generated, according to whether it is recoverable residual material, residual material to be sent for disposal within the meaning of the *Règlement sur l'enfouissement et l'incinération des matières résiduelles* or hazardous residual material (HRM) within the meaning of the *Règlement sur les matières dangereuses* in effect.	D		
If, during the excavation work (namely when building the dewatering basin), the soil shows any signs of contamination (stains, odour, presence of debris, etc.), immediately stop the work and notify the site supervisor.	WA		
Manage the contaminated soil and excavated material in sites authorized by the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), in	WA		

MONITORING ACTIVITY	FREQUENCY	APPLIED Y or N	COMMENTS
accordance with the *Politique de protection des sols et de réhabilitation des terrains contaminés* and the *Règlement sur l'enfouissement des sols contaminés* (RESC).			
A copy of all weight tickets issued at the different disposal, treatment or valorization sites must be submitted to the site supervisor.	WA		
The transportation of the contaminated soil must respect the *Règlement sur le transport des matières dangereuses* (provincial regulation) and the *Transportation of Dangerous Goods Regulations* (federal regulation).	WA		
Whenever possible, position the dredge so that the commercial wharf shelters it from the bay of Gaspé's currents.	WA		
Whenever possible, install a turbidity curtain to limit the dispersal of the mechanically dredged material and ensure that the contractor is capable of repairing the curtains onsite, if needed, in a short timeframe.	WA		
Visually supervise in real time and monitor the concentration of suspended particulate matter (SPM) generated by the work in the water outside the turbidity curtains.	WA		
The contractor must adjust the speed at which the bucket is raised to the surface and out of the water to reduce the loss of material as much as possible. The contractor will be informed of the importance of working carefully. The contractor must also avoid needlessly resuspending disturbed sediment, namely by refraining from making abrupt movements, levelling the seabed with the bucket (mechanical dredging) or creating ripple marks (hydraulic dredging).	WA		
The contractor must suspend the dredging work in inclement weather (storms, violent winds) to limit sediment dispersal.	WA		
The barges used to transport the excavated material must be watertight to prevent the loss of material during transportation. The contractor must refrain from using the barge overflow.	WA		
Issue a notice to mariners before the commencement of the work to inform them of the nature and duration of the work.	BW		
If the sediment is treated, ensure that the selected company has the necessary certificate of authorization to operate the technology, which covers liquid effluents, before the work is set to begin.	BW		
TERRESTRIAL, RIPARIAN AND AQUATIC VEGETATION			
Do not, under any circumstances, overstep the project's right-of-way and take particular care with trees and shrubs in close proximity to the work area.	D		
Limit tree removal (if necessary) and brush clearing in the project's right-of-way.	WA		
Limit encroachment on the riparian and marine environments when planning the temporary works required for the project.	BW		
Do not drive on the strip under the crowns of trees and shrubs near the work area and protect these by installing snow fences, a ring of planks or any other protection considered to be effective.	D		
When the work is complete, and if required by the owner, encourage the return of vegetation by planting the denuded surfaces (namely the dewatering basin) with indigenous species (shrubs and herbaceous plants) compatible with the environment.	EW		
Plan a compensation project for the loss of the seagrass beds that will be affected by the dredging work, approximately 52 106 m^2. This surface area is included in the area to compensate for the loss of the habitat used by fish and other aquatic wildlife.	BW		

MONITORING ACTIVITY	FREQUENCY	APPLIED Y or N	COMMENTS
FISH, OTHER AQUATIC WILDLIFE AND THEIR HABITAT			
If the intervention area is to be confined, take the necessary measures (ex. hitting the surface of the water with the bucket of the mechanical shovel) to scare the fish and thus prevent them from becoming trapped in the enclosure. If needed, use fishing gear (seine nets or gillnets) to capture any live fish trapped in the dredging area and release them in open water. Obtain the necessary permits from Fisheries and Oceans Canada before making such catches.	BW and WA		
In order to protect the aquatic habitats that may be used as feeding or rearing grounds by numerous species, the contractor must respect the following restriction periods, during which dredging work is prohibited: ✓ Brook trout: May 15th to June 30th; ✓ Rainbow smelt: May 15th to June 30th; ✓ Capelin: May 15th to June 30th.	BW		
Plan a compensation project for the loss of habitats used by fish and other aquatic wildlife that will be affected by the dredging work, approximately 59 714 m^2. This surface area is included in the area to compensate for the loss of the seagrass beds.	BW		
TERRESTRIAL HABITAT			
Do any clearing work (if necessary) before the breeding and brooding period for forest bird species, usually between May 1st and August 1st.	WA		
SOUND CLIMATE (RESIDENTIAL SPACE)			
Ensure that all of the machinery and equipment that is used respects the standards for sound levels.	D		
COMMERCIAL AND INDUSTRIAL ACTIVITIES/FISHING AND AQUACULTURE			
Implement an information program for wharf users (commercial and industrial boats, Canadian Coast Guard, fishing and aquaculture boats) and notify these in advance and on a regular basis, of the progress and nature of the work.	BW		
Maintain the conditions required for the use of the commercial wharf (by commercial and industrial boats, the Canadian Coast Guard and fishing and aquaculture boats).	D		
Ensure that the surface areas of the sites selected for the installation of basins and other equipment to dewater and/or treat the sediment do not interfere with existing commercial and industrial activities, the expansion of a business or setup of a new business.	BW		
If necessary, install a temporary water intake for the lobster pound. This intake will need to be moved outside the dredging area, to a location with little possibility of being affected by the migration of suspended matter.	WA		
PUBLIC AND USER SAFETY			
Put up clear signs indicating the constraints imposed by the work (blocked road, detour, no parking, etc.) to ensure the safety of public road users at all times.	BW		
Issue notices to shipping to ensure safe navigation.	D		
Ensure that the chemical and petroleum products stored at the site are carefully managed and monitored so as to prevent all spills, leaks or fires that could affect the health and safety of shoreline residents.	D		
If the sediment is treated, ensure that the company respects the clauses of the certificate of authorization to operate the technology, which clearly indicates the nature	BW		

MONITORING ACTIVITY	FREQUENCY	APPLIED Y or N	COMMENTS
of the authorized products, their quantities and management (storage and handling).			
COMMERCIAL AND INDUSTRIAL INFRASTRUCTURES			
Check for the presence of underground infrastructures (pipes and cables, extension of the shipyard's slipway, right-of-way of the former slipway, sea intake for the lobster pound) before setting up the job site.	BW		
ROAD AND RAIL NETWORKS			
Ensure that the public roads are kept clean throughout the project. Wash mud from all vehicles and construction equipment in the washing area before heading onto the roads.	D		
Always keep the roads that are used during the project in good condition and take measures to ensure that they can be used and crossed without any problem by other users.	D		

** BW = Beginning of the work; D = Daily; EW = End of the work; WA = When applicable

Comments (field observations, unsatisfactory waste management, presence of waste oil, machinery leaks, work carried out, but not included in the environmental assessment, etc. – all details not mentioned in the mitigation measures):		
MONITORING		
Prepared by: Date: Title: Organization: Tel. no.:		
I certify that the information provided above is accurate and complete and corresponds with my interpretation of the work.		
Signature: Written by: Position title: Company:		Date: