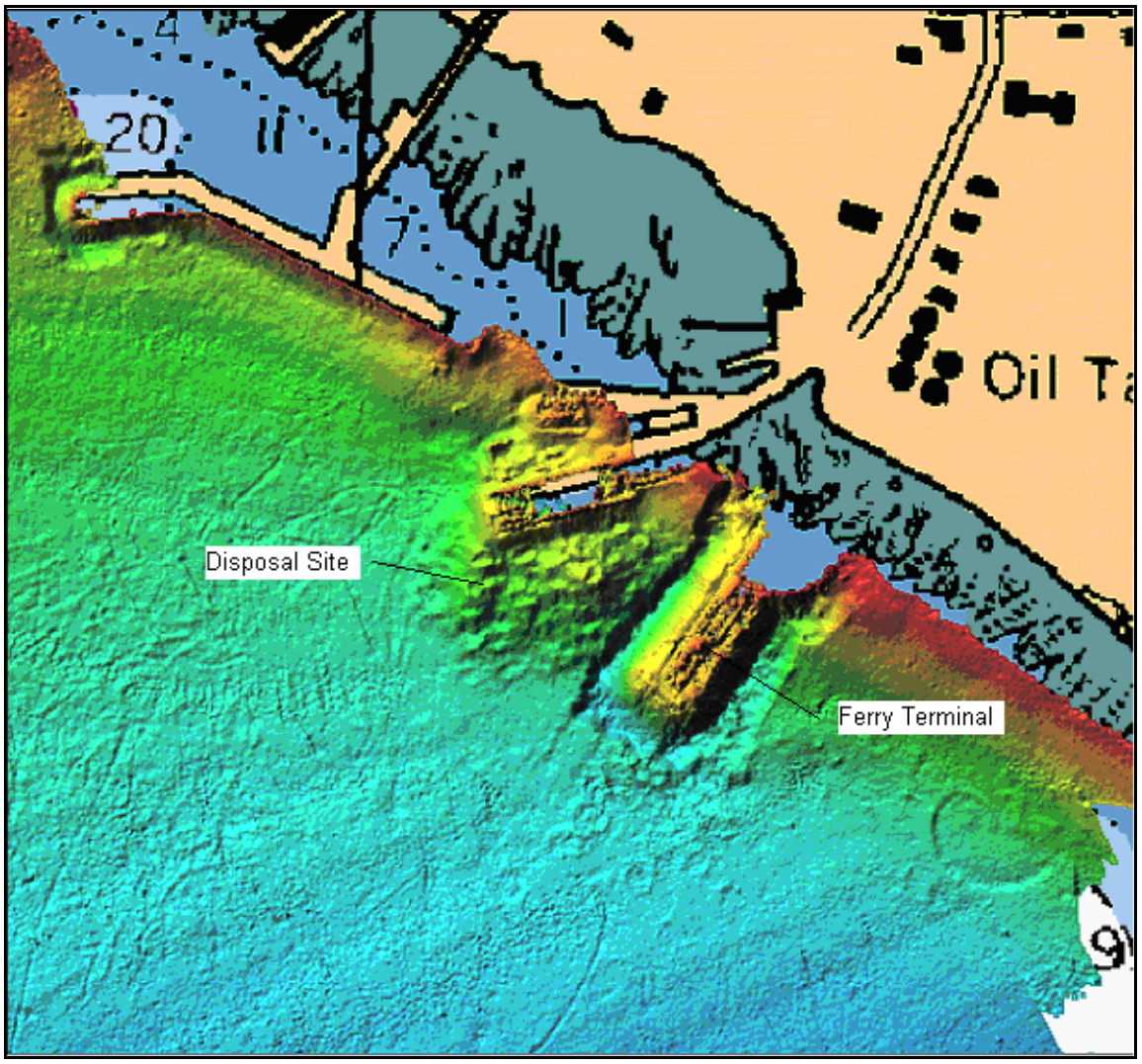
Environment Canada Environnement Canada

Compendium of Monitoring Activities at Disposal at Sea Sites in 2002.



Disposal at Sea Program
Marine Environment Branch
Pollution Prevention Directorate
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Environment Canada

March 2004

Canada

Cover: Multibeam bathymetry of North Head disposal site and ferry terminal, Grand Manan, New Brunswick, 2003. Generated by Atlantic Geoscience Centre.

Summary

Each year, Environment Canada conducts representative monitoring at disposal at sea sites. This is one of the measures in place to protect Canada's marine environment under the *Canadian Environmental Protection Act, 1999* (CEPA) and meet our international commitments under the London Convention 1972 and its 1996 Protocol on preventing marine pollution by controlling the disposal of wastes at sea. This report provides a technical summary of monitoring activities conducted in the year 2002.

A total of seven sites were examined, three in the Atlantic Region, one in Quebec Region, and three in the Pacific and Yukon Region. In the Atlantic Region, geophysical work looked at deposition and transport of disposed dredge spoils. At two of the sites (Bird Island and Table Head) the suitability of dredged material for lobster habitat creation was examined. Results indicate that dredge spoils at two of the sites are sub-optimal as lobster habitat. At the North Head disposal site, off site sediment transport was studied at a site where PAH contaminated sediments had been deposited with an overlying cap of clean sediment. The preliminary results of this study indicate that the disposal site is stable with minimal off-site transport.

Work in the Quebec Region focussed on a disposal site in the Magdalen Islands that had been closed due to concerns over the of-site transport of sediment to adjacent lobster habitat. A geophysical study indicating little off-site sediment transport lead to the re-opening of the site and further disposal activities in the summer of 2002. Benthic community studies, studies of the effect of sediment re-suspension on shellfish, and further geophysical seabed analysis were conducted both during and after the disposal activities. Results from these studies support the re-opening of the site.

In the Pacific and Yukon Region chemical and biological testing was conducted on sediment samples taken at one active site at Ogden Channel in the Strait of Georgia. Preliminary results indicate no increase in chemical contamination at the site due to disposal activities. Some toxicity, however, was seen in biological testing. Additional analysis will follow on these results. Sea bed studies were also conducted at Porlier Pass and Point Grey disposal sites, using remotely operated submersibles and multi-beam bathymetry in order to ascertain that no off-site sediment transport was occurring. Results indicate the stability of both sites.

Comments

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Introduction

Canada is a maritime nation. It possesses 243,790 km of coastline, the longest of any nation in the world, and has a vital interest in preserving a healthy marine environment. Though by world standards the Canadian maritime environment is relatively uncontaminated, Canada's territorial waters do have some problems, especially in harbours, estuaries and near shore areas.

Canada regulates disposal at sea through a permit system under the *Canadian Environmental Protection Act, 1999* (CEPA). This is one of the measures in place to protect Canada's marine environment and meet our international obligations under the London Convention 1972 and its 1996 Protocol on preventing marine pollution by controlling the disposal of wastes at sea.

CEPA requires Environment Canada to monitor representative disposal at sea sites each year. This is conducted in accordance with national monitoring guidelines and dependant on available resources from the disposal fees collected. In order to respond to Canada's national and international reporting obligations, this National Compendium of Monitoring Activities, based on regional reports, is produced annually.

Role of monitoring

Besides being required by law, disposal site monitoring allows permittees continued access to suitable disposal sites by helping to ensure that the permit conditions were met and the use of the site has not caused unacceptable or unpredicted impacts. It verifies that assumptions made during the permit review and site selection process were correct and sufficient to protect the marine environment and human health. Monitoring allows Environment Canada to gather information and take appropriate action to manage the sites in an environmentally sound manner.

Monitoring also plays a critical role in reviewing the overall adequacy of controls. Information compiled nationally and regionally, over time, provides the basis to assess whether the disposal at sea regulatory controls, guidelines and permit conditions are adequate to protect the marine environment and human health.

Experience gained with monitoring may also point to the need for research to develop better monitoring tools, or to refine the monitoring program, on specific environmental, health or public concerns. It is also expected that monitoring will uncover gaps in our understanding of impacts, particularly in the area of cause and effect relationships.

In order to increase the level of involvement of stakeholders, annual meetings with clients and other interested parties provide additional comments on past monitoring and better indication of Regional priorities for future assessments. The annual meetings also ensure Environment Canada’s decisions concerning monitoring activities are carried out in an open and transparent manner.

Finally, Environment Canada’s disposal site monitoring, reporting and communication with stakeholders are activities critical to fulfilling the federal and international obligation to apply the Precautionary Principle in administering CEPA.

Conducting monitoring studies

Monitoring a disposal at sea sites is conducted according to national guidelines. Activities carried out in a given year are based on available resources and can involve an assessment of the physical, chemical and biological features. The impact hypotheses generated by permit reviews form the basis of subsequent monitoring.

Physical monitoring relates to the collection of relevant geological information for determining the area of deposition, delineating the disposal site boundaries, studying the accumulation of dredged material within the area of deposition, and documenting evidence of sediment transport from the disposal site.

Biological and chemical assessments are undertaken concurrently and the monitoring design for these parameters takes into account the size and dispersal characteristics of the site. Chemical monitoring is aimed at measuring the levels of chemicals in sediments and comparing them to lower action levels (Table 1) set out by the *Disposal at Sea Regulations* or other national screening levels for additional parameters of concern.

Table 1. CEPA Lower Action Levels.

Lower Action Levels for chemicals in sediments
(Disposal at Sea Regulations)
(mg/kg, dry weight)

Chemical	Current Level
Cadmium	0.6
Mercury	0.75
total PCBs	0.1
total PAHs	2.5

Biological monitoring is primarily centred on biological testing in the laboratory and benthic community surveys. The biological test methods currently used for sediment assessment include:

- an acute toxicity test using marine or estuarine amphipods (the end point is lethality);
- a fertilization assay using echinoids (the endpoint is significant reduction in fertilization);
- a toxicity test using a photoluminescent bacteria, the Microtox® solid-phase test (the end point is significant reduction in bioluminescence);
- a bedded sediment bioaccumulation test using bivalves (the end point is significant bioaccumulation).

Integrative assessment

If sediments are below the lower action levels, or other national screening levels, for contaminants and pass all biological tests, no further action is required. However, if levels of contaminants or biological test results demonstrate a cause for concern then the first step is to verify compliance with the terms of the permits issued since the site was last monitored.

The second step will generally involve checking potential sources of pollutants and conducting further site characterization. After considering this information, the following hierarchy of interpretative guidance can be applied to the concurrent chemical and toxicological data:

- if sediments at the disposal site contain substances in excess of national screening levels (including lower action levels), pass the acute toxicity test, but fail one sublethal or bioaccumulation test: consideration could be given to modifying further use of the site and investigating the long term stability of the material onsite;
- if the sediments contain substances below the national screening levels, yet fail any of the biological tests, then further investigation would be required to determine if this is the result of either a confounding factor such as laboratory anomaly, or the presence of a contaminant not included in the chemical screening; or
- if the sediments contain substances in excess of the national screening levels and either fail the acute test or fail two (or more) additional tests including the sublethal tests and the bioaccumulation test: further monitoring, site closure or remediation could be considered.

As well, cursory benthic community surveys can be used as a general sediment quality indicator. The overall assessment of the disposal site considers all available information from physical, chemical and biological monitoring.

Intensity of monitoring

Monitoring at every disposal site is not considered necessary, as current knowledge of impacts related to disposal of dredged material allows for good assessments to be drawn from representative disposal sites. In addition, the program attempts to ensure that the major sites (>100,000 m3 of dredged materials/year) are monitored on at least a five year cycle. The monitoring of other sites is determined by triggers set out in the national monitoring guidelines which are based on volume, proximity to sensitive areas, or level of concern. The number of sites monitored in a year and the parameters measured at each site depend on the available resources through the collection of fees from permittees.

Reporting

Canada's Disposal at Sea Program is administered through regional offices which are largely responsible for the permit review process, as well as for planning, conducting and reporting on monitoring studies undertaken in their administrative areas. This compendium, based on regional detailed reports, is now produced annually to respond to Canada's national and international reporting obligations. Readers may request detailed information on any of the monitoring activities in this compendium, from the appropriate regional office.

Atlantic Region: Bird Island and Table Head disposal sites

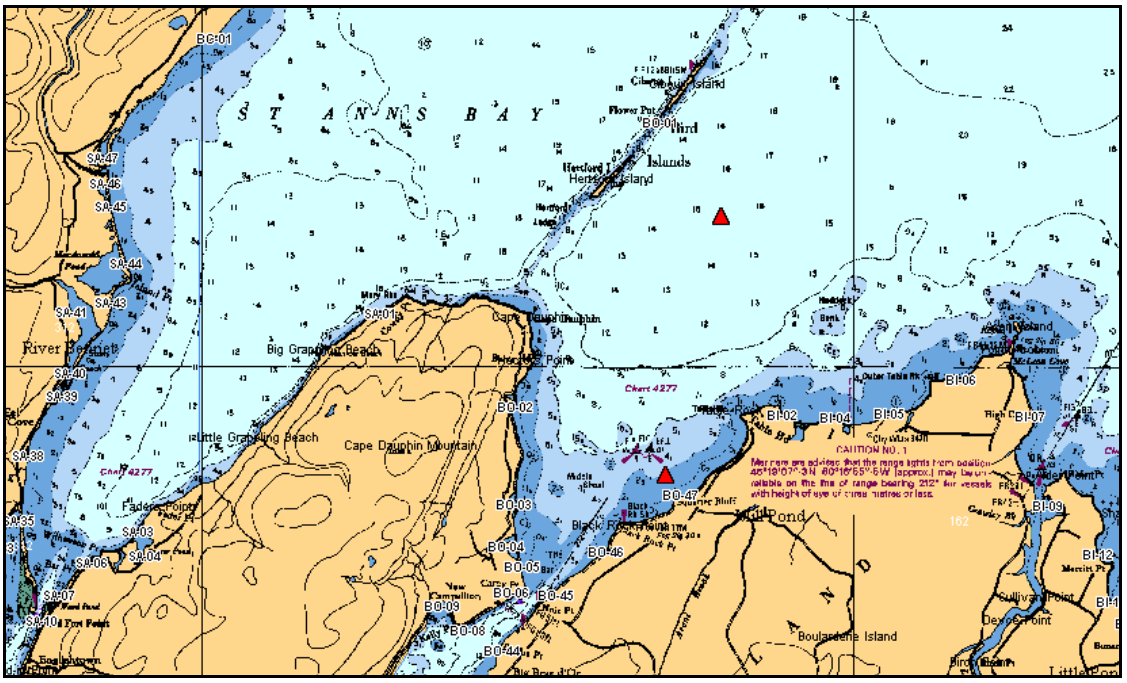


Figure 1. Table Head and Bird Island Disposal Site Locations

Site Description

Location	Cape Breton Island, Nova Scotia	
	Table Head	**Bird Islands**
Depth	10 m	34 m
Material Disposed	Dredged material	Dredged material
Quantity	188,807 m^3	138,414 m^3
Status	Inactive	Inactive
Issue	Evaluation of predicted marginal improvements to lobster habitat	Evaluation of predicted marginal improvements to lobster habitat

Background

Great Bras d'Or channel, with a minimum depth of about 8 metres, provides the main access for marine traffic to Cape Breton's Bras d'Or Lakes. Middle Shoal located northwest of the entrance to Great Bras d'Or has considerably shallower water depths and a narrow channel. The shoal was dredged in 1996 to improve navigation. A permit for the disposal of up to 350,000 cubic meters was granted to the Little Narrows Gypsum Company of Little Narrows, Nova Scotia to dispose of dredged material consisting of rock, boulder, cobble, gravel, sand, and trace quantities of silt and clay. The disposal of dredged material began on August 20, 1996 and ended on October 24, 1996 after 328,021 cubic meters of material had been placed.

To offset any possible reduction in fishing success at the dredge site, the dredged material was placed in two locations (see Figure 1) and evaluated to see if it provided lobster habitat. The locations were selected in

conjunction with the local commercial fishing community and were thought to be areas of poor lobster habitat that might benefit from the deposit of coarser materials.

Impact Hypotheses

Dredged material disposal will provide new fishing grounds and a slight increase in lobster production

Parameters measured

The study of the seafloor utilized the integrated geophysical, sedimentological, geochemical, and biological techniques employed by the Geological Survey of Canada - Atlantic (GSCA) to characterize the nature, distribution and remobilization of marine sediments. The surveys were designed to provide information on the character of seafloor sediments at the disposal sites and to determine the effect of the disposal activities on the seafloor. Geophysical characterization and mapping of the seafloor sediments were accomplished using sidescan sonar, multibeam bathymetry, and sub-bottom profiler surveys. Seafloor samples were taken with grab samplers and gravity corers. Seafloor photographs and video transects were collected to provide information on physical characteristics and benthic communities. The Invertebrate Fisheries Division of Fisheries and Oceans Canada reviewed monitoring data and related information to evaluate the habitat value of the material deposited.

Results and Conclusions

The habitat created at the Table Head and Bird Island sites has been determined to be sub-optimal for lobsters but likely an improvement over the pre-deposition habitat. Discussions with lobster fishermen in the area indicate little commercial lobster fishing at the Bird Island site but some at Table Head. Table Head has been slow to attract commercial sized lobsters, but there is optimism from fishermen that it will improve.

At present there is insufficient information to judge the extent to which lobsters are actually using the habitat created. Further study is needed to fully evaluate the success of providing lobster habitat.

Atlantic Region: North Head Disposal Site

Site Description

Location	North Head, Grand Manan Island, New Brunswick
Depth	13 m
Material Disposed	Dredged material
Quantity	16 000 m^3 in 1999 from dredging operations in the North Head ferry terminal.
Status	Closed
Concerns	Verify that disposed dredged material is not migrating to adjacent areas.

Background

Grand Manan is the largest of a group of three islands situated off the south-west corner of the Province of New Brunswick. The island is accessible via a daily ferry departing from the mainland and arriving at a ferry terminal in North Head. In 1999, the New Brunswick Department of Transportation constructed a new ferry terminal adjacent to the then existing terminal. As part of the construction, the seafloor at the site was dredged and approximately 16,000 cubic metres of material was placed alongside the old ferry wharf.

The top 0.15 metres of the dredge area sediments were contaminated with polycyclic aromatic hydrocarbons (PAHs). Underlying material was clean. As a mitigation measure the Disposal at Sea permit required the dredging of the top 0.30 metres of seafloor, placement of this layer of sediments at the disposal site, and placement of the uncontaminated sub-surface sediments as a cap on the disposal site.

In 2003 Environment Canada contracted Natural Resources Canada to conduct integrated geophysical, geochemical, video, and bottom photography surveys to characterize the nature, distribution and remobilization of marine sediments at the disposal site.

Impact Hypotheses

The disposal site is stable and material is not transported from the disposal site to surrounding areas.

Results

A review of geophysical and bathymetric data for the North Head dumpsite was performed to determine existing conditions. The multibeam bathymetry data shows that the disposal site is well defined with the dredge spoils deposited south of the old ferry terminal. (Figure1). Acoustic backscatter measurements made from the multibeam bathymetry indicate the presence of coarser material on the surface of the disposal site. A preliminary analysis of the seafloor photographs and videos collected show the presence of rip-rap, sand and coarse gravel covering much of the seafloor immediately adjacent to the new ferry terminal. The recent dredge spoils are being re-colonized by a variety of marine biota. Sea stars and sea urchins are seen on many of the photographs. Many of the boulders and cobbles have a coating of the calcareous pink algae *Lithothamnion sp*, suggesting that they are stable and are not frequently moved. Large boulders forming a sharp cliff face were observed on the outer area of the disposal site. Data analysis is ongoing.

Reference

D. R. Parrot. 2003. *North Head Ferry Terminal Offshore Disposal Site Investigation 6-18 May 2002*. Prepared for Environment Canada, Atlantic Region.

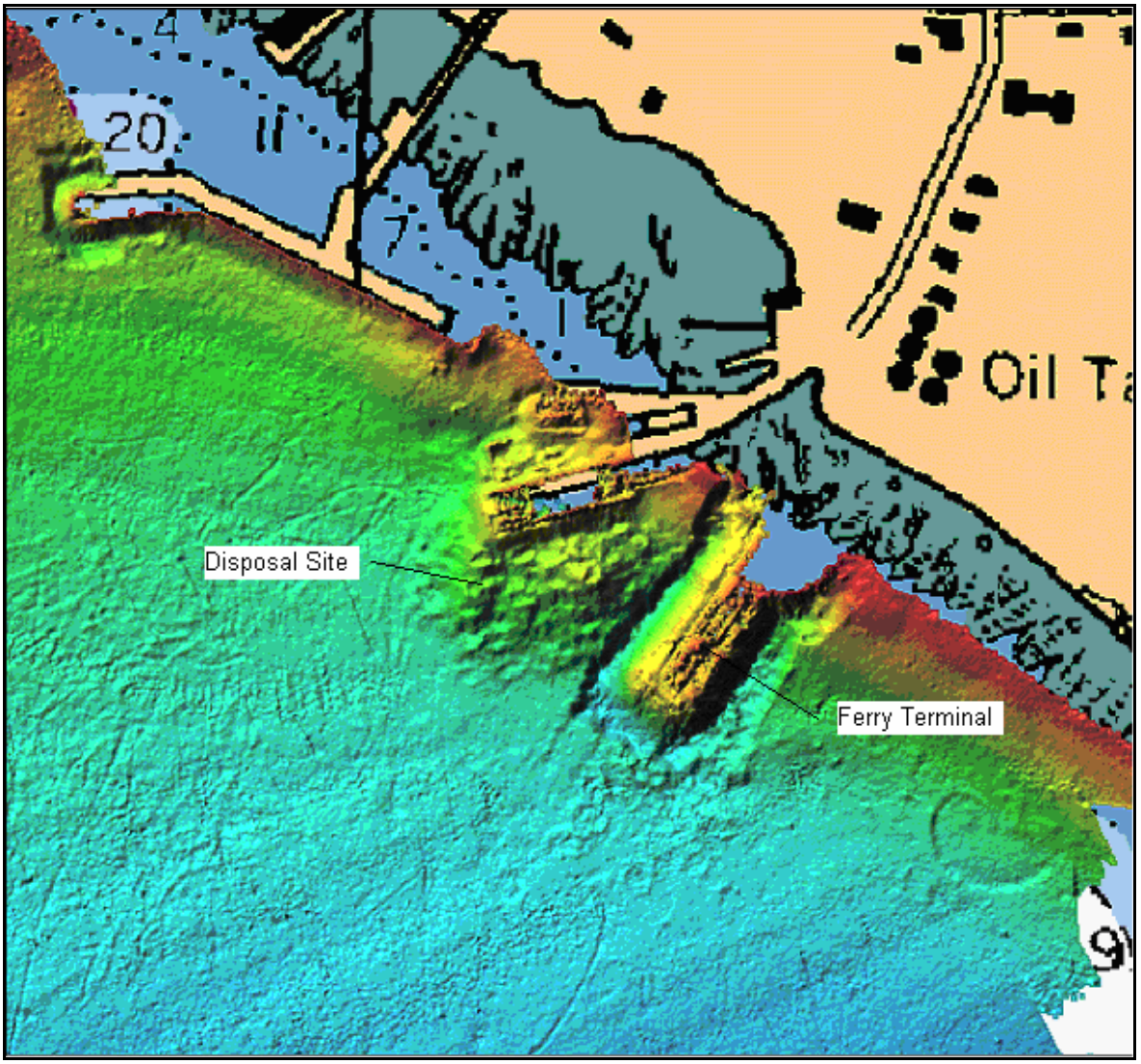


Figure 2. North Head ferry terminal in Grand Manan.
Bathymetric data collected by Natural Resources Canada after excavation for the ferry terminal and all construction was completed. (Modified from Parrot 2003)

Atlantic Region: Amherst Cove Disposal Site

Site Description

Location	Amherst Cove, Price Edward Island
Depth	13 m
Material Disposed	Dredged material consisting mainly of sand and silty sand with gravel
Quantity	473,000 m^3 of sediment from 59 bridge alignment locations and a jetty
Status	Closed
Concerns	Assessment of lobster habitat

Background

The Confederation Bridge was constructed between 1994 and 1996 linking New Brunswick and Prince Edward Island. During its construction, it was necessary to excavate overburden material overlying the bedrock for many of the bridge piers. Strait Crossing Joint Venture received a permit from Environment Canada to dispose of 473,000 m^3 dredged material in a marine disposal site in the inshore waters of Amherst Cove. The dredged material consisted mainly of sand and silty sand with gravel, boulders and pieces of bedrock. The permit imposed mitigation measures for fish habitat improvements on the disposal activities.

To assess the effectiveness of the habitat modification efforts conducted at Amherst Cove PEI following the completion of the Confederation Bridge, Environment Canada (EC) contributed funding to the Geological Survey of Canada (GSC) to conduct a geophysical study in 2001. In 2002 EC and GSC invited Fisheries and Oceans Canada to assess the habitat in relation to its value for lobsters.

Impact Hypotheses

Habitat for crustaceans, namely lobster (*Homarus americanus*) and rock crab (*Cancer irroratus*), at the disposal site will be enhanced by introducing coarse material such as cobbles and boulders on a bottom of low complexity.

Results

Based on maps produced by multibeam data collected in 1994 (Figure 3A), the seafloor of the Amherst Cove area was fairly smooth and featureless. In a 2001 multibeam survey, the new dredge spoils from the construction of the Confederation Bridge can be seen very clearly (Figure 3B). Based on video surveys, the presence of discrete piles of coarse substrate separated by soft substrate was observed inside the disposal site, but not outside the disposal site. This was also confirmed by seafloor photographs and pictures of grab samples.

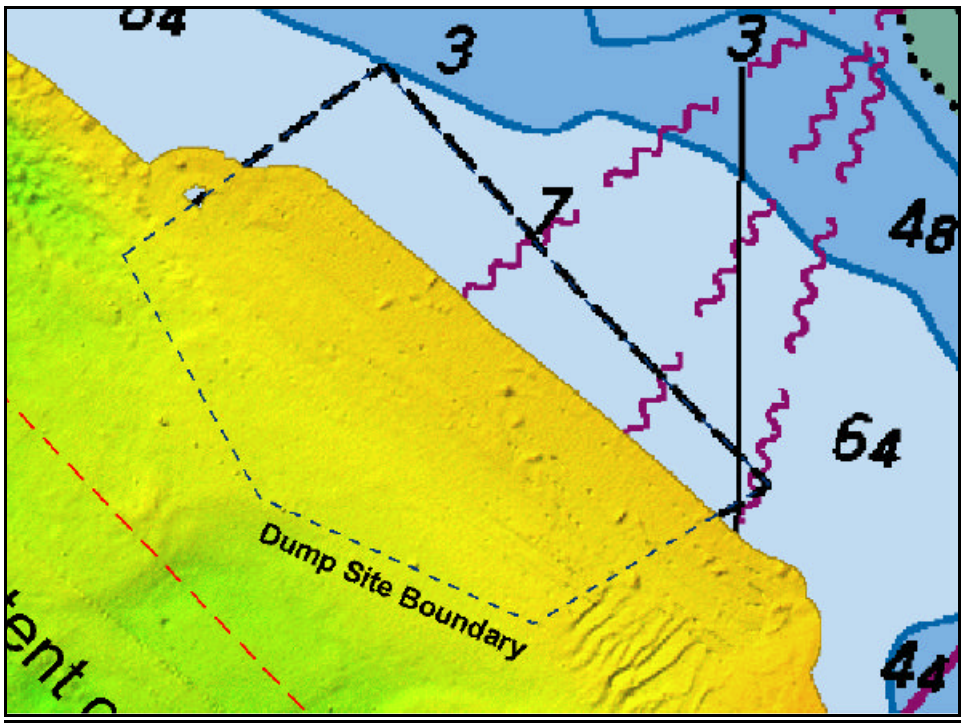
The habitat in the Amherst Cove was changed from a poor to a marginal lobster habitat. The abundance of lobster has increased from a total absence in the disposal site prior to the deposition of dredged material to 74 lobsters per km^2. As it was observed before the deposition of dredged material, rock crabs have been seen in abundance in the disposal area.

No SCUBA diving survey was done to judge the extent to which lobsters are actually using the habitat created and based on fishing data, there is no indication that fishermen harvesting lobster in the immediate area where the disposal site is located have benefited from the habitat modifications.

Reference

M. Comeau. 2003. *Dredged material deposited at Amherst Cove PEI during the construction of the Confederation Bridge: An assessment of habitat enhancement for lobster*. Prepared for Environment Canada, Atlantic Region.

A.



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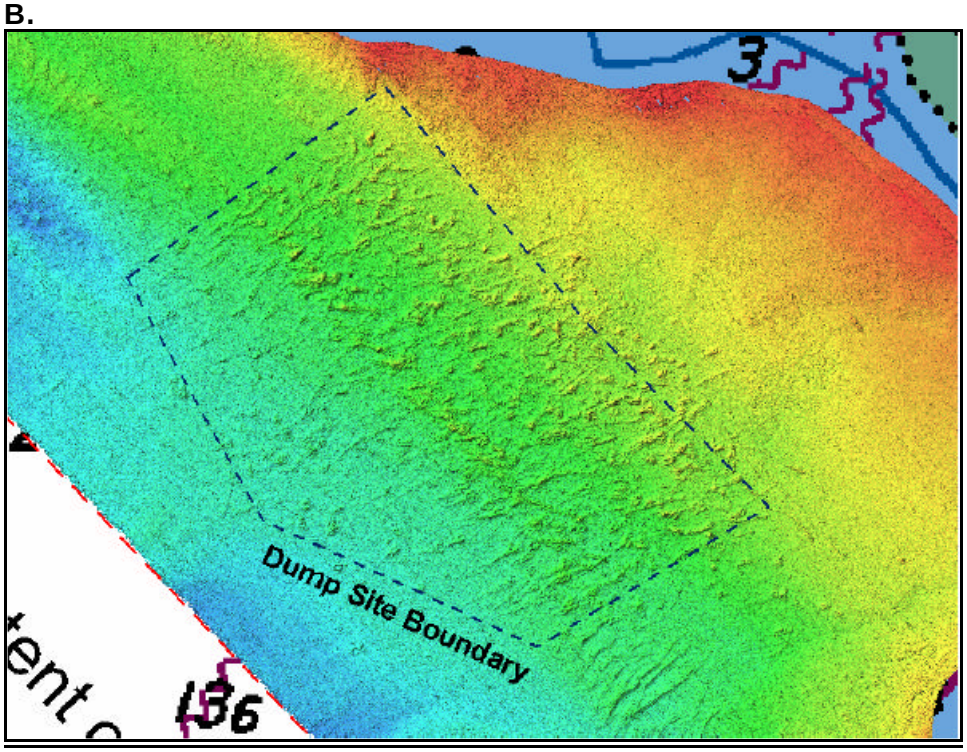

Figure 3 Bathymetric maps from the 1994 (A) and 2001 (B) multibeam surveys.
The outline of the disposal site is shown on the charts by the dashed line identified as "Dump Site Boundary". (Multibeam mosaics supplied by Russell Parrott from GSC)

Quebec Region: Depot D, Part I —Review of site closure

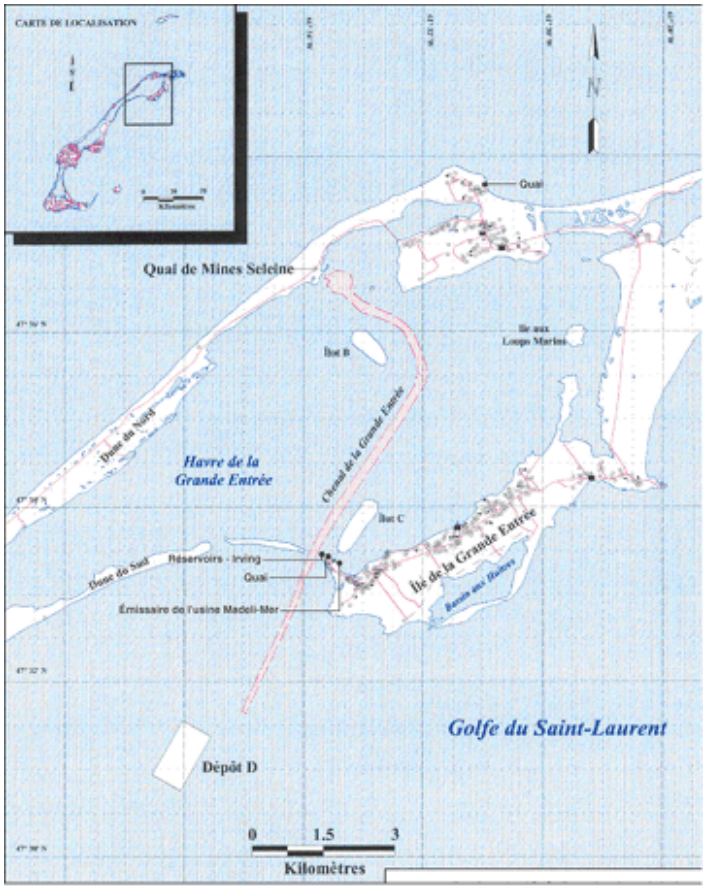

Figure 4. Location of Depot D and Grande Entrée Channel.

Site Description

Location	Depot D, Magdalen Islands, is defined by the following coordinates: 47° 31.55' N, 61° 36.03' W; 47° 31.37' N, 61° 35.55' W; 47° 31.04' N, 61° 35.82' W; 47° 31.20' N, 61° 36.32' W.
Depth	13 m
Material Disposed	Dredged material
Quantity	585 000 m^3 from 1980 to 1982, 609 000 m^3 in 1992 and 193 000 m^3 in 1997 from dredging operations in the Grande Entrée channel.
Status	Closed
Concerns	Disposed dredged material appeared to be migrating west of Depot D towards a zone known for lobster habitat.

Background

The Grande Entrée lagoon, Magdalen Islands, Quebec, serves as a port for a salt mine that operates on its northwest shore. A channel between the main opening to the lagoon and the mine was first

dredged in the early 1980's. Maintenance dredging of the channel occurred in 1992 and again in 1997. The spoils from both years were deposited at disposal site D, located about 4 km south by south-east of the entry to the lagoon.

Depot D was assessed in 1999. The results showed that the material appeared to have migrated to the west of Depot D into an area of known lobster habitat. The data indicated that the entire site was under constant erosion from 1982 to 1998 as part of a wider process occurring throughout the surrounding area. As the precise amount of material coming from Depot D, relative to that being deposited though natural processes, was not known, the extent of disposal-related impact from Depot D on the lobster habitat was not known. Given this, the Depot D disposal site was officially closed until the permittee, Mines Seleine, could demonstrate that the sediments disposed of at the site were not being transported off-site and causing significant harmful effects on nearby lobster habitat.

Hypothesis tested

Monitoring was carried out to examine sediment dynamics around Depot D and test the following questions:

- Are the disposed sediments at Depot D stable?
- Is there sediment transport? If yes, to what degree and direction?
- Is it possible to estimate the rate of spreading and levelling of sediments at Depot D?
- In the zones adjacent to Depot D, what is the significance of sediments from Depot D compared to those transported naturally in the area?

Parameters measured

In 2000 and 2001, Mines Seleine carried out a study of the sediment dynamics around Depot D which included the following elements:

- A literature review of the sedimentology and hydrodynamics in Depot D and adjacent areas;
- Measurements of sediment transport, currents and swells were carried out in the fall of 2000 and April 2001 to identify hydrodynamic aspects responsible for sediment mobility;
- A mathematical model to determine wind induced currents with the goal of estimating the trajectory of re-suspended sediments;
- A wave predictive model to evaluate sediment mobility at difference depths; and
- A study of differences in bathymetry from sonar surveys taken in 1982, 1995, 2000 and 2001 with the view to quantify sediment transport.

This project was a collaboration of Environment Canada, Robert Hamelin and Associates Inc, Laval University, L'Institut national de la recherche scientifique (INRS-Géoressources), Fisheries and Oceans Canada, Public Works and Government Services Canada.

Observations and results

Examining physical characteristics of Depot D permitted the assessment of sediment dynamics around the site and to determine the behaviour of deposited sediments.

The sedimentological study and bathymetric survey confirmed the re-suspension of sediments disposed of at Depot D. As well, this re-suspension was observed throughout all areas between the shoreline and a 15m depth.

Based on bathymetric analysis, there was not major sediment transport near or outside of the boundaries of Depot D. From the measured currents, the quantity of reworked sediments was estimated to be on the order of 28,000 m^3 per year. However, this reworking was carried by the spreading of Depot D sediments rather than in a unidirectional transport process.

Comparisons of bathymetry indicated that a significant part of the sediments which had eroded from the mounds could be found within the boundaries of Depot D or within its proximity. The currents did not appear strong enough to move sediments far from Depot D in any significant manner.

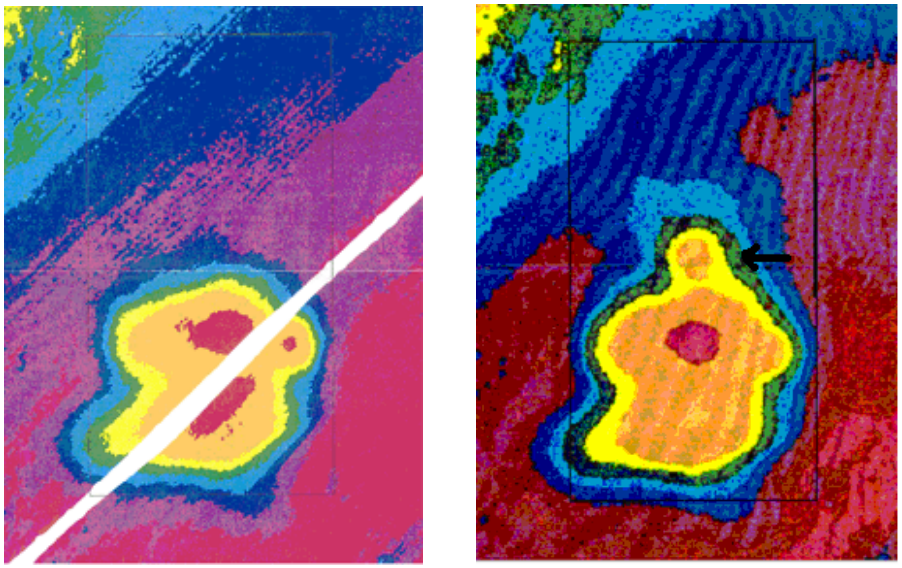

Figure 5. Bathymetry of Depot D from sonar surveys.
Note: Dredged material was disposed of in 1997 which created a new mound seen in 2001 at the top of the original mound. (source: Public Works and Government Services Canada 2002).

Conclusions

The results suggest that sediments from Depot D did not significantly augment the quantity of sediments displaced in the area.

The work demonstrated that the sediments were relatively stable and did not significantly engender a negative effect on lobster habitat found in the adjacent area. This conclusion led to the reopening of the site.

Quebec Region: Depot D, Part II — Benthic community study

Background and Concerns

In the short term, the key concern about the disposal of dredged material on the benthos is the immediate loss of health and habitat for the communities. Over the longer term, benthic life re-colonizes the area, but the time to re-establish a return to a state resembling the original community,

or a state of equilibrium, is not known. This time cannot be generally estimated from the scientific literature because of the large variability of causal factors (volume of sediment, grain size, depth, hydrography, etc.). A study by Fisheries and Oceans Canada showed that the time to re-establish a site in Chaleurs Bay was greater than 2 years, but since, no research has been carried out on this subject in Quebec Region. It is with the goal of assessing the re-colonization time for the benthic community that the survey was undertaken at Depot D.

Work in 1997 at Depot D examined the physical, chemical and benthic characteristics of its sediments and essentially showed that the quality of disposed sediments was satisfactory. Apart from a significant difference in the structure between the benthic communities of the disposal site and the reference site, the disposal of dredged material in open water did not have any adverse impacts on the benthos itself. However, this work did not permit an estimate of the time to re-establish the benthic community because of confounding factors, notably the depth in the reference sites.

To assess the time to re-establish the benthic community, a new physicochemical and benthic community assessment of the sediments in the mounds of Depot D and reference sites was undertaken in the fall of 2001. Specific goals of the study were to:

- determine if the benthic communities in the Depot D mounds and in the reference sites have changed between 1997 and 2001, and if so explain these changes
- by comparing the benthic community structure in different mounds within Depot D, describe the dynamics of the re-establishment of this community.

Parameters measured

Depot D is comprised of three mounds, each corresponding to disposal activity of dredged material from the construction of a channel in 1980-1982 (mound A) and subsequent maintenance dredging in 1992 (mound B) and in 1997 (mound C). In 1997, six zones were sampled; three from the disposal site (mounds A, B, and C) and three from reference sites D, E, and F. In 2001, the three zones of the disposal site and reference zone D were re-sampled. As well, two new reference zones were sampled: one (Z) with a depth, grain size and hydrodynamics comparable to the three mounds and another (N) where dredge spoils will be disposed of in the future. The positioning of stations within each of these zones was randomized.

The survey of the benthic community examined the number of species and individual organisms present in the sediments and was carried out to the lowest taxonomic level possible. The physicochemical analyses were comprised of sediment grain size and redox potential, as well as total organic carbon, total sulphur and total ammonia-based nitrogen in the whole sediment. The redox potential of the sediments was finally not included in the data analysis because of the very large variation of the data.

Observations and results

Various statistical analyses were conducted on the data (multivariate analysis and analysis of variance) to explore the relationships between the physical-chemical data and the benthic data. The results obtained on sediment quality suggest the Depot D site is not contaminated given the low levels of total organic carbon and sulfides in the sediments. Differences between zones may be due to a relatively larger proportion of fines at the reference stations than in the Depot D test stations.

Within the study zones, the benthic community was principally composed of mollusks and polychaetes. A small proportion of echinoderms and crustaceans were also observed. The dominant taxa were the bivalves *Spisula solidissima* and *Tellina agilis* as well as the polycheate *Spiophanes bombyx* which are characteristically found in sandy sediments.

Multivariate analysis of the data suggested that there was an evolution in the benthic community between 1997 and 2001 (see figure 6). The analyses of variance show that density, diversity and evenness of communities have changed significantly since 1997. Further, the communities that were, at the time, dominated by surface detritus feeders, largely due to an abundance of the juvenile echinoderms *Echinarachnius parma*, now show significant proportions of filter feeders.

Conclusions

The current study suggests that the benthic community structures found at the disposal sites are unlikely to ever return to reference site condition, with respect to species composition and abundance, even taking into account the variation in depth and particle size of the sediments between these zones. There is nothing however to prevent the disposal zones from developing a community that is diverse and stable. The time required for a community to regain stable growth conditions is probably greater than 4 years, as zone C continues to show a different community from zone B, 4 years after the disposal event in zone C. However, the time for recovery is probably less than 10 years, as the communities in zones A (created in 1982) and B (created in 1992) are similar in 2001.

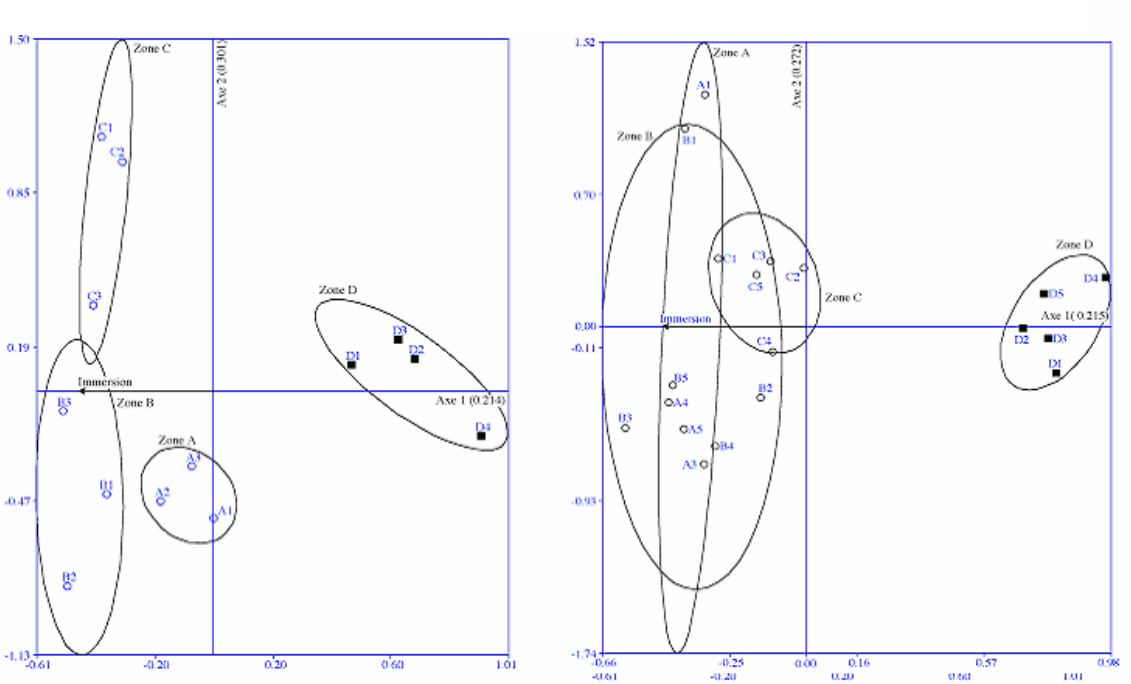

Figure 6. Changes to benthic community structure, Magdalen Islands
As shown by multivariate analyses of abundance data from 1997 (left) and from 2001 (right). (Source: Environment Canada 2003)

Quebec Region: Depot D, Part III — Monitoring suspended sediments

Background and Concerns

In the summer of 2002, the Grande Entrée channel was dredged once again and 260 000 m^3 of spoils again deposited at Depot D. Impacts of suspended sediments from the dredging of the shipping channel in the Grande Entrée lagoon and the deposition of the dredged material at the disposal site present concerns for the organisms that live in the water column or feed there, such as fish and shellfish.

This study assessed the impact of dredging of the shipping channel in the Grande Entrée lagoon, and the disposal of the dredged material outside of the lagoon, on the condition of the sea scallop *Placopecten magellanicus*. Specifically, this study tested three hypotheses:

1) That there will be a correlation between the concentration of seston (measured as sedimentation rates) and the condition (i.e. both shell growth and adductor muscle RNA:DNA ratio) of scallops.
2) That dredging will cause a change in the spatial variability in seston concentrations within the lagoon and disposal site such that relative concentrations will increase adjacent to the dredging and disposal sites more than at sites distant from them.
3) That there will be a concomitant shift in the spatial variability of the condition of scallops such that their relative condition will be lower adjacent to dredging and disposal sites than in sites distant from them.

Parameters measured

A series of sediment traps were placed in the field in an array around both the dredging and disposal sites to measure the cumulative deposition of seston to the bottom. The traps were deployed in the areas in which sedimentation loads were predicted to be most influenced by the dredging and disposal operations, as determined through hydrodynamic modelling. A total of 24 and 16 sampling stations were thus established within the lagoon and around Depot D, respectively. Three distance classes were established both within and outside of the lagoon in which sedimentation levels were expected to increase greatly (close), moderately (intermediate), and only slightly (far). These distance classes are used for statistical analysis of the resulting data.

Two pearl nets, each with 10 individually marked and measured scallops, were deployed around each sediment trap. Traps and scallops were deployed over a period extending from before the dredging until after dredging stopped. On each sampling date, the bottle at the base of each sediment trap was retrieved and replaced with a fresh one, and two scallops were collected from each pearl net for determination of their condition (i.e. both shell growth and adductor muscle RNA:DNA ratio). Any dead scallops were removed and noted.

Observations and results

Over the sampling season, a few sites were damaged or otherwise lost due to various causes. On each date, a minimum of 85% of the initial stations was sampled.

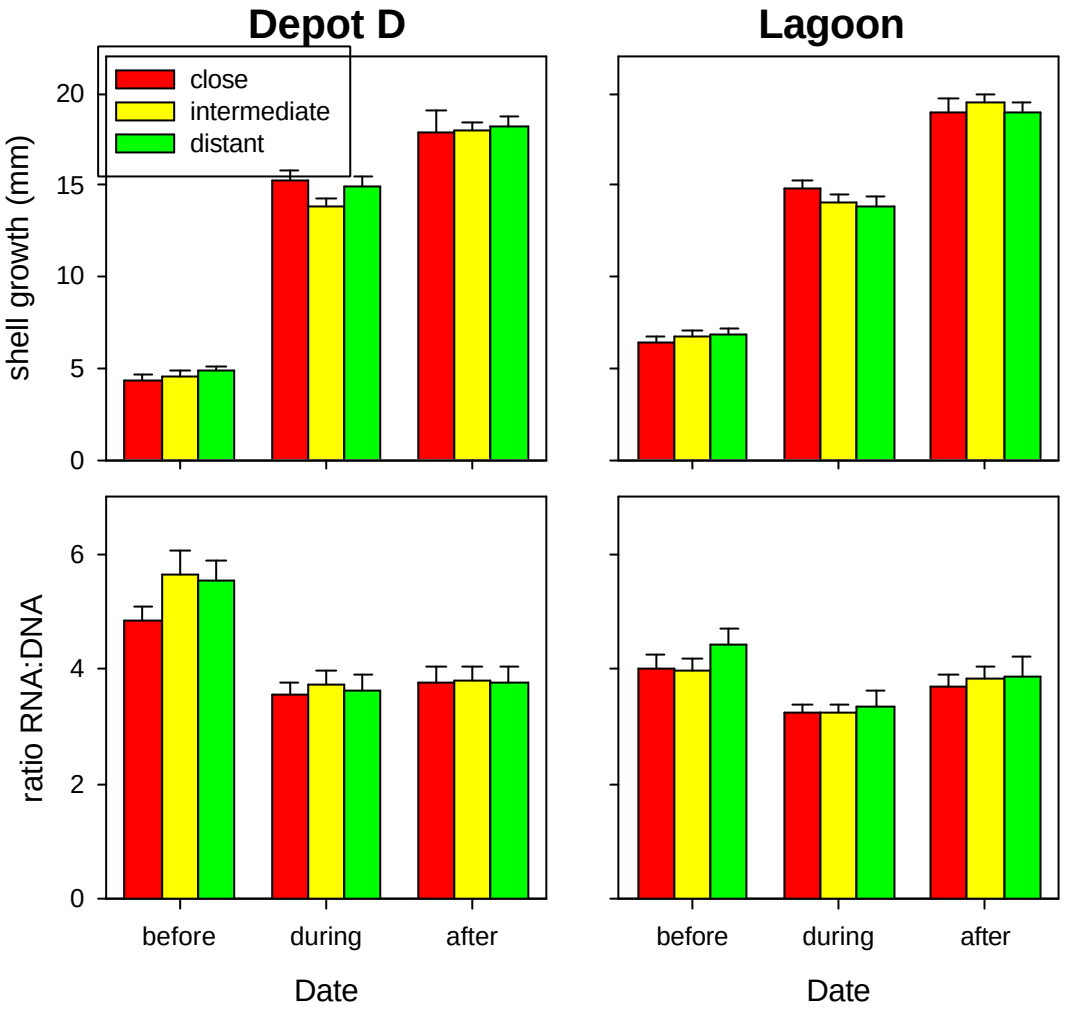

Figure 7. Effect of the disposal and dredging operations on sea scallops, Magdalen Islands.
Around site D and within the lagoon, respectively, on the shell growth and RNA:DNA ratio of the adductor muscle of the sea scallop *Placopecten magellanicus*. (Source: Fisheries and Oceans Canada and Environment Canada 2003)

The hypothesis that there will be a shift in the spatial variability of the growth of scallops such that their relative condition will be lower adjacent to dredging and dumping sites than in sites distant from them, is evaluated by examining the statistical interaction between distance and date. This factor is not significant for both the lagoon and Depot D data sets (statistics not shown) and no clear trends are seen in a visual examination of the data (Figure 7). The same is true for the hypothesis that there will be a shift in the spatial variability of the condition of scallops such that the ratio of RNA:DNA in their adductor muscles will be lower adjacent to dredging and dumping sites than in sites distant from them (Figure 7). Thus, the pattern of temporal-spatial variation in both scallop growth and condition shows no evidence of an impact of the dredging and disposal on this species.

Conclusions

The results show no impact of the dredging of the shipping channel and subsequent disposal of the resulting spoils on the condition of a typical filter-feeder in the Magdalen Islands, *P. magellanicus*.

This is in general agreement with the few other studies that have sought impacts of dredging and disposal of (uncontaminated) sediments on various indices of condition of native benthic species. For example, another study done in a similar area (Baie des Chaleurs) examined the impact of sea disposal on physiological indices of mussel (*Mytilus edulis*) health (Bergeron et al. 1990) and did not find any effect. They proposed that the short deposition period combined with good flushing limited any potential effects on the mussels.

Quebec Region: Depot D, Part IV — 2002 Sonar survey after dredging

Background and Concerns

In the summer of 2002, the Grand Entrée channel was dredged once again and 260 000 m^3 of spoils again deposited at site D. There has been ongoing concern that dredged sediments may migrate outside the site towards an area of known lobster habitat. Physical monitoring carried out in 2000-2001 demonstrated that the sediments disposed at the site were relatively stable and did not cause a significant negative effect on lobster habitat found near the site. (See Depot D, Part I.) This conclusion led to the re-opening of the site in 2002. The objective of the present sonar survey is to monitor the stability of sediments dredged from the Grand Entrée Channel and disposed at the site in August 2002.

Hypothesis tested

Dredged material disposed of at the site will not migrate to any lobster habitat by re-suspension, erosion and sediment transport, in a sufficient quantity to contribute to that habitat's deterioration, destruction, or perturbation.

Parameters measured

The objective of the survey carried out in October 2002, one month after sediments were disposed of on the site, was to determine on the seafloor, the area of all the mounds on Depot D, including the area of the mound created in 2002. Depths were determined by an EM3000 Kongsberg-Simrad multi-beam bathymetric sonar.

Observations and results

All the material dredged in the summer of 2002 was disposed within the boundaries of Depot D. As well, the accumulation of dredged material generally did not reduce the water depth to less than 10.5 m.

Subsequent multi-beam bathymetry surveys will allow variations of the surface of Depot D to be assessed qualitatively and rate of dispersion to be estimated quantitatively.

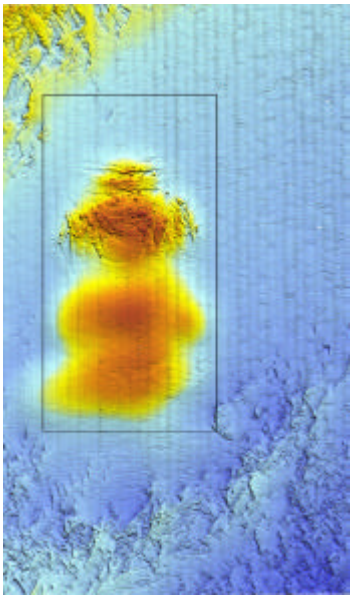

Figure 8. Depot D Bathymetry, Magdalen Islands.
According to multibeam data from October 2, 2002 survey. (Source: Fisheries and Oceans Canada, Canadian Hydrographic Service, 2002).

Pacific and Yukon Region: Ogden Channel

Site Description

Location	Ogden Channel: 53° 55.80' N, 130° 12.60' W.
Depth	150 m
Material Disposed	Dredged material
Status	Active site, but limited use since 1977. Last used in 2001.
Concerns	Validating deposition within site boundaries and contaminants are below Lower Action Levels.

Parameters measured

In June 2002, surface sediment samples were collected with a Smith-McIntyre grab sampler at selected stations on and near the disposal site. The samples were analyses for trace metal concentrations (including cadmium and mercury), organics (tPAH and PCB), TOC, AVS/SEM, and particle size distribution. Results are presented in the following tables (Tables 1 and 2). A composite sample was collected for toxicity testing for acute and sub-lethal responses which included bioassays using the amphipods *Eohaustorius washingtonianus* and *E. estuaries*, the Microtox solid phase test and the echinoid fertilization test. Preliminary results indicate that the disposal of dredged material did not result in a significant increase in trace contaminant levels in the sediments at the disposal site.

Observations and Results

Table 2. Ogden Channel Sediment Chemistry June 2002.

Station	Sample Type	Depth (cm)	Hg	Cd	Cu	Pb	Zn	TOC	tPAH	Gravel	Sand	Silt	Clay
1	Grab	0-5	0.070	0.19	33.5	11	114	IP	IP	3.3	4.2	45.3	47.2
2	Bioassay	0-5	0.060	0.19	34.9	10	119	IP	IP	0.0	8.1	52.2	39.7
2	Grab	0-5	0.059	0.13	33.9	10	108	IP	IP	0.0	10.6	51.6	37.8
2	Grab	0-5	0.063	0.11	33.9	11	109	IP	IP	0.0	7.8	51.5	40.7
2	Grab	0-5	0.062	0.16	34.7	12	112	IP	IP	0.0	10.5	52.6	36.9
2	Core	0-5	0.060	0.16	33.7	11	122	IP	IP	0.0	7.9	52.0	40.1
2	Core	10-20	0.059	0.16	38.3	10	118	IP	IP	0.0	5.6	52.1	42.3
2	Core	30-40	0.060	0.21	38.2	11	115	IP	IP	0.0	6.6	54.1	39.3
2	Core	60-70	0.063	0.17	36.2	10	115	IP	IP	0.0	9.2	54.5	36.3
2	Core	90-100	0.058	0.18	37.1	11	111	IP	IP	0.0	6.3	51.3	42.4
2	Core	130-140	0.051	0.23	33.6	10	106	IP	IP	0.0	10.6	53.2	36.2
3	Grab	0-5	0.064	0.21	34.2	11	108	IP	IP	0.0	3.8	52.3	43.4

All trace metal results expressed in mg/kg. Particle size distribution in %.

Table 3. Ogden Channel Bioassay Results 1997-2002

Date	Amphipod *E. estuarius* % survival	Amphipod *R. abronius* % survival	Amphipod *E. washingtoniaus* % survival	Echinoid *L.pictus* % survival	Microtox *V. fisheri* Solid phase % effect
1997		63.0±9.7	45±7.9*	32±9.9*	0.16*
Control		86±2.2	95±3.5	91±2.5	
2002	78±14	39±26*		44±6.6*	2.25
Control	92±4	96±4		100±3.1	

* Indicates toxic or marginally toxic response.

Pacific and Yukon Region: Video and Sonar surveys of Point Grey and Porlier Pass

Point Grey **Porlier Pass**

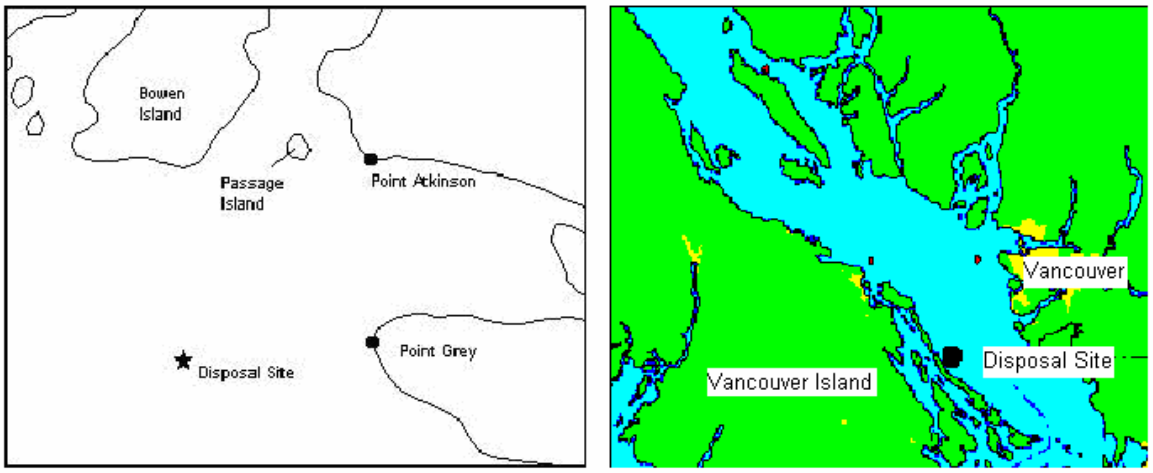

Figure 9. Location of Point Grey and Porlier Pass disposal sites.

Site Description

Location	Strait of Georgia, British Columbia	
	Point Grey 49°15.40'N, 123°22.10'W	**Porlier Pass** 49°00.20'N, 123°29.80'W
Depth	210 m	200 m
Material Disposed	Dredged material and inert geological matter	Dredged material almost exclusively from forest industry (sawmill and sorting grounds).
Quantity	Over 450,000 m^3 each year	40,000 m^3
Status	Open	Open
Issue	Assess conditions at the largest disposal at sea site in Canada. Verify that transport of material outside the disposal site boundary is not occurring	Verify that transport of material outside the disposal site boundary is not occurring.

Parameters Measured

In October 2002, the Department of Fisheries and Oceans ROV, ROPOS, was used to record benthic conditions. Video and computer captured images are recorded and geo-referenced for assessment and comparative purposes for future surveys. In addition, the Interactive Real-time Logging (IRL) system developed by the Canadian Scientific Submersible Facility was used during the survey. The video records of the benthic condition at the sites and the surrounding areas are used to illustrate qualitatively the confinement of material within the disposal site boundaries. Transect lines are extended outside the perimeter boundaries and indications are that the disposal activities are occurring within those limits. In addition, visual records of benthic community types, the effects of national and anthropogenic sedimentation and the recolonization potential are

recorded. During the surveys, the effect of bottom currents is observed to indicate any potential for transport of material off the disposal site once it has reached the bottom.

In October 2002, in partnership with Pacific GeoScience Centre (Natural Resources Canada) a sidescan sonar survey was conducted at the Point Grey disposal site covering a 36 square nautical mile area and repeating work from 1997. This work sought to illustrate coverage of deposited material on the site and compare results to the 1997 survey. PGC has been working with the Canadian Hydrographic Service to survey the entire Strait of Georgia with multi-beam bathymetry. The images from the disposal site in the Strait of Georgia will be made available to Environment Canada through a partnership program.

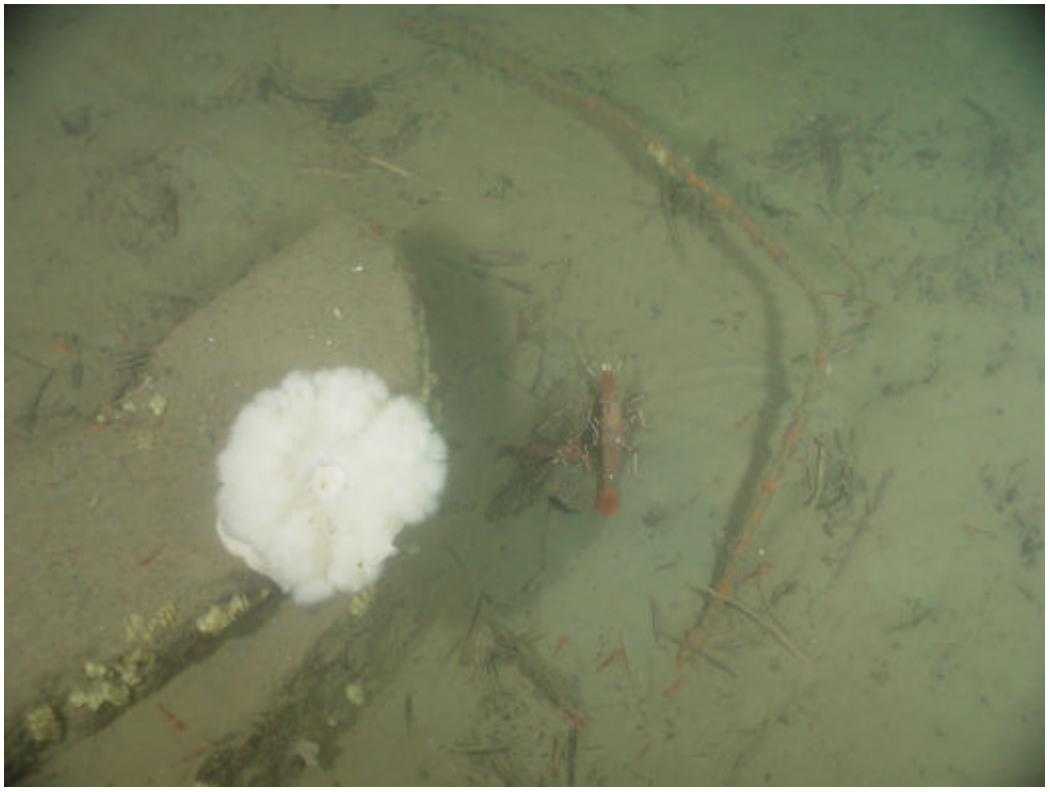

Figure 10. Photograph of sea floor over Porlier Pass Disposal Site, October 2002.

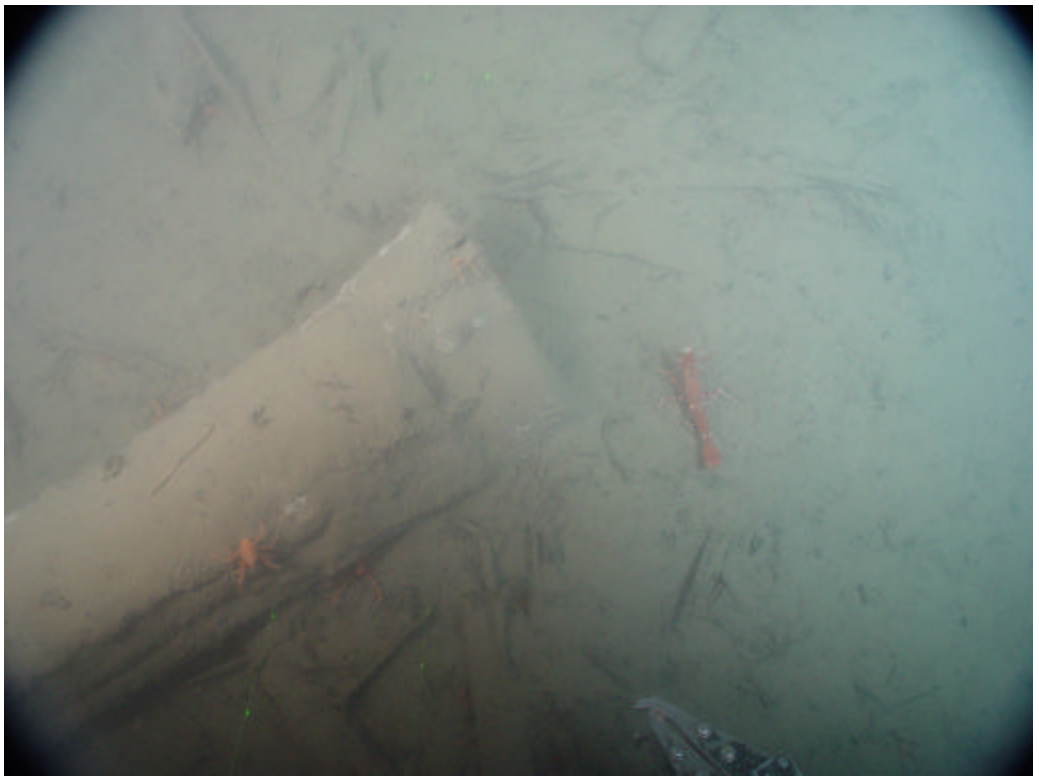

Figure 11. Photograph of sea floor over Point Grey Disposal Site, October 2002.

Annex 1. Monitoring Expenditures

In March 1999, pursuant to Treasury Board policy on cost recovery, Environment Canada introduced a monitoring fee of $470 per 1000$m^3$ of dredged or excavated material. This fee is known as a "right or privilege" fee and is meant to provide Canadians with a fair return for use of public resources. Proceeds from this fee are used to cover the cost of disposal site monitoring, thus allowing environmentally sound management and allowing users continued access to their disposal sites.

Part of Environment Canada's commitment to the regulated community was to provide an annual summary of revenues and expenditures related to disposal site monitoring. The figures below represent the fourth year of cost recovery. In latter part of in the fiscal year, Environment Canada received unexpected applications for major quantities. As a result, Environment Canada collected more funds than expected, amounting to almost $1.4 million. The net amount over federal government costs was $120,598. Environment Canada had a surplus of $490,998 which was carried over into the following year. Surpluses in the monitoring fund are used to offset costs in years when revenue is low due to reduced dredging activity.

Monitoring Expenditures 2002-2003	
Atlantic Region	$ 181,780
Quebec Region	$ 166,300
Pacific and Yukon Region	$ 275,000
Headquarters	$ 20,000
Environment Canada indirect expenditures	$ 264,000
Sub total expenditures for Environment Canada	**$ 907,080**
In-kind support from other federal departments	$ 370,400
Total expenditures for federal government	**$ 1,277,480**
Resources Recovered 2000-2001	
Monitoring Fees	$ 1,398,078
Net Expenditures 2000-2001	
Resources collected over federal government costs	**$ 120,598**
Net Environment Canada surplus	**$ 490,998**

Annex 2. Offices for the Disposal at Sea Program

The Disposal at Sea Program Offices are located in the following Environment Canada offices.

Atlantic Region-Maritimes
Disposal at Sea Program
Environmental Protection Branch
Environment Canada
45 Alderney Drive, 4th Floor
Dartmouth, Nova Scotia
B2Y 2N6

Atlantic Region-Newfoundland and Labrador
Disposal at Sea Program
Environmental Protection Branch
Environment Canada
6 Bruce Street, Mount Pearl
Newfoundland and Labrador
A1N 4T3

Quebec Region
Disposal at Sea Program
Environmental Protection Branch
Environment Canada
105 McGill Street, 4th Floor
Montreal, Quebec
H2Y 2E7

Prairie and Northern Region
Disposal at Sea Program
Environmental Protection Branch
Environment Canada
5204 - 50th Avenue, Suite 301
Yellowknife, Northwest Territories
X1A 1E2

Pacific and Yukon Region
Disposal at Sea Program
Environmental Protection Branch
Environment Canada
201 - 401 Burrard Street
Vancouver, British Columbia
V6C 3S5

National Capital Region
Disposal at Sea Program
Environmental Protection Service
Environment Canada
351 St. Joseph Boulevard, 12th Floor
Hull, Quebec
K1A 0H3

Further details may be found on-line at the Program's web site www.ec.gc.ca/seadisposal/