# SUMMARY OF PUBLIC PARTICIPATION

## ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSAL BY NB DEPARTMENT OF SUPPLY AND SERVICES

## MODIFICATIONS TO THE PETITCODIAC RIVER CAUSEWAY

**November 2006**

**Prepared by the Department of Environment**

New Nouveau Brunswick

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# INTRODUCTION

This document is the Summary of Public Participation for the Modifications to the Petitcodiac River Causeway Project (the undertaking) proposed by the New Brunswick Department of Supply and Services (the proponent). As required by the Environmental Impact Assessment (EIA) Regulation, it summarizes the input of the public as expressed in comments put forward during a public meeting and in written comments. As a summary, this document does not include every individual comment made at the public meetings or in writing; however, a concerted effort has been made to reference each area of concern.

The sub-headings highlight the issues raised by those who actively participated in the meeting and through written submissions. Issues are generally presented in the order they were raised by participants, beginning with the initial public meeting. (For an account of the full public meeting, refer to the Verbatim Transcript, which is available on request including through the Department's Moncton Regional Office).

# BACKGROUND

On April 30, 2002, the Department of Supply and Services (DSS) registered the Modifications to the Petitcodiac River Causeway Project for review under Schedule A of the NB Environmental Impact Assessment (EIA) Regulation. The principal purpose of the project is to provide a long term solution to fulfill fish passage objectives for the Petitcodiac River Causeway. A decision by the Minister of the Environment and Local Government on April 30, 2002 required that the Project undergo a comprehensive Environmental Impact Assessment as per the Regulation.

Initial public consultation on the Project began on May 29, 2002 with the release of the Draft Guidelines and a 30-day period for public comment. This period allowed members of the public to provide comment on what should or shouldn't be included in the EIA study. Final Guidelines with the public's input considered were issued to the DSS on July 26, 2002.

The EIA Guidelines required that four Project Options be assessed pursuant to Section 5(1) of the Canadian Environmental Assessment Act (CEAA) and the Environmental Impact Assessment Regulation (Regulation 87-83) of the *Clean Environment Act.*

The DSS prepared Terms of Reference which were reviewed and accepted by the Technical Review Committee (TRC) and they proceeded to conduct the study.

DSS submitted the first draft EIA report on February 5, 2005 for review by the TRC, which consists of representatives from several provincial and federal government departments and agencies with various areas of expertise. As a result of deficiencies noted, clarifications sought and additional work identified by the Committee, the Report was revised in order to satisfy the Guidelines. The Minister of the Environment and Local Government accepted the final EIA report on October 4, 2005 as a document that satisfied the requirements set out in the Final Guidelines and in accordance with the EIA Regulation and Section 5(1) of CEAA.

Copies of the full EIA report, a Summary of the Report and the TRC's General Review Statement were distributed and made available to the public at various locations in the Moncton and Riverview region as well as communities in the Petitcodiac River watershed and the Department of the Environment and Local Government Branch office in Moncton. Information was also made available on the Department's Internet site. Concurrently, a news release was issued and paid advertisements were taken out to inform citizens that this information was available, of the upcoming public meeting, and where they could view and/or pick up

information. Interested parties were encouraged to contact the Department if they intended to make a formal presentation at the meeting.

The release of the EIA document and General Review Statement and the announcement of the date of the public meeting on October 26, 2005, marked the beginning of the second phase of the formal public consultation process. The Minister then proceeded with the appointment of an Independent EIA Panel to chair the public meeting held on November 29, 2005 at the Coverdale Recreation Centre in Riverview.

The 3-person panel was chaired by George Bouchard. The other members were Dr. Graham Daborn, science advisor to the panel; and Dr. Michael Davies, modelling advisor for the panel.

The independent EIA Panel members heard public comments on the Environmental Impact Assessment Report (EIA) that was prepared for DSS, as part of a coordinated review of the project between the federal and provincial governments. The panel made recommendations to the Minister of the Environment and Local Government on February 13, 2006 in the form of a report titled "Independent EIA Petitcodiac Panel Report" (see Appendix A on page 17).

Attendees were reminded that the EIA Regulation allowed them an additional 15 days after the close of public meetings to submit any written comments to the Minister of the Environment and Local Government. They were also invited to provide their names and addresses to the staff if they wished to subsequently receive a copy of this Summary of Public Participation and/or the verbatim transcript of the meetings. Comment sheets to be submitted to the Department were also made available.

The final stage of public consultation was completed during the summer of 2006 following the closing of the public review period on the federal Screening Report on February 25, 2006 and a subsequent review by the TRC, which included discussions with the Proponent, on issues raised by the public.

# SUMMARY OF ISSUES AND COMMENTS

Approximately 100 persons participated at the public meeting of November 29, 2005 and 13 individuals made presentations or addressed the panel at the meeting. In addition, a total of 119 letters, e-mails and faxes were received during the course of the public comment period. Of these, 107 were generally in agreement with the EIA Study findings and 12 identified some points of concern.

The comments made by participants both at the public meeting and in writing have been summarized and divided into the following seven categories:

- General Comments
- Fish Passage
- Water Quality
- Flooding
- Sediment / Siltation
- Public Health
- Financial Accounting

## GENERAL COMMENTS

Several participants indicated that they were pleased with the formation of an independent panel, however it was mentioned that the purpose of the panel and meeting was not made clear soon enough. One participant noted that the meeting should have been held in a more neutral area, i.e. Moncton.

Several participants commented that the entire EIA process was transparent and based on science and that this four year long study presents to the public for the first time the effects of the causeway, providing evidence that it has decimated the fish population, impacted the Tidal Bore, and clogged the river with silt. It was noted that the EIA project was properly balanced to generate an overall understanding of the Petitcodiac River ecosystem and its socio-economic impact. It was also stated that now is the time to act on the recommendations of the report and any delays would be a disservice to the environment, fish population, and citizens bordering the river.

Many participants had mixed feeling regarding the study and its completeness. Others expressed that the study lacked in substantive research, contained many inadequacies and was written in a way to favour taking out the causeway. One

individual indicated he found the format in which the options were presented in the study to be very confusing. It was also noted that the EIA would have been more comprehensive if it had been looked at from the perspective of determining the impacts of replacing a portion of the causeway rather than on fish passage.

Some participants made reference to the Niles Report. One participant noted that the Niles Report declared the causeway illegal and recommended this EIA. Another participant expressed frustration that the results and recommendations of the Niles Report were not taken into consideration, particularly the need for full cost accounting.

Another participant noted that certain references or personal communications were not referenced in the EIA Report and questioned why these weren't included.

One participant expressed that with all the issues raised relevant to health, it is necessary to have a closer look at this project. It was also noted that the causeway should remain in place until the pollution issue below the causeway is addressed.

It was suggested that determining exactly what would happen may be impossible given the complexity of the issue of restoring the Petitcodiac River. The comment was also made that predictions are based on assumptions and modelling and the longer the time frame is, the less valid the results become. Another participant suggested that the monitoring program proposed in the EIA would be one of the tools used to verify the predictions.

A participant suggested that an existing example should be studied first and noted that there is an existing situation similar to this one which is smaller in the town of Parrsboro and questioned why this wasn't looked at.

There were a few suggestions made for alternatives approaches, such as building another causeway further down the river to avoid the bend in the river which was suggested to be the cause of the problem. Another suggested that perhaps a new fish spawning area and research facility could be designed and created and the fish would not have to go through the causeway at all.

## FISH PASSAGE

Since a solution to long-term fish passage was the principal purpose of the EIA study, this topic generated considerable public comment. The principal comments and concerns can be summarized as follows:

1. It was noted that the original Department of Fisheries and Oceans requirement for fish passage was never achieved. Since improving the fish passage was the principal purpose of the study, status quo is not an option. The study concludes

that option 4B is the optimum solution; therefore it is felt that the fishway and control gates should be removed and government should proceed with the implementation of Project Option 4B as soon as possible.

It was also noted that the fish passage component of the EIA contained the most extensive research and analysis ever undertaken on the Petitcodiac River.

2. A participant made comments regarding the statement that the EIA suggests that no fishway exists that would pass all species of migratory fish at all times of the year, and for that reason no modification of the fishway (as in Project Option 1) is recommended. It was noted that although a single facility to pass all migrating species all of the time may not be feasible, it was felt that there are alternative fish passage designs available and that they should be used to replace the existing, inadequate system, and allow maintenance of the causeway and of the Lake Petitcodiac (also known as the headpond).

3. With all the technology available today, participants questioned why we can not design fishways that would enable all our fish to move through the causeway. A participant questioned if the options put forward by Mr. Niles were considered, including the use of a highly developed, properly investigated fish ladder. It was also noted that there is no documentation in the report that supports dismissing a fish ladder other then a general statement that says any model found wouldn't deal with every fish species, every day, all the time. It was stated by a participant that "if you can move fish two or three hundred meters vertically in British Columbia, how come you can't move them ten meters in New Brunswick?" One participant suggested that if one fish ladder could not accommodate all the fish, then two should be built.

4. The comment was made that the fish passage is compromised by low water quality as a result of the limited treatment of sewage and that this should be corrected.

## WATER QUALITY

Several participants expressed major concerns regarding the water quality in the estuary and Lake Petitcodiac. More specifically, many participants expressed concerns about the water quality below the causeway and proposed that waste water treatment be improved either as a higher priority than changes to the causeway or be improved prior to any changes to the causeway.

There was also agreement with the EIA suggesting that restoration of the full tidal flow should allow the water quality to improve in the entire estuary.

Public comment concerning water quality is divided into eight topics: Dilution of effluent from the Greater Moncton wastewater treatment plant; water quality concerns

with respect to recreational usage of the waterway; groundwater contamination; status quo water quality in Lake Petitcodiac; river system and wetlands; the use of *E. coli* as an indicator; water temperature data; and fate of the leachate from the landfill site. These are each summarized separately below.

**Effluent Dilution**

There was disagreement with statements in the EIA suggesting that primary treatment of sewage would be sufficient if the causeway is opened and greater flow restored in the estuary. Respondents indicated that relying upon dilution of the pollution would not be acceptable, especially in light of policy statements by the federal Minister of Environment that the government intends to implement a requirement for secondary treatment by 2010.

It was suggested that the gates should remain closed until the tide water is clear of pollutants before it is permitted to move upstream. One participant made reference to a previous trial opening and the fact that signs were posted along the banks to warn people that the water was unsafe.

Others expressed that the upgrade to the Greater Moncton Wastewater Treatment Plant should not be tied in with the causeway and that there needs to be another process to deal with the sewage issue.

**Recreational Usage**

Participants commented that recreational uses of the lake would be destroyed if the gates were to be opened. It was also suggested that there would be a negative impact on existing river businesses. There was disagreement with the statement that there would be any advancement in tourism, including recreational usage. One participant made the comment that there was no recreation on the river before the causeway – the tides made it too dangerous.

There were claims that statements regarding the expected pollution levels (even diluted) following opening of the causeway would be incompatible with recreational uses.

A participant commented that the restored river and tides would have long-term economic benefits. Another participant suggested that a properly developed river system would provide sustainable benefits for river users.

**Groundwater Contamination**

One participant expressed concern that his shallow well located above the causeway might be vulnerable to contamination from water, which would be polluted by the sewage plant and landfill, if the causeway were to be removed and the tidal flow restored.

**Lake Petitcodiac / Headpond**

There were claims that the report assessments of water quality in the headpond were incorrect and that water quality is better than that represented in the report. In particular, it was suggested that water quality data for the lake reported in the EIA were unfairly biased by including data from point sources which have since been corrected. Another respondent indicated that upstream contamination of water was possibly affected by the presence of waterfowl during helicopter sampling.

It was stated that the bacteria counts in the lake are within the acceptable limits for recreational use while the levels below the causeway are high and should not be allowed in the lake. One participant questioned what benefits would destroying a clean 21 km lake to allow a polluted river to run free have on the environment currently enjoyed.

It was noted that water bombers had recently used the lake to load up water in order to fight fires.

**River system / Wetlands**

A commenter noted that the problem does not end at Salisbury; it extends up the Petitcodiac and its tributaries, as well as below the causeway. Another participant noted that since the installation of the causeway, there has been a slow decline in the state of the Petitcodiac River and that this is extending to the North River and other tributaries as well.

A participant noted that residents of the East River would benefit more from a restored river.

A participant disagreed with the study findings that wetland distribution after the opening of the causeway would be comparable to pre-causeway conditions and is environmentally positive. It was noted that 200-400 hectares of saltwater wetland below the causeway would be destroyed which is said to not have the same characteristics and is presumed to be of less value.

***E. coli* as an Indicator**

There was criticism of the account of pollution levels in the EIA. It was pointed out that *E. coli* is not a recommended indicator for estuarine waters according to the Council of Canadian Ministers of the Environment, because of the high mortality of coliform bacteria in saline waters; *Enterococcus* spp. are the appropriate indicator for brackish waters. The same respondent pointed out that many of the conclusions of the favorable environmental benefits to be derived from the Project Options, and ranking in the application of the CCME Water Quality Index, seem to rest on misrepresentation or selective use of the limited bacterial data. In particular, it was suggested by that respondent that the poor assessment of water quality in the Lake

Petitcodiac following construction of the causeway is colored by two samplings carried out in 1973 and 1978 that related to "notable point sources" that had been "identified and rectified".

**Water Temperature**

A participant made reference to the fact that water temperatures as high as 30° C were reported in the EIA for Lake Petitcodiac and further commented that in the past year the water temperatures recorded by his fish finder showed temperatures never to exceed 21° C between the causeway and Salisbury.

**Leachate from the landfill**

Concern was expressed that according to the EIA, the Project Options would have the leachate from the Moncton landfill entering the combined sewer system and either entering the river through flood overflow or through the sewage treatment plant which provides only primary treatment.

One participant expressed concern with the possibility that the free flowing river could reach or "cut into" the former Moncton landfill even though precautions would have been taken. There was concern with the contents of the landfill suggesting that it contains chemicals, paint, and other material that would not be allowed in a landfill today. Another participant noted that increasing the flow of the river and possibly relocating the channel with a new structure would bring the river close enough to the landfill to cause on-going concern.

**Flooding**

Concerns were expressed that severe flooding would occur with the proposed project, that the existing causeway does provide flood protection to upstream properties and that the EIA process has not considered this properly. Concerns were also expressed that increasing sea levels (as related to climate change) would create flooding crises that would be increased by removal of the causeway. It was suggested that there was frequent flooding prior to the causeway.

Concerns were also expressed that the existing risks associated with flooding are significant and agreed with the suggestion in the EIA that a flood risk assessment be carried out. It was suggested that flooding would continue to be a problem at the Moncton traffic circle during high tides.

Another participant suggested that with the river flowing more freely, the flooding would be more controlled.

**Sediment /Siltation**

One of the key environmental implications of modifications to the Petitcodiac Causeway is the change to the flow patterns and sediment distribution in the estuary. It is widely recognized that the construction of the causeway has led to large-scale siltation of the estuary. Re-opening the causeway would allow the tide to reach further upstream and would tend to change sedimentation patterns to pre-causeway conditions. The speed at which this would happen and the resulting patterns of erosion and siltation are central themes of the EIA and have generated significant public comment.

Issues and concerns raised by the public include:

1. Concern was expressed with respect to impacts of sediments from the river on the lobster and scallop fisheries in Chignecto and Shepody Bays. The public expressed concern that the re-opening of the causeway would release large quantities of sediment that would be deposited in fishing grounds causing deterioration of fishing conditions.

2. Several members of the public questioned the EIA's claim that sediments leaving Hopewell remain in suspension until they reach the deep waters of the Bay of Fundy. Anecdotal observations were reported of sediment accumulation in lobster traps in the bay during the gate openings in 1998.

3. Questions were asked as to whether the EIA study had addressed long-term infilling rates in the estuary. Public comment stated that the estuary was infilling prior to the causeway and would continue regardless of project alternatives.

4. The comment was made that the lake would not fill in with silt any faster then any other lake except at the gates. A suggestion was made to fix the backflow through the fishway.

5. Concerns were expressed regarding bank erosion and changes to the river under the proposed Project Options. Also noted was concern that there is potential that the process may be accelerated to the point that the Riverfront Park may be destroyed.

6. Regarding sedimentation in the headpond, respondents commented that siltation in the headpond is not as described in EIA and that the sediment plug in the headpond is solely due to silt coming in from the gates.

7. One participant made the suggestion of exploring the idea of having regular silt removal as part of the fishway maintenance.

## PUBLIC HEALTH

One participant expressed serious concern with the lack of information available on human disease vectors in the EIA. The individual made reference to statements in the report such as "Research did not identify any information on human disease vectors pre-dating the causeway" and "zero clinical cases in New Brunswick and therefore no West Nile virus fevers, neurological syndromes, asymptomatic infections or related deaths to this date this year." The individual questioned why two local experts (Dr. Louis LaPierre and Charles McEwan) were not apparently interviewed by the consultants, in spite of their knowledge and involvement in studies of disease and epidemiology in New Brunswick over several decades. It was also noted that the cost-benefit analysis should have taken into consideration the potential to redistribute contaminated effluent which could lead to public health and safety issues from recreational contact.

In relation to the subject of the West Nile virus, this individual commented that opening the gates would create twenty kilometers of new salt marsh and that salt marsh mosquitoes may range eight times as far as fresh water mosquitoes.

Another participant noted that with the river flowing freely, there would be less stagnant waters to bread mosquitoes and feels the population would decrease as a result.

## FINANCIAL ACCOUNTING

### Full Cost Accounting

Many respondents expressed concerns that true full cost accounting was not being applied as was specified in the Niles Report and under the Terms of Reference of the EIA. It was noted that full cost accounting on this project would only be meaningful if the costs estimated are based on modern requirements for the different Project Options, meaning the inclusion of the upgrade of the treatment plant and emptying of the landfill.

It was suggested by a participant that the present costs estimates of restoration would increase with the involvement of government.

### Impact on Fisheries

There was concern expressed with the fact that the purpose of this study was to examine ways to maximize fish passage not to examine ways to foster, develop and protect breading and fishing grounds. It was also noted by a participant that the historic fishery of the Petitcodiac is important.

There were claims that a Full Cost Accounting exercise to assess the impact of the fisheries on the fishers; the fish plant workers and the full economic impact on the Alma community was not properly addressed.

It was noted by a participant that fishing in the Bay of Fundy has improved in the last 20 years, that the bottom of the Bay has stabilized and that lobster fishing is done within 2 km of the Hopewell Rocks. The importance of the area fishing industry was emphasized and it was expressed that the rural economy would suffer greatly if the fishing industry in the area collapsed. It was felt that the siltation caused by opening the causeway would ruin the lobster and scallop grounds.

There was disagreement with the statement that opening the causeway would not alter the lobster and scallop beds in Shepody and Chignecto Bay. One group noted that they would be prepared to take action to obtain compensation.

**Sanitary Sewage System**

As previously stated under Water Quality there was disagreement with the EIA statement suggesting that primary treatment of sewage would be sufficient if the causeway is open and greater flow restored in the estuary. As such, regardless of the option chosen, the cost of a secondary treatment facility should be accounted for prior to being considered.

It was noted that the report suggests that project costs may be further alleviated by the deferred or avoided costs of sewage treatment upgrades which was felt to mean more water dilution is the solution to pollution.

Another participant suggested that the sewage system would be upgraded as needed whether or not the causeway is restored.

**Property Values**

Concerns were expressed by participants that the value of the waterfront properties were not properly recognized. There was disagreement with a statement made in the report that the Project Options would not likely result in a significant change in value to developed waterfront property along the Petitcodiac River. It was also noted that an erroneous suggestion was made in the report that in a full cost accounting exercise, the loss of property value resulting from the opening of the gates would be offset by an increase in the value below the gates.

It was also noted that the costs, including operating costs used in the report were presented in 2004 values.

One participant noted that waterfront property includes riverfront property and felt that land overlooking a restored river system would be very desirable.

**Dykes**

A participant questioned whether dyke reconstruction and maintenance costs upstream of the causeway have been identified and also noted that the provincial government now has the responsibility to build and maintain dykes above the causeway.

**Implementation**

In reference to the three phase implementation strategy: design, opening of existing gates, and construction of the required structure, a participant noted that although some preliminary design work is necessary, it would make more sense to do stage 2 first and accumulate data to determine if the projections are accurate when the gates are open before millions are spent on design work.

# FINAL STEPS IN EIA PROCESS

The submission of the Independent EIA Review Panel's report and the end of the public review period of the Federal Government's screening process completes the public participation component of the Environmental Impact Assessment process. The Minister of Environment will take into account the public input received, the Panel's recommendations, information received as part of the federal consultation process, as well as information provided by the Technical Review Committee, including the General Review Statement, and will make recommendations to the provincial Cabinet as to the environmental feasibility of each of the Project Options. The federal government will also complete the screening process under the *Canadian Environment Assessment Act* (CEAA).

The final step in the harmonized provincial/federal EIA process is a co-coordinated announcement of the federal and provincial decisions regarding the environmental feasibility of each option studied. Once this final step completed, both levels of government will be in a better position to make an informed decision on the future of the Petitcodiac Causeway.

# Appendix A

## Independent EIA Petitcodiac Panel Report Public Meeting Petitcodiac River Causeway

Prepared by:

George Bouchard (Panel Chair)

Graham R. Daborn, Ph.D.

Michael Davies, Ph.D., P.Eng.

February 13, 2006

# Executive Summary

The key conclusions of the independent EIA Petitcodiac panel report are as follows:

## Fish Passage

The conclusion in the EIA that replacement of the fishway with another design (Option 1) is not a feasible solution to problems of fish passage at the causeway is sound. Claims from members of the public that alternative designs exist are not supported.

## Water Quality

1. Public concern that the accounts of water contamination presented in the EIA are misleading, or unduly influenced by transient events, may have merit; however, evidence in the EIA clearly indicates that water quality is currently degraded both above and below the causeway.

Public concern that the EIA understates the risks for continued contamination of water following adoption of Project Option 4B is well founded. The EIA suggestion that dilution by a larger tidal prism will decrease contaminant concentrations to near baseline conditions is not sufficiently sound and therefore should not be used to defer plans for increasing the quality of treatment of effluents entering the Petitcodiac River and Estuary. In fact water quality will decrease upstream of the causeway due to exposure to the more contaminated water that exists downstream

Uncertainties about the rate of increase in the tidal prism, and therefore the effective dilution of contaminated water, require that model predictions of channel widening be confirmed by further study.

Public concern that the leachate from the Moncton landfill may enter the Petitcodiac Estuary as a result of Project Option 4B is unfounded, unless the erosion of the adjacent wetland is greater than forecast in the EIA. If the wetland does erode too much, landfill leachate must be processed in an adequate treatment facility prior to release into the environment.

## Flooding

The public concerns about flooding in the greater Moncton area are valid and the EIA recommends that a flood risk assessment be undertaken to examine these issues in more detail and to develop an appropriate flood response strategy. With respect to the proposed project alternatives, the EIA has adequately analyzed the effects of various flood scenarios (combinations of rainfall, tidal and sea level rise scenarios) and shown that the project options under consideration will be no worse than the status quo for any of the conditions considered. The risk of saltwater flooding upstream of the

causeway is identified within the EIA and repair and/or restoration of dykes and aboiteaux are identified as a mitigation measure within the EIA.

## Sediment Fate

1. The EIA conclusions concerning the fate of sediments leaving Hopewell Cape and entering Shepody and Chignecto Bays are not adequately supported by either the modeling work or by other technical analysis. Since sediment pathways and sedimentation patterns in the bay have not been properly identified, the conclusions made concerning impacts on fisheries are unsupported.
2. There are significant shortcomings in the modeling of river sedimentation and morphology. As such, there is significant uncertainty regarding the rate and extent of changes to the river channel and mudflats under the Project Options. The concerns expressed by the public regarding this issue are considered by the Public Review Panel to therefore be justified.

## Public Health

1. The effects of Project Options on the occurrence and frequency of disease vectors may not have been considered adequately in the EIA, and it is recommended that the NB health authorities reassess the risk of mosquito-borne diseases.

## Financial Accounting

Public statements that the Niles report and the Terms of Reference asking for Full Cost Accounting have not been met. After reviewing the evidence, it was determined that the EIA did meet the expectations of the proponent.

Public concern that the EIA did not assess the impact on the fishery may have merit. The EIA assumes that the fishery in the Bay of Fundy will not be affected. A monitoring system is recommended to identify the effects on the fishery and to address compensation if required.

Public concern that costs for a secondary waste treatment facility was not an integral part of the cost options. In reference to the Water Quality section of this report the Panel recommends that the secondary sanitary sewage treatment cost be part of any option selected.

Public concern that the value of waterfront properties will be affected by the proposed options has merit. The Panel is in agreement with the EIA's recommendation to provide compensation on a case by case basis.

Public concerns were raised on the cost and maintenance of the dykes and aboiteaux. The EIA adequately addresses these concerns.

## Considerations

This review process has identified several shortcomings in the EIA process which will need further consideration.

Some of these issues can be addressed during the proposed Staged Implementation Strategy and monitoring program. This should include a refocused effort to develop and apply appropriate modelling and analysis techniques.

The purpose of the EIA process is to evaluate the potential environmental impacts of a project (both beneficial and negative) and to then identify the mitigation measures necessary to ensure that the net environmental impact of the project is acceptable. Several key findings of this EIA are not sufficiently supported by technical analysis. Further examination and analysis of these issues would be prudent prior to the implementation stage.

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## Introduction

On November 23, 2005 the Department of Environment and Local Government announced the establishment of an independent expert panel to receive public comments and input on the **Environmental Impact Assessment report for the Modification to the Petitcodiac River Causeway**, prepared by AMEC for the Department of Supply and Services.

The three-person panel was chaired by George Bouchard, president of Bouchard & Associates. The other members were Dr. Michael H. Davies, president of Pacific International Engineering Corporation, a coastal engineer and researcher; and Dr. Graham Daborn, director of the Arthur Irving Academy for the Environment at Acadia University, Science Advisor for the panel.

A public meeting was held on November 29, 2005 at the Cloverdale Recreation Centre in Riverview, NB. Furthermore, written submissions from the public were received for 15 days after the meeting (until December 14, 2005).

The present report pertains to the public comments on the EIA concerning the proposal by the Department of Supply and Services for modification to the Petitcodiac River Causeway.

## Methodology

- All information submitted, either at the public meeting or through written documents, was analysed by the panel.
- When required, panel members sought additional information from various sources.
- The report does not refer separately to every question received by the panel. Although the panel did analyse every question, in the present report several issues have been grouped by topic or resource.
- When the panel could not get a satisfactory answer or when issues were not adequately covered, paths to achieving the desired objective were recommended.

## Participation

Approximately 100 persons participated at the public meeting of November 29 2005. Seven individuals had pre-registered in order to make a formal presentation. Only six presenters were on hand on the said evening. Subsequently a letter was received explaining the absence of the 7th presenter.

After the official presentations, the other participants were offered the opportunity to express their concerns related to the EIA report. A total of eight elected to address the panel.

During the 15 days following the meeting a total of 115 letters, e-mails and faxes were received. One hundred and three were letters in support of the EIA and 12 identified some points of concern.

## General Comments

The panel members analyzed all points of concern for validity; after which they researched answers and/or brought the points of concern forward to the attention of the Minister.

## General Concerns

The comments made by presenters at the meeting have been classified into the following six groupings:

- Fish Passage
- Water Quality
- Flooding
- Sediment Fate
- Public Health
- Financial Accounting

This report has been structured with the following headings for each of the above subject grouping:

- Comments: summary of submissions
- Discussion: where in the report these issues are addressed and the extent to which the issues are covered by the EIA reports
- Conclusion: advice to the minister

## Fish Passage

### Comments

A primary purpose of the EIA was to consider the environmental implications of modifying the existing Petitcodiac River Causeway in order to facilitate migration of diadromous fish species.

Consequently, this issue was a central theme of the EIA, and has generated considerable public comment. Principal opinions expressed during the public meeting and in other communications can be summarized as follows:

1. Improving fish passage was the principal purpose of the study, which concludes that option 4B provides an optimum solution. The status quo was not an option. Therefore, remove the fishway and control gates and proceed with option 4B as soon as possible.
2. The EIA suggests that no fishway exists that would pass all species of migratory fish at all times of the year, and for that reason no modification of the fishway (as in Project Option 1) is recommended. A single facility to pass all migrating species all of the time may not be feasible, but alternative fish passage designs are available that should be used to replace the existing, inadequate system, and allow maintenance of the causeway and of Lake Petitcodiac.
3. Why can we not design fishways that would enable all our fish to move through the causeway? After all, we managed to put a man on the moon.
4. Fish passage is compromised by low water quality in the estuary (e.g. high B.O.D., low oxygen) resulting from the limited primary treatment of sewage. This should be corrected.

### Discussion

Section 6 (pp. 108-119) of the Environmental Impact Assessment is devoted to discussion of fish passage conditions as they currently exist at the causeway, including the history of modifications made since the fishway was constructed, and some of the reasons for its failure to meet the requirements to pass all migratory species. The physical impediments to successful fish migration are outlined in Section 3.3.6.2.11 of the Biophysical and Socioeconomic Component Studies (Vol. 1 Pp. 109-114). The fishway is unable to accommodate passage of several of the species of concern for a variety of reasons: slots are too narrow for American shad or Atlantic sturgeon; velocities are too high for smelt and tomcod; elevation of the fishway entrance is too great for ‘gaspereau’ to enter

from the plunge pool at low tides; light levels and structures are deterrents for shad.

In addition to the limiting features of the fishway itself, fish encounter problems associated with heavy mud deposits downstream of the causeway, low oxygen levels in the plunge pool below the causeway, and periodically over other stretches of the estuary (EIA P. 118), and predation by birds when fish are forced to swim near surface or are confined in localized shallow pools. These several barriers to fish passage resulting from the construction of the causeway have the cumulative effect of lowering the success of migration by both adults and young-of-the-year, even without the limitations of the fishway design. The outline of these problems in the EIA and its supporting documents is generally logical and sufficient.

It is stated in the EIA that the Petitcodiac fishway was designed primarily to pass salmonids, and was based upon a design used successfully for Pacific salmon and trout ((EIA P.5); it became apparent "within a few months that fish passage was problematic", and was ineffective for Atlantic salmon and other migratory species. Once salmon have entered the fishway, however, the evidence suggests that the fishway is "marginally effective" (EIA P. 215). Despite stocking, the principal target, Atlantic salmon, has declined over the past 20 years. Because other Inner Bay of Fundy salmon stocks have also declined over the same time period (EIA P. 209-10), it is not absolutely clear that impeded passage at the Petitcodiac Causeway is alone responsible for the virtual disappearance of this stock, but the coincidence of the sharp decline in the Petitcodiac with the construction of the causeway, and evidence relating to mortality within the fishway, supports the belief that failure of this fishway is a primary cause of decline. The authors of the EIA contend that "Unless the survival of the species in the marine environment improves, all inner Bay of Fundy salmon rivers will rely on stocking of fish produced in the gene banks…" (EIA P. 210). The conclusion (P. 211) that: "The Project Options (3, 4A, 4B and 4C) will all have potential positive effects on the Inner Bay of Fundy Atlantic salmon…as they will remove the likely cause of the current endangered status of these species" is valid.

The suite of ten species[1] thought or known to migrate in and out of the Petitcodiac exhibits a great variety of migratory patterns, body sizes, swimming abilities and behaviour, and the writers of the EIA indicate that no single fishway design has been developed that would effectively pass all of these species. This statement is probably true. Numerous fishway designs have been developed over the past century, but most are designed to meet the needs of a single species

[1] Alewife, American eel, American shad, Atlantic salmon, Atlantic sturgeon, Atlantic tomcod, blueback herring, brook trout, rainbow smelt, and sea lamprey. Note: the term 'gaspereau' used in the report is a collective for two closely-related species, the alewife and blueback herring.

of high value, such as a salmon, trout, smelt or shad, and hence incorporate design features that are appropriate for one or two target species. Furthermore, although little note is made of this in the EIA, the vast majority of fishways are designed for river and stream locations in which only one-way flow occurs. The situation in an estuary, especially a turbid, macrotidal estuary, is very different.

The survey of fish passage facilities reported by the consultants made reference to seven dam locations in New Brunswick, and seven others in Canada, the United States and Wales. Of these, the only facility that operates with a strong tidal influence is that at Cardiff (Wales), which was visited and studied in some detail (Appendix B of the EIA). One other site, on the Saco River in Maine, has a small tidal influence (0.3-0.6 m), but is primarily a freshwater system. Most surprisingly, no reference is made to two other turbid macrotidal estuarine causeways that have been constructed in the Bay of Fundy system – the Avon Estuary Dam at Windsor (NS) and the Annapolis River Dam at Annapolis Royal (NS). Neither of these is mentioned in either the EIA or the supporting Biophysical and Socioeconomic Component Studies[2]. Since these are the two closest and most comparable modifications of macrotidal estuaries to the Petitcodiac system, with similar migratory species, the complete absence of reference to them in the EIA report is enigmatic. At Annapolis Royal, the causeway constructed in 1960 (i.e. before that on the Petitcodiac) was provided with a vertical slot fishway that has successfully passed shad, alewife, blueback herring, eel, striped bass, and probably salmon and anadromous brook trout over 4 decades; at least all of these species except the Atlantic salmon have maintained populations upstream of the causeway to the present day. The decline of Atlantic salmon in the Annapolis is very likely to be due primarily to prior construction of a hydro dam further upstream that blocks passage to the original spawning grounds on the Nictaux River. The design of the original vertical slot fishway is undoubtedly different in detail from that in the Petitcodiac, and it has successfully passed very large striped bass, Atlantic sturgeon, seals and at least one whale; the absence of any discussion of this site in the context of fish passage, or of explanation for its omission, is difficult to understand.

A major difference between the Petitcodiac and Annapolis examples is that the latter estuary has relatively low turbidity compared with the Petitcodiac. That is less true of the Avon (Windsor) Causeway, which was constructed in 1970 without a fishway, but which has maintained populations of ‘gaspereau’ (both alewife and blueback herring), white perch, eels, and possibly sea-run trout. Persistence of ‘gaspereau’ in the system seems to have been the result of passage through the gates when opened to lower the water level in Lake

[2] However Windsor is mentioned in Section 4.6.1 *E.I.A. Components* on P.30 of the EIA. It is not mentioned again.

Piziquid (the lake created by the Windsor Causeway). In spite of the obvious relevance of these two examples, no mention is made of them in the EIA.

During a conference call on 19 December, the Panel was advised that discussion with a representative of Nova Scotia Department of Fisheries and Agriculture led them to the conclusion that these two causeways were not relevant. It is unfortunate that the reasons for this were not outlined in the EIA.

In spite of these notable omissions, the contention in the EIA that there is no single fishway design that has the capacity to facilitate upward and downward migration of the ten species in the Petitcodiac is probably true. During the Public Hearing on 29 November, several references were made to a novel design that had been submitted in 2003 to the consultants by a local resident who apparently had received no response until the day of the hearing. The inference was that the design had been 'dismissed out of hand'. Examination of the consultants' response[3] to that request indicates that the proposed design of an Additional Fishway, while improving some conditions for shad, still does not satisfactorally address all of the problems associated with fish passage at the causeway.

For reasons indicated above, it is probable that any single fishway design would have flaws similar to or comparable with the existing system; after all the art and science of fishway design is at least 3 centuries old, although most of the experience is in river (i.e. one way freshwater flow) applications. Another proposal from the public was that new spawning channels be created in the estuary below the causeway and that attempts to pass migratory species upstream should be abandoned. Although artificial spawning channels have been constructed for many salmonids, this is not a feasible solution for the different species of concern here.

## Conclusion

In general, the conclusion that replacement of the fishway with another design (Option 1) is not a feasible solution to problems of fish passage at the causeway is sound. The EIA is somewhat limited in its description of factors affecting fish migration, and of its discussion of alternatives studied. However, if the decision to remove the gates and fishway is taken, the question becomes moot.

[3] TE 23570.1 to Ms. Sherry Sparks, dated 29 November 2005.

## Water Quality

Water quality in the estuary and Lake Petitcodiac were major concerns of several respondents. Many participants expressed serious concerns about the water quality below the causeway and proposed that waste water treatment be improved either as a higher priority than changes to the causeway or be improved prior to any changes to the causeway. As indicated above, water quality was considered an important factor in the objective of recovering migratory fish stocks in the Petitcodiac.

Public comment concerning water quality is subdivided into seven topics: Dilution of effluent from the sewage treatment plant; water quality concerns with respect to recreational usage of the waterway; groundwater contamination; status quo water quality in Lake Petitcodiac; the use of *E. coli* as an indicator; water temperature data; and fate of the leachate from the landfill site. These are each addressed separately below.

### Effluent Dilution

#### Comments

There was disagreement with statements in the EIA suggesting that primary treatment of sewage would be sufficient if the causeway is opened and greater flow restored in the estuary. Respondents indicated that relying upon dilution of the pollution was not acceptable, especially in light of policy statements by the federal Minister of Environment that the government intends to implement a requirement for secondary treatment by 2010.

#### Discussion

The EIA clearly states (P. ix *et. alii*): "The Project Options would result in an improved assimilation capacity … of the river due to the increased tidal prism and the subsequent improvement to [*sic*] oxygen levels. As a consequence, the need for additional sewage treatment facilities at Outhouse Point that exists under the Status Quo is greatly reduced, possibly eliminated. However, additional sewage treatment may be necessary in the future as a result of changes in environmental legislation and increased population." Deferral of the need to spend $36.4M on a new treatment system is presented as a positive attribute of the Project Options.

The issue revolves around the acceptability of primary treatment in general, and the extent to which increased flow in the estuary following opening of the causeway will bring environmental conditions (particularly dissolved oxygen and bacteria concentrations) back to acceptable levels. Currently, tidal waters

below the causeway are impacted by point and non-point sources of pollution to the extent that in summer months oxygen levels are depressed below the levels acceptable for fish habitat (e.g. EIA P. 69-70) over much of the estuary below the causeway. The cause of the low oxygen levels is the heavy biological (and chemical?) oxygen demand, most of which is associated with partially treated sewage entering at Outhouse Point and at other locations down the estuary (cf. P. 104). Under unmodified conditions, well mixed estuaries can assimilate relatively large quantities of organic matter without serious oxygen depletion because the oxygen is replenished from the atmosphere or from primary production (plant growth) processes associated with mudflats and marshes; however, it is possible to overwhelm the replenishment process, as seems to be the case in the Petitcodiac, in spite of the bore.

With opening of the causeway under Project Options 3 and 4, the bore will be allowed to progress upstream into what is now Lake Petitcodiac, taking with it the sediment and the associated organic matter resuspended during the flood tide. If the input of organic matter to the reconstituted estuary is not reduced, there will continue to be oxygen problems that may affect fish migration. The authors of the EIA contend that: "…DO levels will likely be higher in the estuarine environment for Project Options 3/4A because of ***higher dilution potential and increased flushing rate of BOD, nutrients and bacteria***. (Emphasis added by Reviewer).In addition there will likely be a higher DO supply from increased river circulation and increased surface contact of the atmosphere with the river because of the wider river channel that will lead to more diffusion of atmospheric oxygen into the water." (P. 199).

This conclusion seems to betray a misunderstanding about the nature of estuarine circulation in turbid, macrotidal estuaries. It appears that the authors assume that the sediments that are carried in on the flood tide are all dispersed out of the estuary on the ebb, where they might be mixed (and therefore diluted) with cleaner water further out in the Bay of Fundy system. During summer months, little could be further from the truth, unless the river is in full spate, which is not common except in the spring and fall. The typical pattern of sediment behaviour during summer months in macrotidal estuaries such as the Petitcodiac is for fine sediments to be brought up the estuary on the flood tide because of the high current velocities; on the ebb, water velocities tend to be lower than on the flood, and hence the sediment-carrying capacity is also lower. Some of these sediments become deposited during slack water into shallow areas of the estuary where they may remain until flushed out by the fall rains, or by ice action in winter and spring. The capture of fine sediments at the head of the estuary becomes even more extensive as saltmarsh grasses grow during the season. Because organic material (which generates the biological oxygen demand that may lead to low oxygen levels) tends to be adsorbed onto fine sediments, material released

from a sewage treatment plant will tend to travel and deposit where those sediments do. Under the Project Options, that will be toward the head of the reconstituted estuary, in what is now the headpond (Lake Petitcodiac).

The same applies to bacteria. As the EIA points out (P. 104-105), most of the bacteria detected in the flooding waters in the estuary are attached to particles, not free in the water. It is a well-established phenomenon in turbid, well mixed estuaries such as this. Consequently, these bacteria will travel and be deposited wherever the sediment particles are. Under the Project Options, a portion of those bacteria will settle in the upper part of the estuary during the summer months, together with the sediment particles to which they are attached.

Deposit of organically rich, bacteria-laden fine sediment particles in the inner part of the reconstituted estuary therefore means that there will be an increased oxygen demand during summer months; whether this will lead to more or less depressed oxygen levels depends upon the processes that replenish the oxygen. The EIA is correct in stating that, when the causeway is opened under Project Options 3 or 4, the larger channel width and greater surface area in contact with the air will increase the capacity for oxygen to diffuse into the water (P. 199). However, given the much greater oxygen demand resulting from redistribution of the organic loadings from the estuary below the causeway, and the resuspension of deposited organic material by the bore, it is highly unlikely that this diffusion will be sufficient to maintain the high oxygen levels typically found in the existing headpond water. The situation will resemble more the conditions now pertaining downstream of the causeway, where significant oxygen deficits are encountered. When the tide is down, the sediments are exposed directly to air, which has a much higher oxygen concentration than does the water.. In addition, the exposed tidal mudflats that will be created in the new estuary (in the area now occupied by the headpond) will likely be populated by benthic diatoms and other algae which, when exposed at low tide, photosynthesize and generate pure oxygen that may facilitate the breakdown of organic matter in the sediments. These are much more significant sources of oxygen than diffusion into the water, but do not contribute directly to oxygen levels in water, and therefore are unlikely to contribute to improved oxygen levels.

In summary, the conclusion presented in the EIA that DO levels will likely be higher in the inner part of the reconstituted estuary following opening of the causeway is probably wrong. Apart from an apparent lack of recognition of the major processes affecting oxygen concentration, there seems to be a belief that all of the sediments resuspended on the flooding tide will remain in suspension until dispersed to the outer Bay of Fundy: this runs counter to almost all of the research done in the Bay of Fundy and other macrotidal

estuaries over the last 30-40 years. There appears to be a significant problem with the models upon which these conclusions are based (see elsewhere).

### Conclusion

This public concern is well founded. It would be a mistake to assume that problems of contamination decline with the reconstitution of tidal flow up towards Salisbury, and to conclude – as the EIA does – that this provides a reason for not dealing with the sewage problem until some time later in the future. The estuarine portion of the Petitcodiac is contaminated now; opening up the causeway will mostly move the problem further upstream.

## Recreational Usage

### Comments

There were claims that statements regarding the expected pollution levels (even diluted) in the estuary following opening of the causeway are incompatible with recreational uses; this contradicts the EIA statements that recreational usage will be a positive outcome of the recommended Project Options

### Discussion

This appears to be a valid criticism of the EIA, which presents some very contradictory data and conclusions. The following statements regarding bacterial concentrations expected following adoption of one or more of the Project Options occur in EIA Section 9.2.4.2 (Emphasis added by the Reviewer):

a) ” Bacterial concentrations in the newly created estuarine environment ***will be similar or slightly higher than the baseline*** when it was a freshwater environment. This is a result of tidal inflow from downstream waters that ***contain higher concentrations of bacteria, but diluted because of the flooding tide***.” (P. 198);
b) “These concentrations are reduced greatly during high tide conditions in the reach between the outfall (about 6 km downstream of the causeway) and the causeway. …In figure 9.2.2, the ***dilution factor of the Enterococcus concentrations is about 20/100 ml*** [sic][4] ***at the causeway***.”
c) “…approximately 7-fold increase in the water volume that would considerably increase the dilution factor…”(P.199)—for Option 3/4A;
d) “…approximately 9-fold increase in the water volume that would considerably increase the dilution factor…”(P. 200) – for options 4B/C.

[4] This must be a typographical error; it is a meaningless expression in this context.

Data presented in Tables 3.3.21, 3.2.22 and 3.3.23 (Pp. 156-163), of the Biophysical Component Report Vol. 1. provide estimates of the fecal coliform concentrations found in samples taken in 2003 above and below the causeway. Above the causeway, fecal coliform counts ranged from 2 /100 ml to >1,700 /100 ml, the latter being the normal maximum detection limit. The average of 80 samples was over 240 coliforms /100 ml, and 25% of the samples exceed the value of 200 coliforms /100 ml established as the limit for human contact activities (see CCME Guidelines). Extreme values, which tend to bias the average, were sometimes associated with rainfall events, and were mostly found near to the causeway, where they may be augmented by inputs from waterfowl and seagulls (Biophysical Components Study Vol. 1. P. 155). When one of the Project Options is implemented, these fresh waters will be regularly mixed with tidal waters that will have some of the characteristics similar to present day tidal waters below the causeway.

Below the causeway, fecal coliform counts recorded in 2003 averaged more than 8,000 /100 ml, with some estimates as high as 35,000 (expressed as Most Probable Number). As indicated by one respondent (see below), even assuming the most optimistic assessment of dilution of the tidal water (a 9-fold dilution) following opening of the causeway, the bacterial concentrations are not going to be reduced to the levels currently found in the headpond. In fact, this whole section is confusing. It is apparent from the data that the estuarine waters below the causeway currently contain extremely high numbers of bacteria, both coliforms and *Enterococcus* spp. With no further treatment, even with the claimed up to 9 times dilution, the bacteria concentrations will be well above the average of those in the present Lake Petitcodiac; consequently, there will be no improvement in water quality in the area now occupied by the headpond.

Even the estimate of dilution factors appears to be very optimistic, generally being based upon changes in the estuary over the next 20 years. On page 200 the EIA states:

“Assuming that the river would approach the pre-causeway conditions under Project Options 4B/4C, the total water volume above Outhouse Point would be about 28 $Mm^3$ …….. This is approximately a 9-fold increase in the water volume that would considerably increase the dilution factor as compared to baseline conditions.

”The larger tidal prism and volume will provide more dilution of bacteria in both ebb and flood tides, more dilution of sewage effluent containing high nutrient levels, higher DO levels because of better mixing and more flushing capacity. The tidal prism available for dilution will be approximately 50 $Mm^3$ higher than for the baseline condition.”

The increase in tidal prism following opening of the causeway is clearly not going to be instantaneous. Increased tidal prism results from widening and deepening of the channel as deposited sediments are eroded away; elsewhere this is estimated at 10 $Mm^3$ per year, so that one might conclude that it would be 5 or more years before the full dilution effect was evident. In fact, model projections suggest that the rate of increase in tidal prism would be more or less steady over the next 20 years (cf. Fig. 8.3.4). As a result, the favourable estimates of dilution are really not going to be seen for two decades or more.

### Conclusion

Since recreational uses of the Petitcodiac are considered an important benefit of the Project Options into the future, it is critical that the effect of increasing tidal prism, and therefore decreasing bacterial concentrations be verified. In addition to regular monitoring during the progress of the project, the rate of increase in tidal prism, forecasted using the models, should be verified by regular surveys. It may prove necessary for additional dredging to accelerate the increase in tidal volume near to Riverview and Moncton in order to retain those aspects of recreation (swimming, kayaking etc.) that require water that meets the CCME Guidelines.

## Groundwater Contamination

### Comments

Groundwater contamination was not addressed extensively in the EIA. One respondent indicated concern that his shallow well, located above the causeway, might be vulnerable to contamination from polluted estuary water if the tidal flow was restored above the causeway.

### Discussion

There is relatively little information provided about groundwater in either the EIA or the Biophysical Component studies volume. Most of the data were obtained from a Geological Survey of Canada study of the Moncton aquifer in 1992-93. The limited data suggest that with few exceptions, present water quality in wells adjacent to the headpond or estuary is well within Canadian Drinking Water Quality Guidelines in most chemical parameters. Two wells, one above the causeway and one below, had levels of sodium and/or chloride that exceed the Guidelines. The conclusion stated in the EIA is that there were “no identified environmental effects on the groundwater from the Project Options or the Status Quo.” (P. 311).

This conclusion is supported by the limited data reported, and the evidence of other studies which show that in general wells near to

sea level are not easily impacted by tidal waters. The reasons are several: the water level in the estuary rises for a limited period of time during the late stages of the flood tide, before falling again; the surrounding marine-derived sediments are often not very permeable, so that saline water at high tide has little potential for seeping into the ground (although it may move up pipes and tile drains that are not fitted with one-way valves); and there is often a large positive pressure on surficial groundwaters derived from the difference in 'head' between the well and the source of the groundwater, which may be a great distance away and at much higher elevation. At times, however, saltwater flooding of lands within the floodplain is expected to occur if the rebuilt dykes were to fail following the adoption of one of the Project Options (cf. EIA Pp. 146, 238). Although the flooding might be shortlived, contamination of a nearby well could result, especially if the well has not been adequately maintained and its integrity compromised.

Wells that are very close to an estuary or marine environment may be vulnerable to saltwater intrusion where the freshwater of the aquifer (into which the well penetrates) overlies a deeper saline layer. In such cases (which are common very near to coastal waters) if the rate of withdrawal of water from such a well is too great, there is the potential to draw up salt water that lies beneath. This, however, is a feature of the specific well location, and will not change as a result of the proposed Project.

### Conclusion

Although the EIA and Component studies pay little attention to the issue of groundwater, what information does exist suggests that groundwater contamination is not likely to be a widespread problem, although specific wells might be at some risk.

## Lake Petitcodiac

### Comments

There were claims that the report assessments of water quality in the headpond were incorrect and that water quality is better than that represented in the report. In particular, it was suggested that water quality data for the lake reported in the EIA were unfairly biased by inclusion of data from point sources which have since been corrected. Another respondent indicated that upstream contamination of water was possibly affected by the presence of waterfowl during helicopter sampling.

### Discussion

As indicated above, the data presented in the EIA and component studies show that water in Lake Petitcodiac is contaminated, and on

occasion to levels that far exceed guidelines for recreational contact. It is also noted that water quality is now higher than recorded in the early years following construction of the causeway (EIA P. 64; Biophysical Component Studies Vol. 1, P. 129). The results presented from sampling in 2003 show clearly that bacterial contamination is still a problem in the headpond, although this might be attributed in part to waterfowl, especially near to the causeway (Biophysical Component Vol.1. P. 155). The EIA notes "When the gates are open during low tide, there appears to be an increase in fecal coliforms upstream of the causeway" (P. 38). No explanation is offered, but this may be the result of resuspension of sediments from the bottom of Lake Petitcodiac as a result of higher flows as the lake is drawn down. In general, there is little doubt that the water quality in Lake Petitcodiac is a cause for concern; in this the EIA appears to be correct. Most of the contamination is derived from upstream land use; waterfowl contributions, while present occasionally, are limited in locality and extent, and backflow through the fishway/control gate structure will only affect the immediate area of the fishway. On very high tides, water intrusion through the fishway (backflow cf. EIA P. 236; Biophysical and Socioeconomic Component Studies P. 221), could be responsible for introducing contaminants and bacteria into the Lake near the causeway.

### Conclusion

While the data presented in the EIA may be biased, they nonetheless indicate that water quality in Lake Petitcodiac is often poor or marginal. Sources of the contamination in the headpond have not been clearly identified. This requires continuing attention of provincial authorities.

## *E. coli* as an Indicator

### Comments

There was criticism of the account of pollution levels in the EIA. It was pointed out that *E. coli* is not a recommended indicator for estuarine waters according to the Council of Canadian Ministers of the Environment, because of the high mortality of coliform bacteria in saline waters; *Enterococcus* spp. are the appropriate indicator for brackish waters. The same respondent pointed out that many of the conclusions of the favourable environmental benefits to be derived from the Project Options, and ranking in the application of the CCME Water Quality Index, seem to rest on misrepresentation or selective use of the limited bacterial data. In particular, it was suggested by that respondent that the poor assessment of water quality in the Lake Petitcodiac following construction of the causeway is colored by two samplings carried out in 1973 and 1978

that related to “notable point sources” that had been “identified and rectified”.

**Discussion**

This criticism is generally valid. The EIA does report both coliform and *Enterococcus* spp. values where they are available, even for the estuary, where *E. coli* are not an appropriate indicator; however, the EIA comments primarily on *Enterococcus* values for the region downstream of the causeway, which constitutes the remaining estuary. This reviewer was unable to identify the 1973 and 1978 data sets that it was claimed bias the water quality assessment for the headpond, since these were not apparently included in any of the formal reports submitted in support of the EIA; however, if the headpond WQI results are biased in this way, the bias is, as the respondent point out, continued through the rest of the environmental assessment, and somewhat undermines the credibility of the conclusions.

Most importantly, the bacterial data presented show that very high levels of enterococci were found at all stations downstream from the causeway for a distance of more than 30 km. Average enterococci concentrations from a survey in October 1999 (Biophysical Components Vol. 1 P. 136) were 97.5 /100 ml at high tide (range 10 to 340 / 100 ml) and 1048 / 100 ml (range 150 to 2100 /100 ml) at low tide. None of the low tide samples was below the 35 /100 ml guideline recommended by both the CCME and EPA. If we take the consultants’ estimate of a dilution factor of 7 to 9 for the Project Options 4B and 4C, the water quality would still not fall below the guidelines for estuary water, as noted during the presentation to the Panel on 29 November.

**Conclusion**

The authors of the EIA make most reference to *Enterococcus* spp. when accounting for bacterial contamination in the brackish waters of the estuary, which is appropriate. The bacterial data in the EIA indicate that levels of contamination in the headpond and estuary are so high that even increasing the tidal prism by the amount suggested for the Project Options will not be sufficient to lower the bacterial concentrations even when the estuary has fully adjusted to the opening of the causeway over the next twenty years. There appear to be some misconceptions in the EIA about the important estuarine processes that affect dilution and deposition, particularly the fate of sediment-associated bacteria and organic matter. This means that some of the VEC cumulative assessments are less secure than the EIA suggests.

## Water Temperature

### Comments

Water temperatures as high as 30 deg C were reported in the EIA for Lake Petitcodiac. One respondent commented that in the past year the water temperatures recorded by his fish finder showed temperatures never to exceed 21 deg C between the causeway and Salisbury.

### Discussion

The Executive Summary (P. iii) and the very first page of the EIA note that: "The causeway … experiences temperature extremes from 30ºC in the summer to -35ºC in the winter". Although not stated clearly, it seems implicit that this must refer to air temperature (since water does not get that cold in Canada!), and not to water temperature, although 30ºC seems a low value for an 'extreme' summer air temperature in New Brunswick[5]. However, the statement follows reference to suspended solids, and this may have given rise to the public perception that it refers to water. Elsewhere in the document the highest water temperature values mentioned are 25ºC at Salisbury and 24ºC at Turtle Creek. It is possible that surface waters in the estuary below the causeway could reach 30ºC on a summer day when the mudflats have been exposed for several hours before the tide rises; under these conditions, heat transfer from the sediments could raise the temperature to that level.

### Conclusion

Concerns about the accuracy of water temperature measurements reported in the EIA appear to be based upon a misunderstanding. No action is required.

## Leachate

### Comments

Concern was expressed that according to the EIA, the project options would have the leachate from the Moncton landfill entering the combined sewer system and either entering the river through flood overflow or through the sewage treatment plant which provides only primary treatment.

[5] The Canadian Climate Normals list 36.7ºC as the extreme for Moncton.

**Discussion**

There are numerous references (e.g. pp. 11, 41, 151, 164, 172, 238, 242, 328). to leachate from the Moncton landfill, and to risks associated with its potential discharge directly and indirectly into the Petitcodiac River. At present, the landfill is concealed and monitored, and is currently separated from the estuary channel by a wetland (P. 172). Concern is expressed in the EIA that "…under Project Options 4B/C, there is expected to be a greater loss….This could affect the capacity of the wetland that currently exists to treat leachate from the landfill." No evidence was presented to indicate that any of the landfill leachate was currently entering the estuary. In the event that the leachate had to be collected – as might result from greater than expected erosion of the wetland under Option 4B, and would be inevitable for Option 4C – the limited primary treatment currently available would not effectively deal with contaminants such as heavy metals, and these would, as the respondent indicated, be delivered to the Petitcodiac. This reinforces the necessity for improved sewage treatment in the area as noted above.

**Conclusion**

Close monitoring of erosion of the wetland adjacent to the landfill is required to ensure that no untreated leachate can enter the estuary.

## Flooding

### Comments

Concerns were expressed that severe flooding will occur with the proposed project, that the causeway does provide flood protection to upstream properties and that the EIA process has not considered this properly. Concerns were also expressed that increasing sea levels (as related to climate change) will create flooding crises that will be exacerbated by removal of the causeway.

### Discussion

Both the public comments and the EIA recognize that flooding is an issue of ongoing concern for residents of the region. In particular, the Moncton traffic circle and Champlain Mall areas of Moncton are identified as areas particularly prone to flooding. Flooding simulations have been undertaken for a range of tidal and hydrologic conditions and have indicated that flooding conditions downstream of the causeway will continue to worsen under Status Quo conditions as the river continues to silt in and the capacity of the river to carry flood waters diminishes. Under the Project Options, the conveyance of the river will increase as the channel returns toward pre-causeway conditions. As reported in the EIA, this means that the proposed causeway openings will be a net benefit with regards to flood risk. Also, the proposed project alternatives will lessen the likelihood of ice jamming and the associated flood risks.

### Conclusion

Review of the flood modelling undertaken indicates that within the required accuracy of the EIA there are no significant shortcomings in the modelling or analysis as presented. The removal of the gates will result in saltwater flooding of agricultural lands upstream of the causeway. The EIA recognizes this and has identified mitigation requirements in the form of repair and restoration of upstream dykes and aboiteaux . Both public comment and the EIA recommend that a detailed flood risk assessment be undertaken by local governments in order to prepare a flood protection plan for the region (outside of the scope of the present EIA).

## Sediment Fate

One of the key environmental implications of modifications to the Petitcodiac Causeway is the change to the flow patterns and sediment distribution in the estuary. It is widely recognized that the construction of the causeway has led to large-scale siltation of the estuary as the river adjusts to the head of the tide being shifted from Salisbury to Moncton. Re-opening the causeway will allow the tide to reach further upstream toward Salisbury and will tend to revert sedimentation patterns to pre-causeway conditions. The speed at which this redistribution of sediment occurs, and the identification of the resulting patterns of erosion and deposition are central themes of the EIA and are issues that have generated significant public comment. While the physical response of the river to the re-opening (changes to channel geometry, erosion/deposition patterns, changes in tidal flows, etc.) are not identified as key environmental indicators (VECs) within the EIA, the physical response of the river manifests itself in many of the VECs (e.g. Municipal Services and Infrastructure, Road Transportation Network).

## Comments

Issues and concerns raised by the public include:

1. Concern was expressed with respect to impacts of sediments from the river on the lobster and scallop fisheries in Chignecto and Shepody Bays. The public expressed concern that the re-opening of the causeway will release large quantities of sediment, that will deposit in fishing grounds causing deterioration of fishing conditions.
2. Several members of the public challenged the EIA's claim that sediments leaving Hopewell remain in suspension until they reach the deep waters of the Bay of Fundy. Anecdotal observations were reported of sediment accumulation in lobster traps in the bay during the gate openings in 1998.
3. Questions were asked as to whether the EIA study had addressed long-term infilling rates in the estuary. Public comment stated that the estuary was infilling prior to the causeway and will continue regardless of project alternatives.
4. Concerns were expressed regarding bank erosion and changes to the river morphology under the proposed Project Options.
5. Regarding sedimentation in the headpond, respondents commented that siltation in the headpond is not as described in EIA and that the sediment plug in the headpond is solely due to silt coming in from the gates.

Discussion of these issues is addressed in the following two categories: Outer bay sediment fate; and sedimentation/erosion trends in the river.

## Outer Bay Sediment Fate

### Discussion

The EIA addresses sediment fate in Shepody and Chignecto Bays qualitatively, using rationales based on sediment budget work developed by Carl Amos (1991). On the basis of Amos et al's (1991) sediment budget estimates for the bay, it is stated that the long-term fate of sediments in the bay is to go to the deep waters of the Bay of Fundy. However, this is neither appropriate nor completely correct as will be shown in the following:

**Settling in Shepody and Chignecto Bays:** Fall velocities of the sediment in salt water are typically about 1.5 mm/sec (this is the number used in the sediment modelling analysis on page 74 of the modelling report). At this rate, it will take roughly 2 hours for a sediment particle to fall a vertical distance of 10 m. Water depths off Hopewell Cape range from 10 to 40 m. This suggests that there is ample time for a significant amount of sediment to settle to the bed during a two hour slack water period between ebb and flood tides. Admittedly local salinity variations, circulation patterns and wave activity will affect actual settlement patterns, but sediments from the Petitcodiac River will deposit in Shepody and Chignecto Bay. The fact that sediments from estuaries in the Bay of Fundy are routinely deposited within bays such as Shepody and Chignecto is widely accepted within the physical oceanography and geomorphology community (Amos, C.L., pers. comm.) and is documented on the Fisheries and Oceans website[6]:

> …Chignecto Bay on the other hand derives its sediments from its own shoreline and the Petitcodiac watershed which exports sediment into the Bay of Fundy. In the upper basins, flat lowland areas have given rise to extensive salt marshes that extend intertidally into mudflats. The gently slopping intertidal areas create an environment with low wave and tidal action. These so-called low energy environments result in sediments falling out of suspension and being deposited along the shore…

**Erosion/Deposition processes in Chignecto Bay:** Surveys of Chignecto Bay presented in Supplemental Report #5 of the EIA (Evaluation of Seabed Changes Cape Enrage Area), show the results of a 1966 survey by Swift and Lyall that was subsequently re-surveyed in 1996 by NRCAN. In these plots there are differences of between 10 and 30 m in seabed depth between the 1966 and 1996 surveys. This would appear to be clear evidence that erosion and

[6] http://www.glf.dfo-mpo.gc.ca/sci-sci/bysea-enmer/mudflats-vasiere-e.html Web page providing information on tidal mudflats in "By The Sea - A Guide To The Coastal Zone Of Atlantic Canada".

deposition is actively occurring within Chignecto Bay, suggesting that it is unlikely that sediments from the Petitcodiac will not deposit in this area. The EIA report (page 5, Appendix A) states that the 1966 and 1996 surveys are "nearly identical where the two surveys traverse the same areas of the seabed". In fact, the two surveys generally differ in depth by 5 to 10 m in many places (often as much as 25 m) and indicate substantial erosion and deposition over the 30 years between the two surveys. Analysis of the cross-sections along line 104-108 (a transect across the central portion of Chignecto Bay) shows almost a 20% reduction in cross-sectional area between 1966 and 1996. This is not by itself sufficient data to assess the sediment budget for the bay but it does indicate that substantial erosion/deposition processes are at play here.

**Sediment Budgets:** The sediment budget study by Amos does not address trends in sedimentation pre- and post-causeway construction and does not address what re-opening the causeway might do to sedimentation patterns. The bed of the Bay of Fundy is generally considered to be a sediment source not a sink (Carl Amos, pers. comm. 2005). The trend analysis undertaken in the EIA and the 1-D sediment transport modelling both indicate that the project options will result in something between 50 and 70 million cubic metres of sediment being washed out of the estuary into Shepody and Chignecto Bays. At present (and during the time of Amos' study) the river is a net recipient of sediments, removing some 2 million cubic metres a year of sediment from the Shepody and Chignecto Bays. The project alternatives under consideration will change the Petitcodiac River from being a sink of $2Mm^3/yr$ to a source of roughly $10Mm^3/yr$ of sediment. Since the fall velocity analysis presented above shows that sediments from the river will deposit in Shepody and Chignecto Bays, it is reasonable to assume that there will be a net accumulation of sediment in the bays under the project alternatives. Where this sediment will accumulate, the path this sediment will follow under the action of waves and tides and the effects this sedimentation could have on local fisheries have not been addressed by the EIA.

**To put these numbers in perspective:** The project alternatives could result in 50 to 77 million cubic metres of sediment being removed from the Petitcodiac River over the next few decades. To put this in perspective, twenty million cubic metres of sediment can be pictured as a block of sediment 10 km long, 2 km wide and 1 m deep. Figure 1 illustrates this area superimposed along the shores of Chignecto Bay. This suggests that the volumes of sediment that are to be released from the Petitcodiac are sufficiently large to warrant further attention.


**Figure 1 Annotated view of Chignecto Bay and Petitcodiac River**

**Seasonal transport patterns:** The EIA states that, with respect to seasonal transport rates, the present conditions at the Petitcodiac River result in annual sediment 'pulses' of between 10 and 15 $Mm^3$ being released into Shepody and Chignecto Bays. The EIA states (p. 47 of main report) that "The sediment that is deposited in the river during low flow events comes out of suspension when the energy is low and is re-suspended during high flow events. The sediment is held in suspension in Shepody and Chignecto Bays and Cumberland Basin with a portion sent to the middle of the Bay of Fundy and then a portion sent back up the river. It is unlikely that the sediment that leaves the Petitcodiac River during the spring and fall pulses accumulates on the bottom of Chignecto and Shepody Bays." It is further stated (on page 166 of the EIA) that under the project alternatives, the increased energy in the river system will reduce the amount of sediment that accumulates in the silt plug upstream of the causeway and therefore the volume of sediment carried downstream past Hopewell Cape under project scenarios 3 and 4 will be less than the 10 to 15 $Mm^3$ presently seen under status quo conditions. Hence the conclusion is reached that "if the modelling predicts that on an annual basis, the volume of sediment transported to Shepody and Chignecto Bays is less than 10 $Mm^3$, then no negative environmental effect would be anticipated for the lobster and scallop fisheries" (page 160 of EIA final report). This is simply incorrect: the net transport of sediment out of the river under the project alternatives 3

and 4 will increase from -2 under status quo conditions to +10 $Mm^3$ per year. It would be more correct to say that there would be no effect if the net transport was unchanged at -2$Mm^3$/yr. Furthermore, as shown previously, it is incorrect to assume that sediments from the Petitcodiac will pass through the Shepody and Chignecto Bays in suspension before coming to rest in the Bay of Fundy: the simple fall velocity analysis presented above indicates that these sediments will settle out in Shepody and Chignecto Bays.

### Conclusion

The EIA conclusions concerning the fate of sediments leaving Hopewell Cape and entering Shepody and Chignecto Bays are not suitably supported by technical analysis. Further examination and analysis of these issues would be required to support the conclusions made concerning impacts on fisheries.

Section 7.2 of this report discusses the cost implications to the fisheries and the related mitigations.

## Inner Estuary Sediment Transport Patterns

### Discussion

**General Patterns in Estuaries:** It is clear that the partial opening of the causeway will tend to increase the tidal exchange in the estuary, resulting in at least a partial reversal of the sedimentation that has occurred over the past 40 years since construction of the causeway. As shown in the EIA (Modelling Appendix B, page 6, Figures 2.1 and 2.2), the limited historical survey data available do not indicate a significant level of sedimentation between surveys taken in 1861 and 1960. It is a reasonable conclusion of the EIA that the changes in sedimentation due to the causeway far exceed recent historical sedimentation that may be occurring in the background due to other causes. The movement of sediments in estuaries with fine sediments such as those found in the Petitcodiac is an interesting and complex phenomenon. The three main elements that influence sedimentation patterns in estuaries are as follows:

Generally in the outer estuary, the flood tide has a tendency to carry more sediment in than it carries out on the ebb tide. This is due to asymmetry in the tidal wave propagating up the river channel (The velocities are higher during the flood than during the ebb). As the flood wave travels upstream, friction can increase this imbalance until the bed level rises above the low tide mark. This tidal

asymmetry is well-recognized as a major factor in sedimentation of macrotidal estuaries[7].

As the tide diminishes upstream, fresh water flows from the headwaters create a net seaward transport of sediment. Depending on the level of mixing in the river, there can also be a tendency for the fresh water to flow downstream (i.e. seaward) at the top of the water column while there is a net landward movement of water (and hence sediment) near the bed. In these ways, there is a net tendency for maximum sedimentation somewhere in the middle of the estuary.

For fine sediments there is a third factor at play: many fine sediments have very slow settling velocities in fresh water due to the small size (and weight) of the individual particles of sediment. However, in salt water, chemistry changes this: The free sodium ions in the salt water enable the fine sediments to flocculate (join together to form larger, faster settling particles). This results in a natural tendency for sedimentation just downstream of the fresh- saltwater interface. This zone of peak sedimentation is commonly referred to as the 'turbidity maximum'.

**Salinity effects:** With the construction of the causeway at Moncton, the freshwater-saltwater interface was moved to downstream of the causeway and was generally confined to a restricted area within a few kilometers of the causeway. At present there is only freshwater upstream of the causeway. The proposed project alternatives that involve partial opening of the causeway will take away this man-made restraint on the location of the freshwater – saltwater interface and will increase the tidal range in the river. The freshwater-saltwater interface will likely become more variable in its location and its average location will likely move upstream.

The sediment transport modelling and the trend analysis undertaken in the EIA do not directly address the manner in which salinity affects erosion and deposition patterns in the river. The modelling report indicates that salinity is not particularly accurately modeled in the hydrodynamic modelling and that salinity is not used as an input to the sediment transport models. It is unlikely that the analysis undertaken to date can properly forecast where sediment will move or how quickly it will move if sediment settling (through flocculation) in the Petitcodiac is sensitive to changes in salinity (as is the case for most fine-grained estuarine sediments).

The lack of treatment of salinity effects in the EIA is justified by reference to the NWRI sediment tests which indicated that the flocculated and disaggregated sediments had similar fall velocities – however these tests were only undertaken at one salinity (reported as

[7] Allen et al (1980). Effects of tides on mixing and suspended sediment transport in macrotidal estuaries. Sediment Geol. 26: 69-90.

between 5-8 ppt), not over the range of salinities typically observed in the river.

While the 1-D and 2-D hydrodynamic models used in the EIA did model salinity, the verification of the model presented in the modelling report indicates that the model does a poor job of predicting observed salinity patterns (e.g. Figures 5.3 and 5.4 on page 59 of modelling report). Furthermore, the sediment modelling does not use salinity in its modelling of sediment behaviour (sediment fall velocity is a constant, not a function of salinity in the sediment transport modelling, page 15 in the modelling report).

Following the public meeting, M. Davies conducted a simple sediment-salinity flocculation test to explore the validity of the assumptions made regarding salinity. These tests clearly show that salinity has a large influence on settling speed of Petitcodiac River sediments (as would be expected from published literature on cohesive sediments in general).

In this simple demonstration, fresh water and salt water with salinities ranging from 3.5 to 35 parts per thousand (35 representing pure sea water) were used to examine the settling behaviour of mud samples from the Petitcodiac River[8]. Figure 1 below shows the bottles at the start of testing on the left and 1 hour later on in the testing on the right. In fact, the fresh water sample was seen to not show significant clearing for several days. This clearly illustrates that variations in salinity will result in commensurate variations in settling behaviour. Salinity causes settling velocities many times higher than those observed with fresh water. As this demonstration shows, salinity is a critical factor in sediment behaviour.

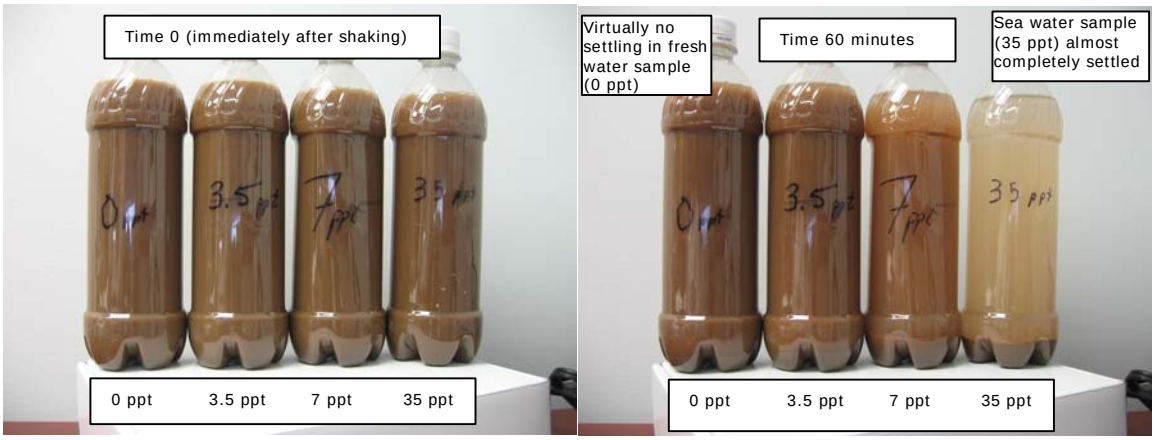


**Figure 2 Demonstration of salinity effect on settling of Petitcodiac River mud**

[8] The mud sample used in this demonstration was collected on December 1st, 2005 from the intertidal zone just upstream of Chateau Moncton.

The consequences of incorrect consideration of salinity effects are that the capacity of the flow to carry sediment will not be represented correctly and therefore areas of erosion and deposition will not be properly identified and the rates of erosion and deposition will be incorrect. .Changes in flow patterns such as partial removal of the causeway will change the location of salt wedge (likely moving it further upstream). Sediment deposition patterns will be strongly influenced by salinity since lower salinity waters will have lower settling velocities and hence higher sediment transport capacity. The present location of 'sediment plug' in the Lake is likely influenced by existing salinity patterns and its movement under project alternatives will be heavily influenced by changes in salinity patterns due to project alternatives. Similarly, erosion and deposition patterns at the bend at Moncton (referred to in the EIA as a sill) are also likely dependent upon salinity patterns, therefore changes to sedimentation and erosion in this area after opening of the causeway is likely not properly predicted by the modeling.

In essence, since the sediment transport models are insensitive to salinity, the models are incapable of evaluating effects of project alternatives that would alter salinity patterns (e.g. any physical changes to causeway).

## Conclusion

It is our opinion that conclusions in the EIA that predict changes to river morphology and sedimentation patterns do not have sufficient scientific basis. This does not change the overall assessment that increasing the opening in the causeway will increase the tidal prism and increase channel width downstream of the causeway. It does, however, mean that predictions of the extent and rate of channel changes and bank erosion and the extent of sedimentation upstream of the causeway is not correctly predicted by the technical analysis presented in the EIA. The concerns expressed by the public regarding this issue are considered by the Public Review Panel to therefore be justified. It would be prudent for the government to review the implications of these findings on the overall predictions of the effects of opening the causeway and on the evaluation of the environmental impacts of this project.

## Public Health

### Comments

One respondent took particular exception to the limited treatment of human disease vectors in the EIA. The criticism focused on statements in section 4.9.3 (P. 302) and 4.9.6 (P. 311) that there were "zero clinical cases in New Brunswick and therefore no West Nile virus fevers, neurological syndromes, asymptomatic infections or related deaths to this date this year." The respondent pointed out that two local experts (Dr. Louis LaPierre and Charles McEwan) were not apparently interviewed by the consultants, in spite of their knowledge and involvement in studies of disease and epidemiology in New Brunswick over several decades.

### Discussion

The EIA certainly places very little emphasis upon potential disease vectors associated with marshland invertebrates, and appears to have relied primarily upon Health Canada statistics that relate to deaths in New Brunswick. The main preoccupation seems to have been with West Nile Virus, for which there have been no records to date. The potential for increase in salt marsh mosquito populations as a result of the growth of marsh bodies is not addressed.

### Conclusion

It appears that this public health issue may have received insufficient treatment in the EIA. It would be prudent for the NB Department of Health to consider whether existing information on mosquito-borne illnesses has been missed, and whether projected changes in saltmarsh distribution would therefore be of concern.

## Financial Accounting

### Full Cost Accounting

#### Comments

Many respondents expressed concerns that true full cost accounting was not being applied as was specified in the Niles Report and under the Terms of Reference of the EIA

#### Discussion

Chapter 12.0 Economic Considerations addresses the benefits and costs of the causeway to date, and into the future with the Project Options that meet the Fish Passage EIA Objective (Chapter 6) and the Status Quo. Note that the term "Project Options" includes Project Options 3, 4A, 4B and 4C; specific mention of a Project Option (e.g., Project Option 4B) is given when warranted. The Guidelines contemplated a full cost accounting analysis (benefit/cost analysis) to allow for comparison of the estimated costs and benefits of the Status Quo and Project Options, including all identified environmental intangibles (i.e., volunteer fund raising groups to support local nonprofit organizations, things that are valued by people in a non-monetary way, such as placing a value on the view of a lake). The purpose of this approach, as described in the Guidelines, was to add important information into economic considerations that tend to neglect unsustainable environmental effects on natural resources and social wellbeing. By considering these benefits and costs that are external to economic transactions (i.e., the direct capital and operating costs), the sustainability of different Project Options could be evaluated and compared to the Status Quo. The full cost accounting analysis called for in the Guidelines was intended to attempt to quantify benefits and costs (e.g., opportunity benefits and costs associated with changes to commercial fisheries, habitats, land use, etc.) that are not included in traditional costing techniques.

The EIA TOR that was developed in response to the Guidelines outlined the approach to be taken by the AMEC Study Team and noted that each Project Option must be considered separately, including the Status Quo. It was proposed that a benefit/cost analysis be undertaken for each of the four Project Options that met the fish passage Project Objective for comparison with the Status Quo.

**In conducting this EIA, the AMEC Study Team has come to some important conclusions that have affected the scope and level of this benefit/cost analysis.** As outlined in Chapter 6, only Project Options 3 and 4 meet the fish passage Project Objective. Project Options 3 and 4, as modified and described in Chapter 7, are

alternative means of carrying out what is in concept the same project. Project Options 3 and 4 involve different technical solutions for opening the causeway permanently;
Project Options 3, 4A and 4B create a permanent opening (of differing dimension) at the existing gates while Project Option 4C involves a permanent opening near the middle of the causeway.

Project Options 1 and 2 were very different potential solutions for meeting the fish passage Project Objective as compared to Project Options 3 and 4. It is likely that there would have been a number of key differences among the potential environmental effects between the Project Options if it had been determined that Project Options 1 and 2 could have achieved the fish passage Project Objective. There would have been benefits and costs with maintaining the Lake under Project Option 1 and possibly 2, versus loss of Lake under Project Options 3 and 4.

Most environmental effects of the Project Options that meet the fish passage Project Objective (Project Options 3, 4A, 4B and 4C) are the same or very similar in magnitude and are related to the degree in which the Petitcodiac River estuary is predicted to return towards pre-causeway conditions. In all instances, the environmental effects are in the same direction (i.e., they are either all positive or negative as outlined in Chapter 9). Key differences from a benefit and cost perspective are quantifiable as capital and operating costs, including the costs of mitigation of potentially significant negative environmental effects. There are no significant negative environmental effects that are predicted to be likely to occur as a result of the Project Options (Chapter 9), and those environmental effects that are predicted to be positive are similar and may only vary in the degree to which they are positive. Consequently, it remains that the only significant negative environmental effects identified in this EIA are those identified for the Status Quo, the majority of which are a continuation of significant negative environmental effects that occurred as a result of the causeway. It is important to reiterate that the Status Quo is not a Project Option as it does not meet the Project Objectives and that it has been carried forward in this EIA for comparative purposes.

Recognizing these conclusions of the environmental effects assessment, the AMEC Study Team has focused efforts on identifying those items that could have an economic value/loss associated with the Project Options characterizing the benefits and costs of the causeway to date in a qualitative way, and where data allow, quantitatively. This analysis, coupled with the environmental effects assessment, enables an understanding of the benefits and costs of the Status Quo as many of the past environmental effects of the causeway would persist in a similar manner into the future. Recognizing the important results of the preceding chapters of the EIA, the economic considerations addressed in this chapter are therefore divided into three categories:

- economic considerations associated with the causeway to date;
- capital and operating costs of the Status Quo and Project Options; and
- other economic considerations of the Status Quo and Project Options.

The first and final categories involve primarily qualitative analyses based on the findings of this EIA with quantification using benefit/cost analysis, where feasible. The second category involves "hard costs" of the construction and operation of the Status Quo and Project Options that meet the fish passage Project Objective.

In the guidelines for an environmental impact assessment – modification to the Petitcodiac River Causeway section 3.7 Cost/Benefit Analysis it is stated that `The proponent (DSS) may consider alternate means of full cost-accounting (including contingent evaluation, hedonic pricing, and avoidance cost techniques) to assign values to impacts on environmental amenities and resources otherwise overlooked in traditional economic decision-making. Opportunities for stakeholder input to the FCA analysis (e.g. workshops, etc) is a requirement of the study (input obtained may also facilitate VEC identification and definition). In addition, the rationale and limitations of each technique used for full cost accounting must be described.

## Conclusion

The public expectation and definition of Full Cost Accounting is different than the interpretation found in the Guidelines for an Environmental Impact Assessment – Modification to the Petitcodiac River Causeway, as was issued by the Department of Environment and Local Government. We can conclude that the EIA has met the expectation of the Guidelines issued for this EIA. This expectation was based on the examination of each option when compared to the Status Quo. When it was realized that Project Option 1 and 2 would not meet the fish passage project objective and that Project Option 3 and 4 were alternative means of carrying out what is in concept the same project; discussions took place between the consultant and the Technical Review Committee to determine the new direction to be taken. It has been confirmed to the Panel that this redirection was fully explained at subsequent public meetings; therefore, we can conclude that the EIA has met the expectations of the Guidelines issued for this EIA.

## Impact on Fisheries

### Comments

There were claims that a Full Cost Accounting exercise to assess the impact of the fisheries on the fisherman; the fish plant workers and the full economic impact on the Alma community was not properly addressed.

### Discussion

The EIA assumes that the fishery in the Bay of Fundy will not be affected by the movement of the sediment. Panel comment regarding this assumption has been discussed previously in Section 5.2 of this report.

The EIA also states that if the fishery is affected; then compensation will be available.

With respect to compensation for losses related to commercial fisheries (i.e.: lobster and scallop), Section 9.2.4.3 of the Final EIA Report states that:

"As described in Section 5.2.4, the quantity of material that will be released into Shepody and Chignecto Bay under Project Options 3/4A will not be significant when compared to that which is annually moved from the estuary on a seasonal basis. Given that there is no linkage between the construction of the causeway and increased landings, there would be no effect on landings associated with the opening of the causeway under Project Options 3/4A.

However, even though the evidence does not support any potential effect on lobster landings, the consequences of any negative effect associated with the opening of the causeway may be serious to lobster fishers. Any significant effect would be reflected in landings of lobster that would be seen in the affected area to a degree larger than such an effect in a non-affected area. **Monitoring of landings in the Upper Bay and a control area (non-affected area) would clearly demonstrate any negative effect associated with modifications to the Petitcodiac River Causeway. Any loss in landings in the affected area, that are not seen in the control area, would form the basis of compensation to fishers for loss in livelihood.**"

A similar write up is included for the scallop fishery. In addition, it is stated that there would likely be a non-detectable difference between Project Options 3/4A and Project Options 4B/4C.

**Since it was assessed that there would be no significant effects to the lobster and scallop fisheries in relation to the implementation of the Project Options it was felt that compensation would not be required (as stated above). However as a precautionary measure**

**the assessment suggested follow-up monitoring to determine impacts. This follow-up program is outlined in Chapter 13 of the EIA Report.**

"13.2.4.12 Labour and Economy

The Follow-up Program for Labour and Economy will evaluate predictions of the environmental effects assessment and the effectiveness of its proposed mitigation. Follow-up for commercial fisheries will continue the annual collection of catch data for commercial lobster and scallop fisheries in the Bay of Fundy and eel fisheries in the Petitcodiac River system, as described in Section 13.2.2.12. If after 10 years it is determined that there is a substantial reduction in harvest levels in the potentially affected areas relative to the control location elsewhere in the Bay of Fundy that can be attributed to the implementation of the Project Option, then compensation will be provided. As noted in Section 12.1.11.1, the value of the potentially affected lobster resource is currently between $85,000 and $175,000 annually. Compensation for each fishery would be negotiated, if required, based on the level of environmental effects in the affected area. Data developed in the baseline Follow-up Program (Section 13.2.2.12) will provide a benchmark for the evaluation of the need for and magnitude of compensation."

From Section 12.1.11.1 Commercial Fisheries

**Lobster**

The commercial lobster fishery in the region has increased (in lobster landings) since about 1996. According to DFO, increased landings in LFA 35 and adjacent LFAs in the area appear to be due to increased populations, improved fishing practices and lobster fishing further from the shore. Observations from local fishers indicate that the change in tidal action and sediment patterns as a result of the causeway may have had a positive effect on lobster landings (Section 9.2.4.3), permitting lobster fishing further into Shepody Bay. However, it is unclear if sedimentation of the Petitcodiac River as a result of the causeway has actually had any causal relationship with the species itself as the increased landings occurred almost 30 years after the causeway was constructed.

To put the lobster fishery in context, Alma fishers report that they take approximately 5% of their lobsters from the area in question, primarily in spring, and expend 10% of their effort there. The combined value of landings in Districts 79 and 81 range between about $1.7M in 1996 and $3.5M in 2001. Assuming that 5% of those landings were taken from this area, the value of landings potentially affected positively could be as much as $85,000 to $175,000 annually. However, it is unlikely that a cause and effect relationship does exist between the establishment of the causeway and the value of landings from this area.

### Scallop

It is thought that construction of the causeway has not affected the value of the scallop fishery since most of this fishery takes place some distance from the mouth of the Petitcodiac River. However, it is noted that some scallop beds have recently extended up to Apple River and observations and reports by fishers suggests that these beds would not have established if the causeway had not been built, because of the higher turbidity associated with high tidal flow under natural conditions. This is unlikely given that the major infilling due to the causeway took place more than 30 years ago. More recent infilling rates are much lower. Also, the seasonal movement of sediment will still occur under the Status Quo. The upper Chignecto and Shepody scallop fishing accounts only for a very small fraction of the $1-$3M annual landings in the Apple River area; a majority of the fishing effort takes place east of Alma, toward Apple River.

As with the lobster fishery, it is unlikely that a cause and effect relationship does exist between the establishment of the causeway and the improvement in the fishery. This potential benefit of the causeway will be subject of a monitoring program to verify or negate it."

### Conclusion

The public concern will continue as long as the EIA's assumption that the fishery in the Bay of Fundy will not be affected remains in place. As discussed in Section 5.2 of this report, the public's concerns regarding fate of sediments in Shepody and Chignecto Bays are not adequately addressed by the scientific analysis undertaken by EIA. Consquently, it is reasonable to expect that public concern regarding the fishery will be an ongoing issue. To offer a 10 year monitoring program before providing compensation is certainly not acceptable for someone whose livelihood can be affected within a short period of time. Monitoring should be put in place and negotiation of compensation should be addressed at first indication that the fishery is affected.

## Sanitary Sewage System

### Comments

As previously stated under Water Quality there was disagreement with the EIA statement suggesting that primary treatment of sewage would be sufficient if the causeway is open and greater flow restored in the estuary. As such, regardless of the option chosen, the cost of a secondary treatment facility should be accounted for prior to being considered.

**Discussion**

The assessment determined that under the Status Quo the water quality in the river would deteriorate and as such the GMSC treatment plant upgrade could become necessary. The EIA concluded that under the Project Options the assimilative capacity of the river would improve the water quality.

"12.3.4.2 Sanitary Sewer Systems

Due to worsening water quality conditions under the Status Quo (Section 9.13.4.4), it will become necessary to upgrade the existing GMSC wastewater treatment and collection system from chemically enhanced primary treatment (i.e., remove large solid objects with filters and sediment and organic matter in settling chambers and treat with chlorine) to secondary treatment (remove biodegradable organic matter from sewage using bacteria and other microorganisms). Tertiary treatment (use a variety of physical, chemical, or biological treatment processes to remove targeted pollutants) is not predicted to be necessary. The estimated cost of this is $32,700,000, which includes $3,700,000 for effluent disinfection. Under the Project Options, this expenditure will not be necessary from a fish passage perspective, as the restoration of the tidal prism and increased assimilative capacity will enable the river to more effectively dilute and flush effluents from the river channel. The resultant water quality is expected to meet current CCME objectives for the protection of aquatic life and recreation."

Furthermore in Section 14.9:

"However, due to anticipated changes in regulatory requirements for municipal wastewater, it is possible that at some time in the future improved treatment may be required at the GMSC wastewater treatment facility regardless of the presence or absence of the causeway. If this were to occur, then the direct costs of improvement (estimated at $36,400,000) would not be attributable to the Status Quo."

9.2.4.2 Water Quality

Status Quo

The water quality for 2005 baseline in the freshwater environment upstream of the causeway (Section 5.15.4.1) can be expected in the fair to marginal range, using the Water Quality Index of CCME (2001) and as determined in the Biophysical Component Study (AMEC, 2005a). The potential water quality by 2025 will remain in this range, or deteriorate even more as a result of urban, industrial and agricultural growth associated with expansion of the human population in the Petitcodiac River watershed. This is also likely to occur downstream of the causeway as a result of human population growth in this area, and as a consequence more drainage and effluent

will be discharged into the river through additional sources and outfalls in addition to the GMSC.

Furthermore, the tidal prism volume will continue to decrease and by 2025 will have decreased by almost 50 $Mm^3$. Therefore, the river will have less capacity for the dilution of effluents and less flushing capacity."

### Conclusion

The EIA has identified adequate costs related to a secondary sewage treatment facility, but this was not included in the report as they did not deem the information pertinent to the causeway project.

Taking into consideration the conclusion in Section 2.1.3, Water Quality, it is the Panel's opinion that a secondary treatment facility must be part of the project. The Panel does not support the EIA`s recommendation of dealing with this issue in the future.

## Waterfront Property Values

### Comments

With respect to housing values; concerns were expressed that the value of the waterfront properties were not properly recognized.

### Discussion

Section 4.4.6.2 in the Biophysical and Socio-economic Component Studies describes the model used to establish the land value upstream and downstream of the causeway. Pages 260-261 of the report deal with the comparison of the waterfront properties:

Seven "pairs" of vacant lots having comparable services, just outside the boundary of the City of Moncton on the upstream side of the causeway and just outside of the boundaries of the City of Dieppe and the Town of Riverview on the downstream side of the causeway, were examined. After identifying and analyzing the seven "pairs" of sales that involved vacant land it was concluded that the enhancement of a waterfront location may have a positive influence on the value of certain vacant residential lots located above the causeway (from Moncton to Salisbury). However, the available evidence does not support a similar conclusion for vacant lots located below the causeway (from Moncton to Shepody Bay). After taking into consideration differences in value as the result of changing market conditions over time and varied physical characteristics, an enhancement in the order of 10% is indicated for comparable lots above the causeway. However, an enhancement in the order of 5% or less is indicated for comparable lots below the causeway.

An analysis of the five “pairs” of sales that involved improved residential property did not reveal any evidence to support a conclusion that there is any measurable difference in value as a result of the presence of the Petitcodiac River (above or below the causeway). However, as there is a range of factors that can influence the prospective purchaser of an improved residential property, it is extremely difficult to isolate the influence that the presence of the Petitcodiac River may or may not have as a solitary factor. The range of factors influencing the prospective purchaser includes social, economic, governmental and physical characteristics.

Another general observation was that although there are a number of dwellings located along the Petitcodiac River, there appears to have been very limited development of private infrastructure (e.g. wharves, trails, ramps) to provide access to the water especially above the causeway on the Lake. In addition, the view of the Petitcodiac River from a number of the dwellings located above the causeway is obscured by trees and it appears that very limited effort has been made to alter this situation. This is considered counter intuitive, as access to and an unimpeded view of a water feature are typically important characteristics of a waterfront property. Notwithstanding this, it is known that there are residents by the river who place high personal value in having access to and/or a view of the river from their residence. In summary, it appears that there is very little data to support a conclusion that the presence of the Petitcodiac River has a measurable influence on the value residential lots above the causeway, as discussed above. However, it is logical to surmise that if all other factors are equal, the fact that a property is located on the Petitcodiac River could result in a positive, but perhaps nominal, influence on its value.

Even if it is not specifically stated in Section 7.1.1 for compensation to property owners; pages 249 and 250 of the EIA report states:

As determined during the public consultation process, some current residential property owners in sight of the river and/or headpond, feel that an alteration or change of the headpond will decrease the intrinsic value of their residential property and that they may choose to sell and relocate if the headpond will be lost. Similarly, access to the Petitcodiac River for recreational purposes (e.g., boating, docks and float planes), would be negatively affected. The presence of the estuary or headpond is not currently a price discriminator for residential property although there is a 5% premium on vacant land; therefore, these residential landowners are expected to receive the current market price for their property, should they decide to sell their property. **Although not anticipated, any negative change in property value attributable to the implementation of Project Options 3/4A should be compensated for on a case by case basis.**

**Loss of access (property owners only) to the Petitcodiac River by dock (for boats) or for float planes will be considered for compensation for that specific use on a case by case basis.**

### Conclusion

Because of the low number of transactions of waterfront property that took place between 1998 and 2003 it is difficult to form any conclusion.

After discussion with the proponent and the consultant the Panel was advised that a review of the real estate transactions for 2004-2005 demonstrated a similar trend in waterfront property values.

The Panel is satisfied that compensation will be considered on a case by case basis.

## Dykes and Aboiteaux

### Comments

There was question as to whether dyke reconstruction and maintenance costs upstream of the causeway have been identified and if the provincial government is aware of their maintenance responsibility.

### Discussion

The EIA report, section 7.1.1 indicates that Stage 1 involves a number of activities that need to be carried out prior to opening the gates.

- Upstream dykes and aboiteaux will be repaired/restored to prevent saltwater inundation (flooding) of land (e.g., agricultural lands, Ducks Unlimited sites).

The capital and operating cost in Tables 7.1.1, 7.2.1, 7.2.2 and 7.2.3 of the EIA report reflect the cost for this activity.

Section 7.4.4 state upstream of the causeway, dykes and aboiteaux protecting agricultural lands will be restored/repaired as mitigation for the selected Project Option. Prior to any repair or upgrading of dykes or aboiteaux, a detailed plan will be developed in consultation with the appropriate regulatory agencies, landowners and Ducks Unlimited. For reasons similar to those presented for Former Moncton Landfill Protection Failure and Unplanned Erosion, the possibility exists for these structures to be eroded by unplanned channel erosion or migration outside of the pre-causeway channel, leading to flooding of these lands by saltwater. This could result in the immediate destruction of existing crops and the short-term rendering of the soil as unsuitable for crop growing due to high levels of salt. Similarly, failure of the dykes protecting the Ducks Unlimited wetland sites could result in damage to freshwater wetland vegetation from saltwater intrusion.

During Stage 1 of the Project Option, the dykes and aboiteaux will be repaired as required. The Emergency Response and Contingency Plan (Section 7.5) will account for a catastrophic unplanned erosion due to unplanned river channel erosion. Remedial action will be taken as prescribed and necessary in the event of unplanned erosion by the river channel outside of the pre-causeway channel.

**Conclusion**

The EIA adequately addresses these concerns.